Addendum to Initial Environmental Examination

Bangladesh: Dhaka and Western Zone Transmission Grid Expansion Project

DRAFT REPORT

ADDENDUM -2

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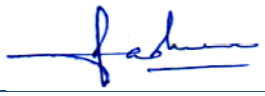
Reviewed by: 	
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ACRONYMS AND ABBREVIATIONS

ADB	Asian Development Bank
AIS	Air-Insulated Switchgear
AP	Affected Persons
ASL	Above Sea Level
BMD	Bangladesh Meteorological Department
CAP	Corrective Action Plan
CHT	Chattogram Hill Tracts
DoE	Department of Environment
DPP	Development Project Proposal
DPs	Displaced Persons
DSC	Design and Supervision Consultants
DWZTGEP	Dhaka and Western Zone Transmission Grid Expansion Project
EIA	Environmental Impact Assessment
EMF	Electromagnetic Field
EMoP	Environmental Monitoring Plan
EMP	Environmental Management Plan
EQS	Environment Quality Standards
ESMS	Environmental and Social Management System
FGD	Focus Group Discussion
GIS	Gas Insulated Switchgear
GoB	Government Of Bangladesh
GRC	Grievance Redress Committee
GRM	Grievance Redress Mechanism
GSS	Grid Substation
HES	Health Environment and Safety

IEC	Important Environmental Component
IEE	Initial Environmental Examination
ISC	Important Social Component
IUCN	International Union for Conservation for Nature
LGI	Local Government Institutions
LGRC	Local Grievance Redress Committee
LILO	Line-In Line-Out
MoEFCC	Ministry of Environment, Forest and Climate Change
NGO	Non-Governmental Organization
PAI	Project's Area of Influence
PAP	Project Affected Persons
PCB	Polychlorinated Biphenyl
PCRs	Physical Cultural Resources
PDB	Power Development Board
PGCB	Power Grid Company of Bangladesh
PMU	Project Management Unit
PPE	Personal Protective Equipment
PSMP	Power System Master Plan
RCC	Reinforced Cement Concrete
RMA	Resource Management Associates (Pvt) Ltd.
RoW	Right of Way
RP	Resettlement Plan
SF6	Sulfur Hexafluoride
SPS	Safeguard Policy Statement
SWTGEP	Southwest Transmission Grid Expansion Project
UPI	Union Parishad Institutions

WEIGHTS AND MEASURES		
cm	-	centimeter
ha	-	hectare
km	-	kilometer (1,000 meters)
kV	-	kilovolt (1,000 volts)
kW	-	kilowatt (1,000 watts)
m	-	meter
mm	-	millimeter
MVA	-	mega-volt ampere
MW	-	megawatt

1 INTRODUCTION

This report is addendum to the original IEE report[1] that was approved by ADB in July, 2019. The addendum is only in respect of three lines; Rupsha-Satkhira 230 kV double circuit transmission line (initially charged at 132 kV), Domar-Purba Sadipur 230 kV double circuit transmission line (initially charged at 132 kV) and Niamatpur-Patnitola 132 kV double circuit transmission line. The report is based on the final alignment of the EPC Contractor and considers the risks and impacts in order to formalize the management plan. The original IEE depicted a detailed project description, baseline data, impact assessment and management plans and remains as applicable for the project. As per PGCB, the construction activities (pilling and soil tests) of one point in the Niamatpur-Patnitola 132 kV double circuit transmission line started in January 2020 and ended in March 2022. Currently, the construction work in this alignment is halted.

The additional risks and mitigation measures under this addendum for Rupsha-Satkhira 230 kV double circuit transmission line, Domar-Purba Sadipur 230 kV double circuit transmission line and Niamatpur-Patnitola 132 kV double circuit transmission line are described in this report.

1.1 Background

The Power Division, under the Ministry of Power, Energy and Mineral Resources (MPEMR) leads the power sector while the Bangladesh Energy Regulatory Commission (BERC) is the regulatory agency which regulates electricity, gas, and petroleum sectors. The electricity sector is unbundled into generation, transmission, and distribution segments. Backbone transmission lines and substation network in the country are operated by the Power Grid Company of Bangladesh Limited (PGCB). As of December 2018[2], PGCB network comprised, transmission lines operated at 400 kV, 230 kV and 132 kV voltage levels with a total length of 11,396 circuit km and 125 132/33 kV substations with a cumulative capacity of 20,211 MVA. Development of transmission and distribution network in line with generation has been identified as a key element of the power sector strategy in the 'Bangladesh Seventh Five Year Plan FY2016 - FY2020'. Development of an inter-region transmission network is required due to the unbalance in concertation of generation and demand, while local network expansions are required to cater the increasing demand at new load centers. Due to the growing electricity demand, a considerable number of grid substations and transmission lines have already been overloaded. Therefore, urgent upgrades and expansions are required by PGCB to supply power to the key economic corridors in the southern and western regions including greater Dhaka area.

The Dhaka and Western Zone Transmission Grid Expansion Project (DWZTGEP) focuses on expanding the local transmission network to deliver electricity to new and expanding load centers while meeting the network operating criteria. PGCB has appointed EQMS Consulting Limited for Conducting Social Value Assessment Surveys, Preparation, Upgradation, and Implementation of Resettlement Action Plans and Environmental and Social Safeguard Supervision and Monitoring for the Proposed Grid Substations and Transmission Lines.

The concept paper for the project was approved by ADB on 6 March 2019, comprising three main investment components. The loan was made effective on 16 July 2020.

Component 1: Transmission system in Greater Dhaka expanded. The project will construct and commission substations with a total capacity of 4,450 MVA and 40 km of transmission lines in Greater Dhaka.

[1]https://www.adb.org/projects/documents/ban-51137-003-iee.

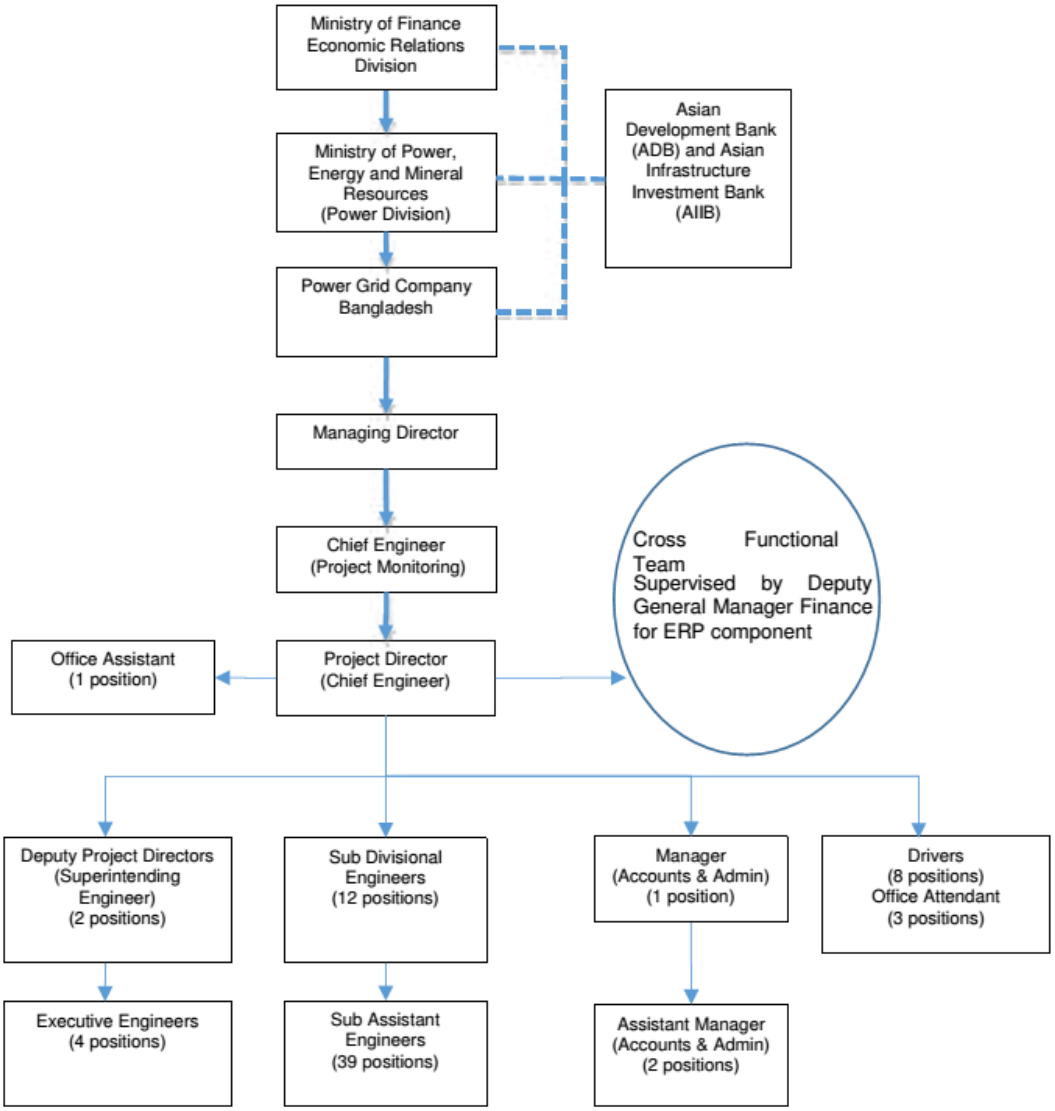
[2] Power Grid Company of Bangladesh Ltd. PGCB at a glance.

Component 2: Transmission system in Western Zone expanded. The project will construct and commission substations with a total capacity of 3,070 MVA and 368 km of transmission lines in western zone.

Component 3: Institutional Capacity of PGCB strengthened. The project will enhance capacity by (a) supporting installation and operation of an enterprise resource planning (ERP) system to assist PGCB in optimally managing its capital-intensive assets; (b) establishing a Drone Inspection Center within the operation and maintenance department of PGCB with some gender equality element.

On behalf of the government, overall coordination of the project will be managed by MPEMR. PGCB will be the Executing Agency (EA) for Component 1, 2 and 3. The project preparation, implementation, monitoring, and reporting to ADB and the government will be handled by the Project Management Unit (PMU) established by PGCB. EPC Contractors with separate environmental officer and Health & Safety Officer for each package will implement Environment Management Plan (EMP). Designated PMU engineers will be trained and supervised by the PGCB safeguards unit to work together with contractors for EMP implementation. Figure 1-1 shows the institutional framework for DWZTGEP.

Figure 1-1: Institutional Framework for Dhaka and Western Zone Transmission Grid Expansion Project



Source: PGCB.

Note: ERP component implementation will be supervised by a deputy general manager (project finance) with support from PGCB's Cross Functional Team which comprises 7 members.

ADB = Asian Development Bank, AIIB = Asian Infrastructure Investment Bank, ERP = Enterprise Resources Planning, PGCB = Power Grid Company of Bangladesh Limited., P&D = planning and design.

2 ADMINISTRATIVE AND LEGAL FRAMEWORK

This chapter provides legal and regulatory framework, covering national requirements as well as guidelines and standards to address environmental and social risks of any proposed project and its associated components and to protect and conserve the environment from any adverse impacts. The intent of this chapter is to discuss the regulatory context, which is directly related to environmental compliance, which must be adhered to by all parties involved in the project throughout the planning, construction, and operation.

Several new policies and guidelines have been introduced since the original IEE was produced and taken into account this addendum for assessment. The newly introduced policies/laws/guidelines are: National Environment Policy, 2018, EIA Guidelines for Industry, 2021, Hazardous Waste (e-waste) Management Rules, 2021, Solid Waste Management Regulations 2021 and Grid Code, 2019.

2.1 Environmental related policies in Bangladesh

Table 2-1: Related policies in Bangladesh

Policies	Description/ Applicability of Acts
National Environment Policy, 2018	• Ensuring sustainable development through reducing human pressure on nature and natural resources. • Considering environmental protection as an integral part of the development programs planned to meet the need of the present and future generations. • Making natural resources extraction, use, environmental conservation, etc. to be based on science. • Considering environmental impacts and risks in extracting and using natural resources. • Evaluating the economic contribution of ecosystem services simultaneously to that of natural resources. • Giving priority to poor and underprivileged groups of people to ensure their participation, equity, justice, accessibility to the use of natural resources, and getting ecosystem services on which, they are dependent. • Taking initiatives to prevent misuse and ensure optimum water, land, natural gas, and other natural resources in the production process as well as day-to-day purposes. • Encouraging sustainable use of new and renewable resources. • Enhancing long-term poverty alleviation and food security through conserving biological diversity. • Realizing compensation from persons and institutes those who are liable to environmental pollution through applying polluter pay principle. • Including environmental conservation and preservation in all national policies and ensuring implementation of the environment policy at both government and nongovernment levels. • Giving priority to preventive measures over curative measures in environmental conservation. • Including adaptation and mitigation programs in all development projects to address adverse impacts of climate change. • Ensure sustainable utilization of ecosystem goods and services. • Implementation of the 3R principle in the utilization of resources.

Policies	Description/ Applicability of Acts
	• Strengthening the institutional and legal capacity of the institution (Government, local, private, and technical) relevant to the enforcing and implementation of rules and regulations relating to environmental policy and environment conservation. • Ensuring considerations of climate change and challenges of calamities in all kinds of infrastructure projects. • Reducing all SLCP (Short-Lived climate pollutants) that are harmful to health and the environment. • Taking development programs considering sustainable production and consumption as an integral part of environmental conservation to meet the need of present and future generations. • Allocating necessary funds to all areas of environmental conservation, preservation, and control. • Taking up programs in favor of a flourishing environment-friendly economy
National Environment Management Action Plan, 1995	• Identification of key environmental issues affecting Bangladesh; • Identification of actions necessary to halt or reduce the rate of environmental degradation; • Improvement of the natural environment; • Conservation of habitats and biodiversity; • Promotion of sustainable development; and • Improvement of the quality of life of the people.
The National Biodiversity Strategy and Action Plan, 2004	• Conserve and restore the biodiversity of the country for the wellbeing of the present and future generations; • Ensure that long-term food, water, health, and nutritional securities of the people are met through conservation of biological diversity; • Maintain and improve environmental stability of ecosystems; • Ensure preservation of the unique biological heritage of the nation for the benefit of the present and future generations; • Guarantee the safe passage and conservation of globally endangered migratory species, especially birds and mammals in the country; and • Stop introduction of invasive alien species, genetically modified organisms, and living modified organisms.
Environment and Social Related Legislations in Bangladesh	
The Environment Conservation Act, 1995 and Subsequent Amendments	• Declaration of Ecologically Critical Areas (ECAs); • Obtaining an Environmental Clearance Certificate (ECC); • Regulation with respect to vehicles emitting smoke harmful to the environment; • Regulation of development activities from an environmental perspective; • Promulgation of standards for quality of air, water, noise, and soils in different areas and for different purposes; • Promulgation of acceptable limits for discharging and emitting waste; and • Formulation of environmental guidelines relating to control and mitigation of environmental pollution, conservation, and improvement of the environment.

Policies	Description/ Applicability of Acts
The Environment Conservation Rules, 1997 and Subsequent Amendments	• The NEQS for ambient air, surface water, groundwater, drinking water, industrial effluents, emissions, noise, and vehicular exhaust; • Categorization of industries, development projects, and other activities on the basis of actual (for existing industries/development projects/activities) and anticipated (for proposed industries/development projects/activities) pollution load; • Procedure for obtaining ECC; • Requirements for undertaking IEE and EIA's as well as formulating EMP according to categories of industries/development projects/activities; and • Procedure for damage-claim by persons affected or likely to be affected due to polluting activities or activities causing hindrance to normal civic life.
Noise Pollution (Control) Rules, 2006	• According to the Rules, motor honking within a 100-meter radius of a hospital, school, and office is prohibited. • The rules also do not allow the use of brick crushers and cement mixers within a 500-meter radius of a residential area. Besides, prior permission is mandatory for using loudspeakers or megaphones. • The rules stipulate safety and precautionary measures in workplaces, designated authorities for allowing noise-generating appliances.
EIA Guidelines for Industry, 2021	The EIA Guidelines for Industry, 2021, introduced by the Department of Environment, Bangladesh, is the only guideline for conducting an Environmental Impact Assessment in Bangladesh. It is not only for industries but also for all types of development works.

Table 2-2: Relevant National Environmental Regulations

Regulation	Brief Description	Remarks
Environment Court Act 2000 (amended in 2002 and 2010)	This Act is under the Judiciary and MoEFCC to ensure the resolution of disputes on environmental and social damages resulting from any development activities. This Act also allows for the completion of environment-related legal proceedings effectively	PGCB will ensure that all potential environmental complaints will be dealt with effectively at the project level through the PMU. SPS 2009 requires setting up of a grievance redress mechanism for projects known to cause potential environmental impacts
Bangladesh Water Act 2013	Makes provisions for integrated development, management, abstraction, distribution, use, protection, and conservation of water resources	Transmission line will cross rivers: Kapotaksha river, Betna river, Buri Bhadra River, Harihar river, Kumar River, Arialkha river and PGCB will ensure compliance with this Act.
Vehicle Act 1927, the Motor Vehicles Ordinance 1983	These are under the Bangladesh Road Transport Authority (BRTA) which regulates vehicular emissions and noise including road safety.	This regulation will be complied with by vehicles that may be used during the

Regulation	Brief Description	Remarks
		construction and operation of Transmission line.
Factories Act 1965 and Bangladesh Labour 2006, Bangladesh Labor Act 2013	Regulations that aim to protect the interests and rights of the workers and to ensure their safety.	Workers recruited under Transmission line will be provided with PPE (if needed) and will comply with these regulations. No worker under 18 years old will be recruited
The Forest Act 1927 (amended in 1982 and 1989)	This Act under the MoEFCC aims to protect forest resources.	Transmission line will not traverse protected forest areas or other forest types.
Telegraph Act 1885	Under the Ministry of Posts and Telecommunications, this provides power to the Telegraph Authority to alter the position of gas or water pipes or drain (Sect. 14; a and b).	The route for Transmission line was selected considering this Act.
Electricity Act 2018	Relates to the supply and use of electrical energy, allows any person to secure a license to supply energy and to put down or place electrical supply lines for the transmission of energy. The Act provides that the licensee, in the exercise of any of the powers conferred by or under this Act, will cause as little damage, detriment, and inconvenience as may be, and will make full compensation for any damage, detriment or inconvenience caused by the licensee or by anyone employed by the licensee.	Transmission line referred to the applicable provisions in this Act.
The Antiquities Act 1968 (amended 1976)	Regulation on the preservation and protection of antiquities.	
Natural Water Bodies Protection Act 2000	According to this Act, the character of water bodies i.e., rivers, canals, tanks, or floodplains identified as water bodies in the master plans or in the master plans formulated under the laws establishing the municipalities in division and district towns shall not be changed without approval of the concerned ministry. This Act is under the Rajdhani Unnayan Kartipakkha/Town Development Authority/Municipalities.	Any part of Transmission line that will cross rivers, ponds, canals, and drainage channels will refer to this Act and will secure the required approval and clearances.
Wildlife (Protection and Safety) Act 2012	Provides for the conservation and safety of biodiversity, forest, and wildlife of the country by repealing the existing law relating to the conservation and management of wildlife of Bangladesh. Under this Act, hunting, trapping, the killing of wildlife is strictly prohibited.	Transmission line will not affect areas of habitats known to host wildlife. The route is along with urban areas.

Regulation	Brief Description	Remarks
National River Protection Act 2013	Creation of National River Protection Commission to manage and control water and environmental pollution, etc., and ensure socio-economic development of a multi-use and rational use of natural resources	Transmission line will ensure compliance with relevant provisions of this Act
The Protection and Conservation of Fish Act 1950 (amended 1973, 1982, 1995, 2002)	Provides for the requirements for the protection and conservation of fish. This Act defines fish as "all cartilaginous, bony fishes, prawn, shrimp, amphibians, tortoise, turtles, crustacean animals, mollusks, echinoderms and frogs at all stages in their life history."	Transmission lines will cross Kapotaksha river, Betna river, Buri Bhadra River, Harihar river, Kumar River, Arialkha river and will ensure that no protected fish species under this Act will be destroyed or affected. Any potential impact will be mitigated.
Acquisition and Requisition of Immovable property Act, 2017	The 2017 Act requires that compensation be paid for (i) land and assets permanently acquired (including houses, trees, and standing crops,); and (ii) any other impacts caused by such acquisition.	-
Environment Conservation Rules 1997	has promulgated the Environment Conservation Rules 1997 under the ECA 1995 to evaluate, review the Environmental Impact Assessment (EIA) of various projects and activities, and procedures are established for approval.	Transmission line will comply with this rule.
Grid Code 2019	The Grid Code specifies criteria, guidelines, basic rules, procedures, responsibilities, standards, and obligations for the operation, maintenance, and development of the Electricity Transmission System of Bangladesh to ensure transparent, non-discriminatory, and economic access and use of the Grid, whilst maintaining a safe, reliable and efficient operation of the same to provide a quality and secure electricity supply as reasonably as practicable.	Transmission line will ensure the compliance of this grid code.
Hazardous Waste (e-waste) Management Rules, 2021	On June 10, 2021, Bangladesh's Department of Environment (DOE) published the Hazardous Waste (e-waste) Management Rules, 2021 under the Bangladesh Environmental Protection Act, 1995. The E-waste rule covers the products listed in the Schedule (home appliances, monitoring and control equipment, medical equipment, automatic machines, IT and communication equipment), and establishes obligations for manufacturers, assemblers, collectors, sellers, and consumers of the products. The rule also sets provisions to limit the use of the 10 substances covered by the EU	Transmission line will ensure compliance with relevant provisions of this rules.

Regulation	Brief Description	Remarks
	RoHS Directive. This regulation entered in force upon publication. The main provisions of this regulation are as follows. • Manufacturers, traders, sellers, transporters, repairers, collection centers, recyclers, dismantlers, etc. of the subject products are required to register with a prescribed form to the DOE. When applying for registration, they shall also submit the Waste Electrical and Electronic Equipment (WEEE) management plan. • Registered manufacturers, recyclers, etc. shall obtain environmental clearance in accordance with the Bangladesh Environmental Protection Rules, 1997. • Manufacturers have to establish individual or joint collection centers and set aside funds for the management of the Waste Electrical and Electronic Equipment (WEEE). • For fluorescent lamps and mercury incandescent lamps, if they cannot be recycled, they need to be handed over to collection centers for storage and disposal. • Manufacturers, importers, etc. shall meet the collection targets for the Waste Electrical and Electronic Equipment (WEEE) as specified in the Schedule (10% in the first year of the implementation, 20% in the second year, 30% in the third year, 40% in the 4th year, and 50% in the fifth year and thereafter). • In order to facilitate the proper management of the Waste Electrical and Electronic Equipment (WEEE), the name, address and contact information of the trader or seller as well as the information on the registered collection center shall be displayed on the product or on the product label, or this information shall be provided to consumers or large consumers. • Traders, sellers and collectors of the Waste Electrical and Electronic Equipment (WEEE) shall receive them from consumers at designated points and transport them to collection centers.	

Regulation	Brief Description	Remarks
Solid Waste Management Regulations 2021	The Solid Waste Management Regulations 2021 were published in Bangladesh on December 23, 2021, under the Bangladesh Environmental Protection Act, 1995. The Regulations define the responsibilities of businesses involved in solid waste management and impose collection, recycling, and disposal obligations according to Extended Producer Responsibility (EPR) on manufacturers of non-biodegradable products such as glass, plastic, and bottles. The Regulations also include provisions for the treatment of solid waste such as composting and energy recovery. The main provisions of the Regulations are as follows. • When recovering resources from waste, the principles of management that consider the waste hierarchy, such as the 3Rs, segregation, and reduction, must be followed at all stages from waste generation to final disposal. • Responsibilities of waste generators, consumers, and users: — Dispose of waste in accordance with the regulations of authorities including local government. — Dispose of waste separately. — Do not dump, store, or burn waste outdoors. • Responsibilities of manufacturers and importers of products — Collect non-biodegradable products such as glass, plastic, polyethylene, multi-layered packaging, bottles, and cans from consumers and recycle or dispose of them if appropriate. — Determine work plans and implementation procedures for recycling and disposal. — Ensure that EPR is properly implemented. — Submit an annual report to the Department of Environment (DOE) on the amount of plastic recycled. — Raise public awareness of proper waste management.	Transmission line will ensure compliance with relevant provisions of this regulations.

3 PROJECT DESCRIPTION

This addendum is only in respect of three lines; (i) Rupsha-Satkhira 230 kV double circuit transmission line (initially charged at 132 kV), (ii) Domar-Purba Sadipur 230 kV double circuit transmission line (initially charged at 132 kV) and (iii) Niamatpur-Patnitola 132 kV double circuit transmission line.

Rupsha-Satkhira route was finalized during original IEE (ref: Table 6.1 of the original IEE, https://www.adb.org/projects/documents/ban-51137-003-iee) after the detailed route survey and analysis. Domar-Purba Sadipur route and Niamatpur-Patnitola analysis was not completed during the during original IEE. However, after the detailed route survey and analysis, these routes were finalized with minimal deviation from the first, second and third stage surveys (ref: Table 6.1 of the original IEE). The final alignments were done considering less impacts e.g., damage to community structures, tree cutting etc. and avoided all types of settlements beneath the RoW from start to end. Lesser number of trees to be cut for final alignments than the original routes (see Table 5-2). The summary and comparisons of both the final routes and original routes are given in Table 3-1.

Table 3-1: The summary and comparisons of Final and Original Alignments

SN	Subproject	Final Alignment				Original Routes
		Size/Length	**Upazilla**	**District**	**Division**	**Size/Length**
1.	**Rupsha-Satkhira 230 kV double circuit transmission line (initially charged at 132 kV)**	62 km; 80 angle towers; 82 suspension towers.	Fakirhat, Batiaghata Dumuria, Satkhira Sadar, Tala	Bagerhat, Khulna, Satkhira	Khulna	62 km; 80 angle towers; 82 suspension towers.
2.	**Domar-Purba Sadipur 230 kV double circuit transmission line (initially charged at 132 kV)**	46.5 km; 46 angle towers; 75 suspension towers	Birganj, Kaharolee, Khansama, Domar, Nilphamari Sadar	Dinajpur, Nilphamari	Rangpur	46.5 km; 46 angle towers; 75 suspension towers
3.	**Niamatpur-Patnitola 132 kV double circuit transmission line**	33 km; 23 angle towers; 74 suspension towers	Mahadebpur, Niamatpur, Patnitala	Naogaon	Rajshahi	33.3 km; 23 angle towers; 74 suspension towers

3.1 Site Details

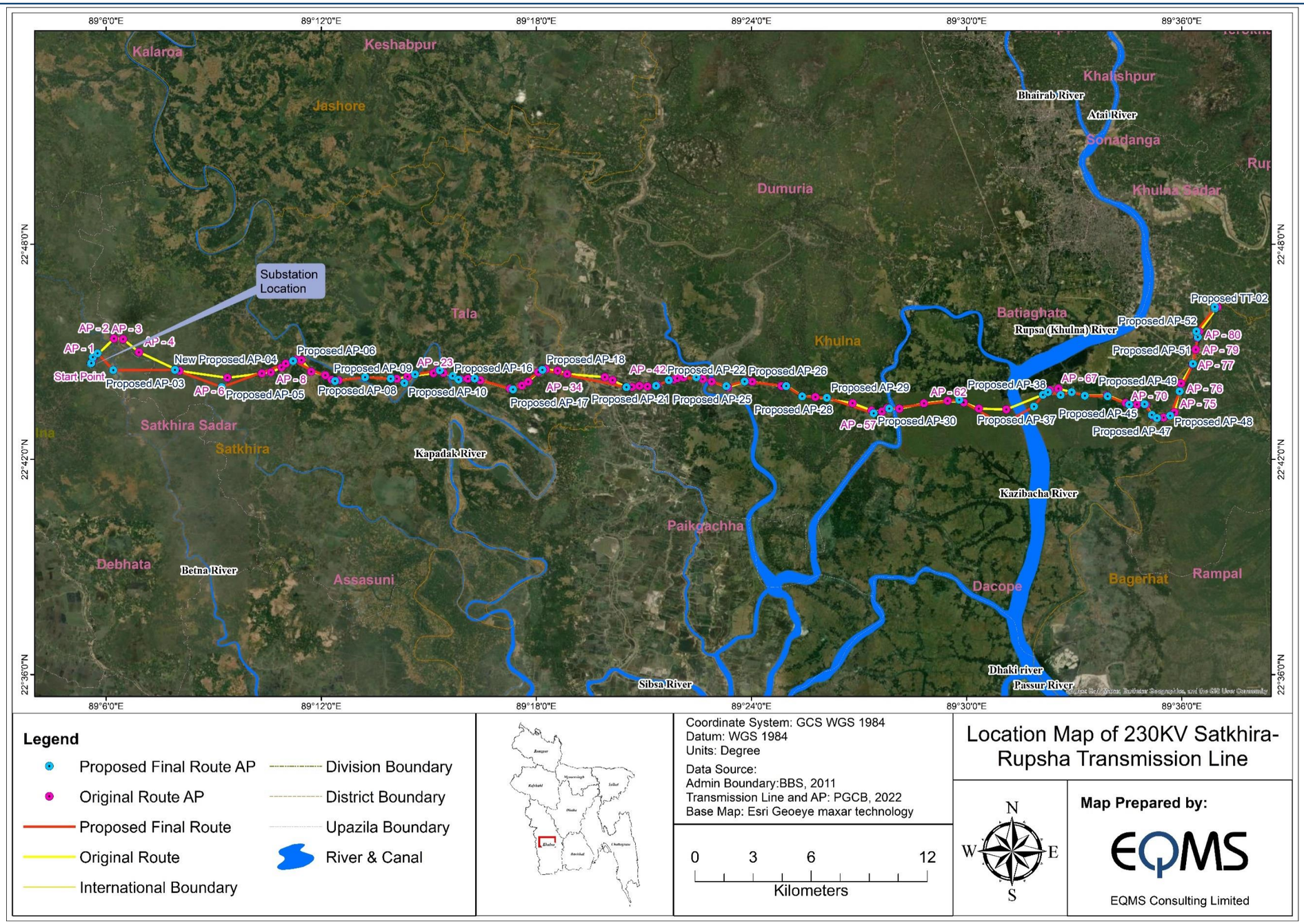
3.1.1 Location of the Project Site

This addendum is only in respect of three lines; (i) Rupsha-Satkhira 230 kV double circuit transmission line (initially charged at 132 kV), (ii) Domar-Purba Sadipur 230 kV double circuit transmission line (initially charged at 132 kV) and (iii) Niamatpur-Patnitola 132 kV double circuit transmission line. These alignments comprise three administrative divisions and six districts of Bangladesh: three in Khulna division (Bagerhat, Satkirha and Khulna), two in Rangpur division (Dinajpur and Nilphamari) and one in Rajshahi division (Naogaon). As per the Table 3.1 of the original IEE, https://www.adb.org/projects/documents/ban-51137-003-iee), and current site visits, the Rupsha-

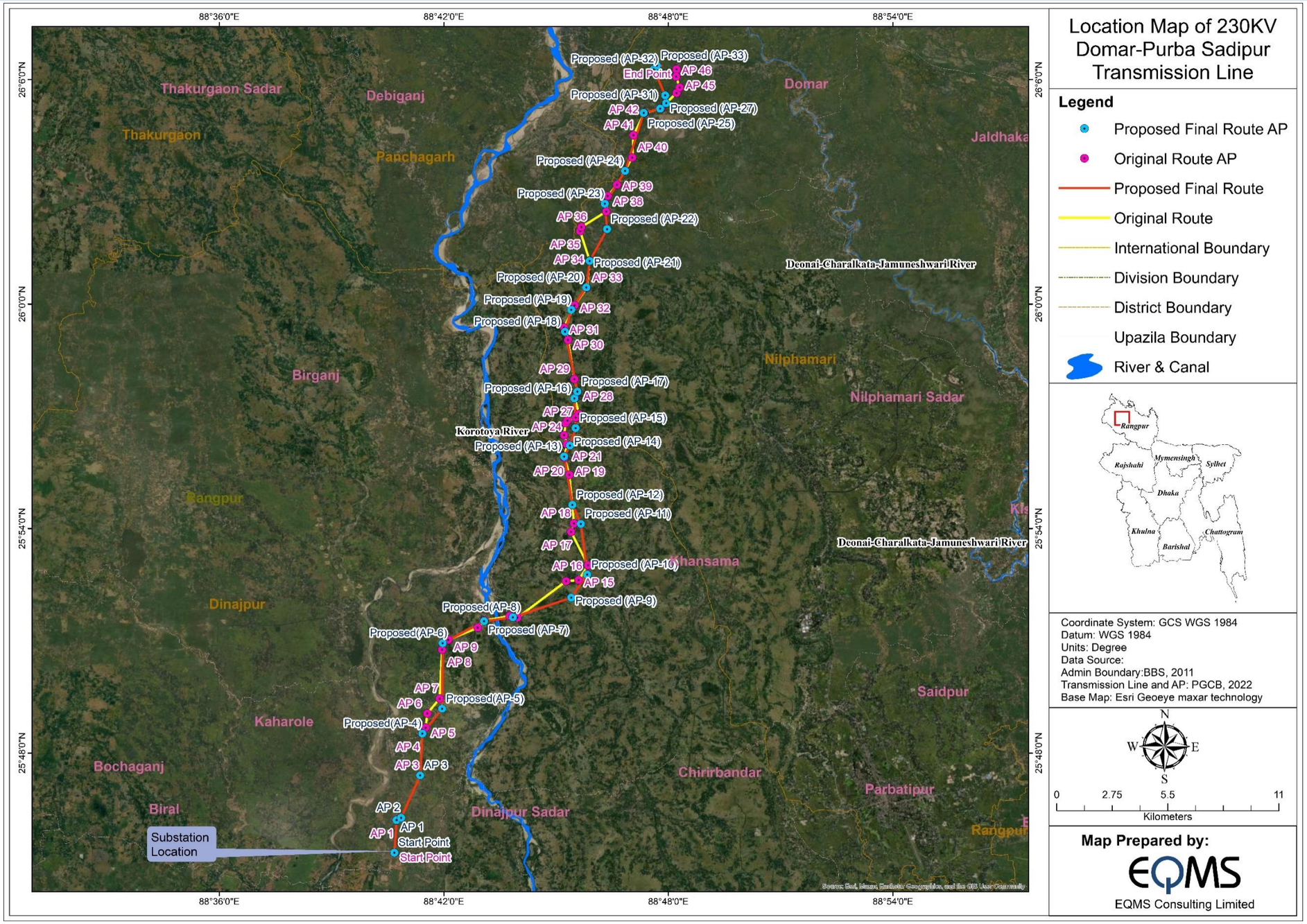
Satkhira 230 kV alignment covers Fakirhat, Batiaghata Dumuria, Satkhira Sadar, Tala Upazilla under Bagerhat, Khulna, Satkhira districts respectively. Domar-Purba Sadipur 230 kV double circuit transmission line covers Birganj, Kaharole, Khansama, Domar, Nilphamari Sadar Upazilla under Dinajpur and Nilphamari districts respectively. Niamatpur-Patnitola 132 kV double circuit transmission line covers Mahadebpur, Niamatpur, Patnitala Upazilla under Naogaon district. The final alignments have been deviated minimally from the original IEE. As per the EMP requirement, PGCB to avoid housing or school structures directly underneath the line. As per the confirmation from PGCB and on ground site visits, there are no housing or school structures directly lies underneath these final routes of the contractor. The major waterbodies covered in the final routes are rivers and gher, however, the transmission line will not pose any risk to these wetlands as well as seasonal habitats of wildlife and birds.

The coordinates of the final alignments and elevation details are given in **Annex A.**

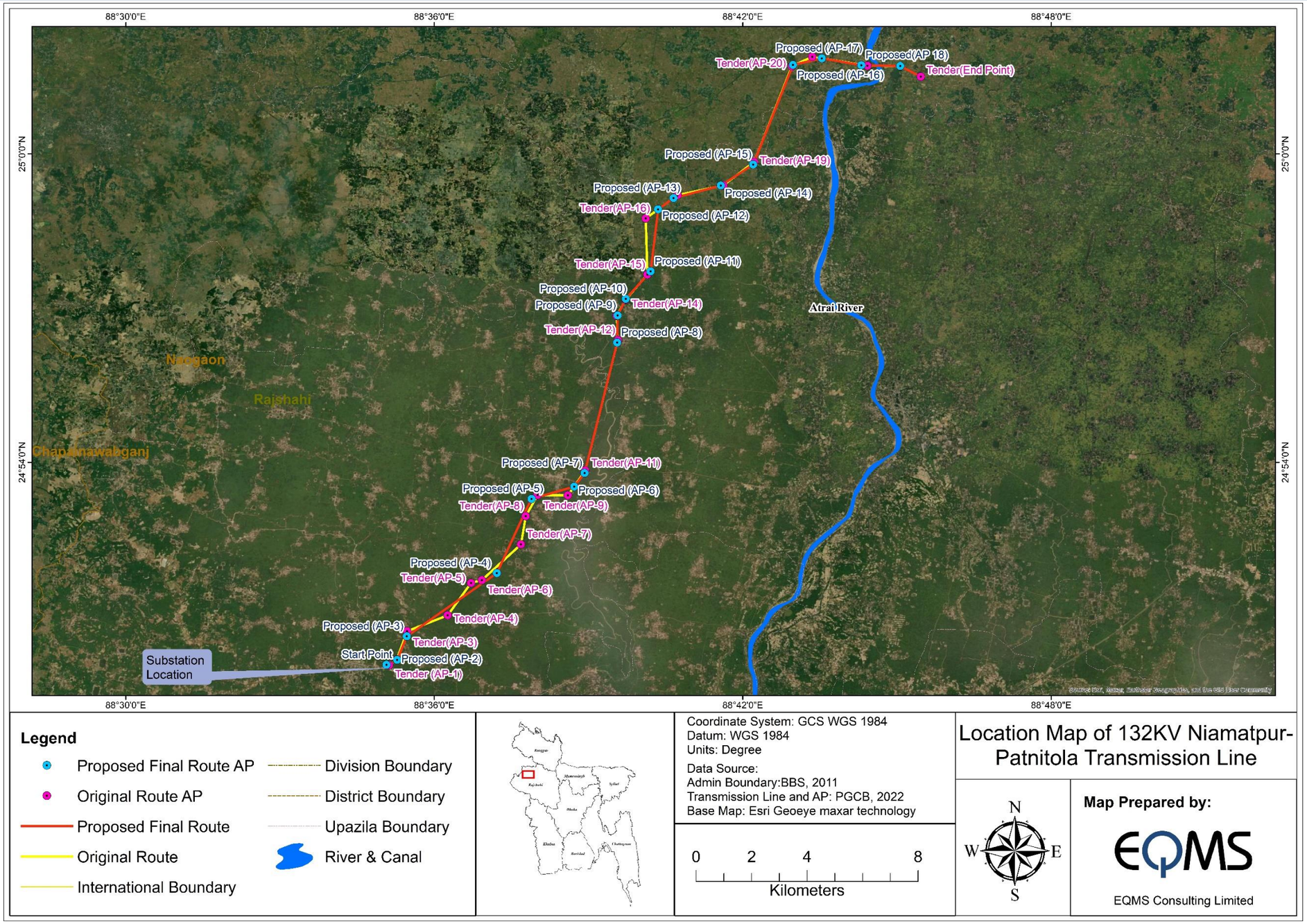
Figure 3-1: Proposed Route of the Transmission Lines



Rupsha-Satkhira



Domar-Purba Sadipur



Niamatpur-Patnitola

Source: Final routes provided by PGCB, 2022

4 ENVIRONMENTAL AND SOCIAL BASELINE

This section describes the existing environmental and social baseline status of proposed overhead transmission lines (Rupsha-Satkhira 230 kV double circuit transmission line, Domar-Purba Sadipur 230 kV double circuit transmission line and Niamatpur-Patnitola 132 kV double circuit transmission line). As per PGCB, the environmental baseline of Niamatpur-Patnitola route is in progress. Partial environmental baseline data (lab sheet) for Niamatpur-Patnitola route has been incorporated in Appendix D.

4.1 Methodology

The analysis was completed through on-ground reconnaissance and surveys to establish an understanding of the environmental and socio-economic baseline. Data for this chapter were collected from:

- Primary Sources: This included gathering information from field surveys, laboratory analysis and consultations/FGDs in the project area.
- Secondary Sources: This included data from literature reviews, maps and monitoring reports;

The baseline condition of environmental quality in the locality of project study area serves as the basis for identification, prediction, and evaluation of impacts. The baseline environmental quality is assessed through field studies within the impact zone for various components of the environment such as air, noise, water, land and socio-economic etc.

Data was collected from secondary sources for the macro-environmental setting like climate (temperature, rainfall, wind speed & direction and humidity), physiography, geology etc. Primary environmental baseline information was collected from the project site and surrounding area to know the current environmental and socio-economic condition of the project study area. Data on ambient air, noise quality, surface water and ground/drinking water quality were gathered from onsite environmental quality monitoring. FGDs were also carried out to investigate local environmental conditions, issues, and possible impacts.

The baseline environment is discussed in three broad categories: (i) Physical Environment which includes factors such as topography, geology, earthquake risk, climate, hydrology/drainage, and environmental pollution related elements; (ii) Biological Environment, which includes flora, fauna, Protected Areas, wildlife sanctuaries, forest reserves, and the general ecosystem; and; (iii) Socio-economic Environment, which includes anthropological factors like demography, income, land use, land requirements and infrastructure.

4.2 Physical Environment

4.2.1 Climate

Although less than half of Bangladesh lies within the tropics, the presence of the Himalaya Mountain range has created a tropical macro-climate across most of the east Bengal land mass. Bangladesh is divided into seven climatic zones and the sub projects are located in five climatic zones.

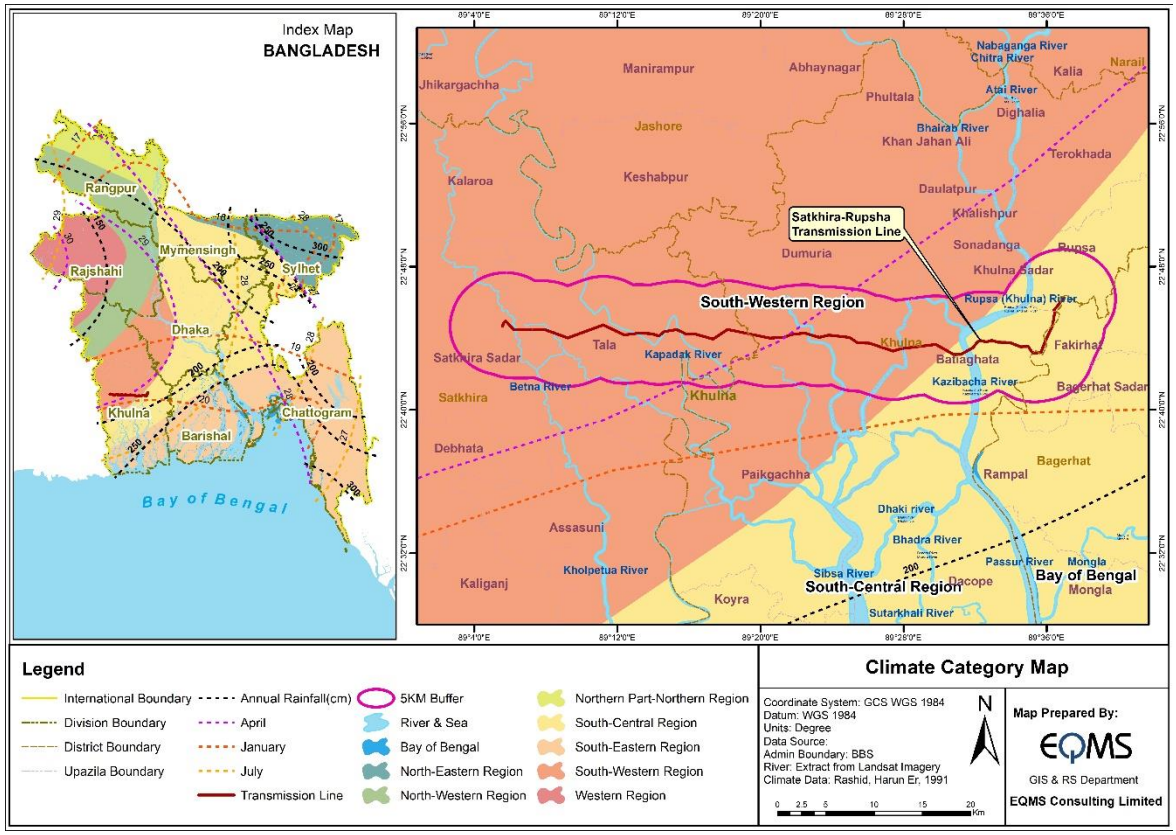
Three distinct seasons can be recognized in Bangladesh: the post-monsoon season from November to February; the pre-monsoon hot season from March to May, and the rainy monsoon season which lasts from June through to October. The month of March may also be considered as the spring season, and the period from mid-October to mid-November may be called the autumn season.

The post-monsoon season (November-February) begins first in the west-central part of the country, where its duration is about four months, and it advances toward the east and south, reaching the eastern and southern margins of the country by mid-March, where its duration is about one month.

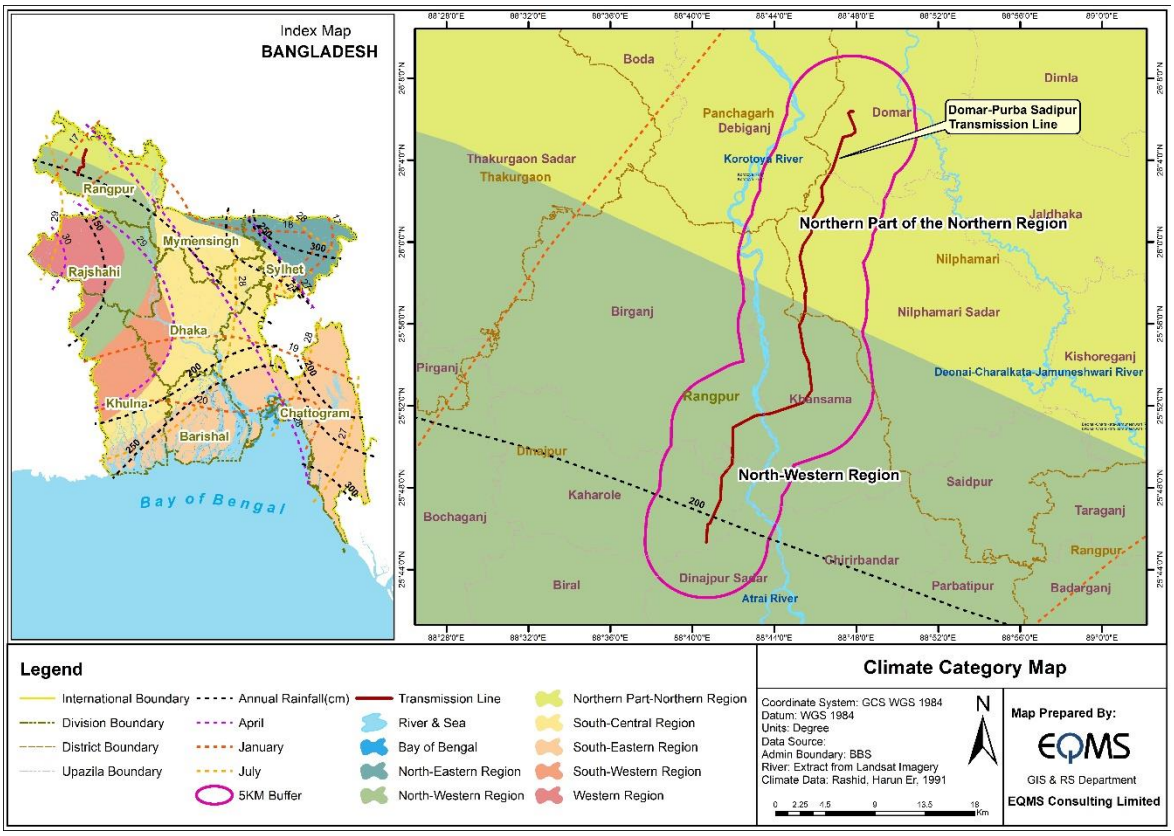
The pre-monsoon hot season (March-May) is characterized by high temperatures and the occurrence of thunderstorms. April is the hottest month when mean temperatures range from 27°C in the east and

south to 31°C in the west-central part of the country. In the western part, summer temperatures sometimes reach up to 40°C. After the month of April, the temperature dampens due to increased cloud cover. The pre-monsoon season is the transition period when the northerly or north-westerly winds of the winter season gradually change to the southerly or south-westerly winds of the summer monsoon or rainy season (June-September). During the early part of this season, the winds are neither strong nor persistent. However, with the progression of this season, wind speed increases, and the wind direction becomes more persistent. Figure 4-1 represents different climatic zones in Rupsha-Satkhira, Domar-Purba Sadipur and Niamatpur-Patnitola transmission line route.

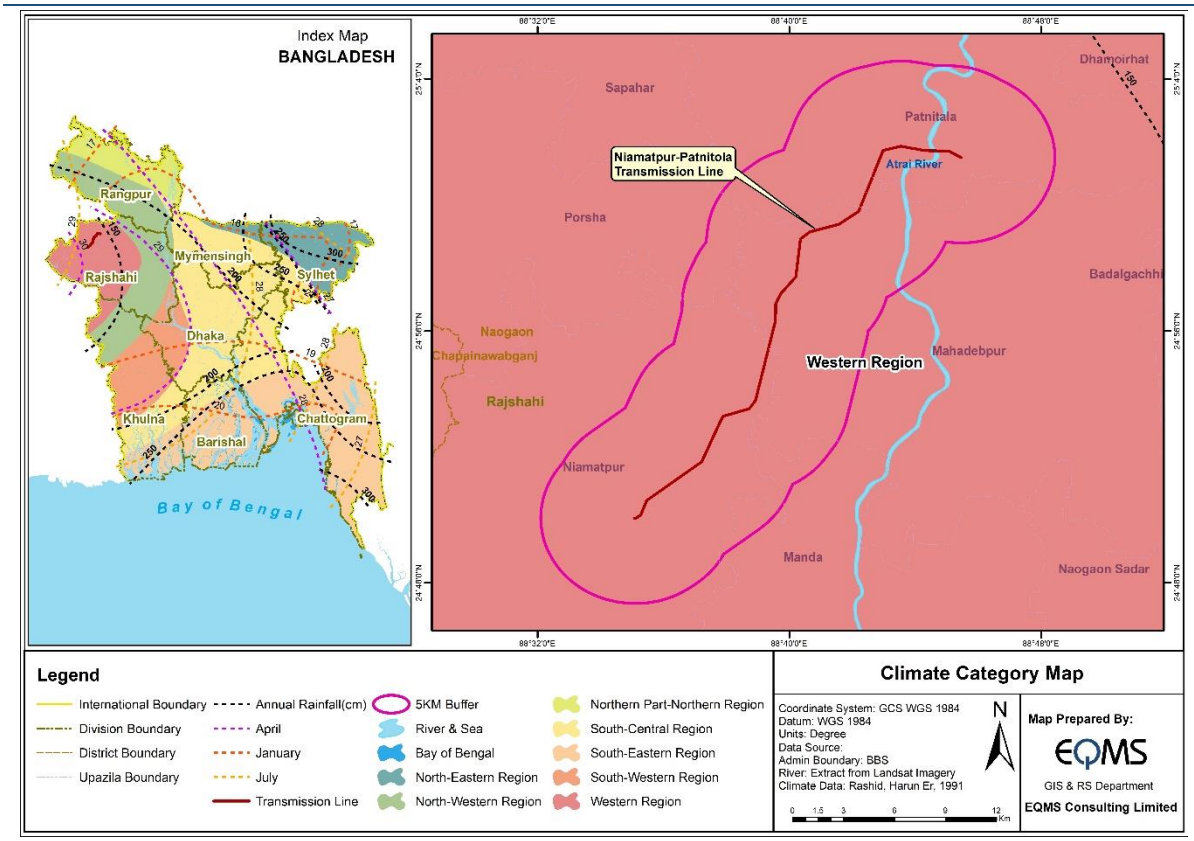
Figure 4-1: Climatic Zones of Rupsha- Satkhira, Domar- Purba Sadipur and Niamatpur- Patnitola



Climate Category of Rupsha-Satkhira



Climate Category of Domar-Purba Sadipur



Climate Category of Niamatpur-Patnitola

Source: Rashid, Haroun Er, 1991.

