Coal Power Generation Company Bangladesh Ltd (CPGCBL)

ENVIRONMENTAL IMPACT ASSESSMENT (EIA) REPORT

for the project,

Construction of 20km 132 KV transmission line from Chakaria to Matarbari CPGCBL power plant proposed and 10 MVA 33/11 KV REB distribution sub-station with renovation of existing 33KV, 11KV &0.415K distribution network

Prepared by

Green Plus Engineering

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ABBREVIATIONS

ADB	Asian Development Bank
AEZs	Agro-ecological Zones
ALAO	Additional Land Acquisition Officer
AP	Affected Person
BBS	Bangladesh Bureau of Statistics
BGS	Geological Survey of Bangladesh
BIWTA	Bangladesh Inland Water Transport Authority
BMD	Bangladesh Metrological Department
BP	Bank Policy
BRAC	Bangladesh Rural Advancement Committee
BUET	Bangladesh University of Engineering & Technology
BWDB	Bangladesh Water Development Board
CC	Cement Concrete
CEGIS	Centre for Environmental and Geographical Information
CPGCBL	Coal Power Generation Company Bangladesh Limited
CUL	Compensation Under Law
CSC	Construction Supervising Consultant
CSS	Country Safeguard System
DC	Deputy Commissioner
DEM	Digital Elevation Model
DO	Dissolve Oxygen
DLAC	District Land Acquisition Committee
DOE	Department of Environment
EA	Executing Agency
ECC	Environmental Clearance Certificate
ECP	Environmental Code of Practices
EIA	Environmental Impact Assessment
EISA	Environmental Impact and Social Assessment
EIV	Environmental Impact Value
ETP	Effluent Treatment Plant
DPHE	Department of Public Health and Engineering
ERP	Emergency Response Plan
EHS	Environmental Health and Safety
EMP	Environmental Management Plan
ESMP	Environmental and Social Management Plan
FS	Feasibility Study
GAD	Gender and Development
GAP	Gender Action Plan
GDP	Gross Domestic Product
GHG	Green House Gasses
GIS	Geographic Information System
GOB	Government of Bangladesh
GRC	Grievance Redress Committee
GW	Ground Water
HCG	House Construction Grant
HTG	House Transfer Grant
HTW	Hand Pump Tube well

IECs	Important Environmental Components
IDB	Islamic Development Bank
ID	Induced Draft
IEA	International Energy Agency
IEE	Initial Environmental Examination
IP	Indigenous People
IPPC	Intergovernmental Panel on Climate Change
IUCN	International Union for Nature Conservation
JICA	Japan International Cooperation Agency
Kiwi	Kreditanstalt für Wiederaufbau
LAP	Land Acquisition Plan
LARAP	Land Acquisition and Resettlement Action Plan
M&E	Monitoring and Evaluation
MOEF	Ministry of Environment and Forests
MDGs	Millennium Development Goals
NGO	Non-Governmental Organization
NEMAP	National Environmental Management Action Plan
O&M	Operation and Maintenance
OP	Operational Policy
PBME	Project Benefit Monitoring and Evaluation
PDB	Power Development Board
PIU	Project Implementation Unit
PGCB	Power Grid Company of Bangladesh
PMO	Project Monitoring Office
PMBP	Padma Multipurpose Bridge Project
PWD	Public Works Datum
RAP	Resettlement Action Plan
RCC	Reinforced Cement Concrete
REB	Rural Electrification Board
RRA	Rapid Rural Appraisal
RSPM	Respirable Suspended Particulate Matter
SA	Social Assessment
SAP	Social Action Plan
SPS	Safeguard Policy Strategy
ESIA	Environment and Social Impact Assessment
SDF	Social Development Fund
SEIs	Significant Environmental Impacts
SCC	Site Clearance Certificate
SPARRSO	Space Research and Remote Sensing Organization
SPM	Suspended Particulate Matter
SUDS	Sustainable Drainage System
TDS	Total Dissolved Solids
TOR	Terms of Reference
TSS	Total Soluble Salts
UNO	Upazila Nirbahi Officer
WB	World Bank

1 EXECUTIVE SUMMARY

Project concept

To augment power generation capacity of Bangladesh, GoB/Coal Power Generation Company Bangladesh Limited (CPGCBL) has decided to establish a coal based 2x600 MW Power Plant project, locating in Matarbari & Dhalghata Union under Moheshkhali Upazila of Cox's Bazar Zilla, named as 'Matarbari Ultra Super Critical Coal-Fired Power Project (MUSCCFPP)' that has already been awarded EIA approval from Department of Environment (DoE).To supply the construction power to the MUSCCFPP and install the 33 KV REB sub-station with upgrading the existing REB lines, the new proposed project named as "Construction of 20km 132 KV transmission line from Chakaria to Matarbari CPGCBL power plant proposed and 10 MVA 33/11 KV REB distribution sub-station with renovation of existing 33KV, 11KV & 0.415KV distribution network" has been formed.It is to be noted that source of 33/11KV REV sub-station will be from Matarbari 132/33 KV sub-station for which no objection certificate for the implementation of it have already been issued by DOE. This assignment is a part of whole project works of MUSCCFPP under REB component. As the studied project does not include in details in the EIA of MUSCCFPP, and as this project is under 'Red' category based on the list of DoE, so it claims to undertake fresh EIA. The Government of the Bangladesh intends to address the issue mentioned with a reinvigorated thrust on the establishment of the power project as a priority concern. Following the government's thrust; CPGCBL has proposed the project, "MUSCCFPP" in Moheshkhali Upazila of Cox's Bazar District. As a part of its continuance, the studied project has been made to accelerate the development of the power plant and upgrade the power distribution network around the project area. Both local and foreign investors will reap the benefits from the project. This project will contribute indirectly to generating a huge number of jobs as well as it will avail directly to increased volume of electricity generation of the national grid for the nation. Indirectly, this project will also be able to facilitate accelerated economic growth of the country.

Project Location

The project location (ChoKorea point) is about 60km away from Cox's Bazar town and adjacent to Palakata village of the Cox's Bazar Chittagong highway. The geographic location of the project is at Easting 386803.6947, Northing 2400659.554 (Chokoria Point) and Easting 404343.9058, Northing 2404211.57 (Matarbari Point). The project area falls under the Agro-Ecological Zone-6.

Development objective:

The main objectives of the project are to supply construction power to the MUSCCFPP and to construct, upgrade and renovate the REB lines in the Matarbari and Dhalghata Union and adjacent area for ensuring power distribution within the areas efficiently and reliably. Consequently, this project will be able to facilitate accelerated economic growth of the regions of the country indirectly through supplying undisturbed electricity to agricultural and industrial firms including households of the localities.

Scope of work:

The scope of work will include design, land-filling, construction of 20km 132 KV transmission line from Chakaria to Matarbari CPGCBL power plant, construction of 10 MVA 33/11 KV REB distribution sub-station, construction of 1 km 33 KV source line for 33/11 sub-station from the 132/33 KV sub-station, upgradation of 29 km of 33 KV line from Dog(19km) & 4/0(10km) to 477 MCM conductor, construction of 15 km for 4 nos. of 11KV feeder, construction of 80 km of HT lateral and LT line, construction of one set 11KV river crossing tower of 0.3 km span of 4/0 conductor and installation of required number of 11/0.4 or 6.35/0.23 KV x-formers and service drop for 4000 nos. of various type of consumers.

Land Acquisition and Resettlement:

About 45 decimal of land in the village of Uttar Nalbila under the Matarbari Union would be required for the development of REB power sub-station. The land will be provided by Cox's Bazar PBS (Polli Biddut Samitee) through purchase of land.

Process of EIA or Environmental & Social Impact Assessment (ESIA)

The EIA or ESIA is a formal process to examine and determine the Environmental and social consequences of a proposed major development. The ESIA examines problems, conflicts, and natural resources constraints that could affect the viability of the project. It investigates how the project might harm or benefit for the people about their households or livelihoods. It also provides important feedback into the design to minimize negative impacts and enhance positive ones. The objectives are to ensure that all needful activities are undertaken in the project:

- Enhance positive environmental and social outcomes
- Prevent negative environmental and social impacts
- Identify and mitigate with appropriate measures, the adverse impacts that might arise
- Obtain Environmental Clearance from DoE and
- Ensure compliance with the environmental and social safeguard policies of the GoB and Co-financer.

Structure of EIA or ESIA

The ESIA document is structured in a sequential manner to assist the reader to understand the background of the preparation of the document, its purpose, objectives and its implementation during design, implementation and operational stages of the project.

Relevant Environmental Laws and Requirements

The ESIA report has been followed the country's laws and regulations to identify the problems raised by project implementation and to recommend necessary mitigation measures. Important country's laws which are already discussed in the ESIA report includes the present Policies, Acts, Rules and Regulation with respect to the Environmental and social issues in the country are under custodianship of the Ministry of Environment and Forest/Department of Environment (DoE). However, there are also some sectoral laws dealing with different environmental issues in Bangladesh which were enacted at different periods but are largely obsolete now. The activities under the project are covered by the Policies, Acts, Rules and Regulation under Environmental Conservation Act'1995 (ECA'95) and Environmental Conservation Rules'1997 (ECR'97).

Requirement on Environmental Clearance in Bangladesh

EIA or ESIA procedure in consideration of project category has been addressed in ESIA report to know and get Environmental Clearance Certificate (ECC) or Site Clearance Certificate (SCC) from DoE. In Bangladesh, the ESIA procedure has three tiers which are :(i) Screening ;(ii) Initial Environmental Examination (IEE); and (iii) Detailed EIA or ESIA. The project (Red category) needs to obtain the Environmental Clearance Certificate (ECC) from DoE in two stages i.e., (i) Initial stage in which an SCC is needed and (ii) an advanced stage in which an ECC is needed. The proposed project falls under Red category according to Environmental Conservation Rule (ECR-97) 1997 and it is mandatory to submit necessary documents for obtaining site clearance from the Department of Environment Bangladesh (DoE) as well as to submit an Environmental Impact Assessment (EIA) to the department mentioned to get the Environmental clearance. There are no indigenous communities those are susceptible to contamination by the project activities. This project has fallen under red category according to DoE rules and require environmental clearance from DOE. Therefore the proposed project needs EIA to get environmental clearance from DoE.

Stakeholder Consultations

Stakeholders' discussions are one of the important parts of the ESIA or EIA. The feedback received from stakeholder consultations will be incorporated in the project design, construction and operation stages for the sustainable development. Detailed stakeholder discussions have been completed in the project area and the abstract of the consultation has been published in the office notice board to spread the events of the project to the people of the study area. Actually the stakeholder discussions are basic requirements of DoE and Co-financer for the project preparation and implementation. As the basic principles require input and feedbacks received from stakeholder consultations which are the major determinants in the selection, location and design of the project and its implementation. Accordingly, a public consultation was done with the stakeholders in attendance and proceedings have been documented in respect of participation, deliberations and decisions reached. Public consultations have been held in the catchment area of the project and the views/opinion come from stakeholders are incorporated in refining the project plan or environmental and social management plan.

Grievance Redress

The project proponents are agreed to form Grievance Redress Committee to solve the conflicts between the parties involved in the proposed project. However, this issue has been addressed in the ESIA report strongly. To implement the issue, the project management will establish a procedure to answer to the project related queries and address complaints and grievances about any irregularities in application of the guidelines adopted for assessment and mitigation of environmental and social safeguards impacts. The complaints related to project activities that may create inconveniences during construction should be addressed based on consensus. This procedure will help to resolve issues/conflicts amicably and quickly without resorting to expensive, time-consuming legal actions. For the purpose, a Grievance Redress Committee (GRC) will be formed by the project management.

Disclosure

The contractor will be disclosed this EIA or ESIA document on the company website and will ensure that copies of the document are available at the project site, office of the implementing agencies, the company head office and other places accessible to the potential stakeholders. The contractor will inform the stakeholders through notification in a local newspaper about the stakeholders' consultation on ESIA.

Impact Identification and Mitigation Measures

EIA or ESIA report included the Impact Identification and Mitigation Measures causing the implementation of the project following the guidelines, laws and regulations of DoE and Co-financers. The overall impact analysis and recommendation are stated in this report. Medium highland and Medium Lowlands will be used for sub-station and transmission line respectively that are at present utilizing as agricultural, shrimp and salt cultivation. It will have a little change in land use plan. Therefore, minor negative impacts might be appeared in the land use pattern. In winter, the land proposed for installation of the tower of the transmission line becomes dry. So, to protect the natural aquatic habitat, all construction works should be done in winter. In case of establishment of power sub-station within the project area, air, water and soil might be contaminated but intensity of pollution might be possible to remain within the permissible range through maintaining necessary environmental safeguards that have been stated in EMP. The project would not create drainage congestion or water logging problem in the area and would not contribute any risk to natural systems as there is option to maintain the EMP properly. The project would not create any obstacle to annual natural flushing of the area too. Although, the dust pollution is an issue for the labor and beneficiaries during the project period of the construction; it may cause health hazard due to air pollution emanated from the machinery or dust generated during construction works. EIA or ESMP has been incorporated this for such pollution. Another issue the increased noise from the movement of machinery, the operation of the electric motor and a diesel generator as well as day to day construction may cause

some health problem. ESMP has been incorporated these for such pollution. Garbage disposal/management becomes another issue for environmental protection as it may pollute the area. The contractor will plan to dump the debris in a legal manner. The contractor is obliged to guarantee and ensure the proper disposal of waste under the conditions of the contract.

Environmental & Social Management Plan

ESMP is the important part of the EIA or ESIA which is already made in this report to monitor the construction and operation works involved in the project and to give proper mitigation measures against impacts result from project implementation. In the context of a project, environmental & social management is concerned with the implementation of the measures necessary to minimize or offset adverse impacts and to enhance beneficial impacts. The ESMP ensures that the mitigation and benefit enhancement measures identified in the ESIA are fully implemented and a clear line of responsibilities for the purpose is assigned. The pollution result from the construction and operation of the project will be considerable but it can be easily mitigated through the implementation of EMP or ESMP (Environmental & Social Management Plan).

Monitoring, Reporting and Auditing

Monitoring policy has been incorporated in this ESIA report which is very needed to oversee the activities involving the project and to implement the project's policy in time to fill up the target of the goal of the project's destination. Actually the purpose of the Environmental and Social Monitoring Report is to satisfy the environmental and social safeguard requirements of the Government of the Bangladesh. Quarterly monitoring report on the project performance management would be submitted to the authorities and shared with the Co-financer for review of the effectiveness of environmental and social management.

Conclusion and Recommendation

EIA and also ESIA study have identified and assessed positive and negative environmental and social impacts likely to result from the project activities. Required mitigation measures have been set out for each significant impact. The ESMP, part of ESIA, also provided a monitoring plan. The monitoring plan included with key indicators/parameters, frequency and schedule of monitoring with institutional arrangements. The contractor will follow the ESMP including monitoring plan and make the necessary institutional arrangements. On the other hand, the project has a positive impact in terms of employment opportunities in the operation and construction phase. An outline of ESMP has been produced in the present report to mitigate the impacts which are expected to occur during different phases of the project. EMP or ESMP has been formed on the results of environmental analysis of the proposed project, secondary information regarding the project site, primary information collected from field visit, issues raised by the local people during public consultation and information from key informant interviews. The total Environmental Impact Value (EIV) of the proposed project is +35 which will improve to +50 with proper implementation of the recommended EMP including mitigation and enhancement measures. The findings of this ESIA highlighted that the project involves the potential, but limited environmental & social impacts to which further careful attention should be given to the operation and maintenance of the project in order to minimize and offset the adverse effects. Noted that, the project staff should be trained so that they can fully implement the actions needed under ESMP. Provision for adequate funding must be made in the project's construction and operational budget for the purposes. However, the direct and indirect beneficial impacts from the establishment of the project are expected to outweigh the adverse impacts.

2 INTRODUCTION

2.1 Project Background

Bangladesh, being a developing country, electricity demand is increasing very rapidly. To meet up the growing of the electricity demand Government of Bangladesh, is highly prioritizing the generation of electricity.As Bangladesh has inadequacy of fuel/energy resources, Government has already taken up a plan to set up an imported coal-based power plant especially in the Chittagong zones as this area is a very effective for transportation.

As a part of imported coal-based power generation, Matarbari of Cox's Bazar is already selected to set up a 1200 MW power plant. According to JICA study team, the generation of power will commence by 2022. To execute the development work smoothly, JICA Facts Finding Mission is very concern about the improvement of living standard of the local community as a part of the overall social development of Matarbari area. Still they are committing to catch dependable and smooth construction power system to carry out the works of power plant implementation.

To establish the power plant, a huge area of the private land acquisition would be required and at the same time there would be the adverse environmental impact on the surrounding area that could create public agitation in the locality. Electrification of whole Matarbari and the Dhalghata Union under the studied project area might be a potential reason for reducing the anticipated public agitation.

To supply the construction power to the power plant and install the 33 KV REB sub-station upgrading the existing REB lines for continuous power supply to the key consumers in the localities, the new proposed project named as "Construction of 20km 132 KV transmission line from Chakaria to Matarbari CPGCBL power plant and 10 MVA 33/11 KV REB distribution sub-station with renovation of existing 33KV, 11KV &0.415KV distribution network" has been formulated.

An EIA needs for the project covering the catchment area of the MoheshKhali Upazila of Cox's Bazar District. A prefeasibility study for this Project was carried out in 2013. On the basis of that study, GOB, REB, PGCB, CPGCBL and co-financer have decided to construct the infrastructures of the project. This study concluded that the most feasible power sub-station site is near to the village of Uttar Nalbila whose latitude and longitude are $21^0$42'53.4N and $91^0$55'54 E of Mohesh Khali Upazilla which is close to the Matarbari Coal based Power plant.The GOB subsequently approved the selection of this site. The Feasibility Study (FS) included, among others, a preliminary technical design, economic and financial evaluation, a framework for Land Acquisition and Resettlement Action Plan (LARAP), an Environmental Impact Assessment and Gender Action Plan (GAP).The FS concluded that the project was economically viable. So, the GOB moved forward for implementation and accordingly PGCB/REB conducted a study to update the previous environmental study and to prepare an Environmental Management Plan (EMP), a Land Acquisition and Resettlement Action Plan (LARAP) in 2013. The above studies formed the basis for the decision of GOB and CPGCBL to proceed with Phase 2, which includes the detailed engineering design and implementation of the project funded by JICA. In 2015, an environmental and social safeguard team and a part of the design consultant's team, started the EIA study in accordance with the relevant laws and regulations in the Bangladesh and EIA guidelines of the co-financer.

2.2 Brief Description

The project will include the following works-

- The design of the infrastructures of the project components.
- Land-filling for the foundation of REB sub-station.
- Construction of 20km 132 KV transmission line from Chakaria to Matarbari CPGCBL power plant.
- Construction of 10 MVA 33/11 KV REB distribution sub-station to deliver the power to the various consumers of Matarbari and Dhalghata Union of MoheshKhali Upazila.
- Construction of 1 km 33 KV source line for 33/11 sub-station.
- Upgradation of 29 km of 33 KV line from Dog (19km) & 4/0(10km) to 477 MCM conductor.
- Construction of 15 km of 11KV feeder (for 4 nos.).
- Construction of 80 km of HT lateral and LT line.
- Construction of one set 11KV River crossing tower of 0.3 km span of 4/0 conductor
- Installation of required number of 11/0.4 or 6.35/0.23 KV x-formers and service drop for 4000 nos. of various type of consumers.

2.3 Rational of the Project

Government of Bangladesh has given highest priority for the supply of electricity to the different zones of Bangladesh. The electricity supply is important both for industrial, agricultural and commercial activities. To increase power generation capacity of Bangladesh, GoB/Coal Power Generation Company Bangladesh Limited (CPGCBL) has decided to establish a coal-based 2x600 MW Power Plant project in Matarbari. The present project is very important to supply initial power to 132 KV PGCB sub-station to start the construction of power plant. During operation of the project, 1200MW electricity will be added to the national grid that will bring ultimately enhanced economic growth of the country. On the other hand, 4000 nos. of various types of consumers including residential, commercial, irrigation project, salt farms, and small industries' people are eager to connect the power in the locality. The power demand is increasing day by day. Due to fast-growing demand for electricity, renovation of the existing system, as well as the addition of new distribution facilities under the project, are essential to meet the demand for the vast numbers of new customers. The quality power supply is indispensable to maintain the normal life of the people, besides development of industrial and commercial activities.

The existing transmission system in the project area is inadequate to meet the demand of the area and cannot feed the demand of the substations and feeder systems of the project area. To meet the electricity demand of the consumers, PGCB is planning to construct transmission line facilities under the project and REB is planning to construct the 33KV/11KV sub-stationupgrading and constructing the existing distribution lines.

After completion the project, socioeconomic condition of the area as well as the livelihood status of the people will be improved undoubtedly. Thus, the project is very important for the economic growth of the locality and the national interest of the country.

GDP growth is mostly dependent on the inflow of foreign direct investment, technology transfer, employment availability, and product diversifications. All these issues depend on power supply directly or indirectly. For the greater interest of the masses and to improve the national economy, the Government of Bangladesh has taken initiatives to set up the Matarbari Coal based Power Plant including other related PGCB & REB components with the help of CPGCBL.

A particular emphasis of the Project is to strengthen the overall capacity of the institutions of the localities and increase the people's participation. An important element regarding the project

implementation is to develop an understanding and consideration of environmental issues for the project beneficiary area.

This project will also improve local as well as regional socioeconomic development through supplying power, and this kind of improved activities will enhance the facility for healthcare, educational and recreational facilities. The people living in the project area will be involved in the operation and maintenance activities of the project and will also be employed that would ultimately help to create employment opportunity in the locality.

In the case of a project of Category 'RED' activity as classified in the ECR'1997, it becomes necessary to carry out an Environmental & Social Impact Assessment (ESIA) integrating the EMP. This Environmental Management Plan (EMP) is an instrument that will allow the project's intervention to include environmental components during the time of project implementation to improve and expand the industrial activities and also economic development in the area. Ensuring the compliance with the EMP is the responsibility of the project proponent. It consists of a set of general and specific recommendations, which serve as the basis for environmental management (impact mitigation).

After completion of the project, about 4000 consumers households located in the catchment area will be benefited and the project will also help to stimulate economic activity in the region by developing a reliable and safe power supply project needed for the locality.

