Initial Environmental Examination (Draft)

Project Number: 51137-001
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Bangladesh: Southwest Transmission Grid Expansion Project

Prepared by Power Grid Company of Bangladesh, Ministry of Power, Energy and Mineral Resources, Government of Bangladesh for the Asian Development Bank.

CURRENCY EQUIVALENTS
(as of 5 December 2017)

Currency unit	–	taka (Tk)
Tk1.00	=	$0.01213592
$1.00	=	Tk82.40

ABBREVIATIONS

ADB	–	Asian Development Bank
AIS	–	air-insulated switchgear
APs	–	affected persons
asl	–	above sea level
BMD	–	Bangladesh Meteorological Department
CHT	–	Chittagong Hill Tracts
DoE	–	Department of Environment
DPs	–	displaced persons
DSC	–	design and supervision consultants
EIA	–	environmental impact assessment
EMF	–	electromagnetic field
EMP	–	environmental management plan
ESMF	–	environmental and social management framework
ESMS	–	environmental and social anagement system
EQS	–	environment quality standards
FGD	–	focus group discussion
GIS	–	gas insulated switchgear
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
LILO	–	line-in line-out
MoEF	–	Ministry of Environment and Forest
NGO	–	non-governmental organization
PAPs	–	project affected persons
PCB	–	polychlorinated biphenyl
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

SF_6	–	sulfur hexafluoride
SPS	–	safeguard policy statement
SWTGEP	–	Southwest Transmission Grid Expansion Project
UPI	–	Union Parishad Institutions

WEIGHTS AND MEASURES

cm	–	centimetre
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

GLOSSARY

Adverse Impact	–	An impact that is considered undesirable.
Ambient Air	–	Surrounding air
Aquatic	–	Growing or living in or near water
Bangla	–	Bengali language
Baseline (or existing) Conditions	–	The 'baseline' essentially comprises the factual understanding and interpretation of existing environmental, social and health conditions of where the business activity is proposed. Understanding the baseline shall also include those trends present within it, and especially how changes could occur regardless of the presence of the Project, i.e. the 'No-development Option'.
Bazar	–	Market
Beel	–	A 'back swamp' or depression can be either perennial or seasonal
Beneficial Impacts	–	Impacts, which are considered to be desirable and useful.
Biological Diversity	–	The variety of life forms, the different plants, animals and microorganisms, genes they contain and the ecosystems they form. It is usually considered at three levels: genetic diversity, species diversity and ecological diversity
Char	–	Newly accreted land: Land, sometimes islands, within main river channels and nearby mainland or in the estuary, subject to erosion and accretion
Ecosystem	–	A dynamic complex of plant, animal, fungal and microorganism communities and associated non-living environment interacting as an ecological unit
Emission	–	The total amount of solid, liquid or gaseous pollutant emitted into the atmosphere from a given source within a given time, as indicated, for e.g., in grams per cubic meter of gas or by a relative measure, upon discharge from the source
Endangered Species	–	Species in danger of extinction and whose survival is unlikely if the existing conditions continue to operate. Included among

		those are species whose numbers have been reduced to a critical level or whose habitats have been so drastically reduced that they are deemed to suffer from immediate danger of extinction
Environmental Effects	–	The measurable changes, in the natural system of productivity and environmental quality, resulting from a development activity
Environmental Impact	–	An estimate or judgment of the significance and value of environmental effects for natural, socio-economic and human receptors
Environment Management Plan	–	A plan to undertake an array of follow-up activities which provide for the sound environmental management of a project/ intervention so that adverse environmental impacts are minimized and mitigated; beneficial environmental effects are maximized; and sustainable development is ensured
Environmental Management	–	Managing the productive use of natural resources without reducing their productivity and quality
Erosion	–	Process in which wind and water removes materials from their original place; for instance, soil washed away from an agricultural field
Evaluation	–	The process of looking back at what has been really done or accomplished. Fauna: A collective term denoting the animals occurring in a particular region or period
Field Reconnaissance	–	A field activity that confirms the information gathered through secondary sources. This field study is essentially a rapid appraisal
Flora	–	All of the plants found in a given area
Habitat	–	The natural home or environment for a plant or animal
Household	–	A household is identified as a dwelling unit where one or more persons live and eat together with common cooking arrangement. Persons living in the same dwelling unit having separate cooking arrangements constitute separate households
Important Environmental Component	–	These are environmental components of biophysical or socio-economic importance to one or more interested parties. The use of important environmental components helps to focus the environmental assessment
Khal	–	Small channel, canal.
Land use		Types include agriculture, horticulture, settlement, pisciculture and industries
Mauza	–	A Bangla word for the smallest government administrative area corresponding to village revenue unit
Mitigation	–	An action, which may prevent or minimize adverse impacts and enhance beneficial impacts
Negative Impact	–	Negative change from the existing situation due to the Project
Public Consultation	–	A range of techniques that can be used to inform, consult or interact with stakeholders affected / to be affected by a proposal
Reversible Impact	–	An environmental impact that recovers either through natural process or with human assistance (e.g. cutting off fish

		migration by an embankment might be reversible at a later stage if a proper regulator is built)
Stakeholders	–	Those who may be potentially affected by a proposal, e.g. local people, the proponent, government agencies, NGOs, donors and others, all parties who may be affected by the Project or to take an interest in it
Taka	–	Unit of Bangladeshi currency
Terrestrial	–	Living on land
Thana	–	Sub-district level of government administration, comprising several unions under district
Union	–	Smallest unit of local self-government comprising several villages
Upazila	–	Sub-district name. Upazila introduced in 1982
Zila	–	Bengali word for district

NOTE

In this report, "$" refers to United States dollars.

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EXECUTIVE SUMMARY

1. The proposed Southwest Transmission Grid Expansion Project (SWTGEP) will ensure that the capacity of electricity supply in southern and western Bangladesh is upgraded, with improvements in the technical efficiency of the transmission system. The proposed project is expected to provide support for the construction of new substations and transmission lines and support the augmentation and rehabilitation of existing transmission network of the Power Grid Company of Bangladesh (PGCB).

2. Bangladesh's power supply has not been able to keep pace with the rapid growth in demand, and consumers continue to experience frequent power outages. As of June 2017, the total nationwide dependable grid-connected peak demand was 9,479 megawatts (MW), against an unconstrained demand of 12,644 MW, indicating that about 3,200 MW of the power demand was met by supply from captive generation and load shedding.[1] On average, over 1,000 MW of load shedding occurs in the summer. Electricity demand is projected to grow by more than 10 percent per annum over the medium term. The Power System Master Plan (PSMP) 2016 has projected that demand will rise to more than 50,000 MW by 2041.

3. The project will construct (i) a 400/132 kilovolt (kV) substation at Gopalganj; (ii) a 230 kilovolt (kV) transmission line in the southern zone of the country's electricity network, in from Barisal to Faridpur; and (iii) a 400 kV transmission line in the western zone of the electricity network, from Bogra to Rohanpur. The project will use transmission lines with state-of-the-art conductors with higher power transmission capacity and lower energy loss. These conductors will significantly reduce electricity loss during transmission and increase the transfer capability of the transmission network, thereby supporting the government's efforts to improve operational performance of the power sector and increase household electrification rate from 76% in 2017 to 100% by 2021.

4. According to the Environment Conservation Act 1995 and Environment Conservation Rules 1997 (amended in 2017) of Bangladesh, all transmission lines and grid substations are categorized as 'red category' projects that require an Initial Environmental Examination (IEE) for site clearance and an Environmental Impact Assessment (EIA) for environment clearance. Therefore, to obtain 'Site Clearance' and 'Environmental Clearance' from the Department of Environment (DoE), PGCB conducted the necessary Route Survey and environmental assessment studies with the help of consultants. The Project also needs to comply with Asian Development Bank (ADB) safeguard requirements that include the need to undertake IEE for the Project. This IEE document is intended to fulfil ADB's Safeguard Policy Statement 2009, environmental assessment requirements for a category B project. An IEE is carried out as the substations and transmission lines are not located in environmentally or ecologically sensitive areas. The project team will re-evaluate the environmental categorization once the final design is available and re-submit the categorization form, if any changes are identified.

5. The proposed Gopalganj (North) substation site will be in an agricultural field adjacent to the Faridpur-Barisal highway. The land extent assigned for the project is 60 acres (24 hectares). The substation will comprise of eleven 400 kV bays, thirteen 132 kV bays, seven 230 kV bays, three 400/132 kV transformers, two 400/230 kV transformers, and three shunt reactors. The Bogra (west) substation will take up 20 acres (8 ha) on an agricultural land, with nine 400 kV gas insulated switchgear (GIS) bays, eleven 230 kV bays, and two 400/230 kV transformers. The

[1] The Bangladesh Power Development Board estimates that load shedding at peak time in 2017 was about 250 MW.

Rohanpur outdoor GIS substation site will also take up 20 acres (8 ha) of agricultural land. The substation will comprise of five 400-kV bays, nine 132 kV bays, and two 400/132 kV transformers.

6. The transmission line from Barisal (North) to Faridpur via Gopalganj (North) will be a 230 kV double circuit line with an approximate length of 126 kilometers (km). This transmission line will have 133 angle tension towers and 199 suspension towers. It will mainly traverse agricultural fields and will cross rivers at three locations.

7. The Bogra (West) to Rohanpur 400 kV line will be approximately 104 km in length and contain 99 angle towers and 149 suspension towers. The 26 km 132 kV double circuit transmission line from Rohanpur to Chapainawabganj will have 32 angle towers and 47 suspension towers. Twelve angle towers and 17 suspension towers will be included in the 11 km long line-in line-out (LILO) connection from the existing Barapukuria-Bogra (South) 230 kV transmission line to the Bogra (West) substation. One angle and three suspension towers will be included in the 1 km long LILO arrangement from the Chowdala-Niamatpur 132 kV transmission line to the Rohanpur 400 kV/132 kV substation.

8. The Right of Way (RoW) of the transmission lines and the land for the grid substation (GSS) are on low lying ground. The land along the transmission lines is predominantly cultivated, at least in the dry season, and has homestead activities. Currently, rice-based crops are grown mainly in the dry season along with potatoes, onions, mustard, garlic, jute and other vegetables.

9. During the construction phase of the Project, there will be some environmental impacts with machinery and vehicle movement to construct tower footings and the erection of towers and stringing of conductors. Various activities will take place for towers and new GSS construction including storage of construction materials, activity of workers and movement of construction vehicles. Mitigation measures are proposed in the Environmental Management Plan (EMP) and will be written into contracts to ensure that good practice is observed with measures included in construction contracts.

10. Existing vegetation including any trees at proposed transmission line tower locations will be cut prior to the start of construction works. And trees with height >5 meters (m) found inside the 10m width of the RoW will be removed. There will be some damage to standing crops in the field during the construction phase and a small amount of crop production will also be affected during the stringing process.

11. An area of 100 acres/40 hectares (ha) land in three substations and a small area of land under the towers, will be effectively taken out of agricultural use. Augmentation of the Barisal and Faridpur GSS does not require any land acquisition and will use the land available within the existing GSS premises.

12. The RoW does not cross any protected area or environmentally/ecologically sensitive sites. Adverse impacts on flora and fauna would be marginal.

13. The Project will not lead to any physical displacement of people or property. The Resettlement Plan (RP) for the Project found that 77 households with structures are inside the RoW of transmission lines, but the alignments have to be adjusted to make sure that all these houses are not affected. Any required compensation will be paid prior to construction. Compensation for crops and trees affected by towers and lines will be provided at replacement value to the affected persons (APs).

14. Measures to mitigate impacts during the pre-construction and construction phases will be undertaken. Efforts will be made to avoid cutting of trees as much as possible. In areas where removal of trees is unavoidable, tree planting will be undertaken. Most trees in the area are associated with homesteads, i.e. they are fruit and rapid growing timber trees and the same species will be replaced. Planting of appropriate tree species will also take place. Proper compensation for all types of damages will be paid.

15. There will be minor impact of noise for short periods during construction of foundations for the transmission line towers and a result in temporary increase in traffic, but work will take place during day time and residents close by will be warned of any foundation piling activity.

16. The transmission and LILO lines will traverse some populated areas. Therefore, inspection of existing electromagnetic field (EMF) along the selected routes of existing and new transmission lines in populated areas would be important. For housing structures, clearance between the transmission line and roof tops should be 6.5 m - 8 m and for river crossings it will 14.6m-15.9m. The estimated EMF values are within the ICNIRP public exposure limits. No houses or people will be directly affected by the EMF of transmission and LILO lines.

17. Labour camps required for the Project will be provided with water supply and sanitation facilities. Proper procedures will be in place for storage, containment and correct disposal of building materials at all work sites during construction. The GSS will be provided with necessary fire-fighting equipment, personal protective equipment (PPE) and access to emergency rescue items such as first aid boxes, etc.

18. There were 27 consultation meetings held in November and December 2017 with local people at various locations along the transmission line routes at which 468 people attended. Local people were concerned about receiving adequate and timely compensation for any losses of land, buildings or crops. Local people consider that the Project would contribute significantly to national development by improving the supply of electricity and they look forward to having employment opportunities during the pre-construction and construction phases. Although the transmission lines will not supply electricity directly to the people immediately beneath the lines, but the consultation meetings indicated that they are happy with the Project. It is seen as contributing to the national development and expanding the power distribution system from which they, along with others, will ultimately benefit.

19. The EMP included in this IEE, along with the monitoring plan, will assist in project implementation during the pre-construction, construction and post-construction phases and ensure corrective measures for the Project. Costing for environmental mitigation measures will be included in construction contracts.

20. A grievance redress mechanism will be established at local union level and there will be recourse to a project level redress system when required.

21. The PGCB will set up a Project Management Unit (PMU) to handle the project. The implementation of this IEE and the associated EMP will meet the ADB environmental safeguard requirements for the Project.

22. PGCB has been found to be adequately responsive on environmental safeguards during the operation of the current substations as existing facilities. The substations need the yard cleanness and appropriate waste handling and disposal practices. Handling of hazardous and non-hazardous material needs to be improved especially in storage arrangement and prevention

of spillage. PGCB needs to carry out corrective measure mentioned in the CAP for better compliance with ADB's Safeguard Policy Statement (SPS) 2009 and International Finance Corporation's Environmental Health and Safety (EHS) guidelines.

1. INTRODUCTION

1.1 Background

1. The Government of Bangladesh has made power sector development a priority for supporting the fast-economic growth. The government has committed to a massive initiative to build a nationwide transmission and distribution network with the aim of providing electricity for all by 2021. As per the Power System Master Plan (PSMP) 2016, a transmission system capable of supplying 40,000 megawatts (MW) of electricity throughout the country is expected by 2030.[2]

2. Bangladesh's power supply has not been able to keep pace with the rapid growth in demand, and consumers have experienced frequent power outages. As of June 2017, the total nationwide dependable grid-connected peak demand was 9,479 MW, against an unconstrained demand of 12,644 MW, indicating that about 3,200 MW of the power demand was met by supply from captive generation and load shedding.[3] On average, over 1,000 MW of load shedding occurs during summer. Electricity demand is projected to grow by more than 10 percent per year over the medium term. The PSMP 2016 has projected that demand will rise to more than 50,000 MW by 2041.

3. The shortage of electricity and poor quality of electricity supply from the aged and low capacity grid network severely impact industry and service sectors, which account for a major share of growth in the economy. According to the latest 2013 World Bank Enterprise Survey, Bangladesh businesses on average suffered power outages for 840 hours per year, resulting in an output loss of approximately 3% of gross domestic product.[4] The availability and reliability of power is hence a key constraint to job creation and poverty reduction.

4. In line with the above stated goals, the government envisages to obtain financial support from the Asian Development Bank (ADB) for the proposed Southwest Transmission Grid Expansion Project (SWTGEP) to ensure that the capacity of electricity supply in the Southwest economic corridor is upgraded, with improvements in the technical efficiency of the transmission system. The proposed project is expected to provide support for the construction of new substations and transmission lines and support the augmentation and rehabilitation of the existing transmission network of the Power Grid Company of Bangladesh (PGCB).

5. PGCB is the state-owned power transmission company in Bangladesh, and it is responsible for operation, maintenance and development of the power transmission system at 132 kV and above. PGCB has experience in the development, operation, and maintenance of 400 kV transmission lines with two operational lines, namely: (i) Meghnaghat-Aminbazar (Phase I, designed to operate at 400 kV but presently operating at 230 kV), and (ii) Bheramara-Baharampur, which provides the grid interconnection between Bangladesh and India. One more 400 kV line, the Bibiyana-Kaliakoir transmission line that is currently under construction.

6. The main components of the project include the following three (Figure 1.31 and Figure 1.32):

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[2] Power System Master Plan 2016, Power Division, Ministry of Power Energy and Mineral Resources, supported by Japan International Cooperation Agency (JICA), September 2016.

[3] The Bangladesh Power Development Board estimates that load shedding at peak time in 2017 was about 250 MW.

[4] Enterprise Surveys data for Bangladesh 2013; http://www.enterprisesurveys.org/

(i) increasing power delivery capacity at Gopalganj that includes construction of Gopalganj (North) 400/132 kV substation inclusive of

(a) switching facilities for 400 kV transmission lines, and
(b) two 400/132 kV transformers each rated at 325 MVA for local power supply;

(ii) expansion of transmission network in southern Bangladesh including

(a) construction of the 126 km Barisal (North)-Gopalganj (North)-Faridpur 230 kV double circuit transmission line;
(b) two 230 kV GIS bay extensions at Barisal (North) substation;
(c) augmentation of Faridpur substation with two 230/132 kV transformers each rated at 250 MVA; and
(d) augmentation of Gopalganj (North) substation with two 400/230 kV transformers each rated at 750 MVA; and,

(iii) Expansion of transmission network in Western Bangladesh including construction of

(a) 104 km Bogra (West)-Rohanpur 400 kV double circuit transmission line;
(b) 400/230 kV Bogra (West) GIS substation;
(c) 400/132 kV Rohanpur GIS substation;
(d) 26 km Chapainawabganj-Rohanpur 132 kV double circuit transmission line;
(e) 11 km line-in line-out connection from Barapukuria-Bogra (South) 230 kV double circuit transmission line to Bogra (West) substation;
(f) 1 km line-in line-out connection from Chowdala-Niamatpur 132 kV double circuit transmission line to Rohanpur substation; and
(g) two 132 kV GIS bay extensions at Chapainawabganj substation

7. The project area comprises of Bogra, Chapainawabganj, Rajshahi, Noagaon, Barisal, Gopalganj, Madaripur and Faridpur districts.

8. Barisal, Gopalganj and Faridpur are in southern Bangladesh. Bangladesh's Seventh Five-Year Plan, particularly envisages an integrated development strategy for the southwest region. The southwest economic corridor development approach is well aligned with this vision in that it seeks to establish public and private special economic zones: high-tech industrial parks; information technology (IT) parks; and, industrial estates for large-, medium-, and small-sized enterprises. Large-scale industrialization is expected to occur in these districts once the Padma Bridge project is completed. The Bangladesh Economic Zone Authority has already planned to establish three economic zones in these districts. Within a few years, electricity demand is expected to rise considerably. It is also necessary to establish secondary transmission infrastructure to evacuate bulk power from upcoming power plants at Payra and Bhola to the major load centres.

9. The western districts such as Bogra, Chapainawabganj, Rajshahi, and Noagaon are major grain cultivation zones. Due to inadequate surface water supply, cultivation mostly depends on ground water which must be pumped. Therefore, electricity demand peaks during the irrigation season. There are not enough local generation sources, which means power must come from a long distance away. Presently, electricity is transmitted at the 132 kV voltage level in this area. Long distances, low transmission voltage, high demand, and lack of reactive power compensation result in a severe low voltage problem in these districts. Lower voltage reduces production and

damages electrical equipment. The proposed project is intended to address these issues and constraints in the Southwest economic corridors.

Figure 1.1: Single Line Diagrams for Project Component 1 and 2

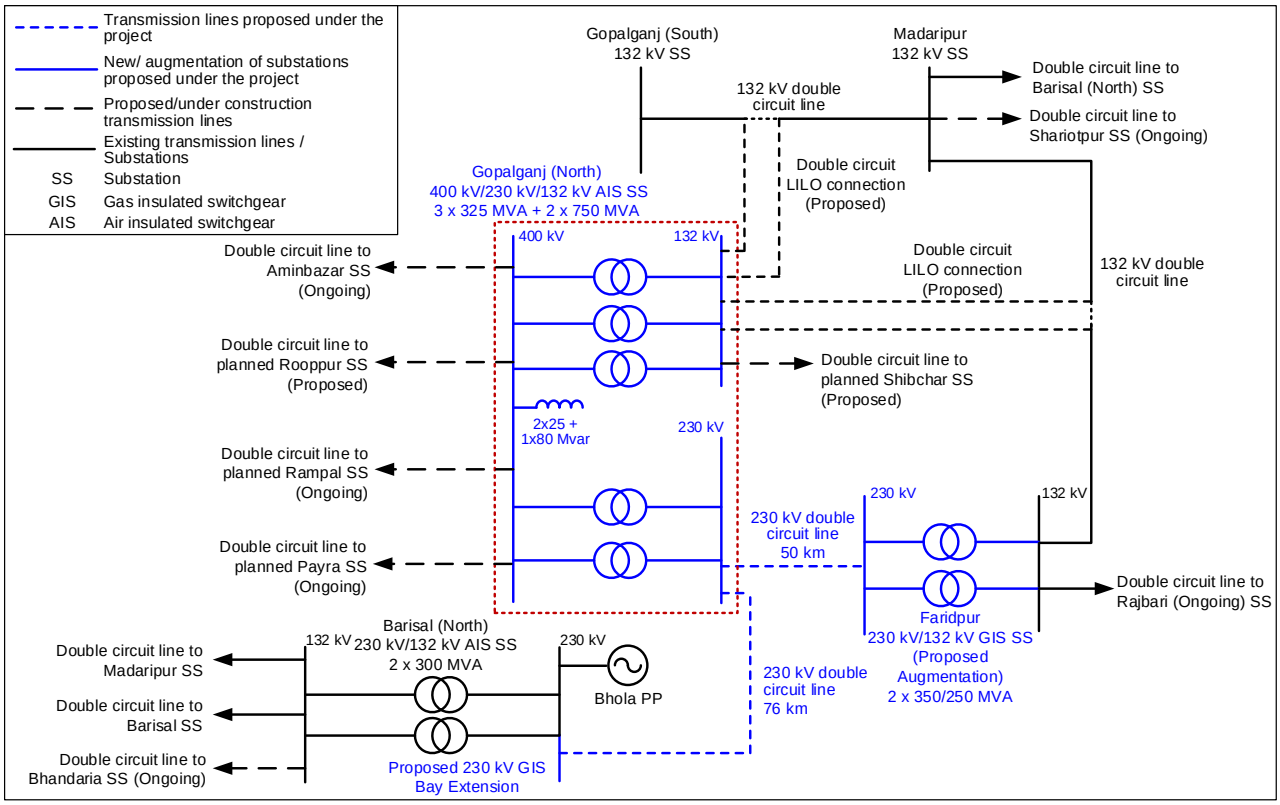
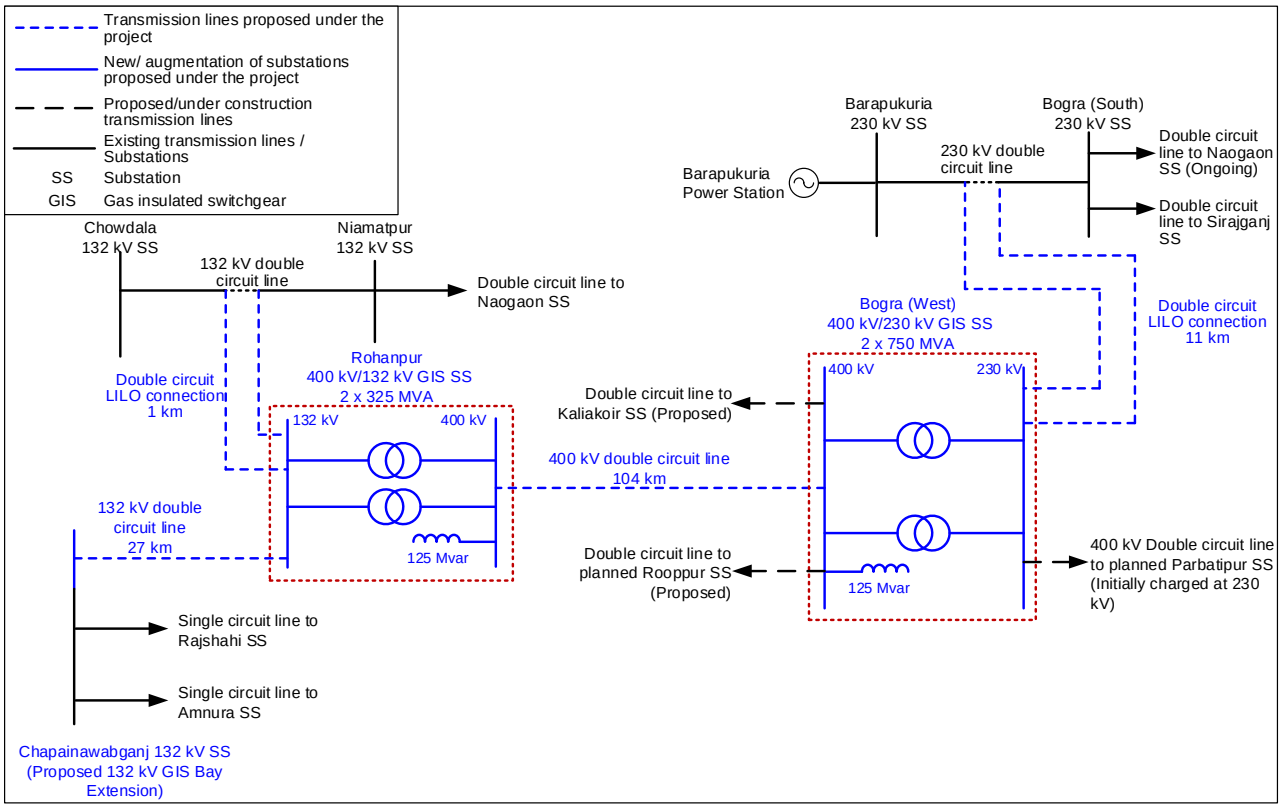


Figure 1.2 Single Line Diagram for Project Component 3



1.2 Objectives of the Initial Environmental Examination

10. The implementation of the project could have both negative and positive impacts on the surrounding environment, depending on environmental sensitivities and the design of responsive mitigation measures. Environmental impacts include physical, ecological and socio-economic impacts. This environmental assessment was carried out to prevent and reduce adverse impacts to an acceptable level, and to enhance the positive impacts linked with the implementation of the project. A rapid environmental assessment checklist for the project was prepared to determine potential adverse environmental and social impacts during project design and planning, construction, and the operation and maintenance phases of the substation and transmission line projects. This project is categorized as an Environmental B project, based on the rapid environmental assessment and the ADB Safeguard Policy Statement (SPS) 2009. For Category B projects, the environmental impacts are expected to be less adverse than Category A projects. An Initial Environmental Examination (IEE) is required to address the anticipated impacts and to suggest appropriate mitigation measures. This IEE report was prepared based on the table of contents provided in Appendix 1 of the ADB SPS 2009. The project team will re-evaluate the environmental categorization once the final design is available and re-submit the categorization form, if any changes are identified.

1.3 Study Area

11. The proposed substations and transmission lines are in eight districts. The Gopalganj (North) substation and the 230 kV transmission line from Barisal (North)-Gopalganj (North)-Faridpur are in the Barisal (Barisal Division), Gopalganj, Madaripur, and Faridpur (Dhaka Division)

districts. The Bogra (West) and Rohanpur proposed substations, 400 kV Bogra (West)-Rohanpur transmission line, Rohanpur-Chapainawabganj 132 kV transmission line and two line-in line-out (LILO) connections are in the Bogra, Noagaon, Rajshahi and Chapainawabganj districts in Rajshahi Division, southwest Bangladesh.

12. The direct impact area of subprojects has been defined as the total land extent of new substations [Gopalganj (North), Bogra (West) and Rohanpur], and areas where augmentation works are conducted in existing substations [Barisal (North), Faridpur and Chapainawabganj]. For transmission lines, a Right-of-Way (RoW) of 46 meters for 400 kV lines, 40 meters for 230 kV lines and 28 metres for 132 kV lines was considered. A 10-meter buffer zone on either side of the transmission line RoW was included to cover the area that the storage of materials, equipment and stringing of conductors could impact. The field assessments were carried out in the direct impact areas to gather environmental and socio-economic data. Note that the potential impacts on ecologically sensitive areas are not relevant in this project since there are no wildlife sanctuaries, biosphere reserves, or protected areas located in the project impact area or in surrounding areas.

13. The proposed Gopalganj (North) substation site will be in an agricultural field adjacent to the Faridpur-Barisal highway. The land extent assigned for the project is 60 acres (24 ha). The substation will comprise of eleven 400 kV bays, thirteen 132 kV bays, seven 230 kV bays, three 400/132 kV transformers, two 400/230 kV transformers, and three shunt reactors. The Bogra (West) substation will take up 20 acres (8 ha) on agricultural land, with nine 400 kV gas insulated switchgear (GIS) bays, eleven 230 kV bays, and two 400/230 kV transformers. The Rohanpur outdoor GIS substation site will also take up 20 acres (8 ha) of agricultural land. The substation will comprise of five 400 kV bays, nine 132 kV bays, and two 400/132 kV transformers.

14. The transmission line from Barisal (North) to Faridpur via Gopalganj (North) will be a 230 kV double circuit transmission line with a length of 126 km. This line will have 133 angle/tension towers and 199 suspension towers. It will mainly traverse agricultural fields and will cross rivers at three locations.

15. The Bogra (West) to Rohanpur 400 kV line will be approximately 104 km in length and contain 99 angle towers and 149 suspension towers. The 26 km long 132 kV double circuit transmission line from Rohanpur to Chapainawabganj will have 32 angle towers and 47 suspension towers. 12 angle towers and 17 suspension towers will be included in the 11 km long LILO connection from the existing Barapukuria - Bogra (South) 230 kV transmission line to the Bogra (West) substation. One angle and three suspension towers will be included in the 1 km long LILO arrangement from the Chowdala-Niamatpur 132 kV transmission line to the Rohanpur 400/132 kV substation (Figure 1.33).

Figure 1.3: Diagrammatic representation of the proposed substations: Gopalganj (North), Bogra (West) and Rohanpur and transmission systems: Barisal (North)-Gopalganj (North)- Faridpur and Bogra (West)-Rohanpur-Chapainawabganj

1.4 Scope of Work

16. According to the Environmental Conservation Act 1995 and Environmental Rules 1997 (amended in 2017), the construction, reconstruction and extension of electricity generation, transmission and distribution facilities fall under the red category. Red category projects require Environmental Impact Assessments (EIAs) to be preceded by IEEs. As this project falls under the red category it is required to undertake an IEE as a pre-condition for obtaining environmental clearance from the Department of Environment (DoE) (see Chapter 2, Policy and Legislation, for details of the IEE/EIA process).

17. The scope of work of the IEE includes:

a) Review of relevant documents and data/information from secondary sources, and identification of gaps to be filled from environmental screening done during field surveys.
b) Providing a description of the environmental baseline (data on physical, ecological and socio-economic characteristics of the project sites, along with areas of influence).
c) Collection of information on environmentally sensitive features at project sites, as well as within the project influence area.
d) Arrangement of consultations with the local people, especially project affected persons, to find out their opinions about the subprojects.
e) Analysis of alternatives to the proposed sub-projects.
f) Identification and assessment of potential environmental impacts due to implementation of the project.
g) Development of an Environmental Management Plan (EMP), including Monitoring Plan, and institutional arrangements for successfully implementing the mitigation and enhancement measures.
h) Prepare an IEE report in accordance with the ADB SPS 2009 and the national regulations of the government.

1.5 Methodology

18. An IEE will be used to estimate the potential environmental impacts of a proposed project, carried out in a relatively short time based on available preliminary information and information readily acquired through rapid environmental surveys. This study has been conducted in accordance with the ADB SPS 2009 and other relevant national/international laws and treaties applicable to the proposed project. This IEE report has been prepared based on the secondary and primary data/information that was collected and analysis of potential project/environment interactions.

1.5.1 Secondary Data Collection

19. The review of secondary sources and informal initial field investigations were undertaken to prepare a preliminary assessment of the physical and social environment, biodiversity, and conservation significance of the identified project area. The preliminary literature reviews also assisted in identifying data gaps which could be addressed with collection of additional primary information through field surveys.

20. Relevant data/information was collected from various government and non-governmental organizations, especially related to site aspects, climate (weather), topography, geology, waterbodies, surface/ground water quality, ecology/biology, socioeconomics, and other aspects. Previous environmental site studies, where available, were reviewed, as well as relevant articles and web sites.

1.5.2 Primary Data Collection

21. Primary data/information included data collected during the field surveys and observations, and discussions with stakeholders, such as community representatives and APs at key project locations and in the project influence area. The main purpose of this approach was to obtain a clear impression on the people's perceptions of the project and its environmental impacts and possible mitigation measures.

22. The primary data on environmental and socioeconomic aspects of the project area were collected during November and December 2017 by the safeguard survey team (Social Safeguard and Development Specialist and team of enumerators under a Transaction Technical Assistance supported by ADB) to comprehensively evaluate the existing project area environmental baseline conditions. An orientation workshop for the field survey team was conducted on 18 and 19 November 2017 before commencing the field work.

23. The status of flora and fauna within the project area was determined by reviewing the literature relevant to the area, as well as observations and surveys at the project sites. Tree counting at the project sites within the RoW was also carried out by the safeguard survey team. Identification of tree species in different habitats, such as home gardens, plantations, and agricultural lands, and assessment of stage of growth (whether mature tree or sapling) were also carried out.

24. A discussion with PGCB officials on 30 January 2018 informed that trees or saplings below five meters in height will not be cleared within the RoW. Trees taller than five meters in height and within 10 meters from the center of the RoW will be cleared to make space for the tower footings and conductors. Tree branches outside 10 meters of the RoW will be cut in a 45° angle to the tower. Cutting branches that grow horizontally towards the conductors and towers will be carried out every three months to prevent the in-growth. The value of the trees was determined according to the information provided by the Bangladesh Forest Department and Department of Agriculture.

25. The field survey team used a combination of desk studies, field investigations, census data, structured interviews, focus group discussions, maps, and reports to generate the data required to describe the existing environment and assess the potential impacts due to the construction and operation of the project. Local knowledge about the ecosystem and problems associated with the project activities were carefully recorded through public consultations and used in the impact assessment and to develop the mitigation plan. Formal public consultations, as well as informal ones, involving local villagers and affected persons were carried out during November and December 2017.

2. POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

2.1 Overview

26. The Environment Conservation Act of 1995 establishes the requirement for an environmental assessment in Bangladesh. Any proposed "industrial unit or project" must obtain prior approval from the Department of Environment (DoE). The act has classified projects to be assessed by the DoE in four categories (Green, Amber A, Amber B, and Red). Power development projects are allocated to the Red category, which triggers an automatic requirement for an IEE followed by a full EIA. The DoE issues an authorization for the project to proceed subject to a satisfactory review of the environmental assessment. The authorization consists of two parts, one is a "site clearance", which gives approval to the site proposed for the project and the other is an "environmental clearance", which approves the content of the project.

27. PGCB, as the project proponent, is responsible for carrying out the IEE and EIA studies of the proposed project. Therefore, it has the responsibility to administer the environment assessment process with the consultants, review the findings, and submit the documents to the DoE for review. A key requirement of the IEE/EIA for projects classified in the Amber and Red categories is an EMP. The function of the EMP is to enable PGCB to show the DoE how it will deliver the environmental performance assessed in the IEE/EIA (for which DoE approval is sought). The EMP should describe the management responsibilities, mitigation measures as well as the institutional arrangements, and explain how monitoring will be carried out.

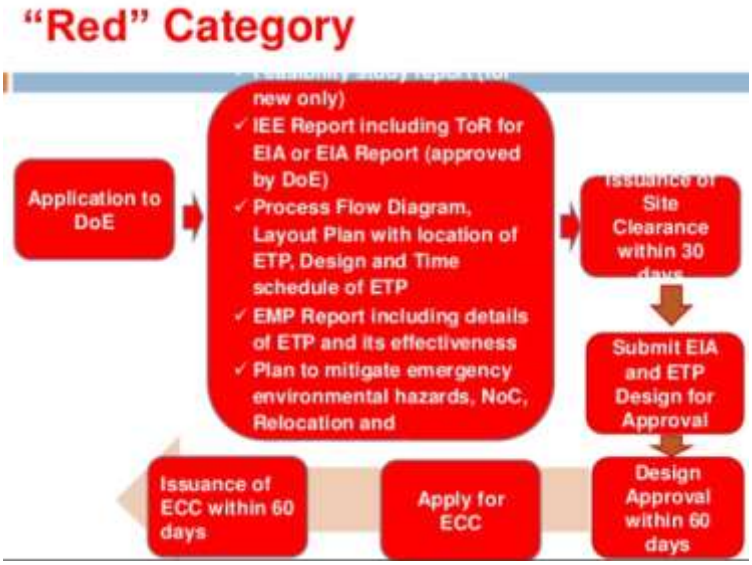
28. Possession of a "clearance" from the DoE does not relieve the developer of a project from the requirement to comply with other environmental regulations. The Bangladesh National Environment Quality Standards for industrial effluents have been set and compliance with them are mandatory (Annex 1). There are also statutory instruments that are applicable to power development projects, which are not primarily environmental but help to mitigate environmental impacts. Compliance with such statutory instruments is mandatory.

2.2 Procedure for Obtaining Site/Environmental Clearance

2.2.1 Requirement for IEE Reports

29. All industries and projects in the Red category must conduct IEEs, which help in understanding the potential extent of environmental changes of the project. Figure 2.1 shows the process of obtaining the environmental clearance for Red category projects.

Figure 2.1: Process of Obtaining Environmental Clearance



30. The IEE process helps in determining ways to mitigate negative impacts by considering available information, past experiences, and standard operating practices. The steps for conducting IEEs are as follows:

- Collection of baseline information with respect to a project and the environmental setting of the project and its site.
- Setting of boundaries of an IEE by identifying the significant issues.
- Impact assessment suggesting mitigation measures, development of an EMP, and discussion of alternative sites for the project or other project modifications.
- In the event the IEE of the project or industry reveals that further investigation is required to be carried out, the sponsors will have to conduct a detailed EIA.

2.2.2 Procedure

31. The project proponent applies to the DoE in the prescribed format for site or environmental clearance after completing the IEE report. The application for environmental clearance for the project classified in the Red category should be accompanied by the following documents:

- Feasibility Study Report of the industry (project)
- IEE report
- No Objection Certificate (from the local authorities concerned
- Pollution minimization plan, including emergency plan for mitigation of adverse environmental impacts
- Outline of relocation plans (where applicable)
- Other information as deemed necessary

32. The Environment Conservation Rules give the Director General of the DoE the discretion to issue environmental clearance directly without issuing any site clearance to any industry or project if the Director General finds an appropriate reason for doing so.

33. The proposed project comprises of the construction of three new substations [Gopalganj (North), Bogra (West), Rohanpur], augmentation of facilities within existing substations in Barisal (North), Faridpur and Chapainawabganj and the construction of Barisal (North)-Gopalganj (North)-Faridpur transmission line and Bogra (West)-Rohanpur-Chapainawabganj transmission line. The proposed project falls under the Red category, and as such all necessary requirements mentioned above have been adopted by PGCB.

2.3 Organization Related with Enforcement of Environmental Standards

34. Roles and responsibilities of various Ministries and Departments involved in the enforcement of environmental requirements are described below.

2.3.1 Ministry of Environment and Forest

35. The Ministry of Environment and Forest (MoEF) is the key government institution in Bangladesh for all matters relating to national environmental policy and regulatory issues. Realizing the ever-increasing importance of environmental issues, the MoEF replaced the Ministry of Agriculture and Forest in 1989 and is at present a permanent member of the Executive Committee of the National Economic Council. The National Economic Council is the major decision-making body for economic policy issues and is also responsible for approving all public investment projects. The MoEF oversees the activities of the following technical and implementing agencies:

- Department of Environment
- Forest Department
- Forest Industries Development Corporation

2.3.2 Department of Environment

36. The Government adopted the Environmental Pollution Control Ordinance in 1977 to expand the scope of environmental management and to strengthen implementation powers. The ordinance established an Environmental Pollution Control Board, which formulates policies and proposes measures for their implementation. In 1982, the Board was renamed as the Department of Environmental Pollution Control. Six divisional offices were established in Dhaka, Chittagong, Khulna, Barisal, Sylhet and Rajshahi.

37. A special presidential order renamed the Department of Environmental Pollution Control as the DoE and placed it under the newly formed MoEF in 1989.

38. The DoE is a department of the MoEF and is headed by a Director General. The Director General has complete control over the DoE. The power of the Director General, as given under the Environment Conservation act, is outlined as follows:

- The Director General has the authority to stop activities considered harmful to human life or the environment. The operator has the right to appeal and procedures are in place for this. However, if the incident is considered an emergency, there is no opportunity for appeal.
- The Director General has the authority to declare an area affected by pollution as an ecologically critical area. The DoE governs the type of work or process within that area.
- Before undertaking any new development project, the project proponent must take an

environmental clearance from the DoE (clearance for this project has been obtained, dated 11/02/2016).

- Failure to comply with any part of the Environment Conservation Act 1995 may result in punishment by a maximum of 5 years' imprisonment or a maximum fine of Tk100,000 ($1,205), or both.

2.3.3 Forest Department

39. This department under the MoEF is responsible for the protection and management of all reserve forests in the country. Department personnel extend down to the union level in areas where there are reserve forests. The department has recently started some agroforestry programs and its officers are also responsible for the protection of wildlife in the forests.

2.3.4 Other Related Organizations

40. There are several other organizations, which have certain social and environmental functions. These organizations include:

- Ministry of Land: Land Reform and Land Acquisition Directorate
- Ministry of Water Resources: Bangladesh Water Development Board
- Ministry of Fisheries and Livestock: Directorate of Fisheries

2.4 National Legislation Relevant to Environment

2.4.1 Environmental Policies and Acts

41. National strategies, policies, acts and rules related with the environment include the following:

- Environment Pollution Control Ordinance, 1977
- Environmental Quality Standards for Bangladesh, 1991
- National Conservation Strategy 1992
- Environment Policy (1992)
- National Environment Management Action Plan 1995
- Environment Conservation Act (ECA 1995)
- Environment Conservation Rules (ECR 1997)

2.4.1.1 *Bangladesh Wildlife Preservation Order (1973; amended to Act in 1974)*

42. The Bangladesh Wildlife (Preservation) Order 1973, and its amendment 1974, provides for the preservation, conservation, and management of wildlife in Bangladesh. Earlier legislation concerning wildlife preservation including the Elephant Preservation Act (1879), the Wild Bird and Animals Protection Act (1912), and the Rhinoceros Preservation Act (1932) have all been repealed and their provisions have been suitably incorporated into this law.

2.4.1.2 *The National Forest Policy (1994)*

43. The National Forest Policy of 1994 is the amended and revised version of the National Forest Policy of 1977, as part of the National Forestry Master Plan. The main purpose of the policy

is to conserve existing forest areas and bring about 20% of the country's land area under the forestation program and increase reserve forest land by 10% (by 2015) through coordinated efforts of government organizations, non-governmental organizations (NGOs) and active participation of the people.

2.4.2 Environmental Related Rules and Policies

44. In addition to the environmental policies and regulations, the following rules and regulations, listed in
Table **2.1**, will be checked for compliance to help maintain a sustainable environment.

Table 2.1: Environmental Laws, Regulations and Standards of Bangladesh

Year	Title	Objectives
1885	The Telegraph Act (Act XIII of 1885)	Under the law sections 10-19, government-built transmission lines throughout the country.
1910	The Electricity Act (Act IX of 1910)	Under the law section 51, government-built transmission lines throughout the country.
1950	East Bengal Protection and Conservation of Fish Act	Protection and conservation of fish in Bangladesh.
1985	The Protection and Conservation of Fish Rules	Prevention of harm to fisheries resource and fisheries habitat in coastal and inland waters.
1953	Town Improvement Act	Improvement and development of Dhaka City.
1958	Antiquities Act	Protection and preservation of archaeological and historical artefacts.
1960, 1966	Port rules, shipping operation	Control of discharges in ports; waterway rules.
1965	Factories Act	Industrial workers' health and working conditions.
1971	Pesticide Ordinance	Pesticide use, production, selection and importation.
1976	Antiquities (Amendment) Ordinance	Protection and prohibition of export of archaeological artefacts.
1977	Municipal Ordinance	Municipal activities in health, sanitation, water supply, drainage, etc. in the city.
1979	Factory Rules	Disposal of wastes and effluents.
1980	Agricultural Pesticides (Amendment) Act	Selection, use and handling of pesticides in the agricultural sector.
1982	Municipal Act	Drainage, sewerage, water supply and sanitation.
1982	Acquisition and Requisition of Immovable Property ordinance	The Acquisition of Immovable Property Rules, 1982 (No. S.R.O. 172-U82) The government adopted these rules in exercise of the powers conferred upon by section 46 of The Acquisition and Requisition of Immovable Property Ordinance, 1982 (Ordinance No. II of 1982).
1983	Agricultural Pesticides (Amendment) Ordinance	Revised Agricultural Pesticides Ordinance.
1985	The Pesticide Rules	Pesticide selling, use and safety measures.
1990	Bangladesh standard specification for drinking water	Formulation and revision of national standards.
1860	The Penal Code	This contains several articles related with environmental protection and pollution management.
1996	Building Construction (Amendment) Act and Building Construction Rules	The Rules are more comprehensive for taking care of the present circumstances and issues of building.

2.5 Policy Related with Energy Development

2.5.1 The Electricity Act (1910) and Electricity Rules (1937)

45. Under the act, any person can obtain a license to supply electricity and lay down or place electric supply lines. The licensee can open and break up the soil and pavement of any street, railway or tramway and can lay down any line or do other work near other utility services (gas, telecommunication, water, sewer, etc.), provided prior permission is taken from the respective authority, as stated in Sections 12-18 of the Act.

46. According to Section 19 (1) of this act, the licensee shall give full compensation for any damage, detriment or inconvenience caused by, or anyone employed by, that licensee.

47. Sub-section (1) of Section 51 of the Electricity Rules, 1937 advises that the licensee should take precautions in laying down electric supply lines near or where any metallic substance or line crosses to avoid electrocution.

2.5.2 The Telegraph Act (1885)

48. Under Sections 10-19, Part III (Power to place Telegraph Lines and posts), the government can build towers on public land without giving any land compensation.

2.5.3 The Power Policy (1995)

49. As with the Petroleum Policy, this is presently an integral part of the National Energy Policy (1996). It has different policy statements on a whole range of issues including demand forecasts, long-term planning and project implementation, investment and lending terms, fuel and technology, power supply to the west zone, isolated and remote load centres, tariffs, captive and standby generation, system loss reduction, load management and conservation, reliability of supply, system stability, load dispatching, institutional issues, private sector participation, human resource development, regional/international cooperation, technology transfer and research program, and environment policy and legal issues.

50. As the proposed project is a power transmission project, all necessary requirements mentioned above will be adopted for the project.

2.5.4 The Energy Policy (1996; updated 2004)

51. The first National Energy Policy of Bangladesh was formulated in 1996 by the Ministry of Power, Energy and Mineral Resources to ensure proper exploration, production, distribution, and the rational use of energy resources to meet growing energy demand sustainably. The policy was updated in 2004 in response to rapid global and domestic change. The updated policy includes additional objectives, namely to ensure environmentally sustainable energy development programs, to encourage public and private sector participation in the development and management of the energy sector, and to electrify the entire country. The policy highlights the importance of protecting the environment by requiring an EIA for any new energy development project, or by introducing an economically viable and environment friendly technology.

2.5.5 The Industrial Policy (1999)

52. The National Industrial Policy (1999) aims to ensure a high rate of investment by the public and private sectors, a strong productive sector, direct foreign investment, development of labor intensive industries, introduction of new appropriate technology, women's participation, development of small and cottage industries, entrepreneurship development, high growth of exports, infrastructure development, and environmentally sound industrial development. The World Trade Organization guidelines have been proposed to be followed in the Industrial Policy.

2.6 Building Construction (Amendment) Act (1990) and Rules (1996)

53. The first Building Construction Act dates back to 1952. The earlier Government Buildings Act (1899) exempted certain buildings and land that belonged to or were occupied by the government and situated within the limits of a municipality, from the municipal building laws. The 1990 Act supersedes the provision of Municipal Building Laws to regulate the creation, re-creation, construction, alteration, or maintenance of buildings within the limits of any municipality. The East Bengal Legislative Assembly promulgated the Building Construction Act (1952) on 21 March 1953 as the East Bengal Act II of 1953 in response to the need to regulate haphazard construction of buildings. The act was framed to allow streamlining of planned development and implement government beautification programs.

54. An important modification to the 1953 act was added through an ordinance titled, "the Building Construction (Amendment) Ordinance, 1986" (Ordinance. No. LXXII of 1986). Later in 1987, the ordinance was adopted for enactment as "The Building Construction (Amendment) Act, 1987" (Act No. 12 of 1987).

55. An authorized officer is empowered through this amendment so that he/she can take necessary action to prevent unauthorized construction or to remove such construction without intervention of the court.

56. The act was further amended in 1990 allowing power to issue limited sanctions to cut down or raze any hill within the area to which this act applies.

57. To support the implementation of the provisions laid down in the Building Construction Act, 1952, the government made the Building Construction Rules, 1953. The Imarat Nirman Bidhimalas (1984) superseded these rules. Later in 1996, the government framed the Imarat Nirman Bidhimala (Building Construction Rules, 1996). The rules are more comprehensive and more relevant to present circumstances and issues of building construction and other related development activities.

2.7 Compliance with International Requirements

58. Bangladesh has acceded to, ratified, or signed a number of major international treaties, conventions and protocols related to environment protection and conservation of natural resources.

2.7.1 Rio Declaration

59. The 1992 United Nations Conference on Environment and Development adopted the global action program for sustainable development called ‘The Rio Declaration’ and ‘Agenda 21’.

Principle 4 of The Rio Declaration, to which Bangladesh is a signatory, states that "in order to achieve sustainable development, environmental protection should constitute an integral part of the development process and cannot be considered in isolation from it".[5]

2.7.2 Convention on Biological Diversity (1992)

60. The Convention on Biological Diversity, Rio de Janeiro, was adopted on 5 June 1992 and entered into force on 29 December 1993. Bangladesh ratified the Convention on 20 March 1994. This is the overarching framework for biodiversity and the signatories are required to develop a National Biodiversity Strategy and Action Plan that incorporates the articles of the Convention into national law and statutes.

61. Obligation has been placed on state parties to provide for environmental impact assessments of projects that are likely to have adverse effects on biological diversity.

2.7.3 Wetlands of International Importance as Waterfowl Habitat (1971)

62. The Convention of Wetlands of International Importance as Waterfowl Habitat (1971) is also known as the Ramsar Convention. It was adopted on 2 February 1971 and entered into force on 21 December 1975. Bangladesh ratified the Convention on 20 April 2002. The Convention provides a framework for national action and international cooperation for the conservation and wise use of wetlands and their resources. There are 127 parties with 1,085 wetland sites designated as 'Wetlands of International Importance.'

63. This is an intergovernmental treaty, which provides the framework for international cooperation for the conservation of wetland habitats. Obligations for Contracting Parties include the designation of wetlands to the "List of Wetlands of International Importance," the provision of wetland considerations within their national land use planning, and the creation of natural reserves.

64. Bangladesh has two Ramsar sites: parts of the Sundarbans Reserved Forest (Southwest of Bangladesh) and Tanguar Haor (Northeast of Bangladesh). The proposed project will not have any effect on these two Ramsar sites.

2.7.4 United Nations Framework Convention on Climate Change

65. The Kyoto Protocol to the United Nations Framework Convention on Climate Change was adopted in 1997 and requires developed countries and economies in transition, listed in Annex B of the Protocol, to reduce their GHG emissions by an average of 5.2% below 1990 levels. Article 12 of the Kyoto Protocol provides for the Clean Development Mechanism (CDM). According to CDM, projects are eligible to earn Certified Emission Reductions (CERs) if they lead to "real, measurable, and long-term" GHG reductions, which are additional to any that would have occurred without the CDM project.

2.7.5 UN Convention on the Law of the Sea, Montego Bay (1982)

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

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[5] United Nations, Rio Declaration on Environment and Development, 1992.

2.7.6 Others (Conventions and Agreements)

67. The following conventions and agreements include provisions which may be relevant for environmental management, nature protection, and biodiversity conservation:

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

2.8 Compliance with ADB Safeguard Policy Statement, 2009

68. ADB's environmental and social safeguards form the cornerstone of its support to inclusive economic growth and environmental sustainability in Asia and the Pacific. In July 2009, ADB's Board of Directors approved the new Safeguard Policy Statement (SPS) governing the environmental and social safeguards of ADB's operations. The objectives of the SPS are to avoid, or when avoidance is not possible, to minimize and mitigate adverse project impacts on the environment and affected people. Objectives also include helping borrowers strengthen their safeguard systems and develop the capacity to manage environmental and social risks.

69. ADB's environmental safeguards emphasize development and implementation of a comprehensive EMP. Key elements of EMP are mitigation measures, monitoring programs, budgets, and institutional arrangements for implementation. In addition, the environmental assessment process emphasizes public consultation, information disclosure, and consideration of alternatives.

70. The key safeguard areas which must be addressed are (i) environmental; (ii) involuntary resettlement; and (iii) indigenous peoples.

71. Further, ADB adopts a set of specific safeguard requirements that borrowers or clients are required to meet in addressing environmental and social impacts and risks associated with a specific project. ADB will not finance projects that do not comply with its safeguard policy statement, nor will it finance projects that do not comply with the host country's social and environmental laws and regulations. The safeguard policy statement applies to all ADB-financed

and/or ADB-administered sovereign and non-sovereign projects, and their components, regardless of the source of financing.

2.8.1 ADB's Environmental Safeguard Requirements – Policy Principles

72. Environmental assessment incorporates the following policy principles:

- Projects are screened and assigned to one of the following categories described in Table 2.2 as soon as possible.
- Conduct an environmental assessment for each proposed project. Assess potential trans-boundary and global impacts, including climate change.
- Examine alternatives to the project's location, design, technology, and components. Avoid, minimize, mitigate, and/or offset adverse impacts.
- Prepare an EMP.
- Carry out meaningful consultation with affected people and facilitate their informed participation.
- Disclose a draft environmental assessment (including the EMP) in a timely manner, before project appraisal, in an accessible place and in a form and language(s) understandable to affected people and other stakeholders. Disclose the final environmental assessment, and its updates if any, to affected people and other stakeholders.
- Implement the EMP and monitor its effectiveness. Document and disclose monitoring results.
- Do not implement project activities in areas of critical habitat, unless (i) there are no measurable adverse impacts on the critical habitat that could impair its ability to function, (ii) there is no reduction in the population of any recognized endangered or critically endangered species, and (iii) any lesser impacts are mitigated. If a project is located within a legally protected area, implement additional programs to promote and enhance the conservation aims of the protected area.
- Apply pollution prevention and control technologies and practices consistent with international good practices such as the World Bank Group's Environmental, Health and Safety Guidelines.
- Provide workers with safe and healthy working conditions and prevent accidents, injuries, and disease.
- Conserve physical cultural resources and avoid destroying or damaging them by using field-based surveys.

73. The project categorization system and the assessment required are described in Table 2.2. The environmental impacts of the project are temporary and reversible. This project is categorized as an Environmental B project.

Table 2.2: ADB's Environmental Safeguards Categorization and Requirements

Category	Definition	Assessment Requirement
A	Likely to have significant adverse environmental impacts that are irreversible, diverse, or unprecedented, and may affect an area larger than the sites or facilities subject to physical works.	Environmental impact assessment (EIA)

Category	Definition	Assessment Requirement
B	Likely to have adverse environmental impacts that are less adverse than those of Category A. Impacts are site-specific, few if any of them irreversible, and in most cases mitigation measures can be designed more readily than Category A.	Initial Environmental Examination (IEE)
C	Likely to have minimal or no adverse environmental impacts.	No environmental assessment is required but the environmental implications of the project will be reviewed.
FI	Project involves investment of ADB funds to or through a financial intermediary (FI).	FIs will be required to establish an environmental and social management system (ESMS) commensurate with the nature and risks of the FI's likely future portfolio to be maintained as part of the FI's overall management system.

