

**Executing Agency: Roads and Highways Department  
Road Transport and Highways Division  
Ministry of Road Transport and Bridges**

**ENVIRONMENTAL IMPACT ASSESSMENT (EIA) (ROAD) FOR JICA  
MATARBARI PORT DEVELOPMENT PREPARATORY SURVEY  
PROJECT**



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# **Environmental Impact Assessment (EIA) (Road) for JICA Matarbari Port Development Preparatory Survey Project**

## **FINAL REPORT**

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Table 14.3-1: Sample Grievance Reporting Form

## **LIST OF ABBREVIATION**

AER	:	Agro-Ecological Region
AQM	:	Air Quality Management
BARC	:	Bangladesh Agricultural Research Council
BBS	:	Bangladesh Bureau of Statistics
BCT	:	Bay Container Terminal
BFRI	:	Bangladesh Forest Research Institute
BETS	:	BETS Consulting Services Ltd.
BEZA	:	Bangladesh Economic Zones Authority
BIG-B	:	Bay of Bengal Industrial Growth Belt Initiative
BMD	:	Bangladesh Meteorological Department
BWDB	:	Bangladesh Water Development Board
CDL	:	Chart Datums are Lowest
CITES	:	Convention on International Trade in Endangered Species
CPA	:	Chittagong Port Authority
DAE	:	Department of Agricultural Extension
DC	:	Deputy Commissioner
DG	:	Director General
DoE	:	Department of Environment
DOF	:	Department of Fisheries
DOF	:	Department of Forest
DTW	:	Deep Tube Well
DWT	:	Dead Weight Tonnage
EA	:	Environmental Assessment
ECA	:	Ecologically Critical Area
ECA	:	Environmental Conservation Act 1995
ECR	:	Environment Conservation Rules 1997
EIA	:	Environmental Impact Assessment
EMP	:	Environmental Management Plan
EPZ	:	Export Processing Zone
EQS	:	Environmental Quality Standards
ESMS	:	Environmental Safety and Management System
EZ	:	Economic Zones
FGD	:	Focus Group Discussion
FIDC	:	Forest Industries Development Corporation
GCB	:	General Cargo Berths
GIS	:	Geographical Information System
GO-NGO	:	Governmental-Non-Governmental Organization
GOB	:	Government of Bangladesh
GPS	:	Global Positioning System
ICTP	:	International Conventions, Treaties and Protocols
IEC	:	Important Environmental Component
IEE	:	Initial Environmental Examination
IFC	:	International Finance Corporation
IMS	:	Information Management System
IOF	:	Institute of Forestry
IUCN	:	International Union for Conservation of Nature and Natural Resources or the World Conservation Union

JICA	:	Japan International Cooperation Agency
KCT	:	Karnaphuli Container Terminal
KII	:	Key Informant Interview
LGED	:	Local Government Engineering Department
MoEF	:	Ministry of Environment and Forest
MoL	:	Ministry of Land
NCS	:	National Conservation Strategy
NCT	:	New-Mooring Container Terminal
NEC	:	National Economic Council
NGO	:	Non-governmental Organization
NOC	:	No Objection Certificates
NWMP	:	National Water Management Plan
NEMAP	:	National Environmental Management Action Plan
NSDS	:	National Sustainable Development Strategy
OECD	:	Organization for Economic Co-operation and Development
PAP	:	Project Affected Person
PPP	:	Policy, Plan and Program
PPP	:	Public Private Partnership
RAP	:	Resettlement Action Plan
RHD	:	Roads and Highway Department
SDG	:	Sustainable Development Goals
SEA	:	Strategic Environmental Assessment
SRDI	:	Soil Resource Development Institute
TEU	:	Twenty Foot Equivalent Unit
TOR	:	Terms of Reference
UNDP	:	United Nations Development Program
WB	:	World Bank Group

## GLOSSARY

**Adverse impact:** An impact that is considered undesirable.

**Ambient air:** Surrounding air.

**Aquatic:** Growing or living in or near water.

**Arsenic:** Arsenic is a chemical element with symbol As and atomic number 33. Arsenic occurs in many minerals, usually in conjunction with sulfur and metals, and also as a pure elemental crystal. Arsenic is a metalloid.

**Bangla:** Bengali language.

**Baseline (or Existing) Conditions:** The ‘baseline’ essentially comprises the factual understanding and interpretation of existing environmental, social and health conditions of where the business activity is proposed. Understanding the baseline shall also include those trends present within it, and especially how changes could occur regardless of the presence of the project, i.e. the ‘No-development Option’.

**Bazar:** Market.

**Beel:** A “back swamp” or depression. It can be either perennial or seasonal.

**Beneficial impacts:** Impacts, which are considered to be desirable and useful.

**Biological diversity:** The variety of life forms, the different plants, animals and micro Organisms, genes they contain and the ecosystems they form. It is usually considered at three levels: genetic diversity, species diversity and ecological diversity

**Biological Oxygen Demand (BOD):** The amount of dissolved oxygen, consumed in a biological process, which degrades the organic matter in water.

**Consultation:** the process of seeking the views of interested or affected stakeholders and engaging them in constructive two-way dialogue.

**Ecology:** Science, which studies relationships and interaction between organisms and their environment.

**Ecological factor:** Any part or condition of the environment that influences the life of one or more organisms.

**Ecosystem:** A dynamic complex of plant, animal, fungal and microorganism communities and associated non-living environment interacting as an ecological unit.

**Emission:** The total amount of solid, liquid or gaseous pollutant emitted into the atmosphere from a given source within a given time, as indicated, for e.g., in grams per cubic meter of gas or by a relative measure, upon discharge from the source.

**Endangered species:** Species in danger of extinction and whose survival is unlikely if the existing conditions continue to operate. Included among those are species whose numbers have been reduced to a critical level or whose habitats have been so drastically reduced that they are deemed to suffer from immediate danger of extinction.

**Environmental effects:** The measurable changes, in the natural system of productivity and environmental quality, resulting from a development activity.

**Environmental enhancement:** An intentional change, which amplifies the anticipated positive impact of the project on an environmental component.

**Environmental and Social impact assessment (ESIA)/Environmental assessment:** The systematic, reproducible and interdisciplinary identification, prediction and evaluation, mitigation and management of

impacts from a proposed development and its reasonable alternatives, sometimes known as environmental assessment.

**Environmental Impact:** An estimate or judgment of the significance and value of environmental effects for natural, socio-economic and human receptors.

**Environmental Management Plan (EMP):** A plan to undertake an array of follow-up activities which provide for the sound environmental management of a project/intervention so that adverse environmental impacts are minimized and mitigated; beneficial environmental effects are maximized; and sustainable development is ensured.

**Environmental management:** Managing the productive use of natural resources without reducing their productivity and quality.

**Erosion:** Process in which wind and water removes materials from their original place; for instance, soil washed away from an agricultural field.

**Evaluation:** The process of looking back at what has been really done or accomplished.

**Fauna:** A collective term denoting the animals occurring in a particular region or period.

**Field Reconnaissance:** A field activity that confirms the information gathered through secondary sources. This field study is essentially a rapid appraisal.

**Flora:** All of the plants found in a given area.

**Flood Plain:** Areas of relatively low-lying land seasonally inundated by over spill from adjacent rivers, lakes and natural depressions.

**Habitat:** The natural home or environment for a plant or animal.

**Household:** A household is defined as a dwelling unit where one or more persons live and eat together with common cooking arrangement. Persons living in the same dwelling unit by having separate cooking arrangements constitute separate households.

**Important Environmental Component (IEC):** These are environmental components of biophysical or socio-economic importance to one or more interested parties. The use of important environmental components helps to focus the environmental assessment.

**Initial Environmental Assessment/ Evaluation:** Preliminary analysis undertaken to ascertain whether there are sufficient likely significant adverse impacts to warrant a “full” ESIA. In some countries, use of initial assessment forms a meaning of “screening” proposed projects.

**Khal:** Small Channel, Canal.

**Land use:** Types include agriculture, horticulture, settlement, pisciculture and industries.

**Mauza:** A *Bangla* word for the smallest government administrative area corresponding to a village revenue unit.

**Magnitude:** The degree of change in an important environmental component that results from a project activity. It refers to the size of the impacts and could be either beneficial or adverse.

**Mitigation:** An action, which may prevent or minimize adverse impacts and enhance beneficial impacts.

**Natural Gas:** Flammable gas, consisting largely of methane and other hydrocarbons, occurring naturally underground (often in association with petroleum) and used as fuel.

**Negative Impact:** Negative Change from the existing situation due to the project.



**pH:** pH is a measure of how acidic/basic water is. The range goes from 0 - 14, with 7 being neutral. pHs of less than 7 indicate acidity, whereas a pH of greater than 7 indicates a base. pH is really a measure of the relative amount of free hydrogen and hydroxyl ions in the water.

**Public involvement/ Public consultation:** A range of techniques that can be used to inform, consult or interact with stakeholders affected/to be affected by a proposal.

**Reversible impact:** An environmental impact that recovers either through natural process or with human assistance (e.g. cutting off fish migration by an embankment might be reversible at a later stage if a proper regulator is built).

**Risk analysis:** A technique used to determine the likelihood or chance of hazardous events occurring (such as the release of a certain quantity of a toxic gas) and the likely consequences.

**Stakeholders:** Those who may be potentially affected by a proposal e.g. Local people, the proponent, government agencies, NGOs, donors and others, all parties who may be affected by the project or take an interest in it.

**Social impact assessment:** The component of ESIA concerned with changes in the structure and functioning of social orderings. In particular the changes that a development would create in: social relationship; community (population, structure, stability etc.); people's quality and way of life; language; ritual; political/economic processes; attitudes/values.

**Socio-economic:** The human environment, which includes social and economic components that are not termed biophysical.

**Sustainability:** Applied to positive impacts only and could be of three different types sustainable, sustainable with mitigation and non-sustainable

**Taka:** Unit of Bangladeshi currency.

**Terrestrial:** Living on land.

**Thana:** Sub-district level of government administration, comprising several unions under a district.

**Union:** Smallest unit of local self-government comprising several villages.

**Upazila:** Sub-district name. Upazila introduced in 1982.

**Wildlife:** Organism that can survive without any artificial help. The four general types are: mammals, amphibians, reptiles and birds.

**Wildlife Habitat:** An area maintained as an undisturbed breeding ground for wild fauna. The habitat is protected for the continued well-being of the resident and migratory fauna.

**Zila:** Bengali word of district

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## **EXECUTIVE SUMMARY**

### **E-1 INTRODUCTION**

The Government of Japan and the GoB has initiated the Bay of Bengal Industrial Growth Belt Initiative (BIG-B), and under this initiative, JICA has implemented the “Data Collection Survey on Integrated Development for Southern Chittagong Region” since 2015 which assessed the potentiality of the development of infrastructure, energy and power, industrial and urban development in the region. Through this survey, the need to conduct “Data Collection Survey on the Matarbari Port Development in the People’s Republic of Bangladesh” for the further detailed plan of Matarbari port development has been recognized.

In this study, the Environmental Impact Assessment (EIA) is pursued due to the requirement of the Department of Environment (DOE) to avoid negative impacts of the access road of the port development from Dhalghata to Fasiakhali.

The detailed scope of the EIA study is as outlined below:

- Screening of the Project derived from applicable reference framework based on reconnaissance survey and desk based review of Project documents;
- Scoping for the EIA study;
- Identification of the Project components;
- Development of a regulatory, policy and administrative framework relevant to the Project;
- Monitoring, analysis and reporting of the environmental and social baseline data of the study area including consultation with local communities and other stakeholders;
- Assessment of the environmental impacts of the Project in the study area;
- Assessment of social impacts on the local community as well as project affected people if any and any other stakeholders, which have been identified during the social consultation process;
- Risk assessment and consequence analysis of the Project;
- Formulation of an Environment Management Plan and associated/specific mitigation plans for identified impacts; and
- Formulation of Stakeholder Consultation and Grievance Redress Mechanism for the Project.

### **E-2 DESCRIPTION OF THE PROJECT**

As per the criteria of DOE, the Port connecting access road project falls under the Red Category and the same requires Environmental Impact Assessment (EIA). Though the project has some environmental impact but of lesser degree as will be revealed from the successive chapters. It is to be mentioned here that as per JICA guideline the proposed project falls under Category-A.

Matarbari area is expected to play the leading role in the realization of the BIG-B initiative. To be more precise, this development will lead to an increase in export industries and hence reduce the trade deficit due to the importation of coal and oil as a source of energy. Furthermore these developments will also lead to short and long term regional economic stability. To maximize the performance of the freight transport route from the Port to inland area, accessibility from the port to N1, the arterial road to Chittagong, will need to be also secured.

The access road is approximately 25.7 km from Moheshkhali Upazila to Chakaria Upazila. Additional Flyover on the Cox’s Bazar Chittagong highway in Chakaria Paurashavais planned for smooth connectivity to Chittagong. But in this EIA study this component shall be excluded. The access road shall travel through Dhalghata, Kalarmarchara, north edge of Saflapur, Badarkhali, South edge of Paschim Bara Bheola, Saharbil, Chiringa and Fasiakhali Mouza of the two upazilas of Cox’s Bazar District.

The components of the port access road project are:

➤ **Matarbari Port Access Road**

- Road Length: 25.7 km
- Number of Bridges: 17 (total 7,104 m)
- Number of Intersections: 4 (3 at-grade, 1 grade separated)
- Number of Railway Crossing: 2
  - Dohazari-Cox's Bazar Railway; and
  - Rail Spur Link to Matarbari

➤ **Dike Road**

- Road Length: 1.8 km

The project is scheduled to start from December 2018 and will be completed in May 2024. The phase wise schedule would be:

- Detailed Design: from Dec 2018 to Nov 2019 (12 months)
- Procurement of Contractor: from Dec 2019 to Nov 2020 (12 months)
- Construction: from Dec 2020 to May 2024 (42 months)

Total construction cost for 2-lane access road was estimated as BDT 56.2 billion but it may vary from BDT 49.5 to 56.2 billion depending on the availability of embankment material. The estimated construction cost is relatively high:

- Embankment Section: BDT 1,395 to 1,824 mil. per km
- Bridge Section: BDT 3,600 per sq. m

### **E-3 LEGAL AND LEGISLATIVE FRAMEWORK**

This document focuses on policy, regulations and the administrative framework under the purview of which the proposed project will fall and this EIA study will be governed, namely:

- ✓ Bangladesh national and local, legal and institutional framework;
- ✓ JICA Guidelines for Environmental and Social Consideration Guideline

The following sections review the relevant National legislative, regulatory and policy requirements along with some international ones. In addition to review of these policies, the gaps between National Laws and JICA Guidelines for Environmental and Social Considerations (April 2010) has been addressed.

### **E-4 STUDY OF ALTERNATIVE OPTIONS**

Three options were analyzed minutely considering the technical, social, environmental and current status of the project area. Second Option has been selected as the best option comparing the other options because of the following characteristics:

- ⇒ Comparatively less private land will be affected due to the project;
- ⇒ Would be much closer to the Chakaria in the Chittagong-Cox's Bazar Highway;
- ⇒ Would be efficient route for the freight transporting;
- ⇒ Much better in traffic safety;
- ⇒ Port connecting road construction activities would be much easier;
- ⇒ Less no. of settlement will be affected
- ⇒ No cultural property will be affected by the selected port option
- ⇒ Loss of productive land will be minimum and will not impacted the national economy
- ⇒ Cumulative and long-term effect seems to be insignificant

- ⇒ Effect on Fish yielding capacity would be insignificant
- ⇒ No significant forest area would be affected due to the selected port option
- ⇒ Loss of indigenous species would be insignificant
- ⇒ Loss of biodiversity would be insignificant

**E-5 ENVIRONMENTAL AND SOCIAL BASELINE**

An overview of the land use and land cover pattern has been prepared based on the satellite images and presented using Geographical Information System (GIS). The total land of the study area is 15,317 hectares. The land cover of the study area is derived from multi-spectral color Rapid Eye satellite images. The major classes extracted from the images are as follows: agricultural land, char land/sandbars, forest, industrial area, road, rural settlement with homestead vegetation, built-up area and water bodies.

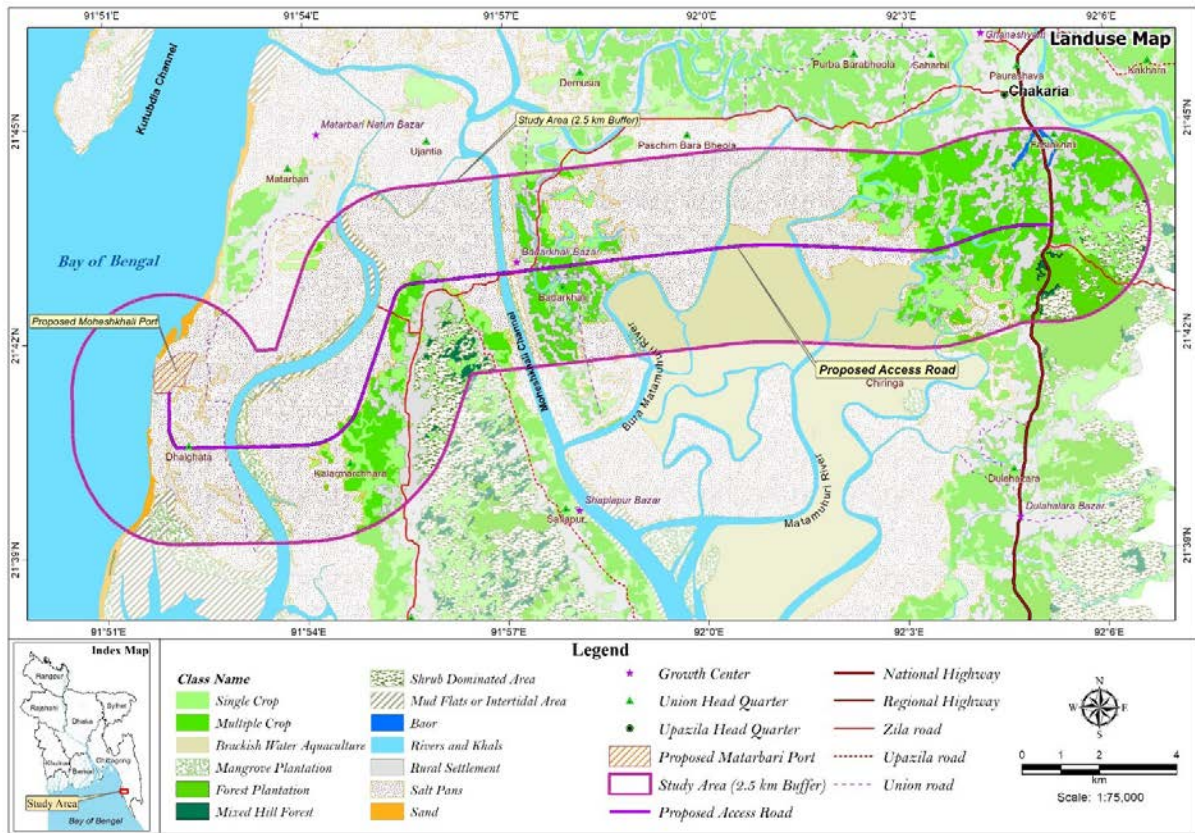


Figure-E-1 General Landuse Map

Ambient temperature of Kutubdia Station is recorded for this project study Area. Data of last 23 years (1991-2013) shows that the monthly maximum temperature varies from 29.7°C to 34.9°C and May is the warmest month in pre-monsoon period. The monthly minimum temperature varies within a range of 11.7°C to 23.7°C and January is the coldest month. The highest recorded maximum temperature during last 23 years is 34.9°C occurred in May, 1994 and the lowest ever recorded minimum temperature was in January, 1994.

Humidity is directly related with temperature fluctuation of a region. The atmosphere of coastal zone is always enriched with humidity because of high evaporation over the sea surface. Kutubdia BMD Station has been selected in order to delineate the situation of humidity of the study area. The monthly average

relative humidity near the Kutubdia station varies seasonally from 76% to 89%. Monsoon period (June to September) is the most humid month while during winter season i.e. December to February it remains lower.

The last 35 years data of Kutubdia BMD station (Station ID: 11925) shows that the annual average rainfall is recorded as 2824.2 mm/yr, according to the data analyzed monthly average maximum rainfall occurred in July (approximately 763.7mm/month) and monthly average minimum rainfall occurred in winter season (December to February) which indicates that the rainy season is very prominent in this region. The ever maximum daily rainfall recorded is 422mm in the 16th July 1998 and ever maximum annual rainfall was recorded as 4587 mm in the year of 1998.

The geology of the Chittagong Hill Tracts in south-east Bangladesh is distinctive: sediments exposed in this region are dominantly older (Tertiary) folded and indurate deposits of sandstone, silt and limestone. The Project area covers Dupi Tila and Beach and Dune geology. Dupi Tila Formation consists of yellowish-brown to brown, fine to medium grained pebbly and cross-bedded sandstone with subordinate clay stone and siltstone. Dune is a hill of sand built either by wind or water flow. Dunes occur in different forms and sizes, formed by interaction with the flow of air or water. Most kinds of dunes are longer on the windward side where the sand is pushed up the dune and have a shorter "slip face" in the lee of the wind. In the coastal area the dunes formatted the beach and Dunes formation.

Earthquake is one of the most deadly natural disasters that may affect the human environment. Even a relatively moderate earthquake can cause a very large number of deaths. Although in recent past no major earthquake has affected this country, a major event may affect the country at any moment. To analyze the earthquake entire Bangladesh is subdivided into four seismic zones where port connecting access road project is located in the earthquake zone III, according to the draft of Bangladesh National Building Code (BNBC) updated in 2012 (Sarraz A., et. al. 2015).

The proposed project area is adjacent to the Bay of Bengal and located in the southeast of Kutubdia Island. The Kutubdia channel, Matamuhuri River and Kohalia River are the main rivers close to the project area. The project area is approachable by road from Chittagong district and water way through the "Bay of Bengal". Heavy construction materials/ machineries can be transported through water way.

Water level data of Moheshkhali Channel was collected from Saflapur (Moheshkhali) BWDB gauge station. The gauge station is located at 8.0 km south from the project area. The analysis of water level data of 1968- 2009 shows that the maximum water level is 4.4 m PWD during high tide while the minimum water level is (-) 2.2 m PWD during low tide.

The groundwater data of BWDB observation well around the study area (station COX009) was collected for the period from 1984 to 2013. The station COX009 is located at Gorakghata of Moheshkhali Upazila. It is observed that the groundwater level goes down in dry season and depth reaches highest in March. On the other hand, water table rises in monsoon and the lowest depth attains in September due to recharge by rain water.

## **E-6 STAKEHOLDER ENGAGEMENT**

Public opinion has been collected through stakeholder meetings and focus group discussion. For better understanding the socio-economic and environmental condition focus group discussions were held with the local people in the closest settlement area of the project route area. Stakeholder meetings were twice held in the Upazila levels as well as the local levels i.e. Union levels of the project study area.

## **E-7 SCOPING AND TOR FOR THE SURVEY ON NATURAL AND SOCIAL ENVIRONMENT**

The scoping of the proposed Port connecting access road project has been narrated in Table-E-1 considering the scoping as well as addressed the results based on the survey results.

Table-E-1 Scoping Results of the Proposed Access Road Project

Item	No.	Impact	Scoping		Result of Assessment		Rationale
			Pre- / construction Phase	Operation Phase	Pre- / construction Phase	Operation Phase	
Pollution Control	1	Air Quality	B-	B-	B-	D	<b>Construction phase:</b> - Dust dispersion will occur. - exhaust gas emissions such as SOx, NOx will occur from machinery. <b>Operation phase:</b> - Air pollution caused by exhaust gas generated from the vehicles using the port is predicted.
	2	Water Quality	B-	B-	B-	B-	<b>Construction/Operation phase:</b> Although turbidity increases due to construction around the river, the effect is temporary. For wastewater accompanying concrete construction and wastewater containing oil, the muddy stream caused by embankment at the time of rainy weather.
	3	Waste	B-	D	D	D	<b>Construction phase:</b> - Waste containing hazardous materials will be generated by construction work. <b>Operation phase:</b> - Little solid waste is expected.
	4	Soil Contamination	B-	B-	B-	D	<b>Construction phase:</b> Since there is a possibility of soil contamination due to leakage of fuel oil and lubricant from construction vehicles and construction machinery, soil contamination is expected. <b>Operation phase:</b> Because salt farm and paddy field are affected by the new traffic, impacts on surrounding rural areas and farmland are occurred, but these impacts are limited.
	5	Noise and Vibration	B-	B-	B-	B-	<b>Construction phase:</b> - Construction machinery and vehicles will be caused regularly. <b>Operation phase:</b> - Noise/vibrations levels generated from construction machinery will be limited to small amount.
	6	Subsidence	C	C	B-	B-	<b>Construction phase:</b> There are some soft ground layers, and there are some chances of ground subsidence <b>Operation phase:</b> same as above
	7	Odor	D	D	D	D	<b>Construction/Operation phase:</b> Little materials will cause the odors.
	8	Sediment	B-	D	B-	D	<b>Construction phase:</b> Negative impacts due to disturbing river mud at the time of bridge constructions can be considered. <b>Operation phase: -</b>
Natural Environment	9	Protected Areas	D	D	D	D	<b>Construction/Operation phase:</b> There is no protected area in the planned site, but there could be some negative environmental impact in the peripheral changes due to the project site.
	10	Ecosystem	B-	B-	B-	D	<b>Construction phase:</b> Since there are mangrove forests due to afforestation or natural forests along the river and canal, there are effects on animals and plants. <b>Operation phase:</b> Although there are slight effects on animals and plants in the adjacent area, the impacts are limited.
	11	Hydrology	C	B-	B-	B-	<b>Construction phase:</b> Individual hydrological conditions are altered by construction work

Item	No.	Impact	Scoping		Result of Assessment		Rationale
			Pre- / construction Phase	Operation Phase	Pre- / construction Phase	Operation Phase	
							such as embankment and soft ground improvement work. Although it is affected by bridge construction over rivers, appropriate measures are taken. <b>Operation phase:</b> Depending on the types of bridges, there are some negative impacts. It is predicted that the embankment of the road will cause changes in the flood expected area at the time of monsoon. For this reason, buffering measures such as draining will be taken.
	12	Topography and Geology	B-	B-	B-	B-	<b>Construction phase:</b> Construction works such as filling embankments and measures against soft soils may affect the topography and geology. However, the impacts are limited because the levees are installed and the majority of project planned places are flat. <b>Operation phase:</b> erosion on the embankment surface is expected due to the occurrence of storm surge or flooding.
Social Environment	13	Resettlement and Land Acquisition	A-	D	A-	D	<b>Pre-Construction:</b> Approximately 121ha of private land including residential area and salt farm need to be acquired. 219 HHs will be resettled. <b>Construction:</b> No impact is expected, as relocation will be completed before construction begins. <b>Operation:</b> No impact is expected, as relocation will be completed before construction begins.
	14	Poor Classes	B-/B+	B-/B+	B-/B+	B-/B+	<b>Pre-Construction:</b> There are poor households among those to be resettled and/or lose their livelihood means. <b>Construction:</b> They will have job opportunities at the construction site. <b>Operation:</b> Resettled people may experience the deterioration of their household economies and loss of livelihood following relocation if appropriate measures are not taken. Positive impact will be expected due to improvement of local economy facilitated by improved road network.
	15	Ethnic Minorities and Indigenous Peoples	C	D	D	D	<b>Pre-Construction:</b> Neither ethnic minorities nor indigenous peoples live in the project affected area. <b>Construction:</b> Neither ethnic minorities nor indigenous peoples live in the project affected area. <b>Operation:</b> Neither ethnic minorities nor indigenous peoples live in the project affected area.
	16	Local Economy such as Employment and Livelihood, etc.	B-/B+	B-/B+	A-/B+	B-/B+	<b>Pre-Construction:</b> Employers/ employees of salt farms, shrimp farms, fishermen, farmers and some ferry boat workers may lose their means of livelihood or their jobs. <b>Construction:</b> Local people will be employed for construction work. Access to market can be limited. <b>Operation:</b> Means of livelihood in salt farming and shrimp farming could be lost. The construction of road and bridges will benefit the lives of local people such as improvement of access to social services and opportunity of employment.
	17	Land Use and the Utilization of Local Resources	B-	D	B-	D	<b>Pre-Construction/ Construction:</b> The implementation of this project will change the traditional land use pattern. Local resources can get stringent. <b>Operation:</b> No impact is expected, as activities requiring change of land use and utilization of local resources will be completed by the end of construction.
	18	Water Usage and Water	B-	B-	B-	B-	<b>Pre-construction:</b> No activities are expected to give any impact on water usage.



Item	No.	Impact	Scoping		Result of Assessment		Rationale
			Pre- / construction Phase	Operation Phase	Pre- / construction Phase	Operation Phase	
		Rights					<p><b>Construction phase:</b> Local economy may be affected by the turbid water discharged from the construction site. Outflows of street dust and oil while it rains, may also cause certain effects on salt/shrimp farms and agricultures.</p> <p><b>Operation phase:</b> Local economy may be affected by the discharged water into salt/shrimp farms and agriculture farms.</p>
	19	Existing Social Infrastructure and Services	B-	B+ / B-	B-	B+ / B-	<p><b>Pre-construction:</b> No social infrastructure will subject to relocation. Access to social infrastructure and social service may be affected due to resettlement of project affected persons.</p> <p><b>Construction:</b> Construction work will disturb access to existing social infrastructure and social services. Graveyard can be partly affected. A mosque existing near the project site will not be physically affected.</p> <p><b>Operation:</b> Access to social infrastructure and services will be improved. Increased traffic volume may disturb the access to existing social infrastructure and services. A mosque existing near the project site will not be physically affected.</p>
	20	Local Communities and Decision-making Institutions	B-/D	B-	B-	B-	<p><b>Pre-construction:</b> Displacement may affect the existing network of local communities and decision-making institutions.</p> <p><b>Construction:</b> Community can be hardly divided though passage is blocked by construction work. Cumulative impact from coal power plant will not be concerned regarding community severance.</p> <p><b>Operation:</b> Community can be hardly divided though passage can be blocked by the access road.</p>
	21	Unequal Distribution of Benefits and Damages	B-	B-	B-	B-	<p><b>Pre-Construction:</b> There may be feelings of resentment, because people living around the project site will benefit through the improvement of social infrastructure and services. People to be resettled and those who lose their means of livelihoods will receive certain damages.</p> <p><b>Construction:</b> Part of residents will have disadvantage because access is limited by construction work. Local resident may not receive benefits if external workers are employed at construction site.</p> <p><b>Operation:</b> People living around the road will benefit through the improvement of social infrastructure and services, but people living far from the road will not benefit much.</p>
	22	Local Conflicts of Interest	B-	D	B-	D	<p><b>Pre-Construction:</b> Local conflicts of interest may occur between residents, and between local administration bodies and local political leaders.</p> <p><b>Construction:</b> Conflicts between local residence and external workers may occur because of changes in local customs if the external workers cannot understand local customs.</p> <p><b>Operation:</b> No activity will be conducted to cause local conflict of interest.</p>
	23	Cultural Heritage	C	C	D	D	<p><b>Pre-Construction/ Construction:</b> There is no historical/ cultural/archaeological properties nor heritage sites at the project site.</p> <p><b>Operation:</b> There is no historical/ cultural/archaeological properties nor heritage sites at the project site.</p>
	24	Landscape	B-	D	D	D	<p><b>Pre-construction:</b> No activities are expected to give any impact on landscape.</p> <p><b>Construction:</b> No significant impact will be expected as there is no scenic spot near the site.</p>

Item	No.	Impact	Scoping		Result of Assessment		Rationale
			Pre- / construction Phase	Operation Phase	Pre- / construction Phase	Operation Phase	
							<b>Operation:</b> No significant impact will be expected as there is no scenic spot near the site.
	25	Gender	B-	B+	B-	B+	<b>Pre-construction:</b> Unequal distribution of compensation can be occurred within households. <b>Construction:</b> Unequal employment opportunity can be provided at construction site. <b>Operation:</b> Improvement of local economy will give positive impact on improvement of job opportunity and livelihood.
	26	Children's Rights	B-	B+	B-	B+	<b>Pre-construction phase:</b> There are children among households to be resettled and/or lose their livelihood means. Children from households losing their land or jobs may suffer from adverse impact on their household economy, such as dropping-out of school. <b>Construction phase:</b> Access way to their schools will be physically hindered by the construction site. Child labour can be provoked at the construction site because of the huge demand for unskilled workers. <b>Operation phase:</b> Children will have better access to social services throughout the year. Education opportunity can be improved. Conversion of existing traffic to the access road will improve safety of children as pedestrian.
	27	Infectious Disease such as HIV/AIDS	B-	B-	B-	B-	<b>Pre-construction:</b> No impact is expected as no influx of migrant labor is expected at this phase. <b>Construction:</b> A temporary influx of migrant labor during the construction period may increase the risk of infectious diseases. <b>Operation:</b> Improved mobility of local residents and influx of external residents may increase the risk of infectious diseases.
	28	Work Environment (Including Work Safety)	B-	D	B-	D	<b>Pre-construction:</b> No activities are expected to give any impact on work environment. <b>Construction phase:</b> Accidents may be caused by construction work. <b>Operation phase:</b> No work will be expected to affect work environment.
Others	29	Accidents	B-	B-	B-	B-	<b>Pre-construction:</b> No activities are expected to cause accidents. <b>Construction phase:</b> Accidents may be caused by construction work. <b>Operation phase:</b> Accidents may be caused by increased traffic.
	30	Cross-boundary Impact and Climate Change	C	C	D	B-	<b>Construction phase:</b> CO2 emissions due to construction activities is temporary impact on climate change. <b>Operation phase:</b> CO2 emissions due to the vehicles that run by fossil fuels affects climate change in the long term, and adaptation measures are necessary.

## **E-8 RESULTS OF THE SURVEY ON NATURAL ENVIRONMENT**

There is no industry in the Matarbari Island to the east the Fasiakhali. A power plant construction activities are ongoing adjacent to the proposed port area. All along the route there are agricultural and fishery activities, and not the industrial area. The air quality survey results indicated overall that the air quality in the rainy/wet season is much better than the Dry Season, with a slightly high concentration of dust (SPM) and a low concentration of SOx and NOx (Table 8.1-1). The reasons of higher SPM concentration in the dry season is the ongoing construction activities of the Coal Power Plant project in

the Matarbari island and traffic movement along the road side area. But the concentrations were lower than the standard. Concentration of PM<sub>10</sub> & PM<sub>2.5</sub> are within the IFC and National Standards.

Table-E-2 Results of air quality survey

Locations	Parameters	SPM	PM <sub>10</sub>	PM <sub>2.5</sub>	SO <sub>2</sub>	NO <sub>2</sub>	O <sub>3</sub>	CO
	Units	µg/m <sup>3</sup>	µg/m <sup>3</sup>	µg/m <sup>3</sup>	µg/m <sup>3</sup>	mg/m <sup>3</sup>	mg/m <sup>3</sup>	mg/m <sup>3</sup>
AQSP-1	Dry	110	43.2	32.1	<12	<0.057	0.0034	<0.30
	Wet	88.9	24.5	10.9	<12	0.057	0.0032	<0.30
AQSP-2	Dry	184	126	90.5	<12	0.051	0.0034	<0.30
	Wet	97.3	35.3	23.8	<12	0.055	0.0031	<0.31
AQSP-3	Dry	178	118	86.2	<12	0.04	0.0031	<0.3
	Wet	101	43.9	33.5	<12	0.042	0.0032	<0.3
<b>Ambient Air Quality Standards</b>		200 (8hr)	150 (24hr) 50 (year)	65 (24hr) 15 (year)	365 (hr)	100 (year)	0.235 (24hr)	40 (24hr)
<b>IFC EHS Guideline (General: 2007)</b>		-	150 (24hr) 70 (year)	75 (24hr) 35 (year)	125 (24hr)	200 (1hr) 40 (Year)	160 (8hr)	-

(Source: JICA Study Team)

### Phytoplankton

Twenty-five species of phytoplankton were observed, and *Monoraphidium sp.* is the largest in number of species. Navicula, Cylindrotheca and Pseudonitzschia genera also present in high number. In surface layer phytoplankton present in high, bottom layer is low amount but bottom layer is fully absent due to absent of sunlight.

Table-E-3: Surface Water phytoplankton abundance (Mean)

Genera	Sampling Sites		
	Kohelia (individuals/L)	Matamuhuri (individuals/L)	Badarkhal (individuals/L)
Aphanizomenon	777.667	-	-
Asteromphalus	-	-	633.33
Aulacoseira	1,811	-	-
Boreadinium	500	-	-
Coscinodiscus	1,111	400	-
Cochlodinium	500	-	-
Cylindrotheca	477.67	15,416.667	-
Ditylum	1,276.67	-	-
Dynophysis	1,000	2,333.33	-
Dissdenium	-	-	-
Euglena	-	10,663.33	-
Entomoneis	777.667	-	-
Gloeocapsa	2,666.67	-	-
Gyrodinium	-	35,966.667	-
Leptocylindrus	-	-	666.667
Monoraphidium	-	62,366.333	-
Navicula	-	21,853.33	-
Planktothrix	1000	2,020	4,166.667
Pleurosigma	-	42,020	1,110
Protoperidinium	-	666.667	-
Pseudo-nitzschia	-	10,673.33	-

Genera	Sampling Sites		
	Kohelia (individuals/L)	Matamuhuri (individuals/L)	Badarkhal (individuals/L)
Rhizoselenia	2,788.667	-	666.667
Spirulina	-	-	-
Scenedesmus	-	4,186.667	-
Stephanopyxis	-	-	333.33
<b>Total</b>	<b>14,687.011</b>	<b>204,379.654</b>	<b>7,576.661</b>

Source: JICA Study Team)

## E-9 ENVIRONMENTAL AND SOCIAL IMPACT EVALUATION

A simple semi-quantitative descriptive checklist method has been applied to evaluate the potential environmental impacts. Firstly, the activities during construction and operation were identified and listed in the impact table. Then the corresponding impacts on the specific ecological components (terrestrial and flora), socio-economic parameters and physico-chemical environment attributes were evaluated based on the baseline scenario and an assessment of the typical interactions with project activities. Assessments were made as to whether the impacts were positive (beneficial) or negative (harmful), short-term (short recovery time) or long-term (extended recovery time); and of high or low/moderate intensity. The results of the assessment of Ecological Impacts are summarized in Tables E-4.

Table E-4 Evaluation of ecological impacts ensuing from different project activities

Sources of Potential Impacts	Ecological Issues										
	Flora		Fish	Fauna							
	AQ	TR		Amphibian		Reptile		Bird		Mammal	
			AQ	TR	AQ	TR	AQ	TR	AQ	TR	
<b>A. Construction Phase</b>											
Camp Setting	0	-1S	0	0	-1S	0	-1S	0	-1S	0	-1S
Land Clearing	0	-1S	0	0	-1S	0	-1S	0	-1S	0	-1S
Soil Excavation	0	-1S	-2S	0	-1S	0	-1S	0	-1S	0	-1S
Generation of Noise	0	0	-2S	0	-1S	0	-1S	0	-1S	0	-1S
Deterioration of Water Quality	-1S	0	-2S	0	-1S	0	0	0	0	0	0
Sewage Discharge on Soil/Water	-1S	0	-1S	0	-1S	0	0	0	0	0	0
<b>B. Operation Phase</b>											
Traffic	-1S	-1S	-2S	-1S	0	0	0	0	-1S	-1S	-1S
Maintenance of Road	-1S	-1S	-1S	-1S	-1S	-1S	-1S	-1S	-1S	-1S	-1S

[Legend :AQ = Aquatic; TR = Terrestrial; 0 = No impact (negligible impact), 3 = High impact, 2 = moderate impact, 1 = Low impact, S = Short term impact, L = Long term impact, +/- = positive/negative impact]

## E-10 ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

The environmental management and monitoring implementation structure in accordance with the reporting flow diagram during the construction phase.

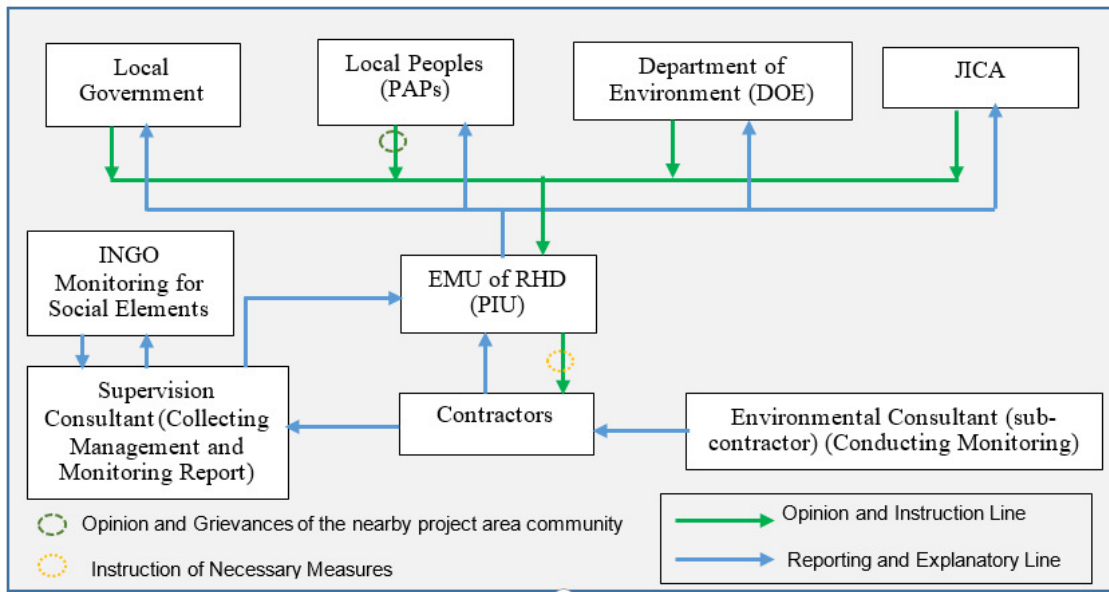


Figure E-2 EMP Implementation Structure in the Construction Phase

Figure E-3 describes the environmental management and monitoring implementation structure with the reporting flow during the operation phase

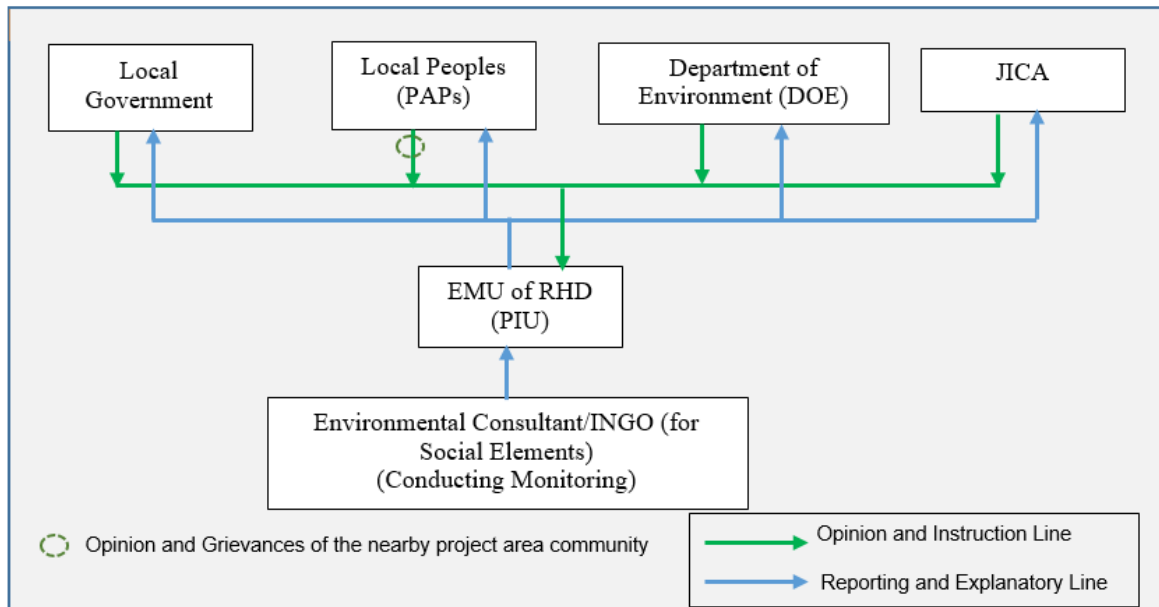


Figure E-3 EMP Implementation Structure in the Operation Phase

**Table E-5 Environmental Management Plan**

Sl. No.	Potential Impact to be Managed	Sources of Potential Impact	Standard of Impact Assessment	Objectives	Management Effort	Management Location	Period of Management	Responsible Authority	Cost
<b>A. Preconstruction Phase</b>									
1	Land acquisition	i) Loss of private land ii) Loss of salt fields, shrimp farms and fishing ground for push net iii) Loss of residential /commercial structures iv) Loss of trees, home gardens, fish ponds and fruit	i), ii), iii) & iv) -The Acquisition and Requisition of Immovable Property Act of 2017 -JICA Guideline (2010)	i) Consideration for land owners ii) Consideration for persons losing their homes iii), iv) Consideration for persons losing their property	i), ii), iii) & iv) - Developing an appropriate LARAP - Land acquisition should be conducted in compliance with the relevant laws and regulations - The cost related to relocation will be given to relocated residents - Employ local residents, especially loss of salt fields, shrimp farms, and fishing ground for push net as much as possible	i), ii), iii) & iv) - Along the right of way (ROW) of the access road	i), ii), iii) & iv) During land acquisition process	- Office of the Deputy Commissioner - RHD	Expenses to be paid by RHD - Total cost relating to land acquisition: ----- ---- Tk.
2	Disturbance to poor classes	- Poor households among those who are to be resettled.	- JICA Guideline (2010)	- Consideration for burden on vulnerable groups	- Developing “livelihood restoration program”, including job training programs to persons who want the training.	- Along the right of way (ROW) of the access road	- Prior to start construction	-Office of the Deputy Commissioner -RHD	Expenses to be paid by RHD - Job training programs: 150,000 Tk./ 20person-20day
3	Deterioration of Local Economy such as Losses of Employment and Means of Livelihood	- Loss of existing livelihood, employment and business opportunities	- Income level	- Maintaining or Improvement of living standards of local residents	- Developing an appropriate LARAP - Compliance with relevant law for land acquisition - Appropriate implementation of compensation	- At the site	- During land acquisition process	- Office of the Deputy Commissioner - RHD	RHD Cost is included in LARAP budget.
4	Land Use and Utilization	- Changing the traditional land use	- Land Use Pattern - Use of Local	- Mitigation of land use change and Prevention	- Ditto	- near the site	- During land acquisition process	- Office of the Deputy Commissioner	RHD Cost is included in

Sl. No.	Potential Impact to be Managed	Sources of Potential Impact	Standard of Impact Assessment	Objectives	Management Effort	Management Location	Period of Management	Responsible Authority	Cost
	of Local Resources	patterns and utilization of local resources	Resources	of local resource depletion				- RHD	LARAP budget.
5	Disturbance to Existing Social Infrastructure and Services	- Loss of access to social infrastructure	- Accessibility to Social Infrastructure and social services -GRM cases	- Ensuring access to social infrastructure and social services	- Ditto	- near the site	- During land acquisition process	- Office of the Deputy Commissioner - RHD	RHD Cost is included in LARAP budget.
6	Disturbance to Local Communities and Decision Making Institutions	- Loss of access to social infrastructure - community severance due to resettlement	- Accessibility within community -Perception of local residents	- Ensuring accessibility within community and maintaining Local Decision making Institutions	- Ditto	- near the site	- Prior to start construction	- Office of the Deputy Commissioner - RHD	Expenses to be paid by RHD
7	Unequal distribution of Benefits and Compensation	- It can occur among residents, workers, government officers and local politicians	-Perception of local residents	- Consideration for unequal distribution of benefits and losses	- Ditto	- Along the right of way (ROW) of the access road	- Prior to start construction	- Office of the Deputy Commissioner - RHD	Expenses to be paid by RHD
8	Local Conflicts of Interest	- It can occur among residents, workers, government officers and local politicians	-Perception of local residents	- Consideration to affected peoples' emotions	- Ditto	- Along the right of way (RW) of the access road	- Prior to start construction	- Office of the Deputy Commissioner - RHD	Expenses to be paid by RHD
9	Gender	- Inappropriate distribution of compensation within HHs	- distribution of compensation within HHs	- Appropriate distribution of compensation within HHs	- Awareness and monitoring for appropriate distribution of compensation within HHs	- Along the right of way (ROW) of the access road	- Prior to start construction	- Office of the Deputy Commissioner - RHD - External Monitoring Agency	Expenses to be paid by RHD
10	Children's Rights	- Deterioration of livelihood due to	- enrollment rate	- ensuring education opportunity	- Ditto	- At the site	- Prior to start construction	- Office of the Deputy Commissioner	Expenses to be paid by RHD

Sl. No.	Potential Impact to be Managed	Sources of Potential Impact	Standard of Impact Assessment	Objectives	Management Effort	Management Location	Period of Management	Responsible Authority	Cost
		resettlement and land acquisition						- RHD	
<b>B. Construction Phase</b>									
1	Air	i) Emission from construction vehicles and machinery ii) Air pollution from various plants affecting settlements iii) Air pollution may exceed the limits prescribed by the DOE/IFC/JICA guidelines iv) Vehicles will generate dust and suspended particles	i)-iv) - Ambient air quality standard - IFC guideline values for ambient air quality (General/ 2007))	i)-iv) Prevention of air pollution in the surrounding area	i) All vehicles, equipment and machinery shall be selected to meet recognized international and national standards for emissions and shall be maintained and operated in a manner that ensures relevant air, noise and discharge rules are followed. Only unleaded petrol and low sulphur diesel or sulphur free diesel shall be used as fuel for vehicles, equipment and machinery. ii) The asphalt plants, crushers and batching plants shall not be sited less than 500m in leeward direction from the nearest human settlement. iii) Regular monitoring or air quality parameters during the construction period as envisaged in the Environmental Monitoring Plan. iv) The dust generated by vehicles on site shall be arrested using a water tanker fitted with a sprinkler capable of applying water uniformly at a controllable rate of flow to variable widths of surface but without any flooding.	i) Wherever the hot mix plant and batching plant is setup i) Locations near settlements ii) Locations given in the monitoring plan iii) Wherever the plants are set up and sensitive locations as suggested in monitoring plan	-During the construction stage	Implementation: Contractor/ Environmental Consultant Supervisor: RHD/ Supervision Consultant	Expense is included in contract cost by Contractor.



<b>Sl. No.</b>	<b>Potential Impact to be Managed</b>	<b>Sources of Potential Impact</b>	<b>Standard of Impact Assessment</b>	<b>Objectives</b>	<b>Management Effort</b>	<b>Management Location</b>	<b>Period of Management</b>	<b>Responsible Authority</b>	<b>Cost</b>
2	Water Quality	i) River water from construction area/water way in salt/paddy field ii) Contamination of water by fuel/oil spillage from vehicles iii) Contamination of stagnant water body by fecal matters from workers' camp iv) Deposition of dust in open wells near construction site v) Using drinking water for construction purpose vi) Hand pump close to road may get affected in road construction vii) Wells or water storage system may get affected in road construction viii) Altering of flow of natural drains/rivers ix) Sanitation of waste disposal in construction camps	-Water Quality Standards for Drinking water and Surface water of DOE -IFC Guidelines 2007 -JICA Guidelines 2010	-Prevention of water pollution in the project area	i)Monitoring of water quality of the river/water way in salt/paddy field ii) Construction vehicles / equipment shall be operated and maintained in such a manner so as to avoid contamination of water bodies due to oil spillage. Fuel storage shall only be done on wasteland and will be kept away from drainage channels and natural water bodies. iii) Labor camp shall not be allowed near any of the water bodies. Proper sanitation facilities shall be provided. iv)The mouth / opening of the well shall be covered with suitable material during any of the construction activities so as to prevent dust from entering the well. v) The contractor shall make arrangements for water required for construction in such a way that water availability and supply to nearby community is unaffected. Wastage of water shall be kept to a minimum during construction. vi)All the hand pumps shall be relocated to a suitable alternate place. vii) Alternate arrangements will be	i) Rivers/water way in the salt/paddy field ii) Near the workers' camp and sites for the installation of construction machineries iii) Preapproved locations Away from water bodies. iv) All the wells along the project corridor v), vi), vii) & viii) At respective planned construction sites ix) Wherever workers' camp is located	-During the construction stage	Implementation: Contractor/ Environmental Consultant Supervisor: RHD/ Supervision Consultant	Expense is included in contract cost by Contractor.

Sl. No.	Potential Impact to be Managed	Sources of Potential Impact	Standard of Impact Assessment	Objectives	Management Effort	Management Location	Period of Management	Responsible Authority	Cost
					made for all wells or water storage systems viii) Waterway shall be channelized with slope protection – Gabion Structure. ix) The construction of camps will be done with sufficient buffer from any habitations. At construction sites and camps, a sufficient number of latrines will be provided. The sewage generated from the camps will be properly disposed of so that it does not affect water bodies.				
3	Noise and Vibration	i) Noise and vibration levels from vehicles, Asphalt plants and equipment ii) Noise barriers	Noise level standards - IFC guideline values for noise (General/ 2007)	Reduction of noise levels from construction activities	i) The plants and equipment used for construction shall conform to DOE norms. Vehicles and equipment used shall be fitted with silencer. Any vehicle and machinery shall be kept in good working order and engines turned off when not in use. Regular monitoring of noise Parameters (Leq) during the construction period as envisaged in the Environmental Monitoring Plan. Construction of noise barriers in the form of walls at sensitive locations upon consultation with stakeholders. ii) Construction of noise barriers in the form of	i) Wherever the plants are setup. All along the corridor wherever the sensitive locations like schools, hospitals and other community places are located. ii) All along the corridor wherever the sensitive locations like schools, hospitals and other community places are located.	-During the construction stage	Implementation: Contractor/ Environmental Consultant Supervisor: RHD/ Supervision Consultant	Expense is included in contract cost by Contractor.

Sl. No.	Potential Impact to be Managed	Sources of Potential Impact	Standard of Impact Assessment	Objectives	Management Effort	Management Location	Period of Management	Responsible Authority	Cost
					walls at Sensitive locations upon consultation with stakeholders.				
4	Soil quality	i) Soil Erosion in borrow pits ii) Loss of top soil in borrow pits iii) Compaction of soil iv) Soil erosion in embankments v) Contamination of soil from fuel and lubricants vi) Contamination of land from construction waste and quarry materials vii) Loss of top soil in land acquisition	-Soil fertility test -JICA guidelines (2010) - EHS Guidelines for Construction Materials Extraction and the General EHS Guidelines -Environmental, Health, and Safety Guidelines for Toll Roads- 2007	-Minimize the deterioration of the soil quality	i) The depth of borrow pits shall be restricted so that the sides of the excavation shall have a slope not steeper than 1:4, from the edge of the final section of the bank. ii) Agricultural fields or productive land shall be avoided for borrowing earth. If unavoidable, topsoil shall be preserved and used for tree plantation. iii) Construction equipment and vehicles shall be restricted to move only within a designated area to avoid compaction of productive soil. iv) Pitching shall be done for slope stabilization as per the RHD guidelines v) Construction vehicles and equipment shall be operated and maintained in such a manner so that soil contamination from spillage shall be at a minimum. Fuel storage shall only be done on wasteland and will be kept away from drainage channels and natural water bodies vi) Debris generated due to the dismantling of the	i) & ii) On approved locations of borrow pits iii) Along the right of way (ROW) of the access road iv) at the embankments v) Near the workers' camp and sites for the installation of construction machineries vi) Along the right of way (ROW) of the access road	-During the construction stage	Implementation: Contractor/ Environmental Consultant Supervisor: RHD/ Supervision Consultant	Expense is included in contract cost by Contractor.

Sl. No.	Potential Impact to be Managed	Sources of Potential Impact	Standard of Impact Assessment	Objectives	Management Effort	Management Location	Period of Management	Responsible Authority	Cost
					existing pavement structure and the cutting of the hill side for the widening shall be suitably reused in the proposed construction, such as for fill materials for embankments. Debris and other material obtained from existing embankment shall be dumped in approved landfill site already identified by concerned agency. All spoils shall be disposed off as desired and the site shall be fully cleaned before handing over. Construction waste including non-bituminous and bituminous waste shall be dumped in approved landfill site identified by RHD or waste management authority if any. All spoils shall be disposed off as desired and the site shall be fully cleaned before handing over.				
5	Odor	- Domestic wastewater of workers	- Wastewater standards	- Prevention of generating odor	-Taking appropriate measures for handling general waste -Prohibit illegal waste disposal	- Construction area	- During construction phase	Implementation: Contractor/ Environmental Consultant -Supervisor: RHD/ Supervision Consultant	Expenses included in contract cost by Contractor.
6	Sediment	i) River bottom sediment ii) Runoff water from	i) ii) iii) & iv) - Wastewater standards	i) ii) iii) & iv) - Prevention of water pollution in the surrounding area	i) Excavate channels, ditches and temporary settling pond around bridge construction area ii) iii) iv) & v)	i) ii) iii) iv) & v) Construction area	i) ii) iii) iv) & v) - During construction phase	Implementation: Contractor/ Environmental Consultant Supervisor:	Expenses included in contract cost by Contractor

Sl. No.	Potential Impact to be Managed	Sources of Potential Impact	Standard of Impact Assessment	Objectives	Management Effort	Management Location	Period of Management	Responsible Authority	Cost
		construction area iii) Domestic wastewater of workers iv) Inappropriate disposal of waste v) Leakages of oil and chemical materials from construction activity			- Implement the same mitigation measures as those addressed in "Water Quality"			RHD/ Supervision Consultant	
7	Ecosystem	i) Mangrove forest ii) Tidal flats	i), ii) -Bangladesh Wild Life Preservation (Amendment) Act, 1974 -JICA Guideline (2010) -World Bank OP4.04	i), ii) Protection of endangered species Protection critical natural habitat	i), ii) Developing "protective measures" Prohibit disturbance, Monitoring of water quality, sedimentation and topographical future	i), ii) Construction area	During construction phase	Implementation: Contractor/ Environmental Consultant Supervisor: RHD/ Supervision Consultant	Expense is included in contract cost by Contractor.
8	Deterioration of Local Economy such as Losses of Employment and Means of Livelihood	- Loss of existing livelihood, employment and business opportunities	- Income level, Number of employment opportunities for local residents and number of businesses around the construction area	- Maintaining or Improvement of the local economy -Maintaining or Improvement of living standards of local residents - Consideration to local residents' feelings	Employ local residents as much as possible Use the services (i.e., laundry and catering services, etc.) and products offered by the local community. Developing "livelihood restoration program", including job training programs to persons who want the training.	- Villages near the site	- During construction phase	- Implementation: Contractor/ Environmental Consultant - Supervisor: RHD/ Supervision Consultant	Expense is included in contract cost by Contractor - Hire local residence: 1,000Tk./person-day
9	Land Use and Utilization of Local Resources	- Changing the traditional land use patterns and utilization of local resources	- Land Use Pattern - Use of Local Resources	- Mitigation of land use change and Prevention of local resource depletion	- Implement the same mitigation measures as those addressed in the "Local economy"	- Villages near the site	- During construction phase	- Implementation: Contractor/ Environmental Consultant - Supervisor: RHD/ Supervision	Expenses included in contract cost by Contractor

Sl. No.	Potential Impact to be Managed	Sources of Potential Impact	Standard of Impact Assessment	Objectives	Management Effort	Management Location	Period of Management	Responsible Authority	Cost
								Consultant	
10	Disturbance to Water Usage, Water Rights, etc.	i) Adverse impact due to water pollution ii) Usage of underground water	i) Water pollution - Same as those addressed in "Water quality" ii) Ground water - Drinking water quality standards	i) Water pollution - Same as those addressed in "Water quality" ii) Ground water - Consideration to local residents' living	i) Water pollution - Implement the same mitigation measures as those addressed in "Water quality" ii) Ground water - Monitoring of water levels and water quality at wells in residential areas	i), ii) - Construction area	i), ii) - During construction phase	- Implementation: Contractor/ Environmental Consultant - Supervisor: RHD/ Supervision Consultant	Expenses included in contract cost by Contractor
11	Disturbance to Existing Social Infrastructure and Services	Loss of access to social infrastructure and social services due to disturbance by construction work	- Access to social infrastructure and social services - Consciousness of Project Affected Persons	- Securing access to social infrastructure and social services	- Securing passage	Villages near the site	During construction phase	- Implementation: Contractor/ Environmental Consultant - Supervisor: RHD/ Supervision Consultant	Expenses included in contract cost by Contractor
12	Disturbance to Local Communities and Decision making Institutions	- Loss of access within social infrastructure - community severance due to resettlement	- Accessibility within community - Perception of local residents	- Ensuring accessibility within community and maintaining Local Decision making Institutions	- Ditto	- near the site	During construction phase	- Implementation: Contractor/ Environmental Consultant - Supervisor: RHD/ Supervision Consultant	Expenses to be paid by RHD
13	Unequal Distribution of Benefits and Damages	- Unequal distribution of benefits and damages between local residents and external workers	- Consciousness of local residents	- Consideration of the attitudes of local residents to the project	- Employ local residents as much as possible - Promote communication between external workers and local people (e.g., join in local events)	- Villages near the site	- During construction phase	- Implementation: Contractor/ Environmental Consultant - Supervisor: CPA/ Supervision Consultant	Expenses included in contract cost by Contractor
14	Local Conflicts of Interest	- Conflicts between local residents and external workers	- Change in local customs	- Consideration of the attitudes of local residents to the project	- Employ local residents as much as possible - Promote communication between external workers and local	- Villages near the site	- During construction phase	- Implementation: Contractor/ Environmental Consultant - Supervisor: RHD/	Expenses included in contract cost by Contractor

Sl. No.	Potential Impact to be Managed	Sources of Potential Impact	Standard of Impact Assessment	Objectives	Management Effort	Management Location	Period of Management	Responsible Authority	Cost
					people (e.g., join in local events)			Supervision Consultant	
15	Gender	Unequal opportunity of employment	- Opportunity of employment	- Equal opportunity of employment	- Opportunity of employment shall be properly provided both for male and female	Construction Site	- During construction phase	- Implementation: Contractor/ Environmental Consultant - Supervisor: RHD/ Supervision Consultant	Expenses included in contract cost by Contractor
16	Children's Rights	- Child labor	- Child labor	- Banning child labor	- Prohibit labor contracts between subcontractor and children - Patrolling periodically to check for any child labor	- Construction area	- During construction phase	- Implementation: Contractor/ Environmental Consultant - Supervisor: RHD/ Supervision Consultant	Expenses included in contract cost by Contractor
17	Infectious Diseases such as HIV/AIDS	- Temporary influx of migrant labor during construction may increase risk of infection	- sanitation for local residents	- Consideration for sanitation for local residents	- Implementation of periodic medical check-ups by temporary medical team - Education and training on health care of workers	- Construction area	- During construction phase	- Implementation: Contractor/ Environmental Consultant - Supervisor: RHD/ Supervision Consultant	Expenses included in contract cost by Contractor - Medical checkups: 45,000Tk./ person (Full Medical Checkup) - Safety education and training: 150,000Tk./ 20 person
18	Work environment (including work safety)	i) Labor accidents ii) Diseases caused by air pollutants, water pollutants, and	i) Labor accidents - Handling heavy loads - Working at heights - Electric	i) & ii) - Prevention of labor accidents, traffic accidents, and health problems	i) Labor accidents - Prepare a manual for labor accident prevention including safety education and training - Provide workers with	i) & ii) - Construction area	i) & ii) - During construction phase	- Implementation: Contractor/ Environmental Consultant - Supervisor: RHD/ Supervision	Expenses included in contract cost by Contractor

Sl. No.	Potential Impact to be Managed	Sources of Potential Impact	Standard of Impact Assessment	Objectives	Management Effort	Management Location	Period of Management	Responsible Authority	Cost
		noise by construction work	shocks ii) Environment pollution Ambient Air Quality Standards - Noise level standards - Waste management rule - IFC guideline values for ambient air quality and noise (General/ 2007)		appropriate personal protective equipment (PPE) - Inspect and ensure that any lifting devices, such as cranes, are appropriate for expected loads - Keep lifting devices well maintained and perform maintenance checks as appropriate during the period of construction - Use equipment that protects against electric shock ii) Environment pollution - Observe related standards and provide workers with appropriate facilities			Consultant	
19	Accidents	- Traffic accidents	i) River traffic ii) Land traffic	i), ii) - Prevention of traffic accidents	i) River Traffic: - Setting marking buoys around the construction area for river safety - Informing construction schedules to local fishermen, etc. ii) Land traffic: - Informing bus schedules to the surrounding villages - Determining a traffic control plan - Training safe operation of vehicles	i) River area around the construction site for bridge construction ii) Area around the construction site	i), ii) - During construction phase	- Implementation : Contractor/ Environmental Consultant - Supervisor: RHD/ Supervision Consultant	Expenses included in contract cost by Contractor
20	Cross-boundary impact and climate change	- CO <sub>2</sub> will be produced by construction work	-	- Reduce CO <sub>2</sub> emissions as much as possible	- Periodic maintenance and management of all construction machinery and vehicles	- Construction area	- During construction phase	- Implementation: Contractor/ Environmental Consultant	Expenses included in contract cost by Contractor



Sl. No.	Potential Impact to be Managed	Sources of Potential Impact	Standard of Impact Assessment	Objectives	Management Effort	Management Location	Period of Management	Responsible Authority	Cost
								- Supervisor: RHD/ Supervision Consultant	
<b>C. Operation Stage</b>									
1	Air Quality	i) Exhaust gas from vehicles used for mobilization of equipment and workers ii) Dust from road	i), ii) Ambient air quality standards -IFC guideline values for ambient air quality (General/2007) -DOE Guidelines -JICA Guidelines (2010)	i), ii) Prevention of air pollution	i), ii) Monitoring the ambient air quality along the road	i), ii) Along the road	1), 2) During the operation of the Road	RHD	RHD
2	Water Quality	Degradation due to Water quality road-run-off	Ambient water Quality standards	Prevention of water pollution	Silt fencing, oil & grease traps, etc. shall be provided at sensitive water bodies to ensure that the water quality is not impaired due to contaminants from road run-off Monitoring shall be carried out as specified in the monitoring plan.	-Bridge locations	During the operation of the Road	RHD	RHD
3	Noise and Vibration	Noise caused by vehicles used for mobilization of equipment and workers	Noise standards -IFC guideline values for noise (General/2007) -JICA guideline (2010)	Prevention of noise and vibration impact	-Monitoring the noise and vibration levels -Determine a traffic control plan including route-setting -Limit truck speed, especially around residential areas -Install noise barrier (wall etc.) in sensitive areas, if necessary	Along the road	During the operation of Road	RHD	RHD
4	Soil Quality	Soil and water contamination from accidental spills	-Soil quality standards	Prevention of soil and water pollution in the surrounding area	-Contingency plans to be in place for cleaning up of spills of oil, fuel and toxic chemicals. -Monitoring shall be carried out as specified in	Salt/ paddy fields	During the operation of the Road	RHD	RHD

Sl. No.	Potential Impact to be Managed	Sources of Potential Impact	Standard of Impact Assessment	Objectives	Management Effort	Management Location	Period of Management	Responsible Authority	Cost
					the Monitoring Plan				
5	Sediment	Existence of bridge piers	World Bank OP4.04	Prevention of deterioration of tidal flat	Monitoring of sediment quality of mud flat and river bottom	River around bridges	During the operation of the Road	RHD	RHD
6	Ecosystem	i) Mangrove forest ii) Tidal flats	i), ii) Bangladesh Wild Life Preservation (Amendment) Act, 1974 JICA Guideline (2010) -World Bank OP4.04	i), ii) Protection of endangered species Protection critical natural habitat	i) -Compensatory Afforestation in the Mangrove area; ii) -Developing “protective measures” -Prohibit disturbance -Monitoring of water quality, sedimentation and topographical features	i) - Compensatory Afforestation in the both bank of the Kuhelia River ii) Around the new bridges.	During the operation of the Road	RHD	RHD
7	Disturbance to Poor People	Improved road connection	Access to social services	Improvement of access to social services	New access road will be built considering the rainy season water level.	Villages near the site	During the operation of the Road	RHD	RHD
8	Deterioration of Local Economy such as Losses of Employment and Means of Livelihood	Improved transportation condition	Economic situation of dealing products	Improvement of the local economy Improvement of living standards of local residents Consideration to local residents' feelings	Same as the above	Villages near the site	During the operation of the Road	RHD	RHD
9	Disturbance to Water Usage, Water Rights, etc.	- Adverse impact due to water pollution	- Same as those addressed in “Water quality”	- Same as those addressed in “Water quality”	- Implement the same mitigation measures as those addressed in “Water quality”	Villages near the site	During the operation of the Road	RHD	RHD
10	Disturbance to the Existing Social Infrastructure and Services	i)Traffic jams caused by increased traffic volumes ii)Improved roads	i) ii) -Accessibility to Social Infrastructure	i) Traffic volume will increase ii) Access to social services	i) Minimizing traffic volume by using buses for employees of port ii) Access to social services. The access road can be used even in the rainy season.	i), ii) Villages near the site	During the operation of the Road	RHD	RHD
11	Disturbance to Local Communities	- Loss of access within community	- Accessibility within community	- Ensuring accessibility within	- Ensuring passage (should be considered as the time of design and	- near the site	During the operation of the Road	RHD	RHD

Sl. No.	Potential Impact to be Managed	Sources of Potential Impact	Standard of Impact Assessment	Objectives	Management Effort	Management Location	Period of Management	Responsible Authority	Cost
	s and Decision making Institutions	due to disturbance to passage	-Perception of local residents	community and maintaining Local Decision making Institutions	construction)				
12	Unequal distribution of Benefits and Compensation	-It can occur among residents, workers, government officers, and local politicians	-Perception of local residents	Consideration to affected peoples' emotions	- Developing an employment plan that is fair to every affected person	Villages near the site	During the operation of the Road	RHD	RHD
13	Gender	Improved road	-Perception of local residents	Access to social services and market	The access road can be used even in the rainy season.	Villages along the road	During the operation of the Road	RHD	RHD
14	Children's Rights	Improved livelihood standard	<del>i) Child labor</del> Access to education	Improved access to education	Improved access to education -The access road can be used even in the rainy season.	Villages along the road	During the operation of the port	RHD	RHD
15	Infectious Diseases such as HIV/AIDS	- Temporary influx of migrant labor during operation may increase risk of infection	- sanitation for local residents	- Consideration for sanitation for local residents	- Education and training on health care of workers	- Port Area	- During operation phase	RHD	RHD
16	Accidents	Traffic accidents	Land traffic	Prevention of traffic accidents	-Observation of traffic regulations, installation of traffic signs, and education on safe driving -Reducing the number of vehicles by scheduling buses -Consulting with related authorities on schedules -Informing vehicle schedules to the surrounding villages	Villages along the road	During the operation of the port	RHD	RHD
17	Cross-boundary Impact and	Efficient road maintenance Idling stops,	Amount of CO <sub>2</sub> emissions	Reduce CO <sub>2</sub> emissions per road length	Efficient maintenance Promotion of efficient fuel driving	Villages along the road	During the operation of the port	RHD	RHD

Sl. No.	Potential Impact to be Managed	Sources of Potential Impact	Standard of Impact Assessment	Objectives	Management Effort	Management Location	Period of Management	Responsible Authority	Cost
	Climate Change	economic driving							

### E-11 MONITORING PLAN

Key environmental impacts, monitoring methods, responsible organizations, and expenses for each environmental item in the preconstruction, construction and operation phases for the port connecting access road project are listed in Table E-6.

**Table-E-6 Environmental Monitoring Plan of the Project**

Sl. No.	Significant Impact to be Monitored	Source of Significant Impact	Monitored Parameter	Purpose of the Monitoring	Monitoring Method			Responsible Authority	Monitoring Cost
					Method of Collecting and Analyzing Data	Location	Duration and Frequency		
<b>A. Preconstruction Phase</b>									
1.	Land acquisition	i) Loss of private land ii) Loss of salt fields, shrimp farms and fishing sites iii) Loss of residential structures iv) Loss of trees and water body	i), ii), iii) & iv) - The Acquisition and Requisition of Immovable Property Ordinance of 2017 - JICA Guideline (2010)	i), ii), iii) & iv) - Confirmation of compensation process	i), ii), iii) & iv) - Attendance at compensation payment - Record of compensation agreements	i), ii), iii) & iv) - Areas eligible for compensation	i), ii), iii) & iv) - During land acquisition process	- Office of the Deputy Commissioner - RHD	Expenses by RHD - Witness: 8,500Tk./person/day

Sl. No.	Significant Impact to be Monitored	Source of Significant Impact	Monitored Parameter	Purpose of the Monitoring	Monitoring Method			Responsible Authority	Monitoring Cost
					Method of Collecting and Analyzing Data	Location	Duration and Frequency		
2.	Disturbance to poor people Classes	i) Poor households among those who are to be resettled  ii) Loss of salt fields, shrimp farms and fishing sites	i), ii)  - JICA Guideline (2010)	i), ii)  - Same as those addressed in “Land acquisition”	i), ii)  - Interviewing affected people	i), ii)  - Affected people	i), ii)  - Once a year	- Implementation: Contractor/ Environmental Consultant  - Supervisor: RHD/Supervision Consultant	Expenses by RHD  - Interviewer: 7,500Tk./ Person/day
3.	Social Institutions such as Social Infrastructure and Local Decision-making Institutions	- Loss of access to social infrastructure  - community severance due to resettlement	-	- Access to social infrastructure  - Continuity of community	- Interviewing affected people	- Affected people	- Once a year	Implementation: Contractor/ Environmental Consultant  Supervisor: RHD/Supervision Consultant	Expenses by RHD
4.	Unequal distribution of Benefits and Compensation	- It can occur among residents, workers, government officers and local politicians	-	- Same as those addressed in “Social Institutions”	- Same as those addressed in “Social Institutions”	- Same as those addressed in “Social Institutions”	- Same as those addressed in “Social Institutions”	- Implementation: Contractor/Environmental Consultant  - Supervisor: RHD/Supervision consultant	Expenses by RHD

Sl. No.	Significant Impact to be Monitored	Source of Significant Impact	Monitored Parameter	Purpose of the Monitoring	Monitoring Method			Responsible Authority	Monitoring Cost
					Method of Collecting and Analyzing Data	Location	Duration and Frequency		
5.	Local Conflicts of Interest	- It can occur among residents, workers, government officers and local politicians	-	- Same as those addressed in "Social Institutions"	- Same as those addressed in "Social Institutions"	- Same as those addressed in "Social Institutions"	- Same as those addressed in "Social Institutions"	-Implementation: Contractor/ Environmental Consultant -Supervisor: RHD/ Supervision Consultant	Expenses by RHD
6.	Gender	Inappropriate distribution of compensation within HHs	distribution of compensation within HHs	- Appropriate distribution of compensation within HHs	Interview of Project Affected Persons	- Same as those addressed in "Land Acquisition"	- Same as those addressed in "Land Acquisition"	- Office of the Deputy Commissioner RHD	Expenses by RHD
7.	Setting up construction camps	i) disturbance to the nearby residence ii) due diligence of the camp's environmental issues	constructed as per the -BNBC Guideline -JICA guidelines (2010)	Ditto	Ditto	Ditto	Ditto	Ditto	Ditto
8.	Setting up hot mix plants	-Due diligence of the hot mix plants environmental issues	-JICA guidelines (2010)	Ditto	Ditto	Ditto	Ditto	Ditto	Ditto
<b>B. Construction Phase</b>									

Sl. No.	Significant Impact to be Monitored	Source of Significant Impact	Monitored Parameter	Purpose of the Monitoring	Monitoring Method			Responsible Authority	Monitoring Cost
					Method of Collecting and Analyzing Data	Location	Duration and Frequency		
1.	Air Quality	i) Emission from construction vehicles and machinery ii) Air pollution from various plants affecting settlements iii) Air pollution may exceed the limits prescribed by the DOE/IFC/JICA guidelines iv) Vehicles will generate dust and suspended particles	i), ii) iii) & iv) - <b>PM<sub>10</sub>, PM<sub>2.5</sub>, SO<sub>2</sub>, NO<sub>x</sub>, CO</b> - Ambient Air Quality Standard - IFC guideline values for ambient air quality (General/ 2007) - <b>Meteorological Condition (Temperature, Moisture, Wind)</b>	i), ii) iii) & iv) - Evaluation of effect of the mitigation measures towards air pollution	i), ii) iii) & iv) - Collecting samples and analyzing at a lab - Measuring meteorological data	i), ii) iii) & iv) - <b>3 points</b> Residential area around the P	i), ii) iii) & iv) - Once every three months	- Implementation: Contractor/ Environmental Consultant - Supervisor: RHD/ Supervision Consultant	Expenses included in contract cost by Contractor Sampling: 50,000Tk./ sample Analyzing: 45,000Tk./ sample
2.	Water Quality (Soil) (Sediment)	i) Runoff water from construction area ii) Domestic wastewater of workers	i), ii) iii) & iv) - <b>pH, BOD, TSS, Oil &amp; Grease, etc.</b> - Wastewater standards	i), ii) iii) & iv) - Evaluation of effect of the mitigation measures towards water pollution	i), ii) iii) & iv) - Collecting samples and analyzing at a lab	i), ii) iii) & iv) - <b>3 point:</b> Foreside of the drain outlet - <b>3 point:</b> Surface water	i), ii) iii) & iv) - Once every three months	- Implementation: Contractor/ Environmental Consultant - Supervisor: RHD/ Supervision Consultant	Expenses included in contract cost by Contractor Sampling: 50,000Tk./ sampling

Sl. No.	Significant Impact to be Monitored	Source of Significant Impact	Monitored Parameter	Purpose of the Monitoring	Monitoring Method			Responsible Authority	Monitoring Cost
					Method of Collecting and Analyzing Data	Location	Duration and Frequency		
		iii) Inappropriate disposal of waste iv) Leakages of oil and chemical materials from construction activity	- Ambient water quality standards (inland surface water) - Ground water (Drinking water quality standards)			near the construction area - <b>3 point:</b> Ground water from existing wells		- Analyzing: 100,000Tk./ all sample	
3.	Noise and Vibration	i) Noise and vibration levels from vehicles, Asphalt plants and equipment ii) Noise barriers	i), ii) <b>Noise level</b> - Noise level standards - IFC guideline values for noise (General/ 2007)	i), ii) - Evaluation of effect of the mitigation measures towards noise levels	i), ii) - Measurement using noise level meter	i), ii) Free field at 1m from the equipment whose noise levels are being determined.	i), ii) - Once every three months	-Implementation: Contractor/ Environmental Consultant -Supervisor: RHD/ Supervision Consultant	Expenses included in contract cost by Contractor - Measurement: 50,000Tk./ session
4.	Wastes (Odor) (Sediment)	i) Construction waste from construction work ii) Domestic waste from workers iii) Hazardous waste such as	i), ii) iii) & iv) - Waste Management Rules	i), ii) & iii) - Evaluation of effect of the mitigation measures for waste	i), ii) & iii) - Record of kinds and quantity of waste, and the disposal method	i), ii) & iii) - Construction area	1) - 4) - Continuous records	-Implementation: Contractor/ Environmental Consultant -Supervisor: RHD/ Supervision Consultant	Expenses included in contract cost by Contractor



Sl. No.	Significant Impact to be Monitored	Source of Significant Impact	Monitored Parameter	Purpose of the Monitoring	Monitoring Method			Responsible Authority	Monitoring Cost
					Method of Collecting and Analyzing Data	Location	Duration and Frequency		
		dry batteries, etc.  iv) River bottom sediment							
5.	Ecosystem (Endangered Species)	i) Mangrove forest ii) Tidal flats	i), ii) <b>Species, Number</b>  - Bangladesh Wild Life Preservation (Amendment) Act, 1974  - JICA Guideline (2010)	i) Evaluation of existence of endangered species	i), ii) - Observation	i) Endangered species  <b>- 3 point:</b> Construction area	i) Endangered species  - Bird: Once a week in migration season  - Others: Twice a year in dry and rainy seasons  ii) Every 3 days in spawning season	- Implementation: Contractor/ Environmental Consultant  - Supervisor: RHD/ Supervision Consultant	Expenses included in contract cost by Contractor  -Observation: 400,000Tk./ Researcher/year
	Ecosystem (Mud Flat, Fish & Nekton)	i), ii) & iii)  Ditto	i), ii) & iii) <b>Species, Number, Weight</b>  - Benthos (Mud flat)  - Fish and Nekton	i), ii) & iii)  Ditto	i), ii) & iii)  - Collecting samples at the site, analyzing at a lab	i), ii) & iii)  <b>- 3 points:</b> In front of the construction sites especially the river crossings	i), ii) & iii)  - Twice a year in dry and rainy seasons	Ditto	Expense is included in contract cost by Contractor  - Sampling & analyzing: 200,000Tk./ season

Sl. No.	Significant Impact to be Monitored	Source of Significant Impact	Monitored Parameter	Purpose of the Monitoring	Monitoring Method			Responsible Authority	Monitoring Cost
					Method of Collecting and Analyzing Data	Location	Duration and Frequency		
6.	Deterioration of Local Economy such as Losses of Employment and Means of Livelihood	- Loss of existing livelihood, - Increase in employment and business opportunities	- Income level, Number of employment opportunities for local residents and number of businesses around the construction area	- Maintaining or Improvement of the local economy - Maintaining or Improvement of living standards of local residents - Consideration to local residents' feelings	- Information from related institutions - Interviewing residents	- Related institutions - Villages near the site	- Once a year	- Implementation: Contractor/ Environmental Consultant - Supervisor: RHD/ Supervision Consultant	Expenses included in contract cost by Contractor  -Interviewer: 5,500Tk./ researcher (Same as "Poor people")
7.	Land Use and Utilization of Local Resources	- Changing the traditional land use patterns and utilization of local resources	- Same as those addressed in "Local Economy"	- Observation of land use change - Observation of local resource usage	- Field observation Interviewing residents	- Villages near the site	- Once a year	Implementation: Contractor/ Environmental Consultant -Supervisor: RHD/ Supervision Consultant	Expenses included in contract cost by Contractor
8.	Disturbance to Existing Social Infrastructure and Services	i) Increase in the number of vessels ii) Increase in the number of cars	i), ii) - Traffic volume by construction	i), ii) - Evaluation of effect of construction schedule	i), ii) - Record of numbers of vessels and cars being used	i), ii) - Project site	i), ii) - Continuous records	- Implementation: Contractor/ Environmental Consultant - Supervisor: RHD/Supervision Consultant	Expenses included in contract cost by Contractor

Sl. No.	Significant Impact to be Monitored	Source of Significant Impact	Monitored Parameter	Purpose of the Monitoring	Monitoring Method			Responsible Authority	Monitoring Cost
					Method of Collecting and Analyzing Data	Location	Duration and Frequency		
9.	Local Conflicts of Interest	- Conflict between local residents and external workers	- Change in local customs	- Confirmation of the attitudes of local residents to the project	- Interviewing residents	- Villages near the site	- Once a year	- Implementation: Contractor/ Environmental Consultant  - Supervisor: RHD/Supervision Consultant	Expenses included in contract cost by Contractor  - Interviewer: 7,500Tk./researcher (Same as "Poor People")
10.	Gender	- Unequal opportunity of employment	Opportunity of employment	Equal opportunity of employment	- Interviewing residents	- Residential area of Project Affected Persons	- Once a year"	- Implementation: Contractor/ Environmental Consultant  - Supervisor: RHD/Supervision Consultant	Expenses included in contract cost by Contractor
11.	Children's Right	- Child labor	-	- Evaluation of effect of banning child labor	- Checking the labor contracts between subcontractor and workers  - Patrolling construction area for child labor	- Construction area	- Once a year	- Implementation: Contractor/ Environmental Consultant  - Supervisor: RHD/Supervision Consultant	Expenses included in contract cost by Contractor
12.	Infectious Diseases such as HIV/AIDS	- Temporary influx of migrant labor during construction may increase risk of infection	-	- Evaluation of sanitation for labor	- Labor health records	- Related institutions	- Once a year	- Implementation: Contractor/ Environmental Consultant  - Supervisor: RHD/Supervision Consultant	Expenses included in contract cost by Contractor

Sl. No.	Significant Impact to be Monitored	Source of Significant Impact	Monitored Parameter	Purpose of the Monitoring	Monitoring Method			Responsible Authority	Monitoring Cost
					Method of Collecting and Analyzing Data	Location	Duration and Frequency		
13.	Work Environment (Including Work Safety)	- Labor accidents	- Handling heavy loads - Working at heights - Electric shock	- Evaluation of effect of the work safety plan	- Record of accidents	- Contractor's office	- Continuous records	- Implementation: Contractor/ Environmental Consultant - Supervisor: RHD/ Supervision Consultant	Expenses included in contract cost by Contractor
14.	Accidents	- Traffic accidents	-River traffic -Land traffic	- Evaluation of effect of traffic schedules	- Record of accidents	- Contractor's office	- Continuous records	- Implementation: Contractor/Environmental Consultant - Supervisor: RHD/ Supervision Consultant	Expenses included in contract cost by Contractor
15.	Cross-boundary Impact and Climate Change	- CO <sub>2</sub> will be produced by construction work	-	- Efforts to reduce CO <sub>2</sub>	- Record of machinery maintenance	- Contractor's office	- Continuous records	- Implementation: Contractor/ Environmental Consultant - Supervisor: RHD/Supervision Consultant	Expenses included in contract cost by Contractor
<b>C. Operation Phase</b>									
1.	Air Quality	i) Exhaust gas from vehicles used for mobilization of equipment and workers ii) Dust from road	i), ii) & iii) <b>CO, SO<sub>2</sub>, NO<sub>2</sub>, PM<sub>10</sub></b> - Emission gas standards - Ambient air quality standards - IFC guideline values for gas emission and ambient air	i), ii) & iii) - Evaluation of effect of the mitigation measures towards air pollution	i), ii) & iii) - Collecting samples at the site, analyzing at a lab - Measuring the meteorological	<b>-3 points measurement</b> : Residential area around the Access Road	-Continuous 24 hours in three points measurements shall be once in every 3 months	- RHD/ Environmental Consultant	Expenses by RHD - Sampling: 50,000Tk./ staff - Analyzing: 45,000Tk./ sample

Sl. No.	Significant Impact to be Monitored	Source of Significant Impact	Monitored Parameter	Purpose of the Monitoring	Monitoring Method			Responsible Authority	Monitoring Cost
					Method of Collecting and Analyzing Data	Location	Duration and Frequency		
			quality (General/2007)  i), ii) & iii)  <b>Meteorological Condition (Temperature, Moisture, Wind)</b>						
2.	Water Quality	Degradation due to Water quality road-run-off	<b>Water Temperature, TSS, pH, DO, SS, Oil &amp; Grease , BOD, COD, Heavy metals</b>  - Wastewater standards  - IFC guideline values for wastewater  - Ground water (Drinking water quality standards)	- Evaluation of effect of the mitigation measure towards water pollution	- Collecting samples at the site, analyzing at a lab	- <b>3 Surface (river crossings) water points</b>  - <b>Three</b> Ground water points	- Pre-monsoon & Monsoon Seasons	- RHD/ Environmental Consultant	- Continuous sensor (Expenses included in contract cost by Contractor) and  Expenses by RHD Sampling: 100,000Tk./staff  - Analyzing: 200,000Tk./sample
3.									
4.									

Sl. No.	Significant Impact to be Monitored	Source of Significant Impact	Monitored Parameter	Purpose of the Monitoring	Monitoring Method			Responsible Authority	Monitoring Cost
					Method of Collecting and Analyzing Data	Location	Duration and Frequency		
5.	Noise and Vibration	Noise caused by vehicles used for mobilization of equipment and workers	<b>Noise level</b> -Noise standards -IFC guideline values for noise	- Evaluation of effect of the mitigation measures towards noise levels	- Measurement using noise level meter	<b>3 points:</b> On the access road of the site near the residential area	- Once every 3 months	- RHD/ Environmental Consultant	Expenses by RHD  - Measurement: 100,000Tk./ season
6.	Soil	Soil and water contamination from accidental spills	Soil Quality -Soil parameters -IFC Guideline values for soil parameters	Prevention of soil and water pollution in the surrounding area	-Sampling as specified in the engineering standards  -Heavy metal, oil & grease etc.	-After any accidental spillage on the road and its nearby area	-after the accidental spillage  -Once in every three months	- RHD/ Environmental Consultant	Expenses by RHD  - Measurement: 100,000Tk./ season
7.	Sediment	Existence of bridge piers	World Bank OP4.04	Prevention of deterioration of tidal flat	Monitoring of sediment quality of mud flat and river bottom	Bridge locations	Twice in a year	- RHD/ Environmental Consultant	Expenses by RHD
8.	Ecosystem (Endangered Species)	i) Mangrove Forest ii) Existence of endangered species (migration bird)	i) & ii) <b>Species, Number</b> - Bangladesh Wild Life Preservation (Amendment) Act, 1974 - JICA Guideline	Evaluation of existence of endangered species	i) & ii) - Observation	Near the bridge crossing at the Kuhelia River	-Once in every three months	RHD/ Environmental Consultant	Expenses by RHD  -Observation: 250,000Tk// researcher

Sl. No.	Significant Impact to be Monitored	Source of Significant Impact	Monitored Parameter	Purpose of the Monitoring	Monitoring Method			Responsible Authority	Monitoring Cost
					Method of Collecting and Analyzing Data	Location	Duration and Frequency		
			(2010)						
	Ecosystem (Mud Flat, Fish & Nekton)	Ditto	<b>Species, Number, Weight</b> -Benthos (mud flat) -Fish and nekton	Ditto	- Collecting samples at the site, analyzing at a lab	Mud flat, fish & Nekton (around the new bridge locations)	i), ii) & iii)  - Twice a year in dry and rainy seasons	Ditto	Expenses by RHD  - Sampling & Analyzing: 350,000Tk./ all sample
9.	Disturbance to Poor Class	- Improved road along with the Access road	-	- Evaluation of access to social services	- Information from related institutions - Interviewing residents	- Related institutions - Villages near the site	Once a year	- RHD/ Environmental Consultant	Expenses by RHD  - Interviewer: 7,500Tk./researcher
10.	Deterioration of Local Economy such as Losses of Employment and Means of Livelihood	- Increase in employment and business opportunities	-	- Evaluation of increase in employment and business opportunities	Ditto	Ditto	Ditto	- RHD/ Environmental Consultant	Expenses by RHD
11.	Land Use and Utilization of Local Resources	- Changing traditional land use patterns and utilization of local resources	-	- Observation of land use change  - Observation of local resource	- Field observation  - Interviewing residents	- Villages near the site	- Once a year	- RHD/ Environmental Consultant	Expenses by RHD  - Interviewer: 7,500Tk./researcher (Same as "Poor people")

Sl. No.	Significant Impact to be Monitored	Source of Significant Impact	Monitored Parameter	Purpose of the Monitoring	Monitoring Method			Responsible Authority	Monitoring Cost
					Method of Collecting and Analyzing Data	Location	Duration and Frequency		
				usage					
12.	Disturbance to the Existing Social Infrastructure and Services	i) Increase in the number of vessels ii) Increase in the number of cars	i), ii) - Traffic volume	i) & ii) - Evaluation of effect of traffic schedules	i), ii) - Record of numbers of vessels and vehicles being used	i) & ii) - Project site	i) & ii) Continuous records	- RHD/ Environmental Consultant	Expenses by RHD
13.	Unequal distribution of Benefits and Compensation	- It can occur among residents, workers, government officers, and local politicians	-	- Same as those addressed in "Land use"	- Same as those addressed in "Land use"	- Same as those addressed in "Land use"	- Same as those addressed in "Land use"	- RHD/ Environmental Consultant	Expenses by RHD
14.	Local Conflicts of Interest	- Conflict between local residents and workers	-	- Same as those addressed in "Land use"	- Same as those addressed in "Land use"	- Same as those addressed in "Land use"	- Same as those addressed in "Land use"	- RHD/ Environmental Consultant	Expenses by RHD



Sl. No.	Significant Impact to be Monitored	Source of Significant Impact	Monitored Parameter	Purpose of the Monitoring	Monitoring Method			Responsible Authority	Monitoring Cost
					Method of Collecting and Analyzing Data	Location	Duration and Frequency		
15.	Gender	i) Improved road along with the access road ii) Improved economy	i) Access to social service of both male and female ii) living standard of residents (both male and female)	- Evaluation of living standard	-Interviewing residents	- Villages near the site	- Once a year	- RHD/ Environmental Consultant	Expenses by RHD
16.	Children's Rights	- Improved road along with the access road - Improved economy	i) Access to social service ii) School attendance rate	i) Evaluation of access to social service ii) Evaluation of school attendance rate"	-Interviewing residents	- Villages near the site	- Once a year	- RHD/ Environmental Consultant	Expenses by RHD
17.	Accidents	-Traffic accidents	Traffic accidents Land traffic	- Evaluation of effect of the work safety plan	- Record of accidents and fire	- Along the Access Road	-Continuous records	- RHD/ Environmental Consultant	Expenses by RHD
18.	Cross-boundary Impact and Climate Change	- CO <sub>2</sub> emissions from road transport.	- Amount of CO <sub>2</sub> emissions	- Efforts to reduce CO <sub>2</sub>	- Calculate the CO <sub>2</sub> emissions from fuel consumption	-3 points Along the Access road area	- every 3 months	- RHD/ Environmental Consultant	Expenses by RHD

## **E-12 OCCUPATIONAL HEALTH AND SAFETY PLAN**

Occupational health and safety means preventing accidents and work related ill health. Improved health and safety management can bring significant benefits to the business. It reduces individual and human costs of accidents and ill health, direct and indirect cost to the business, improves customer perception and company profile and workers' morale. Under occupational health hazards, one can group several categories of working conditions impairing the health conditions of workers, though this impairment is slow. Safety relates more to health hazards that results from accidents and can cause instantaneous impairment of the workers' health. The proposed project has several phases' the construction of infrastructure and operation.

## **E-13 DISASTER MANAGEMENT PLAN AND EMERGENCY RESPONSE/MANAGEMENT PLAN**

The Disaster Management Plan (DMP) contained the following aspects:

- i) Description of the Site
- ii) On-site Emergency Plan
- iii) Off-site Emergency Plan

Highway Traffic Management System (HTMS) will control the traffic monitoring and movements on the port connecting access Road. The following outdoor units will be installed as a part of HTMS:

- Emergency Call Boxes
- Variable Message Signs
- Meteorological Data Systems
- Close Circuit TV Camera System
- Traffic Counting & classification and transmission system

Indoor units will comprise of the following:

- Large Display board with Central Computer and Network monitoring system
- CCTV System
- Uninterrupted Power Supply

The system shall meet the following objectives:

- Smooth and uninterrupted Traffic flow
- Enhanced Road Safety
- Real-time information and guidance to road users
- Round the clock emergency assistance
- Alerts for abnormal road and weather conditions

Reduced journey time and reduced driving fatigue

It has recommended that an Emergency Response Cell (ERC) adequately equipped with highly trained manpower and appropriate gears is to be established in order to effectively implement the emergency response plan.

The main functions of the emergency response cell should include the following:

- Identification of various types of emergencies;

- Identification of groups, communities, and areas those are vulnerable to different kinds of emergencies;
- Preparing service teams for various operations within the organization through extensive training;
- Establishment of early detection system for emergencies;
- Developing reliable, instant information communication system;
- Mobilizing all units within a very short time to address any emergency.

#### **E-14 GRIEVANCE REDRESS MECHANISM**

Two levels of grievance redress mechanism for the project, viz. Grievance redress Cell (GRC) at the project level and another at Union level committee (ULC) have been recommended. The aim of having two levels of grievance redress mechanism is to provide a higher forum to the aggrieved party, if the same is not satisfied with the decision of GRC.

GRC will be driven internally by RHD and shall have the following representation to ensure fair and timely solution to the grievances:

- Community officer serving as grievance officer;
- RHD Environment and social officer
- Project management representative;
- RHD- EHS representative;

The composition of ULC will have the following members:

- All Union Parishad Chairmen or their representatives
- Project Manager of the Access road Project
- Environment and social officer of Access Road Project
- Local elected Ward Member (s)
- Representative of affected people and women

#### **E-15 CONCLUSION AND RECOMMENDATION**

##### **CONCLUSION**

Matarbari area is expected to play the leading role in the realization of the BIG-B initiative. To be more precise, this development will lead to an increase in export industries and hence reduce the trade deficit due to the importation of coal and oil as a source of energy. Furthermore these developments will also lead to short and long term regional economic stability. To maximize the performance of the freight transport route from the Port to inland area, accessibility from the port to N1, the arterial road to Chittagong, will need to be also secured. This EIA study for this port connecting road project is to understand the environmental aspects due to the project activities as well as to prescribe suitable EMP for its sustainability. This EIA study for this port connecting access road project is to understand the environmental aspects due to the project activities as well as to prescribe suitable EMP for its sustainability.

The EIA study has covered the construction and operational phases of the project. The detailed EIA of the proposed port connecting access road was conducted following the guideline (GoB, 1997) of the Department of Environment (DoE) of GoB and the JICA guidelines.

In this study, the effects of the project activities on physico-chemical, ecological and socio-economic (i.e., human interest related) parameters during preconstruction, construction and operation phases have been

assessed. The impacts have been identified, predicted and evaluated, and mitigation measures suggested for preconstruction, construction and operation phases of the proposed project. The important physico-chemical environmental parameters that are likely to be affected by the project activities include air quality and noise level.

The study suggests that most of the adverse impacts on the physico-chemical environment could be offset or minimized if the mitigation measures are adequately implemented. Noise level has been identified as a significant potential impact of the proposed port connecting access road project during both the construction and operation phases. The project workers should not be exposed to the noise produced by the construction equipment for a prolonged period to prevent permanent hearing loss. A rotational work plan is advised for the workers and operators of this equipment.

The proposed project will be constructed within the acquired land. So a comprehensive land acquisition and resettlement action plan (LARAP) shall be prepared. Additionally, this area is an income generating area considering Salt/Shrimp cultivation. Therefore, people will be displaced and for them resettlement will be required for the construction of the port connecting road project, and loss of income is associated with the proposed project.

During operation phase, no significant negative impact is anticipated on socioeconomic environmental parameters. Significant positive impacts are expected due to huge no of employment generation associated with the project activities. During public consultations carried out as a part of the EIA study, people welcomed the proposed project in their locality.

## **RECOMMENDATION**

The environmental assessment carried out for the proposed port connecting access road project suggests medium to minor scale of adverse impacts, which can be reduced to acceptable level through recommended mitigation measures as mentioned in the EMP. It is therefore recommended that the proposed port connecting road provided the suggested mitigation measures are adequately implemented. It is also recommended that the environmental monitoring plan be effectively implemented in order to identify any changes in the predicted impacts and take appropriate measures to offset any unexpected adverse effects.

Apart from risks associated with noise generation, solid waste, hazardous waste and wastewater disposal as a result of construction activities, the RHD may have certain degree of risk of accident and sometime loss of life. An emergency response plan (ERP) for the proposed project has been developed listing various actions to be performed in a very short period of time in a predetermined sequence if it is to deal effectively and efficiently with any emergency, major accident or natural disaster.

It will be the obligation of the contractor to submit their Environmental Management Action Plan (EMAP) before commencement of work. The EMAP should specify all affected environmental values, all potential impacts on environmental values, mitigation strategies, relevant monitoring together with appropriate indicators and performance criteria, reporting requirements and, if an undesirable impact or unforeseen level of impact occurs, the appropriate corrective actions available.

## **CHAPTER-1 INTRODUCTION**

### **1.1 INTRODUCTION**

The Government of Japan and the GoB has initiated the Bay of Bengal Industrial Growth Belt Initiative (BIG-B), and under this initiative, JICA has implemented the “Data Collection Survey on Integrated Development for Southern Chittagong Region” since 2015 which assessed the potentiality of the development of infrastructure, energy and power, industrial and urban development in the region. Through this survey, the need to conduct “Data Collection Survey on the Matarbari Port Development in the People’s Republic of Bangladesh” for the further detailed plan of Matarbari port development has been recognized.

The Government of Bangladesh (GOB) has achieved secure economic growth of 6% (approx.) per annum in the recent years. Thus, export and imports per year have increased by 10% in the past 5 years. At present, Bangladesh has two major ports i.e. Chittagong Port and Mongla Port. Of the two the Chittagong Port handles the vast majority of traffic in the country. It is a river port along the Karnaphuli River. Due to the limited land area of the Chittagong port, it is anticipated to reach its capacity soon. Keeping this projected situation in mind, GoB is giving precedence to port development such as further expansion of the Chittagong Port as well as new port development in the 7th five year plan.

The proposed Matarbari Port will function as an alternate port of Chittagong Port and the majority of freight transport from the Matarbari Port will be destined for the major cities in the north, such as Chittagong and Dhaka. Thus, it is necessary to provide good accessibility from the Matarbari Port to the north.

In this study, the Environmental Impact Assessment (EIA) is pursued due to the requirement of the Department of Environment (DOE) to avoid negative impacts of the access road of the port development from Dhalghata to Fasiakhali.

### **1.2 BACKGROUND**

The economic growth and development of the GOB has been growing steadily over the past years, and was recently labelled as one of the “Next Eleven” countries along with the BRICs. This is mainly attributed to an increase in foreign investment in light manufacturing industries, a shift from China and other South-East Asian countries due to a rise in production costs.

As a result, in Bangladesh, coal is increasingly important as the major source of energy instead of natural gas. In line with this, the Matarbari ultra super coal-fired power is to be constructed in the district of Cox’s Bazar which is to be funded by the Japanese government. With this power plant, Matarbari area will have a deep sea port, coal centre as well. Then, these accumulations will prompt a regional development including that of an energy base, industries and a trade and logistics terminal. To transport the trade and logistics of the port an access road is inevitable.