Scope of the study

The scope of this study is limited to the following areas:

- Direct observation through field visit to the project site;
- Public consultation on the suitability of the project site selection;
- Collection and processing of secondary data from DOE and other relevant organizations;
- Collection of information from the local people regarding demographic & environmental, water course behavior etc.;
- Collection of data regarding the issues related to land acquisition;
- Collection of peoples' opinion on the impact of project implementation;
- Collectiondata on the highest flood level and hydrology;
- Collection of all relevant data including hydrologic, satellite images, etc., from concerned authorities;
- Carrying out field survey for taking information in the environmental baseline settings existed at the site and deciding the Important Environmental Components (IEC);
- Carrying out statistical analysis of water levels at the project site for determination of the highest water levels of the water reservoir for different return periods;
- Consultation with REB, PGCB and CPGCBL personnel during different phases of the study;
- Reporting on the study;

2.4 Methodology

The methodology set to undertake the EIA were as below:

Screening of the project, a process that identified the appropriate infrastructures as being among those that required an EIA or ESIA.

- A scoping exercise that identify key issues to be addressed in the study.
- Documentary review on the nature of the proposed activities, policy and legal framework, environmental setting of the area and other relevant data.
- Detail discussion with the Proponent, Community, DAE, DoE, and Water Development Board (BWDP) etc.
- Physical investigation of the site and the surrounding areas using a prepared checklist identifying possible environmental, social and human safety issues that are more likely to be affected. This investigation followed by a systematic investigation and study of the published literature with respect to physical, biological and social environment of the country and the specific project location in order to establish these facts and reach an informed conclusions.
- Reviewing the proposed project designs and implementation plans with a view to suggesting suitable alternatives.
- Report writing.

2.5 Limitation

The proposed project implementation may be affected any time by serious disasters like earthquake, tornado etc. If it happens, the implementation of the proposed project may be hampered due to these causes. If we were come in disastrous loss, we would face against this strongly through disaster management practices directed by professional experts.

2.6 EIA Team

- **Mohammad Hasanuzzaman**, (Team Leader)
  B.Sc. in Civil Eng., M.Sc. in Env. Engineering (DTU, Denmark)
  Environmental Engineer
- **Dr. Md. Arif Mahmud**
  Ph.D. in Agri. Science, SU, Nagano, Japan
  Soil, Biodiversity and Agriculture Specialist
- **Md. Golam Mostafa**
  BSc. Eng.(Electrical)
  Electrical Engineer
- **Syed NesarAhammed**
  M.Sc.Env. Eng.
  Junior Environmental Engineer
- **Dr. Md. Shahadat Hossain,**
  Ph.D.in Sociology
  Social and Resettlement Specialist
- **Md. Mahbubur Rahman**
  GIS Expert

2.7 Environmental and Social Impact Assessment

The Environmental Conservation Rules (1997) stipulate that the construction of the proposed project lies under the Red Category and the implementation of this project require approval of a full-scale EIA and also ESIA in order to obtain environmental clearance from GOB.An Environmental Clearance Certificate is issued by the Department of Environment (DoE), the technical arm of the Ministry of Environment and Forest (MOEF) and the only regulatory and enforcement agency of all environmental related activities in the country.

The project will have somewhat environmental and social impacts but these will be minimized to bring below the critical levels of standards by implementing the EMP. This document describes some environmental and social impacts of the project installation and its associated activities. It may be noted as stated earlier that there may be a need for some land acquisition and resettlement. It is mentioned that there are no tribal communities in the study area. Assessment of impacts and development of the mitigation measures for the project have been provided in this report. These measures are described and included in the environmental and social action plans covering implementation schedules, responsibilities, and institutional requirements and monitoring plans. These measures are suggested in line with the laws and regulations in Bangladesh as well as relevant policies of the Development partner. The impact assessment addresses the impacts and mitigating measures on the physical, the biological and the human environment. The ESIA has been prepared to ensure that the project is environmentally sound and sustainable as well as has been developed in compliance with the agreed harmonized safeguard requirements of the donor agencies and GOB.

2.8 Environmental awareness

The proponent will be responsive to the needs of the safe environment, so as not to degrade (or remedy any degradation) the existing environmental settings. It is the proponent's primary responsibility to ensure that all parties directly involved in the construction and operation phases of the project, including managers and employees are informed of the need to prevent or minimize environmental impacts. The awareness activities should be guided at least considering the following issues:

- Protecting surface and groundwater from pollution;
- Prevention of decreased air quality;
- Prevention of increased noise levels;
- Prevention/reduction of social and economic disruption;
- Prevention of risks to health and safety of workers and the public.

3 LEGISLATIVE, REGULATION AND POLICY CONSIDERATION

3.1 POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

Applicable legislation on land acquisition in Bangladesh

- The Acquisition and Requisition of Immovable Property Ordinance 1982 are the basic instruments governing land acquisition in Bangladesh. It is restricted to legal owners of theproperty supported by records of ownership such as deeds, title or agreements, compensating for land as well as any business, structure, trees and crops on the land. Owners of acquired land receive cash compensation at the market value with a 50% premium above the assessed price.
- The East Bengal State Acquisition and Tenancy Act 1951 define the ownership and right of use of alluvial land in the country. This law is relevant to the project for the acquisition of lands within the bank line of the river for river training works

Policy Related to Energy Development

- **The Electricity Act (1910)**
  The Electricity Act was enacted in 1910 to amend the laws relating to the supply & use of electrical energy. Under this act, any person can get a license to supply energy and to lie down or place electric supply lines for the conveyance and transmission of energy. 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 (like gas, T&T, water, Sewer, etc.), provided that prior permission is taken from the respective authority, as stated in section 12 – 18 of this Act. According to section 19 (1) of this Act, the licensee shall make full compensation for any damage, detriment or inconvenience caused by him or by anyone employed by him.

  The subsection (1) of Section 52 of the Electricity Rules, 1937 advise that the licensee should take precautions to lay down electric supply lines near or where any metallic substance or line cross.

- **Power Policy, 1995**
  This is presently an integral part of the National Energy Policy 1995, like the Petroleum Policy. It includes different policy statements on demand forecast, long-term planning and project implementation, investment and lending terms, fuels and technologies, power supply to the west zone, isolated and remote load centers, tariff, 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, environment policy and legal issues. As the proposed project is a Power Transmission Project, all necessary requirements mentioned above will be adopted for the project.

- **Energy Policy (1996)**
  The National Energy Policy provides for utilization of energy for sustainable economic growth and supplies to different zones of the country, development of the indigenous energy sources and environmentally sounds sustainable energy development programs. The Policy highlights the importance of protecting the environment by having the requirement of an EIA for any new energy development project, or the introduction of economically viable and environment-friendly technologies.

- **Industrial Policy (1999)**
  The National Industrial Policy, 1999 aims to ensure a high rate of investment in 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 export, infrastructure development and environmentally sound industrial development. WTO guidelines have been proposed to be followed in the Industrial Policy.

- **Mineral Gas Safety Rules (1991)**
  These Rules deal with the materials, design and construction of gas pipelines, pipeline crossings of railways, testing and commissioning, protection against corrosion, pipeline operation and maintenance, storage and distribution, and reporting of accidents. The Rules are quite prescriptive, and include stipulations as to the distances between pipelines and the public, as well as reference to American and British materials standards.

- **Petroleum Policy, 1993**
  The Petroleum Policy was formulated with the primary objective of promoting, monitoring, and regulating all activities in the oil and gas sector in relation to exploration, development, refining, marketing and export.

Applicable environmental legislation in Bangladesh

- Environment Conservation Act (1995), which includes environmental guidelines to control and mitigate environmental pollution, conservation and improvement of environment and provisions for obtaining an Environmental Clearance Certificate (ECC) for development projects.
- Environment Conservation Rules (1997), which provide a first set of rules under the Environment Conservation Act giving categories of development projects and requirements for Initial Environmental Examination (IEE), Environmental Impact Assessment (EIA), and preparation of Environmental Management Plan (EMP), and the procedure for obtaining an ECC. Also quality standards for air, surface water, groundwater, drinking water, industrial effluents, emissions, noise and vehicular exhausts are given.
- Guidelines for Industrial and Development Projects (1997) were prepared by the Department of Environment (DoE), the regulatory and enforcement organization under the Ministry of Environment and Forests (MOEF). The document provides guidance for preparing an EIA.

Other relevant legislation in Bangladesh

- Environment Court Act (2000), describing environmental related legal proceedings.
- The Vehicle Act (1927) and the Motor Vehicles Ordinance (1983), provide rules for exhaust emission, air and noise pollution, and road and traffic safety.
- Rules for Removal of Wrecks and Obstructions in inland Navigable Water Ways (1973).
- Water Supply and Sanitation Act (1996), regulates the management and control of water supply and sanitation in urban areas.
- The Ground Water Management Ordinance (1985) describes the management of groundwater resources and licensing of tube wells.
- The Forest Act (1927) for the protection of forest reserves, protected forests and village forests.
- The Private Forests Ordinance Act (1959) deals with the conservation of private forests and afforestation of wastelands.
- Bangladesh Wild Life Act (1974) describes the preservation of wildlife sanctuaries, parks and reserves.
- The Protection and Conservation of Fish Act (1950) deal with the protection and conservation of fishes in Government-owned water bodies
- The Embankment and Drainage Act (1952) describes the protection of embankments and drainage facilities.
- The Antiquities Act (1968) describes the preservation of cultural heritage, historic monuments and protected sites.
- Acquisition and Requisition of Immovable Property Ordinance (1982) describe procedures and provides guidelines for the acquisition and requisition of land.
- Bangladesh Labor Law (2006) deals with occupational rights and safety of factory workers; provision of thecomfortable work environment and reasonable working conditions.

Environmental Impact Assessment

The Environmental Conservation Rules (1997) stipulate that the construction of an infrastructures and land development to undertake for the project falls under the Red Category of projects requiring the implementation and approval of a full-scale EIA in order to obtain environmental clearance from GOB.An Environmental Clearance Certificate is issued by the Department of Environment (DoE), the technical arm of the Ministry of Environment and Forest (MOEF) and the regulatory body and enforcement agency of all environmental related activities. DoE has approved the TOR of this study and provided a number of additional conditions and suggestions to be incorporated in it.

National policies and International treaties

During recent years a number of national policy documents have been prepared which emphasize the protection of the environment and natural resources in order to achieve sustainable development. It is relevant to mention that GOB has also prepared a National Strategy for Accelerated Poverty Reduction showing its strong commitment to achieving the Millennium Development Goals as defined by the UN.

Bangladesh has signed most international treaties, conventions and protocols on environment, pollution control, biodiversity conservation and climate change, including the Ramsar Convention, the Bonn Convention on migratory birds, the Rio de Janeiro Convention on biodiversity conservation and the Kyoto protocol on climate change.

National Policy, strategy, Management Action Plan:

Industrial Policy 1991

The industrial policy of 1991 contains the following emergency clauses in respect of environmental protection-

- To conserve ecological balance and prevent pollution during industrialization
- To take effective steps for pollution control and conservation of environment during industrialization
- To ensure embodying or necessary pollution control and preventive measures by industrial investment project to overcome problem from endangering environment

Environmental Policy 1992

Bangladesh National Environmental Policy (GoB, 1992) was approved in May 1992 and sets out the basic framework for environmental action, together with a set of broad sectoral action guidelines. Key elements of the policy are:

- Maintenance of the ecological balance and overall progress and development of the country through protection and improvement of the environment.
- Protection of the country against natural disasters.
- Identification and regulation of all types of activities, which pollute and degrade the environment.
- Ensuring sustainable utilization of all natural resources.
- Active association with all environmentally related international initiatives

Environmental policy contains the following specific objectives with respect to the industrial sector:

- To conduct Environmental Impact Assessment (EIA) for all new public and private industries.
- To ban the establishment of any industry that produces goods and in the same time, it causes environmental pollution; do closure of such existing industries in phases and insist discouragement of the use of such goods through the development technologies and/or introduction of environmentally sound substitutes.
- To adopt corrective measures in different phases of industries that might cause pollution.
- To ensure sustainable use of raw materials in industries and to prevent their wastage.

National Conservation Strategy

National Conservation Strategy (GOB/IUCN, 1992) was drafted in late 1991 and submitted to the Government in early 1992. This was approved in principle; however the final approval of the document is yet to be made by the cabinet. It underwent a number of modifications over the last five years, and is waiting to be placed before the cabinet finally sometime in late September 1997. For sustainable development in industrial sector, the report offered various recommendations; some of those are as follows:

- Industries based on nonrenewable resources should be made to adopt technology which conserves raw materials and existing industries should be given incentives to install technical fixed to reduce wastage rate.
- All industries, especially those based on imported raw materials, should be subjected to EIA and adoption of pollution prevention/control technologies should be enforced.
- No hazardous or toxic materials/wastes should be imported for use as raw material.
- Import of appropriate and environmentally sound technology should be ensured.
- Complete dependence on imported technology and machinery for industrial development should gradually be reduced, so that industrial development becomes sustainable with local skills and resources.

National Environmental Management Action Plan (NEMAP)

National Environmental Management Action Plan, also referred to as NEMAP (GOB, 1995) is a wide-ranging and multi-faceted plan, which builds on and extends the statements set out in the National Environmental Policy. NEMAP was developed to address issues and management requirements during the period 1995 to 2005, and sets out the framework within which the recommendations of the National Conservation Strategy are to be implemented. NEMAP has the broad objectives of:

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

One of the key elements of NEMAP is that sectoral environmental concerns are identified. In outline, the environmental issues of the industrial sector include the following:

- Pollution arises from various industrial processes and plants throughout the country causing various degrees of degradation of the receiving environment (Air, Water and Land) appears.
- There is a general absence of pollution abatement in terms of waste minimization and treatment.
- Low level of environmental awareness amongst industrialists and entrepreneurs.

- Lack of technology appropriate to efficient use of resources and waste minimization
- Leading to unnecessary pollution loading in the environment.
- Find out economic constraints on pollution abatement and waste minimization such as the cost of new technology, the competitiveness of labor, and intensive production methods as compared to more modern methods.
- Concentration of industry and hence pollution in specific areas which exacerbate localized environmental degradation and exceed the carrying capacity of the receiving bodies.
- Unplanned industrial development has resulted in several industries located within or close to residential areas, which adversely affects human health and quality of human environment.
- Establishment of industries at the cost of agricultural lands and in the residential areas.
- Lack of incentives to industrialists to incorporate emission/discharge treatment plant in their industries.

Conventions and Protocols

Bangladesh has consented to be bound by the terms of some 21 of the 44 principal international conventions, treaties and protocols relating to the environment (Islam, 1996). Those with partial and indirect relevance to industrial projects are the Paris convention of 1972 concerning the protection of the World Cultural and natural Heritage, Convention concerning safety in the use of chemicals at work. Geneva 1990, Biodiversity Convention, Rio-de-Janeiro, 1992, Convention concerning occupational health services, Geneva 1985 etc.

Safeguard Policy of some International reputed Development Partners and organizations are discussed below to have an exposure of good practices:

Safeguard policies of some Development Partners and Financing Institutions are delineated below:

World Bank Safeguard Policies

- **OP/BP/GP 4.01 – Environmental Assessment.** The World Bank requires an Environmental Assessment (EA) for all projects proposed for Bank financing to ensure that these projects are environmentally sound and sustainable. The Garments Industrial Park (GIP) Project was classified in Category A, because of the scope of the expected impacts from construction and operation, the impacts of land acquisition, the resettlement of about 25,000 persons and the expected impacts on the natural environment.
- **OP 4.04 – Natural Habitats.** There are no designated conservation areas or nature reserves in the project area. However OP 4.04 does apply since part of the area consists of semi-natural char lands in the active Ganges/Brahmaputra floodplain, with typical floodplain habitats and breeding grounds that might be affected by the project.

- **OP 4.11 – Physical and Cultural Resources.** This policy is triggered for any project that requires an EIA. The project involves large-scale earth moving along both embankments and dredging activities in the Padma River. The policy requires a proper management plan for unexpected change finds during implementation of the project
- **OP/BP 4.12 - Involuntary Resettlement**. Some 26,000 people will have to be resettled. Separate social studies have been carried out and resettlement action plans (RAP) prepared. These aim to minimize resettlement while offering adequate compensation or settlement alternatives in conformity with World Bank policies and Bangladesh law.
- **BP 17.50 - Public Disclosure of Information.** According to the Bank Policy the EA should be made available to the public by thedisclosure at public libraries or other places accessible to project-affected groups, including a Summary EA in the local language.
- **Environmental Health and Safety Guidelines.** The EHS Guidelines contain performance levels and measures for development of industrial projects that are considered to be achievable in new facilities at reasonable costs by existing technology.

Asian Development Bank Policies

- **Safeguard Policy Statement (2009).** The policy of the Asian Development Bank (ADB) includes operational guidelines that seek to avoid, minimize or mitigate adverse environmental and social impacts, including protecting the rights of those likely to be affected or marginalized by the development process.
- **Three Safeguard Policies**. ADB's safeguard framework consists of three operational policies on Environment, Indigenous Peoples, and Involuntary Resettlement.

  Two of the safeguard policies are triggered in this project: Environment and Involuntary Resettlement. There are no indigenous peoples as defined by the policy affected by the project. The policies involve a structured process of impact assessment, planning, and mitigation to address the adverse effects of projects throughout the project cycle. The safeguard policies require that:

(i) Impacts are identified and assessed early in the project cycle;

(ii) Plans to avoid, minimize, mitigate, or compensate for the potential adverse impacts are developed and implemented; and that

(iii) Affected people are informed and consulted during project preparation and implementation.

- **Category A project**. The PMBP is classified as a Category A project, which are projects with a potential for significant adverse environmental impacts. An EIA including EMP is required to address significant impacts. The draft EIA report will be disclosed on ADB website for a period of 120 days before board consideration.
- **Category B.** The proposed project's potential adverse environmental impacts are site-specific, few if any of them are irreversible, and in most cases mitigation measures can be designed more readily than for category A projects. An Initial Environmental Examination (IEE), including an EMP, is required.

- **Category C.** A proposed project is likely to have minimal or no adverse environmental impacts. An EIA or IEE is not required, although environmental implications need to be reviewed.
- **Category FI.** A proposed project involves the investment of ADB funds to or through a financial intermediary. The financial intermediary must apply and maintain an environmental and social management system, unless all of the financial intermediary's business activities have minimal or no environmental impacts or risks.

Japan International Cooperation Agency

- **Guidelines**. The JICA guidelines for loan aid (Japan Bank for International Cooperation Guidelines for Confirmation of Environmental and Social Considerations, April 2002) apply.
- **Principle**. The guidelines are based on the following principles:
  - A wide range of environmental and social impacts should be addressed;
  - Measures for environmental and social consideration should be appliedat an early stage until the monitoring stage;
  - During the entire process accountability and transparency should be ensured;
  - Stakeholders opinions should play an eminent role in the decision-making process;
  - Information should be disclosed in consultation with the project proponent;
  - The capacity of organizations involved in environmental and social operations should be enhanced;
  - Promptness in implementation is a concern.
- **Category A project**. The PMBP is classified as Category A, as it is likely to have significant environmental and social impacts. The project proponent must submit EIA reports and for projects that result in large-scale involuntary Resettlement Action Plans should be submitted.
- **Disclosure**. JICA discloses final reports of preparatory surveys, EIA reports and RAPs on the websites 120 days prior to final environmental review and board considerations.

KfW Development Bank

KfW Environmental Guidelines

For more than two decades, KfW, a German Development Bank, has been promoting projects to protect the environment, social development and the climate in numerous areas. Central to its promotional activities is the principles of environmental compatibility and sustainability. Therefore, all promoted projects have long been subject to a comprehensive and systematic assessment by KfW (A German Development Bank) to ensure they are compatible with environmental and other crucial development standards. Based on its Statement on

Environmental Protection and Sustainable Development, which it submitted to the German parliament, the KfW (A German Development Bank) Group has introduced a set of sustainability guidelines. They set forth the environmental and social policies that govern KfW's operations with a view to contributing to sustainable development within the meaning of the German Federal Government's sustainability strategy. Furthermore KfW pursues the objective of actively supporting the implementation of international human rights with the instruments at its disposal to do so. In this regard the KfW Group has issued a declaration of therespect of human rights in its business operations. Starting from these principles, this Guideline provides more specific guiding principles which apply to KfW, while also incorporating some important social aspects. Technically speaking, this Guideline expands on the previous Environmental Protection Guidelines of KfW, building on many years of experience KfW has acquired in assessing the environmental and social impact of German Financial Cooperation (FC) projects.

List of Environmental Guideline of KfW

-Sustainability Guidelines of KfW Development Bank, April 2014.

-Environmental, Social and Climate Change Assessment

-KFW statement on environmental protection and sustainable development, 2013.

-Guideline of KfW for environmentally and socially sound financing.

Islamic Development Bank

The EIA Guidelines of the Islamic Development Bank (IDB) are reported to be under preparation and yet to be published. However the IDB has expressed its support for the harmonized safeguard policies applicable to a project.

Harmonized Safeguard Policies

In view of the different requirements of GOB and the potential co-financiers of the CPGCBL a harmonized environmental safeguard framework was developed to conduct the EIA. This framework was used to prepare the Terms of Reference (TOR) for the EIA, which document has been reviewed and approved by the BBA, DoE and the potential co-financiers of the project. As regards social assessment, the project safeguard policies are based on theharmonization of the co-financiers safeguard policies with GOB legislation involving the 1982 Ordinance II and gap-filling measures. The project safeguard policies address project impacts in terms of minimized impacts, disclosure of impacts, public consultation and participation of the affected people, payments of compensation at replacement cost, resettlement of the affected persons and livelihood restoration and improvements in the post-resettlement period.

The Present Status Compliance with Bangladesh Legislation and Harmonized Safeguard Policies.