4.2.1.1 Climate at Satkhira and Rupsha

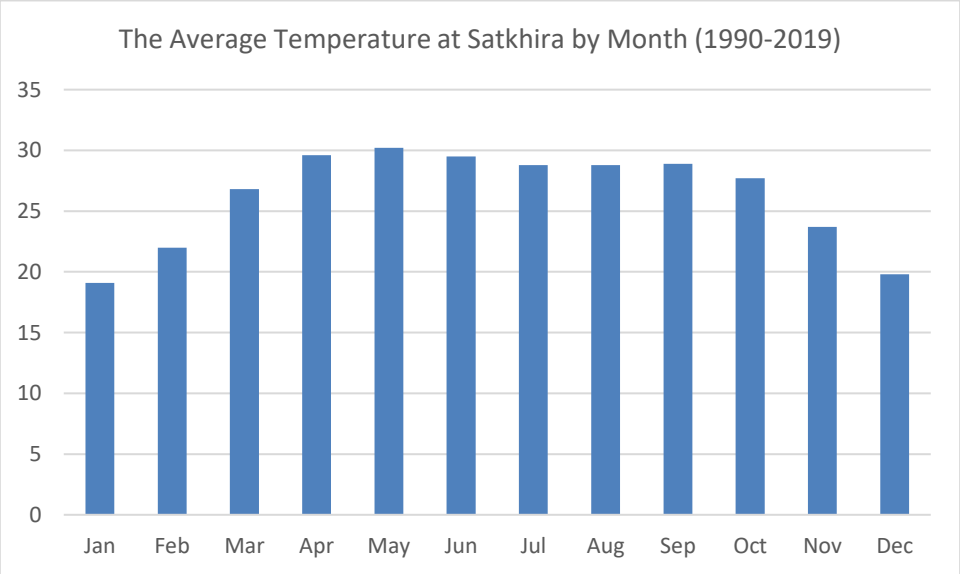
The source of climate data is Bangladesh Meteorological Department (BMD). The climate data was collected from nearby BMD station. For Rupsha-Satkhira alignments, data was collected from Jashore BMD station, which has the coverage for all the districts crossed within this route. The average annual temperature is 26.2 °C in Satkhira and Rupsha. About 1655 mm of precipitation falls annually. The least amount of rainfall occurs in December. The average in this month is 6 mm. With an average of 347 mm, the most precipitation falls in July. The temperatures are highest on average in May, at around 30.2°C. January has the lowest average temperature of the year. It is 19.1°C. The variation in the precipitation between the driest and wettest months is 341 mm. During the year, the average temperatures vary by 11.1 °C.

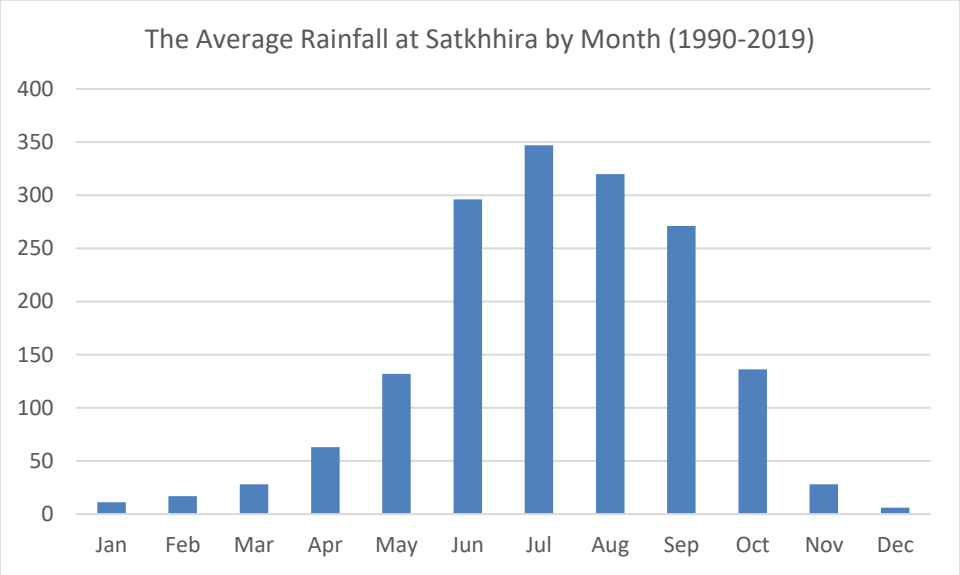
Table 4-1: Average temperature and rainfall at Satkhira and Rupsha by month

Average	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
Avg. Temperature (°C)	19.1	22	26.8	29.6	30.2	29.5	28.8	28.8	28.9	27.7	23.7	19.8
Avg. Rainfall (mm)	11	17	28	63	132	296	347	320	271	136	28	6

Source: Bangladesh Meteorological Department (BMD)

Figure 4-2: Distribution of Rainfall & Temperature at Satkhira and Rupsha.





Source: Bangladesh Meteorological Department (BMD)

4.2.1.2 Climate at Domar and Purba Sadipur

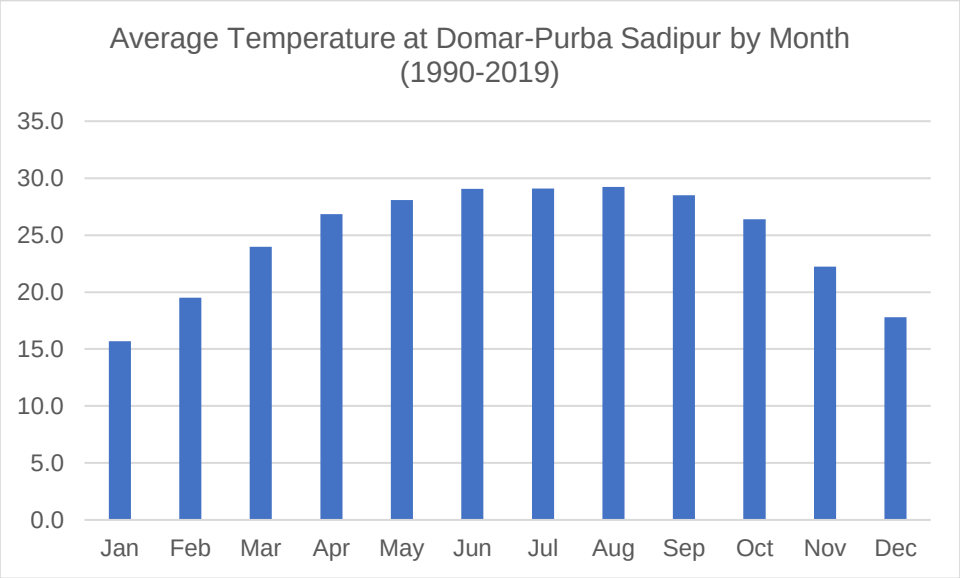
The source of climate data is Bangladesh Meteorological Department (BMD). The climate data was collected from nearby BMD station. For Domar-Purba Sadipur alignments, data was collected from Dinajpur BMD station, which has the coverage for all the districts crossed within this route. The average annual temperature is 24.7 °C in Dinajpur. About 1897 mm of precipitation falls annually. The least amount of rainfall occurs in December. The average in this month is 5 mm. With an average of 377 mm, the most precipitation falls in July. The temperatures are highest on average in August, at around 29.2°C. January has the lowest average temperature of the year. It is 15.7°C. The variation in the precipitation between the driest and wettest months is 372 mm. During the year, the average temperatures vary by 13.5 °C.

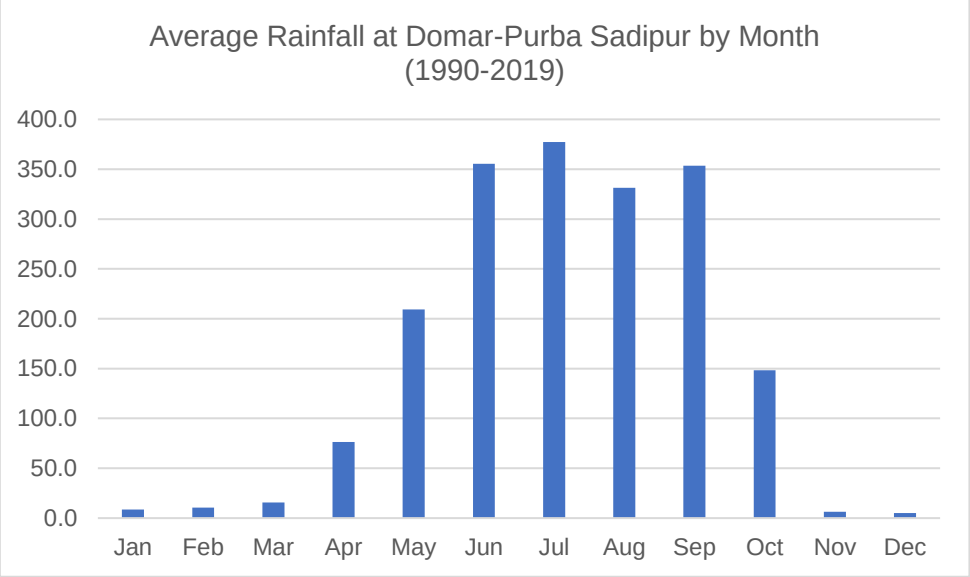
Table 4-2: Average temperature and rainfall at Domar and Purba Sadipur by month

Average	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
Avg. Temperature	15.7	19.5	24.0	26.9	28.1	29.1	29.1	29.2	28.5	26.4	22.2	17.8
Avg. Rainfall	8.5	10.5	15.8	76.4	209.4	355.3	377.4	331.4	353.4	148.4	6.2	5.1

Source: Bangladesh Meteorological Department (BMD)

Figure 4-3: Distribution of Rainfall & Temperature at Domar-Purba Sadipur





Source: Bangladesh Meteorological Department (BMD)

4.2.1.3 Climate at Niamatpur and Patnitola

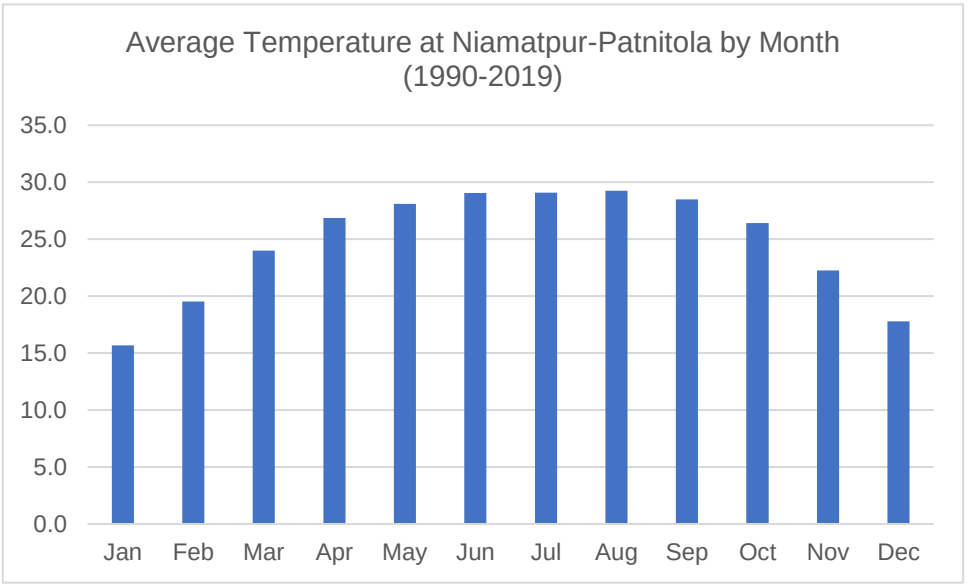
The source of climate data is Bangladesh Meteorological Department (BMD). The climate data was collected from nearby BMD station. For Niamatpur and Patnitola alignments, data was collected from Rajshahi BMD station, which has the coverage for all the districts crossed within this route. The average annual temperature is 25.2 °C in Naogaon. About 1388 mm of precipitation falls annually. The least amount of rainfall occurs in December & January. The average in this month is 6.6 mm. With an average of 288.9 mm, the most precipitation falls in July. The temperatures are highest on average in June, at around 29.5°C. January has the lowest average temperature of the year. It is 16.2°C. The variation in the precipitation between the driest and wettest months is 282.3 mm. During the year, the average temperatures vary by 13.3 °C.

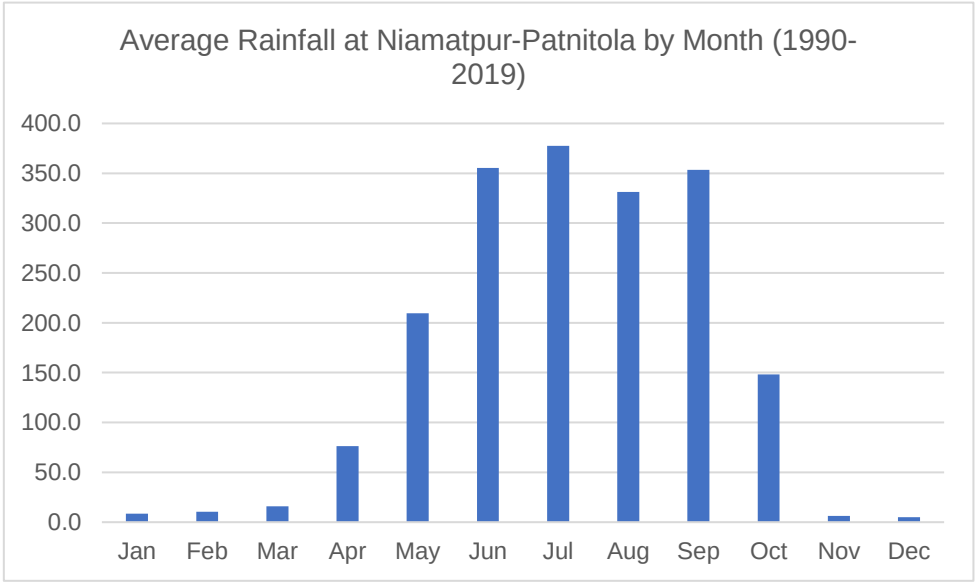
Table 4-3: Average temperature and rainfall at Niamatpur-Patnitola by month

Average	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
Avg. Temperature	16.2	20.1	25.1	28.8	29.3	29.5	29.0	29.1	28.6	26.2	22.5	18.0
Avg. Rainfall	6.6	14.5	26.7	58.8	148.4	231.1	288.9	225.9	253.9	114.3	12.3	6.6

Source: Bangladesh Meteorological Department (BMD)

Figure 4-4: Distribution of Rainfall & Temperature at Niamatpur-Patnitola





Source: Bangladesh Meteorological Department (BMD)

4.2.2 Water Quality

4.2.2.1 Surface Water

Overhead transmission lines in Dhaka and Western zone cross 31 rivers. Rupsha-Satkhira 230kV double circuit transmission line crosses Betna river, Kopotaksha and Bhairab river. The width of these rivers is more than 100 m (Table 4-4) during monsoon. Domar-Purba Sadipur 230 kV double circuit transmission line crosses Atrai, Shewraphull, Karotoya; and the average width of these rivers are more than 100 m. Niamatpur-Patnitola 132 kV double circuit transmission line crosses Chatra, Singhadi, Esapur canals.

Table 4-4: Name of rivers and transmission lines

No.	Overhead Transmission Line	Names and Widths of River
1.	Rupsha-Satkhira 230 kV double circuit transmission line	Line crossing 9 rivers, 6 canals, 1 khal, 150 m distance to the bank of river from tower footings. Betna river, Kopotaksha and Bhairab river.
2.	Domar-Purba Sadipur 230 kV double circuit transmission line	Atrai river (149 m), Shewraphull, Karotoya (>100 m)
3.	Niamatpur-Patnitola 132 kV double circuit transmission line	Atrai river (124 m), Chatra, Singhadi, Esapur canals.

4.2.2.1.1 Surface Water Sampling Methods

The samples have been analyzed for parameters covering bacteriological and physio-chemical characteristics which include certain heavy metals and trace elements. Surface water samples has been collected as grab water sample in a standard sampling bottle and 250 ml sterilized clean PET bottle to complete physio-chemical and bacteriological tests respectively. The samples have been analyzed as per standard procedure/method given in Standard Method for Examination of Drinking Water Edition 20, published by APHA as well as using on site field test kit. Details of the sampling procedures are shown in Table 4-5.

Table 4-5: Analysis Method for Surface Water Samples

Sl. No.	Parameters	Unit	Analysis Method
1.	Biochemical Oxygen Demand (BOD)	mg/L	5 days Incubation
2.	Chemical Oxygen Demand (COD)	mg/L	Closed Reflux Method
3.	Dissolved Oxygen (DO)	mg/L	Hanna Combo Meter
4.	Electrical Conductivity (EC)	µS/cm	Hanna Combo Meter
5.	pH	--	Hanna Combo Meter
6.	Salinity	ppt	Hanna Combo Meter
7.	Temperature (T)	°C	Hanna Combo Meter
8.	Hardness	mg/L	Colorimetric Method
9.	Total Dissolved Solid (TDS)	mg/L	Hanna Combo Meter

Sources: Information Taken from EQMS Wet Laboratory

The quality of surface water was compared with the standards for Inland Surface Water, Environment Conservation Rules (ECR) and 1997-Schedule 3 (A) whereas the groundwater was compared with the Drinking Water Standard ECR Schedule-3 (B), 1997. The standards have been presented along with the monitoring results of surface water for comparison.

4.2.2.1.2 Surface Water Sampling Locations

EQMS team has observed various source of water throughout the transmission line. There are some small cannels, ponds, gher were observed in the project sites. Five surface water samples were collected for surface water quality monitoring during the month of January 2022 for Rupsha – Satkhira route and March 2022 for Domar - Purba Sadipur. The samples were collected from nearby river or canal of the alignment. As per PGCB, the environmental baseline of Niamatpur-Patnitola route is in progress. Partial environmental baseline data (lab sheet) for Niamatpur-Patnitola route has been incorporated in Appendix D.

Table 4-6: Surface Water Sampling Location

Sl. No.	Code	Sampling Location	GPS Coordinate	Type of Source	Sampling Time	Sampling Date
Rupsha to Satkhira						
1.	SW1	Branch of Rupsha River, AP21/1	22°44'12.78"N 89°22'46.81"E	River	01:50 PM	10.01.2022
2.	SW2	Rupsha River, AP31/B	22°43'26.32"N 89°31'34.89"E	River	02:55 PM	10.01.2022
Domar to Purba Sadipur						
3.	SW3	AP-03	25°47'30"N 88°41'19"E	Pond	09:46 AM	11.03.2022
4.	SW4	AP-12	25°54'39"N 88°45'25"E	Pond	11:45 AM	11.03.2022
5.	SW5	AP-25	26°5'12"N 88°47'34"E	Pond	1:30 PM	11.03.2022

Table 4-7: Surface Water Sampling Location

Rupsha to Satkhira

SW1, Branch of Rupsha River, AP21/1


SW2, Rupsha River, AP 31/B

Domar to Purba Sadipur


SW3, AP-03, 25°47'30"N 88°41'19"E


SW4, AP-12, 25°54'39"N 88°45'25"E


SW5, AP-25, 26°5'12"N 88°47'34"E

4.2.2.1.3 Result Analysis

The analyzed results for surface water were compared to Rule 12, Schedule-3 (A), Bangladesh Standards (ECR, 1997). Results of inland surface water analysis are presented in (Table 4-8).

Table 4-8: Surface Water Analysis Result

Parameters		Concentration									
		BOD	COD	DO	EC	pH	Salinity	T	Hardness	TDS	NH4-H
Unit		mg/L	mg/L	mg/L	µS/cm	--	ppt	°C	mg/L	mg/L	mg/L
Rupsha to Satkhira											
SW1	Baseline (Jan. 2022)	0.7	14	8.3	610	8.3	0.38	22.4	157	310	-
SW2	Baseline (Jan. 2022)	0.8	13	7.3	730	7.4	0.44	23.2	248	360	-
Domar to Purba Sadipur											
SW3	March 2022	0.8	4	6.2	210	7.1	0.04	22.4	110	105	4.8
SW4	March 2022	0.9	9	5.9	280	6.8	0.03	22.4	88	150	5.1
SW5	March 2022	1.1	13	5.7	190	7.5	0.05	22.3	94	95	8.6
Bangladesh Standards*		6 or less	--	5 or more	--	6.5 – 8.5	--	--	--	--	-

*NB: *Rule 12, Schedule-3 (A), ECR.1997, Bangladesh*

4.2.2.1.4 Discussion

The surface water samples have been taken from a running river named Betna river, Kopotaksha and Bhairab river in Rupsha-Satkhira route and Atrai, Shewraphull, Karotoya river in Domar-Purba Sadipur route run adjacent to the respective transmission line project. Regular high tide and low tide occur here most of the river and the sedimentation is remarkable. According to tasted result the tested parameters remain under the Bangladesh standard.

- **Biological Oxygen Demand (BOD):** Biological Oxygen Demand is the quantity of oxygen required by bacteria and other microorganisms during the biochemical degradation and transformation of organic matter present in water under aerobic conditions. BOD_5 is an index of the biodegradable organics present. Biological oxygen demanding wastes consume the dissolved oxygen from water. In Rupsha-Satkhira transmission line, the average value of BOD5 varied from 0.7 to 0.8 mg/L which

is lower than the limit of standard. For Domar-Purba Sadipur double circuit transmission line, the average value of BOD5 varied from 0.8 to 1.1 mg/L. In all the locations, the average value of BOD_5 was found within the limits of national standards. So, these low values of BOD_5 indicate the status of oxygen efficiency in the water body which can be helpful to aquatic flora and fauna like fish and microorganisms.

- **Chemical Oxygen Demand (COD):** The chemical oxygen demand is commonly used to indirectly measure the number of organic compounds in water. Most applications of COD determine the number of organic pollutants found in surface water (e.g., lakes and rivers) or wastewater, making COD a useful measure of water quality. In Rupsha-Satkhira transmission line, the average value of COD is 13.5 mg/L, whereas, in Domar-Purba Sadipur double circuit transmission line, the average value of COD varied from 4 to 13 mg/L. In all the locations, the average value of COD was found within the limits of national standards.
- **Dissolved Oxygen (DO):** The presence of sufficient DO in water is a positive sign of a healthy water body but the deficiency of DO is a signal of pollution. DO for all the samples of surface water are remained above 5 which recommended by DoE.
- **Electrical Conductivity (EC):** The electrical conductivity (EC) is usually used for indicating the total concentration of the ionized constituents of water. In Rupsha-Satkhira transmission line, the values of EC of the surface water varied from 610 to 730 µs/cm, whereas, in Domar-Purba Sadipur double circuit transmission line, the values of EC of the surface water varied from 190 to 280 µs/cm. The values indicate the very low amount of ionization in sampling water bodies.
- **pH:** The pH of surface water may continuously be fluctuating depending on the seasonal variation. pH amount fluctuating between the range of neutral nature. It's also noticeable that all the samples of surface water remain between the standard of Bangladesh. There have no construction wastes thrown into the surface water body.
- **Salinity:** The salinity of surface water may continuously be fluctuating depending on the seasonal variation. Salinity in Rupsha-Satkhira transmission line fluctuates between the range of 0.38 to 0.44 ppt. Salinity in Domar-Purba Sadipur double circuit transmission line ranges between 0.03 to 0.05 ppt. It's also noticeable that all the samples of surface water contained a moderate amount of salinity.
- **Temperature (T):** Temperature for all the surface water samples below from the Bangladesh standard. Seasonal variation is completely responsible for decreasing the temperatures.
- **Total Dissolved Solid (TDS):** The high number of suspended dissolved solids in water increases the water density; it influences the osmoregulation of freshwater organisms and reduces the solubility of gases. TDS in Rupsha-Satkhira transmission line ranges from 310 to 360 mg/L. TDS in Domar-Purba Sadipur transmission line ranges from 95 to 150 mg/L. High tide and low tide, sand absorption, or the effluent with suspended particles, such as stormwater from the bathroom, sprayed water runoff contained sand particles, etc. can be responsible for fluctuating TDS.
- **Hardness:** Hardness is a measure of divalent salts, or positively charged ions, particularly calcium (Ca2+) and magnesium (Mg2+), in water. Total hardness is the sum of the concentrations of Ca2+ and Mg2+, expressed in ppm calcium carbonate. In Rupsha-Satkhira transmission line, Hardness value found ranges from 157 to 248 mg/L. In Domar-Purba Sadipur transmission line, Hardness value found ranges from 88 to 110 mg/L.
- **Ammonia (NH4-H):** Excess ammonia can cause overstimulation of growth of aquatic plants and algae. Excessive growth of these organisms, in turn, can clog water intakes, use up dissolved oxygen as they decompose, and block light to deeper waters. The tested report shows the Ammonia value found in Domar-Purba Sadipur route ranges from 4.8 to 8.6 mg/L.

4.2.2.2 Ground Water

4.2.2.2.1 Ground Water Sampling Methods

Ground water samples has been collected from the Ground water supply point or deep tube well or shallow tube well set up in the construction area. Ground water samples has been collected in a

standard sampling bottle and 250 ml sterilized clean PET bottle for complete physio-chemical and bacteriological tests respectively. The samples have been analysed as per standard procedure/method given in Standard Method for Examination of Water and Wastewater Edition 20, published by APHA as well as using a site field test kit. Details of the analysis method and protocol are presented in Table 4-9.

Table 4-9: Analysis Method for Ground Water Samples

Sl. No.	Parameters	Unit	Analysis Method
1.	Biochemical Oxygen Demand (BOD)	mg/L	5 days Incubation
2.	Chemical Oxygen Demand (COD)	mg/L	Closed Reflux Method
3.	Dissolved Oxygen (DO)	mg/L	Hanna Combo Meter
4.	Electrical Conductivity (EC)	µS/cm	Hanna Combo Meter
5.	pH	--	Hanna Combo Meter
6.	Salinity	ppt	Hanna Combo Meter
7.	Temperature (T)	°C	Hanna Combo Meter
8.	Hardness	mg/L	Colorimetric Method
9.	Total Dissolved Solid (TDS)	mg/L	Hanna Combo Meter

Sources: Information Taken from EQMS Laboratory

4.2.2.2.2 Ground-Water Sampling Locations

Ground water samples were collected for determining the quality of existing sources. Ground water in the project area was selected as the source of groundwater. During the site visit, no springs or deep wells/tubewell were found within the ROW of these two lines. As per PGCB, the environmental baseline of Niamatpur-Patnitola route is in progress. Partial environmental baseline data (lab sheet) for Niamatpur-Patnitola route has been incorporated in Appendix D. Detail of the sampling location is provided in Table 4-10.

Table 4-10: Locations and Descriptions of Ground-Water Sampling

Sl. No.	Code	Sampling Location	GPS Coordinate	Type of Source	Sampling Time	Sampling Date
Rupsha to Satkhira						
1.	GW1	Baliadanga, Botiaghata, Khulna (Near AP 34)	22°43'44.77"N 89°32'26.66"E	Tube-Well	03:04 PM	10.01.2022
2.	GW2	Jabusha, Khulna (Near AP 44)	22°45'29.25"N 89°36'23.24"E	Tube-Well	04:48 PM	10.01.2022
Domar to Purba Sadipur						
3.	GW3	AP-03	25°47'30"N 88°41'17"E	Tube-Well	10:15 AM	11.03.2022
4.	GW4	AP-12	25°54'40"N 88°45'27"E	Tube-Well	12:10 PM	11.03.2022
5.	GW5	AP-25	26°5'13"N 88°47'35"E	Tube-Well	2:15 PM	11.03.2022

4.2.2.2.3 Sampling Photographs

Rupsha to Satkhira

GW1, Baliadanga, Botiaghata, Khulna (Near AP 34)

GW2: Jabusha, Khulna (Near AP 44)

Domar to Purba Sadipur

GW4: AP-03: 25°47'30"N 88°41'17"E


GW5: AP-12: 25°54'40"N 88°45'27"E


GW3: AP-25: 26°5'13"N 88°47'35"E

4.2.2.2.4 Ground-Water Quality Analysis Results

Analysis results of the Ground water are represented in Table 4-11 where the values are compared with the standard limit.

Table 4-11: Ground Water Quality Analysis Results

Parameters		Concentration								
		BOD	COD	DO	EC	pH	Salinity	T	Hardness	TDS
	Unit	mg/L	mg/L	mg/L	µS/cm	--	ppt	°C	mg/L	mg/L
Rupsha to Satkhira										
GW1	Baseline (Jan. 2022)	0.1	1.2	7.1	1290	7.5	0.86	22.6	650	247
GW2	Baseline (Jan. 2022)	0.1	1.8	6.4	1560	7.2	1.05	23.4	520	297
Domar to Purba Sadipur										
GW3	March 2022	0.1	1.4	6.4	520	7.4	0.05	22.4	128	260
GW4	March 2022	0.1	2.2	6.2	480	7.2	0.04	22.4	106	240
GW5	March 2022	0.1	2.8	6.1	560	7.5	0.05	22.4	133	265
Bangladesh Standards*		0.2	4	6	-	6.5-8.5	-	20-30	200-500	1000

NB:

**Rule 12, Schedule-3(B), ECR.1997, Bangladesh*

4.2.2.2.5 Discussion

According to the ground, water quality parameters monitoring most of them are under BD standard values. There has not been any groundwater degradation observed during this baseline monitoring period. There were no chemical and hazardous elements found leaching into the ground. Regular groundwater sampling will be conducted during construction period. If any impact will observe in the future, the proper initiative will be taken immediately.

- **Biological Oxygen Demand (BOD):** A BOD level of 1-2 ppm is considered very good. There will not be much organic waste present in the water supply. In all samples, the tested result shows the value of BOD is 0.1 to 0.2 mg/l which indicated the good condition of groundwater.
- **Chemical Oxygen Demand (COD):** The chemical oxygen demand is commonly used to indirectly measure the number of organic compounds in water. In all samples, the tested values of groundwater samples range from 1.2 to 2.8 mg/L which is well within the national standard.
- **Dissolved Oxygen (DO):** Dissolved oxygen is necessary to many forms of life including fish, invertebrates, bacteria, and plants. DO for all the samples of ground water are range from 6.1 to 7.1 mg/L.
- **Electrical Conductivity (EC):** The electrical conductivity (EC) is usually used for indicating the total concentration of the ionized constituents of water. In Rupsha to Satkhira transmission line, the EC of the ground water varied from 1290 to 1560 µs/cm. In Domar to Purba Sadipur double circuit transmission line, the EC of the ground water varied from 480 to 560 µs/cm.
- **pH:** pH for all locations varied from 7.2 to 7.5 and the water quality shows the basic or neutral state which can be no harm to consume. Besides, the change of pH in every location may be occurred for different sources.
- **Salinity:** In the southwestern coastal region of Bangladesh, options for drinking water are limited by groundwater salinity. Recently, aquaculture ponds in areas with a thin surface clay layer have increased the salinity in the underlying shallow aquifers. The tested samples salinity fluctuates between the range of 0.04 to 1.05 ppt in all samples. It's also noticeable that all the samples of ground water contained a moderate amount of salinity.
- **Hardness:** Hardness is a measure of divalent salts, or positively charged ions, particularly calcium (Ca^{2+}) and magnesium (Mg^{2+}), in water. Total hardness is the sum of the concentrations of Ca^{2+} and Mg^{2+}, expressed in ppm calcium carbonate. In Rupsha to Satkhira transmission line, the Hardness value found ranges from 520 to 650 mg/L. In Domar to Purba Sadipur double circuit transmission line, the Hardness value found ranges from 106 to 133 mg/L. All the values were found within the national standards.
- **Total Dissolved Solid (TDS):** Total Dissolved Solids (TDS) data can be used to identify the presence of currently undeveloped fresh or brackish groundwater at depth that may require protection. In Rupsha to Satkhira transmission line, TDS of the groundwater ranges from 247 to 297 mg/L. In Domar to Purba Sadipur double circuit transmission line, TDS of the groundwater ranges from 240 to 265 mg/L. All the values were found within the national standards.
- **Temperature (T):** Temperature for all the ground water samples below from the BD standard. Seasonal variation is completely responsible for decreasing the temperatures.

4.2.3 Air Quality

The subprojects are located in suburban areas of Bangladesh (smaller cities and towns, mixed in the rural context). This section identifies the status of the ambient air quality in three alignments: Rupsha-Satkhira 230 kV double circuit transmission line, Domar-Purba Sadipur 230 kV double circuit transmission line and Niamatpur-Patnitola 132 kV double circuit transmission line. However, as per PGCB, the environmental baseline of Niamatpur-Patnitola route is in progress. Partial environmental baseline data (lab sheet) for Niamatpur-Patnitola route has been incorporated in Appendix D. In these areas, ambient air quality is dependent on many factors like air movement, traffic volume, congestion, emissions from motor vehicles, and suspended dust particles. A continuous monitoring scheme is essential to evaluate air quality and for the development of any plan for mitigation of health risks caused

by polluted air. The "criteria pollutants," particulate matter (PM_{10}, $PM_{2.5}$), CO, SOx and NOx must be monitored. Hence, to establish the baseline air quality, as per the monitoring plan, a primary analysis of air quality is proposed, before commencing the construction activities of subprojects.

4.2.3.1 Air Quality Monitoring Methods

The existing ambient air quality of the both the alignments have been monitored during the construction period of the project. The ambient status of major air pollutants viz. Particulate Matter (SPM, $PM_{10,}$ and $PM_{2.5}$), Gaseous substances (NO_x, $SO_{2,}$ O_3 and CO) and Lead has been assessed.

Haz-Scanner™ (HIM 6000)/Lata Envirotech APM 250 has been used to monitor the ambient air quality. The particulate and gaseous samples have been monitored and analysed as per the procedures specified in Table 4-12.

Table 4-12: Methodology for the Analysis of Ambient Air Quality.

Sl. No.	Parameters	Analysis Procedure
1.	SPM	Particulates Sensor Light Scattering Nephotometer/ Gravimetric
2.	PM_{10}	Particulates Sensor Light Scattering Nephotometer/ Gravimetric
3.	$PM_{2.5}$	Particulates Sensor Light Scattering Nephotometer/ Gravimetric
4.	SO_2	High Sensitivity Electrochemical/ West-Geake
5.	NO_x	High Sensitivity Electrochemical/ Jacob & Hochheiser
6.	03	High Sensitivity Electrochemical/ Ozone meter
7.	Pb	AAS

Sources: Information Taken from EQMS Laboratory

Table 4-13: Air Sample Collection Time and Data Converted Time

Sl. No.	Parameters	Sample Collection time (Hr.)	Conversion Time (Hr.)
1.	SPM	8	-
2.	PM_{10}	24	24
3.	$PM_{2.5}$	24	24
4.	SO_2	24	24
5.	NO_x	24	24
6.	CO	8	-
7.	O_3	8	8
8.	Pb	8	24

Sources: Information Taken from EQMS Laboratory

4.2.3.2 Air Quality Monitoring Locations

The objective of the surrounding air quality observing system was to set up the standard encompassing air quality in the study area. The profile of the Project is mainly rural and urban mixed with two major river confluences. The major sources of air pollution noted within the study area include vehicular movement and domestic emissions apart from the existing infrastructure. Ambient air quality has been monitored in the project activities. The location details are as follows Table 4-14. Besides, the monitoring locations map is attached in the annex section for more clarification.

Air quality monitoring samples has been monitored for a defined time interval and from different sampling points within project areas (Table 4-14) of Rupsha-Satkhira and Domar-Purba Sadipur. Air quality analysis results are shown in Table 4-16.

Table 4-14: Air Quality Measurement Locations and Descriptions

SL No	Sample ID	GPS Coordinate	Location Details
Rupsha-Satkhira			

SL No	Sample ID	GPS Coordinate	Location Details
1.	AQ1	22°45'17.80"N 89° 6'35.25"E	Balerputa, Tala, Satkhira (Near AP 3A)
2.	AQ2	22°44'8.73"N 89°17'41.52"E	Khalilnagar, Tala, Satkhira (Near AP 16/2)
3.	AQ3	22°42'43.80"N 89°33'7.72"E	Gurakhal, Batiaghta, Khulna (AP 37)
Domar-Purba Sadipur			
4.	AQ4	25°47'32.00"N 88°41'22.00"E	AP-03, Near Residential Area
5.	AQ5	25°54'39.12"N 88°45'26.34"E	AP-12, Residential Area
6.	AQ6	26° 5'11.80"N 88°47'34.52"E	AP-25, Residential Area

Monitoring photos are showed in Table 4-15.

Table 4-15 Air Quality Monitoring Pictures

Rupsha-Satkhira	
	
AQ1, Balerputa, Tala, Satkhira (Near AP 3A)	
	
AQ2, Khalilnagar, Tala, Satkhira (Near AP 16/2)	


AQ3, Gurakhal, Batiaghta, Khulna (AP 37)

Domar-Purba Sadipur


AQ4, AP-03: 25°47'32.00"N 88°41'22.00"E


AQ5, AP-12: 25°54'39.12"N 88°45'26.34"E

	
AQ6, AQ3: AP-26° 5'11.80"N 88°47'34.52"E	

4.2.3.3 Analysis Results

Among all the parameters of ambient air, SPM, CO, Pb and O_3 had been taken for 8 hours and the rest of the parameters were taken on a 24-hourly basis. Both particulate and gaseous samples had been analyzed as per the proper procedures. Analysis results of every location are briefly mentioned in the following Table 4-16.

Table 4-16: Air Quality Analysis Results

Sl. No.	Code	Period	Ambient Air Pollution Concentration in µg/m^3							CO ppm
			$PM_{2.5}$	PM_{10}	SO_2	NO_X	SPM	O_3	Pb	
Rupsha-Satkhira										
1.	AQ1	Jan. 2022	55.3	82.6	27.5	36.5	144.7	21.8	BDL	1.208
2.	AQ2	Jan. 2022	45.4	71.6	19.2	31.7	118.5	17.5	BDL	0.601
3.	AQ3	Jan. 2022	39.8	58.3	13.5	22.8	104.8	15.1	BDL	0.284
Domar-Purba Sadipur										
4.	AQ4	Mar. 2022	32.8	53.4	3.1	12.9	92.5	7.2	BDL	0.00
5.	AQ5	Mar. 2022	35.4	55.1	3.4	11.6	102.8	10.9	BDL	0.00
6.	AQ6	Mar. 2022	38.5	71.8	11.3	19.6	127.2	15.9	BDL	0.01
Duration (hours)			24	24	24	24	8	8	8	8
*Bangladesh Standard			65	150	365	100 (Annual)	200	157	0.5	9
**IFC/WHO Standard			25	50	20	40 (Annual)	-	100	-	-

Note:

**According to ECR 1997 and Subsequent amendment 19th August 2005; vide S.R.O. No.220-Law/2005*

***WHO Ambient Air Quality Guideline Values (2005 and 2000), which are also being referred in the World Bank and IFC's General EHS Guidelines (2007).*

BDL-Below Detection level

4.2.3.4 Discussion

Particulate Matter ($PM_{2.5}$): The result of particulate matter under 2.5 micron has been under the BD standard (ECR 1997) level but cross IFC/WHO standard in January 2022 and March 2022 for both Rupsha-Satkhira and Domar-Purba Sadipur respectively. Vehicle movement on local Road in dry season and dry surface is the main reason to cross the standard (IFC/WHO).

Particulate Matter (PM_{10}): The result of particulate matter under 10 microns has been under the BD standard (ECR 1997) level but cross IFC/WHO standard in January 2022 and March 2022 for both Rupsha-Satkhira and Domar-Purba Sadipur respectively. Vehicle movement on local Road in dry season and dry surface is the main reason to cross the standard (IFC/WHO).

Sulphur Dioxide (SO_2): In Rupsha-Satkhira line, SO_2 concentration has been recorded in the range of 13.5 to 27.5 µg/m^3. During the monitoring period, the maximum SO_2 concentration has been reported at AQ1 as 27.5 µg/m^3 in January 2022. So, in this month, SO_2 concentrations at all the monitoring locations have been reported well below ECR 1997 and IFC/WHO standard level

In Domar-Purba Sadipur transmission line, SO_2 concentration has been recorded in the range of 3.1 to 11.3 µg/m^3 in March 2022. During the monitoring period, the maximum SO_2 concentration has been reported at AQ6 of as 11.3 µg/m^3. So, in this month, SO_2 concentrations at all the monitoring locations have been reported well below ECR 1997 and IFC/WHO standard level.

Oxides of Nitrogen (NO_x): In Rupsha-Satkhira line, NO_x concentration has been recorded in the range of 22.8-36.5 µg/m^3. During the monitoring period, the maximum NO_x concentration has been reported in AQ1 as concentration 36.5 µg/m^3 in January 2022. NO_X concentration for all location has been recorded as under the standard of ECR'97 and IFC/WHO standard.

In Domar-Purba Sadipur transmission line, NO_x concentration has been recorded in the range of 11.6-19.6 µg/m^3 in March 2022. During the monitoring period, the maximum NO_x concentration has been reported at AQ6 as concentration 19.6 µg/m^3. NO_X concentration for all location has been recorded as under the standard of ECR'97 and IFC/WHO standard.

Suspended Particulate Matter (SPM): The ambient air quality has been monitored in January 2022 in Rupsha-Satkhira line and in Domar-Purba Sadipur transmission line during March 2022. The 8-hourly SPM concentration ranges from 104.8-144.7 µg/m^3 in Rupsha-Satkhira line. SPM concentration for all location has been recorded as under the standard of ECR'97.

In Domar-Purba Sadipur transmission line, the 8-hourly maximum SPM concentration in ambient air in the study area has been recorded at AQ6 was 127.2 µg/m^3. SPM concentration for all location has been recorded as under the standard of ECR'97.

Carbon Monoxide (CO): In Rupsha-Satkhira line, 8 hourly CO concentration has been recorded in the range of 0.284-1.208 ppm. Maximum concentration of CO level was recorded at AQ1 as 1.208ppm.

In Domar-Purba Sadipur transmission line, 8 hourly CO concentration has been recorded in the range of 0-0.1 ppm. Maximum concentration of CO level was recorded at AQ1 as 1.208ppm. concentration for all location has been recorded below the standard of ECR'97.

Oxone (O_3): In Rupsha-Satkhira line, 8 hourly O_3 concentration has been recorded in the range of 15.1-21.8 µg/m^3. During the monitoring period, the maximum O_3 concentration has been reported in AQ1 as concentration 21.8 µg/m^3.

In Domar-Purba Sadipur transmission line, the 8-hourly high O_3 concentration in ambient air in the study area has been recorded at AQ6 area was 15.9 µg/m^3. O_3 concentration for all location has been recorded as under the standard of ECR'97 and IFC/WHO standard

4.2.4 Noise Level

4.2.4.1 Noise Level Monitoring Methods

This section identifies the status of the ambient noise level in three alignments: Rupsha-Satkhira 230 kV double circuit transmission line, Domar-Purba Sadipur 230 kV double circuit transmission line and Niamatpur-Patnitola 132 kV double circuit transmission line. However, as per PGCB, the environmental baseline of Niamatpur-Patnitola route is in progress. Partial environmental baseline data (lab sheet) for Niamatpur-Patnitola route has been incorporated in Appendix D. The ambient noise level has been measured within the project area for one hour a daytime in every location. One Noise data logger sound level meter (Techoplus, Model: SLM25K) has been used to collect the ambient noise levels. After getting all the noise data it has been downloaded to a computer. The noise meter has been settled in a tripod and kept 2-3 m away from the sources. The only sensitive areas have been covered. The noise level has been analyzed according to the methodology and compared with the Environment Conservation Rules (ECR), 1997- Schedule 4 and Noise Pollution Control Rules, 2006. The SLM has been oriented towards the facility of interest for each measurement taken. The SLM has been calibrated before the noise monitoring survey is carried out. The sound level has been recorded in form of A-weighted equivalent continuous sound pressure level (L_{Aeq}) values with the use of A-weighting filters in the noise measuring instrument.

Table 4-17: Noise Level Standards/ Guidelines

Sl. No.	Category of Area/Receptor	Bangladesh*		IFC-WHO**	
		Day [dB(A)] 6 AM – 9 PM	Night [dB(A)] 9 PM – 6 AM	Day [dB(A)] 7 AM – 10 PM	Night [dB(A)] 10 PM – 7 AM
1.	Silent Zone	50	40	55	45
2.	Residential Area	55	45	55	45
3.	Mixed Area	60	50	-	-
4.	Commercial Area	70	60	70	70
5.	Industrial Area	75	70	70	70

*Note: *The Bangladesh National Ambient Noise Standards have been taken from Schedule 4 (Standards for Sound) of the Environmental Conservation Rules, 1997 amended October 7, 2006; **Guidelines values are for noise levels measured out of doors. Source: Guidelines for Community Noise, World Health Organization (WHO), 1999; As per IFC EHS noise level guidelines, Noise impacts should not exceed the levels presented in the above table.*

Note: The day time is considered from 6 a.m. to 9 p.m. and the night time is from 9 p.m. to 6 a.m.

Area within 100 meters of hospital or education institution or government designated / to be designated/ specific institution/ establishment are considered Silent Zone. Use of motor vehicle horn or other signals and loudspeakers are forbidden in Silent Zone.

4.2.4.2 Noise Level Monitoring Locations

Noise levels were recorded at five locations in two lines in the study area. Noise levels were recorded in the form of sound pressure levels using a digital sound level meter. Detail list of noise level sampling location are given in

Table **4-18**. Noise level was measured at every location at different time. The sound level is recorded in form of A-weighted equivalent continuous sound pressure level (Leq) values with the use of A-weighting filters in the noise measuring instrument.

Table 4-18: Sensitive Noise Locations and Descriptions Rupsha-Satkhira and Domar-Purba Sadipur

Sl. No.	Code	Location	GPS Coordinates	Sampling Date	Time		Category
					Day	Night	
Rupsha-Satkhira							
1.	NL-1	Balerputa, Tala, Satkhira (Near AP 3A)	22°45'17.80"N 89° 6'35.25"E	11.01.2022	11:42 AM	09:23 PM	Commercial Area
2.	NL-2	Khalilnagar, Tala, Satkhira (Near AP 16/2)	22°44'8.73"N 89°17'41.52"E	12.01.2022	01:15 PM	09:07 PM	Commercial Area
3.	NL-3	Jabusha, Khulna (Near AP 44)	22°42'43.80"N 89°33'7.72"E	13.01.2022	04:22 PM	9:11 PM	Silent Area
Domar-Purba Sadipur							
4.	NL-4	AP-03	25°47'32.00"N 88°41'22.00"E	11.03.2022	09:23 AM	09:18 PM	Silent Area
5.	NL-5	AP-12	25°54'39.12"N 88°45'26.34"E	12.03.2022	10:54 AM	09:05 PM	Residential Area
6.	NL-6	AP-25	26° 5'11.80"N 88°47'34.52"E	13.03.2022	12:15 PM	09:32 PM	Residential Area

Table 4-19 Noise level Monitoring Pictures.

Rupsha-Satkhira

NL1- Balerputa, Tala, Satkhira (Near AP 3A)

NL2- Khalilnagar, Tala, Satkhira (Near AP 16/2)

NL3- Jabusha, Khulna (Near AP 44)

Domar-Purba Sadipur

NL4- AP-03, 25°47'32.00"N 88°41'22.00"E


NL5- AP-12, 25°54'39.12"N 88°45'26.34"E


NL6- AP-25, 26° 5'11.80"N 88°47'34.52"E

4.2.4.3 Analysis Results

An electronic and auto-recorded noise meter has been used to conduct the study. The recorded noise levels summary monitoring results are shown in Table 4-20.

Table 4-20: Noise Level Monitoring Results

Sl. No.	Code	Period	Ambient Noise Level [dB(A)]		1 Hour Leq		ECR'97 Standard		IFC/WHO Standard	
			Leq_{day}	Leq_{night}	Max	Min	Day	Night	Day	Night
		Rupsha-Satkhira								
1.	NL1	Jan.2022	67.3	47.2	91.4	41.3	70	60	70	60
2.	NL2	Jan.2022	56.4	37.5	83.1	34.1	70	60	70	60
3.	NL3	Jan.2022	48.5	34.8	65.6	31.8	50	40	55	45
		Domar-Purba Sadipur								
4.	NL4	March 2022	42.7	32.0	58.1	30.1	50	40	55	45

Sl. No.	Code	Period	Ambient Noise Level [dB(A)]		1 Hour Leq		ECR'97 Standard		IFC/WHO Standard	
			Leq_{day}	Leq_{night}	Max	Min	Day	Night	Day	Night
5.	NL5	March 2022	51.4	40.2	71.1	35.4	55	45	55	45
6.	NL6	March 2022	53.6	42.8	76.5	38.5	55	45	55	45

Note:
** According to ECR 1997 and Subsequent amendment on 2006*
***Guidelines for Community Noise, World Health Organization (WHO), 1999; As per IFC EHS noise level guidelines*

4.2.4.4 Discussion

According to Bangladesh Environmental Quality Standard ECR'97 categorizations, the current monitoring location falls into Commercial area (NL1 and NL2), Silent zone (NL3 and NL4) and Residential Area (NL5 and NL6). The daytime noise level all locations values are below from BD Standard and IFC-WHO (Figure 4-5).