Source: ADB. Safeguard Policy Statement 2009, p. 19. http://www.adb.org/sites/default/files/institutional-document/32056/safeguard-policy-statement-june2009.pdf.

2.9 Compliance with PGCB Health Environment and Safety Requirements

74. The PGCB has its own policy and requirements for compliance relating to environment, health and safety issues for its operations. The company is committed to managing its operations in a safe, efficient and environmentally responsible manner. The PGCB's Health Environment and Safety (HES) manuals, guidelines, procedures, and plans are important tools indicating their commitment. HES manuals include:

- Environmental Impact Assessment Module;
- Guideline on Integrated Impact Assessment;
- Health Impact Assessment Module; and
- Social Impact Assessment Module.

75. In addition, the requirement for impact assessment is affirmed in the PGCB's Statement of General Business Principles. The PGCB is committed to:

- Pursuing the goal of no harm to people;
- Protecting the environment; and,
- Managing HES as any other critical business activity.

76. The mandatory company Operations Management System, Environmental Care Element/ Standards, issued in March 1997, refers to Environmental Assessment indicating that "EIA (including a consideration of social impacts) shall be conducted prior to all new activities and facility developments, or significant modifications of existing ones."

2.10 Comparison of Environmental Safeguard Principles between ADB and Bangladesh

77. Table 2.3 presents a summary comparing the environmental safeguard principles of ADB and the government.

Table 2.3: Comparison of Environmental Safeguard Principles

SPS 2009			Government	Gaps (if any)
No.	**Principles**	**Delivery Process**		
1	Use of screening process to determine the appropriate environmental assessment	Uses sector-specific rapid environmental assessment checklist for screening and assigns categories based on potential impacts: • A - EIA required (irreversible, diverse or unprecedented adverse environmental impacts) • B - IEE required • C - no environmental assessment required but a review of environmental implications • FI - ESMS required	ECA 1995 and ECR 1997 (amended in 2017) set screening criteria to classify industries/projects based on potential environmental impacts as follows: Green (pollution-free), Orange-A, Orange-B and Red (causes significant environmental impacts). The screening criteria are based on project or industry type and do not consider the scale and location. The category determines the level of environmental assessment.	No major gaps
2	Conduct an environmental assessment	• EIA and IEE - Identify potential impacts on physical, biological, physical cultural resources, and socioeconomic aspects in the context of project's area of influence (i.e., primary project site and facilities, and associated facilities) • ESMS for FIs	• Industry/project category • Green- no environmental assessment required • Orange-A - no IEE or EIA required but must provide process flow, lay-out showing effluent treatment plant, etc. • Orange-B - IEE required • Red - both IEE and EIA are required	No major gaps
3	Examine alternatives	• Analyze alternatives to the project's location, design, and technology • Document rationale for selecting the project location, design, and technology • Consider "no project" alternative	• Regulations (i.e., ECA 1995 and ECR 1997 amended in 2017) do not require specifically the identification and analysis of alternatives	Not required by law but the TOR for EIA to be approved by the DOE now includes a discussion on analysis of alternatives.
4	Prepare an EMP	• EMP to include monitoring, budget and implementation arrangements	• EMP and procedures for monitoring included in the IEE and EIA (i.e., Orange-A, Orange-B, and Red category projects)	No major gaps
5	Carry out meaningful consultation	• Starts early and continues during implementation • Undertaken in an atmosphere free of intimidation • Gender inclusive and responsive • Tailored to the needs of vulnerable groups	• Public consultation and participation are not mandatory based on ECA 1995 and ECR 1997 (amended in 2017) • Grievance redress mechanism is not mentioned in ECA 1995	Approval of the TOR of EIA by DOE now includes consultation with stakeholders.

SPS 2009			Government	Gaps (if any)
No.	**Principles**	**Delivery Process**		
		• Allows for the incorporation of all relevant views of stakeholders • Establish a grievance redress mechanism	and ECR 1997 (amended in 2017) • EIA format required by DOE includes stakeholders' consultation	
6	Timely disclosure of draft environmental assessment (including the EMP)	• Draft EIA report posted on ADB website at least 120 days prior to Board consideration (for Category A) • Draft IEE/EARF prior to appraisal • Final or updated EIA/IEE upon receipt • Environmental monitoring report submitted by borrowers upon receipt	• No requirement for public disclosure of environmental reports but DOE posts the Minutes of the Meeting on the application for environmental clearance certificate to its website, http://www.doe-bd.org/minutes.php	Still no requirement for public disclosure of environmental assessment
7	Implement EMP and monitor effectiveness	• Prepare monitoring reports on the progress of EMP • Retain qualified and experienced external experts or NGOs to verify monitoring information for Category A projects • Prepare and implement corrective action plan if non-compliance is identified • Requires submission of quarterly, semi-annual, and annual reports to ADB for review	• Environmental clearance is subject to annual renewal based on compliance of the conditions set by DOE	No major gaps
8	Avoid areas of critical habitats (use of precautionary approach to the use, development and management of renewable natural resources)	Provides guidance on critical habitats	• ECA 1995 and ECR 1997 (amended in 2017) identifies ecologically critical areas and the rules to protect them	No major gaps
9	Use pollution prevention and control technologies and practices consistent with international good practices	• Refers to World Bank's Environmental Health and Safety (EHS) General Guidelines 2007 (or any update) • If national regulations differ, more stringent will be followed • If less stringent levels are appropriate in view of specific project circumstances, provide full and detailed justification	• Effluent standards, ambient and emission standards included in ECA 1995 and ECR 1997 (amended in 2017) • Ambient noise levels included in Noise Pollution Control Rules 2006	No major gaps
10	Provide workers with safe and healthy working conditions	• Refers to WB EHS General Guidelines 2007 (or any update)	• Occupational health and safety standards included in the Factories Act 1965, the Bangladesh Labour Law 2006, and the	No major gaps

SPS 2009			Government	Gaps (if any)
No.	**Principles**	**Delivery Process**		
			Bangladesh Labour Act 2013.	
11	Conserve physical cultural resources (PCR) and avoid destroying or damaging them	• Use of field-based surveys and experts in the assessment • Consult affected communities on PCR findings • Use chance find procedures for guidance	• Preservation and protection of cultural resources are within the Antiquities Act 1968.	No major gaps

ADB = Asian Development Bank, DoE = Department of Environment, EARF = Environmental Assessment and Review Framework, ECA = Environment Conservation Act, ECR = Environment Conservation Rules, EHS = Environmental Health and Safety, EIA = Environmental Impact Assessment, EMP = Environmental Management Plan, ESMS = Environmental and Social Management System, FI = Financial Intermediary, IEE = Initial Environmental Examination, NGO = Non-governmental Organization, PCR = Physical Cultural Resources, ToR = Terms of Reference, WB = World Bank.

3. DESCRIPTION OF THE PROJECT

3.1 Project Location

78. The project area comprises Bogra, Chapainawabganj, Rajshahi, Noagaon, Madaripur, Barisal, Gopalganj and Faridpur districts.

79. Barisal, Gopalganj and Faridpur are in southern Bangladesh. Bangladesh's Seventh Five-Year Plan, envisages an integrated development strategy for the Southwest region. The Southwest economic corridor development approach is well aligned with this vision in that it seeks to establish public and private special economic zones: high-tech industrial parks; information technology (IT) parks; and, industrial estates for large, medium, and small-sized enterprises. Large scale industrialization is expected to occur in these districts once the Padma Bridge project is completed. The Bangladesh Economic Zone Authority has already planned to establish three Economic Zones in these districts. Within a few years, electricity demand is expected to rise considerably. It is also necessary to establish secondary transmission infrastructure to evacuate bulk power from upcoming power plants at Payra and Bhola to the major load centres.

80. The western districts such as Bogra, Chapainawabganj, Rajshahi, Noagaon, are major grain cultivation zones. Due to inadequate surface water supply, cultivation mostly depends on ground water (which requires pumping). Therefore, electricity demand peaks during the irrigation season. There are not enough local generation sources, which means power must come from a long distance away. Presently, electricity is transmitted at 132 kV voltage level in this area. Long distance, low transmission voltage, high demand and lack of reactive power compensation result in a severe low voltage problem in these districts. Lower voltage reduces production and damages electrical equipment.

3.2 Project Components

81. **Component 1 – Increasing Power Delivery Capacity at Gopalganj:** Construction of Gopalganj (North) 400/132 kV substation inclusive of (i) switching facilities for 400 kV transmission lines, and (ii) three 400/132 kV transformers each rated at 325 MVA.

82. **Component 2 – Expansion of Transmission Network in Southern Bangladesh:** (i) Construction of 126 km Barisal (North)-Gopalganj (North)-Faridpur 230 kV double circuit transmission line (ii) two 230 kV bay extensions at Barisal (North) substation, (iii) augmentation of existing Faridpur substation with four 132 kV bays, five 230 kV bays and 230/132 kV, 2x250 MVA transformers, and (iv) augmentation of Gopalganj (North) substation with 400/230 kV, 2x750 MVA transformers.

83. **Component 3 – Expansion of Transmission Network in Western Bangladesh:** Construction of (i) 104 km Bogra (West)-Rohanpur 400 kV double circuit transmission line; (ii) Bogra (West) GIS substation with 400/230 kV, 2x750 mega-volt ampere (MVA) transformers, nine 400 kV bays, and 11 230 kV bays; (iii) Rohanpur substation with 400/132 kV, 2x325 MVA transformers, five 400 kV bays and nine 132 kV bays; (iv) 26 km Chapainawabganj-Rohanpur 132 kV double circuit transmission lines; (v) 11 km LILO connection from Barapukuria-Bogra (South) 230 kV double circuit transmission line to Bogra (West) substation; (vi) 1 km LILO connection from Chowdala-Niamatpur 132 kV double circuit transmission line to Rohanpur substation; and (vii) 132 kV bay extension at Chapainawabganj substation.

3.3 Rationale and Detailed Project Description

3.3.1 Increasing Power Delivery Capacity at Gopalganj

84. The Power System Master Plan 2016[6] establishes the need for major transmission capacity to be developed to transfer power from the new power plants to be developed in southern Bangladesh. The master plan envisages the following specific generating capacities to be located in southwestern Bangladesh: Mongla (1,320 MW), Payra (1,320 MW). The proposed ADB-financed power plant project at Rupsha (800 MW) would increase the total new generating capacity to be located in southern Bangladesh to 3,440 MW. This generating capacity is at advanced stages of project planning and financing activities. The Power System Master Plan envisages that by 2022, all the above key generating facilities would be operational. The peak load flow toward Dhaka from these southwestern generating facilities by 2025, is estimated to be about 1,800 MW, after deducting about 430 MW to meet the demand in the local areas of Mongla, Payra and Gopalganj, and for power plant auxiliary requirements. If the local demand, especially from the planned industrial zones do not grow, and since the power plants being built in the southwestern region are of higher capacity, operated on cheaper fuels, the power flow toward Dhaka from the southern region would increase further, exceeding 2,000 MW by 2025.

85. To manage the power flow from Mongla and Payra in southwestern Bangladesh, and to deliver a higher capacity to Dhaka as well as to the local transmission network, PGCB has proposed a new 400 kV[7] substation to be built at Gopalganj. The Gopalganj substation would serve (i) as a switching station for the two major transmission lines from Mongla (the Mongla - Gopalganj line is presently in the procurement stage) and from Payra (the Payra - Gopalganj line is presently under construction); (ii) as a step-down substation to deliver power to the 132 kV and 230 kV network; and (iii) deliver power to the Gopalganj - Aminbazar[8] line to serve the demand in Dhaka.

86. The proposed Gopalganj (North) 400/132 kV substation will have the following key components:

a. Nine (9) 400 kV bays with associated switchgear;
b. Three 400/132 kV transformers, each rated at 325 MVA;
c. Two shunt reactors each rated at 25 MVAr, and one shunt reactor rated at 80 MVAr; and
d. Thirteen (13) 132 kV bays with associated switchgear.

3.3.2 Expansion of Transmission Network in Southern Bangladesh

87. Presently, key towns south of Padma river such as Faridpur and Barisal are interconnected at 132 kV. There is existing thermal generation at Borhanuddin in Bhola, while new thermal generation is also planned at Borhanudddin. With the installation of the Gopalganj (North) substation, the regional transmission network requires to be upgraded to 230 kV, to enable larger customer loads to be served.

[6] Power System Master Plan 2016, Power Division, Ministry of Power Energy and Mineral Resources, supported by Japan International Cooperation Agency (JICA), September 2016.
[7] 400 kV is the highest transmission voltage used in Bangladesh.
[8] Aminbazar is in southwest Dhaka, with a 400 kV substation.

88. The new line would thus be able to receive power from southern region power plants through the Gopalganj (North) substation, as well as from existing generation at Barisal, providing significant operational flexibility to serve regions south of Padma river. The proposed transmission system will consist of the following sub-components:

a. Construction of the 126 km Barisal (North)-Gopalganj (North)-Faridpur 230 kV double circuit transmission line, using twin Aluminium Conductor Steel Reinforced (ACSR) Mallard equivalent Aluminium Conductor Composite Core (ACCC) conductor, inclusive of two river crossings;
b. Extension of the existing 230 kV Barisal (North) substation with two new GIS line bays;
c. Augmentation of the existing 132 kV Faridpur substation with five new 230 kV GIS bays, four (4) new 132 kV AIS bays and two 230 kV/132 kV transformers each rated at 250 MVA; and
d. Augmentation of the Gopalganj (North) 400 kV substation with two 400 kV transformer bays, three 230 kV bays, and two 400 kV/230 kV transformers each rated at 750 MVA.

3.3.3 Expansion of Transmission Network in Western Bangladesh

89. To strengthen the power supply to the west region, the Project would establish a 400 kV transmission system between Bogra and Rohanpur, further extending to Chapainawabganj (see Table 3.1). This component of the Project would consist of the following subcomponents.

a. Construction of the 104 km long Bogra (West)–Rohanpur 400 kV double circuit line with twin ACSR Finch equivalent ACCC conductor.
b. Construction of Bogra (West) substation with nine 400 kV GIS bays, 11 230-kV bays, two 400 kV/230 kV transformers, each rated at 750 MVA, and one shunt reactor rated at 125 MVAr.
c. Construction of the Rohanpur outdoor GIS substation with five 400 kV, nine 132 kV bays, two 400 kV/132 kV transformers, each rated at 325 MVA, and one shunt reactor rated at 125 MVAr.
d. Construction of the 26 km long Chapainawabganj-Rohanpur 132 kV double circuit transmission line with single ACSR Grosbeak equivalent ACCC conductor.
e. Construction of the 11 km long line-in line-out arrangement with twin AAAC conductor from the existing Barapukuria-Bogra (South) 230 kV transmission line to the Bogra (West) substation.
f. Construction of the 1 km long line-in line-out arrangement with single Grosbeak conductor from the Chowdala-Niamatpur 132 kV transmission line to the Rohanpur 400 kV/132 kV substation. This line is under construction.
g. Extension of the existing 132 kV Chapainawabganj substation with two new 132 kV GIS line bays.

Table 3.1: Names of Zila, Upazila, Number of Villages and Unions in the Transmission Line Routes

Zila	Upazila	Village	Union
Barisal (North)- Gopalganj (North)- Faridpur 230 kV transmission line (76 km+ 50 km)			
Barisal	Barisal Sadar, Babuganj, Kharpura, Wazirpur, Gouranadi, Agoiljhara,	29	12
Madaripur	Kalkini, Madaripur Sadar, Rajoir, Moksudpur	18	09
Gopalganj	Muksudpur,	10	03
Faridpur	Vanga, Nagorkanda, Faridpur Sadar	30	13

Zila	Upazila	Village	Union
Bogra (West)- Rohanpur 400 kV transmission line (104 km)			
Bogra	Kahalo, Nodigram, Adomdighi,	13	05
Naogoan	Ranirgar, Naogaon Sadar, Manda	33	10
Rajshahi	Tanor, Niamatpur,	10	03
Chapainawabganj	Nachole	15	03
Rohanpur- Chapainawabganj 132 kV transmission line (26 km)			
Chapainawabganj	Nachole, Gomostapur, Chapainawabganj Sadar,	16	06
LILO from Bogra (South)- Barapukuria 230 kV line (11 km) to Bogra (West) Substation			
Bogra	Kahaloo	05	03

km = kilometre, kV = kilovolt.

3.4 Profile of Barisal (North)-Gopalganj (North)-Faridpur 230 kV Transmission System

90. The proposed transmission line traverses from Barisal (North) to Faridipur via Gopalganj (North) and the total length of the final alignment is 126 km. The line crosses four districts (Barisal, Madaripur, Gopalganj, Faridpur) and 16 upazila with 84 villages and 38 unions. The length of line from Barisal existing grid substation (GSS) to the proposed substation at Gopalganj is 76 km and it is 50 km from Gopalganj to Faridpur existing GSS. The selected transmission line option was finalized after investigating three alignments and excluding the transmission line routes that have more adverse impacts on the social environment. The coordinates of final alignment are given in Annex 2. The line from Barisal (North) to Gopalganj (North) consists of 80 angle/tension towers and 120 suspension towers. The Gopalganj (North) to Faridpur section has 53 angle/tension towers and 79 suspension towers.

91. The transmission line traverses across various land uses and habitats such as agricultural fields, homesteads, rivers, khals, ponds, and unutilized/ degraded and open lands (typical of almost all Bangladeshi rural areas), but no forests. The land under the RoW constitutes both private and government lands which are utilized for settlements, as well as for cultivation purposes. A variety of crops such as paddy, jute, garlic, mustard, onion, vegetables, wheat and potato are cultivated in both homesteads and in open agricultural fields.

92. The maximum slope along the transmission line route is 2.6%–2.8% (almost flat) and the elevation changes from 4 m above sea level (asl) at Barisal (North) substation to the highest elevation of 13 m asl near angle point (AP) 27. The average elevation along the transmission line route is 6 m asl for the Barisal (North)-Gopalganj (North) transmission line and 8 m asl from Gopalganj (North)-Faridpur. The line crosses a tributary of the Arial Khan river between angle points 14 and 15 (near Dehergati, Atipara, where the local name is the Sondha river), the Uzirpur (or Shikapur/ Agapur) river between AP 19 and AP 20 (local name Sughanda river), and the Kumar river near Tekerhat, between AP 60 and AP 61.

93. It also crosses the Barisal-Dhaka highway in three locations: AP 18-19; AP 24-25; and AP 55-56 at Gopalganj. It intersects the Gaurnadi-Agailjhara main road between AP 38-39. The Gopaganj (North)-Faridpur section crosses the Dhaka-Khulna highway between AP10 and 11, the Faridpur-Magura-Jhenaidah-Jessore-Kulna-Mongla road between AP 31 and 32. It also crosses a number of rivers, khals, and ponds between angle points 8-9, 12-13, 14-15, 21-22, 32-33, and 36-37. Note that all road and river crossings are just with the aerial transmission lines (no infrastructure within these features is required).

Figure 3.1: Barisal (North)-Gopalganj (North)-Faridpur 230 kV Transmission Line

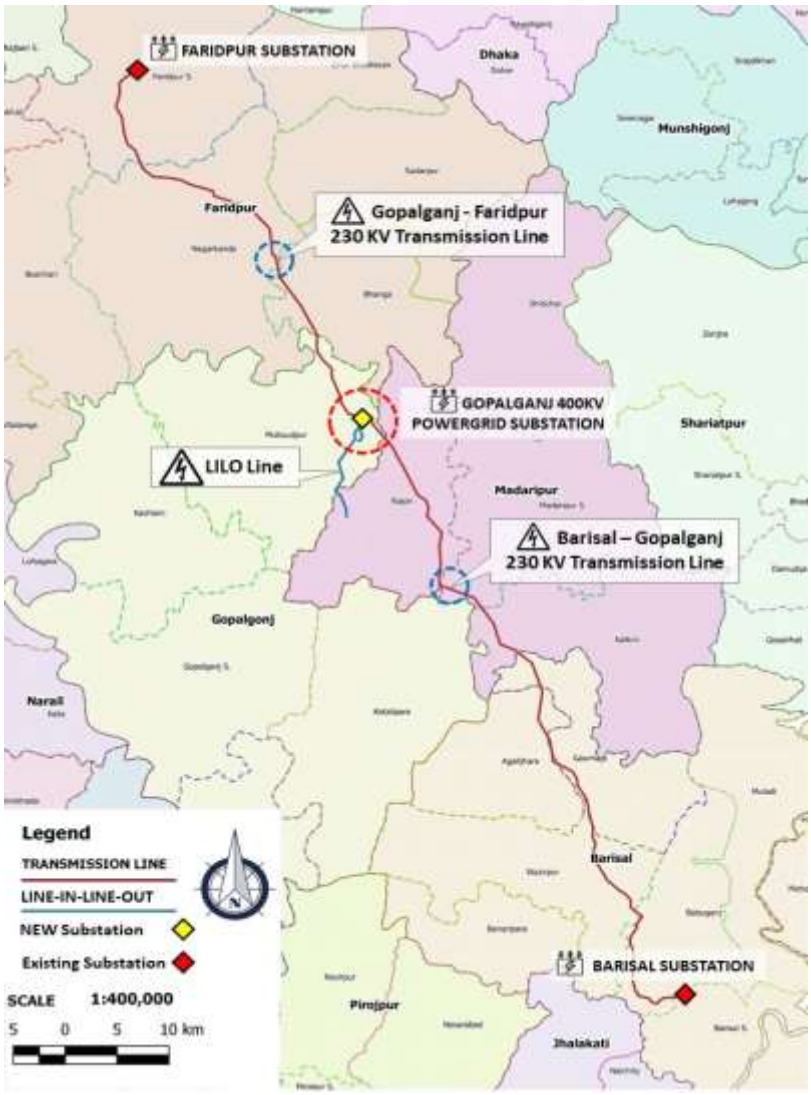


Table 3.2: Physical Features of Barisal (North)-Gopalganj (North)-Faridpur 230 kV Transmission System

Sl. No.	Physical Features	Attribute
1	Voltage rating	230 kV
2	Type of transmission line	Double circuit
3	Width of TL RoW	40 meters for resettlement purposes
4	No of transmission towers	332
5	Transmission towers heights	Standard towers: 37 meters
6	Transmission line clearances	8 m for standard lines
7	Type of line support	Steel 230 kV lattice
8	Conductor material	Aluminium alloy
9	Line insulator	Disc type, porcelain
10	Type of connection	Barisal (North), Gopalganj (North) and Faridpur Grid Substations
11	Duration of project implementation	Approximately 4 years

3.5 Profile of Bogra (West)- Rohanpur- Chapainawabganj Transmission System

94. The Bogra (West)-Rohanpur 400 kV transmission line, Rohanpur-Chapainawabganj 132 kV transmission line and two LILO lines located in Bogra, Noagaon, Rajshahi and Chapainawabganj districts in Rajshahi Division, southwest Bangladesh.

3.5.1 Bogra (West)-Rohanpur 400 kV Transmission Line

95. The total length of the transmission line is estimated at 104 km, as reported in the Development Project Proposal of PGCB in January 2018.[6] The line traverses across various land uses and habitats such as agricultural fields, rivers, homesteads, khals, ponds, and unutilized/ degraded and open lands (as with the other line, no forests are included in the alignment). The entire length was covered in the social and environmental assessments. The proposed transmission line route passes through four zilas, nine upazilas, 73 villages and 22 unions. The RoW for the 400 kV transmission line is established at 23 m either way from the center of the line/tower, which is considered the project impact area. The land under the RoW is exclusively private and is used for settlements as well as for cultivation purposes. A variety of crops such as paddy (rice), jute, mustard, onion, potato and vegetables are cultivated in both homesteads and open agricultural fields. Apart from these agricultural activities, the project impact area also contains 22 residential dwellings belonging to 20 households. The coordinates of the final alignment for this proposed line are given in Annex 2.

96. The elevation along the transmission line changes from 11 m asl at 27.4 km from the Bogra substation, between AP 10-11, near Roktodoho beel at Dhekra, to 47 m asl at 99.9 km from Bogra substation, near Nachole (AP 66-67). The average elevation of the lands in the RoW is 20 m asl. The slope of the land varies from 1.6 to 1.9% (almost flat).

Table 3.3: Physical Features of Bogra (West)-Rohanpur 400 kV Transmission Line

Sl. No.	Physical Features	Attribute
1	Voltage rating	400 kV
2	Type of transmission line	Double circuit
3	Width of TL RoW	46 meters for Resettlement Purposes
4	No of transmission towers	248
5	Transmission towers heights	Standard towers: 50.5 meters
6	Transmission line clearances	11 meters for standard lines
7	Type of line support	Steel 400 kV lattice
8	Conductor material	Aluminium alloy
9	Line insulator	Disc type, porcelain
10	Type of connection	Bogra (West) and Rohanpur Grid Substations
11	Duration of project implementation	Approximately 4 years

3.5.2 Rohanpur-Chapainawabganj 132 kV Transmission Line

97. The total length of the transmission line is estimated at 26 km, as reported in the Development Project Proposal of PGCB in January 2018.[7] The proposed line route passes through one zila, three upazilas, 15 villages, and five unions. The RoW for the 132 kV transmission line is established at 14 m either way from the centre of the line/tower, which is considered the

[6] The length of the line covered for the social/ environmental survey was 103.9 km.
[7] The length of the line covered for the social/ environmental survey was 24.4 km.

project impact area. The land under the RoW is both private and government land which is utilized for settlements, as well as for cultivation of paddy and vegetables. The project impact area also contains five built structures, of which four are residential dwellings and one community building (used for a primary school). The coordinates of the final alignment of this transmission line are given in Annex 2.

98. The elevation along the 132 kV transmission line changes from 19 m asl at 8.74 km from Rohanpur substation, between AP 11-12, to 38 m asl at 5.07 km from the Rohanpur substation, before crossing the Kholsi-Nachole road (between AP 7-8). The average elevation of the land under the transmission line is 25 m asl. The slope of the land in the RoW varies from 3.1 to 3.3% (gently sloping).

Table 3.4: Physical Features of the Chapainawabganj-Rohanpur 132 kV Transmission Line

Sl. No.	Physical Features	Attribute
1	Voltage rating	132 kV
2	Type of transmission line	Double circuit
3	Width of TL RoW	28 meters for resettlement purposes
4	No of transmission towers	79
5	Transmission towers heights	Standard towers: 17.46 meters
6	Transmission line clearances	7 m for standard lines
7	Type of line support	Steel 132 kV lattice
8	Conductor material	Aluminium alloy
9	Line insulator	Disc type, porcelain
10	Type of connection	Rohanpur and Chapainawabganj Grid Substations
11	Duration of project implementation	Approximately 4 years

3.5.3 LILO Connection from Niamatpur-Chowdala 132 kV Transmission Line to Rohanpur Substation

99. The total length of the transmission line is estimated at 1 km as reported in the Development Project Proposal of PGCB in January 2018.[8] The proposed transmission line route passes through one zila, one upazila, one village and one union. The RoW for the 132 kV transmission line is established at 14 m either way from the center of the line/tower. The land under the RoW is private land which is exclusively used for paddy cultivation. No built structures were found within the RoW.

3.5.4 LILO Connection from Barapukuria-Bogra (South) 230 kV Transmission Line to Bogra (West) Substation

100. The total length of the transmission line is estimated at 11 km as reported in the Development Project Proposal of PGCB in January 2018.[9] The proposed line route passes through one zila, one upazila, five villages and three unions. The RoW for the 230 kV transmission line is established at 20 m either way from the center of the line/tower. The land under the RoW is private land which is exclusively used for paddy cultivation. No built structures were found within the RoW.

101. The elevation along the 230 kV LILO line changes from 16 m asl at 4.95 km from the Bogra (West) substation, between AP 6-7, to 24 m asl at 9.72 km from the Bogra (West)

[8] The length of the line covered for the social/ environmental survey was 0.05 km.
[9] The length of the line covered for the social/ environmental survey was 10.6 km.

substation, near Kahaloo (between AP 7-8). The average elevation of the land under the transmission line is 20 m asl. The slope of the land in the RoW differs from 4.8 to 6.3% (gently sloping).

Table 3.5: Physical Features of the LILO Connection from Barapukuria-Bogra (South) 230 kV Transmission Line to the Bogra (West) Substation

Sl. No.	Physical Features	Attribute
1	Voltage rating	230 kV
2	Type of transmission line	Double circuit
3	Width of TL RoW	40 meters for resettlement purposes
4	No of transmission towers	29
5	Transmission towers heights	Standard towers: 37 meters
6	Transmission line clearances	8 m for standard lines
7	Type of line support	Steel 230 kV lattice
8	Conductor material	Aluminium alloy
9	Line insulator	Disc type, porcelain
10	Type of connection	LILO connection to Bogra (West) substation from Barapukuria-Bogra (South) 230 kV transmission line
11	Duration of project implementation	Approximately 4 years

Table 3.6: Length of Transmission Lines (PGCB, Development Project Proposal January 2018), Span (m), Number of Angle/ Tension Towers, Suspension Towers, Land Area Required for Tower Footings and Total Land Area under the RoW

S.I. No.	Length (km)	Aver-age Span (m)	Total Towers	Angle Towers	Suspen sion Towers	Land required for installation of towers (m^2 per tower, and total in ha)		Total land area within the RoW (ha)
						Angle	Suspensi on	
Barisal (North) – Gopalganj (North) - Faridpur 230 kV Transmission Line (RoW 40 m)	126	380	332	133	199	72.25 (0.961 ha)	42.25 (0.841 ha)	504.0
Bogra (West) – Rohanpur 400 kV Line (RoW 46 m)	104	420	248	99	149	83.47 (0.826 ha)	75.31 (1.221 ha)	478.4
Rohanpur – Chapainawabganj 132 kV line (RoW 28 m)	26	330	79	32	47	66.08 (0.211 ha)	36 (0.170 ha)	72.8
LILO from Niamatpur– Chowdala 132 kV line to Rohanpur Substation	1	330	3	1	2	66.08 (0.007 ha)	36 (0.007 ha)	2.8
LILO from Barapukuria – Bogra (South) 230 kV line to Bogra (West) Substation	11	380	29	12	17	72.25 (0.087 ha)	42.25 (0.072 ha)	44.0
Total	**268**		**691**	**277**	**414**	**2.09 ha**	**2.21 ha**	**1,102 ha**
						4.3 ha		

102.
Figure 3.2 shows the Bogra (West)–Rohanpur–Chapainawabganj transmission system. Figure 3.3 shows the Barisal (North)-Gopalganj (North)-Faridpur and Bogra (West)-Rohanpur–Chapainawabganj transmission systems.

Figure 3.2: Bogra (West)-Rohanpur-Chapainawabganj Transmission System

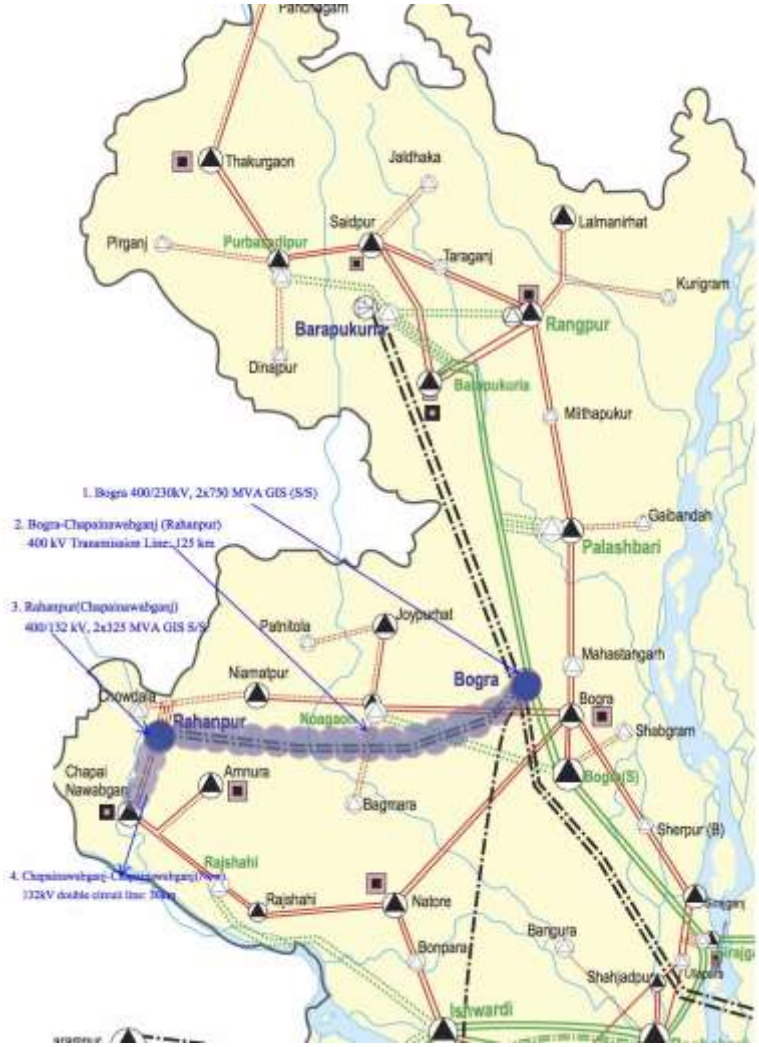
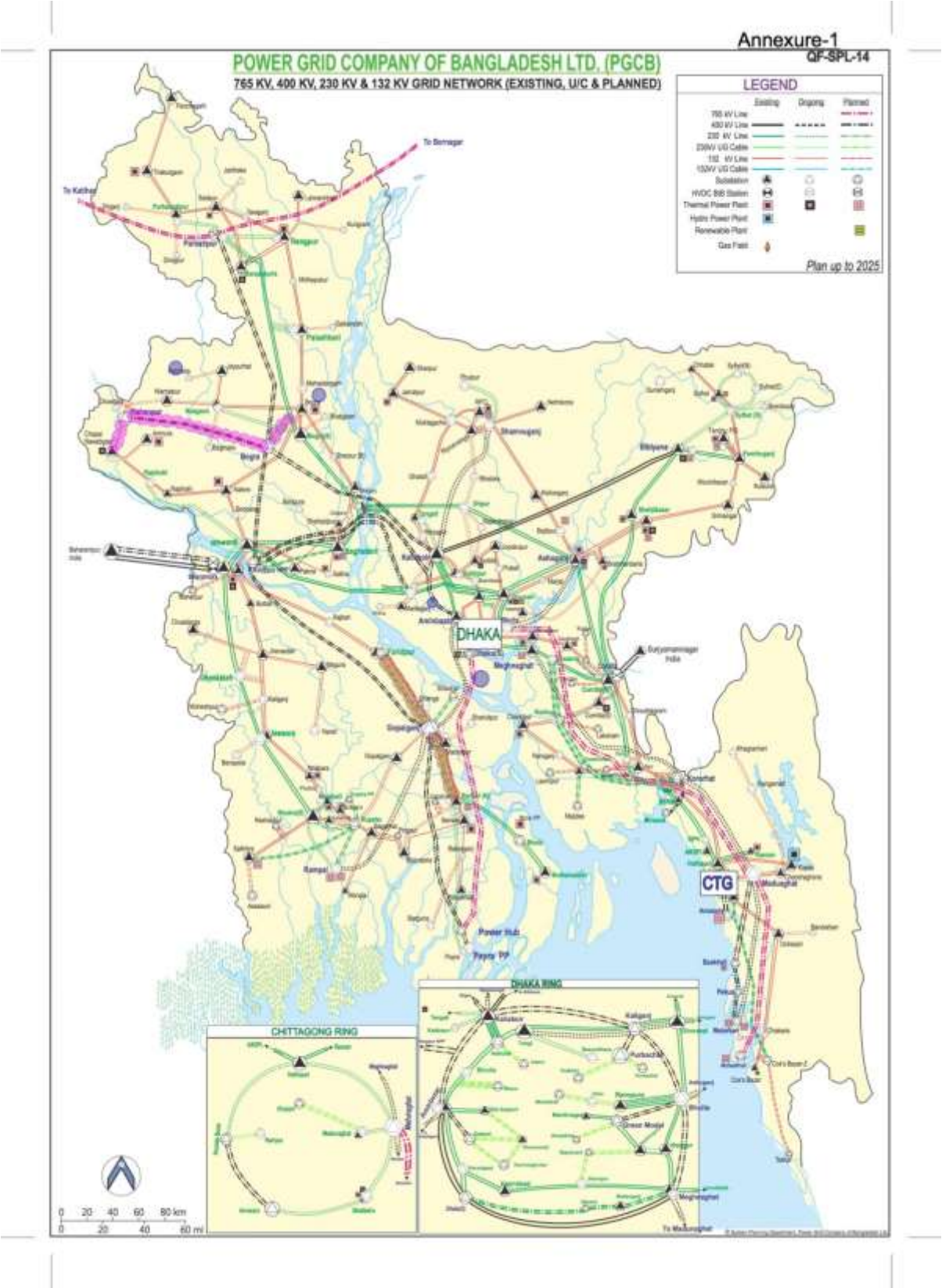


Figure 3.3: Diagrammatic Representation of the Proposed Transmission Systems- Barisal (North)-Gopalganj (North)- Faridpur and Bogra (West)-Rohanpur- Chapainawabganj



3.6 Barisal (North) and Faridpur Substations

103. Augmentation of existing facilities in these substations will be carried out under Component 2 of the Southwest Transmission Grid Expansion Project (SWTGEP). The land area of the existing Barisal (North) substation is 13 acres (5.3 ha). Extension of the existing 230 kV Barisal (North) substation with two new GIS line bays is proposed under the project.

104. The Faridpur substation has 6 acres (2.4 ha) and augmentation of the existing 132 kV Faridpur substation with five new 230 kV GIS bays, four new 132 kV AIS bays and two 230/132 kV transformers, each rated at 250 MVA, will be carried out under the project within substation premises.

Table 3.7: Physical Features of Existing Barisal (North) Grid Substation – Bay Extension

Features	Specification
Land ownership	PGCB
Scheme	Main busbar scheme
Substation type	Outdoor
Voltage	230/132 kV
Switchgear type	Existing: Air Insulated Bay Extension: Gas-insulated
Insulation medium power circuit breaker	SF_6 GAS
Transformer	Oil insulated
Protection system description	Auto fighting water spray system

Table 3.8: Physical Features of Faridpur Grid Substation - Upgradation

Features	Specification
Land ownership	PGCB
Scheme	Main busbar scheme
Substation type	Outdoor
Voltage	230/132 kV
Switchgear type	Existing: Air-Insulated Bay extension: Gas-insulated
Insulation medium power circuit breaker	SF_6 GAS
Transformer	Oil insulated
Protection system description	Auto fighting water spray system

Picture 1. Barisal (North) Grid Substation

Picture 2. Barisal (North) Grid Substation

Picture 3. Two transformers – the Open Land beyond Transformers is Earmarked for the Two Bays of the Grid Substation

Picture 4. D/C LILO Terminal Tower

Picture 5. Entrance to the Faridpur Grid Substation

Picture 6. Existing Faridpur Grid Substation

Picture 7. The Land Allocated for the Augmentation of the GSS

Picture 8. Transformers at Faridpur GSS

105. Table 3.9 to 3.12 provide detailed physical features of each component.

Table 3.9: Physical Features of proposed Gopalganj (North) Grid Substation (60 acres)

Features	Specification
Land ownership	Private
Scheme	Main busbar scheme
Substation type	Outdoor
Voltage	400/132 kV
Switchgear type	Air-insulated
Insulation medium power circuit breaker	SF_6 GAS
Transformer	Oil insulated
Protection system description	Auto fighting water spray system

kV = kilovolt.

Figure 3.4: The Location of the Gopalganj (North) Substation in Muksudpur Upazila

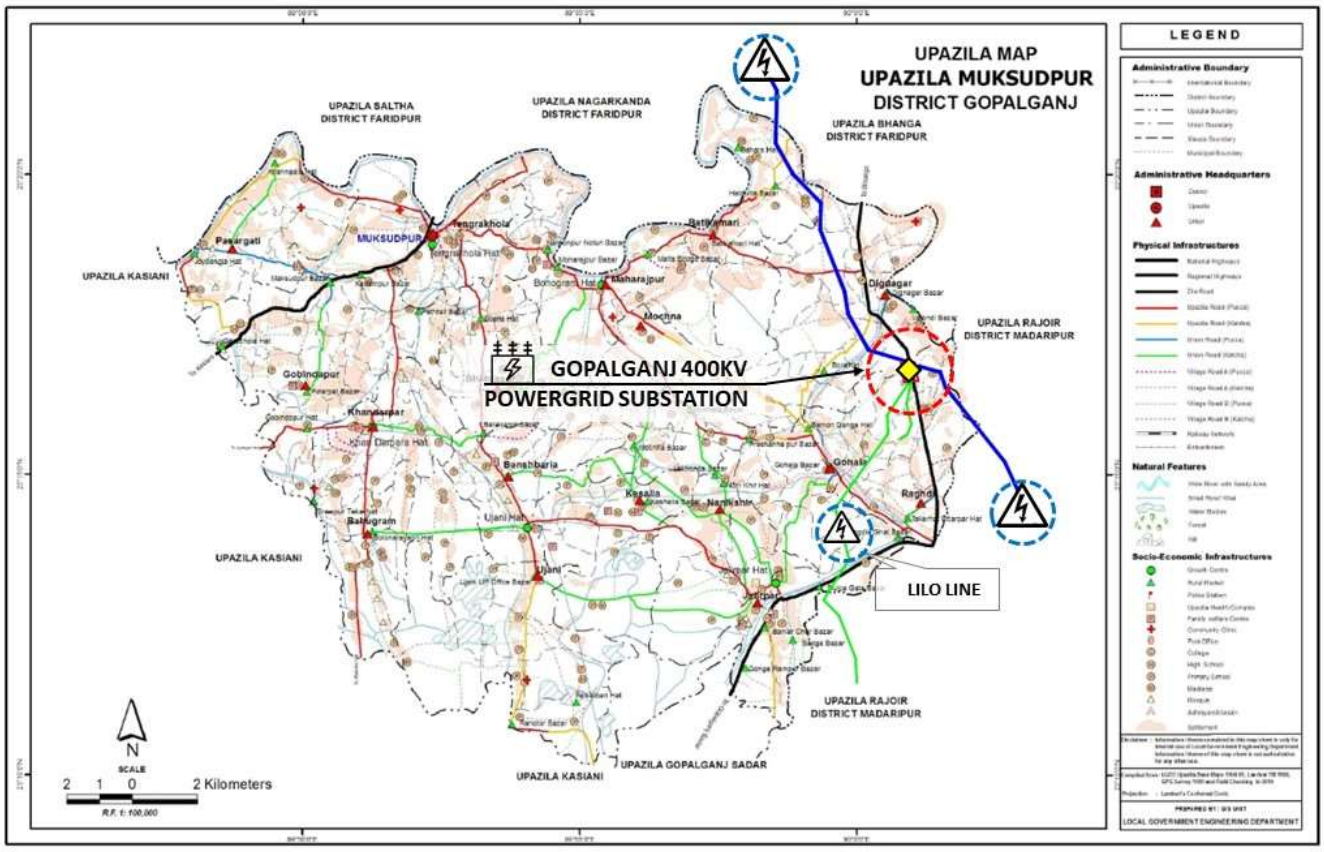
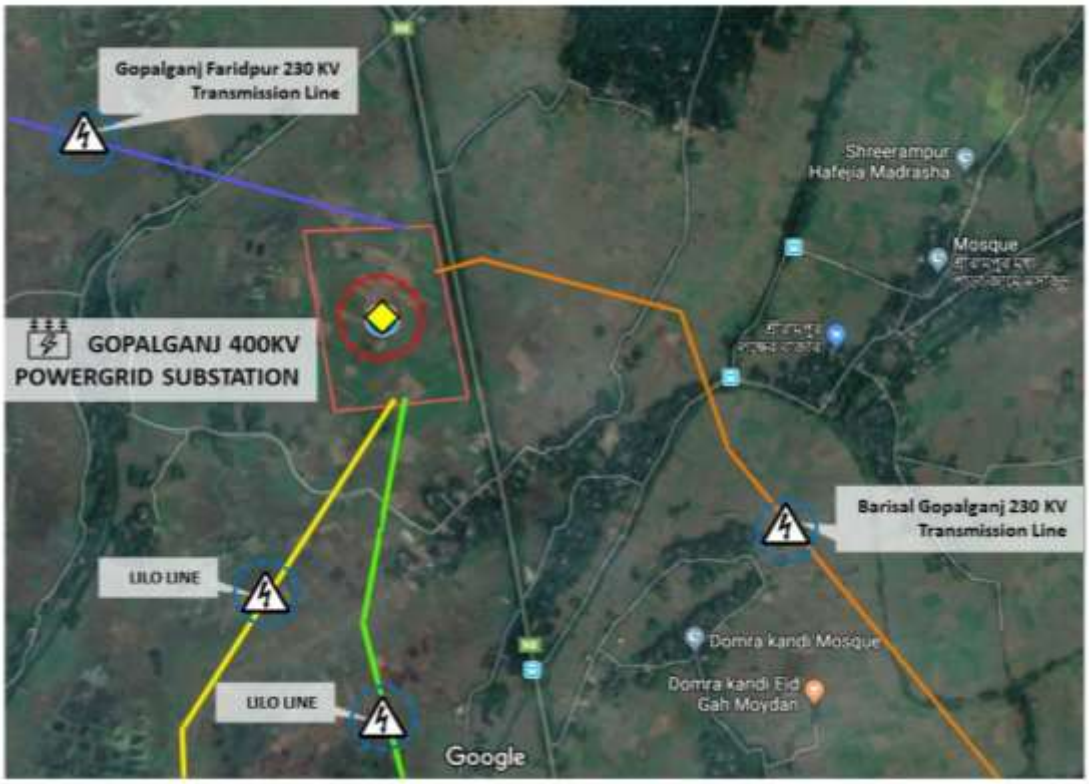


Figure 3.5: Gopalganj (North) Substation Land (60 acres) Adjacent to the Faridpur-Barisal Highway. 230 kV Transmission Line from Barisal (North) Substation to Gopalganj (North) Proposed Substation and 230 kV Line to Faridpur Substation



Source: Google image, 2017.

Table 3.10: Physical Features of Bogra (West) Grid Substation (20 acres)

Features	Specification
Land ownership	Private
Scheme	Main busbar scheme
Substation type	Outdoor
Voltage	400/230 kV
Switchgear type	Gas Insulated
Insulation medium power circuit breaker	SF_6 GAS
Transformer	Oil insulated
Protection system description	Auto fighting water spray system

Figure 3.6: Location of Bogra (West) Substation in Kahaloo Upazila

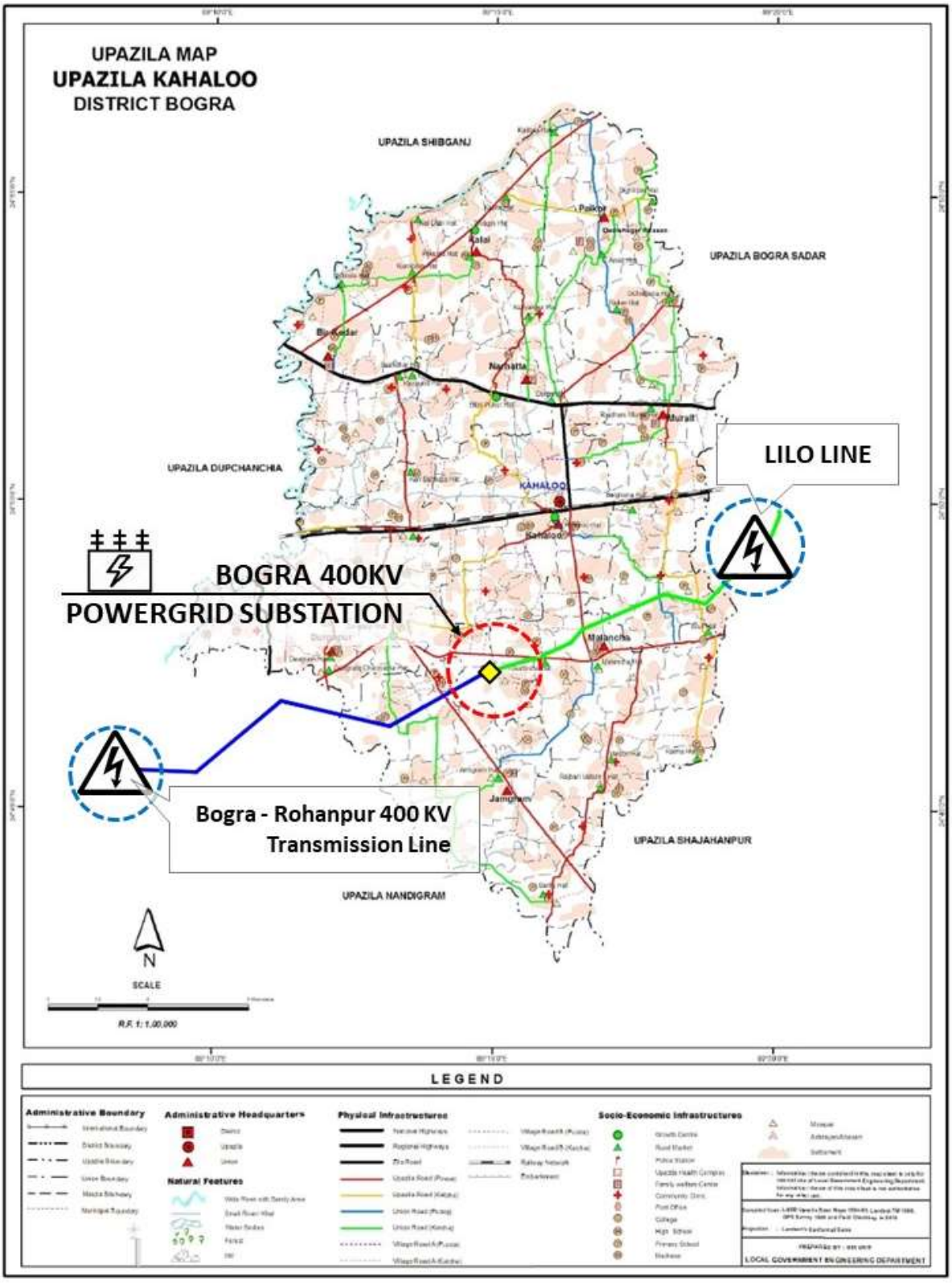


Figure 3.7: Bogra (West) 400 kV Substation Land (20 acres), Bogra (west)-Rohanpur 400 kV Transmission Line, and 230 kV LILO Line to Barapukuria-Bogra (South) Shown in Google Image, 2017

Table 3.11: Physical Features of Rohanpur Grid Substation (20 acres)

Features	Specification
Land ownership	Private
Scheme	Main busbar scheme
Substation type	Outdoor
Voltage	400/132 kV
Switchgear type	Gas Insulated
Insulation medium power circuit breaker	SF_6 GAS
Transformer	Oil insulated
Protection system description	Auto fighting water spray system

Figure 3.8: Location of Proposed Rohanpur Substation Land in Gomastapur Upazila. Bogra (West)-Rohanpur 400 kV Line and Rohanpur-Chapainawabganj 132 kV Line

Figure 3.9: Rohanpur Substation Land (20 acres), Bogra (West)-Rohanpur 400 kV Line and Rohanpur-Chapainawabganj 132 kV Line in Google Image, 2017

Table 3.12: Physical Features of Chapainawabganj Existing Grid Substation – Bay Extension

Features	Specification
Land ownership	PGCB
Scheme	Main busbar scheme
Substation type	Outdoor
Voltage	132/33 kV
Switchgear type	Existing sub is AIS. Bay extension under project is GIS
Insulation medium power circuit breaker	SF_6 GAS
Transformer	Oil insulated
Protection system description	Auto fighting water spray system

3.7 Components of Construction Works

106. The phasing of construction works for the transmission line and the three GSSs is indicated in Table 3.13 below.

Table 3.13: The Phasing of Construction Works

Component	Activities		
	Pre-construction	During Construction	Post Construction/ Operation period
Transmission Line	Route survey	Contractor and manpower recruitment	Clearing of RoW
	Tender documents preparation	Establishment of construction camps for workers	O&M
		Clearing of RoW	
		Establishment of temporary access tracks	
		Transport of materials and equipment to tower sites	
		Civil works (foundation work, RCC, etc.)	
		Tower erection	
		Conductor stringing	
Grid Substation	Topographical survey	Establishment of material storage areas and work sites	O&M
		Establishment of construction camps for workers	
		Establishment of temporary access tracks	
		Transport of materials and equipment to site	
		Clearing site	
		Civil works (land filling, foundation, RCC work)	
		Equipment installation	
		Testing and commissioning	

O&M = operations and maintenance, RCC = reinforced cement concrete.

3.8 Construction Equipment

107. For this project all equipment to be installed will be procured from outside Bangladesh. Construction materials such as bricks, sand, cement, reinforcing rods, etc. will be sourced locally.

3.9 Civil Construction Works

3.9.1 Back-filling of Grid Substation Sites

108. With land allocated for augmenting Faridpur, Barisal (North) and Chapainawabganj GSS, there is adequate space available within the GSS premises. It is at the same level as the rest of the GSS, and hence no back filling is required.

3.9.2 Earthwork in Foundations

109. Construction of the GSS requires earthwork excavation for the foundation to the required depth. For tower foundations, there will be a minimum of four concrete pads for each tower; the tower footprint has a coverage of between 9 m^2 and 11 m^2. Top soil is removed for the general area of the footprint. The area will then be cleared and individual foundation pads will be constructed. The first layer of topsoil which is excavated should be kept in designated areas. On completion of the foundation work, back-filling of the excavated area will be done with local soil and sand. In the case of transmission line towers, the soil can be replaced immediately beneath the tower structure.

3.9.3 Foundation Treatment

110. Geo-technical investigations will be conducted to assist in designing the foundations of structures. It will help to identify whether foundation treatment will be required or not. The type of treatment like pre-cast reinforced cement concrete (RCC) piling or *in situ* concrete piling, removal of peat or loose soil will be suggested as per results of the geo-technical investigation. Piling depth will vary with soil type and, in the case of transmission towers, will depend on the location and type of tower required.

3.9.4 Back Filling with Local Sand

111. Back filling of the excavated area of the foundation and floor of the GSS buildings will be undertaken with local sand.

3.9.5 Reinforced Cement Concrete Work

112. RCC work will be required for the roof, column, beams, and floors of GSS buildings and the foundation for transformers, circuit breakers, steel structures and the transmission line towers.

3.9.6 Brick Work up to Plinth Level and Superstructure

113. Brickwork for constructing buildings will be with first class bricks and coarse sand and cement up to the roof level and will have adequate plinth protection.

3.9.7 Plastering and Finishing

114. Concealed electric wiring of good quality and proper size is to be installed including electric and bulbs and switchboards will be provided. Plastering of walls inside and outside, as well as the roof of the building, will be undertaken with proper curing for at least three weeks. Distemper or plastic painting will be applied to the walls and roof of the building.

3.9.8 Wood Works/Aluminium, Windows and Glass Fittings

115. Wood/aluminium works are to be undertaken on door shutters and windows of buildings along with glass fittings.

3.9.9 Sanitary Works

116. Sanitary works, such as the laying of sewerage pipes (either PVC or RCC), installation, fittings and fixing of toilet accessories will be included in building work.

3.9.10 Water Supply System

117. Water supply systems will be connected for worker use with extension of the existing supply for the existing GSs. If necessary, additional tube wells will be set up.

3.9.11 Boundary Fencing with Concrete Pillar and Barbed Wire

118. The project GSS areas will be protected from any unauthorized entrance of the public by fencing around the boundary with a six feet high wall with barbed wire fitted and concrete pillars three meters apart.

3.10 Electrical Works and Towers

119. For GSS, installation of equipment will include transformers, circuit breakers, isolators, lightning arresters, panel boards, batteries, and battery chargers, etc.

120. All equipment will be installed at the GSS (outdoors and indoors) as per design specifications and standards. For this project, all material will be procured from foreign countries. Use of domestic materials will be minimal; local materials like bricks, sand, cement, and reinforcing rods, will be used for the installation works.

121. Transformers are heavy equipment. Transportation of all such equipment and construction material for augmentation work of the GSS should, however, be possible through the existing GSS and existing access roads.

3.10.1 Erection of Tower

122. Transmission towers will be constructed to take the load of the tower, cables and accessories, and are designed to meet specifications for wind load and earthquake load. Towers in paddy fields will have proper clearance at the maximum level of sag (lowest point on the line). At homesteads (if any), the sag can be adjusted higher to clear any tree canopies.