The present status of compliance of the project with Bangladeshi legislation and harmonized safeguard policies is indicated in Table-1:

Table 1: The present status of compliance of the project

Sl.No.	Laws/ Regulations	Evaluation
1	**The Environment Conservation Act, 1995 and subsequent amendments in 2000 and 2002**	
	Regulated/ Enforced Items	***Evaluation***
	Declaration of Ecologically Critical Areas;	Not applicable as the project is not located in the Ecologically Critical Areas.
	Obtaining Environmental Clearance Certificate;	It is under process
	Regulation with respect to vehicles emitting smoke harmful for the environment;	It has been addressed in EIA
	Regulation of development activities from environmental perspective; Promulgation of standards for quality of air, water, noise, and soils for different areas and different purposes;	Standards for environmental aspects relevant to the project are mentioned and incorporated in EIA.
	Promulgation of acceptable limits for discharging and emitting waste;	Acceptable limits involved in the project are addressed in EIA
	The formulation of environmental guidelines relating to control and mitigation of environmental pollution, conservation and improvement of the environment.	EIA includes the possible mitigation/enhancement measure. To comply with DoE provisions and the co-financer requirement the monitoring arrangement has been addressed in the EIA
2	**Environment Conservation Rules,1997 and subsequent amendments in 2002 and 2003**	
	Regulated/ Enforced Items	**Evaluation**
	Requirement of Environmental Clearance Certificate for various categories of projects;	The project is in the process of obtaining an ECC
	Requirement for IEE/ESIA according to the appropriate category of the project; Renewal of the environmental clearance certificate within 30 days after the expiry;	Renewal of the environmental clearance certificate will be made within the stipulated time period.
	Provision of standards for quality of air, water & sound and acceptable limits for emission/discharges from vehicles and other sources.	Standards for thequality of air, water & sound and acceptable limits for emission/discharges are stated in EIA.
3	**Environment Court Act, 2000 and subsequent amendments in 2002**	
	Regulated/ Enforced Items	**Evaluation**
	GOB has given highest priority to environment pollution and passed "Environment Court Act, 2000" for completing environmental related legal proceedings effectively.	It is stated in EIA
4	**The Vehicle Act, 1927 The Motor Vehicles Ordinance, 1983 The Bengal Motor Vehicle Rules, 1940**	

	Regulated/ Enforced Items	**Evaluation**
	Exhaust emission; Vehicular air and noise; Road safety; Licensing.	It is stated in EIA
5	**The Brick Burning (Control) Act, 1989 The Brick Burning (Control) Amendment Act, 1992**	
	Regulated/ Enforced Items	**Evaluation**
	Control of brick burning requires a license from the MoEF; Restricts brick burning with fuelwood	Not applicable to this project
6	**The Removal of Wrecks and Obstructions in inland Navigable Water Ways Rules 1973**	
	Regulated/ Enforced Items	**Evaluation**
	Removal of wrecks and obstructions in inland Navigable Waterways.	It is incorporated in EIA and also in BOQ
7	**Water Supply and Sanitation Act, 1996**	
	Regulated/ Enforced Items	**Evaluation**
	Management and Control of water supply and sanitation in urban areas.	Not applicable to this project
8	**The Ground Water Management Ordinance 1985**	
	Regulated/ Enforced Items	**Evaluation**
	Management of groundwater resources;	Proper management of ground water resources should be insured for the project which has been stated in EIA
9	**The Forest Act, 1927 and subsequent amendments in 1982 and 1989**	
	Regulated/ Enforced Items	**Evaluation**
	Reserve Forests; Protected Forests; Village Forests.	It has been stated in EIA
	Conservation of private forests and for the afforestation of wastelands.	It has been stated in EIA
10	**Bangladesh Wild Life (Preservation) Act, 1974**	
	Regulated/ Enforced Items	**Evaluation**
	Preservation of Wildlife Sanctuaries, parks, reserves.	The site is not located at a declared wildlife sanctuary, parks or reserves
11	**The Protection and Conservation of Fish Act 1950 subsequent amendments in 1982**	
	Regulated/ Enforced Items	**Evaluation**
	Protection and Conservation of fishes in Government owned water bodies.	Natural fish habitat will not be at disturbed for the project. However, all the protection measures have been stated in the EIAreport to conserve the fish species.
12	**Natural Water Bodies Protection Act 2000**	
	Regulated/ Enforced Items	**Evaluation**
	According to this Act, the character of water bodies i.e. rivers, canals, tanks, or floodplains identified as	It is addressedin EIA to follow the rules strictly.

	water bodies in the master plans or in the master plans formulated under the laws establishing municipalities in division and district owns shall not be Changed without theapproval of the concerned Ministry.	
13	**The Embankment and Drainage Act 1952**	
	Regulated/ Enforced Items	**Evaluation**
	An Act to consolidate the laws relating to embankment and drainage and to make better provision for the construction, maintenance management, removal and control of embankments and water courses for the better drainage of lands and for their protection from floods, erosion and other damage by water.	It has been addressed in the EIA to follow the rules strictly.
14	**Noise Pollution Regulations, 2006**	
	Regulated/ Enforced Items	**Evaluation**
	Regulations to address the problem of noise being above the acceptable limits as set in the regulations	It has been addressed in EIA
15	**The Electricity Act (1910) and Energy Policy 1996**	
	Regulated/ Enforced Items	**Evaluation**
	Management and control of power energy in project areas in an environment friendly way.	It has been addressed in EIA

4 PROJECT DESCRIPTION

4.1 Introduction

To increase power generation capacity of Bangladesh, GOB/CPGCBL decided to install 1200MW coal power plant at the Matarbari Union in Moheshkhali Upazilla of Cox's Bazar District.

As a part of the rural electrification component of the power plant project, The proposed project, construction of 20km 132 KV transmission line from Chakaria to Matarbari CPGCBL power plant proposed and 10 mVA 33/11 KV REB distribution Sub-station with renovation of existing 33KV, 11KV &0.415KV distribution network is undertaken which is very important to start the development works of the power plant.Actually, the assignment is mainly part of the whole project works of the Power Plant.

The project will help to produce electricity which is required to start the constructing work of Matarbari coal based 1200 MW power plant. This power plant will supply electric power to the national grid, thus our nation will be benefited. So, the project is very much helpful to supply electricity in the locality as well as help to start the constructing work of Matarbari coal based 1200 MW power plant. Thus, electricity problems over the country including local demands of electricity would be overcome partially after completion of the project. The Project will create a positive impact on the quality of livelihood in the project areas which is one of the major objectives of the scheme.

An IEE with prefeasibility study for the Project was carried out in September, 2013. This investigated a number of potential routes/locations for the transmission line and the sub-station. On the basis of the outcome of the study, GOB and Donors have decided to construct the transmission line at the mentioned location. The selection of this site was subsequently approved by GOB. The FS (Feasibility Study) includes, among others, a preliminary technical design, economic and financial evaluation, a framework for Land Acquisition, Resettlement Action Plan (LARAP), Environmental examination and its potential impact assessment.As the FS has concluded that the project is economically viable, GOB moved forward for implementation with the help of CPGCBL and accordingly, CPGCBL conducted a study to update the previous Environmental Study to prepare an Environmental Management Plan (EMP), a Land Acquisition and Resettlement Action Plan (LARAP). The above studies formed affirm basis for the decision of CPGCBL to proceed with Phase 2, which includes the detailed engineering design and implementation of the project with the help of PGCB and REB. In the end of June, 2015, a safeguard team on environmental and social issues, and a part of the design consultants' team, commenced the detailed EIA study in accordance with the relevant laws and regulations in Bangladesh and EIA guidelines of the co-financer.

People of the locality are eagerly waiting for starting the project as the local economy and livelihood status of the peoples would be improved as a result of this project. It is safely stated that it is very important to make the EIA report first before moving to structural design and construction of the proposed infrastructures of the project in sustainable, durable and risk-free ways to save it from any danger from the project itself.

4.2 Development objective

The main development objective of the project is to supply the electricity to Matarbari 132/33KV substation proposed which is required to start the constructing work of Matarbari coal based 1200 MW power plant as well as quality and reliable power supply to the locality through installing a 5 MVA 33/11 KV sub-station at Matarbari.

Besides, the objectives of the study are to conduct detailed environmental impact assessment (EIA) and propose an environmental management plan (as part of EIA) for minimizing negative impacts and enhancing positive impacts.

4.3 Project main options

- Land acquisition and resettlement
- Land development
- Total infrastructures development for the Project
- The power supply in the locality and help to start the construction of the Power Plant.
- Eco-friendly options for the development works

4.4 Interventions under selected options

➢ Land Acquisition and Resettlement

About 45 decimals of land is required for the development of REB sub-station in Matarbari. According to the Land Acquisition laws of Bangladesh Land acquisition for the project is being undertaken by the Deputy Commissioner of the concerned District. For the setting the foundation of the electric tower, the project needs some land which will be taken under electricity act 1910 including amendment and **Power Policy, 1995.**

➢ Land development

Land filling for the project, especially for sub-station, would be done by the soil coming from any disposed area.

➢ Total infrastructures development for the Project

Total infrastructures of the project are stated below

- Construction of 20km 132 KV transmission line from Chakaria to Matarbari CPGCBL power plant.
- Construction of 10 MVA 33/11 KV REB distribution sub-station to deliver the power to the various consumers of Matarbari and Dhalghata Union of MoheshKhali Upazila.
- Construction of 1 km 33 KV source line for 33/11 sub-station.
- Upgradation of 29 km of 33 KV line from Dog (19km) & 4/0(10km) to 477 MCM conductor.
- Construction of 15 km for 4 nos. of 11KV feeder.
- Construction of 80 km of HT lateral and LT line.
- Construction of one set 11KV river crossing tower of 0.3 km span of 4/0 conductor
- Installation of required number of 11/0.4 or 6.35/0.23 KV x-formers and service drop for 4000 nos. of various type of consumers.

➢ Eco-friendly options for the development works

The proposed project has planned to make a green-built structure with eco-friendly natural features. Keeping this view in mind, the projects has provision to install/establish the programs like-

- Tree plantation beside internal roads for erosion control as well as economic return and releasing oxygen to the environment.
- Environment friendly sanitation arrangement.
- Environment-friendly roofing for the buildings of the sub-station with rainwater harvesting mechanism.

4.5 Project activities

A list of activities are involved in the construction phase, some of them are given below:

- Land clearance and establishment of site compound for substation and electric tower;
- Construction of stake yard;
- Construction of power substation;
- Construction of power transmission line
- Stockpiling of construction materials;
- Piling works for foundation of infrastructures(Substation and electric tower);
- Earth works for project development;
- Civil works within the substation

4.6 Project schedule

The project will be implementedin three phases. However, the project schedule is stated in below table-2.

Table 2: Project Schedule

Phases	Project activities	2013	2014	2015	2016
1st phase	Survey, Feasibility study, EIA study, Land acquisition & resettlement	⇒	⇒		
2nd Phase	Construction of Infrastructures		⇒	⇒	
3rd Phase	Operation of the project				⇒

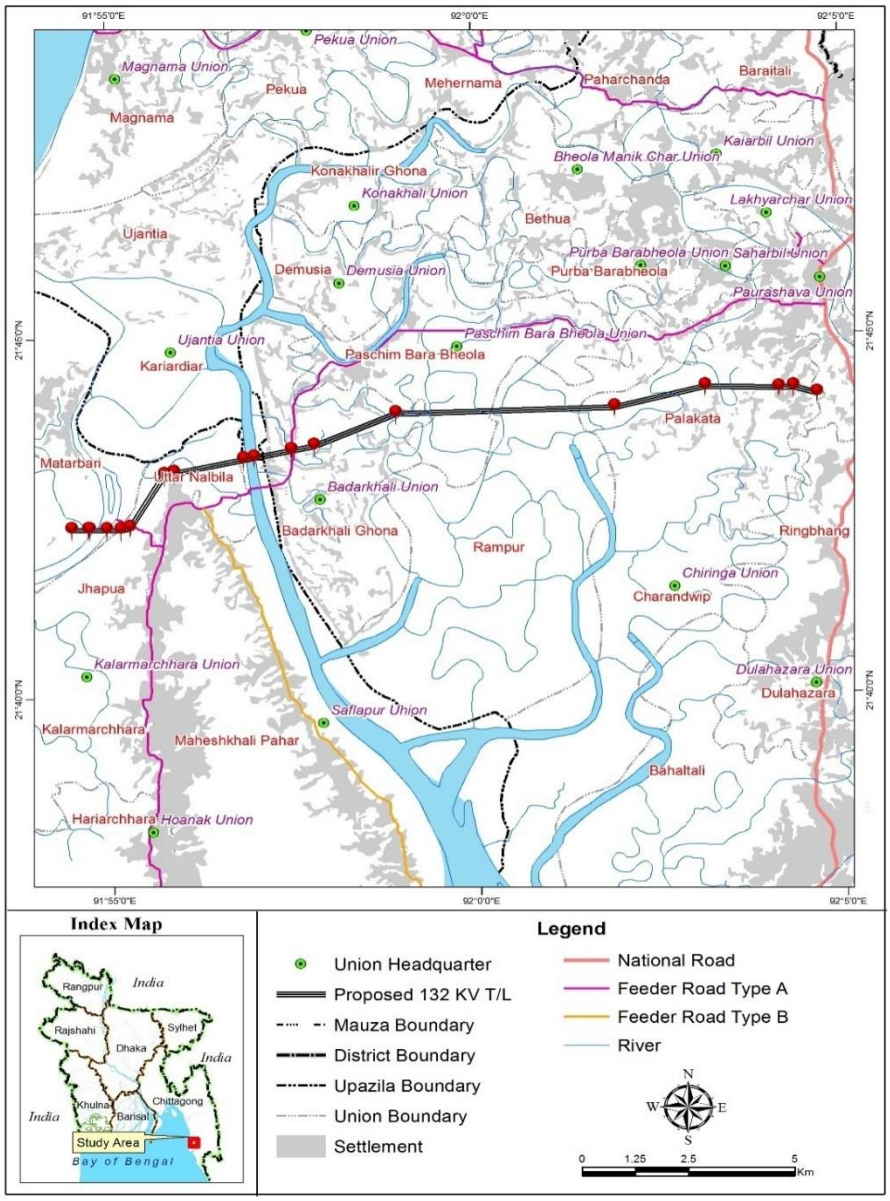
4.7 Resources and Utility Demand

Water consumption will be in the substation area as a domestic purpose but it is the very little amount. This water will come from nearby surface water. However, all waste water will be disposed in a legal way. Electricity would be used from own sources.

4.8 Maps and Survey Information

The proposed Chakaria-Matarbari 132 KV Transmission line is locatedin the Cox's Bazar coastal area where the land is gently sloped towards the sea. This site is about 9.0 km northwesterly from Kutubdia Island and 3 km southward from Chakaria Upazila. From digital elevation model (DEM) analysis it is found that the study area of the proposed Chakaria-Matarbari 132 KV Transmission line has an elevation of 2.5 m ~ 5 m above MSL.

Location map of the study area are given below (**Map-1)**.



Map 1: Location Map of the study area

4.9 Project Plan, design, specification, quantification etc.

The layout of the transmission line and power sub-station of the project is shown in the Appendix 1 & 2.

5 ANALYSES OF ALTERNATIVES

Project alternatives are applicable when and if the impacts of environmental components and issues have significant changes to the area and also the capacity of adaptation to the changes. However, this section presents the alternatives that were considered for the project, which includes the do-nothing option. The main alternatives considered were do-nothing, project costing and site alternatives/alternative route alignment.

The 'No Build' Scenario:

From a purely physical environmental point of view, the "do-nothing" option is preferable to any project implementation, since it would avoid creation of any of the adverse impacts associated with the project. However, with this approach the potential socioeconomic benefits to the nation would be foregone and economic growth would be hampered. Because of the absence of power development, the project area and also the nation will deprive the opportunities on the issue of the potential for increased power supply, generation of new economic activities and employment. A stagnating regional economy will affect incomes and increase the number of people living below the poverty line. So, it is concluded that the 'No build' alternative is unacceptable and the potential socioeconomic benefits of implementation of such project far outweigh the adverse impacts, all of which can be controlled and minimized to an acceptable level.

Site alternatives/ alternative route alignment:

The proposed power sub-station site is located at Matarbari of Moheshkhali of Cox's Bazar but transmission line will be installed from Matarbari to Chakaria, near to the connecting point of MoheshKhali-Chakaria road and Chittagong-Cox's highway road. Three different alternative alignments were studied for the detailed survey with the help of published data/maps and walkover survey. The river crossing over Kohalia River and Matamuhuri River are common for all the three routes. The comparative details study of these three alternatives is stated in **table 3**

Table 3: Comparative study on the alternative route alignment for an electric transmission line of the project.

Sl No.	Description	Alternative-1	Alternative-2	Alternative-3
1	**Route particulars**			
	i)Angle tower no	11	13	13
	ii)Angle type	$0\text{-}10^0$(02)	$0\text{-}10^0$(01)	$0\text{-}10^0$(02)
		$10\text{-}25^0$(05)	$10\text{-}25^0$(03)	$10\text{-}25^0$(07)
		$25\text{-}90^0$(04)	$25\text{-}90^0$(09)	$25\text{-}90^0$(04)
	iii)Length of km	18+706	19+407	19+702
	iv)Terrain(km) a)Plain b)Hilly	Plain	Mixed	Majority plain

Sl No.	Description	Alternative-1	Alternative-2	Alternative-3
2	**Environmental impact**			
	i) Towns onalignment	Chakaria	Chakaria	Chakaria
	ii) Forest involvement	Nil	Nil	Nil
	iii)Historical/Cultural monument	Nil	Nil	Nil
	iv) Abundance of Flora and Faunas	Nil	Nil	Nil
	v) Endangered species, if any	Nil	Nil	Nil
Sl No.	**Description**	**Alternative-1**	**Alternative-2**	**Alternative-3**
3	**Major crossing**			
	I) River (Nos.)	3	3	4
	ii) Power line(Nos.)	11KV-7 nos.	11KV-8 nos.	11KV-7 nos.
	iii) Railway line(Nos.)	Nil	Nil	Nil
	iv) Pucca road/Katcha road	6+5	6+7	7+6
	v) Khal(Nos.)	23	27	25
4	**Construction problems**	Line route passes through mostly on plain area and also involves less khal area and river & road crossing span is minimum	Passes through relatively hilly/undulating terrain and also involve more no. of river/khal crossing	Passes through themostly plain area but involve more khal crossing and also river crossing span is more.
5	**O&M Problems**	O&M will be comparatively easier due to better accessibility of line route	Moderate accessibility of line route	Moderate accessibility of line route

From the above comparison it is evident that although all 3 alternatives are almost similar line length but the line route of alternative-1, passing through mostly plain area with easy accessibility having minimum road crossing, less khal area and also span on river crossings, is less cost and low negative impacts compared to other low alternatives. Thus, Alternative-1 has been found to be most optimum alignment and recommended for selection. It could be mentioned that the proposed electric transmission line could not go over any houses.

Reference for conducting comparative study on the alternative route alignment for the electric transmission line is outlined below-

- Client Name: PGCB
- Project: 132 kV Matarbari Chokoria transmission line
- Surveying Firm: National Survey Organization
- Date: 28.10.2014

In brief survey report and transmission line route plan received from PGCB are attached in Appendix 1.

6 ENVIRONMENTAL & SOCIAL BASELINES

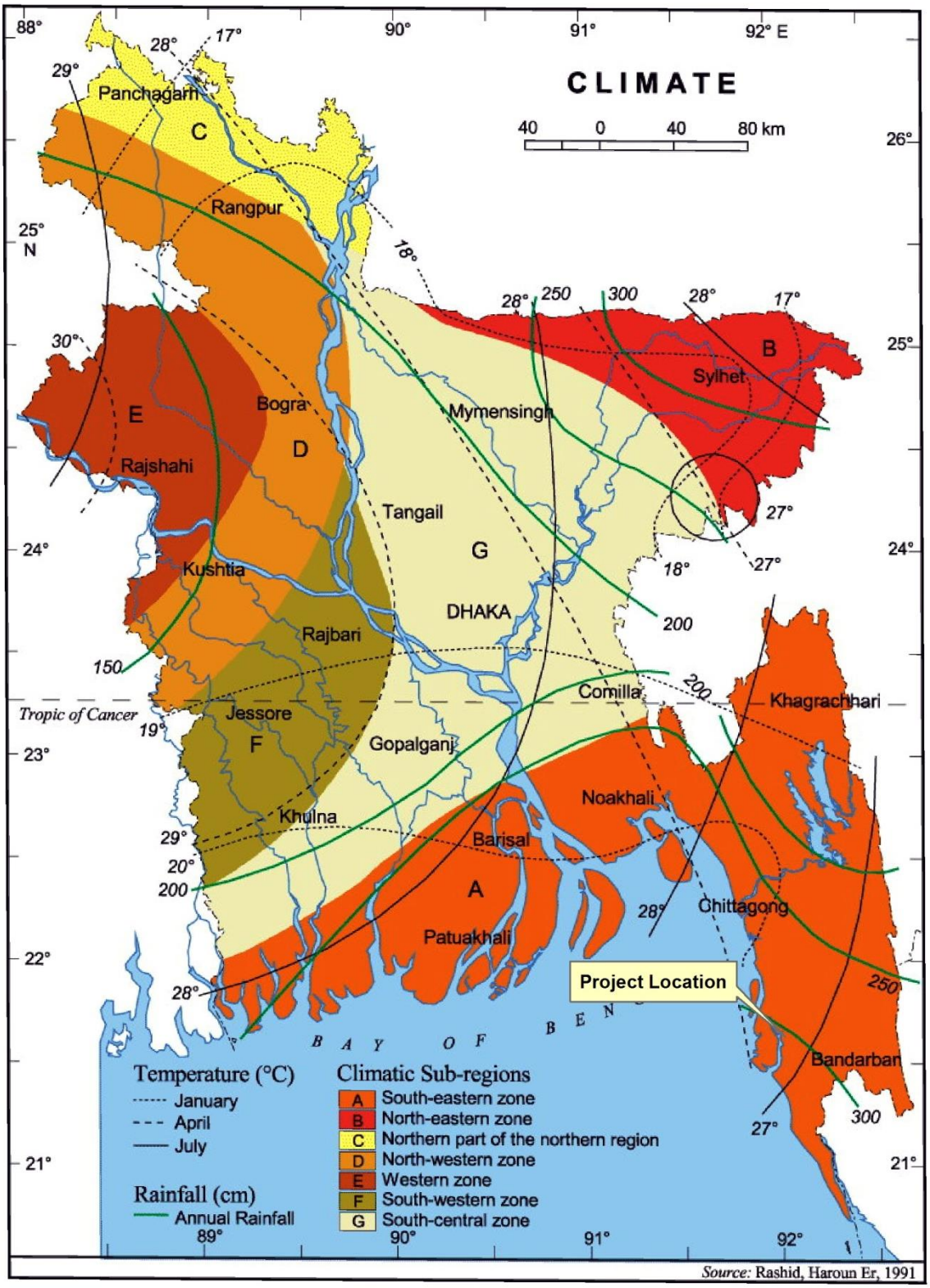
This chapter on the environmental and social baseline has been prepared using both primary and secondary data collected from the proposed project site and surrounding study area. The baseline condition has been defined in respect of physical environment (e.g. including meteorological, hydrological, geological components and processes), biological environment (e.g. including flora, fauna, and ecosystems), land use pattern, agriculture practices, cultural activities, economic status, livelihoods pattern and hazards of the study area.