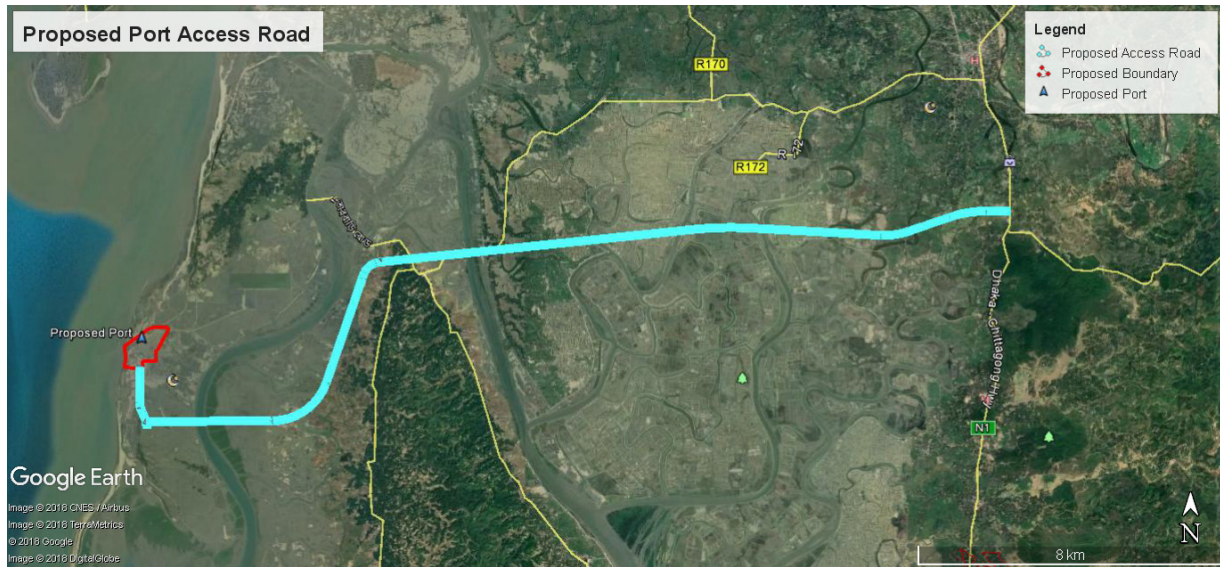


Figure-1.1-1 Proposed Port connecting access Road Dhalghata to Fasiakhali

### 1.3 PROJECT CATEGORIZATION

Matarbari Port access road development activities can result in a large variety of adverse environmental impacts causing damage to natural, physical and ecological resources and to human, economic and quality of life values. To minimize possible adverse impacts and to utilize natural resources properly, as per the existing Environmental Conservation Rules (ECR), 1997 this port development project has categorized as “Category Red” project, requiring preparation of an IEE and EIA, and issuance of a Site Clearance Certificate (SCC), and thereafter an Environmental Clearance Certificate (ECC) by the DoE. Roads and Highway Department (here in after, RHD) the project proponent needs to obtain an environmental clearance (EC). RHD has already got the approved Terms of Reference (TOR) of EIA from the DOE for carrying out the in detail Environmental Impact Assessment of this project (Annex-A).

In contrast, JICA categorizes all projects according to the magnitude or scale of their anticipated environmental impact. Projects classified as ‘A’ with significant adverse environmental impacts that are sensitive, diverse and unprecedented. Whereas the project classified as ‘B’ if potential adverse environmental impacts are less adverse than ‘A’ classified projects. The Port access road project has some pollution potential for physical, physico-chemical, biological and socio-economic environment in and around the project area and the impacts would be major during construction and operation phase of the project if proper implementation of Environmental Management Plan (EMP) is ensured by the project authority. Therefore, in accordance with JICA policy the Port development project will fall in category ‘A’ project and for this type of project Environmental Impact Assessment (EIA) is mandatory. As per JICA Guidelines 2010, RHD is also required to prepare an appropriate assessment report for the JICA’s financing appraisal.

### 1.4 OBJECTIVE OF THE EIA

Matarbari Port Development Project (Access Road) is now a formulated project after passing through the preparation of policies, plans and necessary programs (Figure1.3-1). So, access road project specific EIA

shall be dealt in this study report. An Environmental Impact Assessment (EIA) is a very effective tool, which delineates what needs to be done to make a development activity suitably located and operated in an environment friendly way. It is a formal process to be used to examine the environmental consequences of a proposed project and suggest relevant management actions. Impact assessment is not meant for examining adverse consequence only; it should also look into the plausible positive effects by the project activities and identify ways of enhancing them further by carrying out modifications in the project. EIA process involves study of the plausible changes of the physical, biological and socio-economic environment as the consequence of the proposed project activities, and formulating a suitable Environmental Management Plan (EMP) to minimize or abate adverse effects and to enhance or augment positive effects.

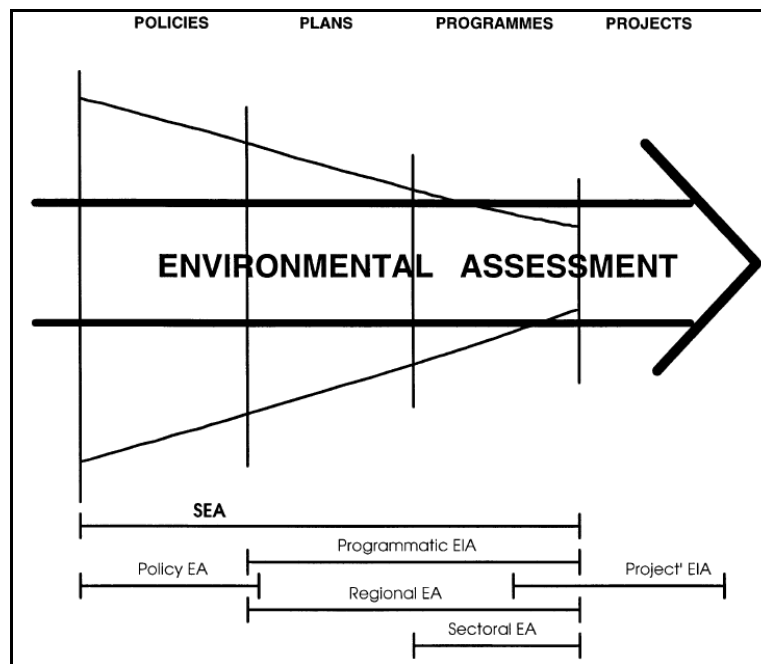


Figure: 1.3-1 EIA in the Project

The objective of an EIA is to understand that potential problems that are foreseen and addressed at an early stage in the project's planning and design. To achieve this, assessment findings are communicated through an EIA report to all the groups who will make decisions about the proposed project, that is, the project developers, their investors, as well as regulating authorities and planners. Design, execution and operation of the project can be planned in light of the findings of EIA, so that the expected benefits can be sustained with minimum and acceptable adverse environmental impacts. Thus essentially, the objective of the EIA is to-

- ❖ Review the proposed site of the port access road and identify potential environmental impacts to be considered in the planning and design and implementation stage of the project;
- ❖ Identify sources of impacts of the project activities, during construction and operational stages, on the various environmental components and recognizes those which are critical to the changes resulting from the project development or its operation phase;

- ❖ Recommend an Environmental Management Plan (EMP) to avoid or mitigate the adverse environmental impacts and enhance positive contributions of the project;
- ❖ Prepare implementable Environmental Management Plan (EMP) integrating the measures for minimizing the identified impacts with suggested mitigation measures and an appropriate monitoring and supervision mechanism to ensure EMP implementation; and
- ❖ Recommend suitable institutional mechanisms to monitor and supervise effective implementation of the EMP.

## **1.4 SCOPE OF WORK**

The detailed scope of the EIA study is as outlined below:

- Screening of the Project derived from applicable reference framework based on reconnaissance survey and desk based review of Project documents;
- Scoping for the EIA study;
- Identification of the Project components;
- Development of a regulatory, policy and administrative framework relevant to the Project;
- Monitoring, analysis and reporting of the environmental and social baseline data of the study area including consultation with local communities and other stakeholders;
- Assessment of the environmental impacts of the Project in the study area;
- Assessment of social impacts on the local community as well as project affected people if any and any other stakeholders, which have been identified during the social consultation process;
- Risk assessment and consequence analysis of the Project;
- Formulation of an Environment Management Plan and associated/specific mitigation plans for identified impacts; and
- Formulation of Stakeholder Consultation and Grievance Redress Mechanism for the Project.

## **1.5 APPROACH AND METHODOLOGY**

At the first step, project screening and scoping exercise was undertaken to identify the parameters needed to be considered for the study and to outline the activities for collecting data on each parameter. Data pertaining to all facets of the environment and social viz. physical, ecological and socioeconomic environment were collected from the study area through both primary and secondary sources.

The stepwise activities are detailed in the following subsections:

### **1.5.1 Preliminary Discussions**

- Discuss with JICA Study team to understand the proposed project, current status of the Project Study, Project milestones, legal requirements and scope; and
- Collation of relevant project documents such as the Inception report of the body project (JICA Data Collection Survey on the Matarbari Port Development), Final report of Data Collection Survey on Integrated Development for Southern Chittagong Region, Strategic Environmental Impact Assessment (SEA) report, relevant road related EIA study reports etc.

### **1.5.2 Screening and Scoping Exercise**

- Desk based review of the relevant documents and available imagery of the project site and its surroundings;



- Reconnaissance survey of the site, surrounding areas, approach road and preliminary discussions with locals, stakeholders;
- Meetings and discussions with Key Informants i.e. Department of Forest (DOF), Department of Environment (DOE), Department of Fisheries (DOF), Roads and Highway Department (RHD), Local Administrations etc. to understand sensitivities and regulatory requirements associated with the proposed project;
- The outcome of the screening was then used to identify the study area, key data to be collected and the categorization of the project; and
- A preliminary stakeholder mapping exercise was also undertaken to identify key stakeholders from the Government, relevant Governmental Agencies, Non-Governmental Organizations (NGOs) as well as the community at the local, regional and national level. This information has been used for consultation during different stages of the project.

### **Categorization**

Categorization of the Project was completed based on the screening assessment, reconnaissance survey, environmental and social sensitivities, limited consultation and the DOE categorization; JICA categorization criteria based on environmental assessment (EA) checklists.

This project is a “Category Red” project, requiring preparation of an IEE and EIA, and issuance of a Site Clearance Certificate (SCC), and thereafter an Environmental Clearance Certificate by the DoE. In accordance with the JICA policy the port connecting access road project is in category ‘A’ project and for this type of project Environmental Impact Assessment (EIA) is mandatory.

### **Scoping**

The categorization with respect to JICA classifications was further used as a basis for defining scope for the impact assessment, planning and implementation of mitigation, monitoring and reporting mechanisms for the project to meet potential lender’s requirements as well as those of the GOB.

#### **1.5.3 Baseline Data Collection**

- The baseline data collection, monitoring and analysis for environmental parameters are dynamic process. The major baseline data collection has been completed from secondary sources;
- Secondary data was also collected from different government departments, local bodies and through literature surveys etc.
- In depth primary data collection particularly focused on the monitoring of Air Quality, Noise, Soil, Sedimentation, flora & fauna, sediment survey for benthos etc. has been planned and some of them has already monitored as environmental baseline information and in particular the Socio-economic baseline survey has been conducted for getting the primary socioeconomic baseline data of the project; and
- All the gathered data has been compiled and compared with applicable standards where relevant, and presented in **Chapter-5** of this report.

#### **1.5.4 Stakeholder Consultation**

- Extensive consultation was conducted with key stakeholders’ including the local population, government departments/agencies, fishermen, and NGOs;

- A Stakeholder consultation was completed with the intent of collecting baseline information on the environmental and social conditions and sensitivities, developing a better understanding of the potential impacts, informing the public of the proposed project and to gain an understanding of the perspectives/concerns of the stakeholders;
- As per the TOR the initial Stakeholder Meetings (SHMs) of the project have been conducted on from 12<sup>th</sup> March to 17<sup>th</sup> March 2018 to disseminate the project message to the stakeholders. A final stakeholder meeting shall be conducted after completing the Draft EIA of the project.
- A summary of the stakeholder engagement process and the profile of the groups and their opinions forms a part of the Information Disclosure, Consultation and Participation Chapter of this report (Chapter 6); and
- Information gathered was used for formulating mitigation measures.

#### **1.5.5 Impact Assessment and Mitigation Measures**

- Analysis of the baseline results and the incremental impacts of the project were assessed in accordance with the Bangladesh national guidelines for air, water and noise emissions; standards stipulated in the Environment Conservation Rules (ECR), 1997 and amendments thereof and with reference to the JICA guidelines;
- The impact assessment involved the prediction and evaluation of impacts from the project in different phases, including site preparation, construction and operation phase and included consideration of mitigation measures towards the same;
- Impact prediction covered residual impacts (impacts remaining after all possible mitigation has been incorporated) and took into account control measures that are part of the project design (e.g. acoustic enclosures for major equipment). Additional measures aimed at further avoiding, minimizing and compensation were proposed where necessary or appropriate; and
- Impacts have been further classified as insignificant, minor, moderate or major based on the criteria for rating of impacts.

#### **1.5.6 Analysis of Alternatives**

Analysis of alternative four options were considered to minimize impacts of the project while undertaking the EIA study. The alternative options assessment in the study will be ranged from technology, project site and operations, including the no project alternative. Alternatives are considered in terms of their potential environmental impacts, the feasibility of mitigating these impacts alternatives for mitigation measures for high residual impact/risk, if any etc.

#### **1.5.7 Management Plans and Grievance Redress Mechanism**

- Environmental Management Plan (EMP) is under preparation for addressing the mitigation measures suggested and included defined roles and responsibilities for implementation;
- A grievance redress mechanism is to be developed to address any complaints and concerns from all stakeholders;
- Based on the risk assessment, risk reduction measures and recommendations for a disaster management plan (DMP) is to be developed; and
- Institutional review and finalization of the EMP and grievance redress mechanisms.

#### **1.5.8 Information/Data Sources**

Key relevant information sources have been summarized in Table 1.5-1.

**Table 1.5-1 Key Data Sources**

<b>Parameters</b>	<b>Information sources</b>	<b>Remarks</b>
Project Background, Technical details on project and associated components	<ul style="list-style-type: none"> <li>• JICA Study Team</li> </ul>	JICA Study Team has provided information required during the course of the study
Study area features and sensitivities	<ul style="list-style-type: none"> <li>• Ground physical Survey</li> <li>• Satellite imageries</li> <li>• National web portal of Bangladesh: <a href="http://www.bangladesh.gov.bd">www.bangladesh.gov.bd</a></li> </ul>	Details of the satellite data used is included in Baseline Chapter
Legal framework	<ul style="list-style-type: none"> <li>• JICA Guidelines</li> <li>• Department of Environment</li> <li>• Department of Forest</li> <li>• Department of Fisheries</li> </ul>	In discussion with the DOE, DOF and local Govt. departments etc.
Land use /Land cover Details, Meteorology and climatic conditions	<ul style="list-style-type: none"> <li>• Ground Physical Survey</li> <li>• GIS based land-use analysis</li> <li>• Bangladesh Meteorological department</li> <li>• Observatory Surface Meteorological Data</li> </ul>	Details of the satellite data used is included in Baseline chapter
Geology, Topography, Hydrology and drainage	<ul style="list-style-type: none"> <li>• Location Map of JICA Study team</li> <li>• Bangladesh water development board</li> <li>• Web portal of National Encyclopedia of Bangladesh (Banglapedia)</li> </ul>	In association with field Observations
Natural hazards	<ul style="list-style-type: none"> <li>• Web portal of National Encyclopedia of Bangladesh (Banglapedia)</li> <li>• Bangladesh Meteorological Department</li> </ul>	Included in consultation with locals
Environmental baseline as Air quality, water quality, soil and sediment quality	<ul style="list-style-type: none"> <li>• Secondary data sources</li> <li>• Applicable Standards from DOE, Bangladesh</li> </ul>	Different project study reports in and around the proposed project area.
Ecological parameters	<ul style="list-style-type: none"> <li>• Secondary data collection, observations, surveys and local consultations</li> <li>• Department of Environment</li> <li>• Department of Forest</li> <li>• Websites of birdlife international</li> <li>• IUCN Data base</li> </ul>	Different study report of the proposed project area. Endangered, critical status was checked from the website <a href="http://www.iucnredlist.org">www.iucnredlist.org</a>
Social-economic parameters	<ul style="list-style-type: none"> <li>• Primary data collection surveys, extensive consultations, meetings and discussions held with stakeholders</li> <li>• Bangladesh population Census for 2011 for Cox's Bazar District</li> <li>• Fisheries Census data</li> <li>• Land Regulation Policy, Bangladesh</li> <li>• Land Acquisition and Compensation data for the project site</li> <li>• OPD data from local Healthcare Department</li> <li>• Website of Department of Social Services</li> <li>• Web portal of National Encyclopedia of Bangladesh (Banglapedia)</li> </ul>	Details provided in baseline environmental and social conditions chapter.

## 1.6 CONTENT OF SEA REPORT

The content of the EIA has been largely structured based on the Scope of work of TOR. The layout of the Report is as follows:

- Chapter 1 Introduction

- Chapter 2 Description of the Project
- Chapter 3 Legal and Legislative Framework
- Chapter 4 Study of Alternative Options
- Chapter 5 Environmental and Social Baseline
- Chapter 6 Stakeholder Engagement
- Chapter 7 Scoping and tor for the survey on natural and social environment
- Chapter 8 Results of the survey on natural environment
- Chapter 9 Environmental and social impact evaluation
- Chapter 10 Environmental and social management plan
- Chapter 11 Monitoring plan
- Chapter 12 Occupational health and safety plan
- Chapter 13 Disaster Management Plan & Emergency response/management plan
- Chapter 14 Grievance Redress Mechanism
- Chapter 15 Conclusions and Recommendations

## **CHAPTER-2 DESCRIPTION OF THE PROJECT**

### **2.1 GENERAL**

Based on the industrial policy 2015 and 7th five years plan, Bangladesh Economic Zones Authority (BEZA) is planning to establish 47 Economic Zones (EZ) all over Bangladesh in addition to the existing 8EZs. With this situation in mind, the GoB is prioritizing port development such as further expansion of Chittagong Port as well as new port development in the 7th five year plan. It also mentions the development of a new port in the Payra and Matarbari areas. From a broader perspective, Matarbari area plays an important role in “The BIG-B Initiative” supported by Japan. The BIG-B initiative is intended to establish an economic corridor from Dhaka to Cox’s Bazar via Chittagong through industrial growth and development. Access road of the port will play the vital role to provide good accessibility from the Matarbari Port to the north.

#### **2.1.1 Project Category**

As per the criteria of DOE, the Port connecting access road project falls under the Red Category and the same requires Environmental Impact Assessment (EIA). Though the project has some environmental impact but of lesser degree as will be revealed from the successive chapters. It is to be mentioned here that as per JICA guideline the proposed project falls under Category-A.

#### **2.1.2 Project Justification**

Matarbari area is expected to play the leading role in the realization of the BIG-B initiative. To be more precise, this development will lead to an increase in export industries and hence reduce the trade deficit due to the importation of coal and oil as a source of energy. Furthermore these developments will also lead to short and long term regional economic stability. To maximize the performance of the freight transport route from the Port to inland area, accessibility from the port to N1, the arterial road to Chittagong, will need to be also secured.

### **2.2 PROJECT LOCATION**

The access road is approximately 25.7 km from Moheshkhali Upazila to Chakaria Upazila. Additional Flyover on the Cox’s Bazar Chittagong highway in Chakaria Paurashavais planned for smooth connectivity to Chittagong. But in this EIA study this component shall be excluded. The access road shall travel through Dhalghata, Kalarmarchara, north edge of Saflapur, Badarkhali, South edge of Paschim Bara Bheola, Saharbil, Chiringa and FasiakhaliMouza of the two upazilas of Cox’s Bazar District. Detailed location of the project area is shown in the Table-2.2-1.

Table-2.2-1: Mouza wise Project Location

District	Name of Affected Thana	Name of Affected Union	Name of Affected Mouza
Cox’s Bazar	Moheshkhali	Dhalghata	Dhakghata
		Kalarmarchara	Kalarmarchara, Jhapua,
		Saflapur	Kaliganj, Eunuskhali, Rampur, Uttor Nalbila
	Chakaria	Badarkhali	Badarkhali Ghona, Palakata,

District	Name of Affected Thana	Name of Affected Union	Name of Affected Mouza
		Paschim Bara Bheola	
		Chiringa	
		Fasiakhali	
		Saharbil	

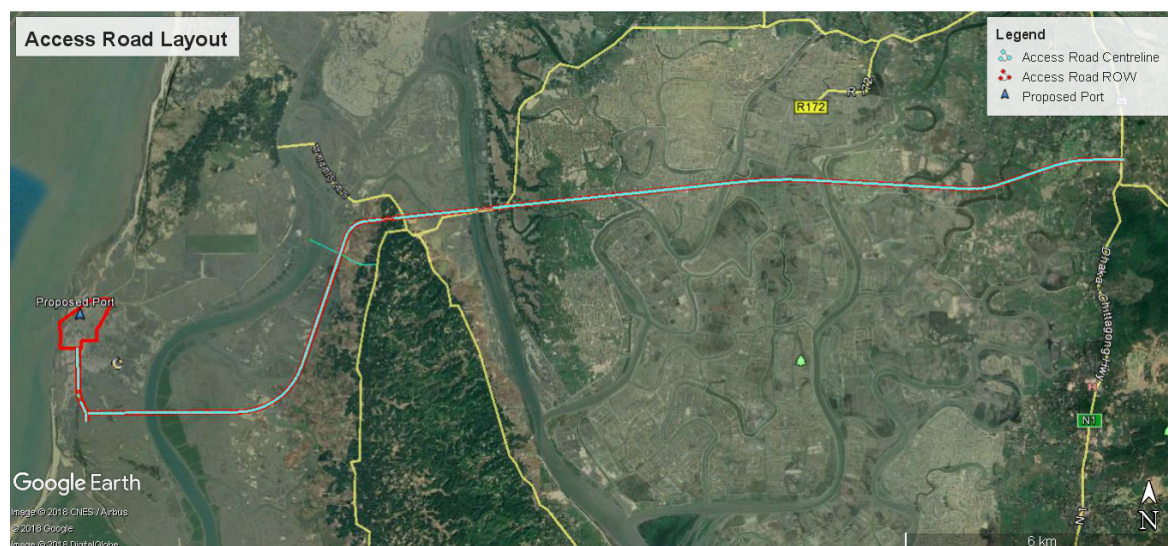


Figure-2.2-1 Project Area in the Moheshkhali and Chakaria Upazila

### 2.3 BASIC DATA

The project authority will be Roads and Highway Department (RHD). Basic data of the project are furnished in Table-2.3.1.

Table-2.3-1: Basic Data of the Project

1.	Name of the Project	Matarbari Port Development (Road) Project
2.	Executing Agency	Roads and Highway Department (RHD)
3.	Project Location	Union: Dhalghata, Kalarmarchara, Shaplapur, Chiringa, Fasiakhali, Saharbil, Paschim Bara Bheola and Saharbil; Upazila: Moheshkhali and Chakaria; District: Cox's Bazar
4	Road Length	25.7 Kilometer
5	Location of Intersection with N1	At Fasiakhali about 4 km south of Chakaria
	Length of River Crossings	5.4 Kilometer
6	Physical Work	a) Survey - Access Road ROW survey - Soil Survey - IEE/EIA and LARAP
	b) Road Construction	25.7 Kilometer
	c) Bridge Construction	17 nos. (Total length of the bridges would be 7.3Km)
	d) Dike Road Construction	1.8 Kilometer
7	Land	a) Acquisition 615 Acres (Approximately)

	Requirement	b) Land use	Private Land: 7 km Government Land: 18 km
8	Project cost		BDT 49.5 to 56.2 Billion
9	Project Implementation Period		December 2018 to May 2024

## 2.4 COMPONENTS OF THE PROJECT

The components of the port access road project are:

### ➤ Matarbari Port Access Road

- Road Length: 25.7 km
- Number of Bridges: 17 (total 7,104 m)
- Number of Intersections: 4 (3 at-grade, 1 grade separated)
- Number of Railway Crossing: 2
  - Dohazari-Cox's Bazar Railway; and
  - Rail Spur Link to Matarbari

### ➤ Dike Road

- Road Length: 1.8 km

### 2.4.1 Road/Railway Crossings

Six crossings will be anticipated all along the 25.6 kilometers four lane road. There will be two rail crossings i.e. Rail Spur line to Matarbari railroad and Dohazari-Cox's Bazar Railway. There will be four road crossings i.e. Dike Road, CPGCBL access road, R172 road and National highway (N1). The list of crossings are tabulated in Table 2.4-1.

Table: 2.4-1 List of Road/Railway Crossings

Sl. No.	Station	Road/Railway Name	Cross Angle	Cross Type
1	0+000	Dike Road	90°	At-Grade
2	8+030	CPGCBL Access Road	85°	At-Grade
3	9+230	Rail Spur Line to Matarbari	60°	At-Grade
4	24+240	Dohazari-Cox's Bazar Railway	64°	At-Grade
5	25+723	N1	90°	At-Grade



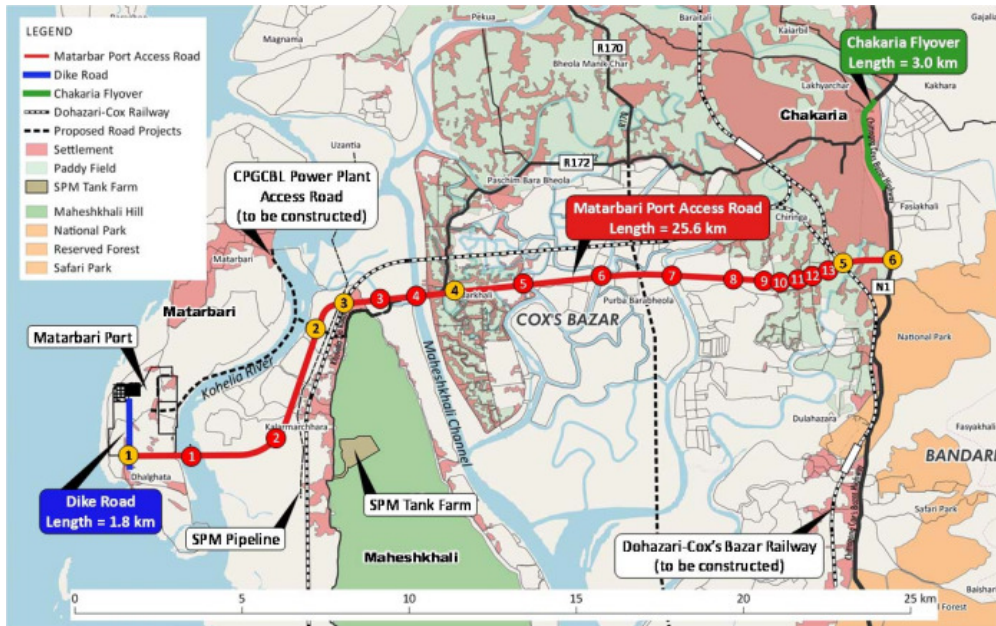


Figure-2.4-1 Project Layout (Scope of the Project)  
(Note: Chakaria flyover is out of the scope of this EIA study)

### 2.4.2 Bridges

The longest bridge will be 1.034Km in length and the smallest one will be less than hundred meters in length. Two types of bridge will be designed for this project. Most of the bridges will be PC-I type and one bridge will be Steel Narrow Box Girder type consisting of four span of 86m of each span arrangement. The steel narrow box girder type bridge will be 344 meters in length. The width of all the bridges will be 21.4 (10.2+1.0+10.2) m with four lane. Details of the bridges are tabulated in the Table 2.4-2.

Table-2.4-3 List of Bridges of the Project

Sl. No.	Station		Bridge Type	No of Spans	Span Arrangement (m)	Total Length (m)	River Name	Remarks
	From	To						
1	0+806	2+040	PC-1	11	11@40m=440m	1234	Kohelia River	BIWTA Class II
			Steel Narrow Box Girder	4	70m+ 2@87m+70m=314m			
			PC-1	12	12@40m=480m			
2	4+430	4+670	PC-1	6	6@40m	240	Nonaichari Khal	*
3	6+080	6+215	PC-1	3	3@45m	135		*
4	9+890	10+115	PC-1	4	4@40m	160		*
5	10+680	12+154	PC-1	11	11@40m=440m	1474	Moheshkhali Channel	BIWTA Class II
			Steel Narrow Box Girder	4	70m+ 2@87m+70m=314m			
			PC-1	18	18@40m=720			
6	14+090	14+450	PC-1	9	9@40m	360	Bura Matamuhuri Khal	
7	16+490	16+760	PC-1	6	6@45m	270	Ditto	
8	18+550	18+910	PC-1	9	9@40m	360	Matamuhuri	



Sl. No.	Station		Bridge Type	No of Spans	Span Arrangement (m)	Total Length (m)	River Name	Remarks
	From	To						
9	20+460	20+580	PC-1	3	3@40m	120	Batamani Khal	*
10	21+340	21+430	PC-1	2	2@45m	90	Ditto	*
11	21+530	21+690	PC-1	4	4@40m	160	Ditto	*
12	21+785	21+920	PC-1	3	3@45m	135	Ditto	*
13	22+680	22+840	PC-1	4	4@40m	160	Fasiakhali Chara	*
14	23+390	23+550	PC-1	4	4@40m	160	Ditto	*
15	24+455	24+495	PC-1	1	40m	40		
16	14+640	15+900	Steel I Girder	23	50m+4@60m+ 50mX3+45m+3@50m+45m	1260		Soft Ground
17	9+012	9+683	PC-1	3	3@45m=135m	671		LNG Pipeline
			Steel Narrow Box Girder	1	35m+5@45m+26m+4@45=466m			
			PC-1	11	70m			

Note: \* represents that bridge construction may not be necessary in view of drainage purpose. Further engineering study should be made during the detailed design stage in order to justify the necessity of bridges

### 2.4.3 Geometric Design Conditions

The road will be designed considering 1500 to 3000 PCU per hour where design speed would be 60km/h. In the geometric design consultant will follow the national standard as well as AASHTO & Japanese standards. Table 2.4-4 shows the geometric design consideration of the access road. A comparative geometric design standards is listed in Table 2.4-5.

Table 2.4-4 Geometric Design Conditions of the Access Road

Items	Unit	Applied Value	Remarks
<b>General Design Considerations</b>			
Design Traffic Volume	PCU/ hour	1,500-3,000	Necessary to be verified
Design Speed	km/h	60	RHD
Number of Through-Traffic Lanes	lane	4	RHD
Design Vehicle	-	WB-15	AASHTO
Minimum Stopping Sight Distance	m	90	RHD
<b>Cross Section Elements</b>			
Normal Cross Slope	-	3%	RHD
Traveled Way Width	m	3.50	RHD
Median Width (including inner shoulder)	m	3.00	0.6 + 1.8 + 0.6
Inner Shoulder Width	m	0.30	
Outer Shoulder Width	m	0.60	
<b>Horizontal Alignment</b>			
Minimum Radius	m	250	RHD
Maximum Radius for use of a Transition Curve	m	999	$R=0.29 \times V^2$ (Japanese Standard)
Radius for Normal Crown	m	2,930	$e=-3\%$ , $f=0.0397$ (AASHTO)
Minimum Curve Length	m	180	$L=3V$ (AASHTO)
Minimum Transition Curve Length	m	50	$L=V/3600 \times 3$ (Japanese Standard)

Items	Unit	Applied Value	Remarks
Maximum Super elevation Rate	-	6%	Japanese Standard
Super elevation Runoff	-	1/167	AASHTO
<b>Vertical Alignment</b>			
Maximum Grade	-	3%	RHD
Minimum Grade	-	0%	
Minimum Rate of Crest Vertical Curvature (K)	K	18	RHD
Minimum Rate of Sag Vertical Curvature (K)	K	18	RHD, AASHTO
Minimum Vertical Curve Length	m	50	L=V/1.2 (Japanese Standard)
Vertical Clearance	m	5.2	4.9 + 0.3 overlay

Table 2.4-5 Comparison of Geometric Design Standards

Items	Unit	RHD	AASHTO	Japan	Applied
<b>General Design Considerations</b>					
Design Speed	km/h	65	<b>60</b>	<b>60</b>	60
Minimum Stopping Sight Distance	m	<b>90</b>	85	75	90
<b>Cross Section Elements</b>					
Normal Cross Slope	-	<b>3%</b>	1.5-2%	1.5-2%	3%
Traveled Way Width	m	3.65	3.6	3.25	3.5
Median Width (inc. inner shoulder)	m	3.00	Min. 1.2	1.0	1.5
Inner Shoulder Width	m	Min. 0.30	0.6	0.25	0.3
Outer Shoulder Width	m	Min. 1.50	2.4	0.5	0.6
<b>Horizontal Alignment</b>					
Minimum Radius	m	<b>250 (SSD)</b> 1,000 (ISD) 8,000 (OSD)	123	150 (200)	250
Maximum Radius for use of a Transition Curve	m	N/A	250	<b>999</b>	999
Radius for Normal Crown	m	1,000	<b>2,930 (3%)</b> 1,440 (2%)	5,700 (3%) 2,000 (2.0%) 1,500 (1.5%)	2,930
Minimum Curve Length	m		<b>180</b> (360)	110 or 1,000/θ	180
Minimum Transition Curve Length	m	45	36	<b>50</b>	50
Maximum Super elevation Rate	-	5%	<b>6, 8, 10%</b>	<b>6, 8, 10%</b>	6%
Super elevation Runoff	-	N/A	<b>1/167</b>	1/125	1/167
<b>Vertical Alignment</b>					
Maximum Grade	-	<b>3%</b>	5%	5%	3%
Minimum Grade	-	N/A	0.3-0.5%	0.3-0.5%	0%
Minimum Rate of Crest Vertical Curvature (K)	K	<b>18 (SSD)</b>	11	14 (20)	18
Minimum Rate of Sag Vertical Curvature (K)	K	<b>18 (SSD)</b>	<b>18</b>	10 (15)	18
Minimum Vertical Curve Length	m	40	12	<b>50</b>	50
Vertical Clearance	m	N/A	4.9	4.5	5.2

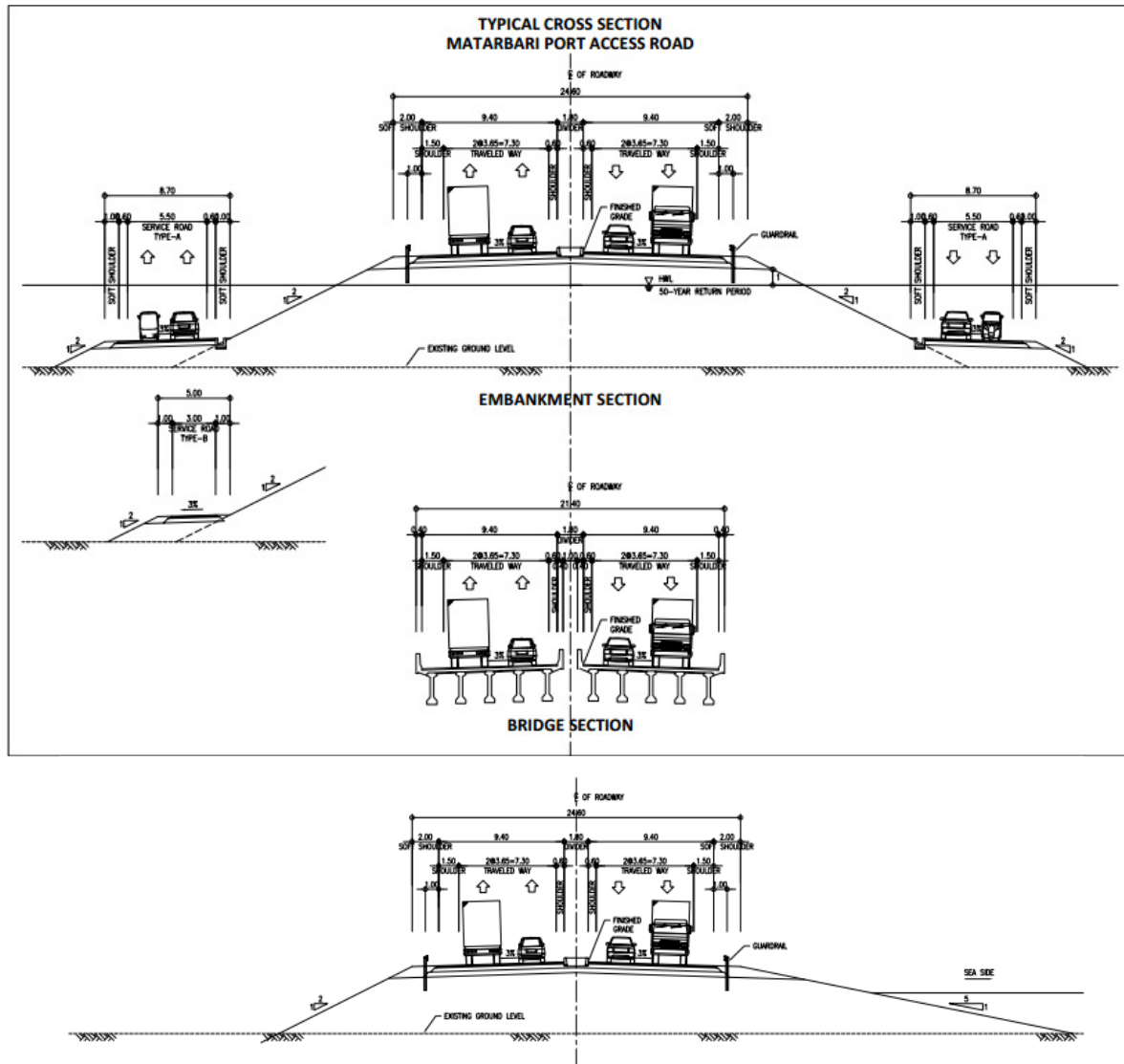


Figure 2.4-2 Typical Cross Section of Matarbari Port Access Road

## 2.5 WORK SCHEDULE AND PROJECT COSTING

The project is scheduled to start from December 2018 and will be completed in May 2024. The phase wise schedule would be:

- Detailed Design: from Dec 2018 to Nov 2019 (12 months)
- Procurement of Contractor: from Dec 2019 to Nov 2020 (12 months)
- Construction: from Dec 2020 to May 2024 (42 months)

Table-2.4-6 Work schedule of the Port Connecting Access Road Project

	3	6	9	12	15	18	21	24	27	30	33	36	39	42	45	48	51	54	57	60	63	66		
Detailed Design	█																							
Procurement of Contractor					█																			
Construction									█															

**Project Cost:**

Total construction cost for 2-lane access road was estimated as BDT 56.2 billion but it may vary from BDT 49.5 to 56.2 billion depending on the availability of embankment material. The estimated construction cost is relatively high:

- Embankment section: BDT 1,395 to 1,824 mil. per km
- Bridge section: BDT 3,600 per sq. m

	Total Construction Cost (excluding VAT & Contingency)			Construction Cost of Embankment Section per km			Construction Cost of Bridge Section per sq. m		
	BDT bln.	JPY bln.	US\$ mil.	BDT mil.	JPY mil.	US\$ mil.	BDT thou.	JPY thou.	US\$
4-lane Case	80.6	103.2	972.2	2,104	2,693	25.4	293.3	378.0	3,600
2-lane Case	56.2	72.0	678.2	1,824	2,335	22.0	293.3	378.0	3,600

For proper maintenance of the project road maintenance cost was estimated as BDT 3,625.5 million for the period of 30 years.

	Frequency	Unit Cost (Million BDT)	No. of Times	Cost (Million BDT)
<b>Routine Maintenance</b>				
Inspection	Every week	0.00625	1,440	10.5
Partial Resurfacing of Pavement	Every year	17	30	510.0
Sub-total				520.5
<b>Periodic Maintenance</b>				
Full Resurfacing of Pavement	Every 10 years	682	3	2,046.0
Bridge pavement resurfacing	Every 15 years	80	2	160.0
Replacement of Expansion Joint	Every 15 years	182	2	364.0
Replacement of Bridge Waterproofing	Every 30 years	265	1	265.0
Repainting of Steel bridge coating	Every 30 years	270	1	270.0
Sub-total				3,105.0
<b>Total Cost per 30 Years</b>				<b>3,625.5</b>

## **CHAPTER-3 LEGAL AND LEGISLATIVE FRAMEWORK**

### **3.1 INTRODUCTION**

To address the environmental and social risks of any proposed Project and its associated components; any protect and conserve the environment from any adverse impacts, the GoB has specified regulations, policy and guidelines. Potential lenders' also have their own set of requirements (such as the JICA Guidelines for Environmental and Social Considerations (2010)) to which any project funded by them must operate.

This document focuses on policy, regulations and the administrative framework under the purview of which the proposed project will fall and this EIA study will be governed, namely:

- ✓ Bangladesh national and local, legal and institutional framework;
- ✓ JICA Guidelines for Environmental and Social Consideration Guideline

The following sections review the relevant National legislative, regulatory and policy requirements along with some international ones. In addition to review of these policies, the gaps between National Laws and JICA Guidelines for Environmental and Social Considerations (April 2010) has been addressed.

### **3.2 ENVIRONMENTAL AGENCIES**

#### **3.2.1 Ministry of Environment and Forest**

The Ministry of Environment and Forest (MoEF) is the key government institution in Bangladesh for matters relating to national environmental policy and regulatory issues. Realizing the ever-increasing importance of environmental issues, the MoEF was created in 1989 and is presently a permanent member of the executive committee of the National Economic Council (NEC). This group is the major decision-making body for economic policy and is also responsible for approving public investment projects. The MoEF oversees the activities of the following agencies:

- Department of Environment (DoE);
- Department of Forest (DoFo);
- Forest Industries Development Corporation (FIDC);
- Bangladesh Forest Research Institute (BFRI) and Institute of Forestry (IoF);
- Forestry division of the Bangladesh Agricultural Research Council (BARC); and
- National Herbarium.

Of the above agencies a precise description of the first two departments including other pertinent ones are presented below as considered relevant.

#### **3.2.2 Department of Environment**

The Department of Environment (DoE), established in 1989 under the jurisdiction of the MoEF, is the executing agency for planning and implementing environmental issues including, but not limited to, the following activities:

- Reviewing environmental impact assessments and issuing environmental clearance where appropriate;
- Implementing environmental monitoring programs and enforcement measures;
- Developing and maintaining environmental data bases; and
- Coordinating international events with the MoEF (e.g., representing Bangladesh in international seminars, workshops, etc.).

The DoE is headed by a Director General (DG) who is supported by a team of directors, deputy directors, assistant directors, engineers, and other technical staff (e.g., chemists and laboratory technicians). The DoE has regional offices, monitoring stations and several laboratories. Figure-3.3-1 shows the organizational set-up of DoE.

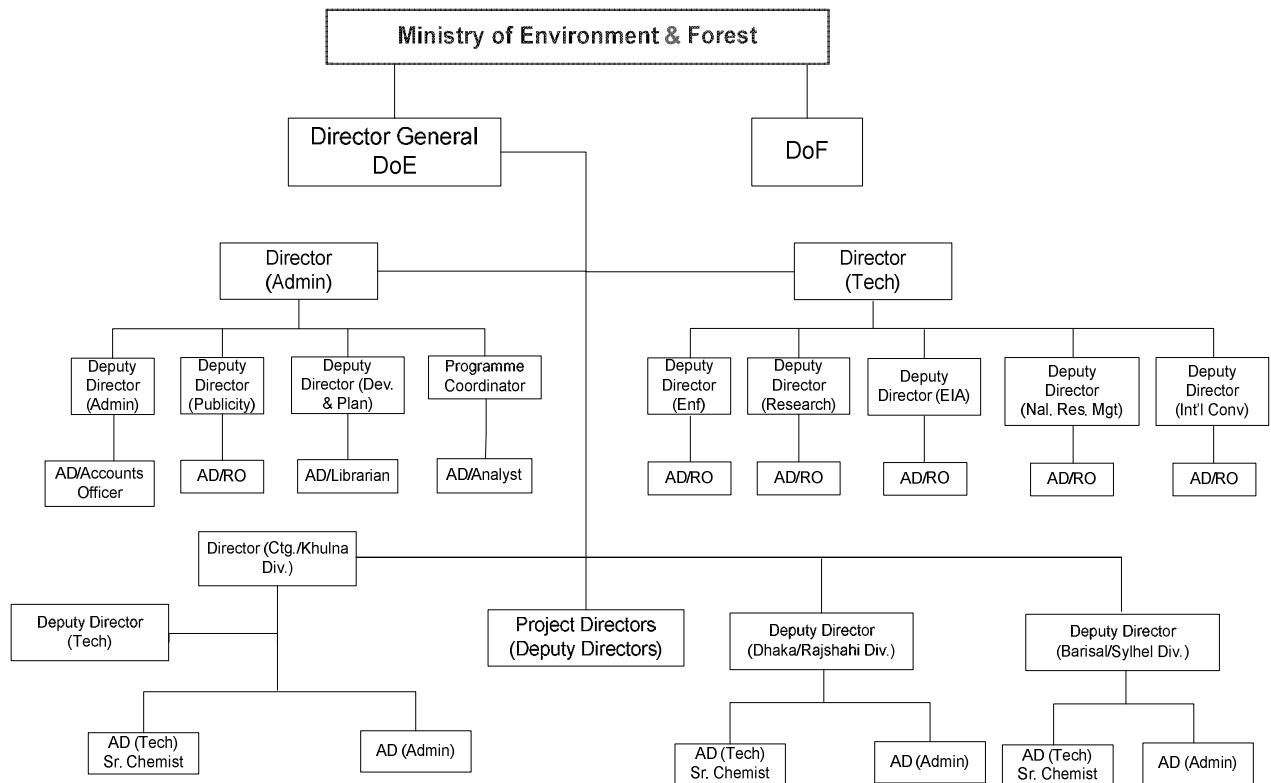
### **3.2.3 Department of Forest**

The Department of Forest (DoFo), under the MoEF, is responsible for protection and management of the reserve forests in the country. The department manpower extends down to union levels in areas where reserve forest exists. Officers of the DoF are responsible for protection of wildlife in these forest areas.

### **3.2.4 Ministry of Land - Land Reform and Land Acquisition Directorate**

The Ministry of Land (MoL) manages revenue generation for government-owned land (called khas), excluding agency-owned lands controlled by the BWDB, roads and highways, etc. The MoL controls open water bodies (rivers, beels, haors) above a specified size, except for those that were transferred to the Ministry of Fisheries (MoF) and livestock under the new fisheries management policy.

The MoL approves the process where the government acquires private land with regard to private development program.



Source: MOEF AD: Asstt. Director, RO: Research Officer

Figure-3.2-1 Organizational Setup of DOE

### 3.3 RELEVANT NATIONAL POLICIES AND LEGISLATION

The GoB has developed a policy framework that requires environmental issues to be incorporated into economic development planning. The key tenets of the various applicable policies are detailed in the following subsections.

#### 3.3.1 National Conservation Strategy (NCS) 1992

In 1987, the National Conservation Strategy (NCS) was formulated by the Bangladesh Agricultural Research Council in cooperation with the IUCN. The NCS was drafted in late 1991 and submitted to the government in early 1992. It aims to:

- assess the usage patterns of natural resources and the future needs and possibilities of major development activities in order to set a feasible and sustainable strategy to conserve limited natural resources; and
- reconcile development and the environment in order to ensure the sustainable use of resources, species and ecosystems in the future. In particular, it underlines the importance of ecosystems in coastal areas, hilly forests and the Sundarban wetland.

### **3.3.2 National Environmental Management Action Plan (NEMAP) 1995**

The NEMAP is a wide ranging and multi-faceted plan, which builds on and extends the statements set out in the national environmental policy. NEMAP was developed to address issues and management requirements for a period from 1995 to 2005 and sets out the framework within which the recommendations of the NCS are to be implemented.

NEMAP has the broad objectives of:

- Identification of key environmental issues affecting Bangladesh;
- Identification of actions necessary to halt or reduce the rate of environmental degradation;
- Improvement of the natural and built environment;
- Conservation of habitats and biodiversity;
- Promotion of sustainable development; and
- Improvement in the quality of life of the people.

To attain the above mentioned objectives, the plan groups all the relevant necessary actions under four headings, namely: institutional, sectoral, location-specific and long-term issues.

The institutional aspects reflect the need of inter sectoral cooperation to tackle environmental problems which need new and appropriate institutional mechanisms at national and local levels. The sectoral action reflects the way the ministries and agencies are organized and makes it easier to identify the agency to carry out the recommended actions. The location-specific action focuses particularly on acute environmental problems at local levels that need to be addressed on a priority basis. The long-term actions include environmental degradation to such degree that might become even more serious and threatening, if cognizance is not taken immediately.

One of the key issues in NEMAP regarding the energy sector has been that “energy conservation awareness is generally low throughout the country”. NEMAP did not recognize mineral resources as an important sector and there is no separate discussion on this.

### **3.3.3 Seventh Five-Year Plan (2016-2020)**

This is the last five-year plan of the country. The PSMP 2010 includes coal-fired power plant projects (both domestic and imported) totalling around 20,000 MW. Given the present status of domestic coal, the implementation of these projects will require imported coal for fuel. The total coal requirement would be approximately 60 million ton per year. Handling this massive volume of coal import will require huge port, rail transport and coal stocking infrastructure. However, so far there is only one on-going deep-sea port project in Matarbari island which will be able to cater ships having 80,000 tonnes capacity. This is currently dedicated for Matarbari Ultra Super Critical Coal-fired Power Plant, one of the six national high prioritized projects under Prime Minister’s direct supervision. In the near future, however, the Government intends to expand this deep-sea port and develop a coal Centre as “An Energy Hub” for the whole country. The coal Centre will be carried out through PPP (Public Private Partnership) scheme.

The development of port facilities for coal imports will be given top priority in order to support the power generation plan. The 1200 MW Matarbari Ultra Super Critical Coal-fired Power Plant project funded by



Government of Japan contains the important component: the deep sea port for the coal import, which will provide the opportunity for generation companies planning to develop the coal-fired power plants to procure the international coal in relatively cheaper price compare to the individual purchased coal from foreign countries. JICA is also examining the possibility to set up the large coal transshipment terminal at the Matarbari port to cater the demand of nearly 3,500MW of power generation by 2020. The Matarbari deep sea port and the associated transshipment terminal are critically linked to the Government's successful implementation of the power generation plan and would have the highest priority in the public investment Programme for transport infrastructure during the Seventh Plan.

The present Seventh Plan's articulation of a sustainable development strategy involves a large array of actions under three key themes: (i) Climate Change Management and Resilience (comprised of adaptation and mitigation) (ii) Environmental Management; and (iii) Disaster Management. These actions are aligned with the overall framework and strategies of National Sustainable Development Strategy (NSDS), and are broadly consistent with the scope of the post-2015 Sustainable Development Goals (SDGs). Some of the objectives and activities that were considered under the Sixth Plan but were not addressed or implemented have also found consideration under Seventh Plan, provided they have an instrumental role in aiding the key objectives of the Plan. This chapter is focused on Climate Change Management and Resilience and Environmental Management mostly. The detail of Disaster Management is discussed in Chapter 14 of Part 2 as the Ministry of Disaster Management and Relief is within the purview of Social Welfare and Security sector.

### **SEA in the 7th Five Year Plan (FY2016 – FY2020)**

Sector 8: Environment and Climate Change

Chapter 8-Sustainable Development: Environment and Climate Change (Page(s)-485-486)

8.6 Internal Environment Management

#### **Activities proposed under 7th Five Year Plan for Environment Management**

Issue 3: Strengthening EIA system as environment management tool

Under ECA '95, EIA has been accepted as a mandatory tool to identify and predict impacts and undertake proper mitigation measures in a project scale. There is another concern that, most of the developing Ministries and agencies escape the process. There is also a need for introducing strategic EIA as a planning tool for sectoral level planning.

Programme:

- Strengthening the EIA processing & implementation through institutional capacity building.
- Issuance of location clearance after approval of EIA report for Red category projects.
- No land development activity to take place prior to environment clearance.
- Gazetting and publicizing EIA guidance manual & sectoral EIA guideline prepared.
- Enlistment of competent EIA consulting firms by the DoE for conducting EIA.
- Immediate framing of detailed rules on EIA as mandated in section 12 of BECA
- Strategic EIA/SEA for all sectoral planning including for exclusive economic zones.

- Achieving compliance to EIA practices by all development Ministries & agencies.
- Public consultation on EIA report of Red category projects

### **3.3.4 National Forest Policy (NFP) (1994)**

The NFP of 1994 is the amended and revised version of the NFP of 1977 in the light of the National Forestry Master Plan (NFMP). The major target of the policy is to conserve the existing forest areas and bring about 20% of the country's land area under the forestation program and increase the reserve forest land by 10% by the year 2015 through coordinated efforts of governmental-NGOs and active participation of the people.

Amendments of the existing laws (acts, rules and regulations) relating to the forestry sector and creation of new laws for sectoral activities have been recognized as important conditions for achieving the policy goals and objectives. The forestry policy also recognizes the importance of fulfilling the responsibilities and commitments under International Conventions, Treaties and Protocols (ICTPs).

### **3.3.5 The Bangladesh Forestry Act 1927**

The Bangladesh Forestry Act (BFA) of 1927 provides for reserving forests over which the government has an acquired property right. This act has made many types of unauthorized uses or destruction of forest produce punishable. The government may assign any village community its right to or over any land, which constitutes a reserved forest.

#### Other Forest Acts

The supplementary rules of 1959 empower the concerned governmental bodies to restrict totally and for a specified period, the shooting, hunting or catching of various birds, animals and reptiles in the controlled and vested forests. The private forest ordinance of 1959 provides for the conservation of private forests and for the forestation, in certain cases, of wastelands in Bangladesh.

### **3.3.6 National Industrial Policy (1999)**

The National Industrial Policy (NIP) of 1999 aims to ensure a high rate of investment by the public and private sectors, a strong productive sector, direct foreign investment, development of labour intensive industries, introduction of new appropriate technology, women's participation, development of small and cottage industries, entrepreneurship development, high growth of export, infrastructure development and environmentally sound industrial development.

World Trade Organization (WTO) guidelines were proposed to be followed in the NIP. Guidelines for mitigating eventual conflicts of intellectual property rights are absent in the policy document. No specific guidelines are given for sustainable extraction and utilization of raw materials for different industries.

One of the 17 objectives of the policy (Section 2.12; Chapter II) is "To ensure a process of industrialization which is environmentally sound and consistent with the resource endowment of the country". However, none of the 24 strategies of the policy relate to the environment.

This Project under consideration fulfils entirely the requirements and objectives of this policy.

### **3.3.7 National Water Policy (1999)**

The National Water Policy (NWP) of 1999 was passed to ensure efficient and equitable management of water resources, proper harnessing and development of surface and ground water, availability of water to

all concerned and institutional capacity building for water resource management. It has also addressed issues like river basin management, water rights and allocation, public and private investment, water supply and sanitation and water needs for agriculture, industry, fisheries, wildlife, navigation, recreation, environment, preservation of wetlands, etc.

The NWP, however, fails to address issues like consequences of trans-boundary water disputes and watershed management.

### **3.3.8 National Tourism Policy (1992)**

One of the aims of the National Tourism Policy (NTP) of 1992 statement is “Development of tourism resources of the country and their maintenance”. Two special sections of the policy focus on ‘archaeological and historical sites’ and ‘conservation of wildlife’.

### **3.3.9 National Energy Policy (1995)**

The National Energy Policy (NEP) of 1995 provides for utilization of energy for sustainable economic growth, supply to different zones of the country, development of the indigenous energy sources and environmentally sound sustainable energy development programs. The NEP highlights the importance of protecting the environment by requiring an EIA for any new energy development project and introducing economically viable and environmentally friendly technology.

One of the seven objectives (Section 1.2) addresses the environment and states, "(vi) to ensure environmentally sound sustainable energy development programs causing minimum damage to the environment".

Seven specific policy recommendations are listed under Chapter 1.9. Of those, the following three are relevant to the present Project:

- Environmental impact assessment should be made mandatory and should constitute an integral part of any new energy development project;
- Use of economically viable environment friendly technology is to be promoted; and
- Public awareness is to be promoted regarding environmental conservation.

### **3.3.10 Bangladesh National Environmental Policy (1992)**

Bangladesh National Environmental Policy (BNEP) of 1992 sets out the basic framework for environmental action, together with a set of broad sectoral action guidelines. The BNEP provides the broader framework of sustainable development in the country. It also states that all major undertakings, which will have a bearing on the environment, (including setting up of an industrial establishment) must undertake an IEE / EIA before they initiate the Project.

The BNEP delineates the DoE, as the approving agency for all such IEE / EIA’s to be undertaken in the country.

Policies of fifteen sectors are described in the BNEP. Under the energy and fuel sector, the use of fuel that has the least environmental impact is encouraged in Section 3.4.1. conservation of fossil fuel is stressed in Section 3.4.5 and the need for conducting EIA’s before implementation of projects for fuel and mineral resources is stressed in Section 3.4.6.

Under the Environmental Action Plan (EAP) Section of the BNEP and sub-section 'Fuel and Energy', it is suggested that:

- The use of gas, coal, kerosene and petrol as fuel will be expanded in the rural areas, so that fuel wood, agricultural residues, and cow dung is conserved. This will help the use of agricultural residues, and cow dung etc. as manure; and
- Appropriate measures will be taken to ensure that extraction; distribution and use of natural resources such as oil, gas, coal, peat etc. do not adversely affect air, water, land, the hydrological balance and the ecosystem.

Section 3.7 "Forest, Wildlife and Biodiversity" requires:

- Conserve wildlife and biodiversity, strengthen related research and help dissemination and exchange of knowledge in these areas; and
- Conserve and develop wetlands and protection of migratory birds.

### **3.3.11 Bangladesh National Environmental Policy (2017) (Upcoming)**

National Environmental Policy-2017 has been placed to the Honourable Prime Minister for Approval. This policy has stated the following points regarding the SEA.

- All the fields required confirmation of the execution of Environmental Impact Assessment (EIA) and Strategic Environmental Assessment (SEA)
- Environmental Policy
  - o Land Resources Management
    - Ecosystem and Regional-Ecosystem based land zoning have to be planned and Regional-Ecosystem based SEA execution should be ensured.
  - o Organizational Set-up
    - Relevant all ministries and offices shall formulate SEA on their sectoral policy, plan and program.
  - o National Environment Policy Compliance
    - Accommodation, Housing and Urbanization
      - EIA and SEA should be carried out before formulation of all National Regional Projects and Master Plan proposed for housing and urbanization
      - For the separation of residential, commercial and industrial areas, the zoning should be made through SEA. Preparation and implementation of environmentally-friendly and regional urban planning.
      - In order to set up industrial establishments in a planned manner, SEA guided land zoning would be required for building the subject based industrial Area. Restricted establishment of industrial factories in residential areas and Transfer existing industrial factories of the residential areas to the scheduled areas.

### **3.3.12 Bangladesh Wildlife Preservation Act (1973; Amended in 1974)**

The Bangladesh Wildlife Preservation Act (BWPA) of 1973 provides for the preservation, conservation and management of wildlife in Bangladesh. The earlier laws on wildlife preservation, namely, the

elephant preservation act of 1879, the wild bird and animals protection act of 1912, and the rhinoceros preservation act of 1932 have been repealed and their provisions have been suitably incorporated in the BWPA.

The BWPA encompasses a range of different activities including hunting and fishing although the provisions of greatest significance relate to the establishment of national parks, wildlife sanctuaries and game reserves by the MoEF. Such designations have enormous significance for the types of developments that may take place.

This legislation does not provide scope for creation of a strong organization, which can adopt appropriate measures to protect wildlife. The importance of wildlife could have been highlighted in the legislation, which it does not do. Punitive provisions are not readily usable. The types of endangered and ecologically valuable animals/birds could have been highlighted in the legislation. It should have asked for active participation and specific action from local administration to protect wildlife. It also does not prescribe seasons when certain animal/birds cannot be hunted or captured.

An executive order issued in June 1998, in relation to the Bangladesh Wildlife Preservation Order (BWPO) of 1973 has imposed a ban for the next five years on hunting of any form of wildlife.

### **3.3.13 Environmental Conservation Act (1995, Amended in 2000, 2002 and as amended till October 5, 2010)**

The Bangladesh Environment Conservation Act (ECA) of 1995 is currently the main legislation in relation to environment protection in Bangladesh. The ECA is promulgated for environment conservation, environmental standards development and environment pollution control and abatement. It has repealed the environment pollution control ordinance of 1977.

The main objectives of ECA are:

- Conservation and improvement of the environment; and
- Control and mitigation of pollution of the environment.

The main strategies of the ECA can be summarized as:

- Declaration of ecologically critical areas and restriction on the operations and processes, which can or cannot be carried/initiated in the ecologically critical areas;
- Regulations in respect of vehicles emitting smoke harmful for the environment;
- Environmental clearance;
- Regulation of the industries and other development activities' discharge permits;
- Promulgation of standards for quality of air, water, noise and soil for different areas for different purposes;
- Promulgation of a standard limit for discharging and emitting waste; and
- Formulation and declaration of environmental guidelines.

Before any new project can go ahead, as stipulated under the rules, the project promoter must obtain environmental clearance from the DG. An appeal procedure does exist for those promoters who fail to obtain clearance. Failure to comply with any part of this Act may result in punishment to a maximum of 3 years imprisonment or a maximum fine of Tk. 300,000 or both. The DoE executes the ECA under the leadership of the DG.

The amendments (2000, 2002 and as amended till October 5, 2010) of the ECA focus on:

- Ascertaining responsibility for compensation in cases of damage to ecosystems;
- Increased provision of punitive measures both for fines and imprisonment; Fixing authority on cognizance of offences;
- Restriction on polluting automobiles;
- Restriction on the sale and production of environmentally harmful items like polythene bags;
- Assistance from law enforcement agencies for environmental actions; and
- Break up of punitive measures and (5) authority to try environmental cases.

#### **3.3.14 Environmental Conservation Rules (1997)**

These are the first set of rules, promulgated under the ECA of 1995 (so far there have been three amendments to this set of rules-February and August 2002 and April 2003). The Environment Conservation Rules (ECR) of 1997 has provided categorization of industries and projects and identified types of environmental assessments needed against respective categories of industries or projects.

Among other things, these rules set (i) the National Environmental Quality Standards for ambient air, various types of water, industrial effluent, emission, noise, vehicular exhaust etc., (ii) the requirement for and procedures to obtain environmental clearance, and (iii) the requirement for IEE/ EIA's according to categories of industrial and other development interventions.

The Rules are not explicit for various oil and gas exploration interventions. Rather, this is covered under the broader heading of "exploration, extraction and distribution of mineral resources" under the Red Category projects.

The proposed Project, according to the DoE, is considered under the Red Category of the ECR (Item 65: Exploration, extraction and distribution of mineral resources) [Page 3122 of the Bangladesh Gazette of 28 August 1997].

#### **3.3.15 Explosives Act, 1884**

As per section 4 of the legislation,

- (1) "Explosives" include:
  - Means, gun powder, nitro-glycerine, dynamite, gun-cotton, blasting powders, fulminate of mercury or of other metals, coloured fires and every other substance, whether similar to those above-mentioned or not, used or manufactured with a view to produce a practical effect by explosion, or a pyrotechnic effect; and
  - Fog-signals, fireworks, fuses, rockets, percussion-caps, detonators, cartridges, ammunitions of all descriptions, and every adaptation or preparation of an explosive as above defined.
- (3) "Vessel" includes every ship, boat and other vessel used in navigation, whether propelled by oars or otherwise;
- (4) "Carriage" includes any carriage, wagon, cart, truck, vehicle or other means of conveying goods, or passengers by land, in whatever manner the same may be propelled;
- (6) "Import" means to bring into (Bangladesh) by sea or land.

Section 6 of the Explosives Act (EA) of 1884 provides punishment for contravening notifications issued under the provisions of this law, which may extend to imprisonment of ten years with or without fine amounting to fifty thousand taka. Section 8 provides for punishment for failing to notify the chief inspector of explosives in Bangladesh and also to the officer-in-charge of the nearest police station in case of an accident due to explosion of any explosives either during manufacturing, possession, usage or carriage. The punishment extends to three months of imprisonment and to a fine of up to five thousand taka.

Under the provisions of explosives rules, 2003 (rules made under the provision of section 5 of the EA), will be required to obtain licenses for explosive related activities i.e.: import, transport and possession and for such Port Authority will apply for a license to import explosives from the chief controller of imports and exports with the clearance from the chief inspector of DoEx. Application for transport and possession must be sought from the chief inspector of DoEx.

### **3.3.16 Explosives Substances Act, 1908**

In this statute in section 2 an “explosive substance” has been defined as follows –2. In this Explosives Substances Act (ESA) of 1908 the expression “explosive substance” shall be deemed to include any materials for making any explosive substance; also any apparatus, machine implement or material used, or intended to be used, or adapted for causing, or aiding in causing, any explosion in or with any explosive substance; also any part of any such apparatus, machine or implement.”

Section 3 provides for maximum punishment of a life jail term for causing any explosion “...unlawfully and maliciously...to endanger life to cause serious injury to property...“, however, this statute does not come within the purview of this Project as there will be no unlawful or malicious intention whatsoever.

### **3.3.17 Marine Fisheries Ordinance (MFO), 1983**

#### *Section 28 – Provisions:*

The government may, by notification in the official gazette declare any area of the Bangladesh fisheries waters and as appropriate, any adjacent or surrounding land, to be a marine reserve where it considers that special measures are necessary:

- To afford special protection to aquatic flora and fauna of such areas and to protect and preserve the natural breeding grounds and habitats of aquatic life with particular regard to flora and fauna in danger of extinction;
- To allow for the natural regeneration of aquatic life in areas where such life has been depleted;
- To promote scientific study and research in respect of such areas; or
- To preserve and enhance the natural beauty of such areas.

#### *Section 29 – Provisions:*

- (1) Any person who, in any marine reserve declared under section 28, without permission granted under this section dredges, extracts sand or gravel, discharges or deposits waste or any polluting matter, or in any other way disturbs, alters or destroys fish or other natural breeding ground of habitats; or shall be guilty of an offence and shall be liable to a fine not exceeding taka one lakh.



(2) The director may give permission to do any of the things prohibited under this section where the doing of such thing may be required for the proper management of the reserve or for any of the purposes referred to in section 28.

*Section 30 – Provisions:*

This Section deals with the granting of permission for scientific research.

The government may, in writing and subject to such terms and conditions, if any as may be specified therein, exempt from all or any of the provisions of this Ordinance or the rules made there under any vessel or person undertaking research into marine fisheries or other marine living resources in the Bangladesh fisheries waters.

### **3.3.18 Coast Guard Act, 1994**

Amongst the functions of the coast guards as embodied in section 7 of the Coast Guard Act (CGA) of 1994, it also embraces to – “investigate into the activities causing pollution to the environment in the maritime zone of Bangladesh and taking measures for their prevention”.

As such no specific permission from the coast guard authority is required; however, information was given prior to offshore surveys and studies.

### **3.3.19 Compliance with Bangladesh Labour Act, 2006**

Matarbari Port will employ workers in the field for the purposes of the survey and as such must comply with the Bangladesh Labour Act (BLA) of 2006. In this statute definition of labour is provided in section 2, whilst classification of a labour is entailed in section 4(1). Every labourer must be provided with a contract and an identification card (section 5). Whilst child labour is clearly defined in section 34, the nature of the activities will inherently exclude any child (section 40) or women labourers (section 45). Compliance to health and safety is provided in Chapters V (sections 51-60) and VI (sections 61-78), and special provisions regarding health and safety are provided in chapter VII (sections 79-85).

With regard to welfare of the labourers, chapter VIII states that first aid materials (section 89) are mandatory.

Regarding working hours for the labourers, chapter IX sections 101 and 102 and section 105-108 (overtime) are required to be followed. Payment of wages of the labourers is provided for in Chapter X (section 120-123 and 137 must be looked at specifically). Compensation for accidents during work (Chapter XII) is contained in sections 150-153 and 155. Schedule IV provides specific mention of labourers engaged in handling explosives and working in mines.

### **3.3.20 East Bengal Protection and Conservation of Fish Act (1950)**

The East Bengal Protection and Fish Conservation Act (EBPFCA) of 1950, as amended by the protection and conservation of fish (amendment) ordinance of 1982 and the protection and conservation of fish (amendment) act of 1995, provides provisions for the protection and conservation of fish in inland waters of Bangladesh. This is relatively unspecific and simply provides a means by which the Government may introduce rules to protect those inland waters not in private ownership.

This is framework legislation with rule making powers. Among others, some of these rules may prohibit the destruction of, or any attempt to destroy, fish by the poisoning of water or the depletion of fisheries by pollution, by trade effluent or otherwise.



### **3.3.21 The Protection and Conservation of Fish Rules (1985)**

These are a set of rules in line with the overall objectives of the EBFPCA. Section 5 of the Protection and Conservation of Fish Rules (PCFR) of 19985 requires that “No person shall destroy or make any attempt to destroy any fish by explosives, gun, bow and arrow in inland waters or within coastal waters”. Section 6 of the PCFR states that -“No person shall destroy or make any attempt to destroy any fish by poisoning of water or the depletion of fisheries by pollution, by trade effluents or otherwise in inland waters”.

### **3.3.22 The Bangladesh Penal Code (1860)**

[Chapter XIV of offences affective Public health, safety, convenience, decency and morals]

The Bangladesh Penal Code (BPC) of 1860 has some valid provisions related to pollution management environment, health and safety protections. Some of these are: Article 277: “Falling Water or Public Spring or Reservoir”; Article 278: “Making Atmosphere Noxious to Health”; Article 284: “Negligent Conduct with Respect to Poisonous Substance”; Article 285: “Negligent Conduct with Respect to Fire or Combustible Matter”; and Article 286: “Negligent Conduct with Respect to Explosive Substance”.

These articles are important in line with the Carriage of raw materials (Explosive Substance) by Port Authority.

### **3.3.23 Acquisition and Requisition of Immovable Property Ordinance (1982)**

This Acquisition and Requisition of Immovable Property Ordinance (ARIPO) of 1982 has replaced the land acquisition act of 1894 and the east Bengal (emergency) requisition of property act of 1948. The ARIPO governs acquisition and requisition by the government of immovable property for any public purpose or in the public interest. It may be noted that contrary to the previous acts (i.e. Act XIII of 1948), the ARIPO deals only with immovable property.

The ARIPO has well-defined procedures regarding payment of compensation for an acquired piece of land. If, for example, the land is used for rice growing, then an amount equivalent to approximately 1.5 times the market value of a given variety of rice (e.g., paddy) that is currently being (or could be) produced annually is fixed as a yearly lease value. In case of outright purchase (carried out on a 99-year lease), the compensation-value of acquired land varies widely according to the locality, soil fertility, and access to transportation and related infrastructure factors. The current compensation and resettlement provisions are however inadequate both in terms of timing of payments and quantum. The procedures involved are cumbersome and time consuming and often causes hindrance to the smooth execution of the Project. Legal provisions covering adequate compensation to the Project affected persons, particularly disadvantaged groups such as women and squatters and such other vulnerable groups are yet to be framed.

### **3.3.24 Property (Emergency) Acquisition Act, 1989**

The Property (Emergency) Acquisition Act (PAA) of 1989 was formulated to expedite the emergency acquisition of land to enable the government 'to control inundation, flood and upsurge caused by natural calamity and to prevent river erosion." The PAA was not meant to replace the 1982 ordinance, but to complement it for special circumstances. Normally, acquisition of land for development purposes would not come under the 1989 act. Use of PAA to acquire land for development would require extremely compelling reasons.

### **3.3.25 Administrative and Regulatory Guidelines and Instructions**

In addition to the provisions in the law, the land acquisition process is regulated by certain administrative instructions and procedural requirements. The most important of these are summarized here:

- In 1976, the government constituted land allocation committees at the district, divisional and central levels to control what was regarded as too lavish taking of land for public purposes. The committees were charged with ensuring 'the most rigid measures of economy in the use of land for purposes other than agriculture.'
- The District Land Allocation Committees (DLACs) are chaired by the DC and have seven other members. These members include executive engineers of the R&H department and the public works department, and the civil surgeon. They are entrusted with land allocation within the district not exceeding two acres.

The divisional LACs are chaired by the divisional commissioner and have technical representation at the superintending engineer and deputy director level. These committees consider land acquisition cases involving between two and five acres of land. All cases of more than five acres go to the Central Land Allocation Committee (CLAC). This committee is chaired by the Minister of Land Administration (MoLA) and has technical representation at the secretary level. In 1989, the government ordered that in all cases involving the acquisition of land exceeding 10 bighas, the president would have to give consent.

### **3.3.25 Framework for Leasing of Government (Khas) Agricultural Land**

The rules for managing and leasing government-owned (Khas) land are framed in two notifications in the Bangladesh Gazette: (1) Notification: Bhumo/Sho-8/Kha-jo-bo/46/84/261, Bangladesh Gazette Extra Edition, May 12, 1997, pp 1527-1536; and (2) Notification: Shuno/Sho-4/Kri-kha-jo--bo-1/98-264, Bangladesh Gazette, September 15, 1998.

Under these regulations, the government leases cultivable agricultural land in the rural areas to landless farming households. The allotments cannot be more than one acre, except in the southern districts where up to 1.5 acres of char land can be allotted. A landless family is defined as one that works in agriculture and may own a homestead, but has no arable land of its own. Given this basic definition, five groups of landless families are given priority in the allotment of leases:

- Families of freedom fighters;
- Families who have lost all their land due to erosion;
- Widows with an adult son capable of working the land;
- Farmers with homesteads but no land; and
- Farmers who have lost all their land due to land acquisition under the eminent domain laws.

The regulation further defines the structure and responsibilities for the management and leasing of Khas Lands at the national, district, and Thana levels.

### **3.3.26 Bangladesh Water Act, 2013**

A National Water Resources Council (NWRC) to be established for implementing the provisions of the Act. A National Water Policy shall be adopted by the Council addressing the following issues:

- Purpose and sectors of water use;

- Affordability of water users;
- Actual cost of water abstraction and distribution;
- Financial ability and backwardness of water users of any group thereof;
- Water demand and supply;
- Any other issues considered relevant by GoB;
- An Executive Committee of the Council shall be established or ensuring efficient performance of the Council;
- The GoB can declare certain areas as Water Stress Areas for the protection of water sources or aquifers;
- Water zone demarcation (industrial, agricultural, brackish water aquaculture and hatchery water zones) through gazette notification and issuance of protection order for efficient water management in such zones.
- Declaration of flood control zone and its management. Restriction on abstraction of total water from any water source.

### **3.3.27 Bangladesh Energy Regulatory Commission Act, 2003 (as amended in 2010)**

As per section 27 of the Bangladesh Energy Regulatory Commission Act (BERCA) of 2003, no person shall engage himself in activities like power generation, energy transmission, and energy supply and energy storage, without a license from Bangladesh Energy Regulatory Commission (BERC), which has been constituted under the BERCA for its implementation.

### **3.3.28 Public Procurement Rule, 2008**

The Public Procurement Rule (PPR) of 2008 includes the adequate measure regarding the ‘Safety, Security and Protection of the Environment’ in the construction works. This clause includes mainly, the Contractor shall take all reasonable steps to (i) safeguard the health and safety of all workers working on the site and other persons entitled to be on it, and to keep the site in an orderly state and (ii) protect the environment on and off the site and to avoid damage or nuisance to persons or to property of the public or others resulting from pollution, noise or other causes arising as a consequence of the Contractors methods of operation.

### **3.3.29 Bangladesh National Building Code**

The basic purpose of the Bangladesh National Building Code (BNBC) is to establish minimum standards for design, construction, quality of materials, use and occupancy, location and maintenance of all buildings within Bangladesh in order to safeguard, within achievable limits, life, limb, health, property and public welfare. The installation and use of certain equipment services and appurtenances related, connected or attached to such buildings are also regulated herein to achieve the same purpose.

Part-7, Chapter-3 of the BNBC has clarified the issue of safety of workmen during construction and with relation to this, set out the details about the different safety tools of specified standard. In relation with the health hazards of the workers during construction, this chapter describes the nature of the different health hazards that normally occur in the site during construction and at the same time specifies the specific measures to be taken to prevent such health hazards. According to this chapter, exhaust ventilation, use of

protective devices, medical check-ups etc. are the measures to be taken by the particular employer to ensure a healthy workplace for the workers.

Section 1.4.1 of chapter-1, part-7 of the BNBC, states the general duties of the employer to the public as well as workers. According to this section, “All equipment and safeguards required for the construction work such as temporary stair, ladder, ramp, scaffold, hoist, run way, barricade, chute, lift etc. shall be substantially constructed and erected so as not to create any unsafe situation for the workmen using them or the workmen and general public passing under, on or near them”.

Part-7, Chapter -1 of the BNBC clearly sets out the constructional responsibilities according to which the relevant authority of a particular construction site shall adopt some precautionary measures to ensure the safety of the workmen. According to the Section 1.2.1 of Chapter-1 of part 7, “in a construction or demolition work, the terms of contract between the owner and the Contractor and between a consultant and the owner shall be clearly defined and put in writing. These however will not absolve the owner from any of his responsibilities under the various provisions of the BNBC and other applicable regulations and byelaws.

The terms of contract between the owner and the Contractor will determine the responsibilities and liabilities of either party in the concerned matters, within the provisions of the relevant acts and codes (e.g. the Bangladesh Labor Act (BLA)).

To prevent workers falling from heights, the BNBC in section 3.7.1 to 3.7.6 of Chapter 3 of part 7 sets out the detailed requirements on the formation and use of scaffolding.

### **3.3.30 Constitution of Bangladesh**

Article 24 of the Constitution of Bangladesh (CoB) says that the state shall adopt measures for the protection against disfigurement, damage or removal of all monuments, objects or places of special artistic or historic importance or interest.

### **3.3.31 National Information and Communication Technology Policy, 2002**

Information Communication Technology (ICT) encompasses the broad fields of data/information processing, transmission and communications by means of computer and telecommunication techniques and these modern tools are being increasingly used for organizational/personal information processing in all sectors of economy and society. The National Information and Communication Technology Policy (NICTP) of 2002 presents the guidelines for the development of the ICT sector in Bangladesh. The NICTP includes a specific section related to the importance of ICT in mitigating environmental issues and disseminating information on environmental problems and their causes in order to create awareness about environment among the common people.

The NICTP encourages information system for making a complete inventory of existing flora and fauna of Bangladesh, their habitats and other natural communities whose existence has been endangered. Use of GIS and other ICT-based systems are promoted for planning at the national level, for agricultural crops estimation, conservation of nature while accommodating compatible land use to maintain the ecological balance. The NICTP also promotes use of ICT to help solve the most pressing problems of environment in the urban areas like toxic emissions from vehicles, industries and other sources.

### 3.4 OTHER POLICIES RELEVANT TO ENVIRONMENT

Additional Bangladesh policies, their key features and applicability to the subject Project are detailed in Table 3.4-1.

Table 3.4-1 Policies Relevant to Environment

Policy	Key Features	Applicability
The National Forest Policy, 1994	<ul style="list-style-type: none"> <li>• Afforestation of 20% land</li> <li>• Bio-diversity of the existing degraded forests</li> <li>• Strengthening of the agricultural sector</li> <li>• Control of Global warming, desertification</li> <li>• Control of trade in wild birds and animals</li> <li>• Prevention of illegal occupation of the forested land, tree felling and hunting of wild animals</li> </ul>	Applicable when considering global warming and the protection of forests
National Land Transport Policy, 2004	<ul style="list-style-type: none"> <li>• All new roads and major improvements will be subjected to an EIA</li> <li>• Funding will be provided for mitigation measures</li> <li>• The Government will publish environmental standards for new roads and new design standards addressing environmental issues</li> </ul>	Not directly applicable, however, the standards may apply for the new approach road
The National Water Policy, 1999	<ul style="list-style-type: none"> <li>• Protection, restoration and enhancement of water resources</li> <li>• Protection of water quality, including strengthening regulations concerning agrochemicals and industrial effluent</li> <li>• Sanitation and potable water</li> <li>• Fish and fisheries</li> <li>• Participation of local communities in all water sector development</li> </ul>	Applicable for the preservation of water quality
National Land use Policy, 2001	<ul style="list-style-type: none"> <li>• Deals with several land uses including: agriculture (crop production, fishery (using ponds, lake etc.) and livestock), housing, forestry, industrialization, railways and roads, tea and rubber</li> <li>• Identifies land use constraints in all these sectors</li> </ul>	Applicable as land use change from agricultural to industrial
Draft Wetland Policy, 1998	<ul style="list-style-type: none"> <li>• Establishment of principles for the sustainable use of wetland resources</li> <li>• Maintenance of the existing level of biological diversity</li> </ul>	Applicable

<b>Policy</b>	<b>Key Features</b>	<b>Applicability</b>
	<ul style="list-style-type: none"> <li>• Maintenance of the functions and values of wetlands</li> <li>• Promotion and recognition of the value of wetland functions in resource management and economic development</li> </ul>	
National Fisheries Policy, 1998	<ul style="list-style-type: none"> <li>• Preservation, management and exploitation of fisheries resources in inland open water</li> <li>• Fish cultivation and management in inland closed water.</li> <li>• Prawn and fish cultivation in coastal areas</li> <li>• Preservation, management and exploitation of sea fishery resources-</li> </ul>	Applicable
National Agriculture Policy, 1999	<ul style="list-style-type: none"> <li>• The act deals with the programs related to make the nation self-sufficient in food through increasing production of all crops, including cereals, and ensure a dependable food security system for all</li> </ul>	Not applicable
The Energy Policy, 1996	<ul style="list-style-type: none"> <li>• Provides for utilization of energy for sustainable economic growth, supply to different zones of the country, development of the indigenous energy source and environmentally sound sustainable energy development programs</li> <li>• Highlights the importance of EIA's for any new energy development project</li> </ul>	Not applicable
The Power Policy, 1995	<ul style="list-style-type: none"> <li>• Is an integral part of the Energy Policy and deals with policy statement on demand forecast, long term planning and project implementation, investment terms, fuels and technologies, load management, institutional issues, private sector participation, technology transfer and research program, environmental policy and legal issues</li> </ul>	Not applicable
Industrial Policy, 1999	<ul style="list-style-type: none"> <li>• Deals with industrial development, direct foreign investments, investment by public and private sector, introduction of new appropriate technology, women's participation, infrastructure development and environmentally sound industrial</li> </ul>	Applicable as this Project will encourage the public and private partnership, industrial development

### **3.5 RELEVANT NATIONAL LEGAL INSTRUMENTS FOR THE PROJECT**

Table 3.5-1 presents an outline of other National legal instruments that will have relevance to the proposed Project with respect to the social and environment considerations.

**Table 3.5-1 National Legal Instruments relevant to the Project**

<b>Act/ Rule/ Law/ Ordinance</b>	<b>Enforcement Agency – Ministry/ Authority</b>	<b>Key Features</b>	<b>Applicability to proposed Project</b>
The Environment Conservation Act, 1995 and subsequent amendments in 2000 and 2002	Department of Environment Ministry of Environment and Forests,	<ul style="list-style-type: none"> <li>Define Applicability of environmental clearance</li> <li>Regulation of development activities from environmental perspective</li> <li>Framing applicable limits for emissions and effluents</li> <li>Framing of standards for air, water and noise quality</li> <li>Formulation of guidelines relating to control and mitigation of environmental pollution, conservation and improvement of environment</li> <li>Declaration of Ecologically critical areas</li> </ul>	Applicable
Environmental Conservation Rules, 1997 and subsequent amendments in 2002 and 2003	Department of Environment Ministry of Environment and Forests	<ul style="list-style-type: none"> <li>Declaration of Ecologically critical areas</li> <li>Requirement of environmental clearance certificate for various categories of projects</li> <li>Requirement of IEE/EIA as per category</li> <li>Renewal of the environmental clearance certificate within 30 days after the expiry</li> <li>Provides standards for quality of air, water and sound and acceptable limits for emissions/discharges from vehicles and other sources</li> </ul>	Applicable Projects falls under Red Category and require environmental clearance
Environment Court Act, 2000 and subsequent amendments in 2002	Ministry of Environment and Forests and Judiciary	<ul style="list-style-type: none"> <li>GOB has given highest priority to environment pollution</li> <li>Passed 'Environment Court Act, 2000 for completing environment related legal proceedings effectively</li> </ul>	Applicable for completing environmental legal requirements effectively
he Vehicle Act, 1927; The Motor Vehicles Ordinance, 1983; and The Bengal Motor Vehicle Rules, 1940	Bangladesh Road Transport Authority	<ul style="list-style-type: none"> <li>Exhaust emissions</li> <li>Vehicular air and noise pollution</li> <li>Road/traffic safety</li> <li>Vehicle Licensing and Registration</li> <li>Fitness of Motor Vehicles</li> <li>Parking by-laws.</li> </ul>	Applicable for proposed Project in relation to road transport
The Removal of Wrecks and Obstructions in inland Navigable Water Ways Rules 1973	Bangladesh Water Transport Authority	<ul style="list-style-type: none"> <li>Removal of wrecks and obstructions in inland navigable waterways</li> </ul>	Applicable as canal- inland navigable waterway will be used for transport of equipment for the Project
Water Supply and Sanitation Act, 1996	Ministry of Local Government, Rural Development and Cooperatives	<ul style="list-style-type: none"> <li>Management and Control of water supply and sanitation in urban areas.</li> </ul>	Not directly applicable, however, indirectly applicable when considering water usage management and sanitation facilities
The Ground Water Management Ordinance, 1985	Upazila Parishad	<ul style="list-style-type: none"> <li>Management of ground water resources</li> <li>Installation of tube-wells at any place after license from Upazila Parishad only</li> </ul>	Proposed Project will use surface water source however, should groundwater also be required then licenses will need

<b>Act/ Rule/ Law/ Ordinance</b>	<b>Enforcement Agency – Ministry/ Authority</b>	<b>Key Features</b>	<b>Applicability to proposed Project</b>
The Forest Act, 1927 and subsequent amendments in 1982 and 1989	Ministry of Environment and Forests	<ul style="list-style-type: none"> <li>• Categorization of forests as reserve, protected and village forests • Permission is required for use of forest land for any non-forest purposes</li> </ul>	to be obtained prior to installation of any tube-wells. Not applicable as proposed Project is not on forest land
The Private Forests Ordinance Act, 1959	Regional Forest Officer, Forest Department	<ul style="list-style-type: none"> <li>• Conservation of private forests and for the afforestation on wastelands</li> </ul>	Not Applicable
Bangladesh Wild Life (Preservation) Act, 1974	Ministry of Environment and Forest; Bangladesh Wild Life Advisory Board	<ul style="list-style-type: none"> <li>• Preservation of Wildlife Sanctuaries, Parks, and Reserves</li> </ul>	Not applicable as the Project study area does not have any wildlife areas
National Biodiversity Strategy and Action Plan (2004)	Ministry of Environment and Forest Bangladesh Wild Life Advisory Board	<ul style="list-style-type: none"> <li>• Conserve, and restore the biodiversity of the country for well being of the present and future generations</li> <li>• Maintain and improve environmental stability for ecosystems</li> <li>• Ensure preservation of the unique biological heritage of the nation for the benefit of the present and future generations</li> <li>• Guarantee the safe passage and conservation of globally endangered migratory species, especially birds and mammals in the country</li> <li>• Stop introduction of invasive alien species, genetically modified organisms and living modified organisms</li> </ul>	Applicable for conservation of bio-diversity
National Water Bodies Protection Act, 2000	Town development authority/Municipalities	<ul style="list-style-type: none"> <li>• The characterization of water bodies as rivers, canals, tanks or flood plains identified in the master plans formulated under the laws establishing municipalities in division and district towns shall not be changed without approval of concerned ministry</li> </ul>	Applicable due to the proximity to and use of surface water bodies
The Protection and Conservation of Fish Act 1950 subsequent amendments in 1982	Ministry of Fisheries and Livestock	<ul style="list-style-type: none"> <li>• Protection and conservation of fish in Government owned water bodies</li> </ul>	Applicable for the conservation of fish as the intake and outfall point will be the canal
The Embankment and Drainage Act 1952	Ministry of Water Resources	<ul style="list-style-type: none"> <li>• An Act to consolidate the laws relating to embankment and drainage and to make better provision for the construction, maintenance, management, removal and control of embankments and water courses for the better drainage of lands and for their protection from floods, erosion and other damage by water</li> </ul>	Applicable due to the site location
Antiquities Act, 1968	Ministry of Cultural Affairs	<ul style="list-style-type: none"> <li>• This legislation governs preservation of the national cultural heritage, protects and controls ancient monuments, regulates antiquities as well as the maintenance, conservation and restoration of protected sites and monuments, controls planning, exploration and</li> </ul>	Not applicable as the study area does not have any likely cultural heritage or ancient monuments of national or international significance. However in case, any such evidence of



<b>Act/ Rule/ Law/ Ordinance</b>	<b>Enforcement Agency – Ministry/ Authority</b>	<b>Key Features</b>	<b>Applicability to proposed Project</b>
The Acquisition and Requisition of Immovable Property Ordinance 1982 and subsequent amendments in 1994, 1995 and 2004	Ministry of Land	<ul style="list-style-type: none"> <li>excavation of archaeological sites</li> <li>Current GOB Act and Guidelines, relating to acquisition and requisition of land</li> </ul>	archaeological findings arise, the Project will act in consonance to the Act Applicable
Administrative and Regulatory Guidelines and Instructions for Land Acquisition	Ministry of Land	<ul style="list-style-type: none"> <li>Regulation of land acquisition process by certain administrative instructions and procedural requirements</li> </ul>	Applicable
Framework for Leasing of Government (Khas) Agricultural Land	Ministry of Land	<ul style="list-style-type: none"> <li>The rules for allotting and leasing Government-owned (khas) land to land less families</li> </ul>	Not directly applicable but indirectly if a family becomes landless in the process of acquisition
The Building Construction Act 1952 and subsequent amendments	Ministry of Works	<ul style="list-style-type: none"> <li>This act provide for prevention of haphazard construction of building and excavation of tanks which are likely to interfere with the planning of certain areas in Bangladesh</li> </ul>	Applicable
The Factories Act, 1965 Bangladesh Labour Law, 2006	Ministry of Labour	<ul style="list-style-type: none"> <li>This Act pertains to the occupational rights and safety of factory workers and the provision of a comfortable work environment and reasonable working conditions</li> </ul>	Applicable
Ozone Depleting Substances (Control) Rules, 2004	Ministry of Environment and Forests	<ul style="list-style-type: none"> <li>Ban on the use of Ozone depleting substances</li> <li>Phasing out of Ozone depleting substances</li> </ul>	Applicable
Noise Pollution (Control) Rules 2006	Ministry of Environment and Forests	<ul style="list-style-type: none"> <li>Prevention of Noise pollution</li> <li>Standards for noise levels</li> </ul>	Applicable

**Source: Websites of DOE, Legislative and Parliamentary Affairs Division:: Bangladesh Laws and Bangladesh Board of Investment: Business laws**

### **3.6 ADMINISTRATIVE FRAMEWORK RELATED TO ENVIRONMENT IN BANGLADESH**

The Ministry of Environment & Forests (MoEF) is the nodal agency in the administrative structure of the GoB, for overseeing all environmental matters relating to national environmental policy and regulatory issues in the country. The MoEF oversees the activities of the following technical/implementing agencies:

- ✓ Department of Environment (DOE);
- ✓ Forest Department (FD);
- ✓ Bangladesh Forest Industries Development Corporation (BFIDC);
- ✓ Bangladesh Forest Research Institute (BFRI); and
- ✓ Bangladesh National Herbarium (BNH).

#### **Other Related Organizations**

There are several other organizations under the administrative framework which would govern social and environmental functions related to the proposed Project, namely:

- ✓ Forest Department;
- ✓ Ministry of Land: Land reform and land acquisition directorate;
- ✓ Ministry of Water Resources: Bangladesh Water Development Board; and
- ✓ Local Government Engineering Department (LGED)

#### **3.6.1 Department Of Environment (DOE)**

The DOE has been placed under the MoEF as its technical wing and is statutorily responsible for the implementation of the Environment Conservation Act, 1995. The Department was created in 1989, to ensure sustainable development and to conserve and manage the environment of Bangladesh.

The principal activities of the DOE are:

- Defining EIA procedures and issuing environmental clearance permits the latter being the legal requirement before the proposed Project can be implemented;
- Providing advice or taking direct action to prevent degradation of the environment;
- Pollution control, including the monitoring of effluent sources and ensuring mitigation of environmental pollution;
- Setting the Quality Standards for environmental parameters;
- Declaring Ecologically Critical Areas (ECAs), where the ecosystem has been degraded to a critical state; and
- Review and evaluation of Initial Environmental Examinations (IEEs) and EIAs prepared for projects in Bangladesh.

#### **3.6.2 Environmental Clearance Process**

As mentioned in the Section 2.3.2, ECR has classified projects to be assessed by the DOE in four categories based on the severity of impacts on IECs:

- Green: Nil;
- Orange A: minor;
- Orange B: medium; and
- Red: severe.

The applicability of Environmental clearance and the process in Bangladesh is described in Figure 3.6-1.

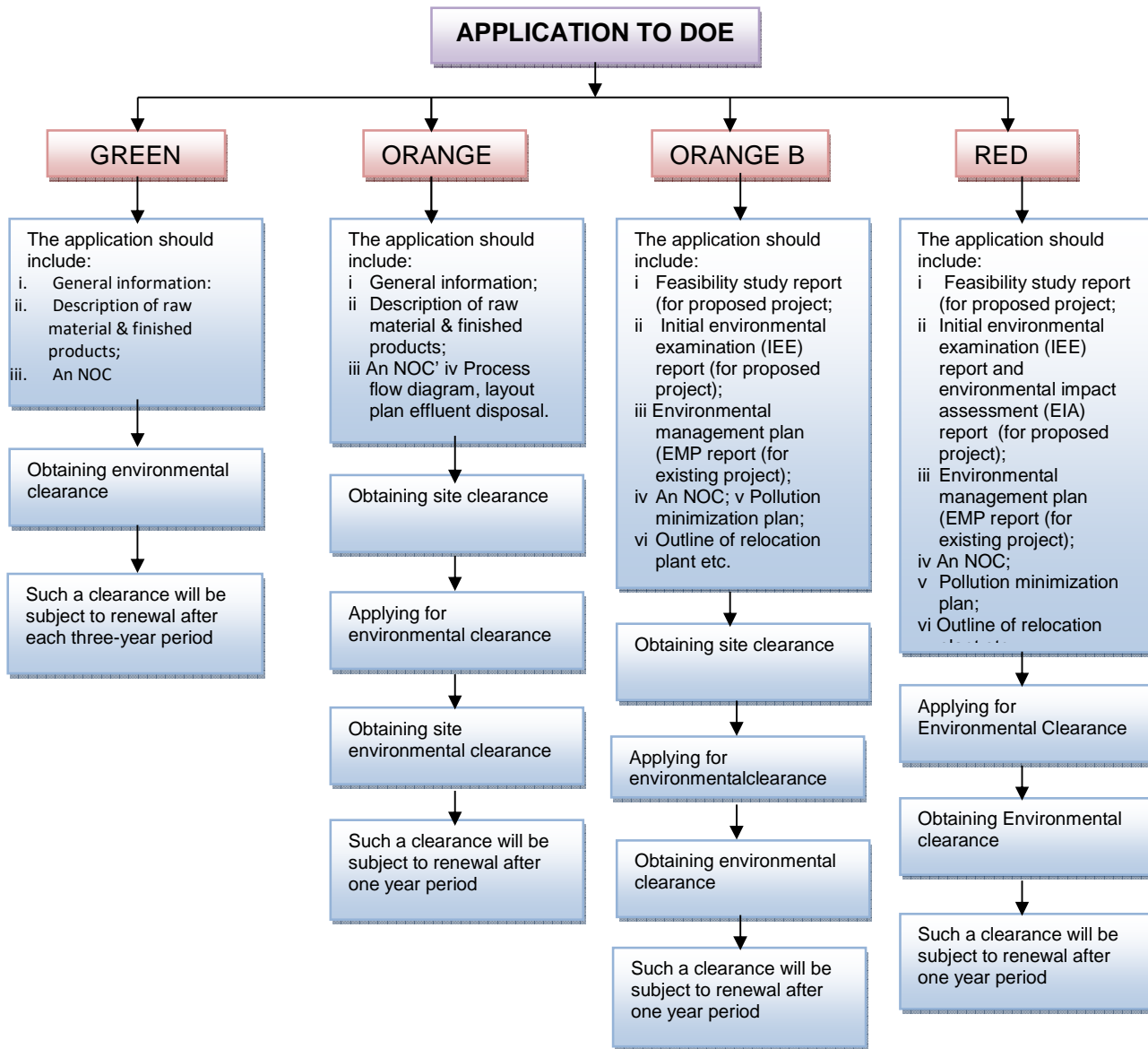


Figure 3.6-1 DOE Environmental Clearance Applicability and Procedure

The EIA process consists of three stages, screening, IEE, and detailed EIA:

- Projects categorized as Green and Orange-A requires no IEE or EIA for environmental clearance however, the proponent has to submit an application in a prescribed format along with specified documents;
- Projects categorized as Orange-B require an IEE to be submitted to the DOE along with an application in a prescribed format and other specified documents; and
- Red category projects require both IEE and EIA. An IEE is required for the location clearance and an EIA is required for the environmental clearance.

The process for obtaining an Environmental Clearance Certificate (ECC) for the proposed project is outlined in Figure 3.6-2.

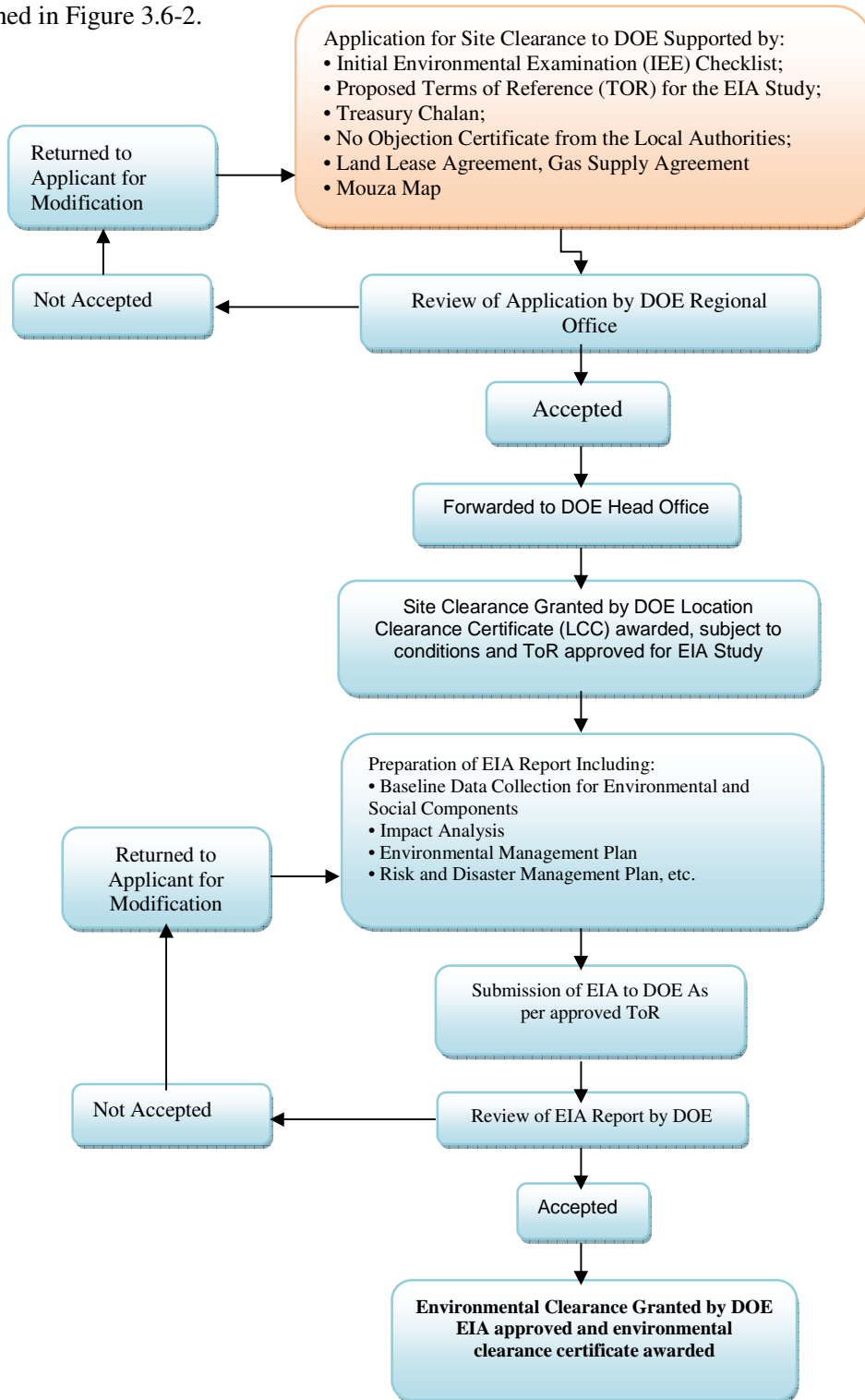


Figure 3.6-2 Flowchart of EIA Process Applicable to the Proposed Project

### **3.7 INSTITUTIONAL ARRANGEMENTS RELATED TO LAND ACQUISITION IN BANGLADESH**

The administrative set up for land acquisition has two tiers under the Ministry of Land Administration. At the Division level, there is an Additional Commissioner dealing with land administration under the Commissioner. At the district level, there is an Additional Deputy Commissioner in charge of land administration. Under him, there is at least one Land Acquisition Officer and several Assistant Land Acquisition Officers. The number of officers depends on the size of the District. Non-gazette officers in the land administration include Kanungos and surveyors.

### **3.8 COMPLIANCE WITH INTERNATIONAL REQUIREMENTS**

Bangladesh already had accessed to, ratified or signed a number of major international treaties, conventions and protocols related to environment protection and conservation of natural resources which shall have to be complied with during implementation of any project. The Environment related International conventions, protocols, treaties signed/ratified by Bangladesh are listed below.

#### **3.8.1 International Convention for the Prevention of Pollution of the Sea by Oil London, 1954 (as amended on 11 April 1962 and 21 October 1969)**

The main objective of this convention is to take action to prevent pollution of the sea by oil discharged from ships. This Convention applies to all ships, except tankers of under 150 tons gross tonnage and other ships of under 500 tons gross tonnage, registered in the territory of, or having the nationality of, a Party. Naval ships and ships engaged in whaling are also excepted (art. 2). Discharges are prohibited, except when a ship is proceeding en route or when the instantaneous rate of discharge does not exceed 60 litres per mile. The prohibition is not applicable when the following conditions are satisfied: in the case of a ship-the oil content of the discharge is less than 100 parts per million parts of the mixture, or the discharge is made as far as practicable from land; in the case of a tanker - the total quantity of oil discharged on a ballast voyage does not exceed one fifteen-thousandth of the total cargo-carrying capacity, or the tanker is more than 50 miles from the nearest land (art. 3); Exceptions to article 3 are provided in cases of necessity to secure safety of ships, save life or prevent damage to cargo, or where leakage is unavoidable and all measures have been taken to minimize it (art. 4). Ships are to be fitted within 12 months to prevent escape of oil into the bilges (art. 7). Parties undertake to provide appropriate facilities at ports and oil-loading terminals (art. 8). All ships covered by the Convention are to carry an oil record book in a form specified in the annex, to be completed whenever certain operations take place (art. 9). Parties agree to send texts of laws, decrees, orders and regulations giving effect to the Convention to the United Nations.

#### **3.8.2 Rio Declaration**

The 1992 United Nations Conference on Environment and Development (UNCED) adopted the global action program for sustainable development called 'Rio Declaration' and 'Agenda 21'.