123. The towers will be erected by a team who are subcontracted for this activity. The parts are to be brought to each site in small sections and will be stored temporarily at the site. Tower legs will have concrete piled foundations, and the towers will be assembled piece by piece.

3.10.2 Drawing of Transmission Line

124. The transmission line will be drawn into position using stringing equipment: winches, pullers, tensioners and puller-tensioners especially designed for stringing operations. The lines can be drawn from both sides and helicopters may also be used. The configuration of the transmission lines will ensure that the lowest design sag points are adhered to.

3.10.3 Testing and Commissioning of Equipment

125. Following installation of all equipment, the GSS will be tested as per specifications and standards and will be commissioned accordingly.

126. Figure 3.10 shows the associated civil works related to the transmission lines.

Figure 3.10: Associated Civil Works for Transmission Line Installation

placing of steel ring bunds

tower piling works

pile cap reinforcement

Casting CC into tower foundation

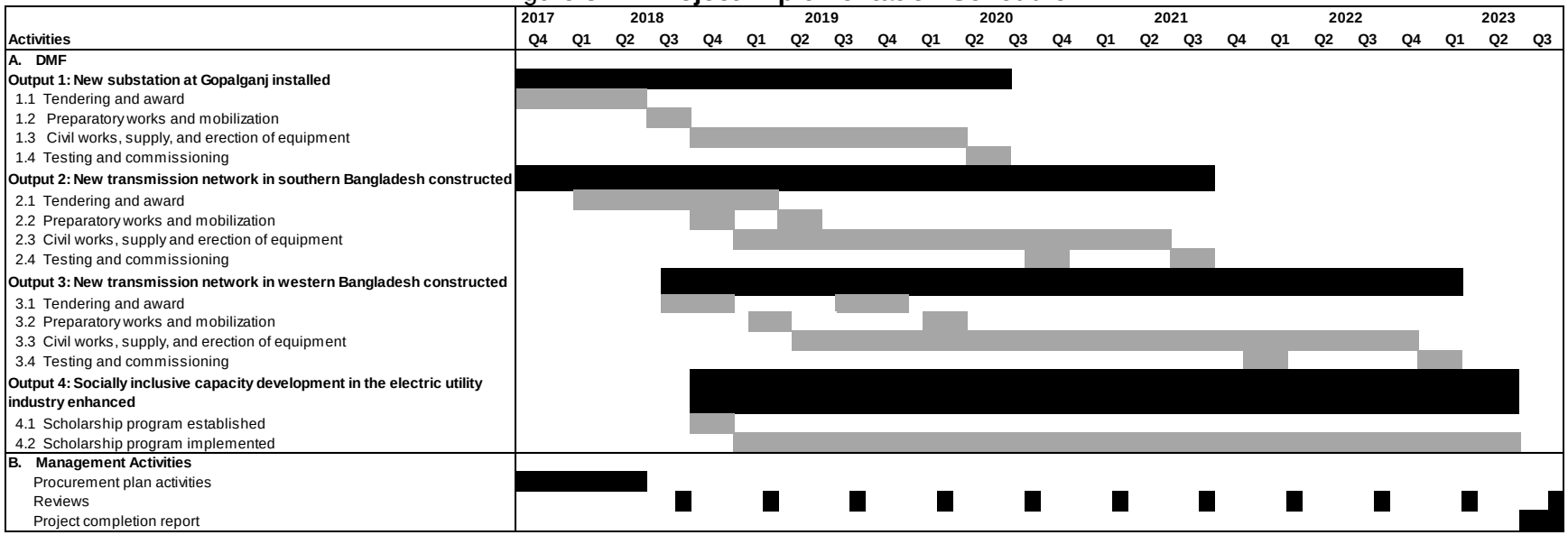
Placing tower on its foundation

Tower erection work

3.11 Work Schedule

127. The completion of works is proposed to take place in 48 months (after loan effectiveness) as indicated below in Figure 3.11.

Figure **3.11**: **Project Implementation Schedule**



Q = quarter.

Effective duration for the entire component

Effective duration for the specific activity

Source: Asian Development Bank estimates.

4. DESCRIPTION OF ENVIRONMENT (BASELINE DATA)

128. Information on the baseline environmental status of the project area is required for the impact assessment process, to assess and predict the possible environmental consequences of the project interventions. Based on the existing environmental scenario, the potential impacts of subprojects were identified and accordingly an environmental management plan was prepared (see subsequent sections of this IEE). The baseline environmental conditions will help in comparing and monitoring the predicted negative and positive impacts resulting from the project during the pre-construction, construction and operation phases. The impact assessment focused on the direct adverse changes that might be caused by project activities, including effects on the quality of habitats, flora, fauna and humans, socio-economic conditions, current use of land and resources, climate change aspects, physical and cultural heritage properties and biophysical surroundings.

129. The baseline environmental information was assessed through secondary data and field studies within the possible impact area (project influence area) for various components of the environment; physical, ecological/biological, and socio-economic parameters.

130. Data/information was collected from secondary sources for the macro-environmental setting, including climate (temperature, rainfall, humidity, and wind speed), topography, geology, and soil. Primary information was collected to record the micro-environmental features within and adjacent to project impact areas. Collection of primary/field data/information included extrapolating environmental features to cover all project footprints, including establishing tree inventories, and the location and measurement of socio-cultural features adjoining proposed subprojects. Data on ambient air, noise quality, surface water and ground/drinking water quality were gathered from secondary sources, and from previous projects conducted in the area. Focus group discussions were carried out in the project impact areas to investigate local environmental conditions, issues, and possible impacts.

131. 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; (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. As mentioned in Chapter 3, all the subprojects under the SWTGEP of PGCB are located in eight districts; four in Rajshahi division (Bogra, Noagoan, Rohanpur and Chapainawabganj), three in Dhaka division (Gopalganj, Madaripur and Faridpur), and one district in Barisal division (Barisal).

4.1 Physical Environment

4.1.1 Climate

132. 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 can be divided into seven climatic zones. According to the classification, the Barisal (North)-Gopalganj (North)-Faridpur line is located in the south-eastern (A) and south-central (F and G) climatic zones. The Bogra (West)-Rohanpur-Chapainawabganj line and substations are found in the north western (D) and western (E) climatic zones (Figure 4.1).

133. **South-eastern zone (A)** comprises the Chittagong sub-region and a strip of land extending from southwest Sundarbans to the south of Comilla. The hills over 300 m in height have the north-eastern zone climate. The rest of the area has a small range of temperature; it rarely goes over a mean of 32°C and below a mean of 13°C. Rainfall is heavy, usually over 2,540 mm/year. In winter, dew fall can be heavy (Figure 4.2 and Figure 4.3).

134. **South-central zone (G).** In this zone rainfall is abundant, being above 1,900 mm/year. The range of temperature is, as can be expected, much less than to the west, but somewhat more than in south-eastern zone. This is a transitory zone between the south-eastern, north-western and south-western zones and most of the severe hail storms, nor ‘westers and tornadoes are recorded in this area.

135. **North-western zone (D).** Except that the extremes are less and the rainfall is lower, this zone is similar to northern part of the northern region. The lower rainfall makes this area drier than other zones.

136. **Western zone (E).** This zone comprises the greater Rajshahi district and parts of adjacent districts. This is the driest area in Bangladesh, with rainfall generally below 1,500 mm (annually) and summer humidity less than 50%. In summer, it is the hottest and driest of all the climatic zones in Bangladesh. Mean summer maximum temperature is over 35°C.

137. Three distinct seasons can be recognized in Bangladesh: the cool dry season from November through February; the pre-monsoon hot season from March through 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 through to mid-November may be called the autumn season.

138. The dry 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.

139. 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: Climatic Zones of Bangladesh and Subproject Locations

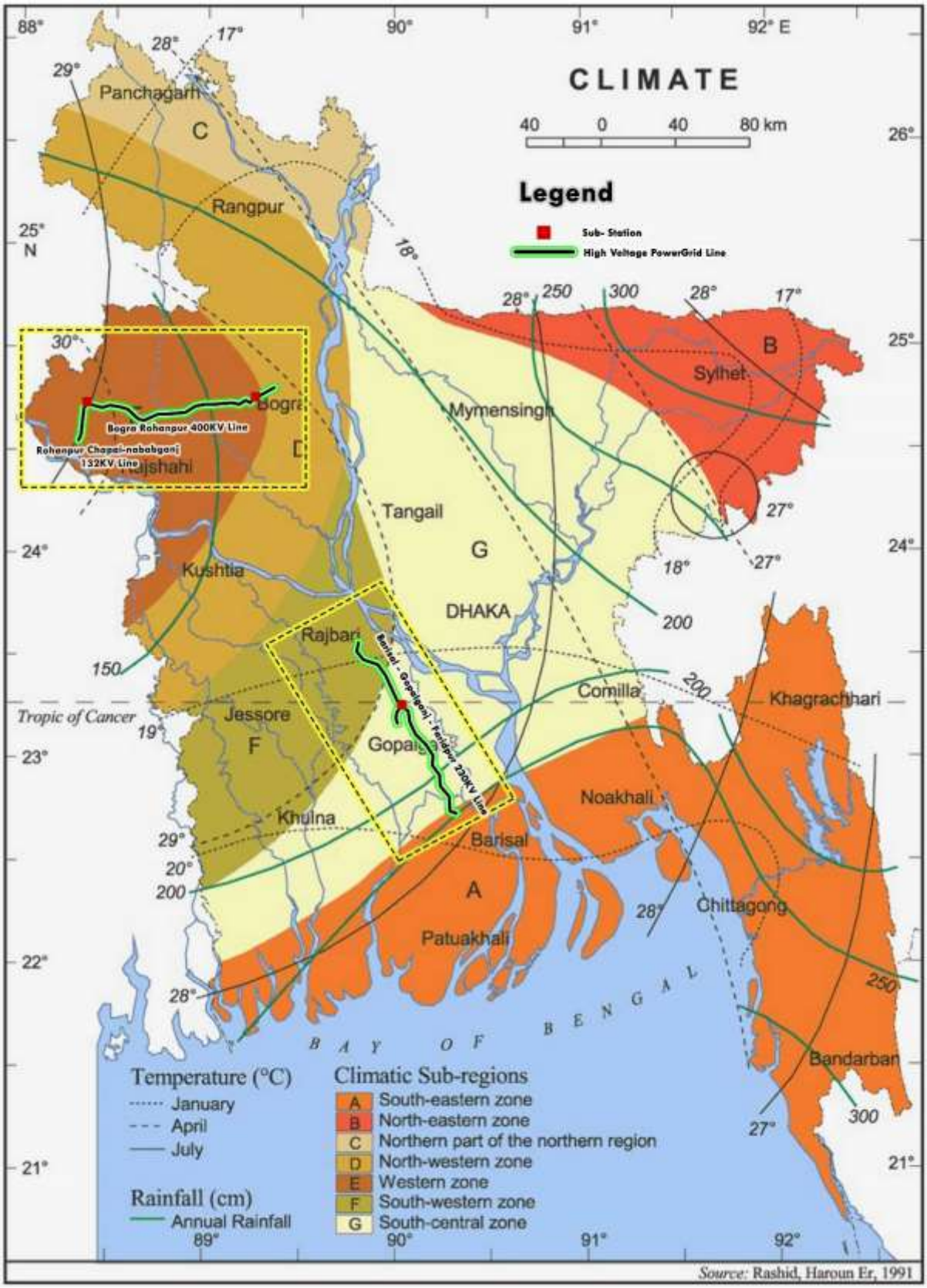


Figure 4.2: Average Rainfall in Bangladesh

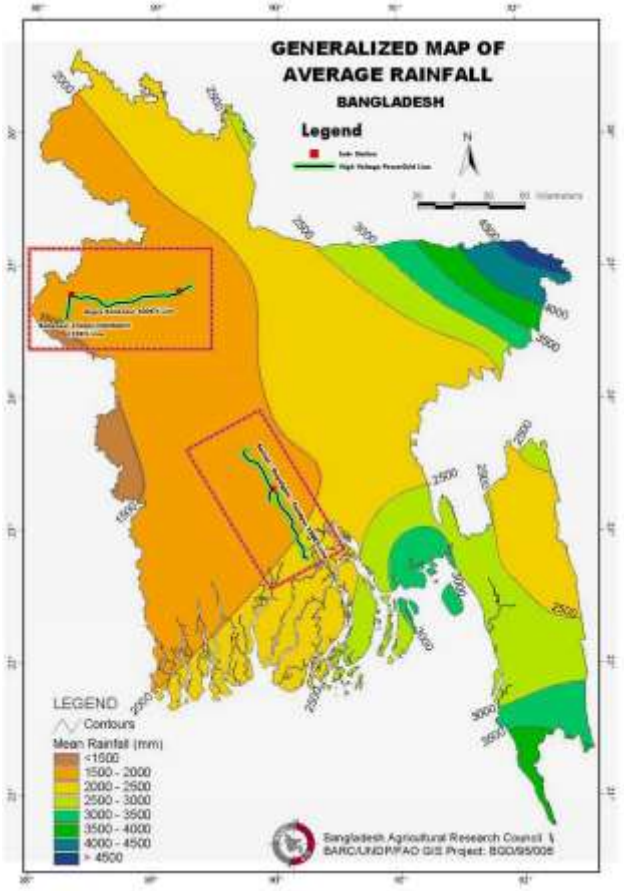
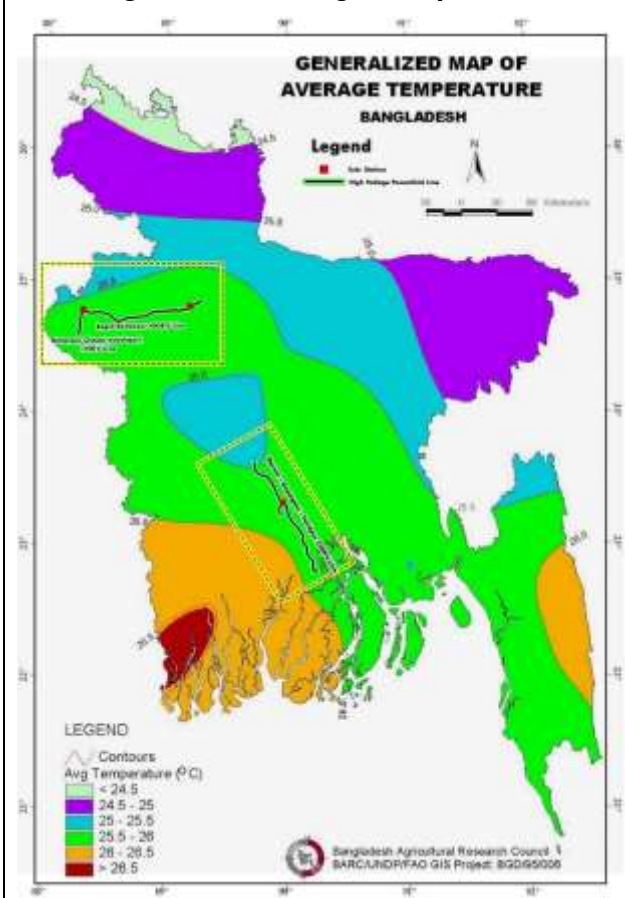
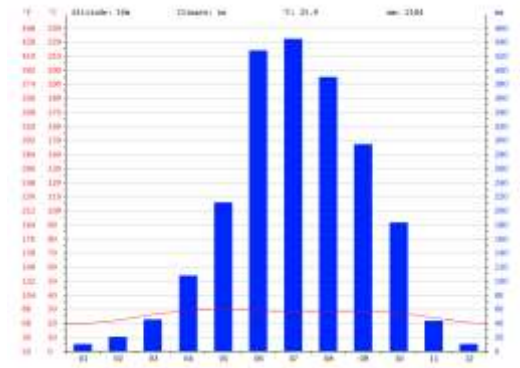


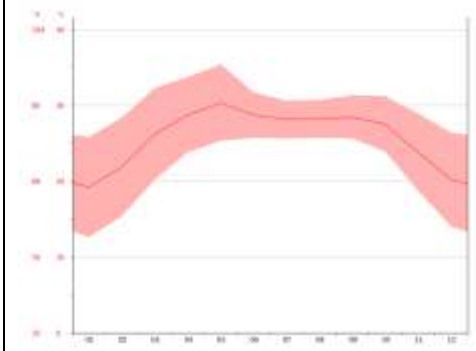
Figure 4.3: Average Temperature



140. The Barisal district has a tropical climate. In winter, there is much less rainfall in Barisal than in summer. This location is classified as savanna (Aw) by Köppen and Geiger climate zone system. In Barisal, the average annual temperature is 25.9°C. The average annual rainfall is 2,184 mm. The driest month is January, with 10 mm of rainfall. With an average of 444 mm, the most precipitation falls in July. The hottest month of the year is May, with an average temperature of 30.3°C. January has the lowest average temperature of the year (19.2°C). The difference in precipitation between the driest month and the wettest month is 434 mm. During the year, the average temperatures vary by 11.1°C.

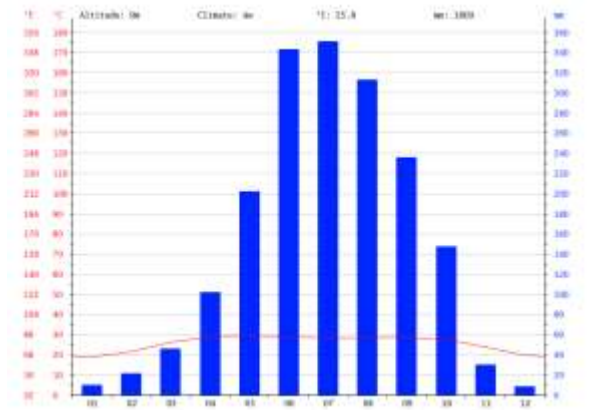
Figure 4.4: Distribution of Rainfall and Temperature in Barisal District

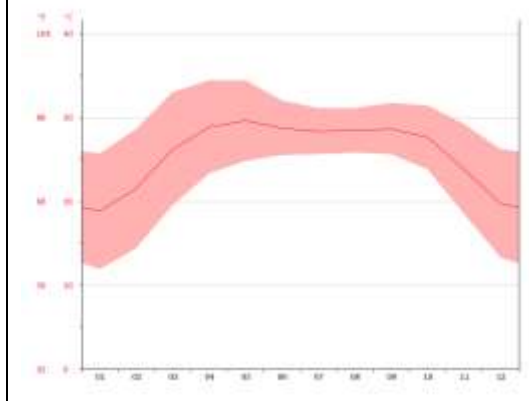




141. The climate is also tropical in Gopalganj. The summers are much rainier than the winters. This climate is considered to be Aw according to the Köppen-Geiger climate classification (like Barisal). The average annual temperature in Gopalganj is 25.8°C. Annual precipitation here averages around 1,809 mm. The driest month is December (8 mm of precipitation). The greatest amount of precipitation occurs in July, with an average of 351 mm. With an average of 29.6°C, May is the warmest month. The lowest average temperatures in the year occur in January, when it is around 18.8°C. The precipitation varies 343 mm between the driest month and the wettest month. The variation in temperatures throughout the year is 10.8°C.

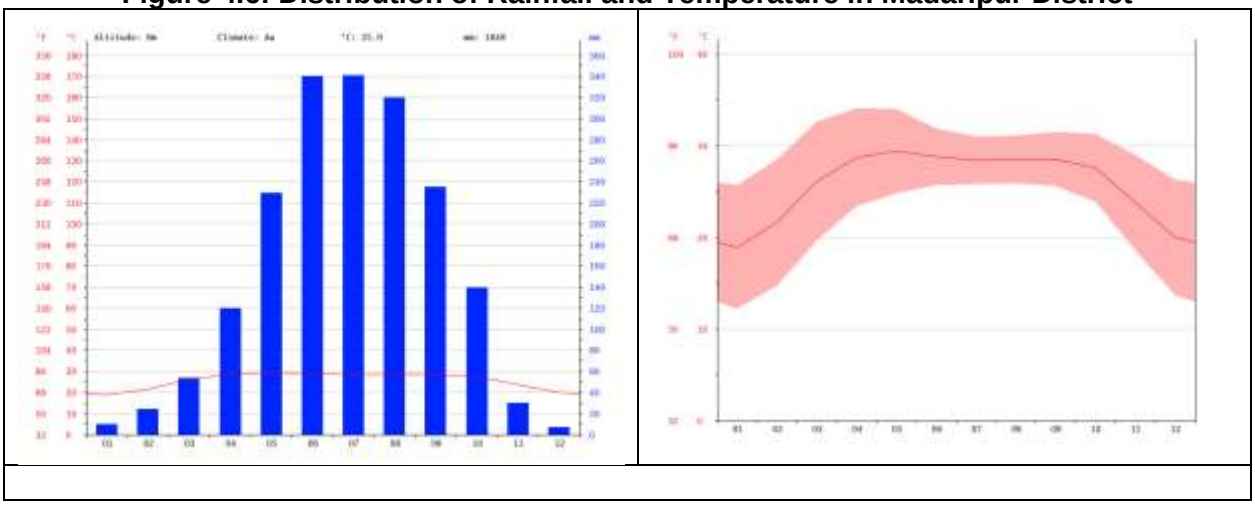
Figure 4.5: Distribution of Rainfall and Temperature in Gopalganj District





142. In winter, there is much less rainfall in Madaripur than in summer. This climate is considered to be Aw according to the Köppen-Geiger climate classification. The average annual temperature is 25.9°C. Annual precipitation here averages 1,849 mm. The driest month is December, with 7 mm of rain. With an average of 341 mm, the most precipitation falls in July. May is the warmest month of the year. The temperature in May averages 29.4°C. January has the lowest average temperature of the year (18.9°C).

Figure 4.6: Distribution of Rainfall and Temperature in Madaripur District



143. Faridpur has a tropical climate. In winter, there is much less rainfall than in summer. This climate is considered to be Aw according to the Köppen-Geiger climate classification (like the districts noted above). In Faridpur, the average annual temperature is 25.3°C. About 1,873 mm of precipitation falls annually. The driest month is January, with 6 mm of rainfall. Most precipitation falls in June, with an average of 360 mm. The warmest month of the year is May, with an average temperature of 28.7°C. In January, the average temperature is 18.0°C. It is the lowest average temperature of the whole year.

Figure 4.7: Distribution of Rainfall and Temperature in Faridpur District

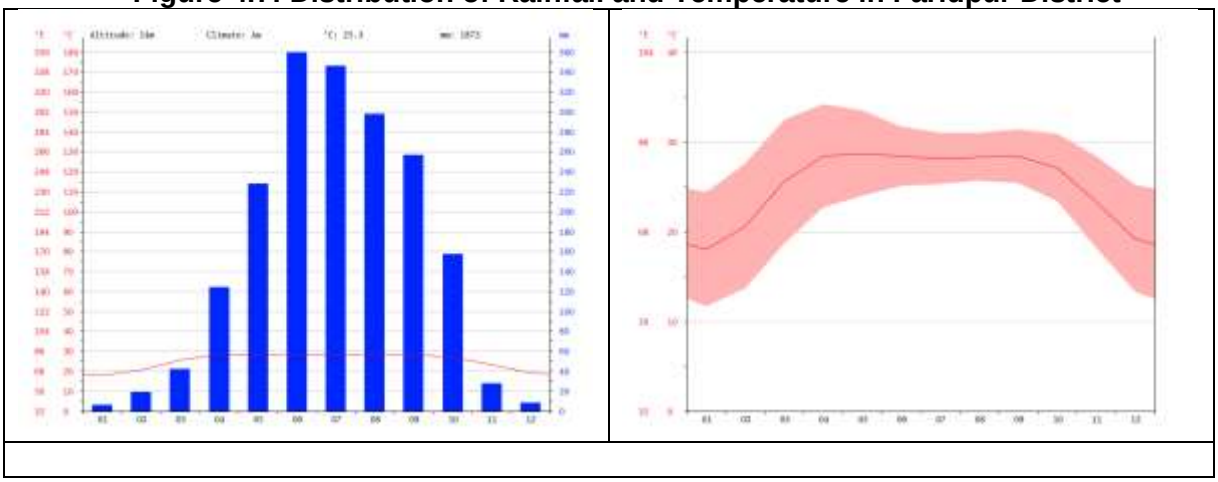


Figure 4.8: Monthly Cumulative Rainfall at Dhaka BMD Station

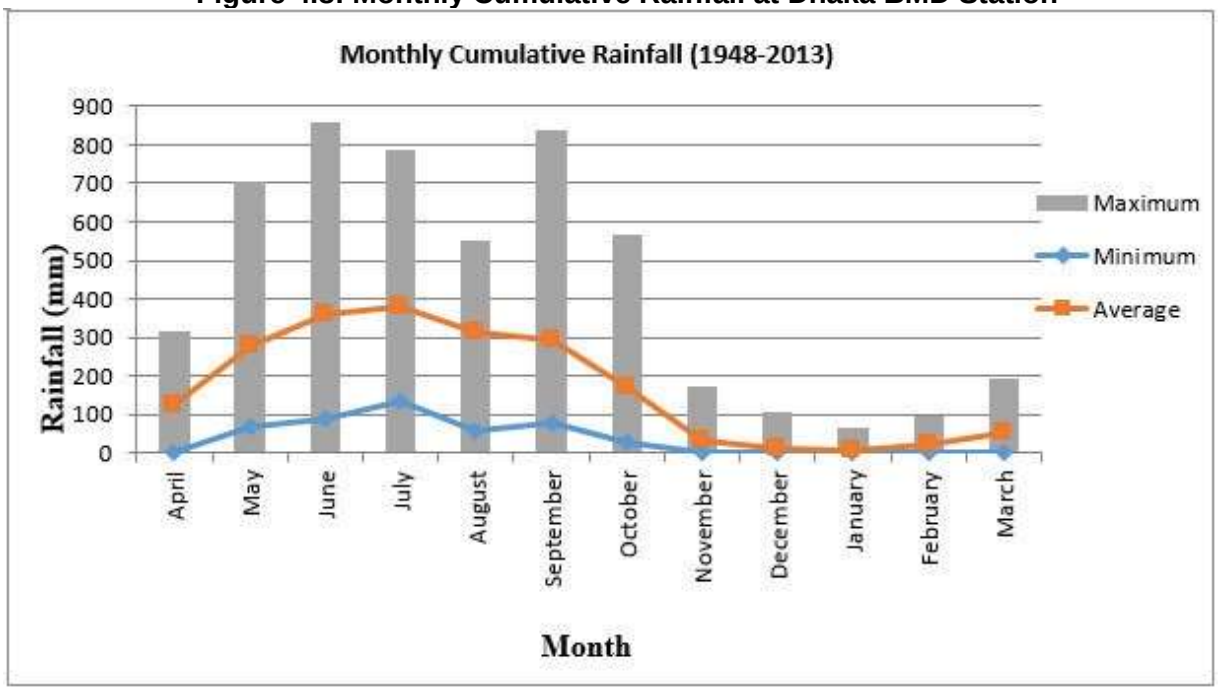
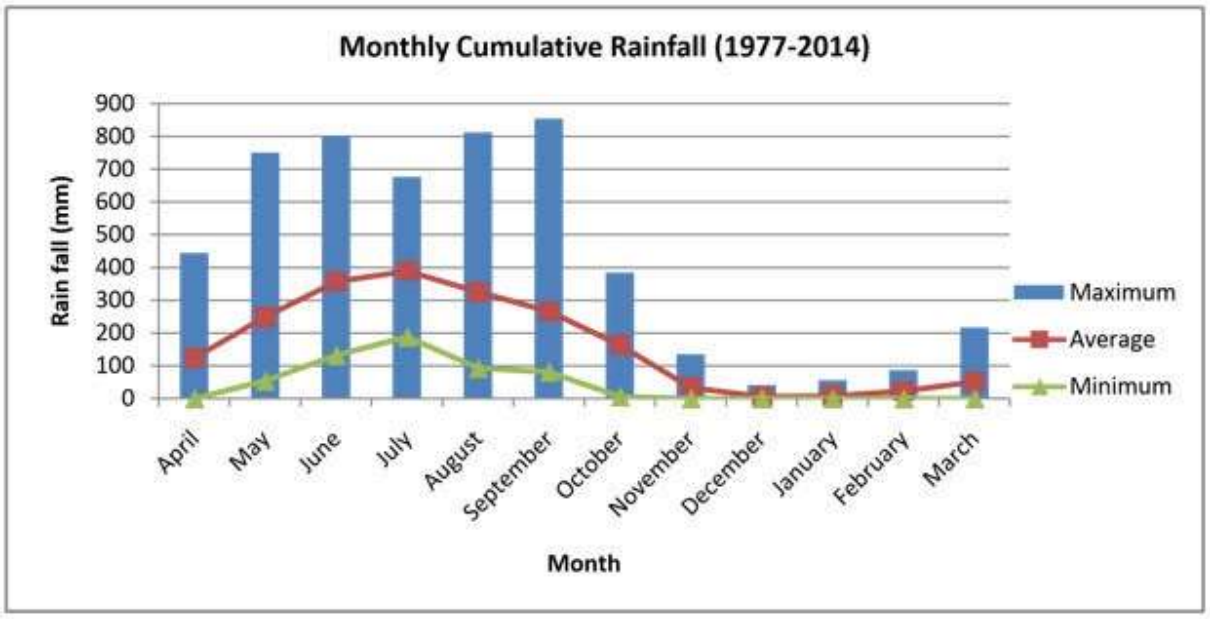


Figure 4.9: Monthly Cumulative Rainfall at Madaripur BMD Station



Ambient Air Temperature and Humidity

144. The temperature of the country has a co-relationship with the period of rainfall. In general, cool seasons coincide with the period of lowest rainfall. **Table 4.1** shows the monthly average temperature along with average monthly humidity of the project area. The maximum mean temperature of 29.1°C was observed in August and minimum average temperature was 17.8°C in January.

Table 4.1: Temperature and Humidity for Project Area, 1975-2015

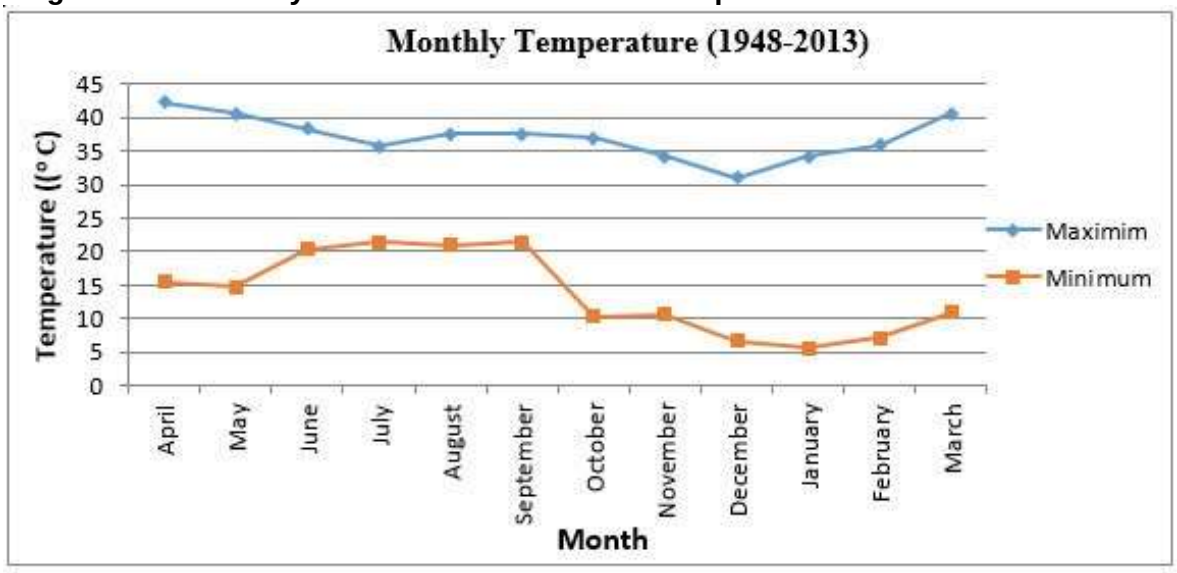
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Avg.
Mean Temp (°C)	17.81	21.16	25.96	28.57	28.82	29.02	28.87	29.13	28.85	27.47	23.78	19.35	25.73
Avg. Humidity (%)	75.93	70.49	65.5	71.41	78.6	84.9	86.31	84.9	84.6	80.9	77.1	77.51	77.61

Source: Bangladesh Meteorological Department.

145. According to the data collected from the Bangladesh Meteorological Department (BMD), April to September appears to be the hottest period of the year while November to February is the coolest. Average annual rainfall in the project area is 1,557.2 mm, with a maximum in July (329.6 mm). During heavy rainfall, water logging can cause 20-25 cm inundation, which lasts for 4-8 hours.

146. May–October is observed to be the most humid period of the year, which matches the rainfall pattern of this region, as more than 70% of the yearly precipitation is encountered during this four-month period.

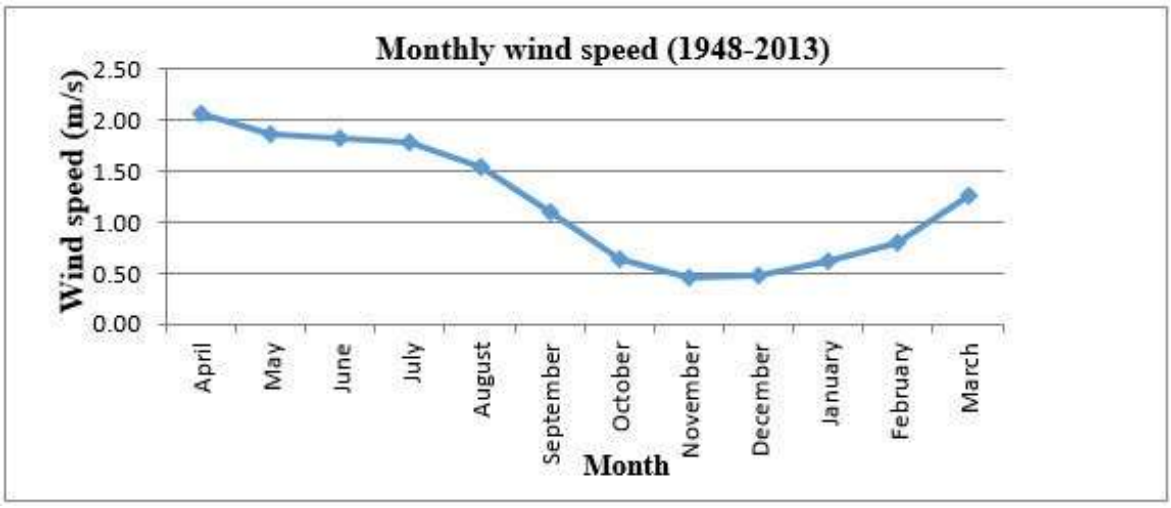
Figure 4.10: Monthly Maximum and Minimum Temperatures at Dhaka BMD Station



Wind Speed

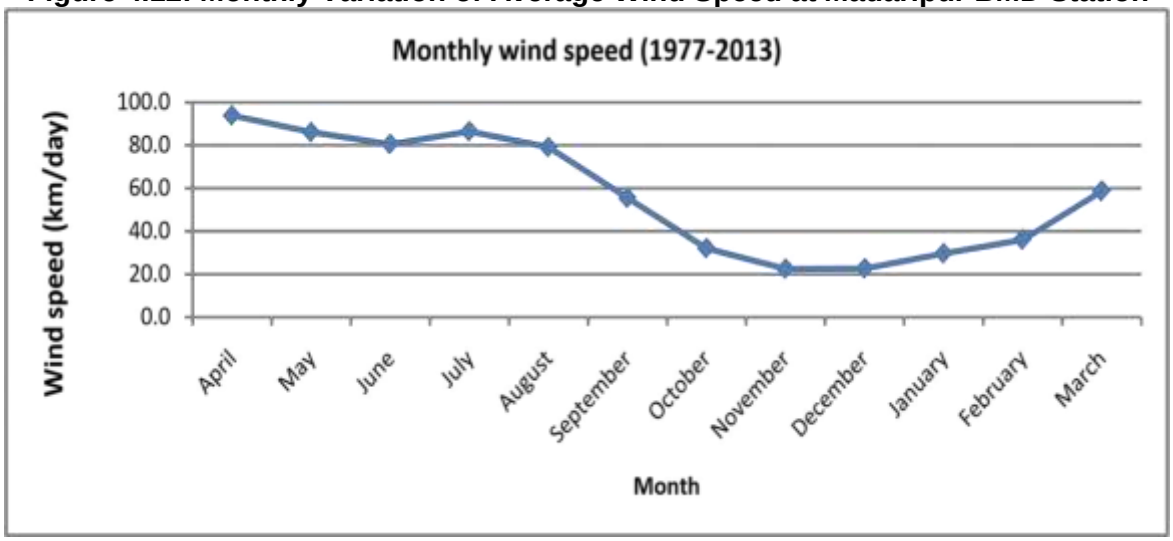
147. Data for Dhaka shows monthly average wind speeds gradually decrease from a high of 2.07 m/s in April to a low of 0.46 m/s in November.

Figure 4.11: Monthly Variation of Average Wind Speed at Dhaka BMD Station



148. Figure 4.12 shows the variation of the monthly average wind speed measured at Madaripur BMD station. Data show a gradual decrease in wind speed from April to November. Highest and lowest average wind speeds have been recorded in April and November and are 97.8 km/day (1.13 m/s) and 22.5 km/day (0.26 m/s), respectively.

Figure 4.12: Monthly Variation of Average Wind Speed at Madaripur BMD Station



Water Quality

149. **Surface Water.** The main rivers in the project area are the Sughanda, Sondha, Kumar, Old Kumar, and Bhubaneshwar. Chapa Beel, Hari Beel, Shakuner Beel, Dhol Samudra, Kole (a strip of shallow water) of Beel Mamunpur and Tepa Kholar Lake (excavated) are the notable water bodies. The Barisal (North)-Gopalganj (North)-Faridpur line crosses the Kumar River in several locations. All the rivers are tidal. The river water is therefore saline, with high sediment load and high turbidity. The project area consists of many ponds that were once used for drinking water (salt water has intruded over the years).

150. **Groundwater.** Water aquifers are present beneath the vast majority of Bangladesh, which are being recharged by the major river systems and by infiltration of rainwater. Most ground water is available within 5 m of the surface. This level fluctuates seasonally, approaching the ground surface over most of the country during the months July to September (during the monsoon).

151. The present source of water supply for the project area is based completely on groundwater. The local groundwater level is lowered to approximately 6 m below ground level during the dry season, with levels returning to their normal level before the end of the monsoon, as reported by the Department of Public Health. This fall in groundwater levels is an entirely natural process that arises because of the hydrological link with the river.

Air Quality

152. The project area is a suburban area of Bangladesh (smaller cities and towns, mixed in the rural context). In the suburban 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, SO_x and NO_x have to be monitored. Hence, to establish the baseline air quality, a primary analysis of air quality at work sites is proposed, before commencing the construction activities of subprojects (air quality has not yet been measured at proposed work sites).

Table 4.2: Bangladesh National Ambient Air Quality Standards compared to the WHO Guideline and US EPA Standard

Pollutant	Averaging Period	Bangladesh Standards[a]	WHO[b] Guideline Values (µg/m³)	US EPA Standards (µg/m³)[d]
CO	8-hour	10,000 µg/m³ (9 ppm)	10,000 [c]	10,000
	1-hour	40,000 µg/m³ (35 ppm)	30,000 [c]	40,000
Pb	Annual	0.5 µg/m³	0.5	–
NO_x	Annual	100 µg/m³ (0.053 ppm)	–	–
TSP	8-hour	200 µg/m³	–	–
PM_{10}	Annual	50 µg/m³	20	revoked
	24-hour	150 µg/m³	50	150
$PM_{2.5}$	Annual	15 µg/m³	10	15
	24-hour	65 µg/m³	25	35
O_3	1-hour	235 µg/m³ (0.12 ppm)	–	235
	8-hour	157 µg/m³ (0.08 ppm)	100	157
SO_2	Annual	80 µg/m³ (0.03 ppm)	–	78
	24-hour	365 µg/m³ (0.14 ppm)	20	365

CO = Carbon monoxide; NO_x = Nitrogen oxide; O_3 = ozone; Pb = lead; PM_{10} = particulate matter with a diameter of not more than 10 microns; $PM_{2.5}$ = particulate matter with a diameter of not more than 2.5 microns; SO_2 = Sulfur dioxide; S.R.O. = US EPA = United States Environmental Protection Agency; TSP = total suspended particulates; WHO = World Health Organization; µg/m³ = micrograms per cubic meter; ppm = parts per million; – = no value

Source: [a]S.R.O. No: 220-Law, 2005; [b]WHO, 2005; [c]WHO, 2000; and [d]US EPA, 2006.

Acoustic Environment

153. Sound is usually measured in decibels (dB). A decibel is a relative measure that is accompanied by a reference scale. Sound (noise) levels can be measured and quantified in several ways. All of them use the logarithmic decibel (dB) scale. The dB scale is logarithmic to

accommodate the wide range of sound intensities found in the environment. Table 4.3 shows typical sound levels generated by common indoor and outdoor activities, along with its effect on humans.

Table 4.3: Sound Levels and Human Response

Common Sounds	Noise Level (dB)	Effect
Carrier deck jet operation; Air raid siren	140	Painfully loud
Thunderclap	130	Painfully loud
Jet take off (200 feet); auto horn (3 feet)	120	Maximum vocal effort
Pile driver; rock concert	110	Extremely loud
Garbage truck; firecrackers	100	Very loud
Heavy truck (50 feet); city traffic	90	Very annoying; hearing damage (8 hours)
Noisy restaurant; Freeway traffic; Business office	70	Telephone use difficult
Air conditioning unit; Conversational speech	60	Intrusive
Light auto traffic (100 feet)	50	Quiet

dB = decibel.

154. Existing ambient noise levels can serve as a baseline from which to measure potential disturbance caused by project activities. Hence, to establish the baseline noise quality, a primary analysis of noise quality is proposed before the start of construction at the proposed sites of subprojects. The standard for noise is shown in Table 4.4.

Table 4.4: Noise Quality Standards, by Zone and Time of Day

	Limits in dB(A)	
Zone Class	Daytime (6 am–9 pm)	Night time (9 pm–6 am)
Silent zone	45	35
Residential zone	50	40
Mixed (residential/commercial/industrial) zone	60	50
Commercial zone	70	60
Industrial zone	75	70

dB(A) = A-weighted decibel.
Source: DOE, Bangladesh.

4.1.2 Physiographic features

155. 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 subregions and 54 units. The subproject areas in eight districts are found in the following physiographic units.

156. **The Ganges River floodplain** comprises the active floodplain of the Ganges and the adjoining meander floodplain. The latter mainly comprises a smooth landscape of ridges, basins and old channels. The relief is locally irregular alongside the present and former river courses, especially in the west (in the project area), comprising a rapidly alternating series of linear low ridges and depressions. The Ganges channel is constantly shifting within its active floodplain, eroding and depositing large areas of new char land each flood season, but it is less braided than

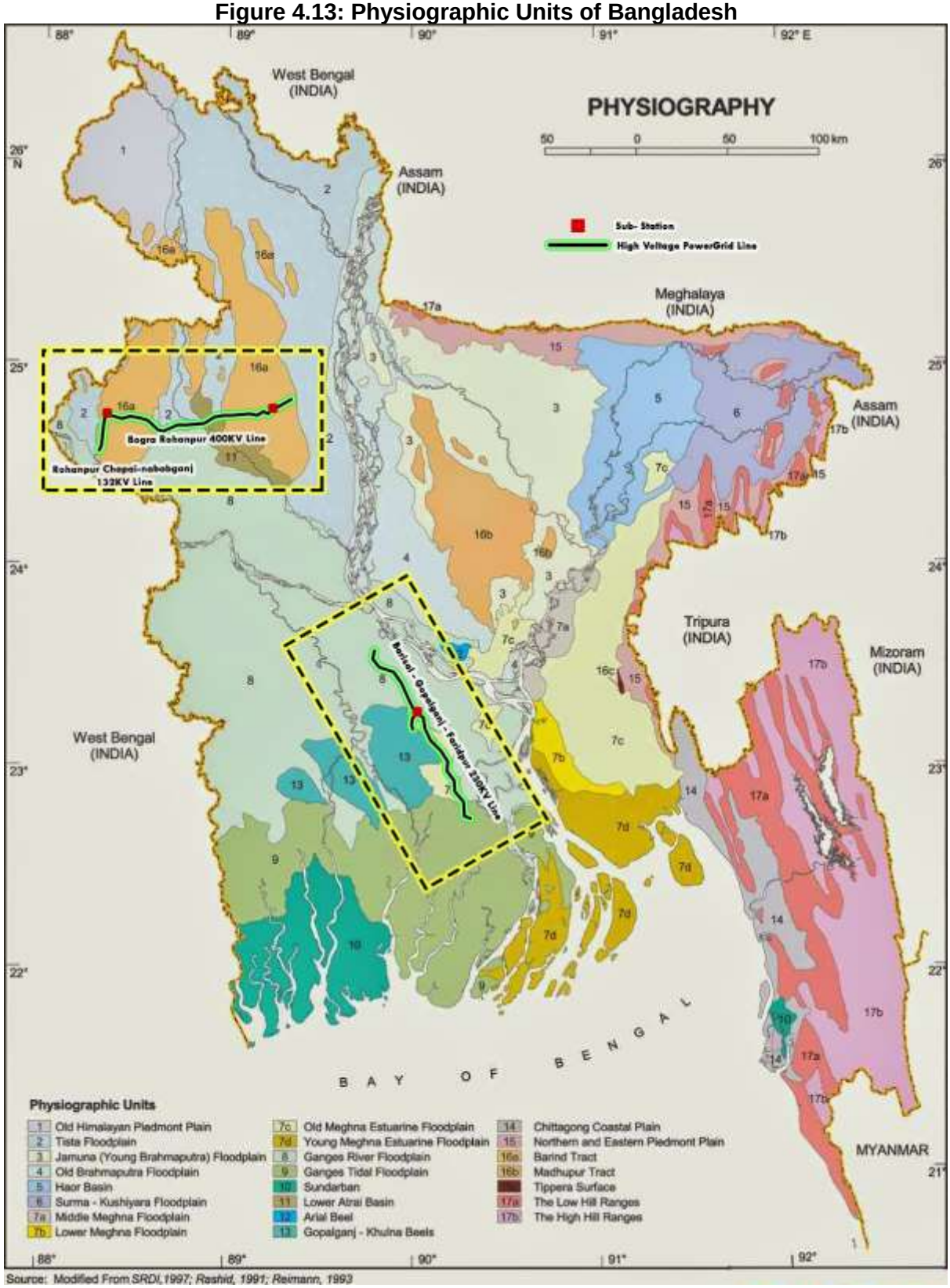
that of the Brahmaputra-Jamuna. Ganges alluvium is calcareous when deposited, but most basin clays and some older ridge soils have been decalcified and acidified in their upper layers; lime is found only in the subsoil or substratum of such soils. Clay soils predominate in basins and on the middle parts of most ridges, with loamy soils (and occasionally sands) occurring mainly on ridge crests.

157. Seasonal flooding is mainly shallow in the west and north, with the highest ridge crests remaining above normal flood levels, but flood depths increase towards the east and the south. Flooding is mainly by accumulated rainwater and the raised groundwater table, except on the active Ganges floodplain and close to distributary channels which cross the meander floodplain. In earlier small-scale maps, the Mahananda floodplain in the northwest and some detached areas of the Old Meghna estuarine floodplain in the southeast used to be included within this unit. The Mahananda floodplain comprises of all irregular landscapes of mixed Tista and Ganges sediments. The cut-off parts of the Meghna floodplain have a smooth relief and predominantly silty soils, which are deeply flooded (by rainwater) in the monsoon season. The unit covers most of the districts of Rajshahi, Natore, Pabna, entire Kushtia, Rajbari, Faridpur, Meherpur, Chuadanga, Jhenaidaha, Magura, parts of Manikganj, Narayanganj, Munshiganj, Shariatpur, Madaripur, Barisal, Gopalganj, Narail, Khulna, Bagerhat, Satkhira, and most of Jessore. This physiographic unit is almost triangular in shape and bounded by the Ganges tidal floodplain on the south. On its southern end it traps the Gopalganj-Khulna Beels.

158. **The Tista Floodplain** is a big subregion that stretches between the Old Himalayan Piedmont Plain in the west and the right bank of the N-S flowing Brahmaputra in the east. An elongated outlier representing the floodplain of the ancient Tista extends up to Sherpur (Bogra district) in the south. Most of the land is shallowly flooded during monsoons. There is a shallow depression along the Ghaghat river, where flooding is of medium depth. The big river courses of the Tista, Dharla and Dudhkumar cut through the plain. The active floodplain of these rivers, with their sandbanks and diaras (depressions), is usually less than six kilometers wide.

159. **The Lower Atrai Basin** is a small physiographic unit that occupies a low-lying area where mixed sediments from the Atrai and Ganges and from the Barind tract overlie the down-warped southern edge of the Barind Tract. The landscape north of the Atrai is mainly smooth, but floodplain ridges and extensive basins occur south of the river. Heavy clay soils predominate, but loamy soils occur on ridges in the south and the west. Drainage from this unit is blocked when high river levels in the Jamuna obstruct the exit through the Hurasagar. Seasonal flooding was formerly deep and extensive and Chalan Beel used to remain wet throughout the year. The construction of polder projects since the 1960s has improved drainage to some extent. However, deep flooding can still occur within polders as well as outside when there is heavy rainfall locally and when flash floods flow down the Atrai or off the adjoining Barind Tract, causing natural or manmade breaches of embankments.

Figure 4.13: Physiographic Units of Bangladesh



Source: Modified From SRDI,1997; Rashid, 1991; Reimann, 1993

4.1.3 Topography

160. 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.

161. 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. In 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 project area lies in the alluvial plain.

162. The hilly areas of the south eastern region of Chittagong, the northeasters hills of Sylhet and highlands in the north and northwest are of low elevation. The Chittagong 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 Chittagong hills is a narrow, wet coastal plain lying parallel to the shoreline.

4.1.4 Geology

163. 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 (Figure 4.14). Majority of the area of the subprojects are under the Barisal Gravity High. However, some portions are also under the Hatia Trough and Barisal Gravity High.

Figure 4.14: Geological Map of Bangladesh and Subproject Location

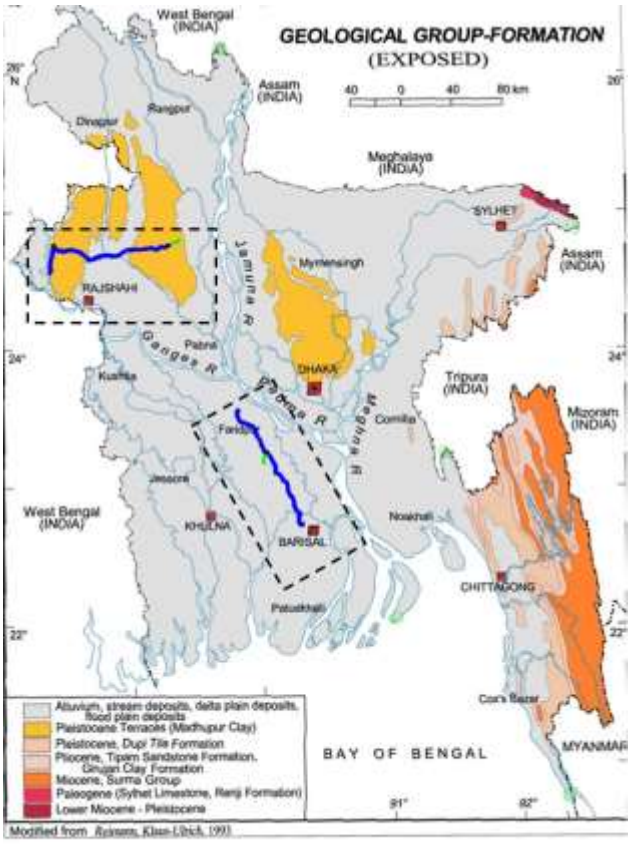
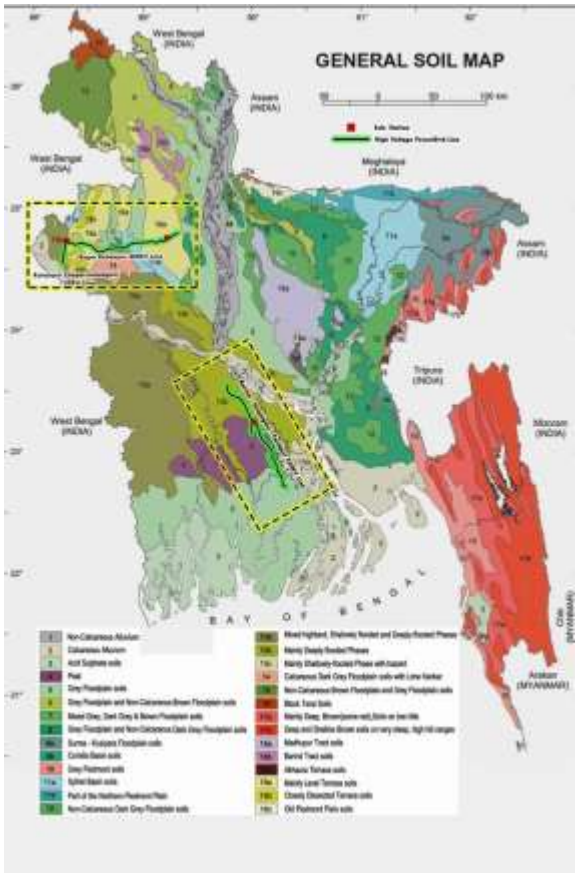


Figure 4.15: Soil Map of Bangladesh and Subproject Locations



Source: Soil Resources and Development Institution (SRDI), Bangladesh

4.1.5 Soil

164. The subproject areas fall into six different soil formation zones (Figure 4.15). The general soil types of Barisal, Dhaka and Rajshahi divisions include the following: acid sulphate, peat, and floodplain soils in the south; and, terrace and calcareous floodplain soils in the north.

4.1.6 Flood prone areas

165. 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. During severe floods, the affected area may exceed 75% of the country, as was seen in 1998 (Figure 4.16 compared with Figure 4.17 main

rivers of Bangladesh). However, small scale flooding in the country is required to sustain agriculture, as sediment deposited by floodwater fertilizes the fields, and the water is required to grow rice, so natural flooding replaces the requirement of artificial irrigation. However, salt deposited on fields (from high rates of evaporation of flood water) can preventing the land from becoming fertile.

Figure 4.16: Flood Prone Area of Bangladesh and Subproject Locations

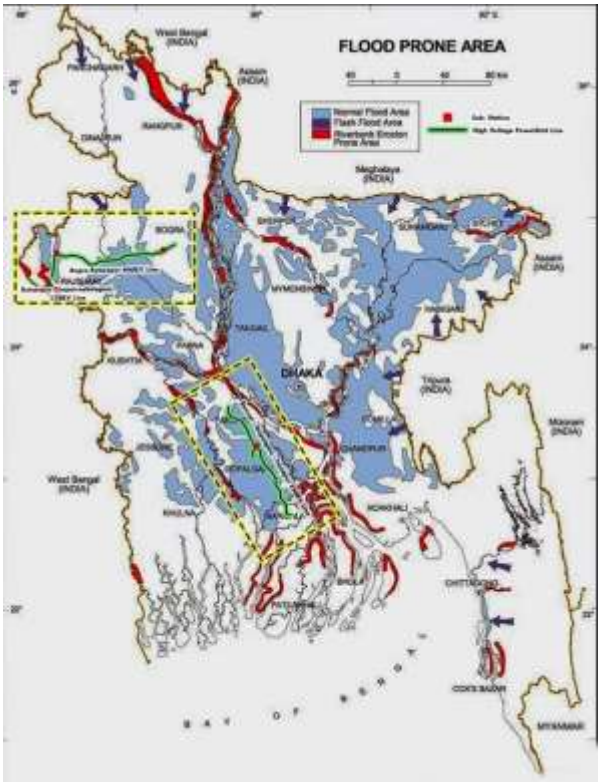
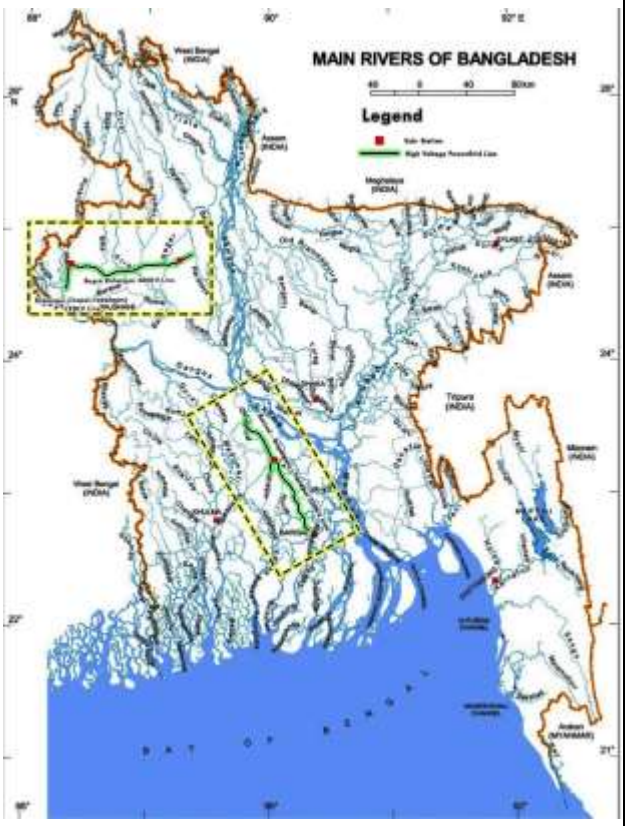


Figure 4.17: Main Rivers of Bangladesh



Sources: National Encyclopedia of Bangladesh

4.1.7 Agro-ecological zones of Bangladesh

166. 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.