6.1 Climate and meteorology

Data on meteorological parameters collected from different secondary sources (BMD) were synchronized with the nearest meteorological station at Kutubdia. The climate of Kutubdia experiences a hot, wet and humid tropical climate. Under the Köppel climate classification, Kutubdia has a tropical wet and dry climate. However, the project area lies in the Southeastern climate zone of the country and shows tropical monsoon climate with three prominent seasons - Summer/pre-monsoon- March to May; Rainy season/Monsoon - June to October; and winter season - November to February. Monsoon comes in the month of June and recedes in the month of late October. Seasonal variation of rainfall, temperature, and humidity is the noteworthy aspect of the climate. The rainy season is hot and humid, and characterized by heavy rainfall. The winter is predominately cool and dry. The summer is hot and humid interrupted by occasional heavy rainfall. Gentle north/north-westerly winds with occasional violent thunderstorms called northwester during summer and southerly wind with an occasional cyclonic storm during monsoon are prominent wind characteristics of the region.

In the study area, the annual average temperature is 25°C (77 °F) and monthly means are substantial varied between 15.0^0C in January and 33^0C in May. Nearly 85% of the annual average rainfall of 2,570 millimeters (101.2 inches) occurs during the monsoon season which last from May till the end of September. Riverine flood is common in almost every year.

Meteorological data for the last twenty seven (27) years was collected from the nearest BMD station in Kutubdia and analyzed to get the overall climatic conditions of the study area. Summary of the analysis of climatic parameters are given in the following sections. The south-eastern climatic zone, studied area, of Bangladesh is shown in Climatic zone map of Bangladesh which is given below (**Map-2).**



Map 2: Climatic zone map of Bangladesh

6.1.1 Temperature

Seasonal variation of the temperature is distinct but does not vary largely. Data of last 27 years (1985-2012) shows that monthly average maximum temperature varies from 25^0C to 33^0C while April is the warmest month and the monthly average minimum temperature varies in the range of 15^0C to 25^0C while January is the coldest month. The highest ever recorded maximum temperature within last 27 years is 38^0C occurred in May and the lowest ever recorded minimum temperature is 5.4^0C occurred in January. The monthly maximum and minimum temperature from 1985 through 2012 along with the monthly average maximum and minimum temperature are shown in **Figure 1**.

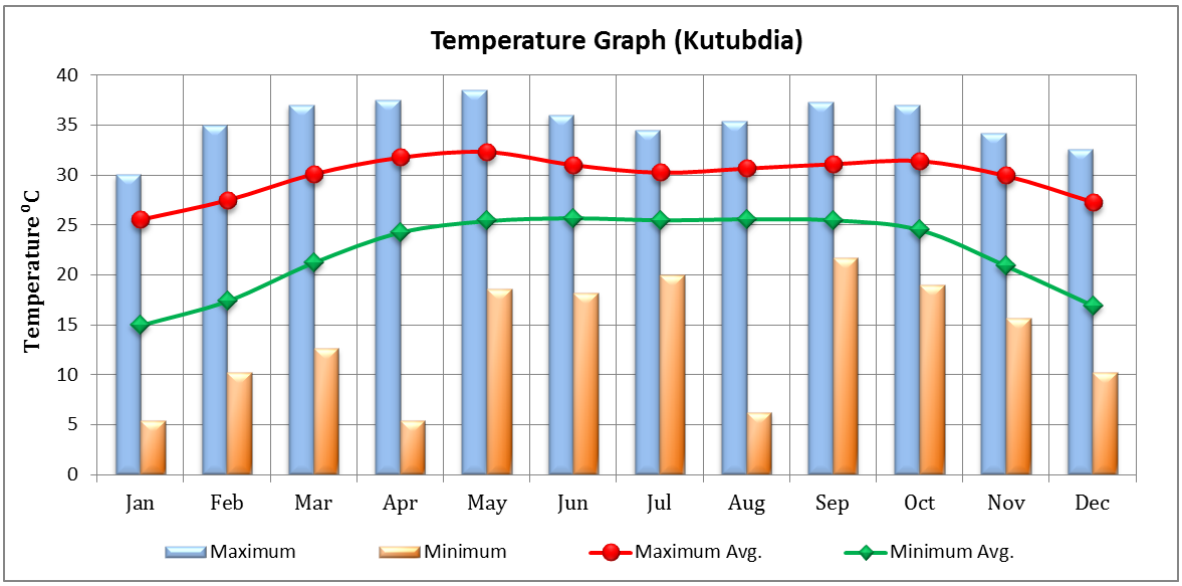


Figure 1: Historical monthly average maximum and minimum temperature records (1985-2012)

6.1.2 Humidity

The collected data from Kutubdia station shows that monthly average relative humidity near the project area varies seasonally from 73.3% to 87.9%. April to October are the most humid months (80 % to 82 %) while during January to March it remains lowest. **Figure-2** shows the average monthly maximum, minimum and an average humidity of last twenty nine years (1985 to 2012).

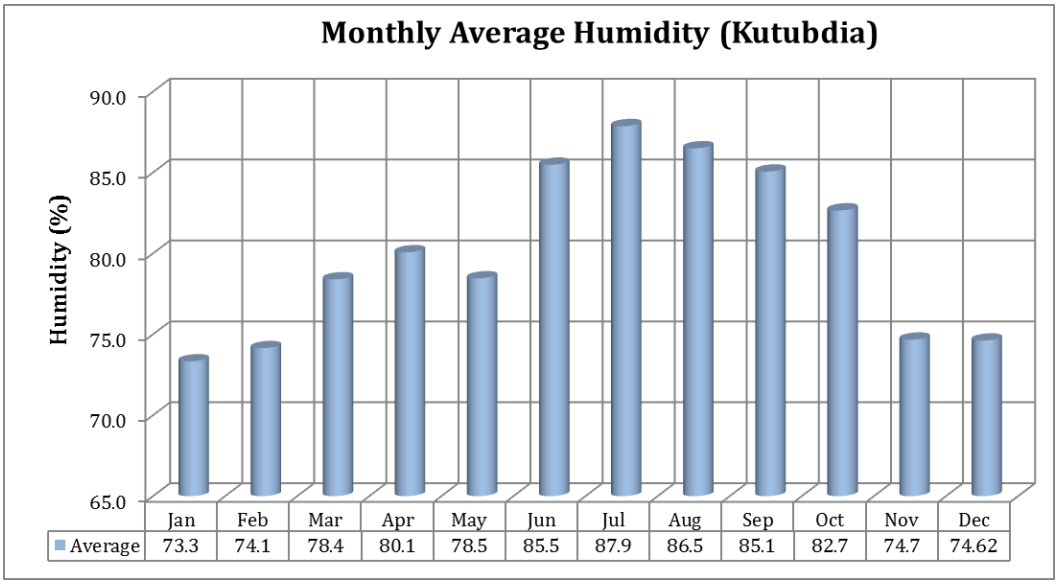


Figure 2: Average Monthly variation of relative humidity (1985-2012)

6.1.3 Rainfall

Rainy season is prominent in this region. The annual average rainfall is 3020 mm/yr. as per last 27 years recorded data of Kutubdia weather station. Maximum monthly rainfall ever recorded is 1805 mm in the month of July during 1998. Twenty seven years average of monthly rainfall is presented in a graph (**Figure-3**) shows that May to September have a maximum rainfall of the year and it varies in the range of 278 mm to 793 mm. On the other hand, November and March show minimum amount of rainfall. Time series rainfall data of Kutubdia station has been used for this analysis.

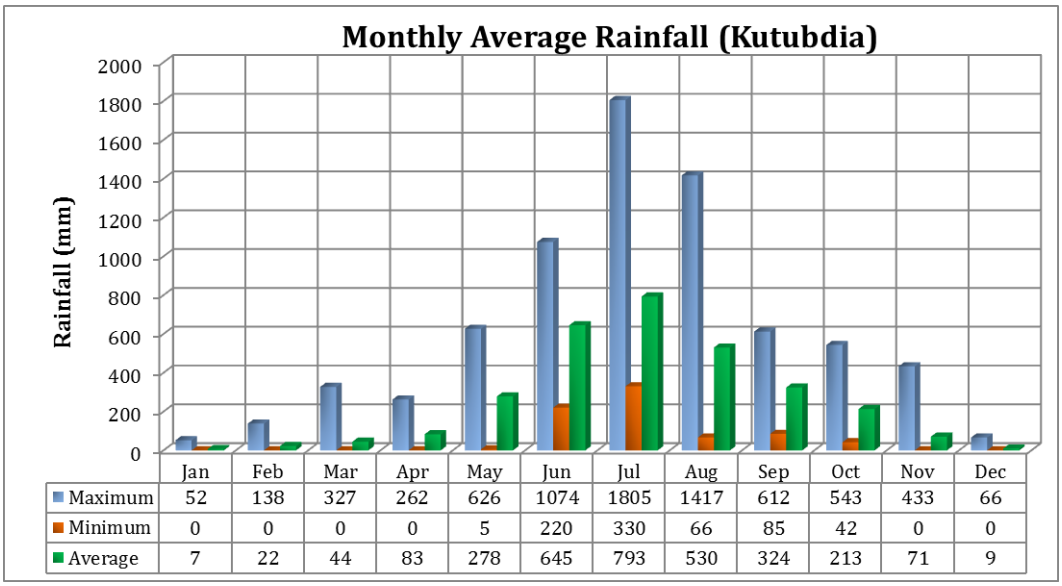
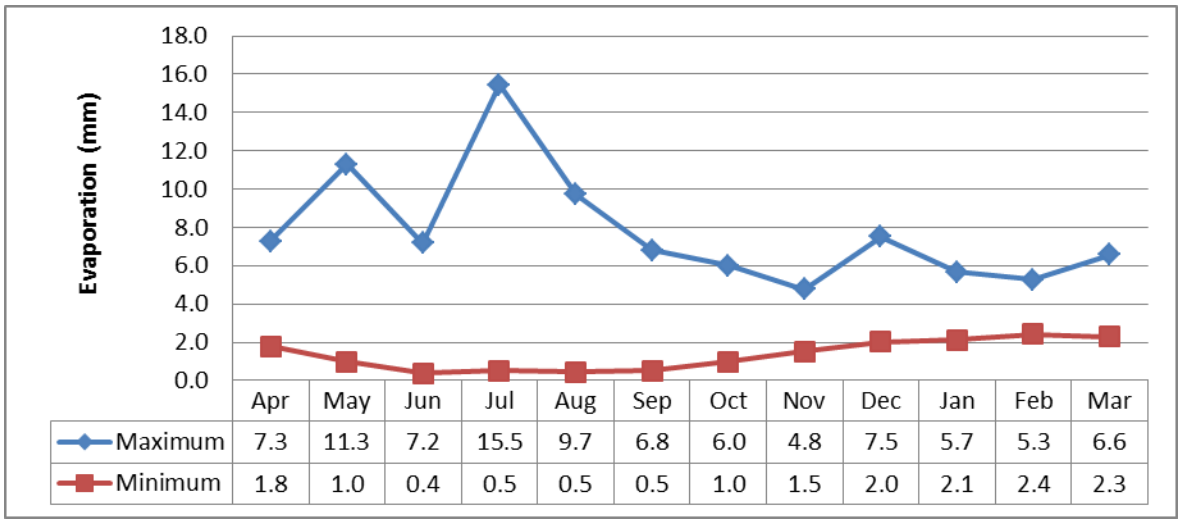


Figure 3: Historical maximum, minimum and average rainfall (1985-2012)

6.1.4 Evaporation

Water comes from atmosphere to the land via rainfall and again goes back to the atmosphere via evaporation; this process is an integral part of our hydrological cycle, which influences the overall water balance on the earth surface.The historical data of last 20 years (1985-2005) shows the monthly average evaporation of Kutubdia as 4.54 mm per month with the highest evaporation of 15.5 mm in the month of July and lowest as 0.5 mm in July to September.**Figure 4** shows the monthly maximum and minimum evaporation of the project area.



	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
Maximum	7.3	11.3	7.2	15.5	9.7	6.8	6.0	4.8	7.5	5.7	5.3	6.6
Minimum	1.8	1.0	0.4	0.5	0.5	0.5	1.0	1.5	2.0	2.1	2.4	2.3

Source: BMD (Bangladesh Metrological Department)

Figure 4: Monthly maximum and average evaporation (1985-2005)

6.1.5 Wind speed and direction

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

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

Figure 5 shows wind speed, direction and duration of wind blowing in the study area. From the wind rose diagram, it can be comprehended that maximum wind is directed from south to north of the project site. The data has been collected for full one year of 2014. About 11% of the total wind flows over the study area which is remarked as calm wind (i.e. speed <1 m/s). The study area is dominated with the wind speed between 4-6 m/s. Similarly, type of wind has been experienced i.e. passing toward north-western away during field investigation.

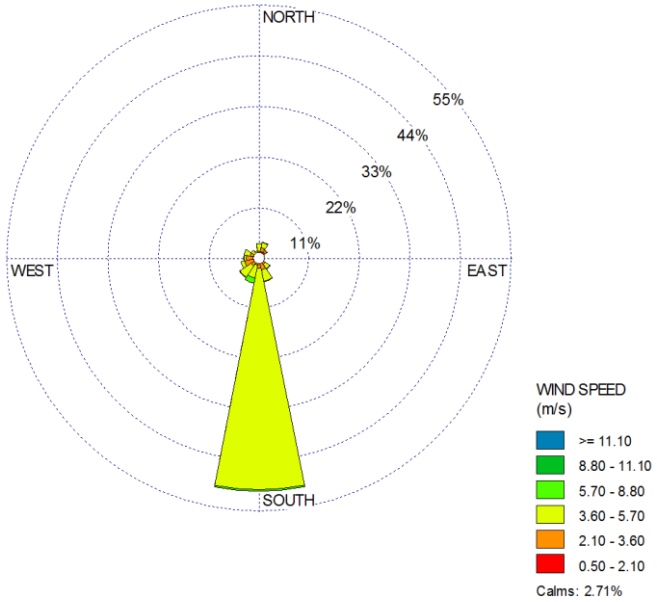


Figure 5: Wind Rose Diagram (1st January-31st December, 2014)

It is observed that the proposed project site is highly windy. Wind data from Kutubdia station has been sorted out to represent the highest wind speed, wind direction and duration of wind flow of this area **Table 4**.

Table 4: Yearly highest wind record

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

Year	Time	Wind speed (knots)	Wind Direction (degree from the North)	Wind Duration (hour)
05/06/2006	9:00PM	18	160	3
14/05/2007	3:00PM	25	360	9
Maximum		95	-	18
Minimum		18	-	3
Average		32.6	-	6.6
Median		26	-	3
Mode		30	-	3

6.1.6 Sunshine hours

Sunshine hour is a climatologically indicator, measuring the duration of sunshine for a given location and period which indicates the total energy delivered by sunlight. In order to investigate the sunshine hour over the study area, sunshine hour records (1961-2008) of Kutubdia BMD station has been analyzed. The monthly average sunshine hour in Kutubdia varies from 4:00 to 8:30 hour/day in a year. The monthly highest sunshine hours occur in July i.e. 13:00 hour/day when the average daily sunshine is only 4 hours. Except monsoon the average of daily sunshine retains around 8 hours due to the dearth of cloud coverage. Length of the sunshine hour reduces during the winter season. **Figure 6** shows the daily sunshine hour condition of the study area in different months.

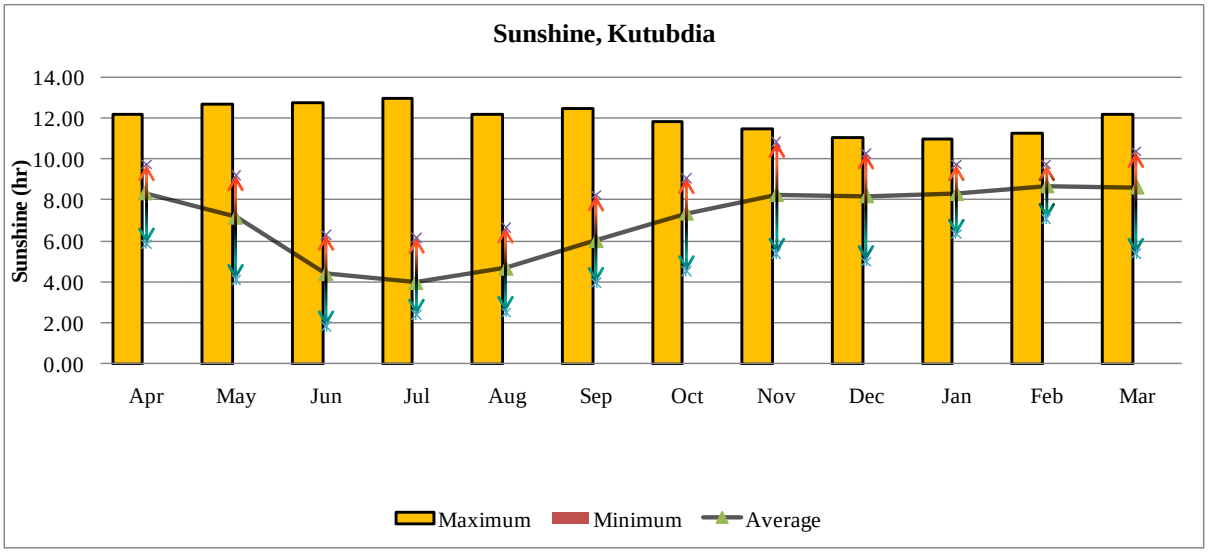


Figure 6: Sunshine hour condition of the study area

6.1.7 Climate trend

The climate of the area is tropical wet and dry, generally marked with monsoons, high temperature, considerable humidity and heavy rainfall. The hot season commences early in April and continues through August. The maximum temperature observed during March to July and the minimum temperature recorded in January. The highest rainfall is observed during monsoon.

In order to assess the change in climatic factors, the trend of annual variations of the aforementioned meteorological parameters was analyzed. Historically, the major impact caused by climate change is arise in temperature. From the analyzes of data and information made for the study area, the average temperature is found gradually increasing in the area. In last 27 years, the mean annual increasing temperature has been experienced which is about 0.024°C per year **(Figure -7).** So, all infrastructures of the project should be designed under the consideration of this increasing trend. The variation of mean annual temperature recorded in Kutubdia station is shown in **Figure-7.**

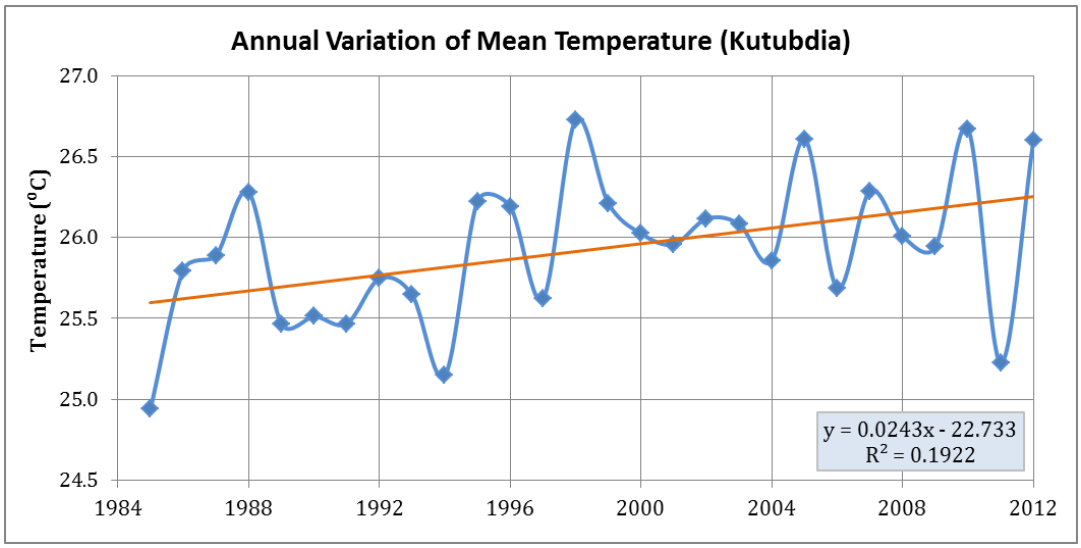


Figure 7: Annual Variation of Mean Temperature at the study area

The increase in mean annual temperature affects the rate of evaporation and thus rainfall intensities. The evaporation rates recorded in Kutubdia station shows an increasing trend (increasing by 0.038 mm/day each year in last 27 years). Owing to increase in the evaporation rates, electricity consumption and water demand would be increased simultaneously. The following figure **(Figure-8)** shows the increasing trend of Evaporation rate. The period of the spring season has been shortened and monsoon has been shifted towards May. Nowadays, monsoon starts from the month of May and lasts up to mid-October. Due to such timing, water scarcity is often observed in the early Boro season. This phenomenon may affect the cropping patterns as well as the biodiversity and ecosystem of the study area.