Principle 4 of the Rio Declaration, 1992, to which Bangladesh is a signatory along with a total of 178 countries, states, "In order to achieve sustainable development, environmental protection should constitute an integral part of the development process and cannot be considered in isolation from it".

### **3.8.3 Convention on Biological Diversity, Rio de Janeiro, (1992)**

The Convention on Biological Diversity, Rio de Janeiro, 1992 was adopted on 05 June 1992 and entered into force on 29 December, 1993. Bangladesh ratified the Convention on 20 March, 1994.

The Contracting Parties of the Convention have committed to:

- Introducing appropriate procedures requiring environmental impact assessments of its proposed projects that are likely to have significant adverse effects on biodiversity, with a view to avoiding or minimizing such effects, and where appropriate allow for public participation in such procedures; and
- Introducing appropriate arrangements to ensure that environmental consequences of its programmes and policies, that are likely to have significant adverse impacts on biodiversity, are duly taken into account.

Obligation has been placed on State parties to provide for environmental impact assessments of projects that are likely to have significant adverse effects on biological diversity (art. 4).

### **3.8.4 Convention on Wetlands of International Importance especially as Waterfowl Habitat, Ramsar (1971)**

This convention is also known as the Ramsar Convention. It was adopted 02 February, 1971 and entered into force on 21 December, 1975. Bangladesh has ratified the Convention 20 April, 2002. This provides a framework for national action and international cooperation for the conservation and wise use of wetlands and their resources. There are 127 Parties with 1085 wetland sites designated as Wetlands of International Importance’.

This is an intergovernmental treaty, which provides the framework for international co-operation for the conservation of wetlands habitats. Obligations for Contracting Parties include the designation of wetlands to the ‘List of Wetlands of International Importance’, the provision of wetland considerations within their national land use planning, and the creation of Natural Reserves.

Bangladesh has two Ramsar sites- Parts of Sundarbans Reserved Forest (Southwest of Bangladesh) and Tanguar Haor (Northeast of Bangladesh).

### **3.8.5 United Nations Convention on the Law of the Sea**

This Convention was adopted on 10 December 1982 at Montego Bay, Jamaica. Bangladesh has ratified this Convention.

Main objectives of the convention are:

- To set up a comprehensive new legal regime for the sea and oceans, as far as environmental provisions are concerned, to establish material rules concerning environmental standards as well as enforcement provisions dealing with pollution of the marine environment; and
- To establish basic environmental protection principals and rules on global and regional co-operation, technical assistance, monitoring, and environmental assessment, and adoption and enforcement of international rules and standards and national legislation with respect to all sources of marine pollution.

### 3.8.6 Others (Convention and Agreements)

The following conventions and agreements may include provisions relevant to different aspects of oil and gas operations for environmental management, nature protection, and biodiversity conservation:

- Convention relative to the Preservation of Fauna and Flora in their Natural State 1933;
- International Convention for the Protection of Birds, Paris, 1950;
- International Plant Protection Convention, Rome. 1951;
- Convention concerning the Protection of the World Cultural and Natural Heritage, Paris, 1972: This convention has been ratified by 175 states. This defines and conserves the world's heritage by drawing up a list of natural and cultural sites whose outstanding values should be preserved for all humanity. Of the 730 total sites, there are currently 144 natural, 23 mixed and 563 cultural sites that have been inscribed on the World Heritage List (distributed in 125 State parties). These are the 'Jewels in the Crown' of conservation;
- Convention on International Trade in Endangered Species of Wild Fauna and Flora, Washington, 1973 (Popularly known as CITES): This provides a framework for addressing over harvesting and exploitation patterns which threaten plant and animal species. Under CITES, governments agree to prohibit or regulate trade in species which are threatened by unsustainable use patterns; and
- Convention on the Conservation of Migratory Species of Wild Animals, Bonn. 1979 (Amended 1988): This provides a framework for agreements between countries important to the migration of species that are threatened.

Bangladesh is a party to MARPOL 73/78 with all its annexes. However, the country has not enacted any enabling act to give effect to the MARPOL Convention in the domestic arena. It is completely undesirable that after a long period of signing and ratifying MARPOL and other IMO Conventions, Bangladesh is yet to enact necessary enabling domestic laws to give effect to these international legal instruments.

Along with the MARPOL, Bangladesh is party to a number (30) of international environmental convention, treaties and agreements. The Project relevant international treaties and conventions relevant to the project signed, ratified and in the process of ratification by Bangladesh are detailed in Table 3.9-1.

**Table 3.8-1 Project Relevant International Treaties and Conventions**

<u>Environment related International convention and Treaties</u>	<u>Status</u>
International Plant Protection Convention (Rome, 1951.)	01.09.78 (ratified)
International Convention for the Prevention of Pollution of the Sea by Oil (London, 1954 (as amended on 11 April 1962 and 21 October 1969.)	28.12.81 (entry into force)
Plant Protection Agreement for the South East Asia and Pacific Region (as amended) (Rome, 1956.)	04.12.74 (accessed) (entry into force)
International Convention Relating to Intervention on the High Seas in Cases of Oil Pollution Casualties (Brussels, 1969.)	04.02.82 (entry into force)
Convention on Wetlands of International Importance especially as Waterfowl Habitat (Ramsar, 1971) ("Ramsar Convention").	20.04.92 (ratified)
Convention Concerning the Protection of the World Cultural and natural Heritage (Paris, 1972.)	03.08.83 (accepted)03.11.83 (ratified)
Convention on International Trade in Endangered Species of Wild Fauna and flora (Washington, 1973.) ("CITES Convention")	18.02.82 (ratified)

<b><u>Environment related International convention and Treaties</u></b>	<b><u>Status</u></b>
United Nations Convention on the Law of the Sea (Montego Bay, 1982.)	10.12.82 (ratified)
Vienna Convention for the Protection of the Ozone Layer (Vienna, 1985.)	02.08.90 (accessed) 31.10.90 (entry into force)
Montreal Protocol on Substances that Deplete the Ozone Layer (Montreal 1987.)	02.08.90 31.10.90 (accessed) (entry into force)
London Amendment to the Montreal Protocol on substances that Deplete the Ozone Layer (London, 1990)	18.03.94 (accessed) 16.06.94 (entry into force)
Copenhagen Amendment to the Montreal protocol on Substances that Deplete the Ozone Layer, Copenhagen, 1992	27.11.2000 (accepted) 26.2.2001 (entry into force)
Montreal Amendment of the Montreal Protocol on Substances that Deplete the Ozone Layer, Montreal, 1997	27.7.2001 (Accepted) 26.10.2001 (Entry into force)
Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal (Basel, 1989.)	01.04.93 (accessed)
International Convention on Oil Pollution Preparedness, Response and Cooperation (London, 1990.)	30.11.90 (signed) In the process of ratification
United Nations Framework Convention on Climate Change, (New York, 1992.)	09.06.92 (signed) 15.04.94 (ratified)
Convention on Biological Diversity, (Rio De Janeiro, 1992.)	05.06.92 (signed) 03.05.94 (ratified)
International Convention to Combat Desertification, (Paris 1994.)	14.10.94 (signed) 26.01.1996 (ratification) 26.12.1996 (entry into force)
Convention on the Prohibition of Military or Any Other Hostile Use of Environmental Modification Techniques, (Geneva, 1976.)	03.10.79 (accessed) (entry into force)
Agreement Relating to the Implementation of Part XI of the United Nations Convention on the Law of the Sea of 10 December 1982 (New York, 1994.)	28.07.96 (signed)
Convention on the Prohibition of the Development, Production, Stockpiling and Use of Chemical Weapons and on their Destruction (Paris, 1993.)	14.01.93 (signed)
Convention on persistent Organic Pollutants, Stockholm	23.5.2001 (signed) 12.03.2007 (ratified)
Kyoto protocol to the United Nations Framework Convention on Climate Change	21.8.2001 (accessed)
International Convention for the Prevention of Pollution from Ships (MARPOL)	Adoption: 1973 (Convention), 1978 (1978 Protocol), 1997 (Protocol - Annex VI); Entry into force: 2 October 1983 (Annexes I and II)

Source: DOE

### **3.9 GAPS BETWEEN LOCAL LAWS AND JICA GUIDELINES FOR ENVIRONMENTAL AND SOCIAL CONSIDERATIONS (APRIL 2010)**

The gaps between local laws and JICA guidelines are listed considering three aspects. The aspects are:

- a) Environmental Assessment;
- b) Involuntary Resettlement; and
- c) Indigenous Peoples.

#### **3.9.1 Gaps between Relevant Regulations in Bangladesh and JICA Guidelines considering Environmental Assessment (EA)**

<b>Sl. No.</b>	<b>Features</b>	<b>JICA Guidelines</b>	<b>Government Laws</b>	<b>Gaps</b>
1.	Objectives	To ensure transparency, predictability, and accountability in its support for an	To make decisions in respect to the following: i) Whether site	The governmental laws pay less attention to



<b>Sl. No.</b>	<b>Features</b>	<b>JICA Guidelines</b>	<b>Government Laws</b>	<b>Gaps</b>
		examination of Environmental and social considerations.	clearance could be given to the project, given the residual significant project impacts on the various environmental components (physical, biological, and socio-economic); and, ii) Which conditions may be prescribed for compliance by the project proponents during design, construction, and operation of the project.	transparency, predictability, and accountability. Because the EIA is conducted within the framework of the Environmental Clearance Certificate (ECC), the EIA tends to be accepted due to its consistency with the ECC.
2.	Procedure of EA	JICA supports and examines appropriate environmental and social considerations undertaken by project proponents etc. to avoid or minimize development projects' impacts on the environment and local communities, and to prevent the occurrence of unacceptable adverse impacts. (1.4).	An EIA is conducted within the framework of the Environmental Clearance Certificate (ECC). The project proponent's application of ECC initiates the EA process.	Although overt classification used to screen the development projects exists, the procedure of EA is relatively vague because it is conducted within the framework of ECC issuance.
3.	Criteria of EA	“Environmental and social considerations” means considering environmental impacts including air, water, soil, ecosystem, flora, and fauna, as well as social impacts including involuntary resettlement, respect for the human rights of indigenous people, and so on.(1.3.1) JICA confirms that projects comply with the laws or standards related to the environment and local communities in the central and local governments of host countries; it also confirms that projects conform to those governments' policies and plans on the environment and local communities. (2.6.2) JICA confirms that projects do not deviate significantly from the World Bank's Safeguard Policies, and refers as a benchmark to the standards of international financial organizations; to internationally recognized standards, or international standards, treaties, and declarations, etc.; and to the good practices etc. of developed nations including Japan, when appropriate. (2.6.3)	i) Are the beneficial and adverse impacts properly explained? ii) What are the risks (probability of occurrence and magnitude of consequences) of adverse impacts; are they properly evaluated? iii) What impacts would the project have on environmentally sensitive areas, endangered species and their habitats, and recreational as well as aesthetic areas? iv) Is the "No Project" scenario acceptable? v) Are any of the alternative sites that are suggested in the report considered suitable from an environmental angle, though it may increase the cost of the project? vi) Did similar projects implemented earlier cause significant adverse impacts and, if so, have the present proposals incorporated adequate measures to minimize adverse impacts at the proposed	Less focus is placed on social consideration.

Sl. No.	Features	JICA Guidelines	Government Laws	Gaps
			<p>site? vii) Which are the unavoidable adverse impacts? viii) Are the concerns expressed by likely affected people genuine, and has the EIA/Initial Environmental Examination (IEE) project addressed these concerns adequately? ix) Are the mitigation measures, as proposed, reasonably feasible, and are they likely to be implemented (particularly those which have to be implemented during the operational phase)? x) What are the parameters that need to be monitored during project construction and operation so that the state of the environment can be studied throughout the project life?</p>	
4.	EA Instruments	JICA conducts an environmental review in accordance with the project category, and refers to the corresponding environmental checklists for each sector when conducting that review as appropriate.	The required documents include: feasibility report, IEE report, EIA report, Environmental Management Plan (EMP), No Objection Certificates (NOC), emergency plan, and relocation/rehabilitation plan.	No significant gaps were identified between JICA Guidelines and governmental laws.
5.	Environmental Screening	Category A: Project proponents etc. must submit EIA reports. JICA publishes the status of host countries' submission of major documents on environmental and social considerations on its website. Prior to its environmental review, JICA also discloses the following: (1) EIA reports and environmental permit certifications, (2) RAPs for projects that will result in large-scale involuntary resettlement, and (3) IPPs for projects that address issues of indigenous people. Specifically, JICA discloses EIA reports 120 days prior to concluding agreement documents. JICA undertakes its environmental reviews based on the EIA and other documents submitted by project	Industrial projects have been divided into four categories: Green, Orange-A, Orange-B, and Red, according to the environmental significance and the location of proposed development. Green projects do not require either an IEE or an EIA. At the other extreme are the Red category projects, for which both IEE and EIA are necessary.	The category equivalent to the JICA's FI Category does not exist in governmental legislation.

Sl. No.	Features	JICA Guidelines	Government Laws	Gaps
		<p>proponents etc. Category B: The scope of environmental reviews for Category B projects may vary from project to project, but it is narrower than that of Category A projects. JICA discloses the following: (1) EIA reports and environmental permit certifications, (2) RAPs for projects, and (3) IPPs for projects that will require measures for indigenous people, when these documents are submitted by project proponents etc. Category C: For projects in this category, environmental review will not proceed after categorization. Category FI: JICA examines the related financial intermediary or executing agency to see whether appropriate environmental and social considerations as stated in the guidelines are ensured for projects in this category.</p>		
6.	EA for Special Project Types	<p>JICA examines the related financial intermediary or executing agency to see whether appropriate environmental and social considerations as stated in the guidelines are ensured for projects in this category. JICA also examines institutional capacity in order to confirm environmental and social considerations of the financial intermediary or executing agency, and, if necessary, requires that adequate measures be taken to strengthen capacity. The financial intermediary or executing agency examines the potential positive and negative environmental impacts of sub-projects and takes the necessary measures to avoid, minimize, mitigate, or compensate for potential negative impacts, as well as measures to promote positive impacts if any such measures are available. (3.2.1(4)) Measures Taken in an Emergency. In an emergency-which means a case that must be dealt with immediately, such as restoration after natural disasters or post-conflict restoration-when it is clear that there is no time to follow the</p>	No specification	No specification is identified under Bangladeshi law.

<b>Sl. No.</b>	<b>Features</b>	<b>JICA Guidelines</b>	<b>Government Laws</b>	<b>Gaps</b>
		procedures of environmental and social considerations mentioned in the guidelines, JICA reports at an early stage to the Advisory Committee for Environmental and Social Considerations on categorization, judgment of emergency, and procedures to follow, and discloses a result. JICA asks advice from the Advisory Committee when it is necessary.		
7.	Institutional Capacity	JICA provides support for and examinations of the environmental and social considerations that project proponents etc. implement in accordance with Sections 2 and 3 of the guidelines, depending on the nature of cooperation projects. (1.5)	Department of Environment (DOE) has the responsibility of conducting EA within the frame of an ECC issuance.	No indication of request for external resources has been noted in the Governmental Laws.
8.	Public Consultation	Project proponents etc. consult with local stakeholders through means that induce broad public participation to a reasonable extent, in order to take into consideration the environmental and social factors in a way that is most suitable to local situations, and in order to reach an appropriate consensus. JICA encourages project proponents etc. to publicize in advance that they plan to consult with local stakeholders, with particular attention to directly affected people, in order to have meaningful meetings. In the case of Category A projects, JICA encourages project proponents etc. to consult with local stakeholders about their understanding of development needs, the likely adverse impacts on the environment and society, and the analysis of alternatives at an early stage of the project, and assists project proponents as needed. (2.4) Consultations with relevant stakeholders, such as local residents, should take place if necessary throughout the preparation and implementation stages of a project. Holding consultations is highly desirable, especially when the items to	Although providing information to local residents, community consultation, and public involvement has been recognized as important in major documents, specific legislation to implement such processes is yet to be enacted.	Significant gaps are found.

<b>Sl. No.</b>	<b>Features</b>	<b>JICA Guidelines</b>	<b>Government Laws</b>	<b>Gaps</b>
		be considered in the EIA are being selected, and when the draft report is being prepared. (Appendix 2) In the case of Category B projects, JICA encourages project proponents etc. to consult with local stakeholders when necessary. (2.4)		
9.	Disclosure	Information about the environmental and social considerations of their projects. JICA encourages project proponents etc. to disclose and present information about environmental and social considerations to local stakeholders. Project proponents etc. disclose information well in advance when they have meetings with local stakeholders in cooperation with JICA. On these occasions, JICA supports project proponents etc. in the preparation of documents in an official or widely used language and in a form understandable by local people. (2.1/1, 6,7) For Category A project, JICA publishes the status of host countries' submission of major documents on environmental and social considerations on its website. Prior to its environmental review, JICA also discloses EIA reports and environmental permit certifications 120 days prior to concluding agreement documents. JICA discloses a translated version of EIA reports, subject to approval by project proponents etc. For Category B project, JICA discloses EIA reports and environmental permit certifications, when these documents are submitted by project proponents etc. (Sec.3/3.2/3.2.1/(1), (2))	No overt requirements of information disclosure, let alone public hearings or comments. GoB passed the Environment Court Act, 2000 (Act No. 11 of 2000) to allow appeals to be made by the public on non-compliance with the ECA (1995) and ECR (1977).	No legal requirements on disclosure of information are present in government laws, while others set clear recommendations/ requirements for information disclosure; significant gaps are identified.
10.	Monitoring Implementation	JICA confirms with project proponents etc. the results of monitoring the items that have significant environmental impacts. This is done in order to confirm that project proponents etc. are undertaking environmental and social considerations for projects that fall under Categories A, B, and FI. The	There is a process of ECC renewal that requires monitoring and assessment. DOE has the responsibility of following up and monitoring ECC conditions. DOE makes the proponent compliance reports available to the public	No legal requirements on monitoring are present in government laws, while others define monitoring as a part of their assessment activities.

Sl. No.	Features	JICA Guidelines	Government Laws	Gaps
		information necessary for monitoring confirmation by JICA must be supplied by project proponents etc. by appropriate means, including in writing. When necessary, JICA may also conduct its own investigations. JICA discloses the results of monitoring conducted by project proponents etc. on its website to the extent that they are made public in project proponents etc. (3.2.2/1, 2, 7)	on its website. There are no formal provisions to obtain independent assessment of EIA reports if found necessary. There is also no formal mechanism or programme at DOE that conducts an independent audit of approved projects. Third-party monitoring is recommended through approved laboratories.	

### 3.9.2 Gaps between Relevant Regulations in Bangladesh and JICA Guidelines considering Involuntary Resettlement

Sl. No.	JICA Guidelines	Laws of Bangladesh	Gap between JICA Guidelines and Laws of Bangladesh
1.	Involuntary resettlement and loss of means of livelihood are to be avoided when feasible by exploring all viable alternatives. (JICA GL)	No formal laws, act or ordinance but common practice at the time of project formulation	There is practice but not legally bound
2.	When population displacement is unavoidable, effective measures to minimize impact and to compensate for losses should be taken. (JICA GL)	No formal laws, act or ordinance but common practice at the time of project formulation; compensation by DC as Cash compensation under law(CCL);50% premium on calculated amount	It is insufficient in terms of actual market price as replacement value
3.	People who must be resettled involuntarily and people whose means of livelihood will be hindered or lost must be sufficiently compensated and supported, so that they can improve or at least restore their standard of living, income opportunities and production levels to pre-project levels. (JICA GL)	No legal provision	Insufficient compensation, support and practice to restore pre project living standard and production level
4.	Compensation must be based on the full replacement cost as much as possible. (JICA GL)	No legal provision	Compensation is below the replacement cost
5.	Compensation and other kinds of assistance must be provided prior to displacement. (JICA GL)	No legal provision	Normally displaced before getting compensation and support
6.	For projects that entail large-scale	Not such legal bindings in the law	Though no legal provision but

Sl. No.	JICA Guidelines	Laws of Bangladesh	Gap between JICA Guidelines and Laws of Bangladesh
	involuntary resettlement, resettlement action plans must be prepared and made available to the public. (JICA GL)		practice in donor funded project
7.	In preparing a resettlement action plan, consultations must be held with the affected people and their communities based on sufficient information made available to them in advance. (JICA GL)	No such arrangement in the law, even no scope of RAP	Preparation of RAP is a social reality
8.	When consultations are held, explanations must be given in a form, manner, and language that are understandable to the affected people. (JICA GL)	No provision of consultations in the law but there is a practice of consultations in donor project	In fact when consultations held, it is clearly understandable to the affected in their local language
9.	Appropriate participation of affected people must be promoted in planning, implementation, and monitoring of resettlement action plans. (JICA GL)	No provision and guideline in law	Stakeholders normally remain in dark regarding project formulation, implementation and monitoring issues
10.	Appropriate and accessible grievance mechanisms must be established for the affected people and their communities. (JICA GL)	There is a scope of arbitration regarding payment related issues for titled owner in case of under Acquisition and Requisition of Immovable Property Ordinance(ARIPO)-1982	But this is not easy for common people and doesn't ensure compensation at the rate of full replacement cost, but for non-titled owners do not get any compensation and not get income restoration support
11.	Affected people are to be identified and recorded as early as possible in order to establish their eligibility through an initial baseline survey (including population census that serves as an eligibility cut-off date, asset inventory, and socioeconomic survey), preferably at the project identification stage, to prevent a subsequent influx of encroachers of others who wish to take advance of such benefits. (WB OP4.12 Para.6)	No provisions of early identification of affected persons, there is act in case of Jamuna Bridge Project (land acquisition)(Compensation Refusal Laws)-1994(Act No-14); for refusal of compensation of fake structure.	Cutoff date is treated Section-3 notice and SES which is later as a practice
12.	Eligibility of benefits includes, the PAPs who have formal legal rights to land (including customary and traditional land rights recognized under law), the PAPs who don't have formal legal rights to land at the time of census but have a claim to such land or assets and the PAPs who have no recognizable legal right to the land they are occupying. (WB OP4.12	No compensation for non-titled owner and squatter in the law	Vulnerable and squatter are deprived

Sl. No.	JICA Guidelines	Laws of Bangladesh	Gap between JICA Guidelines and Laws of Bangladesh
	Para.15)		
13.	Preference should be given to land-based resettlement strategies for displaced persons whose livelihoods are land-based. (WB OP4.12 Para.11)	No support in the law	Lack of legal support, but in donor supported project there is example of Resettlement Site(RS) specially for vulnerable homestead loser
14.	Provide support for the transition period (between displacement and livelihood restoration). (WB OP4.12 Para.6)	No support in the law	Lack of livelihood restoration support
15.	Particular attention must be paid to the needs of the vulnerable groups among those displaced, especially those below the poverty line, landless, elderly, women and children, ethnic minorities etc. (WB OP4.12 Para.8)	No guideline in the line	No distinction or priority in Bangladesh's law regarding vulnerability
16.	For projects that entail land acquisition or involuntary resettlement of fewer than 200 people, abbreviated resettlement plan is to be prepared. (WB OP4.12 Para.25)	No such guideline in the law	Bangladesh law is not clear

### 3.9.3 Gaps between Relevant Regulations in Bangladesh and JICA Guidelines considering Indigenous Peoples

Sl. No.	Features	JICA Guidelines for Environmental and Social Considerations (April 2010)	Government Laws	Gaps Between JICA Guidelines and Government Laws
1.	Term	No relevant statements were identified	Bangladesh national laws define only minority 'ethnic groups'.	Not applicable
2.	Characteristics of indigenous peoples		No specification under Bangladesh national laws.	Not applicable
3.	Objective	Any adverse impacts that a project may have on indigenous	No specification under Bangladesh national laws.	Not applicable



<b>Sl. No.</b>	<b>Features</b>	<b>JICA Guidelines for Environmental and Social Considerations (April 2010)</b>	<b>Government Laws</b>	<b>Gaps Between JICA Guidelines and Government Laws</b>
		<p>peoples are to be avoided when feasible by exploring all viable alternatives.</p> <p>When, after such an examination, avoidance is provided unfeasible, effective measures must be taken to minimize impacts and to compensate indigenous peoples for their losses.</p>		
4.	Screening		No specification under Bangladesh national laws.	Not applicable
5.	Categorization	<p>Projects that are likely to have a significant adverse impact on the environment and society are categorized as 'Category A' even if they are not included in the sectors, characteristic, or areas on the list. Sensitive Areas</p> <p>b) Areas inhabited by ethnic minorities, indigenous peoples, or nomadic peoples with traditional ways of life, and other areas with special social value. Projects are classified as Category B if their potential adverse impacts on the environment and society are less adverse than those of Category A projects. Generally, they are site-specific; few if any are irreversible; and in most cases, normal mitigation measures can be designed more readily.</p>	No specification under Bangladesh national laws	Not applicable
6.	Indigenous Peoples Plan	<p>For some Category A projects that will require the measures for indigenous people, an IPP must be submitted.</p> <p>It is desirable that the IPP include the elements laid out in the</p>	No specification under Bangladesh national laws.	Not applicable

<b>Sl. No.</b>	<b>Features</b>	<b>JICA Guidelines for Environmental and Social Considerations (April 2010)</b>	<b>Government Laws</b>	<b>Gaps Between JICA Guidelines and Government Laws</b>
		<p>World Bank Safeguard Policy, OP4.10,</p> <p>Annex B. JICA's funding of projects is provided to a financial intermediary or executing agency; the selection and appraisal of the sub-projects is substantially undertaken by such an institution only after JICA's approval of the funding. In such cases, JICA examines the related financial intermediary to see whether appropriate environmental and social considerations as stated in the guidelines are ensured for projects in this category. JICA also examines institutional capacity in order to confirm environmental and social considerations of the financial intermediary.</p>		
7.	Social assessment		No specification under Bangladesh national laws.	Not applicable
8.	Free, prior, and informed consultation	When the projects may have adverse impacts on indigenous peoples, efforts must be made to obtain the consent of indigenous peoples in a process of free, prior, and informed consultation.	No specification under Bangladesh national laws.	Not applicable
9.	Preparation of program and subproject IPPs	<p>In principle, JICA undertakes environmental reviews for the sub-projects prior to their implementation in a same manner</p> <p>as specified for Category A projects, if those sub-projects are likely to be under the cooperation projects.</p>	No specification under Bangladesh national laws.	Not applicable

<b>Sl. No.</b>	<b>Features</b>	<b>JICA Guidelines for Environmental and Social Considerations (April 2010)</b>	<b>Government Laws</b>	<b>Gaps Between JICA Guidelines and Government Laws</b>
10.	Disclosure	<p>Prior to its environmental review,</p> <p>JICA disclose IPPs for projects that address issues of indigenous people. Measures for the affected</p> <p>indigenous peoples must be prepared as an IPP and must be made public in compliance with the relevant laws and ordinances of the host country.</p>	No specification under Bangladesh national laws.	Not applicable
11.	Grievance procedures	<p>Appropriate and accessible grievance mechanisms must be established for the affected people and their communities.</p>	No specification under Bangladesh national laws.	Not applicable
12.	Monitoring	<p>After projects begin, project proponents etc. monitor whether any unforeseeable situations occur and whether the performance and effectiveness of mitigation measures are consistent with the assessment's prediction.</p> <p>They then take appropriate measures based on the results of such monitoring.</p>	No specification under Bangladesh national laws.	Not applicable
13.	Commercial development of natural and cultural resources		No specification under Bangladesh national laws.	Not applicable
14.	Physical relocation of indigenous peoples	<p>Involuntary resettlement and loss of means of livelihood are to be avoided when feasible by exploring all viable alternatives. When, after such an examination, avoidance is proved unfeasible, affected people must be sufficiently compensated and supported by project proponents etc. in a</p>	No specification under Bangladesh national laws.	Not applicable

<b>Sl. No.</b>	<b>Features</b>	<b>JICA Guidelines for Environmental and Social Considerations (April 2010)</b>	<b>Government Laws</b>	<b>Gaps Between JICA Guidelines and Government Laws</b>
		timely manner. Prior compensation, at full replacement cost, must be provided as much as possible.		
15.	Indigenous peoples and development	JICA makes efforts to enhance the comprehensive capacity of organizations and operations in order for project proponents etc., to have consideration for environmental and social factors, appropriately and effectively, at all times.	No specification under Bangladesh national laws.	Not applicable

## CHAPTER-4 STUDY OF ALTERNATIVE OPTIONS

### 4.1 ACCESS ROAD ROUTE SELECTION FACTORS

Identification of a suitable access road of port is very important for minimizing the plausible adverse impacts on the environment. Three options for the access road have been developed. The route selection analysis of the Matarbari Port access road has been conducted to select and recommend the most preferable route for the new sea port development among the three options. Technical, environmental and economic aspects were considered for the best site selection. Factors which were taken into account includes:

- Minimal hindrance to habitation;
- Avoidance of forest area;
- Avoidance of homestead, schools, graveyard, mosque, church/ temple, cremation yards etc.;
- Avoidance of environmental sensitive areas, historic and archaeological sites as much as possible; and
- Avoidance of areas with high geo-hazard risk.

Apart from the above factors, the following considerations were made during the route selection process:

#### **Access road Selection:**

The critical and attentive issues for selection of access road are:

- Selection of access road avoiding the following Ecologically Critical Areas: Human Settlements, Forest Sanctuaries, National Parks, Game Reserves, Mangroves, Forest Areas, Wetlands, Wildlife Habitats, Archaeological Sites, Ancient Monument Sites, Biodiversity Areas and Similar Other Areas.
- Considering and weighing up these issues, the preferred route was selected out of the three options.

#### **Preference of Non-productive Land:**

- The non-productive land as an alternative just near the proposed agriculture land is preferable for environmental soundness.

### 4.2 BASIC DESIGN CONCEPT

#### 4.2.1 Available National Road

National Highway No. 1 (N1) and Regional Highway No. 170 (R170) run in parallel along the coastal line as the north-south directional axes for both passenger and freight transport routes in Southern Chittagong Region. Only the N1 would be the available arterial road in the Chittagong region for using it as a freight transport route from Matarbari Port to the north for the following reasons.

- N1 is one of the most important arterial roads in Bangladesh and the section from Chittagong to Cox's Bazar is currently 2-lane. RHD has planned to improve the highway to 4-lane or 6-lane in the future.
- R170 has better alignment than N1 but the roadway and ROW widths are narrow (5.5 m carriageway for 2-lane) and has more difficulty in improvement to 4 to 6 lane highway due to the

settlement of houses and buildings outside of ROW. Also, the elevation of R170 is lower than flooding or storm surge levels, whereas that of N1 is higher than it.

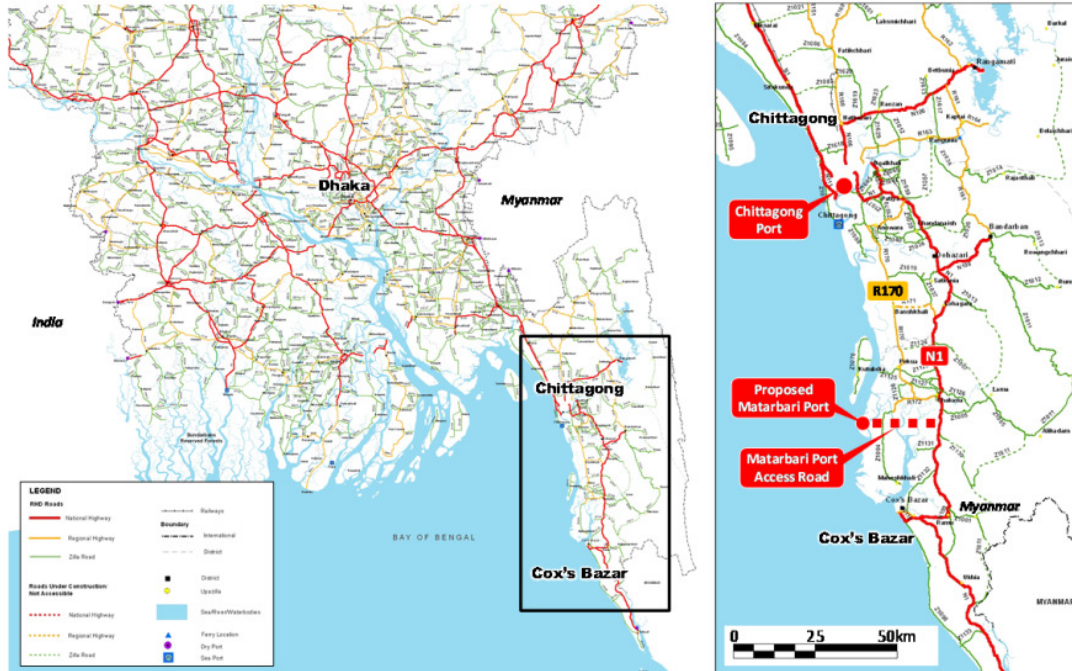


Figure-4.2-1 Existing Route Network of the Chittagong Region

#### 4.2.2 Accessibility from Matarbari Port to N1

Considering that the proposed location of the Matarbari Port is distant from N1 approximately 22 km in direct distance, a new access road is necessary to be constructed in consideration of the following:

- Minimize resettlement of houses and acquisition of private land in order to implement the project smoothly.
- Avoid protected areas and public facilities such as school, hospital, mosque etc. in order to minimize social and environmental impacts.



#### 4.2.3 Accessibility to Chittagong through N1

The traffic volume<sup>1</sup> on N1 between Chittagong and Cox's Bazar has been reaching its traffic capacity especially at the section through towns, which exist along the highway. As RHD has planned to improve N1 to be 4 to 6 lanes highway, improvement of N1 is indispensable for providing smooth freight transport from Matarbari Port. One of the most critical issues for improvement of N1 would be the section through towns where traffic congestions are often occurred.

Table 4.2-1 Comparison of National and Regional Highways in the Region

	Regional Highway No. 170	National Highway No. 1
Carriageway Width	5.5 m (2.75 m x 2)	7.2 m (3.65 m x 2)
ROW Width	Approximately 10 m	Approximately 30 m

<sup>1</sup> The annual average daily traffic (AADT) on N1 (between Chittagong to Cox's Bazar) is currently 6 to 16 thousand vehicles.

Widening Plan	<b>None</b>	Detailed design completed and waiting for financial assistance
Elevation	<b>Lower</b> than flooding/storm surge levels	<b>Higher</b> than flooding/storm surge levels
Easiness of Widening	<b>Difficult: due to large scale social impact</b>	<b>Easy: within current ROW</b>
Photo		
Evaluation		<b>Recommended</b> for port access road connection as the freight transport route

### 4.3 ROUTE SELECTION

Evaluation of the access road alignment was made by 2-step evaluation method.

- Step-1: Evaluation of route from regional level road planning view point; and
- Step-2: Detailed evaluation of alignment in consideration of current land use.

#### 4.3.1 Evaluation of Route

Three alternative route options were considered at the first step of the route selection and the following findings were identified:

- **Route Option A:** It has advantage to provide good accessibility to the north but requires land acquisition of many private lands, which has a risk of delay of project implementation;
- **Route Option B:** It has advantage to avoid environmentally protected area and majority of land along the route would be owned by government. But the route has more social environmental impact than the Route Option C.;
- **Route Option C:** It has advantage to minimize construction cost and social environmental impact and majority of land along the route would be owned by government. But the route has more natural environmental impact than the Route Option B.

As the result of the discussions among concerned ministries and agencies, it was decided that the Route Option B should be selected because the following reasons:

- Cutting of Moheshkhali Hill need the approval of Prime Minister's Office and the approval process may take time, which is a risk of delay of project implementation; and
- As the Government of Bangladesh prohibits cutting hills, conservation of natural environment is a national concern. So, natural environmental impact should be minimized.

However, it was noted that further detailed engineering studies for the Route Options B and C should be made for final justification of the route selection.

Matarbari Port Development Project is a Fast Track Project of Bangladesh Government and early implementation is required. Land acquisition is one of the critical factors for smooth implementation of



the project and the alignment of the access road should minimize the impact for such private lands and settled areas as much as possible. Thus the Route Option A, which is the longest access road length and 55% of the lands on the alignment are privately owned, is not preferable.

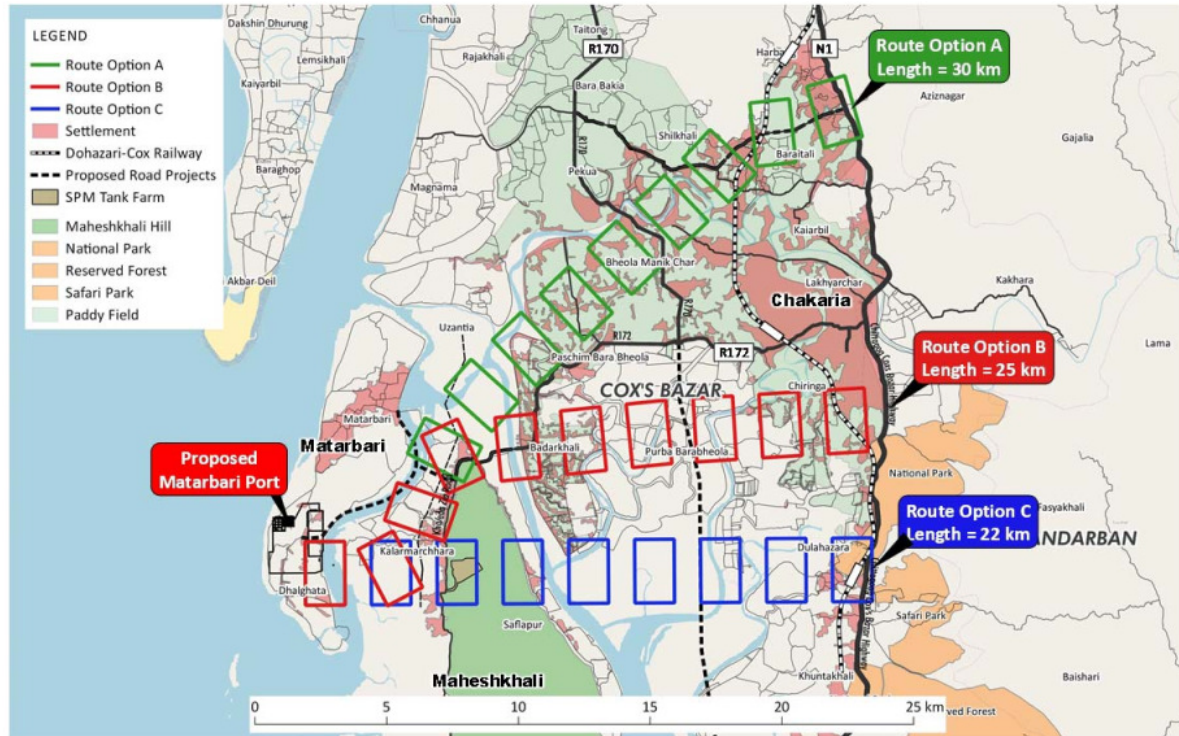


Figure 4.3-1 Three Route options of the Port Access Route

Although, Moheshkhali Hill is not registered as an environmentally protected area, it is recognized as a hilly area where permission by Prime Minister’s Office is required for hill cutting. As the result of the discussion among Ministry of Shipping (MOS), Ministry of Road Transport and Bridges (MORTB) and concerned agencies, it was decided that the cutting of Moheshkhali Hill should be avoided for the Matarbari Port Access Road construction because the application for the hill cutting would take time and it would cause delay of the project implementation. Thus the Route Options C, which passes through Moheshkhali Hill, is not preferable.

Coal Power Generation Company Bangladesh Limited (CPGCBL) is currently constructing a power plant in Matarbari Island at the north of the proposed Matarbari Port area. The scope of the power plant construction project includes construction of an access road, which is the improvement of existing roads between Matarbari and National Highway No. 1. But this access road improvement project will involve a lot of resettlement of houses and the scale of the social impact is very high. Considering that the alignment of Route Option B has a good accessibility to both the Matarbari Port and the CPGCBL’s Power Plant with less social impact than the proposed power plant access road, the required functions of the proposed two access roads can be built together with the alignment of this route.

However, the alignment of the Route Option B will pass through a relatively high-density populated area in the north of Moheshkhali and Badarkhali Bazar. It should be considered to minimize the scale of social impacts such as the number of resettlement of houses and community severance.



The most critical issue for the Route Option C is whether cutting Moheshkhali Hill is allowed or not (Table 4.3-1). Until final confirmation of the environmental status of the hill, further detailed engineering study for both Route Option B and C should be made for the final justification of the access road route.

Also, the traffic congestion of N1 at the section in Chakaria Town should be considered for freight transport planning. The freight transport route through the Route Option B and C to the north such as Chittagong and Dhaka will pass through the section and severe traffic congestion would be expected. Even though RHD has a plan to improve the section to be 4-lane or 6-lane, it would be difficult to provide smooth traffic. Therefore, drastic improvement of the highway such as construction of bypass road or flyover should be considered.



There are Slow Moving Vehicle (SMV) lanes on both sides of N1 and the SMV lanes are often congested severely.



SMV and pedestrians also use the 2-lane through traffic lanes at the center of the road and there are some parking vehicles on the lane.

Photo 1 Traffic Situation of N1 in Chakaria Town

#### **4.3.2 Detailed Evaluation of Alignment for Route Option B**

The available space for the Route Option B is limited due to the settlement in Chakaria especially at the area near N1 and the existence of many water channels. Basically the alignment can be designed by avoiding settled area but it needs to pass through the high-density settled area in Badarkhali and the north of Moheshkhali. Therefore, comparative analysis of alignments was done especially at this section.

As the result of the comparison of three alternative alignments, the Route Option B-1 was evaluated as the optimal alignment for the Route Option B because of the following reasons:

Route Option B-1 can cross the proposed railway to Matarbari Port at the same elevation but the others need grade separation, which need at least 1 km-long viaduct costing more than US\$ 60 mil.

Route Option B-1 has the largest social impact but the construction cost is the minimum.

Construction of the railway connection to Matarbari Port is also under feasibility study and the most provable plan is the construction of marshaling yard in Moheshkhali in between SPM pipeline and Zila Road No.1004. Therefore, the Matarbari Port Access Road needs to be aligned on the river side of SPM pipeline.

Currently two alternative railway route options are studied by the consultant. The railway crossing should be at-grade because the railway will have 8.5 m vertical clearance and grade separation will need approximately 1 km-long viaduct. The Route Option B-1 can cross the railway at-grade because of its cross angle is 60 degree and has certain distance from the bridge section. But the Route Option B-2 and B-3 will have shallow angle with the railway and at-grade crossing would be difficult.

Table 4.3-1 Comparison of Route Options

Route Options		Route Option A		Route Option B		Route Option C	
<b>Characteristic</b>							
Road Length		30 km		25 km		22 km	
Length of River Crossings		3.5 km		5.4 km		5.0 km	
Land Use		Private Land: 16 km Government Land: 14 km		Private Land: 7 km Government Land: 18 km		Private Land: 2 km Government Land: 20 km	
Location of Intersection with N1		Baritali Road (Z1125) About 8 km north of Chakaria		Fasiakhali About 4 km south of Chakaria		Dulahazara About 8 km south of Chakaria	
Affected Buildings		More than 150		Less than 100		Less than 100	
Evaluation Factor	Weight		Score		Score		Score
Efficiency for Freight Transport	3	<ul style="list-style-type: none"> <li>• Shortest route to the north (Chittagong, Dhaka).</li> <li>• Traffic congestion of N1 in Chakaria town center is not a problem.</li> <li>• The best option if N1 will not be improved to 4 or 6 lanes.</li> </ul>	5 (15)	<ul style="list-style-type: none"> <li>• Shortest connection to N1 with avoiding Moheshkhali Hill.</li> <li>• Traffic congestion of N1 will be the problem for smooth freight transport.</li> <li>• If N1 will be improved, the above disadvantage will be solved.</li> </ul>	3 (9)	<ul style="list-style-type: none"> <li>• Shortest connection to N1.</li> <li>• Traffic congestion of N1 will be the problem for smooth freight transport.</li> <li>• If N1 will be improved, the above disadvantage will be solved.</li> </ul>	3 (9)
Regional Road Network Connectivity	3	<ul style="list-style-type: none"> <li>• The section in Moheshkhali will be a part of the main road of Matarbari/Moheshkhali Development Plan.</li> <li>• Good accessibility to Port and Power Plant.</li> </ul>	5 (15)	<ul style="list-style-type: none"> <li>• Same as Route Option A</li> </ul>	5 (15)	<ul style="list-style-type: none"> <li>• Good accessibility to Port only.</li> </ul>	4 (12)
Traffic Safety	1	<ul style="list-style-type: none"> <li>• The route passes through settled areas in Chakaria and a lot of local traffic (mainly SMVs) will use this road.</li> <li>• Traffic safety measure is required.</li> </ul>	3 (3)	<ul style="list-style-type: none"> <li>• Intermediate between Route Option A and C</li> </ul>	4 (4)	<ul style="list-style-type: none"> <li>• The route passes through mainly on salt area (or shrimp farm) and not so much local traffic will use this road.</li> <li>• Not much traffic safety measure is required.</li> </ul>	5 (5)
Constructability	6	<ul style="list-style-type: none"> <li>• There are many crossing roads and easy to access to the construction site.</li> </ul>	5 (30)	<ul style="list-style-type: none"> <li>• There are few crossing roads and difficult to access to the construction site.</li> </ul>	3 (18)	<ul style="list-style-type: none"> <li>• There are few crossing roads and difficult to access to the construction site.</li> </ul>	3 (18)
Social Environmental Impact	6	<ul style="list-style-type: none"> <li>• Over 150 buildings need to be relocated.</li> <li>• Community severance at many locations will be occurred.</li> </ul>	1 (6)	<ul style="list-style-type: none"> <li>• The number of affected buildings is less than Route Option A.</li> <li>• Community severance at few locations will be occurred.</li> </ul>	3 (18)	<ul style="list-style-type: none"> <li>• The number of affected buildings is less than Route Option B.</li> <li>• Community severance at few locations will be occurred.</li> </ul>	5 (30)
Natural Environmental Impact	6	<ul style="list-style-type: none"> <li>• Not much impact</li> </ul>	5 (30)	<ul style="list-style-type: none"> <li>• Not much impact</li> </ul>	5 (30)	<ul style="list-style-type: none"> <li>• Cutting Moheshkhali Hill</li> </ul>	1 (6)
Project Implementation	10	<ul style="list-style-type: none"> <li>• Land acquisition may take time.</li> </ul>	1 (10)	<ul style="list-style-type: none"> <li>• There is no critical issue for this route.</li> </ul>	5 (50)	<ul style="list-style-type: none"> <li>• Hill cutting permission may take time.</li> </ul>	3 (30)
Evaluation			<b>109</b>	<b>Recommended</b>	<b>144</b>		<b>110</b>

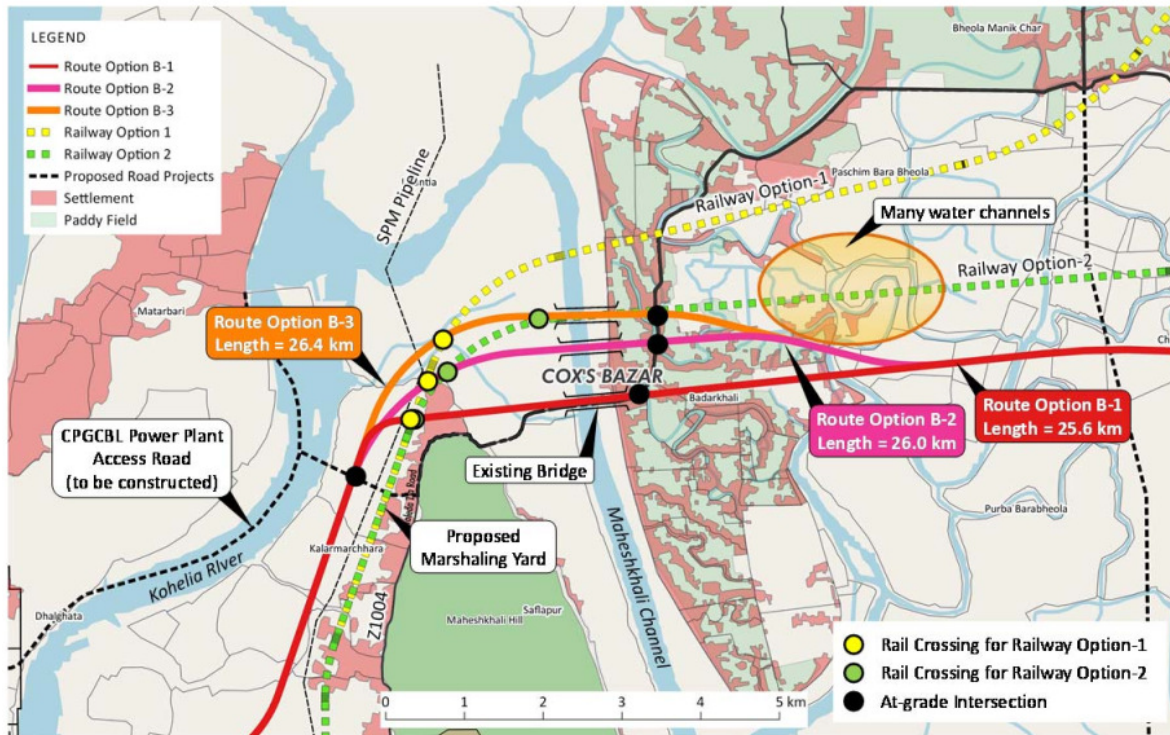


Figure 4.3-2 Detail Evaluation of Route Option B

Also, the project implementation schedules of the Matarbari Port Access Road and the railway are different and the Access Road Project is more urgent. It is important to secure the flexibility of design so that grade separation of railway crossing should be avoided.

Table 4.3-2 Comparison of Alternative Alignments for Route Option B

Characteristics	Route Option B-1	Route Option B-2	Route Option B-3
Road Length	25.6 km	26.0 km	26.4 km
Bridge Length	4.4 km	4.6 km (+ 1 km)	4.0 km (+ 1 km)
Affected Buildings	88	64	42
Compatibility with Railway Project	At-grade railway crossing (10 m MSL)	Grade separated railway crossing with 1 km-long viaduct (22 m MSL)	Grade separated railway crossing with 1 km-long viaduct (22 m MSL)
Construction Cost	Base Case	+ US\$ 70 mil.	+ US\$ 45 mil.
Evaluation	Recommended		

### 4.3.3 Detailed Evaluation of Alignment for Route Option C

Three (3) alternative alignments for Route Option C were considered by avoiding SPM Tank Farm and the environmentally protected areas near N1. Considering the following, the Route Option C-1 was evaluated as the optimal alignment for the Route Option C.

- The location of the intersection with N1 is distant from environmentally protected area.
- Freight traffic to the north will not pass through the section of environmentally protected area.
- Construction cost is minimal and affected buildings are few.

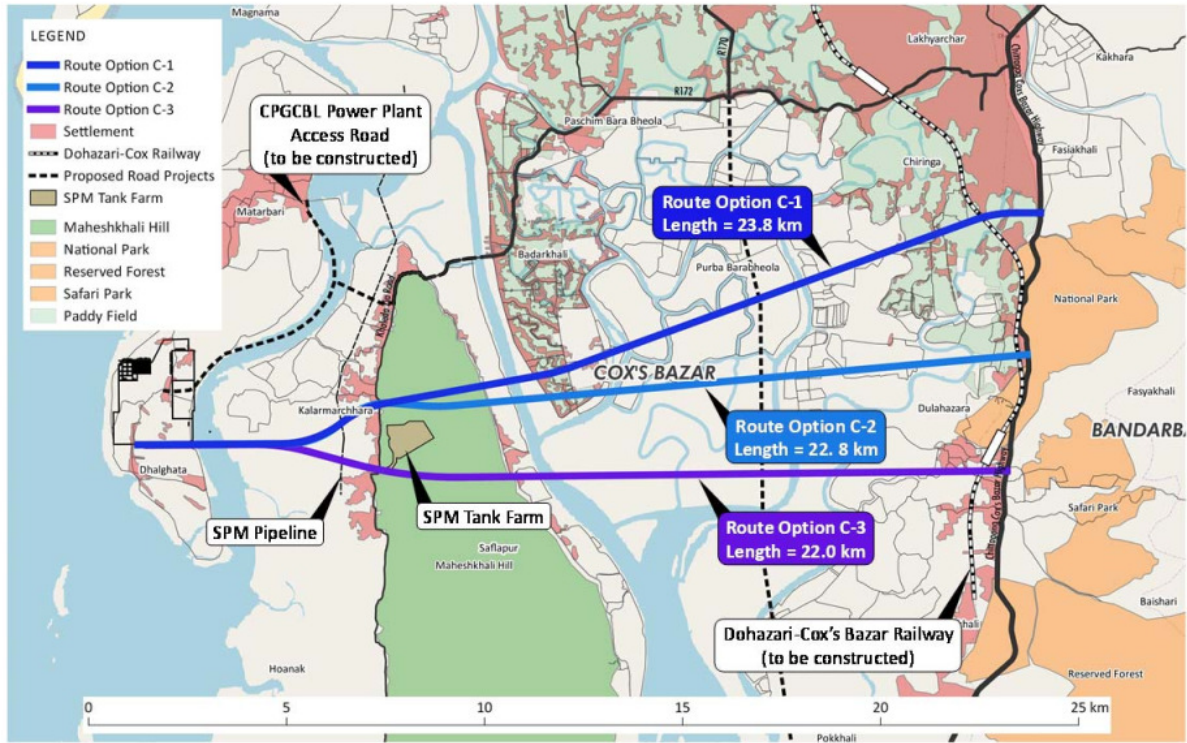


Figure 4.3-3 Detail Evaluation of Option C

New road development will attract housing and commercial developments along the road and the alignment of the access road should avoid the reserved forests, national parks and safari parks in order to preserve the natural environmental conditions. The ending point of the Route Option C-1 at the intersection with National Highway No.1 is distant from the environmental protected area.

Table 4.3-3 Comparison of Alternative Alignments for Route Option C

Characteristics	Route Option C-1	Route Option C-2	Route Option C-3
Road Length	23.8 km	22.8 km	22.0 km
Bridge Length	5.0 km	5.5 km	5.2 km
Intersection with N1	Near Fasiakhali Army Camp	Near Reserved Forest & Railway Crossing	Near proposed Dulahazara Railway Station
Affected Buildings	57	45	74
Construction Cost (Rate)	1.00	1.05	1.03
Evaluation	<b>Recommended</b>		

#### 4.3.4 Detailed Comparative Analysis of Route Option B-1 and C-1

Even though the Route Option B was selected, the following two (2) alignments was further evaluated based on the detailed data of topographic map created by high-resolution satellite image and geotechnical investigation results, for final justification of the route.

- Route Option B-1
- Route Option C-1



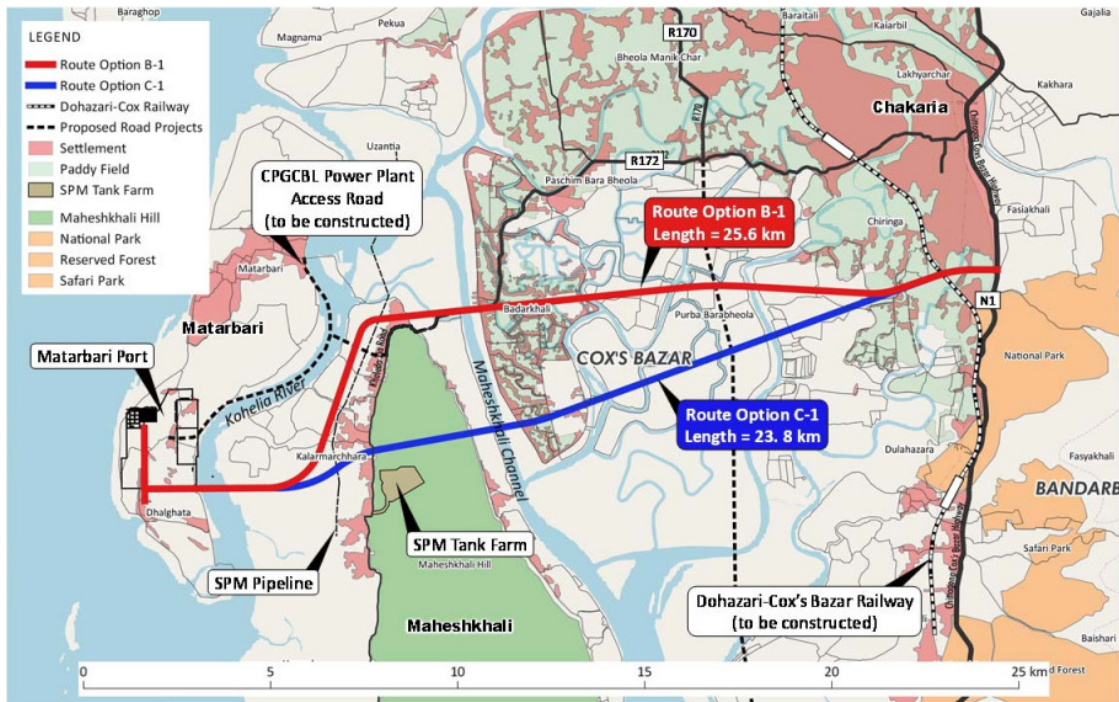


Figure 4.3-4 Comparison of Option B-1 and Option C-1

It has finally decided that the option B-1 would be the scope of this EIA study.

### 4.3 SELECTION OF BEST OPTION

In a nutshell the **Option-B1** has been selected as the best option comparing the other options because of the following characteristics:

- ⇒ Comparatively less private land will be affected due to the project;
- ⇒ Would be much closer to the Chakaria in the Chittagong-Cox's Bazar Highway;
- ⇒ Would be efficient route for the freight transporting;
- ⇒ Much better in traffic safety;
- ⇒ Port connecting road construction activities would be much easier;
- ⇒ Less no. of settlement will be affected
- ⇒ No cultural property will be affected by the selected port option
- ⇒ Loss of productive land will be minimum and will not impact the national economy
- ⇒ Cumulative and long-term effect seems to be insignificant
- ⇒ Effect on Fish yielding capacity would be insignificant
- ⇒ No significant forest area would be affected due to the selected port option
- ⇒ Loss of indigenous species would be insignificant
- ⇒ Loss of biodiversity would be insignificant

## **CHAPTER-5 ENVIRONMENTAL AND SOCIAL BASELINE**

### **5.1 INTRODUCTION**

The environmental and social baseline description has been prepared using both primary and secondary data collected for the study area defined 2.5 km buffer areas from the proposed Matarbari Port Access road. The baseline condition has been delineated in respect of physical environment (e.g. including meteorological, hydrological, morphological components and processes), land resources (e.g., including land use pattern and soil quality), biological environment (e.g., including flora, fauna, fisheries resources and other ecosystems goods and services), socio-economic condition (e.g., including livelihood patterns, historical, cultural and archaeological sites, economic status, etc.) and hazardous events of the study area.

Mainly there are two principal objectives in examining and defining the existing environment:

- To recognize potential environmental impacts of the Project and enable mitigation measures to be identified; and
- To provide a baseline against which environmental conditions can be measured throughout the Project lifetime.

### **5.2 PROJECT AREA**

The proposed Matarbari Port Access road project is confined within Chiringa, Fasiakhali, Saharbil, Paschim Bara Bheola and Saharbil Union of Chakaria upazila and Kalarmarchhara, Dhalghata and Saflapur Union of Moheshkhali Upazila of Cox's Bazaar District. Figure-5.2-1 shows the location of the port access road area.

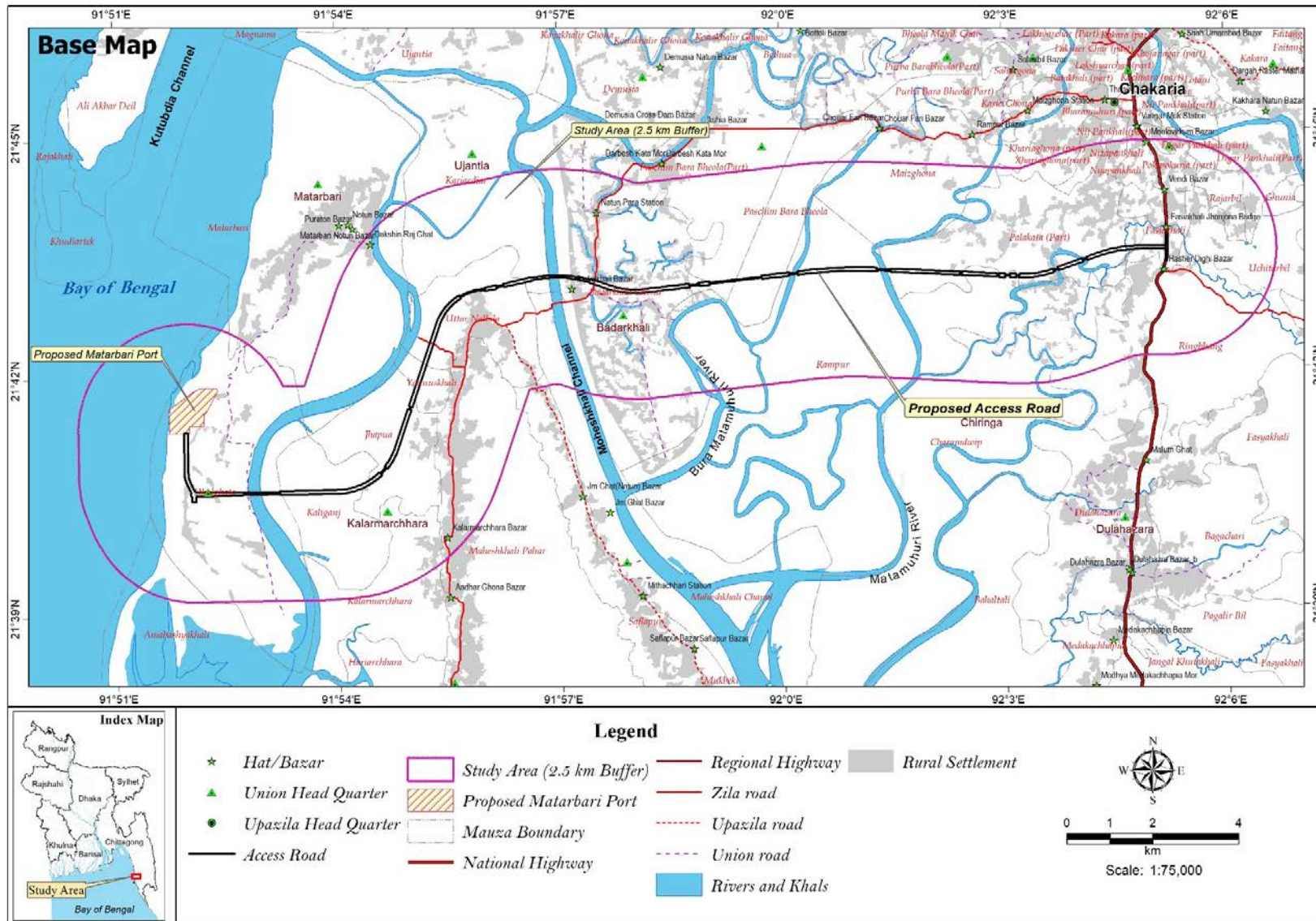


Figure-5.2-1: Location of the Access Road

### 5.3 OBJECTIVES AND METHODOLOGY

The primary objective of the environmental and social baseline condition study is to provide an environmental and social baseline against which potential impacts from the operation of Matarbari Port Access road can be compared. The geographical boundary of the "Project Area" and the Potential "Impact Area" is delineated as a requirement of the environment assessment study. The "Project Area" is the physical location of the proposed Matarbari Port Access road (90m wide and 26.975 km long) while the "Impact Area" covers the geographical extent of the environmental and socioeconomic impacts resulting from implementation of the proposed access road during pre-construction, construction and post-construction periods. It is recognized that the benefits of the proposed port will extend to the national scale. However, the focus of the EIA study of the proposed Matarbari Port Access road will be limited to the area where the physical impacts of the activity will be directly felt.

The methodology adopted for collecting the baseline data was as follows:

- Study area of 2.5 km radial zone from the center of the access road location was selected for the baseline studies.
- Primary data collection was through environmental monitoring and field survey for water, air and noise.
- Social baseline of the study area was captured through social surveys involving field consultations, interviews, meeting with stakeholders, discussions with government departments and secondary data review etc.
- Secondary data was collected from government reports, academic institutes, websites, published literature, interactions with government department and stakeholders etc.

### 5.4 LAND USE AND LAND COVER OF THE STUDY AREA

An overview of the land use and land cover pattern has been prepared based on the satellite images and presented using Geographical Information System (GIS). The total land of the study area is 15,317 hectares. The land cover of the study area is derived from multi-spectral color Rapid Eye satellite images. The major classes extracted from the images are as follows: agricultural land, char land/sandbars, forest, industrial area, road, rural settlement with homestead vegetation, built-up area and water bodies. **Figure 5.4-1** shows the detailed general land use map of the study area.

The study area is mostly surrounded by Salt Pan (5996.2 ha, which is 39.1% of the total area) followed by Aman and Boro of 11.6% and rural settlement with homestead vegetation of 10.5%. Total land of the project area is about 243.4 ha which is mainly covered by salt pan. The detail area coverage of each class and sub class is given in the **Table-5.4-1**.



Table 5.4-1: Land Covers Classification

Major Class	Sub-Class	Study Area (ha)	(%)	Project Area (ha)	(%)
Agricultural Land	Salt Pan	5996.2	39.1	155.9	64.1
	Aman	1191.1	7.8	6.5	2.7
	Aman and Boro	1772.1	11.6	32.0	13.2
	Brackish Water Aquaculture	1543.9	10.1	16.6	6.8
Settlement	Rural Settlement with Homestead Vegetation	1612.6	10.5	17.0	7.0
Forest Land	Forest/Plantation	258.1	1.7	-	-
	Herb-Shurb with Scattered Trees	507.1	3.3	-	-
	Mangrove	229.4	1.5	3.6	1.5
	Mixed Hill Forest	75.7	0.5	-	-
Water Bodies	Pond	1.6	0.0	1.2	0.5
	Rivers and Khals	1854.2	12.1	8.8	3.6
	Baor	22.6	0.1	-	-
Other Land Uses	Sand	59.0	0.4	-	-
	Inter Tidal Area	195.0	1.3	1.7	0.7
<b>Total</b>		<b>15318.8</b>	<b>100.0</b>	<b>243.4</b>	<b>100.0</b>

*Source: Satellite image analysis*

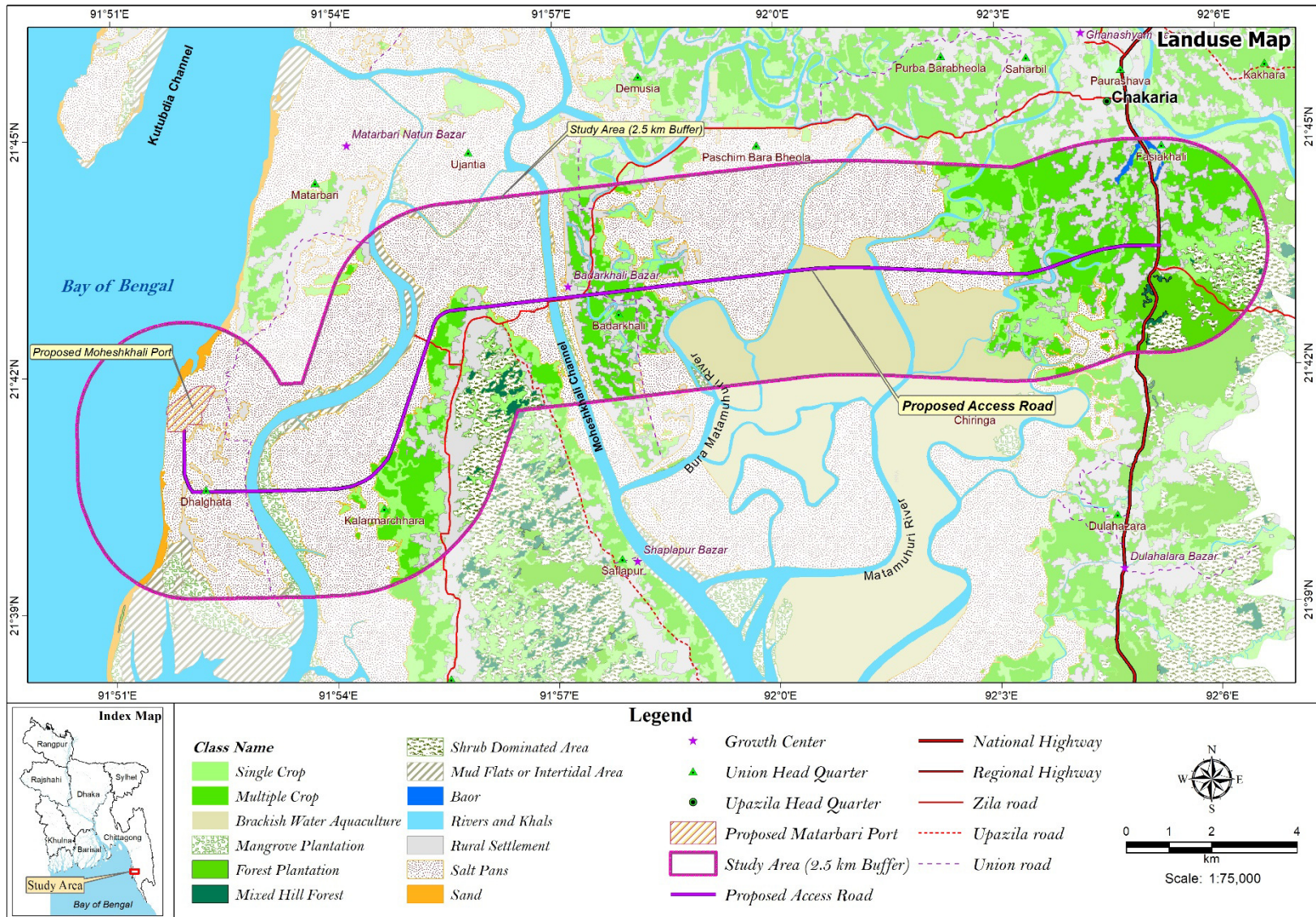


Figure 5.4-1: General Land Use Map (Satellite image of January 2018)

## 5.5 PHYSICAL ENVIRONMENT

### 5.5.1 Landscape and Topography

The proposed Matarbari Port Access road is located at the Cox's Bazar coastal area where the land is gently sloped towards the sea. From digital elevation model (DEM) analysis it is found that the Project area is located over a land which is 1.5m to 6.0m PWD (**Figure-5.5-1**). Land elevation increases towards the hills and decreases towards the Bay of Bengal. Most of the communities reside near the foot hill areas occupied by crop cultivable land to the lower areas. The shrimp farm or salt farms of this area are regularly flooded by tidal flooding. The slope of the western part of the proposed Project site is very mild towards the sea.

### 5.5.2 Climate and Meteorology

#### 5.5.2.1 Background

In order to investigate the climatic condition of the project area different meteorological parameters have been collected from multiple secondary sources. The proposed Matarbari Port Access road falls under tropical climate. Basically this region has a distinct monsoonal season which influences all other climatic parameters. **Figure-5.5-2** shows the location of the study area in the climatic sub-regions of Bangladesh.

The ambient mean temperature of the study area is found as 19°C-20°C in winter and 27°C-28°C in summer. On the other hand, the annual average rainfall in this region varies from 2500 mm – 3000 mm, which is relatively higher than the western areas of the county. Southwest monsoon occurs in this region from June till September; during this period heavy rainfall takes place for which the project area experiences tidal and coastal flood.

Besides, tropical storms i.e. Kalbaishakhi and cyclone occur during summer in the month from April to June and then from September to December. These cyclones occur almost every year in the Chittagong coastal areas with varied intensity and magnitude.

The study area falls in the South-Eastern climatic zone of Bangladesh. Meteorological data for the last thirty years was collected from the nearest BMD stations in Kutubdia (BMD Station ID: 11925) which is analyzed to get the overall micro-climatic conditions of the study area. **Figure-5.5-3** shows the nearby meteorological station of the project area. Summary of the analysis of climatic parameters is given in the following sections.



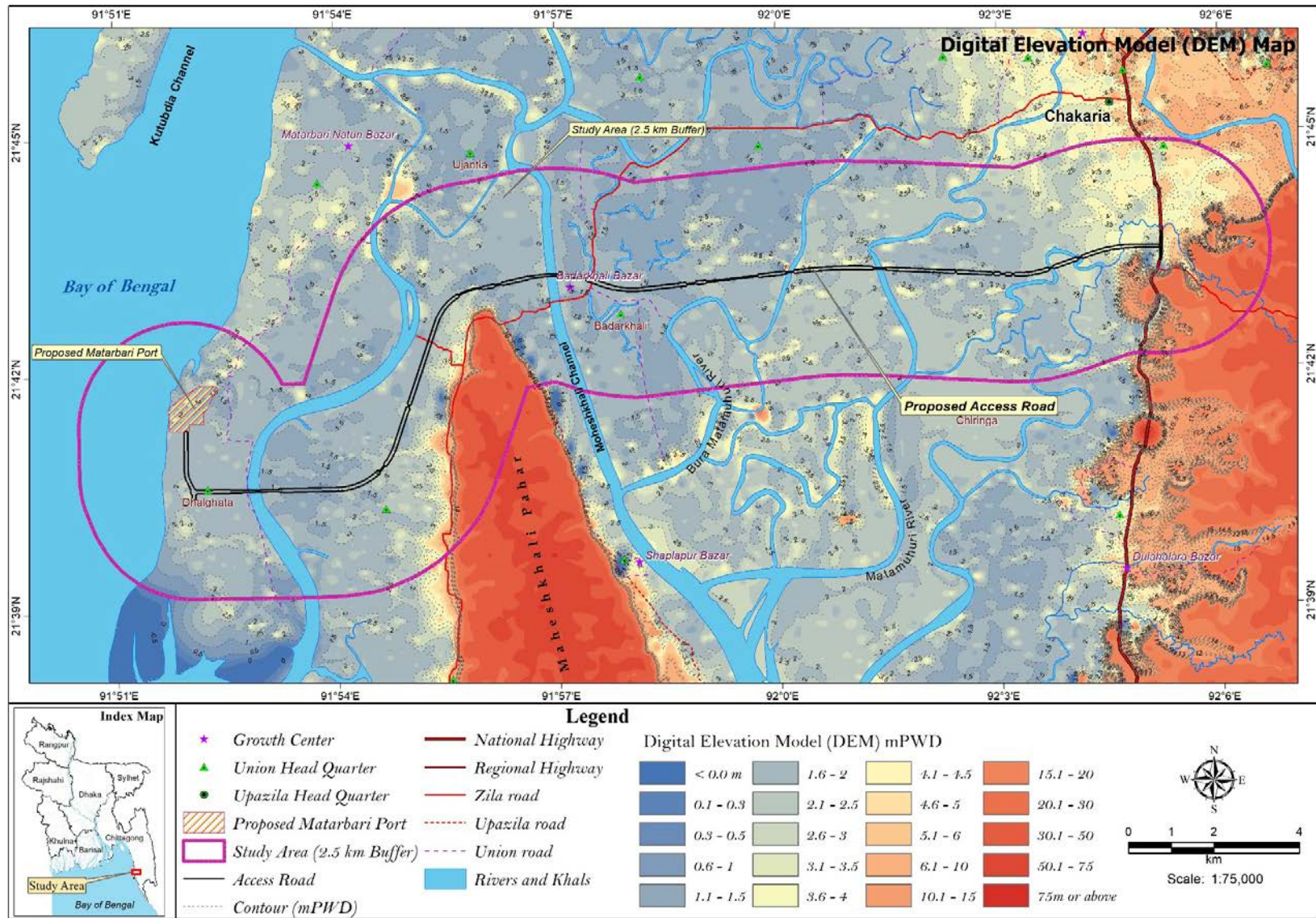


Figure-5.5-1 Digital Elevation Model of the Project Area

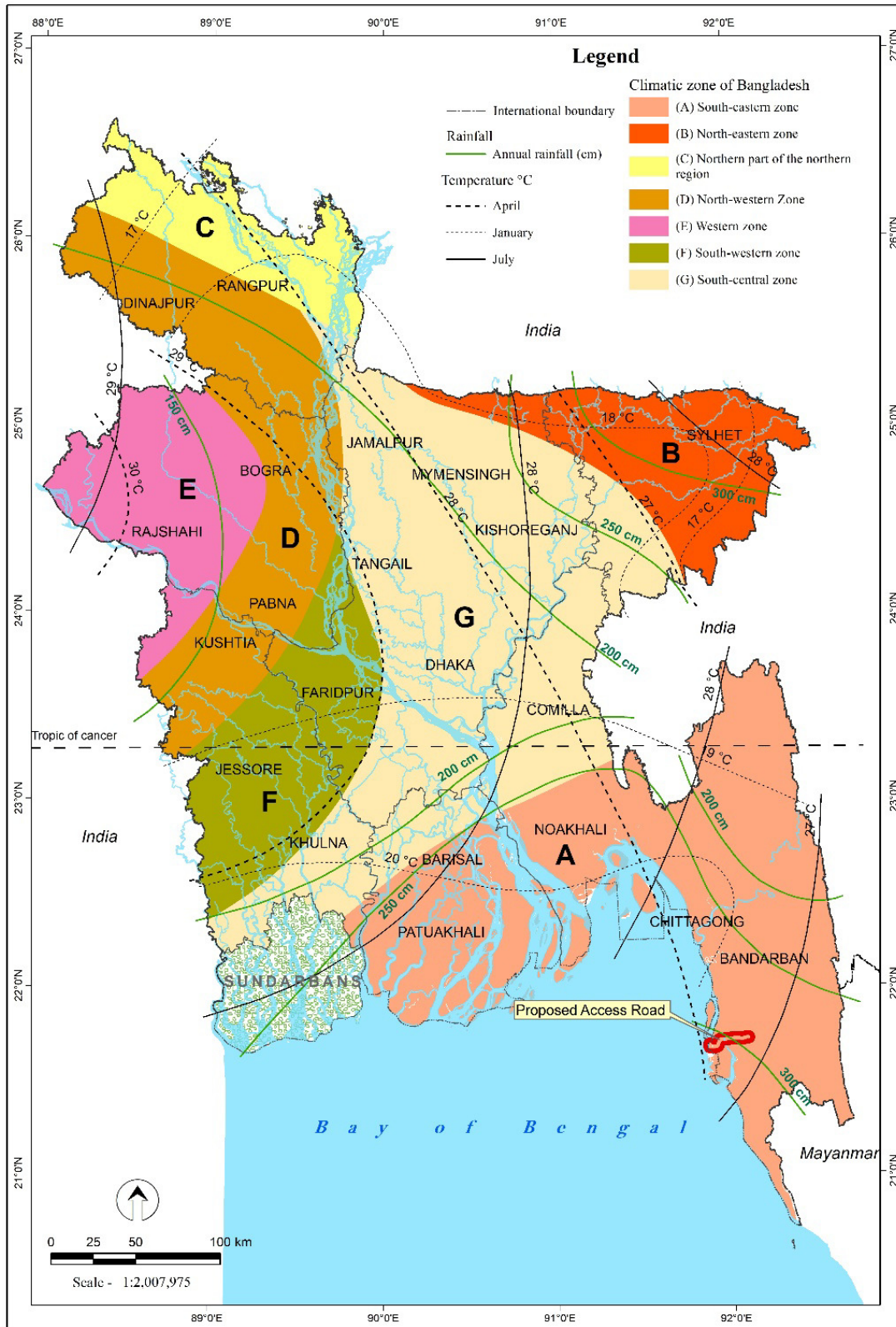


Figure-5.5-2 Climatic sub-regions of Bangladesh



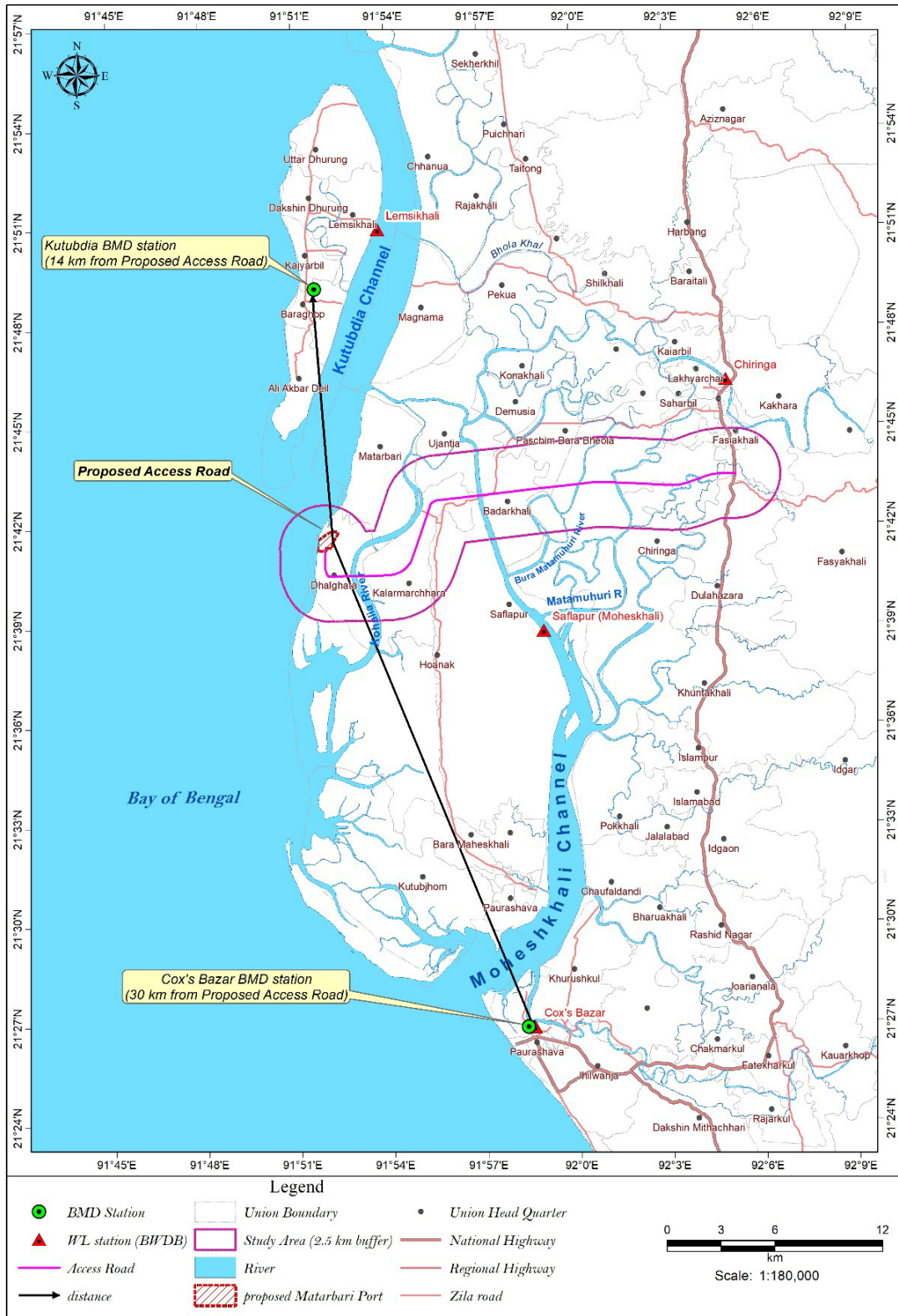


Figure-5.5-3 Locations of nearby Meteorological Stations

### 5.5.2.2 Temperature

Ambient temperature of Kutubdia Station is recorded for this project study Area (**Figure-5.5-3**). Data of last 23 years (1991-2013) shows that the monthly maximum temperature varies from 29.7°C to 34.9°C and May is the warmest month in pre-monsoon period. The monthly minimum temperature varies within a range of 11.7°C to 23.7°C and January is the coldest month. The highest recorded maximum temperature during last 23 years is 34.9°C occurred in May, 1994 and the lowest ever recorded minimum temperature was in January, 1994. The monthly maximum and minimum temperature of last 23 years (1991-2013) are given in **Figure-5.5-4**. **Figure-5.5-5** shows the trend of annual maximum and minimum temperature at Kutubdia.

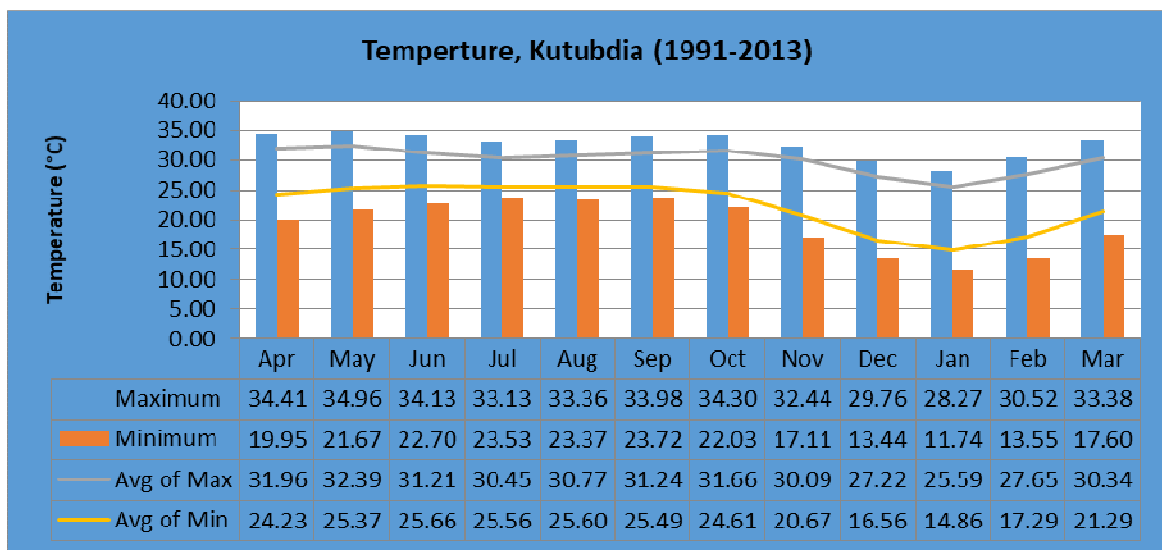


Figure-5.5-4 Monthly maximum and minimum Temperatures (Source: BMD 2013)

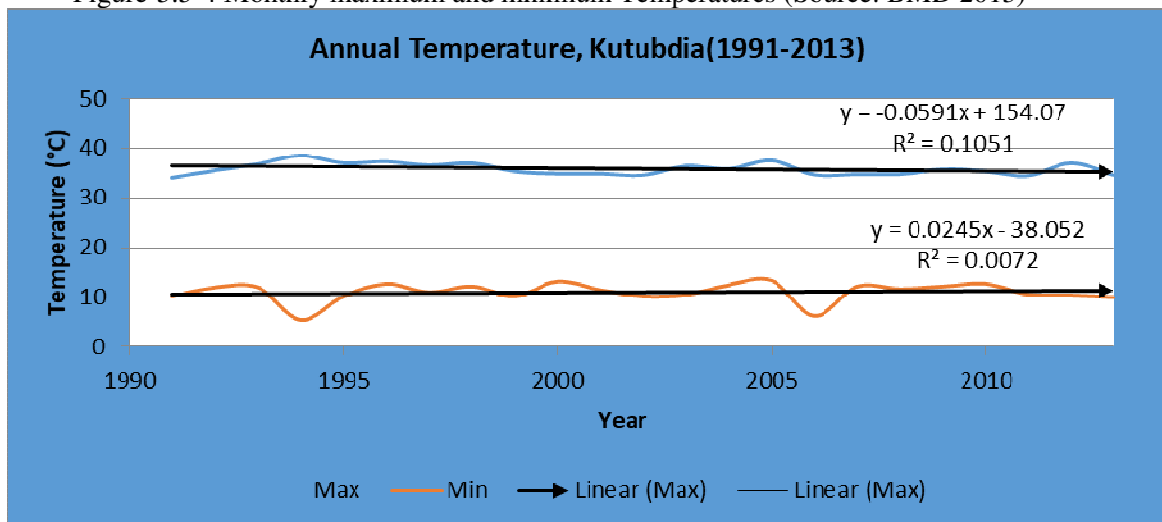


Figure-5.5-5 Trend of annual maximum and minimum Temperature (Source: BMD 2013)

### 5.5.2.3 Humidity

Humidity is directly related with temperature fluctuation of a region. The atmosphere of coastal zone is always enriched with humidity because of high evaporation over the sea surface. Kutubdia BMD Station has been selected in order to delineate the situation of humidity of the study area. The monthly average

relative humidity near the Kutubdia station varies seasonally from 76% to 89%. Monsoon period (June to September) is the most humid month while during winter season i.e. December to February it remains lower. **Figure-5.5-6** shows monthly maximum, minimum and average humidity of last 28 years (1985 to 2013) of Kutubdia station.

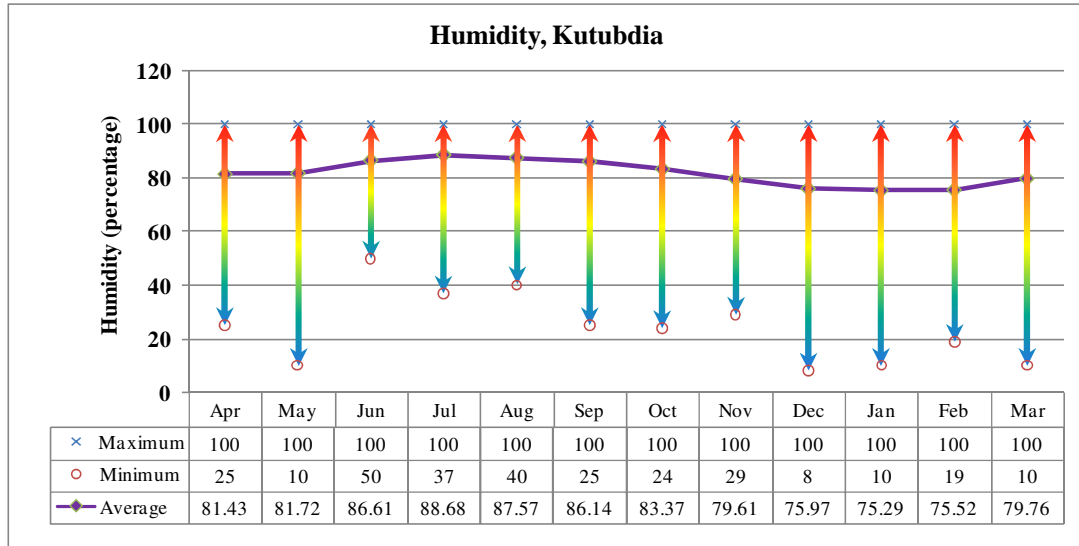


Figure-5.5-6 Average of monthly maximum and minimum humidity (1985-2013)

#### 5.5.2.4 Rainfall

The last 35 years data of Kutubdia BMD station (Station ID: 11925) shows that the annual average rainfall is recorded as 2824.2 mm/yr, according to the data analyzed (**Figure 5.5-7**) monthly average maximum rainfall occurred in July (approximately 763.7mm/month) and monthly average minimum rainfall occurred in winter season (December to February) which indicates that the rainy season is very prominent in this region. The ever maximum daily rainfall recorded is 422mm in the 16th July 1998 and ever maximum annual rainfall was recorded as 4587 mm in the year of 1998. It is also observed that, the annual rainfall in this area is gradually decreasing at a rate of 10.8 mm/year. Average monthly rainfall of thirty years is presented by a graph in **Figure 5.5-7** and **Figure 5.5-8** which shows that the Monsoon period (June to September) has maximum rainfall of the year. On the contrary, December to February shows negligible amount of rainfall. For this analysis time series rainfall data of Kutubdia station (BMD station ID: 11925) has been used. **Figure-5.5.9** shows the Rainfall Map of the study Area.



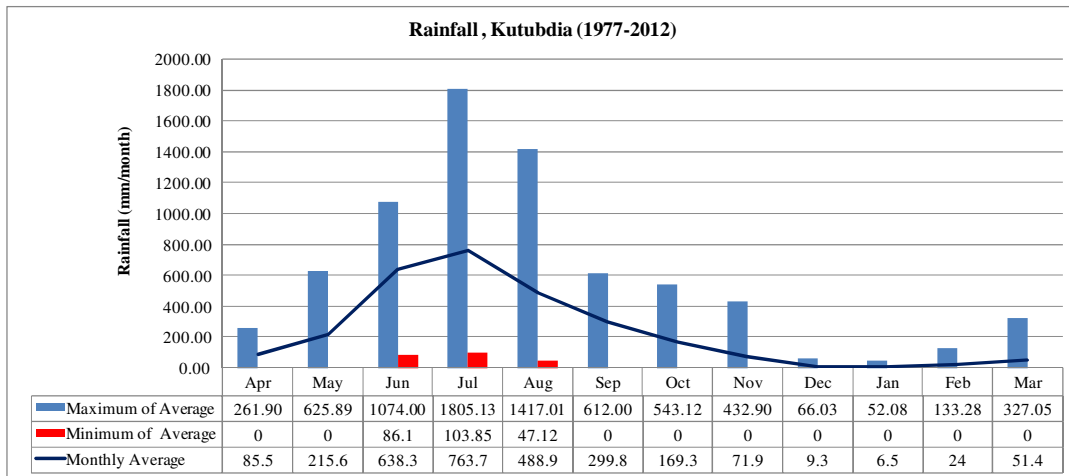


Figure-5.5-7: Average monthly maximum and minimum Rainfall (1977-2012)

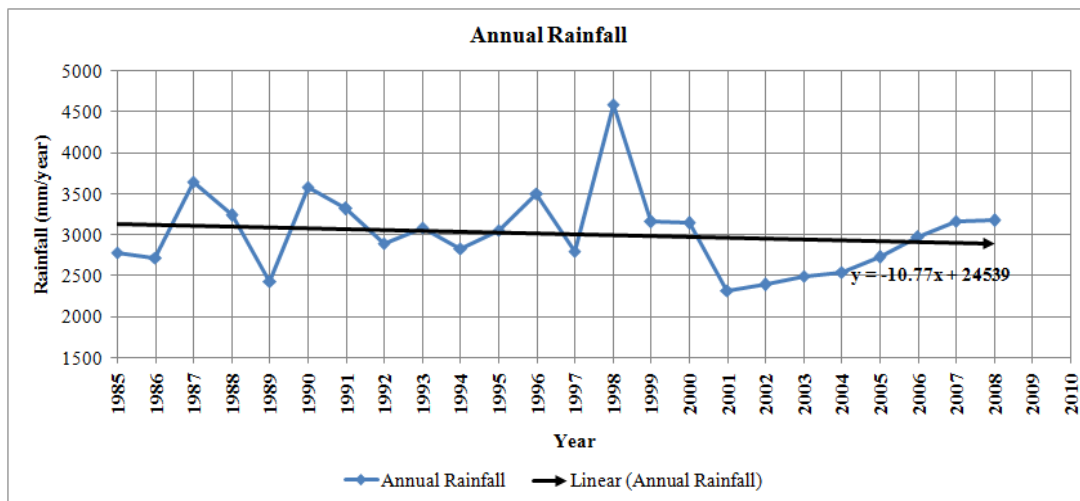


Figure-5.5-8: Trend of annual maximum and minimum Rainfall

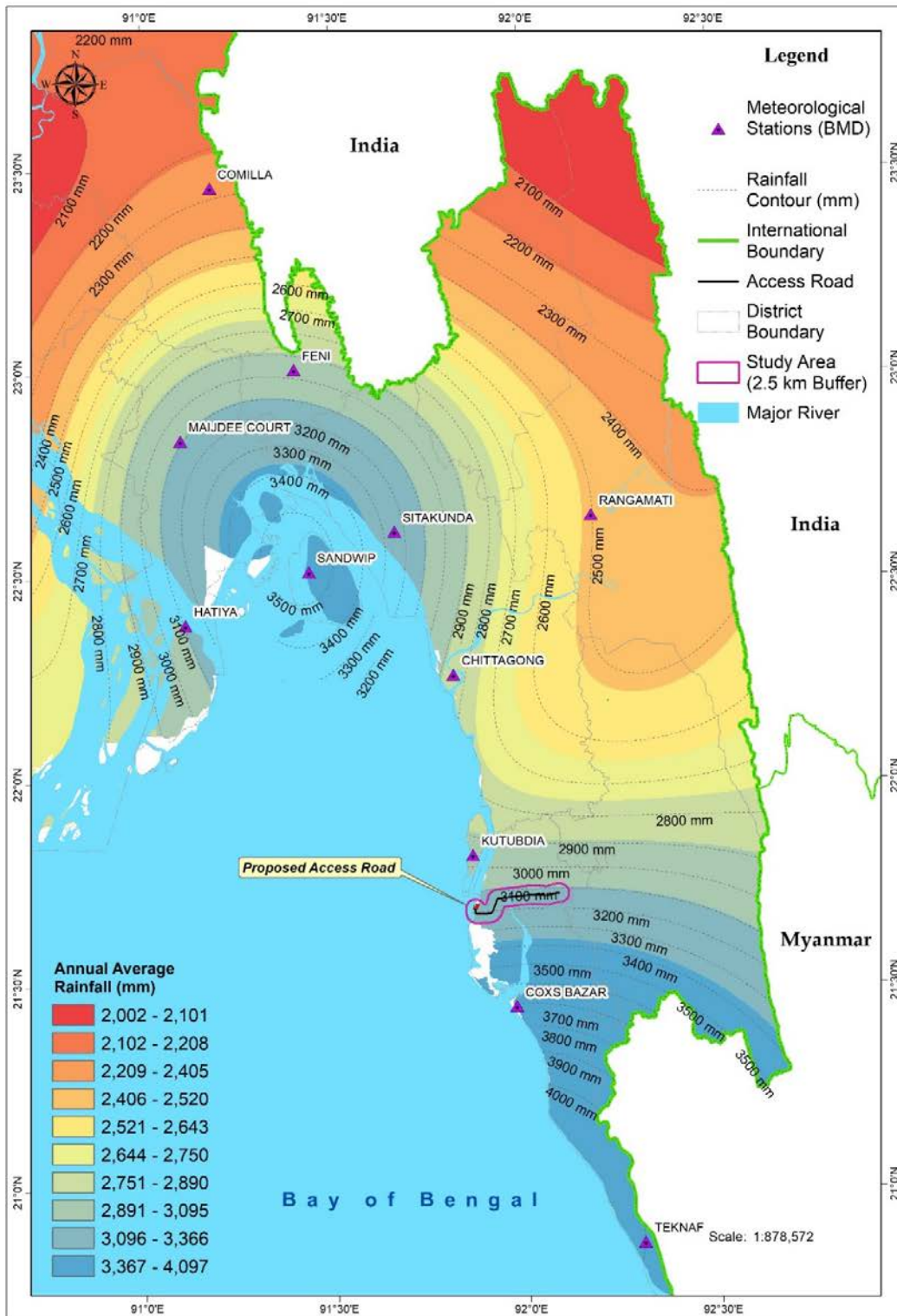


Figure-5.5-9 Rainfall map of the Project Area

### 5.5.2.5 Sunshine Hour

Sunshine hour is a climatological indicator, measuring the duration of sunshine for a given location and period which indicates the total energy delivered by sunlight. In order to investigate the sunshine hour over the study area, sunshine hour records (1985-2013) of Kutubdia BMD station has been analyzed. The monthly average sunshine hour in Kutubdia varies from 4:00 to 8:30 hour/day in a year. The monthly highest sunshine hours occur in July i.e. 13:00 hour/day when the average daily sunshine is only 4 hours. Except monsoon the average of daily sunshine retain around 8 hours due to dearth of cloud coverage. Length of the sunshine hour reduces during winter season. **Figure-5.5-10** shows the daily sunshine hour condition of the study area in different months.