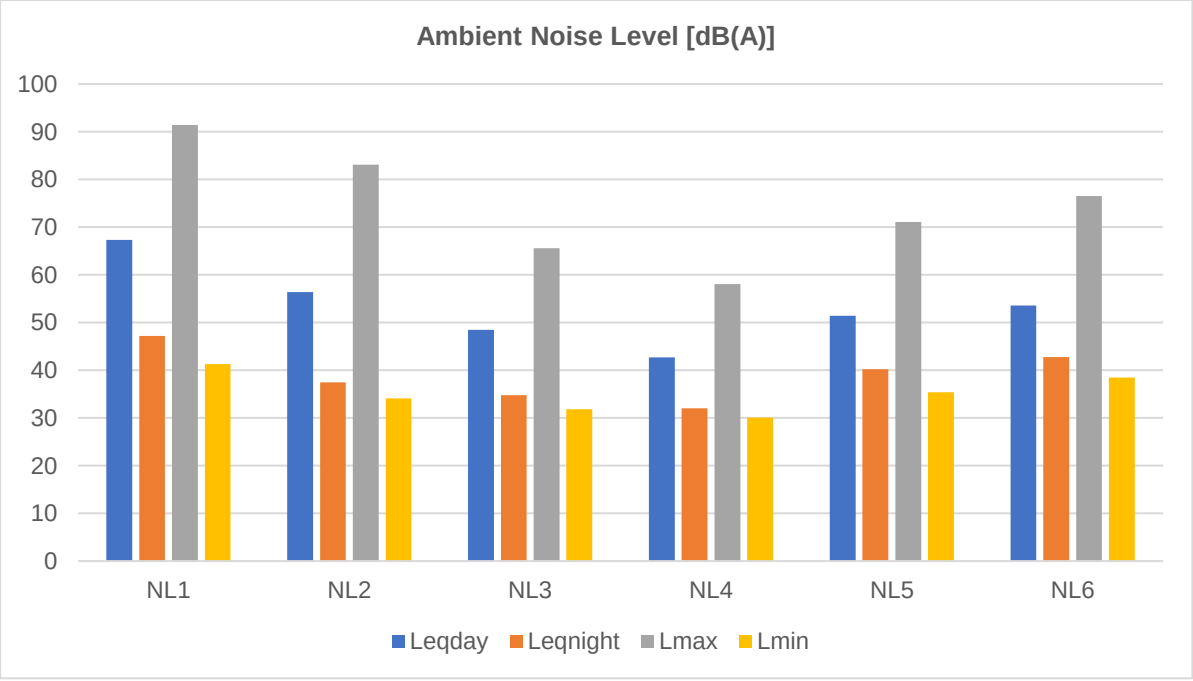


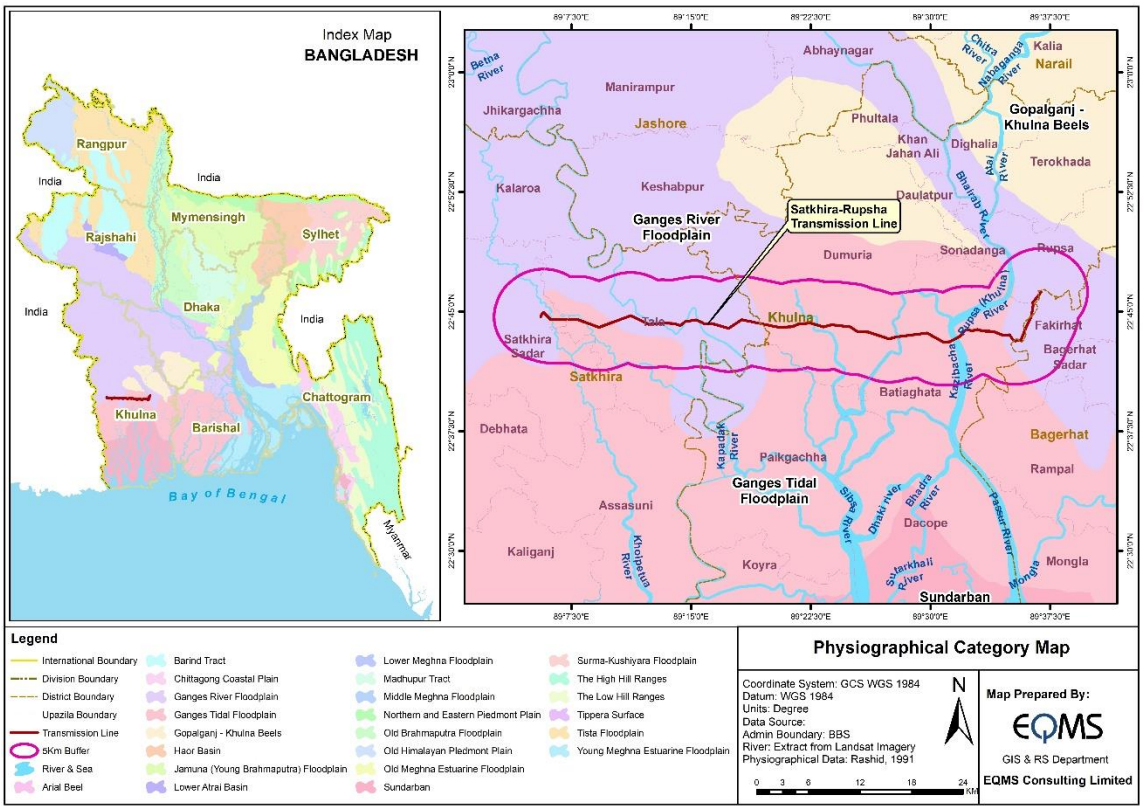
Figure 4-5: Noise level of Rupsha-Satkhira and Domar-Purba Sadipur

The night-time noise level of all location's values is bellow from the standard of Bangladesh and IFC-WHO (**Figure 4-5**).

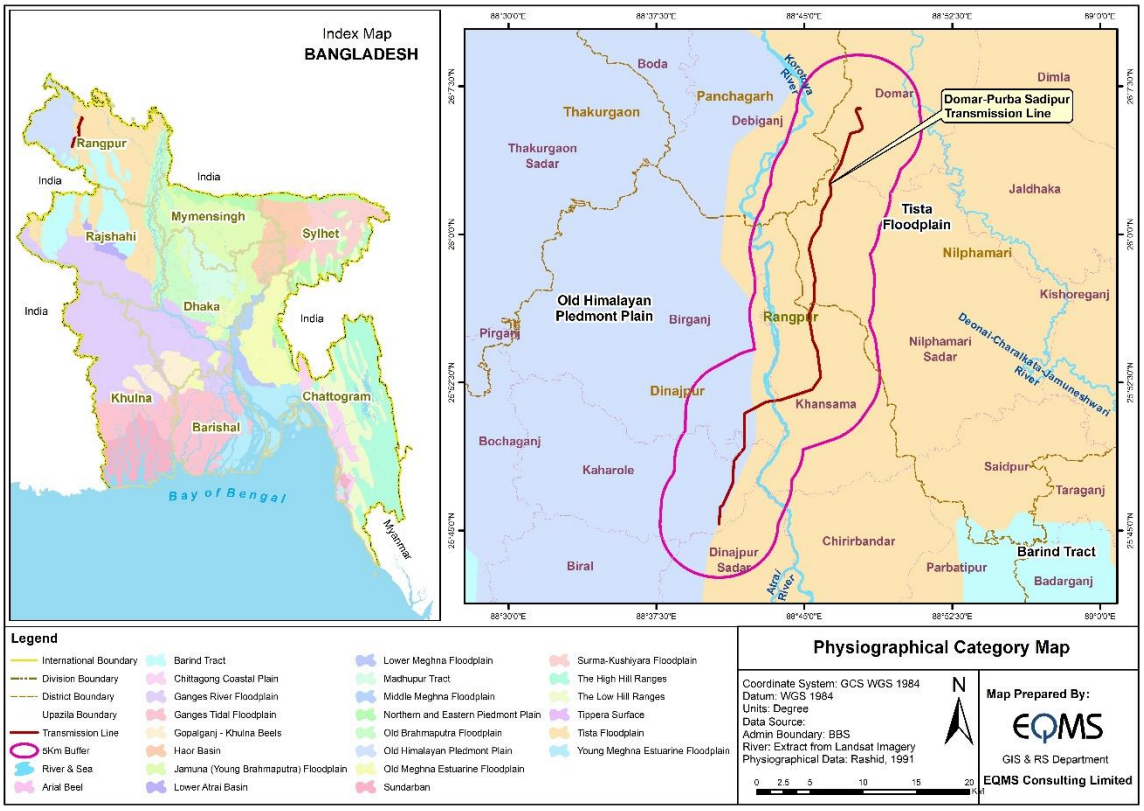
4.2.5 Physiographic Features

In the context of physiography, Bangladesh is classified into three distinct regions: (a) floodplains; (b) terraces; and (c) hills each having distinguishing characteristics of its own. Further, the physiography of the country has been divided into 24 sub regions and 54 units. The physiography of 5km buffer of Rupsha-Satkhira route fall in Ganges River Floodplain and Ganges Tidal Floodplain, Domar-Purba Sadipur fall in Tista Floodplain and Niamatpur-Patnitola route fall in Barind Tract. Figure 4-6 shows the physiographic condition of Rupsha-Satkhira, Domar-Purba Sadipur and Niamatpur-Patnitola.

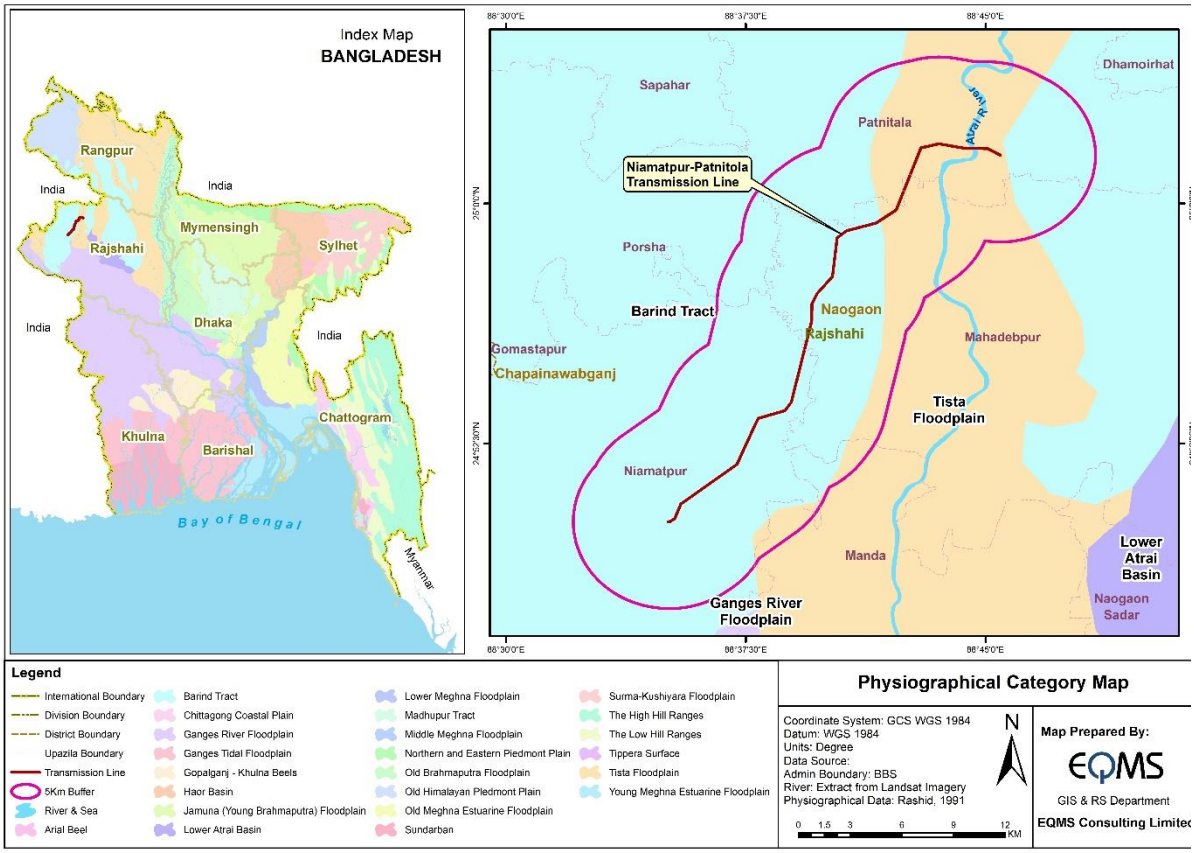
Figure 4-6: Physiographic Map of Rupsha-Satkhira, Domar-Purba Sadipur and Niamatpur-Patnitola



Rupsha-Satkhira



Domar-Purba Sadipur



Niamatpur-Patnitola

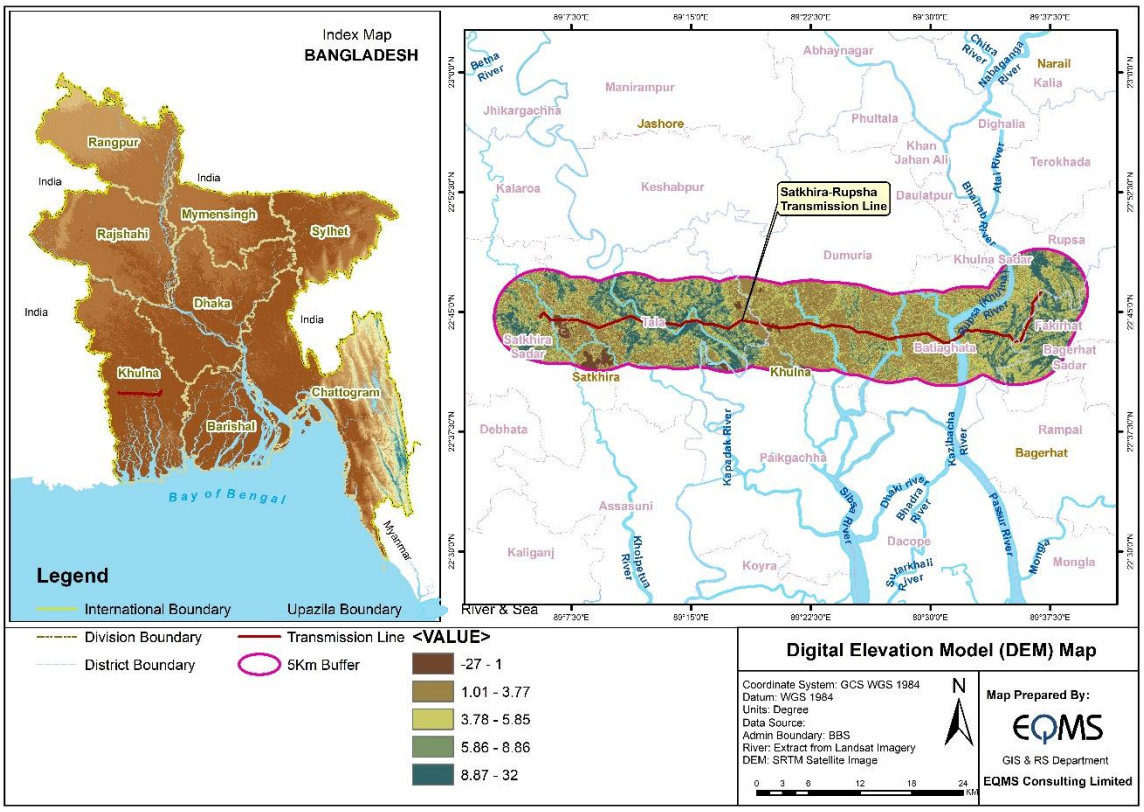
4.2.6 Topography

Bangladesh is one of the largest deltas in the world formed by the confluence of three Himalayan rivers: the Ganges (Padma); the Brahmaputra (Jamuna); and, the Meghna, with a long coastline along the Bay of Bengal. Floodplains (80%), terraces (8%) and hills (12%) cover the land area.

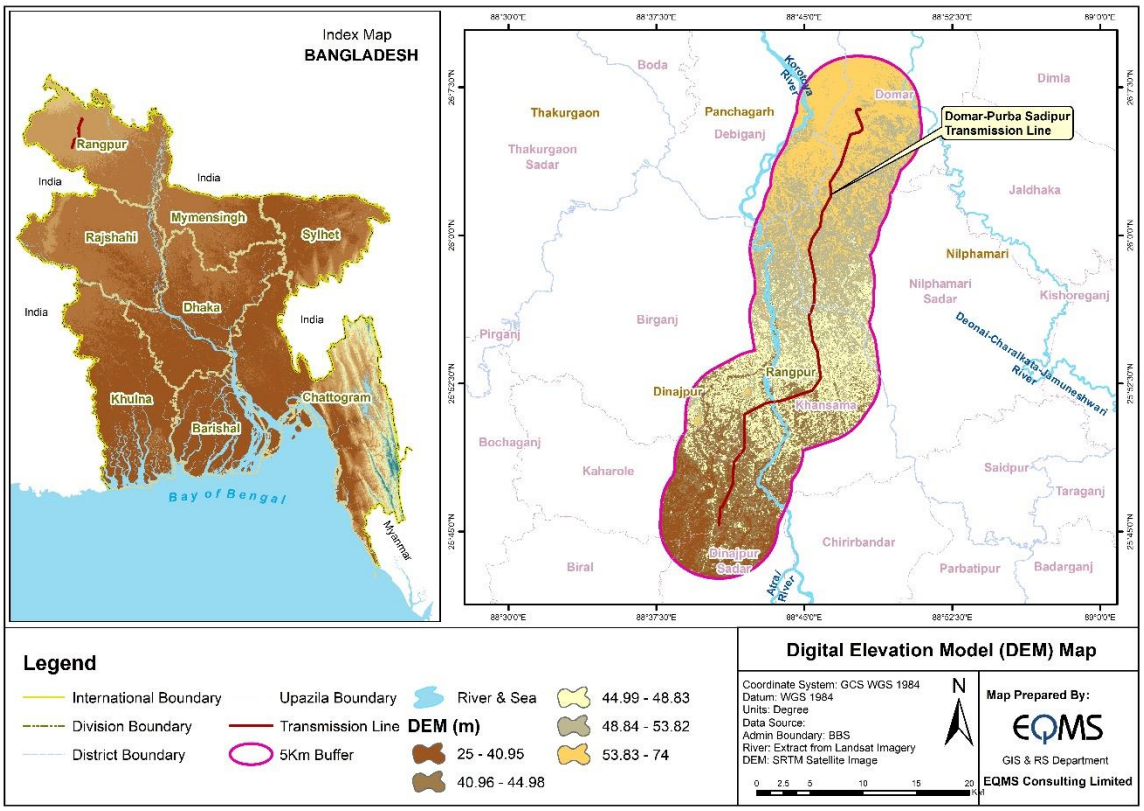
The country has a considerable topographic diversity. It has three distinctive features: (i) a broad alluvial plain subject to frequent flooding; (ii) a slightly elevated relatively older plain; and, (iii) a small hill region drained by flashy rivers. The south is a highly irregular deltaic coastline of about 600 km fissured by many estuarine rivers and channels flowing into the Bay of Bengal. The alluvial plain is part of the larger plain of Bengal, which is sometimes called the Lower Gangetic Plain. Elevations of the plains are less than 10 m above the sea level; elevations further decline to near sea level in the coastal south. Most of the southwest project area in Khulna and Barisal divisions lies in the alluvial plain. The hilly areas of the south eastern region of Chattogram, the northeasters hills of Sylhet and highlands in the north and northwest are of low elevation. The Chattogram Hills constitute the only significant hill system in the country. They rise steeply to narrow ridgelines, with elevation ranging between 600 m and 900 m above mean sea level. The highest point of 1,230 m is at Mt. Keokradong. In between the hilly ridges lie the valleys that generally run north to south. West of the Chattogram hills is a narrow, wet coastal plain lying parallel to the shoreline.

The average elevation of Rupsha-Satkhira alignment is 4.2m. The average elevation of Domar-Purba Sadipur alignment is 48.6m. The average elevation of Niamatpur-Patnitola alignment is 22.8m. The topographic map of these alignments is shown in Figure 4-7.

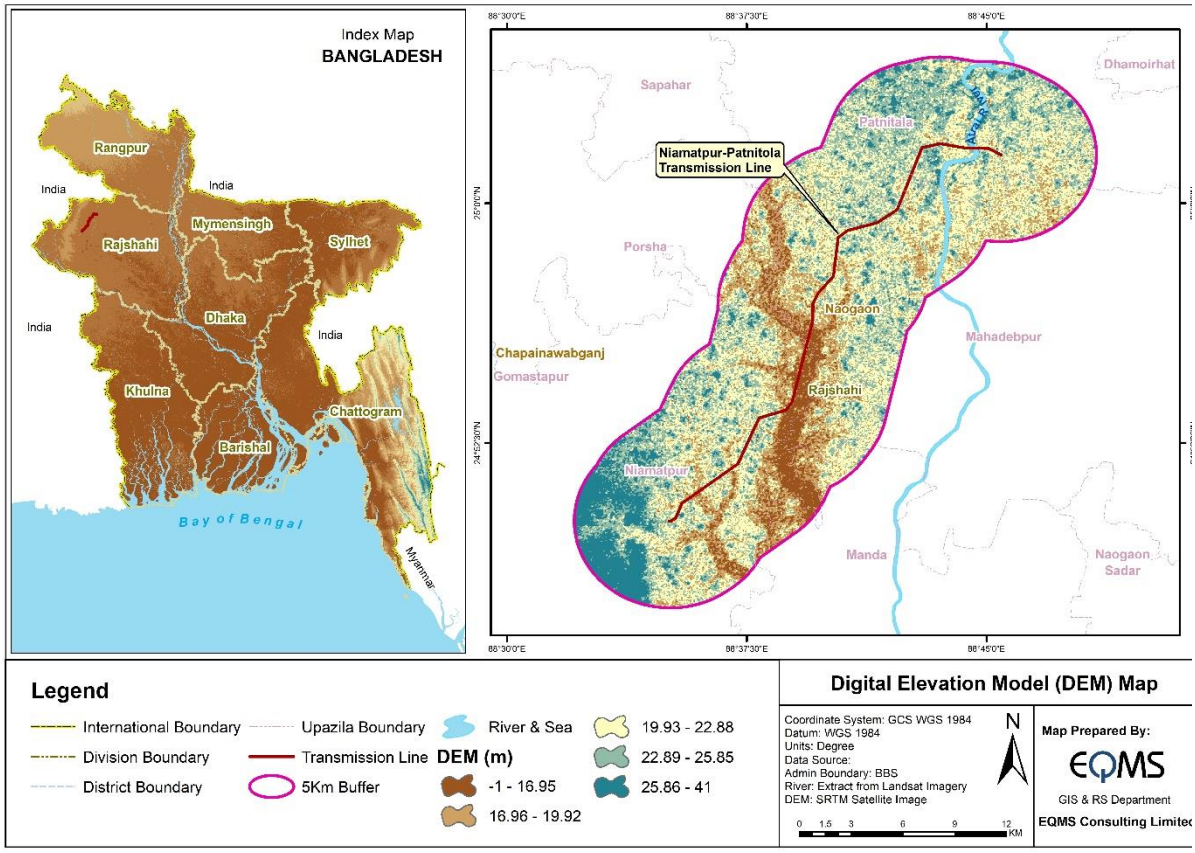
Figure 4-7: Topography of Rupsha-Satkhira, Domar-Purba Sadipur and Niamatpur-Patnitola



Rupsha-Satkhira



Domar-Purba Sadipur



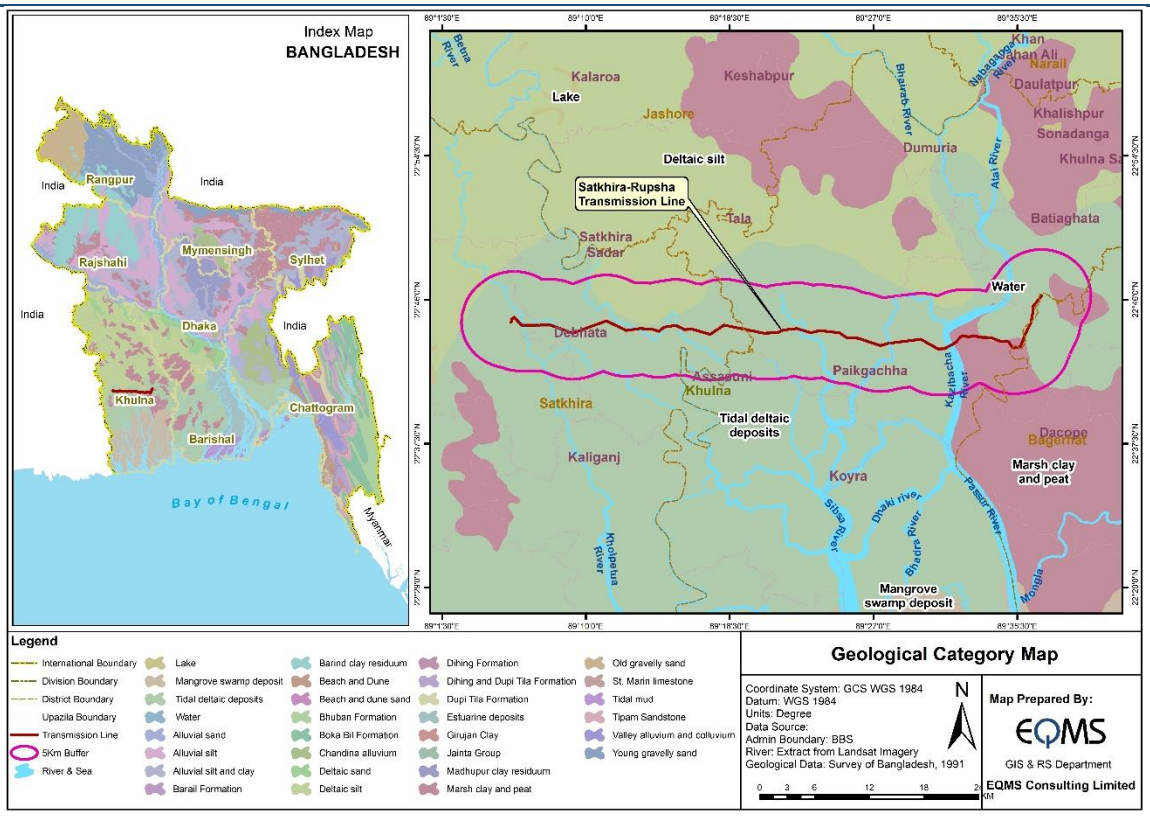
Niamatpur-Patnitola

Source: SRTM Satellite Image

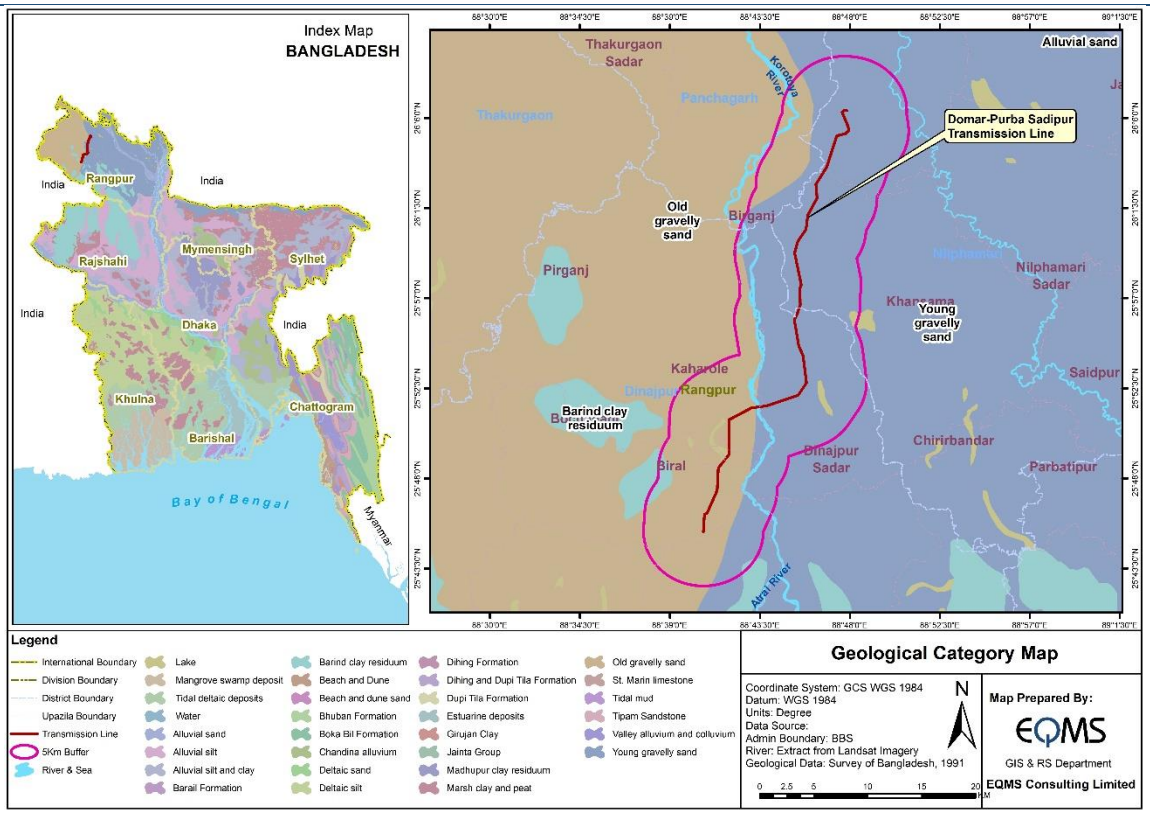
4.2.7 Geology

Bangladesh is situated to the east of the Indian sub-continental plate. Nearly 85% of Bangladesh is underlain by deltaic and alluvial deposits of the Ganges, Brahmaputra, and Meghna River systems. The project area consists of Holocene alluvial deposits in the floodplain and predominantly consisting of fine sand, silts and clay. The site is on deep Cenozoic deposits that overlie Precambrian basement rock. The Precambrian rocks form the basement of all geological formations of the Bengal Basin and shield areas. The materials deposited are a mixture of sediments transported by the old Brahmaputra and by the Jamuna (Brahmaputra) River. The generalized geological features of the project area are shown in the geological map of Bangladesh. As per the geological category map of Bangladesh, the majority of the 5 km buffer of Rupsha-Satkhira route falls under tidal deltaic deposit category (Figure 4-8). As per the geological category map, the majority of the 5 km buffer of Domar-Purba Sadipur route falls under young gravelly sand categories (Figure 4-8). A portion of the Domar-Purba Sadipur alignment falls under the geological category of Barind clay residuum. As per the geological category map, the majority of the 5 km buffer of Niamatpur-Patnitola route falls under Barind clay residuum categories (Figure 4-8).

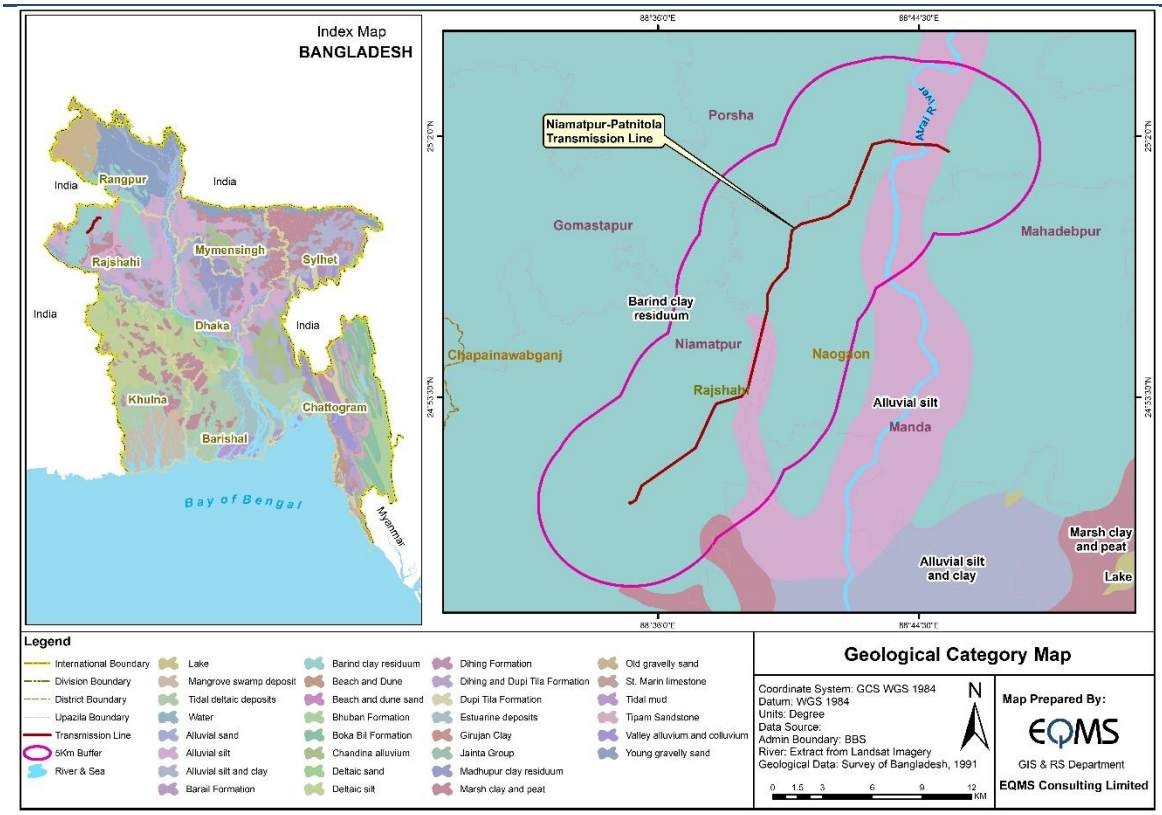
Figure 4-8: Geology of Rupsha-Satkhira, Domar-Purba Sadipur and Niamatpur-Patnitola



Rupsha-Satkhira



Domar-Purba Sadipur



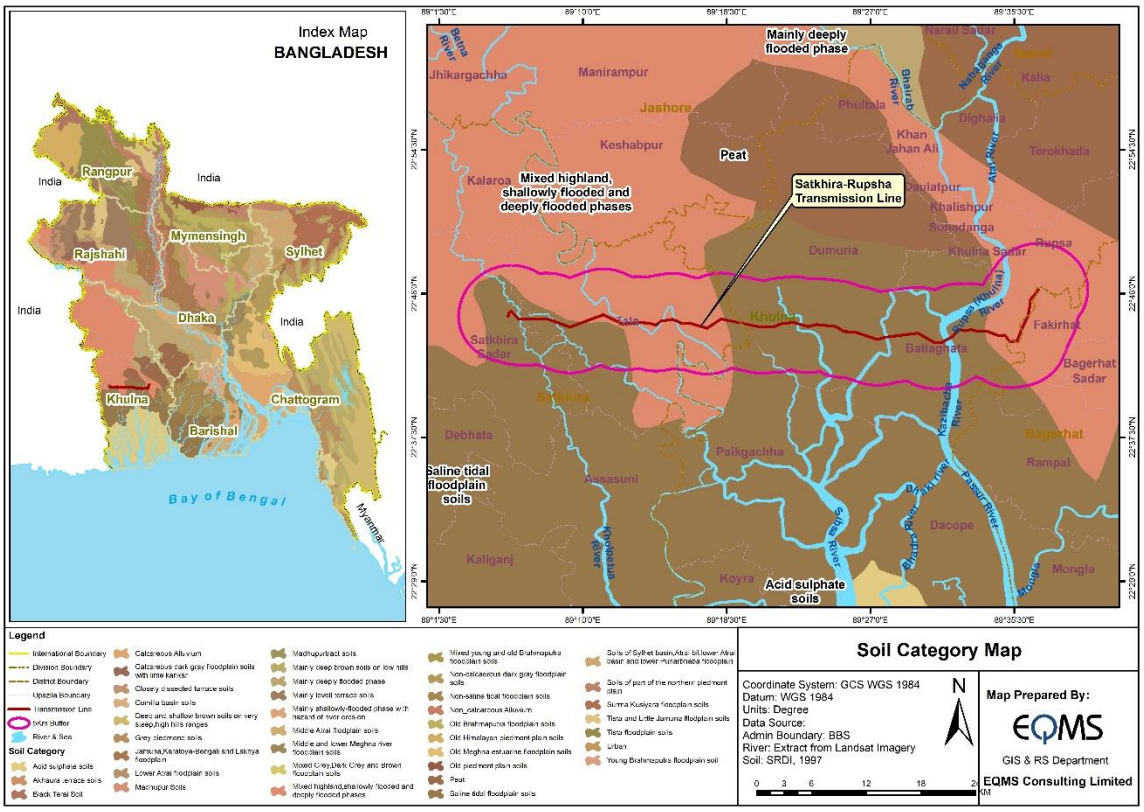
Niamatpur-Patnitola

Source: Survey of Bangladesh

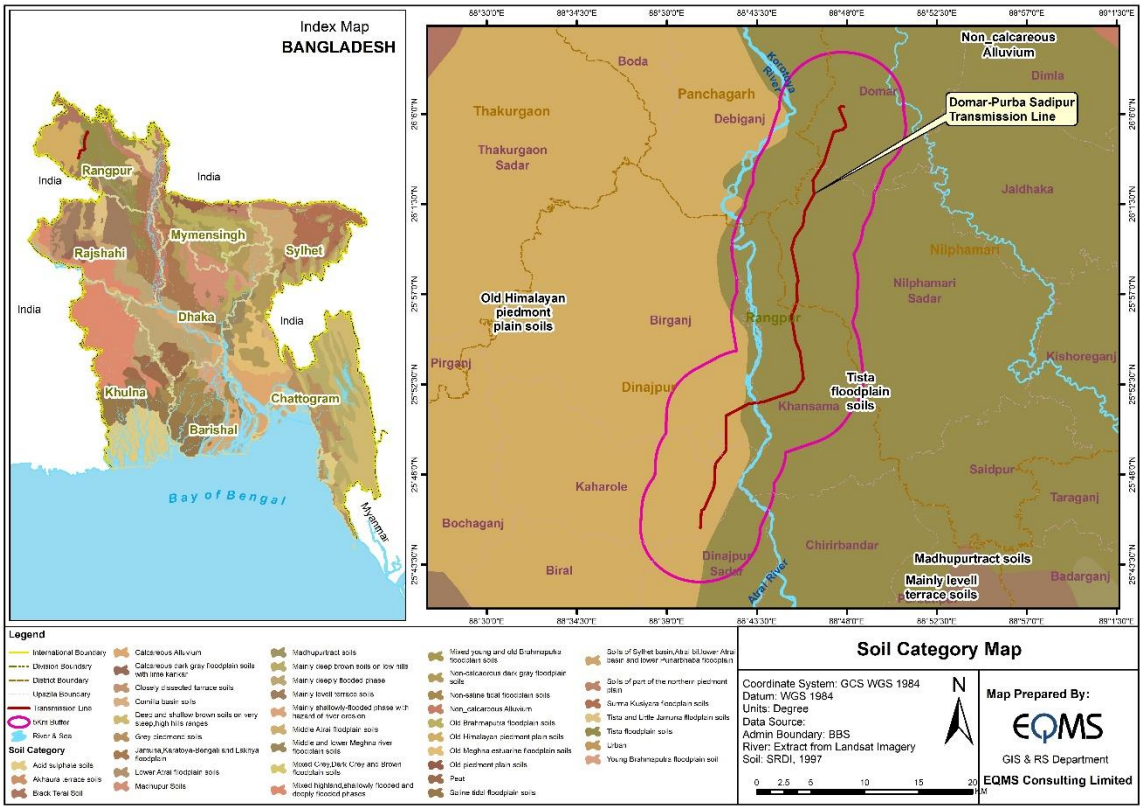
4.2.8 Soil

The project areas fall into seven different soil formation zones (Figure 4-9). The general soil types of 500m buffer of Rupsha-Satkhira, Domar-Purba Sadipur and Niamatpur-Patnitola route include the following: saline tidal floodplain, peat, mixed highland, shallow flooded and deeply flooded phase (Rupsha-Satkhira), mainly Tista floodplain soil in the north (Domar-Purba Sadipur) and mainly level terrace soils (Niamatpur-Patnitola). The soil category of Rupsha-Satkhira, Domar-Purba Sadipur and Niamatpur-Patnitola is shown in Figure 4-9.

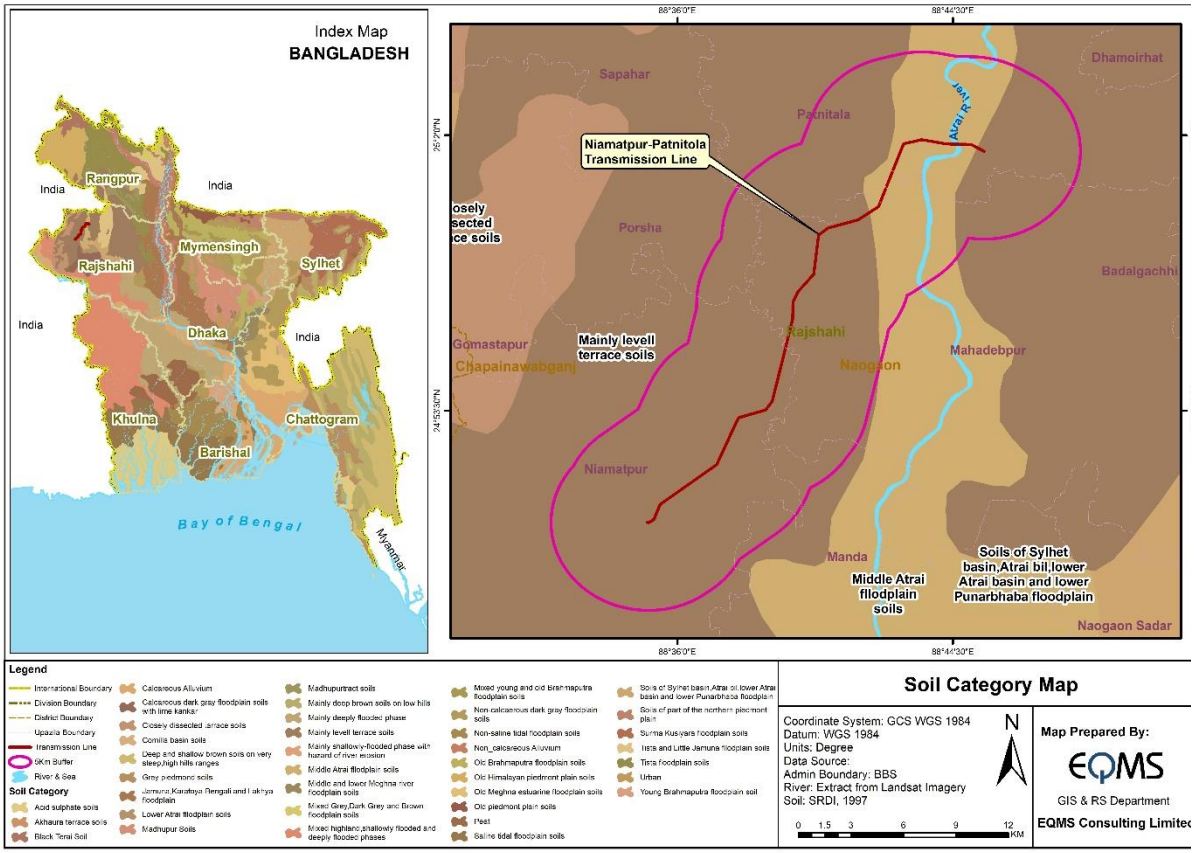
Figure 4-9: Soil Category of Rupsha-Satkhira, Domar-Purba Sadipur and Niamatpur-Patnitola



Rupsha-Satkhira



Domar-Purba Sadipur



Niamatpur-Patnitola

Source: Soil Resource Development Institute (SRDI)

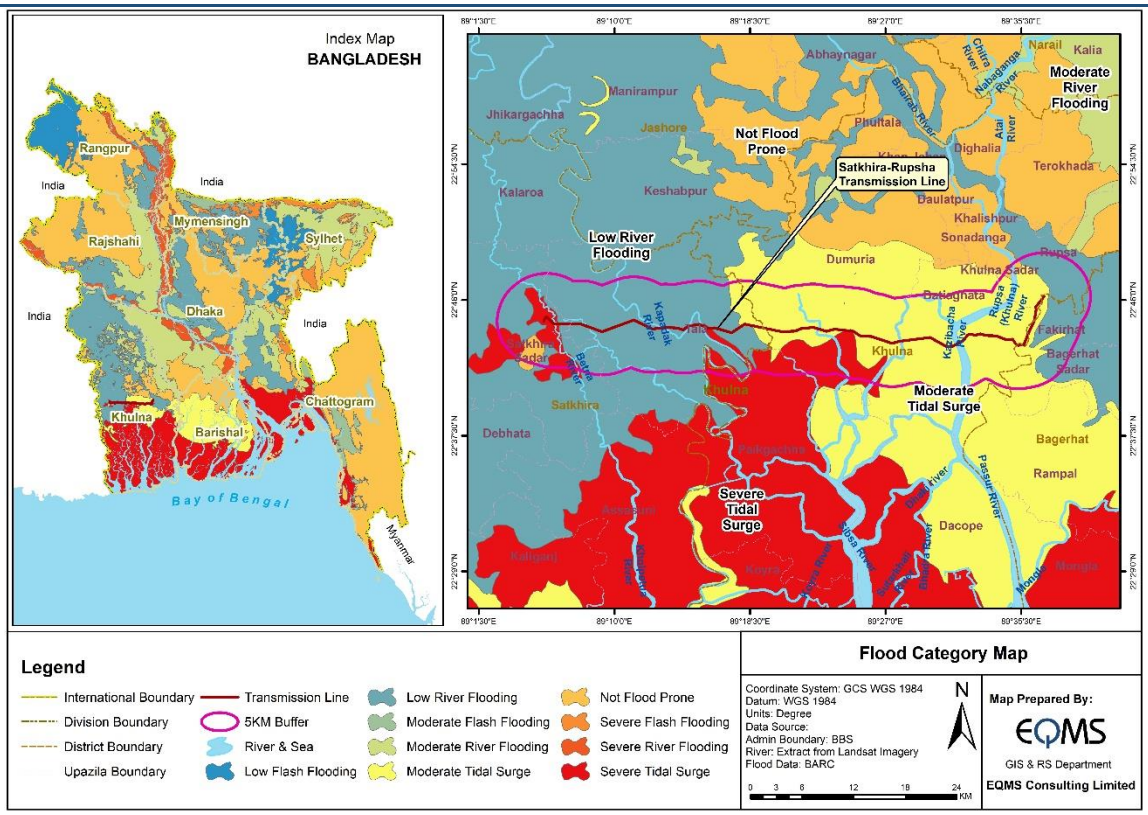
4.2.9 Flood prone areas

Bangladesh is prone to flooding, due to being situated on the Ganges Delta with many tributaries flowing into the Bay of Bengal. Flooding normally occurs during the monsoon season from June to September. The convectional rainfall of the monsoon is added to by relief rainfall caused by the Himalayas. Meltwater from the Himalayas is also a significant input and contributes to floods every year. This often lasts for about a month. Seventy-five percent of Bangladesh is less than 10 m above sea level and 80% is floodplain; therefore, the country is very much at risk of widespread damage due to floods, despite its development. Each year in Bangladesh about 26,000 km^2 (around 18%) of the country is flooded[3] [4]. As per the flood category map, Rupsha-Satkhira alignments fall under low river flooding and moderate tidal surge zone. The flood category map of Domar-Purba Sadipur alignment shows that majority of the 5km buffer of the route is prone to moderate tidal surge and low flash flood zone. As per the flood category map, Niamatpur-Patnitola alignments fall under no flood prone zone. Figure 4-10 represents flood prone areas Rupsha-Satkhira, Domar-Purba Sadipur and Niamatpur-Patnitola.