Agro ecological zones in the Barisal (North)- Gopalganj (North)- Faridpur transmission line area

167. The agro-ecological zones 12, 13, 14 and 19 are found in the Barisal, Gopalganj, Faridpur area. These are identified as the lower Ganges river floodplain, Ganges tidal floodplain, Gopalganj- Khulna beels and old Meghna estuarine floodplain, described below.

168. ***Lower Ganges River Floodplain (7,968 sq km*).** This region comprises the eastern half of the Ganges river floodplain that is low-lying. The area has a typical meander floodplain landscape of broad ridges and basins. Soils of this region are silt loams and silty clay loams on the ridges and silty clay loam to heavy clays on lower sites. General soil types predominantly include calcareous dark grey and calcareous brown floodplain soils. Organic matter content is low in ridges and moderate in the basins. General fertility level is medium.

169. ***Ganges Tidal Floodplain (17,066 sq km*).** This region occupies an extensive area of tidal floodplain land in the southwest of the country. The greater part of this region has smooth relief having large areas of salinity. Riverbanks generally stand about a meter or less above the level of adjoining basins. Non-calcareous grey floodplain soil is the major component of general soil types. Acid sulphate soil also occupies a significant part of the area, where it is extremely acidic during the dry season. Most of the top soils are acidic and subsoils are neutral to mildly alkaline. Soils of the Sundarbans area are alkaline. General fertility level is high, with medium to high organic matter content.

170. ***Gopalganj-Khulna Beels (2,247 sq km).*** This region occupies extensive low-lying areas between the Ganges river floodplain and the Ganges tidal floodplain. Soils of the area are grey, and dark grey, acidic, heavy clays which overlay peat or muck at 25-100 cm depth. General soil types include mainly peat and non-calcareous dark grey floodplain soils. Organic matter content is medium to high. Fertility level is medium.

171. ***Old Meghna Estuarine Floodplain (7,740 sq km).*** This region occupies a large area, mainly low-lying land between the south of the Surma-Kushiyara floodplain and the northern edge of the young Meghna estuarine floodplain. Silt loam soils predominate on highlands and silty clay to clay dominates on the lowlands. Organic matter content of the soils is moderate. Top soils are moderately acidic, but subsoils are neutral. General fertility level is medium.

Agro ecological zones of the Bogra (West)-Rohanpur-Chapainawabganj transmission line area

172. Agro-ecological zones 3, 10, 11, 25, and 26 are found in the Bogra, Rohanpur, Chapainawabganj area. These are named as the Tista meander floodplain, Active Ganges floodplain, High Ganges river floodplain, Level Barind tract, and High Barind tract, described below.

173. ***Teesta Meander Floodplain* (9,468 sq km).** This region occupies the major part of the Teesta floodplain as well as the floodplain of the Atrai, Little Jamuna, Karatoya, Dharla and Dudhkumar rivers. Most areas have broad floodplain ridges and almost level basins. There is an overall pattern of olive brown, rapidly permeable, loamy soils on the floodplain ridges, and grey or dark grey, slowly permeable, heavy silt loam or silty clay loam soils on the lower land and parent materials comprising of medium to weatherable potassium minerals. Eight general soil types occur in the region, moderately acidic throughout, low in organic matter content on the higher land, but moderate in the lower parts. Fertility level is low to medium. Soils, in general, have good moisture holding capacity.

174. ***Active Ganges Floodplain* (3,334 sq km).** This region occupies unstable alluvial land within and adjoining the Ganges river. It has an irregular relief of broad and narrow ridges and depressions interrupted by cut-off channels and active channels. The area has complex mixtures of calcareous sandy, silty and clayey alluvium. The general soil types, predominantly, include

calcareous, alluvium and calcareous brown floodplain soils. Soils are low in organic matter and mildly alkaline. General fertility level is medium but deficient in nitrogen.

175. ***High Ganges River Floodplain*** **(13,205 sq km).** This region includes the western part of the Ganges river floodplain that is predominantly highland and medium highland. Most areas have a complex relief of broad and narrow ridges and inter-ridge depressions. The upper parts of the high ridges stand above normal flood level. The lower parts of the ridges and basin margins are seasonally shallowly flooded. Generally, the soil types predominantly include calcareous dark grey floodplain soils and calcareous brown floodplain soils. Organic matter content in the brown ridge soils is low but higher in the dark grey soils. Soils are slightly alkaline. General fertility level is low.

176. ***Level Barind Tract*** **(8 sq km).** This region is developed over Madhupur clay. The landscape is almost level. The predominant soils have a grey, silty, puddled topsoil with plough pan. Shallow grey terrace soil and deep grey terrace soils are the major components of the general soil types of the area. The soils are low in available moisture holding capacity and slightly acidic to acidic. Organic matter is very low and most of the available nutrients are limiting.

177. ***High Barind Tract*** **(16 sq km).** This includes the southwestern part of the Barind Tract where the underlying Madhupur Clay had been uplifted and cut into by deep valleys. The soils include puddled silt loam to silty clay loam in the top soils and porous silt with mottled plastic clay at varying depths. Deep grey terrace soils and grey valley soils are the major components of the general soil types of the area. General fertility status is low, having low amounts of organic matter.

4.1.8 Seismic zones of Bangladesh

Figure 4.18: Seismic Map of Bangladesh

178. 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 epicentres within the country**.** Figure 4.18 and Table 4.5 shows the three seismic zones of Bangladesh.

179. On the distribution of earthquake epicentres and morpho-tectonic behavior of different tectonic blocks, Bangladesh has been divided into three generalized seismic zones (Figure 4.18). The north eastern folded regions of Bangladesh are the most active zones and belong to Zone I. The basic seismic coefficient of this zone is 0.08. Zone II consists of the regions of recent uplifted Pleistocene blocks of the Barind and Madhupur and the western extension of the folded belt and the basic coefficient for this zone is 0.05. Southwest Bangladesh is a seismically quiet zone and represented by Zone III with a basic coefficient of 0.04. Ground conditions (whether firm or soft) have not been taken into consideration during the seismic zonation of Bangladesh. Characteristic features of seismic zonation of Bangladesh are presented in the table below. The Barisal (North)-Gopalganj (North)-Faridpur transmission line area is located in Seismic Zone III (relatively quiet) and the Bogra (West)-Rohanpur-Chapainawabganj transmission line area is situated in Seismic Zones II and III (also relatively quiet).

Table 4.5: Seismic Zones of Bangladesh

Zoning	Area
I	North and eastern regions of Bangladesh (seismically most active)
II	Lalmai, Barind, Madhupur Tracts, Dhaka, Comilla, Noakhali and western part of Chittagong Folded belt. (moderately active)
III	Khulna division southwest Bangladesh (seismically relatively quiet)

4.2 Biological/ Ecological Environment

4.2.1 Bio-ecological Zones

180. 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, agro-ecosystems and homestead ecosystems, while seasonal and perennial wetlands, rivers, lakes, coastal mangroves, coastal mudflats and chars, and marine ecosystems fall into the aquatic category.

181. 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 flooding, and land use (see Figure 4.19).

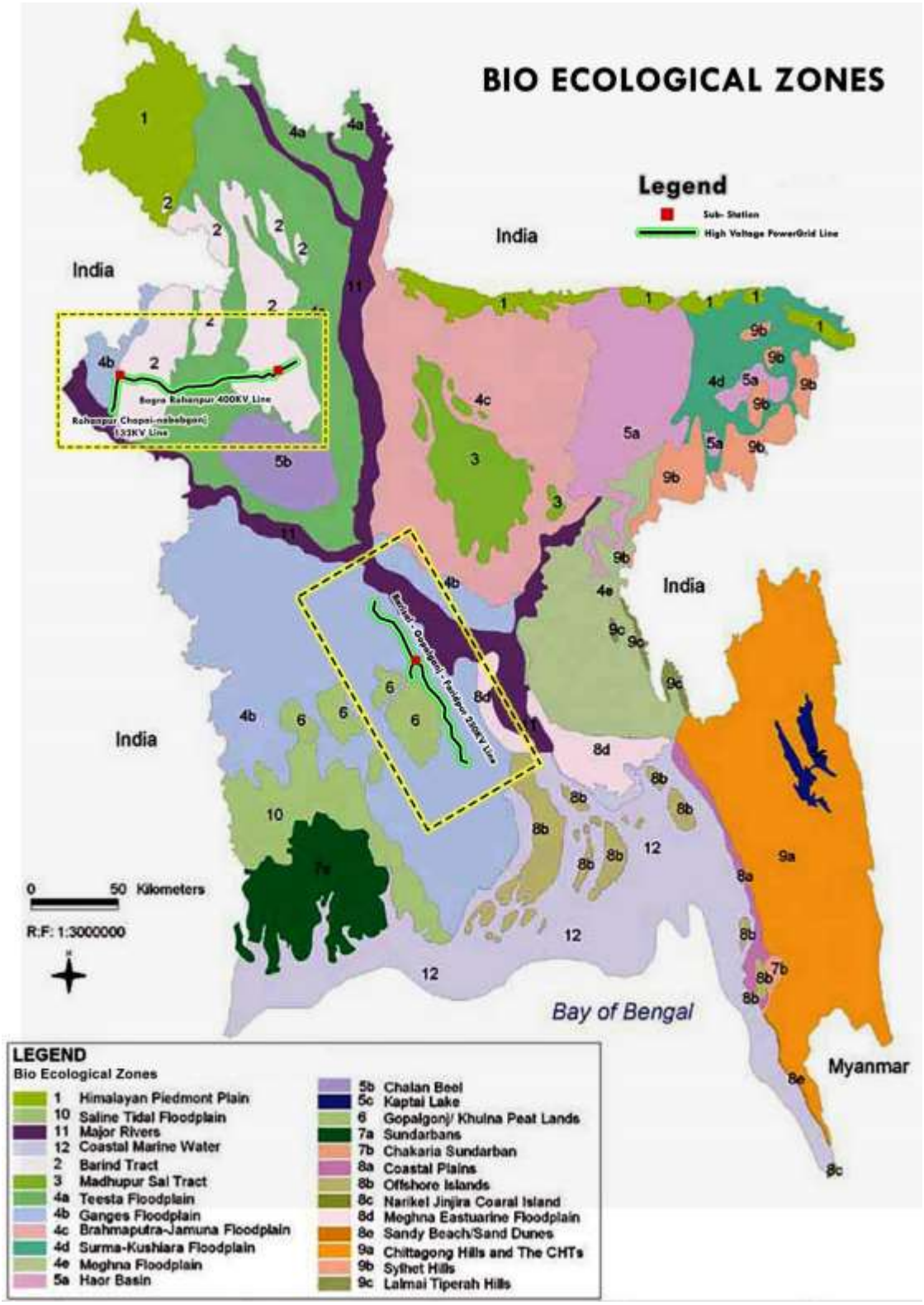
182. The Barisal (North)-Gopalganj (North)-Faridpur line is located in bio-ecological zones 4b and 6 (Ganges floodplain and Gopalganj-Khulna peat lands). The Bogra (West)-Rohanpur-Chapainawbganj line is situated in bio-ecological zones 2, 4a and 4b (Barind tract, Teesta floodplain and Ganges floodplain).

183. The Gopalganj/Khulna Peat Lands occupy low-lying areas between the Ganges river floodplain and the Ganges tidal floodplain in the south of the Faridpur region and the adjoining parts of Khulna and Jessore districts. It is characterized by thick deposits of peat occupying perennially wet basins, but they are covered by clay around the edges and by calcareous silty sediments along the Ganges distributaries crossing the zone. Most of the layers harden irreversibly into coal-like lumps when dry. The soil in this zone is potentially strongly acidic and low in essential plant nutrients. The basins are deeply flooded by rainwater during the monsoon season. However, in the basin close to Khulna, the floodwater is somewhat brackish.

184. The floral diversity in this zone is quite limited. The major tree species found in this zone are: the Bakful (*Sesbania grandiflora*), Hijal (*Barringtonia acutangula*), Barun (*Crataeva nuruvala*), and Custard apple (*Limnophila heterophylla*). Some of the common aquatic plant species observed in this zone include: the Kaoatukri (*Sagittaria guayensis*), Nil komol (*Nymphaea stellate*), Kolmi (*Ipomea aquatica*), and Hogla (*Typha elephantina*).

185. Due to lack of diversity in vegetation, the variety in faunal species and their population size in this zone are limited. The dominant mammalian species present here are: the Smooth-coated otter (*Lutra perspicillata*), Five-striped palm squirrel (*Funambulus pennant)*, and Fishing cat (*Prionailurus viverrinus*). Common reptile species in this zone include the Common krait (*Bungarus caeruleus*), Common wolf snake (*Lycodon aulicus*), Copper head trinket snake (*Elaphe radiate*), and Spotted pond turtle (*Geoclemus hamiltonii*). Only two species of amphibians are found here, namely the Maculated tree frog (*Polypedates maculatus*) and Cricket frog (*Limnonectes limnocharis*). On the other hand, due to the presence of floodplains in the surrounding areas, the diversity of bird species is relatively better in this zone (compared to other animals).

Figure 4.19: Bio-ecological Zones of Bangladesh, Subprojects are in Zone 2, 4a, 4b and 6



4.2.2 Diversity of Floral and Faunal Species

186. The subproject impact area is 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. The fruit trees include jackfruit, mangoes, litchi, banana, coconut, and blackberry. Timber trees include mahogany, neem, Ipil, and koroi. The trees, shrubs, herbs, bushes, and low-growing grasses in the RoW provide habitat for birds and other animals. The data collected from the field survey suggests that the predominant species are those of cultivated vegetables and trees. A detailed list of terrestrial floral species found in the project area is given in Table 4.6.

Table 4.6: List of Terrestrial Flora Recorded in the RoW and Surroundings of the Transmission Line Routes

Scientific Name	Local Name or English Name	Habit	Habitat	Status
Timber/Wood Trees				
Swietenia mahagoni	Mahogony	T	RS, HS	C
Azadirachta indica	Neem	T	HS	C
Albizzia procera	Koroi	T	RS, HS	C
Eucalyptus citriodora	Eucalyptus	T	RS, HS	C
Dalbergia sisoo	Shishu	T	RS, HS	C
Bambusa vulgaris	Bash (Bamboo)	S	HS	C
Samanea saman	Raintree	T	RS, HS	C
Bombax ceiba	Shimul (Cotton Tree)	T	RS, HS	LC
Ficus benghalensis	Banyan tree	T	RS	C
Ficus infectoria	Pakur	T	HS	LC
Polyalthia longifolia	Debdaru	T	RS	LC
Acacia aurculiformis	Akashmoni	T	RS, HS	C
Areca catechu	Supari/ Betel nut	T	HS, RS	C
Tectona grandis	Shegun	T	RS, HS	LC
Terminalia arjuna	Arjun	T	HS, RS	LC
Dillenia indica	Chalta	T	HS, RS	C
Delonix regia	Krishnachura	T	HS	LC
Artocarpus chama Buch-Ham		T	HS	C
Artocarpus heterophyllus	Jack fruit	T	HS	C
Phaleria macrocarpa	Dewa	T	HS	C
Instia bijuga	Ipil	T	HS	LC
Polyalthia longifolia	Debdaru	T	HS, RS	C
Castanea sp.	Chestnut	T	HS	C
Diospyros discolor	Gab	T	HS	C
Lagerstroemia speciosa	Jarul	T	RS	C
Litchi chinensis	Lichi	T	HS	C
Mangifera indica	Mango	T	HS	C
Phyllanthus emblica	Amloki	T	HS, RS	LC
Olea europaea	Olive	T	HS	C
Borassus flabelilifer	Tal	T	HS, RS	C
Fruit Trees				
Musa sapientum	Kalagash (Banana)	H	HS	C
Psidium guajava	Piara (Guava)	T	HS	LC
Cocos nucifera	Narikel (Coconut)	T	HS	C

Scientific Name	Local Name or English Name	Habit	Habitat	Status
Moringa oleifera	Sajna	T	HS	LC
Zizyphus jujuba	Boroi	T	HS	LC
Citrus grandis	Jambura/Badam	S	HS	C
Aegle marmelos	Bel	T	HS	C
Limonia acidissima	Kodbel/ woodapple	T	HS, RS	C
Phoenix dactylifera	Date Tree (Khejur)	T	HS, RS	C
Areca catechu	Supari (Betel Nut)	T	HS	C
Carica papaya	Pepe (Papya)	T	HS	C
Citrus aurantifolia	Labu (Lemon)	S	HS	C
Annona reticulate	Atafal	T	HS	C
Annona squamosa	Ata	T	HS	C
Averrhoa carambola	Kamranga	T	HS	C
Punica granatum	Dalim	S	HS	LC
Manilkara sapota	Sobeda	T	HS	LC
Dillenia indica	Chalta	T	HS	LC
Fruit cum Timber Trees				
Artocarpus heterophyllus	Kathal (Jackfruits)	T	HS	LC
Mangifera indica	Aam(Mango)	T	HS	C
Syzygium cumini	Jam(Blackberry)	T	HS	C
Tamerindus indica	Tetul (Tamarind)	T	HS	C
Borassus flabellifer	Tal (Palm Tree)	T	RS	LC
Elaeocarpus robustus	Jolpai (Olive)	T	HS	LC
Diospyros peregrina	Gub	T	HS, RS	LC
Medicinal Trees				
Azadirachta indica	Neem	T	HS	C
Teominalia arjunna	Arjun	T	HS, RS	LC
	Bohera	T	HS	LC
	Tejpata	T	HS	LC
Ocimum canum	Tulshi	H	HS	LC
Coccinea cordifolia	Telakachu	S	HS	C
Fuel Trees				
	Paiya	T	HS	C
Ficus benghalensis	Bot (Banyan Tree)	T	RS	LC
Acacia nilotica	Babla	T	HS	C
Ricinus communes	Venna	T	HS	C
	Bonziga	T	HS	C
Ficus hispida	Dumoor	T	RS	C
Anthocephalus cadamba	Kadom	T	HS	C
	Shewra	T	HS	C
	Bakul	T	HS	LC
Aesthetic				
Delonix regia	Krisnochura	T	HS	LC
Cassia fistula	Sonalu	T	HS	LC
Codiaeum variegatum	Patabahar	S	HS	LC
Lawsenia inermis	Mehendi	S	HS	C
Gardenia coronaria	Gandha raj	S	HS	C
Casuarina littorea	Jaw	T	HS	LC
Nymphaea nouchalli	Shapla	H	Wild	C

C = Common, H = Herb, HS = Homestead, LC = Less Common, RS = Road Side, S = Shrub, T = Tree.
Source: Field survey, Nov/Dec 2017.

187. The subprojects will require removal of trees of various sizes and species. The inventory carried out during November/December 2017 found a variety of trees on the RoW of the transmission line areas. On the other hand, the lands selected for the three substations are agricultural fields and no trees are found on these lands. The total number of affected trees along the transmission line RoW are presented by category in the Chapter 5. The details of the counted trees are given in Annex 3. The highest number of trees is found under the fruit bearing tree category (4,382) followed by timber trees (4,040) and trees with medicinal properties (495). The size of trees has been determined based on the girth category for the considered species, but the Forest Department will further assess it before paying compensation to the owners. All the PAPs (project-affected persons) will receive compensation for the trees and fruits. Also, they will be able to take away the timber. PAPs will get also additional compensation for fruit bearing trees.

188. While most of the aquatic plant species of the subproject areas are subject to seasonal water level fluctuations, the abundance of wetlands supports a wide variety of aquatic biota. The common aquatic plants are Helencha (*Enhydro fluctuans*), Kalmi (*Ipomoea aquatica*), DholKalmi (*Ipomoea fistulosa*), Cheicha (*Scirpus articulatus*), Kochuripana (*Eichornia crassipes*), Shapla (*Nymphaea nouchali*), Duckweed (*Spiredella* sp.), Khudipana (*Lemna minor*), and Topapana (*Pistia stratiotes*).

189. The diversified habitats and ecosystems in the project area support various types of wildlife. Primary and secondary data were used for identification of fauna that may be in the project area. Most of the faunal species (amphibians, reptiles, birds, and mammals) were identified in the project impact area of the subprojects by using books and the descriptions of the local people provided during the field survey (results given in the following Table 4.7). Note that no endangered species have been encountered in the project area.

Table 4.7: List of Faunal Species found in the Substation/ Transmission Line Subproject Areas

Scientific Name	English Name	Local Name	Conservation Status
Amphibians			
Bufo melanostictus	Common Toad	Kuno bang	NT
Rana temporalis	Bull Frog	Kola bang	NT
R. pipens	Grass Frog	Sona bang	NT
Reptiles			
Hemidactylus flaviviridis	Common House Lizard	Tiktiki	NT
Calotes versicolor	Common Garden Lizard	Rokto-chosha	NT
Varanus bengalensis	Bengal monitor	Gui shap	VU
Xenochrophis piscator	Checkered keelback	Dhora shap	NT
Amphiesma stolata	Stripped keelback	Dora shap	NT
Enhydris	Common smooth water snake	Paina shap	NT
Coluber mucosus	Rat snake	Daraj shap	VU
Atretium schistosum	Olive keelback	Maitta shap	NT
Naja kaouthia	Monocellate cobra/ Spectacled cobra	Khoia gokhra	LC
Birds			
Ardeola grayii	Indian pond heron	Kani bok	NT
Casmerodius albus	Great egret	Sada bok	NT
Egretta garzetta	Little egret	Choto bok	NT

Nycticorax	Black-crowned night heron	Nishi bok	NT
Haliastur indus	Brahminy kite	Shankho chil	NT
Streptopelia chinensis	Spotted dove	Tila Ghughu	NT
Streptopelia decaocto	Eurasian collared dove	Raj Ghughu	NT
Psittacula krameri	Rose-ringed parakeet	Tia	NT
Amaurornis phoenicurus	White-breasted waterhen	Dahuk	NT
Eudynamys scolopacea	Asian cuckoo	Kokil	NT
Cuculus micropterus	Indian cuckoo	Bou-kotha-kao Pakhi	NT
Athene brama	Spotted owlet	Khuruley Pencha	NT
Alcedo atthis	Common kingfisher	Choto Maachranga	NT
Halcyon smyrnensis	White-throated kingfisher	Sada buk Maachranga	NT
Ceryle rudis	Pied kingfisher	Pakra Maachranga	NT
Megalaima haemacephala	Coppersmith barbet	Choto Basanta Bauri	NT
Oriolus xanthornus	Black-headed oriole	Holdey Pakhi	NT
Corvus splendens	House crow	Pati Kak	NT
Dicrurus macrocercus	Black drongo	Fingey	NT
Copsychus saularis	Oriental magpie robin	Doel	NT
Acridotheres fuscus	Jungle myna	Jhuti Shalik	NT
A. tristis	Common myna	Bath Shalik	NT
A. ginginianus	Bank myna	Gang Shalik	NT
Sturnus contra	Asian pied starling	Gobrey Shalik	NT
S. malabaricus	Chestnut-tailed starling	Kath Shalik	NT
Pycnonotus cafer	Red-vented bulbul	Bulbuli	NT
Turdoides striatus	Jungle babbler	Satbhai	NT
Orthotomus sutoriu	Common tailorbird	Tuntuni	NT
Passer domesticus	House sparrow	Charui	NT
Ploceus philippinus	Baya weaver	Babui	NT
Upupa epops	Eurasian Hoopoe	Hudhud Pahkhi	NT
Mammals			
Pteropus giganteus	Flying Fox	Badur	NT
Megaderma lyra	Greater False Vampire	Badur	NT
Herpestes edwarsi	Common Mongoose	Bara benji	VU
H. auropunctatus	Small Indian Mongoose	Benji	NT
Vulpes bengalensis	Bengal Fox	Khek shial	VU
Rattus	Common House Rat	Indur	NT
Bandicota indica	Bandicoot Rat	Bara indur	NT
Mus musculus	House Mouse	Nengri indur	NT
Suncus murinus	House Shrew	Chicka	NT

LC = Less Common, NT = Not Threatened, VU = Vulnerable.
Source: Field Survey, Nov. Dec. 2017, Literature Review and IUCN Red Data Book (2003).

190. Fish are the most important aquatic fauna in the subproject areas (see Table 4.8, there are no endangered species), along with invertebrate and amphibian groups. The aquatic fauna includes prawns (*Macrobrachium* spp.), crabs, snails (Pila, Vivipara, Lymna), freshwater mussels (*Lamellidens* sp.), Kolabang (*Rana tigrina*), Guishap (*Varanus bengalensis*), and Matia sap (*Enhydrisen hydris*). The observed aquatic birds are: Pancowri (*Phalacrocorax carbo*), Kanibok (*Ardeola grayii*), Sadabok (*Egretta garzetta*), Borobok (*Egretta alba*), Machranga (*Halcyon pileata*), Dahuk (*Gallicrex cinerea*), and winter migratory birds, including Balihash (*Dendrocygna javanica*) and Chakha (*Tadorna ferruginea*).

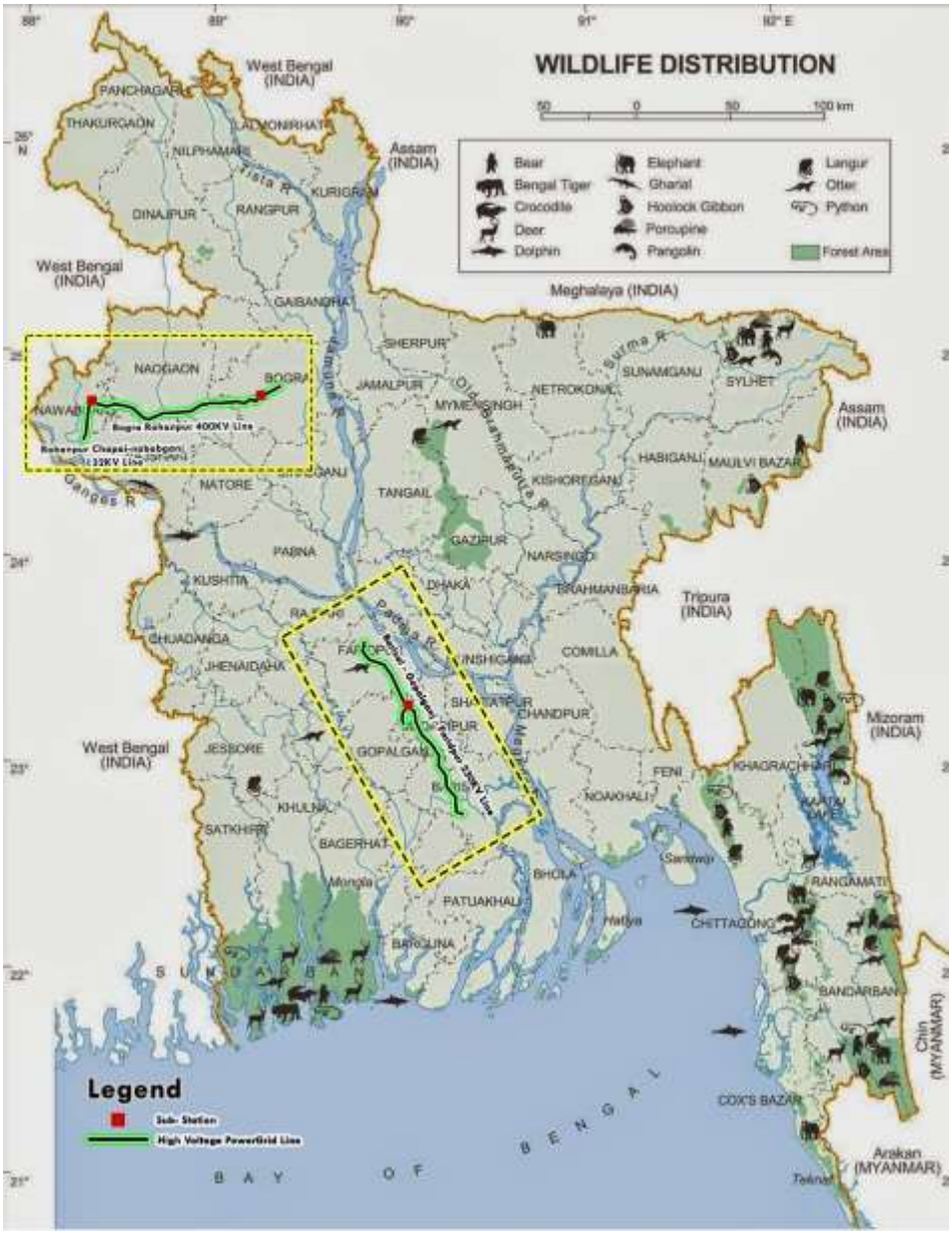
Table 4.8: List of Fish Species found in the Substation/Transmission Line Subproject Areas

Local Name	Scientific Name	English Name	Local Status
Tengra	*Batasio*	Tista Batasio	NT
Pabda	*Ompok pabo*	Pabo catfish	NT
Puti	*Puntius sophore*	Spotfin Swamp Barb	NT
Darkina	*Esomus danricus*	Flying barb	DD
Dhela	*Osteobrama cotio*	Cotio	LC
Rui	*Labeo sp.*		DD
Catla	*Catla*	Catla	NT
Mrigal	*Cirrhinus mrigala*	Mrigal	NT
Ayre	*Aorichthus aor*	Longwhiskered Catfish	VU
Chital	*Notopterus chitala*	Humped Featherback	LC
Boyal	*Wallago attu*		NT
Pungus	*Pangasius*	Pungas	LC
Elish	*Tenualosa ilisha*	Hilsha	NT
Bele	*Awaous gutum*		NT
Foli	*Notopterus*	Grey featherback	VU
Koi	*Anodontosoma chachunda*	Chachunda	NT
Mola	*Amblypharyngodon mola*	Pale carplet	NT
Chapila	*Gonialosa manmina*		NT
Baim	*Mactacembalus armatus*	Tire truck spineel	DD
Gajar	*Channa marulius*	Giant snakehead	LC

DD = Data Deficient, LC = Less Common, NT = Not Threatened, VU = Vulnerable.

Source: Field Survey, November- December 2017 and Literature Review and IUCN Red Data Book (2015)

Figure 4.20: Wildlife Distribution Map of Bangladesh- Subproject Locations and Distribution of Fauna



191. Bangladesh currently has 39 Protected Areas (none of these are adjacent to the subproject areas). Among these, 38 are forest-based and managed by the Forest Department. These include 17 national parks, 20 wildlife sanctuaries and one Special Biodiversity Conservation Area (IUCN Red List, 2015). In all, these terrestrial and coastal protected areas cover about 266,202.5 hectares or 2,662 km^2. The remaining one is a marine ecosystem that is managed by the Forest Department (not relevant to the current project areas).

Figure 4.21: Protected Area Map of Bangladesh

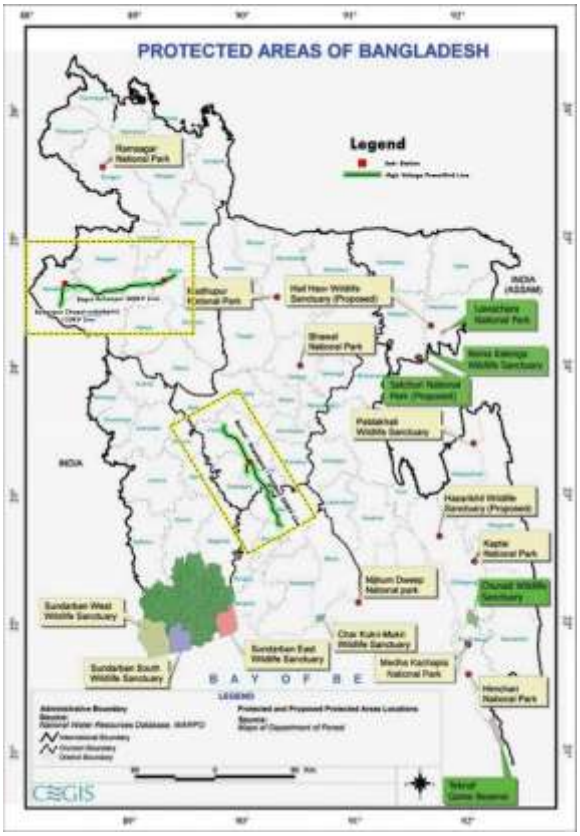
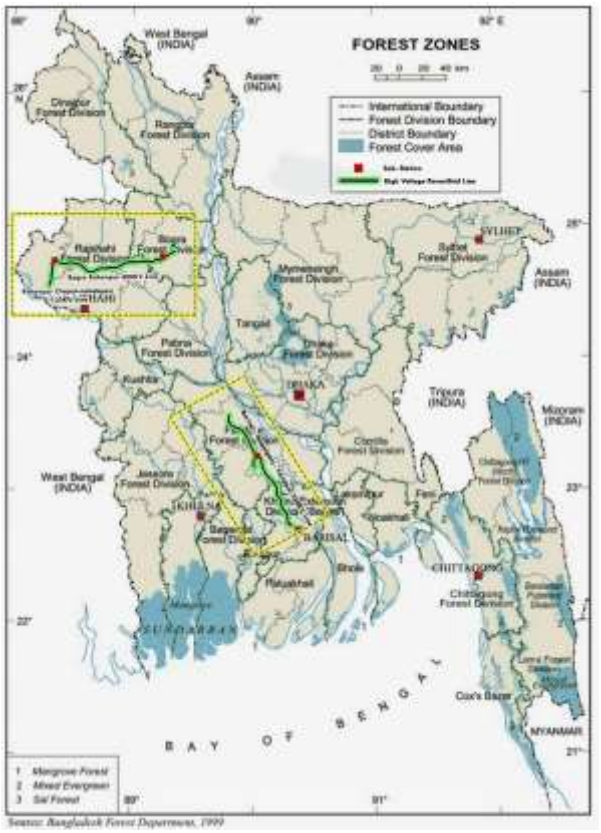


Figure 4.22: Forest Cover Map of Bangladesh and Subproject Locations



4.3 Socio-Economic Environment

192. A socio-economic household survey was conducted with a sample of 355 households living in different subproject impacted areas during the period November to December 2017. The sample included 155 households that lived: within the RoW of the Barisal (North)-Gopalganj (North)-Faridpur 230 kV Transmission Line (126 km); landowners/claimants of Gopalganj substation land (33); and, households that lived within the RoW of the two LILO connections (5), and another 200 households that lived: within the RoW of the Bogra (West)-Rohanpur 400 kV Line (104 km) and Rohanpur-Chapainawabganj 132 kV line (26 km); landowners/claimants of Bogra (West) substation land (15); landowners/claimants of Rohanpur substation land (20); households that lived within the RoW of the two LILO connections (15); and, households that cultivated state land located adjacent to the Rohanpur substation (20).

4.3.1 Demographic characteristics

193. The total population of the 355 households accounted for 1,391 people. The male population exceeds their counterpart females (54.32% and 45.68%, respectively). Children below the age of 6 years are 6.2% of the population. Both children and adolescents in the age group of 6 to 15 years constitute 16.8% of the population. The rest (77%) represent the population over and above 15 years of age. The married population is 59% against an unmarried population of

39.8%. Persons who are widows and divorced from their spouses are 1.2%. Majority of the households are nuclear families (96.6%), while the extended families account for only 3.4% of the surveyed population. The proportion of households that has a male head is 99.1% and the households headed by women are 0.9%. In terms of ethnicity, the entire sample household population is Bengali. The religious composition of the households includes 94% of Islamic and 6% Hindus.

4.3.2 Education

194. Around 37% of the population had education only up to Grade 5. Another 23.3% had completed 6–10 years of schooling. The population that attained senior school certificate or higher school certificate or equivalent is 11.5% and 7.2% respectively. The graduates and those with post-graduate qualifications constitute 3.2%. A significant number (8.8%) could only write their names and place the signature. The population that never had schooling and considered illiterate is 4.7%. Those who had pursued only the Islamic education (hafej) are only 0.2% while another 4% is those below the age of five years. The student population comprises 28.8% of the population.

195. Children receive their education from multiple educational institutions such as kindergartens, primary schools, middle schools, high schools and colleges, English medium schools, vocational training institutions, polytechnic institutions, medical colleges and universities. However, there are no universities in Goplaganj, Faridpur, Bogra or Chapainawabganj. Students who desire to pursue university degree have to enter universities in Dhaka, Chittagong or Barisal, which the most families would not be able to afford. Families would encourage their children irrespective of gender to pursue education and almost all the children are admitted to a school at the age of 5 years. Many families are unable to sustain their aspirations to educate the children primarily because of the household poverty. The number of children who drop out of school at primary level is rather negligible compared to the drop-out rates at secondary level. The boys would drop-out primarily to find employment preferably as an immigrant worker either in a major city like Dhaka or else in a foreign country. Or else they would engage in agricultural work or in daily paid labor work which are locally available. The factors that trigger girls to drop-out of school includes household poverty (equally applies to boys as well), long distances to the schools and the early/child marriages arranged by the families. Girls are keener to pursue education compared to the boys.

4.3.3 Housing Infrastructure

196. Majority of the households live in tin shed and kutcha houses. The occupants of such tin shed and kutcha houses account for 42% and 26.8% respectively. Another 1/4th of the households (25.6%) lived in semi-pucca houses. The households that lived in pucca houses comprised only 5.6%. The number of rooms, including the kitchen available in a house, also varied. The households that have three rooms comprise 43.1% while four-rooms are available for 22.5%. Two-room houses are occupied by 14.4% and single room houses by 7.6%. The rest (12.4%) had houses with more than five rooms.

197. A majority of the households (94.1%) claimed singular ownership to the house they live in, belonging to either of the spouses. Households that live in a house belonging to their parents or children are 4.8% and 1.1%, respectively.

4.3.4 Household Amenities

198. Households collect water from multiple sources. A private tube well is the main source of water for 80.8% of the households. Another 18.3% of the households collect their water from a public tube well installed by the government. The rest (0.8%) access pipe borne water from a government water scheme. Electricity is available for 84.5% of the households. The rest (15.5%) are not connected to electricity. Individual toilets are available for 98.3% of the households. Of this figure, 77% have water seal toilets, whereas flush toilets with commodes are used by 12%. Households that used pit toilets are 10.9%. The households that shared a toilet with another household accounted for 1.1%. Another 0.6% did not have a toilet. Mobile telephones are available for 97.8% of the households, whereas 0.3% have fixed land telephones.

4.3.5 Household Assets

199. The movable assets available in a household are limited to only a few items. Almost one-third of the households (32.1%) have a push bicycle. Motorcycles are available in 12.7% of the households. Motors that are used for pumping water from deep and shallow tube wells are available in 10.1% and 2.3% of the households, respectively. The rest of the household assets includes rickshaws (2.8%), CNG/auto rickshaw (1.1%) and water pumps (2%). However, the electrical appliances used in households are quite significant. Among the main electrical appliances used by households are televisions (in 67.3%); electric fans in 80.3%; refrigerators in 15.8%; telephone chargers in 80%; rice cookers in 12.1%; and electric irons in 6.8% of the households.

4.3.6 Land Ownership

200. Households have a combination of user rights to the land on which they either live or cultivate. The land on which 96.6% of the households live or cultivate is claimed as private property. Leaseholders of government land constitute 0.3%. Households that live/cultivate on encroached land are 1.7%. Land has been taken in for share-cropping by 1.4% of the surveyed population. Majority of the households (92.7%) claim singular ownership to the land they live/cultivate that belonged to either of the spouses. Households that live on land belonging to their parents comprise 5.9% of the survey sample. Government lands (khas lands) are occupied by 1.4%.

201. Of the 355 households, 266 households (74.9%) claimed to have paddy land. The total extent of paddy land claimed by these households is estimated at 179.7 acres (72.7 ha). Highlands are owned by 348 households (98%) and the estimated land area is reported as 67.9 acres (28.2 ha). The size of paddy land owned by the households ranged from 9 acres (3.6 ha) to 0.04 acres (0.016 ha). Similarly, the highland plots also varied between 1.4 acres (0.57 ha) and 0.03 acres (0.012 ha). Accordingly, the average land holding size of an individual household is 0.68 acres (0.28 ha) for paddy and 0.2 acres (0.08 ha) for highlands. Altogether the average landholding size is 0.7 acres (0.28 ha).

4.3.7 Livelihoods

202. Households in the subproject impact areas are dependent on multiple sources of livelihoods. The livelihoods include agriculture, marine fishing, labor work, employment in government and private sector, business activities, and foreign employment. Of the 355 households surveyed, the economically active population is estimated as 456, of whom women constitute only 2%. Women are mostly the housewives. Agricultural activities are the source of

livelihood for 23.2% of the labor force. Various forms of labor-based work provide a source of livelihood for 24.6%. Those employed in the government and private sector jobs are 9.4%. Small and medium-scale businesses and retail trade are sources of livelihood for 22.4% of the surveyed population. Drivers and transport workers constitute 5%, whereas those employed in foreign countries represent 7.2% of the active labor force. Table presents the primary source of livelihoods of the labor force.

Table 4.9: Primary Sources of Livelihoods of the Households

Source of livelihood	Count	Percentage (%)
Paddy cultivation	100	21.9
Highland cultivation	6	1.3
Marine fishing	9	2
Agriculture labor	91	20
Non-agriculture labor	17	3.7
Fishery labor	4	0.9
Employee in government sector	2	0.4
Employee in private sector	41	9
Large scale business	10	2.2
Small & medium scale business	83	18.2
Retail trade	19	4.2
Driver/transport worker	23	5
Employee in a foreign country	33	7.2
Pensioner	2	0.4
Armed services	1	0.2
Others (Self Employed)	15	3.3
TOTAL	**456**	**100%**

Source: Household socio-economic survey, November-December 2017.

203. Some of the household members are also engaged in supplementary livelihood activities. The numbers recorded are 242 persons, of whom women comprised 28.9%. Animal husbandry is the supplementary livelihood source for 63.6%. Women are proactively engaged in animal husbandry activities and they constitute 45.5% of the population engaged in animal husbandry work. Table 4.10 presents the supplementary livelihood activities of the 242 persons.

Table 4.10: Supplementary Sources of Livelihoods of the Households

Source of livelihood	Count	Percentage
Agriculture labor	6	2.48%
Animal husbandry	154	63.64%
Fishery labor	2	0.83%
Highland cultivation	17	7.02%
Marine fishing	5	2.07%
Non-agriculture labor	6	2.48%
Paddy cultivation	45	18.60%
Retail trade	3	1.24%
Skilled/semi-skilled worker	1	0.41%
Small & medium scale business	3	1.24%
Total	**242**	**100.00%**

Source: Household socio-economic survey, November-December 2017.

204. A variety of crops are cultivated by the households in different seasons of the year. Rice is cultivated by 255 households (71.8%) of whom the majority (81.6%) cultivate them in the Boro season, followed by 15.7% in the irrigation and 2.7% in Rupa seasons. Mustard and vegetables are cultivated in the winter season by 25.9% and 27.6% of households, respectively. Other crops cultivated by households in the winter season include onion (4.5%) and garlic (4.8%). In the rainy season, 35 households (9.9%) cultivate jute and 13 households (3.7%) cultivate sugar cane. Farm produce is used for both family consumption and marketing. Households also use hired labor to assist them in cultivation, in addition to the use of their family labor.

4.3.8 Household Income and Expenditure

205. The average monthly incomes of 38.9% households are less than Tk10,000 ($120). Another 42% have monthly incomes ranging from Tk10,001 to Tk20,000 ($240). Another 14.1% of households generate monthly incomes between Tk20,001 to Tk30,000 ($360). Monthly incomes of the rest (5.1%) exceeded Tk40,000 ($480). The average monthly income per household is estimated at Tk17,544 ($ 211).

Table 4.11: Monthly Incomes of the Households

Monthly household income (Tk)	Frequency	Percentage (%)
<10,000	138	38.87
10,001-20,000	149	41.97
20,001-30,000	50	14.08
30,001-40,000	7	1.97
>40,000	11	3.10
TOTAL	**355**	**100.00**

Source: Household socio-economic survey, November-December 2017

206. The monthly household expenditure incurred by 43.1% households is less than Tk10,000. Monthly household expenditure of most households (50.1%) varies between Tk10,001 to Tk20,000. Households that incur monthly expenditure of Tk20,001 to Tk30,000 comprise 4.2% of the surveyed population. The monthly expenditure of the rest (2.5%) exceeded Tk30,000 in their household expenditures. The average monthly expenditure of a household is estimated at Tk12,007 ($241).

Table 4.12: Monthly Expenditure of Households

Monthly expenditure (Tk)	Frequency	Percentage (%)
<10,000	153	43.10
10,001-20,000	178	50.14
20,001- 30,000	15	4.23
30,001- 40,000	5	1.41
40,001-50,000	2	0.56
>50,000	2	0.56
TOTAL	**355**	**100.00**

Source: Household socio-economic survey, November-December 2017.

4.3.9 Indebtedness

207. Loans have been obtained by 16.6% of the surveyed households during the past 12 months. The source of loan for most the households (81.4%) was from an NGO or a community-based organization, followed by 13.4% from a bank and 5.1% from a private moneylender. The widespread operations of micro-credit institutions in Bangladesh such as Bangladesh Rural Advancement Committee, Grameen Bank, etc. may be one of the reasons for rural communities to access loans from NGOs and CBOs. The annual interest rates charged on the loans varied from 10% to 25%, with an average of 17%. The loans have been accessed by the majority (64.9%) to invest in agricultural activities; 14% to spend on a family event; 7% for the educational purposes of their children; 5.3% to build a house; 3.5% to invest in an industry; and 5.3% for medical treatment and family consumption purposes, such as to buy household goods. Almost all the indebted households reported their ability to repay the loans.

4.3.10 Unemployment

208. The number of unemployed persons in the sample is relatively small and represented only 3.3% of the household population. This may be due to the engagement of many household members in a variety of seasonal and casual employment such as in daily paid labor work.

209. Employment opportunities in the project impact areas are rather negligible as there are no industrial or commercial ventures that can absorb the unemployed. Due to lack of employment opportunities in the surrounding areas, most of the unemployed people find work in seasonal agricultural activities or in daily paid casual labor work as a source of livelihood to support their families. Some unemployed persons will operate as tenant farmers, cultivating the land belonging to another party and sharing part of the produce with the landowner. A fair number of children also work in various factories to find extra incomes for their families despite child labor is illegal. Agricultural labors and sharecroppers in Bogra and Chapainawabganj suffer from lack of work and inability to engage in cultivations due to regular flooding in the area. Most of the women are housewives but they would engage in agriculture, livestock farming, tailoring and manufacture of handicrafts to earn a supplementary income for their families. In some communities, women would also engage in casual daily paid labor work whereas in other communities they would not go for such labor work. Many rural women are deprived of working outside due to customary and social beliefs and taboos. Many youths aspire to find employment in foreign countries.

4.3.11 Health and Services

210. No major chronic illnesses are reported from the subproject impact areas. However, incidence of water borne diseases and skin ailments were frequently reported during consultations. People approach multiple institutions for medical care and treatment. Government hospitals, private clinics and pharmacies are the medical/health care institutions that are frequently accessed by the households. Distance from the households to such institutions varied from 2 km to 7 km across the project impact areas. The average number of visits that a household made to a pharmacy over the past 12 months ranged from 16–19; and 2–4 visits to a hospital or a private clinic. Medical services at private clinics are expensive and unaffordable to many families. Government hospitals in local areas lack sufficient medicine, diagnostic facilities and staff. Patients have to wait in long queues. For serious illnesses, people have to go to Dhaka for better treatment. People sometimes travel more than 100 km to get their medical tests done.

4.3.12 Energy Use

211. Electricity is the main source of lighting for the grid-connected households. The non-connected households (91%) use kerosene and solar power (9%). Firewood is the main source of energy used by most households (91.8%) for cooking purposes. However, electricity is used by 7.9% household and kerosene by 0.3% of households for cooking purposes. None of the households use LP gas for cooking purposes.

212. The electrified households, apart from household lighting, use electricity for a variety of other purposes. Electricity is used by 92% for operating fans, 91.7% for charging their mobile telephones, 78.7% for operating televisions, 18.7% for refrigerators, 14.3% for rice cookers, 8% for electric irons and 11.3% for boiling water and heating food. 4% use electricity for operating computers, water pumps, and deep freezers.

213. The electrified households, apart from household lighting use electricity for a variety of other purposes. Electricity is used by 92% for operating fans, 91.7% for charging their mobile telephones, 78.7% for operating televisions, 18.7% for refrigerators, 14.3% for rice cookers, 8% for electric irons and 11.3% for boiling water and heating food. Only 4% of households use electricity for operating computers, water pumps and deep freezers.

214. The average household monthly expenditure on electricity for the connected households is Tk404. The average monthly cost of firewood is Tk645 per household. Households that use kerosene as a source of energy bear an average monthly cost of Tk200, whereas the households with solar systems spend Tk350 per month on average. Among the households are 14.4% who own energy-operated vehicles such as motorcycles. Of them, 88.2% use petrol for their vehicles at an average monthly cost of Tk982.

4.3.13 Poverty

215. The social stratification of the communities in the subproject areas pointed to the presence of around 40% of poor households whose monthly incomes are less than Tk10,000. The poor households largely depend on seasonal agriculture or casual daily paid labor work. Therefore, they do not have a stable source of income and their incomes are subject to fluctuation with a variety of external factors. The middle-income households comprise 55% with monthly incomes ranging from Tk10,000–Tk30,000. The upper income category whose monthly incomes exceed Tk30,000 represents only 5%. Households that live in *kutcha* or tin shed houses and engage in casual odd jobs, tenant farmers who do not have their own land to cultivate, households who are frequently affected by or vulnerable to natural disasters such as flooding and cyclones and households who are dependent on daily paid labor work are considered poor or ultra-poor households. Of the sample households, 42% live in tin shed houses, 27% in *kutcha* houses, and 26% in *semi-pucca* houses. The households that occupied *pucca* houses comprise only 5%. Flooding and water logging in the monsoon period is a common problem that affects many households who are dependent of agriculture as a source of livelihood. The average landholding size of the households is estimated at 0.7 acres (0.28ha), which is hardly sufficient for the sustenance of large families. In the monsoon season, almost all the people suffer from disasters and are vulnerable to poverty, lack of employment and scarcity of food for consumption. The women headed households comprise of only 1%.

216. People in the project impact areas are generally poor compared to other regions in Bangladesh. Incidence of poverty is higher in this region as there are no good industries, schools, universities, medical centres in this region. People are largely dependent on agriculture but

severely constrained by annual floods. Moreover, people in Bogra district experience regular river erosion which adversely affects their livelihoods. Communication system in the project impact area is unsatisfactory and people are unable to call an ambulance service in situations of serious illness or emergencies. Poor transport facilities deprive the farmers carrying their agricultural produce to urban centres to obtain a higher price.

217. Access to external economic opportunities is also curtailed by several factors. Relatively low educational levels and human resource skills of the population, households' inability to pay for higher education or skills development training of their children, limited educational and vocational training opportunities available in the rural areas and the transport difficulties to reach educational and other vocational and technical training institutes that are located in urban areas are some of those factors that prevent particularly the youth in grabbing the new opportunities emerging within and outside the district. Thus, many school leavers would remain unemployed. Most school leaving girls would be forced by their parents and elders to enter an early marriage. Boys would either migrate to other cities such as Dhaka in search of employment or else engage in casual daily paid labor work available locally.

218. No major chronic illnesses are reported from any of the subproject areas. However, the quality of health services still remains to be desired. Inadequate medical personnel and non-availability of drugs and laboratory facilities in government hospitals are two major issues that are faced by patients who seek treatment and medical care from the government hospitals. Around 16% of the households are not connected to grid electricity.

4.3.14 Indigenous Peoples

219. In Bangladesh, indigenous peoples are treated as 'tribal' in official documents, though they are recognized as 'indigenous peoples' in the Act 12 of Chittagong Hill Tracts Regulation, 1995 and Rules 6, 34, 45, 50 of Chittagong Hill Tracts Regulation, 1900, and as 'aboriginals' in section 97 of the State Acquisition and Tenancy Act, 1950. In Bangladesh there are about 45 different indigenous communities living in the lowlands and hill areas. Though they claim that their population is over 3 million, according to the census survey of 2011, the country's indigenous population is around 1,586,141, which represents 1.8% of total population of the country. The Constitution of Bangladesh ensures affirmative action for tribal peoples and prohibits discrimination on grounds of race, religion, or place of birth. The Bangladesh Indigenous Peoples Forum urged the government to enact the Bangladesh Indigenous Peoples Rights Act, 2015 which is being drafted by the Parliamentary Caucus on Indigenous Peoples and formulated by the National Human Rights Commission aiming to secure the economic, social, and cultural rights of indigenous people.

220. With a population of some 160 million and a land area of approximately 144,000 square kilometres, Bangladesh is densely populated. It is the third largest Muslim majority country of the world. Over 85% of the population is Bengali Muslims; the remaining 15% are Hindu, with a very small number of Christians and Buddhists. Ethnic and vulnerable communities comprise about less than 1% (3 million) of the population of Bangladesh living mainly in the Chittagong Hill Tracts (CHT) and in rural communities in Mymensingh, Sylhet, Dinajpur and Rajshahi. There are 45 recognized distinct different tribal groups living in 28 districts of Bangladesh. Of the 45 tribes, 13 are living in 3 CHT districts: Khagrachari, Rangamati and Banderban. These 13 tribal groups in CHT possess separate identities, specific racial backgrounds, different languages, and distinct heritage and culture. The largest groups are the Chakmas, Marmas, and Tripuras. They differ in their social organization, marriage customs, birth and funeral rites, food and other social customs from the people of the rest of the country. The other 32 ethnic communities are scattered in 25

districts although there is good concentration of Garos in greater Mymensingh and Gazipur and of Santals in greater Rajshahi district. There is lack of information on their socioeconomic indicators.

221. The tribal people are generally poorer than the majority communities. Most tribal people in CHT live in settlements in remote hills and valleys that are very difficult to access. Their livelihoods are land based with traditional/customary tenure rights not recognized in the country's land administration system. The areas they inhabit, especially in CHT, are generally characterized by poor basic infrastructures like roads, schools, water supply and sanitation, and health care facilities. The Chakmas are the largest ethnic group in the CHT, making up more than half the tribal population. Chakmas are divided into 46 clans or Gozas. The Chakma have their own language, customs, culture, and are the followers of Theravada Buddhism. The Marmas live in the highland valleys and they too are Buddhists. The Tripura is another indigenous community living both in the plains and the CHT. Tanchangya communities are concentrated in the south eastern Bangladesh. Tanchangyas are the 5th largest indigenous ethnic community in CHT. They are spread in Rangamati, Bandarban, Roisyabili and Sadhikyabili in the Chittagong district, and Ukhia and Teknaf in the Cox's bazaar district. The Mros are considered the original inhabitants of the Chittagong Hills. They live on valleys and often fortified their villages. They had no written language of their own, but some could read the Burmese and Bangla scripts. Most of them claimed to be Buddhists, but their religious practices are largely animistic. There are some other tribal groups in other parts of the country. Santals are inhabitants of Rajshahi and Dinajpur areas. The Khasis, Garos, and Khajons are in Mymensingh and Sylhet regions. About 50% of the IPs is followers of Theravada Buddhism (Chakmas, Marmas Tanchangya, and partially the Mru); 49% are Muslims and Hindus (Tripuras). Christians (Lushais, Pankho and Bawm and some Mru), or animists fall into the balance 1%. However, nearly all the tribes also incorporate traditional indigenous elements into their formal religious beliefs and practices.