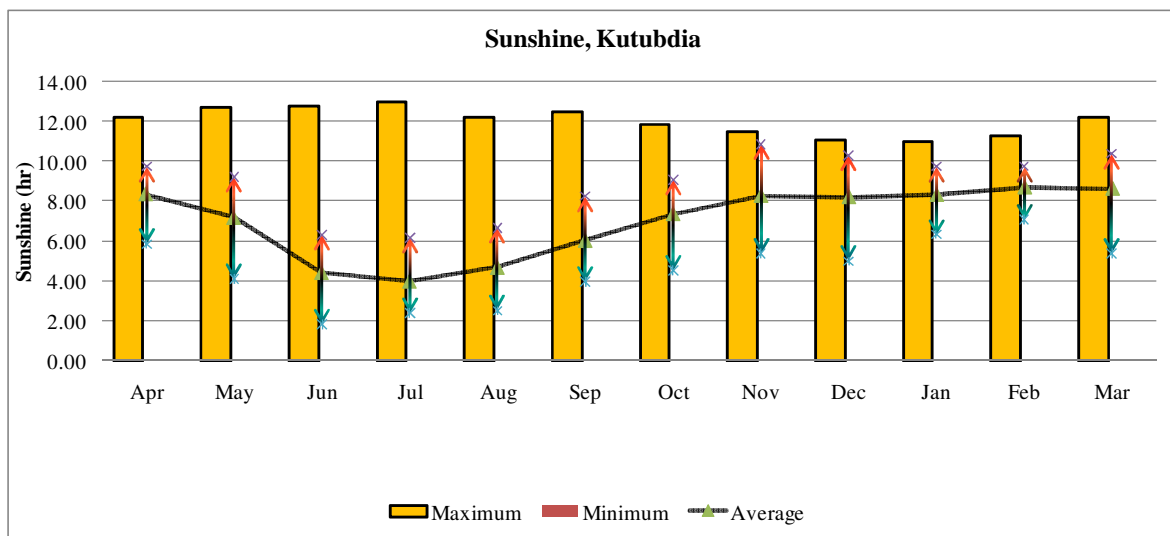


Figure-5.5-10: Sunshine hour condition of the study area (BMD, 1985-2013)

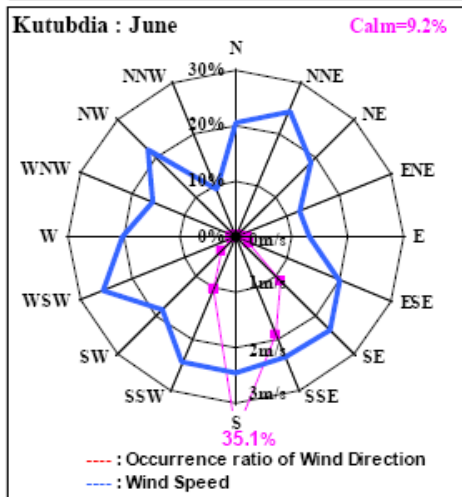
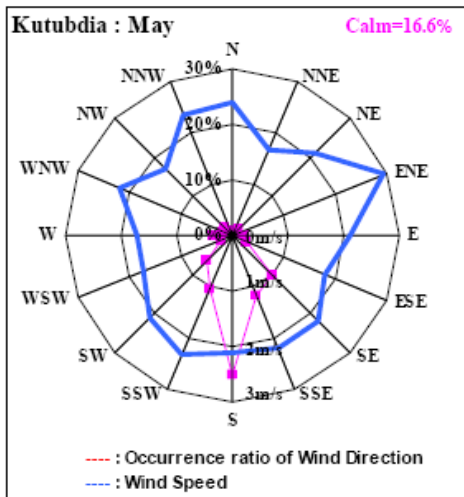
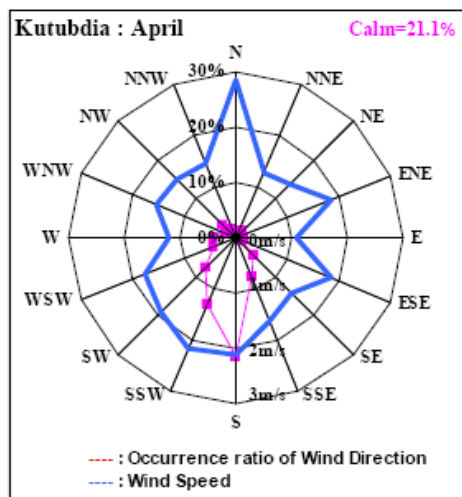
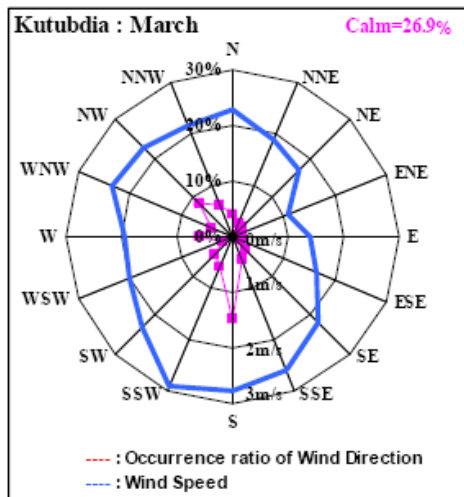
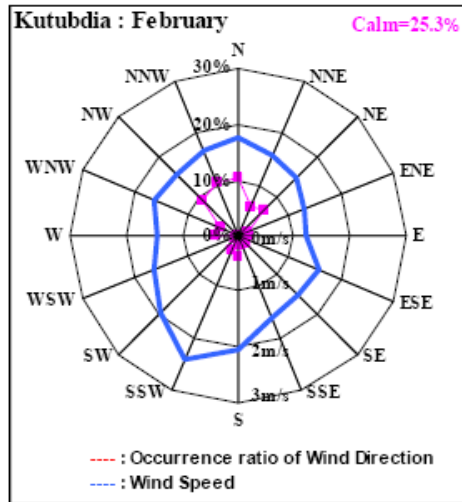
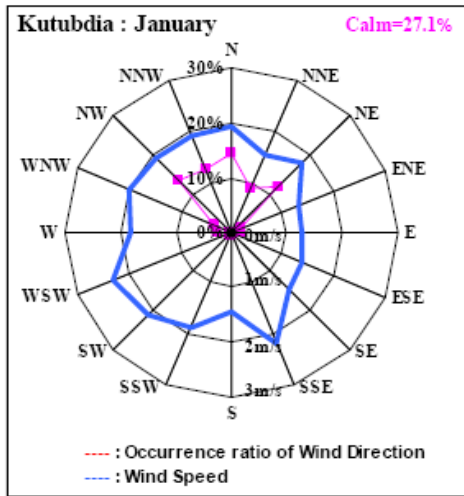
### 5.5.2.6 Wind Speed and Direction

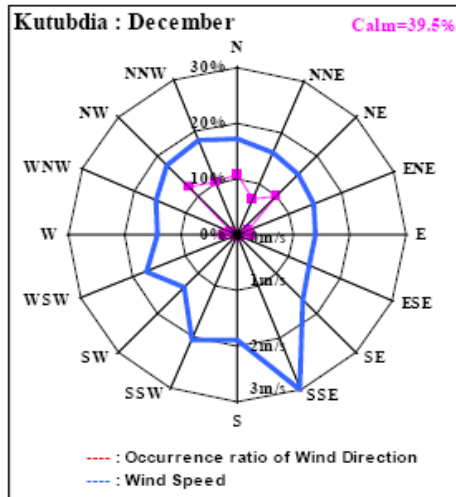
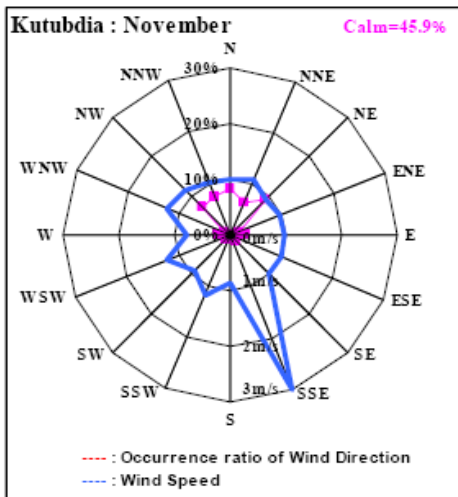
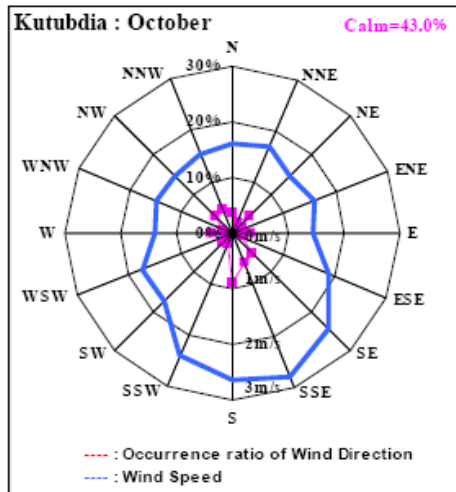
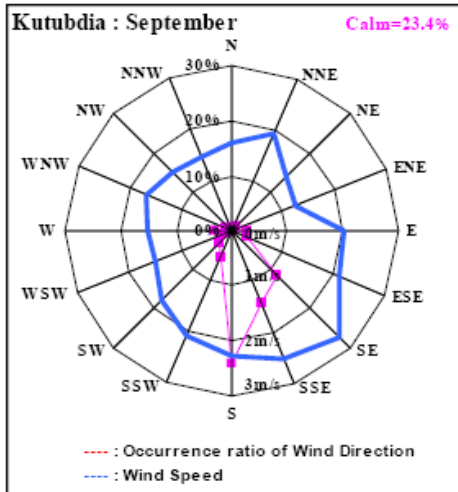
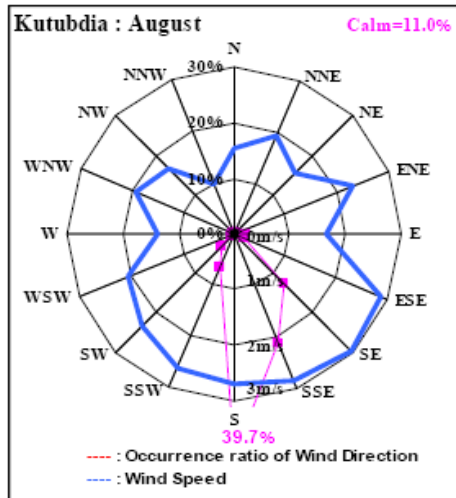
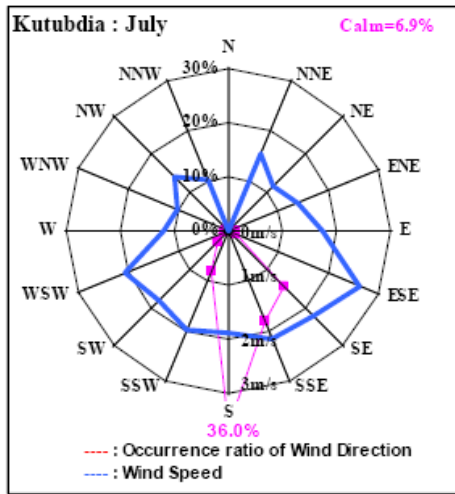
The tropic of cancer passes through the central part of Bangladesh. Therefore, the south-eastern hilly region of Bangladesh lies in the tropical atmosphere. The climate of Bangladesh is governed by monsoon wind which possesses reverse direction in specific seasons.

The study area is influenced by the interaction of sea breeze and hilly topography. Wind flow and direction is not only important for atmospheric status but also for oceanic tides, waves and currents.

**Figure-5.5-11** shows wind speed, direction and duration of wind blowing in the study area. From the wind rose diagram, it can be comprehended that maximum wind is directed from south to north of the project site. The data has been collected for full one year of 2014. About 11% of the total wind flows over the study area which is remarked as calm wind (i.e. speed <1 m/s). The study area is dominated with the wind speed between 4-6m/s. Similarly, type of wind has been experienced i.e. passing toward north-western away during field investigation.

It is observed that the proposed project site is highly windy. Wind data of Kutubdia station has been sorted out to represent the highest wind speed, wind direction and duration of wind flow of this area (**Table-5.5-1**).





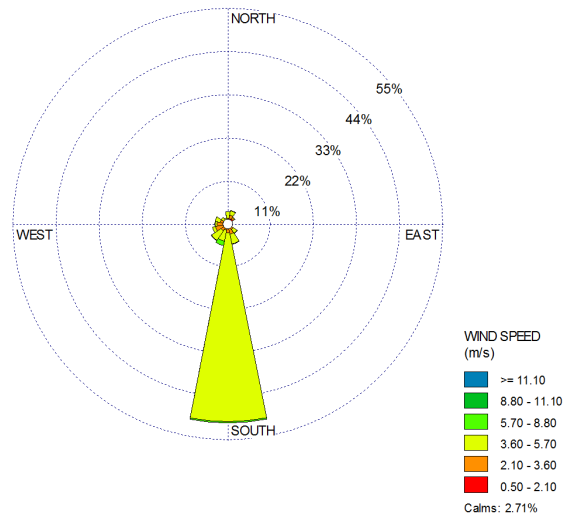


Figure 5.5-11 Wind Rose Diagram (1<sup>st</sup> January-31<sup>st</sup> December, 2014)

Table-5.5-1 Yearly Highest Wind Record

Year	Time	Wind speed (knots)	Wind Direction (degree from North)	Wind Duration (hour)
25/08/1987	9:00PM	23	230	6
30/11/1988	12:00AM	30	130	6
29/04/1989	9:00AM	26	360	3
04/04/1990	9:00AM	30	180	6
01/06/1991	9:00AM	45	180	15
01/05/1992	9:00PM	20	360	3
09/05/1993	9:00PM	40	300	3
09/08/1994	9:00AM	20	180	18
11/06/1995	6:00AM	38	230	15
20/01/1996	6:00AM	30	40	3
19/05/1997	9:00AM	95	210	3
15/05/1998	9:00AM	68	160	3
29/05/1999	3:00AM	25	180	3
13/03/2000	3:00AM	20	180	15
08/05/2001	3:00AM	32	150	9
03/04/2002	3:00AM	20	30	3
12/03/2003	9:00AM	25	40	6
24/06/2004	6:00AM	24	360	3
17/05/2005	3:00PM	30	360	3
05/06/2006	9:00PM	18	160	3
14/05/2007	3:00PM	25	360	9
Maximum		95	-	18
Minimum		18	-	3
Average		32.6	-	6.6
Median		26	-	3
Mode		30	-	3

## 5.6 AIR QUALITY

Agriculture and fishery are the main economic activities of the study area. Therefore, air pollution is not of much significance in the study area. During field visit, it was observed that there was no pollution source around the project site. The project activities involve construction of road and cross drainage works. It is assumed that the ambient air quality due to these activities would not be deteriorated too much. Hence, the air quality was not measured during the field visit. However, the standards of ambient air quality are given in Table below.

Area	Categories	Concentration in micrograms per meter cube (( $\mu\text{g}/\text{m}^3$ ))			
		SPM	SO <sub>2</sub>	CO <sub>2</sub>	NO <sub>x</sub>
A	Industry	500	120	5000	100
B	Commercial	400	100	5000	100
C	Residential and rural area	200	80	2000	80
D	Sensitive	100	30	1000	30

*Source: Environmental Conservation Rules, 1997, DoE*

## 5.7 ACOUSTIC ENVIRONMENT

The study area is quiet in nature as there are no industrial activities in and around the study area.

## 5.8 GEOLOGY AND SEISMICITY

### 5.8.1 Physiography

The Project and the study area fall within the Chittagong Tidal Plain Physiographic units of Bangladesh (**Figure 5.8-1**). More precisely, the project area falls under the sub-region namely South Chittagong Tidal floodplain. The greater part of this region is underlain by sediments washed out from the adjoining hill ranges. The landscape and soils in this sub-region are very different from those in the other sub-regions. This is a complex compound unit which includes different landscapes. The entire sub-region is badly exposed to cyclones and associated storm surges, and affected by a tsunami caused by an earthquake in the eastern half of the Indian Ocean.



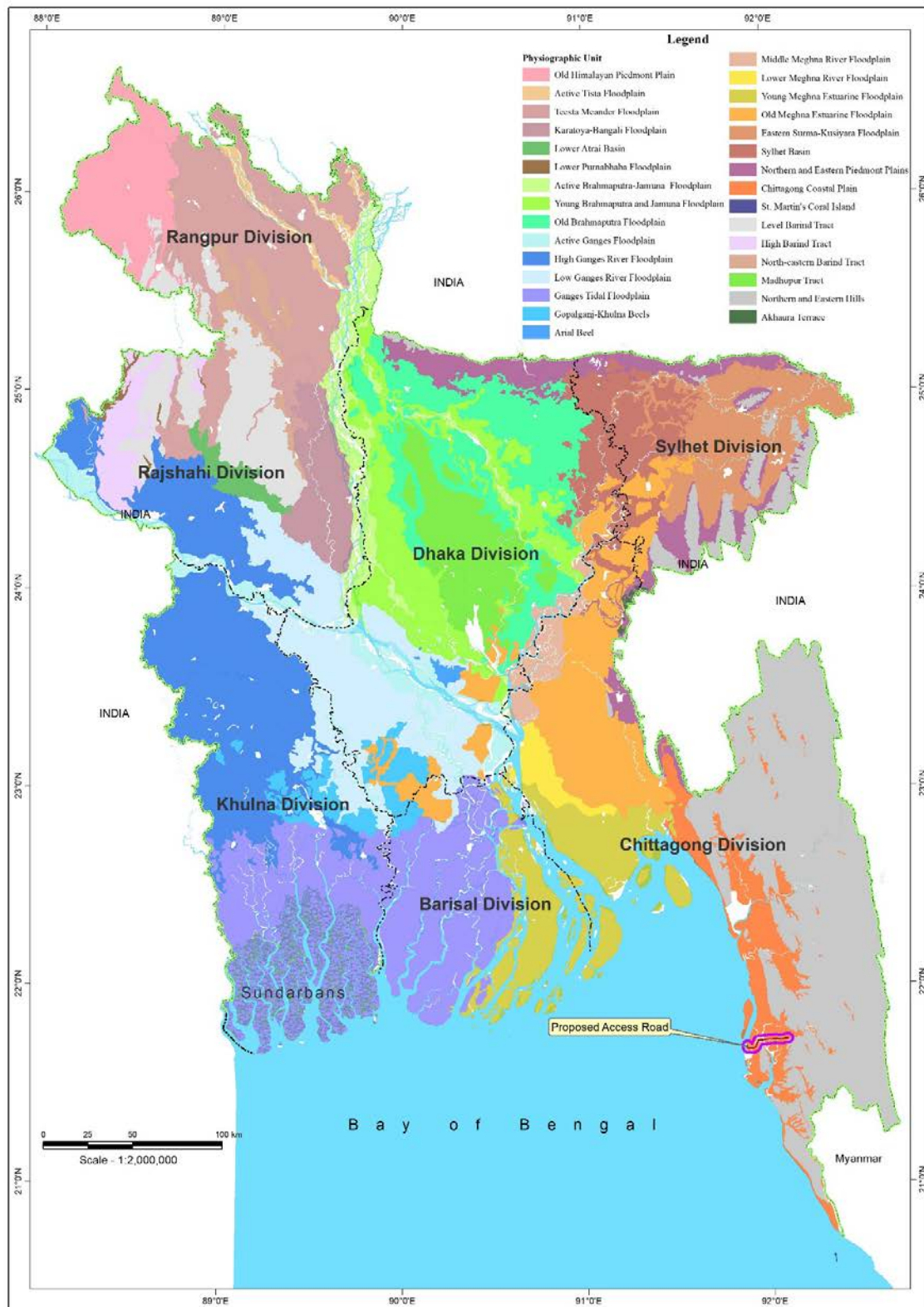


Figure 5.8-1: Physiographic Map of Bangladesh showing the Study area



### 5.8.2 Tectonic Setting

Bangladesh consists of nine tectonic elements, which are listed as below and spatial distribution of the elements are shown in map of **Figure 5.8-2**. The proposed Matarbari Port Access Road lies within the Indo-Burman hill ranges. It is also situated to the South-East of Hatiya Trough/Patuakhali depression.

Sl. No.	Tectonic Elements	Sl. No.	Tectonic Elements
1	Barisal-Chandpur Gravity High	6	Calcutta-Mymensingh Hinge
2	Faridpur-Sylhet Trough (Separated by Tripura-Madhupur thrash hold)	7	Rangpur Platform
3	Hatiya Trough	8	Himalayan Fore Deep
4	Bogra Shelf	9	Sylhet Trough
5	Chittagong Folded belt/Indo-Burman Ranges		

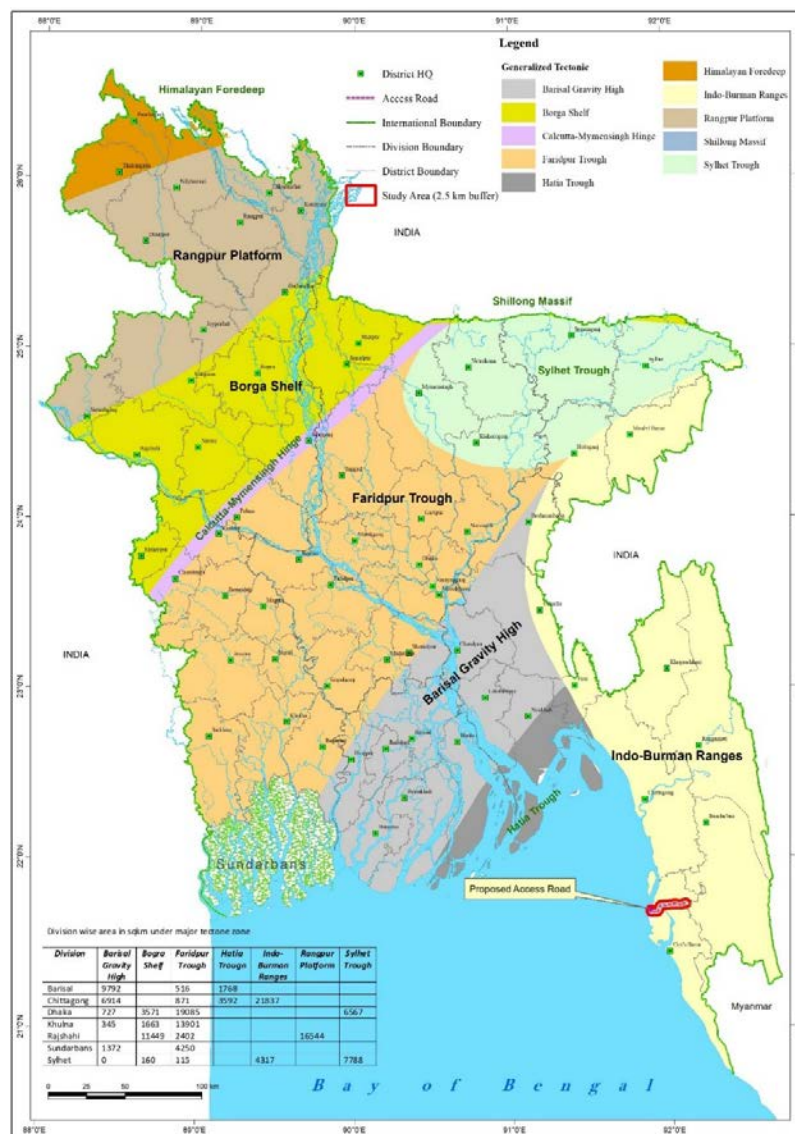


Figure 5.8-2: Tectonic map of Bangladesh showing the Project area

### 5.8.3 Stratigraphy

The study area is situated to Moheshkhali and Chakaria Upazila and immediate west of Kutubdia Island. The stratigraphy of the study area is expected to be identical to Kutubdia and Moheshkhali area.

Sedimentological, palynological data indicate that mangrove community has been developed under transgressive condition in and around the Maheshkhali and the Kutubdia Island areas during Mid Holocene time (7000 to 5500 years BP) leading to the locally wide spread deposition of organic-rich sediments. Global rise and fall of eustatic sea level played an important role not only on the depositional environment but also in creating a geomorphic feature on the island (Md. Golam Kibria *et al.*) during Holocene time.

Holocene sediment sample indicate that the Maheshkhali and the Kutubdia Islands and their surrounding areas were intertidal environment occupied by mangrove community (Md. Golam Kibria *et al.*).

**Table 5.8-1: A generalized Stratigraphic Succession of the Kutubdia and Moheshkhali Islands**

<i>Age</i>	<i>Formation</i>	<i>Lithology</i>
Holocene	Beach sand	Medium grained, sub-rounded, containing heavy minerals.
	Alluvium	Silt and clay
	Peaty and swampy deposits	Black clay with plant roots and twigs
Plio-Pleistocene	Dupi Tila	Whitish and gray medium grained massive sandstone with clay and shale. Poorly sorted
Pliocene	Girujan clay	Bluish gray clay with subordinate shale, siltstone and sandstone
	Tipam sandstone	Yellow, massive, ferruginous sandstone, alternating with shale, claystone. Cross-bedding, ripple marks and fossil wood present
Mio-Pliocene	Boka Bil (Base not seen)	Alternation of sandstone and bluish gray shale with subordinate siltstone and calcareous sandstone

Source: (Md. Golam Kibria *et al.*)

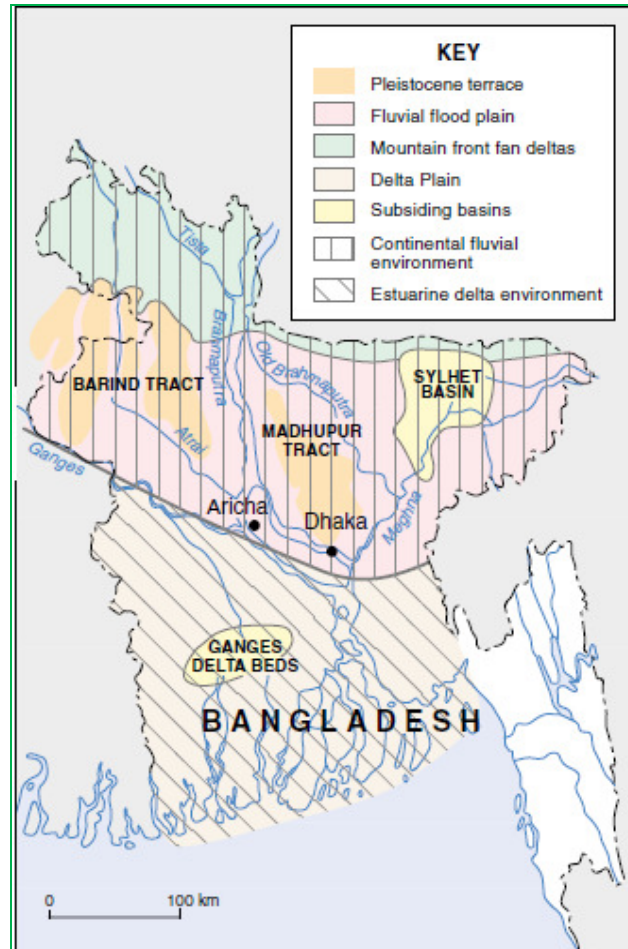
### 5.8.4 Geology

High hill ranges striking towards North-south occupy the entire districts of Chittagong, Cox's Bazar and the three Hill Tract districts. The anticlines form the hills and synclines the valleys. The lowest ranges generally follow the eastern coast of the Bay of Bengal from Feni River to Naf River. However, a narrow strip of coastal plain about 96.5 km long averaging about 9.66 km wide, developed due to a fault along the Sitakund anticline (Hussain and Abdullah, 2001).

The project area falls under the Chittagong plain as per physiographical classification of Bangladesh (Rashid 1991). The coastal plain includes generally narrow strip of land between the Chittagong hills and the sea, together with the Halda, lower Karnaphuli and lower Sangu river floodplains, and the greater part of the off-shore islands. The unit consists of gently sloping, mainly loamy, alluvial flats adjoining the hills, and extensive level clay plains adjoining the three main rivers. Tidal clay plains occupy most of the off-shore islands in the south. Most of the area is subject to shallow flooding and to flash floods from the hills. It is also exposed to cyclone.

The Neogene sedimentary sequence developed here are largely un-fossiliferous and consists mainly of the alteration of shales, clays, clay stones, siltstones and sandstones with occasional intra-formational conglomerates.

The geology of the Chittagong Hill Tracts in south-east Bangladesh is distinctive: sediments exposed in this region are dominantly older (Tertiary) folded and indurate deposits of sandstone, silt and limestone. **Figure-5.8-3** shows the simplified Geology and Geomorphology of Bangladesh. The Project area covers Dupi Tila and Beach and Dune geology. Dupi Tila Formation consists of yellowish-brown to brown, fine to medium grained pebbly and cross-bedded sandstone with subordinate clay stone and siltstone. Dune is a hill of sand built either by wind or water flow. Dunes occur in different forms and sizes, formed by interaction with the flow of air or water. Most kinds of dunes are longer on the windward side where the sand is pushed up the dune and have a shorter "slip face" in the lee of the wind. In the coastal area the dunes formatted the beach and Dunes formation.



**Figure-5.8-3 Simplified Geology and Geomorphology of Bangladesh**

### 5.8.5 Seismicity

Earthquake is one of the most deadly natural disasters that may affect the human environment. Even a relatively moderate earthquake can cause a very large number of deaths. Although in recent past no major earthquake has affected this country, a major event may affect the country at any moment. To analyze the earthquake entire Bangladesh is subdivided into four seismic zones where port project is located in the earthquake zone III (**Figure-5.8-4**) according to the draft of Bangladesh National Building Code (BNBC) updated in 2012 (Sarraz A., et. al. 2015). This zone–III comprises of NNW-SSE area including Chittagong–Tripura folded belt where the basic seismic coefficient is 0.28. There is a possibility of

earthquake in this region as because the region is located adjacent to the Burmese Arc, where a large number of shallow depth earthquakes originate. On 22 July, 1999 a notable earthquake occurred at Moheshkhali Island with the EP Center in the same place. The Richter scale magnitude of that earthquake was 5.2 and the surface wave magnitude was 4.2 feeling severely around Moheshkhali Island and adjoining areas. In that incident fatalities were explored as: death 6 persons, injury 200 persons, a number of houses faced crack while some has been collapsed (SADKN, 2012).

The Project has medium vulnerability in terms of earthquake compared to the other parts of Bangladesh. In such, the Bangladesh building code should be strictly followed during designing of the civil structure for the proposed Power Plant. Details of seismic intensity and the historical records of earthquake in and around Bangladesh, occurred during last 450 years are presented in **Table 5.8-2** and earthquake location map is shown in Figure **Figure-5.8-5**.

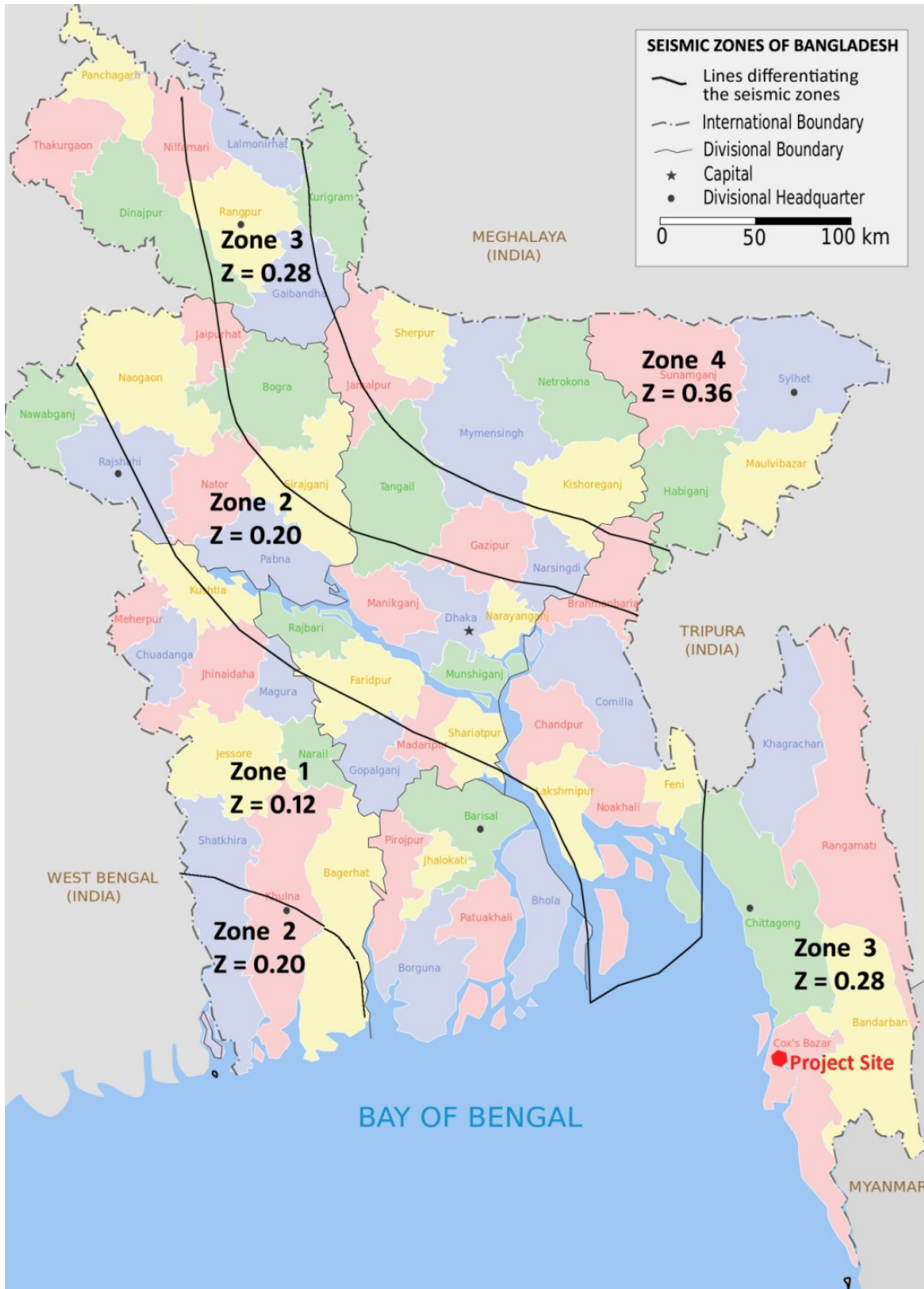


Figure 5.8-4: Earth quake zone of Bangladesh



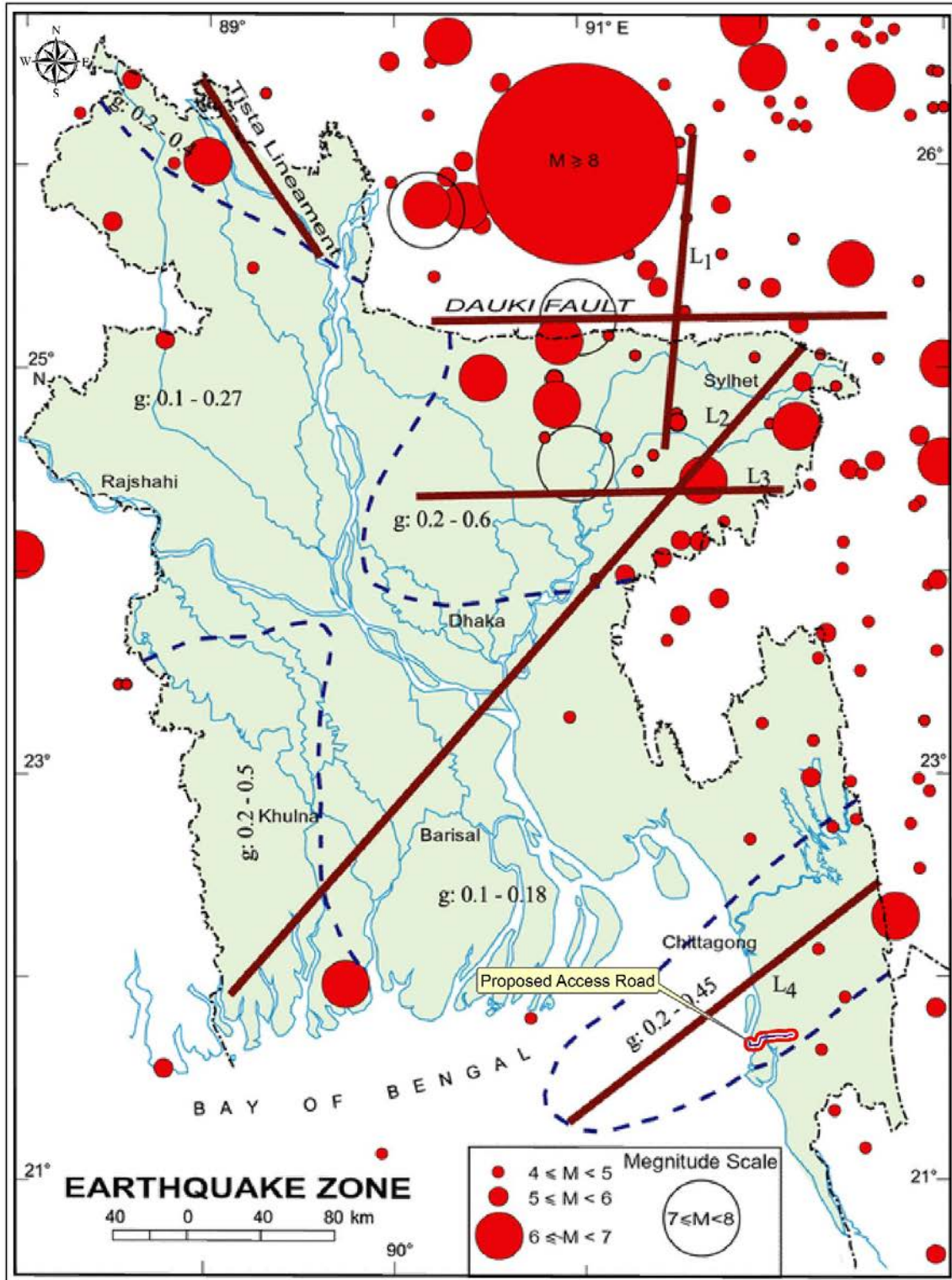


Figure 5.8-5: Earthquake location map of Bangladesh and surrounding area

**Table 5.8-2: List of major earthquakes during last 450 years**

SL	Year	Source Area	Magnitude (Richter Scale)	Depth (Km)
1	1548	Sylhet	-	-
2	1664	Shillong-Plateau	-	-
3	1762	Chittagong-Arakan	-	-
4	1858	Sandway, Myanmar	6.5	-
5	1869	Cachar, India	7.5	48
6	1885	Sirajganj, Bangladesh	7	72
7	1897	Assam, India	8.1	60
8	1906	Calcutta, India	5.5	-
9	1912	Mandalay, Myanmar	7.9	25
10	1918	Srimangal, Bangladesh	7.6	14
11	1930	Dhubri, India	7.1	60
12	1934	Bihar, India-Nepal	8.3	33
13	1943	<a href="#">Numaligarh, Assam, India</a>	7.2	13
14	1938	Mawlaik, Myanmar	7.2	60
15	1950	Assam, Himalaya	8.6	25
16	1950	Chittagong, Bangladesh	6	-
17	1954	Manipur, India	7.4	180
18	1975	Assam, India	6.7	112
19	1984	Cachar, India	5.7	4
20	1988	Bihar, India-Nepal	6.6	65
21	1988	Phek, Manipur, India	7.3	90
22	1995	Monipur, India	6.4	-
23	1997	Sylhet, Bangladesh	5.6	35
24	1997	Bangladesh-Myanmar	5.3	56
25	1999	Moheshkhali, Bangladesh	4.2	10
26	2003	Rangamati, Bangladesh	5.6	-
27	2011	Sikim, India	6.9	-
28	2015	Gorkha, Nepal	7.8	8.2
29	2016	Imphal, India	6.7	-
30	2016	Baniachang, Sylhet, Bangladesh	4.4	30

## 5.9 HYDROLOGY

### 5.9.1 Surface Water Resources

The proposed project area is adjacent to the Bay of Bengal and located in the southeast of Kutubdia Island. The Kutubdia channel, Matamuhuri River and Kohalia River are the main rivers close to the project area. The project area is approachable by road from Chittagong district and water way through the “Bay of Bengal”. Heavy construction materials/ machineries can be transported through water way.

Tides of the Bay of Bengal regularly inundate large area of land mass along the shore side of the project area. During monsoon, huge quantity of rainfall runoff flows to the Kutubdia channel through creeks and rivers which ultimately falls into the Bay of Bengal. The level of salinity is relatively lower due to monsoon. However, the surface water quality in the study area is influenced by monsoon rainfall. Moreover, the offshore zone of the project is influenced by the estuary environment.

## 5.9.2 River Network

A number of rivers in and around the project area (**Figure-5.9-1**) carry fresh water from the eastern hilly areas and ultimately fall into the Bay of Bengal. Number of creeks (Chorra) originates from the hill ranges meet with each other and finally fall into the Bay of Bengal. These rivers, channels, khals carry significant amount of coarse sediment and deposit to the rivers and sea shelf.

### *Hydrologic Connectivity*

Tides of the 'Bay of Bengal' regularly inundate large areas of land mass along the shore side of the project area. During dry season, lack of rainfall is the main reason of high salinity in water of the surrounding rivers and khals. During dry season, the level of salinity is relatively higher. Moreover, the offshore zone of the project is influenced by the estuary environment.

The Matamuhuri and Kohalia River carry salt water and ultimately fall into the Bay of Bengal and Kutubdia Channel. The Matamuhuri River is located at the East side of the project area. Kariardiar khal originates from the Matamuhuri River and meets with the Kohalia River. Finally, Kohalia River meets the Kutubdia Channel and falls into the 'Bay of Bengal'.

### **Kutubdia Channel**

The Kutubdia Channel lies in-between the mainland of Cox's Bazar and Kutubdia Island. The length of the channel is 24 km. The channel is connected with the Bay of Bengal at its both ends; as such it is a tidal channel and is affected by ebb and flow of ocean tides.

Thus this portion of the stream has variable salinity over the tidal cycle. There is temporal variability of water quality parameters within the tidally influenced zone. The channel may often dry up to a muddy channel with little or no flow during low tide, but often with significant depth of water during high tide.



Kutubdia Channel

### **Moheshkhali Channel**

The Moheshkhali channel carries the combined flow of the Matamuhuri and its tributaries and of other rivers such as Bharuakhali khal, Bura Matamuhuri, Mangla Khal, Manikchhari khal, etc. The length of the channel is 35 km and average width is 1.8 km. The channel is connected with the Bay of Bengal. The channel is navigable and is frequently used by speed boats, Trawlers, fish boats and Engine Boats for fishing and navigation purposes. The channel is perennial and is under tidal influence. The channel



becomes turbulent and unsafe for passengers during the monsoon especially when emergency signal is hoisted. The flow direction of the channel is from North to South.

### **Matamuhuri River**

Matamuhuri River originates from the Sangu River in the ranges of hills that divide Arakan from Chittagong. This river also flows northwest in the Hill Tracts and enters Cox's Bazar district from the east. Flowing in the west it falls into the Bay of Bengal at 21°45'N and 91°57'E forming a broad delta at its mouth extending from Bhola Khal to Khuta Khali. The delta is of the same character as the Sundarbans, consisting of groups of channels intersected by a network of tidal creeks and covered by vegetation. The principal Upazila adjoining this river is Chakaria. The length of the river is about 287 km.



Matamuhuri River

### **Kohalia River**

Kohalia River originates from the Kutubdia channel and finally meets the Bay of Bengal. The length of the river is around 12 km and is located about 2 km of the south-east direction of the project area.



Kohalia River

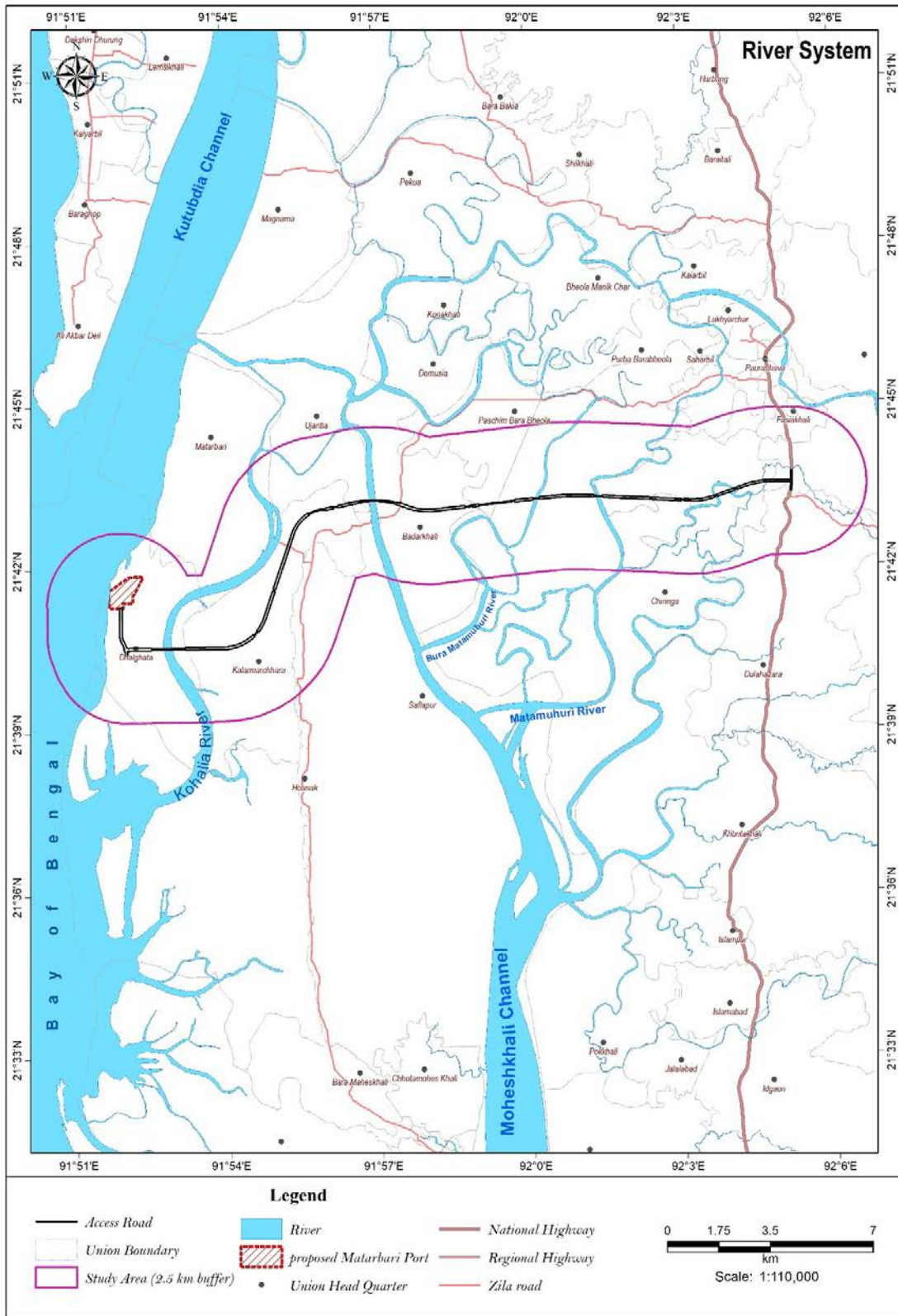
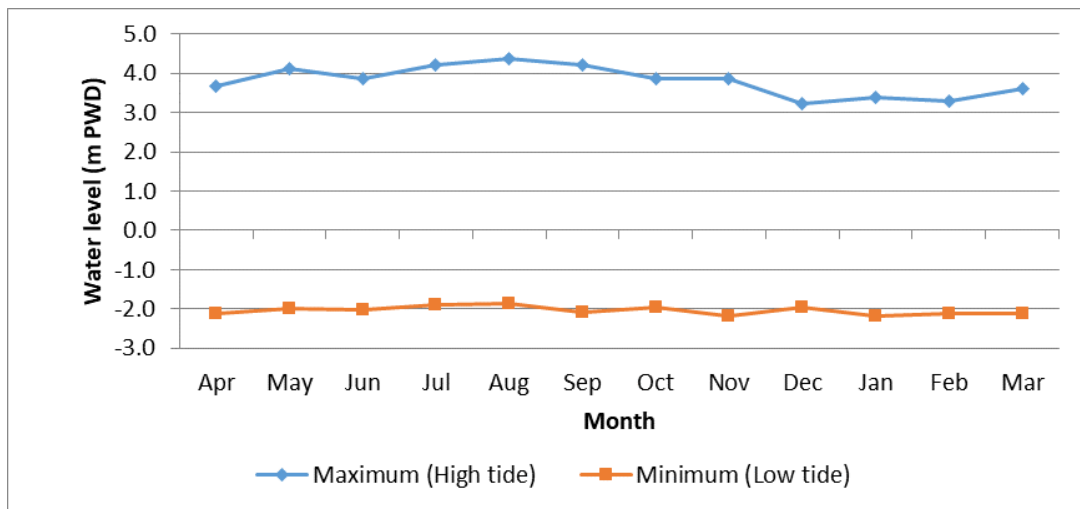


Figure-5.9-1: River System Map of the Project Area

### 5.9.3 Surface Water Level

Water level data of Moheshkhali Channel was collected from Saflapur (Moheshkhali) BWDB gauge station. The gauge station is located at 8.0 km south from the project area. The analysis of water level data of 1968- 2009 shows that the maximum water level is 4.4 m PWD during high tide while the minimum water level is (-) 2.2 m PWD during low tide. **Figure 5.9-2** shows the HWL and LWL at Saflapur (Moheshkhali) station during high tide and low tide period.



**Figure 5.9-2: Water Level at Saflapur (Moheshkhali) station (1968-2009)**

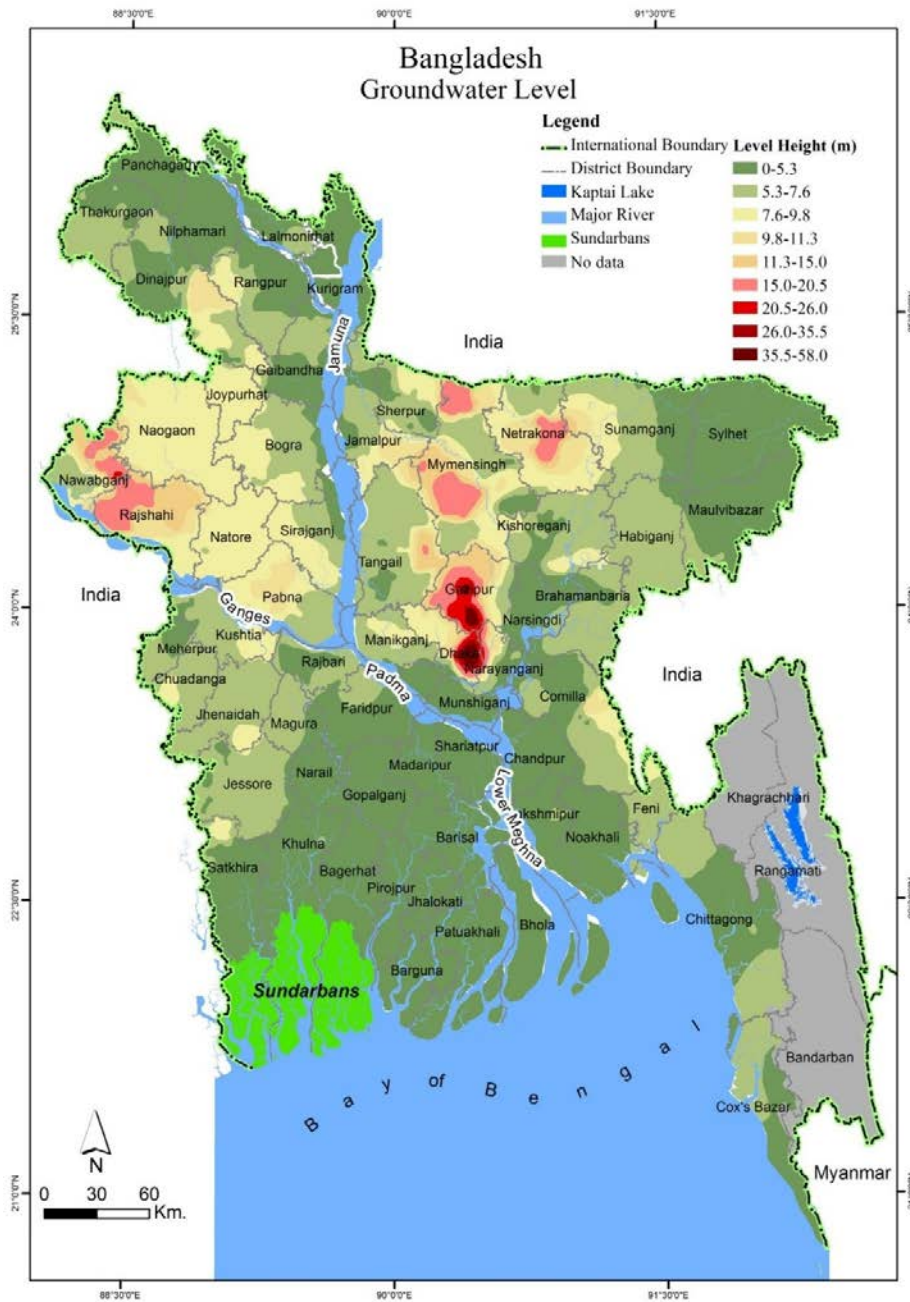
The maximum high tide levels for different return periods have been worked out from maximum water level data of Moheshkhali Channel for the period from 1968 to 2009 using Log Normal Distribution which is presented in **Table 5.9-1**.

**Table 5.9-1: Flood Return period of Moheshkhali Channel**

Return Period (Year)	Maximum high tide level (m PWD)
2	3.49
5	3.93
10	4.18
25	4.46
50	4.65
100	4.83

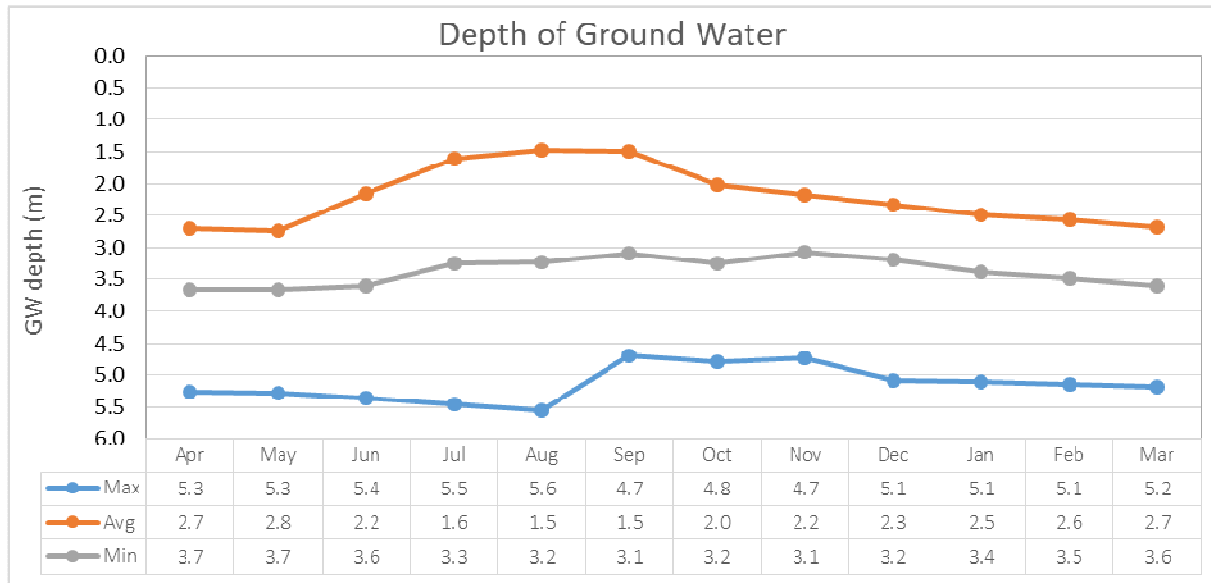
### 5.9.4 Ground Water System

Geographically the average rate of recharge within the study area is about 550-600 mm per annum (**Figure-5.9-3**). Ground water is available at a depth of 100–450 ft (30.48 m-137.16 m) for using hand tube wells which fluctuates with temporal and spatial variation. Again, the farmers use groundwater from a depth ranging from 600-700 ft (182.9 m - 213.4 m) for irrigation. In some of the places, ground water table is depleted up to 100-150 ft (45.7 m) during dry seasons.



**Figure 5.9-3: Potentiality of Recharging Ground Water (MPO, 1986)**

The groundwater data of BWDB observation well around the study area (station COX009) was collected for the period from 1984 to 2013. The station COX009 is located at Gorakghata of Moheshkhali Upazila. It is observed that the groundwater level goes down in dry season and depth reaches highest in March. On the other hand, water table rises in monsoon and the lowest depth attains in September due to recharge by rain water. **Figure 5.9-4** shows the monthly variations of groundwater depth in the study area. Local people of the study area opined that they need to sink tube-well at about 20 to 30 feet depth from the ground surface for fresh drinking water.



**Figure 5.9-4: Depth of Ground Water of the Study Area**

### 5.9.5 Morphology

#### 5.9.5.1 Tidal Behavior

Tides in Bangladesh coastal areas originate from the Indian Ocean. It enters into the Bay of Bengal through the two submarine canyons, the ‘Swatch of No Ground’ and the ‘Burma Trench’. Tide arrives with semi diurnal features all over the coastal zones of Bangladesh as the shoreline experience two almost equal high tides and two low tides each day. The periods of oscillations are 12 hours 25 minutes respectively.

The coastal area of Bangladesh has three tidal zones. These are:

- Macro Tidal Zone: Isotidal fluctuation >4 m
- Meso Tidal Zone: Isotidal fluctuation 2 m to 4 m
- Micro Tidal Zone: Isotidal fluctuation <2 m

The proposed Port access road project area falls under the Meso Tidal Zone where tidal fluctuation occurs regularly and the eastern region regulates the level of inundation within the project area. The yearly average tidal fluctuation is around 3 m to 4 m.

The following **Figure-5.9-5** shows the daily tidal level at Kutubdia, which is adjacent to the study area. The tide level is routinely observed by Bangladesh Water Development Board.



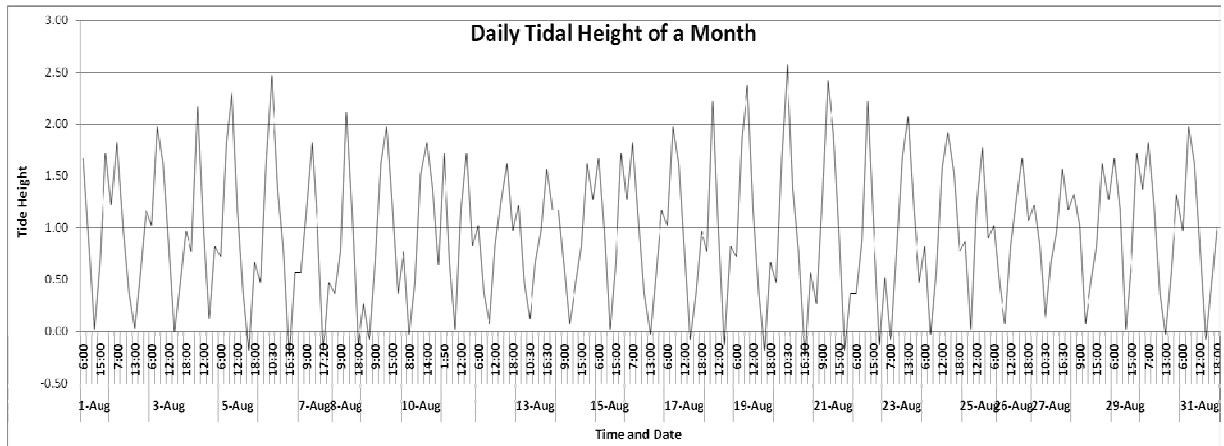


Figure-5.9-5: Daily tidal height of August, 2013

There is a significant difference between consecutive wave crests or troughs due to the effect of semi diurnal process of tides. Tidal height rise at the peak during spring tides and least during neap tide.

The shape of the shoreline and the ocean floor changes propagates tides, so there is no simple or general rule that predicts the time of high water from the Moon's position in the sky. Coastal characteristics such as underwater bathymetry and coastline shape indicate that individual location characteristics affect tide forecasting; actual high water time and height may differ from predictions as the coastal morphology effects on the tidal flow.

Flow of surface water influences the tidal level to a great extent. Tide interrupts discharge of the surface water. Generally, tides enter into the channel or river through the estuaries and obstruct the discharge of fresh water. As a result, sea water penetrates to the inland and back water effects simultaneously increase the water level and flooding to the adjacent flood plain.

### 5.9.5.2 Wave Conditions

Waves are basically generated at sea due to the wind. Small ripples originate on the water as though wind blows across the ocean's surface. The size of waves depends on:

The duration of the wind;

- The strength of the wind; and
- The fetch, or the distance over water across which the wind blows.

Wave height is also very important for the navigation of vessels. It is also important for shaping coastal sea beach. The waves are generally low and show distinct relation with the wind. Maximum wave heights over 2 m were recorded only for few days during small parts of days. The wave periods vary between 3 to 4 seconds of waves of about 0.5 m and about six seconds for waves of 2 m. Flash floods are expected in the month of May to October and are caused by the normal velocity of flow of ebb tide augmented by flow of additional volume of water that drains into the river from the catchment area. Flash floods are expected when rainfall intensity reaches 200 mm in 24 hours. **Table 5.9-2** represents different features of wave height for the last 20 years and **Table 5.9-3** shows the annual maximum wave height through statistical distribution.

**Table 5.9-2: Annual maximum wave height and period for last 20 years**

Year	Deep Water Wave			Shallow Water Wave		
	Wave Height $H_o$ (m)	Wave Period $T_o$ (Sec)	Direction of $H_o$	Wave Height $H_o$ (m)	Wave Period $T_o$ (Sec)	Direction of $H_o$
1987	4.999	11.77	230	4.83	11.77	244
1988	5.9853	12.80	310	5.95	12.80	325
1989	5.9070	9.72	150	5.87	9.72	192
1990	5.9873	10.75	130	5.95	10.75	193
1991	6.5771	9.21	180	6.03	9.21	192
1992	3.7807	10.24	360	3.54	10.24	272
1993	6.0640	12.80	180	6.03	12.80	195
1994	3.7807	10.24	180	3.54	10.24	193
1995	6.0438	12.80	180	6.01	12.80	195
1996	6.0586	12.28	360	5.95	12.28	374
1997	6.2349	11.26	130	6.20	11.26	223
1998	6.1343	12.80	180	6.10	12.80	195
1999	5.9070	12.80	180	5.87	12.80	195
2000	3.7807	10.24	180	3.54	10.24	193
2001	6.0892	12.28	160	5.98	12.28	174
2002	3.7807	10.24	30	3.54	10.24	193
2003	5.9070	12.80	40	5.87	12.79	195
2004	5.4438	12.28	360	3.53	12.28	374
2005	6.0586	12.28	360	5.95	12.28	374
2006	3.0620	9.21	160	2.82	9.21	172
2007	5.9079	12,80	360	5.87	12.80	375

Source: Feasibility Study Report of Deep Sea Port (PCI, 2009) and BN

**Table 5.9-3: Statistical distribution of the annual maximum wave height**

Return Period	Deep Water Wave		Shallow Water Wave	
	Wave Height $H_o$ (m)	Wave Period $T_o$ (Sec)	Wave Height $H_o$ (m)	Wave Period $T_o$ (Sec)
25 years	7.48	12.4	7.48	12.4
50 years	7.95	13.1	7.98	13.1
100 years	8.38	13.7	8.46	13.7

Source: Feasibility Study Report of Deep Sea Port (PCI, 2009) and BN

### 5.9.5.3 Cyclones

In meteorology, a cyclone is an area of closed, circular fluid motion rotating in the same direction as the Earth. This is usually characterized by inward spiralling winds that rotate anti-clockwise in the Northern Hemisphere and clockwise in the Southern Hemisphere of the Earth. Most large-scale cyclonic circulations are centered on areas of low atmospheric pressure. It is a natural phenomenon which is unpredictable in terms of timing, intensity and the actual track. Obviously, no measure of design consideration can influence any of those three factors. The only option is to try to predict, as early as possible, the track and intensity of the cyclone storm. **Figure-5.9-6** shows the track of the cyclone and maximum wind speed during the last 1960 to 2007.

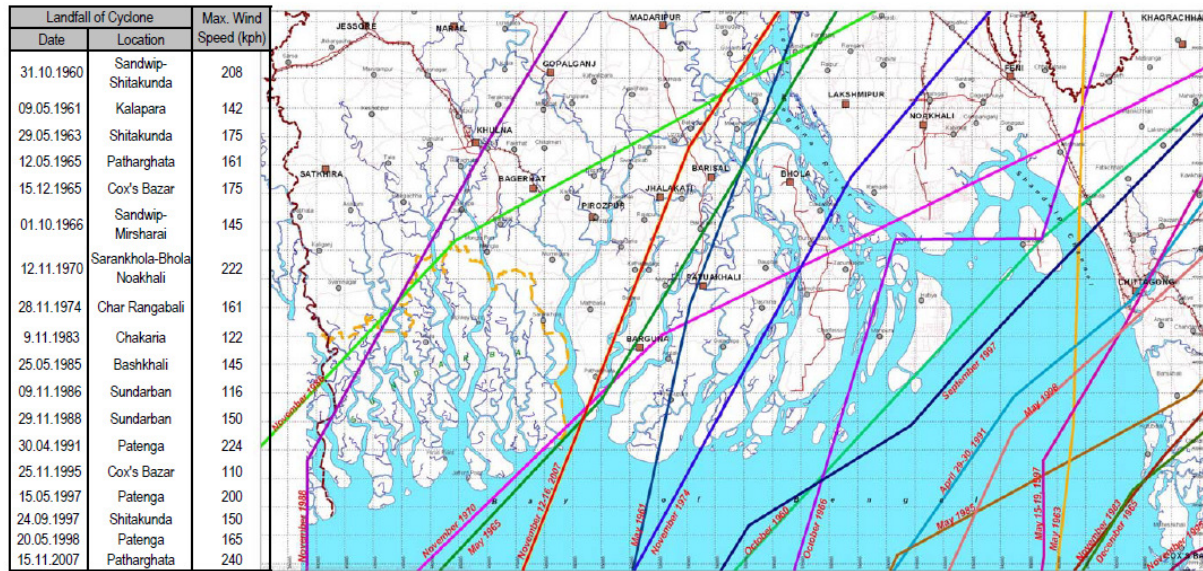


Figure 5.9-6 Tracks of major cyclones that crossed Bangladeshi coast from 1960-2007 Source: BMD 2007

Bangladesh Meteorological Department (BMD) regularly monitors the tropical cyclones and the **Table 5.9-4** below shows the enlisted major historical cyclones that occurred in and around Bangladesh from 2005 to 2015. **Table 5.9-5** below shows the major cyclones crossed Bangladesh Coastal Area, and their maximum wind speed.

**Table 5.9-4: Historical Cyclone**

Sl. No.	Cyclone Name	Status	Landfall Area	Landfall Date
1	BAAZ	Cyclonic Storm	Weakened into a well-marked low pressure area over southwest Bay	02.12.2005
2	AKASH	Cyclonic Storm	Crossed south Bangladesh coast close to south of Cox's Bazar	14.05.2007
3	SIDR	Very Severe Cyclonic Storm	Crossed Bangladesh coast near Baleshwar River	15.11.2007
4	RASHMI	Cyclonic Storm	Crossed Bangladesh coast near Khepupara	26.10.2008
5	BIJLI	Cyclonic Storm	Crossed Bangladesh coast near Chittagong	17.04.2009
6	MAHASSEN	Cyclonic Storm	Crossed Bangladesh coast between Chittagong and Feni	16.05.2013

Source: Bangladesh Meteorological Department, 2014

**Table 5.9-5: Major Cyclones in Bangladesh**

Date of landfall	Nature of Phenomenon	Landfall Area	Max. Wind Speed (kph)
11.10.1960	Severe Cyclonic Storm	Chittagong	160
31.10.1960	Severe Cyclonic Storm	Chittagong	193
09.05.1961	Severe Cyclonic Storm	Chittagong	160
30.05.1961	Severe Cyclonic Storm	Near Feni	160
28.05.1963	Severe Cyclonic Storm	Chittagong- Cox's	209



Date of landfall	Nature of Phenomenon	Landfall Area	Max. Wind Speed (kph)
		Bazar	
11.05.1965	Severe Cyclonic Storm	Chittagong-Barisal Coast	160
05.11.1965	Severe Cyclonic Storm	Chittagong	160
15.12.1965	Severe Cyclonic Storm	Cox's Bazar	210
01.11.1966	Severe Cyclonic Storm	Chittagong	120
23.10.1970	Severe Cyclonic Storm	Khulna-Barisal	163
12.11.1970	Severe Cyclonic Storm with a core of hurricane wind	Chittagong	224
28.11.1974	Severe Cyclonic Storm	Cox's Bazar	163
10.12.1981	Cyclonic Storm	Khulna	120
15.10.1983	Cyclonic Storm	Chittagong	93
09.11.1983	Severe Cyclonic Storm	Cox's Bazar	136
24.05.1985	Severe Cyclonic Storm	Chittagong	154
29.11.1988	Hurricane wind	Khulna	160
18.12.1990	Cyclonic Storm	Cox's Bazar Coast	115
29.04.1991	Severe Cyclonic Storm with a core of Hurricane wind	Chittagong	225
02.05.1994	Severe Cyclonic Storm with a core of Hurricane wind	Cox's Bazar-Teknaf Coast	204
25.11.1995	Severe Cyclonic Storm	Cox's Bazar	140
19.05.1997	Severe Cyclonic Storm with a core of hurricane wind	Sitakundu	232
27.09.1997	Severe Cyclone with Hurricane wind	Sitakundu	150

#### 5.9.5.4 Flooding

The project area is mostly covered by tree plantation and salt production. The area for salt production is protected by earthen levees, which is the common practice to prevent tidal inundation. Saline water is entered in these areas through tidal creeks regulated by indigenous wooden water control structures for silt production.

#### 5.9.5.5 Storm Surges

A storm surge is a coastal flood phenomena of rising water commonly associated with low pressure weather systems, the severity of which is affected by the shallowness and orientation of the water body relative to storm path. Most casualties during tropical cyclones occur as the result of storm surges.

The coastal areas of Bangladesh are the most vulnerable areas which experience and often experience very high cyclonic storm surge. The tracks of different cyclonic storm are shown in **Table 5.9-6**.

The intensity and height of the coastal surge largely depends upon the pressure fall in the sea level. The most severe pressure fall was recorded as 918 mbar, occurred in 1991 and has radius strength of 74 km. The cyclone hits the eastern coast of the Bay of Bengal around Chittagong. The consequent maximum surge was 4.73 m (15.18 ft) MSL which was a result of combination of astronomical tide and the storm surge. It is advisable to consider storm surge height in design the port access road and other infrastructure in the project area. Some safety margin should also be added. However, a more precise calculation should be performed in the process of design of the port access road. The worst condition occurs due to the

combination of the astronomical tide and the storm surge. **Table 5.9-6** shows surge height for 16 cyclones that are recorded in the last 25 years.

**Table 5.9-6: Major storm surge incidents hitting the Bangladesh Coast**

Date	Year	Maximum Wind speed (km/hr)	Storm Surge height (m)
30 October	1960	211	4.6-6.1
30 May	1961	160	6.1-8.8
28 May	1963	203	4.2-5.2
11 May	1965	160	6.1-7.6
15 December	1965	211	4.6-6.1
01 November	1966	146	4.6-9.1
23 October	1970	163	3.0-4.9
12 November	1970	224	6.1-9.1
25 May	1985	154	3.0-4.9
29 November	1988	160	3.0-4.0
29 April	1991	225	6.0-7.5
02 May	1994	210	2.0-3.0
25 November	1995	140	2.0-3.0
19 May	1997	220	3.1-4.2
15 November	2007	240	up to 10
25 May	2009	120	3.0

Source: MCSP, 1993 and Bangladesh Meteorological Department

#### 5.9.5.6 Seal Level Rise

Sea level rise is a crucial issue of climate change and has various impacts on Bangladesh. Its potential threats will come even more strongly in the future. Shore line erosion, river bank erosion, salinity intrusion, flood, damage to infrastructures, crop failure, destruction of fisheries, loss of biodiversity may be caused due to the sea-level rise etc.

The average increase in temperature of Bangladesh would be 1.3°C and 2.6°C by the year 2030 and 2075 respectively with respect to the base year 1990 (Ahmed and Alam, 1999). Two estimations of potential future sea level rise for Bangladesh are 0.30-1.5 m and 0.30-0.50 m for 2050 (DoE, 1993). Analysis of historical data from 1977 to 1998 shows annual sea level rise at the rate of 7.88 mm, 6 mm and 4mm respectively in Cox’s Bazaar (Shamsuddoha and Chowdhury, 2007).

#### 5.9.6 Oceanography

##### 5.9.6.1 Tsunami

According to the Tsunami Vulnerability Map of Bangladesh (**Figure: 5.9-7**), the project area is situated in the Tsunami Vulnerability Coastal Belt I, indicating high population vulnerability in case of a tsunami event. The coastline is close to the tectonic interface of the Indian and Burmese plates. The active Andaman – Nicobar fault system is capable of generating tsunami waves (Islam, 2006).

Even though the risk of a tsunami hitting south-eastern Bangladesh is given, it is stated in Islam (2006) that “the 2004 Indian Ocean tsunami caused no significant damage to the coast”. The author furthermore explains that “the hydrostatic pressure increased, and that resulted in water surges in different water bodies across the country”. According to information received from the NASA Earth Observatory webpage the 2004 tsunami resulted in wave heights of 2m maximum (Figure:5.9-6). (<http://earthobservatory.nasa.gov/NaturalHazards/view.php?id=14404>). Ioualalen et al. (2005)

investigated, through a simulation study, the reasons for the low impact on the Bangladesh coast. They noted that mitigation was attributable to the presence of the extended Bangladesh continental shelf, the non-radioactive direction of propagation onto the Bangladesh coast that was reached mainly by edge waves, and possible delocalization by the Nicobar and Andaman islands.

The shallow Bangladesh continental shelf and the flat coastal land are amplifying cyclonic storm surges. Surges usually exceed normal tide levels by 3 m, in extreme cases 6 m to 9 m (Islam, 2006).

Summarizing the recurrence interval of storms / cyclones vs. tsunamis, the recurring storm surges are of greater concern than an occasional tsunami (Mascarenhas, 2006).

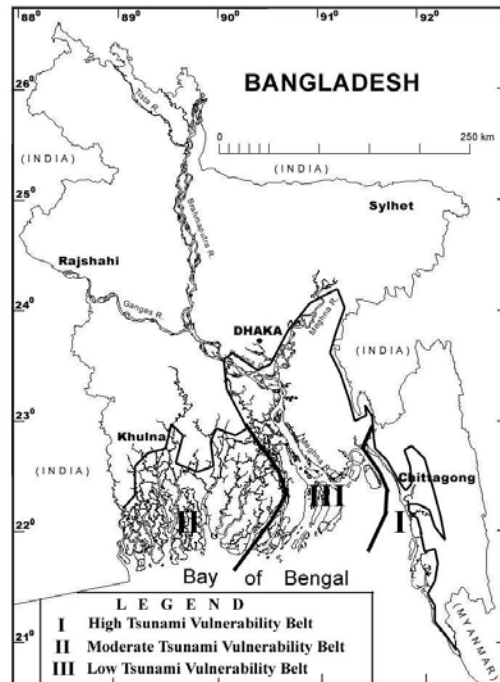


Figure 5.9-7: Tsunami Vulnerability Map of Bangladesh. (Source: Islam, 2006)

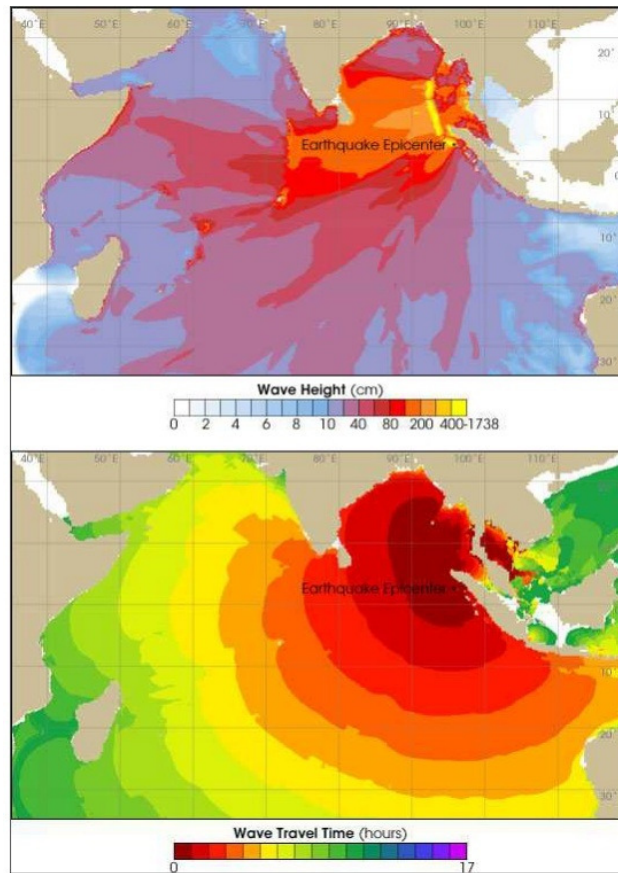


Figure 5.9-8: Modeled for the Indian Ocean Tsunami of December 26, 2004  
(Source: NASA Earth Observatory 2004)

## 5.10 LAND RESOURCES

Land comprises natural resources such as soil, water, minerals and biota. These components are organized in ecosystems which provide a variety of services essential to the maintenance of the integrity of life-support systems and the productive capacity. Land resources are used for various which include organic agriculture or crop production, reforestation, and water resource management. Baseline condition of land resources has been established through collection of secondary data from FAO/UNDP: 1988, BARC and image analysis data.

### 5.10.1 Agro-Ecological Zone (AEZ)

In Bangladesh, thirty agro-ecological zones and 88 sub-zones have been identified by adding successive layers of information on the physical environment which are relevant for land use and assessing agricultural potential. These layers are: Physiography (land forms and parent materials), Soils, Depth and duration of seasonal flooding and Agro-climatology [It comprises four elements: length of kharif and rabi growing seasons, length of pre-kharif transition period, number of days below certain winter critical temperatures (<15<sup>0</sup>C) and number of days with extremely high summer temperature (>40<sup>0</sup>C)]( FAO,1988).

Agro-ecological zones and sub-zones are very broad units. Fertility status of these zones varies greatly. Individual farmers have fragmented the land into small pieces causing wide variation in the management of each and every piece of land. This leads to the large variation in the fertility levels even between

adjacent plots. Realizing the difficulties agro-ecological zones based fertilizer recommendations for cropping patterns have been developed (BARC, 2012).

The proposed project area is comprises under two agro-ecological zones (AEZs) namely (i) Chittagong Coastal Plains (AEZ-23) and (ii) Northern and Eastern Hills (AEZ-29). The former Agro-Ecological Zone is occupying the major part of the project, and the later one is occurring in minor areas. The locations of agro-ecological zones are shown in **Figure-5.10-1**. The descriptions of Agro-Ecological Zones are described briefly as below:

#### **Chittagong Coastal Plains (AEZ- 23)**

This region occupies the plain land. It is a compound unit of piedmont, river, tidal and estuarine floodplain landscapes. The major problem in these soils is high salinity during dry season (October to May).

Grey silt loams and silty clay loam soils are predominant. Acid Sulphate soils which are potentially strongly acidic occur in mangrove tidal floodplains. Non calcareous Grey Floodplain soils, non-calcareous Alluvium and Acid Sulphate soils are the major components of the General Soil Types of the area. General fertility level of the soils is medium, and N and K are limiting. Status of S is low to optimum. Organic matter content is low to medium. The status of Zn and B is low to medium and that of N and P is very low to low. Detailed physic-chemical properties of soils of AEZ-23 are presented in the **Table 5.10-1**.

**Table 5.10-1: Detailed physic-chemical properties of soils of AEZ-23**

Major land type	Soil pH	Soil OM	Nutrients status								
			N	P	K	S	Ca	Mg	Zn	B	Mo
Highland	4.3-6.0	L-M	L	VL-L	L-opt	L-opt	M-Opt	L-opt	L-M	L-M	M
Medium highland	4.4-6.2	L-M	VL-L	VL-L	L-opt	L-opt	M-Opt	L-opt	L-M	L-M	M
Medium low land	4.5-6.2	L-M	VL-L	VL-L	L-M	L-opt	L-M	L-M	L-M	L-M	M

OM=Organic matter; VL=Very low; L=Low; M=Medium; Opt=Optimum; Source: Fertilizer Recommendation Guide, BARC, 2012

#### **Northern and Eastern Hills (AEZ -29)**

This region includes the country's hill areas. Hills have been dissected to different degrees over different rocks. In general, slopes are very steep and few low hills have flat summits.

The major hill soils are yellow-brown to strong brown, permeable, friable, loamy; very strongly acidic and low in moisture holding capacity. However, soil patterns generally are complex due to local differences in sand, silt and clay contents of the underlying sedimentary rocks and in the amount of erosion that has occurred. Brown Hill soils are the predominant General Soil Types of the area. Organic matter content and general fertility level are low to medium with very low to low status of N and P. Detailed physic-chemical properties of the soils of AEZ-29 are presented in the **Table 5.10-2**.

**Table 5.10-2: Some physic-chemical properties of soils of AEZ-29**

Major land type	Soil pH	Soil OM	Nutrients status								
			N	P	K	S	Ca	Mg	Zn	B	Mo
Highland	4.0-7.0	L-M	VL-L	VL-L	L-M	L-M	L-M	L-M	L-M	L-M	L-M

OM=Organic matter; VL=Very low; L=Low; M=Medium Source: Fertilizer Recommendation Guide, BARC, 2012



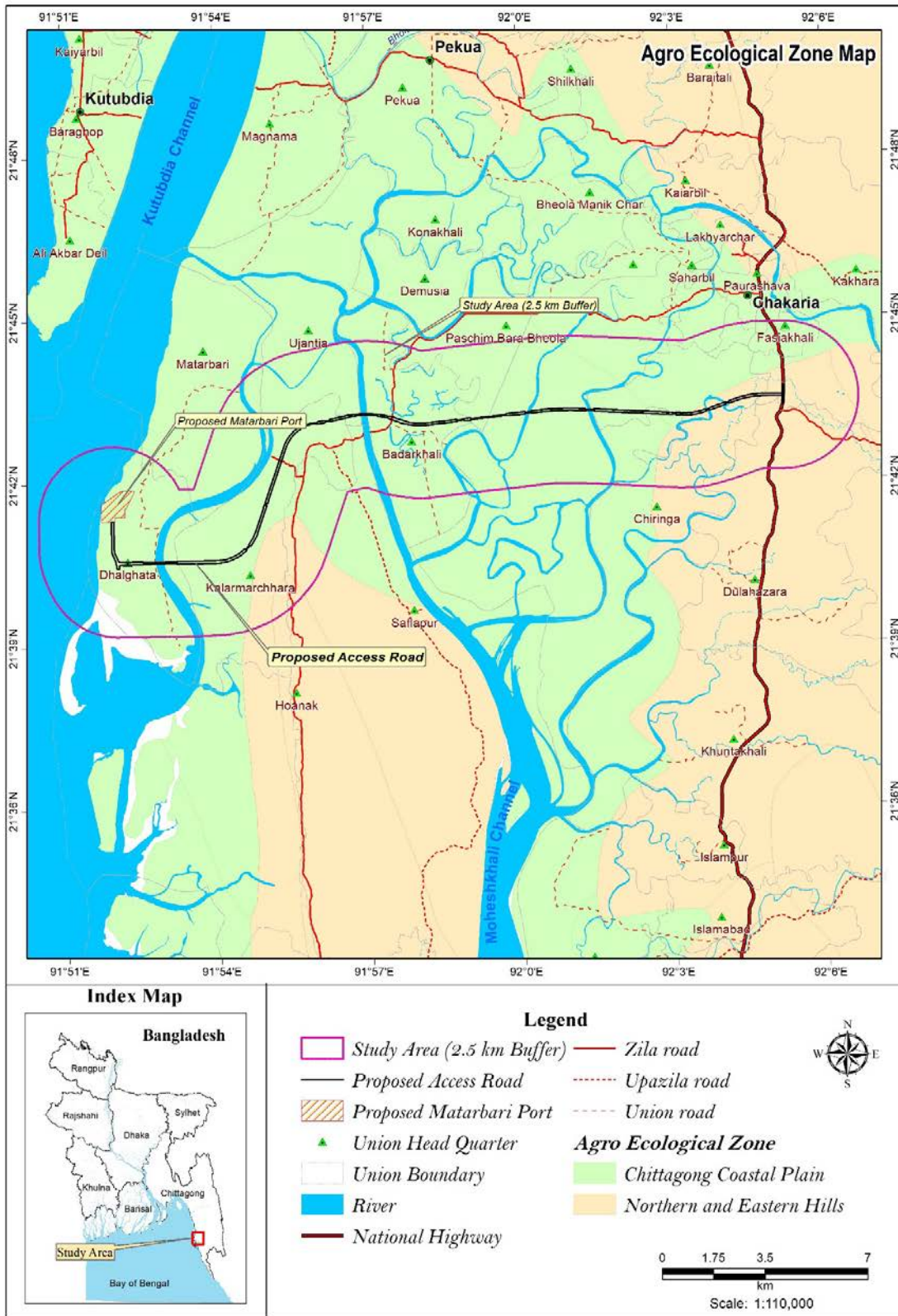


Figure-5.10-1: Agro-Ecological Region of the Study Area

### **5.10.2 Soil Texture**

Soil texture is the relative proportions of sand, silt and clay. It may be described as the percentage distribution of sand, silt and clay in a soil particle is called soil texture. It is very important for tillage operation/agricultural crop production. Most of the area (both project and study area) is covered with clay loam followed by sandy loam.

## **5.11 AGRICULTURAL RESOURCES**

The study area is full of farming, livestock and fishery resources. Baseline of agriculture resources was prepared based on primary and secondary information. The secondary data (2017-18) were collected from DAE office with consultation of DAE personnel.

### **5.11.1 Farming practices**

Farming practices largely depend on the cropping seasons. In the study area, there are three cropping seasons in a year. They are Kharif-I, Kharif-II and Rabi seasons. The Kharif-I season, start from March and ends in June. This season is characterized by the uncertainty of weather of alternating dry and wet spells. The Kharif-II season comprises wet and cloudy environment and heavy rainfall but uneven distribution, low solar radiation, high temperature and humidity. The Kharif-II season starts from July and ends in October. The Rabi season starts from November and ends in February. During this season, crops are favoured with high solar radiation, low humidity and temperature, but lack of adequate soil moisture depresses the crop yield.

In the study area, HYV Aus and vegetables are grown in the kharif-I season. Only HYV Aman is grown in the Kharif-II season. HYV Boro and vegetables crops are practiced in this the Rabi season. HYV Boro is grown under irrigated condition with the help of the low lift pumps (LLPs) and Shallow Tube Well (STWs). Supplementary irrigation is also provided in winter vegetables. However, there are occasional overlaps such that kharif-I season crops, for example HYV Aus and vegetables are harvested in kharif-II season, kharif-II season crops ( T Aman) are harvested in Rabi season as well as Rabi season crops (HYV Boro and vegetables) are harvested in kharif-I season.

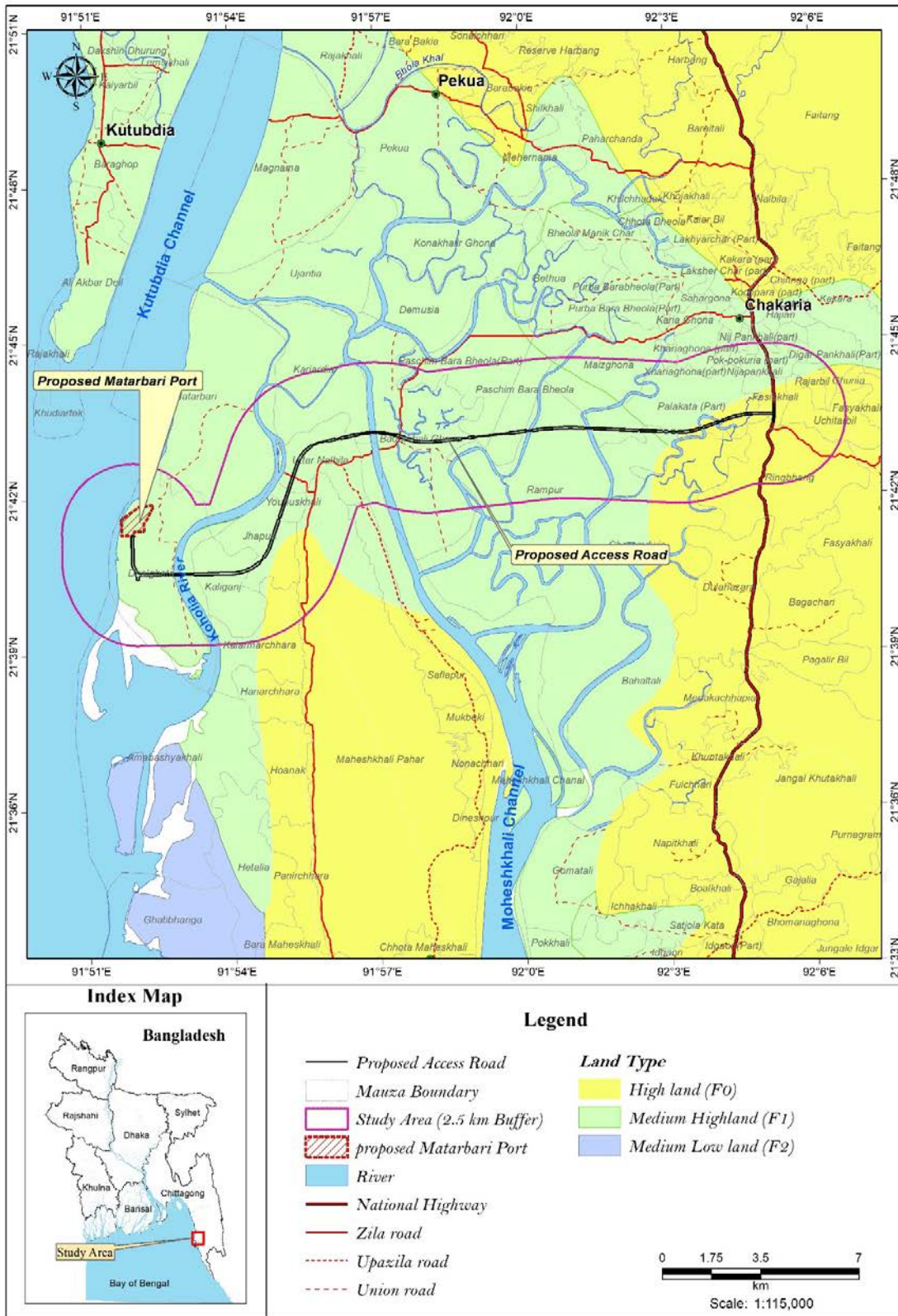


Figure-5.11-1: Land types map of the Project Area



### 5.11.2 Cropping pattern and cropping intensity

The dominant cropping pattern in the medium high land is Fallow-HYV Aman-Fallow which occupies about 40% of the NCA. A detailed cropping pattern along with land type of the study and project areas is presented in **Table 5.11-1**.

In the study area, in Kharif-I season, summer vegetables and HYV Aus are grown in about 3% and 9% of the area and the rest 88% area remains fallow. In the Kharif-II season, HYV Aman occupies about major portion of the NCA. About 3% and 48% of the NCA is covered with winter vegetables and HYV Boro respectively. The rest 49% remains fallow.

In the project area, about 38.5 ha of land is under HYV Aman cultivation in Kharif-II season and about 27.2 ha of land is covered by Rabi crop. However, about 11.36 ha of land remains fallow during Rabi season due to non-availability of fresh water. About 38.5 ha of agricultural land would be permanently lost because of construction of proposed access road.

The single, double and triple cropped areas are about 40%, 57% and 3% respectively. The cropping intensity of the study area is about 163% (**Table 5.11-1**).

**Table 5.11-1: Cropping pattern by land type of both the project and study area**

Project area (243.4 ha)				
Kharif-I (March-June)	Kharif-II (July-October)	Rabi (November-February)	Total area (ha)	% of total area
Fallow	HYV Aman	HYV Boro	25.6	67
HYV Aus	HYV Aman	Fallow	4.8	12
Fallow	HYV Aman	Fallow	6.5	17
Vegetables	HYV Aman	Vegetables	1.6	4
<b>Total</b>			<b>38.5</b>	<b>100</b>
Study area (15,320 ha - 2.5 km buffer)				
Fallow	HYV Aman	HYV Boro	1417.6	48
HYV Aus	HYV Aman	Fallow	265.8	9
Fallow	HYV Aman	Fallow	1191.1	40
Vegetables	HYV Aman	Vegetables	88.6	3
<b>Total</b>			<b>2963.2</b>	<b>100</b>

Source: Field information and DAE; 2018

### 5.11.3 Crop calendar

The detailed crop calendar of the study area is presented in **Table 5.11-2**. It is observed that generally the raising of seedlings of HYV Aman starts in early July and ends at the end August. Transplanting of Aman starts in Early August and continues up to the end of August depending on rainfall. Transplantation of Aus generally starts from early May and continues up to End of June. HYV Boro crops are transplanted during end December to end January. HYV Aman crops are harvested during early December to end of December whereas the harvesting of Aus rice is generally takes place during early August to Mid-August. Some vegetables are very sensitive to temperature. Therefore, the time of sowing and harvesting of vegetables vary.

**Table 5.11-2: Crop calendar of both the project and study area**

Crop name	Seedling		Transplanting/ Sowing		Harvesting	
	Start	End	Start	End	Start	End
HYV Aman	Early Jul	End Aug	Early Aug	Late August	Early Dec	End Dec
HYV Aus	Early Apr	End Apr	Early May	Early June	Early Aug	Mid Aug
HYV Boro	Mid Nov	Mid Dec	End Dec	End Jan	End Apr	Mid May
Brinjal	-	-	October	Mid Nov	End Nov	Mid April
Cucumber	-	-	Mid Sep	Mid Oct	Mid Janu	Mid June
Potato	-	-	Mid Sep	Mid Nov	Mid Janu	End Feb
Bitter gourd/Karala	-	-	Mid Feb	Early June	Mid June	Mid Oct
Salt	-	-	End Dec	-	-	End April

Source: Field Investigation; 2018



a) Demonstration plot in the study area



b) HYV Boro rice field in the study area

#### 5.11.4 Yield and production

The crop and salt area, yield and production of both the study and project area were estimated using primary and secondary data of Chakaria and Moheshkhali upazila under Cox's bazaar district. The secondary data were collected from DAE office with consultation of DAE personnel and primary data collection by field survey in 2018. During estimation of production of vegetables, the average yield of the different vegetables were using. Detailed cropped and salt area and production is presented in **Table 5.11-3**.

**Table 5.11-3: Crops and salt area, yield and production in both project and study area**

<i>Project area(243.4 ha)</i>			
Crop name	Crop area (ha)	Yield(ton/ha)	Total production (ton)
HYV Aus	4.8	1.7*	8.3*
HYV Aman	38	2.2*	85.6*
HYV Boro	26	3.5*	88.6*
<b>Total rice</b>	<b>69</b>		<b>182</b>
Summer vegetables	1.6	9.9	15.8
Winter vegetables	1.6	12.1	19.4
<b>Total non-rice</b>	<b>3.2</b>		<b>35</b>

<b>Project area(243.4 ha)</b>			
<b>Crop name</b>	<b>Crop area (ha)</b>	<b>Yield(ton/ha)</b>	<b>Total production (ton)</b>
<b>Total</b>	<b>72</b>		<b>218</b>
Salt	156	25	3,900
<b>Study area (15,320 ha - 2.5 km buffer)</b>			
HYV Aus	265.8	1.7*	459.6*
HYV Aman	2,963	2.2*	6587.2*
HYV Boro	1,418	3.5*	4902.2*
<b>Total rice</b>	<b>4,647</b>		<b>11,949</b>
Summer vegetables	88.6	9.9	875.4
Winter vegetables	88.6	12.1	1072.4
<b>Total non-rice</b>	<b>177.2</b>		<b>1,948</b>
<b>Total</b>	<b>4,824</b>		<b>13,897</b>
Salt	5,996	25	1,49,900

Sources: Field information and DAE; 2018 \*Indicates cleaned rice

#### ***Crop yield***

The crop yield rate was estimated from the information collected from the local DAE offices and in consultation with the stakeholders and farmers at field level. The yield rate of vegetables is calculated on an average yield rate. The average normal yield rate of HYV Aus, HYV Aman, HYV Boro, summer vegetables and winter vegetables are about 1.7, 2.23, 3.5, 9.9 and 12.1 ton/ha in the project and study area respectively. The yield rate of salt is about 25 ton/ha in the project and study area.

#### ***Crop production***

Total annual crop production in study area is about 13,897 tons of which rice production is about 11,949 tons (86%) and non-rice crops is about 1,948 tons (14%). The contribution of HYV Aus, HYV Aman and HYV Boro are about 4%, 55% and 41% respectively over total rice production.

Similarly, total annual crop production of the project area is about 218 ton of which rice and non-rice production is about 182 tons and 35 tons respectively. However, annually about 218 tons of crop production would be permanently lost due to the proposed access road. Detailed annual agricultural crop and salt production is presented in Table 6.21.

#### ***Salt production***

Total salt production in the study and project area is about 1,49,900 and 3,900 tons respectively. About 156 ha salt pan area that produced 3900 tons of salt annually, would be permanently lost because of proposed access road.

#### ***Local price of the crops and salt***

Farmers of the study area sell their products in local markets. The prices of the different crop and salt are collected from local markets as Tk/kg. Later it was calculated as BDT/ton, which is presented in the **Table 5.11-4**

**Table 5.11-4: Local market price of different crops and salt**

SI No.	Name of the crops	Local price (BDT./ton)
1	HYV Aus	25,000
2	HYV T Aman	25,500
3	HYV Boro	25,500
4	Summer Vegetables	10,000
5	Winter Vegetables	9500
6	Salt	3,750

Source: Farmers interviewed, 2018

### 5.11.5 Agricultural input use

Seed, labor, fertilizer, pesticides, IPM/ICM and irrigation are the major inputs for crop production. The details agricultural inputs are presented below

#### Seeds

The role of seed is very important for growing crops. Good quality seeds have some criteria, i.e. they are to be free from disease infestation, have germination ability of more than 85%, have the capacity for producing higher yields, are improved crop cultivars etc. Seeds are to be selected carefully. The seed rate for different crops varies from crop to crop depending on size and management practices. In case of rice, farmers are using more seed than recommended as they normally use more seedlings per hill. In most cases, seedlings are affected by monsoon flood. Most of the farmers use their own seeds. Seeds are available in the local markets. According to agro-ecological zone (AEZ-23 and AEZ-29) the recommended seed rate (BARI 2011-2012 and BRRI 2013) and the seed rate used by the farmers are presented in **Table 5.11-5**.

Among rice crops, HYV/modern varieties HYV Aus: BINA6, Chandina/BR1, BRRI dhan28, BRRI dhan42, Lal dhan: Indian variety, HYV Aman: BRRI dhan28, BRRI dhan42, BRRI dhan44 and Swarna: Indian variety, HYV Boro: BRRI dhan28, BRRI dhan29, BINA 8 and BINA 10, Potato: Dohazari, Diamant, Yard long bean: Local improved and yard long, (Brinjal: BARI begun-4 and local improved variety, Bitter gourd: Local improved variety and hybrid variety, Cucumber: Local improved variety of cucumber and hybrid variety are very much popular among the farmers.

**Table 5.11-5: Seed used in both the project and study area**

Sl. No.	Crop name	Recommended rate(kg/acre)	Farmer using seed (Kg/acre)
1	HYV Aus	20	25
2	HYV Aman	20	15
3	HYV Boro	20	30
4	Potato	600	5,00
5	Yard long bean	0.4	0.5
6	Brinjal	0.10	0.15
7	Bitter gourd/ Karala	0.75	0.5

Sources: Field information; SAAOs, DAE; 2018 and BARI 2011-12, BARC; 2012, BINA, 2012 and BRRI; 2013

### Labor

Almost 65% of the cultural practices for crop production in the study area are being done manually. So, agricultural labor (seed sowing, intercultural operations, and harvesting and post-harvest technologies) is considered as one of the essential inputs for crop production. The labor requirement is not uniform throughout the year. The number of labor requirement varies from crop to crop and season to season. Female labors are not engaged in the field level activities, they work in the household level activities. The average number of labor (male) per acre used in the study area is presented in **Table 5.11-6**.

**Table 5.11-6: Farmers used in both the project and study area**

Sl. No.	Crop name	No. Labor/acre	Labor wages / day (Tk.)	
			Male	Female
1	HYV Aus	65-75	400(Including food),450-500(Excluding food)	0
2	HYV Aman	60-70	400(Including food),450-500(Excluding food)	0
3	HYV Boro	80-90	400(Including food),450-500(Excluding food)	0
4	Potato	70-80	400(Including food),450-500(Excluding food)	0
5	Yard long bean	50-60	400(Including food),450-500(Excluding food)	0
6	Brinjal	80-90	400(Including food),450-500(Excluding food)	0
7	Bitter gourd	50-60	400(Including food),450-500(Excluding food)	0

Source: Field information; 2015, UAO, SAAOs, DAE

### Fertilizers

The rate of fertilizer use per acre varies considerably from farmer to farmer depending on soil fertility, cropping pattern and financial ability etc. The major fertilizers used in this area are Urea, TSP, DAP and MP. Farmer reported that they use TSP in HYV Boro crops. In most of the cases farmers are using fertilizers in unbalanced way. Organic manures are not used by the farmers in the field crops. Local farmers and SAAO's of DAE reported that cow dung is used for homestead garden and fuel purposes.

**Table 5.11-7: Recommended dose and farmers using dose in both the project and study area**

Sl. No.	Crop Name	Recommended dose of fertilizer(kg/acre)							Farmers using fertilizer (Kg/acre)			
		Cow dung	Urea	DAP	TSP	MP	Gypsum	ZnSO <sub>4</sub>	Urea	DAP	TSP	MP
1	HYV Aman	0	66	0	9	17.0	7	21	40	0	30	15
2	HYV Aus	0	79	0	9	234	9	2	40	0	30	15
3	HYV Boro	0	132	25	18	10	3	1	30	15	18	5
4	Potato	2,000	119	0	27	61	9	2	61	0	16	8
5	Yard long bean	2,000	40	0	19	14	7	1	40	0	32	16
6	Brinjal	2,000	106	0	32	20	17	1	40	0	20	16
7	Bitter gourd	2,000	66	0	27	20	11	0	32	0	20	8

Sources: Field information; March 2015, BARI 2011-12, BARC 2012 and BRRI 2013

### ***Pesticides***

The use of pesticides depends on the degree of pest infestation. The major insects as reported by the farmers are Stem borer, Ear cutting caterpillar, Green leaf hopper, Rice bug and Brinjal fruit and shoot borer. Local farmer reported that they use different types of pesticides such as Virtako, Diatop50SP, Nitro, Basudin, Mr.Top, Trasher 45EC, Karate 2.5 EC and Ripcord etc. to prevent pest infestation in both rice and vegetables cultivation. Both liquid and granular pesticides are being used to prevent pest in rice and vegetables cultivation. Detailed information of pesticides used is presented in **Table 5.11-8**.

**Table 5.11-8: Pesticide used in both the project and study area**

Sl. No.	Crop Name	Farmers using pesticides		
		No of Application	Liq. (ml/acre)	Gran. (Kg/acre)
1	HYV Aus	1-2	280-300	0
2	HYV Aman	2-3	300-350	3-4
3	HYV Boro	3-4	350-500	4-5
4	Potato	2-3	350-400	0
5	Yard long bean	1-2	150-200	0
6	Brinjal	3-4	300-450	0
7	Bitter gourd	1-2	150-200	0

*Sources: CEGIS Estimation based on field information; March, 2015, SAAO, DAE*

### ***Integrated Pest Management (IPM)***

Integrated Pest Management (IPM) is a technique to control pest or insects biologically. It is practiced in many places of the study area. Farmers of the IPM areas use branches of trees, bamboo and jute sticks etc. to make favourable perches for birds in fields with standing crops. The birds eat insects which help to control pest infestation. In this process, the crops are protected without applying pesticides. Light Trap is another technique for controlling pests in the agriculture fields especially on HYV rice and vegetables for attracting insects. It is thus possible to control the harmful insects without applying of pesticides. Recently, ICM (Integrated Crop Management) technique is mainly applied on rice and vegetables crops. Field information (Farmers and SAAOs of DAE) indicates that IPM/ICM is being practiced in the fields covering about 8-10% of the cultivated areas and the impact has been found very encouraging.

#### **5.11.6 Livestock Resources**

##### ***5.11.6.1 Status of livestock and poultry***

Livestock and poultry, being an essential element of integrated farming system, play an important role in the economy of the study area. Livestock provides significant draft power for cultivation, threshing of rice crop; cow dung is used as a source of manure and fuel; a ready source of funds and meat, milk and eggs for human consumption. Most of the households raise poultry and livestock, which significantly reduce poverty through generating income. About 40%, 2%, 30% 5%, 40% and 60% of households of the study area are rearing cows/bullock, buffalo, goat, Sheep, Duck and chicken respectively.





### Livestock in the Project Area

The owner of the livestock population in the project area is facing problems in respect of non-availability of fodder and feeds during the month of July to November due to unavailability of grazing land. Rice straw is used as the main source of fodder. Besides oil cake and rice barns are also used as fodders. Poultry population at family level survives by scavenging and generally no feed supplements are provided. However, at times kitchen waste becomes feed to the poultry.