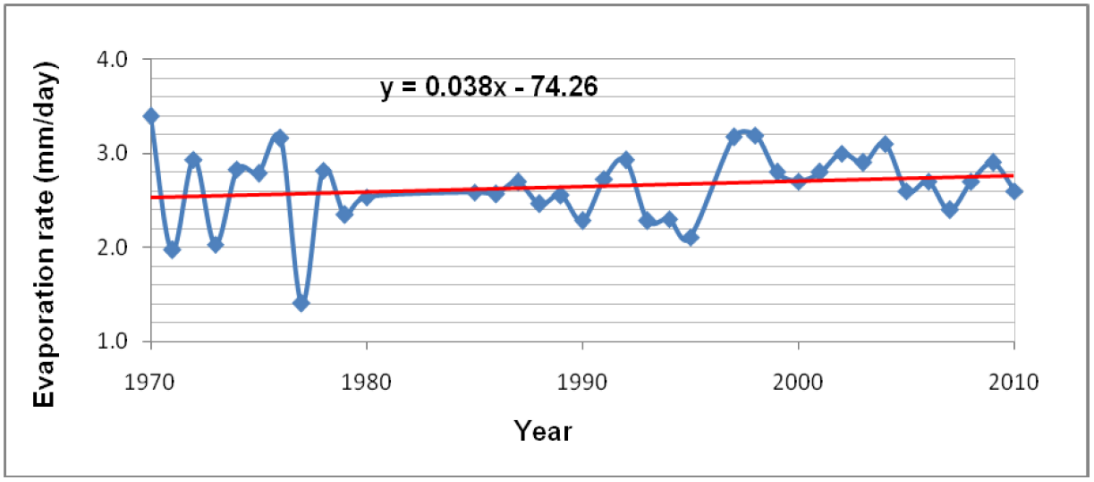


Figure 8: Annual Variation of Mean Evaporation at the study area

The rainfall intensities and patterns have also been changed and the extreme consequences of which have affected the study area. In the last 27 years (from 1985 to 2012), the annual variation of average rainfall has decreased by 5.71 mm per year **(Figure-9)**. The annual variation of average rainfall recorded at Kutubdia station is shown in **Figure-9**.

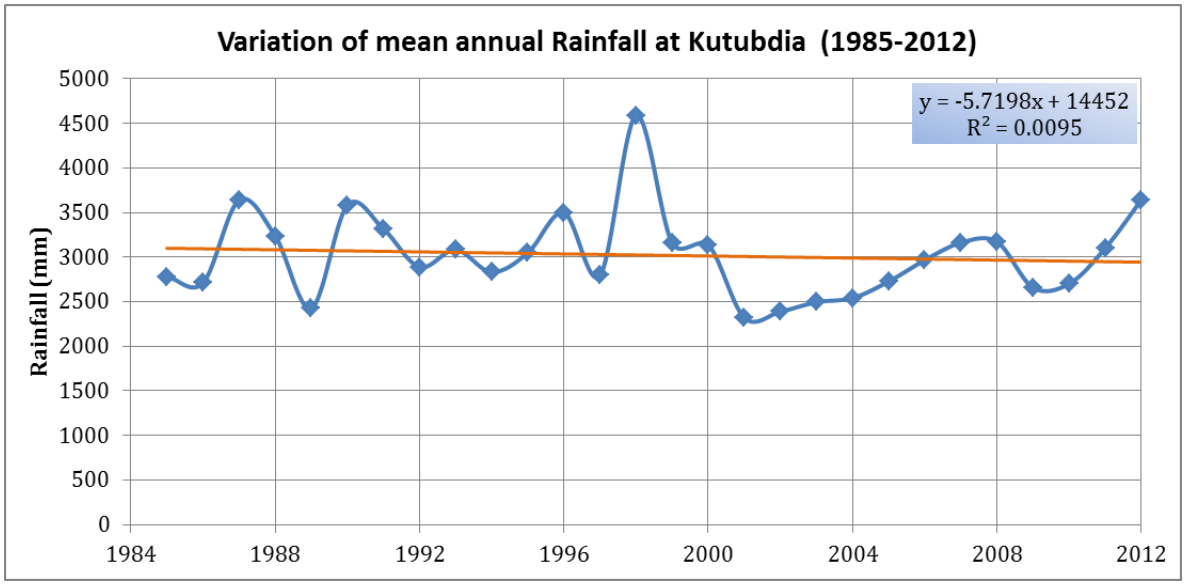


Figure 9: Annual Variation of average Rainfall at the study area

The average humidity has also experienced minor changes in the last two decades. The magnitude of average relative humidity has increased by 0.075% per year **(Figure-10)**.The following figure shows the annual variation of average relative humidity of the study area.

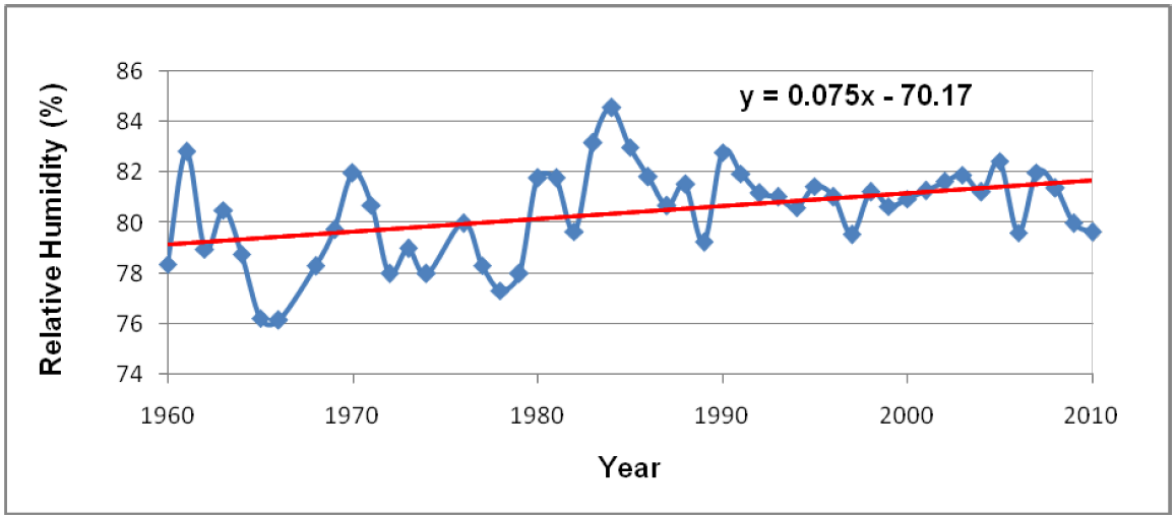


Figure 10: Annual Variation of Mean Relative Humidity at the study area

Apart from the meteorological changes discussed above, climate change also has important impacts on the frequency and intensity of natural disasters in the study area.

6.2 Water resource

The proposed project area is located in Chakaria and Matarbari union under Cox 's Bazar District. It is adjacent to the Bay of Bengal and located over 15mile from the northeast of Kutubdia Island. Matamuhuri River on the north side, Bura Matamuhuri River on the south side, Maheshkhali Island at West and Maheshkhali Channel at the southeast of the project area. The project area is approachable by road from Cox's Bazar district and waterway through the "Bay of Bengal". Heavy construction materials/ machinery can be transported through the waterway.

The Matamuhuri River and Maheshkhali Channel is the mainstream in the project area. The Mangla Khal and Bura Matamuhuri khal are also significant water bodies within the study area. Tides of the Bay of Bengal regularly inundate large area of land mass along the shore side of the project area. During monsoon, huge quantity of rainfall runoff flows to the Maheshkhali Chanel through creeks and rivers which ultimately falls into the Bay of Bengal. At present the level of salinity is relatively lower due to the monsoon. However, the surface water quality in the study area is influenced by monsoon rainfall. Moreover, the offshore zone of the project is influenced by the estuary environment.

6.2.1 Surface water system

A number of rivers in and around the project area carry fresh water from the eastern hilly areas and ultimately fall into the Bay of Bengal through Maheshkhali Channel at Matarbari union. A number of creeks (Chorra) originate from the hill ranges meet with each other and finally fall into the Bay of Bengal. These rivers, channels, khals carry a significant amount of coarse sediment and deposit to the rivers and sea shelf.

Matamuhuri river

The Matamuhuri River is a trans-boundary river flowing through Myanmar and Bangladesh. The source of origin of the river is in the North Arakan Hills of Myanmar. The Arakan Hills form the boundary between Arakan and the Chittagong Hill Tracts. It follows a circuitous northerly course in the hilly areas and then enters into Bangladesh near Chokhyong, Alikadam Upazila, Bandarban District from the east. It flows toward the north through Alikadam, Lama Upazila of Bandarban District. It then flows toward the west through Chakaria Upazila in Cox's Bazar District and flows into the Bay of Bengal. The length of the river is 120 kilometers the width is about 100m and the depth is about 8-10m.

Maheshkhali Channel

The Maheshkhali Channel lies in-between the mainland of Cox's Bazar and Maheshkhali Island. The length of the channel is about 26 km. The channel is connected with the Bay of Bengal at its both ends; as such it is a tidal channel and is affected by ebb and flow of ocean tides.

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

6.2.1 River Hydrology & Morphology

River hydrology

The surface water level is an important issue of water resources. The immediate upstream and downstream water level stations of the project site are Chiringaat Matamuhuri River (Stn. 204) and Saflapur (Moheskhali) at Moheskhali Channel (stn. 200) respectively. Chiringat station is at about 5km away at the upstream and Saflapur (Moheskhali) station is about 9 km away at the downstream of the project site. The station where the daily water level data is available is given in **Table-5**.

Table 5: The stations where the daily water level data is available, collected from Hydrology, BWDB

Station	Station ID	Type	River	Period
Chiringa	Stn.204	Tidal	Matamuhuri	1968-2012
Saflapur	Stn.200	Tidal	Moheskhali Channel	1968-2012

Analysis of Water Level Data

Daily water level data of the peripheral rivers has been analyzed to determine the probable annual highest and lowest water levels of the study area. Gumbel Extreme Value (EV1) distribution method has been used for statistical analysis. The values found from the analysis for different distinct return periods are given in **Table-6.**

Table 6: Probable highest water level for different return periods

Location	Station ID	River		Return Period (Year)					
				2	2.33	5	10	20	50
Saflapur	Stn.200	Moheskhali Channel	High tide	3.72	3.78	4.07	4.29	4.52	4.80
			Low tide	-1.68	-1.63	-1.40	-1.22	-1.04	-0.81
Chiringa	Stn.204	Matamuhuri	High tide	3.67	3.79	4.34	4.79	5.22	5.78
			Low tide	1.86	1.92	2.22	2.46	2.68	2.98

Figure-11 and 12 below shows the monthly maximum, minimum and average water level at Chringa and Saflapur Water level station of the last 44 years starting from 1968 to 2012. From the Figure-11, it is evident that average maximum high tide level at chiringa station is observed in the month of July and minimum tide level is found in the month of March.

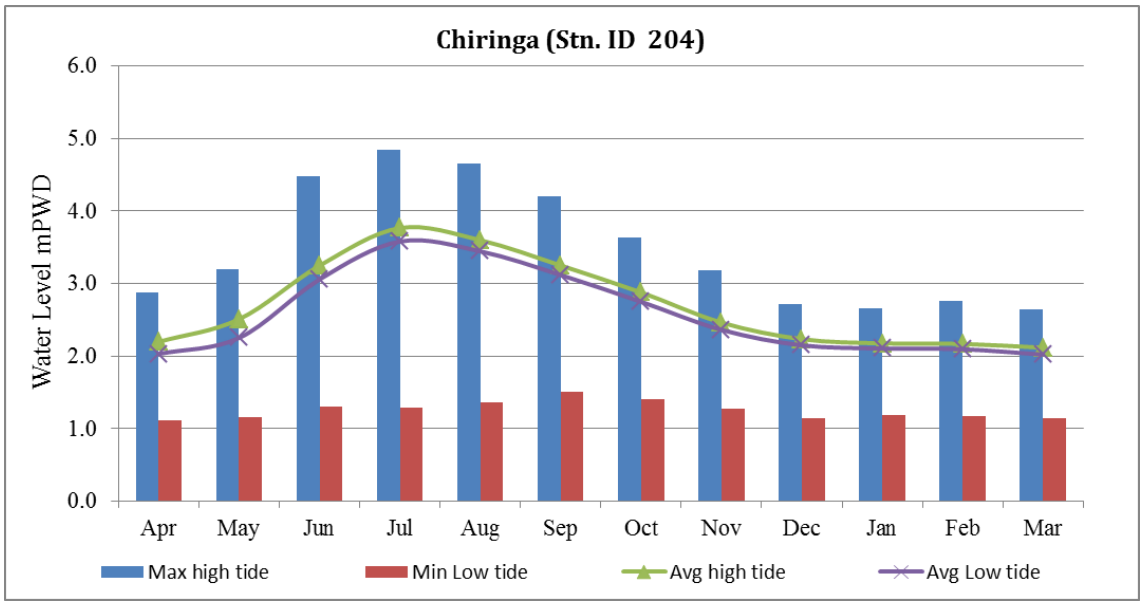


Figure 11: Surface water level at Chiringa, Matamuhuri River

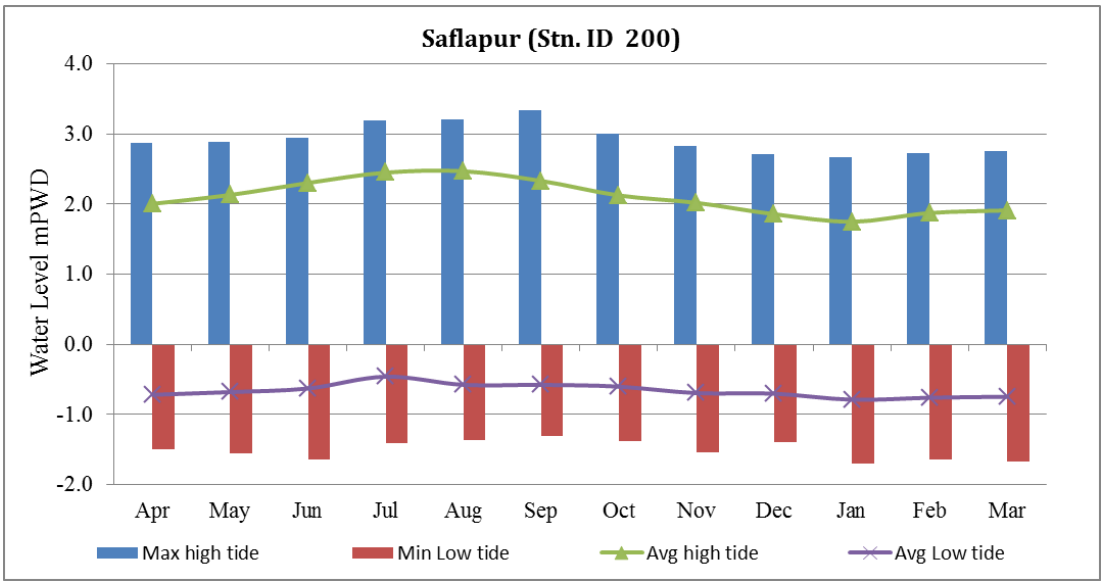


Figure 12: Surface water level at Saflapur, Moheskhali Channel

Tidal Behavior

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

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

Macro Tidal Zone: Isotidal fluctuation > 4m

Meso Tidal Zone: Isotidal fluctuation 2m to 4m

Micro Tidal Zone: Isotidal fluctuation < 2m

The proposed 132 KV power transmission line falls under the Meso Tidal Zone where tidal fluctuation occurs regularly and the eastern region regulates the level of inundation within the project area. The yearly average tidal fluctuation is around 3m to 4m.

The following Figure- 13 shows the daily tidal level at Moheskhali Channel, which is adjacent to the project area. The tide level is routinely observed by Bangladesh Water Development Board.

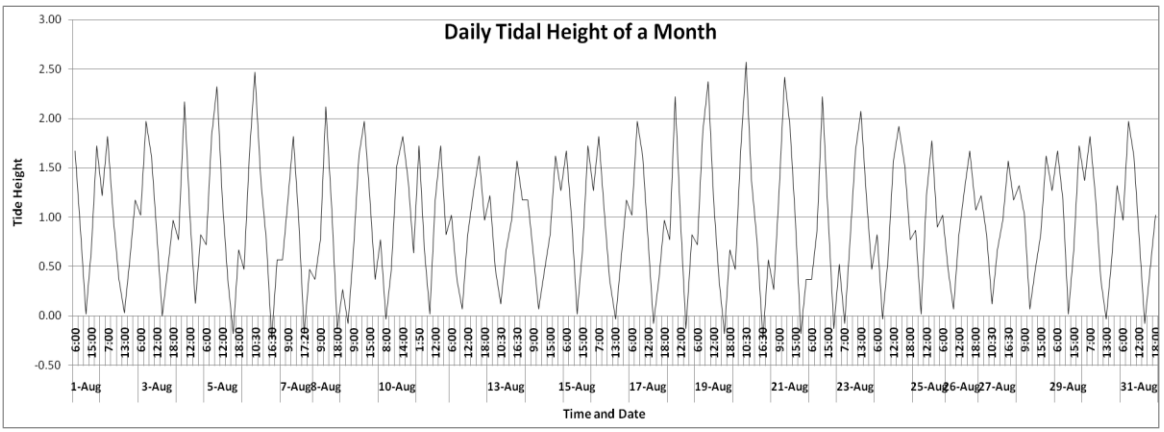


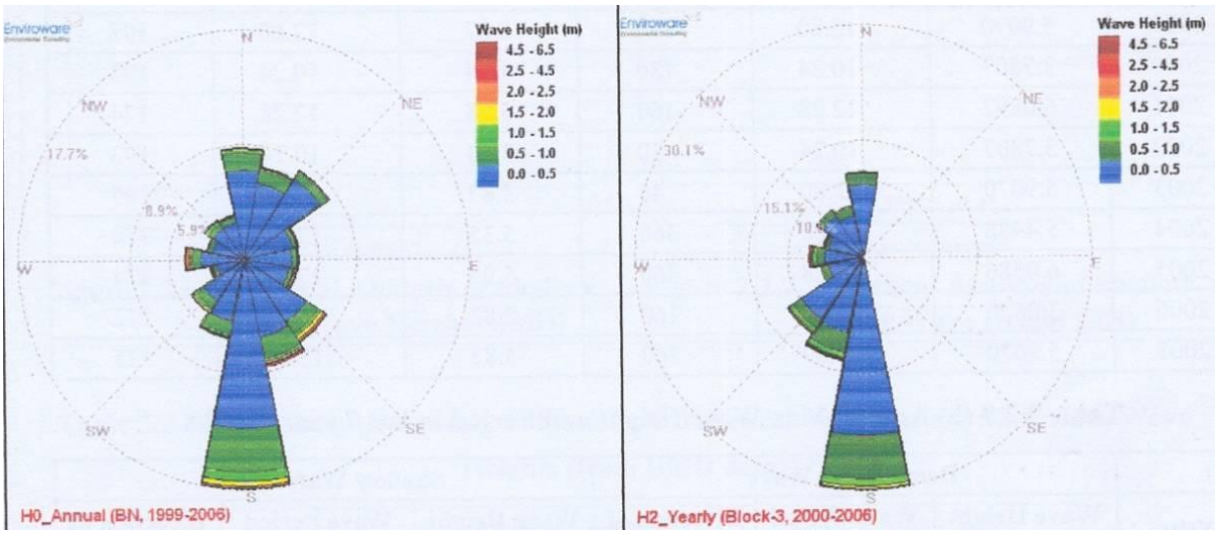
Figure 13: Daily tidal height of August, 2013

There is a significant difference between consecutive wave crests or troughs due to the effect of semi-diurnal process of tides. Tidal height rises at the peak during spring tides and least during the neap tide. The shape of the shoreline and the ocean floor changes propagates tides, so there is no simple or general rule that predicts the time of high water from the Moon's position in the sky. Coastal characteristics such as underwater bathymetry and coastline shape indicate that individual location characteristics affect tide forecasting; actual high water time and height may differ from predictions as the coastal morphology effects on the tidal flow.

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

Wave Conditions

Wave height and wave period is observed by the Bangladesh Navy. Wind data are available from the observatories of Bangladesh Meteorological Department. The followings (Figure 14) are the typical Wave Rose, forecasted for a typical location.



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

Figure 14: Annual wave rose showing deep and shallow water wave height (BN Data)

It is evident from the annual wave roses that both shallow and deep water waves are dominant from the south direction. From April to September, deep water waves mostly come from the southward direction. In October, they start changing their direction and from November to February, waves from the north direction that are dominant.

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

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

Wave height is also very important for the navigation of vessels. It is also important for shaping coastal sea beach. The waves are generally low and show a distinct relation with the wind. Maximum wave heights over 2m were recorded only for few days during small parts of days. The wave periods vary between 3 to 4 seconds of waves of about 0.5m and about six seconds for waves of 2m. Flash floods are expected in the month of May to October and are caused by the normal velocity of flow of ebb tide augmented by flow of additional volume of water that drains into the river from the catchment area. Flash floods are expected when rainfall intensity reaches 200mm in 24 hours. Table-7 represents different features of wave height for the last 20 years and Table-8 shows the annual maximum wave height through statistical distribution.

Table 7 : Annual maximum wave height and period for last 20 years

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

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

Table 8: Statistical distribution of the annual maximum wave height

Return Period	**Deep Water Wave**		**Shallow Water Wave**	
	Wave Height Ho (m)	**Wave Period To (Sec)**	**Wave Height Ho (m)**	**Wave Period To (Sec)**
25 years	7.48	12.4	7.48	12.4
50 years	7.95	13.1	7.98	13.1
100 years	8.38	13.7	8.46	13.7

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

6.2.2 Tropical Cyclones and Storm Surge

Cyclone

Cyclone, a tropical storm or atmospheric turbulence involving circular motion of winds, occurs in Bangladesh as a natural hazard. The tropics can be regarded as the region lying between 30°N latitude and 30°S latitude. All the tropical seas of the earth with the exception of the south Atlantic and southeast Pacific give birth to deadly atmospheric phenomena known as tropical cyclones. On an average, 80 tropical cyclones are formed every year all over the globe. Tropical cyclones are usually destructive and affect Bangladesh and its adjoining areas. Tropical storms are called hurricanes in the American continent, typhoons in the Far East and cyclones in the South Asian subcontinent.