222. It is also reported that the poverty status and overall socio-economic situation of Bangladesh's indigenous people are acutely disadvantaged compared with the rest of the country. Generally, indigenous communities face discrimination and many suffer from ill-health, bad nutritional conditions and bad hygiene. The socio-economic status of most indigenous communities in the plains is known generally to be even worse than that of indigenous communities in the CHT. *Adivasi (indigenous)* face different problems depending on where they live. Many *Adivasi* are being dispossessed of their lands and only receiving nominal compensation. Many instances of land grabbing are accompanied by false cases against the dispossessed, as well as physical intimidation and harassment, but few affected people can obtain redress.[9] The CHT are undergoing deforestation and land degradation resulting from environmentally unsuitable activities such as tobacco cultivation in sloping land, shifting cultivation and logging. And it would create severe difficulties for the indigenous people to eke out a living from these degraded lands.

223. Tribal peoples and other minority groups of Bangladesh have been given equal rights in the constitution as for those of the dominant society. But the rights related to landownership in CHT districts have remained unchanged, and this was one of the major factors contributing to the armed unrest beginning in the mid-1970's. Eventually, an accord was signed in 1997 between the government and Jana Sanghati Samiti organization leading the movement. The accord included a Land Commission to address the issues related to landownership of the tribal people. However, as Jana Sanghati Samiti and other organizations often complain, not much has been done by the Land Commission to ensure tribal people's right to land and other natural resources. On the

[9] Roy R.D. 2012. Country Technical Notes on Indigenous People's Issues People's Republic of Bangladesh p.1.

contrary, their generational rights to lands and other resources have significantly dwindled because of continuing influx of mainstream people. And there is no legislation to protect the livelihood rights of the tribal peoples.

224. The present Bangladesh Acquisition and Requisition of Immovable Property Act, 2017, does not recognize the customary rights and, as a result, the indigenous people are not legally entitled to compensation for loss of lands or anything of value, including homesteads (home-lots, houses/structures, etc.). As noted earlier, the lands being used under customary tenure are likely to be recorded as khas, meaning public lands under the ownership of Land Ministry or other ministries and departments.

4.3.15 Role of Women and Gender Issues

225. Women in the project impact areas are engaged in multiple activities. Apart from their reproductive 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, dress-making, 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 clothes, to supplement the households' consumption needs, and to re-pay 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 the Bangladesh Rural Advancement Committee and Grameen Bank to access micro-credit which they would use to buy cattle, goats and poultry.

226. Women who engage in daily paid labor work are paid less compared to their counterpart men. For example, when a man is paid Tk300 a day, a woman would get only Tk150 or Tk200 though there is not much difference in the work load that both groups carry out and the duration of work. Excess of labor available and social attitudes towards women are also reported as factors that influence to pay lower salaries for women.

227. 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 the household assets despite the key immovable assets like land and house are owned by men. Physical assets such as land and jewellery received by women as part of their dowry remain in their 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.

4.3.16 Awareness on HIV/AIDS

228. Not all men and women in the communities across the subproject areas are equally aware of the root causes of HIV/AIDS, how the disease is communicated and the preventive measures that people should adopt to avoid the spread of HIV/AIDS. In a few communities, awareness has

been raised through educational programs conducted by NGOs over a period of almost two decades. However, not all the villagers have participated in those programs. People who claimed to have some knowledge on HIV/AIDS acquired such awareness through media such as television, newspapers and the brochures and leaflets distributed by NGOs. It is the estimation of the villagers that around 50% to 70% of the villagers in their respective communities are not knowledgeable of the disease.

4.3.17 Common Property Resources along the RoW of Transmission Lines

229. The common property resources found along the Barisal (North)-Gopalganj (North) transmission line route are shown in Table 4.13. They are all located outside the RoW; however, less than 500 m from the center line of the RoW. No common property resources were recorded in the other lines, except the Baghair Jame Masjid, about 100 m from the LILO (Bogra to Barapukuria). The project does not affect any monument of cultural or historical importance.

Table 4.13: The Common Property Resources Found along the Barisal (North)-Gopalganj (North) Line

Chainage	Distance (m)	Description	Type of CPR
2+900	300	South fultala masjid	Mosque
6+000	140	Chandrapara masjid	Mosque
6+520	165	Madhabpasa masjid	Mosque
11+600	270	Rakudia Masjid	Mosque
16+500	150	Munsibari Masjid	Mosque
18+000	215	Masjid	Mosque
18+200	250	Talbari masjid	Mosque
22+700	320	Khankaye Sharif	Mosque
29+100	350	Billogram Bazar	Bazar
32+400	350	Nabojug Jame Masjid	Mosque
33+800	225	Masjid	Mosque
38+000	500	Mondir	Temple
40+900	220	Valluksee Post Office	Post Office
61+300	285	Baitun Nur Jame Masjid	Mosque

CPR = common property resources, m = meter.

230. **Historical places and archaeological sites.** During the Sultanate and Mughal period several Hindu kings ruled Gopalganj area which was under the southern part of ancient Bengal called Vanga. In 1713, Muksudpur upazila was part of Jessore district while the rest of Gopalganj was part of Dhaka - Jalalpur district. Muksedpur was later transferred to Faridpur district in 1807. Gopalganj Mohakuma sub-division was declared as Gopalganj district on 1st February 1984. Barisal district is named after the influential Zamindar Aga Bakr Khan. When Dhaka division was established in 1829, Barisal was included in the Dhaka Division. It was located approximately 380 km east of Kolkata. Historically, Faridpur was known as Fathabad. It was also called Haveli Mahal Fathabad. Despite its importance in agriculture and transport, Faridpur remains one of Bangladesh's relatively poor districts. It was a railway and shipping centre under the British rule in Bengal. This district is notable for its medieval and colonial architecture. This district was established by the British in 1815. The Faridpur subdivision was a part of Dhaka division in the Bengal Presidency established by the East India Company. The municipality of Faridpur was established in 1869. British Faridpur was the birthplace of several nationalist leaders of the subcontinent. Bogra district was formed in 1821 by the British. The area was enveloped in thick fighting in the battle of Bogra between the allied troops of Mukti

Bahini and Indian Army (combined) which defeated the Pakistan Army during the Bangladesh Liberation War of 1971.

231. The name "Chapai Nawabganj" is not very old. Before 2001, it was known as only Nawabganj or Nobabganj. In the pre-British and British-raj era, this place was a vacation spot for the nawabs of Murshidabad and Daudpur Mouja. The nawabs, "Nobab"'s, used to come here for hunting. Therefore, the place is known as "Nobabganj" as Ganj means place. It is believed that the Nawab of Bengal (Bangla-Bihar and Udissa) Sarfaraz Khan (1739–1740 AD) once came here for hunting and built a tent in this place. Most of the researchers believe that during the reign of Alivardi Khan (1740–56 AD), this place was given the name as Nobabganj. Rajshahi is known for its educational, literary and artistic heritage. Rajshahi is famous for Rajshahi silk, which has a special status as clothing material in Indian subcontinent. Along with Chapainababganj, Rajshahi is the home of the region's best mangoes and lychees. Rajshahi is also the location of Barendra Museum which is known for its collection of local sculpture and other artifacts dating from medieval times. It also has some important structures that has made by the British. As an important city of Bangladesh, Rajshahi has a vibrant cultural life. Annual celebrations of Independence Day (26 March), Language Martyrs' Day (21 February) and Victory Day (16 December) are celebrated across the city. *Pohela Baishakh*, the Bengali New Year on 14 April, Muslim festivals of Eid ul-Fitr, Eid ul-Adha, and Muharram; Hindu festivals of Durga Puja; Buddhist festival of Buddha Purnima; and Christmas are celebrated here.

232. **Archeological places/Place of Interest.** Zamindar mansions belong to Mughal and British era are found in Gopalganj district. Father of the Nation Bangabandhu Sheikh Mujibur Rahman's Museum Complex, Boddhyo Bhumi Memorial, Court Mosque, Gaohor Danga Madrasa, Bornir Baor, Sheikh Kamal International Stadium complex and Tangrakhola Bazar are some other places of attraction. Durga Sagar, the largest pond or dighi of southern Bangladesh is found in 12vkm from Barisal city. This is one of the main place of residence for the migrant birds that comes in winter. Ruins of the palace of a local landlord of the British colonial era is also found here. The Bangabandhu Uddan (former Bell's Park) is a place inside the Barisal City, right on the banks of the Kirtonkhola (or Kirton Khola) river. Pathrail Shahi Mosque and Dighi (Bhanga upazila), Mathurapur Deoul, house of Palli Kabi Jasimuddin, Jagabandhuaundor Ashram, house of Shah Saheb, Kanaipur Sikder Bari and campus of Faridpur River Research Institute are found in Faridpur district.

233. Kherua Mosque (Sherpur), remnants of the historic Mahasthangarh Bara Mosque, Mazar of Shah Sultan Balkhi, Mazar of Panchpir, Gokul Medh, palace of Parshuram, Basu Bihara, Palli Unnayan Academy, Saudia Parkcity, Bhimer Jangle, museum of Nawab Bari Palace, Karu Palli, Shanewaz Shishubagan, Woodburn Park, Dreshtinandan Park, Bijayangan (war of liberation museum) are located in Bogra district. One of the most graceful monument of the Sultanate period is the Chhota Sona Masjid or Sona Mosque at Gaur in Chapainawabganj Built by Wali Muhammad during the reign of Sultan Alauddin Husain Shah (1493–1519). Originally it was roofed over with 15 gold-gilded domes including the 3 Chauchala domes in the middle row, from which it derives its curious name. Shahid Qumruzzaman central park and zoo is one of the popular public places of Rajshahi city. It is located on the bank of river Padma. Bank of the Padma river is also very popular destination for recreation. Munsguard park near magnificent old Dutch borokuthi building and Lalonshah park near Shahmukhdum eidgah are recently built to enjoy the magnificent views of Padma river.

5. ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

234. Based on the environmental baseline data and environmental screening, impact assessment for the selected subprojects (substations, transmission lines and LILO lines) was carried out. The results are noted below.

5.1 Introduction

235. Considering the base of a transmission angle tower as 72.25 m^2 and suspension tower as 42.25 m^2 for the 230 kV line, 83.47 m^2 and 75.31 m^2 for the 400 kV line, 66.08 m^2 and 36 m^2 for the 132 kV transmission line, the area affected due to 691 tower bases will be about 10.6 acres (4.3 ha); this is the total direct impact area. With the RoW of 23 m for the 400 kV line, 20 m for the 230 kV line and 14 m for the 132 kV line (on each side of the transmission line), the area that will be cleared of vegetation is 2,723.1 acres (1,102 ha) (slight habitat modification, rather than a direct impact). With a buffer of 10 m on each side of the RoW, the total land area that may be indirectly affected will be 536 ha. Approximately 77 households with structures are within the RoW. Environmental components likely to be impacted by the project are referred to as important environmental components (IECs) and important social components (ISCs). The IECs and ISCs likely to be impacted by the pre-construction, construction, operation, and decommissioning are noted below.

5.1.1 Selection of IECs and ISCs and their Rationale

Table 5.1: IECs-Physical-Chemical Environment

IEC	Rationale for selection
Ambient air quality	Construction and operation of the project will generate a minimal amount of air pollutants, such as particulate matter (PM), hydrocarbons, nitrous oxides (NO_x), carbon monoxide (CO), and sulfur dioxide (SO_2) from the operation of trucks, heavy equipment and from activities such as excavation of foundation for the bases of the transmission line towers. These may impact air ambient quality.
Ambient noise quality	Noise pollution during the construction phase may come from the operation of construction equipment, vehicular movements, construction works and other noise-generating activities at laborer settlements. Elevated noise levels may cause some inconvenience and annoyance in adjacent communities.

Table 5.2: IECs-Water Resources

IEC	Rationale for selection
Surface and groundwater quality	Construction of the project may affect nearby surface water quality due to the excavation of the foundations for the bases of the transmission line towers. This may potentially cause siltation, with sediments going to nearby watercourses. During operation, groundwater may be a source of domestic water supply, which may be contaminated with hazardous wastes coming from the drainage of the substation areas. The hazardous wastes may include used mineral oil disposed from the electrical equipment (such as transformers).
River bank erosion	Where the transmission lines will cross rivers, construction activity and the foundations themselves could alter river banks and lead to scouring and erosion, unless protection works are undertaken.

Table 5.3: IECs-Land and Agriculture Resources

IEC	Rationale for selection
Soil quality for agricultural purposes	There will be permanent land loss where agricultural land is taken up to accommodate the base of the transmission towers. Installation of towers will involve excavation of soil, which may affect soil quality.
Soil/land contamination	During operation of the substations, used insulating mineral oil from electrical equipment (such as transformers), if not disposed properly, may cause land contamination. The mineral oil to be used should be free from PCBs. There can also be soil/land contamination due to improper solid waste disposal from the construction and operation phases of the transmission lines.
Change of land use	Land use may be changed with the presence of transmission towers. Agricultural land will be permanently lost due to tower footings. As a result, present crop land might be changed into non-crop land [but no more than 10.6 acres (4.3 ha)].
Change in surface topography or terrain	During construction and operation, there may be continuous soil erosion in unavoidable slope areas near the transmission towers that may cause permanent changes in landform, topography, and slope.
Loss of crop production	During construction, standing crops in the area might be affected with a possibility of change in crop production (due to dust; use of heavy equipment and movement of vehicles).
Intercropping	Intercropping may be affected due to the installation of towers.
Impairment of visual aesthetics	Aesthetics and urban landscape may be affected by the presence of the transmission towers.

ha = hectare, PCB = polychlorinated biphenyl.

Table 5.4: IECs-Fisheries Resources

IEC	Rationale for selection
Fish disease and mortality	Use of chemicals and mineral oil from substations may affect the culture of fish species.
Fish production	Inundation of the tower base, exposing soil with poor nutrient content, in some areas may affect fish production.

Table 5.5: IECs-Ecological Resources

IEC	Rationale for selection
Terrestrial vegetation	Terrestrial vegetation provides food and shelter to local birds and various animals. Construction activities will require clearing of terrestrial vegetation and the operation phase will require vegetation management along the RoW and restriction of vegetation height below the transmission lines.
Wildlife habitat and their disturbance	Movement of local wildlife may be disturbed due to construction activities and vegetation management along the RoW during the operation phase.

RoW = right of way.

Table 5.6: ISCs-Socio-economic Aspects

ISC	Rationale for selection
Land price	Land affected by the tower footings may be devalued. Land development between transmission towers and below the transmission lines will be restricted, possibly affecting land value.
Employment opportunities	Employment opportunities will be created during the construction and operation phases.

ISC	Rationale for selection
Human health and safety	Working at heights and other construction activities may pose occupational and safety risks. Exposure of workers who maintain the transmission lines may also pose health risks.
Regional and national development	Economic development largely depends on the availability of a reliable power supply. Uninterrupted power supply is expected to improve productivity and development.

5.2 Analysis of the Impacts

5.2.1 Impact assessment methodology

236. Potential environmental and social impacts were identified based on-site visits, interviews with affected persons, stakeholder engagement, environmental sampling, collection of relevant and available secondary data, review of relevant project documents such as the Feasibility Study, survey reports, etc. The significance of potential impacts was assessed using the criteria and methodology described below.

5.2.1.1 *Impact Magnitude*

237. The potential impacts have been categorized as major, moderate, minor or nominal, based on consideration of parameters such as: (i) duration of the impact; (ii) spatial extent of the impact; (iii) reversibility; (iv) likelihood; and (v) legal standards and established professional criteria. The magnitude of potential impacts has been identified according to the categories outlined below.

Table 5.7: Parameters for Determining Magnitude

Parameter	Major	Moderate	Minor	Minimal
Duration	Long-term (more than 15 years)	Medium-term Lifespan of the project (5 to 15 years)	Limited to construction period	Temporary with no detectable potential impact
Spatial extent	Widespread far beyond project boundaries	Beyond immediate project components, site boundaries or local area	Within project boundary	Specific location within project component or site boundaries, with no detectable potential impact
Reversibility	Potential impact is effectively permanent, requiring considerable intervention to return to baseline	Potential impact requires a year or so for recovering with some interventions to return to baseline	Baseline returns naturally or with limited intervention within a few months	Baseline remains almost constant
Legal standards and established professional criteria	Breaches national standards and/or international guidelines/ obligations	Complies with limits given in national standards but breaches international lender guidelines in one or more parameters	Meets minimum national standard limits or international guidelines	Not applicable

Parameter	Major	Moderate	Minor	Minimal
Likelihood of occurrence	Occurs under typical operating or construction conditions (Certain)	Occurs under worst case (negative impact) or best case (positive impact) operating conditions (Likely)	Occurs under abnormal, exceptional or emergency conditions (Occasional)	Unlikely to occur

5.2.1.2 *Sensitivity of Receptor*

238. The sensitivity of an environmental receptor (a parameter that may be affected by the project) has been determined based on review of the local population (including proximity/numbers/vulnerability) and presence of features at the project sites or the surrounding area. Criteria for determining receptor sensitivity are given in Table 5.8.

Table 5.8: Criteria for Determining Sensitivity

Sensitivity Determination	Definition
Very High	Vulnerable receptor with no capacity to absorb proposed changes or minimal opportunities for mitigation.
High	Vulnerable receptor with little or no capacity to absorb proposed changes or limited opportunities for mitigation.
Medium	Vulnerable receptor with some capacity to absorb proposed changes or moderate opportunities for mitigation
Low	Vulnerable receptor with good capacity to absorb proposed changes and/or good opportunities for mitigation

5.2.1.3 *Assigning Significance*

239. Following the assessment of magnitude, and the quality and sensitivity of the receiving environment or potential receptor has been determined, the significance of each potential impact is established using the impact significance matrix shown in Table 5.9.

Table 5.9: Significance of Impact Criteria

Magnitude of Impact	Sensitivity of Receptors			
	Very High	High	Medium	Low
Major	Critical	Major	Moderate	Minimal
Moderate	Major	Major	Moderate	Minimal
Minor	Moderate	Moderate	Minor	Minimal
Minimal	Minimal	Minimal	Minimal	Minimal

5.2.2 Impact Matrix

240. Potential environmental impacts on the IECs during the pre-construction, construction, and operation phases of the project are presented in a matrix form in Table 5.10.

Table 5.10: Impact Matrix

IECs/Issues	Potential Impacts	Sensitivity	Magnitude	Significance Prior to Mitigation
Pre-construction Stage				
Physical-Chemical Environment and Water Resources				
Ambient air quality	Vehicular emissions; dust from excavation works, land clearing, and material stockyards may affect ambient air quality.	Medium	Minor	Minor Adverse
Ambient noise	Noise level may increase due to mobilization of vehicles and unloading of materials.	Medium	Minor	Minor Adverse
Quality of surface and groundwater	N/A	N/A	N/A	N/A
Land and Agricultural Resources				
Soil quality for agricultural purposes	N/A	N/A	N/A	N/A
Soil/Land contamination	N/A	N/A	N/A	N/A
Land use	Would be partially impacted in RoW	Low	Minor	Minimal Adverse
Crop production	Would be highly impacted, but only at tower foundation areas.	Medium	Moderate	Moderate Adverse
Change in topography/ terrain	N/A	N/A	N/A	N/A
Impairment of visual aesthetics	N/A	N/A	N/A	N/A
Fisheries Resources				
Fish habitat	Fish habitat quantity and quality will be the same.	Low	Minor	Minimal Adverse
Fish production	There will be no effect.	Low	Minor	Minimal Adverse
Socioeconomic Resources				
Land price	No or minimal impact.	Low	Minor	Minimal Adverse
Employment opportunities	Temporary or minimal opportunities at this stage.	Medium	Moderate	Moderate Beneficial
Human health and safety	No impact.	Low	Minor	Minimal Adverse
Regional and national development	No impact.	Medium	Moderate	Moderate Beneficial
Construction Stage				
Physical-Chemical Environment and Water Resources				
Ambient air quality	Suspended particulate matter from excavation works and land clearing, including vehicular emissions, may affect workers and community.	Medium	Moderate	Moderate Adverse
Ambient noise	Mobilization of heavy equipment and machinery, use of construction vehicles, transport of materials, and construction activities may increase ambient noise	Medium	Moderate	Moderate Adverse

IECs/Issues	Potential Impacts	Sensitivity	Magnitude	Significance Prior to Mitigation
	level. Exposure to high level ambient noise may cause anxiety and disturbance to workers and community.			
Quality of surface and groundwater	Potential for siltation due to construction works near river.	Medium	Moderate	Moderate Adverse
Riverbank erosion	Potential erosion due to ground movements along the riverbank.	Medium	Major	Moderate Adverse
Land and Agricultural Resources				
Soil quality for agricultural purposes	During construction, top soil at the tower footings may be eroded during excavation.	Medium	Major	Moderate Adverse
Soil/Land contamination	N/A	N/A	N/A	N/A
Land use	Would be partially impacted as agricultural land may be permanently lost due to the tower footings.	Medium	Moderate	Moderate Adverse
Crop production	May be moderately affected due to crop loss at the tower footings and in the clearing for RoW.	Medium	Moderate	Moderate Adverse
Change in topography/terrain	Excavation works for the transmission towers may affect topography.	Low	Minor	Minimal Adverse
Impairment of visual aesthetics	N/A	N/A	N/A	N/A
Fisheries Resources				
Fish habitat	Construction activities may temporarily affect fish habitat.	Medium	Minor	Minor Adverse
Fish production	Fish production not likely to be affected.	Low	Minor	Minimal Adverse
Terrestrial Resources (Flora and Fauna)				
Terrestrial vegetation	Vegetation clearing may be required at the tower footings and RoW.	Medium	Moderate	Medium Adverse
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
Socioeconomic Resources				
Compensation for crop damage	Standing crops at the tower footings and RoW may be damaged.	Medium	Moderate	Moderate Adverse
Land price	Value of land may be temporarily affected.	Medium	Moderate	Moderate Adverse
Temporary employment opportunity	Both technical and non-technical laborers will be required	Medium	Moderate	Moderate Beneficial
Human health and safety	Workers may be exposed to occupational health risks and safety hazards.	Medium	Minor	Minor Adverse
Regional and national development	May create development opportunities in anticipation of stable power supply.	Medium	Moderate	Moderate Beneficial
Operation Stage				

IECs/Issues	Potential Impacts	Sensitivity	Magnitude	Significance Prior to Mitigation
Physical-Chemical Environment and Water Resources				
Ambient air quality	No or minimal impact	Low	Minor	Minimal Adverse
Ambient noise	No or minimal impact	Low	Minor	Minimal Adverse
Quality of surface and groundwater	No or minimal impact	Low	Minor	Minimal Adverse
Riverbank erosion	No or minimal impact	Low	Minor	Minimal Adverse
Flooding	No or minimal impact	Low	Minor	Minimal Adverse
Land and Agricultural Resources				
Soil quality for agricultural purposes	May result in permanent loss of agricultural land due to tower footings [but only a maximum of 10.6 acres (4.3 ha)].	Low	Minor	Minimal Adverse
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
Land use	No impact (changes will have occurred in construction phase).	Low	Minor	Minimal Adverse
Crop production	Tower footings may have minimal impact on crop production due to permanent loss of agricultural land.	Medium	Minor	Minor Adverse
Change in surface topography/ terrain	Transmission towers will have minimal impact on topography.	Low	Minor	Minimal Adverse
Impairment of visual aesthetics	Transmission towers visible on the skyline.	Low	Minor	Minimal Adverse
Fisheries Resources				
Fish habitat	No change expected.	Low	Minor	Minimal Adverse
Fish production	No change expected.	Low	Minor	Minimal Adverse
Terrestrial Resources (Flora and Fauna)				
Terrestrial vegetation	Restriction of vegetation height below the transmission line.	Low	Minimal	Minimal Adverse
Wildlife habitat and their disturbance	Flyway paths of birds may be affected by the transmission towers.	Low	Minimal	Minimal Adverse
Socioeconomic Resources				
Compensation	Ongoing permanent loss of land at the tower footings (but occurred at the construction stage).	Medium	Moderate	Moderate Adverse
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
Employment opportunity	Jobs will be created directly due to Component 3 and indirectly through businesses and development resulting from the availability of power supply.	Medium	Minor	Minor Beneficial

IECs/Issues	Potential Impacts	Sensitivity	Magnitude	Significance Prior to Mitigation
Human health and safety	Occupational and community safety risks (project maintenance) and result from EMF (electromagnetic field)	Low	Moderate	Minimal Adverse
Regional and national development	Availability of a stable and reliable power supply may improve productivity and national development.	Medium	Moderate	Moderate Beneficial

N/A = not applicable, PCB = polychlorinated biphenyl, RoW = right of way.

5.3 Impact Assessment and Mitigation Measures

5.3.1 Transmission Lines

5.3.1.1 *Pre-construction/Construction Stage*

241. ***Land Acquisition:*** A total of 10.6 acres (4.3 ha) of lands will be acquired for the tower foundations (only some of this is private land). As a result, some limited permanent land loss and crop loss will occur, but will be compensated. In addition, a small quantity of land will be required temporarily for the construction camp nearby the tower site.

242. With a 268 km transmission line crossing relatively densely occupied land, there is potential for houses, human infrastructure, crops and trees to be affected by the Project. A Resettlement Plan (RP) has been undertaken in conjunction with the IEE to determine land ownership, any buildings, economic trees, crops and associated users which are affected, to determine fair compensation.

243. Households and a school were originally identified within the chosen alignment. Further adjustment to the transmission line alignment has been made to ensure that none of these will be affected.

244. The Electricity Rule 1910 of the Power Division, Bangladesh does not provide provisions for compensation for the land required for the foundations and platforms for transmission line towers. SPS 2009 requires compensation for loss of land at transmission tower sites. The RP provides compensation details.

245. ***Clearing of Vegetation.*** Prior to starting construction, the tower sites need to be cleared and as a result, standing vegetation (e.g. crops, grass, bushes, etc.) will be lost. As mentioned earlier, a total of 8,921 trees will be partially or fully affected by trimming or cutting during construction of the transmission lines (Table 5.11). In addition, the proposed transmission lines stretch approximately 268 km and will require clearance of the RoW, resulting in temporary loss of vegetation. However, most of the trees need to be trimmed rather than cut, and thus the impact will be only moderately significant. In general, vegetation destruction shall result in some loss of biodiversity, as valuable trees, such as those of medicinal importance or producing fruit may be adversely impacted. Trees also provide habitat for most birds, and some snakes, so these may also be affected, as vegetation cover of the understory is reduced. On the other hand, most of the transmission alignment falls inside paddy fields/ floodplain areas, so tree felling will mostly be restricted to settlement areas. Some additional vegetation damage will occur at sites required for storing construction materials, for construction activities, for labor camps, and for construction vehicle storage.

Table 5.11: Number of Trees (>5 m) Affected by the Project and Average Market Price, Barisal (North)- Gopalganj (North)- Faridpur 230 kV Transmission Line

SL	Type of Trees	Total Affected Trees within 40 m RoW	Total Affected Trees within 10 m RoW	Average Market Price (Tk)
1	Fruits trees	17,022	4,256	7,500
2	Non-fruits	15,483	3,871	1,500
3	Medicinal	1,971	493	6,000
	Total	**34,476**		

m = meter, RoW = right of way, Tk = taka.

Table 5.12: Number of Trees (>5 m) Affected by the Project and Average Market Price, Bogra (West)-Rohanpur 400 kV Transmission Line and Rohanpur-Chapainawabganj 132 kV Line

SL	Type of Trees	Total Affected Trees within 40 m RoW	Total Affected Trees within 10 m RoW	Average Market Price (Tk)
1	Fruits trees	503	126	7,500
2	Non-fruits	670	168	1,500
3	Medicinal	7	2	6,000
Total		**1,180**		

m = meter, RoW = right of way, Tk = taka.

Table 5.13: Number of Trees (>5 m) Affected by the Project, LILO Line from Bogra (South) to Barapukuria

SL	Local Name of trees	Scientific Name of Trees	Type of Trees	Total Affected Trees
1	Akshmoni	(*Acacia auriculiformis*)	Non-fruits	1
4	Date	(*Phoenix dactylifera*)	Fruits trees	1
6	Mango	(*Mangifera indica*)	Fruits trees	1
9	Pulm	(*Borassus flabellifer*)	Fruits trees	2
			Total	**5**

246. Secondary vegetation damage will occur during the stringing of conductors. Trees will need to be lopped inside the RoW and at any settlement or farm areas falling inside the RoW. Existing crop field vegetation may be damaged during stringing activities.

247. After completing of construction works, all herbaceous plants are expected to re-generate within a few years. However, existing vegetation patterns under the proposed transmission line RoW will change to some extent as there will be a restriction for planting large trees in the RoW, and regular pruning of vegetation will be required.

248. ***Disturbance of Wildlife*****.** Project activities such as earthworks for tower foundations, movement of project heavy equipment and transports (with noise especially during the night time) may disturb birds especially. However, most of the alignment occurs in agricultural land with minimal natural habitat. However, open areas under the lines could provide new browsing grounds for various animals. The presence of construction workers in the project area may induce poaching (more likely fish than anything else). Given that the alignment is mostly in agricultural land, few other animals would be affected. Tower foundation works could disturb habitats for smaller mammals, such as rodents (rats and mice).

249. The towers and conductors will be an additional hazard for bats and raptors (kites, eagles, and hawks in general); mostly during project operation, as well as bird movements (accidental ramming of large birds into the power lines during their normal or regional and seasonal migratory flights). The proposed transmission lines are not located close to the key breeding areas. Therefore, regular migratory bird movements are not expected in the project area. Bird deflectors are only likely to be needed in areas with high bird movement, e.g. along ridge lines and across wetlands. On the other hand, transmission towers and conductors may be supportive to local birds as resting, roosting and look-out locations, so they will be positively impacted. All vegetation layers (emergent, canopy and under-story) allow for bird habitat and nesting, and therefore the removal of vegetation may impact negatively on these activities.

250. ***Loss of Top Soil*****.** For the construction of tower foundations, about 10.6 acres (4.3 ha) of land will be used. This is a very small area and of no concern in regard to loss of top soil. Works near watercourses will require protection to guard against loss of soil and turbidity.

251. ***Hydrology/Drainage Congestion*****.** Given the small footprint of the tower foundations and their scattered location over the landscape, it is not expected that the construction works will result in any disruption of hydrology or drainage.

252. ***River Course*****.** Transmission tower platforms alongside the Sugandha river and the Kumar river will be placed such that single wire spans will cross the river (no foundations required in the rivers). While there is a risk of some erosion if works are too close to the river, this risk is expected to be small.

253. ***Irrigation Channels*****.** The proposed transmission and LILO lines will have 691 towers, most of which will occur in areas of intensely used agricultural land, with potential to cause disturbance of irrigation channels which are used in the dry months to irrigate crops, particularly rice, using river or tube well water. Any interference with irrigation activities and associated destruction/loss of crops will be identified and compensated for as part of the RP.

254. ***Interference with Road Crossing*****.** The transmission line will cross various major roads in the Dhaka, Madaripur, Faridpur and Barisal districts, and there are some minor roads to be crossed as well. The selected transmission line alignment is never far from the local road network and various roads and access tracks will be used during construction. Some access roads and road crossing locations will be temporarily impacted during the process of accessing transmission tower locations for erection of towers and stringing conductors between towers at the end of the construction phase.

255. Traffic management plans will be put in place with public awareness programs and warning signs at designated sites. Scaffolding will be placed over road crossing points while stringing of conductors takes place.

256. ***Camps and Construction Work Force*****.** The work force for construction will be sourced locally, as much as possible. Camps will not be necessary for the transmission line construction, but there may be small camps at the Gopalganj, Bogra and Rohanpur proposed GSS. The latter site is away from any settlements; any small camps for laborers will be provided with water supply and sanitation facilities.

257. ***Ground Water Pollution*****.** Contaminated soil or ground water in the path of the project could be disturbed by excavation, resulting in a potential transfer of the contamination to surface

water. Oil spills during construction could introduce contaminants into subsurface waters, which may end up in ground water. Hazardous materials will need to be properly contained and handled.

258. ***Noise, Air and Dust Pollution*.** The proposed areas are in relatively rural locations. Generation of noise pollution will occur, due to construction of the tower foundations, but these will be sporadic and temporary activities over the landscape. Noise will be generated during the preconstruction phase of the project with removal and/or cutting of vegetation in the RoW and during the movement of trucks or other required vehicles. Transmission tower foundations and pads are constructed using a standard drill rig to bore to required depth, depending on geology. If water is encountered, pumps will be used to remove the water to either adjacent defined areas or to waiting tanker trucks for proper disposal. After the construction is completed, the RoW is graded, agricultural soils are de-compacted, and the RoW is cleaned up. All these activities might create noise impacts for short periods at each location. Noise levels should not exceed the levels listed in the following table.

Noise Level Guidelines (IFC, EHS Guidelines, page 52,53)

259. Noise impacts should not exceed the levels presented in the table below or result in a maximum increase in background levels of 3 dB at the nearest receptor location off-site.

Noise Level Guidelines[1]		
	One Hour LAeq (dBA)	
Receptor	Daytime 07:00 - 22:00	Nighttime 22:00 - 07:00
Residential; institutional; educational[2]	55	45
Industrial; commercial	70	70

[1] Guidelines values are for noise levels measured out of doors. Source: Guidelines for Community Noise, World Health Organization (WHO), 1999.

[2] For acceptable indoor noise levels for residential, institutional, and educational settings refer to WHO (1999).

260. Exhaust emissions are likely to be generated by the construction equipment during tower construction. Motor vehicles that will be used to carry construction materials would cause air quality impact by emitting pollutants through exhaust emissions. But the impacts will not be significant (sporadic and temporary).

261. A noise and dust control plan will be developed along with community and safety plans. All vehicles will carry valid fitness certificates issued by Bangladesh Road Traffic Authority and renewed annually under the Motor Vehicles Ordinance 1983, Section 48, Chapter IV and the associated rules. Construction activity (particularly piling for towers) will take place during acceptable hours (between 9 a.m. to 5.00 p.m.). Residents will be informed in advance of any drilling activity for tower foundations. Water will be sprayed on roads, and temporary fencing will be used at construction sites, and camps. Workers will require face masks to avoid dust inhalation.

262. ***Soil Pollution*.** Top and sub-soils will be affected when the land is disturbed to make foundations for the transmission towers. On the other hand, these soils will be pushed back around the foundations, so will remain in a contained area. Proper handling of hazardous materials will reduce the risk of soil contamination during construction.

263. ***Pollution due to Wastes*.** Generation of construction wastes (such as solid wastes: electric wire, pipes, stones, woods, rods etc., and liquid waste: paint, oil, bitumen, etc.) from the construction camp and general wastes (solid wastes: papers, containers, residues of food, fruits

etc., and liquid waste: waste water from bathroom and kitchen, etc.) from workers' camps (if needed) could impact on the health and safety of the local community and workers, as well as on the aesthetic beauty of the area. Proper arrangement will be made for waste management at all work sites.

264. ***Traffic Congestion/Road Accidents*****.** Heavy construction vehicles will be required for carrying of construction materials and equipment. Local vehicles (such as trucks, buses, jeeps, microbuses, cars, rickshaw vans, motorbikes, bicycles), as well as students and local people walking on the roads could result in traffic jams, especially during morning and evening times, as observed during field survey. The construction vehicles will add more traffic and as a result, traffic congestion and road accidents could increase. Traffic congestion may also occur if the stock piling of construction materials will be at the road sides.

265. ***Community infrastructure.*** There is a risk of damage to existing access roads due to the heavy load from trucks for transporting construction materials. The damages to the road or road surface will be restored or improved after the construction phase by the contractors.

266. ***Crop Production*****.** Currently, rice crops are being cultivated on these lands. The standing crops will be affected during the construction of tower bases and stringing. Further, there will be a small change in land use with up to 10.6 acres (4.3 ha) lost for tower foundations. Of the 691 tower sites, nearly all are on private land and few are on the Government land. During construction, activities will be phased to allow farmers to harvest standing crops and for construction storage and vehicle activity, barren areas will be identified.

267. ***Fish Habitat*****.** During construction activities of substations and tower bases there will be some impacts on floodplain fish habitat which predominates in the study area. In most cases, this loss will be only temporary.

268. ***Employment Opportunities and Income Generation*****.** During the 48-month construction phase, there will be a need for both skilled and non-skilled labor to build the tower pads, erect towers, and string conductors. Employment opportunities will be created for people in the immediate area, as well as in the country. Contractors will be encouraged to provide opportunities to local people. Jobs in construction and supporting industries will result in increased productivity and capital income of the people.

269. ***Land Price*****.** The value of land may be affected by the proximity of overhead transmission lines. On the other hand, land values in the general area are likely to increase because of the availability of additional power supply resulting in changes in land use from agriculture to commercial and industrial use.

270. ***Human Safety*****.** Risks for human safety during construction of the Project and operations are envisaged. During construction, the safety of workers, land owners and land users need to be protected. Appropriate safety measures will be required during construction and operation activities. Contractors and sub-contractors will be required to ensure safety for their works and implementation of appropriate measures; e.g., awareness programs, discussions, meetings, signage, posters to be displayed at construction sites, and personal protective equipment (PPE) where required. First aid and ambulatory service will be provided at work sites.

271. PGCB has emergency response measures in place and contractors will be obliged to develop a safety plan with identified safety measures to include a fire safety plan, electrocution safety plan, and medical emergency plan.

272. ***Objects of Cultural or Archaeological Importance*.** During construction, with many small construction sites along the line alignment, there is potential to unearth or discover objects of a cultural nature that will need to be protected. While there is no evidence of such sites within the study area, there are various tombs, temples and other sites in the country. It is, therefore, important to have a procedure in place to ensure that there is a mechanism in place to handle any material culture finds.

273. ***Occupational Health and Safety*.** Construction workers are more likely to face occupational health hazards such as minor or major injuries due to lack of general safety requirements and precautions applicable while working at construction sites, and handling machines and equipment, use of equipment and driving vehicles and so on. Poorly designed temporary labor camp and sanitation facilities may pose a health threat and nuisance to the workers. Uncontrolled vending of food and drinking water at work sites may also pose a risk with respect to the transmission of contagious diseases like typhoid, diarrhoea, malaria, and dengue in particular. Although presently the total ratio of affected people in Bangladesh with HIV/AIDS is far less than 0.1%, this percentage is slowly being increased due to injection drug users and overseas migrant workers returning to Bangladesh. Construction workers will be required to handle hazardous materials such as cement, bitumen, chemicals, fuels, and so on which will increase health risks if personal protective equipment is not used (as noted above).

274. ***Community Health and Safety*.** Improper health policies at work sites may lead to an outbreak of different diseases in the surrounding communities/public, if construction workers are sick. Further, construction vehicles will pose a risk to local communities. Traffic management will be required.

275. ***Employment Generation/Income*.** During construction, considerable quantities of workers (both male & female) may be required at various work sites. Some local people may also involve themselves in small businesses (e.g. tea stall, grocery shop, etc.). Local people can be involved in the project construction work as per their skills.

5.3.1.2 *Operation Stage*

276. ***Drainage Congestion*.** It is not expected that the tower foundations will impede drainage, given their relatively small size and location mostly away from watercourses.

277. ***Landscape*.** The transmission lines, mostly in rural areas, will change the appearance of the natural landscape. This is unavoidable but can be mnimised.

278. ***Hazardous waste.*** During the operation phase hazardous substances and oily waste might get leached through soil by precipitation of water and percolate to the ground water table, due to handling, disposal and oil spills in substation sites. This results in ground water pollution in nearby area. This situation will increase during the rainy season and have a critical impact on soil, surface and ground water. PCB is not used in substation transformers or other project facilities or equipment. Battery, transformer oils, and SF_6 should be stored at substation sites with appropriate care.

279. ***Collision of Birds with Overhead Wires*.** Collision of birds with overhead wires has been identified as one of the most significant impacts of transmission lines on avifauna. However, the preferred route passes through areas that are not particularly important for birds, which reduces the chance of collisions. On the other hand, wires and towers provide roosting areas for birds,

and some, such as kingfishers, and they will benefit from these perches such as being able to hunt fish from them.

280. Key Biodiversity Areas (KBAs) in Bangladesh have been identified based on the BirdLife Important Bird and Biodiversity Area (IBA) criteria, KBAs based on other taxa are yet to be identified. No KBAs are located in the project area. Birds migration routes are yet to be identified in Bangladesh (http://www.cms.int/sites/default/_files/document/inf_04_8_bangladesh_0.pdf.). There seem to be virtually no studies on bird migration, bird ringing has only started recently, some as part of an avian influenza surveillance programme (http://eaaflyway.net/building-capacity-for-waterbird-ringing-in-bangladesh/). Bird migration is not discussed in IUCN-Bangladesh Red Data Book (2015) Vol.3. (https://portals.iucn.org/library/sites/library/files/documents/RL-549.3-003-v.3.pdf).

281. ***Community Health and Safety*.** The transmission lines should not pose a hazard to local communities, as long as they do not climb them. Community health and safety, placement of safety signages within the vicinity, monitoring of encroachers near transmission towers, awareness training will be provided to the people in the vicinity.

282. ***Occupational Health and Safety*.** Workers specially engaged for tower and line maintenance will have to be especially careful with their work and will require full protection equipment, depending on the tasks.

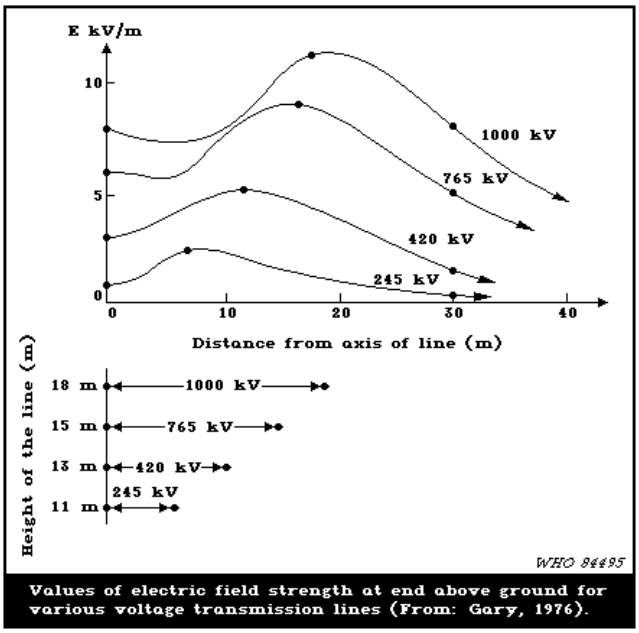
283. ***Short Circuit/Accident*.** Collapse of towers (possibly during a cyclone) and broken lines could pose a risk to local communities. Information and public awareness programs can reduce this risk.

284. ***EMF (electromagnetic field)*.** Overhead lines produce both electric and magnetic fields. Electric fields are created by differences in voltage. The strength of the electric field is measured in kilovolts per meter (kV/m). Any electrical wire that is charged will produce an associated electric field. This field exists even when there is no current flowing. The higher the voltage, the stronger the electric field at a given distance from the wire. Magnetic fields are created when electric current flows; the greater the current, the stronger the magnetic field. Electric fields are strongest close to a charge or charged conductor, and their strength rapidly diminishes with distance from it. Magnetic fields arise from the motion of electric charges. The strength of the magnetic field is measured in micro tesla, µT.

285. Health concerns over exposure to EMF are often raised when a new transmission line or substation is proposed. However, in spite of all the studies that have been carried out over the past 30 years, there is still no persuasive evidence that the fields pose any health risks. Rehabilitation of existing power lines is unlikely to increase EMF, but new lines may induce EMF. The transmission and LILO lines will traverse some populated areas. Therefore, inspection of existing EMF along the selected routes of existing and new transmission lines in populated areas would be important.

286. World Health Organization (June 2007) recommends using exposure guidelines published by the International Commission on Non Ionizing Radiation Protection (ICNIRP). The ICNIRP (2010) has set the limits at 50 HZ for the public exposure as: (1) electric field strength (kV per meter) is 5 kV/m, and (2) magnetic field strength (micro tesla) is 200 µT (equivalent to 160 A/m); while for the occupational exposure as: (1) electric field strength is 10 kV/m and (2) magnetic field strength is 1000 µT.

287. Based on the literature review[10, 11], the maximum electrical field generated by the 400 kV double circuit line is estimated at 5 kV/m, around the distance of 11 m from axis of line, equivalent to the 5 kV/m safe limit for public specified by ICNIRP. The maximum magnetic field generated by the proposed new lines is estimated to be 81.942 µT at the nearest distance from the line, below the 200 µT limit specified by ICNIRP. Thus, any residents living underneath or very close to the proposed transmission lines are not expected to be exposed to an environment above EMF limits. Community health and safety, placement of safety signages within the vicinity, monitoring of encroachers near transmission towers, awareness training will be provided to the people in the vicinity.



Values of electric field strength at end above ground for various voltage transmission lines (From: Gary, 1976).

288. ***Improvement of Social and Economic Life*.** Due to an increase of power transmission capacity and reliability of power supply, the social life and economic condition of the people will be improved.

5.3.2 Substations

5.3.2.1 *Pre-construction/Construction Stage/Operation Stage*

289. A substantial loss of agricultural lands 100 acres (40 ha) is anticipated for the proposed three substations in Gopalganj, Bogra and Rohanpur and it is higher than the combined area required for the 691 towers in transmission lines. None of these sites are in natural habitats. All the elements described above for the transmission lines will apply to the substation construction and operation activities, and so are not repeated here. Especially important will be waste management and site drainage during operation of the substations, to prevent soil and water pollution. All sites will also require secure fencing to maintain local community safety (no entry possible).

[10] Extremely Low Frequency (ELF) Fields (http://www.inchem.org/documents/ehc/ehc/ehc35.htm) published by WHO 1984.

[11] Abu Izzeddin Salma, Berbari Kamal and Obeid Hiba. 2006. *Electromagnetic Field from Power Lines*. American University of Beirut.

6. ANALYSIS OF ALTERNATIVES

290. At the planning stage itself, one of the factors that governs the establishment of the transmission line sub-projects is the possible infringement of populated, forested and cultivated lands. Wherever such infringements are substantial, different alternative options are to be considered. During the route alignment, all possible efforts are made to avoid populated, forested and cultivated areas (completely, if possible, or to keep infringement at a minimum). Wherever it becomes unavoidable due to the geography or terrain, mitigation costs required handle the issue need to be worked out. While identifying the transmission system for a generation project, preliminary route selection is done by PGCB, based on the interpretation of maps and walk-over surveys, according to the topographical and Google maps of the area.

291. Activities like construction of transmission lines and subsequent operations and maintenance are generally non-polluting in nature; environmental impacts are usually minimal, generally restricted to RoW only, and further, usually only confined to the tower foundations. Another feature which is also very crucial in making this statement is the inherent flexibility available in alignment of power transmission lines and locating substations, which helps in avoiding environmentally sensitive areas such as fragile ecosystems with their inherent biodiversity, and also dense human areas and areas of cultural significance.

292. All the potential environmental impacts of transmission lines can be avoided or mitigated through careful route and site selection as explained above. Keeping this aspect in mind, due consideration has been provided in deciding the route alignment, including study of different alternatives for the proposed transmission lines under the scope of the project.

6.1 Transmission and LILO Lines

293. PGCB usually undertakes route selection for transmission lines in close consultation with representatives from government agencies and the local community. Although under National law PGCB has the right of way, yet it considers alternative alignments during site selection, with minor alterations often added to avoid environmentally sensitive areas and settlements at the implementation stage. For selection of the optimal route, the following points are taken into consideration:

i) As a principle, alignments are generally sited at least 500 m away from major towns, whenever possible, to account for future urban expansion and at least 50 m away from any houses or structures.

ii) The route of the proposed transmission lines avoids human habitation as far as possible. Also, the proposed route of a transmission line does not create any threat to the survival of any community with special reference to indigenous/ tribal communities.

iii) Similarly, plantations/forests are avoided to the maximum extent possible. When it is not possible, a route is selected in consultation with the Forest Department that causes minimum damage to existing plantation/forest resources.

iv) Alignments are selected to avoid wetlands and unstable areas for both financial and environmental reasons. In addition, care is taken to avoid/ minimize any protected areas (national parks, sanctuaries, and other declared protected areas/ ecologically sensitive areas rich in biodiversity).

6.2 Grid Substations

294. For selection of appropriate sites for substations, the following points are taken into consideration:

i) Construction activities do not adversely affect the population living near the proposed substations and does not create any threat to the survival of any community with special reference to indigenous, tribal community etc.
ii) The location of the substation does not affect any monument of cultural or historical importance.
iii) No resettlement of households by the substation site, no loss of livelihoods, siting of transformers away from schools, hospitals and other sensitive receptors, with due consultation with the community and local government units concerned.
iv) Transformers and other equipment specifications compliant with government rules/regulations and International Electro-Technical Commission standards shall be followed.
v) Construction techniques and machinery selection shall be made with a view to minimize ground disturbance.
vi) While planning for substations, drainage lines shall also be marked and studied to avoid seepage/leakages and pollution of water sources and springs etc.
vii) Substation location/design to ensure that noise will not be a nuisance to neighbouring properties. Provision of noise barriers near substation sites will be made.
viii) Substation design will comply with the limits of electromagnetic interference within the floor area. Security fences will be erected around substations. Warning signs shall be displayed.
ix) PGCB shall adopt good practices and shall always strive for a high standard of house-keeping for its substations and ancillary facilities.
x) PGCB shall incorporate the best technical practices to deal with environmental issues in its workings.
xi) Site selection should consider seismicity and geography of the local area; the area should not be prone to landslides or be unstable.
xii) Design of substations shall be made to include modern fire control systems/firewalls. Provision of fire-fighting equipment would be made to be located close to transformers, switchgears etc.

6.3 Evaluation of Alternatives

6.3.1 Evaluation of Alternative Route Alignments of 230 kV Transmission Line from Barisal (North)-Gopalganj (North)-Faridpur, 126 km

295. Three different alignments were studied (refer to Figure 6.1 and Figure 6.2) with the help of published data/Google maps and a walkover survey to arrive at the optimal route for detailed surveying. The comparative details of these three alternatives in respect of the proposed line are given in Table 6.1.

Table 6.1: Details of Three Alternatives

Sl No.	Description	(I) PGCB line	(II) PGCB+ RMA line	(III) Revised PGCB line
1.	Route particulars:			
	(i) Length (km)	73.2+47.0	74.2+47.3	74.7+47.7
	(ii) Terrain- Plain/Hilly	Mostly flat	Mostly flat	Mostly flat
2.	Environmental Impact:			
	(i) Residential dwellings	>1,000	>500	243
	(ii) Common properties	22	12	03
	(iii) No. of affected households	>525	450	210
	(iv) Towns in alignment	None	None	None
	(v) Forest areas/Protected areas	None	None	None
	(vi) Historical/Cultural monuments	Not found	Not found	Not found
	(vii) Endangered species, if any	None	None	None
	(viii) Affected trees (fruit/non-fruit/timber)	1,355,740	36,248	34,476
3.	Major Crossings:			
	(i) River (Nos.)	3	3	3
	(ii) Power lines (Nos.)	2	0	0
	(iii) Railway line (Nos.)	0	0	0
	(iv) Highways (Nos.)	8	12	12
	(v) Khal (Nos.)	10	10	10
4.	Construction problems	Number of Settlements, a large number of homesteads	Settlements, homesteads	Few homesteads
5.	O&M problems	High	Moderate	Comparatively easier

O&M = operations and maintenance, RMA = Resource Management Associates (Pvt) Ltd.

6.3.1.1 *Conclusion and Recommendation*

296. **Settlements and affected trees in the RoW.** Many settlements and trees in the RoW were recorded in Alternatives I and II during the field survey. Therefore, deviation to the line has been studied to select the final alignment, Alternative III.

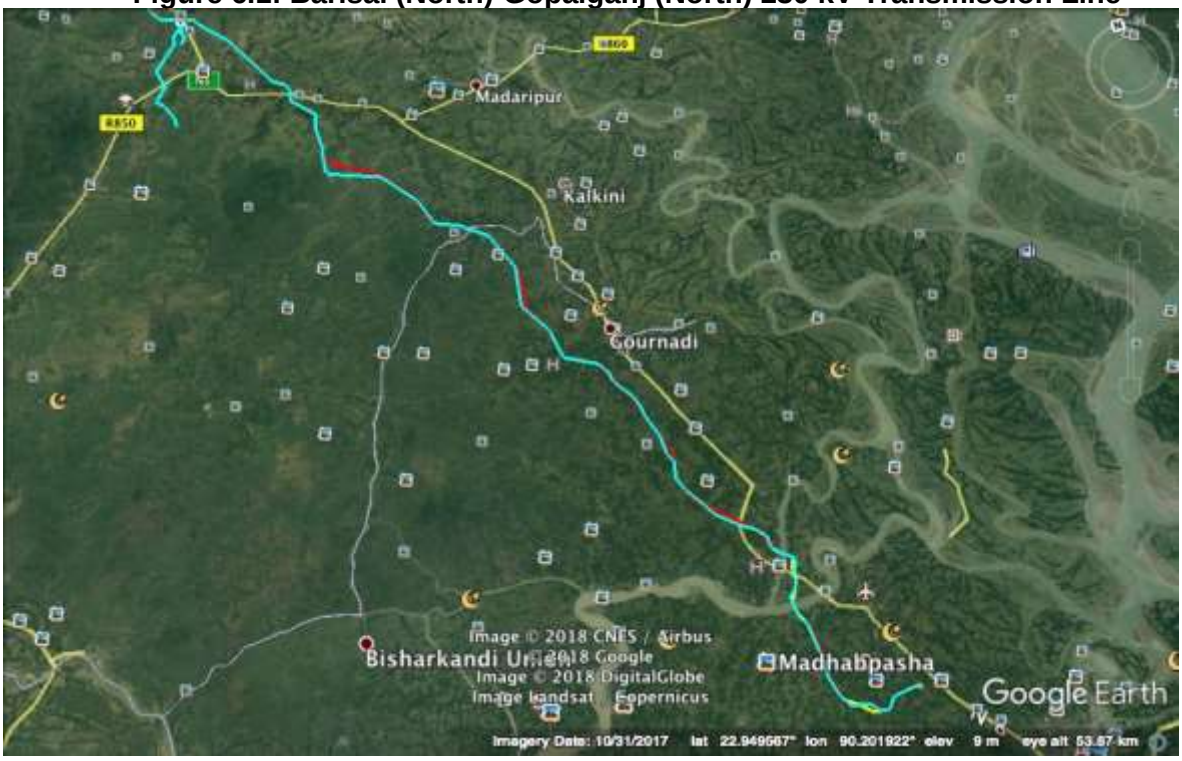
297. **Forest.** Natural forest/ forest reserves or protected areas are not found in all three alternatives.

298. **Terrain Condition and Accessibility.** All the three alternatives are passing through flat land/ plain area and have full accessibility (roads, cart-tracks) for construction and maintenance purposes.

299. **River/Khal Crossing.** The Alternative III is optimal, as it has a minimum number of khal crossings, and river crossings have a minimum span as compared to other alternatives.

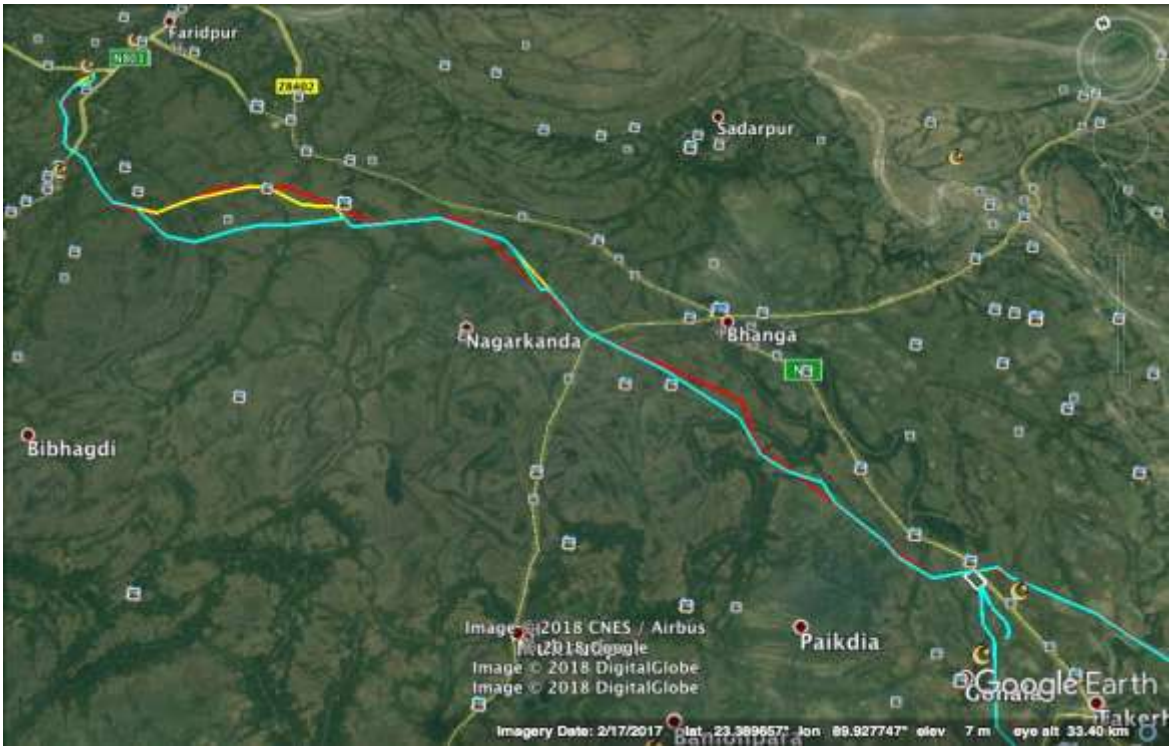
300. Based on the above analysis, Alternative III has been found to be the optimal alignment and was recommended for detailed survey.