Productions of livestock and poultry are mainly constrained due to diseases and death of the population. Sometimes diseases are seen as epidemic form causing a considerable economic loss in livestock farming. Every year livestock population is affected by different diseases like Foot and Mouth Disease (FMD), Anthrax (Torka), Black leg (Badla), Gola fula (Hemorrhagic Septicemia), Pet fula (Enterotoxaemia), Diarrhea, Mastitis (Olan fula), Peste Des Petits Ruminants (PPR) etc. The goat cyst in head is a common disease of goat. Major poultry diseases are New Castle (Ranikhhet), Fowl pox, Duck plague, Chronic Respiratory Disease (CRD) and Dysentery, etc. The most vulnerable period is June to October (rainy season) months for spreading diseases to livestock and poultry populations. The duck plague generally occurs in summer. However, some diseases are found round the year. During monsoon season, the soggy condition of the animal shelter promotes various kinds of diseases to the bullocks and cows.

## 5.12 FISHERIES RESOURCES

The study area is situated in the transitional zone of sea shore and land having characteristic phenomena of fisheries. The fisheries resources of the study area are rich and diversified with mainly brackish water to minor fresh water fish habitats. This area supports a wide variety of marine and fresh water fish species. A number of river, channel and Khal have crossed across the study area. The Moheshkhali Channel and the Kutubdia Channel feeds fresh water to the sea and a brackish water ecosystem is created in the confluence. This ecosystem supports potential breeding grounds to both marine and fresh water fish species by maintaining biological balance of the major fish groups. The fisheries resources related information was collected from field survey in 2018.

### 5.12.1 Habitat Characteristics

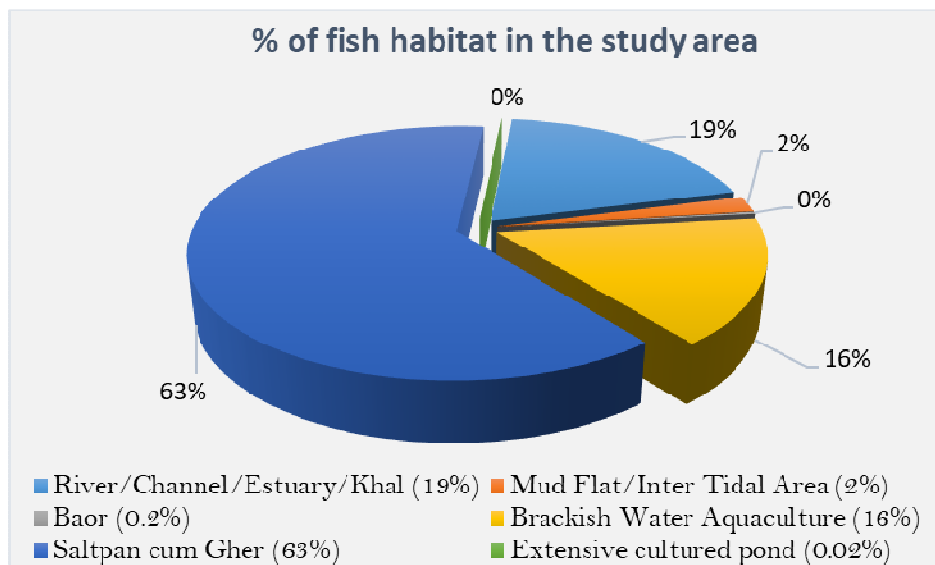
The capture habitats include rivers, channels and khals which have tidal influence and serve as breeding and feeding grounds for brackish and some fresh water fishes. These habitats also act as important migration route like Ilish, Koral, Poa, Bagda, etc in the study area. The Moheshkhali Channel is covered with natural and planted mangrove forest (Parabon) which play an important role as grazing, breeding and nursery ground for various fish species like Vetki, Lakkha, Bagda, Poma, Icha etc.

Shrimp culture is done in the wet season on land in trapped saline water environment which is nourished by tidal flow at times when required. Bagda (*P. monodon*) is the key species in such culture system. Mainly, wild seeds are used in shrimp farms of this area as it is adjacent to the sea. Mortality of those seeds is 50% which is less than the hatchery seeds. Shrimp culture usually starts in May/June and harvested at different times within five months and ended in October. Wild fish or shrimp that enter into the culture are become trapped include but not limited to Chaka Chingri (*P. indicus*), Loli Icha (*M. spinulatus*), Kharul Bata (*M. cephalus*), Choukka (*P. ditchela*), Koral (*L. calcarifer*), Datina (*A. latus*), Chiring (*S. histophorus*), etc.

The fresh water aquaculture is practiced in homestead pond by extensive culture method. Most of the homestead ponds are smaller and single cycle of fish culture is practiced by extensive culture method particularly during wet season. Water availability period of the smaller ponds is 36-40 weeks annually. The larger ponds are practiced with two cycle of fish culture as the ponds contain water round the year.

### 5.12.2 Fish Habitat Assessment

Based on the land use data prepared using Satellite image analysis, mentioned in the **Table 5.12-1**, the estimated total fish habitat of the study area is about 9,614 ha , where the sharing of the project area fish habitat is about 184.3 ha. As a whole, the culture fishery contributes the major (78.5%) and the rest is shared by capture fishery. Among the fishery habitats, shrimp farm contributes about 63% followed by river/channel/estuary/Khal, inter tidal area and others as shown in **Figure 5.12-1**. **For construction of the Access road, about 175 ha of the culture habitat area will be affected permanently.** **Table 5.12-1** presents the distribution of fish habitat in project area and study area.



*Source: Land use data extracted from Satellite image and also validated at field level*

**Figure 5.12-1: Percentage of fish habitat area in the study area**



**Table 5.12-1: Analysis of fish habitat in the study area**

Sl. No.	Fishery Types	Habitat Types	Study Area (hectare)	Project Area (hectare)
1	Capture	River/Channel/Estuary/Khal	1,854	8.8
2		Mud Flat/Inter Tidal Area	195	1.7
2		Baor	23	-
<b>Sub-Total=</b>			<b>2,072</b>	<b>10.5</b>
3	Culture	Brackish Water Aquaculture (Gher/Shrimp culture)	1,544	16.6
4		Saltpan cum Gher (seasonal)	5,996	156.0
5		Extensive cultured pond	1.6	1.2
<b>Sub-Total=</b>			<b>7,542</b>	<b>173.8</b>
<b>Grand Total=</b>			<b>9,614</b>	<b>184.3</b>

Source: Estimation using field data, land use data prepared using Satellite Image



Riverine fish habitat (Kohalia River at Dokhin Rajghat)



Seasonal Shrimp farm

**Picture: Different types of fish habitat (capture and culture) in the study area**

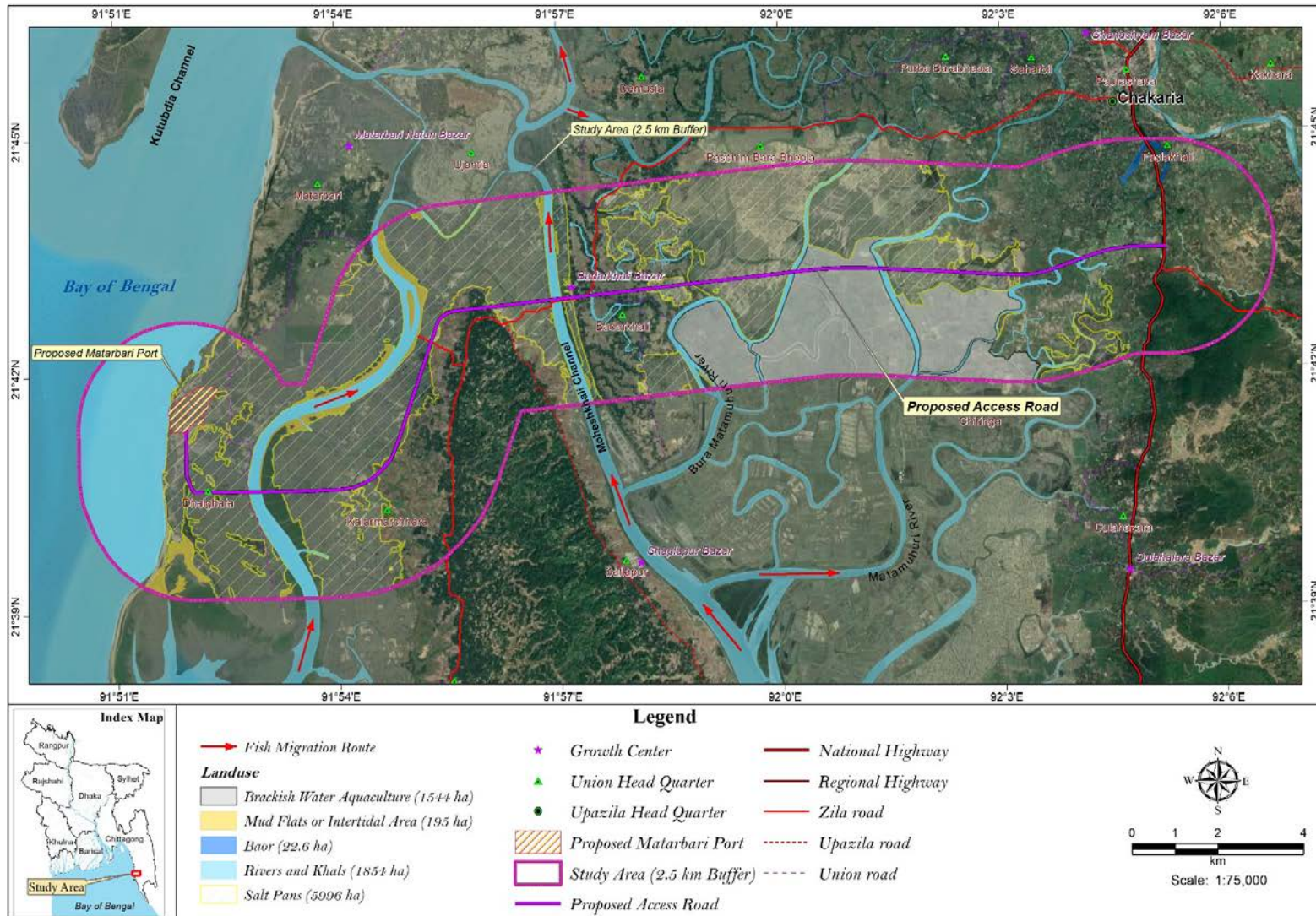


Figure 5.12-2: Fish habitat of the study area

### 5.12.3 Fish Productivity Assessment

The yearly productions of the capture fishery resources in the study area are derived from river/channel/estuary/Khal and inter tidal area. The production of culture fishery resources is derived mainly from seasonal shrimp farm in wet season (saltpan in dry season) and cultured pond. The estimated annual total fish production of the study area is about 3,947 Metric Tons (MT), where the share of the project area is about 88.7 MT. **It is mentioned here that, for construction of the proposed access road about 88.7 MT fish production will be loss permanently.** The production of different fish habitats is presented in Table 5.12-2.

**Table 5.12-2: Fish production assessment**

Habitat Category	Habitat Type	Production rate (Metric ton/hectare)	Production (MT)	
			Study Area	Project Area
Capture	River/Channel/Estuary/Khal	0.125	231.8	1.1
	Mud Flat/Inter Tidal Area	0.09	17.5	0.2
	Baor	0.1	2.3	0.0
<b>Sub-total=</b>			<b>251.6</b>	<b>1.3</b>
Culture	Brackish Water Aquaculture (Gher/Shrimp culture)	0.45	694.8	7.5
	Saltpan cum Gher (seasonal)	0.5	2998.1	78.0
	Extensive cultured pond	1.65	2.6	2.0
<b>Sub-total=</b>			<b>3695.5</b>	<b>87.5</b>
<b>Grand Total=</b>			<b>3947.1</b>	<b>88.7</b>

Source: Field Survey, 2018 and FRSS, 2016

### 5.12.4 Fish Migration

The Kutubdia Channel, the Moheshkhali Channel, the Matamuhuri River, the Kohalia River and internal Khals having tidal influence serve as a major corridor of fish and shrimp migration of the study area. The internal Khals which play important roles in fish migration from sea shore to inland water bodies. Both anadromous and catadromous fishes migrate through these Khals for meeting different biological requirements throughout the year at each stage of their lifecycle. The major migratory fish species of the study area are Ilish (a flagship species), Koral, Khoir, Undara, Poa, Olua, Bata, Tailla, Bagda, etc.

### 5.12.5 Fishing Tools

The study area has the characteristics of a mixture of estuary and inland fishing. Fishing in such habitats is carried out using diversified gears and appliances for catching different fish species. Gears used in this area and gear specific fish species are: (i) Ilish jal, used to catch Ilish, (ii) Gira jal, used to catch Bata, Koral, Datina, Bishtara, etc., (iii) Bata jal, used to catch Bata, Guilla/Tengra, Poa, etc., (iv) Behundi/Bindi jal, used to catch Gura chingri, (v) Gara jal, used to catch Chiring, Noila etc., (vi) Tounga jal/Thela jal, used to catch chingri, (vii) Net jal, used to catch PL of shrimp, (viii) Jhaki jal used to catch Chiring, Icha, Bata, Datina, Telapia, Koral etc.



### 5.12.6 Fish Biodiversity and Composition

During consultation with local fishers and elderly people reported that the fish biodiversity is declining over the years. It is reported that the Matamuhuri River and the Kohalia River once were available with large fish species like Ilish, Koral, Boal, Bangla, Tailla, etc but the catch is now rather meagre. Major factors responsible for the downturn of the species diversity are: (i) narrowing down of the riverine habitat (ii) fishing by destructive gear; (ii) increasing fishing pressure; (iii) collection of shrimp PL which cause the mortality of other fish fauna, (iv) obstruction in fish migration routes; (v) aggradations of riverine habitats due to geo-morphological processes, etc. The study area comprises both brackish and fresh water fish species as shown in **Figure 5.12-3**. The indicative fish species in different habitats of the area are presented in **Table 5.12-3**.



Mixed catch of brackish water



Rupchanda (*Pampus chinensis*)



Chaka chingri (*Penaeus indicus*)



Kalo Datina (*Acanthopagrus berda*)

Checklist of the fishes of different habitats reported by local fishers is analyzed to draw a tentative scenario of the local fish biodiversity of the study area.

**Table 5.12-3: Indicative fish species diversity by habitats with IUCN status**

Scientific Name	Local Name	IUCN Status	Habitat Type		
			Culture		
			Capture	Shrimp Farm	Fish Pond
			River/Channel/ Estuary/Khal		
<b>Brackish water fish species</b>					
<i>Tenualosa ilisha</i>	Ilish	(S, E, R), NO	P	A	A
<i>Otolithoides pama</i>	Poa	(E, S), NO	P	A	A
<i>Lates calcarifer</i>	Koral	(C, E), NO	P	P	A
<i>Harpadon nehereus</i>	Loitya	(E, S), NO	P	A	A
<i>Apocryptes bato</i>	Chiring	(R, E), NO	P	A	A
<i>Mystus gulio</i>	Guilla	(MA), DD	P	A	A
<i>Acanthopagrus latus</i>	Datina	(E, S), VU	P	A	A
<i>Dussumieria acuta</i>	Nailya	(E, S), NO	P	A	A
<i>Rhinomugil corsula</i>	Bata	(E), NO	P	P	A
<i>Penaeus monodon</i>	Bagda	(E, S), NR	P	P	A
<i>Penaeus indicus</i>	Chaka Chingri	(E, S), NR	P	P	A
<i>Macrobrachium rosenbergii</i>	Golda	(R, E), NR	P	P	A
<i>Eleutheronema tetrodactylum</i>	Tailla/Surma	(S, E, R), NO	P	A	A
<i>Acentrogobius caninus</i>	Bailla	(R, E), NO	P	A	A
<i>Taenioides anguillar</i>	Chewa	(R, E), NO	P	A	A
<i>Liza parsia</i>	Parse Bata	(R, E), NO	P	A	A
<i>Coilia dussumieri</i>	Olua	(S, E), NO	P	A	A
<i>Polynemous paradiseus</i>	Tapse	(S, E), NO	P	A	A
<b>Fresh water (culture) fish species</b>					
<i>Labeo rohita</i>	Rui	Ex	A	P	P
<i>Catla catla</i>	Katol	Ex	A	P	P
<i>Cirrhinus cirrhosus</i>	Mrigel	Ex	A	P	P
<i>Tilapia nilotica</i>	Nilotica	Ex	A	P	P
<i>Hypophthalmichthys molitrix</i>	Silver carp	Ex	A	P	P
<i>Pangasius sutchi</i>	Thai pangus	Ex	A	P	P
<i>Puntius sarana</i>	Sharpunti	Ex	A	P	P

Note: Habitat preference (, A=Absent and P=Present, C - Coastal water, E - Estuary, Ex – Exotic species, MA - Migratory anadromus, P - Pond, R - River, S – Sea). Threatened category (CR – Critically endangered, EN – Endangered, VU – Vulnerable, NO - Not threatened, NR – Not reported by IUCN 2000, DD - Data defici ent)

Sources: IUCN Bangladesh, 2000. Red Book of Threatened Fishes of Bangladesh and fishers consultation

## 5.13 ECOLOGICAL RESOURCES

The study area and its surrounding comprise different landforms having varied vegetation patterns which create different habitats. The project area is located very near to the Bay of Bengal. Regular tidal flow, salinity intrusion through the canals and tidal surge is changing the land use pattern. The study area has been occupied by sea, saltpan, canal, forest, stream, shrimp farm, mudflat, pond, homestead, agriculture land etc. The area has been demarcated under certain bio-ecological zone from physiographic and biodiversity points of view.

### 5.13.1 The Bio-ecological Zone

IUCN, The World Conservation Union, has divided Bangladesh into 25 Bio-ecological Zones (Nishat et al, 2002) in context of physiographic and biological diversity. The study area has fallen under four bio-ecological zones: i) Chittagong Hills and the CHTs, ii) off-shore island, iii) Coastal and Marine Waters, and iv) Coastal Floodplain. The area occupies terrestrial as well as aquatic ecosystems. Each of the bio-ecological zones represent overall ecological situation of an area of the country. A brief description of the Bio-ecological zone is presented below.

#### 5.13.1.1 Chittagong Hills and the CHTs

This zone is composed of tropical evergreen and semi-evergreen forest. While the hills are not very high generally about 600m they are ragged and often steep. These hill forests are the most important watershed areas of the country. The tropical evergreen and semi-evergreen forest are not very distinct, and are often intermingled and merged into one another in this zone. The majority of the species in the lower canopy are evergreen, and the upper canopy of the forest is deciduous type. Some of these deciduous tree species shed their leaves in the winter while other does it in the monsoon, so the forests appear evergreen. Tropical evergreen forest is found in the valleys of this zone. The predominant species are; Civit (*Swintonia floribunda*), Garjan (*Dipterocarpus sp.*), Chapalish (*Artocarpus chaplasha*), Chundul (*Tetrameles nudiflora*), Telshur (*Hopea odorata*). In the lower canopy important species like the Pitraj (*Aphanamixis polystachys*), Toon (*Toona ciliata*), Nageshwar (*Mesua ferrea*), Uriam (*Mangifera sylvatica*) and various Ficus species can be found. The undergrowth is usually a tangle of shrubs, in which cane, bamboo and wild banana are the prominent species. Knowledge on the diversity of reptiles and amphibians of this zone is rather rudimentary, as few surveys of these animals have been made. This zone possesses richest avifauna population of the country mostly marine and shore birds. Out of 66 families of birds which are seen in the country, 55 are available in this zone.

#### 5.13.1.2 Offshore Islands

This zone covers mostly mudflats. Moreover, there are extensive inter tidal mudflats composing parts of the islands. Most of these mudflats occur along the inland creeks. There are also large shoals in this area; these may consolidate into large islands by the end of this century. The vast amount of sediment brought down by the Meghna made the estuary shallow for a considerable distance (Rashid, 1991). Among the rich vegetation observed in this zone, there are man-made plantations of mangroves, such as the Keora (*Sonneratia apetala*), and Tiyan baen (*Avicennia officinale*) in the Nijhum dweep, Ghasiar char and Char batao. The vegetation in the interiors of Hatiya is similar to that of the mainland and includes: the Sada koroï (*Albizia procera*), Shaora (*Streblus asper*), Gab (*Diospyros peregrina*), Babla (*Acacia nilotica*), Kadam (*Anthocephalus chinensis*), Banyan (*Ficus bengalensis*), Jam (*Syzygium sp.*), Mandar (*Erythrina indica*), Sonalu (*Cassia fistula*), Date palm (*Phoenix sylvestris*), Toddy palm (*Borassus flabellifer*), Coconut (*Cocos nucifera*) and various bamboo species. The islands of this zone are very important staging and wintering areas for a wide variety of waterfowl, particularly the migratory shorebirds. Rashid

(1989) recorded over 108,000 waterfowl of 49 species, together with 5,500 unidentified ducks and 56,500 unidentified shorebirds. Besides, some of the common reptiles of the zone include: the Common garden lizard (*Calotes versicolor*), Common skink (*Mabuya carinata*), Bengal monitor (*Varanus bengalensis*), Yellow monitor (*V. flavescens*), Checkered keelback (*Xenochrophis piscator*), Binocellate cobra (*Naja naja*) and Spotted flapshell turtle (*Lissemys punctata*). Likewise, common mammalian species of this zone include: the Ganges river dolphin (*Platanista gangetica*), Jackel (*Canis aureus*), Small Indian mongoose (*Herpestes auropunctatus*), Clawless otter (*Aonyx cinerea*), Large Indian civit (*Viverra zibetha*) and Greater bandicoot rat (*Bandicota indica*).

#### **5.13.1.3 Coastal and Marine Waters**

The marine area comprises the territorial waters and the Exclusive Economic Zone (EEZ) of Bangladesh. The coastline along the Bay of Bengal is 1200 kilometers long including the coastlines of numerous islands, but not measuring minor indentations. The coastal zone has its own dynamics and deserves special attention as a very distinct terrain (GoB, 1994). The coastal area, comprising of the complex delta of the Ganges-Brahmaputra-Meghna river system has immense biological resources. The river system, while flowing through Bangladesh on its way to the Bay of Bengal, carries an estimated annual sediment load of about 2.0 billion tons; these sediments are subjected to coastal dynamic processes generated mainly by river flow and tidal wind actions, leading to accretion and erosion in the coastal areas of Bangladesh. Knowledge base on the status of the biological wealth, both in terms of floral and faunal, is very rudimentary of this zone. Nonetheless, some of the faunal species which are known to occur in this zone include the Fin whale (*Balaenoptera physalus*), Humpback whale (*Megaptera novaeangliae*), various species of dolphins: e.g. the Ganges dolphin (*Platanista gangetica*), Irrawaddy dolphin (*Orcaella brevirostris*), Indo-Pacific hump-backed dolphin (*Sousa chinensis*), all five species of marine turtles: the Loggerhead turtle (*Caretta caretta*), Green turtle (*Chelonia mydas*), Hawksbill turtle (*Eretmochelys imbricata*), Olive ridley turtle (*Lepidochelys olivacea*), Leatherback turtle (*Dermochelys coriacea*), snakes, numerous migratory waterfowl, marine fishes, echinoderms, mollusks, etc.

#### **5.13.1.4 Coastal Plains**

The coastal plains are underlain by heavy marine or tidal clays but these have been buried under by more sand or salty deposits near the foot of the hills and along the courses of rivers and streams which run across the plains. The eastern coastline, extending from the mouth of the Feni River to the southern tip of mainland along Chittagong, is regular and unbroken and protected along the sea by mud floods and submerged sands. This zone is important for a wide variety of waterfowls.



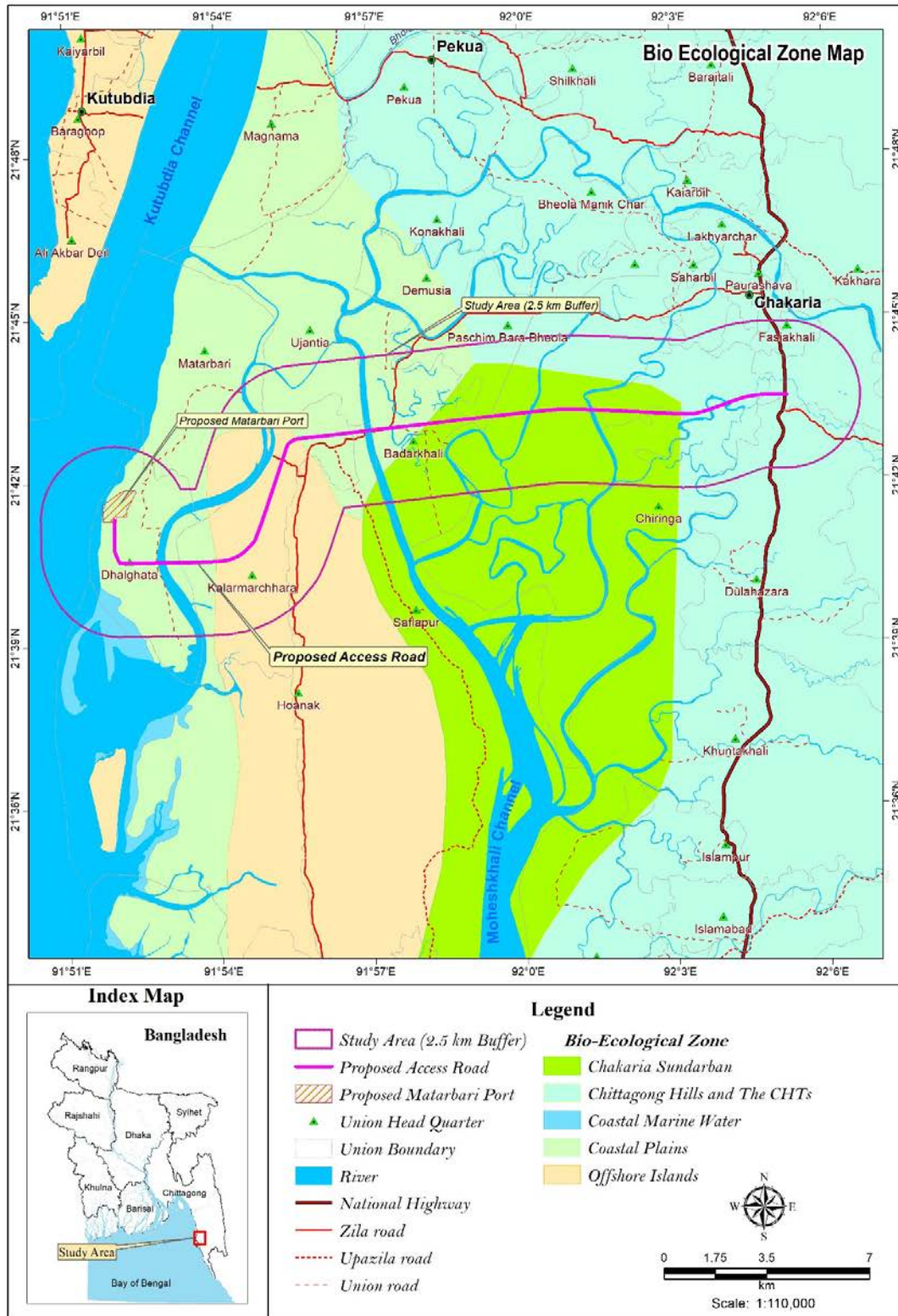


Figure 5.13-1: Bio-Ecological Zones of the Study Area



## **5.14 ECOSYSTEM**

The study area supports different types of habitat with different species of flora and fauna. Ecosystems of the study area can be divided into four major categories, such as i) Terrestrial ecosystem, ii) Mangrove Ecosystem, iii) Aquatic ecosystem and iv) Marine Ecosystem. Each major category is further divided into sub-categories. However, overall situation of ecological resources and ecosystems of the area are described below.

### **5.14.1 Terrestrial Ecosystems**

The terrestrial ecosystem of the study area used to be covered agriculture land, hill vegetation, road side vegetation and homestead vegetation. The hill sides and top, which were not occupied by human habitations, were lightly covered with large growths of semi-spontaneous vegetation. These types of vegetation have a major contribution for meeting food, fodder, medicine, fuel and other household requirements to the local people. Natural vegetation includes wooded areas, grassland and other natural habitats. Human influenced vegetation includes homestead gardens, orchards, plantation, cropland and other planted or cultivated habitat. The ecosystem consists of both static (Flora) and dynamic (Fauna) life lines which are described below.

#### **5.14.1.1 Terrestrial Flora**

The terrestrial flora of the area can be categorized as i) Homestead vegetation, ii) Forest vegetation, iii) Crop field vegetation, iv) Coastal, Roadside and Embankment vegetation. Each category of vegetation has distinguished characteristics to separate them from each other. Characteristics of vegetation by category are described as follows:

##### **Homesteads Vegetation**

The Homestead are planted flora for the household benefits. Species are usually planted in the yard or periphery of the settlement with interest of financial benefits. This type of vegetation mainly contains flower, fruit timber, thatching and medicinal plants and provides facilities for earning money. The dominant plant of the study area is Eucalyptus, Khajur, Neem, Acacia, Rain tree etc. The dykes of the homestead ponds are planted with economically important plant species like Narikel, Murta, Supari, etc. Homestead vegetation is the single most important plant community in the area. The backyard of each homestead is generally cultivated with fruit and timber trees though there are also different types of naturally grown shrubs and herbs.

##### **Forest vegetation**

Under the Climate Resilient Participatory Afforestation & Reforestation Project (CRPARP) there are some afforestation programs of Jhaw and Mangrove in the project study area. This afforestation is on the accretion land formed in the coastal and bank line of the river area. Figure 5.14-1 shows the forest vegetation of the project area.

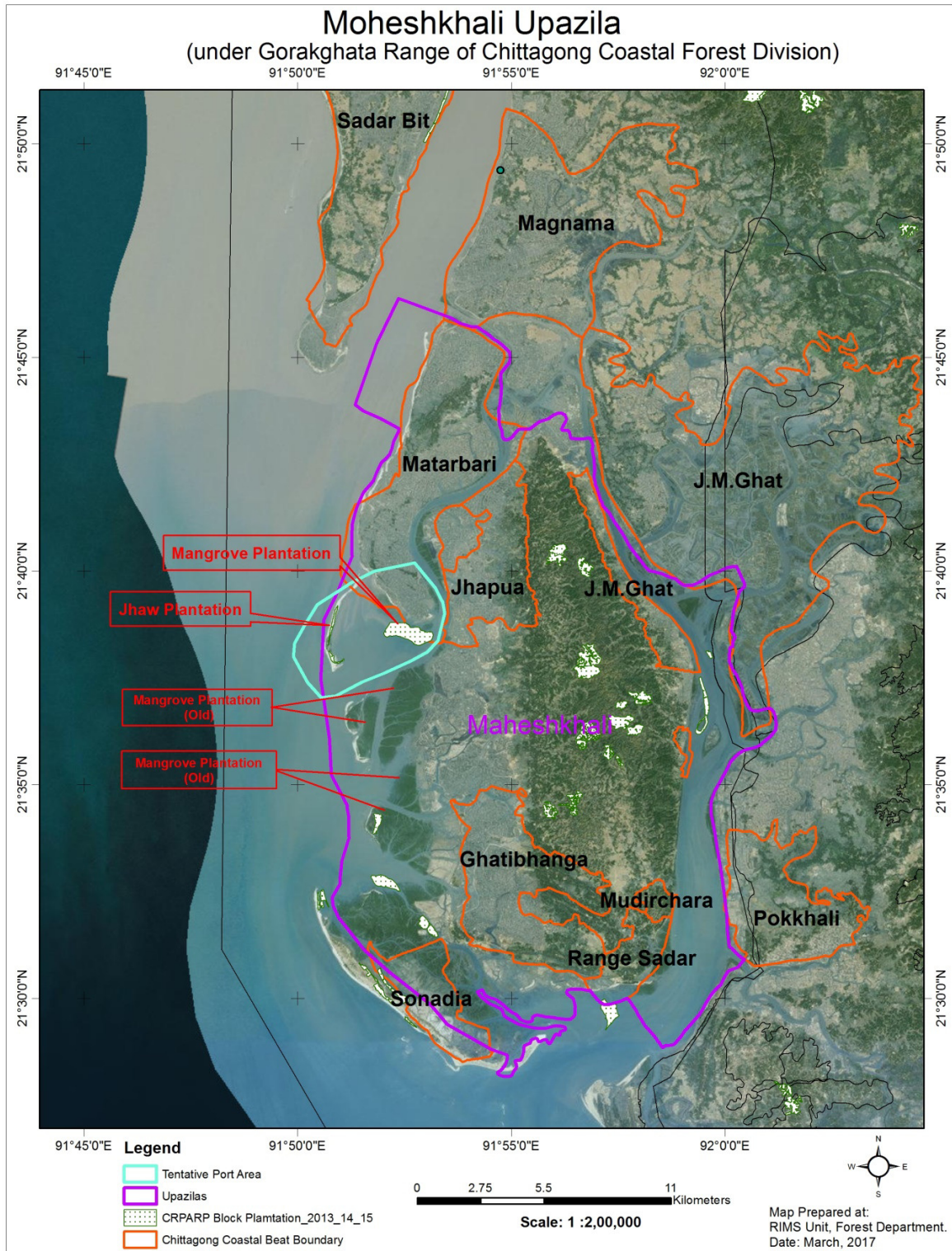


Figure-5.14-1 Afforestation Program in the Project Study Area

### Crop field vegetation

Crop-field ecosystem refers vegetation of the cropland during cultivation of different crop varieties. The crop-field vegetation are especially called weeds in general but these weeds have important role in functioning ecosystem and food web. To consider this, the crop-field vegetation has been considered to discuss. The vegetation in this ecosystem is low in terms of diversity and population. Dominant species in this sub-category are *Hygroryza aristata*, *Eragrostis* Spp. *Eleocharis* Spp. *Oryza rufipogon*, *Digitaria* Spp. *Cyperus diffuses*, *C. distans*, *C. pilosus*, *Fimbristylis dichotoma*, *Najas indica*, and *Monochoria* Spp. These weeds have already found in the paddy field under the proposed transmission lines. The land is also uses as grazing land which providing feeding to cattle includes many invertebrate, amphibians and avifauna.

### Roadside, Coastal and embankment vegetation

Roadside and embankment vegetation's are generally planted and develop an ecosystem which is dominated by hard wood tree species. These species are Raintree, Babla, Mahogoni, Acacia, Koroi, Neem, etc. Some plants also grow naturally in-between the planted plants and remain at the bottom levels on either sides of the road function as barrier of soil weathering. The small-sized herbs are also available and Bhat, Croton, Bondhona, Daton are found commonly everywhere in the area. A large number of Jhau tree are present within the Project area. A table with conservation status of terrestrial flora of the study area is presented in **Table 5.14-1**.

**Table 5.14-1: Terrestrial plant species found in the study area**

Local/English Name	Scientific Name	Use	Abundance	Threatened Status
Betel-nut	<i>Areca catchu</i>	Seed	H	NO
Coconut	<i>Cocos nucifera</i>	Oil	H	NO
Madar	<i>Erythrina indica</i>	Fuelwood	M	NO
Albizia	<i>Albizia lebeck</i>	Timber	H	NO
Bamboo Clump	<i>Bambusa tulda</i>	Thatching	M	NO
Acacia	<i>Acacia auriculiformis</i>	Timber	H	NO
Paddy field Weed	<i>Hygroryza aristata</i>	Fodder	H	NO
Paddy field Weed	<i>Eragrostis</i> Spp	Fodder	H	NO
Paddy field Weed	<i>Eleocharis</i> Spp	Fodder	M	NO
Paddy field Weed	<i>Oryza rufipogon</i>	Fodder	H	NO
Paddy field Weed	<i>Cyperus diffuses</i>	Fodder	H	NO
Paddy field Weed	<i>C. distans</i>	Fodder	L	NO
Paddy field Weed	<i>C. pilosus</i>	Fodder	L	NO
Paddy field Weed	<i>Fimbristylis dichotoma</i>	Fodder	H	NO
Paddy field Weed	<i>Najas indica</i>	Fodder	H	NO
Paddy field Weed	<i>Monochoria</i> Spp	Fodder	H	NO
Mangrove (Baen)	<i>Avicenia officinalis</i>	Fuelwood	H	LC
Mangrove (Baen)	<i>A. alba</i>	Fuelwood	H	LC
Mangrove (Kewra)	<i>Sonneratia apetala</i>	Timber/Fuelwood	H	LC

LC-Least Concern, NO: Not Threatened

### 5.14.1.2 Terrestrial Fauna

The proposed Access road cross different types of vegetative areas. Terrestrial fauna especially wildlife species are described briefly in accordance with their hierarchy below.

The **amphibians** are habituated in microhabitats and their home range is small in comparison with other groups of wildlife. Amphibians are considered as indicator species of the environment where they inherently response to any changes of the environment nevertheless they occupy microhabitats. The dominant terrestrial amphibians in this study area have been noted as Indian Bullfrog (*Hoplobatrachus tigerinus*), Microhylid Frog (*Microhyla ornata*), Common Tree Frog (**Polypedates leucomystax**) and Cricket Frog (*Fejervarya limnocharis*). Most of the amphibians inhabit the edges of paddy-fields, ground holes, grasslands, and bushes. According to IUCN-Bangladesh (2015c), the Microhylid Frog has been categorized as Least Concern (LC) species to the country.

The **reptiles** are not dominant throughout the study area. The species have seen during field investigation are Common Garden Lizard (*Calotes versicolor*), Brahminy Skink (*Mabuya carinata*), and Binocellate Cobra (*Naja naja*), the populations of Bengal Monitor (*Varanus bengalensis*) are good enough but Yellow Monitor (*Varanus flavescens*) is not frequent. Of them, Bengal Monitor (NT), and Yellow Monitor (NT) have been categorized as threatened species by IUCN-Bangladesh (2015c).

Most of the **birds** have observed in the open field environs. Available bird species are Red-vented Bulbul (*Pycnonotus cafer*), Common Myna (*Acridotheres tristis*), Black Drongo (*Dicrurus macrocercus*), Spotted Dove (*Spilopelia chinensis*), Asian Pied Starling (*Sturnus contra*), Barn Swallow (*Hirundo rustica*), Oriental Magpie Robin (*Copsychus saularis*), and Brahminy Kite (*Haliastur indus*). The Brahminy Kites were flipping on their wings over the open field. **No threatened species were noted during the major field investigation.**

**Mammals** are very magnificent but they have been vanishing due to habitat conversion into farmland and hunting pressures. Currently, small-sized mammals occur in this locality are Bandicoot Rat (*Bandicota indica*), Common Mongoose (*Herpestes edwardsii*), and Jungle Cat (*Felis chaus*). The mammals have seen in the periphery of cultivable lands. Of the threatened species, the Common Mongoose has been categorized as Least Concern (LC) and Jungle Cat as endangered (NT) species to the country (IUCN-Bangladesh, 2015a). A list of terrestrial fauna along with their status is given in **Table 5.14-2**.

**Table 5.14-2: List of terrestrial fauna of the study area**

Group	Common Name	Scientific Name	IUCN-Bangladesh Status
Amphibia	Indian Bullfrog	<i>Hoplobatrachus tigerinus</i>	NO
	Microhylid Frog	<i>Microhyla ornata</i>	LC
	Common Tree Frog	<b>Polypedates leucomystax</b>	NO
	Cricket Frog	<i>Fejervarya limnocharis</i>	NO
Reptilia	Common Garden Lizard	<i>Calotes versicolor</i>	NO
	Brahminy Skink	<i>Mabuya carinata</i>	NO
	Binocellate Cobra	<i>Naja naja</i>	NO
	Bengal Monitor	<i>Varanus bengalensis</i>	NT
	Yellow Monitor	<i>Varanus flavescens</i>	NT
Aves/Bird	Red-vented Bulbul	<i>Pycnonotus cafer</i>	NO
	Common Myna	<i>Acridotheres tristis</i>	NO
	Black Drongo	<i>Dicrurus macrocercus</i>	NO



Group	Common Name	Scientific Name	IUCN-Bangladesh Status
	Spotted Dove	<i>Spilopelia chinensis</i>	NO
	Asian Pied Starling	<i>Sturnus contra</i>	NO
	Barn Swallow	<i>Hirundo rustica</i>	NO
	Oriental Magpie Robin	<i>Copsychus saularis</i>	NO
	Brahminy Kite	<i>Haliastur indus</i>	NO
Mammalia	Bandicoot Rat	<i>Bandicota indica</i>	NO
	Common Mongoose	<i>Herpestes edwardsii</i>	LC
	Jungle Cat	<i>Felis chaus</i>	NT

LC-Least Concern, NT-Near Threatened, NO: Not Threatened

#### 5.14.2 Mangrove Ecosystems

The study area comprises of patches of plantation mangrove forest, locally called ‘Parabon’. These forest patches are mostly planted. The species diversity of the ‘Parabon’ is dominated by Bayen covering. Among the species of Bayen, Moricha Bayen was observed most. Other planted species include Kankra, Golpata, Chhoillya, Horgoja, Keora, Nuna etc. Along the Jalkader Khal and its suburbs lowland area consists of some mangrove vegetation and developed mangrove ecosystem. The common mangrove plant species found along the khal and surroundings lowland is Hargoja, Baien, Nona Bhat, Golpata and Gewa. The mangrove ecosystem support survival of the Crab Eating Snake (*Fordonia leucobalia*), Glossy Marsh Snake (*Gerada prevostiana*), Dog-faced Water Snake (*Cerberus rynchops*) etc. The mangrove species including fauna are shown in the **Table 5.14-3 and 5.14-4**.

**Table 5.14-3: Mangrove species (flora) of the study area.**

Sl. No.	Local /common name	Scientific name	Threatened category
1	Baen	<i>Avicennia officinalis</i>	NO
2	Keora	<i>Sonneratia apetala</i>	NO
3	Gewa	<i>Excocharia agallocha</i>	NO
4	Hargoza	<i>Acanthus illicifolious</i>	NO

Note: NO = Not Threatened

**Table 5.14-4: Mangrove species (fauna) of the study area.**

Sl. No.	Local name/common name	Scientific name	Threatened category (IUCN)
1	Crab-eating Snake	<i>Fordonia leucobalia</i>	NO
2	Glossy Marsh Snake	<i>Gerada prevostiana</i>	NO
3	Dog-faced Water Snake	<i>Cerberus rynchops</i>	VU

Note: NO = Not Threatened; VU= Vulnerable

#### 5.14.3 Aquatic Ecosystems

The study area covers different river systems such as Matamuhuri, Kohalia and Kutubdia Channel and their tributaries, supporting different types of wetlands which are both perennial and seasonal in nature. The wetlands consist of different aquatic ecosystems. Aquatic habitat in this area includes the Bay of Bengal, some seasonal wetlands and homestead ponds. The area is flooded in the monsoon and plays a

great role to support aquatic habitats in this area. The seasonal wetlands are flooded during the monsoon for about 4-5 months and perennial wetlands inundates throughout the year like river system and homestead ponds.

### Aquatic Flora

Diversity and density of floral species varies according to wetland types as well as water depth and velocity. Kachuripana (*Eichornia crassipes*) is the most common free floating hydrophytes that covers maximum portion of water area of the ponds and ditches. Topapana (*Pistia strateotes*) are found in most of the ditches as well as ponds along with Kachuripana. Shapla (*Nymphaea stellata*), Chandmala (*Nymphoides* Sp.) are the dominating floodplain vegetation. Sedges (*Fragmites* Spp.) are quite common during monsoon in all types of wetlands. Hydrila (*Hydrillavalesnaria*), Helencha (*Enhydra fluctuans*), *Ludwgija*, *Echinocola*, *Hygrorhyza* are the main components of aquatic vegetation (Table 5.14-5).

**Table 5.14-5: The aquatic vegetation of the study area along with distribution.**

Sl. No.	Local/common name	Scientific name	Distribution	Threatened category
1	Kachuripana	<i>Eichornia crassipes</i>	Widely	NO
2	Topapana	<i>Pistia strateotes</i>	Widely	NO
3	Shapla	<i>Nymphaea stellata</i>	Widely	NO
4	Chandmala	<i>Nymphoides</i>	Widely	NO
5	Helencha	<i>Enhydra fluctuans</i>	Widely	NO
6	Hydrila	<i>Hydrilla valesnaria</i>	Widely	NO

Note: NO- Not threatened

### Aquatic Fauna

Population of aquatic faunal species is found to vary according to wetlands characteristics and surface water quality of the water bodies. Among amphibians, the Skipper Frog (*Euphlyctis cyanophlyctis*) is common and found in all wetlands and is the most successful one in adapting with the altered habitat. Abundance of Bullfrogs (*Hoplobatrachus tigerinus*) is generally increased in rainy season at paddy fields, ditches and other marshy places. Common aquatic snakes which include the Checkered Keelback (*Xenocrophis piscator*), Common Wolf Snake (*Lycodon aulicus*) and Smooth Water Snake (*Enhydra enhydis*) are observed during field investigation.

Different species of migratory and local birds are found to roam in salt pans and floodplains along the canals and shrimp farms in the study area during winter. The common migratory birds seen during field visit are Spotted Redshank (*Tringa erythropus*), Common Greenshank (*Tringa nebular*), Lesser Sand Plover (*Charadrius mongolus*), Pacific Golden Plover (*Pluvialis fulva*), Marsh Sandpiper (*Tringa stagnatilis*), Common Redshank (*Tringa tetanus*), Little Stint (*Calidris minuta*), Grey Plover (*Pluvialis squatarola*), Little Ringed Plover (*Charadrius dubius*), Brown-headed Gull (*Chroicocephalus brunnicephalus*), Pied Avocet (*Recurvirostra avosetta*), Common Sandpiper (*Actitis hypoleucos*), Eurasian Curlew (*Numenius arquata*), Common Snipe (*Gallinago gallinago*), Common Tern (*Sterna hirundo*), etc.

The common shorebirds are Bar-tailed Godwit (*Limosa lapponica*), Eurasian Curlew (*Numenius arquata*), Common Redshank (*Tringa tetanus*), Marsh Sandpiper (*Tringa stagnatilis*), Green Sandpiper (*Tringa ochropus*), Grey Plover (*Pluvialis squatarola*), etc. The study area is also important for globally

threatened marine turtle such as Olive Ridely Turtle (*Lepidochelys olivacea*) and Green Turtle (*Chelonia mydas*). The later two species occur in this study area has been categorized as Vulnerable (VU) and Endangered (EN) species respectively by the IUCN (2008) (Table 5.14-6).

**Table 5.14-6: Aquatic fauna of the study area**

Sl. No.	Local/common name	Scientific name	Distribution	Threatened category (IUCN)
1	Skipper Frog	<i>Euphlyctis cyanophlyctis</i>	Widely	NO
2	Bullfrog	<i>Hoplobatrachus tigerinus</i>	Widely	NO
3	Checkered Keelback	<i>Xenocrophis piscator</i>	Widely	NO
4	Common Wolf Snake	<i>Lycodon aulicus</i>	Widely	NO
5	Smooth Water Snake	<i>Enhydris enhydris</i>	Widely	NO
6	Spotted Redshank	<i>Tringa erythropus</i>	Coastal and Northeast	NO
7	Common Greenshank	<i>Tringa nebular</i>	Coastal an Northeast	NO
8	Lesser Sand Plover	<i>Charadrius mongolus</i>	Coastal	NO
9	Pacific Golden Plover	<i>Pluvialis fulva</i>	Coastal an Northeast	NO
10	Little Stint	<i>Calidris minuta</i>	Northeast	NO
11	Grey Plover	<i>Pluvialis squatarola</i>	Coastal	NO
12	Little Ringed Plover	<i>Charadrius dubius</i>	Coastal	NO
13	Brown-headed Gull	<i>Chroicocephalus brunnicephalus</i>	Coastal	NO
14	Eurasian Curlew	<i>Numenius arquata</i>	Coastal	NO
15	Pied Avocet	<i>Recurvirostra avosetta</i>	Coastal	NO
17	Bar-tailed Godwit	<i>Limosa lapponica</i>	Coastal	NO
18	Olive Ridely Turtle	<i>Lepidochelys olivacea</i>	Coastal	VU
19	Green Turtle	<i>Chelonia mydas</i>	Coastal	EN

Note: NO -Not Threatened; VU- Vulnerable; EN- Endangered

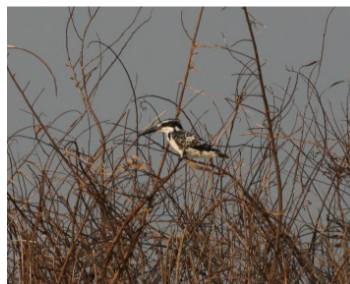
#### 5.14.4 Marine Ecosystems

The study area is located directly on the face of Bay of Bengal and characterizes with Marine ecosystem. They include mudflats, salt marsh, sandbar, sea-shore, and in-shore, intertidal ecology, estuaries, lagoons, deep sea and the sea floor. Marine ecosystems are very important for the overall health of both marine and terrestrial environments.

#### Marine Flora and Fauna



In the sea, many kinds of marine vegetation such as algae and other aquatic plant are found. In coastal mudflat, particular plants are *Ipomea pescapre*, *Vitex trifolia*, *Pandanus odoratissimus* and *Calotropis gigantea*. Shore birds feed on mudflats and sand bars of the study area. These shore birds lay eggs on undulated mudflat during the dry season (March/April). Migratory birds gather in the on shore mudflat during winter season. The offshore areas support four species of globally threatened including Finless porpoise (*Neophocaena phocaenoides*), Irrawaddy dolphin (*Orcaella brevirostris*), Bottlenose dolphin (*Tursiops aduncus*) and Indo-Pacific Humpback dolphin (*Sousa chinensis*). Different species of peneaid, solenocerid, sergestid and careidean prawn species have been found. The beaches and shallow shoals surrounding the site provide an excellent staging area and wintering ground for migratory waterfowl and shorebirds. The common shore bird is Bar tailed Godwit, Whimbrel, Eurasian Curlew, Common Red shank, Marsh Sandpiper, Common Green shank, Green Sandpiper, Grey Plover, Kentish Plover, Lesser sand Plover, Grater sand plover etc. The mudflats are important habitat for migratory and resident birds and mud crab. Sea turtles in the territorial area of Bangladesh are on the verge of extinction, the population having declined sharply over the past two decades. The study area is also important for globally threatened marine turtle such as Olive Ridely and Green Turtle. Benthos is a community of organisms which live on, in, or near the seabed (known as benthic zone). This community lives in or near marine sedimentary environments from tidal pools along foreshore, out to the continental shelf, and down to the abyssal depths. Many organisms adapted to deep-water pressure cannot survive in the upper parts of the water column. Animals ecologically linked to bottom include echinoderms, fishes (Tade Mullet *Liza tade*, Speigler's Mullet *Valamugil speigleri*, crustaceans, molluscs (*Granular Ark Anadara granosa*, Mud Crab *Scylla serrata*, Girdled horn shell, *Cerithidea cingelata*, Moon Shail *Polinices Sp*), poriferans and annelids in the study area. **No sea weeds or coral reef found in marine ecosystems along the project site.**



### Birds of the Project Area

#### 5.15 PROTECTED AREA/WILDLIFE SANCTUARY/FOREST

Based on the significance and ecological sensitivity, Ministry of Environment & Forest (MOEF) has declared a number of areas as "ECAs" and "Protected Areas", but there is not much information or study on the Ecologically Sensitive Area (ESA's) of different coastal and marine Ecosystem and its habitat.

Ecologically Sensitive Areas are:

- ✓ Mangroves
- ✓ Mudflats
- ✓ Salt Marshes
- ✓ Sea grass Bed
- ✓ Coral Reefs
- ✓ Marine Wildlife Protected Areas
- ✓ Turtle Nesting Grounds
- ✓ Seaweed bed
- ✓ Sandy Beaches and Sand Dunes
- ✓ Coastal freshwater bodies
- ✓ Horseshoe crab Habitats
- ✓ Nesting Ground of Bird

The proposed port project area is out of the Ecologically Critical Area (ECA).

**Table 5.15-1: Protected area in the Coastal zone of Bangladesh**

Type	Name	Area (ha)	Location	Effects of 1-m Sea Level Rise (SLR)
Reserved Forest	-	885,043	Khulna, Satkhira, Bagerhat, Bhola, Patuakhali, Noakhali, Chittagong, Cox's bazaar	Yes
National Park	Himchari	1,729	Cox's bazaar	No
Wild life Sanctuaries	Nijhum Deep	4,232	Hatiya, Noakhali	Yes
	Sundarbon south	36,970	Khulna	Yes
	Sundarbon west	71,502	Satkhira	Yes
	Char Kukri-Mukari	2,017	Bhola	Yes
	Chunati	7,761	Chittagong	No
Ramsar Site	Sunderbans	601,700	Khulna, Satkhira, Bagerhat	Yes
Environmental Critical Areas	Sonodia	4,916	Cox's Bazar	Yes
	Teknaf	10,465	Cox's Bazar	Yes
	St. Martin's Island	590	Cox's Bazar	Yes
World Heritage Site	Wild life sanctuaries of the Sunderbans		Khulna, Satkhira, Bagerhat	Yes
Marine Reserve		69,800	Bay of Bengal	Yes

(Source: Islam 2004; (in Hussain & Haq (eds.), 2010)

The Sonadia Island (Figure-5.7-1) is an identified ECA of the Cox's Bazar. Its outer boundary is almost 15 Km away from the Proposed Access road. So the project activities will not intervene the ECA.

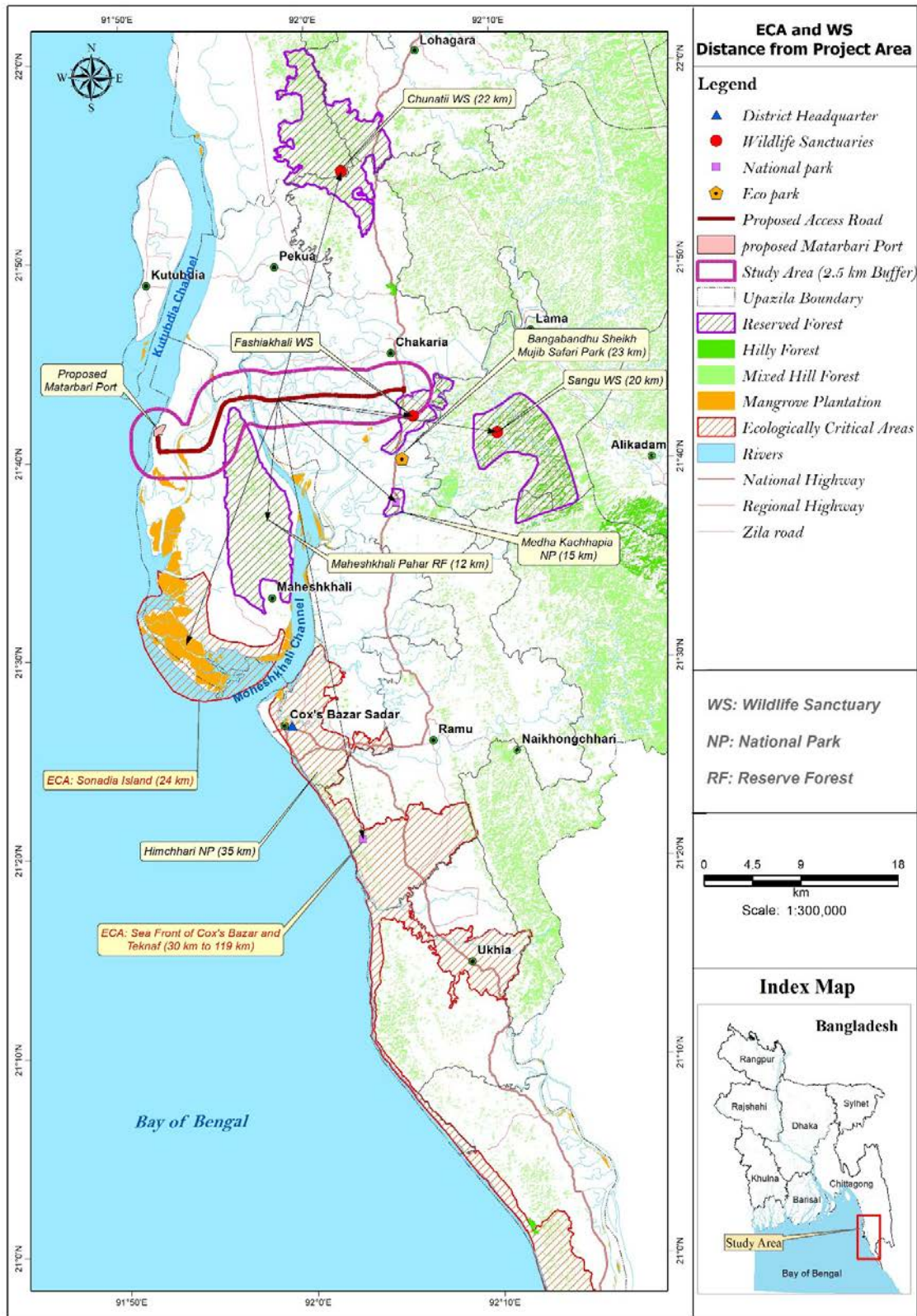


Figure-5.15-2: Comparative Position of ECA and WS



## 5.16 SOCIO-ECONOMIC STATUS OF THE PORT ACCESS ROAD PROJECT AREA

This section presents the socio-economic condition of the proposed Matarbari port access road which has been collected from secondary source (BBS report) and primary sources. The socio-economic information includes demographic, educational, employment opportunity, source of income, cultural and other characteristics of the area and these are presented in the following sub-sections. Both primary and secondary data has been used for preparation of the baseline scenario of the study area.

### 5.16.1 Demographic Profile

#### 5.16.1.1 Household and Population

According to the Population Census of 2011, there are 43,637 households consisting of 240,868 members in the study area which includes 122,993 (51.06%) males and 117,875 (48.93%) females. Considering the above secondary data, the current population and census data is projected<sup>2</sup> for 2018 by multiplying with the upazila wise population growth rate (2.25). On the basis of this calculation there are 50,957 households consisting of 281,271 members in the study area which includes 143,624 males and 137,647 females. The sex ratio<sup>3</sup> of male and female of these unions is 104. The key demographic data of the project study area is presented in **Table 5.16-1**.

#### 5.16.1.2 Household Size

The Bangladesh Bureau of Statistics (BBS, 2011) shows that most of the households in the study area comprises of four or more members in their family. Following figure (**Figure-5.16-1**) shows that the, average household size and proportion of family member is more or less homogenous. Findings reveal that on an average the household in the study area comprises of 5.6 members which is higher than that of the national average (4.44) and indicates that the families are larger.

#### 5.16.1.3 Age Structure

In the study area the highest number of population (18.9%) belongs to age category of 30 to 49 years old. The lowest 2% population belongs in 60 to 64 and 65+ year's old category. Age groups of 0-14 years is defined as children, 15-24 years as early working age, 25-54 years as prime working age, 55-64 years as mature working age and 65 years and over as elderly people (source: World Fact Book, CIA4). This classification is important as the size of young population (under age 15) would need more investment in schools, while size of older populations (ages 65 and over) would call for more invest in health sector.

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<sup>2</sup>The formula to calculate a growth rate given a beginning and ending (Estimated Population) population is:  $Pop_{Future} = Pop_{Present} (1+r)^n$   
Where:  $Pop_{Future}$  = Future Population,  $Pop_{Present}$  = Present Population,  $r$  = Growth Rate and  $n$  = Number of Years

<sup>3</sup>Number of males per 100 females in a population, using the formula: Sex Ratio:  $SR = M \times 100 / F$

<sup>4</sup> Retrieved on 19/3/2015 from <https://www.cia.gov/library/publications/the-world-factbook/docs/notesanddefs.html>

**Table 5.16-1 Demographic scenario of the study area**

Name	Union name	Mauza Name	Total Households		Population 2011			Projected Population 2018			Sex Ratio
			BBS 2011	Projected 2018	Total	Male	Female	Total	Male	Female	
Chakaria Paurashava	Ward No-04	Batakhali (Part)	179	209	899	473	426	1,050	552	497	111
	Ward No-06	Nizapankhali	246	287	1,443	736	707	1,685	859	826	104
		Khariaghona(Part)	727	849	4,392	2,254	2,138	5,129	2,632	2,497	105
	Ward No-07	Nij Pankhali(Part)	170	199	995	508	487	1,162	593	569	104
	Ward No-09	Digar Pankhali (Part)	417	487	2,435	1,248	1,187	2,843	1,457	1,386	105
		Pok-Pokuria (Part)	411	480	2,345	1,226	1,119	2,738	1,432	1,307	110
Nijapankhali		282	329	1,729	895	834	2,019	1,045	974	107	
Chakoria	Badarkhali	Badarkhali Ghona	5,947	6,945	30,964	15,677	15,287	36,158	18,307	17,851	103
	Chiringa	Charamdwip	791	924	4,463	2,245	2,218	5,212	2,622	2,590	101
		Palakata (Part)	1,968	2,298	11,282	5,710	5,572	13,174	6,668	6,507	102
	Dulahazara	Ringbhang	1,591	1,858	8,603	4,353	4,250	10,046	5,083	4,963	102
	Fasiakhali	Digar Pankhali(Part)	349	408	2,000	953	1,047	2,335	1,113	1,223	91
		Fasiakhali	1,746	2,039	9,591	4,922	4,669	11,200	5,748	5,452	105
		Ghumia	774	904	4,237	2,067	2,170	4,948	2,414	2,534	95
		Rajarbil	569	664	3,229	1,586	1,643	3,771	1,852	1,919	97
	Saharbil	Uchitarbil	354	413	1,881	959	922	2,197	1,120	1,077	104
		Maizghona	924	1,079	5,547	2,864	2,683	6,477	3,344	3,133	107
		Paschim Bara Bheola	623	728	3,720	1,983	1,737	4,344	2,316	2,028	114
	Paschim Bara Bheola	Rampur	607	709	3,582	1,816	1,766	4,183	2,121	2,062	103
		Paschim Bara Bheola(Part)	1,670	1,950	8,805	4,413	4,392	10,282	5,153	5,129	100
	Moheshkhali	Dhalghata	Dhalghata	2,250	2,627	12,877	6,688	6,189	15,037	7,810	7,227
Kalarmarchhara		Younuskhali	617	720	3,484	1,771	1,713	4,068	2,068	2,000	103
		Jhapua	1,914	2,235	11,009	5,712	5,297	12,856	6,670	6,186	108
		Kalarmarchhara	4,963	5,795	27,340	14,325	13,015	31,926	16,728	15,198	110
		Uttar Nalbila	1,436	1,677	7,435	3,807	3,628	8,682	4,446	4,237	105
Matarbari		Matarbari	8,168	9,538	44,937	22,801	22,136	52,475	26,626	25,849	103
Saflapur		Moheshkhali Pahar	103	120	610	314	296	712	367	346	106
		Moheshkhali Chanal	27	32	148	73	75	173	85	88	97
	Saflapur	3,814	4,454	20,886	10,614	10,272	24,389	12,394	11,995	103	
Total			43,637	50,957	240,868	122,993	117,875	281,271	143,624	137,647	

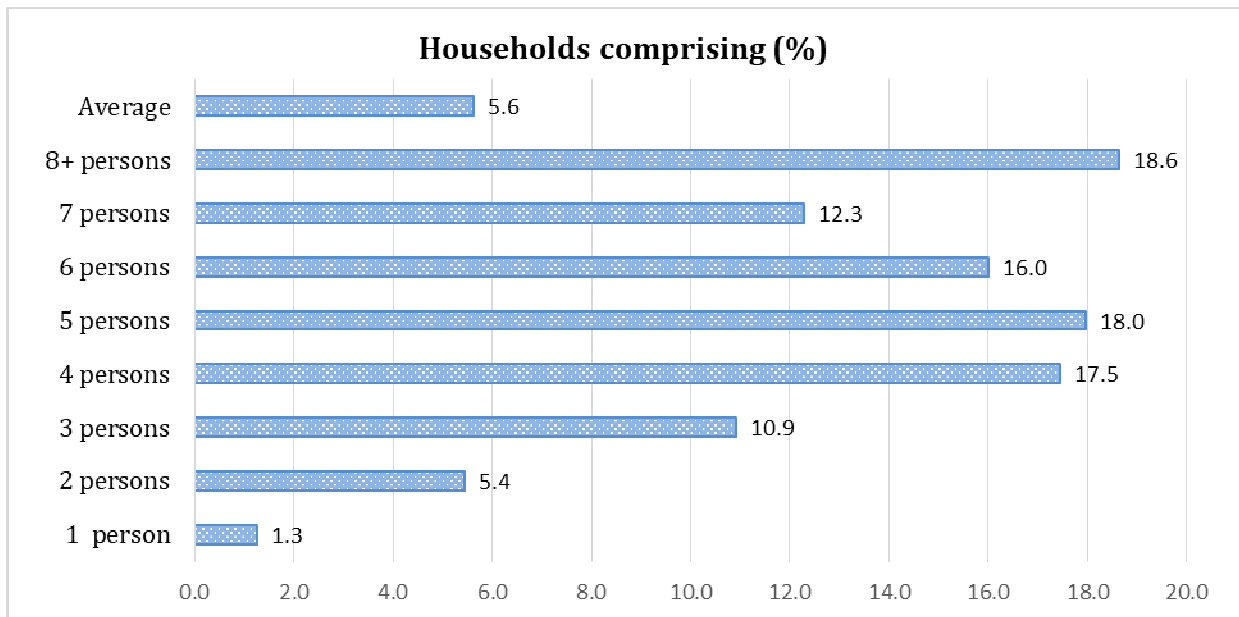


Figure-5.16-1 Households Size of the Project Area

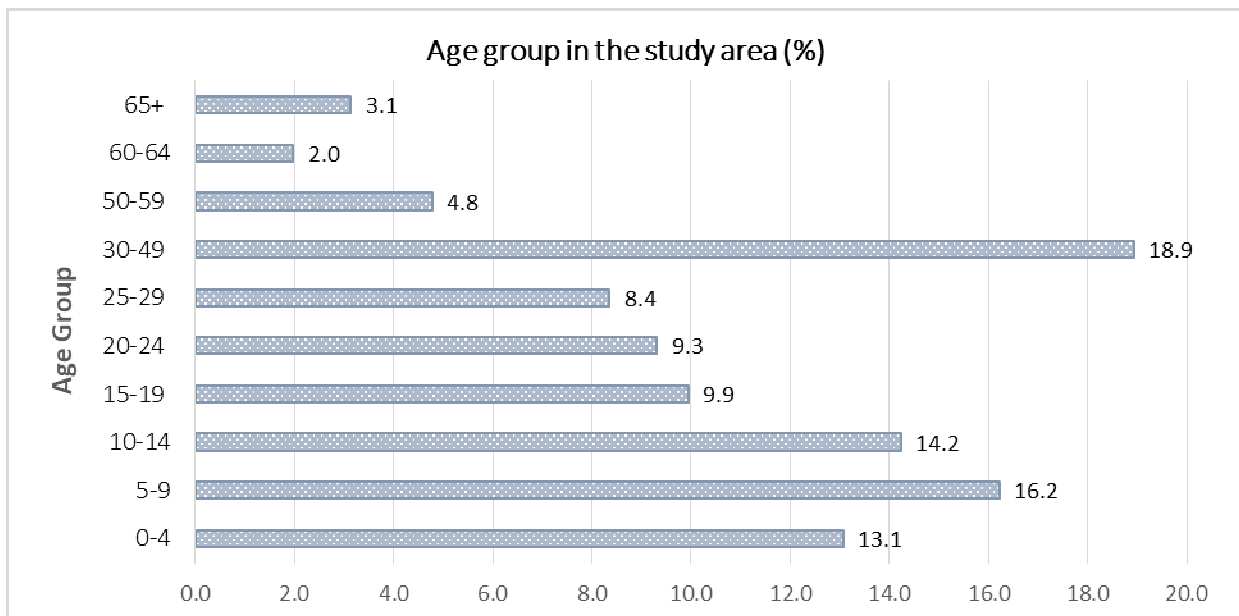


Figure-5.16-2 Population distributions by different age groups

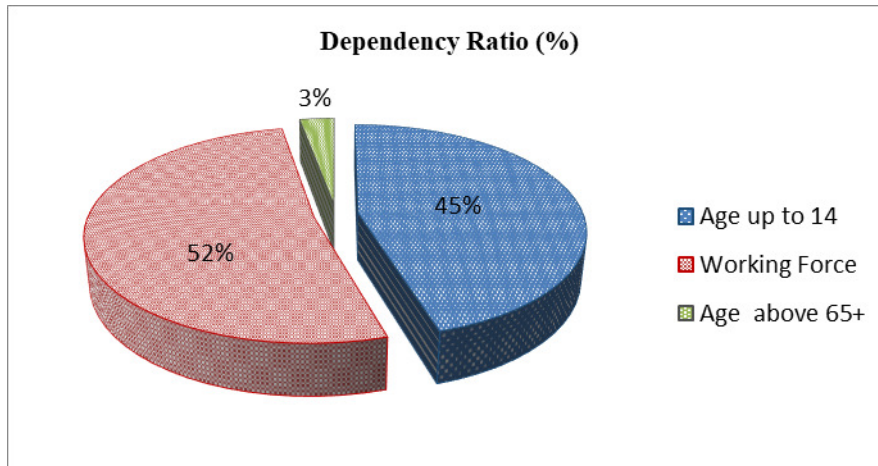
#### 5.16.1.4 Dependency Ratio

According to the international standard, the “economically active population” comprises all persons of either sex who furnish the supply of labour for the production of goods and services as defined by the United Nations systems of national accounts and balances, during a specified time reference period (Ralf Hussmanns et. al, 1992<sup>5</sup>). This definition is adopted by the International Labour Organization (ILO) and categorized population of 15 to 64 years of age as active category force and population below 15 years and 65 and above years is considered as dependent.

Dependency ratio is a measure of the portion of a population which is dependent (people who are too young or too old to work) for their living. The dependency ratio is equal to the number of population

<sup>5</sup>Ralf Hussmannset. al, 1992; *Surveys of economically active population, employment, unemployment and underemployment*; International Labour Office, Geneva.

aged below 15 or above 64 divided by the number of populations aged 15 to 64 expressed as percentage. A rising dependency ratio is a concern in many countries that are facing aging population. Population and Housing Census 2011, reveals that the average dependency rate is 48% in the study area. That is, almost 48 persons are dependent on 100 working people (**Figure 5.16-3**). On the contrary 52% are working force (age 15-64).



Source: Population and Housing Census 2011, BBS

**Figure 5.16-3: Dependency Ratio in the Study Area**

### 5.16.2 Settlement and Housing

During field visit and satellite image analysis, it was found that about 13.8 ha settlement area will be affected in the right of way of proposed Matarbari port access road.

#### 5.16.2.1 Housing Condition

Quoting from BBS (2011), housing condition in the study area is characterized by use of different construction materials; depending on materials used the houses are known as kutcha, jhupri, semi pucca and pucca. **Figure 5.16-4** shows that the highest percentage of houses is <sup>6</sup>kutcha (66%) followed by <sup>7</sup>Jhupri (16%), <sup>8</sup>semi pucca (12%) and <sup>9</sup>pucca (6%). Field findings also validated that most of the households are kutcha and jhupri and the number of pucca household is very poor in the study area.

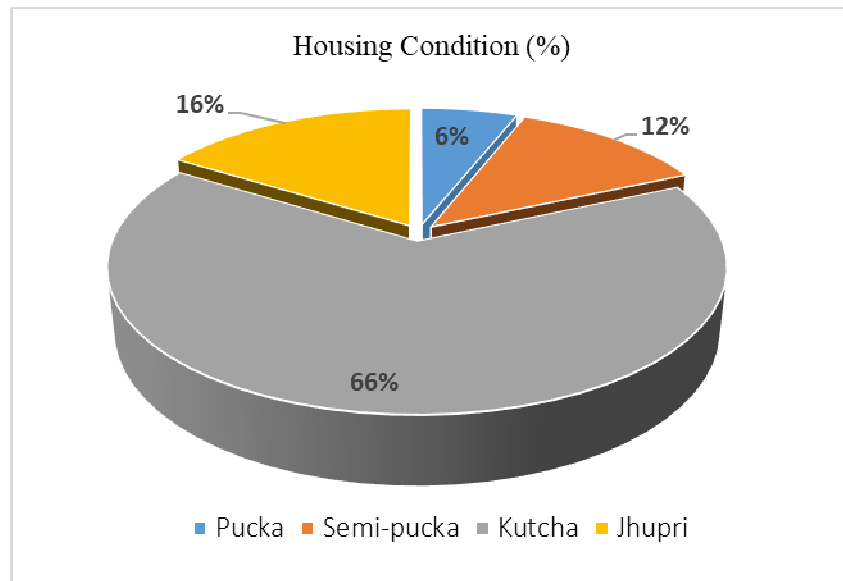
<sup>6</sup>Kutcha: Walls: Organic materials like jute stick, catkin grass, straw, and bamboo mats. Split are bamboo framing. In some areas wall are made by earth. Foundation: Earthen plinth with bamboo or timber posts. Roof: Thatch-rice or wheat or maize straw, and catkin grass, with split bamboo framing;

<sup>7</sup>Jhupri: House which consists of mud walls of 1.5 to 3.0 ft thickness, which carry the roof load. Earthen floor, thatch or CI sheets are used as roofing materials. There is no monolithic joint between the wall and the roof.

<sup>8</sup>Semi-pucca: Walls: Bamboo mats, CI sheet, Timber or bamboo framing. In some areas wall are made by earth, sometimes part or full brick. Foundation: Earthen plinth; Brick perimeter wall with earth infill; Brick and concrete also use. Roof: CI sheet with timber or bamboo framing

<sup>9</sup>Pucca: House which is made of fully concrete, cement, and iron.





Source: Population and Housing Census 2011, BBS

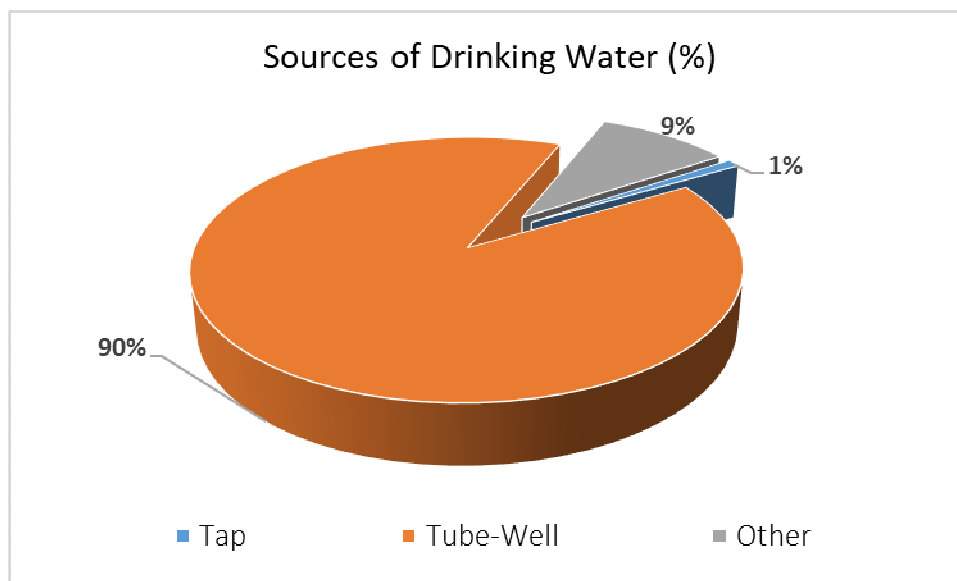
**Figure 5.16-4: Housing Condition in the Study Area**

### 5.16.3 Public Utilities

The term public utilities refer to the set of services provided by government and organizations consumed by the public. These services include water supply, sanitation, solid waste management, electricity supply, telecommunication etc.

#### 5.16.3.1 Water Supply

In the study area, 90% of people are dependent on tube-well as their main source of drinking water, while 9% are used to collect water from different sources like river or springs (**Figure 5.16-5**). Salinity is prevailing here in extreme order, even drinking water from deep tube well (more than 100 feet depth) is saline. Field Investigation reveals that people usually use river water and pond water for other water related activities.

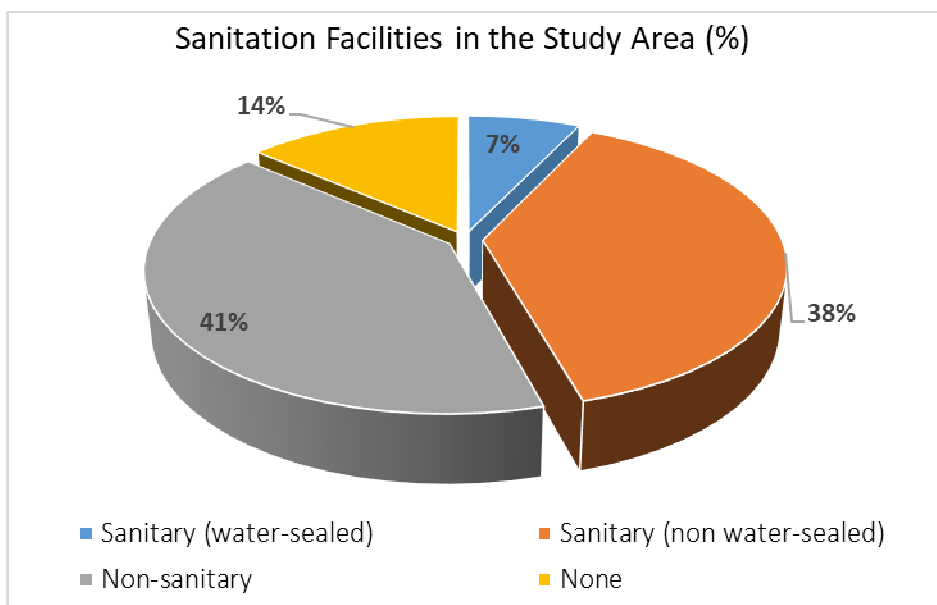


Source: Population and Housing Census 2011, BBS, 2012

**Figure 5.16-5: Drinking Water Facility in the Study Area**

### 5.16.3.2 Sanitation Facilities

According to the Population Census 2011, following **Figure 5.16-6** represents the total sanitation facility of the study area. It illustrates that till now about 41% of total population are using non-sanitary toilets. Still 14% households have no sanitation facility. Besides, about 45% households have sanitary toilet facilities of which 7.0% have water-sealed and 38% have non water-sealed toilets. So, the overall sanitation scenario of the study area is not sound enough.



Source: Population and Housing Census 2011, BBS, 2012

**Figure 5.16-6: Sanitation Facilities in the Study Area**

### 5.16.3.4 Solid Waste

A large number of wastes are disposed in the bank of river, these are flooded by tidal wave as a result water is getting contaminated.

### 5.16.4 Electricity Connection

The study area average electricity coverage is about 40% whereas national average is 59.6%. The deficit is partly covered by solar power which is getting popular in the study area but the number of households used solar power is very poor.

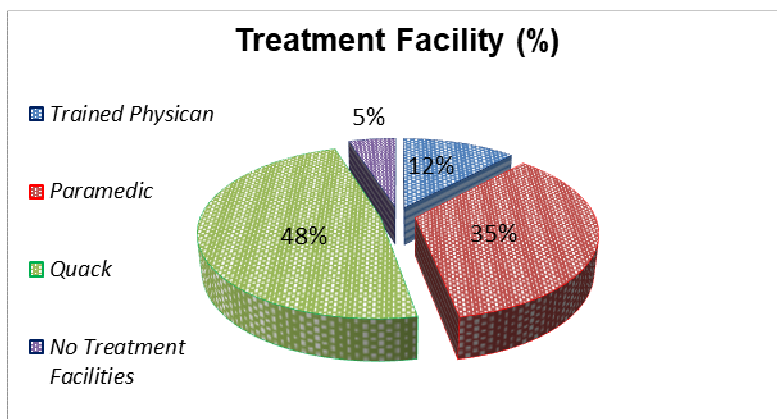
### 5.16.5 Telecommunication and Internet

According to field observation, network coverage as well as internet coverage of all types of telecommunication companies are not sound in the study area. People usually use Rabi and Grameen phone operating services due to their standardized network facilities. Frequency of other telecommunication and internet operators is quite low in this area.

### 5.16.6 Access to Health Facilities

Health is universally regarded as an important index of human development that constitutes one of the basic needs of the population. Access to health care facilities is a basic right of all citizens. Field findings of this study from informal interview and FGDs show that paramedic physician is providing services to 35% of the people and 12% of the people go to trained physician. On the other hand,

people reported that they still have tendency to go to the local healer<sup>10</sup> (48%) for treatment. Still 5% people (mostly the poor) do not get any medical facilities.



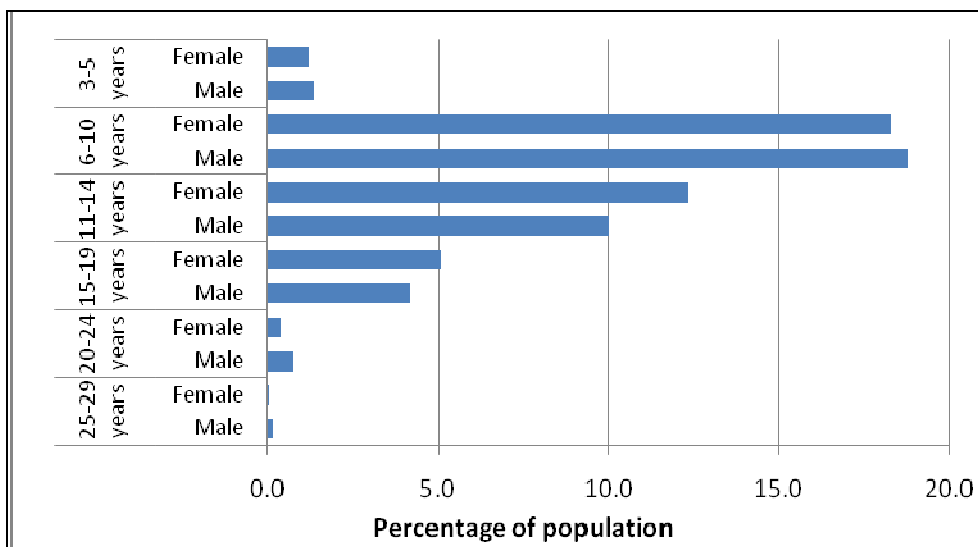
Source: Field investigation, 2018

Figure 5.16-7: Treatment Facilities in the Study Area

### 5.16.7 State of Education

#### School Attendance

Education scenario is a major element of social status. It shows the progress and development of a society. The **Figure 5.16-8** shows that the tendency of having pre- primary education is lower but male-female scenario is almost equal. The proportion of school going children is higher between 6 years to 14 years but the number decreases within the age ranging from 15 to 19 indicating that the children after SSC often leave their studies. There is a lesser tendency of female students to go for tertiary education than the male students due to early marriage and social reasons. The rate of undertaking higher education is lower.



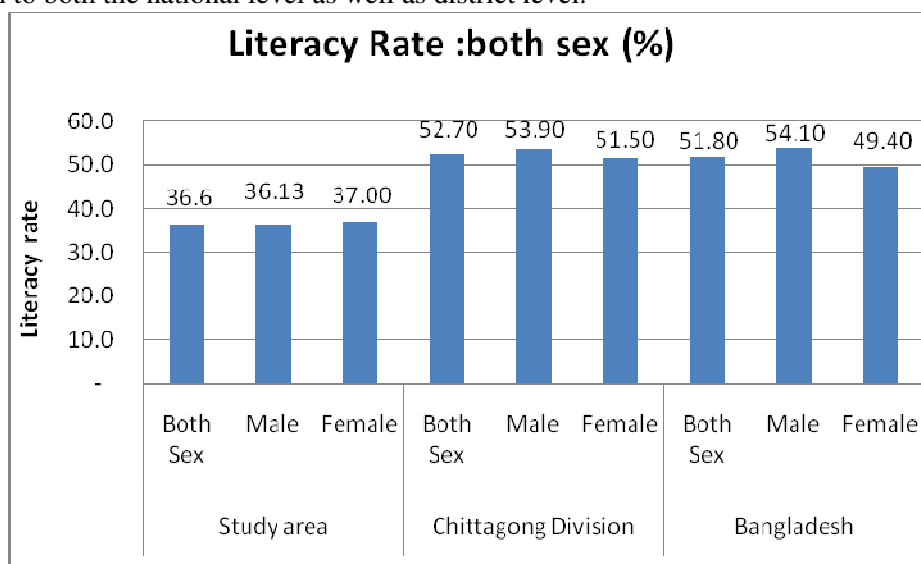
<sup>10</sup>A person in a primitive society who uses long-establishment hods passed down from onehealer to another to treat a persons suffering from various illnesses, many of which have psychological underpinnings. Methods used by traditional healers include the use of roots, fetish dolls voodoo dolls, and the smoking out of a possessing spirit or spell. <http://medical-dictionary.thefreedictionary.com/traditional+healer>

Source: Population Census, BBS, 2011

**Figure 5.16-8: Population distribution by school attendant**

**Literacy**

The average literacy<sup>11</sup> rate in the study area is 36.53% which is lower than that of the national level (51.8%) (**Figure 5.16-9**). It is observed that the literacy rate of the males (36.13%) in that area is poor than the national male literacy level (54.1%) and the same picture is also true for the females of the area. Literacy rate of the study area is much less in comparison to both the national level as well in comparison to both the national level as well as district level.



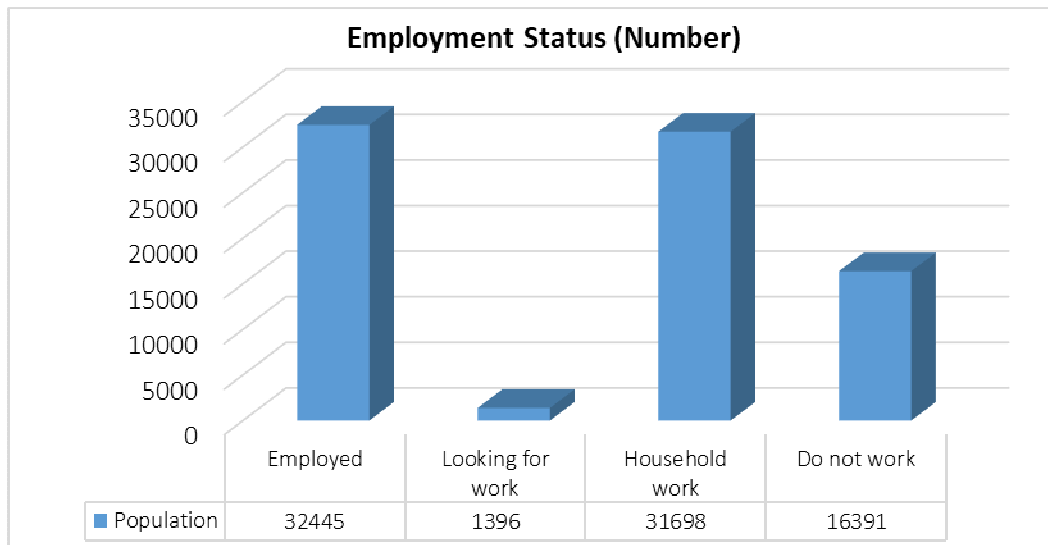
Source: Population Census, BBS, 2011

**Figure 5.16-9: Literacy rate in study area**

**5.16.8 Employment**

It is found from **Figure 5.16-10** that about 32,445 people are employed in different sectors. Beside this, 31,698 people are engaged in household work, 16,391 people are in Do not work category and 1,396 people are under the looking for work category. Though the study area is in semi urban and rural area, the employment status here is moderate and people have actively engaged them in different types of work to lead their livelihood. Field investigation depicts that most of the people are involved in fishing, salt cultivation, and dry fish business. The resources of the Bay of Bengal are regarded as potential source of livelihoods for the people in the study area.

<sup>11</sup>Literacy rate is denotes ability to write a letter in any language. Literacy status assessment is made for population 7 years and over, 15 years and over, and also for population of all ages.

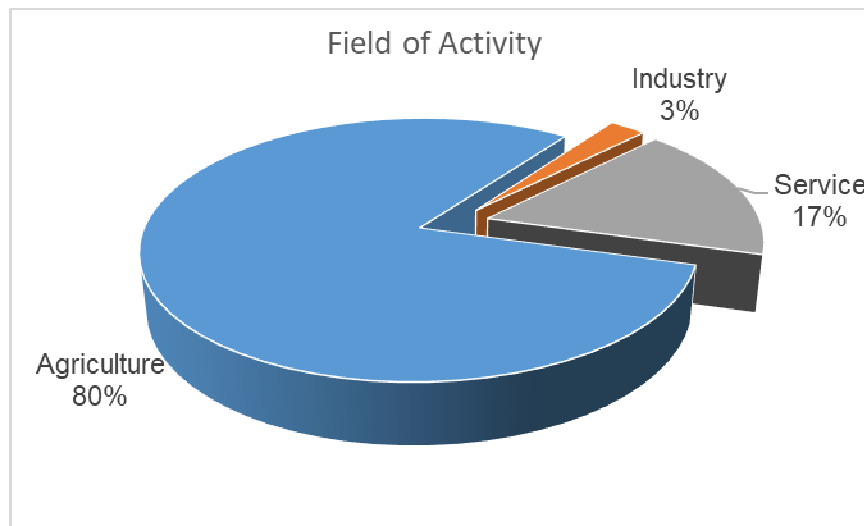


Source: Population and Housing Census 2011, BBS, 2012

**Figure 5.16-10: Employment status in the study area**

Analyzing sector wise distribution (**Figure 5.16-11**) of local population, it is found that agriculture emerged as the dominant sector of employment (80%). Here, agricultural sector includes salt farming, crop farming, and shrimp culture. The second important sector to which people are involved is service (17%). It includes population who are employed in the government or private job and also who are self-employed. Finally, industrial sector comprises only 3% population implying that although administratively the study area is under the oldest export zone of Bangladesh, industrialization is still underdeveloped.

The construction of the proposed access road would also create significant employment opportunities. About 200-300 people of different working levels and expertise will be employed during construction of the road.



Source: Housing and Population Survey, BBS; 2011

**Figure 5.16-11: Distribution of population by field of activity**

### 5.16.9 Availability of Labor and Wage Rate

**Table 5.16-2** shows the availability of wage labor and labor rate in Chittagong division considering the maximum and minimum wage rate for both male and female labor in both farming and non-

farming sector. Availability of labor and wage rate varies from one region to another based on surroundings' condition, standard of living, scope of work, income and opportunity. Women of different regions work as wage laborer contribute more but than the male laborers get less amount.

**Table 5.16-2: Wage rate difference in the study area**

Sectors	Gender	Availability	Wage rate (Daily)	
Farming	Male	High	450	300
	Female	Medium	250	150
Non farming	Male	High	500	300
	Female	low	250	200

Source: Field observation, 2018

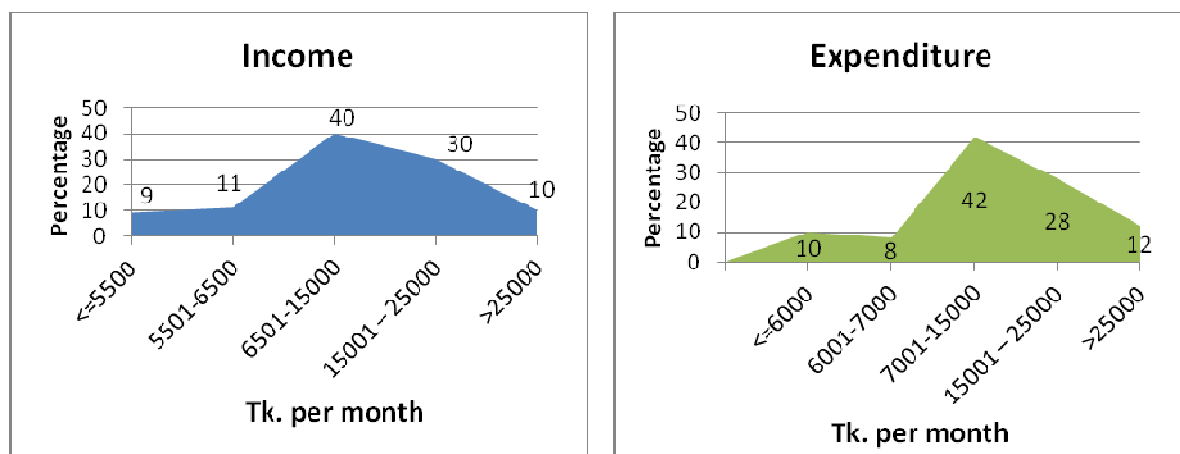
### 5.16.10 Income and expenditure

Household income and expenditure of the study area were assessed on the basis of field findings. Range of income and expenditure was categorized following the poverty line calculated in Household Income and Expenditure Survey (HIES) by BBS, 2010.

It was found that about 09% households earn less than or equal to Tk 5500. About 11% households' income varies between Tk 5501 to 6500 per month. The highest earner households (40%) belong to Tk 6501 to 15000. About 30% household belong to the income range of Tk 15,001 to 25,000 per month.

There expenditure of 42% households in the study area in between Tk 7001 to 15000 per month while and 8% household belong to the range between Tk 6001 to 7000. Besides expenditure of, 10% expenditure are below Tk 6000 per month and 28% households' monthly expenditure is from Tk 15001 to 25,000 per month.

The expenditure of maximum households (42%) in study area ranges between Tk 7,001 to 15,000 per month and the expenditure of minimum, of households 08 % whose ranges between Tk 6001 to 7000. Though 105 households monthly expenditure is below Tk 6000. Again, 28% households monthly expenditure belong to Tk 15001 to 25000 and 12% households spend more than Tk. 25000 per month.

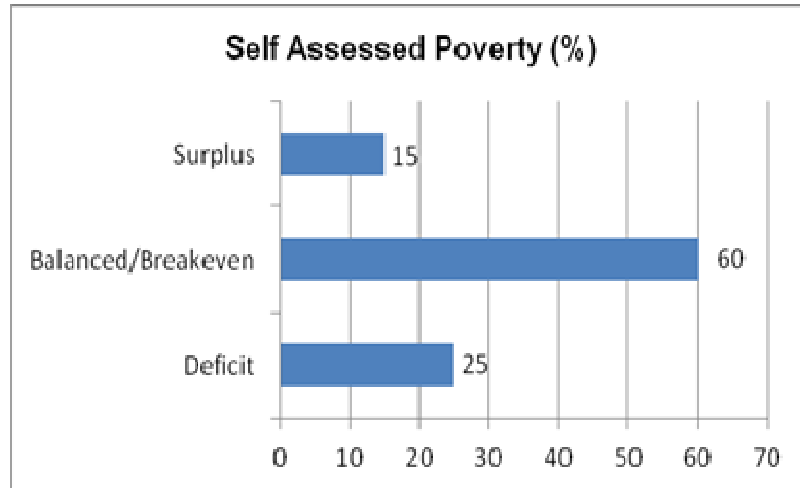


Source: Household Income and Expenditure Survey (HIES), BBS, 2010

**Figure 5.16-12: Distribution of income and expenditure by ranges**

### 5.16.11 Poverty

Poverty has been measured through self-assessment process in the study area. This measurement was mainly based on monetary value. In this process the respondents were requested to assess the overall condition of people living within the study area. Their responses were assembled into three categories such as deficit, balance/breakeven and surplus.



Source: Field observation, 2018

Figure 5.16-13: Self-assessed poverty in the study area

### 5.16.12 Water Communication/Navigation System

The proposed project site is surrounded by various rivers which is accessible throughout the year. The project site is accessible from the Kutubdia channel through Matamuhuri River. The width of the Matamuhuri River varies from 100m -130m due to tidal variation. Kohalia River join with the Matamuhuri at the north side of the project. The width (30m-50m) of Kohalia River is in decreasing trend near the Northern side of the Project. Matamuhuri River nearly encircled the north and eastern side of the project. The communities of study area move to the adjacent villages or market through engine boats. The project site can also be accessed from the Fishery Ghat of Bakhkhali river, Cox's Bazar via Moheshkhali channel and Mathamuhuri River on the north west side of the project site.

### 5.16.13 Railway Communication System

No rail communication system has yet been developed in the study area. Only a single meter gauge train route goes up to Dohazari of Satkania Upazila, which is almost 50 mile away from Cox's bazaar. However, Bangladesh Railway has a plan for extending the rail network in Chittagong-Cox's Bazar region.

### 5.16.14 Air Communication System

Cox's Bazaar Airport is located at the south of the project site. Direct distance of the airport from the project site is about 29 Km. Domestic flights are available to carry passengers and commodities regularly through this airport. Moreover, the Shah Amanat International Airport of Chittagong is located at 61 Km north from the project site.

### 5.16.15 Conflict of Interest & Law and Order Situation

Local conflicts may occur between local residents who may feel that they receive unfair compensation and other local residents or conflict with staff of the Deputy Commissioner's Office. Conflict may



occur between local residents and external workers because of any changes to local customs if external workers cannot understand local customs.

A number of consultations with local residents have been conducted in preparing the LAP & RAP. In the resettlement process, personnel responsible for responding to complaints or suggestions from local residents will work at the road construction works. Local people should be employed at the road project to the maximum extent possible, and any workers from other countries should be taught to respect local customs in order to facilitate good relationships with local people. The lodgings of the project workers should be equipped with sufficient living facilities to keep workers at the project site as much as possible.

## **CHAPTER-6 STAKEHOLDER ENGAGEMENT**

### **6.1 INTRODUCTION**

Participation is a process, through which stakeholders influence and share control over development initiatives, the decisions and the resources, which affects them. Participation of stakeholders in the projects is also a primary requirement in developing an appropriate management plan that addresses project's requirement and suited to the needs of the stakeholders. Stakeholder's involvement is also vastly increases the probability of successful implementation of management plan. In order to make consultation and disclosure process effective and fruitful, comprehensive planning is required to assure that local government, NGOs, host population and project team interacts regularly and purposefully, throughout all stages of the project and contribute toward a common goal.

Public opinion has been collected through interview and focus group discussion meeting. For better understanding the socio-economic and environmental condition of the project area five stakeholder meetings were conducted in the project study area.

### **6.2 APPROACH AND METHODOLOGY FOR CONSULTATION**

The approach undertaken for consultation involved the following key processes.

- Mapping and Identification of key stakeholders such as primary (direct project influence) and secondary (indirect project influence) stakeholders;
- Undertaking questionnaire interviews with the probable affected and non-affected persons of the proposed project area;
- Assessing the influence and impact of the project on these stakeholder meetings; and
- Summarizing of key findings and observations from the consultations.

### **6.3 STAKEHOLDER ASSESSMENT**

A stakeholder is defined as “a person, group, or organization that has direct or indirect stake in a project/organization because it can affect or be affected by the Project or its Proponent's actions, objectives, and policies”. Stakeholders vary in terms of degree of interest, influence and control they have over the Project or the proponent. In the present study, all the stakeholders have been primarily categorized into two categories that have been identified as:

- Primary Stakeholders: include people, groups, institutions that either have a direct influence on the project or are directly impacted (positively or adversely) by the project and its activities; and
- Secondary stakeholders: are those that have a bearing on the project and its activities by the virtue of their being closely linked or associated with the primary stakeholders and due to the influence they have on the primary stakeholder groups.
- Apart from categorization, the stakeholders have also been classified in accordance with the level of influence they have over the project as well as their priority to the project proponent in terms of importance.
- The influence and priority have both been primarily rates as:
  - ✓High Influence/Priority: This implies a high degree of influence of the stakeholder on the project in terms of participation and decision making or high priority for project proponent to engage that stakeholder.
  - ✓Medium Influence/Priority: This implies a moderate level of influence and participation of the stakeholder in the project as well as a priority level for project proponent to engage the stakeholder who are neither highly critical nor are insignificant in terms of influence.

✓Low Influence/Priority: This implies a low degree of influence of the stakeholder on the project in terms of participation and decision making or low priority for project proponent to engage that stakeholder.

Based on the above attributes, the following Table 6.3-1 delineates the stakeholders identified for the project and their analysis.

Table 6.3-1: Stakeholder Mapping for the Project

Stakeholders	Category of stakeholder	Brief profile	Overall influence on the project	Basis of Influence Rating
<b>Project Management</b>				
Roads and Highway Department (RHD)	Primary	RHD will be the primary project proponent own a controlling stake of 100% in the project	Highest	<ul style="list-style-type: none"> <li>The primary project proponent</li> <li>Responsible for operation of this project</li> <li>Primary financial beneficiaries</li> <li>Responsible for all the project related risks and impact liabilities</li> </ul>
<b>Community</b>				
Local Community	Primary	Primarily includes adjacent community to the Dhalghata; Kalarmarchara; Saflapur; Badarkhali; Paschim Bara Bheola; Chiringa; Fasiakhali and Saharbil unions	Medium	<ul style="list-style-type: none"> <li>No major restrictions around the project site especially with respect to Ecologically Critical Area (ECA)</li> <li>Project bring development to the area</li> <li>Increase in employment opportunities and preference in job</li> <li>Minimize impact</li> </ul>
<b>Regulatory/Administrative Authorities &amp; Agencies</b>				
Dept. of Environment, Bangladesh	Primary	The Department of Environment is the primary government regulatory authority for Environmental protection in Bangladesh.	High	<ul style="list-style-type: none"> <li>Responsible for monitoring project's Environmental compliance throughout the project lifecycle.</li> </ul>
Dept. of Forest, Bangladesh	Primary	Department of Forest is the primary government regulatory authorities for Forest Area Protection.	Medium	<ul style="list-style-type: none"> <li>Afforestation program of the Dhalghata union.</li> </ul>
Other Regulatory & Permitting Authorities	Primary	Department of fisheries, Department of Public Health Engineering (DPHE), Deputy Commissioner,	High	<ul style="list-style-type: none"> <li>Agencies required for obtaining permits and licenses for operation of the project</li> <li>Primary involvement during</li> </ul>

Stakeholders	Category of stakeholder	Brief profile	Overall influence on the project	Basis of Influence Rating
		Cox's Bazar etc.		operation phases
<b>Political Administration</b>				
Upazila (sub District Level) Political Administration	Secondary	Elected representative of people at sub-district level for a fixed tenure.	Medium	<ul style="list-style-type: none"> <li>Key linkage between the community and the project proponent.</li> </ul>
Union leaders & local representatives	Secondary	Elected representative at union level i.e. village level for a fixed tenure.	Medium	<ul style="list-style-type: none"> <li>Plays important role in providing public opinion and sentiment on the project.</li> <li>Empowered to provide consent and authorization for establishment of project on behalf of the community.</li> </ul>

#### 6.4 SUMMARY OF CONSULTATION

The details of consultations held with issues raised or discussed and suggestions provided by the respective stakeholders are presented in Table-6.4-1.