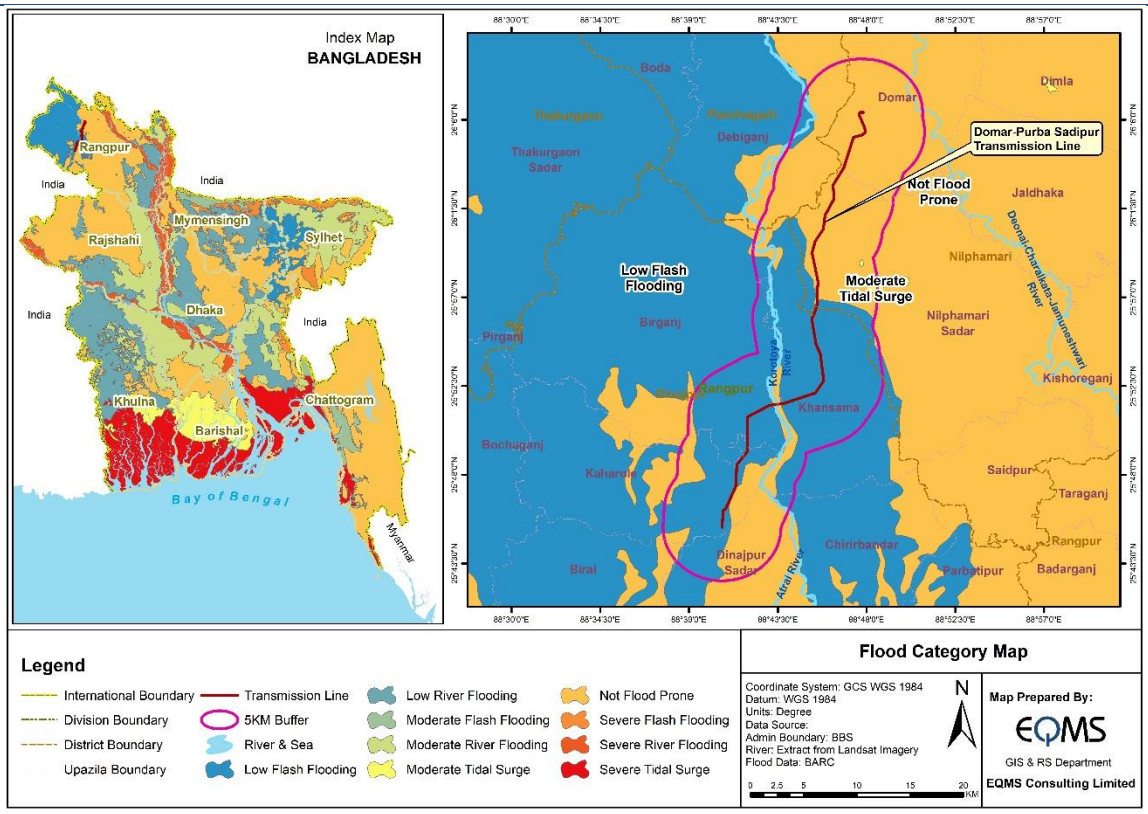
[3] http://en.banglapedia.org/index.php?title=Bangladesh Soil

[4] Bangladesh Agricultural Research Council (BARC)/GIS Project, BGD/95/006)

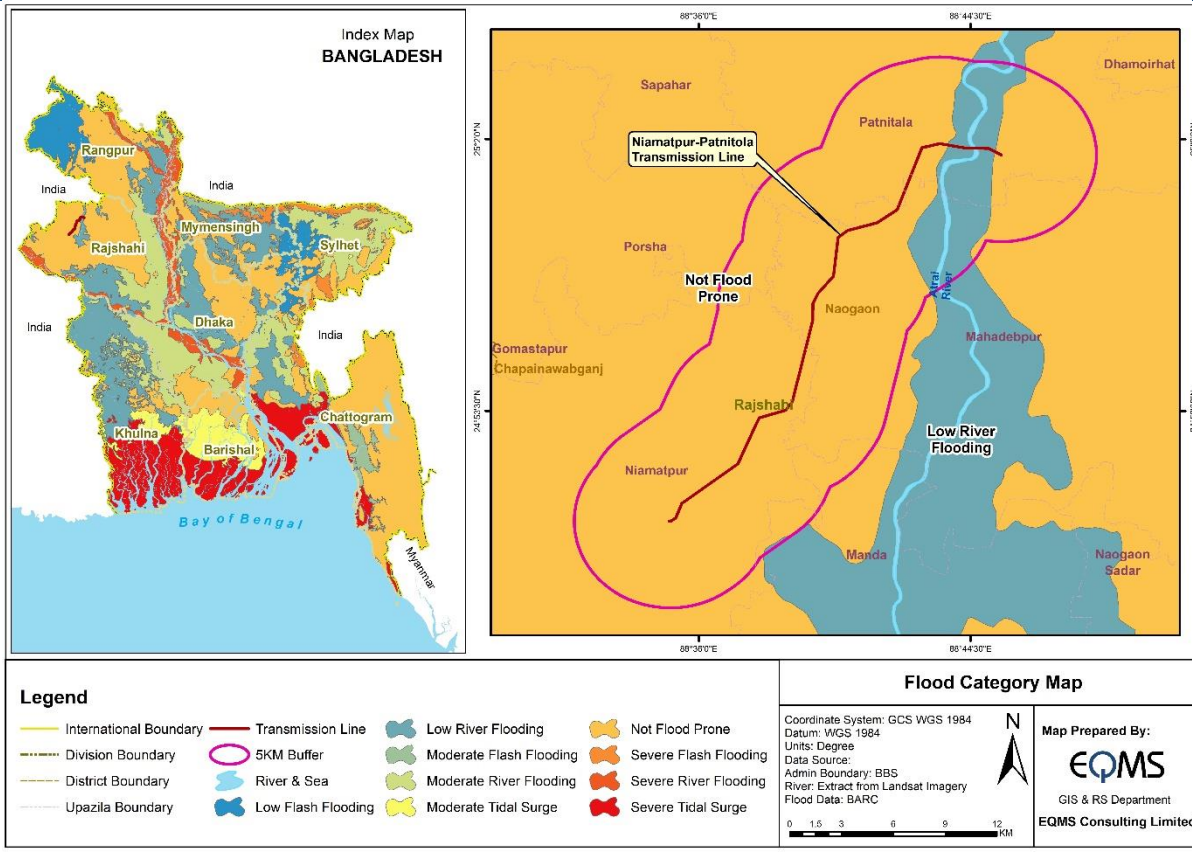
Figure 4-10: Flood Prone Category of Rupsha-Satkhira, Domar-Purba Sadipur and Niamatpur-Patnitola



Rupsha-Satkhira



Domar-Purba Sadipur



Niamatpur-Patnitola

Source: Bangladesh Agricultural Research Council (BARC)

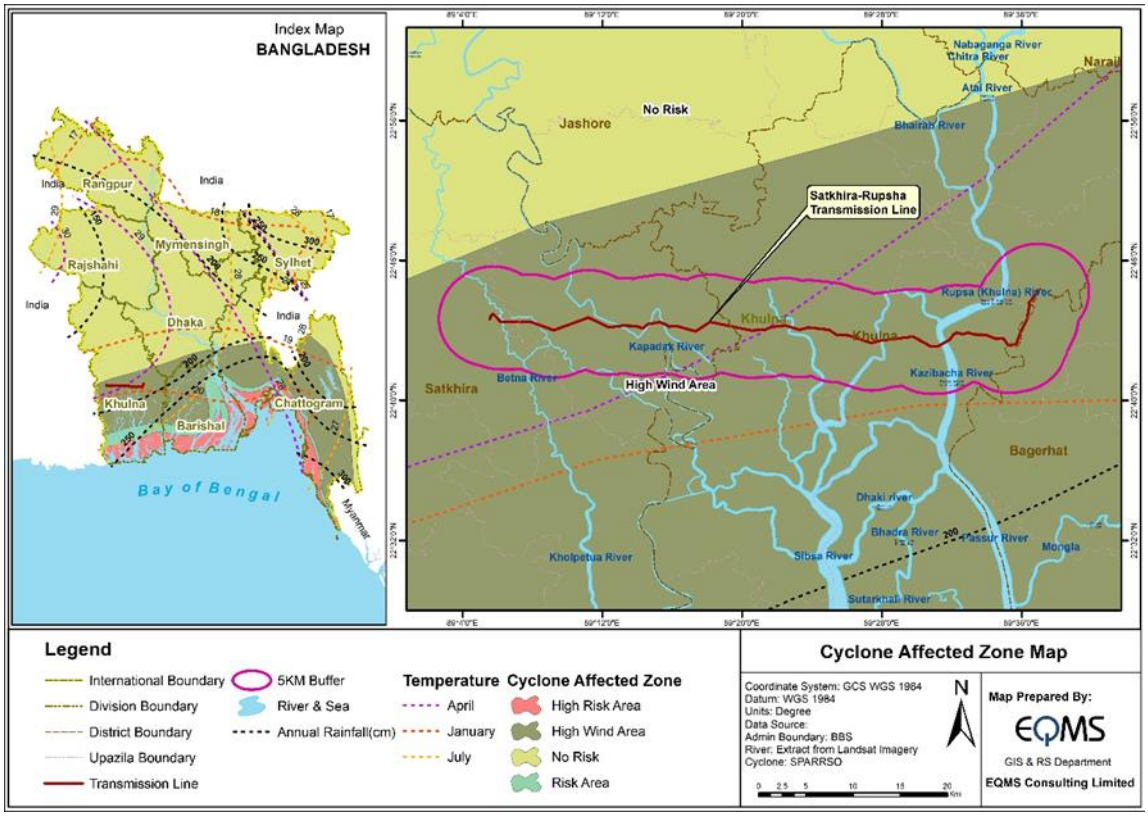
4.2.10 Cyclones

Bangladesh coast is one of the most cyclone prone areas of the world due to its geographical location and funnel shaped coast of the Bay of Bengal. Most of the damage occurs in the coastal regions of Khulna, Patuakhali, Barisal, Noakhali and Chattogram and the offshore islands of Bhola, Hatiya, Sandwip, Manpura, Kutubdia, Maheshkhali, Nijhum Dwip, Urir Char and other newly formed islands. Figure 4-11 shows cyclone affected area map of Bangladesh.

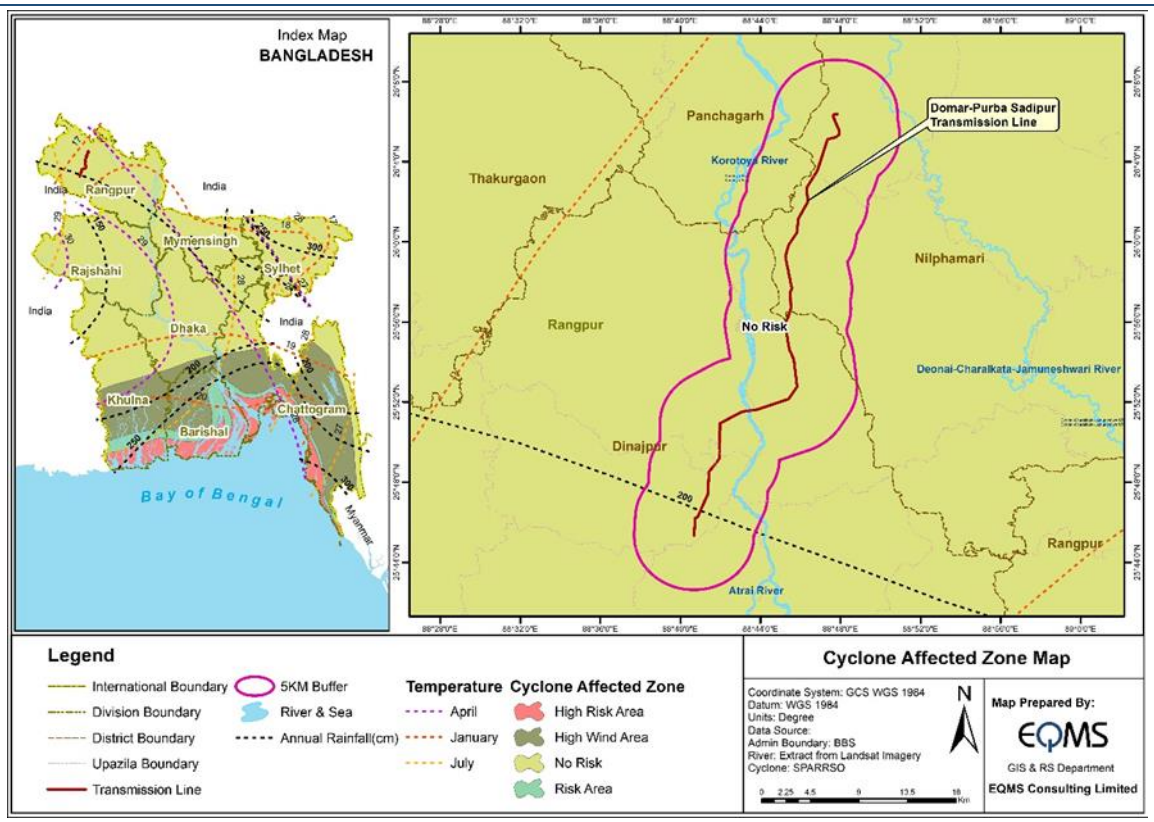
Devastating cyclones and associated storm surges hit the coastal zones almost every year and are usually accompanied by high-speed winds, sometimes reaching 250 km/hr. or more and with 3 m to 10 m high waves, causing extensive damage to life, property and livestock. These cyclones usually occur in two seasons, April- May and October-November i.e., before and after the monsoon season.

As per the cyclone affected zone map, majority of the Rupsha-Satkhira route fall under high wind area. Domar-Purba Sadipur and Niamatpur-Patnitola routes fall in no risk zone in regards to cyclone hazard. Figure 4-11 shows the cyclone affected zone map of the Rupsha-Satkhira, Domar-Purba Sadipur and Niamatpur-Patnitola routes.

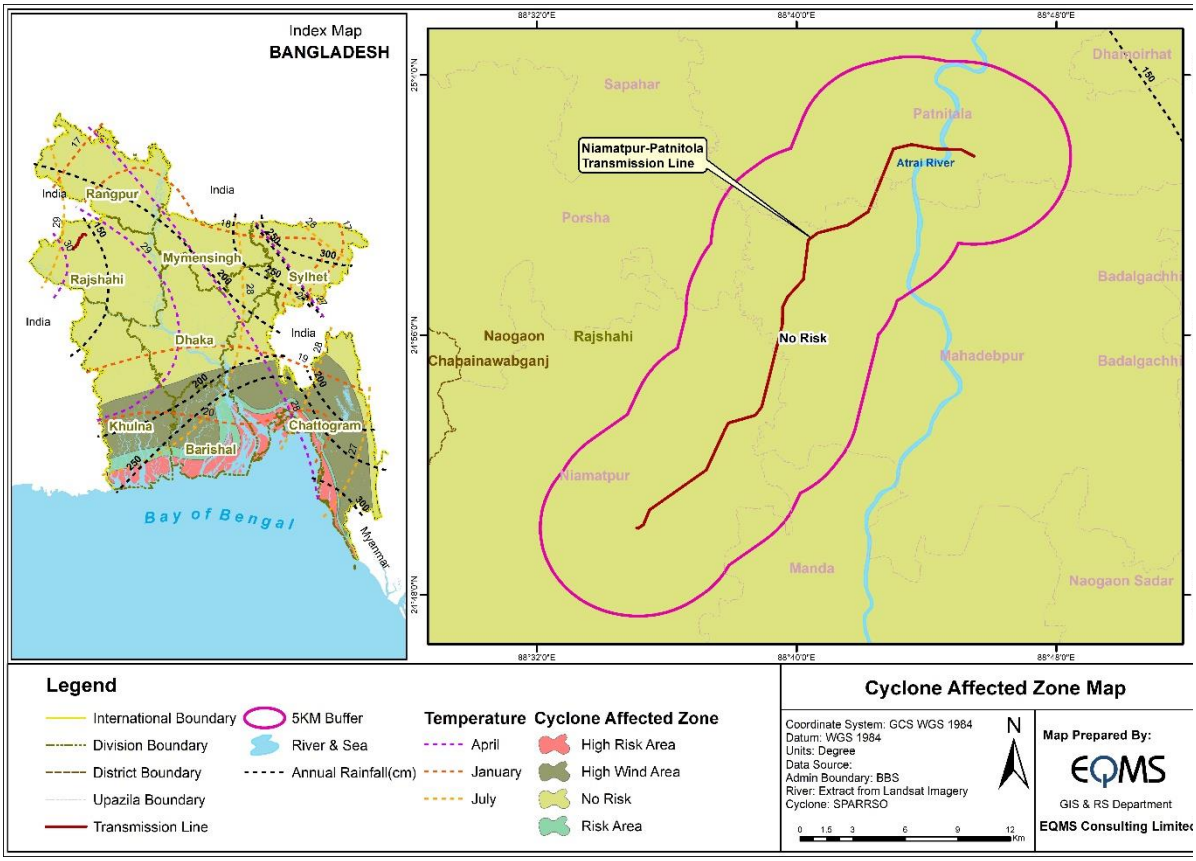
Figure 4-11: Cyclone affected zone map of the Rupsha-Satkhira, Domar-Purba Sadipur and Niamatpur-Patnitola alignments



Rupsha-Satkhira



Domar-Purba Sadipur



Niamatpur-Patnitola

Source: Bangladesh Space Research and Remote Sensing Organization (SPARRSO)

4.2.11 River Erosion

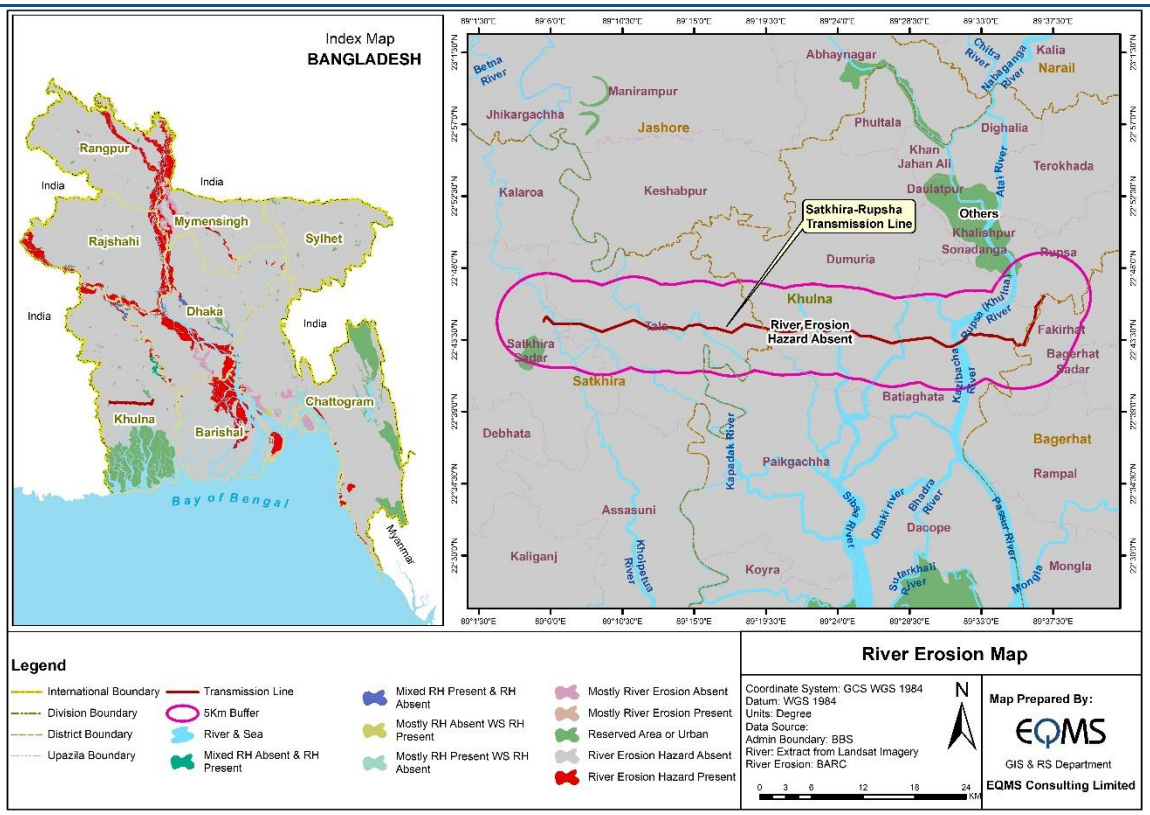
During the monsoon, extensive riverbank spills and riverbank erosion are typical. Riverbank erosion mainly occurs due to the braided nature of rivers in Bangladesh, and is further aggravated by heavy rainfall, particularly upstream, and increased water flow. Most recently, due to climate change, the rate of riverbank erosion has drastically increased, resulting in collapse of riverbanks and devastation of whole Unions and Upazila.

Every year, riverbank erosion leads to millions of people being affected as it results in damage and loss of crops, cattle, housing structures, and farmland. Additionally, it erodes away public infrastructure and communication systems. The unpredictable shifting behavior of the rivers and their encroachments not only affect the rural floodplain population but also the urban growth centers and infrastructures.

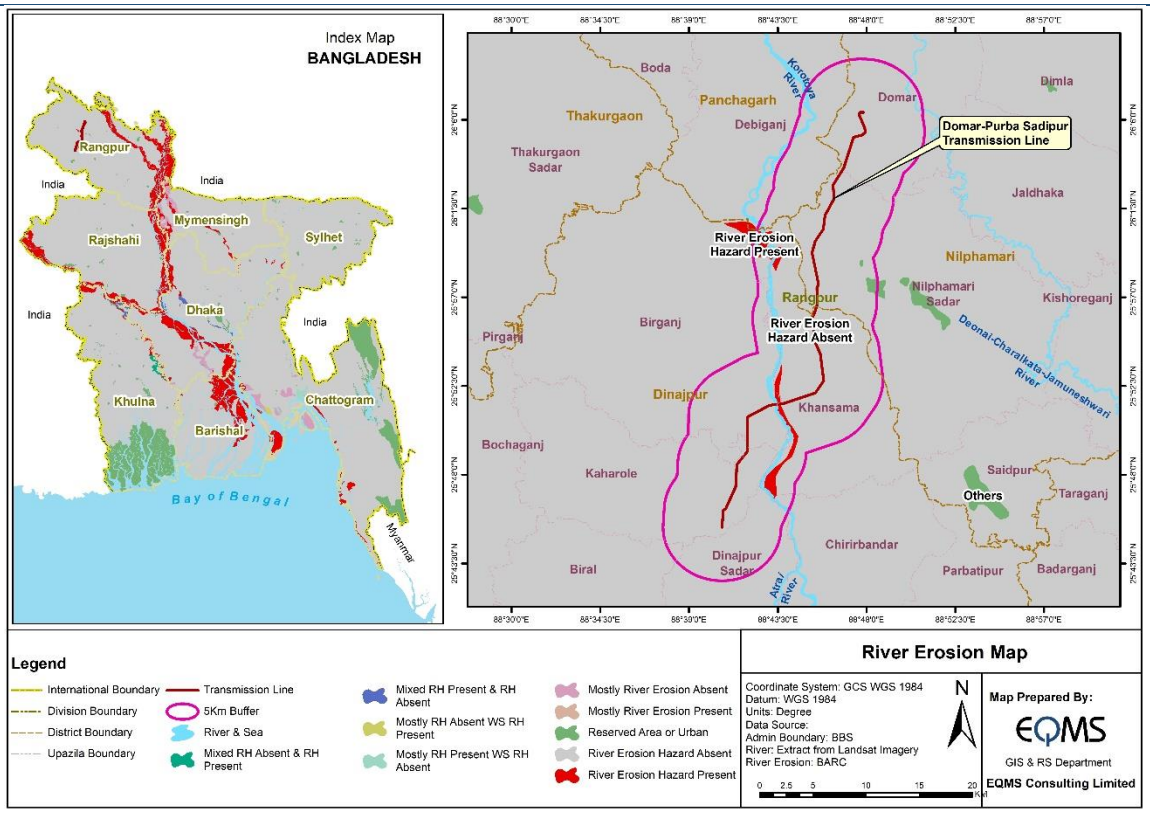
According to the Bangladesh Water Development Board (BWDB) the most erosion prone districts are Bogra, Sirajganj, Kurigram, Lalmonirhat, Gaibandha and Rangpur, in the country's north, and Chandpur, Manikganj, Rajbari Shariatpur, and Faridpur in Dhaka zone, with Tangail and Jamalpur in Mymensingh zone, and the coastal areas of Patuakhali. The most erosion prone area in Bangladesh is Sirajganj, which faced a total land erosion at a rate of 622.2 ha, according to a CEGIS study in 2009 (Unnayan Onneshan 2012).

As per river erosion map, river erosion hazard is absent in majority of the Rupsha-Satkhira, Domar-Purba Sadipur and Niamatpur-Patnitola route. The river erosion map of Rupsha-Satkhira, Domar-Purba Sadipur and Niamatpur-Patnitola routes is shown in Figure 4-12.

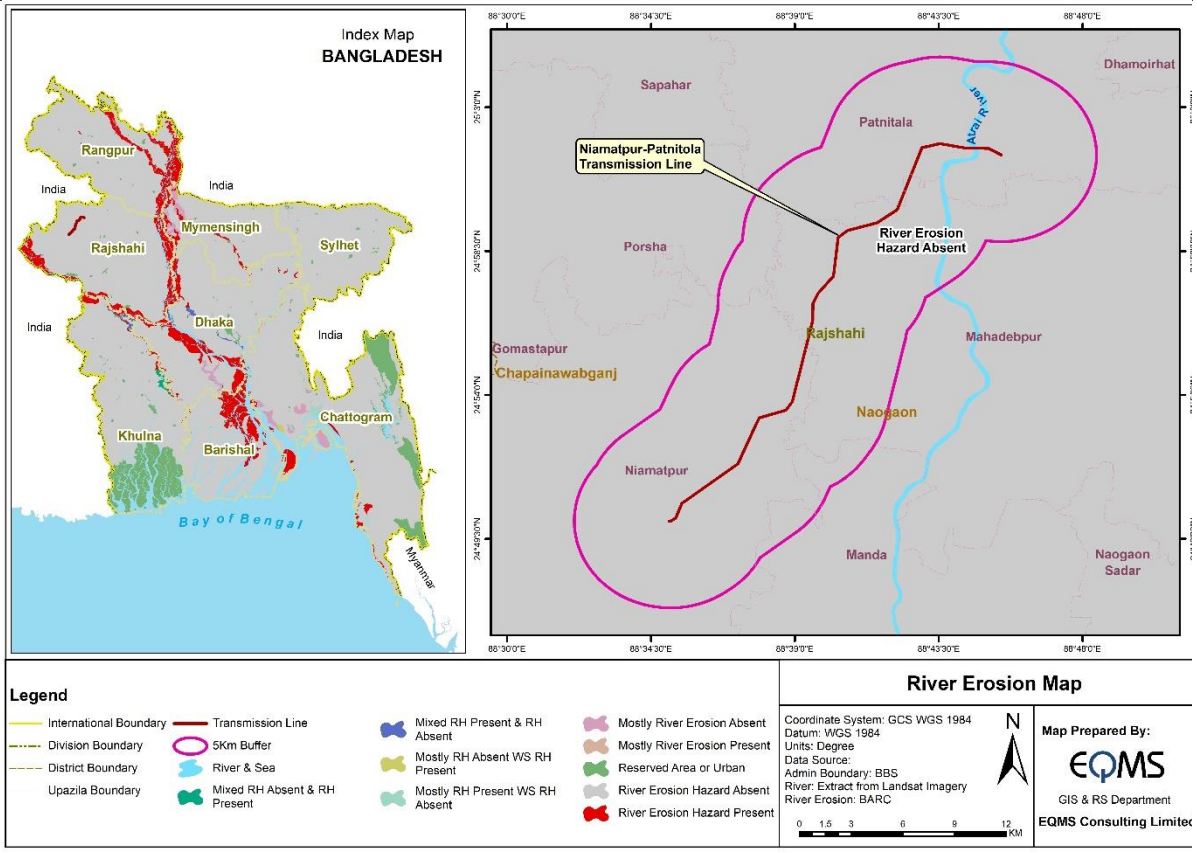
Figure 4-12: River erosion map of Rupsha-Satkhira, Domar-Purba Sadipur and Niamatpur-Patnitola routes.



Rupsha-Satkhira



Domar-Purba Sadipur



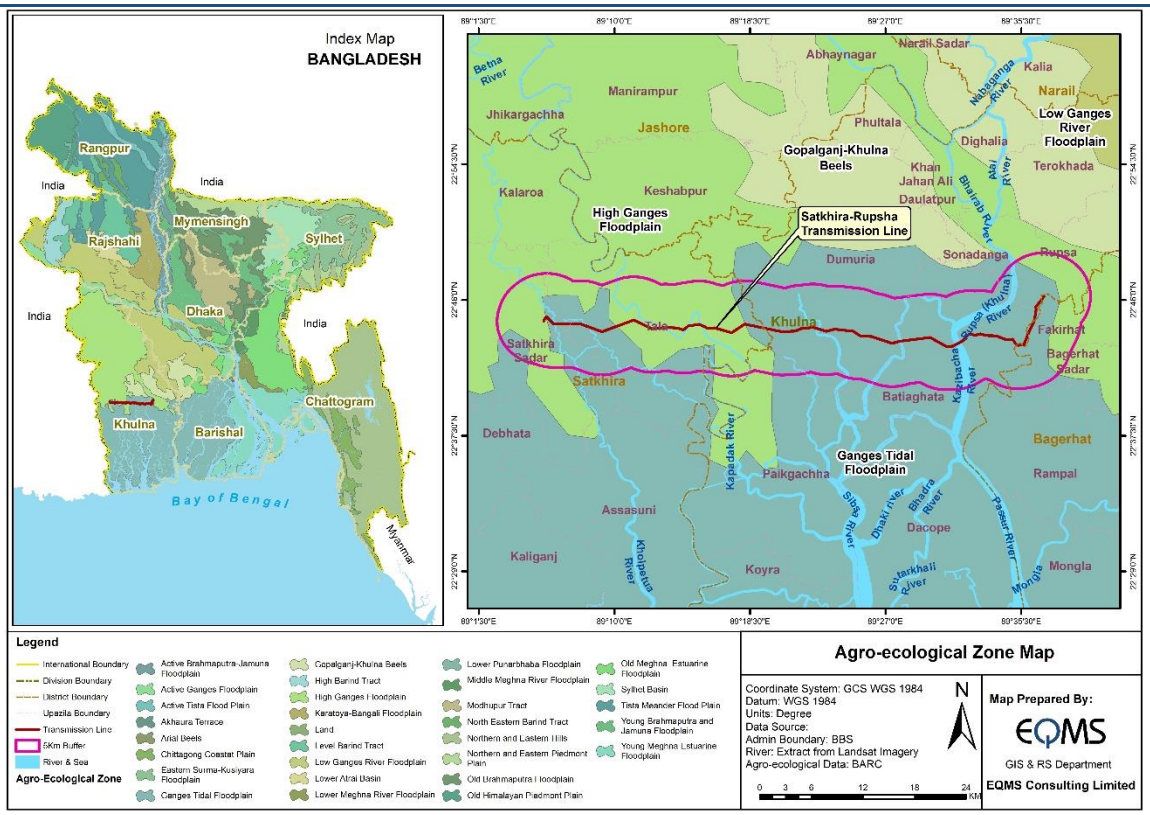
Niamatpur-Patnitola

Source: Bangladesh Agricultural Research Council (BARC)

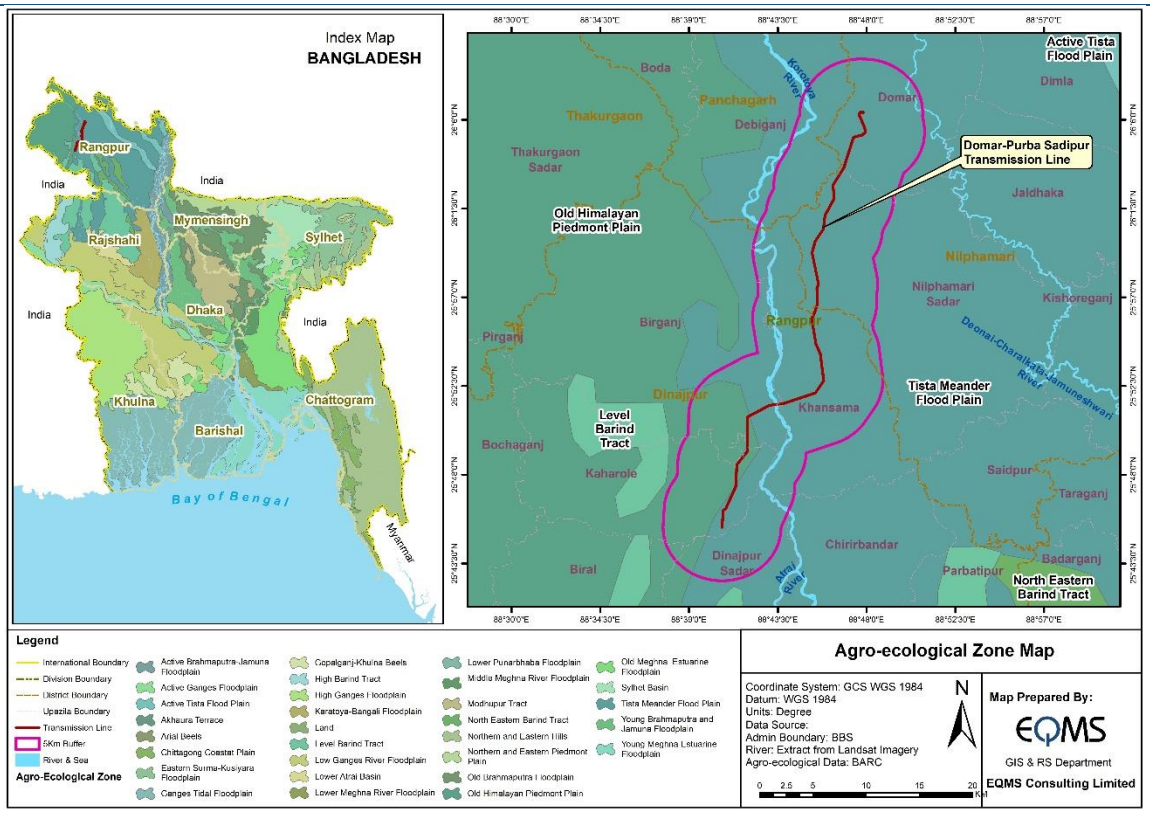
4.2.12 Agro-ecological zones of Bangladesh

The agro-ecological zones of Bangladesh have been identified based on four elements including physiography, soils, land levels in relation to flooding, and agro-climatology. Bangladesh has been tentatively divided into 30 agro-ecological zones. These 30 zones have been further subdivided into 88 agro-ecological sub-regions, which have been further subdivided into 535 agro- ecological units. Rupsha-Satkhira transmission line alignment falls in the High Ganges Floodplain and Ganges Tidal Floodplain zone. On the other hand, Domar-Purba Sadipur route fall in the Tista Meander Floodplain zone. Niamatpur-Patnitola route fall in the Level Barind Tract and Tista Meander Floodplain zone. The Agro-ecological zone of Rupsha-Satkhira, Domar-Purba Sadipur and Niamatpur-Patnitola has been shown in Figure 4-13.

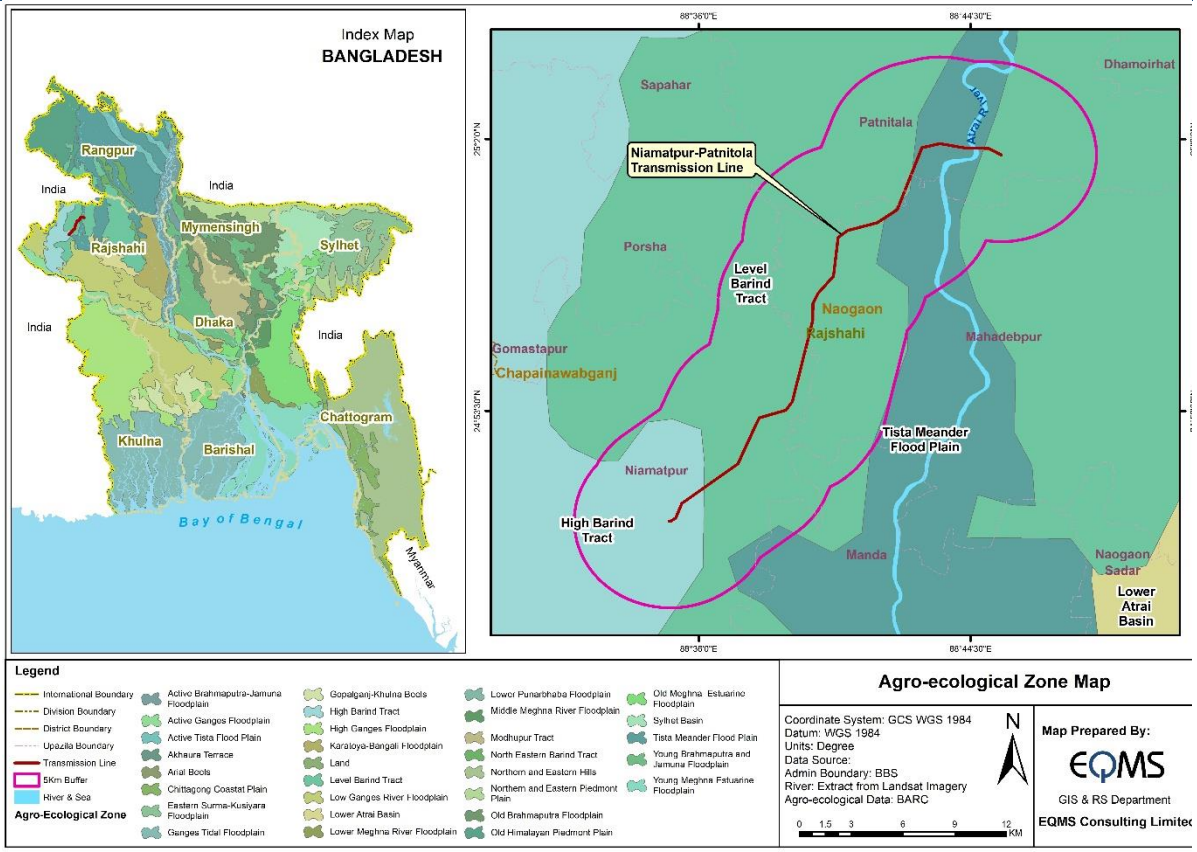
Figure 4-13: Agro-ecological zone of Rupsha-Satkhira, Domar-Purba Sadipur and Niamatpur-Patnitola



Rupsha-Satkhira



Domar-Purba Sadipur



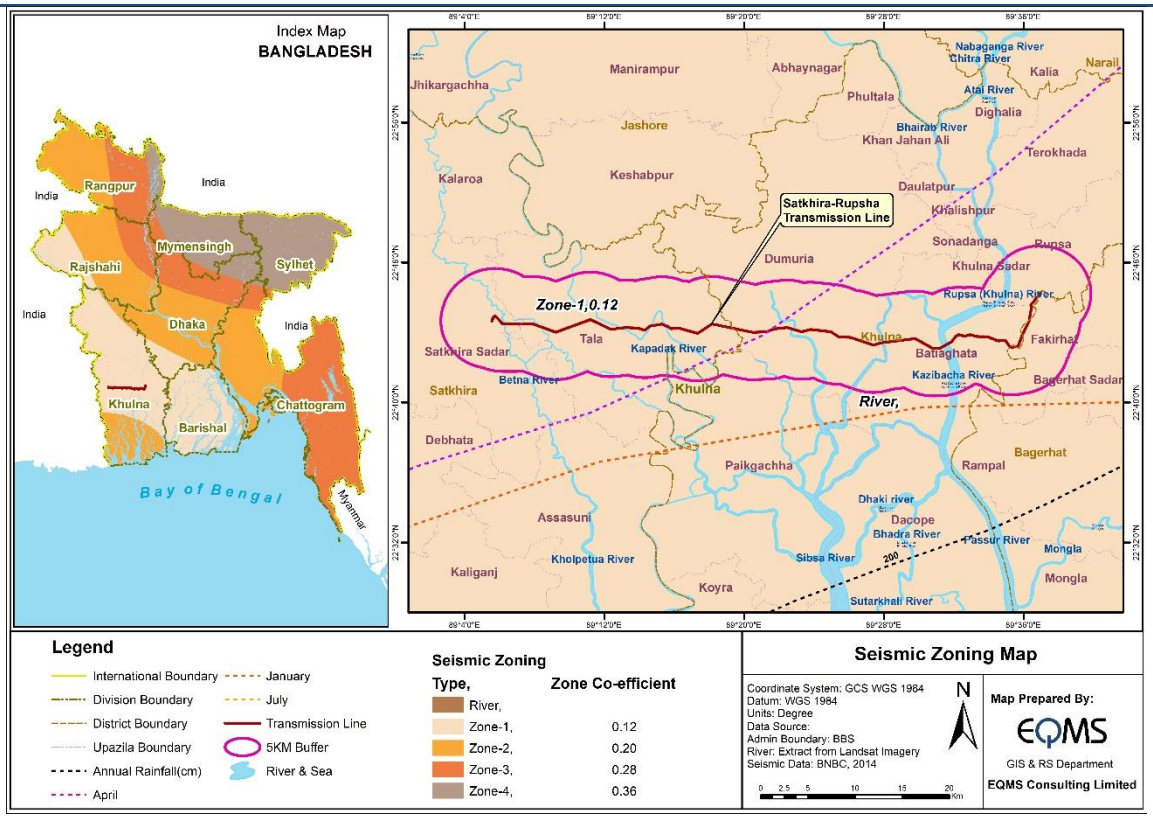
Niamatpur-Patnitola

Source: Bangladesh Agricultural Research Council (BARC)

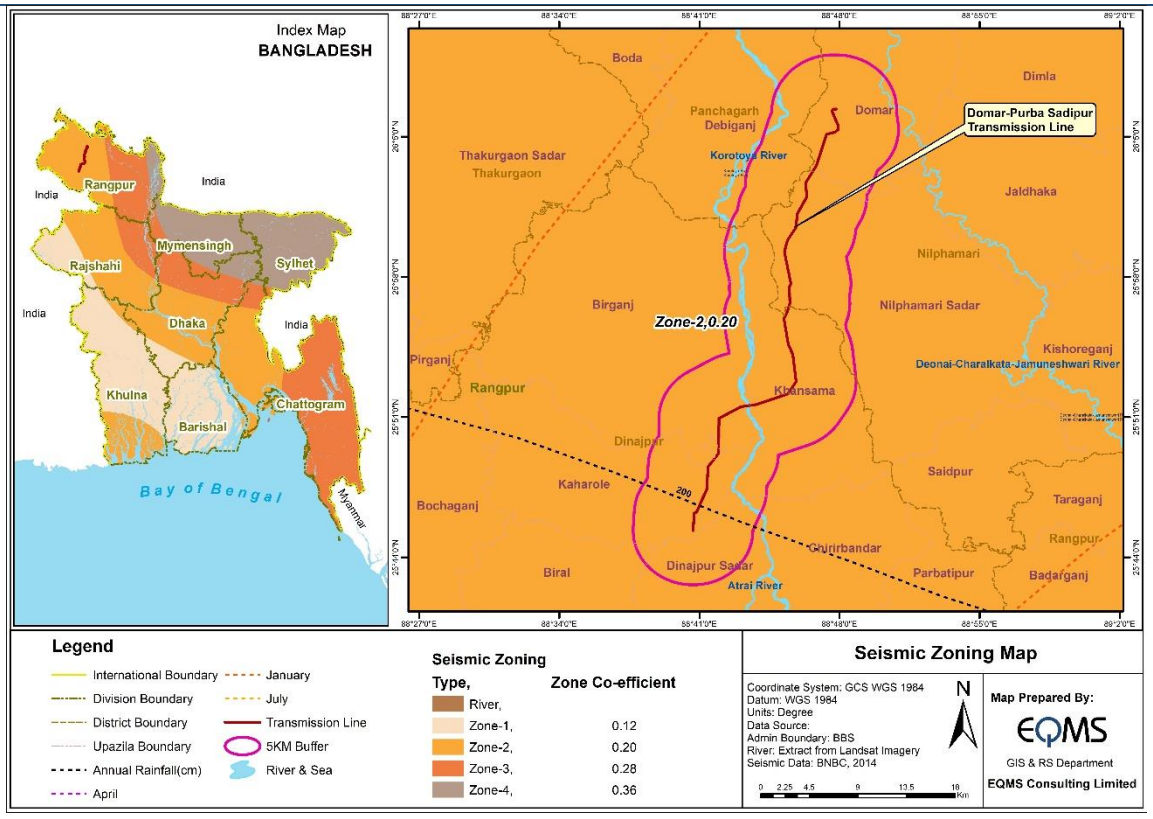
4.2.13 Seismic zones of Bangladesh

Bangladesh can be affected by moderate to strong earthquake events due to its proximity to the collision boundary of the Northeast moving Indian plate and the Eurasian Plate. Strong historical earthquakes with magnitude greater than 7.0 (Richter scale) have affected parts of Bangladesh in the last 150 years; some of them had their epicenters within the country. As per Bangladesh National Building Code (BNBC) seismic zoning map, Rupsha-Satkhira alignment falls into Zone-1 having the coefficient of 0.12. Domar-Purba Sadipur and Niamatpur-Patnitola alignments fall in the Zone-2, which has the zoning coefficient of 0.20. The seismic zoning map of Rupsha-Satkhira, Domar-Purba Sadipur and Niamatpur-Patnitola has been shown in Figure 4-14.

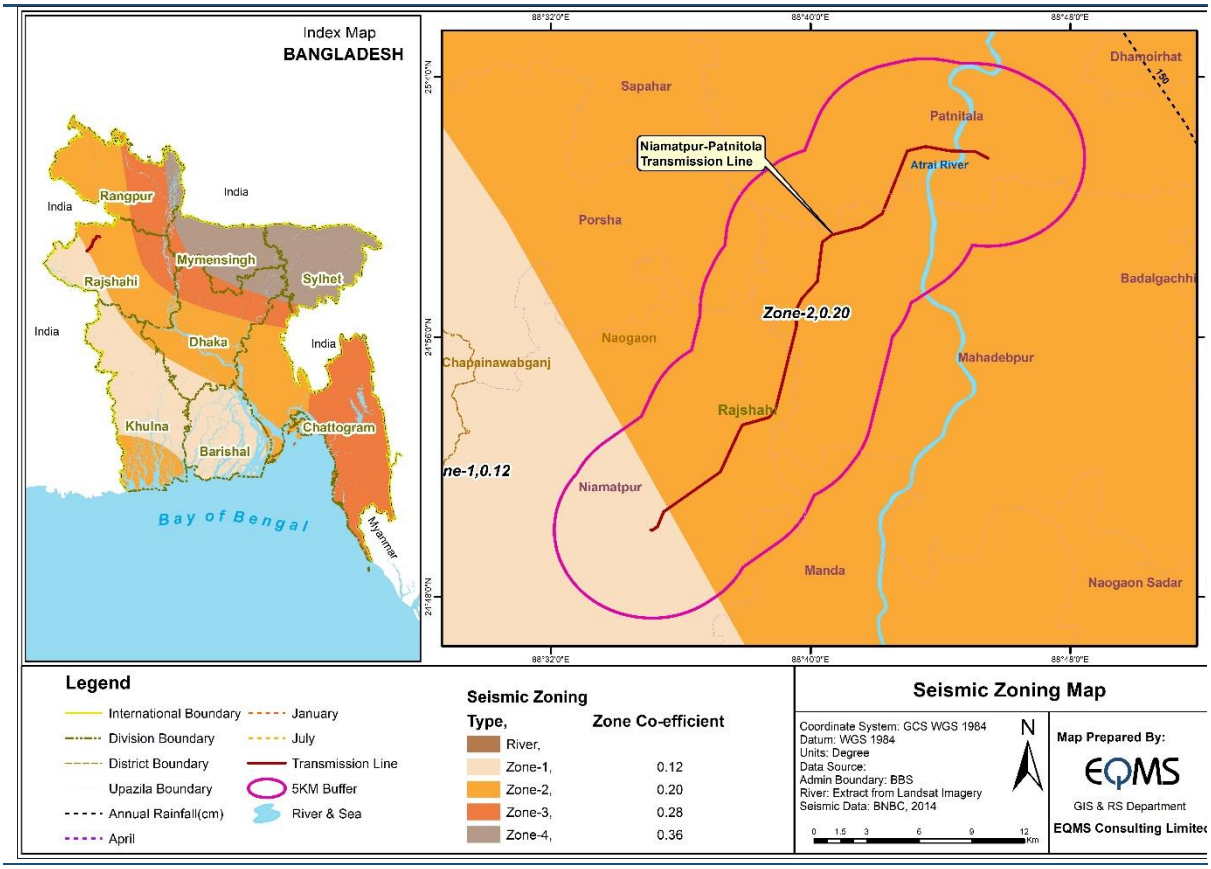
Figure 4-14: Seismic zoning of Rupsha-Satkhira, Domar-Purba Sadipur and Niamatpur-Patnitola



Rupsha-Satkhira



Domar-Purba Sadipur



Niamatpur-Patnitola

Source: Bangladesh National Building Code (BNBC)

4.2.14 Land Use Interpretation of the Study Area

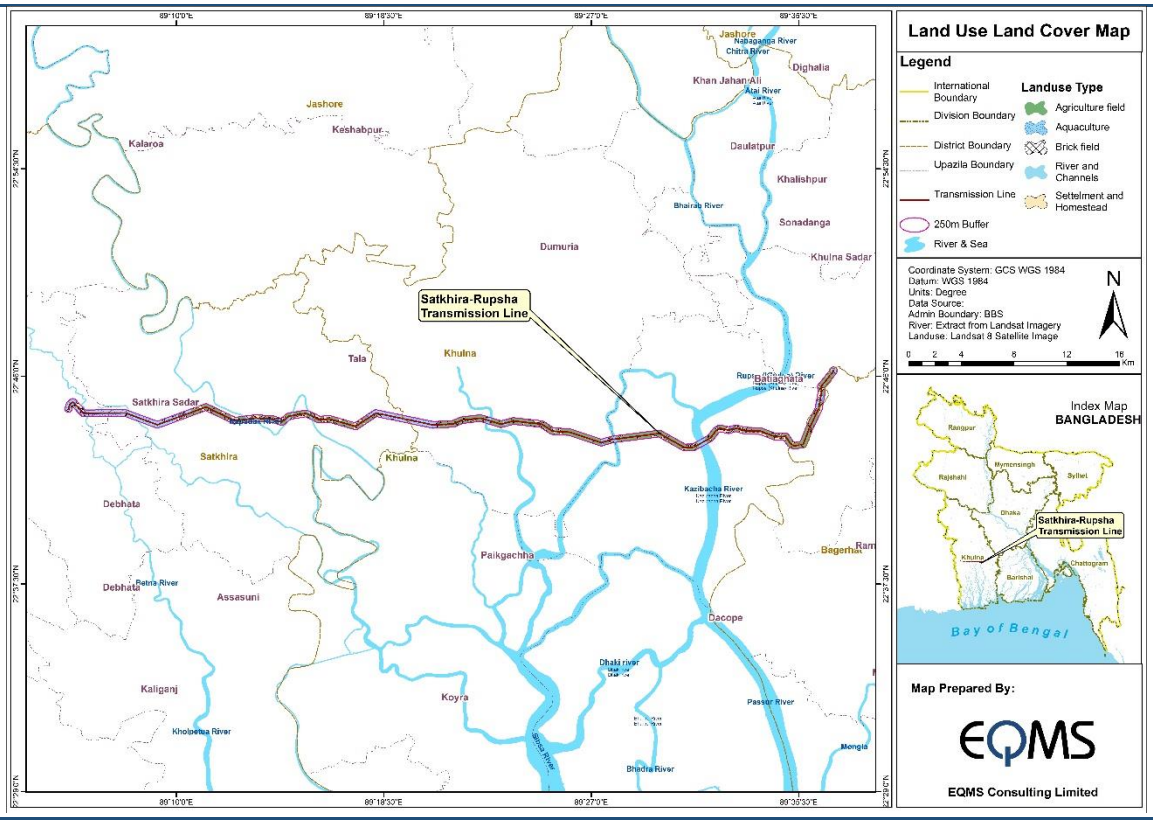
4.2.14.1 Rupsha to Satkhira

The predominant land use-land cover of 500 m buffer (250m each side of the alignment) of Rupsha to Satkhira route includes aquaculture (23.45 %) and agriculture land (57.52 %). Other category land-use and land cover in the study area includes settlement and homestead (15.09 %) and river and channels (3.25 %), road, etc. During the survey, no settlements were found beneath the proposed transmission line route. The major waterbodies covered are rivers and gher, however, the transmission line will not pose any risk to seasonal habitats/wetlands and birds. The land use of the study area is presented in Table 4-21 and Figure 4-15.