Figure 6.1: Barisal (North)-Gopalganj (North) 230 kV Transmission Line



3 Alternatives [red-initial alignment by PGCB, yellow-RMA line, cyan-PGCB revised line (final alignment)]

Figure 6.2: Gopalganj (North)-Faridpur 230 kV Transmission Line



3 Alternatives [red-initial alignment by PGCB, yellow-RMA line, cyan-PGCB revised line (final alignment)]

6.3.2 Evaluation of Alternative Route Alignments of 400 kV Transmission Line Alignments from Bogra (West)-Rohanpur (104 km) and 132 kV Line from Rohanpur-Chapainawabganj (26km)

301. Two different alignments were studied (Figure 6.3 and Figure 6.4) with the help of published data/Google maps and a walkover survey to arrive at the optimal route for detailed survey. The comparative details of these two alternatives in respect of the proposed line are given in the Table 6.2.

Table 6.2: Details of two alternatives

Sl No.	Description	(I) Initial PGCB line	(II) Revised PGCB line
1.	Route particulars:		
	(i) Length (km)	103	104
	(ii) Terrain- Plain/Hilly	Mostly flat	Mostly flat
2.	Environmental Impact:		
	(i) Residential dwellings	31	26
	(ii) Common properties	0	1
	(iii) No. of affected households	29	24
	(iv) Towns in alignment	None	None
	(v) Forest areas/ Protected areas	None	None
	(vi) Historical/ Cultural monuments	Not found	Not found
	(vii) Endangered species, if any	None	None
	(viii) Affected trees (fruit/non-fruit/timber) mostly	1,185	1,180
3.	Major Crossings:		
	(i) River (Nos.)	2	4
	(ii) Power lines (Nos.)	0	0
	(iii) Railway line (Nos.)	4	2
	(iv) Highways (Nos.)	13	13
	(v) Khal (Nos.)	4 (approx.)	3 (approx.)
4.	Construction problems	Few settlements	Few settlements
5.	O & M problems	High	Comparatively easier

km = kilometer, O&M = operations and maintenance, PGCB = Power Grid Company of Bangladesh.

6.3.2.1 *Conclusion and Recommendation:*

302. **Settlements and affected trees.** The number of affected households and trees in the RoW is low in both alternatives.

303. **Forest.** The forest involvement in both alternatives is nil.

304. **Terrain Condition and Accessibility.** Both alternatives are passing through plain area. However, Alternative II has full accessibility (roads, cart-tracks) for construction and maintenance purpose, in comparison to other routes.

305. **River/ Khal Crossing.** The Alternative I have a minimum number of river/khal crossings; however, the number of affected households is slightly higher.

306. Based on the above analysis, Alternative II has been found to be the optimal alignment and recommended for detailed survey.

Figure 6.3: Bogra (West) Substation Land and LILO Line (Bogra (South)-Barapukuria 11 km)

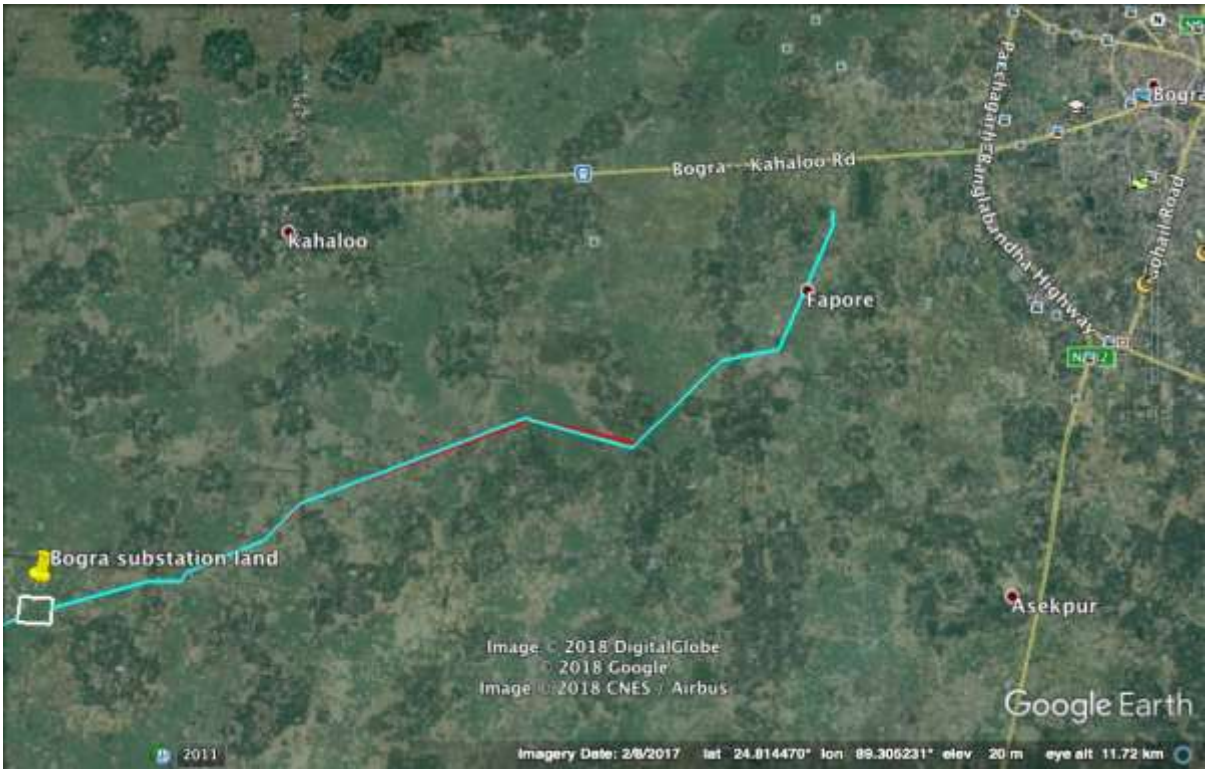


Figure 6.4: Bogra (West) Substation and 400 kV 104 km Transmission Line

Rohanpur-Chapainawbganj 26 km 132 kV line 2 Alternatives

6.3.3 Evaluation of Alternative Route Alignments of LILO of 132 kV Transmission Line

307. The two items include:

i) Construction of a 1 km long line-in line-out connection from the Niamatpur-Chowdala 132 kV line to the Rohanpur 400 kV/132 kV substation; and
ii) Construction of a 11 km long line-in line-out connection from Bogra (South)-Barapukuria existing 230 kV transmission line to the Bogra (West) substation.

308. The length of the LILO line connecting to the Bogra (West) proposed substation is 11 km (Bogra (South)-Barapukuria) and the length of the LILO line connecting to Rohanpur proposed substation is 1 km (Niamatpur- Chowdala). Due to short line length of 1 km through agricultural lands, the associated environmental and social impacts are negligible. Therefore, the evaluation of alternative route alignments was not carried out. The selected route of 11 km LILO line mainly traverses paddy fields and the households and trees affected by the RoW are kept at a minimum. Therefore, finding alternative routes was not required, as anticipated environmental and social impacts are not substantial.

6.3.4 Analyses of Alternatives for Selection of Substations

309. For substation site selection, initially PGCB selected three alternative sites, based on environmental and social aspects and technical requirements. Such analysis considers various site-specific parameters that include availability of infrastructure facilities such as access roads, water, distance from railways, type of land (government/private land), and social impacts, such as number of families affected, common property resources, including feasibility of acquisition.

310. By considering certain issues during project formulation, it is often possible to reduce or eliminate some of the possible negative environmental impacts during both the construction and operational phases of a project. For example, efforts to avoid, where possible, critical homestead areas or crossing of rivers/hills/bamboo groves with the substation subprojects could greatly reduce negative impacts during construction and operational phases. Such considerations at the project formulation stage greatly reduce the possible negative impacts and facilitate proper environmental management of a project. Many such environmental and social issues to be considered for substation subprojects were identified and these issues were addressed during the project formulation stage, as a part of overall environmental management.

- Use of government-owned land or vacant/fallow (non-productive) land for construction of substation, where possible.
- Use of land located at proximity to existing power lines/load centers, and road network (for easier transportation of material and equipment), where available.
- Avoiding lands that are susceptible to inundation/ storm surge.
- Avoiding ecologically and socially critical areas while selecting land for substations.
- Use of Gas Insulated Switchgear (GIS) instead of Air Insulated Switchgear (AIS), to reduce the land requirement for a substation and avoid possible generation of toxic fumes in the control building, due to flashover inside the AIS (especially under high humidity and saline conditions).
- Ensuring purchase and installation of polychlorinated biphenyl (PCB)-free new transformers.
- Treating PCB contained in old transformers using available technologies; namely, super critical oxidation, electro-chemical oxidation, solvated electron technology, chemical reduction method, dehalogenation process, and thermal desorption using pyrolysis, catalyzed dehalogenation and vitrification before disposal.
- Designing substations considering maximum flood level and considering wind speed and earthquake load suggested in the Bangladesh National Building Code.
- Considering the above issues and site inspection/verification, the proposed substation subproject land has been selected and finalized. The selected location for the substation subprojects is given below. The social aspects were provided due weightage after technical requirements in decision making for selection/finalization of land for substation. The details of the selected sites for proposed substations are given in Table 6.3.

Table 6.3: Extent and Coordinates of Three Substations

SNo.	Name of Substation	Area (Acre)	Location	Existing Land use	Remarks
1.	Gopalganj (North) 400/132 kV Substation	60	Gopalganj 23.276822 90.011056	Agriculture/ paddy land	Adjacent to the Faridpur- Barisal highway
2.	Bogra (West) 400/230 kV GIS substation	20	Bogra 24.788620 89.244815	Agriculture paddy land	
3.	Rohanpur 400/132 kV GIS substation	20	Rohanpur 24.784168 88.331446	Agriculture paddy land	

GIS = gas insulated switchgear, kV = kilovolt.

Table 6.4: Summary of Final Alternatives Taken for Project Consideration

SN	Project Component	Alternative Chosen	Reason
01	Increasing Power Delivery Capacity at Gopalganj		
	Gopalganj (North) 400/132 kV Substation	60 acres (24 ha) paddy/ agriculture land	To avoid the settlements, forests, plantations, urban areas
02	Expansion of Transmission Network in Southern Bangladesh		
	Barisal (North)- Gopalganj (North)- Faridpur 230 kV transmission line, 74.7 km+ 47.8 km	Alternative III- Revised PGCB	To avoid the line through the settlements, homesteads, croplands and urban areas as much as possible
	Augmentation Barisal (North) substation	Existing Grid Substation	
	Augmentation of Faridpur substation	Existing Grid Substation	
03	Expansion of Transmission Network in Western Bangladesh		
	Bogra (West)- Rohapur 400 kV transmission line, 104 km and Rohanpur-Chapainawabganj 132 kV transmission line, 26 km	Alternative II- Revised PGCB	To avoid the settlements, to avoid homesteads, croplands and urban areas as much as possible
	Bogra (West) substation	20 acres (8 ha) paddy/ agriculture land	To avoid the settlements
	Rohanpur substation	20 acres (8 ha) paddy/ agriculture land	To avoid the settlements
	Augmentation of Chapainawabganj substation	Existing Grid Substation	
	LILO from Bogra (South)-Barapukuria 230 kV line to Bogra (West) substation, 11 km LILO from Niamatpur-Chowdala 132 kV line to Rohanpur substation, 1 km	The final alignment traverses mainly via agricultural/paddy fields	To avoid the home gardens, villages and urban areas as much as possible

311. For some of the project components, PGCB is in the process of collecting additional information and has taken up detailed survey with the Center for Environmental and Geographic Information Services to prepare the EIA report to be approved by the DoE. These alternative transmission line alignments and substation sites will be studied by the PGCB officials in detail for least techno-economic costs and least environmental and social impacts before they are proposed to ADB for funding. Total land requirement for project components is given in Table 6.5.

Table 6.5: Project Component, Land Area and Ownership of Land in Transmission Line RoW and Substations

SNo	Project component	Total land area	Private land	Government land
01	Increasing Power Delivery Capacity at Gopalganj			
	Gopalganj (North) 400/132 kV Substation	60 acres (24 ha)	yes	-
02	Expansion of Transmission Network in Southern Bangladesh			
	Barisal (North)-Gopalganj (North)-Faridpur 230 kV transmission line (126 km)	RoW land area, 1245 acres (504 ha, 40 m RoW)	yes	-
	Augmentation Barisal (North) substation	Existing GSS	-	PGCB
	Augmentation of Faridpur substation	Existing GSS	-	PGCB
03	Expansion of Transmission Network in Western Bangladesh			
	Bogra (West)- Rohanpur 400 kV transmission line (104 km) and Rohanpur-Chapainawabganj 132 kV transmission line (26 km)	RoW land extent 1181 acres (478 ha, 46 m RoW) RoW land extent 180 acres (72.8 ha, 28 m RoW)	yes	
	Bogra (West) substation	20 acres (8 ha)	yes	
	Rohanpur substation	20 acres (8 ha)	yes	
	Augmentation of Chapainawabganj substation	Existing GSS		PGCB

GSS = grid substation, ha = hectare, km = kilometre, kV = kilovolt, m = meter, PGCB = Power Grid Company of Bangladesh, RoW = right of way.

6.3.5 Reasons for the Final Selection

312. Considering the various reasons based on information in Table 6.1–Table 6.5, the alternatives selected were found to be the most suitable as they involved lesser populated area, few homesteads in the RoW and in the immediate surroundings, no infringement of environmentally sensitive area, plantation/forest reserves, and minimal RoW problems.

7. INFORMATION DISCLOSURE, CONSULTATION AND PARTICIPATION

313. Information disclosure and public consultations were undertaken during the preparation of the IEE to provide information about the concept of the project, environmental issues or inconveniences associated with the project during the construction stage and to obtain the views of members of the immediate community and interested and project affected persons (PAPs) within the sites' immediate areas of influence. The consultations were done with randomly selected people in the neighbourhood of the proposed sites and involved use of a semi-structured public participation form.

314. The public consultation was conducted during November and December 2017 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.

7.1 Consultations with Stakeholders

315. The stakeholder consultations followed a participatory planning process in order to gain local inputs in decision-making and policy development regarding compensation and social development in the Project area. This chapter also focuses on plans for future consultations during the project implementation stage, including information sharing and disclosure meetings among the stakeholders.

7.2 Project Stakeholders

316. Prior to the consultation meetings, a mapping of the relevant stakeholders was conducted to identify both primary and secondary stakeholders of the project (Figure 7.1 Stakeholder Mapping).

Figure 7.1: Stakeholder Mapping

317. The primary stakeholders for consultations include all directly affected persons such as HH's that will be displaced due to the construction of transmission lines, title owners losing land for substations in Bogra, Gopalgonj and Rahanpur and squatters cultivation on proposed substation land or residing under the proposed lines, as well as indirectly affected persons and communities'/host villages. Women, children, physically handicapped or disabled are especially vulnerable and were therefore consulted separately through Focus Group Discussions (FGDs). The section on the socio-economic baseline highlights their status and the need for additional support. A summary description of primary and secondary stakeholders is presented in Table 7.1.

Table 7.1: Description of Primary and Secondary Stakeholders

A. Project Owner	**B. Government of Bangladesh**
The Project Director, The Project Team	Key ministers from the area, Key Ministers with relevant portfolio
C. Affected Persons (Directly/Indirectly Affected)	**D. Financiers/Development Partners**
- Land owners on the right-of-way for transmission lines and sub-stations - Households living within RoW who are non-titled, vulnerable groups, poor and female-headed households - Host area villagers	ADB, the Consultants, other development partners with past, current or future projects in the area, related infrastructure Development Partners with interest in the area.
E. Local Administration	**G. Implementing NGOs and Contractors**
Deputy Commissioner of Gopalgonj, Chapai Nawabganj, Barisal and Bogra, Upazila level land offices, Union level revenue offices, Local union parishad	Implementing NGO, other local partner NGOs in health, microfinance and education or safety net, Rights and Activist NGOs, and contractors of different packages
H. Media	
Local media, National media	

7.3 Methodology

7.3.1 Approach

318. A systematic step-wise approach guided the consultation meetings starting from disclosing the project interventions to the understanding of the area and the perceptions of the people in the Project area.

- First, conducted consultation meeting with the potential affected households due to construction of grid lines and households those will be affected due to the substation land acquisition.
- Second, the team made efforts to understand the baseline conditions including the history of energy consumption as well as the development of the grid lines and substation construction
- Third, the listing of the key issues related to project impacts and mitigations became the focus of the consultation meetings.
- Fourth, attention was paid to the women and the very poor through separate focus groups discussions.
- Finally, the consultation team assessed the responses and attitudes of the people to the Project impacts and planned mitigation measures.

7.4 Tools and Process Used

319. Multiple tools and methods have been used during the consultation meetings. These include: Key Informant Interviews; FGDs with various occupational/interest groups; Stakeholder Consultation Meetings, Issue Specific Consultation Meetings; and Information and Communication Meetings.

320. The use of a wide range of methods helped to fully involve all types of stakeholders and engage them in meaningful consultations. Some of the participatory rural appraisal tools used during community consultation meetings included group discussion, participatory mapping and seasonality (Table 7.2).

321. The team carried out open meetings and FGDs in each substation location and conducted consultations with potential affected households under proposed grid lines. FGDs were conducted with identified community groups, occupational groups as well as vulnerable groups. The location and number of participants at public consultations and gender consultations are given in Table 7.3 and Table 7.4.

Table 7.2: Tools Used in Consultation Meetings

Tools	Methods
Group Discussion and Data Analysis	Project data review
	Identification of impacts – checklist
	Local history, stories, local knowledge, social-classification
	Direct and participants' observations
	Analysis of group discussion and ranking of issues
Participatory Mapping	Village/social mapping
	Resource mapping
	Historical and future vision mapping
	Mobility mapping, including women
	Gender relations and work matrix
Seasonality	Village profile
	Seasonal activity and timeline
	Livelihood analysis
	Impacts of grid lines construction
	Positive impacts
	Negative impacts
	Potential mitigation measures
	Community/social network analysis

Table 7.3: Locations and Number of Participants at Public Consultations

Location	Date	No. of Participants		Total participants
		Male	Female	
Barisal (North)-Gopalganj (North)-Faridpur 230 kV Transmission Line (TL) and 400 kV Gopalganj (North) Substation				
Shikarpur, Ujirpur, Barisal TL	25.11.17	6	11	17
Chandrapara, Khanpura, Madhobpasha, Barisal TL	24.11.17	3	10	13
Fulsuti Union parishad, Fulsuti, Nagorkanda, Faridpur TL	27.11.17	34	0	34
Talma Union Parishad, Talma, Nagorkanda, Faridpur TL	30.11.17	29	5	34
Chagolchira, Raghdi, Muksudpur, Gopalganj Substation	24.11.17	33	1	34
Bogra (West)-Rohanpur 400 kV Transmission Line (TL) and 400 kV Bogra (West) Substation				

Location	Date	No. of Participants		Total participants
		Male	Female	
Nurul Islam House, Magura, Maloncha, Kahalu, Bogra Substation	15.12.17	13	0	13
Nazrul Islam House, Magura, Maloncha, Kahalu, Bogra Substation	16.12.17	15	0	15
Ratnagari, Jamgram, Kahalu, Bogra Substation	15.12.17	13	3	16
Md. Kuddus House, Magura, Maloncha, Kahalu, Bogra Substation	22.12.17	29	0	29
Gangjuar, Chundipur, Nawga Sadar, Nawga TL	19.12.17	18	16	34
Rohanpur-Chapainawabganj 132 kV Transmission Line (TL) and 400 kV Rohanpur Substation				
Belpukur, Kashba, Nachol, Chapainawabganj TL	23.12.17	37	0	37
Noagola, Pourashava, Chapaisadar, Chapainawabganj TL	18.12.17	28	0	28
Chandana, Kashba, Nachol, Rohanpur, Chapainawabganj Substation	15.12.17	36	0	36
Chandana, Kashba, Nachol, Rohanpur, Chapainawabganj Substation	23.12.17	74	0	74

Table 7.4: Locations and Number of Participants at Gender Consultations

Location	Date	No. of Participants		Total participants
		Male	Female	
Barisal (North)-Gopalganj (North)-Faridpur 230 kV Transmission Line (TL) and 400 kV Gopalganj (North) Substation				
Birpasha, Babuganj, Madhobpasha, Barisal TL	23.11.17	1	11	12
Mondrupasha, Shikarpur, Ujirpur, Barisal TL	26.11.17	5	9	14
Baroikhali, Madhobpasha, Babuganj, Barisal TL	24.11.17	3	7	10
Fulsuti Union Parishad, Fulsuti, Nogarkanda, Faridpur TL	27.11.17	2	23	25
Talma Union Parishad, Talma, Nogarkanda, Faridpur TL	30.11.17	0	23	23
Chagolchira Adarsha High School, Chagolchira, Ragdhi, Moksudpur Gopalganj Substation	24.11.17	0	17	17
Bogra (West)-Rohanpur 400 kV Transmission Line (TL) and 400 kV Bogra (West) Substation				
Gangjuar, Chundipur, Nawga Sadar, Nawga TL	18.12.17	0	31	31
Rohanpur-Chapainawabganj 132 kV Transmission Line (TL) and 400kV Rohanpur Substation				
Manpur, Kashba, Chapaisadar, Chapainawabganj TL	18.12.17	0	17	17
Chandana, Kasba, Nachol, Chapainawabganj, Substation	14.12.17	0	31	31

Table 7.5: Locations and Number of Participants at Focused Group Discussions on Environment

Location	Date	No. of Participants		Total participants
		Male	Female	
Barisal (North)-Gopalganj (North)-Faridpur 230 kV Transmission Line (TL) and 400 kV Gopalganj (North) Substation				
Talma Union Parishad, Talma, Nogarkanda, Faridpur TL	30.11.17	10	0	10
Chagolchira Adarsha High School, Chagolchira, Ragdhi, Moksudpur Gopalganj Substation	24.11.17	14	0	14
Bogra (West)-Rohanpur 400 kV Transmission Line (TL) and 400 kV Bogra (West) Substation				
House of Md. Awlad Hossen, Magura, Kahaloo	15.12.17	13	0	13
Rohanpur-Chapainawabganj 132 kV Transmission Line (TL) and 400 kV Rohanpur Substation				
Manpur, Kashba, Chapaisadar, Chapainawabganj TL	18.12.17	17	0	17

7.5 Summary of the Focus Group Discussions on Environment

322. Four focal group discussions on environment were held in Noagola village (Chapainawabganj district), Magura village (Bogra), Talma village (Faridpur) and Chagolchira village (Gopalganj) during November and December 2017, while the field team were carrying out the inventories and data collection on social aspects. Details of focus group discussions are given in the Annex 4, and the photographs are in Annex 5. The main points are summarized below:

i) People in Chapai and Borga area came to know about the project from the ADB consultants (RMA) field team. Some people in Gopalganj and Faridpur area were already aware of the project.
ii) People are in favor of the project, but they request proper compensation for the trees and structures, if affected. They also said that PGCB normally do not pay compensation for the trees. Every year they cut the branches of the trees, thus the fruit-bearing trees lose the yield.
iii) They have also raised the issue of cutting lots of trees which will impact the environment. These trees save them during the cyclone and natural disasters. So, the project should give them additional compensation to plant new trees. If one tree is cut down, the project should provide them with funds to plant 3 trees. This can be used as a livelihood restoration plan.
iv) People want the project to take necessary steps during thunder storms to avoid the impact of lightning. It might cause injury or death to the farmers during the rainy season.
v) There are no protected sites or environmentally sensitive areas within the project area.
vi) Mango in Chapainawabganj and Bogra are famous in Bangladesh. People requested not to cut any mango trees, if possible. Their livelihood mainly depends on selling the mangoes each year.
vii) People wanted to make sure that tower construction does not create any negative impacts on river flow or fish migration.
viii) No presence of indigenous people in the project area. Nearest presence of tribal people is 3 km away from Rohanpur substation.
ix) Grasslands will not be affected due to the activities of the project.
x) In summary, people asked for proper compensation for the trees that are affected due to the project activities. The PGCB contractors cut branches of remaining trees adjacent to the transmission lines every year without paying any compensation and people are not happy with this practice.

323. Awareness of child labor issues and the contractors' obligation to adhere to core labor standards will be further strengthened through trainings together with HIV/AIDS awareness improvement trainings.

8. GRIEVANCE REDRESS MECHANISM

8.1 Objectives of Grievance Redress Mechanism

324. PGCB will ensure that local people can express their legitimate grievance or file a complaint about the Project by establishing a process to address issues raised. This can be achieved by careful implementation of the EMP, continuing consultation and communication with stakeholders during implementation by PGCB, the project management unit (PMU) of PGCB, various contractor(s), and local government authorities. Contact details of the PMU for filing complaints will be posted in villages in the project area.

325. The Grievance Redress Mechanism (GRM) is a locally based, project-specific extra-legal way to deal with and resolve complaints and grievances faster and thus enhance project performance standards in terms of environmental, social and resettlement management.

326. The fundamental objectives of the GRM, implemented through a Grievance Redress Committee (GRC) serving as a para-legal body, are to resolve any environmental and resettlement related grievances in consultation with the aggrieved party to facilitate smooth implementation of social and environmental plans and establish accountability of the affected people.

8.2 Guidelines to Redress Grievances

327. PGCB will establish a procedure to deal with and resolve queries as well as address complaints and grievances. A policy and/or guideline will be prepared and adopted for assessing and mitigating potential social and environmental impacts through the GRM. A GRC will be formed to receive and resolve complaints as well as grievances from aggrieved persons from the local stakeholders including the Project-affected persons. Based on consensus, the procedure will help to resolve issues/conflicts amicably and quickly, saving the aggrieved persons from having to resort to expensive, time-consuming legal actions. The procedure will, however, not prevent a person's right to go to the courts of law. The GRC will be established through a gazette notification from the Ministry of Power, Energy and Mineral Resources; therefore, the GRC will be a legally constituted body.

8.3 Complaints and Grievance Mechanism

328. Affected persons may appeal any disagreeable decision, practice or activity arising from land and assets and from grid line construction related activities to the grievance redress committee. Affected persons will be fully informed of their rights and of the procedures for addressing complaints, whether verbally or in writing during consultation, survey, and time of compensation.

329. The project planning and implementation will be cautious enough and provide advance counselling and technical assistance to the affected persons in the land acquisition and compensation collection process to prevent grievances. This will be ensured through careful land acquisition and resettlement design and implementation, by ensuring full participation and consultation with the affected persons, and by establishing extensive communication and coordination between the affected communities, PGCB, contractors and local governments in general.

8.4 Grievances Redress Committees

330. Due to the nature of the project, there will be two project directors in this project. One project director will be for the Gopalganj (North) substation, and another project director will be for the transmission line construction of the Barisal (North)-Gopalganj (North)-Faridpur and Bogra (West) and Rohanpur substation, together with the Bogra (West)-Rohanpur-Chapainawabganj transmission line construction. So, under each of the three work areas, supervised by two different project directors, the following structures and processes will be followed in the formation of GRCs.

331. According to the Grievance Redress Mechanism, three levels will be established: **GRM – Level 1:** Level 1 of the GRM will be the project officer appointed by PGCB to a specific construction site to supervise and monitor the civil works of the contractor. He can be the line engineer, or any other officer appointed by PGCB to a specific site. In case of grievances that are urgent and minor, aggrieved parties can easily approach PGCB's field officer. Contact phone numbers and names of the concerned field officer will be posted at all construction sites at visible locations. The field officer will record the complaint, name of the complainant and the date of complaint. The field officer will communicate with the relevant persons and agencies implicated in the complaint including the contractor and will try to reach an amicable settlement within a period of two weeks. **GRM – Level 2:** Level 2 of the GRM will be the Local Grievance Redress Committee (LGRC) chaired by the Project Director appointed for individual subprojects. The project will appoint two project directors, one for Gopalganj (North) substation subproject, and the second for the transmission lines of Barisal (North)-Gopalganj (North)-Faridpur and Bogra (West) and Rahanpur substation together with Bogra (West)-Rahanpur-Chapainwabganj grid line construction. The rest of the members of the GRC will include (i) the executive engineer of the project; (ii) contractor or his representative; (iii) a male and a female member of the concerned Union; (iv) a representative of the DC; and (iv) a representative of the aggrieved party (the representative should be a female if the aggrieved party is a female). Grievances that cannot be resolved at GRM-Level 1 or else if the affected persons were dissatisfied with the Level 1 resolution can submit their grievances to LGRC. The LGRC can convene the affected person to explain his/her grievance at its meeting. During the committee deliberations, LGRC will clarify the issues involved and would try its best to reach a settlement acceptable to both the affected person and the PMU within a period of two weeks. The GRC will be located at the local office of the PGCB in the respective project site. If an agreement or resolution is reached, the key points of the agreement/resolution will be summarized, documented and signed by both the affected person and the members of the GRC. **GRM – Level 3:** Level 3 of the GRM will be the Project Management Unit of PGCB. The GRC at the PMU will comprise (i) Chairman of PGCB; (ii) Project Director of the relevant subproject; (iii) Resettlement Specialist of the environmental and social unit (to be established by PGCB); (iv) Team Leader of the contractor; (v) the DC responsible for land acquisition; (vi) a representative of the aggrieved party; and (vii) a representative of the civil society. The complainant and/or his representative will be called to appear before the Level 3 GRC and explain his/her grievance. If necessary, GRC members will undertake field inspections to verify the issues reported. Level 3 GRC will reach a settlement through consensus among its membership, failing which the decision may be taken on a majority vote. GRC decisions will be bound by the safeguards policy framework and the prescribed entitlement matrix. The GRC located at PGCB Headquarters will conclude its proceedings within a period of one month since the submission of the grievance.

332. The member secretary of GRCs will be regularly available and accessible for affected persons to address concerns and grievances. The legal advisor of the PGCB will support the GRC in the regular process.

Table 8.1: Hierarchy of GRMs

Level	Members at Different Levels & Time Frame
Field Level	Project officer appointed by PGCB (Time frame is one month)
Local Community Level	1. Project Directors; 2. Executive engineer of the project; 3. Contractor or his representative; 4. A male and a female member of the concerned Union; 5. A representative of the aggrieved party (the representative should be a female if the aggrieved party is a female). (Time frame is two weeks)
PMU Level	1. Chairman of PGCB; 2. Project Director of the relevant subproject; 3. Resettlement Specialist of the environmental and social unit; 4.Team Leader of the contractor; 5. the one responsible for land acquisition; 6. A representative of the aggrieved party; 7. A representative of the civil society. (Time frame is one month)

8.5 Scope and Jurisdiction of GRC

333. The scope of work and jurisdiction of the GRC are:

- The GRC shall evaluate, consider and resolve grievances, related to social/resettlement and environmental mitigations during implementation, received by the committee.
- Major grievances that might require mitigations include AP's not enlisted, losses of trees and structures not identified correctly, compensation/assistance not as per entitlement matrix, dispute about ownership, delay of disbursement of compensation, improper distribution of compensation, incorrect name in the award book of Deputy Commissioner and for grid line, with contractor
- Any grievances presented to the GRC should ideally be resolved on the first day of the hearing or within a period of one month, in cases of complicated cases requiring additional investigations. Grievances of indirectly affected persons and/or persons affected during project implementation will also be reviewed by GRC.
- The GRC will not engage in any review of the legal standing of an "awardees" other than in direct losses or distribution of shares of acquired property among the legal owners and associated compensation or entitlement issues.
- GRC decisions should ideally be arrived at through consensus, failing which resolution will be based on majority vote. Any decision made by the GRC must be within the purview of social, resettlement and environmental policy framework.
- The GRC will not deal with any matters pending in the court of law. But if the parties agree through a written appeal, GRC can mediate. The parties will withdraw the litigation.
- A minimum of three members shall form the quorum for the meeting of the GRC.
- The Legal Adviser will not play role as a member but will put his/her lawful advice/ suggestion during GRC sessions

8.6 Filing Grievance Cases and Documentation

334. Grievances will be filed without any fear and stress. The contractors will support the affected persons in drafting the grievances. All grievances must be submitted in writing to the Chair, GRC. The affected person himself/herself or appointed agent such as local elected officials/legal advisors are to represent the complainants. The judgment made by GRC will be communicated to the concerned affected person in writing. If dissatisfied, and with the agreement of the GRC, the affected person may request a further review of the judgment of GRC by the Project-level GRC. In such cases, the case will be forwarded to the Convener of the project-level GRC with all documentations. If he/she remains unsatisfied, he/she can go to the formal court of law.

335. Through community meetings, notices and pamphlets in the local language (Bangla) and the GRC procedures and operational rules will be publicized widely, so that DPs are aware of their rights and obligations, and procedure of grievance redresses.

336. To review and for verification, an international non-government organization will maintain all GRC documents for supervision consultants and ADB. The international non-government organization field office(s) will act as the Secretariat to the GRCs. Accordingly, the records will be up-to-date and easily accessible on-site.

337. GRC meetings will be held as agreed by the Committee, in the respective field office of the contractor/PGCB or other location(s). If required, GRC members may carry out field visits to verify and review the issues at dispute, including titles/shares, the reason for any delay in payments or other relevant matters. Through the process described below the affected persons will address the complaints and grievances.

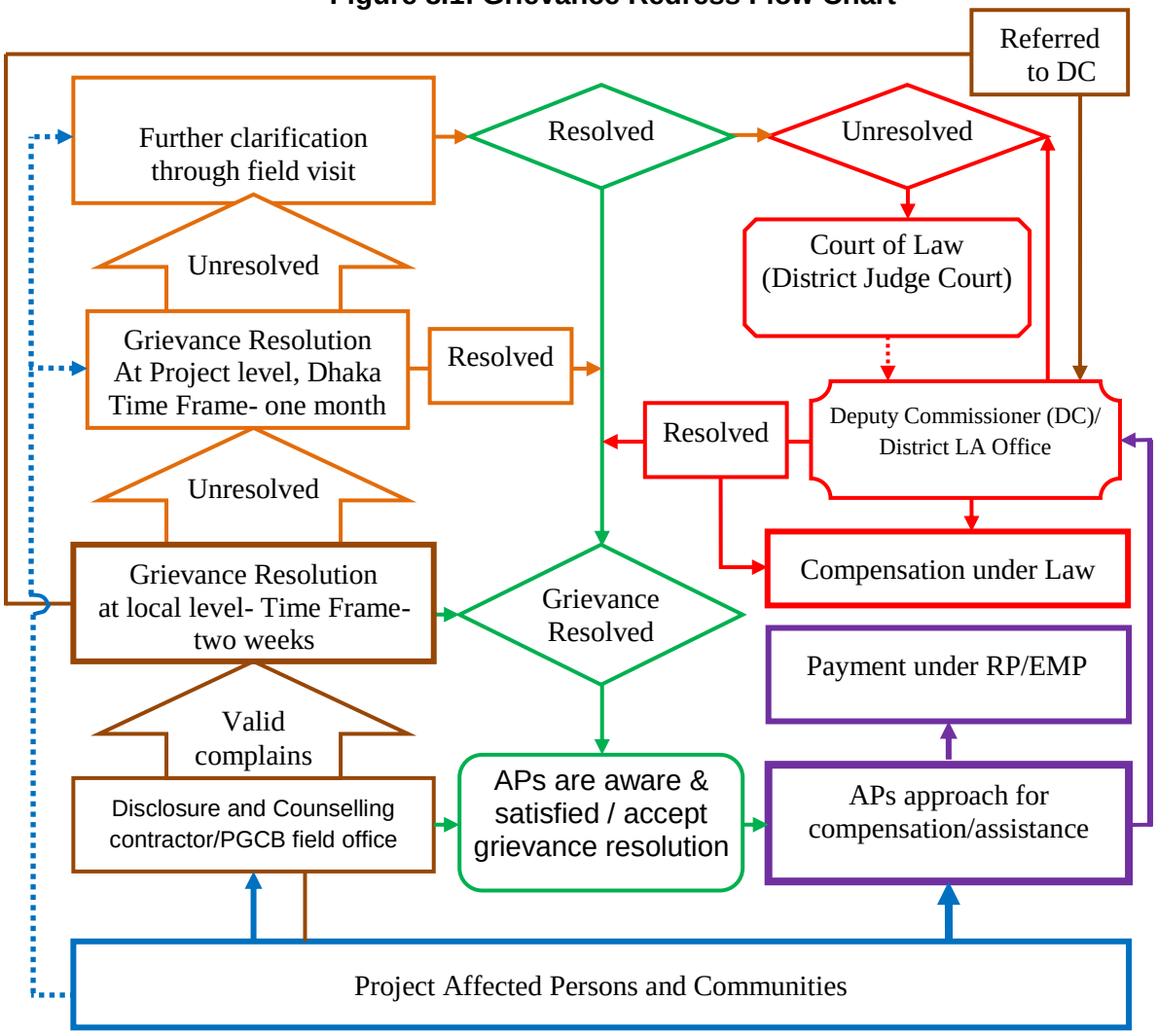
Table 8.2: Grievance Resolution Process

Step 1	• The contractor on behalf of PGCB informs affected persons and counsels on land acquisition and resettlement policy, compensation and entitlement modalities, entitlement packages, and eligibility and process obtain the entitlements. • Affected persons with clear understanding approach Deputy Commissioner, Contractor and PGCB for compensation under law and assistance under Resettlement Plans as applicable. • Affected persons with confusion and valid complaints on land acquisition and resettlement process and entitlements approach GRC for resolution. The aggrieved persons may also opt to produce their grievances directly to the Project Director. • Complaint relating to the environmental impacts will also be entertained by the GRC
Step 2	• The contractor assists the aggrieved affected persons to produce a written complaint to the convener of GRC with stories and expectations. The contractor counsels the aggrieved persons on the mandate and procedure of grievance resolution. • GRC scrutinize the case records and sort out cases to be referred to the Deputy Commissioner or the court of law and those to be resolved in GRC. • Hearing is organized on cases with merit at the GRC secretariat or at Union Parishad/Municipality Offices at local level and resolution is given by the GRC in one month of receiving the complaints. • Aggrieved DPs satisfied with the resolution approach the executing agency for resettlement assistance under the provision of the Resettlement Plan. The agreed resolution is forward to PGCB for approval by the Project Director before processing entitlements for the entitled person.

	• In case the resolution is not acceptable to the aggrieved person, he/she approaches the Project Director through the GRC convener with assistance from the contractor for further review. • Aggrieved DPs may opt to approach to the Court of Law, if the resolution at PGCB is not acceptable to him/her.
Step 3	• The resolution accepted by the aggrieved persons at any level (local, PMU) is approved by the Project Director and forwarded back to the Conveners' office keeping records at his/her office. • Based on the approved grievance resolution, the implementing NGO processes his/her entitlements and assists EA in arranging payment.

EA = executing agency, DP = Displaced Person, GRC = grievance redress committee, NGO = non-governmental organization, PGCB = Power Grid Company of Bangladesh, PMU = Project Management Unit.

Figure 8.1: Grievance Redress Flow Chart



338. The project level GRC at headquarters will keep records of complaints received for its use, as well as for use by ADB during regular supervisions. The GRM does not impede access to the legal system. Affected persons can resort to legal action through the country's judiciary system at any time. They can also submit their grievances to ADB's Accountability Mechanism.

8.7 Approval of GRCs and Entitlements of GRC Members

339. All the decisions and proceedings of GRC meetings at any level will be finally approved by the Project Director, contractor and PGCB. According to the agenda of the resettlement plan, the approved GRC decisions will be implemented in a location.

340. Affected persons will be exempted from all administrative and legal fees, according to the Resettlement Plan proposal. Complainants to the court will also have the right of free legal representation. The detailed procedures for redress of grievances and the appeals process will be widely publicized among the parties involved.

341. All GRC members will attend a training and orientation meeting earlier, before commencement of their work. Project staff and consultants/resettlement specialists will conduct the training.

342. Grievances will be heard once a month by GRC. Before starting project work, the resettlement process must be completed, the GRC may meet more than once in every 30 days depending upon the number of such cases. Within 15 days of the hearing of the grievances the GRC will inform the concerned aggrieved persons of their decision.

8.8 Grievance Redress Monitoring

343. The Project Directors of PMU will keep records of all the grievances and their redress in monthly cumulative formats, which will be provided by the contractor and to be signed by the convener of the GRC. The format will contain information on the number of grievances received with nature, those resolved, and the number of unresolved grievances.

9. ENVIRONMENTAL MANAGEMENT PLAN

344. The EMP has been prepared for the substation and transmission line subprojects. It describes the anticipated impacts, monitoring requirements, and development of mitigation measures with respect to the following stages: (i) pre-construction, (ii) construction, and (iii) operation and maintenance. Detailed, site-specific mitigation measures and monitoring plans are developed and will be implemented during the project implementation phase.

345. The EMP for the project identifies feasible and cost-effective mitigation and remediation measures to be taken to reduce potential significant, adverse impacts to acceptable levels. Here, proper mitigation measures are proposed for each potential impact, including details of responsible parties for implementation of the mitigation measures and the associated monitoring program. Table 9.1 to Table 9.6 show the EMP and Environmental Monitoring Plan (EMoP) and the costs for supporting the activities. Environmental monitoring reports will be submitted to ADB on a semiannual basis during construction phase, while on an annual basis during operation basis by the Design and Supervision Consultant & PGCB. If any of the safeguard requirements that are covenanted in the legal agreements are found not to be satisfactorily met, an appropriate corrective action plan (CAP) will be developed and implemented as agreed upon with ADB to rectify unsatisfactory safeguard compliance. The environment monitoring reports, the CAP and the updated IEE if any, submitted by PGCB during project implementation are disclosed on the ADB website upon receipt.

Table 9.1: Environmental Management Plan for the Impacts of the Substation Subprojects in Components 1, 2 & 3

Environmental Issues/ Parameters	Environmental Impacts	Mitigation Measures	Implementation Agency	Super-vision Agency
(a) Preconstruction/Construction Stage				
Land acquisition/ requisition	Loss of 100 acres (40 ha) (Gopalganj (North) 60, Bogra (West) 20, Rohanpur 20) of land (mainly agricultural/ paddy) permanently for three substation sites. Temporary loss of land (requisition) for construction camps etc.	Prior to commencement of construction activities, the owners of the affected lands must be notified and provided proper compensation in time as per GoB and ADB guidelines. As per GoB and ADB guidelines, RP should be prepared for land acquisition/requisition/ compensation and follow it. Use GIS instead of AIS, in order to reduce land requirement.	DC	DSC/ PGCB
Top soil	Top soil loss (about 0.5 m thick) due to construction of substation sites.	Prior to start of filling of the site, collect and store top soils (minimum 0.5 m thick) for using on the surface of the site boundary and access road side slopes for protection from side slope erosion. The topsoil, excavated from the proposed construction sites, should be re-spread in areas to be landscaped.	Contractor	DSC/ PGCB
Cutting of trees/ Clearing of vegetation	Loss of standing crops (if any), grass and bushes at substation sites and construction camp sites.	Prior to the start of clearing of vegetation, provide adequate compensation to the owners in good time.	Contractor	DSC/ PGCB

Fauna (Wildlife)	Disturbance of wildlife, especially birds, due to project activities such as earthworks, moving of project equipment and transports, especially during night time.	Prepare construction management plan (CMP, by the contractor) and follow it properly. Follow GoB rules and regulations on noise. Project workers should not disturb or kill any wildlife.	Contractor	DSC/ PGCB
Construction Waste	Generation of construction wastes from the construction materials.	Use of durable, long-lasting materials that will not need to be replaced as often, thereby reducing the amount of construction waste generated over time. Provision of facilities for proper handling and storage of construction materials to reduce the amount of waste caused by damage or exposure to the elements. Purchase of perishable construction materials such as paints incrementally to ensure reduced spoilage of unused materials. Use of building materials that have minimal packaging to avoid the generation of excessive packaging waste. Use of construction materials containing recycled content when possible and in accordance with accepted standards. Adequate collection, separation, and storage of waste on site and safe transportation to the disposal sites and disposal methods at designated area shall be provided.	Contractor	DSC/ PGCB
Drainage congestion and flooding	Reducing floodplain storage area and increase local flooding, due to earth filling of substation sites and access roads above highest flood level (HFL). Drainage congestion if the surrounding sites are blocked by the earth embankment.	Provide culverts in the access road of the substation. Ensure adequate monitoring, especially if construction works are carried out during the monsoon period. Provision for pumping of congested water, if needed. Consideration of the HFL during design of substations, to avoid inundation.	Contractor	DSC/ PGCB
Noise level	Noise pollution due to construction activities, generators and construction vehicle movement.	Use of noise reducers in heavy construction equipment. It is recommended that no construction should be allowed during night time (9 PM to 6 AM). Avoid prolonged exposure to noise (produced by equipment) by workers.	Contractor	DSC/ PGCB

		Regulate use of horns and avoid use of hydraulic horns in project vehicles. Generators should be placed within rooms (concrete walls with roof). Monitoring of noise level at construction sites, construction camp as and when required.		
Air quality and dust	Air pollution and dust generation due to construction activities, generators and construction vehicle movement.	All vehicles (e.g., trucks, equipment, and other vehicles that support construction works) shall be well maintained and not emit dark or smoky emissions in excess of the limits described in the EQS. Specific training will be focused on minimizing dust and exhaust gas emissions from heavy construction vehicles. Drivers of vehicles used during construction will be under strict instructions to minimize unnecessary trips and minimize idling of engines. Dust suppression facilities (water sprayer) shall be available where earth and cement works are required. Spray water on dry and loose surfaces of the construction sites regularly. Maintain adequate moisture content of soil during transportation, compaction and handling. Construction materials (sand, gravel, and rocks) and spoil materials will be transported in trucks covered with tarpaulins. Sprinkle and cover stockpiles of loose construction materials (e.g., fine aggregates, sand). Avoid use of equipment such as stone crushers at the sites, which produce significant amount of particulate matter. Dust masks should be provided to all personnel in areas prone to dust emissions throughout the period of construction.	Contractor	DSC/ PGCB
Soil quality	Soil pollution	Laboratory analysis of the river bed materials to be confirmed prior to starting collection from the river. Prevention of spillage and leakage of hazardous liquids at construction sites and camp. Ensure no use of transformers containing PCB to avoid soil and air pollution.	Contractor	DSC/ PGCB
Siting of construction camps	Removal of vegetation such as grass, standing crops	Prior to the start of clearing of vegetation, provide adequate compensation to the owners in time.	Contractor	DSC/ PGCB

	(if any) shrubs and trees. Environmental pollution (such as air/dust, noise, water, wastes, excess soil) affecting nearby the settlements.	Locate construction camps away from residential settlements, cultural sites, water bodies, etc. (minimum 0.5 km). Try to use fallow land to avoid crop damage. Just after completion of the construction, hand over the camp sites to the owners as in earlier condition.		
Traffic congestion/ road accident	Traffic congestion and road accidents due to movement of construction vehicles.	Follow Bangladesh Road Traffic Authority (BRTA) traffic rules and regulations. Schedule deliveries of materials/ equipment during off-peak hours. Engage flagmen especially at the entry of the substation sites and construction camps for traffic control. Engage experienced drivers to drive project vehicles. Arrange for signal lights at night. Prepare and follow proper traffic management. Avoid stockpiling of materials, especially at the road sides, that could disturb traffic movement.	Contractor	DSC/ PGCB
Pollution due to wastes	Pollution due to wastes (construction wastes from construction activities and general wastes from workers' camps)	Solid wastes collection system will be essential, which should include separation and collection of solid wastes in the dustbins/waste containers throughout the work sites, construction yard/ labor camps. Wastes such as pieces of rods and wood, newspapers, containers etc. can be sold to the vendors and the rest of the waste can be dumped into the nearby road side waste containers/ waste bins from which they will go to the nearest land fill dumping site (taken by the Contractors). A log of the disposal of toxic and other waste materials is to be kept by the Contractors. Prior to the start of construction, contractor should prepare waste management plan (WMP) based on the EMP.	Contractor	DSC/ PGCB
Community health and safety (H&S)	Community H&S nearby the substation site could be affected.	Safety barriers and warning signs surrounding the construction site. Generators should be placed in closed rooms. Formulate and implement an emergency risk management plan (by the contractor).	Contractor	DSC/ PGCB
Occupational health and safety (H&S)	Health and safety risks of construction workers.	An experienced Health & Safety (H&S) Manager must be engaged by the contractor prior to start of construction.	Contractor	DSC/ PGCB

		Only permit trained and certified workers to work with any electrical equipment. Safety induction by the H&S Manager should be provided for the workers. Prior to starting work, a tool box meeting should be arranged by the H&S Manager for the workers. First Aid Box and personal protective equipment, PPE (such as safety helmets, safety shoes, eye protection glasses, ear plugs/muffs, waist belts, masks, hand gloves, body protective aprons and insulating boots) must be provided to the workers and ensure their use by the workers. Safety signs, health signs, prohibition signs, warning signs, mandatory signs, emergency escape signs, first-aid signs, information signs, signboards, supplementary signboards, safety collar, symbol, pictogram, illuminated signs, acoustic signals, verbal communication and hand signals must be fitted at the designated sites of the subproject areas.		
Employment generation/ income	Employment opportunities for the local people, especially for PAPs.	Employ local people, especially PAPs, for the project activities (as much as possible).	Contractor	DSC/ PGCB
(b) Operation Stage				
Tree replantation	A total of 30,000 indigenous tree species can be planted at the access road side slopes, at appropriate intervals.	Planting of 30,000 saplings to replace felled trees, on the side slopes of the access roads, during the monsoon period. The number of saplings which die should be replaced by new saplings. Nursing period of planted saplings should not less than 3 years.	FD	PGCB
Drainage congestion	Drainage congestion could occur in the surface drains within the substation area, if proper O&M is not done regularly.	Clean the drains, especially during the monsoon, regularly. Ensure adequate monitoring.	PGCB	PGCB
Community health and safety	Community H&S nearby the substation site.	Safety barriers and warning signs surrounding the substation sites. Generators should be placed in the closed rooms.	PGCB	PGCB
Safety and security of workers	Risk to continuous power supply and even damage of substation.	Ensure security of substation in collaboration with law enforcement agencies. Keep complaint book in the substation for recording of people's complaints.	PGCB	PGCB

		Ensure availability of adequate safety gear for substation operations.		
Power Supply	Due to adequate reliability of power supply, social life and economic condition of the people will be improved.	O&M of the substations should be done in time for adequate power generation.	PGCB	PGCB
Short Circuit/Accident	Due to a possible short circuit of the substation, disruption of power and accident could occur.	O&M of substations should be done in time by experienced personnel.	PGCB	PGCB

ADB = Asian Development Bank, BRTA= Bangladesh Road Traffic Authority, CMP = Construction Management Plan, DC = Deputy Commissioner, DSC = Design and Supervision Consultants, EMP = Environmental Management Plan, EQS = Environment Quality Standards, FD = Forest Department, GoB = Government of Bangladesh, H&S = health and safety, HFL = highest flood level, km = kilometre, m = meter, O&M = operations and maintenance, PAP = project affected person, PCB = polychlorinated biphenyl, PGCB = Power Grid Company of Bangladesh, PPE = personal protective equipment, RP = Resettlement Plan, WMP = waste management plan.