Table 6.4-1 Details of Consultations held for the Project

Date	Stakeholder Details	Details of Participants	Issues discussed/raised	Response/ Suggestions made
10/03/2018	Local Representative	Mr. Kamrul Union Chairman, Dhalghata Union	<ul style="list-style-type: none"> <li>Matarbari Port access road Development</li> <li>Local attitude about the project</li> <li>Job opportunities</li> </ul>	<ul style="list-style-type: none"> <li>Welcomed the proposed port connecting road project;</li> <li>Local peoples are positive about the road project;</li> <li>Route selection was appropriate;</li> <li>Minimum HH will be affected; and</li> <li>To up compensation should be made Project affected people.</li> </ul>
11/03/2018	Local representatives	Mr. Tareq Bin Osman Sharif, UP Chairman, KalamerChara	Ditto	<ul style="list-style-type: none"> <li>Welcomed the proposed port connecting road project;</li> <li>Compensation should be properly made;</li> <li>Route selection seems good;</li> <li>Minimum HH will be affected by the project;</li> <li>Local people should get the priority in the project works;</li> </ul>
17/03/2018	Local Representaive	Mr. Khairul	Ditto	<ul style="list-style-type: none"> <li>Welcomed the project;</li> </ul>

Date	Stakeholder Details	Details of Participants	Issues discussed/raised	Response/ Suggestions made
		Bashar, UP Chairman, Badarkhali		<ul style="list-style-type: none"> <li>Avoidance of school, madrassa, college would be highly appreciating for the local people;</li> <li>Top up compensation should be made for the PAPs.</li> </ul>



### 6.5 STAKEHOLDER MEETINGS

Five stakeholder meetings (SHMs) were conducted in the project area from 12<sup>th</sup> March 2018 to 17<sup>th</sup> March 2018. The SHM were arranged in-

- i. UNO office Moheshkhali, Cox’s Bazar;
- ii. UNO office Chakaria, Cox’s Bazar;
- iii. Kalarmarchara Union Parishad Office, Moheshkhali, Cox;s Bazar;
- iv. Dhalghata Union Parishad office, Moheshkhali, Cox’s Bazar;
- v. Badarkhali Union Parishad office, Chakaria, Cox’s Bazar.

The highlights of the SHM is listed below:

- Compensation should be fixed in consultation with the local people;;
- There should have an integrated access road project for both the Power plant and the port;
- Dhalghata union’s people has complaint about the naming of the project;
- This project name should be Dhalghata port development project;
- Proposed port access road project should find out the project impacts before the project launching and mitigation measures should be taken care of during the project work period;
- Job opportunities for the local peoples should be in every stages of the project work;
- To make sure the local peoples involvement in the job there should have a technical institutions in the local area to provide technical education to the local people;
- Road alignment should avoid the School, Madrasa, College, Graveyard etc.;
- Entitlement matrix should be prepared vary carefully so that livelihood restoration plan can work smoothly;
- To keep the water flow uninterrupted adequate no. of bridges, culverts should be constructed on the water channels;
- As the land price is getting higher so there should have the resettlement plan for the PAPs in consideration of land for land compensation to another mouza/area;
- Proper investigation of the project baseline should be carried out in consideration of the diversified ecology of the project area;
- Request have been placed to the RHD to make sure the hassle free compensation payment to the PAPs;
- It has also addressed that improper compensation might create the sufferings of the project activities; and
- Overall all the participants have shown positive attitude about the project.

## **6.6 PUBLIC DISCLOSURE**

The final EIA report will need to be disclosed in an accessible place (e.g. local government offices, libraries, community centres, etc.), and a summary translated into local language (Bengali) for the project-affected people and other stakeholders. The JICA will post the final EIA document on its website so affected people, other stakeholders, and the general public can provide meaningful inputs into the project design and implementation. As a part of the disclosure, all versions (Bengali and English) should be available at the project office as well as the RHD's website. In addition, hard copies of summary Bangla versions of EIA should be available in publicly accessible locations in project area of influence.

## CHAPTER-7 SCOPING AND TOR FOR THE SURVEY ON NATURAL AND SOCIAL ENVIRONMENT

### 7.1 INTRODUCTION

Scoping occurs early in the project cycle at the same time as outline planning and pre-feasibility studies. It is the process of identifying the key environmental issues and is perhaps the most important step in this EIA study. This EIA study canvasses the views of groups of peoples of the project communities, particularly decision makers, the local population and the scientific community. Scoping is important for two reasons.

- First, so that problems can be pinpointed early allowing mitigating design changes to be made before expensive detailed work is carried out.
- Second, to ensure that detailed prediction work is only carried out for important issues.

The key issues are identified for the full scale EIA study of this project and then the scoping includes terms of reference for these further studies.

A major activity of scoping is to identify key interest groups, both governmental and non-governmental, and to establish good lines of communication. People who are going to be affected by this project were well communicated to understand their views, ideas, problems and suggestions. Their knowledge and perspectives were the major bearing on the focus of the EIA. Rapid rural appraisal techniques has been used a means of assessing the needs and views of the affected population.

The main EIA techniques used in scoping were baseline studies, checklists and matrices. These techniques collected and presented the knowledge and information in a straightforward way which were helpful for taking logical decisions about which impacts are most significant.

### 7.2 SCOPING MATRIX

Based on the field survey and the survey results of existing related materials, the environmental impact assumed in connection with port maintenance is examined. The results were organized as the scoping plan including the reason for evaluation.

Table-7.2-1 Scoping matrix of the Port Connecting Access Road Project

Item	Sl. No.	Impact	Rating		Results
			Pre- / construction Phase	Operation Phase	
Pollution Control	1	Air Quality	B-	B-	<p><b>Construction phase:</b> Production of dust is expected from land preparation and other construction work, but the impact will be temporary. The Emission of atmospheric pollutants (SO<sub>x</sub>, NO<sub>x</sub>, etc.) by heavy machinery and trucks is considered, but the influence range due to discharge is limited to the vicinity of the construction site.</p> <p><b>Operation phase:</b> Air pollution is predicted caused by exhaust gas generated from the vessels using the port.</p>
	2	Water Quality	B-	B-	<p><b>Construction phase:</b> Turbid water is expected to be produced from the dredging activity. Also, concrete wastewater and oil-containing wastewater are expected to have an effect.</p> <p><b>Operation phase:</b> It is assumed that the exposed soil flows into the river with</p>



Item	Sl. No.	Impact	Rating		Results
			Pre- / construction Phase	Operation Phase	
					surface water.
	3	Waste	B-	D	<b>Construction phase:</b> General waste and hazardous waste will be generated by the construction work. <b>Operation phase:</b> No solid waste will be generated.
	4	Soil Contamination	B-	B-	<b>Construction phase:</b> There is a possibility of soil contamination due to leakage of fuel oil and lubricant from construction vehicles and construction machinery. <b>Operation phase:</b> Salt pans and paddy fields soil may be affected by traffic.
	5	Noise and Vibration	B-	B-	<b>Construction phase:</b> Although the effects of noise and vibration are assumed due to the operation of heavy machinery and trucks, the influence range is limited to the vicinity of the construction site. <b>Operation phase:</b> Impact of noise and vibration from the vehicles is predicted.
	6	Subsidence	C	C	<b>Construction Phase:</b> The impact will occur if the soft ground is existing. <b>Operation phases:</b> Same as above.
	7	Odor	D	D	<b>Construction and Operation phases:</b> No usage of substances that may be a potential source of foul odors is anticipated and the impact is temporary.
	8	Sediment	B-	D	<b>Construction phase:</b> Some negative influences due to disturbing river mud at the time of bridge construction can be considered. <b>Operation phase:</b> No effect or minor. no discharge or disposal will be necessary.
Natural Environment	9	Protected Areas	D	D	<b>Construction and Operation phases:</b> The protected areas are not existent in the Project area.
	10	Ecosystem	B-	B-	<b>Construction Phase:</b> There are mangrove forests by afforestation or natural forest along the river. If there is construction in the vicinity of the surrounding reserve, there are effects on animals and plants. <b>Operation phase:</b> When passing through neighboring protected areas, there are effects on animals and plants.
	11	Hydrology	C	B-	<b>Construction phase:</b> The influence is seen depending on the type of bridge construction on the river. <b>Operation phases:</b> Depending on the type of bridge, there are negative impacts. Due to the embankment of the road, it is expected that changes of the flood-affected area will occur at the time of monsoon, so countermeasures such as drainage are required.
	12	Topography and Geology	B-	B-	<b>Construction phase:</b> The embankment and cutting may influence the topography and geology, but significant impacts are not assumed as the embankment is used as most of the project planning area is flat. <b>Operation phases:</b> The erosion of the slope is assumed, but the influence is minimized by revetment construction.
Social Environment	13	Resettlement and Land Acquisition	A-	D	<b>Pre-Construction phase:</b> Approximately 55ha of private land including residential area need to be acquired. Approximately 150 HHs will be resettled. <b>Construction:</b> No impact is expected, as relocation will be completed before construction begins. <b>Operation:</b> No impact is expected, as relocation will be completed before construction begins.
	14	Poor Classes	B- / B+	B- / B+	<b>Pre-Construction phase:</b> There are poor households among those to be resettled and/or lose their livelihood means. <b>Construction phase:</b> They will have job opportunities at the construction site. <b>Operation phase:</b> Resettled people may experience the

Item	Sl. No.	Impact	Rating		Results
			Pre- / construction Phase	Operation Phase	
					deterioration of their household economies and loss of livelihood following relocation if appropriate measures are not taken. Positive impact will be expected due to improvement of local economy.
	15	Ethnic Minorities and Indigenous Peoples	C	C	<b>Pre-Construction:</b> There can be no ethnic and indigenous people found in or around the project site. <b>Construction:</b> Livelihood of ethnic minority can be affected by employment in construction work if ethnic minority and indigenous people live in or around the project site. <b>Operation:</b> Livelihood of ethnic minority can be affected by change of regional economy after road operation if ethnic minority and indigenous people live in or around the project site..
	16	Local Economy such as Employment and Livelihood, etc.	B- /B+	B- /B +	<b>Pre-Construction phase:</b> Employers/ employees of salt farms, shrimp farms, fishermen and farmers may lose their means of livelihood <b>Construction phase:</b> Local people will be employed for construction work. Access to market may be restricted. <b>Operation phase:</b> There is the possibility of reductions of means of livelihood in salt farming, shrimp farming and rice farming activities. The construction of road and bridges will benefit the lives of local people such as improvement of access to social services and opportunity of employment.
	17	Land Use and the Utilization of Local Resources	B-	D	<b>Pre-Construction/ Construction/ Operation phase:</b> There is the possibility of a change of traditional land use patterns and utilization of local resources <b>Operation:</b> No impact is expected, as activities requiring change of land use and utilization of local resources will be completed by the end of construction.
	18	Water Usage and Water Rights	B-	B-	<b>Pre-Construction/ Construction phase:</b> Salt farm/ paddy field may be affected by the turbid water discharged from the construction site. Outflows of street dust and oil while it rains, may also cause certain effects. <b>Operation phase:</b> Salt farm/ paddy field may be affected by the discharged water from the road.
	19	Existing Social Infrastructure and Services	B-	B +/ B-	<b>Pre-construction:</b> Some social infrastructure may subject to relocation. Access to social infrastructure and social service may be affected due to resettlement of project affected persons. <b>Construction:</b> Construction work may disturb access to existing social infrastructure and social services. <b>Operation:</b> Access to social infrastructure and services will be improved. Increased traffic volume may disturb the access.
	20	Local Communities and Decision-making Institutions	B-	B-	<b>Pre-construction:</b> Partial resettlement of existing local communities may affect the concerned local communities and decision-making institutions. <b>Construction:</b> Community can be divided because passage is blocked by construction work. <b>Operation:</b> Community can be divided because passage is blocked by the access road.
	21	Unequal Distribution of Benefits and Damages	B-	B-	<b>Pre-Construction Phase:</b> There may be feelings of resentment, because people living around the project site will benefit through the improvement of social infrastructure and services. People to be resettled and those who lose their means of livelihoods will receive certain damages. <b>Construction phase:</b> Part of residents will have disadvantage because access is limited by construction work. <b>Operation:</b> People living around the road will benefit through the improvement of social infrastructure and services, but people living far from the road will not benefit much

Item	Sl. No.	Impact	Rating		Results
			Pre- / construction Phase	Operation Phase	
	22	Local Conflicts of Interest	B-	D	<p><b>Pre-Construction:</b> Local conflicts of interest may occur between residents, and between local administration bodies and local political leaders.</p> <p><b>Construction:</b> Conflicts between local residence and external workers may occur because of changes in local customs if the external workers cannot understand local customs.</p> <p><b>Operation:</b> No activity will be conducted to cause local conflict of interest.</p>
	23	Cultural Heritage	C	C	<p><b>Pre-Construction/ Construction:</b> There can be historical, cultural and archaeological properties and heritage sites existing at the site, which will be confirmed through survey.</p> <p><b>Operation:</b> There can be historical, cultural and archaeological properties and heritage sites existing near the site, which will be confirmed through survey.</p>
	24	Landscape	B-	D	<p><b>Pre-construction:</b> No activities are expected to give any impact on landscape.</p> <p><b>Construction:</b> Landscape will be affected during construction.</p> <p><b>Operation:</b> No significant impact will be expected as there is no scenic spot near the site.</p>
	25	Gender	B-	B +	<p><b>Pre-construction:</b> Unequal distribution of compensation can be occurred within households.</p> <p><b>Construction:</b> Unequal employment opportunity can be provided at construction site.</p> <p><b>Operation:</b> Improvement of local economy will give positive impact.</p>
	26	Children's Rights	B-	B +	<p><b>Pre-construction phase:</b> There are children among those to be resettled and/or lose their livelihood means. Children from households losing their land or jobs may suffer from adverse impact on their household economy, such as dropping-out of school.</p> <p><b>Construction phase:</b> Children's ability to go to school may further deteriorate if access way to their school is physically blocked by the construction site. Child labour can be provoked at the construction site because of the huge demand for unskilled workers.</p> <p><b>Operation phase:</b> Children will have better access to social services throughout the year. Education opportunity can be improved.</p>
	27	Infectious Disease such as HIV/AIDS	B-	B-	<p><b>Pre-construction:</b> No impact is expected as no influx of migrant labor is expected at this phase.</p> <p><b>Construction phase:</b> A temporary influx of migrant labor during the construction period may increase the risk of infectious diseases.</p> <p><b>Operation:</b> Improved mobility of local residents and influx of external residents may increase the risk of infectious diseases</p>
	28	Work Environment (Including Work Safety)	B-	D	<p><b>Pre-construction:</b> No activities are expected to give any impact on work environment.</p> <p><b>Construction phase:</b> Accidents may be caused by construction work.</p> <p><b>Operation phase:</b> No work will be expected to affect work environment.</p>
Others	29	Accidents	B-	B -	<p><b>Pre-construction:</b> No activities are expected to cause accidents.</p> <p><b>Construction phase:</b> Accidents may be caused by construction work.</p> <p><b>Operation phase:</b> Accidents may be caused by increased traffic. Flyover may hinder firefighting.</p>
	30	Cross-boundary	C	C	<p><b>Construction phase:</b> CO<sub>2</sub> will be produced from construction</p>

Item	Sl. No.	Impact	Rating		Results
			Pre- / construction Phase	Operation Phase	
		Impact and Climate Change			work, but the impact on climate change will be checked. <b>Operation phase:</b> CO2 will be produced by entry and departure of vessels, but the impact on climate change will be checked.

### 7.3 SURVEY TOR

#### 7.3.1 Survey Area

The coverage of the survey is the planned site of the access road described previously and its surrounding area including spoil dumps, quarries, construction yards, workers’ camps, approach roads for construction equipment and related infrastructures such as power distribution and water supply facilities. Moreover, as for the related infrastructures grasped at the moment, after their locations and scales are established, details of evaluation, mitigation measures and monitoring will be considered. In addition, also for the infrastructures which cannot be grasped, after the impact is established, locations and scales to reduce the impact are described and the mitigation measures and monitoring details thereafter are considered.

#### 7.3.2 Survey Methods

Table 7.3-1 Survey Methods and predicted Assessment and Countermeasures

Environmental Items	Survey Items	Survey Method	Prediction assessment and countermeasures
Subsidence	- Usage of ground water by project activity	- Design of usage of ground water	<b>Construction phase</b> - Predicting ground water volume used by project activity <b>Operation phase</b> - The same as those addressed in “Construction phase”
Protected areas	- Current habitat status of flora, mammals, birds, reptiles, amphibians, fish, tidal land organisms, rare species (migrant birds, sea turtles, dolphins)	- Survey the distribution of flora and fauna. - Survey the operation of large vessels.	<b>Construction phase</b> - Predicting air pollutant and water pollutant diffusion, and noise. Assessing the environmental impact on the protected area. <b>Operation phase</b> - The same as those addressed in “Construction phase”
Ecosystem	- Current habitat status of ecologically valuable habitats (coral reefs, mangrove forests, or tidal flats). - Current habitat status of flora, mammals, birds, reptiles, amphibians, fish, tidal land organisms, precious species (migrant birds, sea turtles, dolphins)	- Survey the distribution of flora and fauna.	<b>Construction phase</b> - Estimating the degree of the impact on endangered species living near the port facility, and taking preventive measures if significant impact on the species is expected <b>Operation phase</b> The same as those addressed in “Construction phase”
Hydrology	- Sea bottom topography - Current status of tidal current	- Water depth measurement - Survey of tidal current (tidal direction, current speed): conducted in the rainy and dry seasons to	<b>Construction phase</b> - Conducting tidal current simulation to understand change in tidal current <b>Operation phase</b>

Environmental Items	Survey Items	Survey Method	Prediction assessment and countermeasures
		reflect seasonal change.	- The same as those addressed in "Construction phase"
Topography and Geology	- Terrestrial topography - Sea bottom topography - Tidal current	- Acquisition of information about terrestrial topography - Water depth measurement - Survey of tidal current (tidal direction, current speed): conducted in the rainy and dry seasons to reflect seasonal change.	<b>Construction phase</b> - Conducting tidal current simulation to understand drift sand behavior. <b>Operation phase</b> - The same as those addressed in "Construction phase"
Resettlement and Land Acquisition	Residents affected by land acquisition and involuntary resettlement. Property of the affected residents. Lives and livelihoods of the affected residents.	- Relevant laws and regulations and case studies - Population census survey - Survey of assets inventory - Socioeconomic survey	Resettlement and Land Acquisition
Poor Classes	Poor households among the affected residents	- Relevant laws and regulations and case studies - Population census survey - Survey of assets inventory - Socioeconomic survey	Poor Classes
Local Economy such as Employment and Livelihood, etc.	- Current status of occupation and livelihoods of the potentially affected households Local economic development plan	- Material on local peoples' employment and income - Interview the affected households - Local economic development plan	Local Economy such as Employment and Livelihood, etc.
Land Use and Utilization of Local Resources	Current land use Current status of occupation and livelihood of the potentially affected households	material on local peoples' employment and income - Interview the affected households - Local economic development plan	Land Use and Utilization of Local Resources
Water Usage and Water Rights	Current condition of water usage and water rights	- Interview survey	Water Usage and Water Rights
Existing Social Infrastructure and Services	- Usage of existing road - access to market and school	- Survey the operation of large vessels.	Existing Social Infrastructure and Services
Local Communities and Decision-making Institutions	- Existing decision-making Institutions	- Interview survey	Local Communities and Decision-making Institutions
Unequal Distribution of Benefits and Damages	- Occupation and livelihood of the potentially affected households	- Materials on local peoples' employment and income - Interview the affected households	Unequal Distribution of Benefits and Damages
Local Conflicts of Interest	- Occupation and livelihood of the potentially affected households	- Materials on local people's employment and income - Interview the affected households	Local Conflicts of Interest
Gender	- Gender of the affected people	- The relevant laws, regulations and case studies - Population census survey	Gender

<b>Environmental Items</b>	<b>Survey Items</b>	<b>Survey Method</b>	<b>Prediction assessment and countermeasures</b>
		- Socioeconomic survey - Focused Group Discussion	
Children's Rights	-Number of children among the affected people -Education rate -Access to medical facilities -Vaccination rate	- The relevant laws, regulations and case studies - Population census survey - Socioeconomic survey	Children's Rights
Infectious Diseases such as HIV/AIDS	- Rate of diseases	- Existing documents - Socioeconomic survey	Infectious Diseases such as HIV/AIDS
Work environment (including work safety)	- Law	- The relevant laws, regulations and case studies	Work environment (including work safety)
Accidents	- None	- None	Accidents

Source: JICA Survey Team

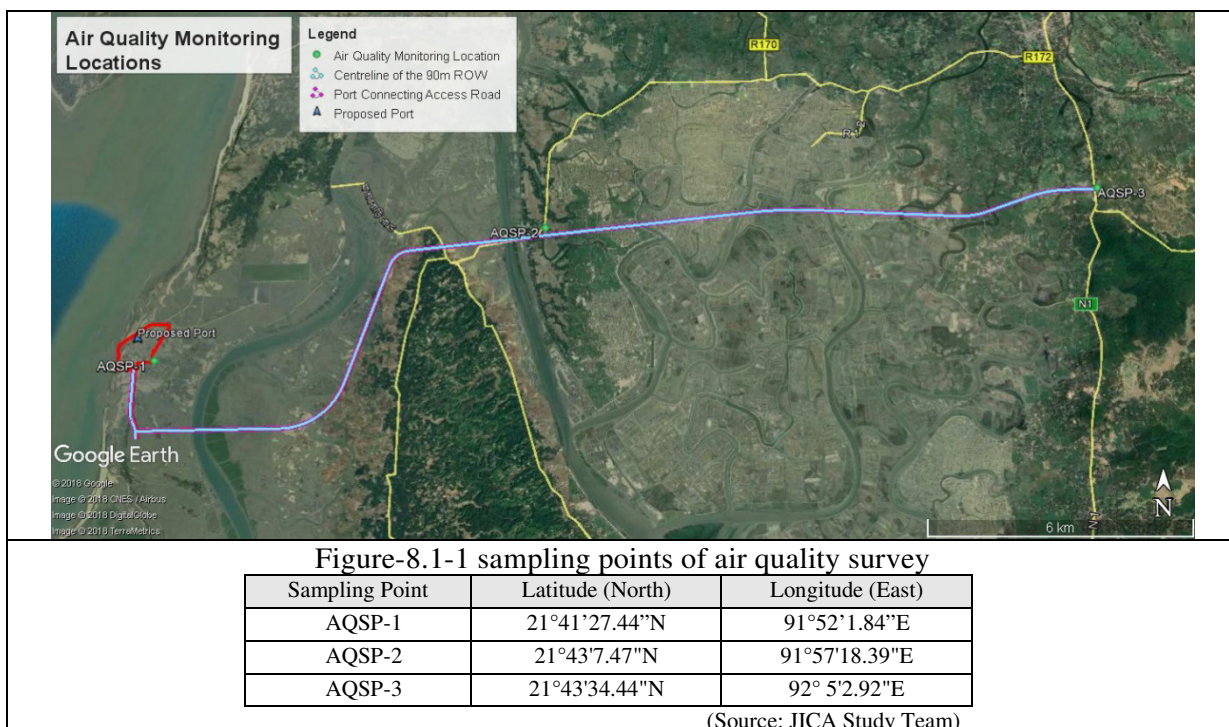
## CHAPTER-8 RESULTS OF THE SURVEY ON NATURAL ENVIRONMENT

### 8.1 POLLUTION CONTROL

#### 8.1.1 Air Quality

##### i) Sampling Points

Residential areas on the way of the ROW of the proposed port connecting access road project site were selected as sampling point for air quality measurement. The survey was conducted in the dry season (15 to 16 of February 2018, 28 to 29 April 2018) and in the wet season (08 to 09 of June 2018) to reflect the influence of precipitation in the fluctuation of air quality.



##### ii) Results:

There is no industry in the Matarbari Island to the east the Fasiakhali. A power plant construction activities are ongoing adjacent to the proposed port area. All along the route there are agricultural and fishery activities, and not the industrial area. The air quality survey results indicated overall that the air quality in the rainy/wet season is much better than the Dry Season, with a slightly high concentration of dust (SPM) and a low concentration of SO<sub>x</sub> and NO<sub>x</sub> (Table 8.1-1). The reasons of higher SPM concentration in the dry season is the ongoing construction activities of the Coal Power Plant project in the Matarbari island and traffic movement along the road side area. But the concentrations were lower than the standard. Concentration of PM<sub>10</sub> & PM<sub>2.5</sub> are within the IFC and National Standards.



Table-8.1-1 Results of air quality survey

Locations	Parameters	SPM	PM <sub>10</sub>	PM <sub>2.5</sub>	SO <sub>2</sub>	NO <sub>2</sub>	O <sub>3</sub>	CO
	Units	µg/m <sup>3</sup>	µg/m <sup>3</sup>	µg/m <sup>3</sup>	µg/m <sup>3</sup>	mg/m <sup>3</sup>	mg/m <sup>3</sup>	mg/m <sup>3</sup>
AQSP-1	Dry	110	43.2	32.1	<12	<0.057	0.0034	<0.30
	Wet	88.9	24.5	10.9	<12	0.057	0.0032	<0.30
AQSP-2	Dry	184	126	90.5	<12	0.051	0.0034	<0.30
	Wet	97.3	35.3	23.8	<12	0.055	0.0031	<0.31
AQSP-3	Dry	178	118	86.2	<12	0.04	0.0031	<0.3
	Wet	101	43.9	33.5	<12	0.042	0.0032	<0.3
<b>Ambient Air Quality Standards</b>		200 (8hr)	150 (24hr) 50 (year)	65 (24hr) 15 (year)	365 (hr)	100 (year)	0.235 (24hr)	40 (24hr)
<b>IFC EHS Guideline (General: 2007)</b>		-	150 (24hr) 70 (year)	75 (24hr) 35 (year)	125 (24hr)	200 (1hr) 40 (Year)	160 (8hr)	-

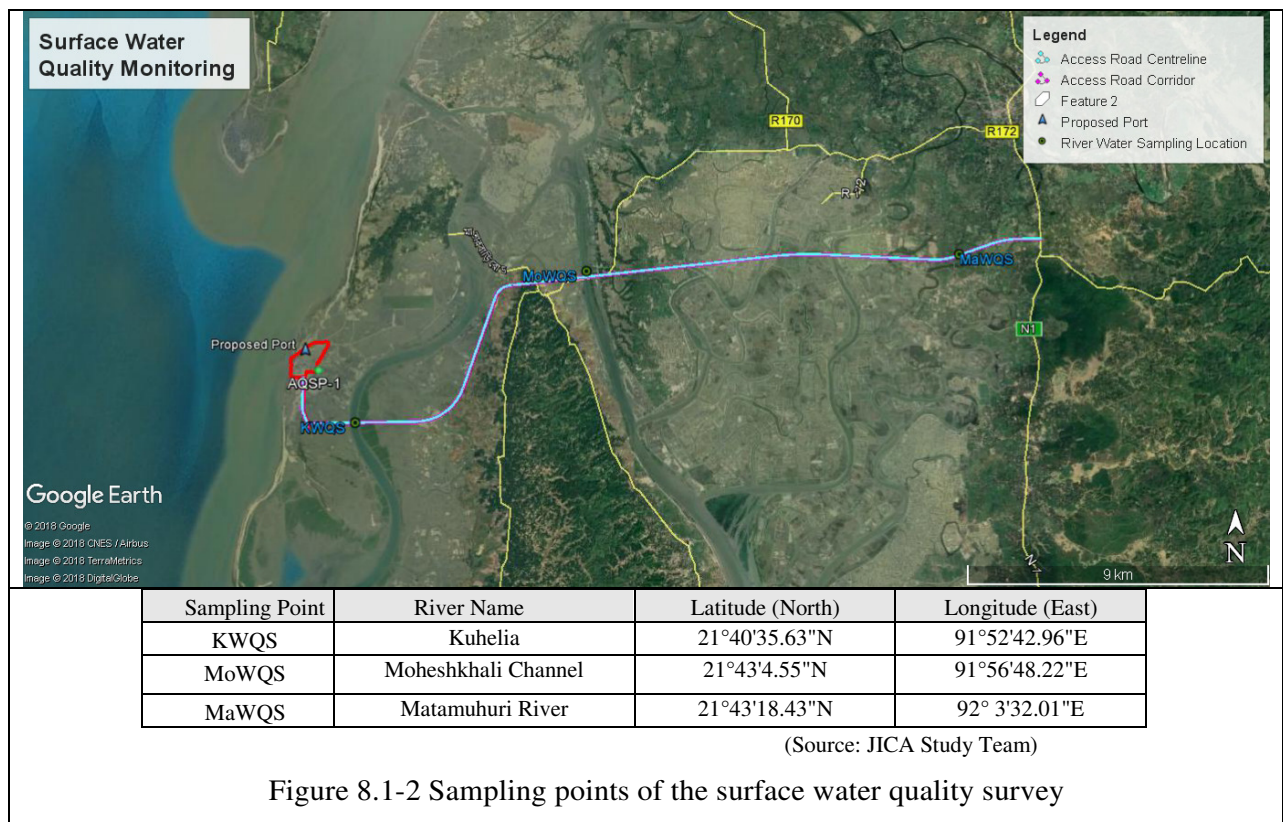
(Source: JICA Study Team)

### 8.1.2 Water Quality

a) Surface water

i) Sampling point

The river water quality of the rivers (Koheli River, Moheshkhali Channel & Matamuhuri River) on the way of the proposed access road project were surveyed. The survey was conducted in the dry season in the end of 30<sup>th</sup> April 2018 and the rainy season from 18 to 19 May 2018.



ii) Results

The results of the surface water quality survey are shown in Table 8.1-3. The value of salinity suggests that the surveyed area has brackish water that is under the influence of sea water in the rainy season. SS and TDS shows high concentration levels. Matamuhuri river does not contain the salinity and this rivers water is a very good source of sweet water fisheries in the study area.

Environmental standards for surface water quality are determined by 6 criteria in Bangladesh, and the survey results satisfied the defined standards.

Table 8.1-3 Results of the surface water quality survey

Parameter	Unit	Results					Standards for Inland Surface Water					
		Kuhelia River		Moheshkhali Channel		Matamuhuri River	A	B	C	D	E	F
		Rainy Season	Dry Season	Rainy Season	Dry Season	Rainy Season						
Depth	M	0.5	0.5	0.5	0.5	0.5	-	-	-	-	-	-
Temperature	oC	30.5	25	28	24.5	26.57	-	-	-	-	-	-
Salinity	-	26	36.89	24	36.3	0	-	-	-	-	-	-
pH	-	8.07	7	8	7	8.07	6.5-8.5	6.5-8.6	6.5-8.7	6.5-8.8	6.5-8.9	6.5-8.9
DO	mg/L	5.95	6.1	6.02	5.46	6.68	6 or above	5 or above	6 or above	5 or above	5 or above	5 or above
BOD	mg/L	3	2	3	3	5	2 or less	3 or less	3 or less	6 or less	10 or less	10 or less
COD	mg/L	6	8	8	16	8	-	-	-	-	-	-
TDS	mg/L	30750	28800	24450	28200	1280	-	-	-	-	-	-
SS	mg/L	19.5	22	14.4	18	4.1	-	-	-	-	-	-

Notes: Category of water body is as below.

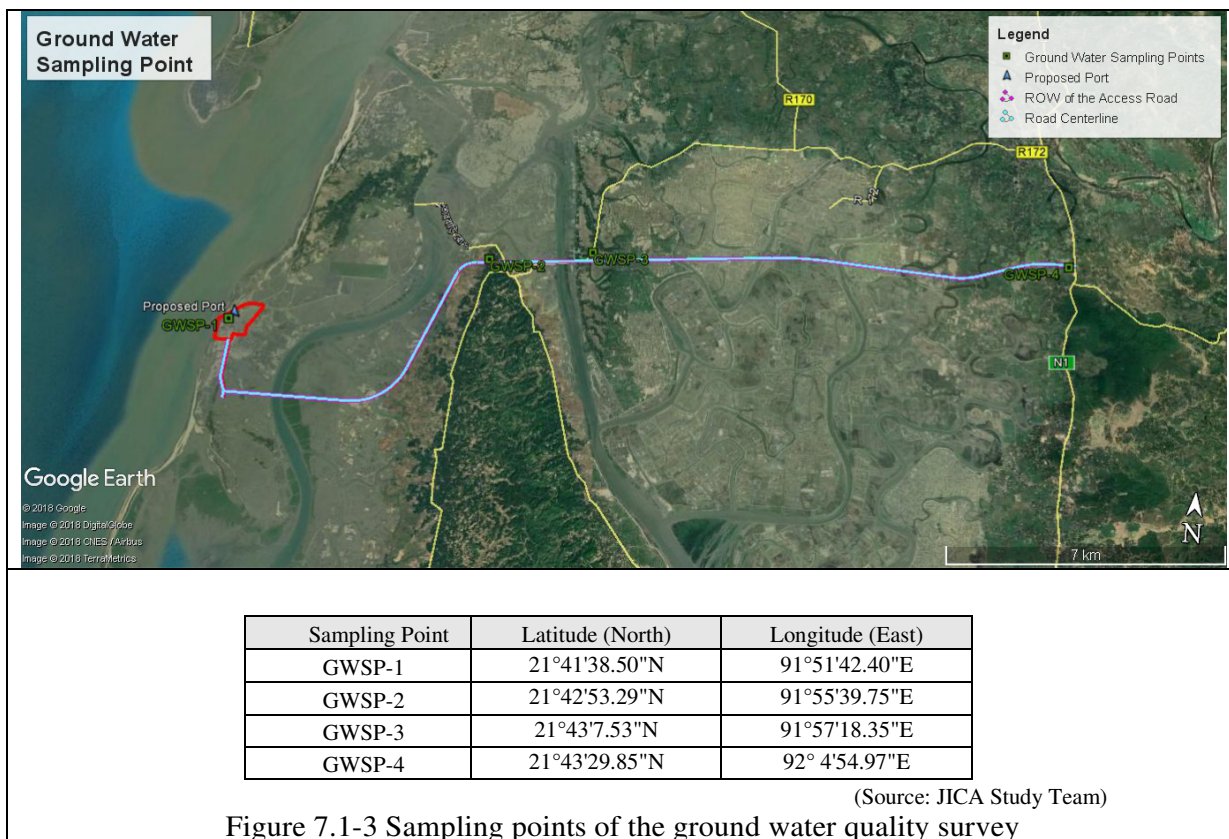
- A: Potable water source supply after bacteria freeing only
- B: Water used for recreational purposes
- C: Potable water source supply after conventional processing
- D: Water used for pisciculture
- E: Industrial use water including chilling and other processes
- F: Water used for irrigation

(Source: JICA Study Team)

b) Ground Water

i) Sampling Point

The water quality of well water around the proposed project’s right of way were surveyed. The survey was conducted in the dry season in the end of 30<sup>th</sup> April 2018 and the rainy season from 8 to 9 June 2018 to reflect the seasonal change of well water quality.



ii) Results

The results of the ground water quality survey are shown in Table 8.1-4. The results of both the rainy and dry seasons satisfied most of the drinking water standards of Bangladesh except Fe, Mn and Color.

Table 8.1-4 Results of the ground water quality survey

Parameters	Temperature	pH	Chloride	Nitrogen (NO <sub>3</sub> )	Iron (Fe)	Odor	Arsenic (As)	SS	Coliform	Colour	Lead (Pb)	Manganese (Mn)	Phosphate	Total Dissolved Solid (TDS)	Barium (Ba)	Cadmium (Cd)	
Unit	C	-	mg/L	mg/L	mg/L	Odores	mg/L	mg/L	CFU/100mL	Hzan	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	
GWSP-1	Dry	25	6.7	12	3.8	2.98	0	0	5	0	85	0	0.23	1.48	150	0.05	0.0002
	Wet	28	6.7	20	5.1	2.06	0	0	1.0	0	98.3	0	0.21	2.4	154	0.06	0.0002
GWSP-2	Dry	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Wet	29	-	45	2.9	1.24	0	0	12	0	25.51	0	0.06	2.1	282	0.05	0.0002
GWSP-3	Dry	26	6.7	14	1.4	2.68	0	0	11	0	-	0	0.21	1.3	-	0.06	0.0002
	Wet	30	7.2	23	2.8	1.54	0	0	11	0	36.3	0	0.05	1.73	110	0.05	0.0002
GWSP-4	Dry	25	6.9	55	3.4	1.06	0	0	12	0	-	0	0.03	2.6	-	0.04	0.0002
	Wet	30	-	84	5	1.32	0	0	14	0	11.7	0	0.03	3.8	370	0.05	0.0002
Standards for Drinking	30-30	6.5-8.5	150-300	5	0.3-10	Odores	0.05	10	0	15	0.05	0.1	4	1000	0.01	0.005	

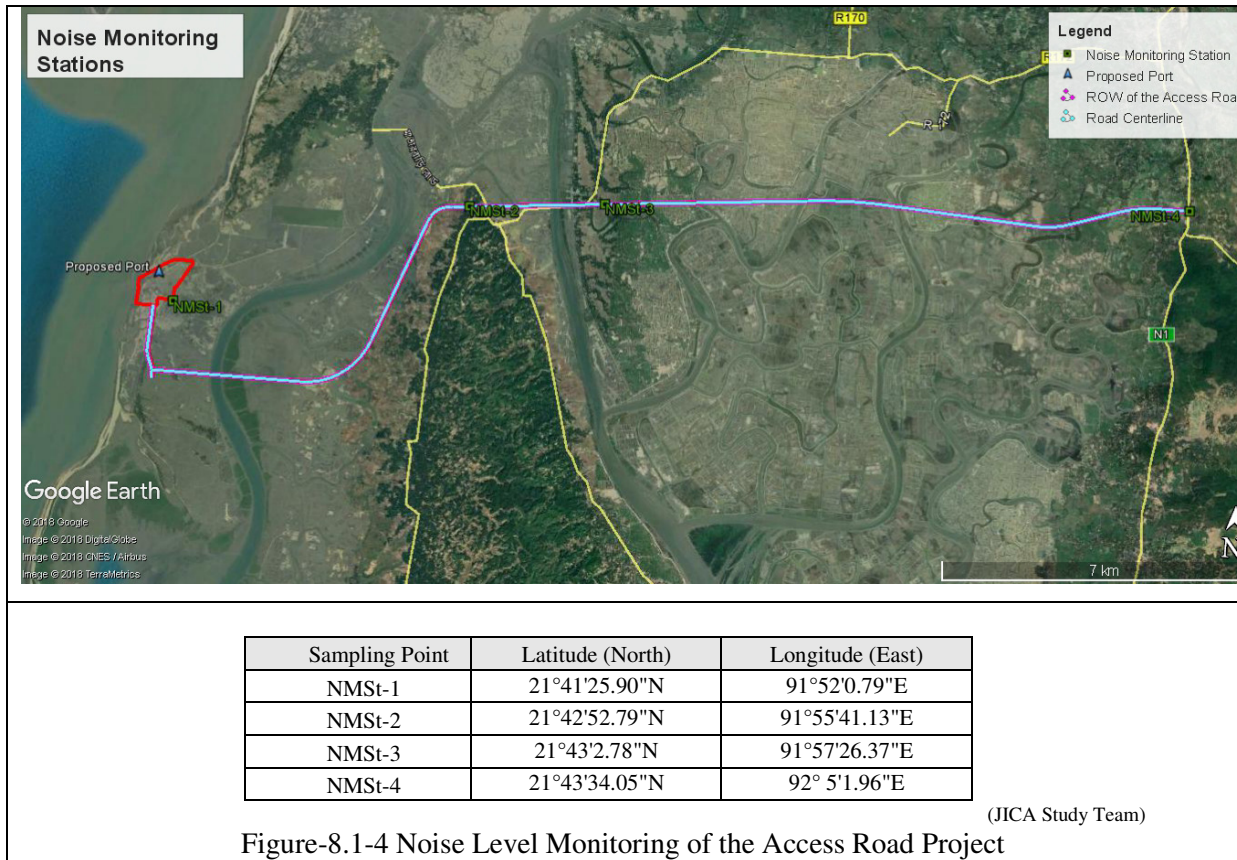
(JICA Study Team)

8.1.3 Noise

i) Sampling points



The residential areas and a filling stations all along the right of way of the access road and the southeast corner of the port were selected as the sampling points for the noise survey. The survey was conducted in the dry season (15-16 February 2018 and 28-29 April 2018) and in the wet season (08-09 June 2018) to reflect the seasonal changes of noise levels.



ii) Results

The noise measurement results indicated that the day time noise level was above the environmental standards for residential areas consideration at two monitoring points. Adjacent to the proposed port connecting access road project there is a project of Coal based power plant which is under the construction now, therefore vehicles used for construction activities, local transportation were the noise sources. These vehicles are limited in uses at the night time but the movement of local transportation naturally has increased which has increased the noise level in compare to the Residential area. On the other hand the noise were monitored on the roadside and a filling station where the traffic movements were always in a regular interval with noise.

Table-8.1-5 Noise Level data of the Study Area

Season	Results				Standards for Noise (dB) (Day: 6AM-9PM) (Night: 9PM-6AM)				
	NMSt-1	NMSt-2	NMSt-3	NMSt-4	A	B	C	D	E
Rainy	59.1±3.3	51.3±0.3	53.1±0.30	56.8±1.9	Day: 45	Day: 50	Day: 60	Day: 70	Day: 70
	48.9±2.1	35.1±0.3	41.2±0.60	40.5±2.1	Night: 35	Night: 40	Night: 50	Night: 60	Night: 70
Dry	49.3±2	40.5±0.21	59.4±3.1	59.2±1.2	Day: 45	Day: 50	Day: 60	Day: 70	Day: 70
	42.1±1.9	34.1±0.33	42.1±1.3	43.4±2.2	Night: 35	Night: 40	Night: 50	Night: 60	Night: 70

Notes: Category of areas is as below.

A: Silent zone

B: Residential area

C: Mixed area (mainly residential area, and also simultaneously used for commercial and industrial purposes)

D: Commercial area

E: Industrial area

(Source: JICA Study Team)

Reference: IFC/EHS guidelines

Receptor	Day 07:00-22:00	Night 22:00-07:00
Residential, institutional, educational area	55	45
Industrial, commercial area	70	70

(Source: IFC/EHS General Guidelines, 2007)

## 8.2 NATURAL BIOLOGICAL RESOURCES

### a) Protected Forest and Ecologically valuable habitats

#### (i) ECA & Protected Area:

The Bangladesh Environment Conservation Act (BECA), 1995 has provision for Ecologically Critical Area (ECA) declarations by the Director General of the Department of Environment in certain cases where ecosystem is considered to be threatened to reach a critical state. On the Other hand, protected area like all sanctuaries, national parks, community conservation areas, safari parks, eco-parks, botanical gardens designated by Department of Forest under the wildlife order & forest act, 1927. A list of these protected areas with some information is presented in table 8.2-1.

Table-8.2-1 Protected and Significant Areas Located within the Study Area

Sl. No.	Name of the area	Type of forest	Upazila	Declared Year	Area * (sq.kilometer)
<b>National Park</b>					
1.	MedhaKachhapia	Dipterocarp forest in hillocks	Chakaria	2004	3.70
2.	Himchari	Mixed-evergreen forest in hills	Cox's Bazar Sadar	1980	0.23
<b>Wildlife Sanctuary</b>					
1.	Fasiakhali	Dipterocarp forest in hillocks	Chakaria	2007	11.78
2.	Chunati	Dwarf bamboo and other vegetation	Pekua and Lohagar	1986	22.65
<b>Safari Park</b>					
3.	Dulahazara	Dipterocarp forest in hillocks	Cox's Bazar Sadar	1997	2.99
<b>Ecologically Critical Area (ECA)</b>					
(i)	Sonadia Island	Mangrove Forest	Moheshkhali	1999	74.59
(ii)	Cox's Bazar-Teknaf Peninsula	Mixed-evergreen Forest	Cox's Bazar Sadar	1999	72.26
<b>Reserve Forest</b>					
1.	Garjania Khutakhali	Mixed-evergreen Forest	Chakaria	-	22.73
2.	Chakaria Sundarbans	Mixed-evergreen Forest	Chakaria		77.19
3.	Ringbhang	Mixed-evergreen Forest	Chakaria	-	12.28
4.	Harbang	Mixed-evergreen Forest	Pekua	-	5.68
5.	Nalbila	Mixed-evergreen Forest	Pekua	-	3.79
6.	Sonaichari	Mixed-evergreen Forest	Moheshkhali	-	3.15
7.	Boalkhali	Mixed-evergreen Forest			20.16
8.	Kakara	Mixed-evergreen Forest	Chakaria		1.20
9.	Chambi Rubber	Mixed-evergreen Forest			0.003

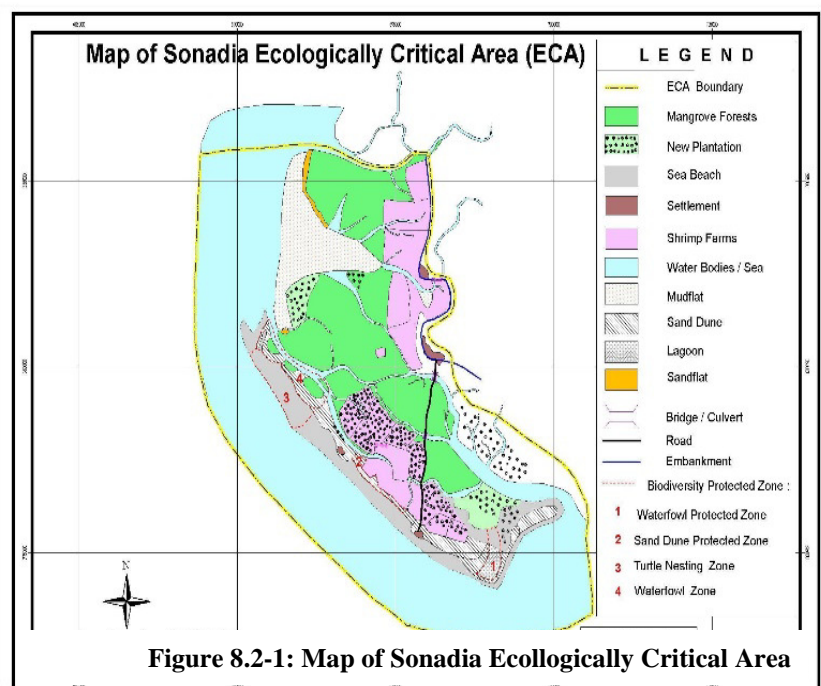
Sl. No.	Name of the area	Type of forest	Upazila	Declared Year	Area * (sq.kilometer)
	Estate				
10.	Toitang	Mixed-evergreen Forest			0.61
11.	Moheshkhali Hill Forest	Tropical and semi evergreen Forest		1953	72.40

\* approximate area that falls within and upto study area boundary

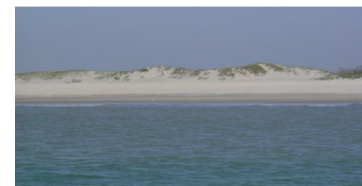
**(ii) Sonadia Island ECA**

Sonadia Island (in its entirety) is part of the adjacent Moheshkhali Island, fall under Kutubjum Union, MoheshkhaliUpazila. Species diversity varies season to season for various ecological and environmental factors. There is a large number of species which can be commercially exploited from this island. The Island lies between 21°28' N to 21°33' N latitude & 91°46' E to 91°52' E longitude. The Island lies between 21°41' N to 21°44' N latitude & 91°50' E to 91°56' E longitude.

Department of Environment declared Sonadia Island as an Ecologically Cretial Area (ECA) in 1995. The total area of this island is 7 square km. There are 27 mangrove flora species, 35 sanddune species, 10 mamuls, 145 birds, 12 crabs, 13 amphibia, 7reptiles, 56 shell, 27 shrimp species etc found in this island. Endangered bird of Spoon bill sand piper found in this island.



**Figure 8.2-1: Map of Sonadia Ecologically Critical Area**



**Sand dune in Sonadia**



**Carleo Bird of Sonadia Island**



**Mangrove Forest of Sonadia**



**(iii) Bangabondu Safari Park**

Dulahazra Safari Park is one of Bangladesh’s most unique destinations is right here at Chakaria Upazila in Cox's Bazar District. A place where threatened and endangered animals from all over the world–Royal Bengal tiger, giraffe, elephants, Crocodiles, Bears, Chitals and lots of different types of birds and monkeys. A place where scientists, and educators are working to better understanding and conserve the world’s animal and natural resources. A place where visitors can encounter and learn about nature and wildlife. Total area is 900 hectares.



**Figure 8.2-2: Dulahazra Safari Park (Source: Field Survey)**



Snippet of the Dulahazra Safari Park (source: Field Survey)



**(iv) Fasiakhali Wildlife Sanctuary**

Fasiakhali wildlife sanctuary probably 47 KM Northern distance from world longest sea beach town Cox’s Bazar. It stands on the east-west side of Chittagong-Cox’s Bazar Highway and within the Fasiakhali and Dulhazara Union, Upazila Chakaria, District Cox’s Bazar.

The Government Covered by the wildlife protection Act 1974 of this area. In the year of 2007 Bangladesh Government declared by the Gazette No PABAMSHAW/5/ 6785 dated 02/06/2007 named as a Fasiakhali Wildlife Sanctuary.

Bangladesh Forest department, FKWS Co-management Committee maintaining their work within the 1302 hectares Reserve/Protected forests. There are 1537 Accor’s Buffer Forest lands within the protected area.

Flagship species are Northern Pig-tailed Macaque & Asian Elephant. There are approximately 25 mammals, 162 birds, 15 amphibian, 35 reptile’s species etc. found in this island. Endangered bird of Spoon bill sand piper found in this island.

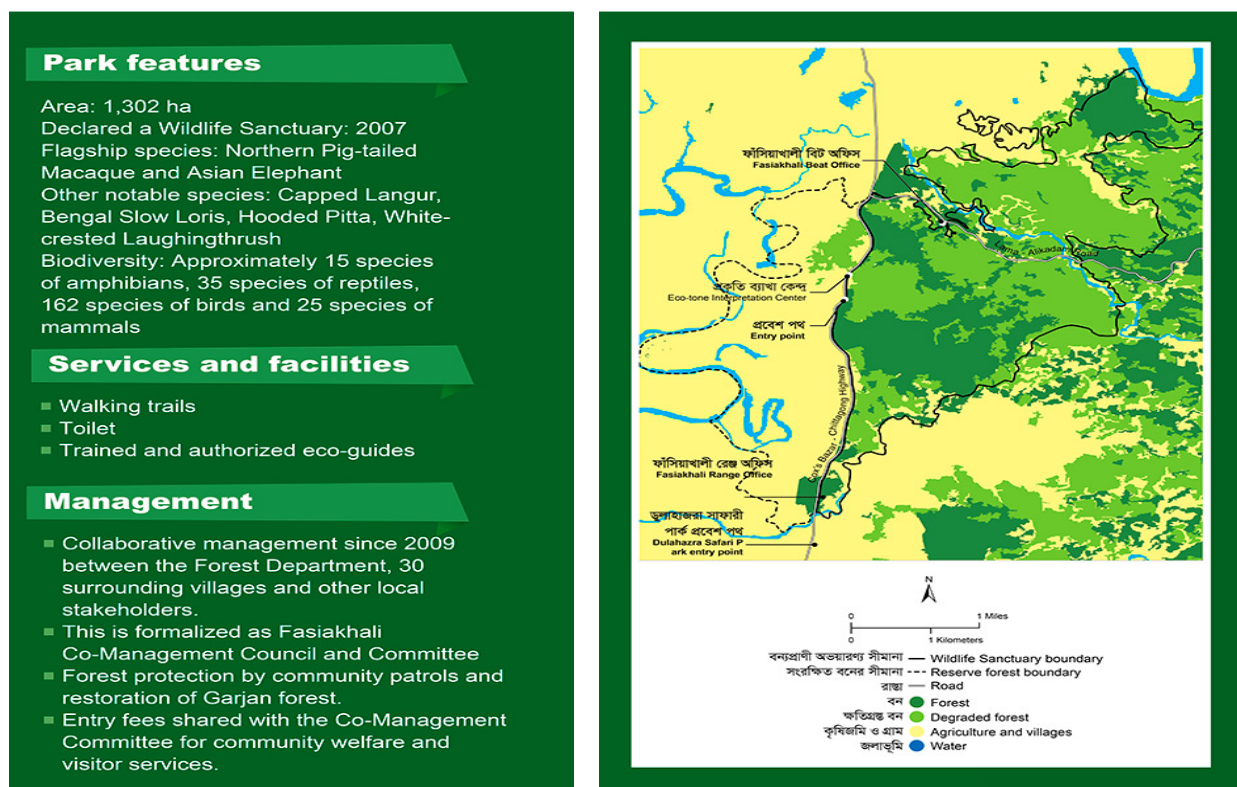






Figure 8.2-3: Map of Fasiakhali Wildlife Sanctuary

**(v) Medakacchapia National Park**

The Medhakacchapia National Park is generally tropical semi-evergreen forest of Bangladesh. It is situated around 50 km north of renowned tourist capital of Bangladesh-Cox’s Bazar. The GPS location of the park is 21°40’ to 21°45’ N and 92°4’ to 92°8’ E. The park has covered on Khutakhali Union of Chakaria Upazila. The Government Covered by the wildlife protection Act 1974 of this area. In the year of 2004 Bangladesh Government declared by the Gazette No PABAM (SHAW-

3)32/2003/356 dated 04/04/2004 named as a Medhakacchapia National Park. Total Area of this National Park is 396 hectares.

	
<p><i>Dipterocarpus tarbinatus</i> (Garjan)</p>	<p>Northern Pig-tailed Macaque</p>
	
<p>Asian Elephant</p>	<p>Hill Maina</p>

**Park features**

Area: 396 ha  
 Declared a National Park: 2004  
 Flagship species: Garjan  
 Other notable species: Hog Badger, Crested Serpent Eagle, Great Slaty Woodpecker, White-crested Laughingthrush  
 Biodiversity: Approximately 13 species of amphibians, 30 species of reptiles, 168 species of birds and 21 species of mammals

**Services and facilities**

- Walking trails
- Tall Garjan forest
- Picnic area
- Toilet
- Trained and authorized eco-guides

**Management**

- Collaborative management since 2009 between the Forest Department, 13 surrounding villages and other local stakeholders.
- This is formalized as Medakachapia Co-Management Council and Committee
- Forest protection by community patrols and restoration of Garjan forest.
- Entry fees shared with the Co-Management Committee for community welfare and visitor services.

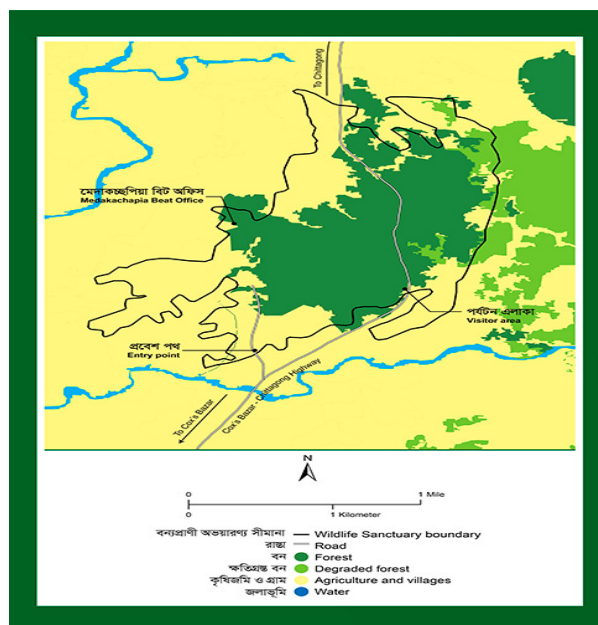


FIGURE 0.4.1 Medhakachapia National Park





*Dipterocarpus tarbinatus* (Garjan)



*Calotes versicolor* (Girgity)



*Prionailurus viverrinus* (Fishing Cat)



Parrot(Hill)

#### (vi) Ecologically Valuable Habitats

The study area comprises a mosaic of unique habitats making the area suitable for diverse assemblage of flora and fauna. A total of 6 type of habitats could be recognized within the study area, viz. (i) Coastal habitat covering coastal wetlands and beaches, (ii) Wetlands covering rivers, (iii) Homestead, (iv) Mangrove forest (v) Natural forest/hill forest, (vi) Agricultural lands and shrimp farms/salt pans ( *Source: IDCJ, 2016*). A brief description of identified habitat is provided below:

- a) **Coastal habitat covering coastal wetlands and beaches** – Coastal habitat is an important habitat with diverse biodiversity. This particular habitat is composed of coastal wetlands (up to 2 meter depth of sea water during low tide), sandy beaches and mudflats. Mangroves grow only in the mudflat areas. The sandy and mudflats are the main roosting grounds of many migratory and resident water birds. Sea turtles normally use only the sandy beaches for nesting. Sand dunes vegetation grows in the sand dune areas. The coastal wetlands are the habitats for dolphins and are also the main source of marine fishes, crabs, shrimps and shells.
- b) **Wetlands covering rivers and beels** – This type of habitat include ponds, lakes, beels, pits and also small to large rivers. The Kuhelia, Badarkhali, and Matamuhuri are the main rivers in the area. However, some seasonal and perennial beels and ponds are observed in the inlands of the area. Wetlands are the main source of freshwater fishes and also some brakish water fishes.
- c) **Homestead areas** –The homestead area is also a major habitat type, having local and indigenous species of plants and common wildlife. Large and conspicuous plant species are planted and mainly represent both timber and fruit yielding species. It provides refuge for feeding and nesting of many common wildlife.
- d) **Mangrove forest** –
- e) **Natural forest/hill forest** – Natural forests exist normally in hilly areas. All the national parks, wildlife sanctuaries and reserve forests of the study area are situated in the hilly areas having rich flora and fauna diversity. Hill forests are rich in both herbs and tree species. Major resident bird, amphibian and mammal species occur in this habitat type.

- f) **Agricultural lands and shrimp farms/salt pans** –There are a number of shrimp farms/salt pans located in Moheshkhali, Kutubdia Island, Sonadia Island, Maheshkhali Island and some parts of Chakaria Sundarbans area at the southeastern part of Chakaria Upazila. These are extensively used for shrimp farming and are therefore poor in biodiversity. Salt pans have also extremely poor in biodiversity. These shrimp farms have been established by clearing mangrove vegetation. Agricultural land also a dominant habitat type within the study area. Flora species of agricultural land represent the herbaceous species. Some common bird species, frogs, etc. are found in this habitat type.
- g) **Coral Reef:** Chief Scientific Officer of the Bangladesh Fisheries Research Institute in Cox’s Bazar has informed that there is no coral reef habitat around the proposed project site. The closest coral reef to the project site is the St. Martins Island which is located approximately 120km from the proposed project site.

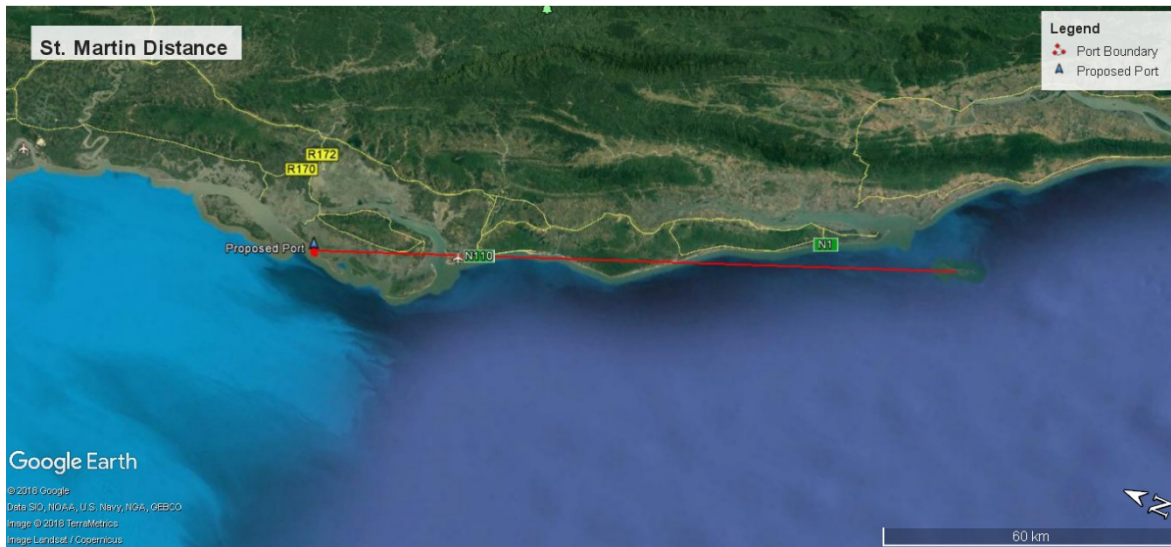


Figure 8.2-5 Project Site and St. Martins Island (Source: Google Earth)

- h) **Seaweed:** As said by the Chief Scientific Officer of the Bangladesh Fisheries Research Institute in Cox’s Bazar, seaweed does not grow around the study area because the transparency of the sea water is low.
- i) **Mangrove Forest:** Mangrove vegetation grows in mudflat areas, often in estuarine areas. Mangroves are found in the outer boundary of Kutubdia Island, Moheshkhali Island and maximum parts of Sonadia Island, Bakhkhali and Choufladi estuaries within the study area. A total of 29 plant species were recorded from the mangroves. Mangroves also harbor a rich fauna species, particularly birds and invertebrates. Otter is also found in this habitat type. On the route there would be a small mangrove forest area on the crossing of the Kuhelia River. These Mangrove forests are only scattered at the riverside of the Kuhelia River, which flows between Matarbari and Moheshkhali Islands. There is a mangrove forest, which is large scale and artificially established, at the south side of Matarbari Island and its opposite bank is Moheshkhali Island. Mangrove species were found 15 seedling/m<sup>2</sup> in Kuhelia river, Haser char & Badarkhali site. Major Mangrove species are *Avicennia sp. (Baen)*, *Acanthus ilicifolius (Hargoja)*, *Aegialitis rutundifolia (Nuinna)* etc.

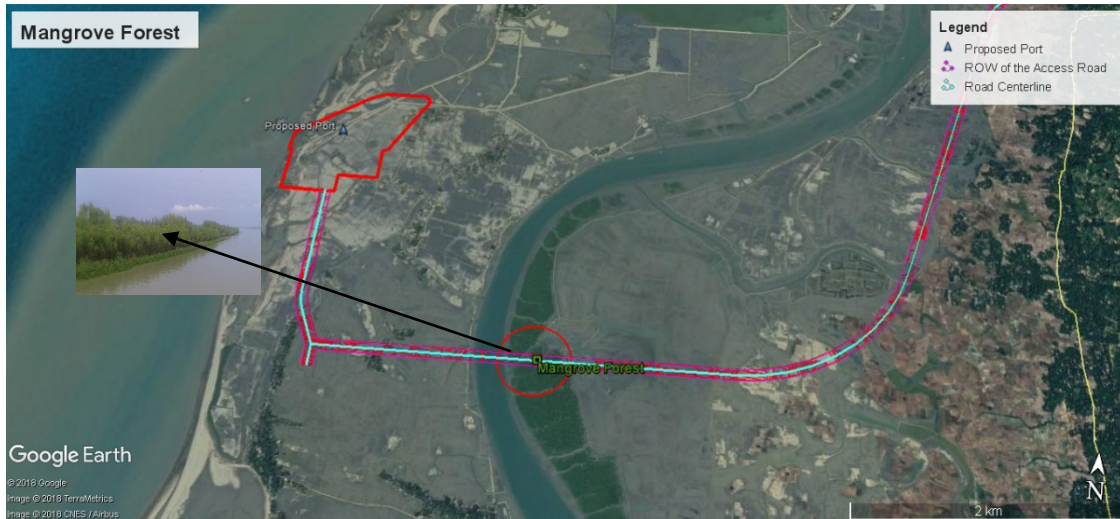


Figure 8.2-6 Mangrove Forest in the Project Study Area

- j) **Mud Flats:** The coastline of Matarbari Island is a long sandy beach. The slope of the sandy beach is steep, and the area of its inter-tidal zone is relatively small. On the other hand, a sand bar and shallow sea area lie in the estuary of the Kohalia River located south of Matarbari Island due to sedimentation.

**(vii) Organisms**

**(a) Phytoplankton**

**a. Sampling Points**

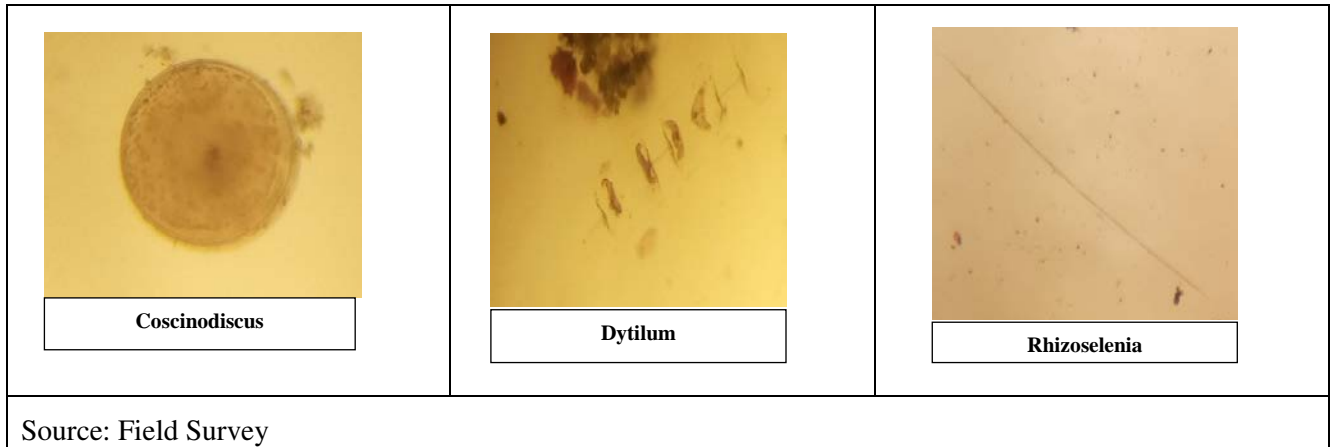
Phytoplankton survey was conducted at three points of Kuhelia, Matamuhuri & Badarkhali rivers and similar to water quality survey (Figure -3), at three water layers, surface (0.5 m depth), middle (1/2 depth) and bottom (1m up from the bottom).

**b. Method**

Water samples from different depths (pre-selected) were collected by using Nenson bottle & were immediately transferred to commercially available plastic bottles as is the recommended method by Soumya (1978). After collection, samples were preserved in 2% neutralized formalin. Collected samples were brought to the lab and continuous filtration was done. Samples were then reduced to 50 ml in each individual amount. In the laboratory, the samples were transferred to measuring cylinder (1000 ml). The mouth of the cylinder was plugged and left-over night. After the phytoplankton settled down, water from the top layer was removed and concentrated to 50 ml and then concentrated samples were kept in labeled vials for microscopic examination.

**c. Result**

Twenty-five species of phytoplankton were observed, and *Monoraphidium sp.* Is the largest in number of species (appendix, table-13). Navicula, Cylindrotheca and Pseudonitzschia genera also present in high number (appendix, table-13). In surface layer phytoplankton present in high, bottom layer is low amount (appendix, table-13,14) but bottom layer is fully absent due to absent of sunlight.



**Table-8.2-2: Surface Water phytoplankton abundance (Mean)**

Genera	Sampling Sites		
	Khohelia (individuals/L)	Matamuhuri (individuals/L)	Badarkhal (individuals/L)
Aphanizomenon	777.667	-	-
Asteromphalus	-	-	633.33
Aulacoseira	1,811	-	-
Boreadinium	500	-	-
Coscinodiscus	1,111	400	-
Cochlodinium	500	-	-
Cylindrotheca	477.67	15,416.667	-
Ditylum	1,276.67	-	-
Dynophysis	1,000	2,333.33	-
Dissdenium	-	-	-
Euglena	-	10,663.33	-
Entomoneis	777.667	-	-
Gloeocapsa	2,666.67	-	-
Gyrodinium	-	35,966.667	-
Leptocylindrus	-	-	666.667
Monoraphidium	-	62,366.333	-
Navicula	-	21,853.33	-
Planktothrix	1000	2,020	4,166.667
Pleurosigma	-	42,020	1,110
Protoperidinium	-	666.667	-
Pseudo-nitzschia	-	10,673.33	-
Rhizosolenia	2,788.667	-	666.667
Spirulina	-	-	-
Scenedesmus	-	4,186.667	-
Stephanopyxis	-	-	333.33
<b>Total</b>	<b>14,687.011</b>	<b>204,379.654</b>	<b>7,576.661</b>

**Table-8.2-3: Middle Water phytoplankton abundance (Mean)**

Genera	Sampling sites			
	Sea (individuals/L)	Khohelia (individuals/L)	Matamuhuri (individuals/L)	Badarkhal (individuals/L)
Ditylum	27.5	-	-	-
Dynophysis	-	-	27.33	-
Dissdenium	-	-	-	5000
Euglena	-	-	1,236.667	-
Entomoneis	-	-	-	-
Gloeocapsa	-	-	-	-
Leptocylindrus	-	-	-	22.33
Monoraphidium	-	-	1,996.667	-



Genera	Sampling sites			
	Sea (individuals/L)	Khohelia (individuals/L)	Matamuhuri (individuals/L)	Badarkhal (individuals/L)
Navicula	-	-	2,070	-
Planktothrix	-	-	46	153.333
Pleurosigma	-	800	906.667	423.333
Pseudo-nitzschia	-	-	-	-
Rhizoselenia	80	766.667	-	-
Spirulina	8.25	-	-	-
<b>Total</b>	<b>107.75</b>	<b>1,566.667</b>	<b>6,505.331</b>	<b>5,598.996</b>

**Table-8.2-4: Abundance of Phytoplankton of Khohelia River-01**

SL NO	Genera	Surface (Individuals/L)	Middle (Individuals/L)	Bottom (Individuals/L)
1	Planktothrix	3000	-	--
2	Ditylum	2330	-	--
3	Coscinodiscus	3333	-	--
4	Rhizoselenia	-	3000	--
5	Pleurosigma	-	2400	--

**Table-8.2-5: Abundance of Phytoplankton of Khohelia River-02**

SL NO	Genera	Surface	Middle	Bottom
1	Dynophysis	3000	-	--
2	Gloeocapsa	8000	-	--
3	Rhizoselenia	1666	-	--
4	Entomoneis	2333	-	--
5	Aphanizomenon	2333	-	--
6	Ditylum	1500	-	--
7	Cochlodinium	1500	-	--
8	Boreadinium	1500	-	--
9	Avlucoseira	-	5233	--
10	Coscinodiscus	-	2766	--
11	Cylindrotheca	-	3150	--

**Table-8.2-6: Abundance of Phytoplankton of Khohelia River-03**

SL NO	Genera	Surface (individuals/L)	Middle (individuals/L)	Bottom (individuals/L)
1	Aulacoseira	5433	-	--
2	Cylindrotheca	1533	49	--

**Table-8.2-7: Abundance of Phytoplankton of Matamuhuri River-01**

SL NO	Genera	Surface (individuals/L)	Middle (individuals/L)	Bottom (individuals/L)
1	Gyrodinium	107900	-	--
2	Monoraphidium	103433	3860	--
3	Rhizoselenia	19333	4220	--
4	Euglena	8430	-	--
5	Psedu-nitzschia	16560	-	--
6	Planktothrix	2300	138	--
7	Scendesmus	9120	1140	--

**Table-8.2-8: Abundance of Phytoplankton of Matamuhuri River-02**

SL NO	Genera	Surface (individuals/L)	Middle (individuals/L)	Bottom (individuals/L)
1	Euglena	23560	3710	--
2	Monoraphidium	83666	2130	--



3	Navicula	53560	6210	--
4	Planktothrix	1760	-	--
5	Pleurosigma	2730	510	--
6	Pseudo-nitzschia	15460	-	--
7	Scenedesmus	12,560	-	--

**Table-8.2-9: Abundance of Phytoplankton of Matamuhuri River-03**

SL NO	Genera	Surface (individuals/L)	Middle (individuals/L)	Bottom (individuals/L)
1	Cylindrotheca	46,250	660	--
2	Dinophysis	7,000	82	--
3	Navicula	12,000	--	--
4	Pleurosigma	1,23,330	2,210	--
5	Planktothrix	2,000	--	--
6	Protoperdinium	2,000	--	--
7	Rhizoselenia	39,330	290	--

**Table-8.2-10: Abundance of Phytoplankton of Badarkhal-01**

SL NO	Genera	Surface (individuals/L)	Middle (individuals/L)	Bottom (individuals/L)
1	Cylindrotheca	10933	-	--
2	Planktothrix	3500	320	--
3	Monoraphidium	1660	-	--
4	Pleurosigma	3330	170	--
5	Pseudo-nitzschia	2000	-	--
6	Asteromphalus	1900	-	--
7	Ditylum	1766	82	--
8	Leptocylindrus	13333	-	--
9	Unidentified	18300	-	--

**Table-8.2-11: Abundance of Phytoplankton of Badarkhal-02**

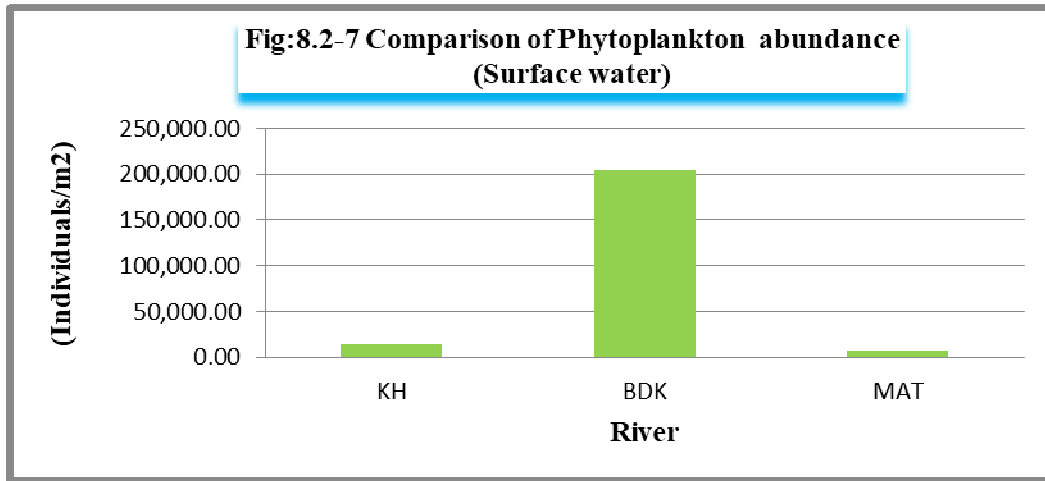
SL NO	Genera	Surface (individuals/L)	Middle (individuals/L)	Bottom (individuals/L)
1	Rhizoselenia	2000	-	--
2	Cylindrotheca	2500	-	--
3	Planktothrix	3000	-	--
4	Coscinodiscus	1200	-	--
5	Dissdenium	-	15000	--
6	Pleurosigma	-	1100	--

**Table-8.2-12: Abundance of Phytoplankton of Badarkhal-03**

SL NO	Genera	Surface (individuals/L)	Middle (individuals/L)	Bottom (individuals/L)
1	Planktothrix	6,000	140	--
2	Leptocylindrus	2,000	67	--
3	Stephanopyxis	1,000	-	--

**d. Comparison of Phytoplankton Abundance**

High abundance of phytoplankton is found at Matamuhuri river (Appendix, Table B13). Kuhelia, Matamuhuri and Badarkhal river phytoplankton abundance comparison is shown in the figure below:



**(b) Zooplankton**

**a. Sampling Points:**

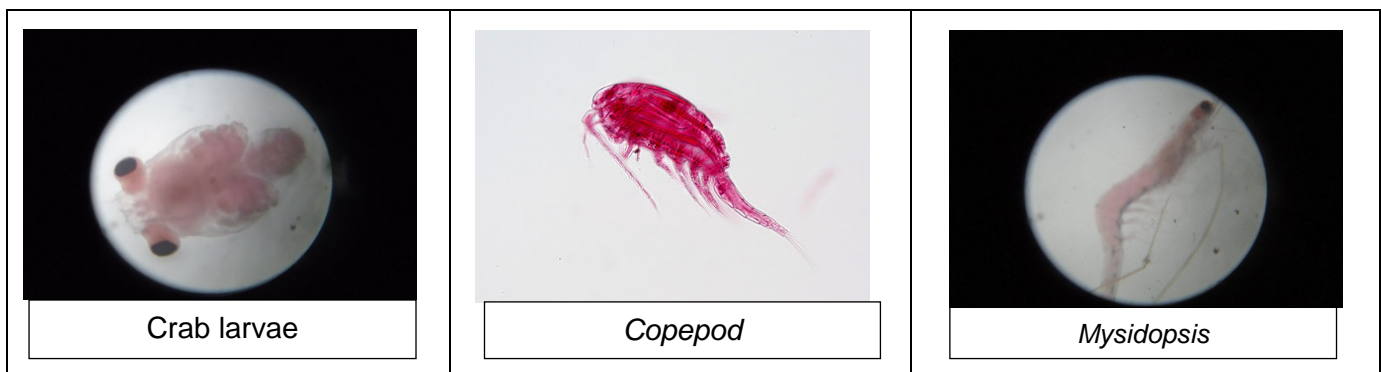
Zooplankton survey was conducted at three sampling points similar to water quality survey ((Fig -3) at three water layers, surface (0.5 m depth), middle (1/2 depth) and bottom (1m up from the bottom).

**b. Method**

Zooplankton sampling was carried out with the help of conical zooplankton net made by Nylon Silk of 325 micro meter mesh size and having 24 cm circular mouth opening fitted with a plastic bucket at the cod. A digital flow meter was set up at the mouth of the net to record the quantity of the water filtered through the net during sampling. Precaution was taken for clearing the net & bucket before every sampling to avoid any possible contamination. Sample were collected from three distinct layers (surface, middle and bottom) around 10-15 min. After collecting samples were preserved in 5% formalin. For effective sorting, the samples were stained with Eosin and left for 24 hours. All the zooplankton attained reddish color, which helped to easy identification.

**c. Result:**

Seven species of zoo-plankton were observed, and Copepoda (Arthropoda) is the largest in number of species (Appendix, Table-33). In surface layer zoo-plankton present in high, middle & bottom layer is low amount.



Source: Field Survey

**Table-8.2-13: Abundance of Zooplankton of Khohelia River station -01**

Zooplankton	Surface (individuals/ m <sup>3</sup> )	Middle (individuals/ m <sup>3</sup> )	Depth (individuals/ m <sup>3</sup> )
Crab larvae	0.0453	-	-
Copepod	8.4747	7.60999	3.0029
Jelly fish	0.0452	0.08953	0.00457

Lucifer	0.0634	0.17906	0.0826
Sagitta	1.2495	0.79458	-
Shrimp larvae	0.1539	0.50361	0.0422

**Table-8.2-14: Abundance of Zooplankton of Khohelia River station -02**

Zooplankton	Surface (individuals/ m <sup>3</sup> )	Middle (individuals/ m <sup>3</sup> )	Depth (individuals/ m <sup>3</sup> )
Crab larvae	0.0937	-	-
Copepod	18.7488	2.4949	1.425
Jelly fish	0.1874	0.1247	0.273
Lucifer	0.50	0.2494	-
Sagitta	3.1247	0.9356	0.379
Shrimp larvae	0.6250	0.1247	-

**Table-8.2-15: Abundance of Zooplankton of Khohelia River station -03**

Zooplankton	Surface (individuals/ m <sup>3</sup> )	Middle (individuals/ m <sup>3</sup> )	Depth (individuals/ m <sup>3</sup> )
Crab larvae	-	0.01175	0.00425
Copepod	1.6050	3.5257	1.4691
Jelly fish	0.1921	0.1762	0.0292
Lucifer	0.2713	0.7051	-
Sagitta	0.2825	0.8226	-
Shrimp larvae	0.0188	0.01469	0.0022

**Table-8.2-16: Abundance of Zooplankton of Matamuhuri River station -01**

Zooplankton	Surface (individuals/ m <sup>3</sup> )	Middle (individuals/ m <sup>3</sup> )	Depth (individuals/ m <sup>3</sup> )
Crab larvae	-	-	-
Copepod	11.4151	5.9231	2.0612
Jelly fish	-	-	-
Lucifer	-	-	-
Sagitta	-	-	-
Shrimp larvae	17.6750	9.7213	4.471
Mysid	0.3682	0.1871	-

**Table-8.2-17: Abundance of Zooplankton of Matamuhuri River station -02**

Zooplankton	Surface (individuals/ m <sup>3</sup> )	Middle (individuals/ m <sup>3</sup> )	Depth (individuals/ m <sup>3</sup> )
Crab larvae	0.01718	0.0029	-
Copepod	28.63909	19.4569	7.8923
Jelly fish	-	-	-
Lucifer	-	-	-
Sagitta	-	-	-
Shrimp larvae	1.1455	0.2591	-

**Table-8.2-18: Abundance of Zooplankton of Matamuhuri River station -03**

Zooplankton	Surface (individuals/ m <sup>3</sup> )	Middle (individuals/ m <sup>3</sup> )	Depth (individuals/ m <sup>3</sup> )
Crab larvae	-	-	-
Copepod	50.4466	29.3623	17.4146
Jelly fish	1.5286	0.8741	-
Lucifer	15.2868	4.975	0.895
Sagitta	0.7643	0.281	-
Shrimp larvae	-	-	-

***unknown [2]	0.07643	-	-
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**Table-8.2-19: Abundance of Zooplankton of Badarkhal station -01**

Zooplankton	Surface (individuals/ m <sup>3</sup> )	Middle (individuals/ m <sup>3</sup> )	Depth (individuals/ m <sup>3</sup> )
Crab larvae	-	-	-
Copepod	0.8782	0.3281	0.0132
Jelly fish	0.5488	0.1256	0.0027
Lucifer	0.1258	0.0469	-
Sagitta	-	-	-
Shrimp larvae	0.3293	0.0239	-
Mysid	0.7684	0.0237	-

**Table-8.2-20: Abundance of Zooplankton of Badarkhal station -02**

Zooplankton	Surface (individuals/ m <sup>3</sup> )	Middle (individuals/ m <sup>3</sup> )	Depth (individuals/ m <sup>3</sup> )
Crab larvae	-	-	-
Copepod	0.7955	0.6295	0.4297
Jelly fish	0.3421	0.313	0.211
Lucifer	0.03977	0.0159	-
Sagitta	0.4243	0.125	-
Shrimp larvae	0.0662	0.0026	0.0014

**Table-8.2-21: Abundance of Zooplankton of Badarkhal station -03**

Zooplankton	Surface (individuals/ m <sup>3</sup> )	Middle (individuals/ m <sup>3</sup> )	Depth (individuals/ m <sup>3</sup> )
Crab larvae	0.0069	0.0070	-
Copepod	5.3578	5.4556	3.236
Jelly fish	0.4701	0.4787	0.0729
Lucifer	-	-	-
Sagitta	0.4701	0.4787	0.238
Shrimp larvae	0.6982	0.7110	0.390

**Table 8.2-22: Surface water zooplankton abundance (Mean)**

Taxa	Sampling sites		
	Khohelia (individuals/m <sup>3</sup> )	Matamuhuri (individuals/m <sup>3</sup> )	Badarkhal (individuals/m <sup>3</sup> )
Copepod	9.6095	30.167	2.3438
Crab larvae	0.46	0.0057	0.0023
Jelly fish	0.142	1.5286	0.454
Lucifer	0.278	15.2868	0.05519
Mysid	-	-	0.256
Sagitta	1.55	0.7643	0.298
Shrimp larvae	0.3223	-	0.3645
Total	12.3618	47.7524	3.77379

**Table-8.2-23: Mid-layer zooplankton abundance (Mean)**

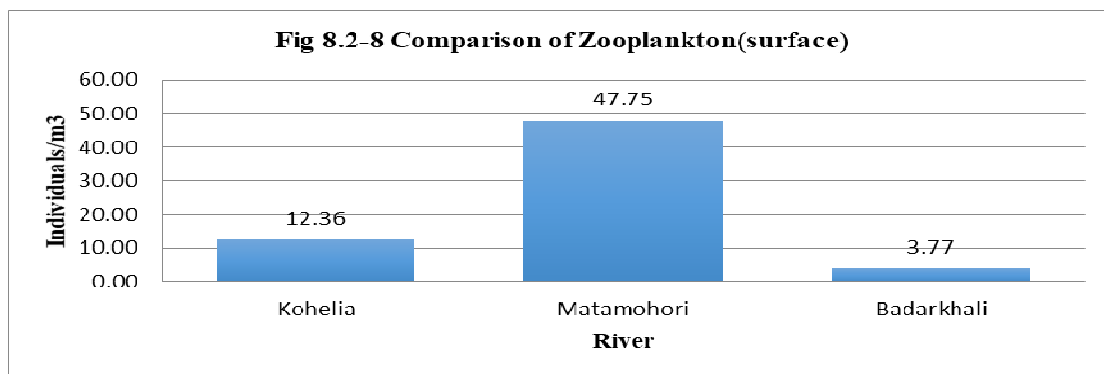
Taxa	Sampling sites		
	Khohelia	Matamuhuri	Badarkhal

	(individuals/ m <sup>3</sup> )	(individuals/m <sup>3</sup> )	(individuals/m <sup>3</sup> )
Copepod	3.4076	28.247	1.3978
Crab larvae	0.0039	0.00096	0.0023
Jelly fish	0.1301	0.8741	0.3058
Lucifer	0.378	4.975	0.0209
Mysid	-	-	0.0079
Sagitta	0.8509	0.281	0.2012
Shrimp larvae	0.2143		0.2458
Total	4.9848	34.37806	2.1817

**Table 8.2-24: Bottom water zooplankton abundance (Mean)**

Taxa	Sampling sites		
	Kohelia (individuals/ m <sup>3</sup> )	Matamuhuri (individuals/m <sup>3</sup> )	Badarkhal (individuals/m <sup>3</sup> )
Copepod	1.999	9.1227	1.2263
Crab larvae	0.0014	-	-
Jelly fish	0.1023	-	0.956
Lucifer	0.1107	0.895	-
Mysid	-	-	-
Sagitta	0.126	-	0.793
Shrimp larvae	0.0148	-	0.130
Total	2.3542	10.0177	3.1053

**d. Comparison of zooplankton Abundance**



**(c) Benthos**

**a. Sampling Points**

The Micro benthos survey was conducted at three sampling points of Kuhelia, Matamuhuri and Badarkhali River.

**b. Method:**

Macro benthos sampling was carried out at the selected study stations. Sediment sample containing macro-benthos were collected using a Petersen Grab (APHA 1974, SUESS 1982) having a mouth opening of 0.024 m<sup>2</sup>. The collected sediments were then placed in plastic buckets and washed through sieve of mesh size 0.5mm and .25mm to retain all benthic fauna. Collected animals were preserved in a pre-labeled plastic container containing 5% formalin and transported to the ecology laboratory. The organisms were counted and calculated for total amount in m<sup>3</sup>.

**c. Result**

The Population of high individuals observed, Oligochaeta (390 ind/m<sup>2</sup>) & Hydrobiidae (390 ind/m<sup>2</sup>) in Matamuhuri. On the other hand population observed, *Nuculidae* (Molluska-280 ind/m<sup>2</sup>) in Kuhelia river, and Polychaeta (252 ind/m<sup>2</sup>) in Matamuhuri. Huge numbers of dead shell (211ind/m<sup>2</sup>) also found in Kuhelia river (Appendix, Table 45).



Source: Field Survey

**Table-8.2-25: Abundance of Benthos Khohelia-01**

SL NO.	Taxa	Individuals/m <sup>2</sup>
1	Nereidae	123

**Table 8.2-26: Abundance of Benthos Khohelia-02**

SL NO.	Taxa	Individuals/m <sup>2</sup>
1	Nuculidae	840.5
2	Death Shell	410
3	Myzostomidae	20.5
4	Antrobis	20.5
5	Naididae	20.5
6	Dead Shell	594.5

**Table-8.2-27: Abundance of Benthos Khohelia-03**

SL NO.	Taxa	Individuals/m <sup>2</sup>
1	Crab	20.5
2	Olygochaeta	61.5
3	Shrimp	20.5
4	Polychaeta	41

**Table-8.2-28: Abundance of Benthos Matamuhuri-01**

SL NO.	Taxa	Individuals/m2
1	Fluminicola	184.5
2	Polychata	61.5
3	Tarneaia	471.5

**Table-8.2-29: Abundance of Benthos Matamuhuri-02**

SL NO.	Taxa	Individuals/m2
1	Copepod	41
2	Oligochaeta	922.5
3	Polychaeta	410
4	Tarbeia	758.5

Table-8.2-30: Abundance of Benthos Matamuhuri-03

SL NO.	Taxa	Individuals/m2
1	Green muscle	4612.5
2	Tarbeia	20.5
3	Dead shell	20.5

Table 8.2-31: Abundance of Benthos Badarkhal-01

SL NO.	Taxa	Individuals/m2
1	Hydrobiidae	1168.5
2	Oligochaeta	246
3	Polychaeta	287
4	Shrimp	123

Table-8.2-32: Abundance of Benthos Badarkhal-02

SL NO.	Taxa	Individuals/m2
1	Nereidae	102.5
2	Mants shrimp	410
3	Myzostomidae	41
4	Shrimp	82
5	Naididae	

Table-8.2-33: Abundance of Benthos Badarkhal-03

SL NO.	Taxa	Individuals/m2
1	Green muscle	307.5
2	Nereidae	123
3	Olygochaeta	328
4	Myzostomidae	20.5

Table 8.2-34: Abundance of Benthos (Mudflat, Mean)

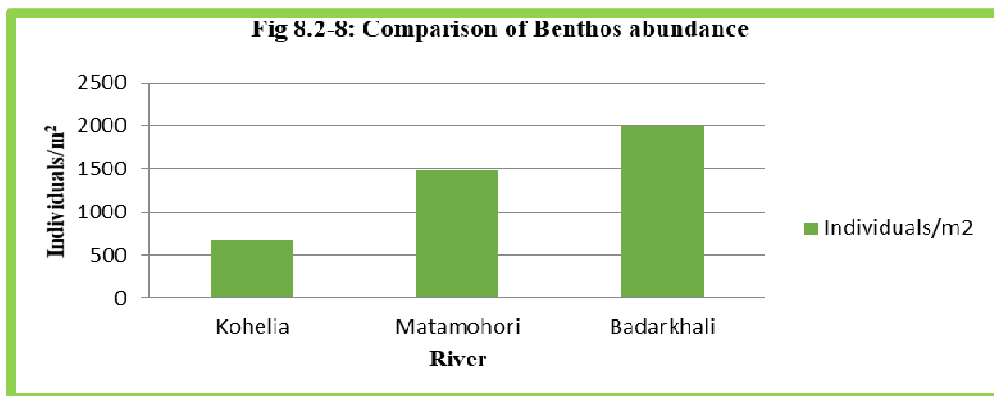
SL NO	Taxa	Mud Flat (Individuals/m <sup>2</sup> )		
		KH	MAT	BDK
1	Alitta	-	-	-
2	Antrobis	6.833	-	-
3	Nadide	-	-	-
4	Naididae	6.833	-	-
5	Nadiadae	-	-	-



SL NO	Taxa	Mud Flat (Individuals/m <sup>2</sup> )		
		KH	MAT	BDK
6	Nereidae	41	-	75.1667
7	Neridae	-	-	-
8	Nucula	-	-	-
9	Nuculidae	280.1667	-	-
10	Massanoidea	-	-	-
11	Olygocheta	20.5	389.5	109.333
12	Pyrgulopsis	-	-	-
13	Tasserkidrilus	-	-	-
14	Unicidae	-	-	-
15	Crab	6.833	-	-
16	Lucifer	-	-	-
17	Myzostomidae	6.833	-	20.5
18	Polychaeta	13.667	252.833	-
19	Shrimp	6.833	41	-
20	Dead Shell	211.8167	-	6.833
21	Fluminicola	61.5	-	-
22	Tarbeia	-	410	6.833
23	Hydrobiidae	-	389.5	-
24	Mants shrimp	-	-	136.667
25	Green muscle	-	-	1640
<b>Total</b>		<b>662.8154</b>	<b>1,482.8333</b>	<b>1,995.3327</b>

**d. Comparison of Benthos abundance:**

Highly abundance found in Badarkhali river site and low abundance in Kuhelia site



**(d) Fish & Necton**

**a. Sampling Point**

The fish & Necton survey were conducted at three points of Kuhelia, Matamuhuri & Badarkhali Rivers and one sample was collected from local fish farm (Gona) of Dhalghata.

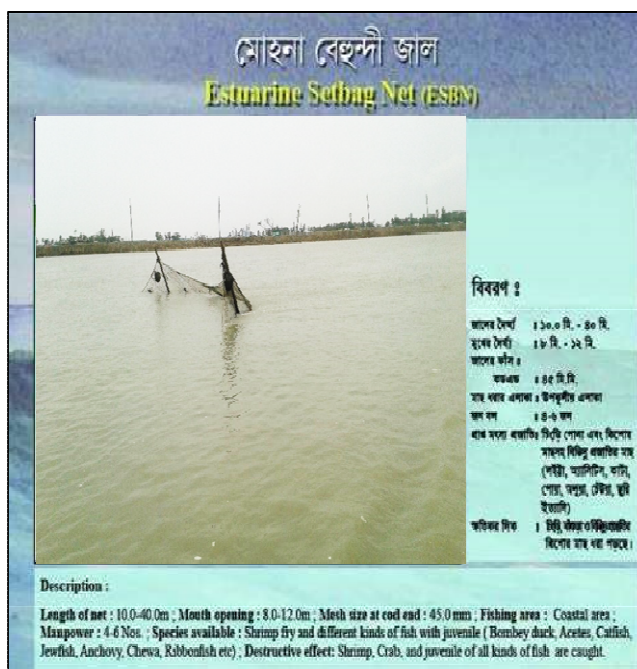
**b. Sampling Methodology**

➤ **Sampling gear:**

The sampling gear of fish was estuarine set bag net (SBN), locally known as “Behundi Jal”. The SBN is a fixed tapering net, resembling a trawl net, set in the tidal stream by attaching it to hold-fasts. It has a rectangular mouth kept open by two vertical bamboo poles. The net is held in a fishing position against the current by linking the extended sides of the net (wing tips) to hold-fasts by means of long bamboo poles and steel wires. The hold-fasts are two wooden stakes embedded some distance apart in the sea bed, so that the net is parallel to the direction of the current. The set bag net catches species of fish which drift with the current or do not swim fast enough to stem the current and maintain a fixed position in relation to the sea bed. At each slack water period, the net comes to the surface (by means of the bamboo poles used for opening of the net, the bamboos serving as sweep lines) when it is emptied; it is then reversed in the opposite direction ready for fishing. Because of the difficulties of embedding the wooden stakes in the sea bed, this method of fishing is restricted to a maximum water depth of about 25 m.

**Identification & sorting**

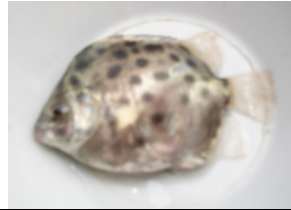



Fish have been identified following Fischer & Whitehead 1974, Howladar 1976, Shafi & Quddus 1982a, 1982b, Siddiqui & Zafar 2002, Fishbase 2010. Identification was made on the morphometric & meristic characters. Attempts have been made to provide valid scientific name of all genera & species were listed in accordance with the rules & principles as set forth in the international code (Fishbase 2010, WoRMS 2010). After identification all the fishes were sorted according to their visible similarity, morphologic & meristic characters. Then the number in each species has been counted.



**c. Result**

High abundant of fish species were found in Kuhelia river (Table-46) species and low abundant in Badarkhali river. At Matamuhuri river people are created several cross dam for fish culture. Badarkhali river have mangrove area which is fisheries nursery ground. From all sampling stations a total of 20 species of fishes (Appendix, Table46) were found, on the other hand, Dhalghata & Badarkhali (Gona) have 20 species of fishes (Appendix, Table47).

(Source: [http://www.fisheries.gov.bd/album\\_details/507](http://www.fisheries.gov.bd/album_details/507))

			
<i>Scatophagus argus</i> ( <i>Scatophagus argus</i> )	<i>Penaeus monodon</i>	<i>Arius maculatus</i>	<i>Pomadasys hasta</i>

Source: Field Survey

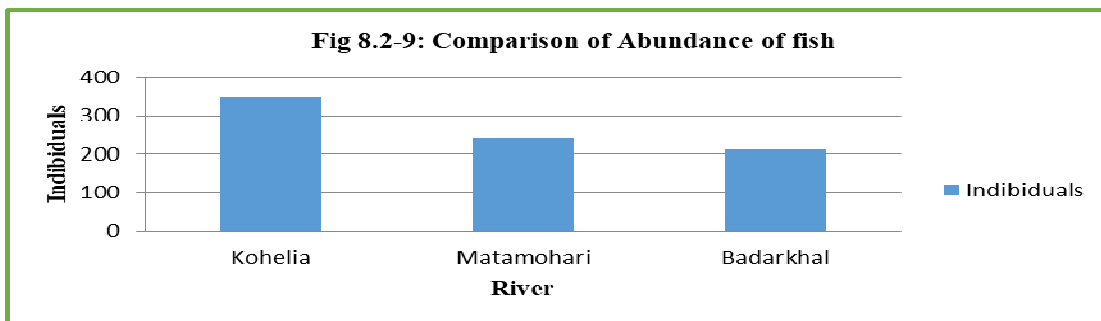
Table 8.2-35 - Inventory of Fish Species in different zones of the study area (Road).

Sl. No.	Scientific Name	English Name	Local Name	Season (D/W)	Kuhelia (Individuals)	Matamuhuri (Individuals)	Badarkhal (Individuals)	
1.	<i>Terapon jarbua</i>	Crescent bass	Gogo mach	D & W	11	7	9	
2.	<i>Liza sp.</i>	Greenback mullet	Lomba bata	D & W	7	5	2	
3.	<i>Valamugil speigleri</i>	Speigler's mullet	Bata mach	D & W	5	4	6	
4.	<i>Trypauchen vagina</i>	Burrowing goby	Lal chua	D & W	9	7	11	
5.	<i>Pseudapocryptes elongatus</i>	Forktail large-eye bream	-	D & W	2	-	-	
6.	<i>Odontamblyopus rubicundus</i>	Eel goby	-	D & W	1	1	-	
7.	<i>Acanthopotamon martensi</i>	Padanian goby	-	D & W	11	4	2	
8.	<i>Pisodonphis boro</i>	Rice-paddy eel	-	W	1	-	1	
9.	<i>Glosogobius giuris</i>	Gobioid fish	Sada bele	D & W	15	11	12	
10.	<i>Lates calcarifer</i>	Asian sea bass	Koral mach	D & W	2	-	-	
11.	<i>Metapenaeus monoceros</i>	Gray shrimp	Horina chingri	D & W	68	34	39	
12.	<i>Metapenaeus lysianassa</i>	Bird shrimp	Hanny chingri	D & W	30	21	-	
13.	<i>Strongylura strongylura</i>	Spottail needle fish	Kakle mach	D & W	6	2	3	
14.	<i>Loligo sp.</i>	Squid	Noinna	W	2	2	1	
15.	-	Gastropod	Shamuk	D & W	31	23	13	
16.	<i>Scatophagus argus</i>	Spotted scat	Bish tara	D & W	1	-	-	
17.	<i>Exopaleomon styliferus</i>	Roshna prawn	Gura icha	D & W	143	123	112	
18.	<i>Lutjanus johnii</i>	John's snapper	Ranga koi	D & W	1	-	-	
19.	<i>Stelopherus tri</i>	Spined anchovy	Fulkra fasha	W	3	-	-	
20.	<i>Ambassis sp.</i>	Glass fish	-	D & W	1	-	-	
	<b>Total</b>					350	244	211

Table- 8.2-35 Fish Species Survey in Dhalghata (Gona) & Badarkhali Gona)




Sl. No.	Scientific Name	English Name	Local Name	Season (D/W)	Dhalghata (Individuals)	Badarkhali (Individuals)
1	<i>Odontamblyopus rubicundus</i>	Eel goby	-	D & W	1	-
2	<i>Scylla sp.</i>	Mud crab	Maitta kakra	D & W	1	2
3	<i>Acanthopotamon martensi</i>	Padanian goby	-	D & W	11	3
4	<i>Pisodonphis boro</i>	Rice-paddy eel	-	W	1	2
5	<i>Glosogobius giuris</i>	Gobioid fish	Sada bele	D & W	15	11
6	<i>Terapon jarbua</i>	Crescent bass	Gogo mach	D & W	11	12
7	<i>Liza sp.</i>	Greenback mullet	Lomba bata	D & W	7	5
8	<i>Valamugil speigleri</i>	Speigler's mullet	Bata mach	D & W	2	3
9	<i>Trypauchen vagina</i>	Burrowing goby	Lal chua	W	9	5
10	<i>Pseudapocryptes elongatus</i>	Forktail large-eye bream	-	D & W	2	-
11	<i>Scatophagus argus</i>	Spotted scat	Bish tara	D & W	1	1
12	<i>Exopaleomon styliferus</i>	Roshna prawn	Gura icha	D & W	154	123
13	<i>Lutjanus johnii</i>	John's snapper	Ranga koi	W	1	-
14	<i>Stelopherus tri</i>	Spined anchovy	Fulkra fasha	D & W	3	1
15	<i>Ambassis sp.</i>	Glass fish	-	D & W	1	-
16	<i>Lates calcarifer</i>	Asian sea bass	Koral mach	D & W	2	3
17	<i>Metapenaeus monoceros</i>	Gray shrimp	Horina chingri	W	68	44
18	<i>Metapenaeus lysianassa</i>	Bird shrimp	Hanny chingri	D & W	30	23
19	<i>Strongylura strongylura</i>	Spottail needle fish	Kakle mach	D & W	6	1
20	<i>Loligo sp.</i>	Squid	Noinna	D & W	2	3
<b>Total</b>					328	242

**d. Comparison of Abundance of fish in different sampling stations**



**(e) Crab**

There are 18 species of Crab found in Kuhelia, Matamuhuri and Badarkhali river site. Mud crab were found in mangrove, mudflat and shrimp project area.