Table 4-21: Land Use Pattern for Rupsha to Satkhira Route

Type	Area (Acres)	Percentage
Agriculture field	4420.13	57.52
Aquaculture	1801.74	23.45
Brick field	53.41	0.70
River and Channels	249.44	3.25
Settlement and Homestead	1159.31	15.09
Total	**7684.03**	**100**

Figure 4-15: Land Use Map of Rupsha to Satkhira Route



Source: GIS Mapping and Interpretation of Satellite imagery by EQMS

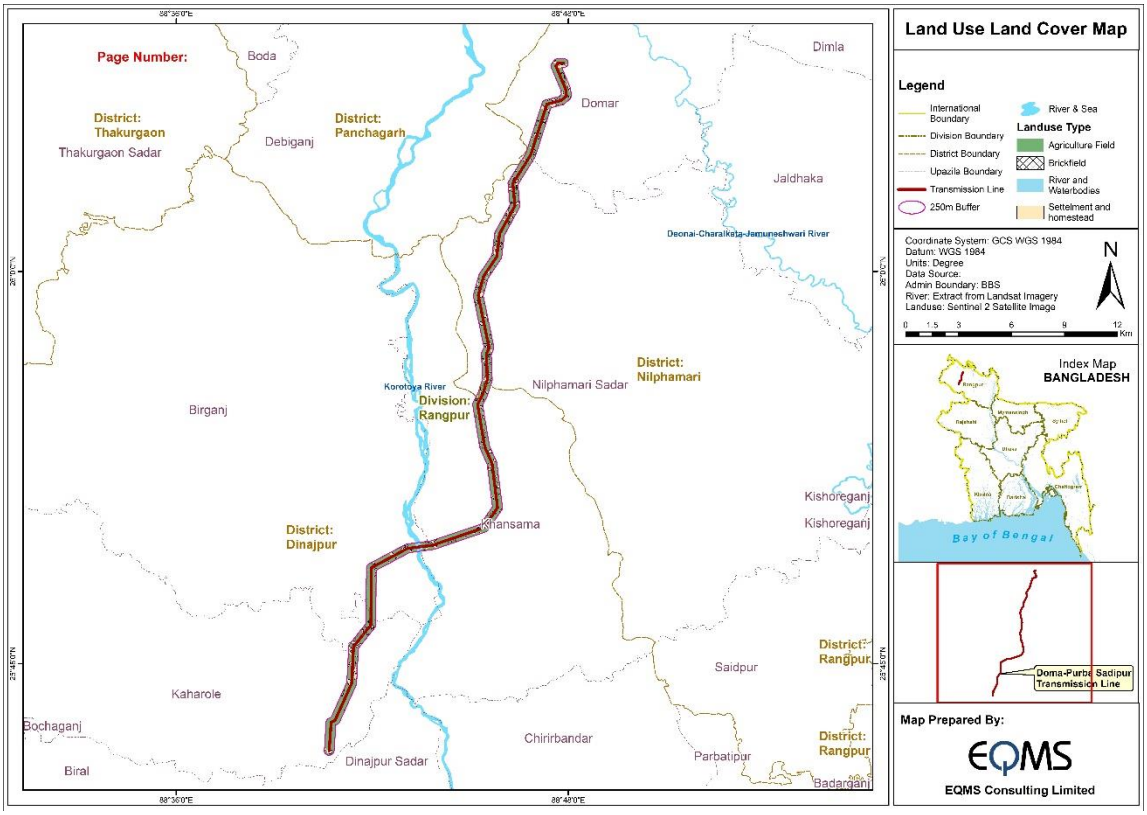
4.2.14.2 Domar to Purba Sadipur

The significant land use-land cover of 500 m buffer (250m each side of the alignment) of Domar to Purba Sadipur route includes settlement and homestead (10.99 %) and agriculture land (87.98 %). Other category land-use and land cover in the study area includes brickfields (0.27 %) and waterbody (0.76 %) etc. During the survey, no settlements were found beneath the proposed transmission line route. The 230 kV transmission line will not pose any risk to seasonal habitats/wetlands and birds. The land use of the study area is presented in Table 4-21 and Figure 4-16.

Table 4-22: Land Use Pattern for Domar to Purba Sadipur route

Type	Area (Acres)	Percentage
Agriculture Field	5007.15	87.98
Brickfield	15.63	0.27
River and Waterbodies	43.08	0.76
Settlement and homestead	625.22	10.99
Total	**5691.08**	**100**

Figure 4-16: Land Use Map of Domar to Purba Sadipur route



Source: GIS Mapping and Interpretation of Satellite imagery by EQMS

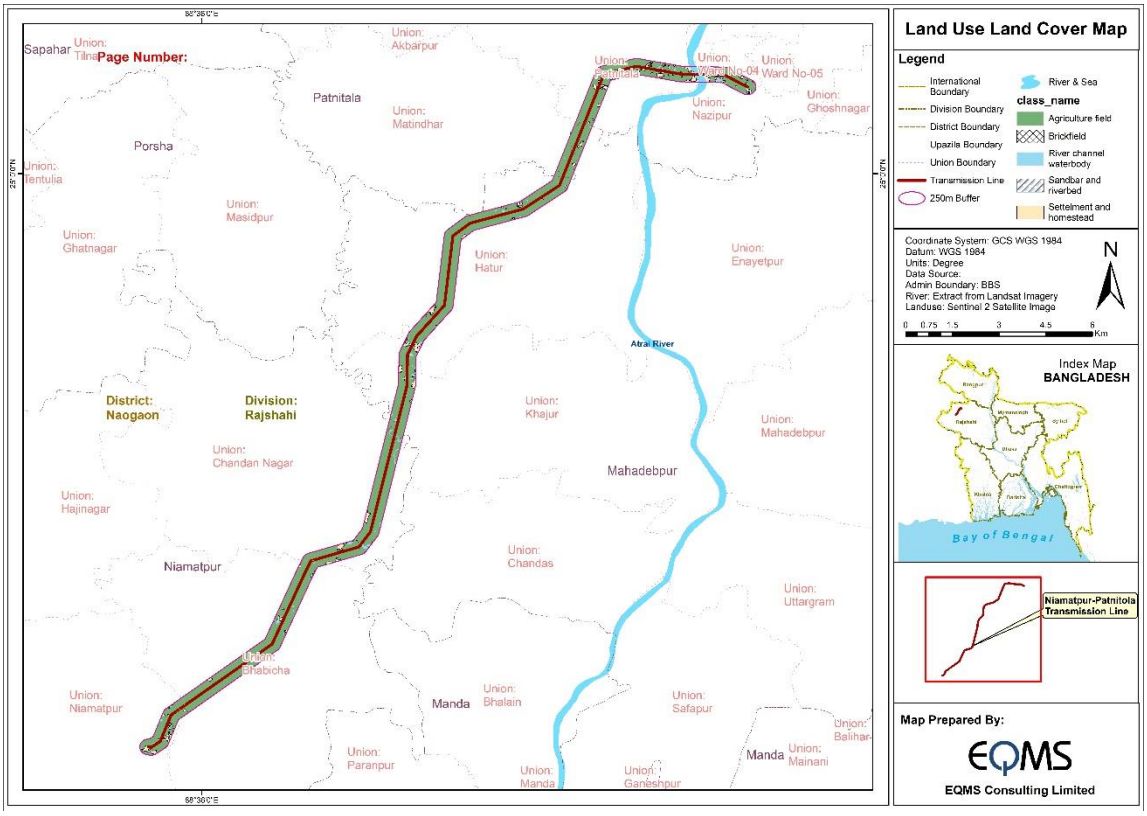
4.2.14.3 Niamatpur to Patnitola

The significant land use-land cover of 500 m buffer (250m each side of the alignment) of Domar to Purba Sadipur route includes settlement and homestead (5.68 %) and agriculture land (91.62 %). Other category land-use and land cover in the study area includes brickfields (0.24 %) and waterbody (2.39 %) etc. During the survey, no settlements were found beneath the proposed transmission line route. The 230 kV transmission line will not pose any risk to seasonal habitats/wetlands and birds. The land use of the study area is presented in Table 4-21 and Figure 4-16.

Table 4-23: Land Use Pattern for Niamatpur-Patnitola route

Type	Area (Acres)	Percentage
Agriculture field	3624.45	91.62
Brickfield	9.61	0.24
River and Waterbodies	94.57	2.39
Sandbar	2.55	0.06
Settlement and homestead	224.80	5.68
Total	**3955.98**	**100**

Figure 4-17: Land Use Map of Niamatpur-Patnitola route



Source: GIS Mapping and Interpretation of Satellite imagery by EQMS

4.3 Bio-Ecological Zones

Within a relatively small geographic area, Bangladesh has a diverse array of ecosystems. Being a low-lying deltaic country, seasonal variation in water availability is the major factor, which generates different ecological scenarios in Bangladesh. Temperature, rainfall, physiographic variations in soil and different hydrological conditions play vital roles in the country's diverse ecosystems. The ecosystems of Bangladesh are categorized into two major groups: (i) land based and (ii) aquatic. The land-based ecosystems include forest and hill ecosystems, agroecosystems and homestead ecosystems, while seasonal and perennial wetlands, rivers, lakes, coastal mangroves, coastal mudflats and chars, and marine ecosystems fall into the aquatic category.

In 2002, the International Union for Conservation of Nature (IUCN) classified the country into 12 bio-ecological zones (25 sub-bio-ecological zones) according to factors such as fauna and flora, geographical characteristics, annual average rainfall, administrative regions, soil types, water level in Bangladesh.

4.3.1 Diversity of Floral and Faunal Species

The subproject impact areas are mixed with different vegetation. Crops and vegetables dominate and are cultivated in the surrounding areas and include mainly paddy (rice), jute, mustard, onion, garlic, potato and a variety of homestead vegetables. A sizeable number of fruit trees with economic value were observed in the project area.

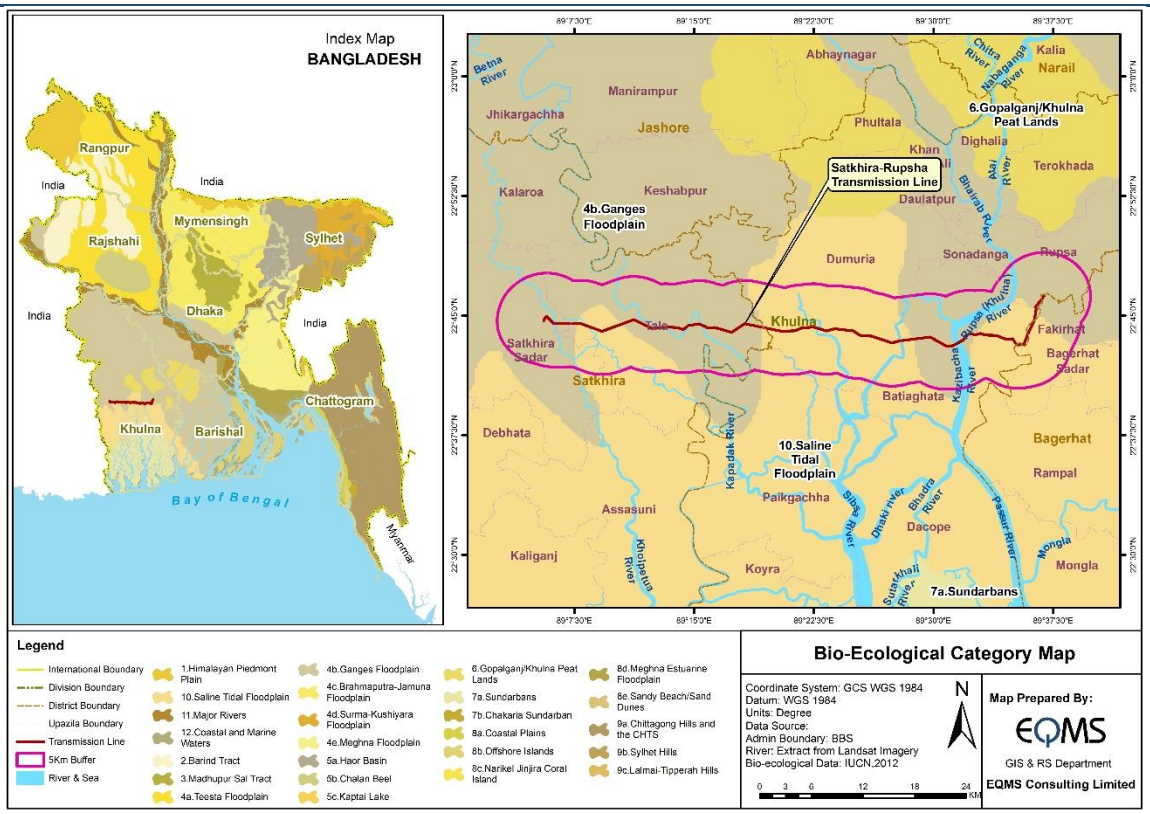
As per EQMS Survey 2022, In Rupsha-Satkhira transmission line, the number of trees estimated in the 12 m clearing width of the line was 264 (>5 m in height). The common trees are Mahogany, Albizia, date palm, Areca palm and coconut. The number of trees in the clearing width which are less than 5 m in height was 439.

As per EQMS Survey 2022, In Domar-Purba Sadipur transmission line, the number of trees estimated in the 12 m clearing width of the line was 726 (>5 m in height). The common trees are Eucalyptus, Acacia, Litchi, Margosa, Samanea saman (Renty Korol) and Mahogany. The number of trees in the clearing width which are less than 5 m in height was 73.

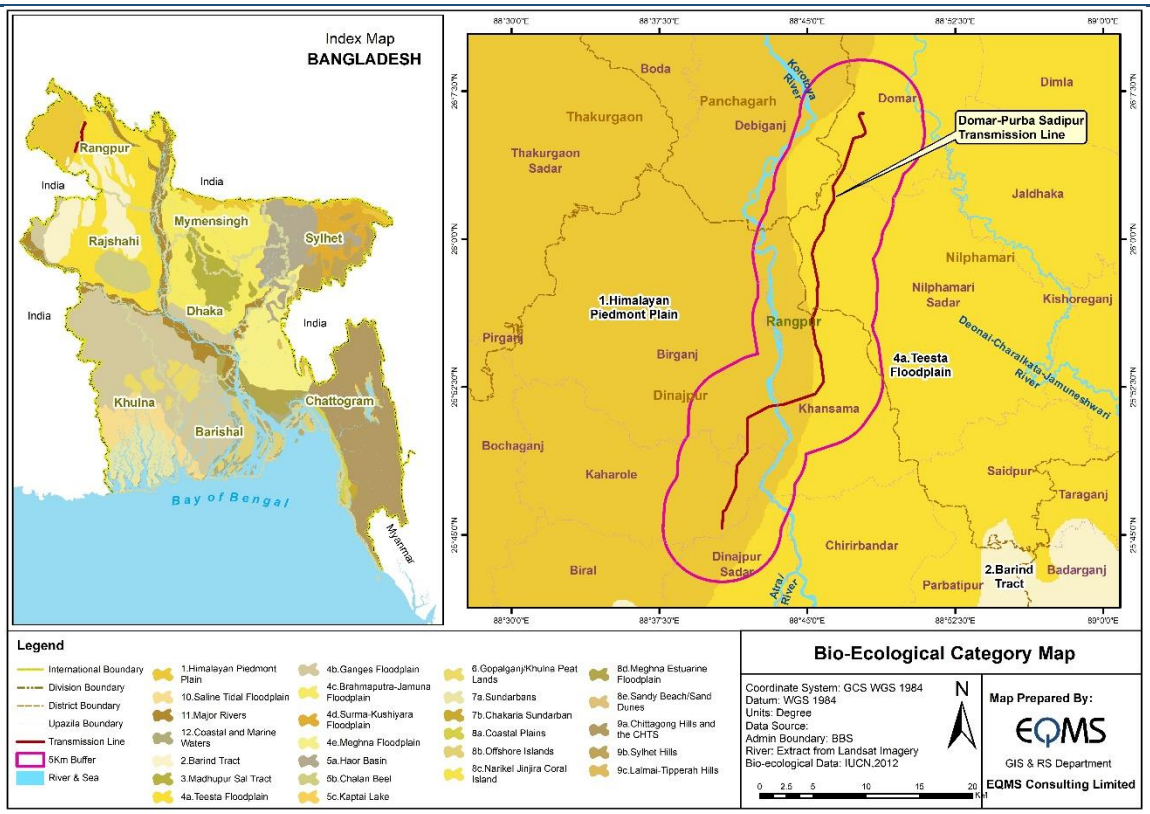
The trees which are greater than 5 m in height found in the direct impact zone (12 m clearing width) of the Niamatpur-Patnitola Transmission Line is 474 excluding bamboo and banana trees. The trees less than 5 m in height recorded at 70 within the direct impact zone. The common tree species are Eucalyptus, Mahogany, Margosa, Palmyra, and Dalbergia (Shisu).

No IUCN Red listed threatened species were recorded during site visit walkover. Major waterbodies covered in the alignments are rivers and gher. The proposed transmission line will not pose any risk to seasonal habitats/wetlands and birds. Bio-ecological Zones of Rupsha-Satkhira, Domar-Purba Sadipur and Niamatpur-Patnitola is shown in Figure 4-18.

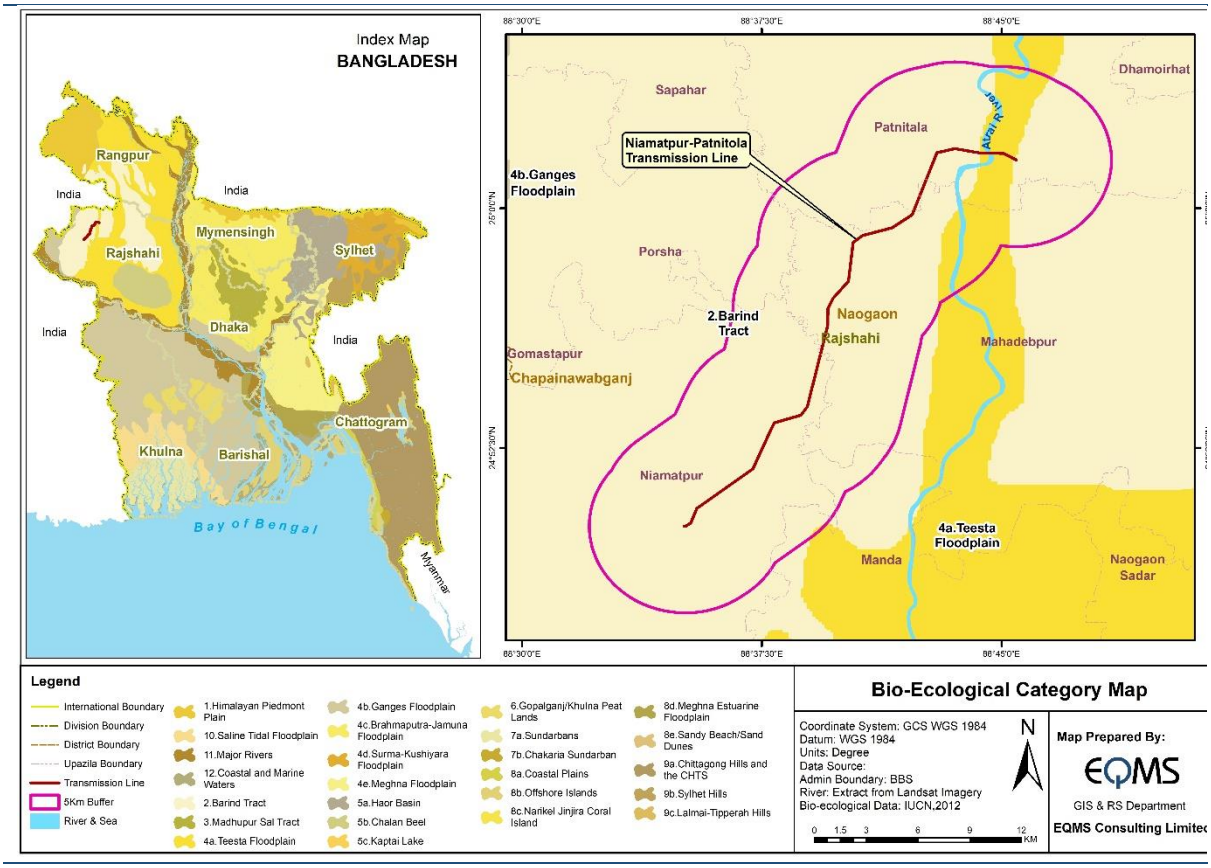
Figure 4-18: Bio-ecological Zones of Rupsha-Satkhira, Domar-Purba Sadipur and Niamatpur-Patnitola



Rupsha-Satkhira



Domar-Purba Sadipur



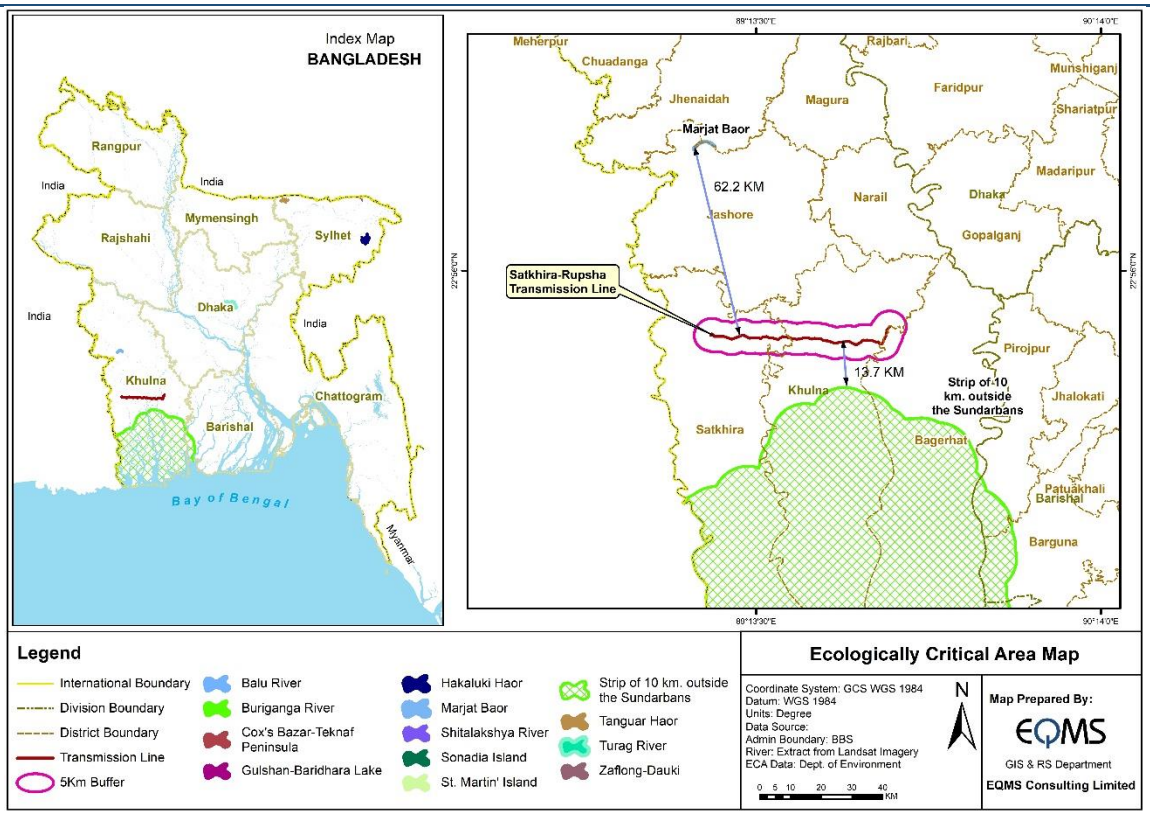
Niamatpur-Patnitola

Source: International Union for Conservation of Nature (IUCN)

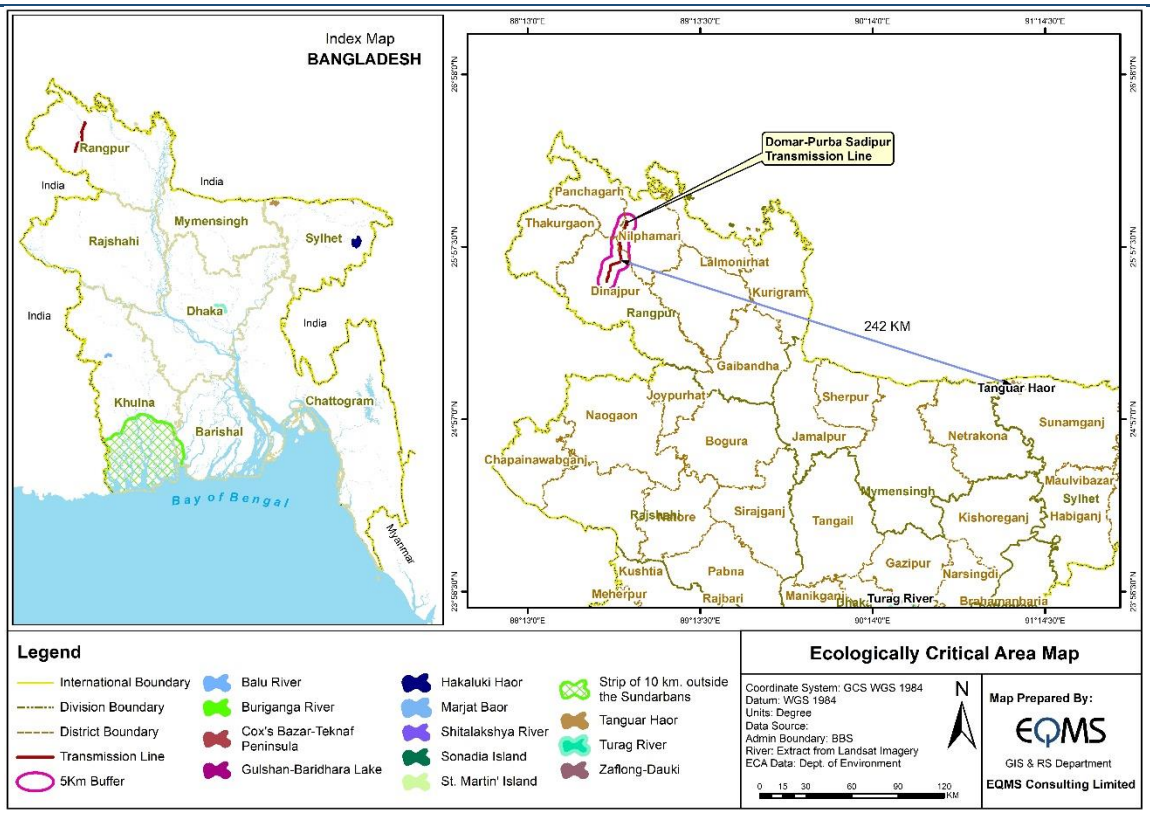
4.3.2 Ecologically Critical Area (ECA)

There are two ECAs situated near Rupsha-Satkhira transmission line. These are the Sundarbans and Marjat Baor. The Sundarbans border lies 13.7 km away from transmission line and Marjat Baor situated far away from the line is about 62.2 km. The nearest ECA from the Domar-Purba Sadipur alignment is Tanguar haor which is 242km away from the route. The nearest ECA from the Niamatpur-Patnitola alignment is Marjat Baor situated far away from the line is about 183.1 km. The ECAs near transmission lines of Rupsha-Satkhira, Domar-Purba Sadipur and Niamatpur-Patnitola is shown in Figure 4-19.

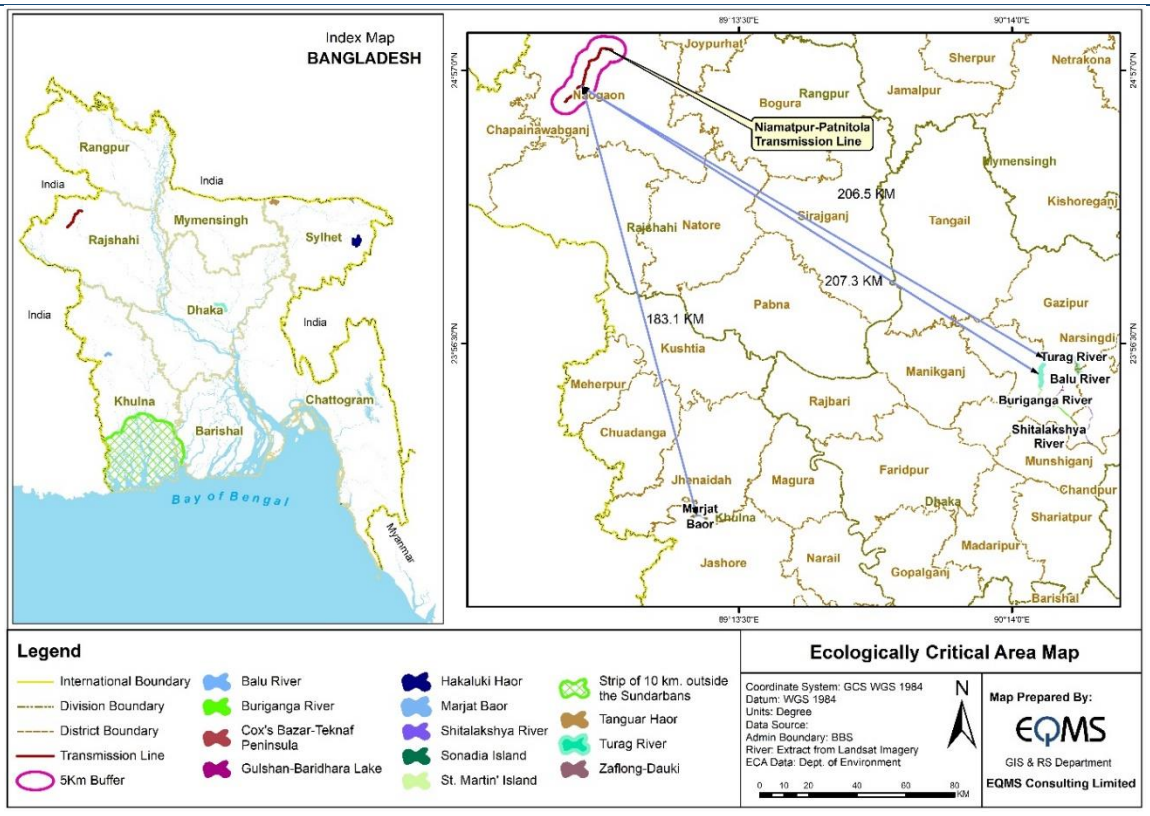
Figure 4-19: ECAs near transmission lines of Rupsha-Satkhira, Domar-Purba Sadipur and Niamatpur-Patnitola



Rupsha-Satkhira



Domar-Purba Sadipur



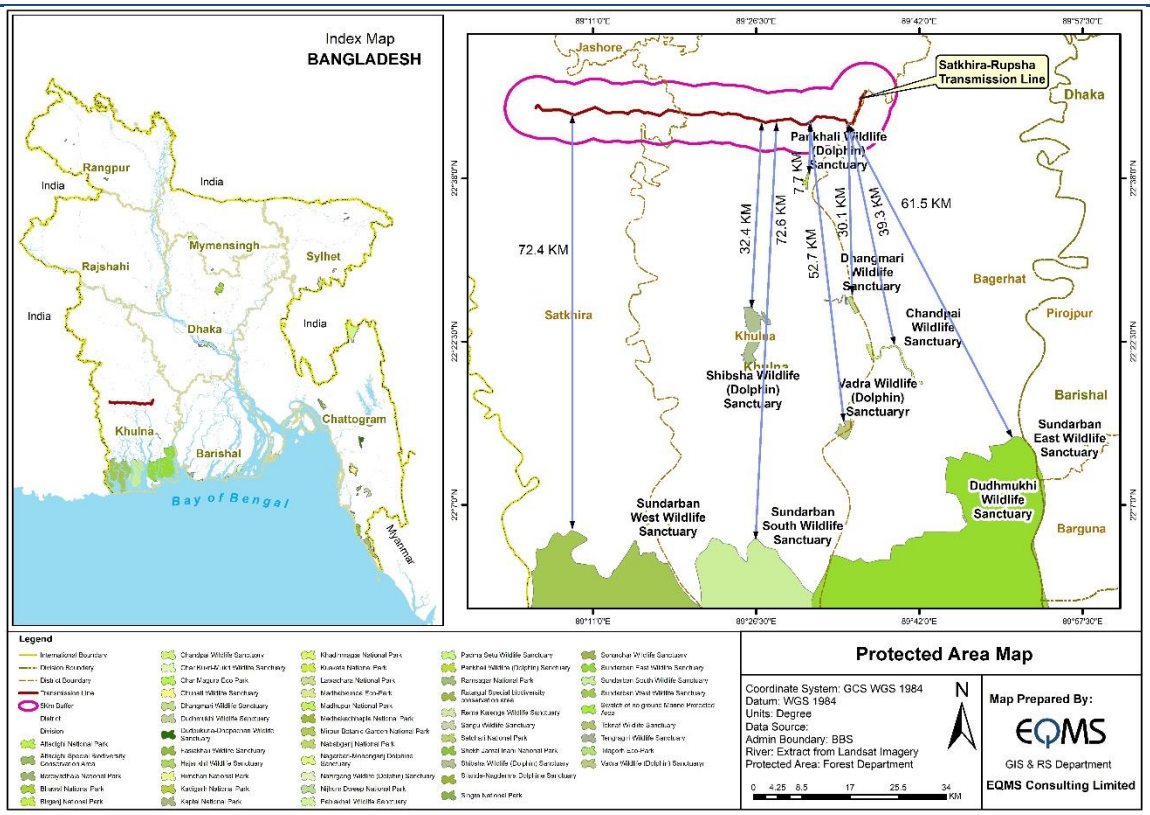
Niamatpur-Patnitola

Source: Department of Environment (DOE)

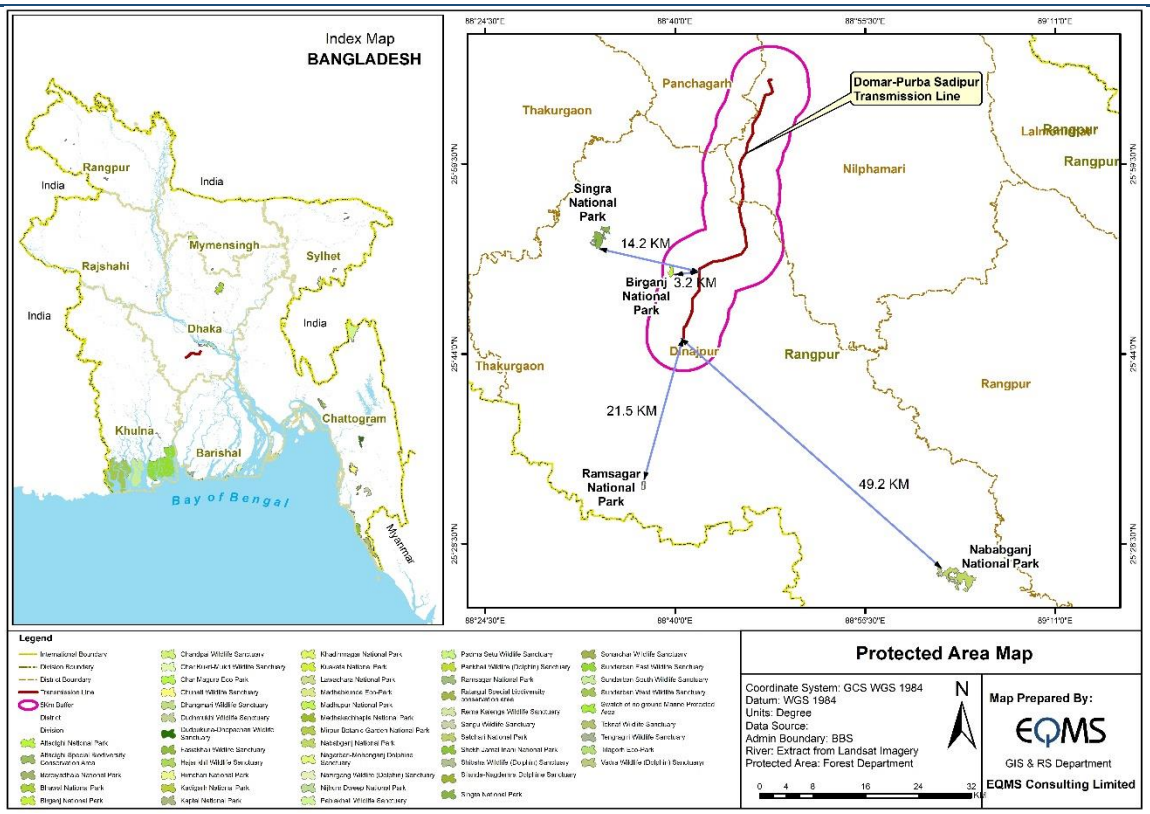
4.3.3 Protected Areas

The nearest protected areas that are situated in the South-East corner from Rupsha to Satkhira transmission line are: Pankhali Wildlife (Dolphin) Sanctuary (7.7km), Shibsha Wildlife (Dolphin) Sanctuary (32.4km) etc. The nearest protected area from Domar-Purba Sadipur route is Birganj National Park (3.2km). The nearest protected area from Niamatpur-Patnitola route is Altadighi National Park (19.7km).

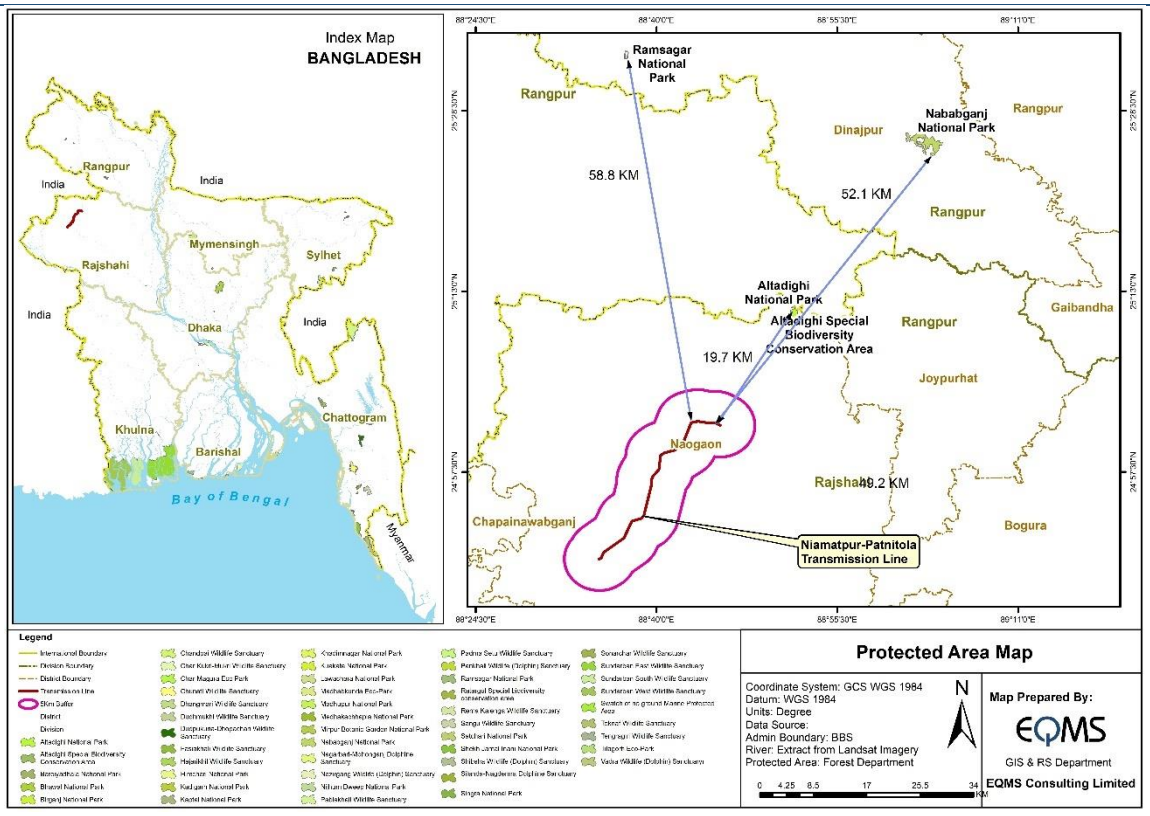
Figure 4-20: Protected areas near transmission lines of Rupsha-Satkhira, Domar-Purba Sadipur and Niamatpur-Patnitola



Rupsha-Satkhira



Domar-Purba Sadipur



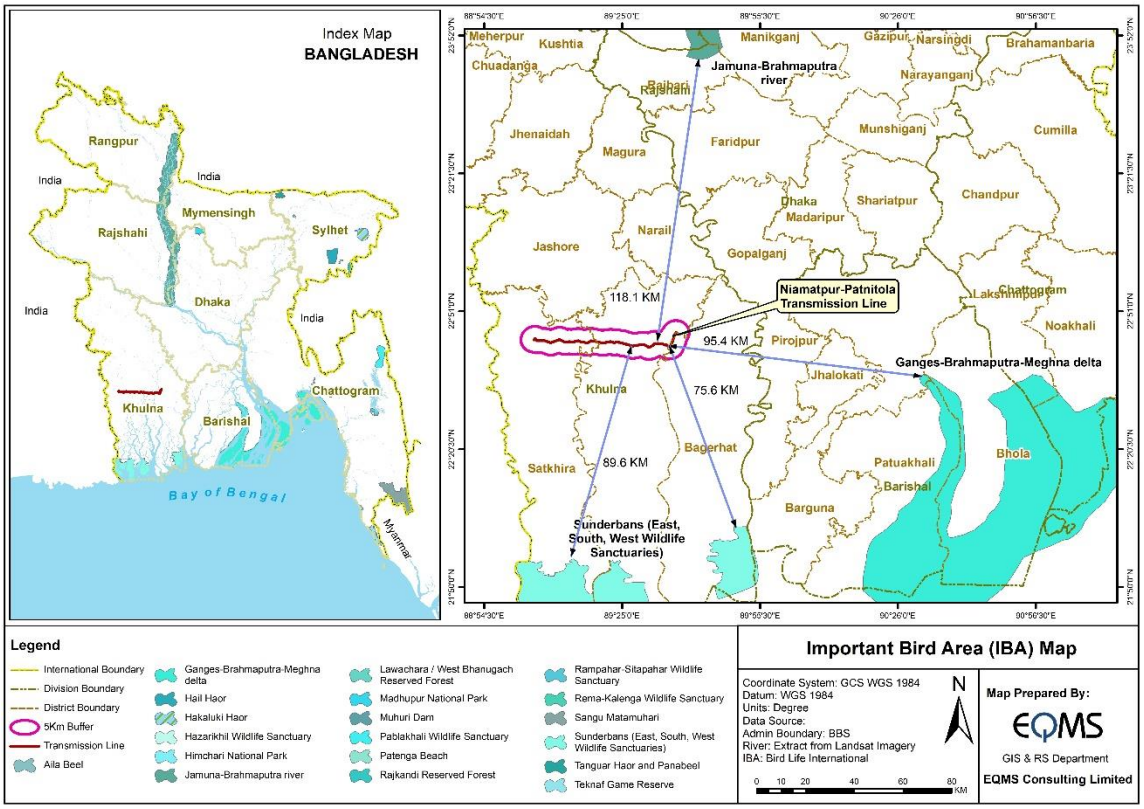
Niamatpur-Patnitola

Source: Forest Department (FD)

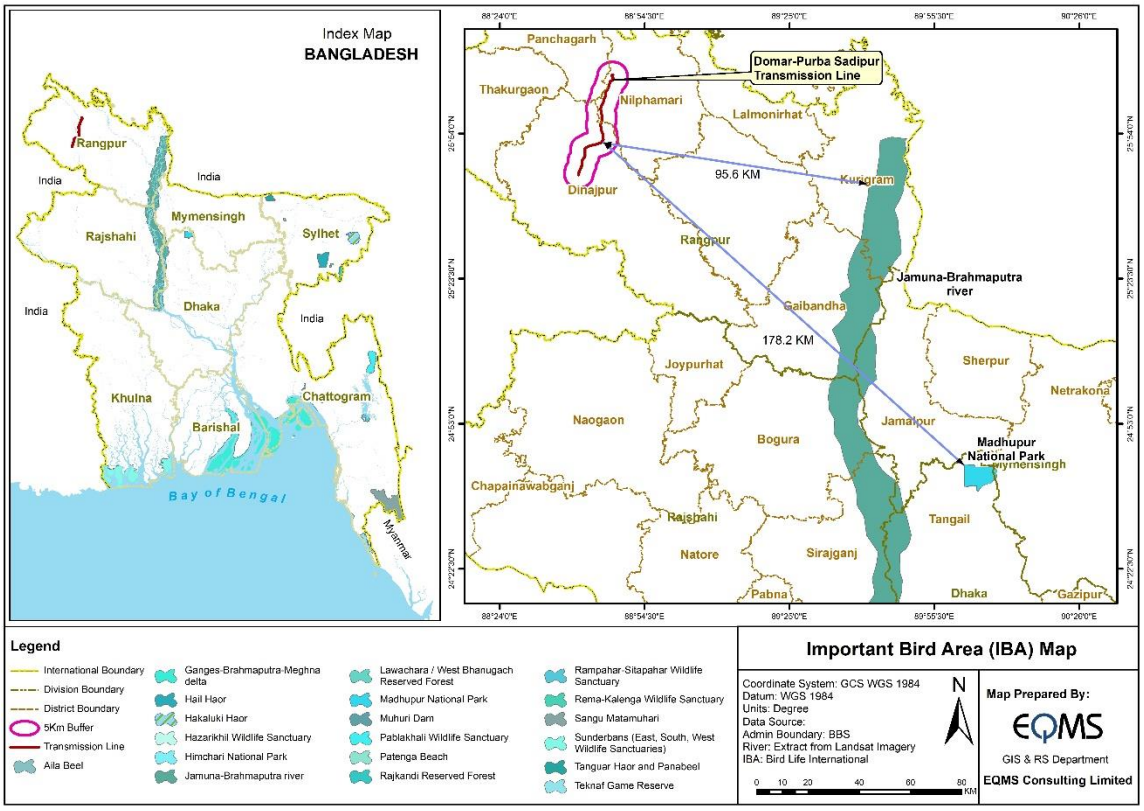
4.3.4 Important Bird Areas

Bangladesh's Important Bird Areas (IBAs) cover less than 4% of the total land area of the country, reflecting the great reduction and fragmentation of natural habitats. However, additional sites are likely to be added to this preliminary list of IBAs in the future. Of the 20 IBAs in Bangladesh, 11 support globally threatened species, 10 have biome-restricted species and nine qualify as IBAs because they hold large congregations of water birds. Ten IBAs (53%) contain examples of terrestrial forest ecosystems, which together cover all significant areas of forest known to remain in Bangladesh. They include the Indo- Malayan tropical dry forests in Madhupur National Park (IBA 1) to the north of Dhaka, three IBAs in north-eastern Bangladesh where Indochinese tropical moist forest is the dominant biome, and six IBAs in the Chattogram hill tracts in the south-east of the country, where Indochinese tropical moist forest and Sino-Himalayan subtropical forest are the main habitats. The nearest IBA, the Sundarbans (East, South, West Wildlife sanctuaries) is located at 75.6 km away from the Rupsha-Satkhira route. The nearest IBA, Madhupur National Park is located at 178.2 km away from the Domar-Purba Sadipur route. The nearest IBA, Madhupur National Park is located at 137.3 km away from the Niamatpur-Patnitola route. Figure 4-21 shows the transmission alignments and the nearest IBAs.

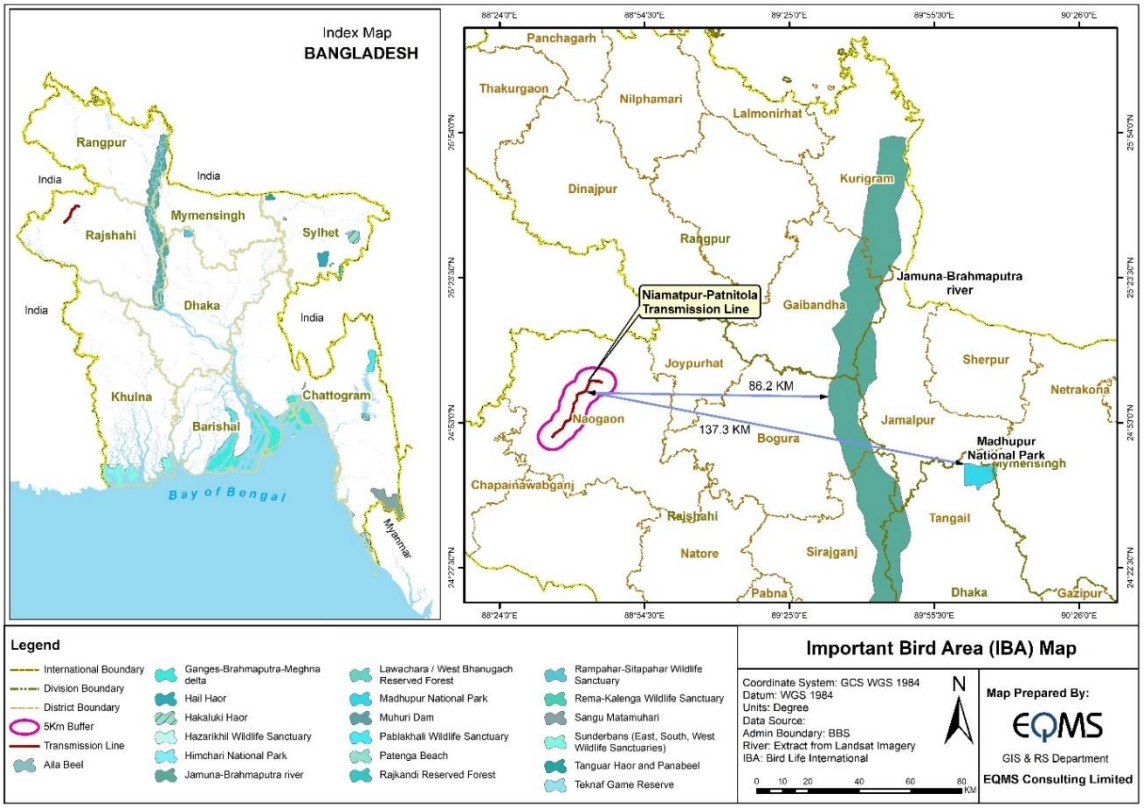
Figure 4-21: Project locations and nearest Bird Staging Areas (IBA) in Bangladesh



Rupsha-Satkhira



Domar-Purba Sadipur



Niamatpur-Patnitola

Source: BirdLife International

4.4 Socio- economic Information and Profile

4.4.1 Rupsha to Satkhira

4.4.1.1 Introduction

The socio-economic profile of the affected HHs is presented following demographic profile of the HHs. A total of 152 HHs comprising 655 people will be affected by the project with average HH size 4.3 which is equal the national average (4.3) according to BBS (2011).

Table 4-24 General Profile of Affected Population

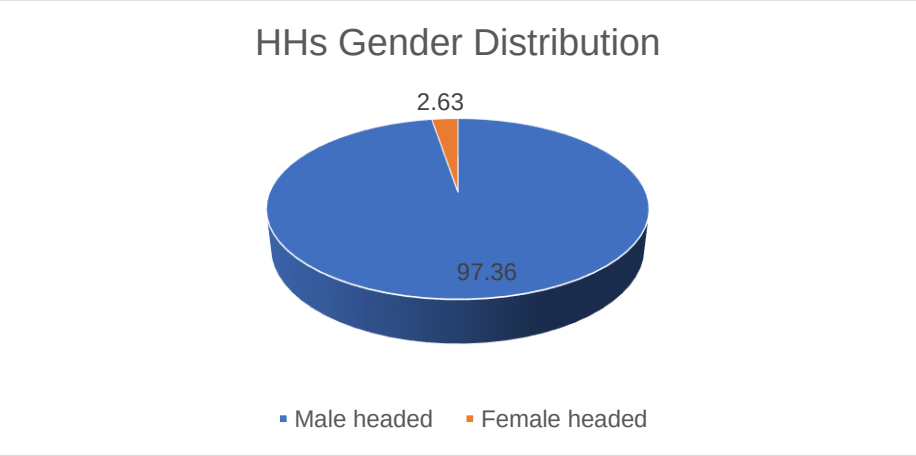
Number of total affected households	152
Number of total populations	655
Average HH size	4.3

Source: EQMS census and IOL survey, February 2022

4.4.1.2 Demographic Information

Demographic profile of the affected community has been analyzed as part of socioeconomic profile of the project area. This comprises of gender profile and age-sex distribution of the PAPs. Precisely, only 2.63% of the HHs are female headed, while the remaining 97.36% are male headed HHs against 88% male headed HHs in national level (BBS, 2011)[5]. However, the general scenario in Bangladesh is similar as most of the HHs are headed by male.