Table 9.2: Budget for the Environmental Management and Monitoring Plan

Item	**Qty**	**Rate/Ref.**	**Total Amount (US$)**
Tree planting program in the operation phase, planting of seedlings in access road side slopes and other available spaces to compensate the felled trees, and maintain the seedlings for 3 years	Three times the number of trees in the 10 m width of RoW (c. 30,000 seedlings/ saplings)	Lump sum	20,000
Implementation of EMP		Table 9.1, 9.3, 9.4, 9.5	35,000
Sub total			**55,000**
Monitoring Plan			
Consultant (for monitoring)	30 persons – month	$ 2,000 per month	60,000
Transport (for monitoring team)	200 days	$ 200 per day	40,000
Reporting and others (yearly DoE license renewal cost)		Lump sum	20,000
Laboratory analysis (see Table 9.6)		Lump sum	75,000
Sub Total			**195,000**
Total Cost			**250,000**

Table 9.3: Mitigation Measures for the General/Common Impacts of Transmission Line and LILO Line Subprojects

Environmental Issues/ Parameters	Environmental Impacts	Mitigation Measures	Implementation Agency	Supervision Agency
(a) Preconstruction/Construction Stage				
Tree felling, Clearing of vegetation	8,921 trees will be directly affected by cutting and trimming, as well as standing crops (if any) and bushes along the RoW will also be affected.	Prior to the start of clearing of vegetation, provide adequate compensation to the owners.	Contractor	DSC/ PGCB
Requisition of land (loss of 10.6 acres of land for the construction period of about 3- 4 years, and beyond)	Loss of 10.6 acres (4.3 ha) land permanently for 691 tower bases of the TL/LILO lines.	Prior to commencement of construction activities, the owners of the affected land must be notified and provided proper compensation as per GoB and ADB guidelines. As per GoB and ADB guidelines, RP should be prepared for land acquisition/requisition/compensation and follow it.	DC	DSC/ PGCB
Fauna (Wildlife)	Disturbance of wildlife, especially birds, due to project activities such as moving of project equipment and transports (especially during night time).	Preparation of construction management plan by the contractor and follow it. Follow GoB rules and regulations on noise. Project workers should not disturb or kill birds or other animals.	Contractor	DSC/ PGCB
Construction Waste	Generation of construction wastes from the construction materials.	Use of durable, long-lasting materials that will not need to be replaced as often, thereby reducing the amount of construction waste generated over time. Provision of facilities for proper handling and storage of construction materials to reduce the amount of waste caused by damage or exposure to the elements Purchase of perishable construction materials such as paints incrementally to ensure reduced spoilage of unused materials Use of building materials that have minimal packaging to avoid the generation of excessive packaging waste. Use of construction materials containing recycled content when possible and in accordance with accepted standards. Adequate collection and storage of waste on site and safe transportation to the disposal sites and disposal methods at designated area shall be provided.	Contractor	DSC/ PGCB
Noise level	Noise pollution due to construction activities, generators, and construction vehicle movement.	It is recommended that no construction should be allowed during night time (9 PM to 6 AM). Avoid using of construction equipment producing excessive noise at any time. Avoid prolonged exposure to noise (produced by equipment) by workers. Regulate use of horns and avoid use of hydraulic horns in project vehicles.	Contractor	DSC/ PGCB

Environmental Issues/ Parameters	Environmental Impacts	Mitigation Measures	Implementation Agency	Supervision Agency
Air quality and dust	Air pollution and dust generation due to construction activities, generators and construction vehicle movement.	All vehicles (e.g., trucks, equipment, and other vehicles that support construction works) shall be well maintained and not emit dark or smoky emissions in excess of the limits described in the Environment Quality Standards (EQS). Specific training will be focused on minimizing dust and exhaust gas emissions from heavy construction vehicles. Drivers of vehicles used during construction will be under strict instructions to minimize unnecessary trips and minimize idling of engines. Dust suppression facilities (back pack water sprayer) shall be available where earth and cement works are required. Spray water on dry and loose surfaces of the construction sites regularly. Maintain adequate moisture content of soil during transportation, compaction and handling. Construction materials (sand, gravel, and rocks) and spoil materials will be transported in trucks covered with tarpaulins. Sprinkle and cover stockpiles of loose construction materials (e.g., fine aggregates, sand). Dust masks should be provided to all personnel in areas prone to dust emissions throughout the period of construction.	Contractor	DSC/ PGCB
Soil quality	Soil pollution.	Prevention of spillage and leakage of hazardous liquid at tower sites.	Contractor	DSC/ PGCB
Sitting of construction camps (if needed for tower construction)	Temporary loss of land for the construction camps for towers. Clearing of standing crops (if any), grass and bushes. Environmental pollution (such as air, noise, water, wastes and soil) affecting nearby the settlements.	Prior to commencement of construction activities, the owners of the affected land must be notified and provided proper compensation as per GoB and ADB guidelines. As per GoB and ADB guidelines, RP should be prepared for land acquisition/ requisition /compensation. Prior to the start of clearing of vegetation, provide adequate compensation to the owners in time. Locate construction camps away from residential settlements, cultural sites, water bodies etc. (minimum 0.5 km). Try to use fallow land and just after completion of construction, hand over camp sites to the owners as in earlier condition.	Contractor	DSC/ PGCB
Traffic congestion/road accident	Traffic congestion and road accident due to movement of construction vehicles.	Follow Bangladesh Road Transport Authority (BRTA) traffic rules and regulations. Schedule deliveries of material/ equipment during off-peak hours. Engage flagman where needed. Engage experienced drivers to drive project vehicles. Arrange for signal lights at night, for proper traffic management. Avoiding stockpiling of materials, especially at the road sides, that could hamper traffic movement.	Contractor	DSC/ PGCB

Environmental Issues/ Parameters	Environmental Impacts	Mitigation Measures	Implementation Agency	Supervision Agency
Pollution due to wastes	Pollution due to wastes (construction wastes from construction activities and general wastes from workers' camps).	Solid wastes collection system will be essential, which should include separation and collection of solid wastes in the dustbins/waste containers throughout the tower work sites. Wastes, such as pieces of rods and wood, newspapers, containers etc. can be sold to vendors and the rest can be dumped into the nearby road side waste containers/ waste bins from which they will be taken to the nearest landfill dumping site by the Contractors. A log of the disposal of toxic and other waste materials is to be kept by the Contractors. Contractor should prepare a waste management plan based on the EMP	Contractor	DSC/ PGCB
Community health and safety (H&S)	Community H&S along the transmission line.	Safety barriers and warning signs surrounding the tower construction site. Formulate and implement an emergency risk management plan (by the contractor).	Contractor	DSC/ PGCB
Occupational health and safety (H&S)	Health and safety risks of construction workers.	An experienced H&S Manager must be engaged by the contractor prior to the start of construction of the towers. Only permitting trained and certified workers to work with any electrical equipment. 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.	Contractor	DSC/ PGCB
Employment generation/ income	Employment opportunities for the local people, especially for PAPs.	Employ local people, especially PAPs, for the tower construction activities as much as possible.	Contractor	DSC/ PGCB
(b) Operation Stage:				
Community health and safety	Community H&S along the transmission lines.	Safety barriers and warning signs at each tower.	PGCB	PGCB
Safety and security of workers	Risk to continuous power supply.	Ensure security of transmission towers in collaboration with law enforcing agencies. Ensure availability of adequate safety gear for tower maintenance workers.	PGCB	PGCB
Power Supply	Due to adequate reliability of power supply, social life and economic condition of the people will be improved	O&M of towers should be done in time to ensure their integrity.	PGCB	PGCB

Environmental Issues/ Parameters	Environmental Impacts	Mitigation Measures	Implementation Agency	Supervision Agency
EMF	Due to EMF, human health may be affected	For housing structures, clearance between the transmission line and roof tops should be 6.5 m - 8 m and for river crossings it will 14.6 m -15.9 m. Note that no houses will be directly affected by the TL/LILO lines.	PGCB	PGCB

ADB = Asian Development Bank, BRTA= Bangladesh Road Traffic Authority, DC = Deputy Commissioner, DSC = Design and Supervision Consultants, EMF = electromagnetic field, EMP = Environmental Management Plan, EQS = Environment Quality Standards, GoB = Government of Bangladesh, H&S = health and safety, ha = hectare, km = kilometre, LILO = line-in line-out, m = meter, O&M = operations and maintenance, PAP = project affected person, PGCB = Power Grid Company of Bangladesh, PPE = personal protective equipment, RoW = right of way, RP = Resettlement Plan, TL = transmission line.

Table 9.4: Environmental Monitoring Plan for Substation Subprojects (Gopalganj (North), Bogra (West) and Rohanpur)

Environmental Issues/Parameters	Monitoring Parameters	Standards/ Guidelines	Means of Monitoring	Frequency	Location	Implementation Agency	Supervision Agency
Preconstruction/Construction Stage							
Clearing of vegetation	Checking whether proper compensation as mentioned in the RP is received by PAPs.	DoE/FD	Inspection	Regular frequency during site clearing operations.	Within the substation land and access road sites	Contractor/FD	DSC/PGCB
Fauna (Wildlife)	Checking whether wildlife is disturbed/ killed by the workers.	DoE/FD	Inspection	Weekly	Substation sites	Contractor/FD	DSC/PGCB
Drainage Congestion/ Flooding	Checking drainage congestion and top of substation site above HFL.	Hydrological/ Drainage study	Inspection	Regular during earthworks	Substation sites	Contractor	DSC/PGCB
Noise Pollution	Ambient noise level	DoE Noise Pollution Control Rules, 2006	Measurement	As and when required	At construction sites and camps	Contractor	DSC/PGCB
Dust Pollution	Dust should be controlled by water spraying regularly, especially during dry period.	DoE guidelines	Inspection	Regular	Substation sites	Contractor	DSC/PGCB
Surface Water Quality	pH, BOD5, COD, NH3-N, PO4	DoE Standards	Sampling and Laboratory Analysis	Quarterly	Nearby Waterbodies	Contractor	DSC/PGCB
Ground Water/Drinking Water Quality	pH, Mn, Fe, As, TC, FC	DoE Standards	Sampling and Laboratory Analysis	Quarterly	At construction camps	Contractor	DSC/PGCB
Pollution due to Wastes	Checking collection, storage, transportation, and disposal of hazardous waste. Waste from construction sites to be collected and	DoE guidelines	Inspection	Regular	Construction camps	Contractor	DSC/PGCB

	disposed safely to the designated sites. Wastes from labor camp to be disposed properly at the designated sites.						
Traffic Congestion/ Road Accident	Checking meeting points of existing road and access road	BRTA	Inspection	Regular	Meeting point of existing road and access road	Contractor	DSC/PGCB
Occupational health and safety	Checking health, use of PPE and first aid facilities, DWQ, sanitation and accommodation	DoE/IFC guidelines	Inspection and testing of DWQ	Regular	At construction sites and camps	Contractor	DSC/PGCB
Community health and safety	Awareness of local people and staying safely away from the project activities	DoE/IFC guidelines	Inspection	Regular	At construction site and camps	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	As and when required	Access road side slopes	FD	PGCB
Drainage congestion	Checking drainage congestion in the substation sites during monsoon	Hydrological /Drainage study	Inspection	As and when required during monsoon	Substation sites	PGCB	PGCB
Community health and safety	Community H&S nearby the substation site	DoE/IFC guidelines	Inspection	Regular	Substation sites	PGCB	PGCB
Safety and security of substation and workers	Checking use of PPE and duties of security force	DoE/IFC guidelines	Inspection	Regular	Substation sites	PGCB	PGCB

As = arsenic, BRTA= Bangladesh Road Traffic Authority, COD = chemical oxygen demand, BOD5 = five-day biochemical oxygen demand, DoE = Department of Environment, DSC = Design and Supervision Consultants, DWQ = Drinking Water Quality, FC = Faecal Contamination , FD = Forest Department, Fe = iron, H&S = health and safety, HFL = highest flood level, IFC = International Finance Corporation, NH3-N = ammonia nitrogen, PAP = project affected person, PGCB = Power Grid Company of Bangladesh, PO_4 = phosphate, PPE = personal protective equipment, Mn = manganese, RP = Resettlement Plan, TC =Total Coliform .

Table 9.5: Environmental Monitoring Plan for TL/LILO Line Subprojects (Barisal (North)- Gopalganj (North)- Faridpur Line, Bogra (West)- Rohanpur- Chapainawabganj Line and Two LILO Lines)

Environmental Issues/Parameters	Monitoring Parameters	Standards/ Guidelines	Means of Monitoring	Frequency	Location	Implementation Agency	Supervision Agency
Preconstruction/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
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
Noise Pollution	Ambient noise level	DoE standards	Measurement	As and when required	At adjacent subproject cultural sites and construction camps	Contractor	DSC/PGCB
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
Surface Water Quality	pH, BOD5, COD, NH3, PO4	DoE Standards	Sampling and Laboratory Analysis	Quarterly	River Crossing Sites near towers	Contractor	DSC/PGCB
Ground Water /Drinking Water Quality	pH, Mn, Fe, As, TC, FC	DoE Standards	Sampling and Laboratory Analysis	Quarterly	At representative tower construction sites	Contractor	DSC/PGCB
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
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	A mosque (Chandrapara Masjid) about 140m	Contractor	DSC/PGCB

					distance at ch 6+000 Barisal-Gopalganj line.		
Occupational health and safety	Use of PPE, general health, water supply and sanitation	DoE/IFC guidelines	Inspection	Regular	At construction sites and camps	Contractor	DSC/PGCB
Community health and safety	Awareness of local people	DoE/IFC guidelines	Inspection	Regular	At tower construction sites and crossing of roads	Contractor	DSC/PGCB
Operation Stage							
Tall trees	Trimming of tall trees under the transmission line	ESMF	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 Health and Safety (OHS)	Use of PPE	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, ESMF = Environment and Social Management Framework, 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 = personal protective equipment, RoW = right of way, RP = Resettlement Plan, TC = total coliform, TL = transmission line.

Table 9.6: Cost of Laboratory-based Environmental Monitoring

Environmental Parameter	Monitoring Parameter	Standards/ Guidelines	Means of Monitoring	Frequency	Location	Implementing Agency	Monitoring Agency	Cost (Tk)
Ambient Air Quality Parameters	SPM, PM_{10}, $PM_{2.5}$, SOx, NOx, Co & Pb- 24hr monitoring	EQS/ DOE	Sampling/ laboratory analysis	Before construction, then quarterly	Substation land and surroundings	Contractor	PGCB	50,000 ($602)/ location 3 x new substations (before construction & every three months Tk750,000 ($9,040)
Noise level monitoring	Leq day and Leq night Ambient Noise Level	EQS/DOE Noise pollution control Rules, 2006	Measurement	Before construction & when required	Substation land and surroundings, near settlements where tower bases/ towers are constructed	Contractor	PGCB	5,000 ($60)/ location 3 x substations (before construction & every three months) Tower bases near settlements 5 locations x12 Tk375,000 ($4520)
Surface Water Quality Monitoring	pH, Turbidity, BOD5, COD, TDS, TSS, DO, Total Coliform, Ammonia-Nitrogen, Oil and grease	EQS/DOE Standards	Sampling/ laboratory analysis	Before construction & when required	Substation land and surroundings, near settlements where tower bases/ towers are constructed	Contractor	PGCB	30,000 ($360)/ location 3 x substations (before construction & every three months) 5 locations in TLs x 3 measurements Tk900,000 ($10,845)
Ground Water Quality	pH, Turbidity, manganese, Iron, Arsenic, EC, Chloride	EQS/DOE Standards	Sampling/ laboratory analysis	Before construction & when required	Substation land and surroundings, near settlements where tower bases/ towers are constructed	Contractor	PGCB	20,000 ($240)/ location 3 x substations (before construction & every three months)

								5 locations in TLs x 3 measurements Tk600,000 ($7,230)
Soil Pollution	pH, Texture, Organic content, Lead, Copper, Chromium, Cadmium	EQS/DOE Standards	Sampling/ laboratory analysis	Before construction & when required	Substation land and surroundings, near settlements where tower bases/ towers are constructed	Contractor	PGCB	20,000 ($240)/ location 3 x substations (before construction & every three months) 5 locations in TLs x 3 measurements Tk600,000 ($7230)
								Tk3,225,000 (= $ 38,865) + cost of sampling (Tk25,000 per location x 120) 3,000,000 (= 36,145)
							Total	$ 75,000

Laboratory analysis will be carried out at **Atomic Energy Commission, Bangladesh** (Air and Noise measurements); **Bangladesh Council of Scientific and Industrial Research** (Surface & Ground water quality) and **Soil Research Development Institute** (soil parameters).

10. CONCLUSION AND RECOMMENDATION

346. The proposed SWTGEP will ensure the capacity of electricity supply in Southern and Western Bangladesh through improvements in the technical efficiency of the transmission system. The proposed project is expected to provide support for the construction of new substations and transmission lines and support the augmentation and rehabilitation of the existing transmission network of the PGCB.

347. The main components of the project include:

- Construction of Gopalganj (North) 400/132 kV substation to increase power delivery capacity at Gopalganj substation with switching facilities for 400 kV transmission lines, and 400/132 kV transformers for local power supply.

- Expansion of Transmission Network in Southern Bangladesh by construction of Barisal (North)-Gopalganj (North)-Faridpur 230 kV, 126 km transmission line, 230 kV bay extension at Barisal (North) substation, augmentation of Faridpur substation, and Gopalganj (North) substation with 400/230 kV transformers.

- Expansion of Transmission Network in Western Bangladesh by Construction of Bogra (West)-Rohanpur 400 kV, 104 km transmission line, 400/230 kV Bogra (West) GIS substation, 400/132 kV Rohanpur GIS substation, Chapainawabganj-Rohanpur 132 kV, 26 km transmission line, line-in line-out connection from Barapukuria-Bogra (South) 230 kV, 11 km transmission line to Bogra (West) substation, line-in line-out connection from Chowdala-Niamatpur 132 kV, 1 km transmission line to Rohanpur substation, and 132 kV bay extension at Chapainawabganj substation.

348. The scope of work of the IEE included:

a. review of relevant information/data/documents from secondary sources, and identification of gaps to be filled, relevant to the environmental screening needs from primary surveys;
b. provision of a description of the environment (such as baseline data on physical, biological/ecological and socio-economic characteristics of the subproject sites along with impact area);
c. primary surveys where needed to include baseline data (air, water, noise, and riverbed) and environmental quality monitoring at representative and sensitive locations, and identification of all macro-level environmental issues within the project impact area;
d. survey of the environmentally sensitive locations at and along the sub-projects and within the project impact area;
e. arrangement of stakeholder consultations/individual consultations with the local people from all professions to find out their opinions on the subprojects;
f. analysis of alternatives to the proposed subproject;
g. identification and assessment of potential environmental impacts due to implementation of the subprojects; and
h. formulation of an EMP.

349. The 268 km of transmission and LILO lines follows low lying land which is extensively farmed (mainly with rice and winter crops), and terrestrial lands with homesteads. The proposed transmission line will cross Sugandha, Sondha, and Kumars rivers. There will be 691 towers to carry the transmission line conductors in two transmission lines and LILO lines.

350. Three alternatives for the Barisal (North)-Gopalganj (North)-Faridpur transmission line and two alternatives for Bogra (West)-Rohanpur-Chapainawabganj line were studied. Environmental screening and assessment for these two transmission lines were carried out to identify the potential impacts based on the collected baseline information/data by the safeguard survey team. Lands in predominantly agricultural areas were selected for all three substations and alternatives were not identified, as these areas avoid the settlements and individual homesteads. Also, trees were not found in any of the lands chosen for construction of substations. These are away from ecologically sensitive areas, forest reserves, and protected areas in the country.

351. About 100 acres (40 ha) of agricultural lands will be permanently affected by the construction of three substations. The total land area required for 691 tower bases is 10.6 acres (4.3 ha), which will be permanently affected. However, there will be no loss of residential homes or property. Various project activities will, however, have adverse impacts during the construction phase of the project. There will be some damage to vegetation and standing crops in the fields to access each of the transmission tower locations. There will be further damage during stringing of conductors between the towers. Construction activities will affect crop production and there will be some crop loss and lopping of fruit and economic trees. During the operation phase of the Project, there will be restriction for planting large trees and pruning in the transmission line RoW. The vegetation pattern will be changed in some locations within the transmission line RoW. At most tower locations, herbaceous plants will re-generate within a few years and agricultural practices will return to normal.

352. During the construction phase of the project, measures will be undertaken to keep impacts to a minimum. The EMP included in this IEE defines mitigation measures and responsibility for implementation. Measures for mitigation will be included in construction contracts to ensure that materials are properly stored and that waste materials are properly disposed of. Work camps will be controlled and will be fully equipped with fire-fighting equipment. PPE and emergency rescue items will also be available.

353. Crop and tree losses because of the Project have been assessed and affected people will be compensated under the Resettlement Plan.

354. During November and December 2017, 27 consultation meetings took place with local people at various locations along the final alignment at which 468 people attended. The transmission line will not supply electricity directly to the people along the line route. However, during the public consultations people expressed keen interest for implementation of the transmission line substation subprojects. Their main interest is that overall development in the power sector would contribute to the national development from which they along with others can benefit.

355. Construction of the subprojects will require skilled and non-skilled laborers and thus will create employment opportunities for people in the area. The additional power supply made possible by the transmission line will impact positively on industrial development.

356. In conclusion, there will be some minor negative impacts caused by the Project during the construction and operations phases. Compensation will be paid for loss of land, trees, and crops.

There are no protected or environmentally sensitive areas impacted by the project. The impacts identified in the IEE can be mitigated with implementation of the Environmental Management Plan and monitoring measures included in the IEE. PGCB has formed a PMU and will strengthen its capacity to implement and monitor the project.

357. For implementing the EMP, a total amount of $250,000 has been budgeted, including the monitoring cost. Subject to implementation of the mitigation measures in the EMP and monitoring, it is recommended the Project should proceed.

Annex 1: Environment Quality Standards in Bangladesh

Air Quality

Table 1 shows the air quality standards in Bangladesh.

Table 1: Bangladesh Standards for Ambient Air Quality Schedule-2, Rule 12, Environment Conservation Rules of 1997 (amended in 2017)

Pollutant	Averaging Period	Bangladesh Standards[a]	WHO[b] Guideline Values (µg/m³)	US EPA Standards (µg/m³)[d]
CO	8-hour	10,000 µg/m³ (9 ppm)	10,000 [c]	10,000
	1-hour	40,000 µg/m³ (35 ppm)	30,000 [c]	40,000
Pb	Annual	0.5 µg/m³	0.5	–
NO_x	Annual	100 µg/m³ (0.053 ppm)	–	–
TSP	8-hour	200 µg/m³	–	–
PM_{10}	Annual	50 µg/m³	20	revoked
	24-hour	150 µg/m³	50	150
$PM_{2.5}$	Annual	15 µg/m³	10	15
	24-hour	65 µg/m³	25	35
O_3	1-hour	235 µg/m³ (0.12 ppm)	–	235
	8-hour	157 µg/m³ (0.08 ppm)	100	157
SO_2	Annual	80 µg/m³ (0.03 ppm)	–	78
	24-hour	365 µg/m³ (0.14 ppm)	20	365

CO = Carbon monoxide; NO_x = Nitrogen oxide; O_3 = ozone; Pb = lead; PM_{10} = particulate matter with a diameter of not more than 10 microns; $PM_{2.5}$ = particulate matter with a diameter of not more than 2.5 microns; SO_2 = Sulfur dioxide; S.R.O. = US EPA = United States Environmental Protection Agency; TSP = total suspended particulates; WHO = World Health Organization; µg/m³ = micrograms per cubic meter; ppm = parts per million; – = no value

Source: [a]S.R.O. No: 220-Law, 2005; [b]WHO, 2005; [c]WHO, 2000; and [d]US EPA, 2006.

Notes:

(i) Sensitive area includes national monuments, health resorts, hospitals, archaeological sites, educational institutions and other government designated areas (if any).

(ii) Any industrial unit located not in a designated industrial area will not discharge such pollutants, which may contribute to exceed the ambient air quality above in the surrounding areas of category “Ga” and ‘Gha’.

(iii) Suspended articulate matters mean airborne particles of diameter 10 micron or less.

Water Quality

Table 2 shows ambient water quality standard (inland surface water), and Table 3 shows environmental water quality standards (drinking water).

Table 2: National Standards for inland Surface Water

No.	Best Practice Based Classification	pH	BOD mg/1	Dissolved Oxygen (DO), mg/l	Total Coliform Bacteria quantity/ml
a)	Potable water source supply after bacteria freeing only	6.5-8.5	2 or less	6 or above	50 or less
b)	Water used for recreation purpose	6.5-8.5	3 or less	5 o above	200 or less
c)	Potable water source supply after Conventional processing	6.5-8.5	3 or less	6 or above	5000 or less

d)	Water used for pisci-culture	6.5-8.5	6 or less	5 or above	5000 or less
f)	Water used for irrigation	6.5-8.5	10 or less	5 or above	1000 or less

In water used for pisciculture, maximum limit of presence of ammonia as Nitrogen is 1.2 mg/l.
Electrical conductivity for irrigation water – 2250 µmhoms/cm (at a temperature of 25◦C); Sodium less than 26%; Borone less than 0.2%.
Source: DoE, BOD = Biological oxygen demand, mg/l = milligram per litre, pH = negative logarithm of the hydrogen ion activity in a solution.
Notes:

Table 3: National Standards for Drinking Water

No.	Parameter	Unit	Standard Limit	WHO Guidelines
1	Aluminium	mg/l	0.2	0.2
2	Ammonia (NH_3)	mg/l	0.5	-
3	Arsenic	mg/l	0.05	0.01
4	Barium	mg/l	0.01	0.7
5	Benzene	mg/l	0.01	0.01
6	BOD_5 20◦C	mg/l	0.2	-
7	Boron	mg/l	1.0	0.5
8	Cadmium	mg/l	0.005	0.003
9	Calcium	mg/l	75	-
10	Chloride	mg/l	150-600	-
	Chlorinated Alkanes			-
11	Carbon Tetrachloride	mg/l	0.01	-
	1.1 Dichloroethylene	mg/l	0.001	-
	1.2 Dichloroethylene	mg/l	0.03	-
	Tetrachloroethylene	mg/l	0.03	-
	Trichloroethylene	mg/l	0.09	-
12	Chlorinated Phenols			
	Pentachlorophenol	mg/l	0.03	-
	2.4.6 Trichlorophenol	mg/l	0.03	-
13	Chlorine (residual)	mg/l	0.2	-
14	Chloroform	mg/l	0.09	0.3
15	Chromium (hexavalent)	mg/l	0.05	-
16	Chromium (total)	mg/l	0.05	0.05
17	COD	mg/l	4	-
18	Coliform (faecal)	n/100ml	0	-
19	Coliform (total)	n/100ml	0	-
20	Colour	Huyghens unit	15	-
21	Copper	mg/l	1	-
22	Cyanide	mg/l	0.1	-
23	Detergents	mg/l	0.2	-
24	DO	mg/l	6	-
25	Fluoride	mg/l	1	1.5
26	Hardness (as $CaCO_3$)	mg/l	200-500	-
27	Iron	mg/l	0.3-1.0	-
28	Nitrogen (Total)	mg/l	1	-
29	Lead	mg/l	0.05	0.01
30	Magnesium	mg/l	30-35	-
31	Manganese	mg/l	0.1	0.4
32	Mercury	mg/l	0.001	0.006

33	Nickel	mg/l	0.1	0.07
34	Nitrate	mg/l	10	3
35	Nitrite	mg/l	Less than 1	-
36	Odour		Odourless	-
37	Oil & Grease	mg/l	0.01	-
38	pH		6.5-8.5	-
39	Phenolic compounds	mg/l	0.002	-
40	Phosphate	mg/l	6	-
41	Phosphorus	mg/l	0	-
42	Potassium	mg/l	12	-
43	Radioactive Materials (gross alpha activity)	Bq/l	0.01	-
44	Radioactive Materials (gross beta activity)	mg/l	0.1	-
45	Selenium	mg/l	0.01	-
46	Silver	mg/l	0.02	-
47	Sodium	mg/l	200	-
48	Suspended particulate matter	mg/l	10	-
49	Sulphide	mg/l	0	-
50	Sulphate	mg/l	400	-
51	Total dissolved solids	mg/l	1000	1000
52	Temperature	◦C	20-30	-
53	Tin	mg/l	2	-
54	Turbidity	JTU	10	-
55	Zinc	mg/l	5	-

Source: DOE, BOD = biological oxygen demand, mg/l = milligram per litre, ml = millilitre
Notes: In coastal area 1000. Reference. Bangladesh Gazette, Addendum, August 28, 1997.

Noise

As for noise, the standard limit is set for every category of zonal class. Table 4 shows the Noise standards in Bangladesh.

Table 4. Bangladesh Standards for Noise

No.	Zonal Class	Limits in dBA ECR	
		Day	Night
a)	Silent Zone	45	35
b)	Residential Zone	50	40
c)	Mixed Zone (this area is used combining residential, commercial and industrial purposes)	60	50
d)	Commercial Zone	70	60
e)	Industrial Zone	70	70

Source: The Environmental Conservation Rules, 1997 (amended in 2017); IFC Environmental Health Safety Guidelines, 2008)
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 ate considered Silent Zone. Use of motor vehicle horn or other signals and loudspeakers are forbidden in Silent Zone.

International Standards

The international standards for heavy metals of the river bed materials are given in Table 5.

Table 5: USA EPA, 2000 Standard value of Heavy Metals of River Bed Materials (Sand)

Parameters	Unit	Standard Values	Remarks
Lead (Pb)	mg/kg	128	
Cadmium (Cd)	mg/kg	4.98	
Chromium (Cr)	mg/kg	111	
Copper (Cu)	mg/kg	144	
Zinc (Zn)	mg/kg	459	
Manganese (Mn)	mg/kg	-	
Arsenic (As)	mg/kg	33	
Mercury (Hg)	mg/kg	1.06	
Selenium (Se)	mg/kg	-	

Annex 2: Coordinates of Final Alignments of Transmission and LILO Lines

Table 1: Angle Point Number, Coordinates, Distance between Angle Points and Cumulative Distance of the Proposed Barisal- Gopalganj 230 kV Transmission Line

Angle Point	Latitude	Longitude	Distance between two APs (km)	Cumulative distance (km)
TT1	22.75446487	90.30757198	0.00	0.00
AP2	22.75387979	90.29955739	0.82	0.82
AP3	22.75321279	90.29368716	0.61	1.43
AP4	22.74856369	90.28887055	0.71	2.14
AP5	22.74924236	90.28406925	0.50	2.64
AP6	22.7532316	90.2809519	0.55	3.19
AP7	22.7554606	90.2710117	1.05	4.24
AP8	22.75772845	90.27044026	0.26	4.50
AP9	22.7596532	90.26839006	0.30	4.80
AP10	22.7688308	90.26603933	1.05	5.84
AP11	22.77111467	90.26586288	0.25	6.10
AP12	22.77767459	90.26678499	0.74	6.83
AP13	22.79593839	90.26644169	2.03	8.86
AP14	22.80018138	90.26366602	0.55	9.41
AP15	22.81082497	90.26326306	1.18	10.60
AP16	22.81335697	90.26701617	0.48	11.07
AP17	22.81737214	90.26982581	0.53	11.60
AP18	22.81942665	90.26905414	0.24	11.85
AP19	22.82524171	90.273092	0.77	12.61
AP20	22.82839505	90.27324878	0.35	12.96
AP21	22.83400452	90.2651639	1.04	14.00
AP22	22.83629093	90.26373774	0.29	14.29
AP23	22.84219143	90.26410232	0.66	14.95
AP24	22.84793764	90.25867565	0.85	15.80
AP25	22.85099933	90.25334476	0.64	16.44
AP26	22.86032185	90.24184182	1.57	18.01
AP27	22.86785369	90.23733494	0.96	18.96
AP28	22.8766458	90.23157193	1.14	20.10
AP29	22.88443159	90.22826447	0.93	21.03
AP30	22.89394501	90.23104034	1.09	22.13
AP31	22.89853916	90.22840079	0.58	22.71
AP32	22.90826887	90.22853028	1.08	23.79
AP33	22.9227671	90.22429225	1.67	25.46
AP34	22.9258238	90.22432308	0.34	25.80
AP35	22.93403828	90.22243719	0.93	26.73

Angle Point	Latitude	Longitude	Distance between two APs (km)	Cumulative distance (km)
AP36	22.94538272	90.21466347	1.49	28.22
AP37	22.946316	90.21396804	0.13	28.34
AP38	22.95210582	90.21348902	0.65	28.99
AP39	22.95884552	90.2094945	0.85	29.84
AP40	22.96798142	90.19113297	2.14	31.98
AP41	22.98649616	90.18838249	2.08	34.06
AP42	23.00583552	90.1771056	2.44	36.49
AP43	23.03149427	90.18106027	2.88	39.37
AP44	23.05701159	90.17129078	3.01	42.38
AP45	23.06531343	90.15993638	1.48	43.86
AP46	23.06849691	90.15604011	0.53	44.40
AP47	23.07426949	90.14144224	1.62	46.02
AP48	23.09298057	90.13515533	2.18	48.20
AP49	23.11624862	90.11692239	3.19	51.38
AP50	23.12760035	90.08451856	3.54	54.93
AP51	23.13284596	90.084218	0.58	55.51
AP52	23.14103561	90.08451686	0.91	56.42
AP53	23.14681464	90.08572318	0.65	57.08
AP54	23.16323865	90.08428757	1.83	58.91
AP55	23.175028	90.08670879	1.33	60.24
AP56	23.19013743	90.07261504	2.21	62.45
AP57	23.19716133	90.07427881	0.80	63.25
AP58	23.2040547	90.07205665	0.80	64.05
AP59	23.20915269	90.064013	1.00	65.05
AP60	23.23539212	90.05003713	3.25	68.29
AP61	23.24415771	90.04470481	1.12	69.41
AP62	23.2522389	90.04052102	0.99	70.40
AP63	23.27296355	90.02198733	2.98	73.38
AP64	23.27698867	90.02045905	0.47	73.86
AP65	23.27850188	90.01418059	0.66	74.52
TT66	23.27815005	90.01276985	0.15	74.67

Table 2: Angle Point Number, Coordinates, Distance between Angle Points and Cumulative Distance of Gopalganj- Faridpur 230 kV Transmission Line

Angle point	Latitude	Longitude	Distance between two APs (km)	Cumulative distance (km)
TT1	23.279427	90.011675 (Gopalganj -N)	0.00	0.00
AP2	23.28276	89.99864	1.38	1.38
AP3	23.292837	89.992218	1.30	2.68
AP4	23.298677	89.991128	0.66	3.34
AP5	23.315939	89.983367	2.08	5.41
AP6	23.323357	89.983385	0.82	6.24
AP7	23.331395	89.974653	1.26	7.50
AP8	23.339886	89.969315	1.09	8.59
AP9	23.354229	89.969448	1.59	10.18
AP10	23.3806	89.954077	3.32	13.50
AP11	23.404637	89.935422	3.28	16.78
AP12	23.409636	89.933692	0.58	17.37
AP13	23.417158	89.932261	0.85	18.22
AP14	23.424851	89.930619	0.87	19.09
AP15	23.426662	89.927611	0.37	19.45
AP16	23.445927	89.925686	2.15	21.60
AP17	23.450516	89.924542	0.52	22.13
AP18	23.469463	89.905068	2.89	25.02
AP19	23.479259	89.872804	3.46	28.48
AP20	23.483943	89.871577	0.54	29.02
AP21	23.489512	89.851015	2.19	31.20
AP22	23.493765	89.841488	1.08	32.28
AP23	23.495675	89.830762	1.11	33.40
AP24	23.496689	89.815688	1.54	34.94
AP25	23.503619	89.806257	1.23	36.17
AP26	23.520441	89.798875	2.01	38.18
AP27	23.526422	89.791345	1.02	39.20
AP28	23.535887	89.788478	1.09	40.29
AP29	23.545381	89.787059	1.06	41.36
AP30	23.550658	89.786276	0.59	41.95
AP31	23.555218	89.783448	0.58	42.53
AP32	23.557901	89.781567	0.35	42.88
AP33	23.560927	89.780971	0.34	43.23
AP34	23.569348	89.783522	0.97	44.20
AP35	23.572669	89.784559	0.38	44.58
AP36	23.581336	89.783911	0.97	45.55
AP37	23.586802	89.790197	0.88	46.43
AP38	23.58740631	89.79244116	0.24	46.67

Angle point	Latitude	Longitude	Distance between two APs (km)	Cumulative distance (km)
AP39	23.58678288	89.79767251	0.54	47.20
AP40	23.5872855	89.79942804	0.19	47.39
TT41	23.5904641	89.8003795 (Faridpur)	0.37	47.76

Table 3: Angle Point Numbers, Coordinates, Distance between Angle Points and Cumulative Distance of Bogra- Rahanpur 400 kV Transmission Line

AP	Latitude	Longitude	Distance between two APs (km)	Cumulative distance (km)
TT1	24.787697	89.243118 Bogra (W)	0.00	0.00
AP2	24.772852	89.215849	3.21	3.21
AP3	24.778905	89.183536	3.33	6.54
AP4	24.758915	89.158799	3.34	9.88
AP5	24.759314	89.135108	2.39	12.27
AP6	24.768077	89.114811	2.27	14.54
AP7	24.765474	89.086229	2.90	17.43
AP8	24.765248	89.082137	0.41	17.85
AP9	24.761989	89.069819	1.29	19.14
AP10	24.756445	89.00103	6.97	26.11
AP11	24.760042	88.974525	2.70	28.82
AP12	24.755793	88.960043	1.54	30.35
AP13	24.75546	88.956741	0.34	30.69
AP14	24.754525	88.954358	0.26	30.95
AP15	24.753011	88.940694	1.39	32.34
AP16	24.755812	88.936229	0.55	32.89
AP17	24.757451	88.931547	0.51	33.39
AP18	24.747479	88.899382	3.43	36.82
AP19	24.715506	88.850479	6.08	42.90
AP20	24.71123	88.836922	1.45	44.35
AP21	24.710656	88.824706	1.23	45.59
AP22	24.708718	88.819167	0.60	46.19
AP23	24.707773	88.798225	2.12	48.30
AP24	24.711402	88.790567	0.87	49.17
AP25	24.712582	88.784826	0.59	49.77
AP26	24.71374	88.778292	0.67	50.44
AP27	24.711542	88.771702	0.71	51.15
AP28	24.715705	88.759014	1.36	52.51
AP29	24.715775	88.750637	0.85	53.36
AP30	24.713823	88.747127	0.42	53.77
AP31	24.714217	88.743175	0.40	54.17
AP32	24.712701	88.741072	0.27	54.44

AP	Latitude	Longitude	Distance between two APs (km)	Cumulative distance (km)
AP33	24.711314	88.740341	0.17	54.61
AP34	24.711	88.733968	0.64	55.26
AP35	24.711619	88.727063	0.70	55.96
AP36	24.711721	88.716721	1.04	57.00
AP37	24.710453	88.714321	0.28	57.28
AP38	24.709842	88.708556	0.59	57.87
AP39	24.703316	88.69983	1.14	59.01
AP40	24.703978	88.695552	0.44	59.45
AP41	24.702465	88.693346	0.28	59.73
AP42	24.703475	88.688872	0.47	60.19
AP43	24.700609	88.685228	0.49	60.68
AP44	24.699033	88.673277	1.22	61.90
AP45	24.694401	88.668705	0.69	62.59
AP46	24.692277	88.657066	1.20	63.79
AP47	24.684585	88.64585	1.42	65.21
AP48	24.685078	88.641327	0.46	65.67
AP49	24.677799	88.615717	2.71	68.38
AP50	24.678345	88.606779	0.90	69.28
AP51	24.693521	88.600384	1.81	71.09
AP52	24.721719	88.559725	5.16	76.25
AP53	24.730922	88.552047	1.28	77.53
AP54	24.732945	88.53931	1.31	78.84
AP55	24.73758	88.532925	0.82	79.66
AP56	24.743742	88.514839	1.95	81.61
AP57	24.744968	88.504584	1.04	82.66
AP58	24.74795	88.494524	1.07	83.72
AP59	24.748293	88.488985	0.56	84.29
AP60	24.752322	88.475719	1.41	85.70
AP61	24.751229	88.461397	1.45	87.15
AP62	24.749344	88.451442	1.03	88.17
AP63	24.747109	88.440877	1.09	89.27
AP64	24.742221	88.431328	1.11	90.37
AP65	24.746106	88.421123	1.12	91.49
AP66	24.744607	88.417062	0.44	91.93
AP67	24.743031	88.414789	0.29	92.22
AP68	24.74271	88.412106	0.27	92.49
AP69	24.743572	88.407259	0.50	92.99
AP70	24.73921	88.402589	0.68	93.67
AP71	24.741269	88.398077	0.51	94.18
AP72	24.746112	88.393613	0.70	94.88

AP	Latitude	Longitude	Distance between two APs (km)	Cumulative distance (km)
AP73	24.74718	88.38721	0.66	95.54
AP74	24.744339	88.370522	1.71	97.25
AP75	24.753413	88.362432	1.30	98.55
AP76	24.755215	88.357233	0.56	99.11
AP77	24.755625	88.348458	0.89	100.00
AP78	24.762816	88.33795	1.33	101.32
AP79	24.76652	88.337114	0.42	101.74
TT80	24.784056	88.331592 Rahanpur	2.03	103.77

Table 4: Angle Point Number, Coordinates, Distance between Angle Points, and Cumulative Distance of Rahapur -Chapainawbganj 132 kV Transmission Line

Angle point	Latitude	Longitude	Distance between two APs (km)	Cumulative distance (km)
TT1	24.784141	88.331461 Rahanpur	0.00	0.00
AP2	24.768251	88.331165	1.77	1.77
AP3	24.763536	88.330569	0.53	2.29
AP4	24.756617	88.329997	0.77	3.06
AP5	24.752064	88.326623	0.61	3.67
AP6	24.746244	88.328101	0.66	4.34
AP7	24.740804	88.326298	0.63	4.97
AP8	24.735354	88.325239	0.61	5.58
AP9	24.728062	88.323563	0.83	6.41
AP10	24.720756	88.320571	0.87	7.28
AP11	24.712963	88.31694	0.94	8.22
AP12	24.700132	88.31767	1.43	9.65
AP13	24.690896	88.314192	1.08	10.73
AP14	24.673534	88.307824	2.03	12.76
AP15	24.662786	88.307239	1.20	13.96
AP16	24.651136	88.303781	1.34	15.30
AP17	24.634293	88.304589	1.87	17.17
AP18	24.627566	88.303282	0.76	17.93
AP19	24.613892	88.302764	1.52	19.45
AP20	24.60512	88.30991	1.21	20.67
AP21	24.597094	88.310761	0.90	21.56
AP22	24.58412	88.297943	1.94	23.50
AP23	24.583337	88.294413	0.37	23.87
AP24	24.58069	88.290736	0.47	24.34
TT25	24.579687	88.290382 Chapainawabganj	0.12	24.46

Table 5: LILO Line- Rohanpur to Barapukuria

AP	Latitude	Longitude	Distance between two APs (km)	Cumulative distance (km)
TT1	24.788854	89.246678	0.00	0.00
AP2	24.79204	89.256781	1.08	1.08
AP3	24.79223	89.260335	0.36	1.44
AP4	24.793188	89.260848	0.12	1.56
AP5	24.79679	89.268929	0.91	2.46
AP6	24.800682	89.272535	0.57	3.03
AP7	24.81071	89.296584	2.67	5.70
AP8	24.808411	89.30877	1.26	6.95
AP9	24.81788	89.318148	1.41	8.37
AP10	24.819431	89.324531	0.67	9.04
AP11	24.83277	89.330091	1.58	10.62
AP12	24.834405	89.330022	0.18	10.80

Annex 3: Flora/ Fauna Species and Number of Affected Trees Recorded in the Project Area

Table 1: List of Terrestrial Flora Recorded in the RoW and Surroundings of the Transmission Line Routes.

Scientific Name	Logical Name (English Name)	Habit	Habitat	Status
Timber/Wood Trees				
Swietenia mahagoni	Mahogoni	T	RS, HS	C
Azadirachta indica	Neem	T	HS	C
Albizzia procera	Koroi	T	RS, HS	C
Eucalyptus citriodora	Eucalyptus	T	RS, HS	C
Dalbergia sisoo	Shishu	T	RS, HS	C
Bambusa vulgaris	Bash (Bamboo)	S	HS	C
Samanea saman	Raintree	T	RS, HS	C
Bombax ceiba	Shimul (Cotton Tree)	T	RS, HS	LC
Ficus benghalensis	Banyan tree	T	RS	C
Ficus infectoria	Pakur	T	HS	LC
Polyalthia longifolia	Debdaru	T	RS	LC
Acacia aurculiformis	Akashmoni	T	RS, HS	C
Areca catechu	Supari/ Beetle nut	T	HS, RS	C
Tectona grandis	Shegun	T	RS, HS	LC
Terminalia arjuna	Arjun	T	HS, RS	LC
Dillenia indica	Chalta	T	HS, RS	C
Delonix regia	Krishnachura	T	HS	LC
Artocarpus chama Buch-Ham		T	HS	C
Artocarpus heterophyllus	Jack fruit	T	HS	C
Phaleria macrocarpa	Dewa	T	HS	C
Instia bijuga	Ipil	T	HS	LC
Polyalthia longifolia	Debdaru	T	HS, RS	C
Castanea sp.	Chestnut	T	HS	C
Diospyros discolor	Gab	T	HS	C
Lagerstroemia speciosa	Jarul	T	RS	C
Litchi chinensis	Lichi	T	HS	C
Mangifera indica	Mango	T	HS	C
Phyllanthus emblica	Amloki	T	HS.RS	LC
Olea europaea	Olive	T	HS	C
Borassus flabelilifer	Tal	T	HS, RS	C
Fruit Trees				
Musa sapientum	Kalagash (Banana)	H	HS	C
Psidium guajava	Piara (Guava)	T	HS	LC
Cocos nucifera	Narikel (Coconut)	T	HS	C
Moringa oleifera	Sajna	T	HS	LC
Zizyphus jujuba	Boroi	T	HS	LC
Citrus grandis	Jambura/Badam	S	HS	C
Aegle marmelos	Bel	T	HS	C
Limonia acidissima	Kodbel/ woodapple	T	HS, RS	C
Phoenix dactylifera	Date Tree (Khejur)	T	HS, RS	C
Areca catechu	Supari (Betel Nut/Nut)	T	HS	C
Carica papaya	Pepe (Papya)	T	HS	C
Citrus aurantifolia	Labu (Lemon)	S	HS	C

Scientific Name	Logical Name (English Name)	Habit	Habitat	Status
Annona reticulate	Atafal	T	HS	C
Annona squamosa	Ata	T	HS	C
Averrhoa carambola	Kamranga	T	HS	C
Punica granatum	Dalim	S	HS	LC
Manilkara sapota	Sobeda	T	HS	LC
Dillenia indica	Chalta	T	HS	LC
Fruit cum Timer Trees				
Artocarpus heterophyllus	Kathal (Jackfruits)	T	HS	LC
Mangifera indica	Aam(Mango)	T	HS	C
Syzygium cumini	Jam(Blackberry)	T	HS	C
Tamerindus indica	Tetul (Tamarind)	T	HS	C
Borassus flabellifer	Tal (Palm Tree)	T	RS	LC
Elaeocarpus robustus	Jolpai (Olive)	T	HS	LC
Diospyros peregrina	Gub	T	HS, RS	LC
Medicinal Trees				
Azadirachta indica	Neem	T	HS	C
Teominalia arjunna	Arjun	T	HS, RS	LC
	Bohera	T	HS	LC
	Tejpata	T	HS	LC
Ocimum canum	Tulshi	H	HS	LC
Coccinea cordifolia	Telakachu	S	HS	C
Fuel Trees				
	Paiya	T	HS	C
Ficus benghalensis	Bot (Banyan Tree)	T	RS	LC
Acacia nilotica	Babla	T	HS	C
Ricinus communes	Venna	T	HS	C
Lannea coromandelica	Ziga	T	HS, RS	C
	Bonziga	T	HS	C
Ficus hispida	Dumoor	T	RS	C
Anthocephalus cadamba	Kadom	T	HS	C
	Shewra	T	HS	C
	Bakul	T	HS	LC
Aesthetic				
Delonix regia	Krisnochura	T	HS	LC
Cassia fistula	Sonalu	T	HS	LC
Codiaeum variegatum	Patabahar	S	HS	LC
Lawsenia inermis	Mehendi	S	HS	C
Gardenia coronaria	Gandha raj	S	HS	C
Casuarina littorea	Jaw	T	HS	LC
Nymphaea nouchalli	Shapla	H	WL	C

Source: Field survey, Nov. Dec. 2017. Note: C-Common, LC- Less Common, UC- Uncommon, CU- Cultivated Habit: T=Tree, H= Herb, S=Shrub, G=Grass; Habitat: HS=Homestead, RS-Road side

Table 2: List of Faunal Species Found in the Substation/ Transmission Line Subproject Areas.

Scientific Name	English Name	Local Name	Conservation Status
Amphibians			
Bufo melanostictus	Common Toad	Kuno bang	NT
Rana temporalis	Bull Frog	Kola bang	NT
R. pipens	Grass Frog	Sona bang	NT
Reptiles			
Hemidactylus flaviviridis	Common House Lizard	Tiktiki	NT
Calotes versicolor	Common Garden Lizard	Rokto-chosha	NT
Varanus bengalensis	Bengal monitor	Gui shap	VU
Varanus Salvatore	Ring lizard	Kalo gui	EN
Xenochrophis piscator	Checkered keelback	Dhora shap	NT
Amphiesma stolata	Stripped keelback	Dora shap	NT
Enhydris	Common smooth water snake	Paina shap	NT
Coluber mucosus	Rat snake	Daraj shap	VU
Ahaetulla nasutus	Common vine snake	Laodoga shap	VU
Atretium schistosum	Olive keelback	Maitta shap	NT
Naja	Monocellate cobra/ Spectacled cobra	Khoia gokhra	EN
Birds			
Ardeola grayii	Indian pond heron	Kani bok	NT
Casmerodius albus	Great egret	Sada bok	NT
Egretta intermedia	Intermediate egret	Mazla bok	NT
Egretta garzetta	Little egret	Choto bok	NT
Nycticorax	Black-crowned night heron	Nishi bok	NT
Ixobrychus cinnamomeus	Cinnamon Bittern	Lal bok	NT
Anastomus oscitans	Asian Openbill	Shamuk-khol	NT
Haliastur indus	Brahminy kite	Shankho chil	NT
Milvus migrans	Black kite	Bhubon chil	NT
Actitis hypoleucos	Common sandpiper	Kada Khocha	-
Streptopelia chinensis	Spotted dove	Tila Ghughu	NT
Streptopelia decaocto	Eurasian collared dove	Raj Ghughu	NT
Psittacula krameri	Rose-ringed parakeet	Tia	NT
Amaurornis phoenicurus	White-breasted waterhen	Dahuk	NT
Eudynamys scolopacea	Asian cuckoo	Kokil	NT
Centropus sinensis	Greater coucal	Kanakua	NT
Cuculus micropterus	Indian cuckoo	Bou-kotha-kao Pakhi	NT
Athene brama	Spotted owlet	Khuruley Pencha	NT
Alcedo atthis	Common kingfisher	Choto Maachranga	NT
Halcyon smyrnensis	White-throated kingfisher	Sada buk Maachranga	NT
Ceryle rudis	Pied kingfisher	Pakra Maachranga	NT
Megalaima haemacephala	Coppersmith barbet	Choto Basanta Bauri	NT
Oriolus xanthornus	Black-headed oriole	Holdey Pakhi	NT
Corvus splendens	House crow	Pati Kak	NT
Dicrurus macrocercus	Black drongo	Fingey	NT
Copsychus saularis	Oriental magpie robin	Doel	NT
Acridotheres fuscus	Jungle myna	Jhuti Shalik	NT
A. tristis	Common myna	Bath Shalik	NT

A. ginginianus	Bank myna	Gang Shalik	NT
Sturnus contra	Asian pied starling	Gobrey Shalik	NT
S. malabaricus	Chestnut-tailed starling	Kath Shalik	NT
Pycnonotus cafer	Red-vented bulbul	Bulbuli	NT
Turdoides striatus	Jungle babbler	Satbhai	NT
Orthotomus sutoriu	Common tailorbird	Tuntuni	NT
Passer domesticus	House sparrow	Charui	NT
Ploceus philippinus	Baya weaver	Babui	NT
Upupa epops	Eurasian Hoopoe	Hudhud Pahkhi	NT
Mammals			
Pteropus giganteus	Flying Fox	Badur	NT
Pipistrellus coromandra	Indian Pipistrelle	-	NT
Megaderma lyra	Greater False Vampire	Badur	NT
Herpestes edwarsi	Common Mongoose	Bara benji	VU
H. auropunctatus	Small Indian Mongoose	Benji	NT
Rattus	Common House Rat	Indur	NT
Bandicota indica	Bandicoot Rat	Bara indur	NT
B. bengalensis	Lesser Bandicoot Rat	Indur	NT
Mus musculus	House Mouse	Nengri indur	NT
Suncus murinus	House Shrew	Chicka	NT

EN = Endangered, VU = Vulnerable, NT = Not Threatened.
Source: Field Survey, Nov. Dec. 2017, Literature Review and IUCN Red Data Book (2003).

Table 3: List of Fish Species Found in the Substation/ Transmission Line Subproject Areas.

Local Name	Scientific Name	English Name	Local Status
Tengra	*Batasio*	Tista Batasio	NT
Pabda	*Ompok pabo*	Pabo catfish	EN
Puti	*Puntius sophore*	Spotfin Swamp Barb	NT
Darkina	*Esomus danricus*	Flying barb	DD
Dhela	*Osteobrama cotio*	Cotio	EN
Chela	*Salmostoma acinaces*	Silver Razorbelly Minnow	DD
Rui	*Labeo sp.*		DD
Catla	*Catla*	Catla	NT
Mrigal	*Cirrhinus mrigala*	Mrigal	NT
Ayre	*Aorichthus aor*	Longwhiskered Catfish	VU
Chital	*Notopterus chitala*	Humped Featherback	EN
Boyal	*Wallago attu*	Freshwater	NT
Pungus	*Pangasius*	Pungas	CR
Elish	*Tenualosa ilisha*	Hilsha	NT
Bele	*Awaous gutum*		NT
Foli	*Notopterus*	Grey featherback	VU
Koi	*Anodontosoma chachunda*	Chachunda	NT
Mola	*Amblypharyngodon mola*	Pale carplet	NT
Chapila	*Gonialosa manmina*	Ganges River	NT
Baim	*Mactacembalus armatus*	Tire truck spineel	EN
Gajar	*Channa marulius*	Giant snakehead	EN

EN= Endangered, VU= Vulnerable, CR= Critically Endangered, NO= Not Threatened, DD= Data Deficient.
Source: Field Survey, November- December 2017 and Literature Review and IUCN Red Data Book (2003)

Table 4: Local Name, Scientific Name, Type of Tree and Number of Affected Trees Recorded in the RoW (40 m) During the Field Survey in the RoW of Barisal- Gopaganj-Faridpur 126 km Transmission Line.

SL	Local Name of trees	Scientific Name of Trees	Type of Trees	Maximum Height(METER)	Total Affected Trees
1	Akashmoni	(*Acacia auriculiformis*)	Non Fruits	30	2165
2	Amra	(*Spondias mombin*)	Fruits trees	22	530
3	Arjun	(*Terminalia arjuna*)	Medicinal	25	647
4	Banyan Tree	(*Ficus benghalensis*)	Non Fruits	30	1344
5	Betel Nut	(*Areca palm*)	Fruits trees	20	1292
6	Blackberry	*(Syzygium cumini)*	Fruits trees	25	1862
7	Chalta	(*Dillenia indica*)	Fruits trees	10	70
8	Chambol	(*Artocarpus chama Buch-Ham*)	Non Fruits	40	2565
9	Chestnut	(*Castanea*)	Fruits trees	35	621
10	Coconut	(*Cocos nucifera*)	Fruits trees	30	3056
11	Date	(*Phoenix dactylifera*)	Fruits trees	30	1026
12	Deuya	(*Phaleria macrocarpa*)	Fruits trees	18	205
13	Devdaru	(*Polyalthia longifolia*)	Non Fruits	20	531
14	Ipilipil	(*Intsia bijuga*)	Non Fruits	50	10
15	Fir tree	(*Abies grandis*)	Non Fruits	70	5
16	Gab	(*Psidium guajava*)	Fruits trees	10.73	511
17	Jack Fruit	(*Artocarpus heterophyllus*)	Fruits trees	21	2531
18	Jarul	(*Lagerstroemia speciosa*)	Non Fruits	20	397
19	Jujube	(*Ziziphus jujuba*)	Fruits trees	12	2
20	Koroi	(*Albizia procera*)	Non Fruits	30	820
21	Krisnachura	(*Delonix regia*)	Non Fruits	12	20
22	Latai		Non Fruits	25	2
23	Mango	(*Mangifera indica*)	Fruits trees	35	1986
24	Margosa	(*Azadirachta indica*)	Medicinal	40	1192
25	Mehoguni	(*Swietenia macrophylla*)	Non Fruits	35	3684
26	Myrobalan/ Amloki	(*Phyllanthus emblica*)	Medicinal	20	132
27	Olive	(*Olea europaea*)	Fruits trees	30	844
28	Palm Tree	*(Borassus flabellifer)*	Fruits trees	20	1724
29	Pitha Bora		Non Fruits	30	2
30	Rain Tree	(*Samanea saman*)	Non Fruits	50	2103
31	Sajina	(*Moringa oleifera)*	Fruits trees	12	3
32	Shal	*(Shorea robusta)*	Non Fruits	25	6
33	Shimul	(*Bombax ceiba*)	Non Fruits	30	5
34	Shisu	(*Dalbergia sissoo*)	Non Fruits	30	46
35	Tamarind	(*Tamarindus indica*)	Fruits trees	24	640
36	Tectona	(*Tectona grandis)*	Non Fruits	30	1141
37	Trot/ Kodom	(*Anthocephalus chinensis*)	Non Fruits	30	306
38	Eucalyptus	(*Eucalyptus globulus)*	Non Fruits	55	24
39	Wood		Non Fruits	30	307
40	Wood Apple	(*Limonia acidissima*)	Fruits trees	15	119
Total					**34,476***

*Only the trees in the center of RoW i.e. 10 m will be removed.

Table 5: Summary of Trees and Average Market Price.

SL	Type of Trees	Total Affected Trees	Average Market Price
1	Fruits trees	17,022	7,500
2	Non Fruits	15,483	15,000
3	Medicinal	1,971	6,000
	Total	**34,476**	

Table 6: Local Name, Scientific Name, Type of Tree and Number of Affected Trees Recorded During the Field Survey in the RoW of Bogra- Rohanpur (400 kV, 104 km) and Rohanpur- Chapai Nawabganj Line (132 kV, 26 km)

SL	Local Name of trees	Scientific Name of Trees	Type of Trees	Total Affected Trees
1	Akshmoni	(*Acacia auriculiformis*)	Non Fruits	154
8	Chambol	(*Artocarpus chama Buch-Ham*)	Non Fruits	1
10	Date	(*Phoenix dactylifera*)	Fruits trees	14
11	Euklyptus	(*Eucalyptus globulus)*	Non Fruits	310
13	Jack Fruit	(*Artocarpus heterophyllus*)	Fruits trees	135
16	Kodom	(*Anthocephalus chinensis*)	Non Fruits	3
17	Koroi	(*Albizia procera*)	Non Fruits	18
19	Lichi	(*Litchi chinensis*)	Fruits trees	7
20	Mango	(*Mangifera indica*)	Fruits trees	327
21	Mehoguni	(*Swietenia macrophylla*)	Non Fruits	149
22	Margosa	(*Azadirachta indica*)	Medicinal	7
23	Olive	(*Olea europaea*)	Fruits trees	2
24	Paikor		Non Fruits	1
25	Palm Tree	(*Borassus flabellifer*)	Fruits trees	18
27	Rain Tree	(*Samanea saman*)	Non Fruits	20
30	Shisu	(*Dalbergia sissoo*)	Non Fruits	14
Total				**1,180***

*Only the trees in the center of RoW i.e. 10 m will be removed

Table 7. Summary of Trees and Average Market Price.