		
Red Crab( <i>Ocypode ceratophthalma</i> )	King Crab ( <i>Carcinoscorpius rotundicauda</i> )	Mud Crab( <i>Scylla serrata</i> )

Source: Field Survey

The result of crab survey were shown in the following table:

Table-8.2-36 List of Crab in the Study Area

SL No	Family	Scientific Name	Local Name	Season (D/W)	KH	BDK	MAT
1.	Portunidae	<i>Portunus plagicus</i>	Blue swimmer crab	D & W	-	✓	-
2.	Portunidae	<i>Charybdis feriatus</i>	Crucifix crab	D & W	✓	✓	✓
3.	Grapsidae	<i>Episesarma versicolor</i>	Tree-climbing/ Vinegar crabs	D & W	-	✓	-
4.	Portunidae	<i>Portunes</i>	Three spotted swimmer crab	D & W	✓	-	✓
5.	Calappidae	<i>Calappa lophos</i>	Box crab or shame-faced crabs	D & W	-	✓	-
6.	Calappidae	<i>Calappa sp.</i>	Box crabs	D & W	-	✓	-
7.	Calappidae	<i>Matuta planipes</i>	Flower Moon crabs	D & W	✓	-	✓
8.	Portunidae	<i>Scylla serrata</i>	Mud crab	D & W	✓	✓	✓
9.	Portunidae	<i>Scylla olivacea</i>	Mud crab	D & W	✓	✓	✓
10.	Ocypodidae	<i>Ocypoda</i>	Horn-eyed ghost crab	D & W	✓	✓	✓
11.	Grapsidae	<i>Grapsus sp.</i>	Red rock crab	D & W	✓	✓	-
12.	Portunidae	<i>Uca sp.</i>	Fiddler crab	D & W	✓	✓	✓
<b>Total</b>					<b>8</b>	<b>10</b>	<b>7</b>

**(f) Shell**

There are 30 species of shell found in Kuhelia, Matamohari and Badarkhali river site. Some are found in mudflat and some are in sandy area. Dead shell are also found in noticeable amount in the study area. The result of Shell survey were shown in the table 8.2-37.

Table 8.2-37 List of Shell in the Study Area

Sl. No.	Family	Scientific Name	Common Name	Season (D/W)	KH	BDK	MAT
1	Arcidae	<i>Anadara granosa</i>	Granular Ark	D & W	-	✓	✓
2		<i>Anadara rhombia</i>	Blood cockle	D & W	✓	-	✓
3		<i>Scapharca derrollie</i>	Ark Shell	D & W	✓	-	✓
4		<i>Scapharca sp.</i>	Ark Shell	D & W	✓	-	-
5	Carditidae	<i>Vepricardium asiaticum</i>	Asiatic cockle	D & W	✓	✓	✓

6		<i>Cardita laticostata</i>	Asiatic cockle	D & W	✓	-	✓
7	Donacidae	<i>Donax faba</i>	Pacific Baen Donax	D & W	✓	-	-
8	Mactridae	<i>Mactra abbreviata</i>	Trough shell	D & W	✓	-	✓
9	Mytilidae	<i>Perna viridis</i>	Asian brown mussel	W	✓	✓	-
10	Ostreidae	<i>Crassostrea ariakensis</i>	Oyster	D & W	✓	✓	-
11	Pectinidae	<i>Chlamys tranquebaricus</i>	Scallop	D & W	-	✓	✓
12	Placudidae	<i>Placuna placenta</i>	Windowpane oyster	D & W	✓	-	-
13	Psammobiidae	<i>Psammotaeta obesa</i>	Sunset clams	D & W	-	-	✓
14	Solenidae	<i>Solen vagina</i>	Nife and razor clams	D & W	-	✓	-
15	Veneridae	<i>Sunetta meroe</i>	Truncate sunetta	D & W	-	✓	-
16	Buccinidae	<i>Babylonia formosa</i>	Formosan ivory shell	W	-	✓	-
17	Cypraeidae	<i>Cypraea sp.</i>	Cowries	D & W	✓	✓	✓
18	Gastropods	<i>Agaronia nebulosa</i>	Cowries	D & W	✓	✓	✓
19		<i>Argobuccinum australasiae</i>	Pustular triton	D & W	-	-	-
20	Melongenidae	<i>Pugilina colosseus</i>	Spiral melongena	D & W	✓	✓	✓
21	Muricidae	<i>Thais bufo</i>	Toad purpura	D & W	-	-✓	-
22	Naticidae	<i>Polinices sp.</i>	Moon snail	D & W	-✓	-	-
23	Neritidae	<i>Nerita lineat</i>	Nerite	D & W	✓	✓	✓
24	Olividae	<i>Olivancillaria sp.</i>	olive-shaped shells	D & W	✓	✓	-
25	Potamididae	<i>Cerithidea cingulata</i>	Girdled horn shell	W	-	-	✓
26	Tonnoidea	<i>Tonna sulcosa</i>	Banded tun	D & W	✓	✓	-
27		<i>Trochus radiatua</i>	Radiate top	D & W	-	-	✓
28		<i>Umbonium gigantium</i>	Giant button top	W	-✓	-	-
29		<i>Umbonium sp.</i>	Button top	D & W	-	✓	✓
30	Turritellidae	<i>Turritella sp.</i>	Turret shells	D & W	-	-	✓
<b>Total</b>					<b>18</b>	<b>15</b>	<b>16</b>

### (viii) Terrestrial & Aquatic Wildlife

#### a) Terrestrial Wildlife

South-eastern part of Bangladesh is covered with hill forest, coast and off shore islands. The hilly areas mainly represent mixed evergreen forests (Source-IDCJ,2016). Mangrove forests are observed in Kohelia and Badarkhali river side. The area is also rich in different species of wildlife, fish and invertebrates. Some of them are locally and globally significant. The coastal line is important for staging of migratory birds and nesting sites of sea turtles. The specimens have been collected from Proposed Port & road area, Sandy beach, mangrove area, Uttar Nolbilla hill reserve forest, both side of Badarkhali, Matamuhuri and Kuhelia river, identified and documented through field work during May 18-19, 2018. The present study is based on field data, department of forest knowledge, secondary data and local knowledge of the community. Photographs have been taken wherever necessary with a digital camera to identify and to confirm if necessary.

Quadrat counting method has been followed for flora counting. Used the nylon rope, bamboo pole and red flag for this method. Upper, Mid and lower level species were counted during the field survey.





Photo of the Field Survey of Terrestrial Flora (Source: Field Study)

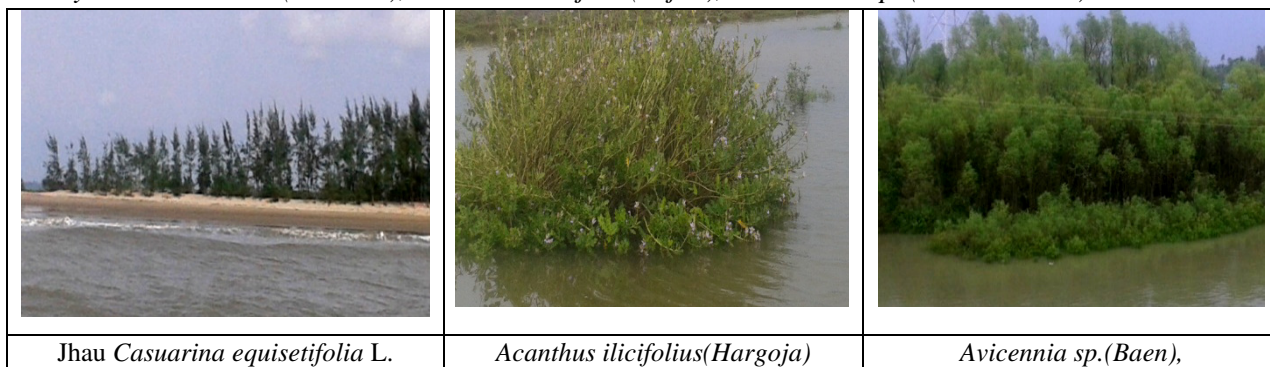
Total 53 flora, 102 birds, 9 amphibian, 13 reptile, (Appendix-F, Table-F.1-3) are identify from mangrove & hill region.

**Mangrove** species are found 15 seedling/m<sup>2</sup> in dence area of Badarkhali & Kohelia river site but uper site of river bank it was 2 seedling/m<sup>2</sup>. Major Mangrove species are *Avicennia sp. (Baen)*, *Acanthus ilicifolius (Hargoja)*, *Aegialitis rutundifolia(Nuinna)*, *Sonneratia apetala(Kewra)* etc.







**In Coastal** area Haser char, front site of port, Forest department planted fast growing Jhau (*Casuarina equisetifolia*) for protection of coastal belt and irrution. In Sandy beach of Haserchar & adjasent port has foud *Portulaca olearacea (Nunna Shak)*, *Suaeda maritima (sagor soda)*, *Ipomoea pes-caprae (Sagor lota)* etc.

In Hill region, Department of Forest has planted the trees by steep forest or bloc system like fruit plant, medicinal plant and timber yield in plantation forest. Another observation is that a vast amount of naturally growing wild weeds like herb, shrub, climber, grasses and cedges were found.

In Uttar Nolbilla, hill region was govt. reserve forest but locally a family declared they lease from govt. (FD). Maximum hill species *Dipterocarpus sp.(Gaarjan)*, *Acacia Auriculacformis (Akasmoni)*, *Phyllanthus emblica(Amoloki)*, *Terminalia arjuna(Arjun)*, *Melastoma sp. (Tea indicator)* etc.





		
<i>Pandanus odorifer</i> (Keya)	<i>Dipterocarpus sp.</i> (Gaarjan)	<i>Melustoma Sp.</i>
		
<i>Ipomoea pes-caprae</i> (Sagor lota)	Uttar Nolbungia Hill Area	Mangrove in Badarkhali River site

Source: Field Survey

#### b) Rare and Threatened Species of ECA & Protected Area

Flora: According to Red Data Book of Vascular Plants of Bangladesh (Volume–1 and 2), of the recorded flora species, a total of 36 species of flora (macrophytes) are variously threatened within the study area. Among them, 3 species are critically endangered, 15 species endangered, 5 species vulnerable, 1 at lower risk and 11 species are data deficient. Threatened flora species were observed mostly in the protected areas (national parks, eco-parks and especially in Dulahazara Safari Park) and reserve forests. Some of the threatened species are: *Bulbophyllum protractum*, *Chonemorpha assamensis*, *Cryptocarya andamanica*, *Sterculia versicolor*, *Nyssa javanica* and *Tetraphyllum bengalense* (IDCJ, 2016).









Table 8.2-38 Information on the Threatened Flora Species recorded from the Study Area

Sl. No.	Scientific Name	Local Name	Season (D/W)	Location	Status
(i)	<i>Swintonia floribunda</i>	Civit/ Boilam	D & W	Kalatuli Chara (Cox's Bazaar)	DD
(ii)	<i>Uvarialurida</i>	NA	D & W	Cox's Bazar (Upper Rezu)	NE
(iii)	<i>Rauwolfiaserpentina</i>	Sarpogandha	D & W	Cox's Bazaar	LR
(iv)	<i>Bombax insigne</i>	NA	D & W	Cox's Bazar and Teknaf Hillock	DD
(v)	<i>Tournefortiaroxburghii</i>	NA	D & W	Cox's Bazar District	DD
(vi)	<i>Terminalia citrina</i>	Haritaki	D & W	Cox's Bazar	DD
(vii)	<i>Cyatheagigantea</i>	NA	D & W	Cox's Bazar District	NE
(viii)	<i>Dioscorea prazeri</i>	NA	D & W	Cox's Bazar District (Ramu)	NE
(ix)	<i>Anisopterascaphula</i>	Boilam	D & W	Cox's Bazar District	DD
(x)	<i>Gnetum oblongum</i>	NA	D & W	Cox's Bazar District	NE
(xi)	<i>Osbeckiacapitata</i>	NA	D & W	Cox's Bazar	NE
(xii)	<i>Pycnarrhenapleniflora</i>	NA	D & W	Cox's Bazar	NE
(xiii)	<i>Knemabengalensis</i>	Khude Barala	D & W	Cox's Bazar (Upper Rezu)	VU
(xiv)	<i>Calamus latifolius</i>	Korak Bet/budum Bet	D & W	Cox's Bazar	DD
(xv)	<i>Calamus longisetus</i>	Udom Bet	D & W	Cox's Bazar	DD
(xvi)	<i>Pterospermum semisagittatum</i>	Asswar	D & W	Cox's Bazar	DD
(xvii)	<i>Morungaromaticum</i>	Morung Elachi	D & W	Cox's Bazar	DD
(xviii)	<i>Hedychium thyriforme</i>	NA	D & W	Cox's Bazar	DD

(xix)	<i>Mantisiaradicalis</i>	NA	D & W	Cox`s Bazar	DD
(xx)	<i>Acanthus leucostachyus</i>	Kastacha	D & W	Cox`s Bazar	EN
(xxi)	<i>Agrostophyllumkhasianum</i>	NA	D & W	Cox`s Bazar (Dulahazari Safari Park)	VU
(xxii)	<i>Brownlowiaelata</i>	NA	D & W	Cox`s Bazar (Dulahazara, Ukia and Teknaf)	VU
(xxiii)	<i>Bulbophyllumprotractum</i>	NA	D & W	Cox`s Bazar (Dulahazari Safari Park)	EN
(xxiv)	<i>Chonemorphaassamensis</i>	NA	D & W	Cox`s Bazar (PanerChara)	EN
(xxv)	<i>Cryptocaryaandamanica</i>	NA	D & W	Cox`s Bazar (Upper Rezu)	CR
(xxvi)	<i>Diospyrosbenghalensis</i>	Lohamori, Khatla	D & W	Cox`s Bazar	VU
(xxvii)	<i>Elaeocarpusrugosus</i>	Phul Champa	D & W	Cox`s Bazar	VU
(xxviii)	<i>Fissistigma polyanthum</i>	NA	D & W	Cox`s Bazar (Dulahazara Safari Park)	VU
(xxix)	<i>Horsfieldiakingii</i>	HolduBarella	D & W	Cox`s Bazar (Fasiakhali, Bhomoriagona)	VU
(xxx)	<i>Lithocarpusthomsonii</i>	Dholi-batna	D & W	Cox`s Bazar	VU
(xxx1)	<i>Melodinusmonogynus</i>	SandulKon	D & W	Cox`s Bazar (Upper Rezu Reserve Forest)	
(xxxii)	<i>Nyssa javanica</i>	NA	D & W	Cox`s Bazar(Bhomoriagona)	CR
(xxxiii)	<i>Parthenocissussemicordata</i>	Munderi	D & W	Cox`s Bazar (Himchari National Park)	VU
(xxxiv)	<i>Polyalthiasimiarum</i>	Arjan/ Chami	D & W	Cox`s Bazar	VU
(xxxv)	<i>Sterculia versicolor</i>	NA	D & W	Cox`s Bazar (Moheshkhali)	EN
(xxxvi)	<i>Tetraphyllumbengalense</i>	NA	D & W	Cox`s Bazar (BaroInani)	CR

(Note: CR=Critically Endangered, EN=Endangered, NE=Not Evaluated, DD=Data Deficient, LR=Lower risk, VU=Vulnerable.)

Out of 36 threatened species of plants, the following were observed in the Moheshkhali Reserve Forest. Threatened Species Observed in the Study Area (Source-IDCJ, 2016)

			
<i>Tournefortia roxburghii</i>	<i>Cyathea gigantea</i>	<i>Pycnarrhenapleniflora</i>	<i>Acanthus leucostachyus</i>
			
<i>Calamus latifolius</i>	<i>Calamus longisetus</i>	<i>Hedychium thyriforme</i>	<i>Sterculia versicolor</i>

Source: IDCJ, 2016

**c) Terrestrial Flora & Fauna in the study Area**

Southeastern part of Bangladesh is covered with hill forest, coast and off shore islands. The hilly areas mainly represent mixed evergreen forests. Mangrove forests are observed in Sonadia, Moheshkhali and Kutubdia Islands and also in tidal influenced areas of Chakaria Upazila (known as Chakaria Sundarbans). The area is also rich in different species of wildlife, fish and invertebrates. Some of



them are locally and globally significant. The coastal line is important for staging of migratory birds and nesting sites of sea turtles.

Government declared protected areas under Chakaria Upazila like Dulazara Safari Park, Medhakachapia National Park, Fasiakhali Wildlife Sanctuary and ECA of Sonadia Island of Moheshkhali Upazila & Cox's Bazar-Teknaf Peninsula under Cox's Bazar Sadar Upazila; some areas of Chunati Wildlife Sanctuary of Pekua Upazila and Teknaf Wildlife Sanctuary of Teknaf Upazila are situated within the project area. Both the ECAs cover both coastal and hilly areas of Cox's Bazar Sadar and Teknaf Upazilas. In addition some reserve forests in the project area, namely Nalbila Reserve Forest of Chakaria Upazila, Baraitali Reserve Forest of Chakaria Upazila, Harbang Reserve Forest of Pekua Upazila, Sonaichari Reserve Forest of Pekua Upazila, Toitang Reserve Forest of Pekua Upazila and Moheshkhali Reserve Forest of Moheshkhali Upazila are also included within the project site.

### (i) Sampling Locations

The specimens have been collected from Port area, Sandy beach, mangrove area, Uttar Nolbilla hill reserve forest, both side of Kuhelia, Baderkhali & Matamuhuri river identified and documented through fieldwork during May 18-19, 2018. The present study is based on field data, department of forest and local knowledge of the community. Photographs have been taken wherever necessary with a digital camera to identify and to confirm if necessary.

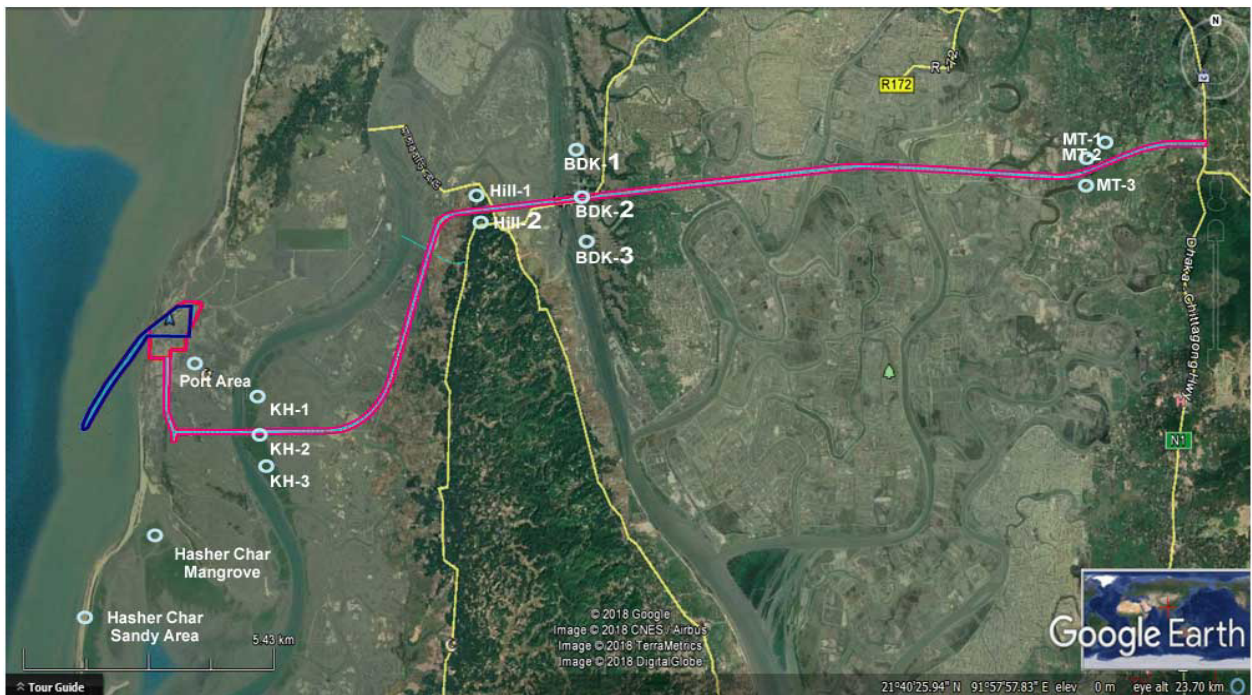


Figure: 8.2-10 Study Area of Terrestrial Wildlife (Flora & Fauna)

### (ii) Method:

Quadrat counting method has been followed for flora counting. Mangrove species are found 15 seedling/m<sup>2</sup> in Kuhelia river & Badarkhali site. Major Mangrove species are *Avicennia* sp. (Baen), *Acanthus ilicifolius* (Hargoja), *Aegialitis rutundifolia* (Nuinna) etc. Department of Forest has planted the trees by steep forest or bloc system like fruit plant, medicinal plant and timber yield in plantation forest. Another observation is that a vast amount of naturally growing wild weeds like herb, shrub, climber, grasses and cedges were found. 50 flora, Insects 23, 115 birds, 7 amphibian, 14 reptile, (Table-50, 51, 52, 53) are identify from mangrove & hill region. The observed hill species are mostly

*Dipterocarpus sp.*(Gaarjan), *Acacia Auriculacformis* (Akasmoni),*Phyllanthus emblica*(Amoloki), *Terminalia arjuna*(Arjun)etc.



Hill Area Flora at Uttar Nalbungia



Mangrove in Badarkhali River site



Garjan (*Dipterocarpus sp.*)



Hargojaja(*Acanthus ilicifolius*)

➤ Bird:

In the study area of Kuhedia, Matamuhuri and Badarkhali river and nearest shrimp projec and mudflat area have found 116 species of bird. Some bird are migratory which migrate basically in winter season. Mangrove forest & hill forest are their nesting habited. Brown-headed Gull (*Larus brunnicephalus*), Black-naped Tern (*Sterna sumatrana*), Greater Sand Plover (*Charadrius leschenaultii*), Curlew Sandpiper (*Calidris ferruginea*) etc are Major species in study area.




		
Eurasian Curlew( <i>Numenius arquata</i> )	Common-and-Spotted-Redshank	Grey Heron

Table 8.2-39 Terrestrial Fauna

Sl. No.	Scientific name	Local name	Season (D/W)	Family	Habit
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1.	<i>Acanthus ilicifolius</i> L.	Hargoja	D & W	Acanthaceae	Shrub
2.	<i>Aegialitis rutundifolia</i> Roxb.	Nuniya	D & W	Plumbaginaceae	Tree
3.	<i>Albizia odoratissima</i> (L.f.) Benth.	Jatkorai	D & W	Mimosaceae	Tree
4.	<i>Albizia procera</i> (Roxb.) Benth.	Silkorai	D & W	Mimosaceae	Tree
5.	<i>Alocasia macrorrhizos</i> (L.) G. Don	Mankachu	D & W	Araceae	Herb
6.	<i>Alocasia odora</i> (Lindl.) K.Koch*	Hatal kachu	D & W	Araceae	Herb
7.	<i>Aloe vera</i> (L.) Burm.f.	Gritakumari	D & W	Aloaceae	Herb
8.	<i>Alternanthera philoxeroides</i> (Mart.) Griseb.	Helencha, Molicha	D & W	Amaranthaceae	Herb
9.	<i>Alternanthera sessilis</i> (L.) R.Br. ex DC.	Sachishak	D & W	Amaranthaceae	Herb
10.	<i>Avicennia alba</i> Blume	Dulia baen	D & W	Verbenaceae	Tree
11.	<i>Avicennia officinalis</i> L.	Baro baen	D & W	Verbenaceae	Tree
12.	<i>Azadirachta indica</i> A. Juss.	Nim	D & W	Meliaceae	Tree
13.	<i>Bacopa monnieri</i> (L.) Pannell	Brammishak	D & W	Scrophulariaceae	Herb
14.	<i>Bombax ceiba</i> L.	Simul tula	D & W	Bombacaceae	Tree
15.	<i>Bothriochola pertusa</i> (L.) A.Camus	Gora dubla	D & W	Poaceae	Herb
16.	<i>Calotropis gigantea</i> (L.) Ait.f.	Akand	D & W	Asclepiadaceae	Shrub
17.	<i>Cassia fistula</i> L.	Sonalu	D & W	Caesalpiniaceae	Tree
18.	<i>Casuarina equisetifolia</i> L.	Jaw, Popan	D & W	Casuarinaceae	Tree
19.	<i>Cayratia trifolia</i> (L.) Domin*	Amol lata	D & W	Vitaceae	Climber
20.	<i>Centella asiatica</i> (L.) Urban.	Thankuni	D & W	Apiaceae	Herb
21.	<i>Chromolaena odorata</i> (L.) R.M.King & H.Rob.	Asamlata	D & W	Asteraceae	Herb
22.	<i>Chukrasia tabularis</i> A. Juss.	Cikrasi	D & W	Meliaceae	Tree
23.	<i>Citrus limon</i> (L.) Burm.f.	Lebu	D & W	Rutaceae	Tree
24.	<i>Citrus maxima</i> (Burm.f.) Merr.	Jambura, Santara	D & W	Rutaceae	Tree
25.	<i>Cuscuta reflexa</i> Roxb.	Sunnalata	D & W	Cuscutaceae	Climber
26.	<i>Delonix regia</i> (Hook.) Raf.	Krisnachura	D & W	Caesalpiniaceae	
27.	<i>Dillenia indica</i> L.	Chalta	D & W	Dilleniaceae	Tree
28.	<i>Dipterocarpus turbinatus</i> Gaertn.	Garjan	D & W	Dipterocarpaceae	Tree
29.	<i>Elaeocarpus floribundus</i> Blume	Jalpai	D & W	Elaeocarpaceae	Tree
30.	<i>Ficus benghalensis</i> L.	Bat	D & W	Moraceae	Tree
31.	<i>Ficus comosa</i> Kurz	Mosa dumur	D & W	Moraceae	Tree
32.	<i>Kalanchoe pinnata</i> (Lam.) Pers.	Pathorkuchi	D & W	Crassulaceae	Herb
33.	<i>Leucas indica</i> (L.) R.Br. ex Vatke	Dondokalosh	D & W	Lamiaceae	Herb
34.	<i>Mentha arvensis</i> L.	Pudina	D & W	Lamiaceae	Herb
35.	<i>Mimosa pudica</i> L.	Lajjabati	D & W	Mimosaceae	Herb
36.	<i>Oryza rufipogon</i> Griff.	Uri dan	D & W	Poaceae	Herb
37.	<i>Pandanus odorifer</i> (Forssk.) Kuntze	Keya	D & W	Pandanaceae	Tree
38.	<i>Phyllanthus emblica</i> L.	Amloki	D & W	Euphorbiaceae	Tree
39.	<i>Portulaca olearacea</i> L.	Nunashak	D & W	Portulacaceae	Herb
40.	<i>Smilax ovalifolia</i> Roxb. ex D.Don	Kumairra lata	D & W	Smilacaceae	Climber
41.	<i>Sonneratia apetala</i> Buch.-Ham.	Keowra, Kerpa	D & W	Sonneratiaceae	Tree
42.	<i>Sterculia foetida</i> L.	Keron	D & W	Sterculiaceae	Tree
43.	<i>Suaeda maritima</i> (L.) Dumort.	Sagorsuda	D & W	Chenopodiaceae	Shrub
44.	<i>Swietenia mahagoni</i> (L.) Jacq.	Mehagoni	D & W	Meliaceae	Tree
45.	<i>Terminalia arjuna</i> (Roxb. ex DC.)	Arjun	D & W	Combretaceae	Tree



46.	<i>Terminalia bellirica</i> (Gaertn.) Roxb.	Bahera	D & W	Combretaceae	Tree
47.	<i>Terminalia catappa</i> L.	Katbadam	D & W	Combretaceae	Tree
48.	<i>Terminalia chebula</i> (Gaertn.) Roxb.	Horitoki	D & W	Combretaceae	Tree
49.	<i>Acacia Auriculacformis</i>	Akasmoni	D & W	Fabaceae	Tree
50.	<i>Eucalyptus citriodora</i>	Eucaliptus		Myrtaceae	Tree

Table 8.2-40: Terrestrial Fauna (Insect)

Sl. No.	Species Name	English Name (Local Name)	Habitat	Season (D/W)	(KH)	(BD K)	(MA T)	Conservation Status		Remarks
								IUCN	Local Status	
1	<i>Gryllus</i> spp.	Cricket (Urchunga)	Rice field	D & W	√	√	√	-		Agricultural pest
2	<i>Oxya chinensis</i> (Thunberg)	Small Rice Grasshopper (Ghas Foring)	Rice field	D & W	√	√	√	-		Agricultural pest
3	<i>Periplaneta Americana</i> Linn.	American Cockroach (Telapoka)	Restaurant	D & W	√	√	√	-		Household pest
4	<i>Agromyza</i> spp.	Miner flies	Bush bean	D & W	√	√	√	-		Leaf miner pest of vegetables
5	<i>Bactrocera cucurbitae</i> (Coquillett)	Melon fly	Bottle gourd	D & W		√		-		Pest of vegetables
6	<i>Eristalinus</i>	Hoverfly	Cucumber	D	√		√	-		Pollinator in
7	<i>Agriocnemis femina</i> (Brauer)	Narrow-winged Damselfly (Foring)	Bush bean (Near the pond)	D & W	√		√	-		Predator and Bioindicator
8	<i>Agriocnemis pygmaea</i> (Rambur)	Damselfly (Foring)	Common bean (Near the pond)	D & W	√	√	√	-		Predator and Bioindicator
9	<i>Ceragrion cerinorubellum</i> (Brauer)	Damselfly (Foring)	Woods of vegetation	D & W	√	√		-		Predator and Bioindicator
10	<i>Tholymis</i> sp.	Evening Skimmer (Foring)	Woods of vegetation	D & W			√	-		Predator and Bioindicator
11	<i>Episyrphus</i> spp.	Hover fly	Cucumber field	D & W	√		√	-		Predator and pollinator in most cases
12	<i>Musca domestica</i> Linn.	House fly	Restaurant	D & W	√	√		-		Pathogen carrier and pollinator in few cases
13	<i>Chrysomya megacephala</i> (Fabricius)	Oriental latrine fly	Dry fish	D & W	√	√	√	-		Pest of dry fish and pollinator in few cases
14	<i>Eurema hecabe</i>	Common Grass	Common	D & W	√	√	√	-		Pollinator in

Sl. No.	Species Name	English Name (Local Name)	Habitat	Season (D/W)	(KH)	(BDK)	(MAT)	Conservation Status		Remarks
								IUCN	Local Status	
	<i>contubernalis</i> Moore	Yellow (Holud)	been							adult aged
15	<i>Delias descombesi descombesi</i> (Boisduval)	Red spot jezebel (Kanka)	Secondary forest	D & W		√	√	-		Pollinator in adult aged
16	<i>Junonia atlites</i> (Linn.)	Chandnori	Agricultural field	D & W	√	√		-		Pollinator in adult aged
17	<i>Melanitis phedima bela</i> Moore	Dark Evening Brown	Agricultural field	D & W	√	√		-		Pollinator in adult aged
18	<i>Parnara guttatus mangala</i> Moore	Straight Swift (Nillbijuri)	Snake gourd	D & W	√			-		Pollinator
19	<i>Oriens goloides</i> Moore	Smaller Darlet	Agricultural field	D & W	√		√	-		Pollinator
20	<i>Aulacophora foveicollis</i> Lucas	Red pumpkin beetle	Pumpkin field	D	√	√		-		Agricultural pest
21	<i>Aulacophora frontalis</i> Baly	Pumpkin beetle	Pumpkin field	D & W	√	√		-		Agricultural pest
22	<i>Nephotettix cincticeps</i> Matsumura	Spotted jassid	Ricefield	D		√	√	-		Pest of rice
23	<i>Leptocorisa acuta</i> Thunb.	Rice bug	Rice field	D & W		√		-		Pest of rice
24	<i>Rhopalosiphum sp.</i>	Aphis	Common bean	D & W				-		Agricultural pest
25	<i>Amegilla spp.</i>		Brinjal	D & W		√		-		Pollinator
26	<i>Lasioglossum sp.</i>	Solitary Bee	Cucumber field	D & W	√	√	√	-		Pollinator And bioindicator
27	<i>Trigona sp.</i>	Sweat bee	Cucumber field	D & W				-		Pollinator
28	<i>Apis mellifera</i> Linn.	Western Honey bee (Momachhi)	Cucumber field	D		√	√	-		Pollinator and Bioindicator
29	<i>Micraspis crocea</i> (Mulsant)	Lady beetle	Rice	D	√	√		-		Rice pest
<b>Total</b>					<b>21</b>	<b>22</b>	<b>16</b>			

Table 8.2-41: Terrestrial Fauna (Amphibians and Reptiles) (Road side)

Sl. No.	Species Name	English Name (Local Name)	Habitat	Season (D/W)	Survey Sites (Rainy Season)			Conservation Status		Remarks
					(KH)	(BDK)	(MAT)	IUCN	Local Status	
1	<i>Duttaphrynus (Bufo) melanostictus</i>	Southeast Asian toad	Kono bang	D & W	√	√	√			Very common throughout the county
2	<i>Euphlyctis cyanophlyctis</i>	Green Forg	Kotkoti bang	D & W	√	√				Very common
3	<i>Fejervarya limnocharis</i>	Cricket frog		D & W	√	√				Common
4	<i>Fejervarya sp</i>	Cricket frog		D & W	√	√				



Sl. No	Species Name	English Name (Local Name)	Habitat	Season (D/W)	Survey Sites (Rainy Season)			Conservation Status		Remarks
					(KH)	(BDK)	(MAT)	IUCN	Local Status	
5	<i>Hoplobatrachus tigerinus</i>	Bull frog	Kola bang, Sona bang, Bhawa beng	W	√	√	√			Wide spread
6	<i>Sylvirana leptoglossa</i>	Cope's Assam Frog	Koper Ashami Bang	D & W	√	√				
7	<i>Rana temporalis</i>	Bronzed Frog	Gaso Bang	D & W	√					
	<i>Total</i>			D & W						
1	<i>Calotes versicolor</i>	Garden lizard	Roktochusha	D & W	√	√			TH	
2	<i>Mabuya mabuya</i>	Skink	Achil	D & W	√	√			TH	
3	<i>Gekko gekko</i>	Tokay Gecko	Tokkhak/Tokhha	D & W	√	√	√		TH	
4	<i>Hemidactylus brooki</i>	House lizard	Tiktiki	D & W	√	√	√	NO		
5	<i>Hemidactylus frenatus</i> Schlegel in Duméril & Bibron, 1836	House lizard	Tiktiki	D & W	√	√	√			
6	<i>Melanochelys trijuga</i> (Schweigger, 1812)	Indian Black Turtle	Kalo Kossop	D & W	√	√	√			
7	<i>Geoclemys hamiltonii</i> (Gray, 1830)	Spotted Pond Turtle	Kalo Kasim	D & W	√	√		EN	TH	
8	<i>Pangshura tentoria</i> (Gray, 1834)	Median Roofed Turtle	Majhari Kaitta	D & W	√	√			TH	
9	<i>Ahaetull prasina</i> (Boie, 1827)	Common Vine snake	Laodoga Shap/sutanolli Shap	D & W	√					
10	<i>Xenocrophis piscator</i>	Checkered keel back	Dhora sap	D & W	√	√	√			
11	<i>Naja kaouthia</i> Lesson, 1831	Monocled Cobra	Jati Sap	D	√	√	√			
12	<i>Naja naja</i>	Bicled Cobra	Gokhra Shap	D	√	√	√		TH	
13	<i>Cerberus rynchops</i> (Schneider, 1799)	Dog faced water snake	Andha sap	W			√			
14	<i>Enhydri s sieboldi</i> (Schlegel, 1837)	Siebold's Smooth Water Snake	Sibolder Joloj Shap	W	√	√	√			

Note: TH= Threatened, EN – Endangered, VU – Vulnerable and NO – Not Threatened.)

Table-8.2-42: Terrestrial Fauna (Birds)

Sl. No	Species Name	English Name	Local Name	Season (D/W)	Survey Sites (Early winter)			Conservation Status		Remarks
					(KH)	(BDK)	(MAT)	IUCN	Local Status	
1	<i>Passer domesticus</i>	House Sparrow	Pati Chorui	D & W	√	√		-		
2	<i>Dicrurus macrocerus</i>	Black Drongo	Kala Fingey	D & W	√	√	√	-		
3	<i>Sturnus contra</i>	Pied Myna	Pakra Shalik/Gubra Shalik/Gu Shalik	D & W	√	√	√	-		
4	<i>Sturnus malabaricus</i>	Chestnut-tailed Starling	Khoiralej Kathshalik/Deshi Pawei	D & W	√	√	√	-		
5	<i>Acridotheres cinereus</i>	Pale-bellied Myna	Dholatola Shalik	D & W	√	√	√	-		
6	<i>Acridotheres tristis</i>	Common Myna	Bhat Shalik	D & W	√	√	√	-		
7	<i>Acridotheres fuscus</i>	Jungle Myna	Jhuti Sahlik	D & W	√	√	√	-		
8	<i>Gracula religiosa</i>	Common Hill Myna		D	√		√	-		
9	<i>Copsychus saularis</i>	Oriental Magpie-Robin	Doel/Udoi Doel	D & W	√	√	√	-		
10	<i>Orthotomus sutorius</i>	Common Tailorbird	Pati Tuntuni	D & W	√	√	√	-		
11	<i>Columba livia</i>	Common Pigeon	Gola Paira/Jalali Kabutor	D & W	√	√	√	-		
12	<i>Treron bicinctus</i>	Oreng-breasted Green Pigeon	Komlabook Horial/Horikol	D	√	√	√	-		
13	<i>Streptopelia decaocto</i>	Eurasian Collared Dove	Eurashio Konthighughu/Raj Ghughu	D & W	√	√	√	-		
14	<i>Streptopelia chinensis</i>	Spotted Dove	Tila Ghughu	D	√		√	-		
15	<i>Treron phoenicopterus</i>	Yellow-footed Green Pigeon	Holdepa Horial/Botkol	D & W	√	√	√	-		
16	<i>Pycnonotus cafer</i>	Red-vented Bulbul	Bangla Bulbul/Bulbuli	D & W	√	√	√	-		
17	<i>Pycnonotus jocosus</i>	Red-whiskered Bulbul	Shipahi Bulbul/Bulbuli	D & W		√	√	-		
18	<i>Corvus splendens</i>	House Crow	Pati Kak	D & W	√	√	√	-		
19	<i>Corvus macrorhynchos</i>	Jungle Crow	Dar Kak/Danr Kak	D & W	√	√	√	-		
20	<i>Oriolus xanthornus</i>	Black-hooded Oriole	Kalamatha Benebou/Holdey	D & W	√	√	√	-		

Sl. No	Species Name	English Name	Local Name	Season (D/W)	Survey Sites (Early winter)			Conservation Status		Remarks
					(KH)	(BDK)	(MAT)	IUCN	Local Status	
			Pakhi							
21	<i>Artamus fuscus</i>	Ashy Woodswallow	Metey Bonababil/Latoraa	D & W	√	√	√	-		
22	<i>Dendrocitta vagabunda</i>	Rufous Treepie	Khoira Harichacha/Hari Chacha	D & W	√	√	√	-		
23	<i>Dicaeum cruentatum</i>	Scarlet-backet Flowerpecker	Lalpith Fuljhuri	D & W	√	√	√	-		
24	<i>Dicaeum erythrorhynchos</i>	Pale-billed Flowerpecker	Metethot Fuljhuri	D & W	√	√	√	-		
25	<i>Dicaeum trigonostigma</i>	Orange-bellied Flowerpecker	Komlapet Fuljhuri	D & W	√	√	√	-		
26	<i>Chalcoparia singalensis</i>	Ruby-cheeked Sunbird	Chunimukhi Moutushi	D & W	√	√	√	-		
27	<i>Leptocoma zeylonica</i>	Purple-rumped Sunbird	Begunikomor Moutushi	D & W	√	√	√	-		
28	<i>Cinnyris asiaticus</i>	Purple Sunbird	Beguni Moutushi	D & W	√	√	√	-		
29	<i>Aethopyga siparaja</i>	Crimson Sunbird	Shidure Moutushi	D & W	√	√	√	-		
30	<i>Arachnothera magna</i>	Streaked Spiderhunter		D & W	√	√	√	-		
31	<i>Ploceus philippinus</i>	Baya Weaver	Deshi Babui/Baoi	D & W	√	√	√	-		
32	<i>Lonchura malabarica</i>	Indian Silverbill	Deshi Chandithot	D & W			√	-		
33	<i>Lonchura malacca</i>	Black-headed Munia	Kalamatha Munia	D & W	√	√	√	-		
34	<i>Lonchura punctulata</i>	Scaly-breasted Munia	Tila Munia	D & W	√	√	√	-		
35	<i>Lonchura straiata</i>	White-rumped Munia	Dholakomor Munia	D & W	√	√	√	-		
36	<i>Anthus rufulus</i>	Paddyfield Pipit	Dhani Tulika	D & W	√	√	√	-		
37	<i>Pellorneum ruficeps</i>	Puff-throated Babbler	Golafola Satarey	D & W	√	√	√	-		
38	<i>Zosterops palpebrosus</i>	Oriental White-eye	Udoi Dholachokh/Shet Ankhi	D & W	√	√	√	-		

Sl. No	Species Name	English Name	Local Name	Season (D/W)	Survey Sites (Early winter)			Conservation Status		Remarks
					(KH)	(BK)	(MAT)	IUCN	Local Status	
39	<i>Prinia inornata</i>	Plain Prinia	Nirol Prina	D & W	√	√	√	-		
40	<i>Ficedula albicilla</i>	Taiga Flycatcher	Taiga Chutki/Lalbook Chotok	D & W	√	√	√	-		
41	<i>Aegithina tiphia</i>	Common Iora	Fatik Jal	D & W		√	√	-		
42	<i>Hypothymis azurea</i>	Black-naped Monarch	Kalaghar Rajon	D & W	√	√	√	-		
43	<i>Disrurus paradiseus</i>	Greater Racket-tailed Drongo	Boro Recket-Fingey/B himraj	D & W	√	√		-		
44	<i>Disrurus aeneus</i>	Bronzed Drongo	Fingey	D & W	√	√	√	-		
45	<i>Rhipidura albicollis</i>	White-throated Fantail	Dholagola Chatighurani/Lej Nachuni	D & W	√	√	√	-		
46	<i>Alcedo atthis</i>	Common Kingfisher	Pati Machranga	D & W	√	√	√	-		
47	<i>Alcedo meninting</i>	Blue-eared Kingfisher	Neelkan Machranga	D & W	√	√	√	-		
48	<i>Halcyon smyrnenensis</i>	White-throated kingfisher	Dholagoloa Machranga	D & W	√	√	√	-		
49	<i>Ceryle rudis</i>	Pied Kingfisher	Pakra Machranga	D & W	√	√		-		
50	<i>Upupa epops</i>	Eurasian Hoopoe	Pati Hoodhood	D & W	√	√		-		
51	<i>Dinopium bengalensis</i>	Lesser goldenback	Bangla kaththokra	D & W			√	-		
52	<i>Merops leschenaulti</i>	Chestnut-headed Bee-eater	Khoiramatha Shuichora	D & W	√	√	√	-		
53	<i>Merops philippinus</i>	Blue-tailed Bee-eater	Neel-lej Shuichora	D & W	√	√	√	-		
54	<i>Psittacula alexandri</i>	Red-breasted Parakeet	Modna Tia	D & W	√	√	√	-		
55	<i>Psittacula krameri</i>	Rose-ringed Parakeet	Shobuj Tia	D & W	√	√	√	-		
56	<i>Cypsiurus balasiensis</i>	Asian Palm Swift	Asio Talbatashi/Nak kati	D & W	√	√	√	-		
57	<i>Ketupa zeylonensis</i>	Brown Fish Owl	Khoira mechupacha/Bho ootom Pecha	D & W	√	√	√	-		
58	<i>Athene brama</i>	Spotted Owlet	Khuruley Pencha/Konthi Kutipecha	D & W	√		√	-		
59	<i>Caprimulgus macrurus</i>	Large-tailed Nightjar	Lenja Ratchora	D & W		√		-		

Sl. No	Species Name	English Name	Local Name	Season (D/W)	Survey Sites (Early winter)			Conservation Status		Remarks
					(KH)	(BDK)	(MAT)	IUCN	Local Status	
60	<i>Ichthyophaga ichthyaetus</i>	Grey-headed Eagle	Metemetha Kura Eagle	D & W				-		
61	<i>Spilornis Cheela</i>	Crested Eagle	Tila Nag-eegol/Shapkeheko Baj	D & W	√		√	-		
62	<i>Phalacrocorax niger</i>	Little Cormorant	Choto Pankouri	D & W	√	√	√	-		
63	<i>Phalacrocorax fuscicollis</i>	Indian Cormorant	Deshi Pankouri	D & W	√		√	-		
64	<i>Egretta garzetta</i>	Little Egret	Choto Boga	D & W	√	√	√	-		
65	<i>Egretta intermedia</i>	Yellow-billed Egret	Majhla Boga/Korche Bok	D & W	√			-		
66	<i>Casmerudias albus</i>	Great Egret	Boro Boga	D & W		√		-		
67	<i>Bubulcus ibis</i>	Cattle Egret	Go Boga	D & W	√	√	√	-		
68	<i>Ardeola buccus</i>	Chinese Pond Heron	China Kanibok	D & W	√	√	√	-		
69	<i>Ardeola grayii</i>	Indian Pond Heron	Deshi Kanibok	D & W						
70	<i>Sterna aurantia</i>	River Tern	Nodia Panchil	D & W		√	√	-		
71	<i>Glareola lactea</i>	Small Pratincole	Choto Babubatan	D & W		√	√	-		
72	<i>Ardea cinerea</i>	Grey Heron	Dhupni Bok	D & W	√	√	√	-		
73	<i>Sterna albifrons</i>	Little Tern	Choto Panchil	D & W	√	√	√	-		
74	<i>Nycticorax nycticorax</i>	Black-crowned Night Heron	Kalamatha Nishibok	D & W	√	√	√	-		
76	<i>Pandion haliaetus</i>	Osprey	Machmural/Mechubaj	D & W	√	√	√			
77	<i>Tadorna ferruginea</i>	Ruddy Shelduck	Khoira Chokachoki	D & W	√			-		
78	<i>Anas clypeata</i>	Northern Shoveler	Utturey Khuntehash/Panta mukhi	D & W			√	-		
79	<i>Jynx torquilla</i>	Eurasian Wryneck	Eureshio Gharbeta	D & W		√		-		
80	<i>Halcyon pileata</i>	Black-capped Kingfisher	Kalatupi Machranga	D & W	√			-		
81	<i>Todiramphus chloris</i>	Collared Kingfisher	Dholaghar Machranga	D & W	√	√		-		
82	<i>Porzana pusilla</i>	bailon's Crake	Bailoner Gurguri	D & W				--		
83	<i>Gallinago gallinago</i>	Common Snipe	Pati Chega	D & W			√	-		

Sl. No	Species Name	English Name	Local Name	Season (D/W)	Survey Sites (Early winter)			Conservation Status		Remarks
					(KH)	(BDK)	(MAT)	IUCN	Local Status	
84	<i>Gallinago stenura</i>	Pin-tailed Snipe	Lenja Chega	D & W	√		√	-		
85	<i>Limosa lapponica</i>	Bar-tailed Godwit	Dagilej Jorali	D & W		√	√	-		
86	<i>Limosa limosa</i>	Black-tailed Godwit	Kalalej jorali	D & W			√	-		
87	<i>Numenius arquata</i>	Eurasian Curlew	Eureshio Gulinda	D & W	√	√	√	-		
88	<i>Numenius phaeopus</i>	Whimbrel	Choto Gulinda	D & W		√		-		
89	<i>Tringa glareola</i>	Wood Sandpiper	Bon Batan/Balu Batan	D	√	√	√	-		
90	<i>Actitis hypoleucos</i>	Common Sandpiper	Pati Batan/Chapakhi	D	√	√	√	-		
91	<i>Tringa stagnatilis</i>	Marsh Sandpiper	Bali Batan	D			√	-		
92	<i>Tringa guttifer</i>	Nordmann's Greenshank	Nordman Shabujpa	D			√	EN	TH	
93	<i>Tringa nebularia</i>	Common Greenshank	Pati Shabujpa	D		√	√	-		
94	<i>Tringa totanus</i>	Common Redshank	Pati Lalpa	D		√	√	-		
95	<i>Xenus cinereus</i>	Terek Sandpiper	Terek Batan	D			√	-		
96	<i>Arenaria interpres</i>	Ruddy Turnstone	Lal Nuribatan	D	√		√	-		
97	<i>Limnodromus semipalmatus</i>	Asian Dowitcher	Eshio Daucher	D			√	-		
98	<i>Calidris alba</i>	Sanderlin	Sanderlin	D	√		√	-		
99	<i>Calidris ferruginea</i>	Curlew Sandpiper	Gulinda Batan	D			√	-		
100	<i>Calidris minuta</i>	Little Stint	Choto Chaha	D			√	-		
101	<i>Calidris ruficollis</i>	Red-necked Stint	Lalghar Chaha	D			√	-		
102	<i>Calidris temminckii</i>	Timminck's Stint	Timinker Chaha	D	√	√	√	-		
103	<i>Calidris tenuirostris</i>	Graet Knot	Boro Noth	D			√	-		
104	<i>Himantopus himantopus</i>	Black-winged Stilt	Kalapakh Thengi/ Lal pa Dhenga	D			√	-		
105	<i>Pluvialis fulva</i>	Pacific Golden Plover	Proshanto Shonajiria	D	√		√	-		
106	<i>Charadrius alexandrinus</i>	Kentish Plover	Kentish Jiria	D	√	√	√	-		
107	<i>Charadrius dubius</i>	Little Ring Plover	Choto Nothjiria	D		√		-		
108	<i>Charadrius leschenaultii</i>	Greater Sand Plover	Boro Dhuljiria	D	√	√	√	-		
109	<i>Charadrius mongolus</i>	Little Sand Plover	Choto Dhuljiria	D	√	√	√	-		

Sl. No	Species Name	English Name	Local Name	Season (D/W)	Survey Sites (Early winter)			Conservation Status		Remarks
					(KH)	(BDK)	(MAT)	IUCN	Local Status	
110	<i>Eurynorhynchus pygmeus</i>	Spoon-billed Sandpiper	Chamuchthuto Batan	D			√	CR	TH	
111	<i>Larus brunnicephalus</i>	Brown-headed Gull	Khoiramatha Gangchil	D	√	√	√	-		
112	<i>Larus ichthyaetus</i>	Great Black Gull	Palasi Gangchil/Bara Jal	D	√	√	√	-		
113	<i>Larus heuglini</i>	Heuglin's Gull	Heugliner Gangchil	D			√	-		
114	<i>Larus ridibundus</i>	Common Black-headed Gull	Kalamatha Gangchil	D			√	-		
115	<i>Sterna sumatrana</i>	Black-naped Tern	Kalaghar Panchil	D	√	√	√	-		
116	<i>Threskiornis melanocephalus</i>	Black-headed Ibis	Kalamatha Kastechora	D	√		√	-		
<b>Total</b>					<b>84</b>	<b>86</b>	<b>97</b>			

Note: CR - Critically Endangered, EN – Endangered and TH= Threatened

### 8.3 ENVIRONMENTAL POLLUTANT ANALYSIS

#### 8.3.1 GHG Emissions from the Port Connecting Access Road Project

##### i. Vehicles Details

Four types of vehicles will be run on the proposed port connecting access road project. These vehicles will be mainly for:

- Port Related Traffic
  - Truck & Car
- Diverted Traffic from Present Road
  - Truck, Utility & Car
- Power Plant Related Traffic
  - Car & Bus

##### ii. Prediction of Traffic Volume



JICA study team has forecasted the road traffic and flow of the traffic for the years 2026-2035. The details are tabulated in table-8.3-1.

Table-8.3-1 Estimated Vehicles Number/per day

	Veh Type	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
Port Related Traffic	Truck	1,565	1,691	1,828	1,977	2,138	2,292	2,455	2,631	2,818	3,019
	Car.	730	792	859	933	1,013	1,088	1,169	1,256	1,349	1,448
Diverted Traffic from Present Road	Car	53	54	55	57	58	60	61	63	64	66
	Utility	26	28	29	30	31	32	33	34	36	37
	Truck	107	111	114	118	122	125	128	132	135	139
Power Plant Related Traffic	Car	616	616	616	616	616	881	881	881	881	881
	Bus	47	47	47	47	47	66	66	66	66	66
Total (veh/day)		3,144	3,338	3,549	3,777	4,025	4,544	4,794	5,063	5,349	5,655
Total (PCU/day)		6,582	7,035	7,527	8,060	8,639	9,508	10,093	10,719	11,388	12,103
Peak Hour Flow (veh/hour)		592	627	664	705	739	835	864	894	925	958
Peak Hour Flow (pcu/hour)		1,200	1,281	1,368	1,463	1,543	1,685	1,751	1,821	1,894	1,970
Required No. of Lanes (Ref: Japanese Port Road Standard <sup>1</sup> )		2	2	4	4	4	4	4	4	4	4
Required No. of Lanes (Ref: RHD Standard <sup>2</sup> )		2	2	2	2	2	2	2	2	2	2

**iii. Traffic Details**

It is assumed that the traffic will run on the road for twice a day i.e. up/down and the estimated travel for each vehicle would be fifty (25X2) kilometers as the proposed access road length is 25 kilometers. It has also assumed that all the vehicles will run on diesel fuel. The average run of traffic per liter diesel would be 4 kilometers (Fuel Consumption Standards for Heavy-Duty Vehicles in India).

**iv. GHG Emission Factor**

This study has followed the method of IPCC GHG emission factor. It is related with the gram emission of GHG per Liter burning of diesel fuel. The IPCC GHG Emission factors are listed below.

<b>Sources of Emission Factor</b>			
<b>On-road mobile sources</b>	<b>GHGs Emission Factor</b>		
	<b>CO<sub>2</sub></b>	<b>CH<sub>4</sub></b>	<b>N<sub>2</sub>O</b>
<b>Gasoline vehicles</b> - Motorcycles - Passenger cars - Light-duty gasoline trucks	<b>IPCC</b> (2241 g/L)	<b>IPCC</b> (1.107 g/L)	<b>IPCC</b> (0.078 g/L)
<b>Diesel vehicles</b> - Light-duty diesel trucks - Buses - Heavy-duty diesel trucks	<b>IPCC</b> (2701 g/L)	<b>IPCC</b> (0.153 g/L)	<b>IPCC</b> (0.102 g/L)

**v. GHG Emission**

The GHG emissions are estimated based on the per day traffic volume of the yearly estimated total Passenger car unit (PCU). The generated CO<sub>2</sub> emission per day would be 222 Tones in the base year 2026. The CO<sub>2</sub> emission in the projected year 2035 would be 409 Tones which is almost double of the base years estimated GHG. Table-8.3-2 detailed out the estimated emissions of the proposed access road project.

**Table-8.3-2 Estimated GHG emissions of the proposed port connecting access road project**

Item	Vehicle Type	Year											
		2026	2027	2028	2029	2030	2031	2032	2033	2034	2035		
Port Related Traffic	Truck	1565	1691	1828	1977	2138	2292	2455	2631	2818	3019		
	Car	730	792	859	933	1013	1088	1169	1256	1349	1448		
Diverted Traffic from Present Road	Car	53	54	55	57	58	60	61	63	64	66		
	Utility	26	28	29	30	31	32	33	34	36	37		
	Truck	107	111	114	118	122	125	128	132	135	139		
Power Plant Related Traffic	Car	616	616	616	616	616	881	881	881	881	881		
	Bus	47	47	47	47	47	66	66	66	66	66		
Total (Vehicle/day)		3144	3339	3548	3778	4025	4544	4793	5063	5349	5656		
Total (PCU/Day)		6582	7035	7527	8060	8639	9508	10093	10719	11388	12103		
Peak Hour flow (Vehicle/day)		592	627	664	705	739	835	864	894	925	958		
Peak Hour flow (PCU/day)		1200	1281	1368	1463	1543	1685	1751	1821	1894	1970		
GHG inputs		Emissions Calculation (Tonnes)											
GHG	Factor (gm/l)	Diesel Fuel Consumption l/km	Travelling Distance (Km)	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
CO <sub>2</sub>	2701	0.25	50	222.22	237.52	254.13	272.13	291.67	321.01	340.76	361.90	384.49	408.63
CH <sub>4</sub>	0.153	0.25	50	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.02
N <sub>2</sub> O	0.102	0.25	50	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02

### 8.3.2 NOx Emission

#### (i) NOx Emission Factor

This study has followed the method of Nitrous Oxide Emissions from Vehicles, prepared by Jean Muhlbaier Dasch, General Motors Research Laboratories, Warren, Michigan. It is related with the gram emission of NOx per mileage burning of diesel fuel. The NOx Emission factor is listed below in Table-8.3-3.

Table-8.3-3 NOx Emission Factor

Vehicle	N <sub>2</sub> O mg/mile	NO <sub>x</sub> g/mile	Mean N <sub>2</sub> O/NO <sub>x</sub> %	Range N <sub>2</sub> O/NO <sub>x</sub> %
<b>Cars-FTP</b>				
No catalyst	3.6 ± 1.7	1.6 ± 0.5	0.22 ± 0.04	0.18-0.24
Oxid. Cat.	29 ± 22	1.8 ± 1.1	1.8 ± 1.5	0.4-5.4
Dual-bed	61 ± 26	1.2 ± 0.5	5.4 ± 2.7	3.0-11
Three-way	45 ± 28	0.7 ± 0.4	8.2 ± 5.3	3.5-21
All Catalyst	44 ± 28	1.2 ± 0.9	5.2 ± 4.5	0.4-21
<b>Cars-HFET</b>				
Dual/Three-way	12 ± 8	0.8 ± 0.5	2.6 ± 2.5	0.7-7.3
<b>Diesel trucks-FTP</b>				
No catalyst	50 ± 19	28 ± 19	0.20 ± 0.13	0.1-0.4

Table-8.3-4 NOx Emission Calculation of the Access Road Project

Item	Vehicle Type	Year										
		2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	
Port Related Traffic	Truck	1565	1691	1828	1977	2138	2292	2455	2631	2818	3019	
	Car	730	792	859	933	1013	1088	1169	1256	1349	1448	
Diverted Traffic from Present Road	Car	53	54	55	57	58	60	61	63	64	66	
	Utility	26	28	29	30	31	32	33	34	36	37	
	Truck	107	111	114	118	122	125	128	132	135	139	
Power Plant Related Traffic	Car	616	616	616	616	616	881	881	881	881	881	
	Bus	47	47	47	47	47	66	66	66	66	66	
Total (Vehicle/day)		3144	3339	3548	3778	4025	4544	4793	5063	5349	5656	
Total (PCU/Day)		6582	7035	7527	8060	8639	9508	10093	10719	11388	12103	
Peak Hour flow (Vehicle/day)		592	627	664	705	739	835	864	894	925	958	
Peak Hour flow (PCU/day)		1200	1281	1368	1463	1543	1685	1751	1821	1894	1970	
NOx input		Emissions Calculation (Tonnes)										
Item	Diesel Fuel Consumption (gm/km)	Travelling Distance (Km)	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
NOx	1.305	50	0.43	0.46	0.49	0.53	0.56	0.62	0.66	0.70	0.74	0.79

### 8.3.3 PM & TSP Emission

#### i. Vehicles Details

Four types of vehicles will be run on the proposed port connecting access road project. These vehicles will be mainly for:

- Port Related Traffic
  - Truck & Car
- Diverted Traffic from Present Road
  - Truck, Utility & Car
- Power Plant Related Traffic
  - Car & Bus

#### ii. Prediction of Traffic Volume

JICA study team has forecasted the road traffic and flow of the traffic for the years 2026-2035. The details are tabulated in table-8.3-5.

Table-8.3-5 Estimated Vehicles Number/per day

	Veh Type	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
Port Related Traffic	Truck	1,565	1,691	1,828	1,977	2,138	2,292	2,455	2,631	2,818	3,019
	Car.	730	792	859	933	1,013	1,088	1,169	1,256	1,349	1,448
Diverted Traffic from Present Road	Car	53	54	55	57	58	60	61	63	64	66
	Utility	26	28	29	30	31	32	33	34	36	37
Power Plant Related Traffic	Truck	107	111	114	118	122	125	128	132	135	139
	Car	616	616	616	616	616	881	881	881	881	881
Total (veh/day)	Bus	47	47	47	47	47	66	66	66	66	66
		3,144	3,338	3,549	3,777	4,025	4,544	4,794	5,063	5,349	5,655
Total (PCU/day)		6,582	7,035	7,527	8,060	8,639	9,508	10,093	10,719	11,388	12,103
Peak Hour Flow (veh/hour)		592	627	664	705	739	835	864	894	925	958
Peak Hour Flow (pcu/hour)		1,200	1,281	1,368	1,463	1,543	1,685	1,751	1,821	1,894	1,970
Required No. of Lanes (Ref: Japanese Port Road Standard <sup>1</sup> )		2	2	4	4	4	4	4	4	4	4
Required No. of Lanes (Ref: RHD Standard <sup>2</sup> )		2	2	2	2	2	2	2	2	2	2

#### iii. Traffic Details

It is assumed that the traffic will run on the road for twice a day i.e. up/down and the estimated travel for each vehicle would be fifty (25X2) kilometers as the proposed access road length is 25 kilometers. It has also assumed that all the vehicles will run on diesel fuel.

#### iv. PM & TSP Emission Factor

This study has followed the method of emission factors for tyre wear used in RAINS. The emission factors for tyre wear used in the RAINS PM Module (Table-8.3-6) are based on the summary of TSP and PM<sub>10</sub> emission factors. It is related with the gram emission of PM and TSP per kilometer running of the light duty vehicles with diesel fuel burning.

Table-8.3-6: Emission factors for tyre wear used in RAINS (g/km)

Sector	RAINS code	PM <sub>2.5</sub>	Coarse	PM <sub>10</sub>	>PM <sub>10</sub>	TSP
Light duty vehicles	TRT_RD_LD4	0.0003	0.0062	0.0065	0.0596	0.0661
Motorbikes	TRT_RD_LD2	0.0001	0.0031	0.0032	0.025	0.0282
Heavy duty vehicles	TRT_RD_HD	0.002	0.038	0.04	0.3808	0.4208

Source: <http://www.iiasa.ac.at/~rains/PM/docs/documentation.html>

**v. PM & TSP Emission**

The PM and TSP emissions are estimated based on the per day traffic volume of the yearly estimated total Passenger Car Unit (PCU). The generated Particulate Matter (PM) emission greater than PM<sub>10</sub> (>PM<sub>10</sub>) size per day would be around 20kg in the base year 2026. The generated total suspended particulate (TSP) matters would be around 22Kg in the base year 2026. These emissions would be 36Kg & 40Kg for the >PM<sub>10</sub> size & TSP respectively in the projected year 2035 which are almost double of the base years PM and TSP estimation. Table-3 detailed out the estimated emissions of the proposed access road project.

Table-8.3-7 Estimated PM and TSP emissions of the proposed port connecting Access Road Project

Item	Vehicle Type	Year										
		2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	
Port Related Traffic	Truck	1565	1691	1828	1977	2138	2292	2455	2631	2818	3019	
	Car	730	792	859	933	1013	1088	1169	1256	1349	1448	
Diverted Traffic from Present Road	Car	53	54	55	57	58	60	61	63	64	66	
	Utility	26	28	29	30	31	32	33	34	36	37	
	Truck	107	111	114	118	122	125	128	132	135	139	
Power Plant Related Traffic	Car	616	616	616	616	616	881	881	881	881	881	
	Bus	47	47	47	47	47	66	66	66	66	66	
Total (Vehicle/day)		3144	3339	3548	3778	4025	4544	4793	5063	5349	5656	
Total (PCU/Day)		6582	7035	7527	8060	8639	9508	10093	10719	11388	12103	
Peak Hour flow (Vehicle/day)		592	627	664	705	739	835	864	894	925	958	
Peak Hour flow (PCU/day)		1200	1281	1368	1463	1543	1685	1751	1821	1894	1970	
PM & TSP inputs		Emissions Clculation (Kg)										
PM & TSP	Factor (gm/Km)	Travelling Distance (Km)	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
PM <sub>2.5</sub>	0.0003	50	0.0987	0.1055	0.1129	0.1209	0.1296	0.1426	0.1514	0.1608	0.1708	0.1815
Coarse	0.0062	50	2.04	2.18	2.33	2.50	2.68	2.95	3.13	3.32	3.53	3.75
PM <sub>10</sub>	0.0065	50	2.14	2.29	2.45	2.62	2.81	3.09	3.28	3.48	3.70	3.93
>PM <sub>10</sub>	0.0596	50	19.61	20.96	22.43	24.02	25.74	28.33	30.08	31.94	33.94	36.07
TSP	0.0661	50	21.75	23.25	24.88	26.64	28.55	31.42	33.36	35.43	37.64	40.00

**8.3.4 Accident**

As per the road accident and casualties statistics, last nine years accident data shows that on an average 3028 accident happens per year. The accident statistics are listed below in Table-8.3-8.

Table-8.3-8: Road Accident and casualties Statistics (2009-2017)

Sl. No.	Year	Number of Accidents
1	2009	3381
2	2010	2827
3	2011	2667
4	2012	2636
5	2013	2029
6	2014	2027
7	2015	2394
8	2016	4312
9	2017	4979
10	Average	3028

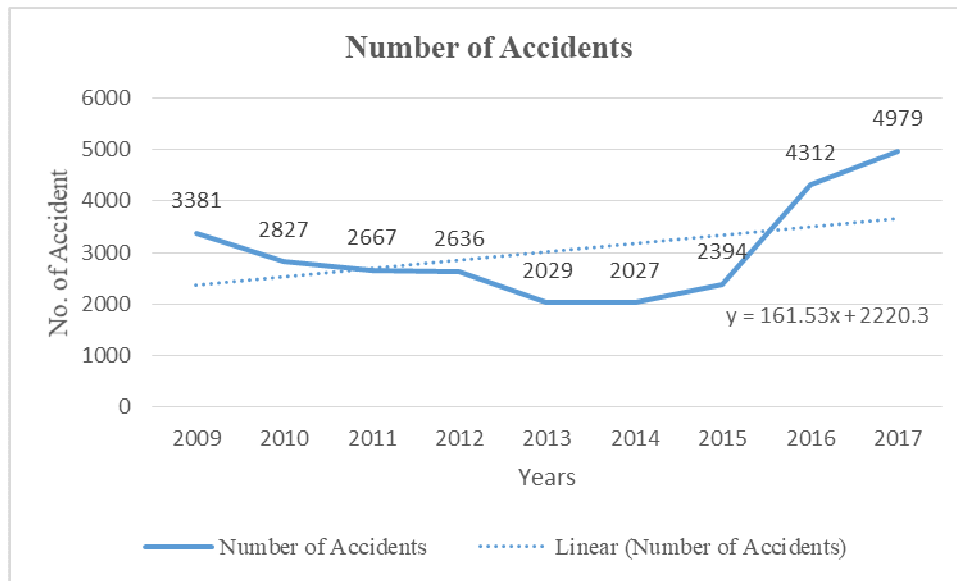


Figure-8.3-1 Yearly Accident Rate of Bangladesh

The total number of registered motor vehicles in Bangladesh as on march 2018 is 3.4 million; among of them are in percentages as Ambulance (0.15), Auto Rickshaw CNG (7.28), Auto Tempo (0.6), Bus (1.3), Cargo Van (0.26), Covered Van (0.79), Delivery Van (0.82), Human Hauler (0.51), Jeep(Hard/Soft) (1.59), Microbus (2.87), Minibus (0.82), Pick Up (Double/Single Cabin) (3.07), Private Passenger Car (9.81), Special Purpose Vehicle (0.28), Tanker (0.14), Taxicab (1.34), Tractor (1.19), Truck (3.95). The nos. of accident per year has been calculated based on the average accident a year with the total passenger car unit per day passing through the access road.

Table-8.3-9 Possible Accident Per year On the Access Road

Item	Vehicle Type	Year									
		2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
Port Related Traffic	Truck	1565	1691	1828	1977	2138	2292	2455	2631	2818	3019
	Car	730	792	859	933	1013	1088	1169	1256	1349	1448
Diverted Traffic from Present Road	Car	53	54	55	57	58	60	61	63	64	66
	Utility	26	28	29	30	31	32	33	34	36	37
	Truck	107	111	114	118	122	125	128	132	135	139
Power Plant Related Traffic	Car	616	616	616	616	616	881	881	881	881	881
	Bus	47	47	47	47	47	66	66	66	66	66
Total (Vehicle/day)		3144	3339	3548	3778	4025	4544	4793	5063	5349	5656
Total (PCU/Day)		6582	7035	7527	8060	8639	9508	10093	10719	11388	12103
Peak Hour flow (Vehicle/day)		592	627	664	705	739	835	864	894	925	958
Peak Hour flow (PCU/day)		1200	1281	1368	1463	1543	1685	1751	1821	1894	1970
Accident inputs		Probable Nos. of Accident									
No. of Registered Vehicles	Average Accident (2009-2017)	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
3400000	3028	6	6	7	7	8	8	9	10	10	11

## 8.4 SOCIAL ENVIRONMENT

### 8.4.1 Resettlement and Land Acquisition

Out of 201 ha required for the Project, private land to be acquired will be 144 ha. 130 HHs will be subject to displacement of their houses and 7 HHs will be subject to displacement of their shops. (Since 2 HHs will be with both their houses and shops displaced, total number of HHs with their houses/shops displaced will be 135 HHs.) 576 HHs will have their land affected, out of which 97 HHs will have also their houses and/or shops affected. Total number of HHs with their structures and/or land will be 614 HHs.

Table 8.4-1 Involuntary Resettlement Impact

Serial	Type of Impact	Amount/No	Comments
1	Land Required for the Project	201 ha	
1-1	Private land to be Acquired	144 ha	
	Loss of Residential land	8 ha	
	Loss of Agricultural land	63 ha	
	Loss of Salt farm	72 ha	
1-2	Government land to be transferred	57 ha	
2	Affected Household		
2-1	Household with their structures / land affected	614 households	
	With their Houses affected	130 households	Including 33 households of informal settlers
	With their Shops affected	7 households	2 households with both houses and shops affected
	Loss of Land (Residential land and/or Salt farm)	576 households	97 households with both structures and land affected.
2-2	Households with their livelihood affected	515 households	
	Sharecroppers	258 households	
	Agri-Labours	26 households	
	Labours in salt/shrimp farm etc.	112 households	
	Other employees	119 household	

Source: JICA Survey Team

#### 8.4.2 Poor people

In Bangladesh, Poverty Reduction Strategy was formulated and poverty reduction has been taken up as a critical issue in "Seventh Five-Year Plan 2016-2020". Expenditure on Social Security programs in Bangladesh in FY 2014-15 is 306.4 billion taka, which is equivalent to 2.02% of GDP. Among them, 0.5% is allocated for "Economic Empowerment of the Poor", and 5.5% is allocated for "Vulnerable Group Feeding". However, especially as for the "Vulnerable Group Feeding", coverage of beneficiary is low. The "National Social Security Strategy" formulated in 2015 aims to expand the social security system to socially vulnerable people including the poor.

The per capita monthly income of the population below the "upper poverty line" in Bangladesh based on the basic needs cost method, is 1,304.64 Taka in the rural area of the Chittagong Division (Bangladesh Bureau of Statistics (2011), Report of Household Income & Expenditure Survey 2010). In order to grasp the number of poor households in this survey, households with monthly income below 15,000 Taka as of 2018 is defined as "poverty", considering the average inflation rate of about 7% and the average household size of 5.3 persons in addition to the above per capita monthly income.

According to this definition, 34 households are the poor out of 130 households to be displaced. Informal settlers are 33, out of which 12 households are the poor. Land loser excluding the aforementioned house losers are 484 HHs, out of which 114 HHs are the poor. 37 HHs out of 290 HHs of sharecroppers/ employees interviewed could be regarded as the poor. However, it shall be noted that income level can be reported higher in interview survey, which means there can be more HHs below poverty line than reported.

### 8.4.3 Indigenous people and ethnic minorities

In Bangladesh, ethnic minorities are treated as 'tribals' in official documents, though in the Act 12 of 1995 and Rules 6, 34, 45, 50 of Chittagong Hill Tracts (CHT) Regulation (1900), they are documented as 'indigenous peoples' or 'aboriginal' as per section 97 of the SAT Act (1950). The State Acquisition and Tenancy Act (1950) restricts the sale of lands of 'aboriginal castes and tribes' to anyone except aboriginal castes domiciled in Bangladesh. In Bangladesh there are about 50 different indigenous communities living in the plain lands and hill areas. Though they claim that their population is over 3 million, according to the census survey of BBS in 2011, the country's indigenous population is around 1,586,141, which signifies 1.8% of total population of the country.

Through the socio-economic survey, it was confirmed that there are no ethnic minority and indigenous people in PAPs.

### 8.4.4 Local Economy and Livelihood

#### (1) Overview

The proposed Project site is mainly salt cultivation and agricultural area. Households are on salt, shrimp cultivation, agriculture and different types of small business.

#### (2) Employment

Out of 3,303 Project Affected Persons, 36.0% are employed, 7.0% are unemployed, 21.9% are house worker, and 34.6% are students as the table below.

Table 8.4-2 Employment of the Project Affected Persons

Upazila	Union	Employed	Unemployed	House worker	Student	**Others	Total
Moheshkhali	Dhalghata	163	44	108	183		498
	Kalarmarchhara	653	83	360	544	5	1,645
Chakaria	Badarkhali	99	22	74	104	4	303
	Saharbil	1	2	1	0	0	4
	Chiringa	195	52	117	202	1	567
	Fasiakhali	69	22	54	92	7	244
Total		1190 (36.0%)	230 (7.0%)	723 (21.9%)	1143 (34.6%)	17 (0.5%)	3,303 (100.0%)

\*\*People with disability

Source: JICA Survey Team

#### (3) Income

Average household income for each occupation (per month) are as follows.

Table 8.4-3 Household Income for Each Occupation (Tk per month)

Occupation	Household with their land/structure affected	Household without their livelihood only
Fisherman	46,000	-
Salt farm and shrimp cultivator	46,018	26,264
Agricultural farmer	33,176	23,380
Business	41,651	

Source: JICA Survey Team



**(4) Economic Development Project**

Among surrounding development projects, the projects which might directly affect Socio-economic conditions are as follows:

- Moheshkhali Special Economic Zone Project
- Dohazar-Cox’s bazar Railway Line Project
- Matarbari Ultra Super Critical Coal-Fired Power Project

Along with improvement of employment, business transaction and mobility through the above projects, employment promoted by the Project will stimulate the local economy. On the other hands, salt farm and shrimp farm might be affected by these projects in Moheshkhali. Therefore, appropriate compensation and assistance for livelihood restoration are required in the Project.

**8.4.5 Land Use**

Main land use of port area is salt cultivation and shrimp culture. The land owners cultivate salt in the dry season and in the same land they culture shrimp and other varieties of fishes in the wet season.

**8.4.6 Water Usage, Water Rights, and Communal Rights**

Regarding water usage and communal right in the country, there is no distinct law. Also jurisdiction between local government and central government is not clearly identified. Local government is very weak in decision making and budget constraints are a major problem. Union Parishad in project area has no manpower, scope and scanty budget for development. On the other hand, there is no fishing ground except river and the Bay of Bengal. There is no closed water large water body and irrigation facilities. Incase water usage, main source of drinking water is tube well.

**8.4.7 Social Infrastructure and Services**

There are primary schools and high schools in each Union. It is necessary to use the Upazial medical complex in the center of Moheshkhali or Chakaria, about 30 to 40 km away as the road distance when medical treatment is required. The social infrastructure and services which can be affected by the project are as follows. Schools and mosques will not be affected.

Two graveyards will be affected. The graveyard in Dhalghata will be affected by mostly port component and partially by access road component. For considering future plan of the port, relocation of the graveyard, whose cost is borne by the Project, will be inevitable. Where to be relocated shall be decided in close consultation with the concerned households considering that the households live in the area away from the Project site now. Graveyard in Badarkhali can be preserved since viaduct will be installed in the concerned section.

**Table 8.4-4 Social infrastructures near the Project Site**

Existing infrastructure to be affected in the project area	No. of Infrastructure	Address /Location	Remarks
School	3	Badarkhali	(1) Iqra Academy (not affected) (2) Little Jewels Kindergarten (not affected) (3) Badar Sha Academy School (not affected)
College	1	Badarkhali	Badarkhali Degree College (not affected)
Madrasa	1	Badarkhali	Badarkhali Fazil (Degree) Madrasa (not affected)
Clinic/ hospital	0		
Mosque	1	Badarkhali	Baitullah Mosque (not affected)

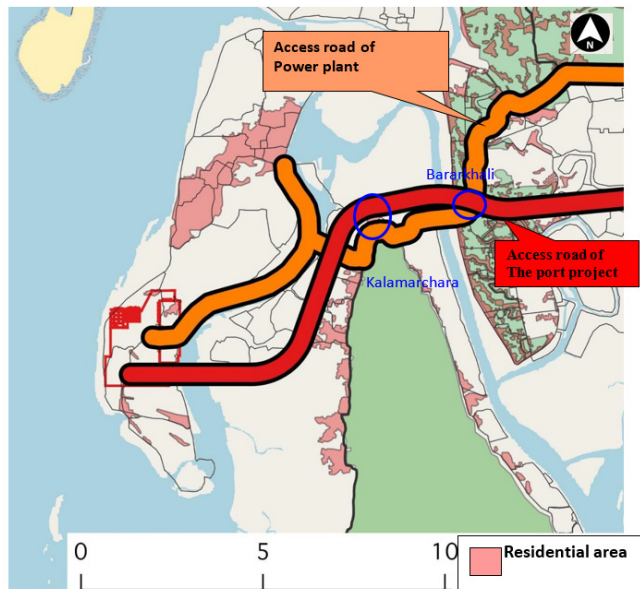
Existing infrastructure to be affected in the project area	No. of Infrastructure	Address /Location	Remarks
Graveyard	2	Dhalghata Badarkhali	Dhalghata Public Graveyard (affected) Badarkhali Association Graveyard (affected)
<b>Total:</b>	<b>8</b>		

Source: JICA Survey Team

**8.4.8 Social Institutions and Local Decision Making Institutions**

No such traditional leader or headman or institutions are formally involved in preliminary decision making process from planning stage. There may be PAPs committee including key representative of civil society of local community for suggesting the project proponent in decision making process. In the proposed project area, PAPs, local union Parishad Chairman and Members are found vocal relating to project issue. Institutionalization of such committee or advisory group with proper representation of all section of people could eliminate communication gap between project proponent and project affected community.

It shall be noted that as for the initially proposed alignment of the access road, there was concern that the access road of the Project along with access road of the adjacent coal power plant project could interfere with the north-south passage and cumulatively divide the community. This concern is because two routes by this Project and Adjacent project will traverse the Kalamarchara residential area, Badarkhali Bazar and neighboring residential area without distance. In this project, however, after the consultation meeting with PAPs, a proposal for detouring to the north side was made, which would not interfere with the passage in Kalamarchara's residential area. Since the new alignment also avoids Badarkhali Bazar and the most of residential areas, the possibility of the community severance is quite low. As the embankment might still hinder the residents north to the alignment from using the Bazar, box culvert will be installed to secure the existing road and the access to the Bazar.



Access Road by this Project and Adjacent Project(Near the Starting Point)

Figure 8.4-1 Location Map of Both Projects

**8.4.9 Unequal Distribution of Benefit and Damage and Local Conflicts of Interest**

In the stakeholders meeting at union level, chairman and other members expressed their opinion that local community shall be engaged in construction work of the project, not outsiders. Engagement of

local community into the project work would contribute to maintain social harmony and local people's satisfaction.

#### **8.4.10 Local Conflict of Interest**

At this stage, there is no conflict of interest among region. As mentioned above “9) Unequal Distribution of Benefit and Damage”, engagement of local community into the Project work would contribute to prevent the conflict of interest.

#### **8.4.11 Cultural Heritage**

The main place of cultural and historical heritage around the Project area are Adinath Temple and the temple for the Rakhine (ethnic minority ethnic group originated from Myanmar). Adinath Temple (16th century) is one of the most attractive and famous Hindi temple. Adinath temple is located in Thakurtala village of Gorakhghata Union, the southern part of Moheshkhali, however the temple is far away, approximately 20km, from the Project site. Therefore, Adinath temple will not be affected by the Project.

One of the greatest attraction of Moheshkhali is the famous Buddhist temple of 400 years old in Rakhine para. A large number of people visit the temple of the Rakhine everyday. In addition, this temple has been used as a place for Buddhist prayer of Rakhine. Since the distance between temple and project site is approximately 20km, the temple of the Rakhine also will not be affected by the Project.



Figure 8.4-2 Location of the Project Site and Cultural Heritage

Cultural Heritage	Latitude	Longitude	Distance from
Adinath Temple	21°31'41.00"N	91°58'29.40"E	Approximately 20km
Temple of the	21°31'35.17"N	91°58'23.49"E	

Source: Google Earth edited by JICA Survey Team



### 8.4.12 Landscape

As mentioned above, the scenic spots in Moheshkhali are Adinath Temple, temple of the Rakhain, the Sonadia, enriched biological diversity place, at the southern tip of Moheshkhali island. However, they will not be affected by the project since all of them are approximately 20 km away from the Project site.

### 8.4.13 Gender

Significant gender gap is found in educational level and occupation. Females tend to be severely restricted from going out particularly after their marriage in Moheshkhali.

The below table shows the gender-wise educational level of PAPs. Illiteracy rate of male is 6.7% while female is 7.9%. The rate of primary level are 31.2% for males and 34.9% for females. The rate of secondary level are 27.4% for males and 33.4% for females. These mean that education level of approximately 80% of females is up to secondary level. Females educated in HSC level are less than males; Males with HSC level are 12.5%, while females are 10.6%. The gender gap is more significant in graduate level; males are 10.6% while females are 3.9%.

Table 8.4-5 Gender-wise Education Level of the Project Affected Persons

Educational Level	Male		Female		Total	
	No. of Member	%	No. of Member	%	No. of Member	%
(1) Illiterate	125	6.7	113	7.9	238	7.2
(2) Primary Level	586	31.2	497	34.9	1,083	32.8
(3) Secondary Level	515	27.4	475	33.4	990	30.0
(4) HSC Level	235	12.5	151	10.6	386	11.7
(5) Graduate	199	10.6	55	3.9	254	7.7
(6) Post graduate	97	5.2	15	1.1	112	3.4
(7) Vocational	2	0.1	2	0.1	4	0.1
(8) Others	29	1.5	21	1.5	50	1.5
(9) Children < 5yrs	91	4.8	95	6.7	186	5.6
Total:	1,879	100.0	1,424	100.0	3,303	100.0

Source: JICA Survey Team

Gender is more vital issue and should be properly addressed for socio-economic development of the area. The project proponents should employ more female workers in the construction works and in port job facilities, provide and ensure discrimination free scope for the women.

Potential impact of the project is to expand female education in the area. The new development program will create scope of employment in the area. Socio-economic survey reveals that enrollment of female students are more in the secondary level now. New opportunity will encourage female towards higher education. In this way social taboo regarding female student’s education will gradually wither away.

Inclusion and consultation local women community is needed for improvement in project preparation and implementation period.

In tender documents, RHD should include terms and conditions to ensure female workers during the construction. For materializing this, equal wage shall be ensured with necessary supports to female workers.

**8.4.14 Children’s Rights**

Bangladesh ratified Convention No. 182 of the International Labor Organization "Worst Forms of Child Labour Convention". Labor law in 2006 stipulated that employment of children under 14 years is prohibited and employment of children under 18 years in hazardous form is prohibited. Though National Child Labour Elimination Policy was issued in 2010, child labor is still widely and commonly observed in Bangladesh.

The percentage of child labor in Chittagong is 5.0% against the total number of children from 5 years to 17 years. This percentage is higher than the national average, 4.3%. Children working in salt farm are commonly found in the project site during the survey. Some of them are considered to be child labor which could interfere with school attendance. The bidding document of the contractor shall stipulate that child labor shall be eliminated based on domestic law and FIDIC regulation.

Table 8.4-6 The Percentage and Number of Child Labor (2013)

Region	Child labor (5~17years)			Whole Child (5~17years)		
	Boy	Girl	Total	Boy	Girl	Total
Bangladesh	953,204	745,690	1,698,894	20,596,636	19,055,748	39,652,384
	4.6%	3.9%	4.3%	-	-	-
Chittagong	252,715	153,235	405,950	4,215,758	3,954,735	8,170,493
	6.0%	3.9%	5.0%	-	-	-

Source: BBS “Child Labour Survey 2013”

In Cox's Bazar, vaccination rate of children by age of 23 months is slightly higher than the national average.



Table 8.4-7 Vaccination Rate by Age of 23 Months

Classification	Region	BCG	OPV1	Penta1	OPV2	Penta2	OPV3	Penta3	MR1	FVC
Vaccination Rate	National	99.5	99.3	99.3	98.7	98.7	97.9	97.9	95.3	95.1
	Chittagong Division	99.6	99.5	99.5	99.2	99.2	98.7	98.7	96.8	96.7
	Cox's Bazar	100.0	99.8	99.8	99.8	99.8	99.1	99.1	97.2	96.7
Vaccination rate within valid period	National	99.5	97.9	97.9	97.2	97.2	90.4	90.4	92.3	86.8
	Chittagong Division	99.6	97.9	97.9	97.2	97.2	90.4	90.4	93.9	87.8
	Cox's Bazar	100.0	98.1	98.1	98.4	98.4	92.3	92.3	92.2	87.4

Source: Expanded Programme on Immunization, Directorate General of Health Services, "Coverage Evaluation Survey 2016"

#### 8.4.15 STD and HIV/AIDS

In Bangladesh, HIV infection rate is less than 1%, though it is pointed out that the actual infection rate might be higher because of insufficient inspection system. The number of HIV is the highest in Dhaka, while Chittagong has been reported to have the highest concentration of HIV along with Sylhet. (Health Bulletin 2017, Bangladesh)

In addition, many Rohingya refugees have flowed in Cox's bazar from Rakhine State in Myanmar. Rohingya diagnosed as infected with HIV/AIDS has been reported to be increased. Due to the examination system is underdeveloped, it is concerned that the number of HIV/AIDS would be higher.

Moreover, the Project itself will facilitate influx of outsiders including construction workers. Consequently, the budget shall be estimated considering social awareness program to check and minimize these social problems.

#### 8.4.16 Work Environment (Including Work Safety)

No issues on work environment were reported through Focus Group Discussions.

Labor law in Bangladesh stipulates that working hours shall not exceed 8 hours a day, or 10 hours a day at a maximum even though overtime allowance will be additionally paid. The working hours per week shall not exceed 48 hours a week, or 60 hours a week at a maximum even though overtime allowance will be additionally paid. The working hours in a week shall not exceed 56 hours in annual average. These provisions shall be strictly complied in the Project.

### 8.5 OTHERS

#### 8.5.1 Accident

Accidents in construction activities are concerned. In addition, traffic accident due to an increase traffic volume after operation is also concerned.

## CHAPTER-9 ENVIRONMENTAL AND SOCIAL IMPACT EVALUATION

### 9.1 GENERAL

This chapter identifies and evaluates the potential impacts associated with the port Project facilities. With the help of survey results the impacts were identified and therefore examination of interactions between Important Environmental Components (IECs) and Project activities were assessed through the scoping matrix and the results of scoping matrix is listed in the next section of this chapter.

### 9.2 SCOPING RESULTS

The scoping of the proposed Port project has been narrated in Table-9.2-1 considering the scoping as well as addressed the results based on the survey results.

Table-9.2-1 Scoping Results of the Proposed Port connecting access road Project

Item	Sl. No.	Impact	Scoping		Result of Assessment		Rationale
			Pre- / construction Phase	Operation Phase	Pre- / construction Phase	Operation Phase	
Pollution Control	1	Air Quality	B-	B-	B-	D	<p><b>Construction phase:</b></p> <ul style="list-style-type: none"> <li>- Dust dispersion will occur.</li> <li>- exhaust gas emissions such as SOx, NOx will occur from machinery.</li> </ul> <p><b>Operation phase:</b></p> <ul style="list-style-type: none"> <li>- Air pollution caused by exhaust gas generated from the vehicles using the port is predicted.</li> </ul>
	2	Water Quality	B-	B-	B-	B-	<p><b>Construction/Operation phase:</b></p> <p>Although turbidity increases due to construction around the river, the effect is temporary. For wastewater accompanying concrete construction and wastewater containing oil, the muddy stream caused by embankment at the time of rainy weather.</p>
	3	Waste	B-	D	D	D	<p><b>Construction phase:</b></p> <ul style="list-style-type: none"> <li>- Waste containing hazardous materials will be generated by construction work.</li> </ul> <p><b>Operation phase:</b></p> <ul style="list-style-type: none"> <li>- Little solid waste is expected.</li> </ul>
	4	Soil Contamination	B-	B-	B-	D	<p><b>Construction phase:</b></p> <p>Since there is a possibility of soil contamination due to leakage of fuel oil and lubricant from construction vehicles and construction machinery, soil contamination is expected.</p> <p><b>Operation phase:</b></p> <p>Because salt farm and paddy field are affected by the new traffic, impacts on surrounding rural areas and farmland are occurred, but these impacts are limited.</p>
	5	Noise and Vibration	B-	B-	B-	B-	<p><b>Construction phase:</b></p> <ul style="list-style-type: none"> <li>- Construction machinery and vehicles will be caused regularly.</li> </ul> <p><b>Operation phase:</b></p> <ul style="list-style-type: none"> <li>- Noise/vibrations levels generated from construction machinery will be limited to small amount.</li> </ul>
	6	Subsidence	C	C	B-	B-	<p><b>Construction phase:</b></p> <p>There are some soft ground layers, and there are some chances of ground subsidence</p> <p><b>Operation phase:</b></p> <p>same as above</p>



Item	Sl. No.	Impact	Scoping		Result of Assessment		Rationale
			Pre- / construction Phase	Operation Phase	Pre- / construction Phase	Operation Phase	
	7	Odor	D	D	D	D	<b>Construction/Operation phase:</b> Little materials will cause the odors.
	8	Sediment	B-	D	B-	D	<b>Construction phase:</b> Negative impacts due to disturbing river mud at the time of bridge constructions can be considered. <b>Operation phase: -</b>
Natural Environment	9	Protected Areas	D	D	D	D	<b>Construction/Operation phase:</b> There is no protected area in the planned site, but there could be some negative environmental impact in the peripheral changes due to the project site.
	10	Ecosystem	B-	B-	B-	D	<b>Construction phase:</b> Since there are mangrove forests due to afforestation or natural forests along the river and canal, there are effects on animals and plants. <b>Operation phase:</b> Although there are slight effects on animals and plants in the adjacent area, the impacts are limited.
	11	Hydrology	C	B-	B-	B-	<b>Construction phase:</b> Individual hydrological conditions are altered by construction work such as embankment and soft ground improvement work. Although it is affected by bridge construction over rivers, appropriate measures are taken. <b>Operation phase:</b> Depending on the types of bridges, there are some negative impacts. It is predicted that the embankment of the road will cause changes in the flood expected area at the time of monsoon. For this reason, buffering measures such as draining will be taken.
	12	Topography and Geology	B-	B-	B-	B-	<b>Construction phase:</b> Construction works such as filling embankments and measures against soft soils may affect the topography and geology. However, the impacts are limited because the levees are installed and the majority of project planned places are flat. <b>Operation phase:</b> erosion on the embankment surface is expected due to the occurrence of storm surge or flooding.
Social Environment	13	Resettlement and Land Acquisition	A-	D	A-	D	<b>Pre-Construction:</b> Approximately 121ha of private land including residential area and salt farm need to be acquired. 219 HHs will be resettled. <b>Construction:</b> No impact is expected, as relocation will be completed before construction begins. <b>Operation:</b> No impact is expected, as relocation will be completed before construction begins.
	14	Poor Classes	B-/B+	B-/B+	B-/B+	B-/B+	<b>Pre-Construction:</b> There are poor households among those to be resettled and/or lose their livelihood means. <b>Construction:</b> They will have job opportunities at the construction site. <b>Operation:</b> Resettled people may experience the deterioration of their household economies and loss of livelihood following relocation if appropriate measures are not taken. Positive impact will be expected due to improvement of local economy facilitated by improved road

Item	Sl. No.	Impact	Scoping		Result of Assessment		Rationale
			Pre- / construction Phase	Operation Phase	Pre- / construction Phase	Operation Phase	
							network.
	15	Ethnic Minorities and Indigenous Peoples	C	D	D	D	<p><b>Pre-Construction:</b> Neither ethnic minorities nor indigenous peoples live in the project affected area.</p> <p><b>Construction:</b> Neither ethnic minorities nor indigenous peoples live in the project affected area.</p> <p><b>Operation:</b> Neither ethnic minorities nor indigenous peoples live in the project affected area.</p>
	16	Local Economy such as Employment and Livelihood, etc.	B-/B+	B-/B+	A-/B+	B-/B+	<p><b>Pre-Construction:</b> Employers/ employees of salt farms, shrimp farms, fishermen, farmers and some ferry boat workers may lose their means of livelihood or their jobs.</p> <p><b>Construction:</b> Local people will be employed for construction work. Access to market can be limited.</p> <p><b>Operation:</b> Means of livelihood in salt farming and shrimp farming could be lost. The construction of road and bridges will benefit the lives of local people such as improvement of access to social services and opportunity of employment.</p>
	17	Land Use and the Utilization of Local Resources	B-	D	B-	D	<p><b>Pre-Construction/ Construction:</b> The implementation of this project will change the traditional land use pattern. Local resources can get stringent.</p> <p><b>Operation:</b> No impact is expected, as activities requiring change of land use and utilization of local resources will be completed by the end of construction.</p>
	18	Water Usage and Water Rights	B-	B-	B-	B-	<p><b>Pre-construction:</b> No activities are expected to give any impact on water usage.</p> <p><b>Construction phase:</b> Local economy may be affected by the turbid water discharged from the construction site. Outflows of street dust and oil while it rains, may also cause certain effects on salt/shrimp farms and agricultures.</p> <p><b>Operation phase:</b> Local economy may be affected by the discharged water into salt/shrimp farms and agriculture farms.</p>
	19	Existing Social Infrastructure and Services	B-	B+/B-	B-	B+/B-	<p><b>Pre-construction:</b> No social infrastructure will subject to relocation. Access to social infrastructure and social service may be affected due to resettlement of project affected persons.</p> <p><b>Construction:</b> Construction work will disturb access to existing social infrastructure and social services. Graveyard can be partly affected. A mosque existing near the project site will not be physically affected.</p> <p><b>Operation:</b> Access to social infrastructure and services will be improved. Increased traffic volume may disturb the access to existing social infrastructure and services. A mosque existing near the project site will not be physically affected.</p>
	20	Local Communities and Decision-making Institutions	B-/D	B-	B-	B-	<p><b>Pre-construction:</b> Displacement may affect the existing network of local communities and decision-making institutions.</p> <p><b>Construction:</b> Community can be hardly divided though passage is blocked by construction work. Cumulative impact from coal power plant will not be concerned regarding community severance.</p> <p><b>Operation:</b> Community can be hardly divided though passage can be blocked by the access road.</p>

Item	Sl. No.	Impact	Scoping		Result of Assessment		Rationale
			Pre- / construction Phase	Operation Phase	Pre- / construction Phase	Operation Phase	
	21	Unequal Distribution of Benefits and Damages	B-	B-	B-	B-	<p><b>Pre-Construction:</b> There may be feelings of resentment, because people living around the project site will benefit through the improvement of social infrastructure and services. People to be resettled and those who lose their means of livelihoods will receive certain damages.</p> <p><b>Construction:</b> Part of residents will have disadvantage because access is limited by construction work. Local resident may not receive benefits if external workers are employed at construction site.</p> <p><b>Operation:</b> People living around the road will benefit through the improvement of social infrastructure and services, but people living far from the road will not benefit much.</p>
	22	Local Conflicts of Interest	B-	D	B-	D	<p><b>Pre-Construction:</b> Local conflicts of interest may occur between residents, and between local administration bodies and local political leaders.</p> <p><b>Construction:</b> Conflicts between local residence and external workers may occur because of changes in local customs if the external workers cannot understand local customs.</p> <p><b>Operation:</b> No activity will be conducted to cause local conflict of interest.</p>
	23	Cultural Heritage	C	C	D	D	<p><b>Pre-Construction/ Construction:</b> There is no historical/cultural/archaeological properties nor heritage sites at the project site.</p> <p><b>Operation:</b> There is no historical/ cultural/archaeological properties nor heritage sites at the project site.</p>
	24	Landscape	B-	D	D	D	<p><b>Pre-construction:</b> No activities are expected to give any impact on landscape.</p> <p><b>Construction:</b> No significant impact will be expected as there is no scenic spot near the site.</p> <p><b>Operation:</b> No significant impact will be expected as there is no scenic spot near the site.</p>
	25	Gender	B-	B+	B-	B+	<p><b>Pre-construction:</b> Unequal distribution of compensation can be occurred within households.</p> <p><b>Construction:</b> Unequal employment opportunity can be provided at construction site.</p> <p><b>Operation:</b> Improvement of local economy will give positive impact on improvement of job opportunity and livelihood.</p>
	26	Children's Rights	B-	B+	B-	B+	<p><b>Pre-construction phase:</b> There are children among households to be resettled and/or lose their livelihood means. Children from households losing their land or jobs may suffer from adverse impact on their household economy, such as dropping-out of school.</p> <p><b>Construction phase:</b> Access way to their schools will be physically hindered by the construction site. Child labour can be provoked at the construction site because of the huge demand for unskilled workers.</p> <p><b>Operation phase:</b> Children will have better access to social services throughout the year. Education opportunity can be</p>

Item	Sl. No.	Impact	Scoping		Result of Assessment		Rationale
			Pre- / construction Phase	Operation Phase	Pre- / construction Phase	Operation Phase	
							improved. Conversion of existing traffic to the access road will improve safety of children as pedestrian.
	27	Infectious Disease such as HIV/AIDS	B-	B-	B-	B-	<b>Pre-construction:</b> No impact is expected as no influx of migrant labor is expected at this phase. <b>Construction:</b> A temporary influx of migrant labor during the construction period may increase the risk of infectious diseases. <b>Operation:</b> Improved mobility of local residents and influx of external residents may increase the risk of infectious diseases.
	28	Work Environment (Including Work Safety)	B-	D	B-	D	<b>Pre-construction:</b> No activities are expected to give any impact on work environment. <b>Construction phase:</b> Accidents may be caused by construction work. <b>Operation phase:</b> No work will be expected to affect work environment.
Others	29	Accidents	B-	B-	B-	B-	<b>Pre-construction:</b> No activities are expected to cause accidents. <b>Construction phase:</b> Accidents may be caused by construction work. <b>Operation phase:</b> Accidents may be caused by increased traffic.
	30	Cross-boundary Impact and Climate Change	C	C	D	B-	<b>Construction phase:</b> CO2 emissions due to construction activities is temporary impact on climate change. <b>Operation phase:</b> CO2 emissions due to the vehicles that run by fossil fuels affects climate change in the long term, and adaptation measures are necessary.

Source: JICA Survey Team

Note: A+/-: Significant positive/negative impact is expected.

B+/-: Positive/negative impact is expected to some extent.

C: Possibility, degree or extent of impact is unknown. (Further examination is needed)

D: No impact is expected.

Note: The selections are pursued using the JICA guidelines

### 9.3 IMPACT EVALUATION

A simple semi-quantitative descriptive checklist method has been applied to evaluate the potential environmental impacts. Firstly, the activities during construction and operation were identified and listed in the impact table. Then the corresponding impacts on the specific ecological components (terrestrial and flora), socio-economic parameters and physico-chemical environment attributes were evaluated based on the baseline scenario and an assessment of the typical interactions with project activities. Assessments were made as to whether the impacts were positive (beneficial) or negative (harmful), short-term (short recovery time) or long-term (extended recovery time); and of high or low/moderate intensity. The results of the assessment are summarized in Tables 9.3-1, 9.3-2 & 9.3-3.

Table 9.3-1 Evaluation of ecological impacts ensuing from different project activities

Sources of Potential	Ecological Issues		
	Flora	Fish	Fauna

Impacts			Amphibian		Reptile		Bird		Mammal		
	AQ	TR	AQ	TR	AQ	TR	AQ	TR	AQ	TR	
<b>A. Construction Phase</b>											
Camp Setting	0	-1S	0	0	-1S	0	-1S	0	-1S	0	-1S
Land Clearing	0	-1S	0	0	-1S	0	-1S	0	-1S	0	-1S
Soil Excavation	0	-1S	-2S	0	-1S	0	-1S	0	-1S	0	-1S
Generation of Noise	0	0	-2S	0	-1S	0	-1S	0	-1S	0	-1S
Deterioration of Water Quality	-1S	0	-2S	0	-1S	0	0	0	0	0	0
Sewage Discharge on Soil/Water	-1S	0	-1S	0	-1S	0	0	0	0	0	0
<b>B. Operation Phase</b>											
Traffic	-1S	-1S	-2S	-1S	0	0	0	0	-1S	-1S	-1S
Maintenance of Road	-1S	-1S	-1S	-1S	-1S	-1S	-1S	-1S	-1S	-1S	-1S

[Legend :AQ = Aquatic; TR = Terrestrial; 0 = No impact (negligible impact), 3 = High impact, 2 = moderate impact, 1 = Low impact, S = Short term impact, L = Long term impact, +/- = positive/negative impact]

Table 9.3-2: Socio-economic impacts from activities associated with the Construction and Operation

Project Activities		Socio-economic Impacts				
		Loss of Land and income	Traffic (road and Rail)	Impact on indigenous/tribal people	Public Health and safety	Employment and commercial activities
<b>A. Preconstruction Phase</b>	Resettlement and Land Acquisition	-2S	0	0	0	-2S
<b>B. Construction Phase</b>	Construction noise	0	0	0	-1S	0
	Labor camp setting	0	0	0	0	+2S
	Land clearing	0	0	0	0	+2S
	Soil excavation	0	0	0	0	+2S
	Piling work	0	0	0	-1S	+2S
	Concreting work	0	0	0	-1S	+2S
	Local road use	0	-1S	0	-1S	+1S
	Provision for safe water and sanitation facilities for workers	0	0	0	+2S	0
<b>C. Operation Phase</b>	Traffic	-1S	-1S	-1S	-1S	+3L
	Maintenance of Road	0	-1S	0	-1S	+3L

[+3 = High Positive Impact, +2 = Moderate positive impact, +1 = Low Positive Impact, 0 = No impact, -1 =Low Negative Impact, -2 = Moderate Negative Impact, -3 = High Negative Impact S = Short term impact, L= Long term impact]

Table 9.3-3: Physico-chemical impacts from activities associated with the construction and operation

Project Activities	Physico-chemical Impacts
--------------------	--------------------------

		Drainage congestion	Noise level	Air quality	Surface Water quality	Groundwater quality	Physical cultural	Soil quality
<b>A. Construction Phase</b>	Labor camp setting and its operation	0	0	0	-1S	0	0	0
	Land clearing	-1S	0	0	0	0	0	0
	Soil excavation	-2S	-2S	-2S	-1S	0	-1S	-1S
	Piling work	0	-2S	-1S	-1S	-1S	-1S	0
	Concreting work	0	-2S	-1S	0	0	0	0
	Provision for safe water and sanitation facilities for workers	0	0	0	0	0	0	0
<b>B. Operation Phase</b>	Traffic	0	-1S	-1S	-1S	-1S	0	0
	Maintenance of Road	0	-2S	-2S	-1S	-1S	0	-1S

[+3 = High Positive Impact, +2 = Moderate positive impact, +1 = Low Positive Impact, 0 = No impact, -1 =Low Negative Impact, -2 = Moderate Negative Impact, -3 = High Negative Impact S = Short term impact, L= Long term impact]

#### 9.4 NO PROJECT SCENARIO

The “no action alternative” would have no negative impacts on the existing environmental and social resources but the positive socio-economic and beneficial commercial impacts would also not be realized as well. All these impacts are likely to contribute to improve the quality of life of the local community, in addition to contributing to national economic growth.