Figure 4-22 HHs Gender Distribution in the project area



Source: EQMS census and IOL survey, February 2022

4.4.1.3 Population distribution by gender

Population distribution by gender is shown in Table. From the table, we can find out that the percentage of male populations is higher than the females in the project area. The overall male female ratio of the project area is 100:112.98 (the national ratio is 100:99.68) which implies that the project area is different from the corresponding national condition with a higher female population.

[5] POPULATION AND HOUSING CENSUS 2011, Socio-Economic and Demographic Report, National Series, Volume - 4

Table 4-25 Population distribution by gender

Male No	%	Female No	%	Total
357	54.50	298	45.49	655

Source: EQMS census and IOL survey, February 2022

4.4.1.4 Marital Status

Marital status of the people from surveyed households are distributed by married, unmarried and widow as the survey did not find any separated person during the survey. Among 655 people a total 421 people were found married, 208 people unmarried, 25 widow and 1 people separate. **Table 4-26Error! Reference source not found.** shows the distribution of marital status among surveyed people from the affected households.

Table 4-26 Marital Status

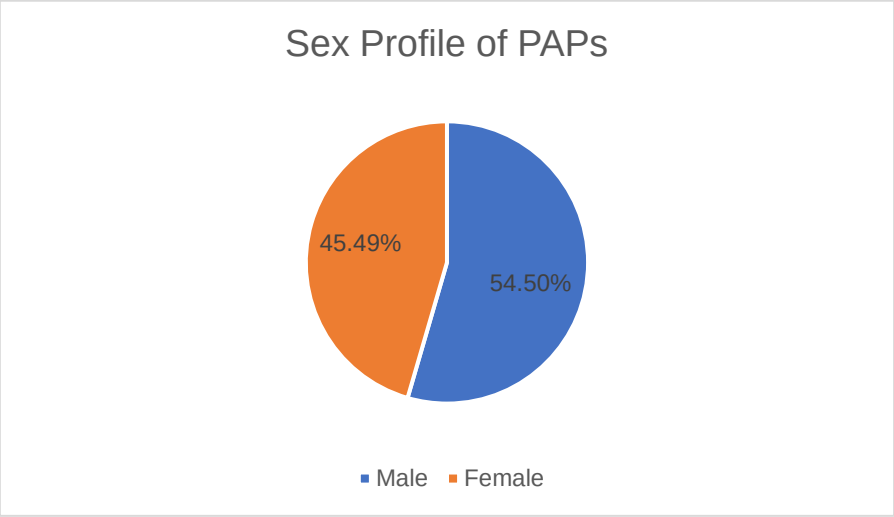
Married No	%	Unmarried No	%	Widow No	%	Separate No	%	Total
421	64.27	208	31.75	25	3.81	1	0.15	655

Source: EQMS census and IOL survey, February 2022

4.4.1.5 Sex Profile of the Affected Populations

Sex profile of the affected HHs is shown in Figure. From the sex profile, we can find out that the percentage of male populations is higher than the females in the project area. The overall male female ratio of the project area is 100:112.98 (the national ratio is 100:99.68) which implies that the project area is different from the corresponding national condition with a higher female population.

Figure 4-23 Sex Profile of the Affected Populations

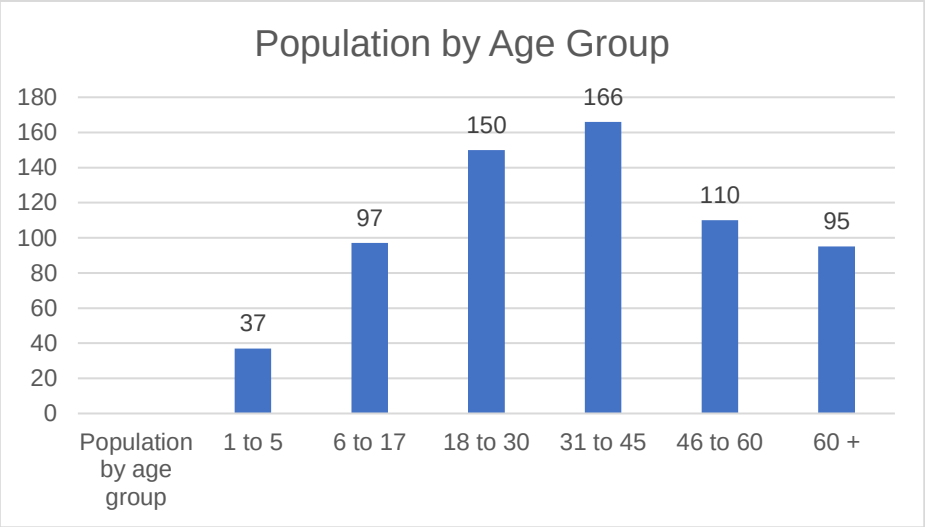


Source: EQMS census and IOL survey, February 2022

4.4.1.6 Age Distribution

Population distribution by age group from the survey shows that, highest number of populations from age group 31-45 and second highest population group from 18-30 while lowest age group 1-5.

Figure 4-24 Population by age group



Source: EQMS census and IOL survey, February 2022

4.4.1.7 Education status of PAPs

Education status of the affected population is presented in the below Table. The table demonstrates that primary and secondary level enrolment is high in the area. It also indicates that higher education rate is high among female population. Furthermore, illiteracy is high among male population. HH members whose age is 5 years and above are counted in this analysis.

Table 4-27 Level of Education of PAPs

Level of Education	Female		Male	
	Count	%	Count	%
Primary	113	37.91	131	36.69
SSC	53	17.78	76	21.28
HSC	27	9.06	41	11.48
Hon's or Equivalent	23	7.71	31	8.68
MA or Equivalent	11	3.69	32	8.96
Islamic Education (Madrasa)	3	1.00	1	0.28
Not School Going Age	17	5.70	22	6.16
Illiterate	51	17.11	23	6.44
Total	298	45.49	357	54.50

Source: EQMS census and IOL survey, February 2022

4.4.1.8 Primary Occupation of PAHs

According to the census of the affected households 22% HHs primary occupation is agriculture. There will not be any impact on their income as compensation will be paid for the entire season and after one season; affected HHs will be able to use land as usual. Based on the income level, their socio-economic condition is better than rest of the population in that region. In addition to Agriculture, the other significant occupations are service, business, retired person etc.

Table 4-28 Occupation of PAH

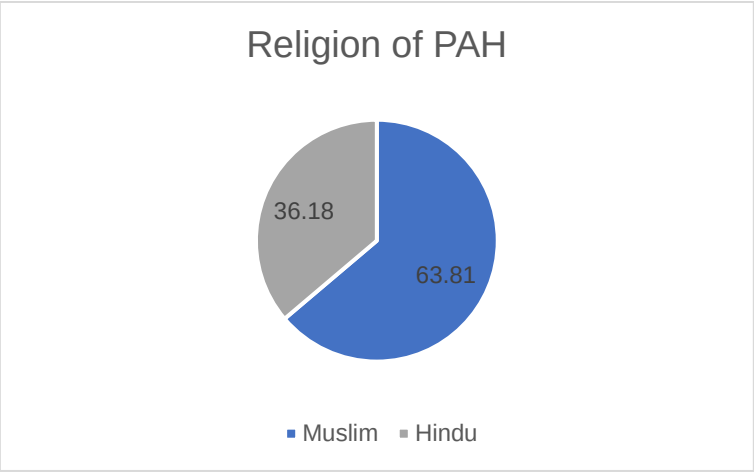
Name of Occupation	Male	Female	Total	Percentage
Agriculture	145	0	145	22.13
Service	27	1	28	4.27
Teacher	10	7	17	2.59
Business	34	0	34	5.19
Household work	0	196	196	29.92
Day labor	2	0	2	0.30
Van puller	1	0	1	0.15
Fisher man	1	0	1	0.15
Doctor	5	0	5	0.76
Unemployed	5	0	5	0.76
Children	19	17	36	5.49
Student	90	60	150	22.90
Elder person	15	17	32	4.88
Expatriate	2	0	2	0.30
Disable	1	0	1	0.15
Total	357	298	655	100.00

Source: EQMS census and IOL survey, February 2022

4.4.1.9 Religion of PAHs

The religious background of the affected HHs is presented in figure revealing that most of the population of affected household are Muslim (63.81%). On the other hand, 36.18% of the affected households are Hindu in religion in this project area. Therefore, there is no opportunity for religious discrimination through this project.

Figure 4-25 Religion of PAHs in the Project Area

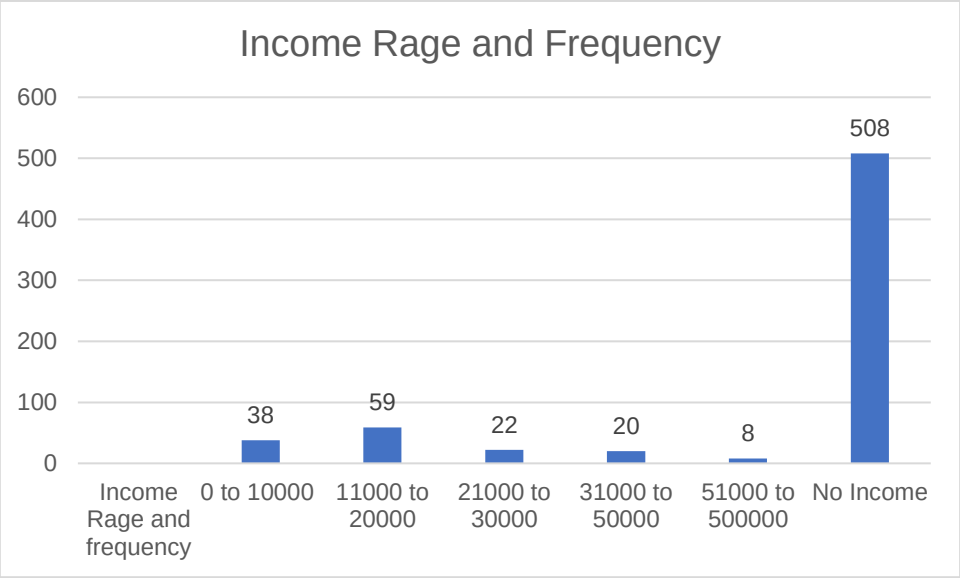


Source: EQMS census and IOL survey, February 2022

4.4.1.10 Income of Affected HH

Income of the affected household as per the employment status from survey data found was presented in the Figure 3-2, where it is seen that majority of the people found with zero income and most of the people belongs to 0-10 thousand income range and 11-20 thousand income range.

Figure 4-26 Monthly Income of the AHHs



Source: EQMS census and IOL survey, February 2022

4.4.1.11 Energy Use of PAHs

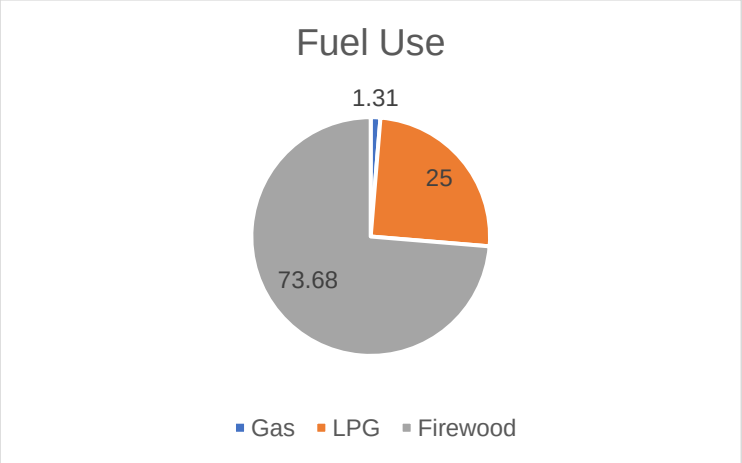
The main source of lighting is electricity for 100% grid connected households. Households also use multiple and combined energy sources for domestic purposes such as kerosine.

In the project areas project affected households experience frequent load shedding which deprives them regular supply of electricity throughout the day. Load shedding is extensive and continues for several hours in night and daytime. It adversely affects in irrigating of cultivation fields and irregular supply of water, children's studies at nighttime, and women in watching television programs. Sleep at nighttime is also difficult for them as they cannot operate fans during summer seasons. In spite of irregular and limited power supply, households lament over having to pay high electricity bills.

4.4.1.12 Fuel Source of PAP

More than fifty percent households' main source of energy is firewood (73.68%) for cooking and boiling purposes, almost 25.00% using liquefied petroleum gas, particularly by people living closer to urban areas and 1.31% using Gas.

Figure 4-27 Fuel Source of PAHs



Source: EQMS census and IOL survey, February 2022

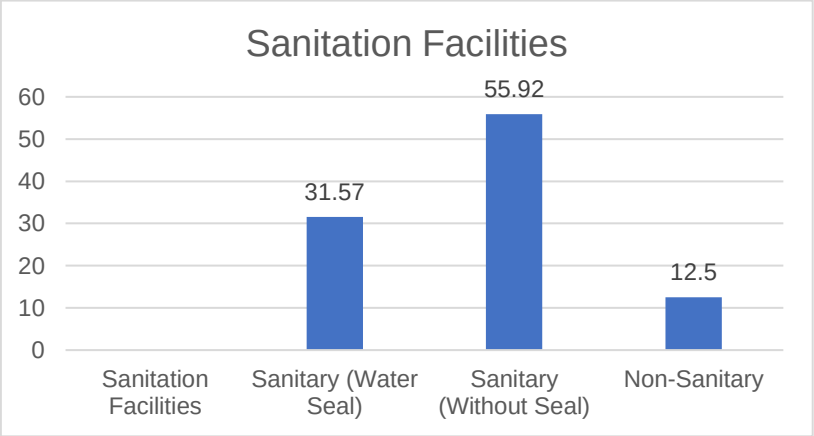
4.4.1.13 Water Source of PAHs

The major source of drinking water is tube-well where about 80.92% households use tube-wells water and 6.57% people have access to deep tube-well water, 12.5% households have access of supply water. The uses of river water for the domestic purposes were not recorded during the census. However, river water used in domestic animals bathing and for the irrigation.

4.4.1.14 Sanitation Facilities of PAHs

About 31.57% and 55.92% of households use water sealed and non-water-sealed sanitary latrine facility, respectively, whereas only 12.5% households use non-sanitary facilities. The following Figure shows sanitation facility of the project area.

Figure 4-28 Sanitation Facilities of PAHs



Source: EQMS census and IOL survey, February 2022

4.4.1.15 Health and Services

No chronic illnesses are reported from the project affected areas. However, incidence of water borne diseases and skin ailments were frequently reported during consultations. People approach multiple institutions for medical care and treatment. Upazilla Health Complex or Community Clinic are accessed for their medical and health needs. Despite the presence of several health and medical service institutions, access to them from rural distance from the households varies from 2 km to 5 km across the project affected areas. Medical services at private clinics are expensive and unaffordable to many families. Government hospitals in local areas lack enough medicine, diagnostic facilities and staff. Patients must wait in long queues. For serious illnesses, people go to Dhaka for treatment. People sometimes travel more than 100 km to get their medical tests done.

4.4.1.16 Role of Women and Gender Issues

Women are engaged in multiple activities in the project affected areas. Beside they played a vital role in household management such as household cooking, cleaning, fetching water, feeding children, helping in children's studies and looking after the in-laws (particularly those living in extended families), women across the project areas also make a significant contribution to the household economy.

Even though strong pressures from the families to dissuade women finding employment, they take a lead role in livestock farming and take care of the feeding of their cattle, goats, poultry and duck. Home gardening and vegetable production is another important economic activity of women, produce of which is used for both household consumption and marketing. Other forms of economic activities conducted by women include agricultural labor work, dressmaking, handicraft-making, employment in apparel industries etc. Educated women are employed in both government and private sector jobs. Women's earnings are mainly used for children's education and clothing, to supplement the households' consumption needs, and to repay the past debts. Some women would also save some money to be used in emergencies or for their children's future. In some communities, however, it has been reported that women must hand over their earnings to husbands or else get prior consent of the husband to spend their earnings. Women also participate in the activities of NGOs like ASA, BRAC, and Grameen Bank to access micro-credit which they would use to buy cattle, goats and poultry.

Household level decision-making is largely vested with the husband. A few instances of joint decision making by both men and women were reported. Women also perform a significant role in managing household assets despite the key immovable assets like land and house are owned by men. Physical assets such as land and jewelry received by women as part of their dowry remain in her possession but in some occasions, they are transferred to the ownership of men as part of matrimonial agreements. Women are discouraged from participating in social and political activities mostly by their male counterparts. However, many women struggle to change this situation.

4.4.1.17 Indigenous Peoples

There are no indigenous community lives in the project affected areas. Therefore, no permanent or temporary and direct or indirect impacts on indigenous people's communities are anticipated. The project has taken necessary steps to avoid the indigenous people's communities and their properties and other social and cultural activities from the areas identified for project implementation.

4.4.2 Domar to Purba Sadipur

4.4.2.1 Introduction

The proposed project transmission line will cross 5 Upazilla named Nilphamari Sadar, Domar, Khansama, Birganj and Kaharole. The length of total transmission line is 46 km.

The landowners were considered for conducting the social survey. A total number of 38 sample number was purposively considered to understand the socio-economic scenario of the alignment.

The socio-economic profile of the affected HHs is 38 presented following demographic profile of the HHs. A total of 38 HHs comprising 186 people will be affected by the project with average HH size 4.9 which is higher than the national average (4.3) according to BBS (2011).

Table 4-29: General Profile of Affected Population

Number of total affected households	38
Number of total populations	186
Average HH size	4.9

Source: Socioeconomic Survey, EQMS, July 2022

4.4.2.2 Demographic Profile of Affected HHs

Demographic profile of the affected community has been analyzed as part of socioeconomic profile of the project area. This comprises of gender profile and age-sex distribution of the PAPs. In the study area, about 38 households (HHs) were surveyed purposively including squatters with a total population of that will be influenced by the implementation of the proposed project. The average sex ratio is 85.6 and the average household size is 4.62. **Table 4-30** shows the gender distribution in the project area.

Table 4-30: Demographic Profile of Study Area

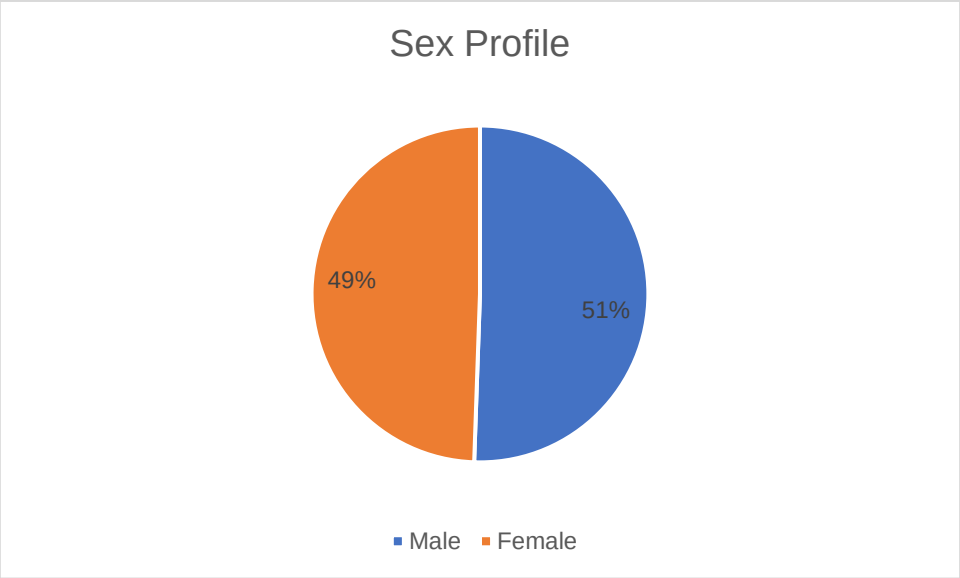
District Name	Upazilla	Total HHs	Total Pop	Sex Ratio	Avg. HH Size
Dinajpur	Birganj	10	53	165	5.3
	Kaharole	25	120	93	4.8
	Khansama	1	4	100	4
Lalmonirhat	Kaliganj	1	3	50	3
Nilphamari	Nilphamari	1	6	20	6
Total		38	186	85.6	4.62

Source: Socioeconomic Survey, EQMS, July 2022

4.4.2.3 Sex Profile of Affected Populations

Sex profile of the affected populations is shown in **Figure 4-29**. From the sex profile, we can find out that the percentage of male populations is higher than the females in the project area. The overall male female ratio of the project area is 100:102.22 (the national ratio is 100:99.68) which implies that the project area is quite different from the corresponding national condition with a higher female population.

Figure 4-29: Sex Profile of Affected Populations

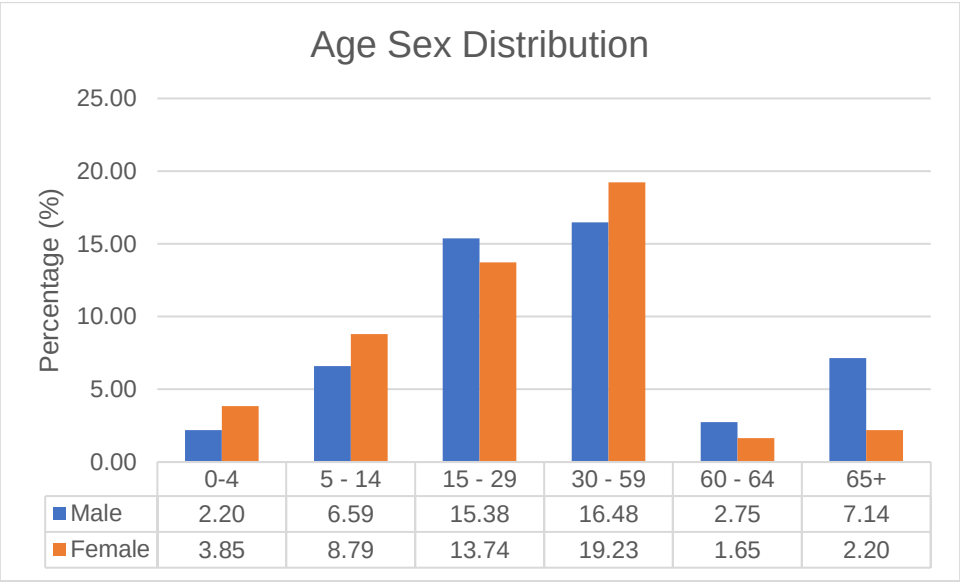


Source: Socioeconomic Survey, EQMS, July 2022

4.4.2.4 Age and Sex Distribution of Affected Population

Figure 4-30 to the below presents age-sex distribution of the affected Populations. The survey findings indicate that population percentage increases respectively from the age group of 5-14 years. According to the age group distribution, the most prominent one is 30-59 years, which comprises of 16.48% of the total male population and 19.23% of the total female population. The numbers of affected persons steadily decrease at age limit 60-64 years. The steady decline in the number of populations after this age limit can be considered significant for low life expectancy in the region. It is almost similar to the national scenario.

Figure 4-30: Age Sex Distribution of the PAPs

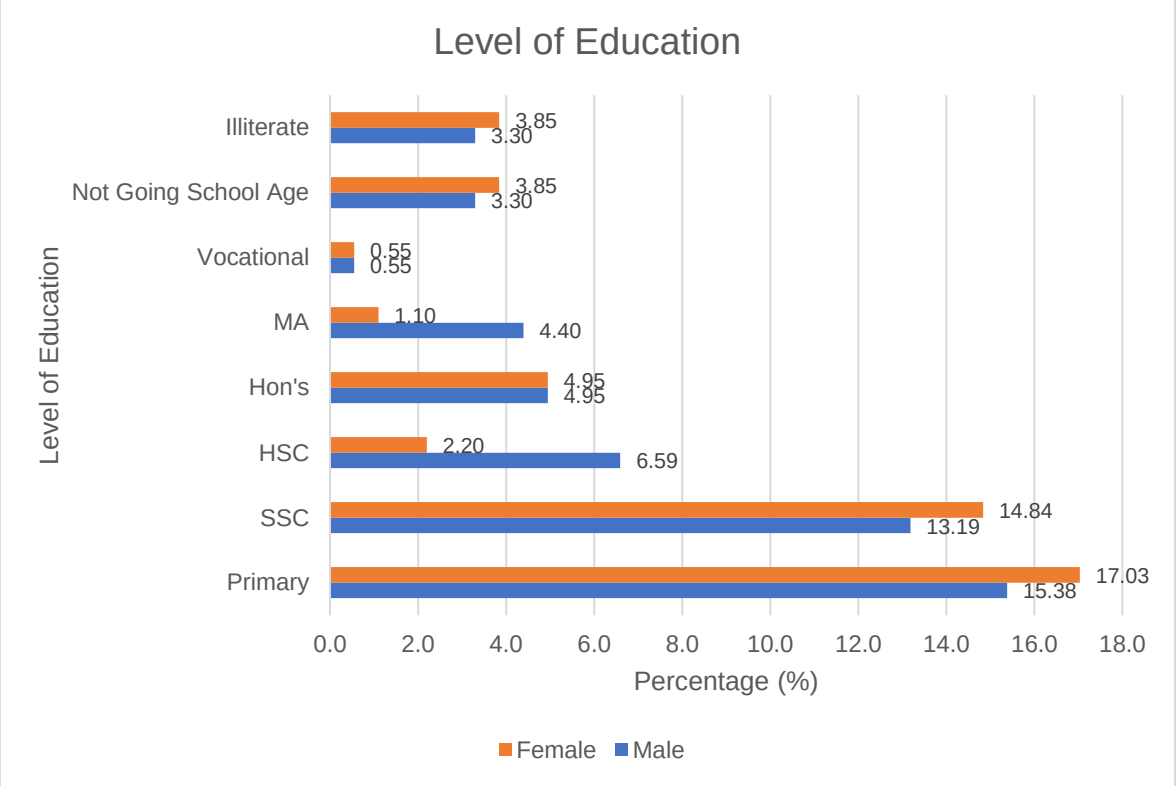


Source: Socioeconomic Survey, EQMS, July 2022

4.4.2.5 Level of Education of the PAPs

Education level of the affected population is presented in the below **Figure 4-31**. The table demonstrates that primary and secondary level enrolment is high in the area. It also indicates that higher education rate is comparatively higher among male population. Furthermore, illiteracy is high among female population.

Figure 4-31: Level of Education of the PAPs



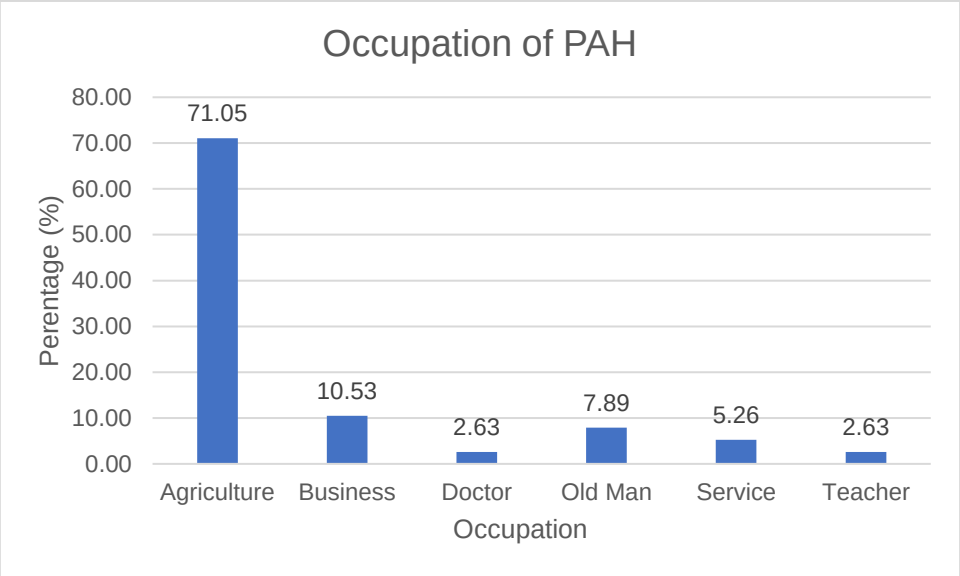
Source: Socioeconomic Survey, EQMS, July 2022

As per the consultation and site visit, there were no educational institutions under the transmission lines. Survey team found Kayempur Dakhil Madrasa is the nearest educational institution situated within 100 meters of a transmission tower (AP - 12). On the other hand, Duhashuha Government Primary School is distanced from the transmission line about approximately 500 meters. During consultation and socio-economic survey, consultants found that the during the construction period of the project, there is no possibility of hampering the regular activities of these educational institution.

4.4.2.6 Primary Occupation of PAHs

According to the census of the affected households 71.05% HHs primary occupation is agriculture. There will not be any impact on their income as compensation will be paid for the entire season and after one season; affected HHs will be able to use land as usual. Based on the income level, their socio-economic condition is better than rest of the population in that region. In addition to Agriculture, the other significant occupations are business, service, teaching etc.

Figure 4-32: Occupation of PAH



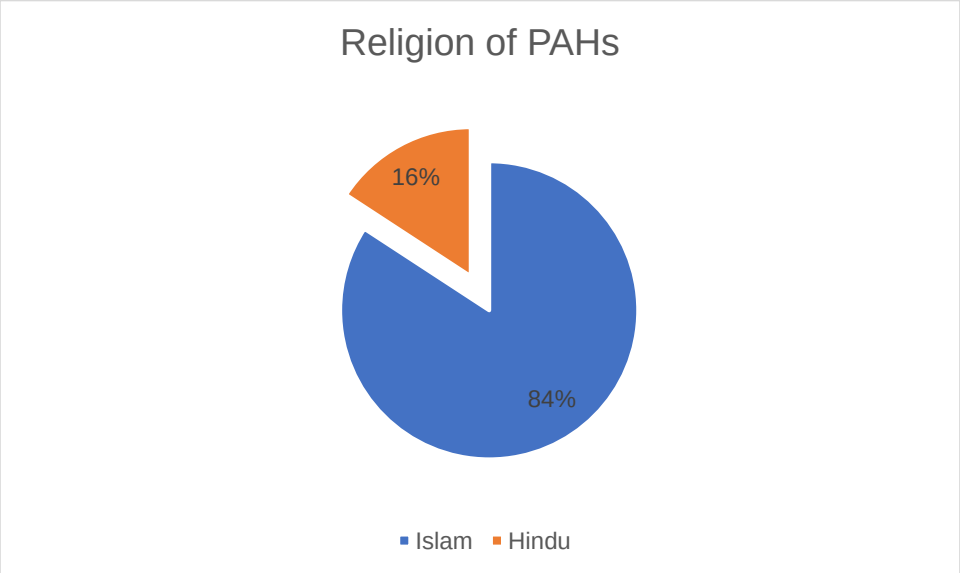
Source: Socioeconomic Survey, EQMS, July 2022

4.4.2.7 Religion of the PAHs

The religious background of the affected HHs is presented in

Figure 4-33 revealing that 84% (32) of affected household are Muslim. On the other hand, 16% (6) of the affected households are Hindu in religion in this project area. Therefore, there is no opportunity for religious discrimination through this project.

Figure 4-33: Religion of PAHs



Source: Socioeconomic Survey, EQMS, July 2022

No religious institutions were found under the proposed ROW of the transmission line during the site visit and socio-economic survey. Some religious institutions such as Mosques, Mandirs are located within on average of 500 meters away from the proposed transmission line which will not be hampered for the transmission towers and transmission line during the construction period.

4.4.2.8 Income of the Affected HH

The average monthly incomes of 33.94% households are Tk 10,000 to 20,000. Another 26.61% have monthly incomes ranging from Tk 20,000 to Tk 30,000. Households receiving monthly incomes between Tk 30,000 to Tk 40,000 are 15.60%. Monthly incomes of the below 10,000 are 8.26%. Around 15.60% of households earn more than 40000 per month. As per the official poverty line of Bangladesh, households earning an annual income of less than Tk 65000 are considered those living below the poverty line. **Table 4-31** shows the monthly income range of the affected households.

Table 4-31: Monthly Income of the AHHs

Income Range	Frequency	Percent (%)
Below 10000	3	7.89
10000 - 20000	13	34.21
20000 - 30000	10	26.32
30000 - 40000	6	15.79
40000 - 50000	3	7.89
Above 50000	3	7.89
Total	38	100.00

Source: Socioeconomic Survey, EQMS, July 2022

4.4.2.9 Expenses of Affected HHs

The average monthly expenses of 44.73% households are Tk 10,000 to 20,000. Another 26.31% have monthly expenses ranging from Tk 20,000 to Tk 30,000. Households consumes between Tk 30,000 to Tk 40,000 are 7.89%. Monthly expenditure of the below 10,000 are 10.52%. More than 10% of households expense more than 40000 per month. **Table 4-32** shows the monthly income range of the affected households.

Table 4-32: Monthly Expenditure of the AHHs

Expense Range	Frequency	Percent (%)
Below 10000	4	10.52
10000 - 20000	17	44.73
20000 - 30000	10	26.31
30000 - 40000	3	7.89
40000 - 50000	4	10.52
Total	38	100

Source: Socioeconomic Survey, EQMS, July 2022

4.4.2.10 Basic Amenities at Household Level

4.4.2.10.1 Energy Use of PAHs

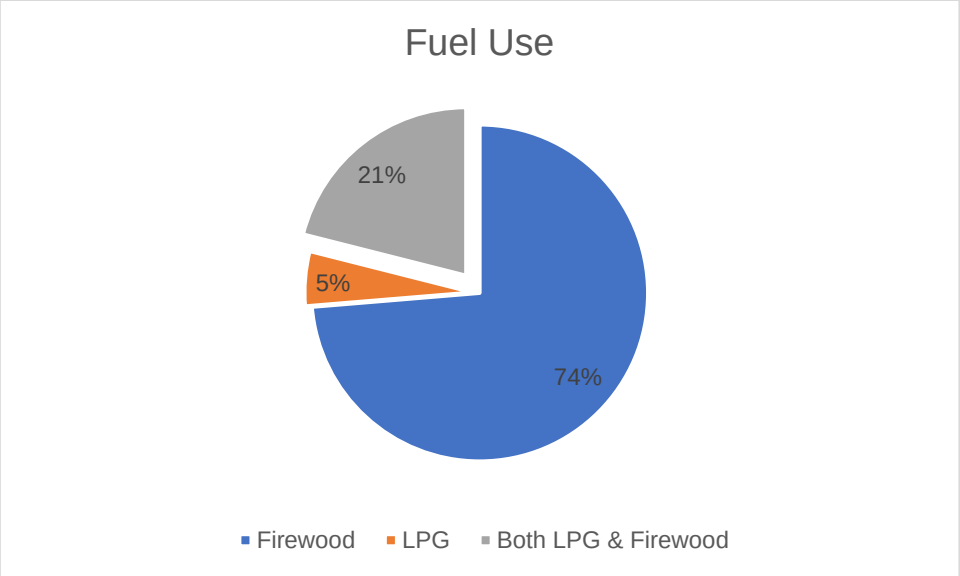
Electricity is the main source of lighting for 100% grid connected households. Households use multiple and combined energy sources for domestic purposes.

Households in the project affected areas experience frequent load shedding which deprives them regular supply of electricity throughout the day. Daily power shedding is extensive and continues for several hours both daytime and night. Load shedding adversely affect the farmers in irrigating their cultivation fields and providing a regular supply of water, children's studies at nighttime, and women in watching television programs during their leisure time. Sleep at night after a day's hard work is difficult as they cannot operate fans particularly during warm seasons. Despite irregular and limited power supply, households lament over having to pay high electricity bills.

4.4.2.10.2 Fuel Sources of PAHs

Firewood is the main source of energy used by most of the households (74%) for cooking and boiling purposes followed by only 5% using liquefied petroleum gas, particularly by people living closer to urban areas. Around 21% households use both firewood and LPG gas for their regular cooking and boiling purposes. Below **Figure 4-34** shows the source of fuel of the affected area.

Figure 4-34 : Fuel Source of PAHs



Source: Socioeconomic Survey, EQMS, July 2022

4.4.2.10.3 Water Source of AHs

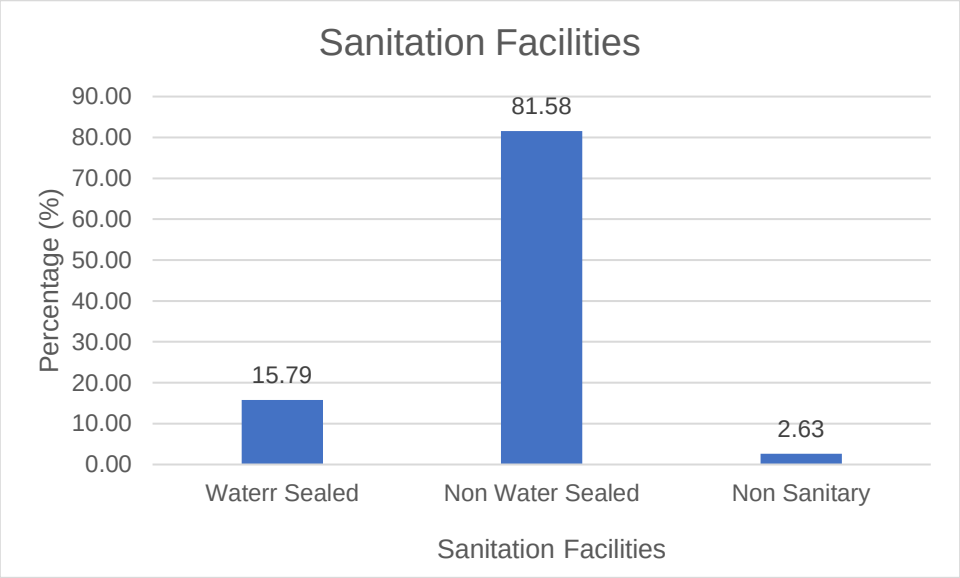
The major source of drinking water is tube-well where about 86.84% population use tube-well water and rest 13.15% people have access to dip tube-well water. The uses of river water for the domestic purposes were not recorded during the census. However, river water for the irrigation. During the site visit and consultation with the local community, landowners and the women group; no tube wells (shallow/deep) were identified under the transmission line /in the ROW.

4.4.2.10.4 Sanitation Facilities of AHs

About 15.79% and 81.58% of households use water sealed and non-water-sealed sanitary latrine facility, respectively, whereas only about 2.63% households use non-sanitary facilities. The following

Figure 4-35 shows sanitation facility of the project area.

Figure 4-35: Sanitation Facilities of the AHs



Source: Socioeconomic Survey, EQMS, July 2022

4.4.2.11 Transportation and Communications

The proposed transmission line does not cross any highway roads. The transmission line will cross the village internal roads communication such as the Shanka – Kajal – Birganj Road, Rajibpur Road, Bacchagram – Modhubonpur Road and so on. Road condition of the project area is shown in **Table 4-33**. Most of these internal communication roads are metaled roads. A total of 473.84 km roads of the study area are metaled road. On the other hand, only 39.75 km is unmetalled road. Any transmission towers, which may affect the transportation system of the local people and vehicles, could not find on the road by the consultants during the site visit and socio-economic survey.

Table 4-33: Road Condition of the Project Area

Upazilla	Non-metalled Road (km)	Metaled Road (km)	Total (km)
Nilfamari Sadar	5.19	111.48	116.66
Domer	21.16	90.10	111.26
Khansama	0.00	120.09	120.09
Birganj	0.00	102.51	102.51
Kahalore	13.40	49.69	63.09
Total	**39.75**	**473.87**	**513.61**

Source: LGED Database

The proposed transmission line from Purba Sadipur to Domar crosses a river named Atrai River in between towers no. 7/1 to 7/2. The average distance from the river side of the towers in both side is approximately 200 to 250 meters where there will be no such impact in towers as well as river side.

4.4.2.12 Health Services

No major chronic illnesses are reported from the project affected areas. However, incidence of water borne diseases and skin ailments were frequently reported during consultations. People approach multiple institutions for medical care and treatment. Despite the presence of several health and medical service institutions, access to them from rural areas is rather remote. Distance from the households to such institutions varies from 2 km to 10 km across the project affected areas. There are around 7 private hospitals in the project area. Among these, 4 in Nilphamari Sadar, 2 in Birganj and 1 in Domar. Moreover, there are also 13 diagnostic centers in these areas. These private hospitals and diagnostic centers usually provide health care support to the people of the project area. 38 specialized doctors are engaged to provide health care services in these areas. Below **Table 4-34** shows the health care status of the project area.

Table 4-34: Health Care Status

Upazilla	Private Hospital	Diagnostic Center	MBBS/ FCPS
Nilphamari Sadar	4	5	15
Domar	1	1	4
Khansama	0	1	5
Birganj	2	4	5
Kaharole	0	2	9
Total	**7**	**13**	**38**

Source: District Statistics, BSS 2011

Medical services at private clinics are expensive and unaffordable to many families. Government hospitals in local areas lack enough medicine, diagnostic facilities and staffs. Patients must wait in long queues. For serious illnesses, people must go to Dhaka for treatment. People sometimes travel more than 100 km to get their medical tests done.

4.4.2.13 Role of Women and Gender Issues

Women in the project affected areas are engaged in multiple activities. Apart from their household roles such as household cooking, cleaning, fetching water, feeding children, helping in children's studies and looking after the in-laws (particularly those living in extended families), women across the project areas also make a significant contribution to the household economy

Despite strong pressures from the families to dissuade women finding employment, they take a lead role in livestock farming and take care of the feeding of their cattle, goats and poultry. Home gardening is another important economic activity of women, produce of which is used for both household consumption and marketing. Other forms of economic activities conducted by women include agricultural labor work, dressmaking, handicraft-making, employment in apparel industries etc. Educated women are employed in both government and private sector jobs. Women's earnings are mainly used for children's education and clothing, to supplement the households' consumption needs, and to repay the past debts. Some women would also save some money to be used in emergencies or for their children's future. In some communities, however, it has been reported that women must hand over their earnings to husbands or else get prior consent of the husband to spend their earnings. Women also participate in the activities of NGOs like BRAC and Grameen Bank to access micro-credit which they would use to buy cattle, goats and poultry.

Household level decision-making is largely vested with the husband. A few instances of joint decision making by both men and women were reported. Women also perform a significant role in managing household assets despite the key immovable assets like land and house are owned by men. Physical assets such as land and jewelry received by women as part of their dowry remain in her possession but in some occasions, they are transferred to the ownership of men as part of matrimonial agreements. Women are discouraged from participating in social and political activities mostly by their male counterparts. However, many women struggle to change this situation.

4.4.2.14 Indigenous people

There are no indigenous people's settlements in the affected area of the project. Therefore, no permanent or temporary and direct or indirect impacts on indigenous people's communities are anticipated. The project has taken necessary steps to avoid the indigenous people's communities and their properties and other social and cultural activities from the areas identified for project implementation.

4.4.3 Niamatpur to Patnitola

4.4.3.1 Introduction

The socio-economic profile of the affected HHs is presented following demographic profile of the HHs. A total of 113 HHs comprising 461 people will be affected by the project with average HH size 4.07 which is lower than the national average (4.3) according to BBS (2011).

Table 4-35 General Profile of Affected Population

Number of total affected households	113
Number of total populations	461
Average HH size	4.07

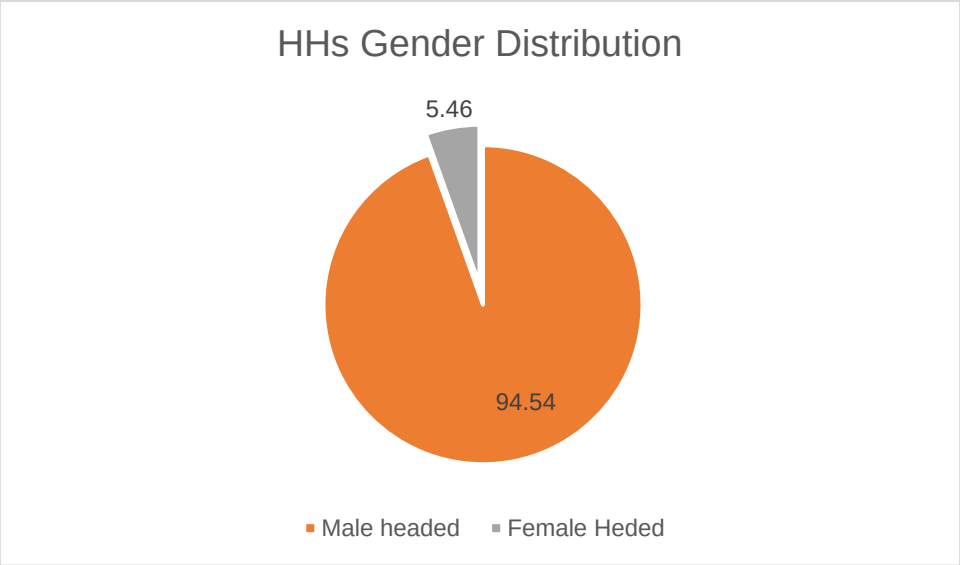
Source: EQMS census and IOL survey, January 2022

4.4.3.2 Demographic Information

Demographic profile of the affected community has been analyzed as part of socioeconomic profile of the project area. This comprises of gender profile and age-sex distribution of the PAPs. Precisely, only 5.46% of the HHs are female headed, while the remaining 94.54% are male headed HHs against 88% male headed HHs in national level (BBS, 2011)6. However, the general scenario in Bangladesh is similar as most of the HHs are headed by male.

[6] POPULATION AND HOUSING CENSUS 2011, Socio-Economic and Demographic Report, National Series, Volume - 4

Figure 4-36 HHs Gender Distribution in the project area



Source: EQMS census and IOL survey, January 2022

4.4.3.3 Population distribution by gender

Population distribution by gender is shown in Table. From the table, we can find out that the percentage of male populations is higher than the females in the project area. The overall male female ratio of the project area is 100:112.98 (the national ratio is 100:99.68) which implies that the project area is different from the corresponding national condition with a higher female population.

Table 4-36 Population distribution by gender

Male No	%	Female No	%	Total
245	52.92	216	47.07	461

Source: EQMS census and IOL survey, January 2022

4.4.3.4 Marital Status

Marital status of the people from surveyed households are distributed by married, unmarried and widow as the survey did not find any separated person during the survey. Among 461 people a total 299 people were found married, 147 people unmarried and 15 widow. **Table 4-37** shows the distribution of marital status among surveyed people from the affected households.

Table 4-37 Marital Status

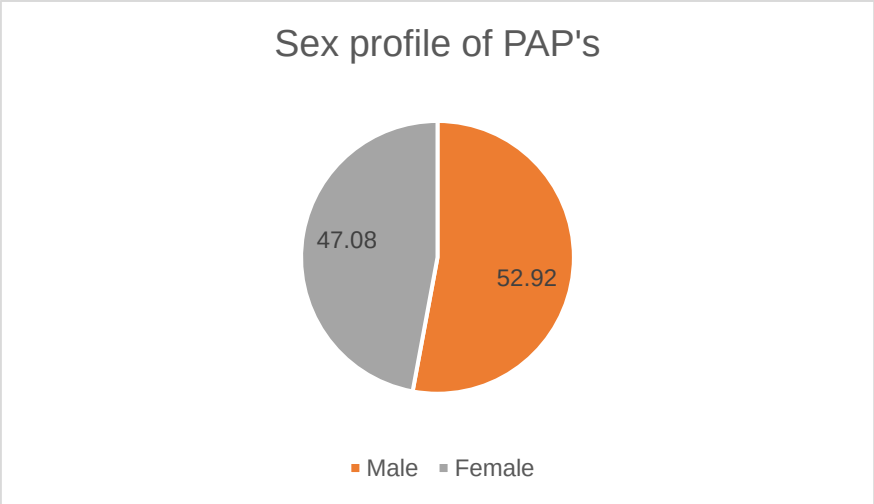
Married No	%	Unmarried No	%	Widow No	%	Total
299	64.8	147	32	15	3.2	461

Source: EQMS census and IOL survey, January 2022

4.4.3.5 Sex Profile of the Affected Populations

Sex profile of the affected HHs is shown in Figure 4-37. From the sex profile, we can find out that the percentage of male populations is higher than the females in the project area. The overall male female ratio of the project area is 100:112.98 (the national ratio is 100:99.68) which implies that the project area is different from the corresponding national condition with a higher female population.

Figure 4-37 Sex profile of the affected HHs

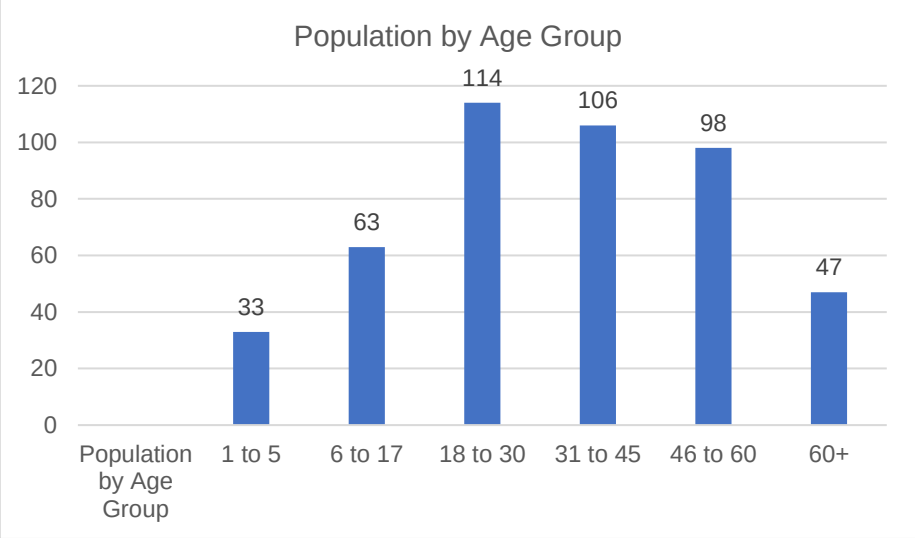


Source: EQMS census and IOL survey, January 2022

4.4.3.6 Age Distribution

Population distribution by age group from the survey shows that, highest number of populations from age group 18-30 and second highest population group from 31-45 while lowest age group 1-5.