SL	Type of Trees	Total Affected Trees	Average Market Value
1	Fruits trees	503	7500
2	Non Fruits	670	15000
3	Medicinal	7	6000
Total		**1180**	

Table 8: Local Name, Scientific Name, Type of Tree and Number of Affected Trees Recorded During the Field Survey in the RoW of LILO Line from Bogra to Barapukuria (230 kV, 11 km)

SL	Local Name of trees	Scientific Name of Trees	Type of Trees	Total Affected Trees
1	Akshmoni	(*Acacia auriculiformis*)	Non Fruits	1
4	Date	(*Phoenix dactylifera*)	Fruits trees	1
6	Mango	(*Mangifera indica*)	Fruits trees	1
9	Pulm	(*Borassus flabellifer*)	Fruits trees	2
Total				**5***

*Only the trees in the center of RoW i.e. 10 m will be removed

Annex 4: Photographs of the Existing Environment and Public Consultations

Table 1. Photographs of the existing environment- Barisal- Gopaganj- Faridpur 230 kV transmission line

	
Plate 1 River crossing location	Plate 2 Cultivation on the river bed in January/ February, low rainfall season
	
Plate 3 Transmission line crosses river/ water channels (Khal) in number of locations	Plate 4 Kumar River in February 2018
	
Plate 5 Houses and the garden, Dashar village	Plate 6 House and the garden, Dashar village

Plate 7 A pond in a home garden

Plate 8 Mustard (*Brassica juncea*) cultivation

Plate 9 A Paddy field

Plate 10 Bamboo (*Bambusa vulgaris*) cultivation along the road

Plate 11 Mahogany planted along the road

Plate 12 Tree garden and a paddy filed

Plate 13 Paddy cultivation at Gopaganj land

Plate 14 Farmers working at the land earmarked for the Gopalganj GSS (2nd February 2018)

Plate 15 Agricultural field- Gopalganj land

Plate 16 Gopalganj land in the background- from the highway

Plate 17 Fact Finding Mission at Gopalganj, Faridpur- Barisal highway (2nd February 2018)

Plate 18 Gopalganj land

	
Plate 19 Barisal GSS- Fact Finding Mission team (2nd February 2018)	Plate 20 An area set aside for the GIS bays- Barisal GSS
	
Plate 21 Barisal GSS- Fact Finding Mission team	Plate 22 A large number of trees in a home garden
	
Plate 23 A home garden, Dighnagar village	Plate 24 Location where line crosses the road

Plate 25 Fulshuti village- TL route changed to avoid a mosque

Plate 26 Fulshuti village

Plate 27 Existing 132 kV line Madaripur- Faridpur

Plate 28 TL tower footing, 132 kV, in a paddy field

Plate 29 Line crossing a settlement area- Talma

Plate 30 Line route changed in a settlement area

Table 2. Bogra to Chapainawabganj transmission line Alignment

	
Plate 1**.** Transmission line final alignment crossing a river	Plate 2. Alignment crossing a river
	
Plate 3. Transmission line crossing a Pucca Road	Plate 4. Transmission line crossing a Kucca Road
	
Plate 5. Households in the RoW	Plate 6. Household in the RoW

	
Plate 7. Trees in the RoW	Plate 8**.** Trees in the RoW

Table 3. Rohanpur substation land

	
Plate 1 A paddy field	Plate 2 Land preparation for cultivation
	
Plate 3 Harvested area	Plate 4 Scattered trees at the edge of the land

Table 4. Public consultations – Bogra- Rohanpur- Chapainawabganj transmission line

Bogra substation land- 22 Dec 2017

Public consultation with the affected people at Bogra- Rohanpur transmission line, 23 Dec. 2017

	
	Public consultation near Bogra grid substation land 22 Dec. 2017
	
	

Annex 5: Focused Group Discussion on Environment

SOUTHWEST TRANSMISSION GRID EXPANSION PROJECT
Attendance Sheet for Environment (FGD)

Meeting Place/Venue: Noagola Bot tola mor
Meeting Time: 4:00pm
Distance from ROW: 300m
Date: 18.12.17
Village: Noagola
Union/Ward: Pourasava
Upazilla: Chapai Sadar
Zilla: Chapai Nawabganj

1. At the beginning of their discussion the team of ADB consultant (RMA) asked the villagers if they have any idea about the project. In reply the villagers said that they have no idea about the project. Then the consultant facilitator discussed about the project, its implementation plan and importance of the project with the villagers in details. They also discussed about the environmental effect on that area if the project starts implementing there.
2. People are in generally happy with the project with the best interest of the country, but people are afraid whether they will receive any compensation for the affected trees and structures. They also said that they are looking after the trees for a long time and trees are directly involved with the livelihood of the people. They have requested for the adequate compensation for the trees and they have also requested additional compensation for the fruit bearing trees.
3. There are many mango and mahogany garden within the 400 away the project ROW. There are many mango trees in this area and people's livelihood mainly depends on the mango trees. This Chapai area is famous for the mango trees and these mangoes are sold all over the countries. There is lake beside (400 meter away from ROW) the project area in which villagers cultivate different types of fish. In the Chapa Nawabganj area there are different lakes which helps to drain the rain water. People have requested project authority to take care of the lakes so that no negative impact arise during construction.
4. In the project area there are paddy land, pond and agricultural land. But there is no nursery, forestland, school, college, mosque within the project t ROW. If the project is implemented, the fish of those ponds will be damaged and also lost their habitats. It will impact the livelihood of the people as well. People requested to pay compensation for the fish as well.
5. There is some guava orchard near the project area. The names of the major trees which we found in the project area are the following: Mahogany, Rain-tree, Eucalyptus, mango, Banana etc.
6. During the project implementation of sub-station, not a large number of trees will cut down. The name of the trees which is under the grid line are the following: Mango, coconut, banana, date, lemon, guava, mahogany etc.
7. There is no animal and migratory bird which can be affected by this project.
8. In between 100km of the sub-station or under grid line there is no grassland. Animals like cow, goat, sheep and buffalo are seen in the field when there is no water in the lake which is beside the project area.
9. As there are some auto rice mills in their village, the villagers face air pollution. Besides, there is no other environmental problem which the villagers have to face.
10. People are worried about the thunder storm and people requested project authority to take care of the issues so that it do not create any problem during rainy season. As the towers will be high, during the rainy season, thunder storm, it may affect thus cause death of the farmers and general people.
11. There is no threatened animals or trees are found in this area according to people's opinion. But fishes are found less in the rivers. There are two main rivers in the project are namely Ganges and Mahananda. 20 to 30 years ago people used to have fish every day in their meal and but due to increase of population and development projects on the river, fishes are going down.

12. There is one famous mosque named Sona masque which is 100 km away from the project area. This mosque is constructed in 1500.
13. There is some presence of indigenous people in this district, but none will be affected due to project implementation. Closest tribal community reside within 4 km of project ROW.
14. At the end, people said that PGCB people used to cut their tree branches every year and it affects their trees. Rather than cutting every year, they have requested to pay them proper compensation for the trees and cut the entire trees. So that it will not create any problems with the grid line.

ATTENDANCE SHEET

S.N.	Name of the Participants	Gender	Occupations/status	Mobile Number
1.	MD.JAKIR HOSSEN	MALE	STUDENT	01721355414
2.	MD.YEAKUB ALI	MALE	FARMER	
3.	HOZROT ALI	MALE	FARMER	01768801744
4.	HABIB UDDIN	MALE	FARMER	01758453082
5.	BASHIR UDDIN	MALE	FARMER	01725820964
6.	ASHIK	MALE	BUSINESS	01704671275
7.	TARIK HOSSEN	MALE	BUSINESS	01752400810
8.	BASIR	MALE	STUDENT	01718728039
9.	MUBAROK ALI	MALE	DRIVER	01730855103
10.	MOZLU	MALE	FARMER	
11.	SUJAD ALI	MALE	FARMER	
12.	HASAN ALI	MALE	STUDENT	01763552376
13.	KABIL UDDIN	MALE	FARMER	01745578237
14.	ABDUL ZABBAR	MALE	FARMER	01773721511
15.	ALAM HOSSEN	MALE	FARMER	01729754722
16.	ALMAS	MALE	FARMER	01755356610
17.	SALMAN	MALE	FARMER	01734396847
NOTE: TOTAL PARTICIPANTS: 17, MALE: 17, FEMALE:0				

SOUTHWEST TRANSMISSION GRID EXPANSION PROJECT
Attendance Sheet for FGD -Environment (Substation)

Meeting Place/Venue: House of Md. Awlad Hossen — Meeting Time:
Distance from ROW: — Date: 15.12.17
Village: Magura — Union/Ward: Maloncha
Upazilla: Kahalu — Zilla: Bogra

1. People were not aware of the project and project team has informed them about the project. Project team also informed them about the impact, benefits of the project including the timeline of the project. Participants said that the villagers will not get the power or energy directly from the substation rather they can get energy from power distribution company. They said that as it's a high voltage station, it is very risky for the people of that area. So no one can roam around the station. They have suggested to give them proper compensation for the trees and structures so that they can maintain their livelihood. People understood that If the project is implemented, people of that area will get rid from many problems such as: load shedding will stop, there will no scarcity of electricity during the time of cultivation. If the electricity will available during cultivation, farmers can able to grow more food which will develop their financial condition and also develop the area. Md. Mahfuj said that the authority should be more careful so that the environment of the area will not lose its previous condition due to the implementation of the project. Proper safety measures should be taken by the project so that during thunder stream no one gets affected by the electric poll.
2. Md. Rafiqul Islam said that there is no archeological evidence, park, garden or orchard in this project area but there are many parks and archeological places in Bogra district. Those are mainly Mahastangor (150 meter away), Wonderland Sisupark (children park), Woodburn park, Bara Mosque etc.
3. There are some ponds in the project areas, but project grid lines will mainly have constructed on agricultural land. People requested to pay proper compensation for the affected crops. People also said that during construction, for access road contractor damages lots of crops and they do not pay compensation for that. Project should take care of this issue seriously. Most of the people in this area is poor and they depend on agriculture. For constructing of the towers, project will occupy lots of land for which people request for compensation though people know that government do not pay compensation for the agricultural land.
4. Mahabur (one of the participant) said that there are different types of trees in the project area such as: Mango (*Mangifera indica),* Blackberry *(Rubus),* Jack Fruit *(Artocarpus heterophyllus),* Koroi *(Albizia procera),* Date *(Phoenix dactylifera), Plam/Tal(Borassus flabellifer), Mehogony (Swietenia macrophylla), Banana (Musa acuminata), Guava (Psidium guajava), Lemon (Citrus × limon), Akashmoni (Acacia auriculiformis), Banyan Tree (Ficus benghalensis), Eucalyptus (Eucalyptus globulus), Coconut (Cocos nucifera),* Shimul (*Bombax ceiba),* Shisu (*Dalbergia sissoo), Arjun (Terminalia arjuna)* etc. peoples livelihood mainly depends on the mentioned trees.
5. Mahabur said that during the project implementation, a lot of trees have to cut and that will create a large impact on environment. So he suggests the project authority to cut fewer amounts of trees as much as possible. People requested to pay additional compensation, so that they can plant more trees.
6. There is no animal and migratory bird which can be affected by this project. People keep their domestic animals inside their houses.
7. In between 100km of the ROW or under grid line there is no pasture. Few animals like cow, goat, ram, buffalo are seen in the field here because most of the animals keeps their domestic animals inside their houses.

8. There is no presence of tribal people in the project area.

9. Abu Hanif said that as there is no mill or factory in their area. They didn't face air and nose pollution. But as the villagers are not aware about the use of plastic bags and bottles, they throw their unused plastic bags and bottles, so that the environment as well as the soil gets polluted by these things. Farmers also dropped out their insecticides plastic bags or bottles beside their lands.

At first the people of the village had a bad intension about the project. They thought this project is someone's personal project. But after the discussion about the project they take this project in a positive way and said they will help for the implementation of the project.

ATTENDENCE SHEET

S.N.	Name of the Participants	Gender	Occupations/status	Mobile Number
1.	MD. AWLAD HOSSEN	MALE	SERVICE HOLDER	01752401767
2.	MD.MAHFUZ	MALE	FARMER	01918706781
3.	MD.KALAM	MALE	LABOR	
4.	MD.RAFIQUL	MALE	BUSINESS	01716783803
5.	MD.ATAUR	MALE	FARMER	01856626125
6.	ABU HANIF	MALE	FARMER	01738226125
7.	GULZAR	MALE	BUSINESS	01729447563
8.	RAZZAK KHAN	MALE	FARMER	01840113075
9.	MAHABUR	MALE	LABOR	01753777873
10.	SAKIB ALI	MALE	FARMER	
11.	NASIR MULLA	MALE	FARMER	01867456399
12.	BASHIR ALI	MALE	TAILOR	01736581506
13.	MD.SAIDUR RAHMAN	MALE	VAN DRIVER	01760175380
NOTE: TOTAL PARTICIPANTS: 13, MALE: 13, FEMALE:0				

SOUTHWEST TRANSMISSION GRID EXPANSION PROJECT
Attendance Sheet for Environment(FGD)

Meeting Place/Venue: Talma Union Parishad
Meeting Time:3.00 pm
Distance from ROW:200m
Date:30.11.17
Village: Talma
Union/Ward: Talma
Upazilla: Nogorkanda
Zilla: Faridpur

1. At the beginning of their discussion they talked about the project in details. They also discussed about the environmental effect on that area if the project starts working there. People said that they knew about the project.
2. There is no forest, national park, archeological place under the ROW or the surroundings area which is selected for Sub-station. That is why the environment will not be affected.
3. There are village which is 300 meters far from the project ROW. There are many trees in the project area and many trees have to cut off for the grid line construction. People asked for right compensation and also asked additional compensation so that they can plant more trees.
4. People believe that if the project is implemented, the fish of those ponds will be damaged and also lost their habitats. A lot of crops such as paddy, jute, onion, garlic, vegetables, mustard etc will be damaged and the production of those crops will be stopped as the project area is based on agriculture. People requested proper mitigation from the project.
5. There is some family orchard in the area but none of these are within project ROW. The name of the trees which we found in the orchard are given below:

1. Fruits: Mango, Banana, Jackfruit, Guava, Berry, Lemon, Papaya, Olive, Lichi, Averrhoa Carambola (Kamranga), White lead (sofeda).

2. Wood: Mahogany, Rain-tree, Eucalyptus, Acacia Auriculiformis (akashmoni).

6. During the project implementation of sub-station, no trees will cut down but during implementation of the grid line a lot of trees have to cut and that will create a large impact on environment.
7. There is no animal and migratory bird which can be affected by this project.
8. Within the ROW, there is no grass land. There are many domestic animals in the project area and those are mainly cow, goat and buffalo etc.
9. There is no major project in this district, so there is no presence of environmental pollution.

At the end the people said that for the betterment of their life they will help for the implementation of the project though they will lose some of their structure or property.

ATTENDANCE SHEET

S.N.	Name of the Participant	Occupation/Status	Mobile No.
1.	KABIRUL ISLAM	AGRICULTURE	01837915895
2.	MD.SHAHADAT HOSSEN	BUSINESS	01747899463
3.	LAILI BEGUM	HOUSEWIFE	
4.	MD.BADAL MULLA	AGRICULTURE	01778044163
5.	ABDUL KALAM MULLA	AGRICULTURE	
6.	KAZI AMENA	JOB	01765696097
7.	JAHEDA BEGUM	HOUSEWIFE	01731659758
8.	AMINUR ISLAM	STUDENT	01794350853
9.	NASIMA BEGUM	HOUSEWIFE	01960696432
10.	MD.CHAN MIA	AGRICULTURE	01789536938

SOUTHWEST TRANSMISSION GRID EXPANSION PROJECT
Attendance Sheet for Environment (FGD)

Meeting Place/Venue: Chagolchira Adarsha High School Meeting Time:2.30pm
Distance from ROW: 300m Date:24.11.17
Village: Chagolchira Union/Ward: Raghdi
Upazilla: Muksudpur Zilla: Gopalganj

1. They all knew about the project and the area of this project. Such as households, trees, land, crops and they also knew that affected people will get compensation.
2. As there is no forest, park, archeological place around the sub-station or under the grid lines, so there is no possibility of destruction or damage.
3. As the substations area is an agricultural land so there is no possibility which will harmful for CPR, Nursery or any forest but the crops of land will be damaged. In between 300 meters of the sub-station there are no households, but we noticed some ponds.
4. There are different types of trees inside and outside of the project area such as Mahogany, Mango, Lemon, Lichi, Coconut, Guava, Date, Neem etc.
5. A lot of trees may be cut down from the outside of the sub-station which create a bad impact on the environment.
6. There is no animal and migratory bird which can be affected by this project.
7. Some environmental problem may be arising during implementation such as: sound pollution, air pollution, water pollution etc. An extra burden will create on the area when the labor from outside area come & start working there.
8. Though some problems will arise for the project, but the people wants to develop their life by this project.

ATTENDANCE SHEET

S.N.	Name of the Participant	Occupation/Status	Mobile No.
1.	MD.HAREZ SHEIKH	AGRICULTURE	01933475371
2.	MD.BABUL	BUSINESS	01718163510
3.	SHREE KESHAB DHAR	DAY LABOUR	01727602026
4.	ABDUL KADER SHEIKH	AGRICULTURE	
5.	JALAL KHAN	BUSINESS	01922756687
6.	MD.RUBEL SHEIKH	JOB	01954767094
7.	RUBAYET	STUDENT	01724766029
8.	MD.SALAM KHAN	MASON	01743891180
9.	YEAKUB ALI	BUSINESS	
10.	MD.ZIARUL	BUSINESS	
11.	ABDUR RAHIM MULLA	JOB	01726766923
12.	ABU BOKOR SIDDIK	AGRICULTURE	01770219487
13.	MD.NAZIR SHEIKH		01753982244
14.	MD.RUBEL	AGRICULTURE	0175533437

Annex 6: Environmental Safeguard Monitoring Report

Environmental Safeguard Monitoring Report

Reporting Period {From Month, Year to Month, Year}
Date {Month, Year}

BAN: xxxx Southwest Transmission Grid Expansion Project

Prepared by the PGCB, Ministry of Power, Energy and Mineral Resources, Government of Bangladesh for the Asian Development Bank

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Annex 7: Environmental Audit

Environmental Audit of the Existing Substations Barisal, Faridpur, and Chapainawabganj

Document stage: Draft
Project Number: 51137-001
March 2018

Bangladesh: Southwest Transmission Grid Expansion Project

Prepared by the PGCB, Ministry of Power, Energy and Mineral Resources, Government of Bangladesh for the Asian Development Bank

ABBREVIATIONS

ADB	Asian Development Bank
CAP	Corrective Action Plan
DoE	Department of Environment
ECR	Environmental Conservation Rules
EHS	Environment, Health and Safety
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
GIS	Gas insulated switchgear
GoB	Government of Bangladesh
IEE	Initial Environmental Examination
IFC	International Finance Corporation
IPP	Indigenous Peoples Plan
PCB	Polychlorinated Biphenyl
PGCB	Power Grid Company of Bangladesh
PSMP	Power System Master Plan
SPS	Safeguards Policy Statement

TABLE OF CONTENTS

1. INTRODUCTION

1.1 Background

1. The Government of Bangladesh (The Government) has made power sector development a priority for supporting the fast-economic growth. The Government has committed to a massive initiative to build a nationwide transmission and distribution network with the aim of providing electricity for all by 2021. As per the Power System Master Plan (PSMP) 2016, a transmission system capable of supplying 40,000 megawatts (MW) of electricity throughout the country is expected by 2030.[12]

2. Bangladesh's power supply has not been able to keep pace with the rapid growth in demand, and consumers have experienced frequent power outages. As of June 2017, the total nationwide dependable grid-connected peak demand was 9,479 MW, against an unconstrained demand of 12,644 MW, indicating that about 3,200 MW of the power demand was met by supply from captive generation and load shedding.[13] On average, over 1,000 MW of load shedding occurs during summer. Electricity demand is projected to grow by more than 10 percent per year over the medium term. The PSMP 2016 has projected that demand will rise to more than 50,000 MW by 2041.

3. The shortage of electricity and poor quality of electricity supply from the aged and low capacity grid network severely impact industry and service sectors, which account for a major share of growth in the economy. According to the latest 2013 World Bank Enterprise Survey, Bangladesh businesses on average suffered power outages for 840 hours per year, resulting in an output loss of approximately 3% of gross domestic product.[14] The availability and reliability of power is hence a key constraint to job creation and poverty reduction.

4. The Government envisages to obtain financial support from the Asian Development Bank (ADB) for the proposed Southwest Transmission Grid Expansion Project to ensure that the capacity of electricity supply in the Southwest economic corridor is upgraded, with improvements in the technical efficiency of the transmission system. The proposed project is expected to provide support for the construction of new substations and transmission lines and support the augmentation and rehabilitation of the existing transmission network of the Power Grid Company of Bangladesh (PGCB).

5. PGCB is the state-owned power transmission company in Bangladesh, and it is responsible for operation, maintenance and development of the power transmission system (transmission lines and substations) at 132 kV and above.

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[12] Power System Master Plan 2016, Power Division, Ministry of Power Energy and Mineral Resources, supported by Japan International Cooperation Agency (JICA), September 2016.

[13] The Bangladesh Power Development Board estimates that load shedding at peak time in 2017 was about 250 MW.

[14] Enterprise Surveys data for Bangladesh 2013; http://www.enterprisesurveys.org/

1.2 The Project

1.2.1 Project Location

6. The project area comprises Bogra, Chapainawabganj, Rajshahi, Noagaon, Madaripur, Barisal, Gopalganj and Faridpur districts (Figure 0.1).

Figure 0.1 - Diagrammatic Representation of the Locations of Existing Substations: Barisal (North), Faridpur, and Chapainawabganj

7. Barisal, Gopalganj, and Faridpur are in southern Bangladesh. Bangladesh's Seventh Five-Year Plan, envisages an integrated development strategy for the Southwest region. The Southwest economic corridor development approach is well aligned with this vision in that it seeks to establish public and private special economic zones: high-tech industrial parks; information technology parks; and, industrial estates for large, medium, and small-sized enterprises. Large scale industrialization is expected to occur in these districts once the Padma Bridge project is completed. The Bangladesh Economic Zone Authority has already planned to establish three Economic Zones in these districts. Within a few years, electricity demand is expected to rise considerably. It is also necessary to establish secondary transmission infrastructure to evacuate bulk power from upcoming power plants at Payra and Bhola to the major load centres.

8. The western districts such as Bogra, Chapainawabganj, Rajshahi, Noagaon, are major grain cultivation zones. Due to inadequate surface water supply, cultivation mostly depends on ground water (which requires pumping). Therefore, electricity demand peaks during the irrigation season. There are not enough local generation sources, which means power must come from a long distance away. Presently, electricity is transmitted at 132 kV voltage level in this area. Long distance, low transmission voltage, high demand and lack of reactive power compensation result in a severe low voltage problem in these districts. Lower voltage reduces production and damages electrical equipment.

9. The existing substations are located in Barisal (North), Faridpur, and Chapainawabganj districts (Barisal Division, Dhaka Division and Rajshai Division). The direct impact area of augmentation has been defined as the total land extent where augmentation works are conducted in existing substations: Barisal (North), Faridpur, and Chapainawabganj.

1.2.2 Main Components of the Project

10. Component 1 - increasing power delivery capacity at Gopalganj that includes construction of Gopalganj (North) 400/132 kV substation inclusive of (i) switching facilities for 400 kV transmission lines, and (ii) two 400/132 kV transformers each rated at 325 MVA for local power supply.

11. Component 2 - expansion of transmission network in southern Bangladesh including (i) construction of the 126 km Barisal (North)-Gopalganj (North)-Faridpur 230 kV double circuit transmission line, (ii) two 230 kV GIS bay extensions at Barisal (North) substation, (iii) augmentation of Faridpur substation with two 230/132 kV transformers each rated at 250 MVA, and (iv) augmentation of Gopalganj (North) substation with two 400/230 kV transformers each rated at 750 MVA.

12. Component 3 - expansion of transmission network in Western Bangladesh including construction of (a) 104 km Bogra (West)-Rohanpur 400 kV double circuit transmission line, (b) 400/230 kV Bogra (West) GIS substation, (c) 400/132 kV Rohanpur GIS substation, (d) 26 km Chapainawabganj-Rohanpur 132 kV double circuit transmission line, (e) 11 km line-in line-out connection from Barapukuria-Bogra (South) 230 kV double circuit transmission line to Bogra (West) substation, (f) 1 km line-in line-out connection from Chowdala-Niamatpur 132 kV double circuit transmission line to Rohanpur substation, and (g) two 132 kV GIS bay extensions at Chapainawabganj substation.

1.2.3 Objectives of the Environmental Compliance Audit

13. The implementation of the Project could have both negative and positive impacts on the surrounding environment, depending on environmental sensitivities and the design of responsive mitigation measures. Environmental impacts include physical, ecological, and socio-economic impacts. This environmental assessment was carried out to prevent and reduce adverse impacts to an acceptable level, and to enhance the positive impacts linked with the implementation of the Project. A rapid environmental assessment checklist for the Project was prepared to determine potential adverse environmental and social impacts during Project design and planning, construction, and the operation and maintenance phases of the substation and transmission line projects. This Project is categorized as an Environmental B project, based on the rapid environmental assessment and the ADB Safeguard Policy Statement (SPS) 2009. For Category B projects, the environmental impacts are expected to be less adverse than Category A projects. An Initial Environmental Examination (IEE) is required to address the anticipated impacts and to suggest appropriate mitigation measures. This IEE report was prepared based on the table of contents provided in Appendix 1 of the ADB SPS 2009.

14. As per ADB Operations Manual, Section F1/OP para 53, for projects involving facilities and/or business activities that already exist or are under construction before ADB's involvement, ADB requires the borrower/client to conduct an environment and/or social compliance audit to determine their safeguard compliance status. The audit by the borrower/client confirms that on-site environmental and social assessments carried out to identify past or present safeguards concerns related to the impacts on the environment, involuntary resettlement and Indigenous Peoples.

15. Where noncompliance is identified, ADB and the borrower/client agree on a CAP, implementation schedule, and sufficient funds to bring the project into compliance with the safeguard policy requirements. If an upgrade or expansion of a project is not foreseen, the audit report (including the CAP, if any) constitutes the EIA, IEE, resettlement plan, and/or IPP.

16. The audit report is disclosed on the ADB website following the disclosure requirements in this Operations Manual section (part C). For a project involving an upgrade or expansion of existing facilities that have potential impacts on the environment, involuntary resettlement, or Indigenous Peoples, the requirements for environmental and social assessments and planning specified in this Operations Manual section (part C) apply in addition to the audit.

17. The Project has to comply with the Safeguards Policy Statement (SPS), 2009 and Operational Manual F1 (2013). Also, the Project complies with the Bangladesh Environment Conservation Rules (ECR), 1997 (amended in 2017). According to the categorization of ECR, 1997 (amended in 2017), the Project has been categorized as ‘Red’ meaning that it has significant adverse environmental impacts, which are to be mitigated with proper mitigation measures.

18. The audit has been conducted with the aim to assess the Project’s compliance with-

(i) ADB Operations Manual, Section F1/OP (2013), para 53;
(ii) Environment Conservation Rules (ECR)1997 (amended in 2017) of GoB;

(iii) Environmental and social safeguards according the Safeguards Policy Statement (SPS), 2009 and other relevant standards and guidelines of the ADB;
(iv) Proposed mitigation measures and monitoring procedures according to the environmental management plan (EMP), environmental monitoring plan as are applicable.

1.2.4 The Purpose of the Environmental Audit Assessment

19. The purposes of the Environmental Audit Assessment are:

(i) to identify present inadequacies in environmental management, and occupational health and safety issues in the facilities to be augmented;
(ii) to determine the need for remedial actions necessary to bring the subject facilities into compliance with ADB safeguard policies; and
(iii) to recommend actions to be taken to improve and strengthen PGCB's environmental, health, and safety management.

1.2.5 Scope of Work

20. The environmental audit assessment focused only on the three substations earmarked for augmentation as outlined above. The audit took place in November and December 2017.

1.2.6 Method and Approach

21. Reviewing all available relevant in-house documents including the following:

i. Development Project Proposal, Southwest Transmission Grid Expansion Project (February 2018);
ii. Power System Master Plan 2016, Power Division, Ministry of Power, Energy and Mineral Resources, supported by Japan International corporation Agency; and
iii. IFC, General EHS guidelines 2007, 1.7 Noise, page 51-52.

1.2.7 Site Observation and Interview

22. All three substations were visited in November and December 2017. During the visit, we conducted visual inspection and cross checked the critical issues using the prepared checklist. The checklist identifies issues as per the following criteria as deduced from the guidelines mentioned above.

- General environmental management
- Waste management practices
- Hazardous material management
- Ground water and soil contamination control
- Occupational health and safety management and
- Noise management

2. POLICY, LEGAL AND INSTITUTIONAL FRAMEWORK

23. The Environment Conservation Act of 1995 establishes the requirement for an environmental assessment in Bangladesh. Any proposed "industrial unit or project" must obtain prior approval from the Department of Environment (DoE). The act has classified projects to be assessed by the DoE in four categories (Green, Amber A, Amber B, and Red). Power development projects are allocated to the Red category, which triggers an automatic requirement for an IEE followed by a full EIA. The DoE issues an authorization for the project to proceed subject to a satisfactory review of the environmental assessment. The authorization consists of two parts, one is a "site clearance", which gives approval to the site proposed for the project and the other is an "environmental clearance", which approves the content of the project.

24. The PGCB, as the project proponent, is responsible for carrying out the IEE and EIA studies of the proposed project. Therefore, it has the responsibility to administer the environment assessment process with the consultants, review the findings, and submit the documents to the DoE for review. A key requirement of the IEE/EIA for projects classified in the Amber and Red categories is an EMP. The function of the EMP is to enable PGCB to show the DoE how it will deliver the environmental performance assessed in the IEE/EIA (for which DoE approval is sought). The EMP should describe the management responsibilities, mitigation measures as well as the institutional arrangements, and explain how monitoring will be carried out.

25. Possession of a "clearance" from the DoE does not relieve the developer of a project from the requirement to comply with other environmental regulations. The Bangladesh National Environment Quality Standards for industrial effluents have been set and compliance with them are mandatory (Annex 1). There are also statutory instruments that are applicable to power development projects, which are not primarily environmental but help to mitigate environmental impacts. Compliance with such statutory instruments is mandatory.

26. Detailed assessment of policy, legal, and institutional framework has been described in Chapter 2 of the Initial Environmental Examination report.

3. SITE BASELINE INFORMATION, AUDIT FINDINGS AND REMEDIAL ACTIONS

27. The substations included in this environmental audit assessment are located as follows:

3.1 Barisal (North), Faridpur and Chapainawabganj Substations

28. Expansion of existing facilities in these substations will be carried out under component 2 and 3 of the Southwest Transmission Grid Expansion Project. The land area of the existing Barisal (North) substation is 13 acres (5.3 ha). Extension of the existing 230 kV Barisal (North) substation with two new GIS line bays is proposed under the Project.

29. The Faridpur substation has 6 acres (2.4 ha) and augmentation of the existing 132 kV Faridpur substation with five new 230 kV GIS bays, four new 132 kV AIS bays, and two 230/132 kV transformers, each rated at 250 MVA, will be carried out under the Project within the substation premises (Plates 1-8).

30. The Chapainawabganj substation has 5 acres (2.0 ha) and extension of the existing 132 kV line bays to connect the 132 kV double circuit line constructed by the Project from Rohanpur is expected at this substation.

Table 0.1 - Physical Features of Existing Barisal (North) Grid Substation – Bay Extension

Features	Specification
Land ownership	PGCB
Scheme	Main busbar scheme
Substation type	Outdoor
Voltage	230/132 kV
Switchgear type	Existing: Air Insulated Bay Extension: Gas-insulated
Insulation medium power circuit breaker	SF_6 Gas
Transformer	Oil cooled
Protection system description	Auto fighting water spray system

Table 0.2 - Physical Features of Faridpur Grid Substation - Upgradation

Features	Specification
Land ownership	PGCB
Scheme	Main busbar scheme
Substation type	Outdoor
Voltage	132/33 kV
Switchgear type	Existing: Air-Insulated Bay extension: Gas-insulated
Insulation medium power circuit breaker	SF_6 Gas
Transformer	Oil cooled
Protection system description	Auto fighting water spray system

Table 0.3 - Physical Features of Chapainawabganj Grid Substation

Features	Specification
Land ownership	PGCB
Scheme	Main busbar scheme
Substation type	Outdoor

Voltage	132/33 kV
Switchgear type	Existing: Air-Insulated Bay extension: Gas-insulated
Insulation medium power circuit breaker	SF_6 Gas
Transformer	Oil cooled
Protection system description	Auto fighting water spray system

Picture 1. Barisal (North) Grid Substation

Picture 2. Barisal (North) Grid Substation

Picture 3. Two transformers – the open land beyond transformers is earmarked for the two bays of the Grid Substation

Picture 4. Double Circuit line-in line-out terminal tower

Picture 5. Entrance to the Faridpur Grid Substation

Picture 6. Existing Faridpur Grid Substation

Picture 7. The land allocated for the augmentation of the Grid Substation

Picture 8. Transformers at Faridpur Grid Substation

31. This environmental audit was conducted in November and December 2017. The audit was based on criteria stipulated below:

- General environmental management
- Waste management practices
- Hazardous material management
- Ground water and soil contamination control
- Occupational health and safety management and
- Noise management

32. These criteria were translated into a checklist (Annex 1) which was used to identify issues of strength to the subject or issues that need corrective actions so as to meet the minimum required standard.

33. Substations which have been audited using the criteria above include the following.

34. **Barisal (North) substation:** Audit findings and the required remedial actions;

a. The substation is earthed and has protective shields to minimize radiation and magnetic field effects.
b. The substation has two transformers and oil circuit breakers, but none of these use PCB. The substation is PCB free.
c. The substation is fenced and has warning signs to prevent the general public from being exposed to any risk of electrocution.

35. The substation needs improvements in the following areas:

a. The substation needs the yard cleanness and appropriate waste handling and disposal practices.
b. Handling of hazardous and non-hazardous material needs to be improved especially in storage arrangement and prevention of spillage.

c. Waste handling and disposal.

36. Faridpur substation: Audit findings and the required remedial actions;

a. The substation is earthed. Safe touch and step voltages are maintained at all accessible locations.
b. The substation has two 132/33 kV transformers and oil circuit breakers, but none of these use PCB. The substation is PCB free.
c. Ongoing transformer replacement work was observed during the audit. The work was observed to be carried out with minimum impact to other equipment in the substation. However, the commissioning and handover checklists should cover environmental aspects to ensure a safe working environment after completion of the construction work.
d. The substation is fenced and has warning signs to prevent the general public from being exposed to any risk of electrocution.

37. The substation needs improvements in the following areas:

a. The substation needs the yard cleanness and appropriate waste handling and disposal practices.
b. Handling of hazardous and non-hazardous material needs to be improved especially in storage arrangement and prevention of spillage.
c. Waste handling and disposal.

38. Chapainawabganj substation: Audit findings and the required remedial actions;

a. The substation is earthed. Safe touch and step voltages are maintained at all accessible locations.
b. The substation has two 132/33 kV transformers and oil circuit breakers, but none of these use PCB. The substation is PCB free.
c. The substation is fenced and has warning signs to prevent the general public from being exposed to any risk of electrocution.

39. The substation needs improvements in the following area: the substation needs the yard cleanness and appropriate waste handling and disposal practices

3.2 Public Concern

40. There are no public concerns regarding the substations as the substations are located a safe distance away from settlements.

4. ENVIRONMENT MANAGEMENT AND MONITORING PLAN

41. Construction and operation of the substations may have various impacts to the environment. Environmental Assessment as a management tool could be used to identify the impacts before the construction of a substation or augmentation of existing substation. The audit study has identified the environmental impacts that are likely to occur in the construction and operation of the substation. The significance of these impacts may be reduced if mitigation measures and monitoring are put in place (Table 0.4 and Table 0.5). This chapter provides a summary of impacts, mitigation measures and monitoring plan.

Table 0.4 - Environmental Management Plan for the Impacts of the Substation Subprojects in Components 1, 2, & 3

Environmental Issues/ Parameters	Environmental Impacts	Mitigation Measures	Implementation Agency	Super-vision Agency
(a) Preconstruction/Construction Stage				
Land acquisition/ requisition	Loss of 100 acres (40 ha) (Gopalganj (North) – 60 acres, Bogra (West) – 20 acres, Rohanpur – 20 acres) of land (mainly agricultural/ paddy) permanently for three substation sites. Temporary loss of land (requisition) for construction camps etc.	Prior to commencement of construction activities, the owners of the affected lands must be notified and provided proper compensation in time as per GoB and ADB guidelines. As per GoB and ADB guidelines, RP should be prepared for land acquisition/requisition/ compensation and follow it. Use GIS instead of AIS, in order to reduce land requirement.	DC	DSC/ PGCB
Top soil	Top soil loss (about 0.5 m thick) due to construction of substation sites.	Prior to start of filling of the site, collect and store top soils (minimum 0.5 m thick) for using on the surface of the site boundary and access road side slopes for protection from side slope erosion. The topsoil, excavated from the proposed construction sites, should be re-spread in areas to be landscaped.	Contractor	DSC/ PGCB
Cutting of trees/ Clearing of vegetation	Loss of standing crops (if any), grass and bushes at substation sites and construction camp sites.	Prior to the start of clearing of vegetation, provide adequate compensation to the owners in good time.	Contractor	DSC/ PGCB
Fauna (Wildlife)	Disturbance of wildlife, especially birds, due to project activities such as earthworks, moving of project equipment and transports, especially during night time.	Prepare construction management plan (CMP, by the contractor) and follow it properly. Follow GoB rules and regulations on noise. Project workers should not disturb or kill any wildlife.	Contractor	DSC/ PGCB
Construction Waste	Generation of construction wastes from the construction materials.	Use of durable, long-lasting materials that will not need to be replaced as often, thereby reducing the amount of construction waste generated over time.	Contractor	DSC/ PGCB

		Provision of facilities for proper handling and storage of construction materials to reduce the amount of waste caused by damage or exposure to the elements. Purchase of perishable construction materials such as paints incrementally to ensure reduced spoilage of unused materials. Use of building materials that have minimal packaging to avoid the generation of excessive packaging waste. Use of construction materials containing recycled content when possible and in accordance with accepted standards. Adequate collection, separation, and storage of waste on site and safe transportation to the disposal sites and disposal methods at designated area shall be provided.		
Drainage congestion and flooding	Reducing floodplain storage area and increase local flooding, due to earth filling of substation sites and access roads above highest flood level (HFL). Drainage congestion if the surrounding sites are blocked by the earth embankment.	Provide culverts in the access road of the substation. Ensure adequate monitoring, especially if construction works are carried out during the monsoon period. Provision for pumping of congested water, if needed. Consideration of the HFL during design of substations, to avoid inundation.	Contractor	DSC/ PGCB
Noise level	Noise pollution due to construction activities, generators and construction vehicle movement.	Use of noise reducers in heavy construction equipment. It is recommended that no construction should be allowed during night time (9 PM to 6 AM). Avoid prolonged exposure to noise (produced by equipment) by workers. Regulate use of horns and avoid use of hydraulic horns in project vehicles. Generators should be placed within rooms (concrete walls with roof). Monitoring of noise level at construction sites, construction camp as and when required.	Contractor	DSC/ PGCB
Air quality and dust	Air pollution and dust generation due to construction activities, generators and construction vehicle movement.	All vehicles (e.g., trucks, equipment, and other vehicles that support construction works) shall be well maintained and not emit dark or smoky emissions in excess of the limits described in the EQS. Specific training will be focused on minimizing dust and exhaust gas emissions from heavy construction	Contractor	DSC/ PGCB

		vehicles. Drivers of vehicles used during construction will be under strict instructions to minimize unnecessary trips and minimize idling of engines. Dust suppression facilities (water sprayer) shall be available where earth and cement works are required. Spray water on dry and loose surfaces of the construction sites regularly. Maintain adequate moisture content of soil during transportation, compaction and handling. Construction materials (sand, gravel, and rocks) and spoil materials will be transported in trucks covered with tarpaulins. Sprinkle and cover stockpiles of loose construction materials (e.g., fine aggregates, sand). Avoid use of equipment such as stone crushers at the sites, which produce significant amount of particulate matter. Dust masks should be provided to all personnel in areas prone to dust emissions throughout the period of construction.		
Soil quality	Soil pollution	Laboratory analysis of the river bed materials to be confirmed prior to starting collection from the river. Prevention of spillage and leakage of hazardous liquids at construction sites and camp. Ensure no use of transformers containing PCB to avoid soil and air pollution.	Contractor	DSC/ PGCB
Siting of construction camps	Removal of vegetation such as grass, standing crops (if any) shrubs and trees. Environmental pollution (such as air/dust, noise, water, wastes, excess soil) affecting nearby the settlements.	Prior to the start of clearing of vegetation, provide adequate compensation to the owners in time. Locate construction camps away from residential settlements, cultural sites, water bodies, etc. (minimum 0.5 km). Try to use fallow land to avoid crop damage. Just after completion of the construction, hand over the camp sites to the owners as in earlier condition.	Contractor	DSC/ PGCB
Traffic congestion/ road accident	Traffic congestion and road accidents due to movement of construction vehicles.	Follow Bangladesh Road Traffic Authority (BRTA) traffic rules and regulations. Schedule deliveries of materials/ equipment during off-peak hours. Engage flagmen especially at the entry of the substation sites and	Contractor	DSC/ PGCB

		construction camps for traffic control. Engage experienced drivers to drive project vehicles. Arrange for signal lights at night. Prepare and follow proper traffic management. Avoid stockpiling of materials, especially at the road sides, that could disturb traffic movement.		
Pollution due to wastes	Pollution due to wastes (construction wastes from construction activities and general wastes from workers' camps)	Solid wastes collection system will be essential, which should include separation and collection of solid wastes in the dustbins/waste containers throughout the work sites, construction yard/ labor camps. Wastes such as pieces of rods and wood, newspapers, containers etc. can be sold to the vendors and the rest of the waste can be dumped into the nearby road side waste containers/ waste bins from which they will go to the nearest land fill dumping site (taken by the Contractors). A log of the disposal of toxic and other waste materials is to be kept by the Contractors. Prior to the start of construction, contractor should prepare waste management plan (WMP) based on the EMP.	Contractor	DSC/ PGCB
Community health and safety (H&S)	Community H&S nearby the substation site could be affected.	Safety barriers and warning signs surrounding the construction site. Generators should be placed in closed rooms. Formulate and implement an emergency risk management plan (by the contractor).	Contractor	DSC/ PGCB
Occupational health and safety (H&S)	Health and safety risks of construction workers.	An experienced Health & Safety (H&S) Manager must be engaged by the contractor prior to start of construction. Only permit trained and certified workers to work with any electrical equipment. Safety induction by the H&S Manager should be provided for the workers. Prior to starting work, a tool box meeting should be arranged by the H&S Manager for the workers. First Aid Box and personal protective equipment, PPE (such as safety helmets, safety shoes, eye protection glasses, ear plugs/muffs, waist belts, masks, hand gloves, body protective aprons and insulating boots) must be provided to the workers and ensure their use by the workers.	Contractor	DSC/ PGCB

		Safety signs, health signs, prohibition signs, warning signs, mandatory signs, emergency escape signs, first-aid signs, information signs, signboards, supplementary signboards, safety collar, symbol, pictogram, illuminated signs, acoustic signals, verbal communication and hand signals must be fitted at the designated sites of the subproject areas.		
Employment generation/ income	Employment opportunities for the local people, especially for PAPs.	Employ local people, especially PAPs, for the project activities (as much as possible).	Contractor	DSC/ PGCB
(b) Operation Stage				
Tree replantation	A total of 30,000 indigenous tree species can be planted at the access road side slopes, at appropriate intervals.	Planting of 30,000 saplings to replace felled trees, on the side slopes of the access roads, during the monsoon period. The number of saplings which die should be replaced by new saplings. Nursing period of planted saplings should not less than 3 years.	FD	PGCB
Fugitive emissions of SF_6	SF_6 is a potent greenhouse gas (GHG) with a global warming potential of 23,900 times compared to CO_2	Monitoring any leakage of the SF_6 following the guidelines of Institute of Electrical and Electronics Engineers (IEEE) and International Electro-Technical Commission (IEC). Annual inventory on the use of SF_6 will be conducted to monitor usage and losses. A very high grade sealing system and erection methodology will be followed to keep the loss of SF_6 within 0.1% every year. SF_6 gas handling system for evacuation and storage will always be used for the maintenance of the circuit breaker. SF_6 emergency response plan.	PGCB	PGCB
Drainage congestion	Drainage congestion could occur in the surface drains within the substation area, if proper O&M is not done regularly.	Clean the drains, especially during the monsoon, regularly. Ensure adequate monitoring.	PGCB	PGCB
Community health and safety	Community H&S nearby the substation site.	Safety barriers and warning signs surrounding the substation sites. Generators should be placed in the closed rooms.	PGCB	PGCB
Safety and security of workers	Risk to continuous power supply and even damage of substation.	Ensure security of substation in collaboration with law enforcement agencies. Keep complaint book in the substation for recording of people's complaints. Ensure availability of adequate safety gear for substation operations.	PGCB	PGCB

Power Supply	Due to adequate reliability of power supply, social life and economic condition of the people will be improved.	O&M of the substations should be done in time for adequate power generation.	PGCB	PGCB
Short Circuit/Accident	Due to a possible short circuit of the substation, disruption of power and accident could occur.	O&M of substations should be done in time by experienced personnel.	PGCB	PGCB

ADB = Asian Development Bank, BRTA= Bangladesh Road Traffic Authority, CMP = Construction Management Plan, DC = Deputy Commissioner, DSC = Design and Supervision Consultants, EMP = Environmental Management Plan, EQS = Environment Quality Standards, FD = Forest Department, GoB = Government of Bangladesh, H&S = health and safety, HFL = highest flood level, km = kilometre, m = meter, O&M = operations and maintenance, PAP = project affected person, PCB = polychlorinated biphenyl, PGCB = Power Grid Company of Bangladesh, PPE = personal protective equipment, RP = Resettlement Plan, WMP = waste management plan.

Table 0.5 - Environmental Monitoring Plan for Substation Subprojects

Environmental Issues/Parameters	Monitoring Parameters	Standards/ Guidelines	Means of Monitoring	Frequency	Location	Implementation Agency	Supervision Agency
Preconstruction/Construction Stage							
Clearing of vegetation	Checking whether proper compensation as mentioned in the RP is received by PAPs.	DoE/FD	Inspection	Regular frequency during site clearing operations.	Within the substation land and access road sites	Contractor/FD	DSC/PGCB
Fauna (Wildlife)	Checking whether wildlife is disturbed/ killed by the workers.	DoE/FD	Inspection	Weekly	Substation sites	Contractor/FD	DSC/PGCB
Drainage Congestion/ Flooding	Checking drainage congestion and top of substation site above HFL.	Hydrological/ Drainage study	Inspection	Regular during earthworks	Substation sites	Contractor	DSC/PGCB
Noise Pollution	Ambient noise level	DoE Noise Pollution Control Rules, 2006	Measurement	As and when required	At construction sites and camps	Contractor	DSC/PGCB
Dust Pollution	Dust should be controlled by water spraying regularly, especially during dry period.	DoE guidelines	Inspection	Regular	Substation sites	Contractor	DSC/PGCB
Surface Water Quality	pH, BOD5, COD, NH3-N, PO4	DoE Standards	Sampling and Laboratory Analysis	Quarterly	Nearby Waterbodies	Contractor	DSC/PGCB
Ground Water/Drinking Water Quality	pH, Mn, Fe, As, TC, FC	DoE Standards	Sampling and Laboratory Analysis	Quarterly	At construction camps	Contractor	DSC/PGCB
Pollution due to Wastes	Checking collection, storage, transportation, and disposal of hazardous waste. Waste from construction sites to be collected and disposed safely to the designated sites. Wastes from labor camp to be disposed properly at the designated sites.	DoE guidelines	Inspection	Regular	Construction camps	Contractor	DSC/PGCB
Traffic Congestion/ Road Accident	Checking meeting points of existing road and access road	BRTA	Inspection	Regular	Meeting point of existing road and access road	Contractor	DSC/PGCB
Occupational health and safety	Checking health, use of PPE and first aid facilities, DWQ,	DoE/IFC guidelines	Inspection and testing of	Regular	At construction sites and	Contractor	DSC/PGCB

	sanitation and accommodation		DWQ		camps		
Community health and safety	Awareness of local people and staying safely away from the project activities	DoE/IFC guidelines	Inspection	Regular	At construction site and camps	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	As and when required	Access road side slopes	FD	PGCB
Drainage congestion	Checking drainage congestion in the substation sites during monsoon	Hydrological /Drainage study	Inspection	As and when required during monsoon	Substation sites	PGCB	PGCB
Community health and safety	Community H&S nearby the substation site	DoE/IFC guidelines	Inspection	Regular	Substation sites	PGCB	PGCB
Safety and security of substation and workers	Checking use of PPE and duties of security force	DoE/IFC guidelines	Inspection	Regular	Substation sites	PGCB	PGCB

As = arsenic, BRTA= Bangladesh Road Traffic Authority, COD = chemical oxygen demand, BOD5 = five-day biochemical oxygen demand, DoE = Department of Environment, DSC = Design and Supervision Consultants, DWQ = Drinking Water Quality, FC = Fecal Contamination , FD = Forest Department, Fe = iron, H&S = health and safety, HFL = highest flood level, IFC = International Finance Corporation, NH3-N = ammonia nitrogen, PAP = project affected person, PGCB = Power Grid Company of Bangladesh, PO_4 = phosphate, PPE = personal protective equipment, Mn = manganese, RP = Resettlement Plan, TC =Total Coliform .

5. CORRECTIVE ACTION PLAN (CAP)

42. Waste management and handling was seen to be a problem in all substations. Pieces of solid wastes (removed parts of transformers, scraps) had no specific and designated area for collection and eventual disposal. Substation facilities should designate special areas/ points for solid waste collection and collect all unwanted scraps for a safe disposal. Wastes such as pieces of cables, switch gears and other waste could have special bins. Handling of hazardous and non-hazardous material needs to be improved especially in storage arrangement and prevention of spillage.

43. To ensure used and scrap equipment/material are properly disposed after removal/replacement, it is recommended for hand-over procedures of equipment/projects to include an environmental checklist which prompts the disposal method. This is required to avoid new debris and waste/scrap being accumulated at the substations in the future, leading up to project implementation.

44. The corrective action plan should be completed before the commencement of augmentation work in all substations.

6. CONCLUSION AND RECOMMENDATION

45. PGCB has been found to be adequately responsive on environmental safeguards during the operation of the current substations as existing facilities. They have duly monitored the air, water and noise quality according to the requirement of EMP. The monitoring results have been found to be within the acceptable limit requiring no corrective measures.

46. The substations need the yard cleanness and appropriate waste handling and disposal practices. Handling of hazardous and non-hazardous material needs to be improved especially in storage arrangement and prevention of spillage. So, it is felt that PGCB requires to carry out corrective measure mentioned in the CAP for compliance with ADB's SPS 2009 and IFC's EHS guidelines.

47. Based on the findings of environmental compliance audit, it can be concluded that PGCB is satisfactorily responsive in regard of complying with environmental safeguards during the operation and only the yard cleanness, collection and disposal of waste should be addressed before the commencement of activities planned under the Southwest Transmission Grid Expansion Project.

Table 0.6 Environmental Audit Checklist for Electric Power Transmission and Distribution - Substations

Guidelines Considered	**Barisal** 230/132 kV 2xGIS line bays	**Faridpur** 230/132 kV 5x230 kV GIS line bays, 4x132 kV AIS line bays, 2x250 MVA 230/132 kV t/fs	**Chapainawabganj** 132/33 kV 2x132 kV GIS line bays
PCB oil in transformers and switchgear			
• Transformers with PCB	X	X	X
• Switchgear with PCB	X	X	X
• Safe disposal of PCB oil	NA	NA	NA
• Prevention of PCB fires	NA	NA	NA
• PCB Labelling	NA	NA	NA
• PCB oil leakage	X	X	X
• Retrofitting	X	X	X
• PCB oil Storage	X	X	X
Use of SF_6 and other greenhouse/hazardous gases			
• Gas insulated switchgear	X	X	X
• Gas insulated t/f	X	X	X
• Presence of SF_6 in switchgear	✓	✓	✓
• SF_6 retrieval arrangements	NA	NA	NA
• Presence of other hazardous gases	X	X	X
Storage of liquid fuels, raw and in-process materials, solvents, wastes: to prevent spills, to prevent soil contamination and to prevent ground and surface water contamination			
• Containment, Dikes, and Berms (e.g. for transformers)	X	X	X
• Storage facility	✓	✓	✓
• Drainage	✓	✓	✓
• Oil leakage	X	X	X
• Need for extra gravel	X	X	X
Workplace air quality			
• Monitoring of workplace air quality	X	X	X
• Good ventilation (ensure)	✓	✓	✓
• Maintenance of air quality	✓AC	✓AC	✓AC
• Providence of respiratory equipment	X	X	X
• Enforcement of the application of personal protective equipment whenever exposure levels of fumes, solvents and other materials exceed threshold limit	NA	NA	NA

Workplace noise					
• Noise control equipment			X	X	X
IFC/ EHS Noise levels					
Ambient Noise (dB)	Day	Night	Level within 45 dB limit	Level within 45 dB limit	Level within 45 dB limit
Residential	55	45			
Industrial	70	70			
• Maintenance of equipment			✓	✓	✓
• Use of protective gear when noise level exceeds 85 dB			NA	NA	NA
Other Physical Agents					
• Safe working area (absence of radiation, magnetic fields)			✓	✓	✓
• Monitor regularly for radiation and field levels and equipment integrity (earthing, protective shields, lockouts etc.			✓	✓	✓
Electrocution					
• Strict procedure for de-energizing before working on electrical equipment			✓	✓	✓
• Training of personnel for safety procedures			✓	✓	✓
Occupational health and safety guidelines					
• Physical factors in the workplace signage			✓	✓	✓
• Lighting (including security lights)			✓	✓	✓
• Fire detection mechanism/equipment			✓	✓	✓
• Firefighting equipment			✓	✓	✓
• Cleanness (inside and outside substation)			✓	✓	✓
• First Aid Kit			✓	✓	✓
• Features that pose safety risks (missing or broken slabs, dogged holes, etc.)			✓NI	✓NI	✓NI
• Fence or enclosure of the site (Restriction of unauthorized people)			✓	✓	✓
Welfare Facilities					
• Safe and clean drinking water			✓	✓	✓
• Toilets			✓	✓	✓
• TV/Radio/internet			✓	✓	✓
• Guard kiosk			✓	✓	✓
Personal Protective Equipment					
• Eye and face			✓	✓	✓

• Head	✓	✓	✓
• Hearing	✓	✓	✓
• Hand	✓	✓	✓
• Respiratory	X	X	X
• Leg and body	X	X	X
Ambient factors in the workplace			
• Noise	✓	✓	✓
• Vibration	✓	✓	✓
• Illumination	✓	✓	✓
• Reflections	X	X	X
• Temperature	✓	✓	✓
• Hazardous materials	✓	✓	✓
• Biological agents	X	X	X
• Ionization radiation	✓	✓	✓
Training and Documentation			
• Training (Learning materials, equipment and tools)	✓	✓	✓
• Training on operational hazardous and how to control the hazards	✓NI	✓NI	✓NI
• Training on health risks, hygiene, and exposure prevention	✓NI	✓NI	✓NI
• Training on accidents and accident prevention, protective equipment and clothing	✓NI	✓NI	✓NI
Performance Monitoring			
• OHSMS organization policy	✓	✓	✓
• Emergency prevention, preparedness and response	✓NI	✓NI	✓NI
• Investigation of work related injuries, ill health, disease and accidents	✓	✓	✓
• Safety inspection, testing and calibration	✓	✓	✓
Material handling (Hazardous and non-hazardous materials)			
• Storage	✓NI	✓NI	✓NI
• Labelling	✓	✓	✓
• Handling	✓	✓	✓
Solid Waste/Scraps			
• Handling	✓	✓	✓
• Disposal	✓NI	✓NI	✓NI
Space for Expansion			
• Availability of space for expansion	✓	✓	✓

OHSMS- Occupational Health & Safety Management System

NA	Not Applicable,
✓	Yes/OK
X	No
✓t/f	Yes, on transformers
✓CB	Yes, on oil Circuit Breakers
✓AC	Yes, with air conditioners
✓NI	It is there, but Need Improvements
NI	Need Improvements
S/S	Substation
NT	Need Training
NR	Need some Repair
NM	Need Maintenance
✓Con	Yes, it is contaminated