Bangladesh is part of the humid tropics, with the Himalayas on the north and the funnel-shaped coast touching the Bay of Bengal on the south. This peculiar geography of Bangladesh brings not only the life-giving monsoon but also catastrophic cyclones, tornadoes and floods. The Bay of Bengal is an ideal breeding ground for tropical cyclones. Cyclones are usually formed in the deep seas and hence their study has been very difficult. Cyclones in their initial stages move at a rate of 5 to 10 km/hr. In their final stage they may move at a rate of 20 to 30 km/hr or even up to 40 km/hr. Cyclones in the Bay of Bengal usually move northwest in the beginning and then curve eastwards. But this pattern is not uniform as seen from the tracks of various cyclones (**Map 3**). Cyclones accompanied by heavy rains and sea swells are called storm surges. If this occurs during high tide, the storm surge is reinforced considerably and can rise as high as 12m and created tidal flooding. This deadly wall of water does most of the damage to life and property. Throughout most of the south-central and southwest regions, flooding is mainly associated with tidal influences, storm surges and poor drainage.

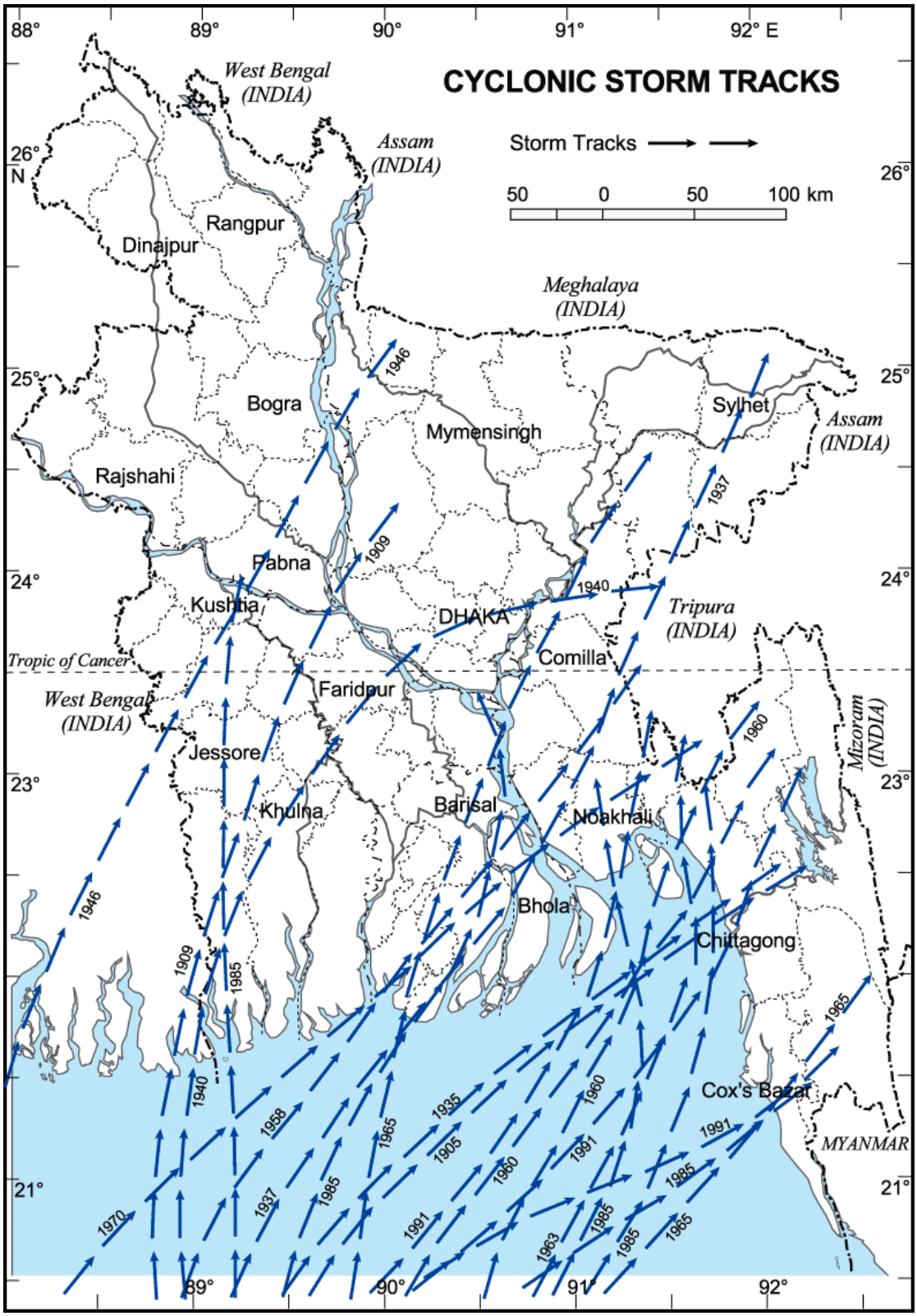
Tropical cyclones from the Bay of Bengal accompanied by storm surges are one of the major hazards in Bangladesh. The high number of casualties is due to the fact that cyclones are always associated with storm surges. Storm surge height in excess of 10 mPWD is common in this region. For example, the 1876 cyclone had a surge height of 13.6 m PWD (WARPO, 2005). The recent highest average surge height was about 4.9 mPWD at 1991. The project is located at tidal flooding, storm surges and frequent cyclone prone area of Bangladesh. So, much analysis on the issue are is required for establishing the project. List of historical cyclone and storm surge in Chittagong division has been given in thetable below. A map of cyclonic storm tracks is shown here (**Map 3**).

Table 9: List of Historical Cyclone and Storm surges in Chittagong Division

21–24 October 1958	A cyclonic storm struck Chittagong coast. Effect: Approx. 100,000 families were rendered homeless.
30–31 October 1960	A severe cyclonic storm hit Chittagong, Noakhali, Bakerganj, Faridpur, Patuakhali and eastern Meghna estuary, with winds speed up to 210 km/h. The storm surge reached a height of 4.5-

	6.1 m. Casualty: about 10,000 people, 27,793 cattle. Losses: 568,161 houses destroyed (including 70% houses in Hatiya). Also, two large ocean-going ships ran aground on the shore, and 5-7 vessels capsized in Karnaphuli River
28–29 May 1963	A severe cyclonic storm devastated Chittagong, Noakhali, Cox's Bazar and coastal islands of Sandwip, Kutubdia, Hatiya and Maheshkhali. The storm surge reached 4.3-5.2 m in Chittagong. Maximum windspeed was up to 203 km/h and at Cox's Bazar 164 km/h. Casualty: 11,520 people, 32,617 cattle. Damages: 376,332 houses, 4,787 boats, and standing crops.
1 October 1966	A cyclone hit Sandwip, Bakerganj, Khulna, Chittagong, Noakhali and Comilla. The maximum strong surge was 4.7-9.1 m. The maximum wind speed was 146 km/h. Total people affected: 1.5 million people. Casualty: 850 people, 65,000 cattle.
24–28 November 1974	A cyclone struck the coastal areas near Cox's Bazar and Chittagong, including the offshore islands. Maximum wind speed reached 161 km/h. The storm surge was up to 2.8-5.2 m. Casualty: 200 people, 1000 cattle. Damages: 2,300 houses destroyed.
9–12 May 1977	Khulna, Noakhali, Patuakhali, Barisal, Chittagong and offshore islands were hit by a cyclone. Maximum wind speed was up to 112.63 km/h.
14–15 October 1983	A strong cyclone hit the coastal islands and chars near Chittagong and Noakhali. Maximum wind speed reached 122 km/h: Casualty: 43 people. 6 fishing boats and a trawler lost, more than 150 fishermen and 100 fishing boats went missing Damages: 20% of the Aman rice crops in the affected regions were destroyed.
5–9 November 1983	A cyclone hit Chittagong, Cox's Bazar coast near Kutubdia, St Martin's Island, Teknaf, Ukhia, Moipong, Sonadia, Barisal, Patuakhali and Noakhali. The maximum wind speed reached 136 km/h. The storm surge was 1.52 m. Casualty: 300 fishermen with 50 boats are missing. Damages: 2,000 houses destroyed.
24–25 May 1985	A severe cyclone hit Chittagong, Cox's Bazar, Noakhali and coastal islands (Sandwip, Hatiya, and Urirchar). Maximum wind speed at Chittagong was 154 km/h, at Sandwip was 140 km/h, at Cox's Bazar was 100 km/h. The storm surge reached a height of 3.0-4.6

	m. Casualty: 11,069 people, 135,033 cattle. Damages: 94,379 houses and 74 km of road, and embankments destroyed
8–9 November 1986	A severe cyclonic storm hit the coastal island and chars near Chittagong, Barisal, Patuakhali and Noakhali. Maximum windspeed was 110 km/h at Chittagong and 90 km/h at Khulna. Casualty: 14 people. Damages: 972 km² of paddy fields were inundated; Schools, mosques, warehouses, hospitals, houses and buildings were destroyed at AmtaliUpazila in Barguna District.
29–30 April 1991	The 1991 Bangladesh cyclone hit Bangladesh late 29 April night. The storm originated in the Indian Ocean and reached the Bay of Bengal coast after 20 days. The diameter of the storm was close to 600 km. The maximum wind speed (observed at Sandwip) reached 225 km/h. At other places, the maximum wind speed was reported as follows: Chittagong 160 km/h, Khepupara (Kalapara) 180 km/h, Kutubdia 180 km/h, Cox's Bazar 185 km/h, and Bhola 178 km/h. (The NOAA-11 satellite estimated the maximum wind speed to be about 240 km/h at 1.38 pm on 29 April). The storm made landfall near the coast north of Chittagong port during the night of the 29th April. The maximum storm surge height reached about 5 to 8 m. Casualty: 150,000 people, 70,000 cattle. Damages: loss of property was estimated at about Taka 60 billion
31 May-2 June 1991	A cyclone hit the coastal islands and chars near Patuakhali, Barisal, Noakhali and Chittagong. Maximum wind speed reached 110 km/h. The storm surge was 1.9 m.
16–19 May 1997	A severe cyclonic storm hit the coastal islands and chars near Chittagong, Cox's Bazar, Noakhali and Bhola Districts. The maximum wind speed was 225 km/hour, and the storm surge reached 3.05 meters. Casualty: 126 people.
25–27 September 1997	A severe cyclonic storm hit coastal islands near Chittagong, Cox's Bazar, Noakhali and Bhola. It had wind speeds of up to 150 km/hour, and a storm surge of 1.83 to 3.05 meters.
16–20 May 1998	A severe cyclonic storm with awind speed of 150 km/hour struck coastal islands near Chittagong, Cox's Bazar, and Noakhali. The storm surge was from 1.83 to 2.44 meters



Map 3: Previous cyclonic storm tracks in and around the project area.

Storm Surge

A storm surge is a coastal flood phenomenon of rising water commonly associated with low pressure weather systems, the severity of which is affected by the shallowness and orientation of the water body relative to storm path. Most casualties during tropical cyclones occur as the result of storm surges. The coastal areas of Bangladesh are the most vulnerable areas which experience and often experience very high cyclonic storm surge. The studied areas are vulnerable to cyclone and surge attack.

The intensity and height of the coastal surge largely depend upon the pressure fall in the sea level. The most severe pressure fall was recorded as 918 mbar, occurred in 1991 and has radius strength of 74 km. The cyclone hits the eastern coast of the Bay of Bengal. The maximum consequent surge was 4.73m (15.18 ft) MSL which was a result of acombination of astronomical tide and the storm surge. It is advisable to consider a similar figure in design in the coal terminal adjacent to the project area. Some safety margin should also be added. However, a more precise calculation should be performed in the process of design of the project. The worst condition occurs due to the combination of the astronomical tide and the storm surge. **Table 10**shows surge height for 16 cyclones that are recorded in the last 25 years.

Table 10: Major storm surge incidents hitting the Bangladesh Coast

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

6.2.3 Salinity

Salinity occurs in water and soil due to enriching or excess soluble salts in its solution. For increasing soil and water sanity, crops and other plants do not take essential nutrients properly. Saline water and Soil contains an excess of soluble salts, especially sodium chloride. In other

words, soil that develops under the influence of the electrolyte of sodium salts, with a nearly neutral reaction. Dominant salts are sodium sulphate and sodium chloride, but seldom sodium nitrate, magnesium sulphate, or magnesium chloride. They are non-sodic soils containing soluble salts in such quantities that they interfere with the growth of most crop plants. The amount of the soluble salts in a soil is expressed in terms of percentage or parts per million, or other convenient units like EC in µmhos/cm, or dS/m. The pH of the saturated saline soil is usually less than 8.3.These soils are geographically associated with arid, semi-arid, sub-humid and humid areas as well. The estimates indicate that Bangladesh has about 2.8 million ha of land affected by salinity and poor quality water.

Due to a number of environmental factors the coastal soils are slight to moderately saline on the surface, and highly saline in sub-surface layers and sub-strata. The process of accumulation of salts in the soil is called salinization. There are a number of factors responsible for the salinization of an area, particularly a coastal area, depending on its situation. The land relief and degree of flooding have mainly affected the formation of coastal saline soils of Bangladesh. The other factors are: i) the nature of the soil, ii) precipitation, iii) tidal action, iv) the effect of the river system and their discharges, v) depth of the ground water and salt deposits, and vi) the slope of the ground and the proximity to drainage channels, v) salt cultivation by the farmers

The study area is located only 8.0 km eastern side from the Bay of Bengal. During high tide, sea water enters the study area through Moheskhali Channel and inundates the adjacent lowlands. Therefore, the soil of the study area is moderate salinity and salinity concentration is about 4~8 ds/m. So, extra cares against the issue are required to construct the infrastructures in the project.

6.2.4 Drainage Congestion and Water Logging

Drainage congestion and water logging are not prominent in the study area. The project has the option to establish the appropriate drainage facility to protect water logging in the area. During high tide, water frequently flows enter the project area through Kohelia River and Bara Matamuhuri khal and other connecting khals meanwhile it inundates the lowland. Accordingly, during ebb tide, water drain out properly so drainage congestion is not found the study area.

6.2.1 Erosion in the context of water, soil and Sedimentation

Watershedconservation is the detachment and movement of soil particles by natural forces, primarily water and the wind. More broadly, erosion is the process of wearing away rocks, geologic, and soil material via water, the wind, or ice (e.g., glaciers). Erosion will transport materials after mechanical weathering has broken rock and geologic materials down into smaller, moveable pieces.

Sedimentation is the process in which particulate matter carried from its point of origin by either natural or human-enhanced processes is deposited elsewhere on land surfaces or in waterbodies. Sediment is a natural product of stream erosion; however, the sediment load may be increased by human practices.

However, slight land erosion is occurred owing to riverine flooding from Kohilia river during monsoon and create somewhat sedimentation in lowland of the study area.

Average distance from electric tower to river bank line is 50 m. EIA team thought that it is enough distance to sustain it because any vulnerable area like river bank erosion is about to zero in the river crossing point. By analyzing time series available Google satellite images (2006-2014) and results from the public consultation on the issue, it is revealed that the erosion prone trend of the rivers, Kohalia and Matamuhuri, is very less rather the width of the rivers are being reduced somewhat day by day. Some places in the rivers are going silted up. The google earth maps showing electric tower points besides river bank and necessary GPs points related to river crossing toweris attached in Appendix-9.

6.2.2 Navigation

Rivers are an important mode of transportation in Bangladesh. Situated in the lower end of the three great rivers, the Brahmaputra, the Ganges and the Meghna, Bangladesh is one massive alluvial floodplaincriss-crossed by a network of several rivers, their numerous tributaries and canals. Inland water transport (IWT) is a very important mode of maintaining transport link between the various remote parts of the country and at the same time a means for transporting export-import cargo as well. Transport sector incorporates about 8.27% of GDP and from water sector specifically contributes about 0.64% of total GDP. However, gradually the flow of waterways has become alarmingly erratic causing huge siltation in the rivers. As a result inland navigation is becoming hazardous and waterways shrinking rapidly. The change in waterways is very much evident and visible. NEDECO (1963) study shows 12,000 km of navigable waterways in the 1960s. Another study in 1989 shows about 6000 km of waterways are navigable, of these vessels could negotiate only 3800 km during low water period. Presently waterways have reduced to about 4500 km which not more than 2500 km can be used for navigation in the lean period. The requirement for maintenance dredging is growing very high beyond the national capacity in hand.

Navigability of rivers in Bangladesh has been deteriorating over a long period. Both natural and morphological processes and the withdrawal of water from the river beyond the border and within Bangladesh for irrigation and other purposes have resulted in a decreased dry season navigability of the rivers, channel depths turned out to gradually decline.

Major rivers include Matamuhuri river, Bakkhali river, channels adjacent to the project area which would be utilized for transportation of construction materials of the infrastructure of the in project. This river is not enough depth of navigability for river transportation especially cargo, steamer etc. The water of the rivers is used mainly for the transportation of Agricultural goods by non-engine and engine driven country boats only. Increased sedimentation in the rivers bed of the rivers leading to somewhat drainage congestion and water-logging in some portion in winter. But the navigation of the rivers is now still active. River transport route of the rivers is under one category listed by BIWTA which means the river is major transport corridors where LAD of 3.6m is required to be maintained round the year.

6.2.3 Groundwater System

Groundwater level data are collected and analyzed for two different BWDB observation wells located at Matarbari and Badarkhali Mauza. The monthly variation of mean ground water level at rata (from 1966 to 2013) and Harbang (from 1968 to 2013), are shown in Figure **(Figure 15)**.

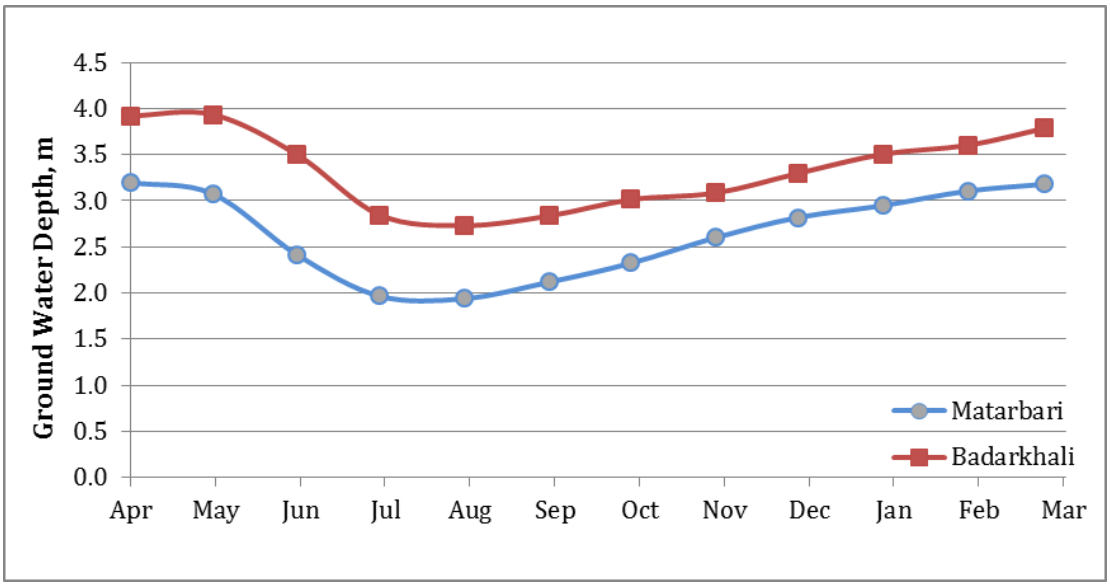
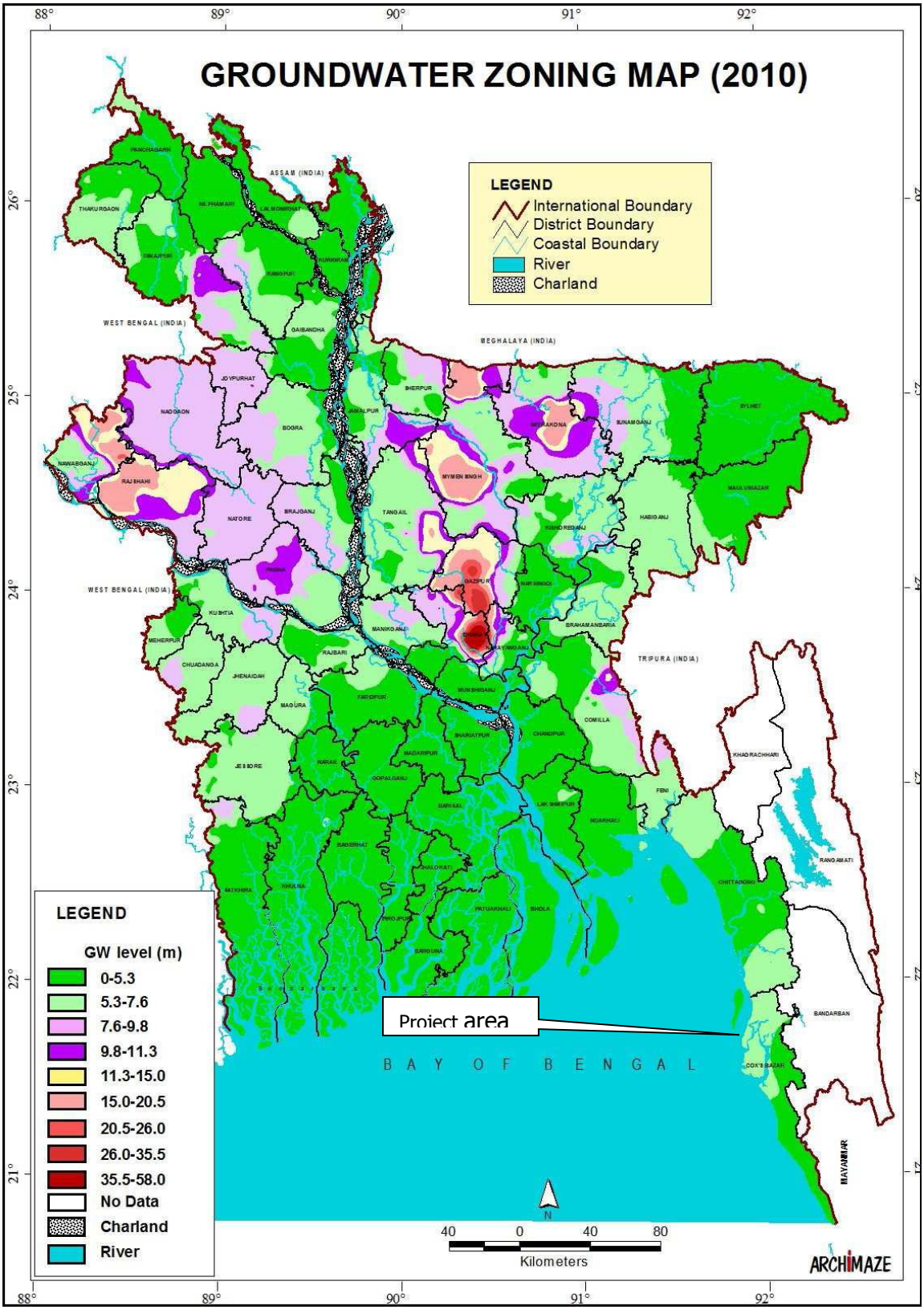