Figure 4-38 Population by Age Group



Source: EQMS census and IOL survey, January 2022

4.4.3.7 Education status of PAPs

Education status of the affected population is presented in the below Table 4-38. The table demonstrates that primary and secondary level enrolment is high in the area. It also indicates that higher education rate is high among female population. Furthermore, illiteracy is high among male population. HH members whose age is 5 years and above are counted in this analysis.

Table 4-38 Level of Education of PAPs

Level of Education	Female		Male	
	Count	%	Count	%
Primary	93	20.17	88	19.08
SSC	28	6.07	30	6.50
HSC	23	4.98	29	6.29
Hon's or Equivalent	18	3.90	39	8.45
MA or Equivalent	7	1.51	12	2.60
Islamic Education (Madrasa)	0	0	1	0.20
Not School Going Age	21	4.55	24	5.20
Illiterate	26	5.63	22	4.77
Total	216	46.81	245	53.09

Source: EQMS census and IOL survey, January 2022

4.4.3.8 Primary Occupation of PAHs

According to the census of the affected households 26% HHs primary occupation is agriculture. There will not be any impact on their income as compensation will be paid for the entire season and after one season; affected HHs will be able to use land as usual. Based on the income level, their socio-economic condition is better than rest of the population in that region. In addition to Agriculture, the other significant occupations are service, business, retired person etc.

Table 4-39 Occupation of PAH

Name of Occupation	Male	Female	Total	Percentage
Agriculture	115	5	120	26
Service	16	6	22	5
Business	14	0	14	3
Household work	6	128	134	29
Day labor	5	2	7	1.51
Doctor	2	0	2	0.44
Unemployed	5	1	6	1

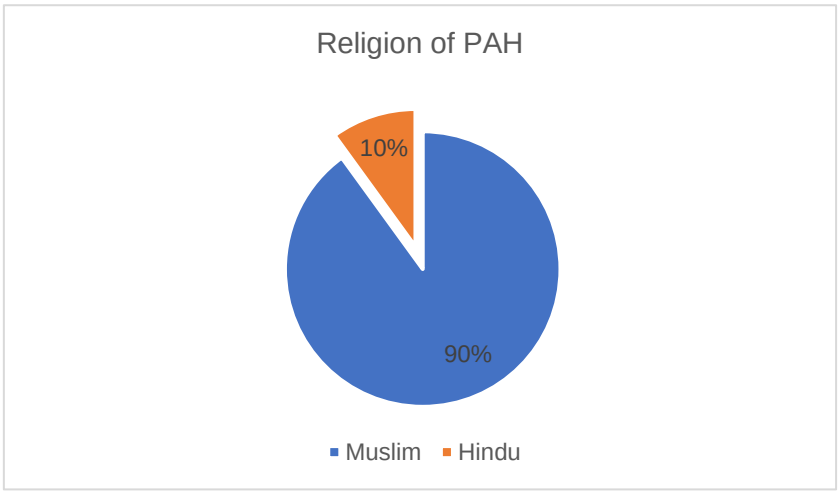
Name of Occupation	Male	Female	Total	Percentage
Children	17	14	31	7
Student	58	44	102	22
Elder person	8	13	21	4.55
Expatriate	1	1	2	0.50
Total	247	214	461	100.00

Source: EQMS census and IOL survey, January 2022

4.4.3.9 Religion of PAHs

The religious background of the affected HHs is presented in figure revealing that most of the population of affected household are Muslim (90%). On the other hand, 10% of the affected households are Hindu in religion in this project area. Therefore, there is no opportunity for religious discrimination through this project.

Figure 4-39 Religion of PAHs in the Project Area

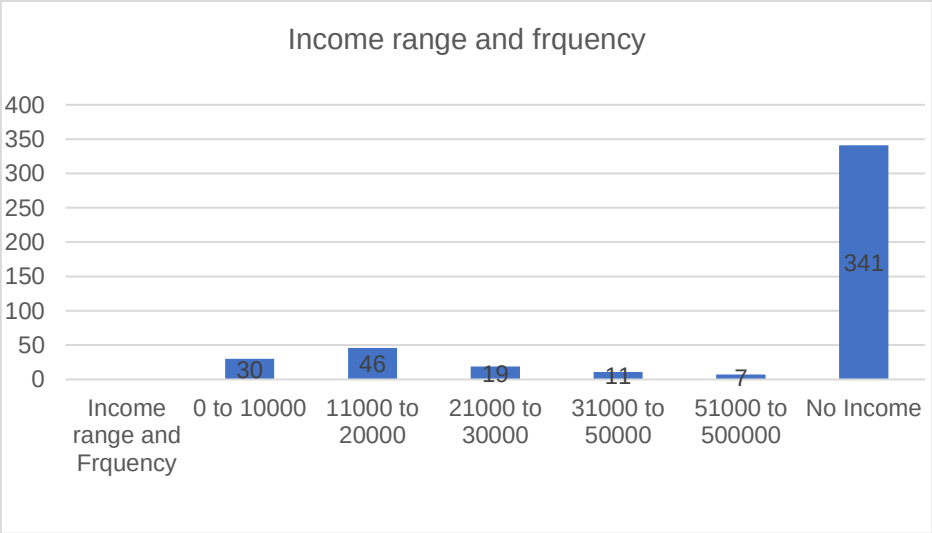


Source: EQMS census and IOL survey, January 2022

4.4.3.10 Income of Affected HH

Income of the affected household as per the employment status from survey data found was presented in the Figure 4-40, where it is seen that majority of the people found with zero income and most of the people belongs to 0-10 thousand income range and 11-20 thousand income range.

Figure 4-40 Monthly Income of the AHHs



Source: EQMS census and IOL survey, January 2022

4.4.3.11 Energy Use of PAHs

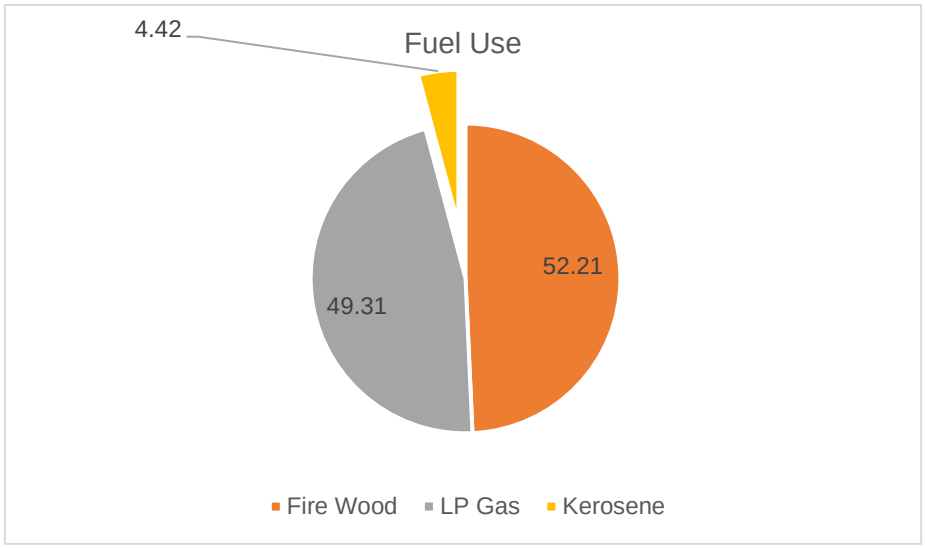
The main source of lighting is electricity for 100% grid connected households. Households also use multiple and combined energy sources for domestic purposes such as kerosine.

Project Affected Households in the project areas experience frequent load shedding which deprives them regular supply of electricity throughout the day. Load shedding is extensive and continues for several hours in night and daytime. It adversely affects in irrigating of cultivation fields and irregular supply of water, children's studies at nighttime, and women in watching television programs. Sleep at nighttime is also difficult for them as they cannot operate fans during summer seasons. In spite of irregular and limited power supply, households lament over having to pay high electricity bills.

4.4.3.12 Fuel Source of PAP

More than fifty percent households' main source of energy is firewood (52.21%) for cooking and boiling purposes, almost 49.31% using liquefied petroleum gas, particularly by people living closer to urban areas. Kerosene is used by 4.42% which is very harmful for the health and environment caused by indoor pollutants.

Figure 4-41 Fuel Source of PAHs



Source: EQMS census and IOL survey, January 2022

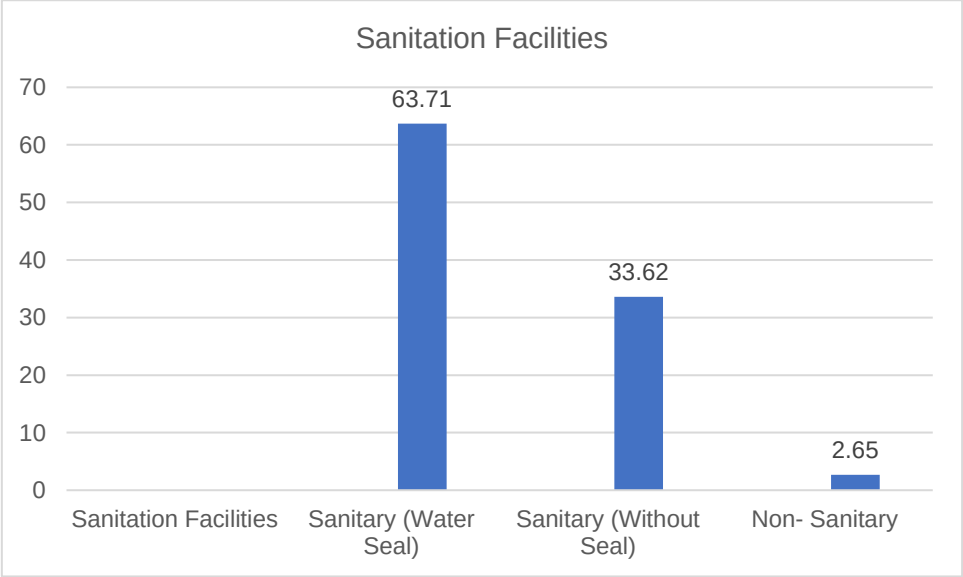
4.4.3.13 Water Source of PAHs

The major source of drinking water is tube-well where about 71.69% households use tube-wells water and 9.73% people have access to deep tube-well water. About 15.93% households use motor connected tube well and only 2.65% households have access of supply water. The uses of river water for the domestic purposes were not recorded during the census. However, river water used in domestic animals bathing and for the irrigation.

4.4.3.14 Sanitation Facilities of PAHs

About 63.71% and 33.62% of households use water sealed and non-water-sealed sanitary latrine facility, respectively, whereas only 2.65% households use non-sanitary facilities. The following Figure shows sanitation facility of the project area.

Figure 4-42 Sanitation Facilities of AHs



Source: EQMS census and IOL survey, January 2022

4.4.3.15 Health and Services

No chronic illnesses are reported from the subproject affected areas. However, incidence of water borne diseases and skin ailments were frequently reported during consultations. People approach multiple institutions for medical care and treatment. Upazilla health Complex or Community Clinic are accessed for their medical and health needs. Despite the presence of several health and medical service institutions, access to them from rural distance from the households varies from 2 km to 5 km across the project affected areas. Medical services at private clinics are expensive and unaffordable to many families. Government hospitals in local areas lack enough medicine, diagnostic facilities and staff. Patients must wait in long queues. For serious illnesses, people go to Dhaka for treatment. People sometimes travel more than 100 km to get their medical tests done

4.4.3.16 Role of Women and Gender Issues

Women are engaged in multiple activities in the project affected areas. Beside they paled a vital role in household management such as household cooking, cleaning, fetching water, feeding children, helping in children's studies and looking after the in-laws (particularly those living in extended families), women across the project areas also make a significant contribution to the household economy.

Even though strong pressures from the families to dissuade women finding employment, they take a lead role in livestock farming and take care of the feeding of their cattle, goats, poultry and duck. Home gardening and vegetable production is another important economic activity of women, produce of which is used for both household consumption and marketing. Other forms of economic activities conducted by women include agricultural labor work, dressmaking, handicraft-making, employment in apparel industries etc. Educated women are employed in both government and private sector jobs. Women's earnings are mainly used for children's education and clothing, to supplement the households' consumption needs, and to repay the past debts. Some women would also save some money to be used in emergencies or for their children's future. In some communities, however, it has been reported that women must hand over their earnings to husbands or else get prior consent of the husband to spend their earnings. Women also participate in the activities of NGOs like ASA, BRAC, and Grameen Bank to access micro-credit which they would use to buy cattle, goats and poultry.

Household level decision-making is largely vested with the husband. A few instances of joint decision making by both men and women were reported. Women also perform a significant role in managing household assets despite the key immovable assets like land and house are owned by men. Physical assets such as land and jewelry received by women as part of their dowry remain in her possession but in some occasions, they are transferred to the ownership of men as part of matrimonial agreements. Women are discouraged from participating in social and political activities mostly by their male counterparts. However, many women struggle to change this situation.

4.4.3.17 Indigenous Peoples

There are some indigenous communities such as Shantal, Orao, Mahato lives in the project affected areas. They are mainly landless and most of these people are employed as sharecroppers- working on others' land or as wage labour. Therefore, no permanent or temporary and direct or indirect impacts on indigenous people's communities are anticipated. The project has taken necessary steps to avoid the indigenous people's communities and their properties and other social and cultural activities from the areas identified for project implementation.

5 IMPACT ASSESSMENT AND EVALUATION

Assessment of potential impacts are based on activities that will be involved in the implementation of the project, nature and extent of the proposed activities, and present environmental setting of the project area.

The section 5 of the original IEE (Table 9.3 of the original IEE) remains as applicable for impact evaluation of the project.

This section evaluates additional potential impacts based on activities that will be involved in construction and operation phase of the three proposed transmission lines: (i) Rupsha-Satkhira 230 kV transmission line, (ii) Domar-Purba Sadipur 230kV double circuit transmission line and (iii) Niamatpur-Patnitola 132kV double circuit transmission line and compares them with the original IEE.

5.1 Impact Assessment Methodology

The impact assessment has involved the prediction, evaluation, and mitigation of impacts and report on impacts including residual impacts and cumulative impacts. The impact assessment methodology of this addendum follows the methodology of the original IEE (section 5.2 of the original IEE).

5.2 Impact Identification

The potential impacts have been identified through a systematic process whereby the activities (both planned and unplanned) associated with the project have been considered with respect to their potential to interact with environmental and social resources or receptors.

The interaction matrix enables a methodical identification of the potential interactions each project activity may have on the range of resources/receptors within the area of influence i.e., the study area of the project. The interaction matrix for the project activities and likely impacted resources/receptors is presented in Table 5-1.

Table 5-1: Potential environmental impacts on the IECs during the Phases and Comparison with Addendum-2

IECs/Issues	Potential Impacts	Sensitivity	Magnitude	Significance Prior to Mitigation	Potential Impacts during Addendum-2
Pre-construction Stage					
Physical Environment					
Ambient air quality	Vehicular emissions: dust from excavation works, land clearing, and material stockyards may affect ambient air quality.	Medium	Minor	Minor Adverse	Same as previous
Ambient noise	Noise level may increase due to mobilization of vehicles and unloading of materials.	Medium	Minor	Minor Adverse	Same as previous
Quality of surface and groundwater	The quality of surface water of the water bodies close to the project construction sites may deteriorate if erosion products and silt reach water bodies, especially during rains	Medium	Moderate	Moderate Adverse	Same as previous
Soil	During the pre-construction period, site clearance work will be done accordingly. Site clearance will impact the fertile top soils that are enriched with nutrients	Low	Minor	Minimal Adverse	Same as previous
Land and Agricultural Resources					
Land use	Would be partially impacted in RoW	Low	Minor	Minimal Adverse	Minimal Adverse/ Same as previous
Crop production	Would be highly impacted, at tower foundation areas and substation lands	Medium	Moderate	Moderate Adverse	Same as previous
Fisheries Resources					
Fish habitat	Fish habitat quantity and quality will be changed.	Medium	Moderate	Moderate Adverse	Same as previous

IECs/Issues	Potential Impacts	Sensitivity	Magnitude	Significance Prior to Mitigation	Potential Impacts during Addendum-2
Fish production	Production reduced due to waterbody loss	Low	Minor	Minimal Adverse	Same as previous
Socioeconomic Resources					
Land price	Reduced near RoW and substation lands, increase away from transmission lines and substations due to availability of electricity	Low	Minor	Minimal Adverse	Same as previous
Employment opportunities	Temporary or minimal opportunities at this stage.	Medium	Moderate	Moderate Beneficial	Same as previous
Human health and safety	Ensure proper Health and safety for workers involved for site clearance. Road traffic safety with number of trucks for fill import.	Low	Minor	Minimal Adverse	Same as previous
Road/ river/ canal/ water body crossings	Minimal impacts	Low	Minor	Minimal adverse	Same as previous
PCRs	Proper chance find procedures will also be implemented in case of a chance find.	Low	Minor	Minimal Adverse	Same as previous
Construction Stage					
Physical Environment					
Ambient air quality	Suspended particulate matter from excavation works and land clearing, including vehicular emissions, may affect workers and community.	Medium	Moderate	Moderate Adverse	Monitoring results were found well within the limits of national standards for both the alignments.

IECs/Issues	Potential Impacts	Sensitivity	Magnitude	Significance Prior to Mitigation	Potential Impacts during Addendum-2
Ambient noise	Mobilization of heavy equipment and machinery, use of construction vehicles, transport of materials, pile driving, and construction activities may increase ambient noise level. Exposure to high level ambient noise may cause anxiety and disturbance to workers and community.	Medium	Moderate	Moderate Adverse	Monitoring results were found well within the limits of national standards.
Quality of surface and groundwater	Potential for siltation due to construction works near pond or river.	Medium	Moderate	Moderate Adverse	Monitoring results were found well within the limits of national standards.
Riverbank erosion	Potential erosion due to ground movements along the riverbank.	Medium	Major	Moderate Adverse	Same as previous
Soil	During construction, top soil at the tower footings may be eroded during excavation. Construction wastes like metal scraps and wooden packing material, and polythene may create a disturbance to the surrounding land, settlements, and the communities; Domestic wastes from labor camp.	Medium	Major	Moderate Adverse	Same as previous
Land and Agricultural Resources					
Land use	Would be partially impacted as agricultural land may be permanently lost due to the tower footings.	Medium	Moderate	Moderate Adverse	Same as previous

IECs/Issues	Potential Impacts	Sensitivity	Magnitude	Significance Prior to Mitigation	Potential Impacts during Addendum-2
Crop production	May be moderately affected due to crop loss at the tower footings and in the clearing for RoW.	Medium	Moderate	Moderate Adverse	Same as previous
Intercropping	Maybe affected due to the erection of towers	Low	Minor	Minimal Adverse	Same as previous
Change in topography/terrain	Excavation and erection work for the transmission towers may affect topography.	Low	Minor	Minimal Adverse	Same as previous
Impairment of visual aesthetics	Transmission towers partially visible on the skyline.	Low	Minor	Minimal Adverse	Same as previous
Fisheries Resources					
Fish habitat	Few lands selected for substations having water bodies, permanent loss of fish habitats in substation lands. Construction activities may temporarily affect nearby fish habitats.	Medium	Minor	Minor Adverse	Same as previous
Fish production	Lands earmarked for 2 substations contain 3-acre waterbodies. These waterbodies might be filled for the construction of substations. This will affect the fish production.	Medium	Moderate	Moderate Adverse	Same as previous
Terrestrial Resources (Flora and Fauna)					
Terrestrial vegetation	Vegetation clearing/ tree cutting is required at the tower footings and RoW.	Medium	Moderate	Medium Adverse	In these three alignments, tree cutting due to tower footings and RoW will be less than the

IECs/Issues	Potential Impacts	Sensitivity	Magnitude	Significance Prior to Mitigation	Potential Impacts during Addendum-2
					previous count
Wildlife habitat and their disturbance	Route will be mainly in urban or peri-urban areas. Habitat in the areas affected may not host wildlife.	Medium	Moderate	Medium Adverse	Same as previous
Socioeconomic Resources					
Compensation for crop damage	Standing crops at the tower footings and RoW may be damaged.	Medium	Moderate	Moderate Adverse	Crop compensation status has been incorporated in the updated RAP
Land price	Value of land may be temporarily affected.	Medium	Moderate	Moderate Adverse	Same as previous
Temporary employment opportunity	Both technical and non-technical laborers will be required	Medium	Moderate	Moderate Beneficial	Same as previous
Human health and safety	The safety and health of the public may be impacted due to the hazards created during the construction period, e.g., movement of heavy equipment, vehicles, and machineries. Damages to structure within RoW. Workers may be exposed to occupational health risks and safety hazards, mostly working with electricity and working at height.	Medium	Minor	Minor Adverse	Moderate Adverse. Occupational health risk observed in both the alignments due to lack of general safety requirements and precautions while working at these two construction sites
Road/ river/ canal/ water body crossings	Road use for construction activities as haulage of construction materials, spoil, and equipment, river bank and Soil erosion	Medium	Moderate	Moderate Adverse	Same as previous

IECs/Issues	Potential Impacts	Sensitivity	Magnitude	Significance Prior to Mitigation	Potential Impacts during Addendum-2
PCRs	Proper chance find procedures will also be implemented in case of a chance find.	Low	Minor	Minimal Adverse	Same as previous
Regional and national development	May create development opportunities in anticipation of stable power supply.	Medium	Moderate	Moderate Beneficial	Same as previous
Operation Stage					
Physical-Chemical Environment					
Ambient air quality	Climate change from fugitive emission (negligible) of SF6	Low	Minor	Minimal Adverse[7]	Same as previous
Ambient noise	Noise in the form of buzzing or humming can often be heard around transformers or power lines producing corona. Outside of RoW will be negligible.	Low	Minor	Minimal Adverse	Same as previous
Quality of surface and groundwater	Transformer oil spill and leakage	Low	Minor	Minimal Adverse	Same as previous
Riverbank erosion	No or minimal impact	Low	Minor	Minimal Adverse	Same as previous
Soil/Land contamination	Potential for spill or improper disposal of mineral oil used as insulating oil in transformers. No use of PCB or PCB-containing material will be allowed.	Low	Minor	Minimal Adverse	Same as previous
Land and Agricultural Resources					

[7] Due to high global warming potential, SF_6 may contribute to the man-made greenhouse-effect, if it is released into the atmosphere. However in electrical switchgear the SF_6 gas is always used in gas-tight compartments, greatly minimizing leakage. This makes the real impact on greenhouse effect negligible. As per ECOFYS, Sina Wartmann, Dr. Jochen Harnisch, June 2005, “Reductions of SF_6 Emissions from High and Medium Voltage Equipment in Europe” study, the contribution to the greenhouse effect in Europe is estimated to 0.05 %.

IECs/Issues	Potential Impacts	Sensitivity	Magnitude	Significance Prior to Mitigation	Potential Impacts during Addendum-2
Land use	No impact (changes will have occurred in construction phase).	Low	Minor	Minimal Adverse	Same as previous
Crop production	Tower footings may have minor impact on crop production due to permanent loss of agricultural land.	Medium	Minor	Minor Adverse	Same as previous
Change in surface topography/ terrain	Transmission towers will have minimal impact on topography.	Low	Minor	Minimal Adverse	Same as previous
Impairment of visual aesthetics	Transmission towers visible on the skyline.	Low	Minor	Minimal Adverse	Same as previous
Fisheries Resources					
Fish habitat	No change expected	Low	Minor	Minimal Adverse	Same as previous
Fish production	No change expected	Low	Minor	Minimal Adverse	Same as previous
Terrestrial Resources (Flora and Fauna)					
Terrestrial vegetation	Restriction of vegetation height below the transmission line.	Low	Minimal	Minimal Adverse	Same as previous
Wildlife habitat and their disturbance	Natural forest, Protected areas or ecologically sensitive areas are not present in the proposed substation lands or along the transmission line routes	Low	Minimal	Minimal Adverse	Same as previous
Socioeconomic Resources					
Compensation	Ongoing permanent loss of land at the tower footings (but occurred at the construction stage).	Medium	Moderate	Moderate Adverse	Same as previous

IECs/Issues	Potential Impacts	Sensitivity	Magnitude	Significance Prior to Mitigation	Potential Impacts during Addendum-2
Land price	No land value at the tower footings (compensation already paid); development restrictions below the transmission line and between towers may affect land value.	Medium	Moderate	Moderate Adverse	Same as previous
Employment opportunity	Jobs will be created directly due to the project and indirectly through businesses and development resulting from the availability of power supply.	Medium	Minor	Minor Beneficial	Same as previous
Human health and safety	• Occupational and community safety risks (project maintenance); • There is public and scientific concern over the potential health effects associated with exposure to EMF.	Medium	Minor	Moderate Adverse	• Same as previous • As per the final alignment and confirmation from PGCB, there are no housing or school structures directly lies underneath these two lines. • PGCB confirms that consultations with the nearby residents undertaken to discuss the health and safety implications, with education program for residents and

IECs/Issues	Potential Impacts	Sensitivity	Magnitude	Significance Prior to Mitigation	Potential Impacts during Addendum-2
					communities on how to minimize the risks involved.
Road/ river/ canal/ water body crossings	No disturbances to vehicular traffic	Low	Minor	Minimal Adverse	Same as previous
Regional and national development	Availability of a stable and reliable power supply may improve productivity and national development.	Medium	Moderate	Moderate Beneficial	Same as previous

5.3 Potential Impacts during Addendum- 2

5.3.1 Terrestrial Resources (Flora and Fauna)

5.3.1.1 Clearing of Vegetation during Construction Phase

As per the original IEE, 2019, a significant number of big trees were estimated to be cleared in Rupsha-Satkhira transmission line, in the Domar-Purba Sadipur alignments and in the RoW of the Niamatpur-Patnitola transmission line. However, as per the primary survey of EQMS during this addendum, the total number of trees to be cut were counted less. The comparison of tree count is given in Table 5-2 .

Table 5-2: Comparison of tree count

SN	Sub-projects	Counted during original IEE, 2019	Counted during Addendum-2, 2022*
1.	Rupsha-Satkhira 230 kV transmission line	2,516 (>5 m in height)	264 (>5 m in height)
2.	Domar-Purba Sadipur 230 kV transmission line	1,432 (>5 m in height)	726 (>5 m in height)
3.	Niamatpur-Patnitola transmission line	301 (>5 m in height)	274 (>5 m in height)

*Source: https://www.adb.org/projects/documents/ban-51137-003-iee and EQMS Survey 2022

Most of the trees in the RoW of these two lines need to be trimmed rather than cut, and thus the impact will be only moderately significant. Both the transmission alignment falls inside paddy fields/ floodplain areas, so tree felling will mostly be restricted to settlement areas.

Mitigation Measures

- Vegetation clearance should be minimum within the designated areas.
- Workers should be aware of the importance of natural resources and should not unnecessarily clear any area or break branches, twigs, flowers, etc. of adjacent vegetation.
- Crops and plant health monitoring should be conducted.
- A detailed bird survey will be conducted along the transmission line focused on the major river crossings to confirm the findings of the IEE that it does not have a significant impact on their route and staging.

As the project impact will be for long term in a local extent within the adjacent areas of the project site, potential impact on Terrestrial Flora can be reduced to Very Low by following proper mitigation measures.

5.3.1.2 Occupational health and safety during Construction Phase

The construction of civil works such as transmission towers poses an inherent risk of injury to workers from accidents and hazardous working environments. Unsafe working conditions could place workers at risk of injury or death. Such conditions could be caused by vehicles and equipment that do not meet safety standards (seat belts, horns, lights, tires, etc.), unprotected access to dangerous locations (unmarked excavations), poor practices and equipment for lifting operations, poor electrical safety (untrained workers, inadequate tools, etc.), inadequate safeguards on tools and equipment (unprotected saws, etc.), and other poor practices.

During the survey of this addendum, it was observed that lack of general safety requirements and precautions prevails at these two lines construction yards. This non-compliance will trigger the

possibility of risk of injury to workers. Also, sanitation facility of the workers was observed in poor conditions at the construction yards of these two alignments.

Inadequate water and/or sanitation can affect workers' health, contaminate soil and surface water, and lead to worker illness or disease. Contractors will also have to provide sanitary facilities, including portable toilets in remote areas, and to enforce the Code of Conduct's prohibition on using the non-pit latrine.

Mitigation Measures

- Provide preventive and protective measures, including modification, substitution, or elimination of hazardous conditions, with particular attention to live power lines, working at height, working above water, high noise levels.
- Provide measures for the management and appropriate disposal of hazardous wastes to ensure protection of the workforce and the prevention and control of releases and accidents.
- Provide for the provision of appropriate fire extinguishers and fire response plans and appropriately trained first aid response staff.
- Provide for the provision of appropriately stocked first-aid equipment and stations at both work sites and temporary construction camps, including appropriately trained first-aid staff on site and provision of adequate transport facilities for moving injured persons to the nearest hospital.
- Provide for the provision of appropriate personal protective equipment (PPE) to minimize risks, such outerwear, boots, and gloves; eye protectors; ear plugs safety helmets, etc.
- Provide training for workers and establish appropriate incentives to use and comply with health and safety procedures and utilize PPE; Include procedures for documenting and reporting occupational accidents, diseases, and incidents; Include emergency prevention, preparedness, and response arrangements in place.

6 ENVIRONMENTAL MANAGEMENT PLAN

The primary objective of the Environmental Management Plan (EMP) is to avoid or eliminate or reduce the negative environmental impacts by possible mitigation measures and to enhance the positive impacts by enhancement measures. It would also address any unexpected or unforeseen impacts that may arise during construction and operation stages of the subprojects.

The aim of the EMP is to ensure implementation of the recommended mitigation and enhancement measures effectively. The mitigation measures are designed either to prevent impacts or by mitigating those to reduce the negative impacts to an acceptable level that complies with the environmental guidelines of the DOE and ADB.

The section EMP of the original IEE (Table 9.3 of the original IEE) remains as applicable management plan that depicts possible mitigation measures to avoid or eliminate or reduce the negative impacts and to enhance the positive impacts.

The additional mitigation measures under this addendum for Rupsha-Satkhira 230 kV transmission line Domar-Purba Sadipur 230 kV transmission line and Niamatpur-Patnitola 132 kV Transmission Line are incorporated in the Table 6-1. The environmental and social monitoring plan of the original IEE and update till this addendum has been incorporated in Table 6-2.

Table 6-1: Mitigation Measures for the Impacts of Transmission Lines of during Addendum-2

Environmental Issues/ Parameters	Environmental Impacts	Mitigation Measures	Implementation Agency	Supervision Agency
(a) Pre-construction/Construction Stage				
Tree cutting, Clearing of vegetation	1,264 trees (>5 m in height) will be directly affected by cutting and trimming along the RoW of Rupsha-Satkhira 230 kV transmission line Domar-Purba Sadipur 230 kV transmission line and Niamatpur-Patnitola 132 kV transmission line.	• Prior to the start of clearing of vegetation, provide adequate compensation to the owners. • Tree cutting and vegetation clearance should be done within the designated areas. • A compensatory tree plantation program should be adopted. Tree plantation will be carried out with a ratio of 1:3. The contractor will be responsible for the plantation and maintenance (replacing losses) of the trees for at least 3 years under the supervision of PGCB. These plantations would be the part of 75,000 trees that are already included in the EMP for the operational stage in the original IEE. • Trees should be checked for nests and holes before cutting. Active nests, eggs, hatchling must be safeguarded. • A detailed bird survey will be conducted along the transmission line focused on the major river crossings to confirm the findings of the IEE that it does not have a significant impact on their route and staging.	Contractor	DSC/ PGCB
Occupational health and safety (H&S)	Health and safety risks of construction workers.	• Site H&S Manager must be engaged on each alignment. • Only permitting trained and certified workers to work with any electrical equipment. • Before access to site granted, contractor to prepare H$S plan based on risk assessment for approval by PGCB following national and EHS guideline	Contractor	DSC/ PGCB

		requirements. • Safety instruction by the E&H Manager should be provided for the workers and visitors before they will be allowed to access the site. • First aid box and personal protective equipment, PPE (such as helmet, safety shoes, eye protection glass, ear plugs, waist belt, mask, hand gloves, body protective apron, ear muff and insulating boots, as needed) must be provided to the workers, and ensure their use by workers. • Safety signs as needed at the tower sites. • Provide for the provision of appropriate fire extinguishers and fire response plans and appropriately trained first aid response staff. • The EPC Contractor will be required to provide affordable group medical and accident insurance to their workers or arrange with the local health facilities to aid in the event of emergency; • Noise barrier will be installed in areas and equipment with high level noise • EPC Contractor will provide workers with sanitary facilities, safe drinking water, wash area, adequate water for washing purposes, fire-fighting unit, etc.		

6.1 Environmental Monitoring

Table 6-2: Environmental Monitoring Plan for TL/LILO Line Subprojects

Environmental Issues/Parameters	Monitoring Parameters	Standards/ Guidelines	Means of Monitoring	Frequency	Location	Implementation Agency	Supervision Agency	Update until Addendum-2
Pre-construction/Construction Stage								
Requirement of land	Ensure that PAPs get compensation as per RP	As per RP	Inspection	As per RP	RoW of the TL/LILO lines	DC	DSC/PGCB	Same as previous
Trimming of trees within RoW and clearing vegetation from the tower bases of the TL/LILO lines.	Checking whether proper compensation as mentioned in RP is received by PAPs.	DoE/FD	Inspection	Regular during tree felling and site clearing operations	Trimming of trees within RoW and clearing vegetation from the tower bases of the TL/LILO lines.	FD	DSC/PGCB	Same as previous
Ambient Air Quality Parameters	SPM, PM10, PM2.5, SOx, NOx, CO & Pb- 24hr monitoring	DoE standards	Sampling/ laboratory analysis	Before construction, then quarterly	At representative tower construction sites	Contractor	PGCB	Monitoring conducted for two alignments (Rupsha-Satkhira 230 kV double circuit transmission line, Domar-Purba Sadipur 230 kV double circuit transmission line) under this addendum. As per PGCB, the environmental baseline monitoring of Niamatpur-Patnitola route is in progress. Partial environmental baseline data (lab sheet) for Niamatpur-Patnitola route has been incorporated in Appendix D.
Noise Pollution	Ambient noise level	DoE standards	Measurement	Regularly during construction at the locations with sensitive receptors and during piling works if any.	At adjacent subproject cultural sites and construction camps	Contractor	DSC/PGCB	Monitoring conducted for two alignments (Rupsha-Satkhira 230 kV double circuit transmission line, Domar-Purba Sadipur 230 kV double circuit transmission line) under this addendum. As per PGCB, the environmental baseline monitoring of Niamatpur-Patnitola route is in progress. Partial environmental baseline data (lab sheet) for Niamatpur-Patnitola route has been incorporated in Appendix D.
Pollution due to Wastes	Checking storage, transportation, handling, and disposal of wastes. Wastes from construction sites and camps to be disposed properly at the designated waste dumping sites.	DoE guidelines	Inspection	Regular	Construction sites and camps	Contractor	DSC/PGCB	

Environmental Issues/Parameters	Monitoring Parameters	Standards/ Guidelines	Means of Monitoring	Frequency	Location	Implementation Agency	Supervision Agency	Update until Addendum-2
Surface Water Quality	pH, BOD5, COD, NH3-N, PO4, TPH and coliforms	DoE Standards	Sampling and Laboratory Analysis	At all river crossings within 500m of waterbodies before and after works	River Crossing Sites near towers	Contractor	DSC/PGCB	• Monitoring conducted for two alignments (Rupsha-Satkhira 230 kV double circuit transmission line, Domar-Purba Sadipur 230 kV double circuit transmission line) under this addendum. • As per PGCB, the environmental baseline monitoring of Niamatpur-Patnitola route is in progress. Partial environmental baseline data (lab sheet) for Niamatpur-Patnitola route has been incorporated in Appendix D. • NH_3-N, PO_4, TPH and coliforms were missing parameters during the surveys of Addendum-2. These parameters will be from now on in the quarterly monitoring. • Also, the below parameters will be monitored from now on in the quarterly monitoring: Biochemical Oxygen Demand (BOD_5), Chemical Oxygen Demand (COD), Dissolved Oxygen (DO), Electrical Conductivity (EC), pH, Salinity, Temperature (T), Hardness, Total Dissolved Solid (TDS).
Groundwater /Drinking Water Quality	pH, Mn, Fe, As, TC, FC, TPH	DoE Standards	Sampling and Laboratory Analysis	Quarterly at all tube wells within 500m	At representative tower construction sites	Contractor	DSC/PGCB	• Monitoring conducted for two alignments (Rupsha-Satkhira 230 kV double circuit transmission line, Domar-Purba Sadipur 230 kV double circuit transmission line) under this addendum. • As per PGCB, the environmental baseline monitoring of Niamatpur-Patnitola route is in progress. Partial environmental baseline data (lab sheet) for Niamatpur-Patnitola route

Environmental Issues/Parameters	Monitoring Parameters	Standards/ Guidelines	Means of Monitoring	Frequency	Location	Implementation Agency	Supervision Agency	Update until Addendum-2
								has been incorporated in Appendix D. • Mn, Fe, As, TC, FC, TPH were missing parameters during the surveys of Addendum-2. These parameters will be from now on in the quarterly monitoring. • Also, the below parameters will be monitored from now on in the quarterly monitoring: Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Dissolved Oxygen (DO), Electrical Conductivity (EC), pH, Salinity, Temperature (T), Hardness, Total Dissolved Solid (TDS).
Traffic congestion/ Road Accident	Checking road crossing points, roads adjacent to towers.	BRTA	Inspection	Regular	At road/railway. crossing points and roads adjacent to towers	Contractor	DSC/PGCB	• Monitoring conducted for two alignments (Rupsha-Satkhira 230 kV double circuit transmission line, Domar-Purba Sadipur 230 kV double circuit transmission line) under this addendum. • As per PGCB, the environmental baseline monitoring of Niamatpur-Patnitola route is in progress. Partial environmental baseline data (lab sheet) for Niamatpur-Patnitola route has been incorporated in Appendix D.
Cultural sites (such as a mosque)	Checking whether cultural sites are affected by the project activities such as noise, wastes, etc.	DoE guidelines	Inspection	As and when required		Contractor	DSC/PGCB	
Physical Cultural Resources	Chance find procedure to be developed	DoE/IFC guidelines	Inspection	Regular	At construction site	Contractor	DSC/PGCB	

Environmental Issues/Parameters	Monitoring Parameters	Standards/ Guidelines	Means of Monitoring	Frequency	Location	Implementation Agency	Supervision Agency	Update until Addendum-2
Occupational health and safety	Use of PPE, general health, water supply and sanitation. Record of all occupational H&S incidents, any people lost time or fatal must be reported to ADB within 48hrs with corrective action plan.	DoE/IFC guidelines	Inspection	Regular	At construction sites and camps	Contractor	DSC/PGCB	
Community health and safety	Awareness of local people. Record of all community H&S incidents, any people lost time or fatal must be reported to ADB within 48hrs with corrective action plan.	DoE/IFC guidelines	Inspection	Regular	At tower construction sites and crossing of roads	Contractor	DSC/PGCB	
Operation Stage								
Tree replantation	Replanting of saplings and checking replacement of dead saplings, and watering and fertilizing of saplings for 3 years	FD	Inspection	Quarterly	Access road side slopes	FD	PGCB	
Tall trees	Trimming of tall trees under the transmission line	FD	Inspection	Once every year and as directed by the relevant engineer of PGCB	Along the TL/LILO Lines	PGCB	PGCB	
EMF	Checking of clearance of transmission line and tops of houses (for housing structures) and for river crossing clearance from HFL to TL	Australian Standard for the safety of power lines (No BD standard and no device available in BD)	Inspection	As and when required	At populated /housing areas where TL/LILO lines pass over	PGCB	PGCB	
Short circuit/ accident	Safety	DoE guidelines	Inspection	Regular	Along the TL/LILO lines	PGCB	PGCB	
Occupational and Community Health and Safety	Use of PPE. Record of all occupational and community H&S incidents, any people lost time or fatal must be reported to ADB within 48hrs with corrective action plan.	As required	Inspection	Regular	Along the TL/LILO lines	PGCB	PGCB	
Power Supply	Access to electricity in the rural area on priority basis.	DoE/PDB guidelines	Inspection	Whole project period	Along the TL/LILO lines	PGCB	PGCB	

As = arsenic, BD = Bangladesh, BOD5 = five-day biochemical oxygen demand, BRTA= Bangladesh Road Traffic Authority, COD = chemical oxygen demand, DC = Deputy Commissioner, DoE = Department of Environment, DSC = Design and Supervision Consultants, EMF = electromagnetic field, FC = faecal coliform, Fe = iron, HFL = highest flood level, IFC = International Finance Corporation, LILO = line-in line-out, m = meter, Mn = manganese, NH3-N = ammonia nitrogen, OHS = Occupational Health and Safety, PAP = project affected person, PDB = Power Development Board , PGCB = Power Grid Company of Bangladesh, PO4 = phosphate, PPE = personalprotective equipment, RoW = right of way, RP = Resettlement Plan, TC = total coliform, TL = transmission line.

7 GRIEVANCE REDRESS MECHANISM

A Grievance Redress Mechanism (GRM), consistent with the requirements of ADB's SPS 2009 has been established by PGCB to prevent and address community concerns, reduce risks, and assist the project to maximize environmental and social benefits. A three-tire GRM has been established to deal with and resolve complaints and grievances faster and thus enhance project performance standards in terms of environmental and social management. The detailed grievance mechanism and resolution procedure has been incorporated in the original IEE, 2019.

Until the date of addendum-2, no grievance has been reported with respect to environmental and social issues.

8 PUBLIC CONSULTATION AND DISCLOSURE

The public consultations were conducted in Rupsha-Satkhira in February 2022 and Niamatpur in January 2022 and in Purba Sadipur in July 2022 through stakeholder consultations, and individual meetings during the environmental study of the proposed project in conformity with the DoE's environmental guidelines to achieve the following objectives:

- To share information on the subprojects (substations, transmission lines) of the proposed project.
- To understand stakeholders, including PAPs, concerns regarding various aspects of the proposed project including existing power supply facilities/system and expected potential environmental impacts along with possible mitigation measures during the construction and operation stages of the proposed project.
- To identify the conflict issues in advance and to find acceptable solutions; and,
- To gather local knowledge before decision making on the proposed project.

Also, the consultations followed the below requirements of ADB SPS 2009 requirements for meaningful consultations.

- The consultation begins early in the project preparation stage and carried out on an ongoing basis throughout the project cycle;
- The consultation provides timely disclosure of relevant and adequate information that is understandable and readily accessible to affected people;
- The consultation is undertaken in an atmosphere free of intimidation or coercion;
- The consultation is gender inclusive and responsive, and tailored to the needs of disadvantaged and vulnerable groups; and
- The consultation enables the incorporation of all relevant views of affected people and other stakeholders into decision making, such as project design, mitigation measures, the sharing of development benefits and opportunities, and implementation issues.

8.1 Focus Group Discussions

Focus group Discussion (FGD) is a small, but demographically diverse group of people and whose reactions are studied about a proposed project or something else to determine the reactions that can be expected from a larger population. It is a form of qualitative study consisting of interviews in which groups of people are asked about their perceptions, opinions, beliefs, and attitudes towards the project, service, concept, advertisement, idea, or packaging. Questions are asked in an interactive group setting where participants are free to talk with other group members. During the study, eleven FGDs with various groups including women and affected people were conducted using local language (Bengali) for easy understanding of the opinions for both the transmission lines.

Discussion was held with the local people at near the proposed project site. Date, location, and the number of participants of each discussion is listed in **Table 8-1** and Error! Reference source not found.**.**

Table 8-1: Location and number of participants at FGDs (Transmission Line)

SL.NO.	Name of Transmission line	Venue	No. of Male (M)/ Female(F)		Total Participants	Date
			M	F		
1.	Rupsha- Satkhira	Batiaghata	0	6	6	February-March 2022
2.		Dacop	5	0	5	
3.		Aushkhali	7	0	7	
4.	Domar-Purba Sadipur	Shewraphuli	0	8	8	May 2022 and July 2022
5.		Dipnagar	0	7	7	
6.		Hossenpur	5	0	5	
7.		Birganj	10	0	10	
8.		Gourgram	6	0	6	
9.	Niamatpur-Patnitola	Mohadebpur	0	8	8	January 2022
10.		Niamatpur	4	2	6	
11.		Patnitola	6	0	6	

8.1.1 Summary of Focus Group Discussion with Local Community and Affected Persons (Transmission Line)

- Participants had been informed about the project before through public advertisement. They are appreciated the project after knowing that the objective of the Project is to increase the supply of electricity.
- The major crops grown are vegetables, rice like. Irri and Amon paddy is grown in the region. Rice is cultivated twice in a year. Moreover, Corn is also cultivated a lot in these areas.
- Due to transmission line, natural forest will be affected. A huge amount of deforestation might be happened for covering the transmission line.
- There will be a possibility of some environmental impacts on the area at the construction period and most of the people are mostly concerned about it. The survey team explained those impacts will be temporary and can be mitigated to minor level.
- Using locally available materials during the construction phase of the proposed subprojects will contribute towards growth of the economy by contributing to the gross domestic product.
- People of that area think that the project will develop the electricity condition of the area. Project might increase the availability of new industries and factories in the area. These industries and factories will create job opportunity for local affected people to develop their economic condition.
- Labor is available in the project area and the participants expect that PGCB/Contractor will engage local labor to support the economic condition of the local community. Moreover, due to Covid-19 many people have lost their jobs and waiting to engage them in any work including labor.
- Local people want priority to work as labor and employee based on their qualifications during construction phase.

8.1.2 Summary of Focus Group Discussion with Women Group

- Women of the area mostly involved in household works and a few are working outside to assist men in agricultural work.
- Most of the women of the area are illiterate, some are Primarily educated. A very few women have passed S.S.C and H.S.C level.
- Early Marriage is the most common problem faced by the women of the project area.
- Most women are supportive for the proposed project to be implemented at their locality. They think, some agricultural land may be lost, but the nation as well as the project area will be benefited by the proposed project.
- Project might increase the availability of new industries and factories in the area. These industries and factories will create job opportunity for local women to develop their economic condition.
- Electricity is available for 3-4 hours in peak season. Most people are unhappy with the present power situation and demanded uninterruptable eclectic supply from PGCB.
- Study of local children will be easier after getting uninterruptable eclectic supply.
- Economic activities would be much better.
- There was concern over the possibility high noise and vibration levels in the project site as a result of construction works. However, the proponent will have to take appropriate steps to minimize noise production by ensuring that all construction equipment is well maintained.
- They don’t have any land parcel of their own name in the proposed project area.
- Contractor should be careful about decreasing gender-based violence such as sexual harassment which can be occurred by labor influx in the project site. So, contractors should avoid labor influx in project site and give priority to local labors.

9 CONCLUSION AND RECOMMENDATIONS

This addendum report to original IEE[8] study has been conducted based on the final surveyed alignments of the two transmission line routes: Rupsha-Satkhira 230 kV transmission line, Domar-Purba Sadipur 230 kV transmission line and Niamatpur-Patnitola 132 kV Transmission Line, where the main scope was to update the baseline condition, impact assessment and suggest environmental management plan. As per the impact assessment it has been found that many of the impacts are localized and short-term or temporary in nature and can be mitigate as suggested in the EMP of the original IEE and this addendum. The Project received favorable support from local people and other stakeholders during consultations. Stakeholders appreciated that in addition to providing a reliable power supply to the region, the Project will have several other benefits such as supporting economic growth in the region by opening avenues for further development, employment (direct and indirect) and improving local infrastructure.

Rupsha-Satkhira 230 kV transmission line was 62 km and had some deviation considering less impacts e.g., damage to community structures, tree cutting etc. in the original route. The final route avoided all the settlements and structures within the RoW. The protected or environmentally sensitive areas, forest, scrublands or wildlife reserves are not found along the line route. There are no springs or deep wells/tubewell other common and individual properties situated underneath this line. During the consultation and site visit of the consultants, it was revealed that there were no physical cultural resources situated within ROW. The major waterbodies covered are rivers and gher, however, the transmission line will not pose any risk to seasonal habitats/wetlands. Due to the slight deviation towards the end for the final route, a smaller number of trees to be cut in this alignment than the original route.

Domar-Purba Sadipur 230 kV transmission line is estimated at 46.5 km by the PGCB. During the field surveys it was observed that the line has some deviations considering less impacts e.g., damage to community structures, tree cutting etc. to the original line route. There are no settlements, structures, common and individual properties situated underneath this line. There are no protected areas, ecologically critical areas, reserve forests and other wildlife reserves are found within the RoW. A smaller number of trees to be cut in this alignment than the original route.

Similarly, the total length of Niamatpur-Patnitola 132 kV transmission line is estimated at 33.3 by the PGCB. After the field surveys the length of the line has been decreased to 33 km due to few deviations considering less impacts e.g., damage to community structures, tree cutting etc. to the original line route. There are no settlements, structures, common and individual properties situated underneath this line. There are no protected areas, ecologically critical areas, reserve forests and other wildlife reserves are found within the RoW. A smaller number of trees to be cut in this alignment than the original route.

A detailed birds survey/migratory birds surveys for these two alignments are suggested to be conducted in order to eliminate any potential threat to their route and staging.

In conclusion, there will be some minor negative impacts caused by the project during implementation. Compensation will be paid for loss of land, trees, and crops. The impacts identified in the original IEE and this addendum can be mitigated with implementation of the EMP and monitoring measures.