## **CHAPTER-10 ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN**

### **10.1 INTRODUCTION**

This chapter summarizes the mitigation and abatement measures in order to minimize or eliminate the assessed impacts as well as presents an environment management plan (EMP), including the resources and institutional setup for implementation of the EMP. Since loss of land and associated income, effects on social, business structures etc. are anticipated in this project, a comprehensive Land Acquisition and Resettlement Action Plan (LARAP) study will be applicable and JICA is preparing parallel to this EIA study.

### **10.2 SCOPE OF EMP**

The primary objective of the environmental management plan is to record environmental impacts resulting from the project activities and to ensure implementation of the “mitigation measures” identified earlier in order to reduce adverse impacts and enhance positive impacts from specific project activities. Besides, it would also address any unexpected or unforeseen environmental impacts that may arise during construction and operation phases of the project. The EMP should clearly layout:

- a) the measures to be taken during both construction and operation phases of the project to eliminate or offset adverse environmental impacts, or reduce them to acceptable levels; and
- b) the actions needed to implement these measures.

Activities of the Environmental Management Plan for the proposed Access Road project would be of two phases:

- i. During Preconstruction and construction phase, and
- ii. During operation phase

### **10.3 IMPLEMENTATION WORK PLAN**

#### **10.3.1 Preconstruction and Construction Phase**

The environmental management program should be carried out as an integrated part of the project planning and execution. It must not be seen merely as an activity limited to monitoring and regulating activities against a pre-determined checklist of required actions. Rather it must interact dynamically as project implementation proceeds, dealing flexibly with environmental impacts, both expected and unexpected.

At this phase, the Project Implementation Unit (PIU) of RHD shall carefully consider all preconstruction and construction activities with the supervision consultant, and encourage the contractor to fully understand the necessary mitigation measures and to implement them.

For this purpose, an environmental management unit (EMU) shall be organized prior to construction activity. An expert of environmental management administrator in the EMU shall be deployed. The unit will discuss and prepare mitigation measures with the supervision consultant and the contractor prior to the start of construction.

It is anticipated that a large inflow of workers and vehicles will be in the project activities once construction work begins. The EMU shall also be responsible for functioning as a grievance organization to understand and address any grievances from local people during the construction phase, and conduct appropriate mitigation measures.



The EMU shall improve the understanding of the surrounding community regarding construction details, the schedule and mitigation measures, and shall obtain local input from people and change the mitigation measures as appropriate.

In order to confirm the implementation of environmental management and to consider further mitigation measures, the contractor would be responsible for submitting the regular reports to the supervisory consultant and the EMU on the implementation status of the management plan.

The administrator of the EMU shall regularly hold explanation sessions with the local community, continuously listen to their grievances, submit reports to the Department of Environment, JICA and other relevant organizations regarding those grievances, as well as the implementation status of environmental management and environmental monitoring (described hereinafter).

If any environmental problems occur due to construction work, the EMU shall confirm the cause with the contractor as soon as possible. In order to resolve these problems, the administrator of the EMU shall instruct the contractor and consultant regarding necessary measures. If the problem is serious, the PIU may order the contractor to halt construction work until the problem is resolved.

Figure 10.3-1 outlines the environmental management and monitoring implementation structure in accordance with the reporting flow diagram during the construction phase.

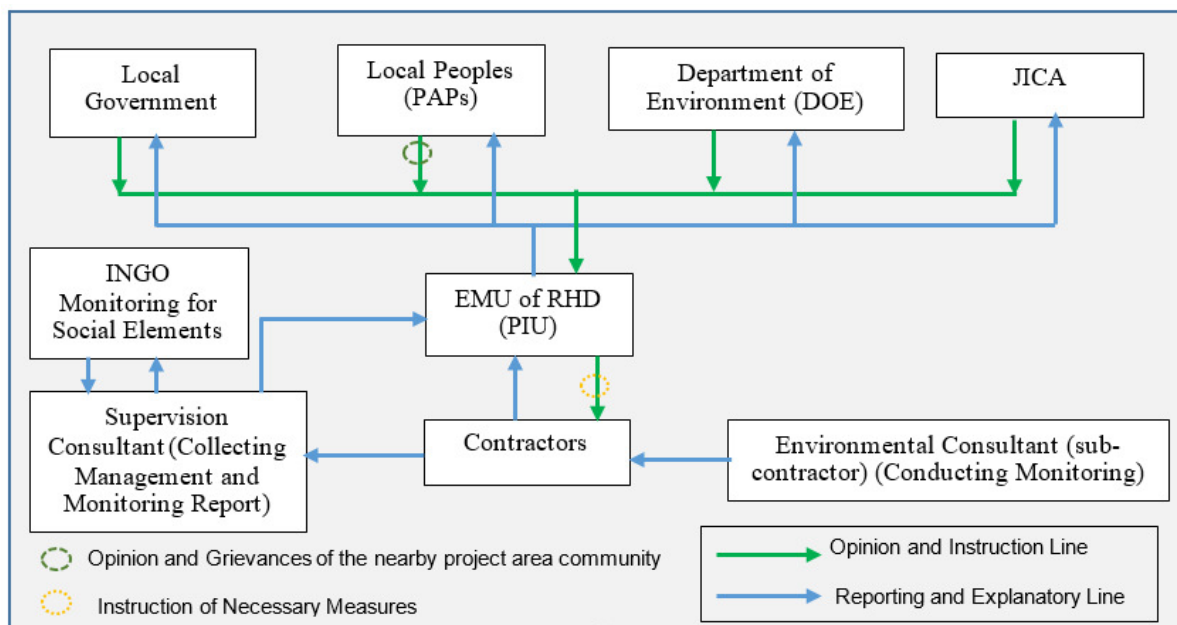


Figure 10.3-1 EMP Implementation Structure in the preconstruction and Construction Phases

### 10.3.2 Operation phase

RHD is responsible for organizing the EMU in a manner that allows it to develop and implement an environmental management plan that includes mitigation measures. An expert of environmental management administrator shall be employed at the EMU to make sure the appropriate implementation of the proposed environmental management plan. The administrator shall encourage the project staff to familiarize themselves with the environmental management plan prior to the start of port access road operation, and shall regular educate those regarding ongoing matters

during the operation phase of the port access road. The EMU shall also function as a grievance organization and will strive to understand and address any grievances from the local people during the operation phase, and undertake appropriate mitigation measures.

The basic function of the environmental management plan is to lease with the local community and to provide them with sufficient explanations based on positive mitigation measures, which is very important.

The administrator shall report on the contents and implementation status of the environmental management plan and environmental monitoring plan described below to the director of the port access road, with the director taking final responsibility.

The administrator of the EMU shall regularly hold explanation sessions with the local community, continuously listen to their grievances, submit reports to the Department of Environment, JICA and other relevant organizations regarding those grievances, as well as on the implementation status of environmental management and environmental monitoring activities (described hereinafter).

Figure 10.3-2 describes the environmental management and monitoring implementation structure with the reporting flow during the operation phase

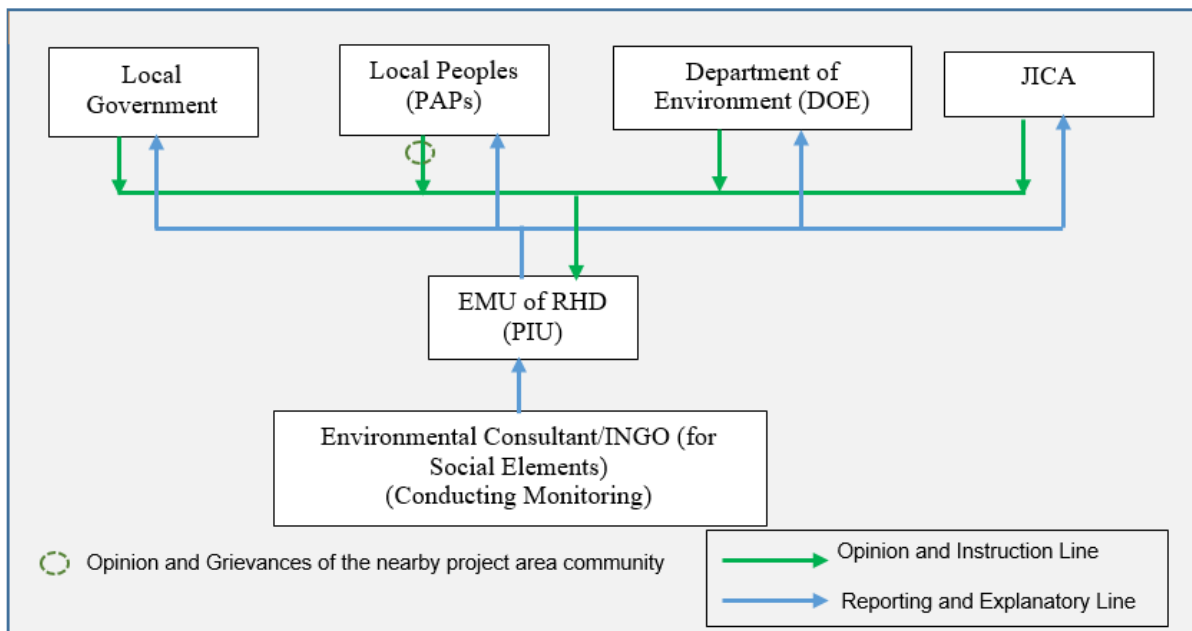


Figure 10.3-2 EMP Implementation Structure in the Operation Phase

#### 10.4 MITIGATION MEASURES

Key environmental impacts, mitigation measures, responsible organizations, and expenses for each environmental item during the construction and operation phases for the port access road project is listed in Table-10.4-1.

**Table 10.4-1 Environmental Management Plan**

Sl. No.	Potential Impact to be Managed	Sources of Potential Impact	Standard of Impact Assessment	Objectives	Management Effort	Management Location	Period of Management	Responsible Authority	Cost
<b>A. Preconstruction Phase</b>									
1	Land acquisition	i) Loss of private land ii) Loss of salt fields, shrimp farms and fishing ground for push net iii) Loss of residential /commercial structures iv) Loss of trees, home gardens, fish ponds and fruit	i), ii), iii) & iv) -The Acquisition and Requisition of Immovable Property Act of 2017 -JICA Guideline (2010)	iii) Consideration for land owners iv) Consideration for persons losing their homes iii), iv) Consideration for persons losing their property	i), ii), iii) & iv) - Developing an appropriate LARAP - Land acquisition should be conducted in compliance with the relevant laws and regulations - The cost related to relocation will be given to relocated residents - Employ local residents, especially loss of salt fields, shrimp farms, and fishing ground for push net as much as possible	i), ii), iii) & iv) - Along the right of way (ROW) of the access road	i), ii), iii) & iv) During land acquisition process	- Office of the Deputy Commissioner - RHD	Expenses to be paid by RHD - Total cost relating to land acquisition: ----- ---- Tk.
2	Disturbance to poor classes	- Poor households among those who are to be resettled.	- JICA Guideline (2010)	- Consideration for burden on vulnerable groups	- Developing “livelihood restoration program”, including job training programs to persons who want the training.	- Along the right of way (ROW) of the access road	- Prior to start construction	- Office of the Deputy Commissioner -RHD	Expenses to be paid by RHD - Job training programs: 150,000 Tk./ 20person → 0day
3	Deterioration of Local Economy such as Losses of Employment and Means	- Loss of existing livelihood, employment and business opportunities	- Income level	- Maintaining or Improvement of living standards of local residents	- Developing an appropriate LARAP - Compliance with relevant law for land acquisition - Appropriate implementation of compensation	- At the site	- During land acquisition process	- Office of the Deputy Commissioner - RHD	RHD Cost is included in LARAP budget.

Sl. No.	Potential Impact to be Managed	Sources of Potential Impact	Standard of Impact Assessment	Objectives	Management Effort	Management Location	Period of Management	Responsible Authority	Cost
	of Livelihood								
4	Land Use and Utilization of Local Resources	- Changing the traditional land use patterns and utilization of local resources	- Land Use Pattern - Use of Local Resources	- Mitigation of land use change and Prevention of local resource depletion	- Ditto	- near the site	- During land acquisition process	- Office of the Deputy Commissioner - RHD	RHD Cost is included in LARAP budget.
5	Disturbance to Existing Social Infrastructure and Services	- Loss of access to social infrastructure	- Accessibility to Social Infrastructure and social services -GRM cases	- Ensuring access to social infrastructure and social services	- Ditto	- near the site	- During land acquisition process	- Office of the Deputy Commissioner - RHD	RHD Cost is included in LARAP budget.
6	Disturbance to Local Communities and Decision making Institutions	- Loss of access to social infrastructure - community severance due to resettlement	- Accessibility within community -Perception of local residents	- Ensuring accessibility within community and maintaining Local Decision making Institutions	- Ditto	- near the site	- Prior to start construction	- Office of the Deputy Commissioner - RHD	Expenses to be paid by RHD
7	Unequal distribution of Benefits and Compensation	- It can occur among residents, workers, government officers and local politicians	-Perception of local residents	- Consideration for unequal distribution of benefits and losses	- Ditto	- Along the right of way (ROW) of the access road	- Prior to start construction	- Office of the Deputy Commissioner - RHD	Expenses to be paid by RHD
8	Local Conflicts of Interest	- It can occur among residents, workers, government officers and local	-Perception of local residents	- Consideration to affected peoples' emotions	- Ditto	- Along the right of way (RW) of the access road	- Prior to start construction	- Office of the Deputy Commissioner - RHD	Expenses to be paid by RHD

Sl. No.	Potential Impact to be Managed	Sources of Potential Impact	Standard of Impact Assessment	Objectives	Management Effort	Management Location	Period of Management	Responsible Authority	Cost
		politicians							
9	Gender	- Inappropriate distribution of compensation within HHs	- distribution of compensation within HHs	- Appropriate distribution of compensation within HHs	- Awareness and monitoring for appropriate distribution of compensation within HHs	- Along the right of way (ROW) of the access road	- Prior to start construction	- Office of the Deputy Commissioner - RHD - External Monitoring Agency	Expenses to be paid by RHD
10	Children's Rights	- Deterioration of livelihood due to resettlement and land acquisition	- enrollment rate	- ensuring education opportunity	- Ditto	- At the site	- Prior to start construction	- Office of the Deputy Commissioner - RHD	Expenses to be paid by RHD
<b>B. Construction Phase</b>									
1	Air	i) Emission from construction vehicles and machinery ii) Air pollution from various plants affecting settlements iii) Air pollution may exceed the limits prescribed by the DOE/IFC/JICA guidelines iv) Vehicles will generate dust and suspended particles	i)-iv) - Ambient air quality standard - IFC guideline values for ambient air quality	i)-iv) Prevention of air pollution in the surrounding area	v) All vehicles, equipment and machinery shall be selected to meet recognized international and national standards for emissions and shall be maintained and operated in a manner that ensures relevant air, noise and discharge rules are followed. Only unleaded petrol and low sulphur diesel or sulphur free diesel shall be used as fuel for vehicles, equipment and machinery. vi) The asphalt plants, crushers and batching plants shall not be sited less than 500m in leeward direction from the nearest human settlement. vii) Regular monitoring or air quality parameters	i) Wherever the hot mix plant and batching plant is setup  iv) Locations near settlements v) Locations given in the monitoring plan vi) Wherever the plants are set up and sensitive locations as suggested in monitoring plan	-During the construction stage	Implementation: Contractor/ Environmental Consultant  Supervisor: RHD/ Supervision Consultant	Expense is included in contract cost by Contractor.

Sl. No.	Potential Impact to be Managed	Sources of Potential Impact	Standard of Impact Assessment	Objectives	Management Effort	Management Location	Period of Management	Responsible Authority	Cost
					during the construction period as envisaged in the Environmental Monitoring Plan. viii) The dust generated by vehicles on site shall be arrested using a water tanker fitted with a sprinkler capable of applying water uniformly at a controllable rate of flow to variable widths of surface but without any flooding.				
2	Water Quality	i) River water from construction area/water way in salt/paddy field  ii) Contamination of water by fuel /oil spillage from vehicles  iii) Contamination of stagnant water body by fecal matters from workers' camp  iv) Deposition of dust in open wells near	-Water Quality Standards for Drinking water and Surface water of DOE  -IFC Guidelines 2007  -JICA Guidelines 2010	-Prevention of water pollution in the project area	x) Monitoring of water quality of the river/water way in salt/paddy field xi) Construction vehicles / equipment shall be operated and maintained in such a manner so as to avoid contamination of water bodies due to oil spillage. Fuel storage shall only be done on wasteland and will be kept away from drainage channels and natural water bodies. xii) Labor camp shall not be allowed near any of the water bodies. Proper sanitation facilities shall be provided. xiii) The mouth / opening of the well shall be covered with suitable material during any of the construction activities so as to prevent dust from entering the well.	i) Rivers/water way in the salt/paddy field ii) Near the workers' camp and sites for the installation of construction machineries iii) Preapproved locations Away from water bodies. iv) All the wells along the project corridor v), vi), vii) & viii) At respective planned construction sites ix)	-During the construction stage	Implementation: Contractor/ Environmental Consultant  Supervisor: RHD/ Supervision Consultant	Expense is included in contract cost by Contractor.

Sl. No.	Potential Impact to be Managed	Sources of Potential Impact	Standard of Impact Assessment	Objectives	Management Effort	Management Location	Period of Management	Responsible Authority	Cost
		<p>construction site</p> <p>v) Using drinking water for construction purpose</p> <p>vi) Hand pump close to road may get affected in road construction</p> <p>vii) Wells or water storage system may get affected in road construction</p> <p>viii) Altering of flow of natural drains/rivers</p> <p>ix) Sanitation of waste disposal in construction camps</p>			<p>xiv) The contractor shall make arrangements for water required for construction in such a way that water availability and supply to nearby community is unaffected. Wastage of water shall be kept to a minimum during construction.</p> <p>xv) All the hand pumps shall be relocated to a suitable alternate place.</p> <p>xvi) Alternate arrangements will be made for all wells or water storage systems</p> <p>xvii) Waterway shall be channelized with slope protection – Gabion Structure.</p> <p>xviii) The construction of camps will be done with sufficient buffer from any habitations. At construction sites and camps, a sufficient number of latrines will be provided. The sewage generated from the camps will be properly disposed of so that it does not affect water bodies.</p>	Wherever workers' camp is located			
3	Noise and Vibration	iii) Noise and vibration levels from vehicles, Asphalt plants and equipment	Noise level standards - IFC guideline values for noise (General/	Reduction of noise levels from construction activities	iii) The plants and equipment used for construction shall conform to DOE norms. Vehicles and equipment used shall be fitted with silencer.	iii) Wherever the plants are setup. All along the corridor	-During the construction stage	Implementation: Contractor/ Environmental Consultant Supervisor: RHD/	Expense is included in contract cost by Contractor.



Sl. No.	Potential Impact to be Managed	Sources of Potential Impact	Standard of Impact Assessment	Objectives	Management Effort	Management Location	Period of Management	Responsible Authority	Cost
		iv) Noise barriers	2007)		Any vehicle and machinery shall be kept in good working order and engines turned off when not in use. Regular monitoring of noise Parameters (Leq) during the construction period as envisaged in the Environmental Monitoring Plan. Construction of noise barriers in the form of walls at sensitive locations upon consultation with stakeholders. iv) Construction of noise barriers in the form of walls at Sensitive locations upon consultation with stakeholders.	wherever the sensitive locations like schools, hospitals and other community places are located. iv) All along the corridor wherever the sensitive locations like schools, hospitals and other community places are located.		Supervision Consultant	
4	Soil quality	viii) Soil Erosion in borrow pits ix) Loss of top soil in borrow pits x) Compaction of soil xi) Soil erosion in embankments xii) Contamination of soil from fuel and lubricants xiii) Contamination of land	-Soil fertility test -JICA guidelines (2010) - EHS Guidelines for Construction Materials Extraction and the General EHS Guidelines -Environmental, Health, and Safety Guidelines	-Minimize the deterioration of the soil quality	vii) The depth of borrow pits shall be restricted so that the sides of the excavation shall have a slope not steeper than 1:4, from the edge of the final section of the bank. viii) Agricultural fields or productive land shall be avoided for borrowing earth. If unavoidable, topsoil shall be preserved and used for tree plantation. ix) Construction equipment and vehicles shall be restricted to	i) & ii) On approved locations of borrow pits iii) Along the right of way (ROW) of the access road iv) at the embankments v) Near the workers' camp and sites for the installation	-During the construction stage	Implementation: Contractor/ Environmental Consultant Supervisor: RHD/ Supervision Consultant	Expense is included in contract cost by Contractor.

Sl. No.	Potential Impact to be Managed	Sources of Potential Impact	Standard of Impact Assessment	Objectives	Management Effort	Management Location	Period of Management	Responsible Authority	Cost
		<p>from construction waste and quarry materials</p> <p>xiv) Loss of top soil in land acquisition</p>	for Toll Roads-2007		<p>move only within a designated area to avoid compaction of productive soil.</p> <p>x) Pitching shall be done for slope stabilization as per the RHD guidelines</p> <p>xi) Construction vehicles and equipment shall be operated and maintained in such a manner so that soil contamination from spillage shall be at a minimum. Fuel storage shall only be done on wasteland and will be kept away from drainage channels and natural water bodies</p> <p>xii) Debris generated due to the dismantling of the existing pavement structure and the cutting of the hill side for the widening shall be suitably reused in the proposed construction, such as for fill materials for embankments.</p> <p>Debris and other material obtained from existing embankment shall be dumped in approved landfill site already identified by concerned agency. All spoils shall be disposed off as desired and the site shall be fully cleaned before handing over. Construction waste</p>	<p>of construction machineries</p> <p>vi) Along the right of way (ROW) of the access road</p>			

Sl. No.	Potential Impact to be Managed	Sources of Potential Impact	Standard of Impact Assessment	Objectives	Management Effort	Management Location	Period of Management	Responsible Authority	Cost
					including non-bituminous and bituminous waste shall be dumped in approved landfill site identified by RHD or waste management authority if any. All spoils shall be disposed off as desired and the site shall be fully cleaned before handing over.				
5	Odor	- Domestic wastewater of workers	- Wastewater standards	- Prevention of generating odor	-Taking appropriate measures for handling general waste  -Prohibit illegal waste disposal	- Construction area	- During construction phase	Implementation: Contractor/ Environmental Consultant  -Supervisor: RHD/ Supervision Consultant	Expenses included in contract cost by Contractor.
6	Sediment	i) River bottom sediment ii) Runoff water from construction area iii) Domestic wastewater of workers iv) Inappropriate disposal of waste v) Leakages of oil and chemical materials from construction	i) ii) iii) & iv)  - Wastewater standards	i) ii) iii) & iv)  - Prevention of water pollution in the surrounding area	i) Excavate channels, ditches and temporary settling pond around bridge construction area ii) iii) iv) & v)  - Implement the same mitigation measures as those addressed in “Water Quality”	i) ii) iii) iv) & v)  Construction area	i) ii) iii) iv) & v)  - During construction phase	Implementation: Contractor/ Environmental Consultant  Supervisor: RHD/ Supervision Consultant	Expenses included in contract cost by Contractor

Sl. No.	Potential Impact to be Managed	Sources of Potential Impact	Standard of Impact Assessment	Objectives	Management Effort	Management Location	Period of Management	Responsible Authority	Cost
		activity							
7	Ecosystem	i) Mangrove forest ii) Tidal flats	i), ii) -Bangladesh Wild Life Preservation (Amendment) Act, 1974 -JICA Guideline (2010) -World Bank OP4.04	i), ii) Protection of endangered species Protection critical natural habitat	i), ii) Developing “protective measures” Prohibit disturbance, Monitoring of water quality, sedimentation and topographical future	i), ii) Construction area	During construction phase	Implementation: Contractor/ Environmental Consultant  Supervisor: RHD/ Supervision Consultant	Expense is included in contract cost by Contractor.
8	Deterioration of Local Economy such as Losses of Employment and Means of Livelihood	- Loss of existing livelihood, employment and business opportunities	- Income level, Number of employment opportunities for local residents and number of businesses around the construction area	- Maintaining or Improvement of the local economy - Maintaining or Improvement of living standards of local residents - Consideration to local residents’ feelings	Employ local residents as much as possible Use the services (i.e., laundry and catering services, etc.) and products offered by the local community. Developing “livelihood restoration program”, including job training programs to persons who want the training.	- Villages near the site	- During construction phase	- Implementation: Contractor/ Environmental Consultant  - Supervisor: RHD/ Supervision Consultant	Expense is included in contract cost by Contractor  - Hire local residence: 1,000Tk./person-day
9	Land Use and Utilization of Local Resources	- Changing the traditional land use patterns and utilization of local resources	- Land Use Pattern - Use of Local Resources	- Mitigation of land use change and Prevention of local resource depletion	- Implement the same mitigation measures as those addressed in the “Local economy”	- Villages near the site	- During construction phase	- Implementation: Contractor/ Environmental Consultant  - Supervisor: RHD/ Supervision Consultant	Expenses included in contract cost by Contractor
10	Disturbance to Water Usage, Water Rights, etc.	i) Adverse impact due to water pollution ii) Usage of	i) Water pollution  - Same as those addressed in	i) Water pollution  - Same as those addressed in	i) Water pollution  - Implement the same mitigation measures as those addressed in	i), ii)  - Construction area	i), ii)  - During construction phase	- Implementation: Contractor/ Environmental Consultant  - Supervisor:	Expenses included in contract cost by Contractor

Sl. No.	Potential Impact to be Managed	Sources of Potential Impact	Standard of Impact Assessment	Objectives	Management Effort	Management Location	Period of Management	Responsible Authority	Cost
		underground water	“Water quality” ii) Ground water - Drinking water quality standards	“Water quality” ii) Ground water - Consideration to local residents’ living	“Water quality” ii) Ground water - Monitoring of water levels and water quality at wells in residential areas			RHD/ Supervision Consultant	
11	Disturbance to Existing Social Infrastructure and Services	Loss of access to social infrastructure and social services due to disturbance by construction work	-Access to social infrastructure and social services - Consciousness of Project Affected Persons	-Securing access to social infrastructure and social services	-Securing passage	Villages near the site	During construction phase	- Implementation: Contractor/ Environmental Consultant - Supervisor: RHD/ Supervision Consultant	Expenses included in contract cost by Contractor
12	Disturbance to Local Communities and Decision making Institutions	- Loss of access within social infrastructure - community severance due to resettlement	- Accessibility within community - Perception of local residents	- Ensuring accessibility within community and maintaining Local Decision making Institutions	- Ditto	- near the site	During construction phase	- Implementation: Contractor/ Environmental Consultant - Supervisor: RHD/ Supervision Consultant	Expenses to be paid by RHD
13	Unequal Distribution of Benefits and Damages	- Unequal distribution of benefits and damages between local residents and external workers	- Consciousness of local residents	- Consideration of the attitudes of local residents to the project	- Employ local residents as much as possible - Promote communication between external workers and local people (e.g., join in local events)	- Villages near the site	- During construction phase	- Implementation: Contractor/ Environmental Consultant - Supervisor: CPA/ Supervision Consultant	Expenses included in contract cost by Contractor
14	Local Conflicts of Interest	- Conflicts between local residents and external	- Change in local customs	- Consideration of the attitudes of local residents to the project	- Employ local residents as much as possible - Promote communication	- Villages near the site	- During construction phase	- Implementation: Contractor/ Environmental Consultant	Expenses included in contract cost by

Sl. No.	Potential Impact to be Managed	Sources of Potential Impact	Standard of Impact Assessment	Objectives	Management Effort	Management Location	Period of Management	Responsible Authority	Cost
		workers			between external workers and local people (e.g., join in local events)			- Supervisor: RHD/ Supervision Consultant	Contractor
15	Gender	Unequal opportunity of employment	- Opportunity of employment	- Equal opportunity of employment	- Opportunity of employment shall be properly provided both for male and female	Construction Site	- During construction phase	- Implementation: Contractor/ Environmental Consultant - Supervisor: RHD/ Supervision Consultant	Expenses included in contract cost by Contractor
16	Children's Rights	- Child labor	- Child labor	- Banning child labor	- Prohibit labor contracts between subcontractor and children - Patrolling periodically to check for any child labor	- Construction area	- During construction phase	- Implementation: Contractor/ Environmental Consultant - Supervisor: RHD/ Supervision Consultant	Expenses included in contract cost by Contractor
17	Infectious Diseases such as HIV/AIDS	- Temporary influx of migrant labor during construction may increase risk of infection	- sanitation for local residents	- Consideration for sanitation for local residents	- Implementation of periodic medical check-ups by temporary medical team - Education and training on health care of workers	- Construction area	- During construction phase	- Implementation: Contractor/ Environmental Consultant - Supervisor: RHD/ Supervision Consultant	Expenses included in contract cost by Contractor - Medical checkups: 45,000Tk./ person (Full Medical Checkup) - Safety education and training: 150,000Tk./

Sl. No.	Potential Impact to be Managed	Sources of Potential Impact	Standard of Impact Assessment	Objectives	Management Effort	Management Location	Period of Management	Responsible Authority	Cost
									20 person
17	Work environment (including work safety)	i) Labor accidents ii) Diseases caused by air pollutants, water pollutants, and noise by construction work	i) Labor accidents - Handling heavy loads - Working at heights - Electric shocks ii) Environment pollution Ambient Air Quality Standards - Noise level standards - Waste management rule - IFC guideline values for ambient air quality and noise (General/ 2007)	i) & ii) - Prevention of labor accidents, traffic accidents, and health problems	iii) Labor accidents - Prepare a manual for labor accident prevention including safety education and training - Provide workers with appropriate personal protective equipment (PPE) - Inspect and ensure that any lifting devices, such as cranes, are appropriate for expected loads - Keep lifting devices well maintained and perform maintenance checks as appropriate during the period of construction - Use equipment that protects against electric shock iv) Environment pollution - Observe related standards and provide workers with appropriate facilities	i) & ii) - Construction area	i) & ii) - During construction phase	- Implementation: Contractor/ Environmental Consultant - Supervisor: RHD/ Supervision Consultant	Expenses included in contract cost by Contractor
18	Accidents	- Traffic accidents	i) River traffic ii) Land traffic	i), ii) - Prevention of traffic accidents	i) River Traffic: - Setting marking buoys around the construction area for river safety - Informing construction	i) River area around the construction site for bridge	i), ii) - During construction phase	- Implementation : Contractor/ Environmental Consultant - Supervisor:	Expenses included in contract cost by Contractor



Sl. No.	Potential Impact to be Managed	Sources of Potential Impact	Standard of Impact Assessment	Objectives	Management Effort	Management Location	Period of Management	Responsible Authority	Cost
					schedules to local fishermen, etc. ii) Land traffic: - Informing bus schedules to the surrounding villages - Determining a traffic control plan - Training safe operation of vehicles	construction ii) Area around the construction site		RHD/ Supervision Consultant	
19	Cross-boundary impact and climate change	- CO2 will be produced by construction work	-	- Reduce CO2 emissions as much as possible	- Periodic maintenance and management of all construction machinery and vehicles	- Construction area	- During construction phase	- Implementation: Contractor/ Environmental Consultant  - Supervisor: RHD/ Supervision Consultant	Expenses included in contract cost by Contractor
<b>C. Operation Stage</b>									
1	Air Quality	i) Exhaust gas from vehicles used for mobilization of equipment and workers ii) Dust from road	i), ii) Ambient air quality standards -IFC guideline values for ambient air quality (General/2007) -DOE Guidelines -JICA Guidelines (2010)	i), ii) Prevention of air pollution	i), ii) Monitoring the ambient air quality along the road	i), ii) Along the road	1), 2) During the operation of the Road	RHD	RHD
2	Water	Degradation due to Water quality	Ambient water	Prevention of	Silt fencing, oil & grease traps, etc. shall be provided at sensitive	-Bridge	During the operation of the	RHD	RHD

Sl. No.	Potential Impact to be Managed	Sources of Potential Impact	Standard of Impact Assessment	Objectives	Management Effort	Management Location	Period of Management	Responsible Authority	Cost
	Quality	road-run-off	Quality standards	water pollution	water bodies to ensure that the water quality is not impaired due to contaminants from road run-off Monitoring shall be carried out as specified in the monitoring plan.	locations	Road		
3	Noise and Vibration	Noise caused by vehicles used for mobilization of equipment and workers	Noise standards -IFC guideline values for noise (General/2007) -JICA guideline (2010)	Prevention of noise and vibration impact	-Monitoring the noise and vibration levels -Determine a traffic control plan including route-setting -Limit truck speed, especially around residential areas -Install noise barrier (wall etc.) in sensitive areas, if necessary	Along the road	During the operation of Road	RHD	RHD
4	Soil Quality	Soil and water contamination from accidental spills	-Soil quality standards	Prevention of soil and water pollution in the surrounding area	-Contingency plans to be in place for cleaning up of spills of oil, fuel and toxic chemicals. -Monitoring shall be carried out as specified in the Monitoring Plan	Salt/ paddy fields	During the operation of the Road	RHD	RHD
5	Sediment	Existence of bridge piers	World Bank OP4.04	Prevention of deterioration of tidal flat	Monitoring of sediment quality of mud flat and river bottom	River around bridges	During the operation of the Road	RHD	RHD
6	Ecosystem	i) Mangrove forest ii) Tidal flats	i), ii) Bangladesh Wild Life Preservation (Amendment) Act, 1974 JICA Guideline (2010) -World Bank	i), ii) Protection of endangered species Protection critical natural habitat	i) -Compensatory Afforestation in the Mangrove area; ii) -Developing “protective measures”	i) - Compensatory Afforestation in the both bank of the Kuhelia River ii) Around	During the operation of the Road	RHD	RHD

Sl. No.	Potential Impact to be Managed	Sources of Potential Impact	Standard of Impact Assessment	Objectives	Management Effort	Management Location	Period of Management	Responsible Authority	Cost
			OP4.04		-Prohibit disturbance -Monitoring of water quality, sedimentation and topographical features	the new bridges.			
7	Disturbance to Poor People	Improved road connection	Access to social services	Improvement of access to social services	New access road will be built considering the rainy season water level.	Villages near the site	During the operation of the Road	RHD	RHD
8	Deterioration of Local Economy such as Losses of Employment and Means of Livelihood	Improved transportation condition	Economic situation of dealing products	Improvement of the local economy Improvement of living standards of local residents Consideration to local residents' feelings	Same as the above	Villages near the site	During the operation of the Road	RHD	RHD
9	Disturbance to Water Usage, Water Rights, etc.	- Adverse impact due to water pollution	- Same as those addressed in "Water quality"	- Same as those addressed in "Water quality"	- Implement the same mitigation measures as those addressed in "Water quality"	Villages near the site	During the operation of the Road	RHD	RHD
10	Disturbance to the Existing Social Infrastructure and Services	i)Traffic jams caused by increased traffic volumes ii)Improved roads	i) ii) -Accessibility to Social Infrastructure	i) Traffic volume will increase ii) Access to social services	i) Minimizing traffic volume by using buses for employees of port ii) Access to social services. The access road can be used even in the rainy season.	i), ii) Villages near the site	During the operation of the Road	RHD	RHD
11	Disturbance to Local Communities and Decision	- Loss of access within community due to disturbance to	- Accessibility within community -Perception of local residents	- Ensuring accessibility within community and maintaining	- Ensuring passage (should be considered as the time of design and construction)	- near the site	During the operation of the Road	RHD	RHD

Sl. No.	Potential Impact to be Managed	Sources of Potential Impact	Standard of Impact Assessment	Objectives	Management Effort	Management Location	Period of Management	Responsible Authority	Cost
	making Institutions	passage		Local Decision making Institutions					
12	Unequal distribution of Benefits and Compensation	-It can occur among residents, workers, government officers, and local politicians	-Perception of local residents	Consideration to affected peoples' emotions	- Developing an employment plan that is fair to every affected person	Villages near the site	During the operation of the Road	RHD	RHD
13	Gender	Improved road	-Perception of local residents	Access to social services and market	The access road can be used even in the rainy season.	Villages along the road	During the operation of the Road	RHD	RHD
14	Children's Rights	Improved livelihood standard	<del>i) Child labor</del> Access to education	Improved access to education	Improved access to education -The access road can be used even in the rainy season.	Villages along the road	During the operation of the port	RHD	RHD
15	Infectious Diseases such as HIV/AIDS	- Temporary influx of migrant labor during operation may increase risk of infection	- sanitation for local residents	- Consideration for sanitation for local residents	- Education and training on health care of workers	- Port Area	- During operation phase	RHD	RHD
16	Accidents	Traffic accidents	Land traffic	Prevention of traffic accidents	-Observation of traffic regulations, installation of traffic signs, and education on safe driving -Reducing the number of vehicles by scheduling buses -Consulting with related	Villages along the road	During the operation of the port	RHD	RHD

Sl. No.	Potential Impact to be Managed	Sources of Potential Impact	Standard of Impact Assessment	Objectives	Management Effort	Management Location	Period of Management	Responsible Authority	Cost
					authorities on schedules -Informing vehicle schedules to the surrounding villages				
17	Cross-boundary Impact and Climate Change	Efficient road maintenance Idling stops, economic driving	Amount of CO <sub>2</sub> emissions	Reduce CO <sub>2</sub> emissions per road length	Efficient maintenance Promotion of efficient fuel driving	Villages along the road	During the operation of the port	RHD	RHD

### 10.5 CONTINGENCY PLAN

In case of non-compliance with the construction noise criteria or when complaint is received, more frequent monitoring as specified in the Event Contingency Plan (ECP) shall be carried out. This additional monitoring shall be continued until the recorded noise levels are rectified or proved to be irrelevant to the construction activities.

#### A. Event Contingency Plan for Construction Noise

The Action and Limit levels for construction noise are defined in Table-8.1-5 of Chapter-8 of the EIA report. Should non-compliance of the criteria occurs, action in accordance with the Event Contingency Plan in Table 10.5-1, shall be carried out.

Table 10.5-1 Event Contingency Plan for Construction Noise Monitoring

EVENT	ACTION	
	ET / ER	Contractor
<i>Action Level</i>	i. Notify Contractor	i. Submit noise mitigation proposals to Supervision Consultant (Collecting Management and Monitoring Report)
	ii. Analyze investigation	ii. Implement noise mitigation proposals
	iii. Require Contractor to propose measures for the analyzed noise problem	
	iv. Increase monitoring frequency to check mitigation effectiveness	
<i>Limit Level</i>	i. Notify Contractor	i. Implement mitigation measures
	ii. Require contractor to implement mitigation measures. Increase monitoring frequency to check mitigation effectiveness	ii. Prove to Supervision Consultant (Collecting Management and Monitoring Report) the effectiveness of measures applied

#### B. Event Contingency Plan for Air Quality

- (i) The baseline monitoring results form the basis for determining the air quality criteria for the impact monitoring. The Environmental Team shall compare the impact monitoring results with the relevant air quality criteria. Table-8.1-1 of Chapter-8 shows the air quality standards & guidelines to be used. Should non-compliance of the air quality criteria occurs, the Supervision Consultant (Collecting Management and Monitoring Report) and the Contractor shall undertake the relevant action in accordance with the Action Plan in Table 10.5-2.
- (ii) The effectiveness of the dust control measures required to be implemented under the national Ambient Air Quality Standards of DOE & IFC EHS Guideline (General: 2007) shall be checked by the EMU. If the measures adopted and implemented by the contractor are found not sufficient to keep ambient air qualities within acceptable levels, as reflected by the environmental monitoring programme, upon the advice of EMU, the Contractor shall liaise with the Supervision Consultant (Collecting Management and Monitoring Report) and Project Engineer on implementation of some other possible mitigation measures.

Table 10.5-2 Event Contingency Plan for Air Quality

EVENT	ACTION		
	Supervision Consultant	Project Engineer	Contractor
<i>ACTION LEVEL</i>			
1.Exceedance	▪ Identify source	▪ Notify Contractor	▪ Rectify any

EVENT	ACTION		
	Supervision Consultant	Project Engineer	Contractor
for one sample	<ul style="list-style-type: none"> <li>▪ Inform Project Engineer</li> <li>▪ Repeat measurement to confirm finding if necessary</li> <li>▪ Increase monitoring frequency if necessary</li> </ul>	<ul style="list-style-type: none"> <li>▪ Check monitoring data and Contractor's working methods</li> </ul>	<ul style="list-style-type: none"> <li>unacceptable practice</li> <li>▪ Amend working methods if appropriate</li> </ul>
2.Exceedance for two or more consecutive samples	<ul style="list-style-type: none"> <li>▪ identify source</li> <li>▪ inform Project Engineer</li> <li>▪ repeat measurements to confirm findings</li> <li>▪ Increase monitoring frequency to daily</li> <li>▪ Discuss with Project Engineer for remedial actions required</li> <li>▪ If exceedance continues, arrange meeting with Contractor</li> <li>▪ If exceedance stops, cease additional monitoring</li> </ul>	<ul style="list-style-type: none"> <li>▪ Confirm receipt of notification of failure in writing</li> <li>▪ Notify Contractor</li> <li>▪ Check monitoring data and Contractor's working methods</li> <li>▪ Discuss with ET and Contractor on potential remedial actions</li> <li>▪ Ensure remedial actions properly implemented</li> </ul>	<ul style="list-style-type: none"> <li>▪ Submit proposals for remedial actions to ER within 3 working days of notification</li> <li>▪ Implement the agreed proposals</li> <li>▪ Amend proposal if appropriate</li> </ul>
<b>LIMIT LEVEL</b>			
1. Exceedance for one sample	<ul style="list-style-type: none"> <li>▪ Identify source</li> <li>▪ Inform ER and EPD</li> <li>▪ Repeat measurement to confirm finding</li> <li>▪ Increase monitoring frequency if necessary</li> <li>▪ Assess effectiveness of Contractor's remedial actions and keep EPD and ER informed of the results</li> </ul>	<ul style="list-style-type: none"> <li>▪ Confirm receipt of notification of failure in writing</li> <li>▪ Notify Contractor</li> <li>▪ Check monitoring data and Contractor's working methods</li> <li>▪ Discuss with ET and Contractor potential remedial actions</li> <li>▪ Ensure remedial actions properly implemented</li> </ul>	<ul style="list-style-type: none"> <li>▪ Take immediate action to avoid further exceedance</li> <li>▪ Submit proposals for remedial actions to ER within 3 working days of notification</li> <li>▪ Implement the agreed proposals</li> <li>▪ Amend proposal if appropriate</li> </ul>
2.Exceedance for two or more consecutive samples	<ul style="list-style-type: none"> <li>▪ Identify source</li> <li>▪ Inform the Contractor</li> <li>▪ Inform EMU &amp; DOE actions taken for the exceedances</li> <li>▪ Repeat measurement to confirm findings</li> <li>▪ Increase monitoring frequency to daily if necessary</li> <li>▪ Investigate the causes of exceedance</li> <li>▪ Arrange meeting with DOE and EMU to discuss the remedial actions to be taken</li> <li>▪ Assess effectiveness of</li> </ul>	<ul style="list-style-type: none"> <li>▪ Confirm receipt of notification of failure in writing</li> <li>▪ Notify Contractor</li> <li>▪ Carry out analysis of Contractor's working procedures to determine possible mitigation to be implemented</li> <li>▪ Discuss amongst Supervision Consultant and the Contractor potential remedial actions</li> <li>▪ Review Contractor's remedial actions</li> </ul>	<ul style="list-style-type: none"> <li>▪ Take immediate action to avoid further exceedance</li> <li>▪ Submit proposals for remedial actions to EMU within 3 working days of notification</li> <li>▪ Implement the agreed proposals</li> <li>▪ Resubmit proposals if problem still not under control</li> <li>▪ Slow down or</li> </ul>



EVENT	ACTION		
	Supervision Consultant	Project Engineer	Contractor
	Contractor's remedial actions and keep DOE and EMU informed of the results ■ If exceedance stops, cease additional monitoring	whenever necessary to assure their effectiveness	stop the relevant portion of works until the exceedance is abated

**C. Site Inspection**

Ad hoc site inspections shall also be carried out on situations when significant environmental problems are identified. Inspections may also be required subsequent to receipt of an environmental complaint, or as part of the investigation work, as specified in the Event Contingency Plan for environmental monitoring and audit.

**D. Interim Notifications of Environmental Quality Limit Exceedances**

With reference to the Event Contingency Plans presented in this section, when the environmental quality limits are exceeded, the supervision consultant along with project engineer will immediately notify the EMU & DOE, as appropriate. The notification shall be followed up with advice to DOE on the results of the investigation, proposed action and success of the action taken, with any necessary follow-up proposals.

## **CHAPTER-11 MONITORING PLAN**

### **11.1 INTRODUCTION**

Environmental management is a sustainable way of planning, arranging, supervising, organizing, and developing the environment for the maintenance of the preservation of natural resources and the prevention or reduction of damage to the environment. For this access road development project an Environmental Monitoring Plan would be prepared to provide guidelines for environmental management plan during its construction and operation phases. The environmental aspects which are positively or negatively affected, or expected to be affected, by construction activity would be monitored in a prescribed monitoring format.

### **11.2 ENVIRONMENTAL MONITORING PLAN**

Key environmental impacts, monitoring methods, responsible organizations, and expenses for each environmental item in the preconstruction, construction and operation phases for the access road project are listed in Table 11.2-1.

**Table-11.2-1 Environmental Monitoring Plan of the Project**

Sl. No.	Significant Impact to be Monitored	Source of Significant Impact	Monitored Parameter	Purpose of the Monitoring	Monitoring Method			Responsible Authority	Monitoring Cost
					Method of Collecting and Analysing Data	Location	Duration and Frequency		
<b>A. Preconstruction Phase</b>									
1.	Land acquisition	i) Loss of private land ii) Loss of salt fields, shrimp farms and fishing sites iii) Loss of residential structures iv) Loss of trees and water body	i), ii), iii) & iv) - The Acquisition and Requisition of Immovable Property Ordinance of 2017 - JICA Guideline (2010)	i), ii), iii) & iv) - Confirmation of compensation process	i), ii), iii) & iv) - Attendance at compensation payment - Record of compensation agreements	i), ii), iii) & iv) - Areas eligible for compensation	i), ii), iii) & iv) - During land acquisition process	- Office of the Deputy Commissioner - RHD	Expenses by RHD - Witness: 8,500Tk./person/day
2.	Disturbance to poor people Classes	i) Poor households among those who are to be resettled ii) Loss of salt fields, shrimp farms and fishing sites	i), ii) - JICA Guideline (2010)	i), ii) - Same as those addressed in "Land acquisition"	i), ii) - Interviewing affected people	i), ii) - Affected people	i), ii) - Once a year	- Implementation: Contractor/ Environmental Consultant - Supervisor: RHD/Supervision Consultant	Expenses by RHD - Interviewer: 7,500Tk./Person/day

Sl. No.	Significant Impact to be Monitored	Source of Significant Impact	Monitored Parameter	Purpose of the Monitoring	Monitoring Method			Responsible Authority	Monitoring Cost
					Method of Collecting and Analysing Data	Location	Duration and Frequency		
3.	Social Institutions such as Social Infrastructure and Local Decision-making Institutions	- Loss of access to social infrastructure - community severance due to resettlement	-	- Access to social infrastructure - Continuity of community	- Interviewing affected people	- Affected people	- Once a year	Implementation: Contractor/ Environmental Consultant  Supervisor: RHD/Supervision Consultant	Expenses by RHD
4.	Unequal distribution of Benefits and Compensation	- It can occur among residents, workers, government officers and local politicians	-	- Same as those addressed in "Social Institutions"	- Same as those addressed in "Social Institutions"	- Same as those addressed in "Social Institutions"	- Same as those addressed in "Social Institutions "	- Implementation: Contractor/Environmental Consultant - Supervisor: RHD/Supervision consultant	Expenses by RHD
5.	Local Conflicts of Interest	- It can occur among residents, workers, government officers and local politicians	-	- Same as those addressed in "Social Institutions"	- Same as those addressed in "Social Institutions"	- Same as those addressed in "Social Institutions"	- Same as those addressed in "Social Institutions "	-Implementation: Contractor/ Environmental Consultant -Supervisor: RHD/Supervision Consultant	Expenses by RHD
6.	Gender	Inappropriate distribution of compensation within HHs	distribution of compensation within HHs	- Appropriate distribution of compensation within HHs	Interview of Project Affected Persons	- Same as those addressed in "Land Acquisition"	- Same as those addressed in "Land Acquisition"	- Office of the Deputy Commissioner RHD	Expenses by RHD

Sl. No.	Significant Impact to be Monitored	Source of Significant Impact	Monitored Parameter	Purpose of the Monitoring	Monitoring Method			Responsible Authority	Monitoring Cost
					Method of Collecting and Analysing Data	Location	Duration and Frequency		
7.	Setting up construction camps	i) disturbance to the nearby residence ii) due diligence of the camp's environmental issues	constructed as per the -BNBC Guideline -JICA guidelines (2010)	Ditto	Ditto	Ditto	Ditto	Ditto	Ditto
8.	Setting up hot mix plants	-Due diligence of the hot mix plants environmental issues	-JICA guidelines (2010)	Ditto	Ditto	Ditto	Ditto	Ditto	Ditto
<b>B. Construction Phase</b>									
1.	Air Quality	i) Emission from construction vehicles and machinery ii) Air pollution from various plants affecting settlements iii) Air pollution may exceed the limits prescribed by the DOE/IFC/JICA	i), ii) iii) & iv) - <b>PM<sub>10</sub>, PM<sub>2.5</sub>, SO<sub>2</sub>, NOx, CO</b> - Ambient Air Quality Standard - IFC guideline values for ambient air quality (General/ 2007) - <b>Meteorological Condition (Temperature, Moisture,</b>	i), ii) iii) & iv) - Evaluation of effect of the mitigation measures towards air pollution	i), ii) iii) & iv) - Collecting samples and analyzing at a lab - Measuring meteorological data	i), ii) iii) & iv) - <b>3 points</b> Residential area around the P	i), ii) iii) & iv) - Once every three months	- Implementation: Contractor/ Environmental Consultant - Supervisor: RHD/ Supervision Consultant	Expenses included in contract cost by Contractor Sampling: 50,000Tk./ sample Analyzing: 45,000Tk./ sample

Sl. No.	Significant Impact to be Monitored	Source of Significant Impact	Monitored Parameter	Purpose of the Monitoring	Monitoring Method			Responsible Authority	Monitoring Cost
					Method of Collecting and Analysing Data	Location	Duration and Frequency		
		guidelines  iv) Vehicles will generate dust and suspended particles	<b>Wind)</b>						
2.	Water Quality (Soil) (Sediment)	i) Runoff water from construction area  ii) Domestic wastewater of workers  iii) Inappropriate disposal of waste  iv) Leakages of oil and chemical materials from construction activity	i), ii) iii) & iv)  <b>pH, BOD, TSS, Oil &amp; Grease, etc.</b>  - Wastewater standards  - Ambient water quality standards (inland surface water)  - Ground water (Drinking water quality standards)	i), ii) iii) & iv)  - Evaluation of effect of the mitigation measures towards water pollution	i), ii) iii) & iv)  - Collecting samples and analyzing at a lab	i), ii) iii) & iv)  <b>- 3 point:</b> Foreside of the drain outlet  <b>- 3 point:</b> Surface water near the construction area  <b>- 3 point:</b> Ground water from existing wells	i), ii) iii) & iv)  - Once every three months	- Implementation: Contractor/ Environmental Consultant  - Supervisor: RHD/ Supervision Consultant	Expenses included in contract cost by Contractor  Sampling: 50,000Tk./ sampling  - Analyzing: 100,000Tk./ all sample
3.	Noise and Vibration	i) Noise and vibration levels from vehicles, Asphalt plants and equipment  ii) Noise barriers	i), ii)  <b>Noise level</b>  - Noise level standards  - IFC guideline values for noise	i), ii)  - Evaluation of effect of the mitigation measures towards noise levels	i), ii)  - Measurement using noise level meter	i), ii)  Free field at 1m from the equipment whose noise levels are being	i), ii)  - Once every three months	-Implementation: Contractor/ Environmental Consultant  -Supervisor: RHD/ Supervision Consultant	Expenses included in contract cost by Contractor  - Measurement: 50,000Tk./ session

Sl. No.	Significant Impact to be Monitored	Source of Significant Impact	Monitored Parameter	Purpose of the Monitoring	Monitoring Method			Responsible Authority	Monitoring Cost
					Method of Collecting and Analysing Data	Location	Duration and Frequency		
			(General/ 2007)			determined.			
4.	Wastes (Odor) (Sediment)	i) Construction waste from construction work ii) Domestic waste from workers iii) Hazardous waste such as dry batteries, etc. iv) River bottom sediment	i), ii) iii) & iv) - Waste Management Rules	i), ii) & iii) - Evaluation of effect of the mitigation measures for waste	i), ii) & iii) - Record of kinds and quantity of waste, and the disposal method	i), ii) & iii) - Construction area	1) - 4) - Continuous records	-Implementation: Contractor/ Environmental Consultant -Supervisor: RHD/ Supervision Consultant	Expenses included in contract cost by Contractor
5.	Ecosystem (Endangered Species)	i) Mangrove forest ii) Tidal flats	i), ii) <b>Species, Number</b> - Bangladesh Wild Life Preservation (Amendment) Act, 1974 - JICA Guideline (2010)	ii) Evaluation of existence of endangered species	i), ii) - Observation	i) Endangered species <b>- 3 point:</b> Construction area	i) Endangered species - Bird: Once a week in migration season - Others: Twice a year in dry and rainy seasons ii) Every 3 days in	- Implementation: Contractor/ Environmental Consultant - Supervisor: RHD/ Supervision Consultant	Expenses included in contract cost by Contractor -Observation: 400,000Tk./ Researcher/year



Sl. No.	Significant Impact to be Monitored	Source of Significant Impact	Monitored Parameter	Purpose of the Monitoring	Monitoring Method			Responsible Authority	Monitoring Cost
					Method of Collecting and Analysing Data	Location	Duration and Frequency		
							spawning season		
	Ecosystem (Mud Flat, Fish & Nekton)	i), ii) & iii) Ditto	i), ii) & iii) <b>Species, Number, Weight</b>  - Benthos (Mud flat)  - Fish and Nekton	i), ii) & iii) Ditto	i), ii) & iii)  - Collecting samples at the site, analyzing at a lab	i), ii) & iii)  - <b>3 points:</b> In front of the construction sites especially the river crossings	i), ii) & iii)  - Twice a year in dry and rainy seasons	Ditto	Expense is included in contract cost by Contractor  - Sampling & analyzing: 200,000Tk./ season
6.	Deterioration of Local Economy such as Losses of Employment and Means of Livelihood	- Loss of existing livelihood,  - Increase in employment and business opportunities	- Income level, Number of employment opportunities for local residents and number of businesses around the construction area	- Maintaining or Improvement of the local economy  - Maintaining or Improvement of living standards of local residents  - Consideration to local residents' feelings	- Information from related institutions  - Interviewing residents	- Related institutions  - Villages near the site	- Once a year	- Implementation: Contractor/ Environmental Consultant  - Supervisor: RHD/ Supervision Consultant	Expenses included in contract cost by Contractor  - Interviewer: 5,500Tk./ researcher (Same as "Poor people")

Sl. No.	Significant Impact to be Monitored	Source of Significant Impact	Monitored Parameter	Purpose of the Monitoring	Monitoring Method			Responsible Authority	Monitoring Cost
					Method of Collecting and Analysing Data	Location	Duration and Frequency		
7.	Land Use and Utilization of Local Resources	- Changing the traditional land use patterns and utilization of local resources	- Same as those addressed in “Local Economy”	- Observation of land use change - Observation of local resource usage	- Field observation  - Interviewing residents	- Villages near the site	- Once a year	Implementation: Contractor/ Environmental Consultant  -Supervisor: RHD/ Supervision Consultant	Expenses included in contract cost by Contractor
8.	Disturbance to Existing Social Infrastructure and Services	i) Increase in the number of vessels  ii) Increase in the number of cars	i), ii)  - Traffic volume by construction	i), ii)  - Evaluation of effect of construction schedule	i), ii)  - Record of numbers of vessels and cars being used	i), ii)  - Project site	i), ii)  - Continuous records	- Implementation: Contractor/ Environmental Consultant  - Supervisor: RHD/Supervision Consultant	Expenses included in contract cost by Contractor
9.	Local Conflicts of Interest	- Conflict between local residents and external workers	- Change in local customs	- Confirmation of the attitudes of local residents to the project	- Interviewing residents	- Villages near the site	- Once a year	- Implementation: Contractor/ Environmental Consultant  - Supervisor: RHD/Supervision Consultant	Expenses included in contract cost by Contractor  - Interviewer: 7,500Tk./researcher (Same as “Poor People”)
10.	Gender	- Unequal opportunity of employment	Opportunity of employment	Equal opportunity of employment	- Interviewing residents	- Residential area of Project Affected Persons	- Once a year”	- Implementation: Contractor/ Environmental Consultant  - Supervisor: RHD/ Supervision Consultant	Expenses included in contract cost by Contractor

Sl. No.	Significant Impact to be Monitored	Source of Significant Impact	Monitored Parameter	Purpose of the Monitoring	Monitoring Method			Responsible Authority	Monitoring Cost
					Method of Collecting and Analysing Data	Location	Duration and Frequency		
11.	Children's Right	- Child labor	-	- Evaluation of effect of banning child labor	- Checking the labor contracts between subcontractor and workers  - Patrolling construction area for child labor	- Construction area	- Once a year	- Implementation: Contractor/ Environmental Consultant  - Supervisor: RHD/ Supervision Consultant	Expenses included in contract cost by Contractor
12.	Infectious Diseases such as HIV/AIDS	- Temporary influx of migrant labor during construction may increase risk of infection	-	- Evaluation of sanitation for labor	- Labor health records	- Related institutions	- Once a year	- Implementation: Contractor/ Environmental Consultant  - Supervisor: RHD/Supervision Consultant	Expenses included in contract cost by Contractor
13.	Work Environment (Including Work Safety)	- Labor accidents	- Handling heavy loads  - Working at heights  - Electric shock	- Evaluation of effect of the work safety plan	- Record of accidents	- Contractor's office	- Continuous records	- Implementation: Contractor/ Environmental Consultant  - Supervisor: RHD/ Supervision Consultant	Expenses included in contract cost by Contractor
14.	Accidents	- Traffic accidents	-River traffic  -Land traffic	- Evaluation of effect of traffic schedules	- Record of accidents	- Contractor's office	- Continuous records	- Implementation: Contractor/Environmental Consultant  - Supervisor: RHD/ Supervision Consultant	Expenses included in contract cost by Contractor

Sl. No.	Significant Impact to be Monitored	Source of Significant Impact	Monitored Parameter	Purpose of the Monitoring	Monitoring Method			Responsible Authority	Monitoring Cost
					Method of Collecting and Analysing Data	Location	Duration and Frequency		
15.	Cross-boundary Impact and Climate Change	- CO <sub>2</sub> will be produced by construction work	-	- Efforts to reduce CO <sub>2</sub>	- Record of machinery maintenance	- Contractor's office	- Continuous records	- Implementation: Contractor/ Environmental Consultant - Supervisor: RHD/Supervision Consultant	Expenses included in contract cost by Contractor
<b>C. Operation Phase</b>									
1.	Air Quality	i) Exhaust gas from vehicles used for mobilization of equipment and workers ii) Dust from road	i), ii) & iii) <b>CO, SO<sub>2</sub>, NO<sub>2</sub>, PM<sub>10</sub></b> - Emission gas standards - Ambient air quality standards - IFC guideline values for gas emission and ambient air quality (General/ 2007)  i), ii) & iii) <b>Meteorological Condition (Temperature, Moisture, Wind)</b>	i), ii) & iii) - Evaluation of effect of the mitigation measures towards air pollution	i), ii) & iii) - Collecting samples at the site, analyzing at a lab - Measuring the meteorological	<b>-3 points measurements:</b> Residential area around the Access Road	-Continuous 24 hours in three points measurements shall be once in every 3 months	- RHD/ Environmental Consultant	Expenses by RHD - Sampling: 50,000Tk./ staff - Analyzing: 45,000Tk./ sample

Sl. No.	Significant Impact to be Monitored	Source of Significant Impact	Monitored Parameter	Purpose of the Monitoring	Monitoring Method			Responsible Authority	Monitoring Cost
					Method of Collecting and Analysing Data	Location	Duration and Frequency		
2.	Water Quality	Degradation due to Water quality road-run-off	<p><b>Water Temperature, TSS, pH, DO, SS, Oil &amp; Grease , BOD, COD, Heavy metals</b></p> <ul style="list-style-type: none"> <li>- Wastewater standards</li> <li>- IFC guideline values for wastewater</li> <li>- Ground water (Drinking water quality standards)</li> </ul>	- Evaluation of effect of the mitigation measure towards water pollution	- Collecting samples at the site, analyzing at a lab	<p>- <b>3 Surface (river crossings) water points</b></p> <p>- <b>Three</b> Ground water points</p>	- Pre-monsoon & Monsoon Seasons	- RHD/ Environmental Consultant	<ul style="list-style-type: none"> <li>- Continuous sensor (Expenses included in contract cost by Contractor) and Expenses by RHD</li> <li>Sampling: 100,000Tk./ staff</li> <li>- Analyzing: 200,000Tk./sample</li> </ul>
3.									
4.									
5.	Noise and Vibration	Noise caused by vehicles used for mobilization of equipment and	<p><b>Noise level</b></p> <ul style="list-style-type: none"> <li>-Noise standards</li> <li>-IFC guideline values for noise</li> </ul>	- Evaluation of effect of the mitigation measures towards noise levels	- Measurement using noise level meter	<b>3 points:</b> On the access road of the site near the residential area	- Once every 3 months	- RHD/ Environmental Consultant	<ul style="list-style-type: none"> <li>Expenses by RHD</li> <li>- Measurement: 100,000Tk./ season</li> </ul>

Sl. No.	Significant Impact to be Monitored	Source of Significant Impact	Monitored Parameter	Purpose of the Monitoring	Monitoring Method			Responsible Authority	Monitoring Cost
					Method of Collecting and Analysing Data	Location	Duration and Frequency		
		workers							
6.	Soil	Soil and water contamination from accidental spills	Soil Quality -Soil parameters -IFC Guideline values for soil parameters	Prevention of soil and water pollution in the surrounding area	-Sampling as specified in the engineering standards  -Heavy metal, oil & grease etc.	-After any accidental spillage on the road and its nearby area	-after the accidental spillage  -Once in every three months	- RHD/ Environmental Consultant	Expenses by RHD  - Measurement: 100,000Tk./ season
7.	Sediment	Existence of bridge piers	World Bank OP4.04	Prevention of deterioration of tidal flat	Monitoring of sediment quality of mud flat and river bottom	Bridge locations	Twice in a year	- RHD/ Environmental Consultant	Expenses by RHD
8.	Ecosystem (Endangered Species)	i) Mangrove Forest ii) Existence of endangered species (migration bird)	i) & ii) <b>Species, Number</b>  - Bangladesh Wild Life Preservation (Amendment) Act, 1974  - JICA Guideline (2010)	Evaluation of existence of endangered species	i) & ii)  - Observation	Near the bridge crossing at the Kuhelia River	-Once in every three months	RHD/ Environmental Consultant	Expenses by RHD  -Observation: 250,000Tk// researcher

Sl. No.	Significant Impact to be Monitored	Source of Significant Impact	Monitored Parameter	Purpose of the Monitoring	Monitoring Method			Responsible Authority	Monitoring Cost
					Method of Collecting and Analysing Data	Location	Duration and Frequency		
	Ecosystem (Mud Flat, Fish & Nekton)	Ditto	<b>Species, Number, Weight</b> -Benthos (mud flat) -Fish and nekton	Ditto	- Collecting samples at the site, analyzing at a lab	Mud flat, fish & Nekton (around the new bridge locations)	i), ii) & iii)  - Twice a year in dry and rainy seasons	Ditto	Expenses by RHD  - Sampling & Analyzing: 350,000Tk./ all sample
9.	Disturbance to Poor Class	- Improved road along with the Access road	-	- Evaluation of access to social services	- Information from related institutions  - Interviewing residents	- Related institutions  - Villages near the site	Once a year	- RHD/ Environmental Consultant	Expenses by RHD  - Interviewer: 7,500Tk./researcher
10.	Deterioration of Local Economy such as Losses of Employment and Means of Livelihood	- Increase in employment and business opportunities	-	- Evaluation of increase in employment and business opportunities	Ditto	Ditto	Ditto	- RHD/ Environmental Consultant	Expenses by RHD
11.	Land Use and Utilization of Local Resources	- Changing traditional land use patterns and utilization of local resources	-	- Observation of land use change  - Observation of local resource usage	- Field observation  -Interviewing residents	- Villages near the site	- Once a year	- RHD/ Environmental Consultant	Expenses by RHD  - Interviewer: 7,500Tk./researcher (Same as “Poor people”)
12.	Disturbance to the Existing Social Infrastructure	i) Increase in the number of vessels  ii) Increase in	i), ii)  - Traffic volume	i) & ii)  - Evaluation of effect of traffic schedules	i), ii)  - Record of numbers of vessels and	i) & ii)  - Project site	i) & ii)  Continuous records	- RHD/ Environmental Consultant	Expenses by RHD



Sl. No.	Significant Impact to be Monitored	Source of Significant Impact	Monitored Parameter	Purpose of the Monitoring	Monitoring Method			Responsible Authority	Monitoring Cost
					Method of Collecting and Analysing Data	Location	Duration and Frequency		
	and Services	the number of cars			vehicles being used				
13.	Unequal distribution of Benefits and Compensation	- It can occur among residents, workers, government officers, and local politicians	-	- Same as those addressed in "Land use"	- Same as those addressed in "Land use"	- Same as those addressed in "Land use"	- Same as those addressed in "Land use"	- RHD/ Environmental Consultant	Expenses by RHD
14.	Local Conflicts of Interest	- Conflict between local residents and workers	-	- Same as those addressed in "Land use"	- Same as those addressed in "Land use"	- Same as those addressed in "Land use"	- Same as those addressed in "Land use"	- RHD/ Environmental Consultant	Expenses by RHD
15.	Gender	i) Improved road along with the access road ii) Improved economy	i) Access to social service of both male and female ii) living standard of residents (both male and female)	- Evaluation of living standard	-Interviewing residents	- Villages near the site	- Once a year	- RHD/ Environmental Consultant	Expenses by RHD
16.	Children's Rights	- Improved road along with the access road - Improved economy	i) Access to social service ii) School attendance rate	i) Evaluation of access to social service ii) Evaluation of school attendance rate"	-Interviewing residents	- Villages near the site	- Once a year	- RHD/ Environmental Consultant	Expenses by RHD

Sl. No.	Significant Impact to be Monitored	Source of Significant Impact	Monitored Parameter	Purpose of the Monitoring	Monitoring Method			Responsible Authority	Monitoring Cost
					Method of Collecting and Analysing Data	Location	Duration and Frequency		
17.	Accidents	-Traffic accidents	Traffic accidents - Land traffic	- Evaluation of effect of the work safety plan	- Record of accidents and fire	- Along the Access Road	-Continuous records	- RHD/ Environmental Consultant	Expenses by RHD
18.	Cross-boundary Impact and Climate Change	- CO <sub>2</sub> emissions from road transport.	- Amount of CO <sub>2</sub> emissions	- Efforts to reduce CO <sub>2</sub>	- Calculate the CO <sub>2</sub> emissions from fuel consumption	-3 points Along the Access road area	- every 3 months	- RHD/ Environmental Consultant	Expenses by RHD

## CHAPTER-12 OCCUPATIONAL HEALTH AND SAFETY PLAN

### 12.1 OCCUPATIONAL HEALTH AND SAFETY PLAN

Occupational health and safety means preventing accidents and work related ill health. Improved health and safety management can bring significant benefits to the business. It reduces individual and human costs of accidents and ill health, direct and indirect cost to the business, improves customer perception and company profile and workers' morale. Under occupational health hazards, one can group several categories of working conditions impairing the health conditions of workers, though this impairment is slow. Safety relates more to health hazards that results from accidents and can cause instantaneous impairment of the workers' health.

#### 12.1.1 General Requirements

In Bangladesh the main law related to occupational health and safety is Labour Law 2006. The law has provisions on occupational hygiene, occupational diseases, industrial accidents, protection of women and young persons in dangerous occupation. The salient features of the general requirements for the workers' health and safety stated in this law is presented in Table 12.1-1.

#### 12.1.2 Workplace Environmental Quality

The proposed project has several phases' the construction of infrastructure and operation.

#### Health Hazards

The construction phase includes site preparation and port connecting access road construction etc. The health hazards associated with these activities are mainly due to dust and noise pollution. Excessive noise contributes to loss of hearing and triggers physiological and psychological body changes. Dust pollution can cause eye and respiratory irritation and in some cases allergic reactions. The inhalation of exhaust gases from vehicles and machinery are also harmful for health. Stress can be caused by working in shifts, high work load, poor living condition of workers etc.

Table 12.1-1 General requirement for workers' health and safety

Issue	Requirements
<b>Health and Hygiene</b>	<ul style="list-style-type: none"> <li>- Cleanliness</li> <li>- Ventilation and temperature</li> <li>- Dust and fumes</li> <li>- Disposal of wastes and effluents</li> <li>- Overcrowding</li> <li>- Illumination</li> <li>- Latrines and urinals</li> <li>- Spittoons and dustbins</li> </ul>
<b>Safety</b>	<ul style="list-style-type: none"> <li>- Safety for building and equipment</li> <li>- Precautions in case of fire</li> <li>- Fencing of machinery</li> <li>- Floor, stair and passage way</li> <li>- Work on or near machinery in motion</li> <li>- Carrying of excessive weights</li> </ul>
<b>Compensation for accidents at work</b>	<ul style="list-style-type: none"> <li>- Owner's responsibility for compensation</li> <li>- Amount of compensation</li> <li>- Report on fatal accident and treatment</li> <li>- Compensation on contract and contract registration</li> <li>- Appeal</li> </ul>
<b>Dust and Fumes</b>	<ul style="list-style-type: none"> <li>- Any dust or fumes or other impurities likely to be injurious to the workers, effective measures shall be taken to prevent its accumulation and its inhalation by workers</li> </ul>

Issue	Requirements
<b>Overcrowding</b>	<ul style="list-style-type: none"> <li>- No work room in any factory shall be overcrowded</li> <li>- At least five hundred cubic feet of space shall be provided for every worker employed in a work room</li> </ul>
<b>Latrines and urinals</b>	<ul style="list-style-type: none"> <li>- Sufficient latrines and urinals shall be provided</li> <li>- Shall be maintained in clean and sanitary condition</li> <li>- Shall be adequately lighted and ventilated</li> </ul>
<b>Precautions in case of fire</b>	<ul style="list-style-type: none"> <li>- Shall be provided with means of escape in case of fire</li> <li>- Effective measures shall be taken to ensure that all the workers are familiar with the means of escape</li> <li>- Firefighting apparatus should be provide and maintained</li> </ul>
<b>First aid</b>	<ul style="list-style-type: none"> <li>- Provided and maintained first aid facility</li> <li>- One for every one hundred and fifty workers</li> <li>- Shall be kept with a responsible trained person who shall be available during the working hours</li> <li>- In every facility where five hundred or more workers are employed, a dispensary shall be provided and maintained</li> </ul>
<b>Disposal of wastes and effluents</b>	<ul style="list-style-type: none"> <li>- Provide with proper disposal system for solid waste and effluents.</li> <li>- In case of a factory where no public sewerage system exists, prior approval of the arrangements should be made for the disposal of wastes and effluents</li> </ul>
<b>Occupational and poisoning diseases</b>	<p>16 occupational diseases notifiable to the Chief Inspector of Factories:</p> <p>1. lead poisoning 2. lead tetraethyl poisoning 3.phosphorous poisoning 4.mercury poisoning 5. manganese poisoning 6. Arsenicpoisoning7. poisoning by nitrous fume 8. carbon di sulfide poisoning9. benzene poisoning 10. chrome ulceration 11. Anthrax12.silicosis13. poisoning by halogens 14. Primary epitheliomatous cancer of the skin15. toxic anemia 16. Pathological manifestation due to radium or x-rays</p>
<b>Compensation</b>	<ul style="list-style-type: none"> <li>- If personal injury is caused to workmen by accident arising in the course of employment, employer shall be liable to pay compensation</li> <li>- 36 occupational diseases for compensation payable</li> <li>- Monthly payment as compensation for temporary disablement are             <ol style="list-style-type: none"> <li>1. Compensation should be paid for the period of disable mentor for one year whichever period is shorter</li> <li>2. Such compensation shall be paid at the rate of full monthly wages for the first two months</li> <li>3. Two thirds of the monthly wages for the next two months and at the rate of the half of the monthly wages for the subsequent months</li> <li>4. In case of chronic occupational diseases , half of the monthly wages during the period of disablement for a maximum period of two years shall be paid</li> </ol> </li> </ul>

A quantification of the measure of severity in health hazards is not well defined. They are slow acting and cumulative, their effects may not be visible for years. During the project construction and operation phase, use of chemicals (paints, solvents, thinners etc.) batteries, welding materials, lubricants etc. may contribute to health hazards to the workers. These substances may be carcinogenic or detrimental in other ways. Use of industrial solvents can cause anemia, liver and kidney damage, cardiovascular diseases and neurological disorder.

### Remedial Measures

To minimize the hazards arising from the activities at different phases of port connecting road project construction and operation, the following measures should be taken:

- employees should be informed of the potential health impacts they are facing;

- the employer should inform his employees of these potential hazards, arrange proper medical examination prior to and during employment, as well as tests and analyses necessary for the detection of diseases;
- works with volatile toxic chemicals should be undertaken in a well-ventilated place;
- laborers handling offensive toxic chemicals should be provided with and forced to use protective clothing;
- workers exposed to an excessive amount of noise should be provided with protective gear and be relieved frequently from their post;
- workers exposed to large amounts of dust should be provided with adequate protective gear;
- frequent spraying of water should be undertaken to minimize dust pollution;
- persons undertaking construction and installation works should have access to amenities for their welfare and personal hygiene needs such as sanitary toilets, potable drinking water, washing facilities, shelter sheds etc.;
- proper disposal of waste and sullage should be arranged;
- health education and information on hygiene should be provided to the workers;
- regular checks on food quality should be arranged within the work site.

### **Safety**

Safety implies the reduction of risk of accidents at the work site. Accident prevention is more valuable than any mitigatory or compensatory measures. This may be achieved through strict rules and procedures for the execution of specific tasks, enforcement of the rules, and discipline amongst workers, maintenance of machineries used and by providing all necessary gear or equipment that may enhance the safety of the workers.

The following guidelines should be followed to maintain the safety of the workers:

- workers have to be informed about the possible damage or hazards related to their respective jobs
- if pedestrian, traffic or plant movements at or near the site are affected by construction works, the person with control of the construction project must ensure that these movements are safely managed so as to eliminate or otherwise to control any associated health and safety risks
- must ensure sufficient lighting in the area where a person performs construction work or may be required to pass through, including access ways and emergency exit or passage without risk to health and safety
- construction site needs to provide safe access to and egress from all places where they may be required to work or pass through. This includes the provision of emergency access and egress route that must be free from obstructions
- adequate perimeter fencing should be installed on the site before construction work commences and that should be maintained during the construction work and signs should be placed which is clearly visible from outside the site including emergency telephone numbers.
- must ensure that electrical installations materials, equipment and apparatus are designed, installed, used, maintained and tested to eliminate the risk of electrical shock, burns, fire or explosion.
- construction site should be kept orderly and tidy. Access ways should be kept clear of materials and debris and maintained in a non-slippery condition. Materials should be stored in an orderly manner so that it does not pose any risk to the health or safety of any person
- arrangements of first aid facility should be made accessible when construction work is being undertaken.

### **12.1.3 Hazardous Material Handling and Storage**

During construction of the project, commercially available chemicals (paints, thinners, etc.) will be used and stored in the construction area. Hence small amount of unused or spent chemicals (used paints, motor oils) will be generated. Operation and maintenance of the project also may generate some hazardous wastes. However this is not often the case and the following set of storage guidelines should be adopted:

- the storage place must be sheltered from rain and other water sources and if possible , away from heat sources;
- the storage place must have a ground cover;
- the storage place must have an exhaust ventilation system in order to avoid gas accumulation;
- the storage place must have a restricted access and be identified as a hazardous material storing place;
- any other lead materials which may eventually arise, such as plumbing, should be conveniently packaged and stored in accordance with its characteristics.

### **12.1.4 Training**

Training is an integral part of a preventive strategy. The target groups requiring training should be managers, supervisors, and technicians and related staff who may be exposed to risk at work. The following issues should be addressed in training of the managers, staff and workers:

- Workers should be trained to use the engineering controls where installed
- Arrange workplace consultation on noise control
- Workers should participate in training and contribute to the noise management strategy
- Employee representatives should represent the views of workers to management about occupational health and safety and report to workers about management policy
- Persons likely to be exposed to risks should be provided with information and instruction in safety procedures associated with the factory at the work place.
- Relevant health and safety information should be provided to persons involved in construction and operation of the factory.
- Information on emergency procedures relating to the factory should be displayed in a manner that can be readily observed by persons who may be affected.
- Training should be provided to use firefighting equipment when necessary.
- Facility staff needs to be trained in the safety procedures that are to be implemented during unloading, transfer and storage of hazardous materials.

### **12.1.5 Record Keeping and Reporting**

Record keeping and reporting is one of the requirements of any QA/QC system and essentially of a good management tool. Properly maintained records of construction, installation, training, equipment maintenance, operation, fault detection and remedy can help in reducing risks of accidents, legal costs and thereby overall cost of operation of the project. Records also help in identifying causes of any accident and elimination of the same accident in future. Records may be maintained for the proposed port connecting road project as follows.

#### **Port connecting road Construction**

A person with control of a construction project or control of construction work should retain records for a reasonable period after the completion of the construction project of the occupational health and safety induction training and any other training given to persons directly engaged or trained by them to undertake construction work on the project.

### **Port connecting road Operation**

During operation of the port connecting road, arrangements should be made to keep records on any relevant tests, maintenance, inspection and alteration of the factory, and make those records available to any employee or relevant health and safety representative.

### **Noise**

Audiometric test records of employees should be kept during the employee's period of employment and longer as necessary, as they may provide a useful reference for workers' compensation. The records should be kept in a safe, secure place and held as confidential documents.

### **Hazardous Substances**

Assessment reports which indicate a need for monitoring and/or health surveillance together with the results of monitoring and/or health surveillance shall be kept as records in a suitable form for at least 30 years from the date of the last entry made. Retention for a period of at least 30 years is necessary because some health effects, such as cancers, may take a long time to become evident. The information kept will be valuable in epidemiological studies and for developing effective control strategies.

All other records, including assessment reports not indicating a need for monitoring and/or health surveillance and records of induction and training, shall be maintained for at least five years in a suitable form.

## **12.2 CONTRACTOR REQUIREMENT**

Apart from the provisions under “General Specification” and “Particular Specification” for different sub-project components, the following special environmental clauses (SECs) shall be included in the Tender Document under General/Particular Specification. These clauses are aimed at ensuring that the Contractor carries out his responsibility of implementing the EMP and other environmental and safety measures.

**Environmental Management Plan (EMP):** The Contractor shall carry out all mitigation and enhancement measures (including those related to mitigation of air/noise/water pollution; drainage/traffic congestion) as specified in the Environmental Management Plan (EMP), annexed to his Contract.

**Temporary Works:** The Contractor shall make sure that all equipment and safeguards required for the construction work such as temporary stair, ladder, ramp, scaffold, hoist, run away, barricade, chute, lift, etc. are substantially constructed and erected, so as not to create any unsafe situation for the workmen using them or the workmen and general public passing under, on or near them.

### **Occupational Health and Safety:**

The Contractor shall-

- observe and maintain standards of Health and Safety towards all of his employees not less than those laid down by the national standards or statutory regulations.
- provide all appropriate protective clothing and equipment for the work to be done and ensure its proper use. Where required, safety nets, the contractor shall provide belts, harnesses and lines. The “safety directives for work equipment” and “safety directives for protective gears”, as specified in the Occupational Health and Safety Guidelines shall be followed.
- provide and maintain in prominent and well-marked positions all necessary first-aid equipment, medical supplies and other related facilities. A sufficient number of trained personnel will be required to be available at all times to render first aid.
- provide or ensure that appropriate safety and/or health signs are in place at their work sites where hazards cannot be avoided or reduced.



- report to the Engineer promptly and in writing particulars of any accident or unusual or unforeseen occurrences on the site, whether these are likely to affect progress of the work or not.

**Disposal and Pollution:**

The Contractor shall-

- not dispose any waste, rubbish or offensive matter in any place not approved by the Engineer or Statutory Authority having jurisdiction. The Contractor shall not discharge into any watercourse oil, solids, noxious or floating materials.
- take all reasonable precautions to keep public or private roads clean of any spillage or droppings from his vehicles or equipment. Any spillage or droppings, which accrue, shall be cleaned without delay to the satisfaction of the Engineer.
- provide waste bins/ cans for collection of solid waste at appropriate locations (as directed by the Engineer), and ensure proper transfer/disposal of solid waste.

**12.3 CONCLUDING REMARKS**

Apart from the services mentioned above, the Environmental Management Unit (EMU) must ensure that all staffs working within the port connecting road are care oriented, through orientation programs, about the do's and don'ts during emergencies as well as overall environmental aspects and issues related to port connecting road operations. It is however, to be emphasized that the emergency response plan (ERP) outlined in the Chapter-13 is to be used as guide only and that the Environmental Management Unit and the Emergency Response Cell shall develop their own environmental management system (EMS) following other international guidelines and standards.

## **CHAPTER-13 DISASTER MANAGEMENT PLAN & EMERGENCY RESPONSE/MANAGEMENT PLAN**

### **13.1 INTRODUCTION**

A disaster, and therefore an emergency, occurring as a result of a malfunction of the normal operating procedures or an intervention of an outside force such as a cyclone, flood or sabotage, that may affect several sections within it and/or may cause serious injuries, loss of lives, extensive damage to property or serious disruption outside the works. Apart from earthquakes, cyclones, flood, arson and sabotage, serious accidents may take place through explosion in Gas/Fuel Tankers, heavy leakage and subsequent fire in the oil storage tanks etc.

In order to be in a state of readiness to face any accident or disaster caused by the project operation, a Disaster Management Plan (DMP) shall be prepared. Such a plan ought to cover possible disaster, on and off-site emergency preparedness plan, establishment of Emergency Control Centres (ECC), location of emergency services, and duties of the officers/staff during emergency.

Emergency response plans are developed to address a range of plausible risk scenarios and emphasize the tasks required to respond to a physical event. The emergency response plan (ERP) for the proposed Port connecting access road has been developed listing various actions to be performed in a very short period of time in a predetermined sequence if it is to deal effectively and efficiently with any emergency, major accident or natural disaster. The primary objective of the plan is to keep the loss of life, material, machinery/equipment damage, and impacts on the environment to minimum.

### **13.2 BASIC CONTENTS OF DISASTER MANAGEMENT PLAN**

Basically, the DMP will contain the following aspects:

- iv) Description of the Site
- v) On-site Emergency Plan
- vi) Off-site Emergency Plan

Types, causes, phases and categories of disasters are figured out in Figure-13.2-1.

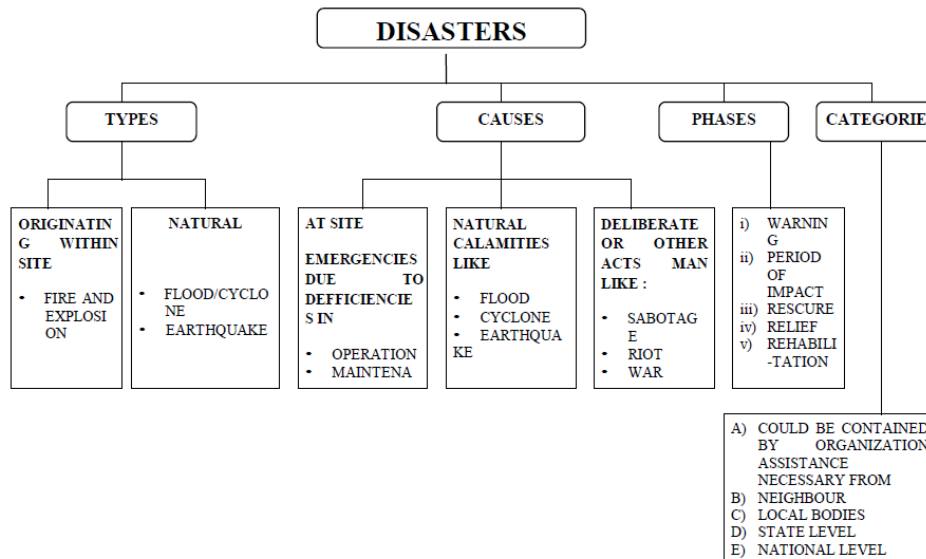


Figure: 13.2-1 Disaster Types, Causes, Phases, And Categories

### 13.3 OPERATING PROCEDURE IN PROJECT WORKS

During Construction Phases the following project works may be involved:

- Borrow Pits for Embankment Construction
- Quarry Operations
- Control of Soil Erosion, Sedimentation & Water Pollution
- Pollution from Plants and Batching Plants
- Substances hazardous to health
- Use of Nuclear Gauges
- Environment Protection
- Occupational Health and Safety of the Workforce
- Control & Disposal of Waste
- Transport of hazardous materials
- Emergency Response

Highway Traffic Management System (HTMS) will control the traffic monitoring and movements on the port connecting access Road. The following outdoor units will be installed as a part of HTMS:

- Emergency Call Boxes
- Variable Message Signs
- Meteorological Data Systems
- Close Circuit TV Camera System
- Traffic Counting & classification and transmission system

Indoor units will comprise of the following:

- Large Display board with Central Computer and Network monitoring system
- CCTV System
- Uninterrupted Power Supply

The system shall meet the following objectives:

- Smooth and uninterrupted Traffic flow
- Enhanced Road Safety
- Real-time information and guidance to road users
- Round the clock emergency assistance
- Alerts for abnormal road and weather conditions
- Reduced journey time and reduced driving fatigue

#### **13.4 EMERGENCY RESPONSE CELL**

It is highly recommended that an Emergency Response Cell (ERC) adequately equipped with highly trained manpower and appropriate gears is to be established in order to effectively implement the emergency response plan.

The main functions of the emergency response cell should include the following:

- Identification of various types of emergencies;
- Identification of groups, communities, and areas those are vulnerable to different kinds of emergencies;
- Preparing service teams for various operations within the organization through extensive training;
- Establishment of early detection system for emergencies;
- Developing reliable, instant information communication system;
- Mobilizing all units in the complex within a very short time to address any emergency.

#### **13.5 EMERGENCY PREPAREDNESS**

The ERC headed by a trained Manager should establish an Emergency Control Room with links to all building control rooms and all other services. The ERC shall work as a team of the following officials:

- Emergency Manager (Team Leader),
- Security and Safety Officer,
- Chief Medical Officer, and
- Public Relations Officer

The AGM, Planning and Implementation of the proposed Environmental Management Unit for the port with adequate skills of facing emergency situation can act as the Emergency Manager of ERC. The Emergency Manager (EM) shall have the privilege of shutting down of building or any other unit, which are affected or may further deteriorate damages, in case of an emergency.

The EM however, shall have to report to the GM (HSE) of such an event without any delay.

The team will be responsible for preparing and executing a specific emergency response plan for the port connecting access road area. The team should meet at regular intervals to update the plan, based on port connecting access road emergency data and changes in support agencies.

The team should undertake some trial runs, e.g. fire drill, in order to be fully prepared and to improve upon the communication links, response time, availability and workability of emergency gears and other critical factors.

Upon receiving information about an accident, the ERC team will assemble in the Emergency Control Room within the shortest possible time and formulate emergency control procedure.

### **13.6 FIRE FIGHTING SERVICES**

- The Security and Safety officer will be the commanding officer of the firefighting services. The Security and Safety officer will head a fire fighting team of trained officers and workers. The size of the team should be determined by the port considering requirement of all Cargo Operations and Waterfront Industry within the port connecting access road.
- Adequate firefighting equipment e.g. fire extinguishers of different types appropriate for different strategic locations must be planned according to requirements of Cargo Operations and Waterfront Industry.
- Depending on the scale of emergency, the firefighting team will work in close association with security and maintenance personnel of the port connecting access road. Additional assistance may also be sought from outside fire stations when required.
- Preparedness is extremely important for efficient and effective firefighting services at the time of emergency. This can be better achieved by organizing fire drills at regular intervals, e.g. once every two weeks during dry summer months and once every two months during wet months involving all team members, all other service groups, all staff of the port connecting access road, and utilizing all firefighting gears.

### **13.7 EMERGENCY MEDICAL SERVICES**

- Nearby Medical Center of the Port connecting access road need to be ensured that they are well equipped with adequate medical personnel and equipment for providing emergency services in addition to normal Medicare services to provide the emergency services.
- A team of well-trained Medical Officers specializing in burn injury, orthopedics, electrocution, chemical toxicity or poisoning, and shock treatment must be available at the port Medical Center. And this team shall be helpful to provide the emergency medical services to the access road project personnel if needed.

### **13.8 RESCUE SERVICES**

Without going for additional manpower, the rescue team can be formed with potential staffs of the port, e.g. from medical services, security services and fire fighting services, for conducting rescue operations following an emergency. The Security and Safety Officer will be responsible for formulating rescue plan and guiding the team as well. Important functions include:

- Cut-off electricity, fuel or water supply to accident spots;
- Rescue people from debris of collapsed structures;
- Demolish damaged structures that may endanger human lives;
- Rescue people from fire areas with adequate protection;
- Assist other services promptly to save human lives;
- Salvage equipment from debris;
- Isolate damaged equipment or machineries that may endanger human lives; and
- Provide repair services as appropriate to restore operations.

### **13.9 SECURITY SERVICES**

The RHD will have a strong independent security team headed by the Security and Safety Officer and will be responsible for the overall security of the project activities, its equipment, machineries, buildings,

utilities. The security office shall maintain liaison with other emergency services at the time of emergency and during normal hours.

The Security and Safety Officer shall communicate with local police and other law enforcing agencies and seek assistance as may be needed during an emergency. In particular they will ensure that all roads are unobstructed during emergencies.

### **13.10 PUBLIC RELATIONS SERVICES**

The Public Relations Officer (PRO) of the port authority will be responsible for communicating emergency related information to concerned officials within the factory complex. The PRO however, will consult the Emergency Manager before communication with outside agencies. The PRO will be responsible for warning people in and around the factory complex against potential fire hazards, or possible chemical contamination of water. The PRO will keep close contact with outside local community and provide direction, and participate along with management team in the welfare services for the affected communities.

## **CHAPTER 14 GRIEVANCE REDRESS MECHANISM**

### **14.1 INTRODUCTION**

Experience from past projects shows that project implementation is a complex process involving numerous interested and aggrieved parties giving rise to likely instances of conflict, allegations, etc. Most of the conflicts and allegations appear not to be of a serious nature but may snowball into a bigger issue if not given adequate attention from the beginning itself.

Some of the potential points that could give rise to grievances could be related to compensation payment, improper estimation of affected assets, failure to fulfil commitments, poor management of construction activities, inappropriate planning of vehicle movement, and cultural conflicts between migrant workers and local communities etc.

Therefore, it is imperative to have an internal mechanism in place where the aggrieved party/s can lodge their complaints and get it amicably settled prior to approaching the formal mode of solution available to them i.e. access to legal system through courts. In order to provide a formal forum to the aggrieved parties to deal with issues arising out of project, it is proposed that a joint grievance redress mechanism be instituted for both environmental and social related issues.

The proposed Grievance Redress mechanism (GRM) will be developed for the Project in order to settle as many disputes as possible through consultations. Such a mechanism is important as it is expected that most cases, if not all, would be resolved amicably; and the process, as a whole, will promote dispute settlement through mediation to reduce litigation. However, the options of legal recourse will not be restricted in any way by the project proponent.

### **14.2 OBJECTIVES OF GRIEVANCE REDRESS MECHANISM**

The basic objective of the GRM shall be to provide an accessible mechanism to the affected people, community and any stakeholder(s) having stake in the project to raise their issues and grievances as well as concerns. The Grievance Redress Cell (GRC) shall be officially recognized “non-judicial” body that will seek to resolve non-judicial disputes arising out of various matters related to the implementation of the EMP, as well as other aspects of the project, as may deemed fit to be raised before the GRC.

The fundamental objective of GRM is to resolve any resettlement and environmental related grievances locally in consultation with the aggrieved party to facilitate smooth implementation of the EMP. Another important objective is to democratize the development process at the local level and to establish accountability towards the stakeholders.

### **14.3 COMPOSITION OF GRC AND ULC**

It is suggested to have two levels of grievance redress mechanism for the project, viz. Grievance redress Cell (GRC) at the project level and another at Union level committee (ULC). The aim of having two levels of grievance redress mechanism is to provide a higher forum to the aggrieved party, if the same is not satisfied with the decision of GRC.

GRC will be driven internally by Matarbari Access Road Authority and shall have the following representation to ensure fair and timely solution to the grievances:

- Community officer serving as grievance officer;
- RHD Environment and social officer
- Project management representative;
- RHD-EHS representative;

The composition of ULC will have the following members:



- All Union Parishad Chairmen or their representative
- Project Manager of the Matarbari Port Access road project
- Environment and social officer of Matarbari Port access road project
- Local elected Ward Member (s)
- Representative of affected people and women

The normal route to be followed for any grievance shall be GRC, and in case not satisfied then to ULC; however, the grievances can be directly taken to ULC too. The ULC shall be empowered to take a decision which is binding on CPA and considered final. However, the decision of ULC is not binding on aggrieved person; he or she can take the legal course if not satisfied with the outcome of GRC decision.

The representation in the committee makes project affected persons to have trust and build confidence in the system. The grievance redress committee reports its plan and activities to the Implementation committee.

GRC will maintain a Complaints Database, which will contain all the information on complaints or grievances received from the communities or other stakeholders. This would include: the type of complaint, location, time, actions to address these complaints, and final outcome.

The procedures to be followed and adopted by the grievance redress should be transparent and simple to understand or uniform process for registering complaints provide project affected persons with free access to the procedures. The response time between activating the procedure and reaching a resolution should be as short as possible. An effective monitoring system will inform project management about the frequency and nature of grievances. GRC will arrange half yearly meetings where the activities and the outcomes/measures taken according to the Complaints Database are to be monitored and reviewed by third party consultant to ensure the required transparency. In addition to the above, if there are any grievances related to social or environmental management issues in the project area, the GRC will record these grievances and suggestions and pass it on to the relevant consultant for necessary action and follow up.

In case a dispute is not resolved by arbitrational tribunal, then if any of the Party disagrees, the aggrieved party has the right to appeal to the ordinary courts of law.

However, the preferred option of dispute settlement ought to be the option of settling the dispute amicably because recourse to courts may take a very long time even years before a final decision is made and therefore, should not be the preferred option for both parties concerned.

A grievance form is presented below and hard copies of both English and Bangla will be made available at the RHD project office.

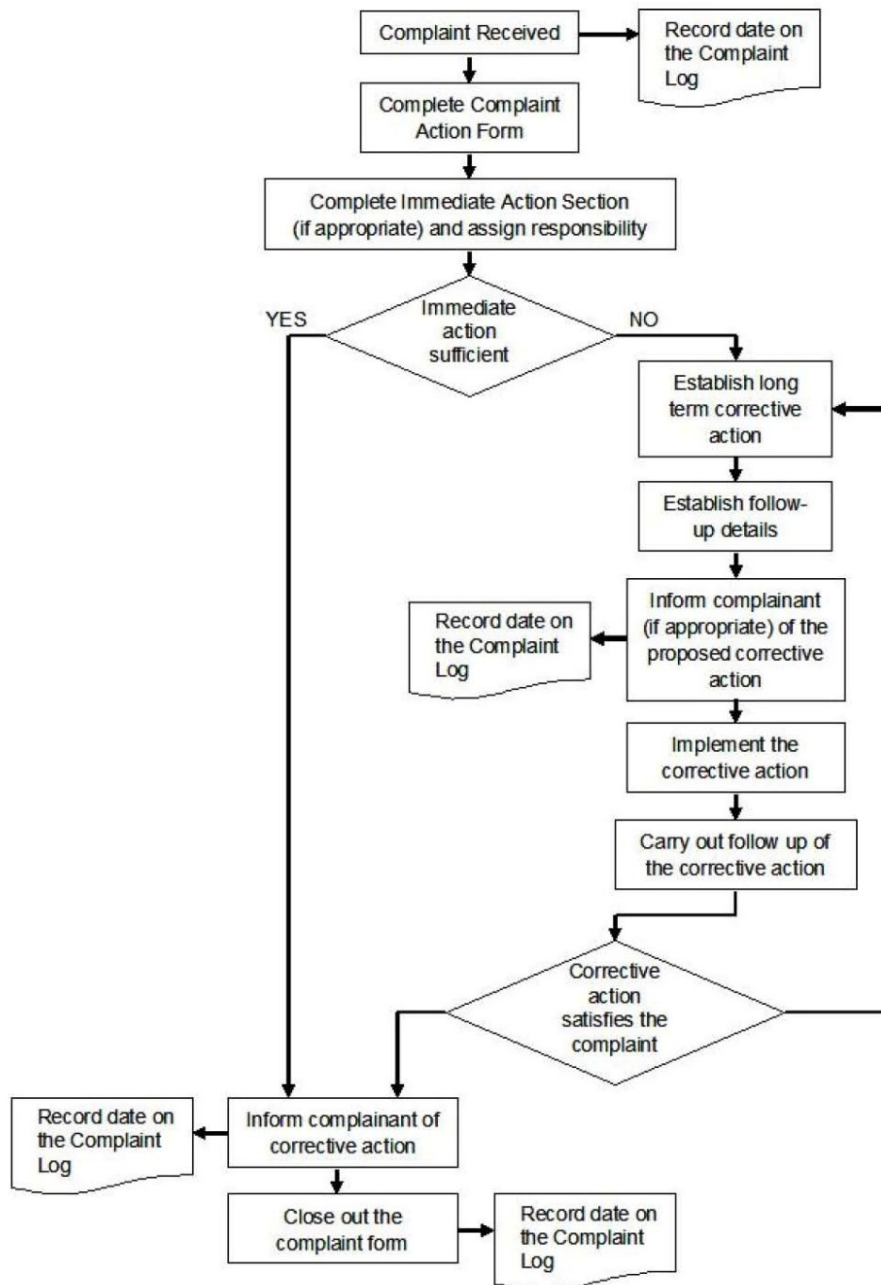


Figure 14.3-1 Flow Chart of Grievance Procedure

Table 14.3-1: Sample Grievance Reporting Form

Reference No.	Date:
Contact Details	Name
	Address
	Telephone Number/Cell Number:
	Email:
How would you prefer to be contacted? (please tick box)	<input type="checkbox"/> By Phone <input type="checkbox"/> By Email

Details of your Grievance: (Please describe the problems, how it happened, when , where, and how many times, as relevant)	
What is your suggested resolution for the grievance?	
Signature of complainant/ Thump impression of complainant	Signature of person filling the form (RHD Representative )

## **CHAPTER-15 CONCLUSION AND RECOMMENDATION**

### **15.1 CONCLUSION**

Matarbari area is expected to play the leading role in the realization of the BIG-B initiative. To be more precise, this development will lead to an increase in export industries and hence reduce the trade deficit due to the importation of coal and oil as a source of energy. Furthermore these developments will also lead to short and long term regional economic stability. To maximize the performance of the freight transport route from the Port to inland area, accessibility from the port to N1, the arterial road to Chittagong, will need to be also secured. This EIA study for this port connecting road project is to understand the environmental aspects due to the project activities as well as to prescribe suitable EMP for its sustainability.

The EIA study has covered the construction and operational phases of the project. The detailed EIA of the proposed port access road project was conducted following the guideline (GoB, 1997) of the Department of Environment (DoE) of GoB and the JICA guidelines.

In this study, the effects of the project activities on physico-chemical, ecological and socio-economic (i.e., human interest related) parameters during preconstruction, construction and operation phases have been assessed. The impacts have been identified, predicted and evaluated, and mitigation measures suggested for preconstruction, construction and operation phases of the proposed project. The important physico-chemical environmental parameters that are likely to be affected by the project activities include air quality and noise level.

The study suggests that most of the adverse impacts on the physico-chemical environment could be offset or minimized if the mitigation measures are adequately implemented. Noise level has been identified as a significant potential impact of the proposed port connecting access road project during both the construction and operation phases. The project workers should not be exposed to the noise produced by the construction equipment for a prolonged period to prevent permanent hearing loss. A rotational work plan is advised for the workers and operators of this equipment.

The proposed project will be constructed within the acquired land. So a comprehensive land acquisition and resettlement action plan (LARAP) shall be prepared. Additionally, this area is an income generating area considering Salt/Shrimp cultivation. Therefore, people will be displaced and for them resettlement will be required for the construction of the access road, and loss of income is associated with the proposed project.

During operation phase, no significant negative impact is anticipated on socioeconomic environmental parameters. Significant positive impacts are expected due to huge no of employment generation associated with the port connecting road activities. During public consultations carried out as a part of the EIA study, people welcomed the proposed project at their locality.

### **15.2 RECOMMENDATION**

The environmental assessment carried out for the proposed port connecting access road project suggests medium to minor scale of adverse impacts, which can be reduced to acceptable level through recommended mitigation measures as mentioned in the EMP. It is therefore recommended that the proposed port connecting road provided the suggested mitigation measures are adequately implemented. It is also recommended that the environmental monitoring plan be effectively implemented in order to identify any changes in the predicted impacts and take appropriate measures to offset any unexpected adverse effects.

Apart from risks associated with noise generation, solid waste, hazardous waste and wastewater disposal as a result of construction activities, the RHD may have certain degree of risk of accident and sometime

loss of life. An emergency response plan (ERP) for the proposed project has been developed listing various actions to be performed in a very short period of time in a predetermined sequence if it is to deal effectively and efficiently with any emergency, major accident or natural disaster.

It will be the obligation of the contractor to submit their Environmental Management Action Plan (EMAP) before commencement of work. The EMAP should specify all affected environmental values, all potential impacts on environmental values, mitigation strategies, relevant monitoring together with appropriate indicators and performance criteria, reporting requirements and, if an undesirable impact or unforeseen level of impact occurs, the appropriate corrective actions available.

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**APPENDIX-A: APPROVED TOR OF THE DOE**



## **APPENDIX-B: WATER QUALITY TEST RESULTS**

## **APPENDIX-C: AIR QUALITY TEST DATA**

**APPENDIX-D: NOISE LEVEL DATA**