Figure 15: Ground Water Depth of the study area

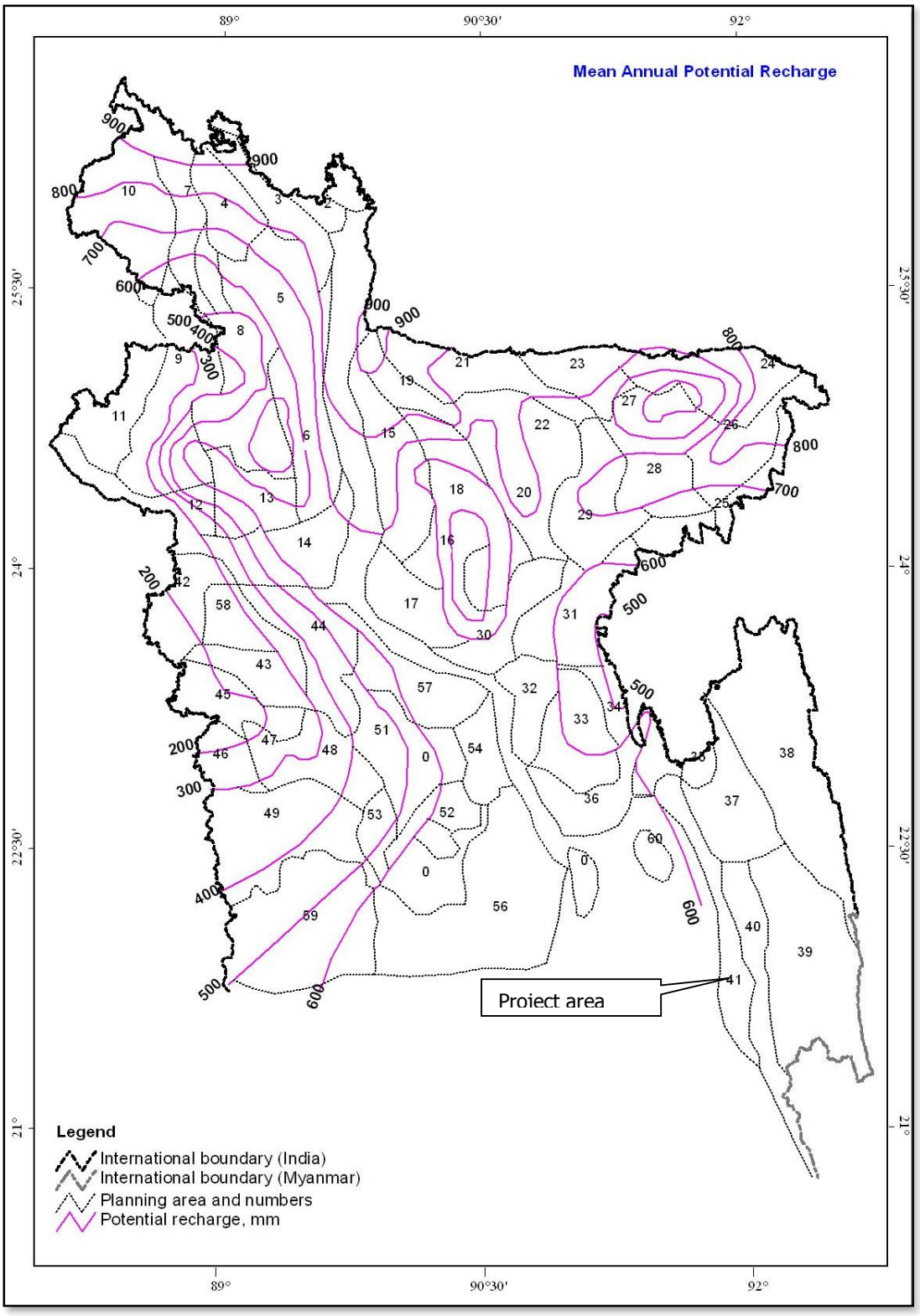
The Ground Water Table (GWT) measured at the aforementioned locations at ten-year intervals are shown in Table 13. Values are analyzed for the months of April (Considered as a dry period) and September (considered as a wet period). In the dry season, increased the dependency of the local people on the ground water, lowers the GWT and needs to go lower depth from existing ground level comparing with the wet season. During monsoon, the higher availability of surface water leads to higher recharge of ground water sources and groundwater table is found at relatively lower depth than that in the dry period situation. **Table 11** shows that the GWT with respect to the G.L (Ground Level) in the dry period and wet period differ significantly over the years. Ground water zoning map and Mean annual potential recharge of the study area is shown in **Map 4 and Map 5**.

Table 11: Ground Water Tables (GWT) shown at ten-year intervals

Location	Depth (m)							
	1970		1980		1990		2000	
	Apr	Sep	Apr	Sep	Apr	Sep	Apr	Sep
Badarkhali	5.16	1.97	3.84	2.79	2.87	2.58	3.87	3.65
Matarbari	3.43	2.5	2.17	1.76	2.54	1.95	3.01	1.83



Map 4: Ground Water Zoning Map



Source: DPHE (Department of Public Health and Engineering)

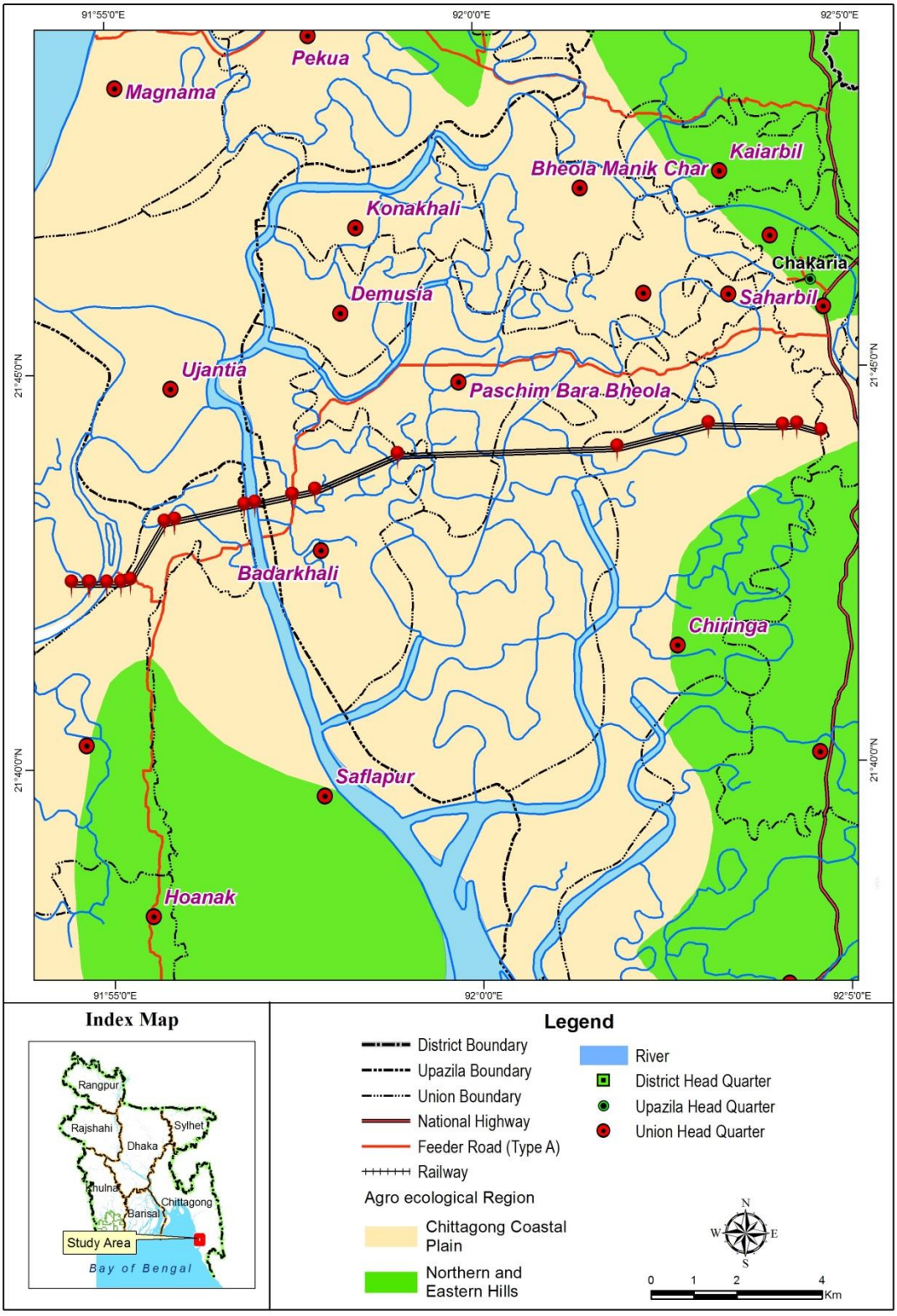
Map 5: Mean annual potential recharge of ground water

6.3 Land Resource

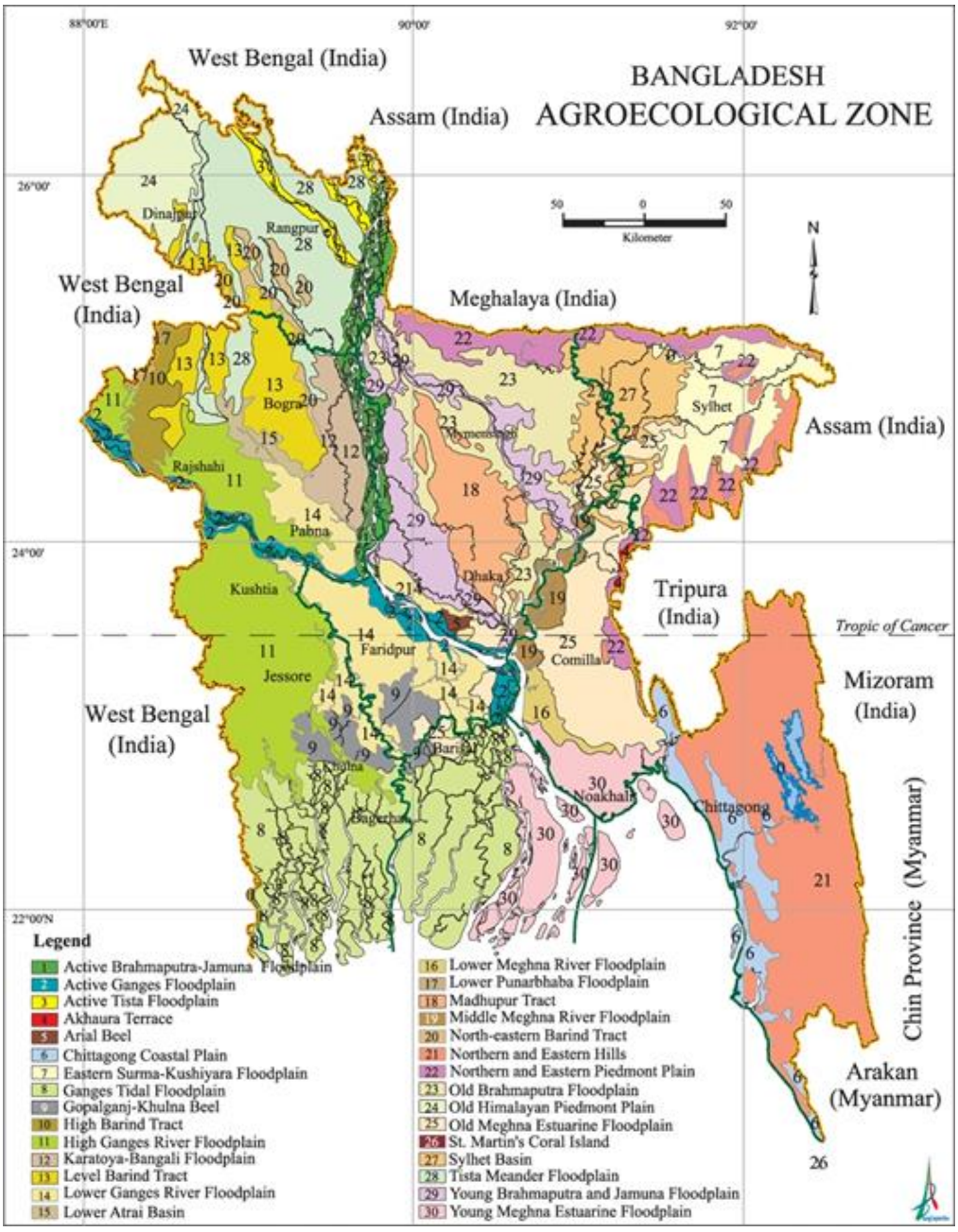
6.3.1 Agroecological Region

Bangladesh has a wide range of environmental conditions. Environmental diversity occurs not only at national and regional levels, but it also occurs at the Upazila and village levels. Besides considerable year to year variability in moisture, the temperature and flood regimes create major problems for planning program on environment and agricultural research, extension and development activities. Thirty agro-ecological regions and 88 sub-regions have been identified by adding successive layers of information on the physical environment which are relevant for land use and assessing agricultural potential. These layers are (i) Physiographic (land forms and parent materials), (ii) Soils and their characteristics, (iii) Depth and duration of seasonal flooding, (iv) Length of the rained Kharif and rabi growing periods, (v) Length of the pre-Kharif period of unreliable rainfall, (vi) Length of the cool winter period and frequency of occurrence of extremely low (below 0.40C) winter temperature and (vii) Frequency of occurrence of extremely high (> 400C) summer temperature(BARC, 2005).

Agro-ecological regions and sub-regions are very broad units. Fertility status of these regions varies considerably. Individual farmers have fragmented the land into small pieces causing wide variation in the management of each and every piece of land. This leads to the large variation in the fertility levels even between adjacent plots. For detailed information about physical and chemical properties of soils, respective Upazila Nirdeshika may be consulted. However, for fertility data of a specific area soil samples should be collected for detailed analysis. The project area is covered with only one Agro-ecological region of Chittagong Coastal Plains (AEZ-6). The locations of agro-ecological zones are shown in **Map-6** and total agro ecological zones are shown in **Map-7**. The brief description of the agro-ecological regions is as follow:



Map 6: Agro-ecological zones of the study

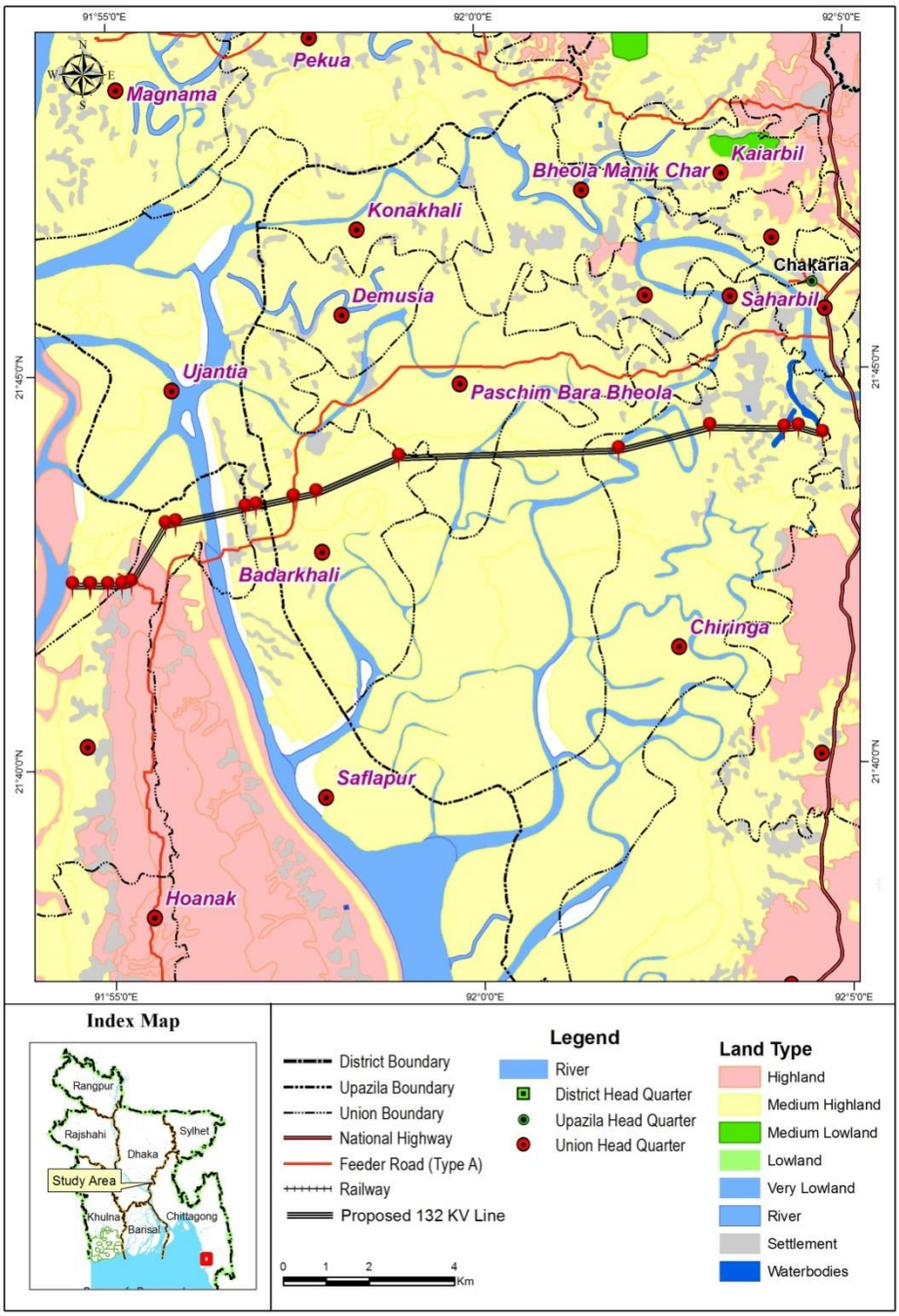


Map 7: All zones of agro-ecological Map

6.3.2 Land types

In order to understand the flooding and flood management, it is better to have a look at the land types. Seasonal flooding regime has been characterized by means of inundation land types. Usually, it is classified into 5 categories namely Highland(less than 90cm deep), medium highland (above 90 cm deep), Medium lowland (90-180cm), low land(180-300) and very low land (above 300cm).From the land types it is evident that except highlands all other land types are subjected to flood inundation to different degrees. Normally, 20-25% of the country is inundated during every monsoon from June to September.

The land type of the proposed project is high land and medium high land. Of course population density is medium high land. The land type classification is based on the depth of inundation during the monsoon season. About 95% of the cultivable areas belong to the medium high land and 5% being medium low land.



Map 8: Land type of the study area

6.3.3 Soil texture

Soil texture is a qualitative classification tool used in both the field and laboratory to determine classes for agricultural soils based on their physical texture. The classes are distinguished in the field by the "textural feel" which can be further clarified by separating the relative proportions of sand(2.0-0.05mm), silt(0.05-0.002mm) and clay (<0.002mm) using grading sieves: The Particle-size distribution (PSD). The class is then used to determine crop suitability and to approximate the soils responses to environmental and management conditions such as drought or calcium (lime) requirements. The soil of the proposed project area is seemed by the Agricultural Expert of EIA Team to be sandy or silty clay loam to clay loam. Here, twelve textural classes are shown in soil texture pyramid (Figure-20)

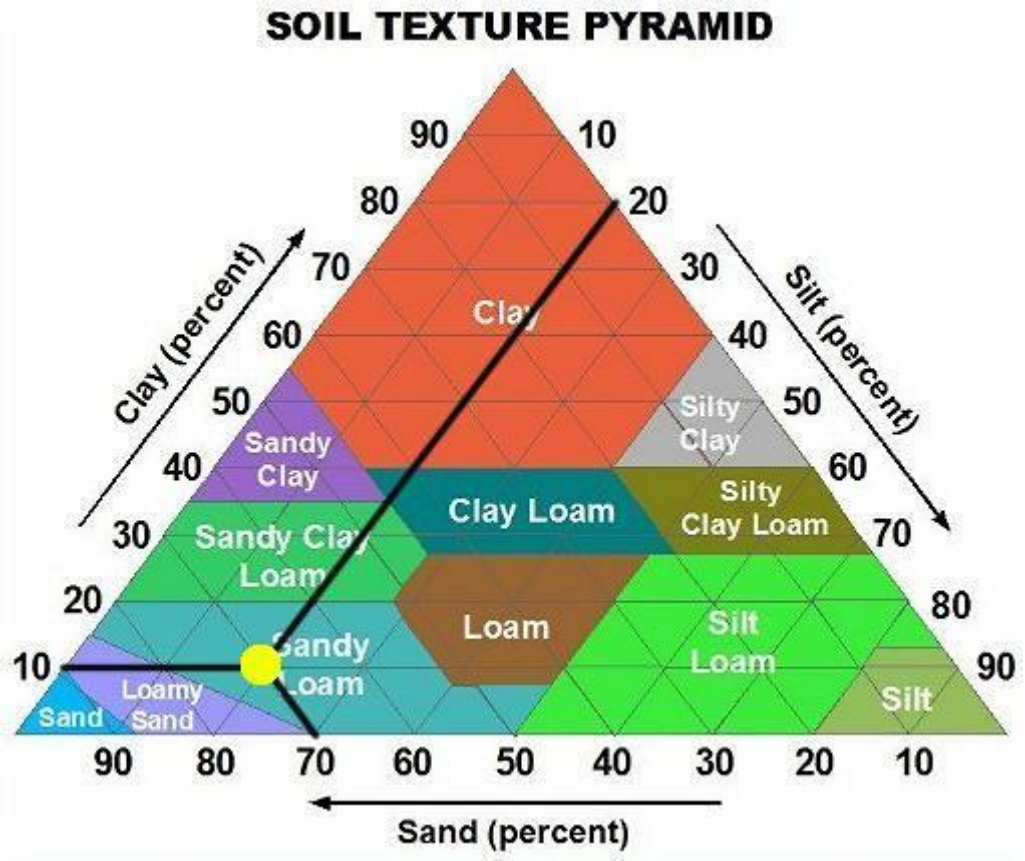


Figure 16: Soil texture pyramid

Some physic-chemical properties of soils are also presented in Table 12. It was observed from the table that, the pH ranges within the limit i.e pH level is neutral (6.6-7.3) in medium highland soils in the study area. Salinity level was 7.39(ds/m) in the medium highland soil. Organic Matter (OM) content was 2.7%. It indicates that, OM status was medium (1.8-3.4%) level. The content of Ca was 4.6(meq/100gsoil), it indicates that Ca ranges within optimum 3.1-6.0(meq/100gsoil) level as well as above 2.0(meq/100gsoil) from the critical limit. The Mg level was 7.3(meq/100gsoil), which indicates that it was high to very high 1.51-> 1.875 (meq/100gsoil) levels and above the critical limit 0.50(meq/100gsoil). In case of K, it was 0.5 (meq/100g soil). K

was high level 0.361-0.45 (meq/100gsoil) and above the critical limit where thecritical value is 0.12(meq/100gsoil).