[8] https://www.adb.org/projects/documents/ban-51137-003-iee

APPENDIX

APPENDIX A: COORDINATES OF FINAL ALIGNMENTS OF TRANSMISSION AND LILO LINES OF DWZTGEP COMPONENT 2

Rupsha-Satkhira 230 kV Transmission Line

Line Length: 62 km

No	Coordinates (Decimal Degrees)		Elevation (m)	Name and Angle
	Latitude	Longitude		
1	22°44'29.73"N	89° 7'54.93"E	1	AP- 04
2	22°44'25.95"N	89° 8'5.23"E	1	DL- 4/1
3	22°44'21.59"N	89° 8'17.12"E	2	DL- 4/2
4	22°44'21.59"N	89° 8'17.12"E	2	DL- 4/3
6	22°44'9.28"N	89° 8'50.68"E	1	DL- 4/5
7	22°44'5.09"N	89° 9'2.09"E	4	DL- 4/6
8	22°44'0.94"N	89° 9'13.41"E	5	AP- 05
9	22°44'5.31"N	89° 9'25.33"E	5	DL- 5/1
10	22°44'9.68"N	89° 9'37.22"E	4	DL- 5/2
11	22°44'14.30"N	89° 9'49.83"E	6	DL- 5/3
12	22°44'18.75"N	89°10'1.95"E	6	DL- 5/4
13	22°44'23.38"N	89°10'14.56"E	9	DL- 5/5
14	22°44'27.79"N	89°10'26.59"E	5	DL- 5/6
15	22°44'31.72"N	89°10'37.31"E	6	DL- 5/7
16	22°44'35.81"N	89°10'48.45"E	8	DL- 5/8
17	22°44'40.17"N	89°11'0.35"E	6	DL- 5/9
18	22°44'44.65"N	89°11'12.56"E	7	AP-06
19	22°44'38.92"N	89°11'24.56"E	6	DL-6/1
20	22°44'33.43"N	89°11'36.05"E	9	DL-6/2
21	22°44'27.83"N	89°11'47.80"E	7	DL-6/3
22	22°44'22.29"N	89°11'59.39"E	6	DL-6/4

No	Coordinates (Decimal Degrees)		Elevation (m)	Name and Angle
	Latitude	Longitude		
23	22°44'16.64"N	89°12'11.23"E	4	DL-6/5
24	22°44'11.04"N	89°12'22.96"E	6	AP- 07
25	22°44'12.72"N	89°12'36.16"E	4	DL-7/1
26	22°44'14.33"N	89°12'48.79"E	6	DL-7/2
27	22°44'15.95"N	89°13'1.53"E	10	DL-7/3
28	22°44'17.42"N	89°13'13.08"E	5	AP - 08
29	22°44'16.82"N	89°13'23.57"E	4	DL-8/1
30	22°44'16.15"N	89°13'35.43"E	4	DL-8/2
31	22°44'15.50"N	89°13'46.69"E	2	DL-8/3
32	22°44'14.97"N	89°13'56.13"E	3	AP - 09
33	22°44'11.09"N	89°14'8.40"E	4	DL- 9/1
34	22°44'7.73"N	89°14'19.03"E	3	AP- 10
35	22°44'14.45"N	89°14'27.35"E	1	DL-10/1
36	22°44'22.14"N	89°14'36.86"E	0	AP- 11
37	22°44'23.66"N	89°14'46.11"E	0	DL-11/1
38	22°44'25.45"N	89°14'57.12"E	3	DL-11/2
39	22°44'27.17"N	89°15'7.64"E	2	DL-11/3
40	22°44'28.89"N	89°15'18.17"E	2	AP-12
41	22°44'28.89"N	89°15'18.17"E	2	DL-12/1
42	22°44'22.34"N	89°15'33.45"E	2	DL-12/2
43	22°44'19.59"N	89°15'39.86"E	3	AP - 13
44	22°44'13.60"N	89°15'49.79"E	3	AP - 14
45	22°44'14.09"N	89°15'57.86"E	2	DL-14/1
46	22°44'14.69"N	89°16'7.55"E	2	DL-14/2

No	Coordinates (Decimal Degrees)		Elevation (m)	Name and Angle
	Latitude	Longitude		
47	22°44'15.25"N	89°16'16.68"E	2	AP - 15
48	22°44'11.25"N	89°16'30.72"E	4	DL-15/1
49	22°44'8.01"N	89°16'42.12"E	5	DL-15/2
50	22°44'4.26"N	89°16'55.29"E	2	DL-15/3
51	22°44'0.76"N	89°17'7.57"E	1	DL-15/4
52	22°43'57.02"N	89°17'20.74"E	2	AP - 16
53	22°44'3.95"N	89°17'31.15"E	2	DL-16/1
54	22°44'10.39"N	89°17'40.83"E	3	DL-16/2
55	22°44'16.78"N	89°17'50.42"E	3	DL-16/3
56	22°44'23.22"N	89°18'0.10"E	2	DL-16/4
57	22°44'29.78"N	89°18'9.95"E	3	AP - 17
58	22°44'27.34"N	89°18'21.75"E	2	DL- 17/1
59	22°44'24.68"N	89°18'34.64"E	3	DL- 17/2
60	22°44'21.98"N	89°18'47.67"E	3	DL- 17/3
61	22°44'19.33"N	89°19'0.53"E	3	DL- 17/4
62	22°44'16.66"N	89°19'13.43"E	3	DL- 17/5
63	22°44'14.69"N	89°19'22.97"E	3	DL- 17/6
64	22°44'11.97"N	89°19'36.13"E	3	DL- 17/7
65	22°44'9.61"N	89°19'47.52"E	3	DL- 17/8
66	22°44'7.38"N	89°19'58.33"E	3	DL- 17/9
67	22°44'5.30"N	89°20'8.38"E	3	DL- 17/10
68	22°44'2.98"N	89°20'19.60"E	5	DL- 17/11
69	22°44'0.69"N	89°20'30.69"E	4	AP - 18
70	22°44'1.15"N	89°20'40.41"E	4	DL- 18/1

No	Coordinates (Decimal Degrees)		Elevation (m)	Name and Angle
	Latitude	Longitude		
71	22°44'1.79"N	89°20'53.67"E	4	DL- 18/2
72	22°44'2.43"N	89°21'6.90"E	7	DL- 18/3
73	22°44'3.06"N	89°21'20.20"E	6	AP - 19
74	22°44'7.08"N	89°21'29.47"E	6	DL- 19/1
75	22°44'12.28"N	89°21'41.50"E	5	AP - 20
76	22°44'13.38"N	89°21'51.31"E	5	DL- 20/1
77	22°44'14.80"N	89°22'4.04"E	5	DL- 20/2
78	22°44'16.14"N	89°22'16.00"E	4	DL- 20/3
79	22°44'17.45"N	89°22'27.69"E	4	AP - 21
80	22°44'13.25"N	89°22'41.77"E	5	DL- 21/1
81	22°44'9.91"N	89°22'52.94"E	3	DL- 21/2
82	22°44'6.66"N	89°23'3.84"E	4	DL- 21/3
83	22°44'3.87"N	89°23'13.17"E	6	AP- 22
84	22°44'5.53"N	89°23'22.14"E	3	DL- 22/1
85	22°44'7.81"N	89°23'34.44"E	6	DL- 22/2
86	22°44'10.37"N	89°23'48.23"E	5	AP - 23
87	22°44'9.07"N	89°23'59.84"E	2	DL- 23/1
88	22°44'7.71"N	89°24'12.09"E	4	DL- 23/2
89	22°44'6.38"N	89°24'23.91"E	4	DL- 23/3
90	22°44'5.24"N	89°24'34.11"E	5	DL- 23/4
91	22°44'3.87"N	89°24'46.38"E	4	DL- 23/5
92	22°44'2.57"N	89°24'58.01"E	4	AP - 24
93	22°43'56.13"N	89°25'7.91"E	4	DL- 24/1
94	22°43'50.76"N	89°25'16.17"E	8	DL- 24/2

No	Coordinates (Decimal Degrees)		Elevation (m)	Name and Angle
	Latitude	Longitude		
95	22°43'45.29"N	89°25'24.57"E	5	AP- 25
96	22°43'44.79"N	89°25'33.69"E	6	DL- 25/1
97	22°43'44.13"N	89°25'45.55"E	6	DL- 25/2
98	22°43'43.53"N	89°25'56.39"E	9	DL- 25/3
99	22°43'42.99"N	89°26'6.16"E	8	AP- 26
100	22°43'39.27"N	89°26'17.38"E	3	DL-26/1
101	22°43'35.58"N	89°26'28.53"E	4	DL-26/2
102	22°43'31.66"N	89°26'40.38"E	5	DL-26/3
103	22°43'27.87"N	89°26'51.83"E	5	DL-26/4
104	22°43'24.42"N	89°27'2.25"E	4	DL-26/5
105	22°43'20.85"N	89°27'13.04"E	3	DL-26/6
106	22°43'17.14"N	89°27'24.26"E	1	AP- 27
107	22°43'21.08"N	89°27'37.76"E	1	DL-27/1
108	22°43'24.74"N	89°27'50.31"E	4	AP- 28
109	22°43'26.38"N	89°28'3.26"E	2	DL-28/1
110	22°43'28.33"N	89°28'18.67"E	2	DL-28/2
111	22°43'29.70"N	89°28'29.53"E	3	DL-28/3
112	22°43'31.40"N	89°28'42.97"E	6	DL-28/4
113	22°43'32.95"N	89°28'55.22"E	3	DL-28/5
114	22°43'34.60"N	89°29'8.27"E	6	DL-28/6
115	22°43'36.27"N	89°29'21.46"E	4	DL-28/7
116	22°43'36.27"N	89°29'21.46"E	3	DL-28/8
117	22°43'39.55"N	89°29'47.41"E	6	AP- 29
118	22°43'33.71"N	89°29'57.81"E	3	DL- 29/1
119	22°43'28.28"N	89°30'7.49"E	1	DL- 29/2
120	22°43'22.80"N	89°30'17.26"E	4	DL- 29/3
121	22°43'17.16"N	89°30'27.30"E	4	DL- 29/4
122	22°43'11.60"N	89°30'37.22"E	4	DL- 29/5

No	Coordinates (Decimal Degrees)		Elevation (m)	Name and Angle
	Latitude	Longitude		
123	22°43'5.39"N	89°30'48.27"E	2	AP- 30
124	22°43'5.65"N	89°30'58.78"E	3	DL- 30/1
125	22°43'5.98"N	89°31'12.18"E	4	AP- 31
126	22°43'9.81"N	89°31'19.06"E	4	31A-RIVER CROSSING
127	22°43'24.20"N	89°31'44.88"E	6	31B-RIVER CROSSING

Domar-Purba Sadipur 230 kV

Line Length: 46.5 km

No	Coordinates (Decimal Degrees)		Elevation (m)	Name and Angle
	Latitude	Longitude		
1	25.75559	88.67795	46	Start Point
2	25.77011	88.67891	40	AP - 1 (60 degrees - RT)
3	25.77111	88.68095	39	AP - 2 (40 degrees - LT)
4	25.79003	88.68943	40	AP - 3 (22 degrees - LT)
5	25.80871	88.69031	43	AP - 4 (29 degrees - RT)
6	25.81132	88.69189	42	AP - 5 (26 degrees - LT)
7	25.81762	88.69256	41	AP - 6 (34 degrees - RT)
8	25.82424	88.69812	43	AP - 7 (38 degrees - LT)
9	25.84603	88.69912	46	AP - 8 (30 degrees - RT)
10	25.85045	88.70193	44	AP - 9 (36 degrees - RT)
11	25.85587	88.71507	45	AP - 10 (25 degrees - LT)
12	25.85907	88.71806	46	AP - 11 (38 degrees - RT)
13	25.86103	88.7293	45	AP - 12 (21 degrees - RT)
14	25.86035	88.73276	48	AP - 13 (48 degrees - LT)
15	25.87654	88.75439	46	AP - 14 (32 degrees - RT)

No	Coordinates (Decimal Degrees)		Elevation (m)	Name and Angle
	Latitude	Longitude		
16	25.87704	88.75996	46	AP - 15 (53 degrees - LT)
17	25.88366	88.76416	45	AP - 16 (60 degrees - LT)
18	25.89855	88.75665	45	AP - 17 (46 degrees - RT)
19	25.90231	88.75792	49	AP - 18 (24 degrees - LT)
20	25.92397	88.75591	50	AP - 19 (11 degrees - LT)
21	25.93155	88.75371	49	AP - 20 (26 degrees - RT)
22	25.93765	88.75473	49	AP - 21 (27 degrees - LT)
23	25.94161	88.75353	52	AP - 22 (24 degrees - RT)
24	25.94701	88.7542	48	AP - 23 (29 degrees - RT)
25	25.94811	88.75498	49	AP - 24 (35 degrees - RT)
26	25.9495	88.75866	48	AP - 25 (27 degrees - LT)
27	25.95105	88.7601	46	AP - 26 (57 degrees - LT)
28	25.95805	88.75837	48	AP - 27 (36 degrees - RT)
29	25.96106	88.75959	47	AP - 28 (37 degrees - LT)
30	25.96657	88.75811	50	AP - 29 (6 degrees - RT)
31	25.984	88.75527	51	AP - 30 (9 degrees - LT)
32	25.98963	88.75345	51	AP - 31 (44 degrees - RT)
33	25.99953	88.75819	50	AP - 32 (10 degrees - RT)
34	26.00727	88.76365	51	AP - 33 (30 degrees - LT)
35	26.0194	88.76493	53	AP - 34 (25 degrees - LT)
36	26.03255	88.76062	51	AP - 35 (37 degrees - RT)
37	26.03436	88.76122	53	AP - 36 (40 degrees - RT)
38	26.04121	88.77225	55	AP - 37 (53 degrees - LT)
39	26.0482	88.77294	54	AP - 38 (34 degrees - RT)

No	Coordinates (Decimal Degrees)		Elevation (m)	Name and Angle
	Latitude	Longitude		
40	26.05316	88.77703	53	AP - 39 (11 degrees - LT)
41	26.06532	88.78385	55	AP - 40 (26 degrees - LT)
42	26.07527	88.78444	53	AP - 41 (23 degrees - RT)
43	26.08512	88.78923	55	AP - 42 (49 degrees - RT)
44	26.08721	88.7967	55	AP - 43 (30 degrees - LT)
45	26.09406	88.80357	55	AP - 44 (15 degrees - LT)
46	26.09657	88.80503	55	AP - 45 (49 degrees - LT)
47	26.10137	88.80339	56	AP - 46 (23 degrees - RT)
48	26.10467	88.80361	55	End Point
49	25.77069	88.68005	39	D/T Line
50	25.8586	88.71771	45	D/T Line
51	25.86105	88.7338	43	D/T Line
52	25.92407	88.7557	50	D/T Line
53	25.93154	88.75382	49	D/T Line
54	25.93154	88.75382	49	D/T Line
55	25.75577	88.67796	46	Road (Highway)
56	25.82351	88.6975	42	Road (Katcha)
57	25.8375	88.69875	43	Road (Katcha)
58	25.84624	88.69914	46	Road (Katcha)
59	25.8497	88.70145	44	Road (Katcha)
60	25.85156	88.7046	43	Road (Katcha)
61	25.85456	88.71187	46	Road (Katcha)
62	25.85542	88.71397	47	Road (Katcha)
63	25.85853	88.71776	45	Road (Katcha)

No	Coordinates (Decimal Degrees)		Elevation (m)	Name and Angle
	Latitude	Longitude		
64	25.8591	88.71822	46	Road (Katcha)
65	25.85955	88.72091	46	Road
66	25.76648	88.6787	42	Road (Katcha)
67	25.86021	88.72451	44	Road (Katcha)
68	25.86071	88.73147	47	Road
69	25.86162	88.73455	41	Road (Pucca)
70	25.87162	88.74758	43	Road (Katcha)
71	25.8762	88.75357	48	Road (Katcha)
72	25.87718	88.76	45	Road (Katcha)
73	25.87758	88.76048	47	Road
74	25.88612	88.76259	45	Road (Katcha)
75	25.8973	88.75744	46	Road (Pucca)
76	25.90311	88.75797	47	Road (Katcha)
77	25.77029	88.6793	40	Road (Katcha)
78	25.91081	88.75717	49	Road (Pucca)
79	25.91507	88.75676	47	Road (Pucca)
80	25.9171	88.75617	48	Road (Katcha)
81	25.9224	88.75622	46	Road (Katcha)
82	25.92367	88.75608	48	Road (Pucca)
83	25.93254	88.75383	48	Road (Katcha)
84	25.94638	88.75411	48	Road
85	25.95291	88.75958	47	Road
86	25.96288	88.75911	50	Road
87	25.97384	88.75693	51	Road

No	Coordinates (Decimal Degrees)		Elevation (m)	Name and Angle
	Latitude	Longitude		
88	25.78353	88.68652	40	Road (Katcha)
89	25.98334	88.75538	50	Road
90	25.99155	88.75448	51	Road
91	25.99979	88.75835	49	Road
92	26.00308	88.76076	51	Road
93	26.01279	88.76422	51	Road
94	26.0182	88.76486	51	Road
95	26.02535	88.76296	54	Road
96	26.03052	88.76127	53	Road
97	26.03318	88.7609	54	Road
98	26.03555	88.76326	54	Road
99	25.79224	88.68952	40	Road
100	26.03853	88.7679	51	Road (Pucca)
101	26.04261	88.7724	52	Road
102	26.04608	88.77271	53	Road
103	26.05225	88.7763	53	Road
104	26.05826	88.77997	54	Road
105	26.06181	88.78196	54	Road
106	26.07463	88.78449	53	Road
107	26.08614	88.79293	56	Road
108	26.09575	88.80458	54	Road
109	26.09901	88.80435	56	Road
110	25.79991	88.6899	43	Road
111	26.10305	88.80359	58	Road

No	Coordinates (Decimal Degrees)		Elevation (m)	Name and Angle
	Latitude	Longitude		
112	25.80472	88.69013	43	Road (Katcha)
113	25.8098	88.69098	43	Road (Katcha)
114	25.81696	88.69249	40	Road (Katcha)
115	25.93254	88.75383	48	Road (Katcha)
116	25.87162	88.74758	43	Road (Katcha)
117	25.9356	88.75432		River
118	25.86004	88.72303		River
119	25.98933	88.75353	51	Canal
120	25.99161	88.75456	51	Canal
121	25.99289	88.75503	48	Canal

Niamatpur-Patnitola 132 kV

Line Length: 33 km

No	Coordinates (Decimal Degrees)		Elevation (m)	Name and Angle
	Latitude	Longitude		
1	24.83436	88.58452	22	Start Point
2	24.83422	88.58533	21	AP - 1 (46 degrees - LT)
3	24.83602	88.58781	22	AP - 2 (34 degrees - LT)
4	24.84525	88.59119	20	AP - 3 (49 degrees - RT)
5	24.85048	88.60455	22	AP - 4 (34 degrees - LT)
6	24.8609	88.61193	20	AP - 5 (41 degrees - RT)
7	24.8618	88.61543	19	AP - 6 (28 degrees - LT)
8	24.87341	88.6281	22	AP - 7 (38 degrees - LT)
9	24.88255	88.62966	19	AP - 8 (20 degrees - RT)

No	Coordinates (Decimal Degrees)		Elevation (m)	Name and Angle
	Latitude	Longitude		
10	24.88941	88.63347	23	AP - 9 (62 degrees - RT)
11	24.8893	88.64331	18	AP - 10 (56 degrees - LT)
12	24.89732	88.64893	17	AP - 11 (21 degrees - LT)
13	24.93965	88.6595	18	AP - 12 (17 degrees - LT)
14	24.94754	88.65913	18	AP - 13 (32 degrees - RT)
15	24.95281	88.66208	18	AP - 14 (12 degrees - RT)
16	24.96089	88.66907	21	AP - 15 (43 degrees - LT)
17	24.9791	88.66855	20	AP - 16 (56 degrees - RT)
18	24.98669	88.67891	21	AP - 17 (25 degrees - RT)
19	24.98984	88.69371	21	AP - 18 (26 degrees - LT)
20	24.99744	88.7037	22	AP - 19 (32 degrees - LT)
21	25.02847	88.71592	24	AP - 20 (44 degrees - RT)
22	25.03154	88.72254	21	AP - 21 (35 degrees - RT)
23	25.02863	88.74041	21	AP - 22 (9 degrees - LT)
24	25.02854	88.75106	22	AP - 23 (27 degrees - RT)
25	25.02507	88.75771	22	End Point
26	24.8389	88.58885	22	Road (Katcha)
27	24.94099	88.65945	21	Road (Katcha)
28	24.9503	88.66068	20	Road (Pucca)
29	24.9526	88.66195	18	Road
30	24.95841	88.66686	22	Road (Tertiary)
31	24.95875	88.66719	21	Road (Pucca)
32	24.96957	88.66882	20	Road
33	24.977	88.6686	22	Road (Pucca)

No	Coordinates (Decimal Degrees)		Elevation (m)	Name and Angle
	Latitude	Longitude		
34	24.98781	88.68405	24	Road (Highwat)
35	24.99237	88.69705	24	Road
36	25.00944	88.70846	22	Road (Katcha)
37	24.8426	88.59022	18	Road (Katcha)
38	25.02569	88.71485	21	Road (Pucca)
39	25.03054	88.72884	24	Road (Pucca)
40	25.02984	88.73283	20	Road (Katcha)
41	25.02982	88.73321	23	Road (Katcha)
42	25.02829	88.74542	24	Road (Katcha)
43	25.02812	88.75183	22	Road (Katcha)
44	25.02529	88.75735	22	Road (Pucca)
45	24.85106	88.60496	21	Road
46	24.86549	88.6194	21	Road (Pucca)
47	24.87124	88.62574	20	Road
48	24.8787	88.62899	21	Road
49	24.88476	88.63089	20	Road (Tertiary)
50	24.88934	88.63914	23	Road (Pucca)
51	24.89311	88.646	17	Road (Pucca)
52	24.84252	88.59015	18	Canal
53	24.84695	88.5956	18	Canal
54	24.90708	88.65137	13	Canal
55	24.92435	88.65564	17	Canal
56	24.93139	88.65744	16	Canal
57	24.97079	88.6688	20	Canal

No	Coordinates (Decimal Degrees)		Elevation (m)	Name and Angle
	Latitude	Longitude		
58	24.88745	88.63239	23	Pond
59	25.02859	88.74357		River (Atrai)

APPENDIX B: Photographs of the Existing Environment and Public Consultations

Existing Environment

Rupsha- Satkhira 230 kV Transmission Line

TL 5/4

TL 6/1

AP 7

TL 7/2

AP 20	TL 20/1
	
TL 17/9	**TL 17/3**
	
TL 17/4	**TL 17/5**

Domar- Purba Sadipur 230 (KV) Transmission Line

TL 2/5

TL 5/8

TL 6/1

TL 6/4

TL 9/2

Niamatpur- Patnitola 230 kV Transmission Line

	
AP 5	**TL 5/1**
	
TL 5/2	**TL 5/3**
	
TL 5/4	**AP 09**

The Safeguard Consultation Photographs (January- March 2022)

Rupsha-Satkhira

Public Consultation -1

Public Consultation 2

Public Consultation 3

Domar-Purba Sadipur

Public Consultation -1

Public Consultation 2

Public Consultation 3

Public Consultation 4

Public Consultation 5

Niamatpur-Patnitola

Public Consultation -1

Public Consultation 2

Public Consultation 3

APPENDIX C: Attendance of Consultations

Dhaka & Western Zone Transmission Grid Expansion Project

FOCUS GROUP DISCUSSION
ATTENDANCE SHEET

Location: Batiaghata

Date: 19/02/2022 Time: 10:15 am

Sl.	Name of Participant	Age	Occupation	Phone Number	Signature
1	Nargis Begum	38	House wife	01738719964	
2	Fazila Begum	55	"	01627608853	
3	Sajana Khatun	36	"	01365974222	
4	Sumaiya	42	"	01849-821175	
5	Selina Khatun	54	"	01725-937787	
6	Rehana Akter	35	"	01768466719	
7					
8					
9					
10					
11					
12					
13					
14					
15					

Dhaka & Western Zone Transmission Grid Expansion Project

FOCUS GROUP DISCUSSION
ATTENDANCE SHEET

Location: Dashkhali

Date: 20th/01/2022 Time: 3:45 pm

Sl.	Name of Participant	Age	Occupation	Phone Number	Signature
1	Md. Monwar Hossain	42	Farmer	01723680664	
2	Musa Ali	65	"	—	-
3	Ziaur Rahman	42	Bisiness	01795-567005	
4	Alamgir Hossen	42	Farmer	01776-942232	
5	Ismail Hossain	40	"	01745-281234	
6	Ranta	38	"	01776-576156	
7	Mohibur	50	"	-	—
8	Abdul Gafur	38	Business	01746-913580	
9	Abu Sufian	50	Van	01 —	-
10					
11					
12					
13					
14					
15					

Dhaka & Western Zone Transmission Grid Expansion Project

FOCUS GROUP DISCUSSION
ATTENDANCE SHEET

Location: Dakope

Date: 20/02/2022 Time: 11:50 am

Sl.	Name of Participant	Age	Occupation	Phone Number	Signature
1	Md Shakinul Islam	42	Business	01915359413	
2	Shantosh Mandal	48	Farmer	01405087548	Santosh Mondol
3	Probhito Maleda	45	"	01972869912	
4	Thandu	47	"		
5	Md Hbibur Rahman	50	Business	01930453699	
6	Md Rafiqul Islam	45	"	01712744060	Md Rafiqul
7	Badol Mandal	50	Farmer	01744945984	
8	Md Malek	36	Van puller	01905182787	
9	Zakir hossain	48	Business	01960424366	
10	Arshadul Isla	50	"		
11	Ratan Maleta	22	Farming	01968433950	Roton
12	Muhibul	22	"	01767238038	Mohibul
13					
14					
15					

Dhaka & Western Zone Transmission Grid Expansion Project

FOCUS GROUP DISCUSSION
ATTENDANCE SHEET

Location: Niamatpur

Date: 01/02/2022 Time: 4:30 pm

Sl.	Name of Participant	Age	Occupation	Phone Number	Signature
1	Azad Hossen	45	Farmer	017992484 74	
2	Mosium Rahman	38	Busines	01718987490	
3	Ahmad Ullah	49	Farmer	017 49829964	
4	Jamal Uddin	29	Teacher	0193550 4384	
5	Muni Islam	52	—	01811359585	—
6	Jamela Uddin Khatun	35	Farmer	01985-508384	
7					
8					
9					
10					
11					
12					
13					
14					
15					

Dhaka & Western Zone Transmission Grid Expansion Project

FOCUS GROUP DISCUSSION
ATTENDANCE SHEET

Location: Mahadevpur

Date: 29/01/2022 Time: 10:45

Sl.	Name of Participant	Age	Occupation	Phone Number	Signature
1	Mahida Begum	46	Housewife	01725-937787	
2	Munsalinah Begum	27	"	018 79-577820	
3	Manjira Khatun	~~55~~	—	—	
4	Menina Sultana	40	"	01720660584	
5	Disha Khatun	22	Student	01980-668931	
6	Amina Begum	32	Housewife	01719-627207	
7	Kaniz Fatema	46	"	01798-316279	
8	Feroza Shammee-	28	"	0196 60-490908	
9					
10					
11					
12					
13					
14					
15					

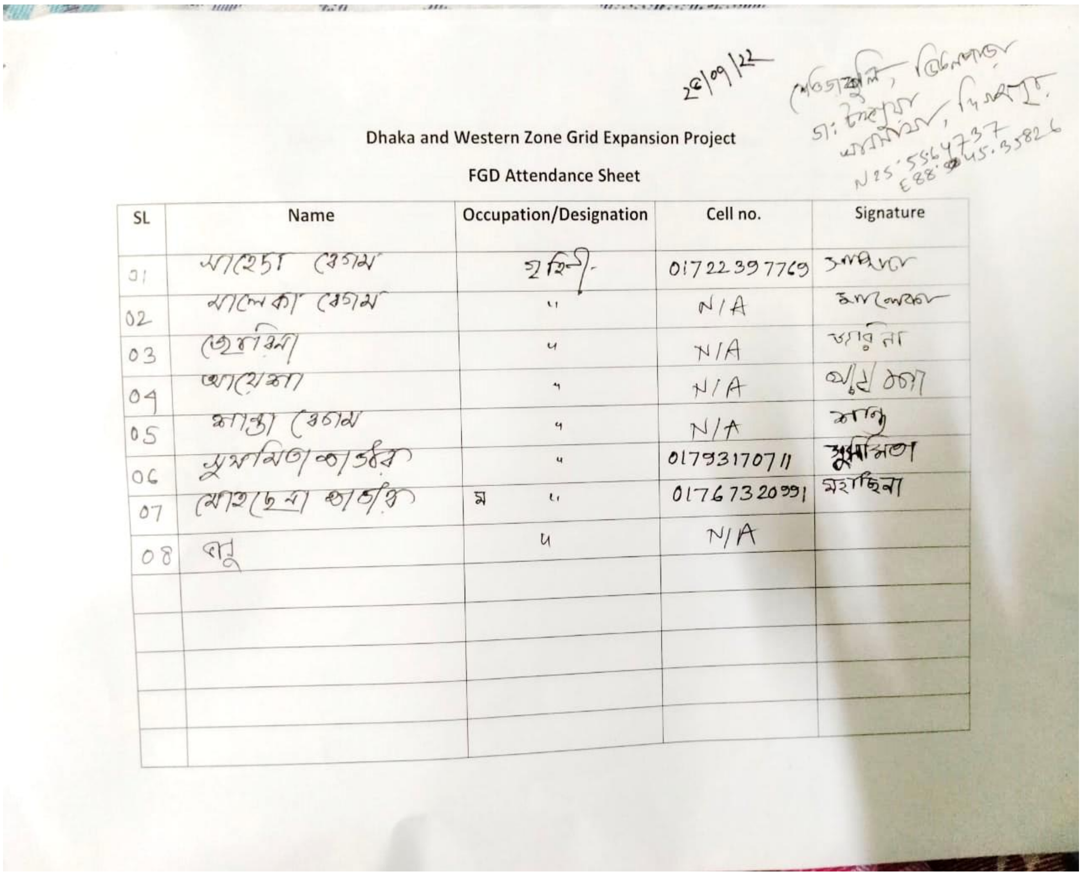
Dhaka & Western Zone Transmission Grid Expansion Project

FOCUS GROUP DISCUSSION
ATTENDANCE SHEET

Location: Patnitola

Date: 02/02/2022 Time: 11:00 am.

Sl.	Name of Participant	Age	Occupation	Phone Number	Signature
1	Abdul Mannan	65	Farmer	01787-760952	
2	Kamruzzaman	45	"	01701-743755	
3	Mostak Ali	51	"	01773-718432	
4	Rintu	51	"	01926-559552	
5	Shahabul Islam	38	"	01765-970516	
6	Fahim	20	Student	01726-923958	
7					
8					
9					
10					
11					
12					
13					
14					
15					



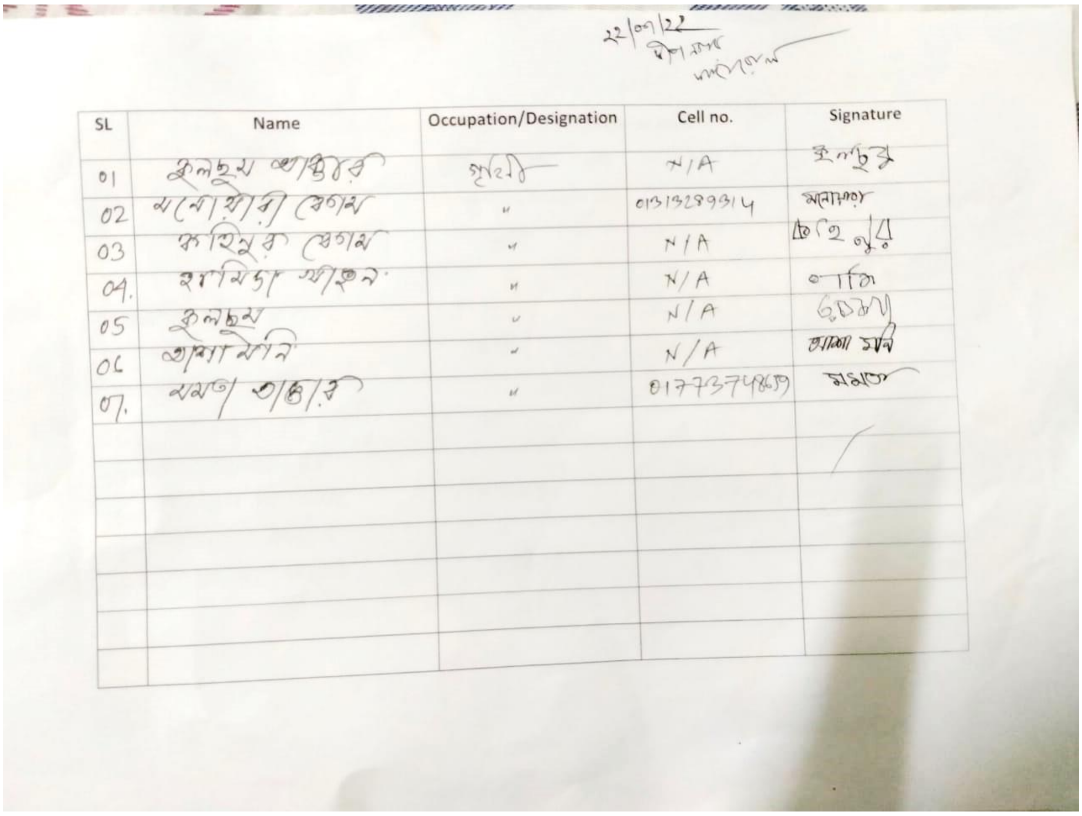
28/09/22

[illegible]
N 25° 55.64737
E 88° 45.35826

Dhaka and Western Zone Grid Expansion Project

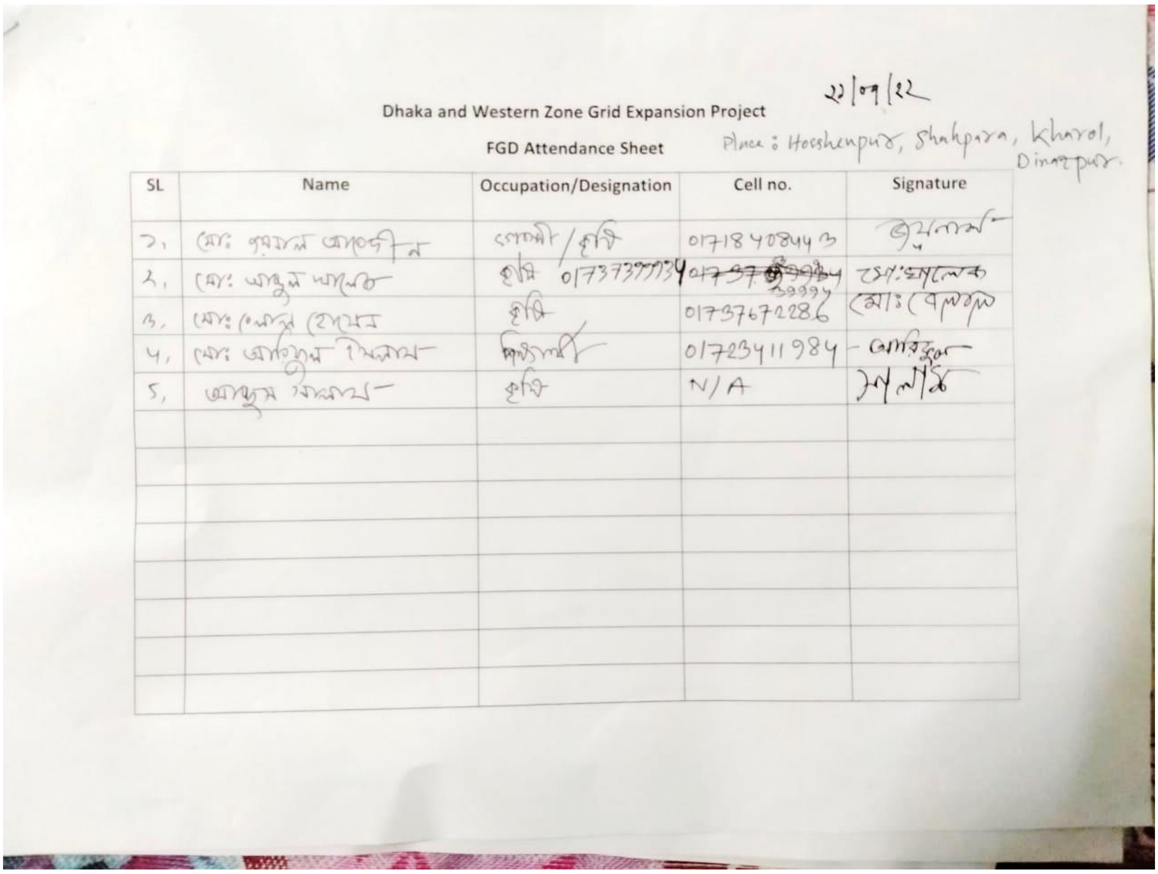
FGD Attendance Sheet

SL	Name	Occupation/Designation	Cell no.	Signature
01	সাহেদা বেগম	গৃহিণী	01722397769	[illegible]
02	মালেকা বেগম	"	N/A	[illegible]
03	তেহমিনা	"	N/A	[illegible]
04	আয়েশা	"	N/A	[illegible]
05	জান্না বেগম	"	N/A	জান্না
06	সুস্মিতা কার্তিক	"	01793170711	সুস্মিতা
07	মোহছেনা খাতুন	"	01767320991	মহাছিনা
08	বানু	"	N/A	



22/09/22
[illegible]

SL	Name	Occupation/Designation	Cell no.	Signature
01	কুলছুম আক্তার	গৃহিণী	N/A	[illegible]
02	মনোয়ারা বেগম	"	01313289314	মনোয়ারা
03	ফাহিমুন বেগম	"	N/A	[illegible]
04	হাসিনা খাতুন	"	N/A	[illegible]
05	কুলছুম	"	N/A	[illegible]
06	আশা মনি	"	N/A	আশা মনি
07	মমতা আক্তার	"	01773749659	মমতা



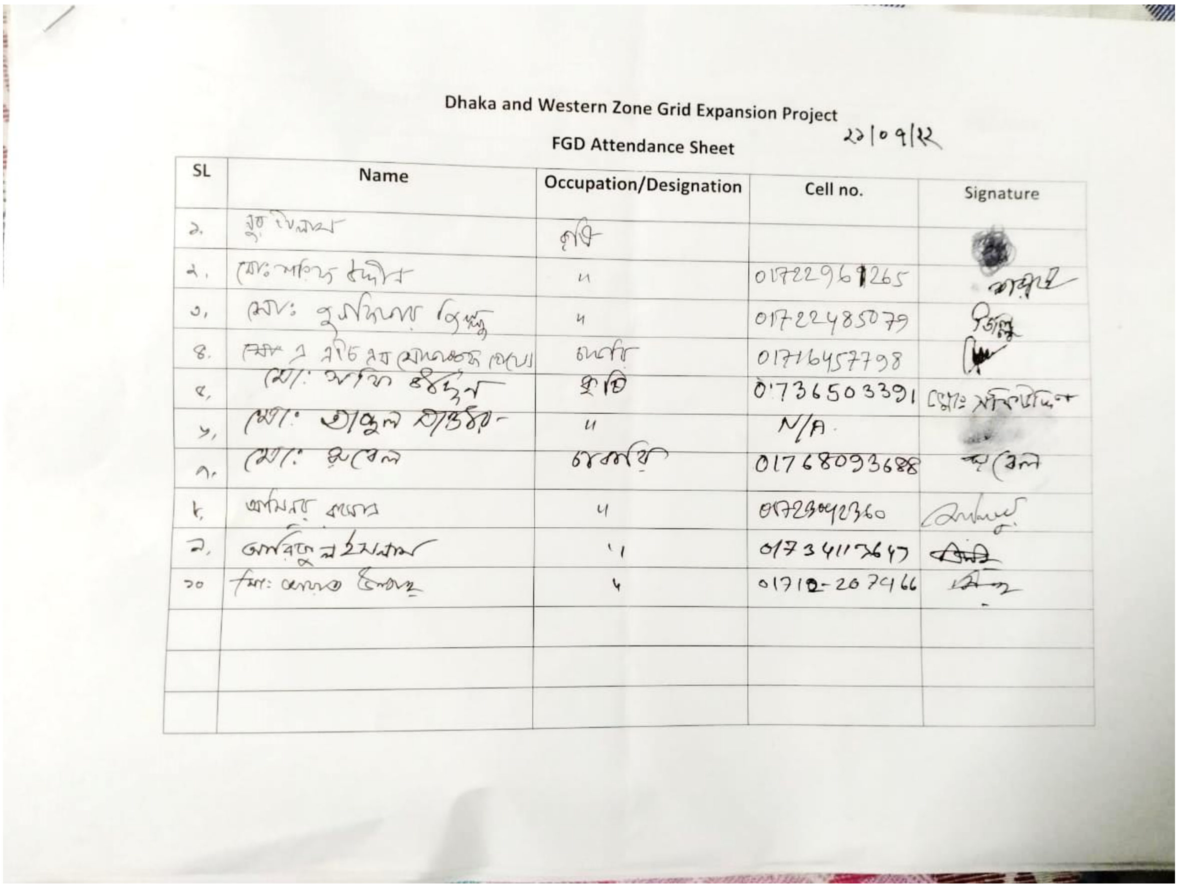
Dhaka and Western Zone Grid Expansion Project

22/09/22

FGD Attendance Sheet

Place : Hosshenpur, Shahpara, Kharol, Dinajpur.

SL	Name	Occupation/Designation	Cell no.	Signature
১,	মোঃ [illegible]	[illegible]/কৃষি	01718408443	[illegible]
২,	মোঃ আব্দুল খালেক	কৃষি	01737399734 ~~01737399994~~	মোঃ খালেক
৩,	মোঃ [illegible] হোসেন	কৃষি	01737672286	মোঃ [illegible]
৪,	মোঃ আমিনুল ইসলাম	শিক্ষার্থী	01723411984	[illegible]
৫,	[illegible] ইসলাম	কৃষি	N/A	[illegible]



Dhaka and Western Zone Grid Expansion Project

22/09/22

FGD Attendance Sheet

SL	Name	Occupation/Designation	Cell no.	Signature
১.	নূর ইসলাম	কৃষি		[thumbprint]
২,	মোঃ [illegible]	"	01722961265	[illegible]
৩,	মোঃ [illegible]	"	01722485079	[illegible]
৪.	[illegible]	[illegible]	01716457798	[illegible]
৫,	মোঃ [illegible]	কৃষি	01736503391	মোঃ [illegible]
৬,	মোঃ [illegible]	"	N/A	[thumbprint]
৭,	মোঃ রুবেল	[illegible]	01768093688	রুবেল
৮,	[illegible]	"	01723042360	[illegible]
৯,	[illegible] ইসলাম	"	01734117647	[illegible]
১০	মিসেস [illegible]	"	01712-207466	[illegible]

25°59.58048
88°45.18204

Dhaka and Western Zone Grid Expansion Project

[illegible]

FGD Attendance Sheet

SL	Name	Occupation/Designation	Cell no.	Signature
১.	মোঃ [illegible]	[illegible] / কৃষি	01309406495	[illegible]
২.	[illegible]	গৃহিনী	01784072694	[illegible]
৩.	[illegible]	[illegible]	01750248471	[illegible]
৪.	[illegible]	কৃষি	01785379963	[illegible]
৫.	মোঃ [illegible]	ব্যবসা	01962714460	[illegible]
৬.	মোঃ [illegible] ইসলাম	[illegible]	01761020859	রবিউল ইসলাম

APPENDIX D: Environmental Monitoring (Lab sheet-Niamatpur-Patnitola)

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AIR QUALITY PARAMTERSANALYSIS REPORT

Report No.	:ECIL/2022/501/ADB/01
Name of the Client	: Transrail Lighting Limited
Project:	:Design, Supply, Installation, Testing & Commissioning of 230 kV & 132 kV Transmission Lines in Western Zone on Turnkey Basis (Package - 4)
Transmission Line	Niamatpur -Patnitola TL project
Sampling Location	:Nimatpur Grid Substation, Naogaon
GPS Location	: 24°50'1.67"N 88°35'4.07"E
Description of Sample	: Ambient Air Quality Parameters
Sampling Date	: 19 July 2022
Reporting Date	: 24 July 2022

Table 1: Results of ambient air quality parameters at Nimatpur Grid Substation, Naogaon under the package –P4

Location Name	Concentration present of different parameter in ambient air.							
	SPM µg/m³	PM_{10} µg/m³	$PM_{2.5}$ µg/m³	SO_2 µg/m³	CO µg/m³	NO_2 µg/m³	Lead µg/m³	O_3 µg/m³
Niamatpur grid SS under Niamatpur - Patnitola TL project 24°50'1.64"N 88°35'4.15"E	**28**	**58**	**27**	**5.6**	**157**	**8.1**	**0.01**	**11**
Method of Analysis	Gravimetric			TCM UV Visible Method at 560 nm	Iodine penta-oxide Method	NEDA-Visible at 540 nm	AAS Method	UV method at 353 nm
Bangladesh (DoE) Standard for ambient Air (NAAQS)	200	150	65	365	10000	100	0.5	157
International /World Bank Standard 1998 WHO Ambient Air Quality Guidelines	230	150	75	80	-	100	-	160

Equipment Used Details:- This ambient air monitoring report was usually accomplished by – High Volume Sampler (Model-Ecotech India AAS-217 NL) and Fine Particulate Sampler (Model-Ecotech India AAS-127). Equipment calibrated by NABL Accredited Lab.

Comment: As part of environmental management & monitoring guidelines, periodical environmental air quality monitoring has been carried out by the high-volume sampler with gaseous attachment which has been using for collecting air for a certain period of time from Nimatpur Grid Substation, Naogaon under the project of Design, Supply, Installation, Testing & Commissioning of 230 kV & 132 kV Transmission Lines in Western Zone on Turnkey Basis (Package - 4). Appropriate methods were used for determination of air pollutant parameters. The origin of ambient air quality standard for Bangladesh has set at Environmental Conservation Rules, 1997, later on, the standard limit ambient air quality has been revised since 2005 as National Ambient Air Quality Standard for Bangladesh. The values of ambient air quality parameters are showed in the above-mentioned table. It has observed

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that the concentrations of ambient air quality parameters were below the allowable ambient limit as per DoE, Bangladesh Standard (NAAQS) for ambient air quality parameters at Nimatpur Grid Substation area, Naogaon.

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Inorganic & Analytical Chemistry, PhD
Fellow, NU (Environmental Chemistry)

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Dhaka

Fig: GPS location of ambient air sampling site (Nimatpur)

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NOISE LEVEL ANALYSIS REPORT

Report No. :ECIL/2022/501/ADB/02
Name of the Client : Transrail Lighting Limited
Project: :Design, Supply, Installation, Testing & Commissioning of 230 kV & 132 kV Transmission Lines in Western Zone on Turnkey Basis (Package - 4)
Transmission Line Niamatpur -Patnitola TL project
Sampling Location :Nimatpur Grid Substation, Naogaon
GPS Location : 24°50'1.67"N 88°35'4.07"E
Description of Sample : Ambient Noise Level
Sampling Date : 19 July 2022
Reporting Date : 24 July 2022

Table 1: Results of ambient noise level at Nimatpur Grid Substation, Naogaon under Western Zone _ KFW Project

SN.	Location ID	Parameter	Sampling Locations with GPS coordinate	Results of Noise level (dBA) Day		Measurement
				Max	Min	
01	NM1	Noise level	South –East side of Nimatpur Grid substation 24°50'3.16"N 88°35'7.20"E	51.2	47.3	Noise meter
02	NM2		100 m distance apart from Nimatpur Grid substation 24°50'5.86"N 88°35'11.32"E	48.5	45.3	
03	NM3		200 m distance apart from Nimatpur Grid substation 24°50'8.75"N 88°35'15.73"E	46.1	43.2	
04	NM4		300 m distance apart from Nimatpur Grid substation 24°50'15.35"N 88°35'19.11"E	45.5	42.7	
Bangladesh (DoE) Standard as ECR 1997						
Industrial area				75		
Commercial				70		
Mixed areas(mainly residential area, and also simultaneously used for commercial and industrial purposes)				60		
Residential area				50		
Silent Zone (Sensitive areas such as parks, school, hospitals and mosques)				45		
World Bank / IFC Standard						
Industrial area				70		
Residential; Intuitional; Educational				55		
OHSA Noise for Workplace				85		

Comments: Noise levels were measured a Nimatpur Grid Substation, Naogaon under the project of Design, Supply, Installation, Testing & Commissioning of 230 kV & 132 kV Transmission Lines in Western Zone on Turnkey Basis (Package - 4).. The noise levels were within the level of the residential areas as per ECR 1997 for the Nimatpur Grid Substation, Naogaon standard area of noise level.

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GROND-WATER QUALITY ANALYSIS REPORT

Report No.	:ECIL/2022/501/ADB/04
Name of the Client	: Transrail Lighting Limited
Project:	:Design, Supply, Installation, Testing & Commissioning of 230 kV & 132 kV Transmission Lines in Western Zone on Turnkey Basis (Package - 4)
Transmission Line	Niamatpur -Patnitola TL project
Sampling Location	:Nimatpur Grid Substation, Naogaon
GPS Location	: 24°50'1.67"N 88°35'4.07"E
Description of Sample	: Groundwater Quality Parameters
Sampling Date	: 19 July 2022
Reporting Date	: 25 July 2022

Table: Groundwater quality parameters (Specific Parameters) of Nimatpur Grid Substation, Naogaon under the package –P4

SN.	Name of the Parameter	Concentration present	DoE (Bangladesh) Standard for Drinking water quality	Method of analysis
01	pH	7.11	6.5-8.5	pH Meter
02	Turbidity	1.2	Not set yet	Turbidity meter
03	Arsenic	0.01	0.05	HVG-AAS
04	Manganese	0.09	0.1	AAS Flame
05	Iron	0.11	0.1-0.3	AAS Flame
08	Chloride	12.4	150-600	Silver Nitrate method
09	EC	201	-	EC method

Comments: Groundwater has been collected from own deep tube well of Nimatpur Grid Substation [24°50'0.05"N 88°35'4.24"E], Naogaon under the project of Design, Supply, Installation, Testing & Commissioning of 230 kV & 132 kV Transmission Lines in Western Zone on Turnkey Basis (Package - 4). The selected parameters were determined by different analytical methods. The concentration of ground water parameters were within the limit of standard for drinking water quality as per ECR 1997, Department of Environment (DOE), Bangladesh. This water may be used as potable water to labours.

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SURFACE WATER QUALITY ANALYSIS REPORT

Report No.	:ECIL/2022/501/ADB/03
Name of the Client	: Transrail Lighting Limited
Project:	:Design, Supply, Installation, Testing & Commissioning of 230 kV & 132 kV Transmission Lines in Western Zone on Turnkey Basis (Package - 4)
Transmission Line	Niamatpur -Patnitola TL project
Sampling Location	:Nimatpur Grid Substation, Naogaon
GPS Location	: 24°50'1.67"N 88°35'4.07"E
Description of Sample	: Surface water
Sampling Date	: 19 July 2022
Reporting Date	: 25 July 2022

Table: Surface water quality parameters (Specific Parameters) of pond water of the project Nimatpur Grid Substation, Naogaon under package P4

SN.	Name of the Parameter	Concentration present	DoE (Bangladesh) Standard for Inland surface water	Method of analysis
1	pH	7.1	6.0 – 9.0	pH Meter
2	Turbidity	16 JTU	-	Turbidity meter
3	TDS	128 mg/l	2100 mg/l	EC method
4	DO	4.9 mg/l	4.5-8.0 mg/l	Azide modification
5	BOD_5 at 20 °C	8.3 mg/l	50 mg/l	Dilution Method
6	COD	24 mg/l	200 mg/l	COD Refluction
7	TSS	1.3 mg/l	150	Gravimetric
8	Total Coliform	10 mg/l	200	Agar method
9	Ammonia- Nitrogen	2.3 mg/l	50	UV method (Nessler 's)
10	Oil & Grease	1.0 mg/l	10 mg/l	n-Hexane Extraction and Gravimetric

Comments: One surface water has been collected from pond water (North-East side) of Nimatpur Grid Substation, Naogaon under the project of Design, Supply, Installation, Testing & Commissioning of 230 kV & 132 kV Transmission Lines in Western Zone on Turnkey Basis (Package - 4). The selected parameters were determined by different analytical method. The concentration of surface water quality parameters were within limit of Inland surface water quality parameters as per ECR 1997.

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