Table 12: Soil quality of the study area

Soil Quality														
Major land type	pH	OM (%)	Salinity EC (ds/m)	meq//100g of soil			µg/g soil							
				Ca	Mg	K	$(NH4)_2NO_3$	P	S	B	Cu	Fe	Mn	Zn
Medium highland	4.8	2.7	7.3	4.6	7.3	0.5	27.5	5.8	72.8	0.91	10.9	158.5	24.2	3.0
Optimum	5.5-7.0	*	*	4.5-6.0	1.2-1.5	0.2-0.3	*	15.8-21.0	22.6-30.0	0.5-0.6	*	9.1-12.0	2.2-3.0	1.4-1.8

Source: Land Resource Appraisal, Chittagong, 1996; Not specified*

The concentration of P has been found 5.8 (µg/g soil), it was in low-level 5.3-10.5(meq/100gsoil) and below the critical level 7.00 (meq/100gsoil). S level was 72.8(µg/g soil) which was above very high > 37.5(µg/g soil) level and above the critical limit 10(µg/g soil) level also. Boron (B) level was 0.91(µg/g soil). It indicates that, B level is very high >0.75 (µg/g soil) level and higher than critical limit 0.20 (µg/g soil). Cu level is 10.9 (µg/g soil). Fe level is 158.5 (µg/g soil) and it was very high level. Mn level was observed 24.2 (µg/g soil) and it was very high level >3.75 (µg/g soil). In case of Zn, it was 3.0 (µg/g soil) and very high level as well as higher than critical limit 0.60 (µg/g soil). It is summarizedfrom the above information that the soil quality of the study area is good for crop cultivation.

6.3.4 Land use

Land use human activities that are directly related to land, making use of its resources or having an impact upon it. Land cover is the physical attributes of the land, while land use is a pattern of human activities undertaken within a socio-economic context. The natural land cover is changed by use of man in meeting cultivation, homestead or other demands. Land use pattern in Bangladesh is determined by physiography, climate and land levels in relation to flooding. In this context land includes all land and water within the national boundaries of the country. Water bodies within land areas are therefore considered to be a part of the land. The use of land is of paramount importance in a country which is thickly populated and still very reliant on primary production.

The gross study area is about 861 ha of which net cultivable area (NCA) is about 804 ha which about 93.38% of the gross area. About 45decimal lands will be required for construction of sub-station. Detailed land use is presented in **Table 13.**

Table 13: Detailed Land type of the study area

Type	Area(Ha)	% of NCA
Gross Area	149.8	100
NCA	139.9	93.4
Settlement	8.2	5.48
Water Bodies	0.5	0.35
Rivers	1.2	0.8
Total		**100.0**

6.3.5 Physico-chemical properties of soils

This region occupies the plain land in greater Chittagong District. It is a compound unit of Piedmont, river, tidal and estuarine floodplain landscapes. The major problem in these soils is high salinity during the dry season (October to May). Grey silt loams and silty clay loam soils are predominant. Acid SulphateSoilswhich are potentially extremely acidic occur in mangrove tidal floodplains. Non calcareous Grey Floodplain soils, Non calcareous Alluvium and Acid Sulphate soils are the major components of the General Soil Types of the area. General fertility level of the soils is medium, and N and K are limiting. Status of S is high. Some physicochemical properties of the soil of the Chittagong Coastal Plains are presented in **Table 14.**

Table 14: Some physicochemical properties of soil of the Chittagong Coastal Plains

Major Land Type	Soil p^H	Soil OM	Nutrient Status								
			N	P	K	S	Ca	Mg	Zn	B	Mo
High Land	4.3-6.0	L-M	L	VL-L	L-M	M-Opt	L-M	L-M	L-M	L-M	L
Medium High Land	4.4-6.2	L-M	L	VL-L	L-M	M-Opt	L-M	L-M	L-M	L-M	L

(OM- Organic matter, L-low, VL- Very low, M-Medium, Opt. – Optimum)

Source: Fertilizer Recommendation Guide' 2005; BARC;

6.4 Agricultural Resource

6.4.1 Farming Practices:

Farming practices, a set of organized conditions for production of crops, livestock, fish, agroforestry, etc. in our country can differ from place to place. Farming practices belongs to Farming system that includes the procedure of using the land, labour, inputs, and capital to manage farm, household, non-farm and off-farm production and consumption to meet its objectives and priorities under a certain physical, biological and socio-economic conditions. A farming system is not simply a collection of crops and animals to which one can apply his input and expect immediate results. Rather, it is a complicated interwoven mesh of soils, plants, animals, implements, workers, other inputs, and the environment.

In mixed farming, cropping, livestock, poultry, fisheries, and possibly other enterprises are present within the farming system. In Bangladesh, different production systems are practiced. Most of the large farms may have more than one enterprise that may be complementary or supplementary depending upon the situation. For example, some production systems are Crop-Cattle-Goat-Poultry-Fish, Crop-Cattle-Buffalo-Poultry, Cattle-Goat-Poultry, Crop-Fish, etc.

Various types of farming practices occurred in the proposed project area are prominent as namely dairy, crop, fish farming etc. which is run by individually or combined or mixed. Mixed farming is a common practice in the study area.

Agricultural crops grow by cropping seasons. There are two distinct cropping seasons in a year. They are the Kharif and the Rabi seasons. The Kharif season starts from March and ends in October while the Rabi season starts from November and ends in February. Based on crop adaptability and crop culture, the Kharif season has been further sub-divided into Kharif-I (March-June) and Kharif-II (July-October) season.

The Kharif-I characterizes by high temperature, low humidity, high evaporation, high solar radiation and uncertainty of rainfall of low alternating dry and wet spells. In this season, mainly Aus Rice and Vegetables are grown. The Kharif-II season characterizes by high rainfalls, lower temperatures, high humidity, low solar radiation and high floods that recede towards the end of the season. Rice is the predominant crop grown during this season due to the submergence of soil. Excessive soil moisture also restricts other crops suitable for a high-temperature regime. High Yielding Varieties of transplanted Aman (HYV Aman) rice grows in Kharif-II season in the study area. The Rabi/Boro season favoures with high solar radiation, low humidity and temperature, but thelack of adequate soil moisture depresses the crop yield because of very low or even no rainfall throughout the season. Wide ranges of crops can grow in this season. Major crops grown in this season of the study area are HYV Boro, Potato, Chilli, Cowpea, and Vegetables. Farmers of the respective area culture salt in thedry season by entering saline water through Maheshkhali Channel. However, there are occasional overlaps such that the Kharif-I season crops (Aus rice) harvest in Kharif-II season, the Kharif-II season crops (Aman rice) harvest in Rabi season and Rabi season crops (Boro, cowpea, Vegetables and Chili) harvest in Kharif-I season.

6.4.2 Cropping Pattern and Intensity

Cropping pattern is a spatial and temporal arrangement of crops within a cropping year, largely determined by physical, biological, and socio-economic factors. There are three cropping seasons (Rabi, Kharif-I or Pre-Kharif, and Kharif-II) during a year in Bangladesh. Since rice is the major crop, it dominates the cropping patterns in Bangladesh. Depending on the land type, soil characteristics, and water availability, rice cropping may be single, double, or triple.

In the study area, the most dominant cropping patterns are Fallow-HYV Aman-HYV Boro and HYV Aus-HYV Aman- HYV Boro which cover about 25% of each the NCA in the medium highland. Summer vegetables-Fallow–Winter vegetables occupied about 15% of the NCA in the highland.

In the Kharif-I season; HYV Aus and summer vegetables are grown in about 31% and 19% of the NCA respectively. The rest 50% of the NCA remains fallowduring this season.

In the Kharif-II season; HYV Aman crops growin about 69% of the NCA. The rest 31% of the NCA remains fallow in this season.

In the Rabi/Boro season; HYV Boro, winter vegetables, Chilli and Potatoes are grown in about 42%, 19%, 10% and 9% of the NCA respectively. The rest 20% of the NCA remains fallow in this season.

The cropping intensity of the study area is about 218 %. The single, double and triple cropped area is about 20%, 61% and 19% of the NCA. Detailed cropping patterns along with the land type of the study area are presented in Table 15.

Table 15: Major cropping pattern by land type in the project and study area

Study location	Land Type	Cropping patterns			Sub-station		Study area	
		Kharif-I (March-June)	Kharif-II (July-October)	Rabi (Nov.-Feb.)	Area (ha)	%	Area (ha)	% of NCA
Sub-Station		Fallow	Fallow/bettle leaf/rice	Fallow/bettle leaf	1	100	-	-
Study area	F_1	Summer vegetables	HYV Aman	Winter vegetables/bettle leaf/ shrimp cultivation	-	-	26.20	19
		Fallow	HYV Aman	HYV Boro	-	-	27.58	20
		HYV Aus	Fallow	HYV Boro			30.34	22
		Fallow	HYV Aman	Fallow/ HYV Boro	-	-	27.58	20
		Fallow	HYV Aman	Chilli			13.79	10
		HYV Aus	Fallow	Potato	-	-	12.41	9
		Total			**2**	**100**	137.90	**100**

6.4.3 Cropped area

Total cropped area covered by the both sides of the transmission line in the project is about 140 ha. The project will not have a considerable positive impact on agricultural development yet the farmers will be benefited indirectly through increasing irrigation facilities influenced by the electric power come from the project.

6.4.4 Agricultural input use

Soil fertility is an important factor for crop production. Local people reported that in general the study area is quite low in soil fertility. The organic matter content of the top soils is low to medium. The low organic content in soils indicates the poor physical condition of the soils of the study area. Thus in addition to salinity, plant nutrients in soils affect plant growth. Seed, labor, fertilizer, pesticide and irrigation are the major inputs for crop production.

Seeds

The role of seeds is very important for growing crops. Good seeds have some criteria, i.e. they should be free from disease infestation, have germination ability of more than 85%, have the capacity for producing higher yields, are improved crop cultivars etc. A selection of seeds has to be made carefully. The seed rate for different crops varies from crop to crop depending on size and management practices. According to agro-ecological zone (AEZ-6) the recommended seed rate (BARI 2011-2012 and BRRI 2011) and farmers using seed rate is presented in Table 18.Among the rice crops farmers using for HYV Aus: BR14, BR26 and BRRI dhan42, HYV Aman: BR9, BR10, BR11, BR22 and BR23, HYV Boro: BR16, BR17, BR26, BRRI rice 28 and BRRI dhan29.Among the non-rice crops, local improved and HYV/modern varieties (Brinjal: BARI begun-4 and BARI begun-5, Teasel Gourd: BARI Kakrol-2, Bitter gourd: BARI Bitter gourd-1, Oakra/Ladies finger: BARI Dherosh-1 and local improved variety, Cucumber: Local improved variety of cucumber and hybrid variety, Potato: Local improved variety: Dohazari, Chilli: Local improved variety and Cowpea: BARI Cowpea-1 are very much popular among the farmers.

Table 16: Seed and Labor used in the study area

Crop Name	Recommended rate(kg/ha)	Farmer Using Seed (Kg/ha)	Nos. of Labor/ha
Rice			
HYV Aman	40	60	150
HYV Boro	40	50	180
HYV Aus	40	60	150
Non-rice			
Winter Vegetables			
Potato	1,500	1,200	180
Yard long bean	30	40	120
Brinjal	0.20*	0.25	140
Cucumber	0.4*	0.25	120
Summer Vegetables			
Teasel Gourd	100(bulb)	120(bulb)	140
Bitter gourd	2*	1.5	140
Ladies finger	7*	5	120
Spice			
Chili	0.23*	1.0	180
Pulse			
Cowpea	50	80	90

*Sources: Farmers interviewed 2014, BARI, 2011-12, BRRI, 2011 and BARC, 2012 *variable depending on size*

Labor

In the study area, almost 80% of the cultural practices for crop production are being done manually. So, agricultural labor is considered as one of the essential inputs for crop production.

The labor requirement is not uniform throughout the year. The number of labor requirement varies from crop to crop. In the peak periods (November-January, April – May and July-August), the requirement of labor is much more. The main activities during peak periods are transplanting of HYV Boro and HYV Aus, harvesting of HYV Boro and HYV Aus and transplanting of HYV Aman and harvesting of HYV Aman. The number of labor requirement varies from crop to crop, season to season. The average number of labor used per hectare in the study area is presented in Table 18.

Fertilizer and pesticides application

The rate of fertilizer use per hectare varies considerably from farmer to farmer depending on soil fertility, cropping pattern and financial ability. The major fertilizers used in this area are Urea, TSP, MP and Gypsum. The use of pesticides depends on the degree of pest infestation. Most of the cases farmers used fertilizers in an unbalanced way. Farmers used less chemical fertilizer than the recommended doses in all crops. The major insects as reported by the farmers in both rice and non-rice crop fields are Stem borer, Ear cutting catter pillar, green leaf hopper, Leafroller Rice bug, Fruit weevil and Brinjal fruit and shoot borer, Different diseases such as Bacterial leaf blight, Blast and Mosaic of Potato etc. Both liquid and granular pesticides are being used to prevent pest infestation. Local farmer reported that they were using different types of pesticides such as Diazinon 60EC, Diatop50SP, Darsban20EC, Basudin, Furadan 3G, Fighter, Rovral, Ridomil Gold, Virtako 40WG, Tilt 250EC, Trasher 45EC, Karate 2.5 EC and Ripcord etc. to prevent pest infestation both in rice and vegetables cultivation. Fertilizer recommendation rate as developed by BARC, 2012 on the basis of the agro-ecological zone (AEZ 23 and AEZ 29) and farmers used in the study area is presented in Table 17.

Table 17: **Recommended dose of fertilizer and farmers using fertilizer and pesticides**

Crop Name	Recommended dose of fertilizer(kg)ha)						Farmers using fertilizer (Kg/ha)				Farmers using pesticides		
	Urea	TSP	MP	Gypsum	ZnSo4	Cow dung	Urea	TSP	MP	Other (Gyp)	No of Appli.	Liq. (ml/ha)	Gran. (Kg/ha)
Rice													
HYV Aus	196	22	58	22	5	0	190	100	50	10	1-2	700	0
HYV Aman	163	22	42	17	3	0	190	100	50	10	2-3	700	0
HYV Boro	326	44	108	33	4	0	200	110	75	15	2-3	800	8
Non-rice													
Potato	293	67	150	22	5	5000	150	40	20	0	1-2	1,000	0
Teasel gourd	163	67	50	28	0	5000	80	50	20	0	1-2	500	0
Yard long bean	98	47	35	17	3	5000	100	80	40	0	1-2	500	0
Brinjal	261	80	50	42	3	5000	100	50	40	0	1-2	500	0
Bitter gourd	163	67	50	28	0	5000	80	50	20	0	1-2	500	0
Cucumber	130	53	53	33	3	5000	100	60	40	0	1-2	500	0

Ladies finger	196	67	67	28	3	5000	120	80	40	0	1-2	400	0
Chili	174	127	53	14	3	0	150	40	20	0	2-3	500	0
Cowpea	33	33	20	38	3	0	80	0	0	0	0	0	0

Sources: Farmers interviewed; 2015, Fertilizer Recommendation Guide, BARC, 2012

6.4.5 Crop Production

Overall agricultural production in Bangladesh has steadily improved during the last three decades, principally, due to moderate increase in rice, wheat, tobacco, fibers, vegetables and potatoes. The crop is the dominant sector that contributes 77 percent to the total value addition of agriculture and 27 percent to gross domestic product (GDP) of Bangladesh (Hashem et.al, 1996).

Main crops are Paddy, potato, mustard, pepper, maize, sugarcane, wheat, groundnut, betel, tobacco, watermelon, vegetables in the study area. *Crop production especially for* Paddy, wheat and potato in the study area is not a full satisfactory trend. Here the yields of major crops in the study area are stated in below table-28.

Table 18 : Produced crops with Yield

SL. No.	Name of the crops	Yield(Ton/ha)
1	Rice	1.5-2.0
2	Wheat	2
3	Potato	11
4	Pulse	0.9

6.4.6 Crop Damage

Crop production, including paddy, mustard, pepper, maize, sugarcane, wheat, groundnut, betel, watermelon, vegetables are damaged by different climatic threats like food, drought, heavy rainfall, untimely rainfall, tornado, cyclone, river bank erosion etc. Within the threats, flood and cyclone are main objects that can damage the crops seriously. Every year, almost one-third of Bangladesh is flooded. However, because of topographical characteristics, the regions of the country experience varied the degree of flooding; some parts may be under deep flood water, others unaffected. Flooding is beneficial only within certain limits of timing, duration and magnitude.

In the project area, mostly flood and cyclone with tidal surge are main responsible to damage the crops. So, the project should have scope to do required management in the project area.

6.4.7 Main Constraints of Crop Production

Agriculture is the single most important sector of the economy in Bangladesh. It is the major source of livelihood in the rural areas, where some 80 percent of the population live. Approximately two-thirds of the labor force employee in agriculture. Although its share in the GDP is predictably declining, agriculture (crops, livestock, fisheries and forestry) contributes approximately one-third of the GDP and agricultural production accounts for 32 percent of the value of exports. The performance of this sector affects the overall economic growth. With irrigation covering only around 42 percent of the potentially irrigated area, agriculture is still weather dependent and has grown slower than was earlier expected, particularly because of the predominantly small farmer holdings in Bangladesh.

The crop production situation in Bangladesh is becoming worse due to a range of soil, water and climate related constraints. Global warming and climate change phenomena exacerbate this situation. Declining soil fertility, accelerated soil erosion and soil salinity are the major soil-related constraints to crop production. About 0.87 million hectares (Mha) of land is affected by different degrees of salinity and about 1.74 Mha is prone to soil erosion. The rise of 3°C atmospheric temperature would cause an 11% decrease in soil organic matter (SOM) content. Judicious use of chemical fertilizer and increasing use of organic manure with legume-based cropping pattern can restore soil fertility. Shortage of water in the dry season and abundance of water in the rainy season are the main water-related constraints. Winter (boro) season rice cultivation using a huge amount of groundwater creates arsenic contamination in soil and water. Less water consumptive crops should select in the rabi season. Climatic changes result in natural hazards like floods, drought and cyclones. Short duration and increasing temperature are the recent trends of the winter season in Bangladesh. Therefore, appropriate crop variety (heat and salt tolerant), improved crop management, fertilizer use, water management and agronomic practices are needed to alleviate these constraints.

However, main constraints of crop production in the study area are non-introducing the new high yielding varieties, lack of enough supply of irrigation water (in winter), fertilizers, pesticides, quality seed and unavailability of credits. Other climatic constraints are Flood, Cyclone and somewhat riverbank erosion etc.

6.5 Livestock and Poultry

6.5.1 Status of livestock and poultry

Livestock and poultry, being an essential element of integrated farming system, play an important role in the economy of the project area. Livestock provides significant draft power for cultivation, threshing of rice crop; cow dung use as a source of manure and fuel; a ready source of funds and meat, milk and eggs for human consumption. Most of the households raise poultry and livestock, which significantly reduce poverty through generating income. About 40%, 5%, 30% 5%, 80% and 90% of households in the project area are rearing cows/bullock, buffalo, goat, Sheep, Duck and chicken respectively. Detailed information on livestock and poultry is presented in Table 19.

Table 19: Status of livestock and poultry of the project area

Name of Livestock/ poultry	% of HH having Livestock/ Poultry	Number of livestock and poultry of the scheme area
Cow/Bullock	40	9908
Buffalo	5	1239
Goat	30	7431
Sheep	5	1239
Duck	80	19816

Name of Livestock/ poultry	% of HH having Livestock/ Poultry	Number of livestock and poultry of the scheme area
Chicken	90	22293

6.5.2 Feed and Fodder shortage

Livestock sub-sector contributes 12% to agricultural GDP and 3% of National economy. Livestock sub-sector provides new raw material for industry, serves a social security for the rural poor, and provides security against crop failure or damage during drought or cyclone. Though Bangladesh has one of the highest livestock populations in the world, but characterized by very low productivity, particularly in cattle because of low productivity, inferior genetic material, indiscriminate breeding leading to severe genetic erosion, neglect of animal healthcare and non-existence of an efficient value chain, shortage of feeds and fodder resources, and lack of awareness.Goat and sheep are commonly maintained by landless marginal farmers in selected hubs across the country.

In Bangladesh, high-quality fodder is scarce from December to May for ruminant livestock and feed is expensive throughout the year for poultry. It is also the same case for the project area.

In some cases, smallholder dairy farmers in the study area produce sufficient amounts of quality fodder for dairy cows in their house premises and feed for poultry during periods of severe fodder shortages. The owner of the livestock population in the project area is facing problems in respect of non-availability of fodder and feeds during the month of July to November due to theunavailability of grazing land. Rice straw use as the main source of fodder. Besides oil cake, rice husk is also used as fodders. Poultry population at family level survives by scavenging and no feed supplements provide. However, at times kitchen waste becomes feed for the poultry.

Photograph 1: Cattle and poultry of the project area

6.5.3 Livestock/Poultry diseases

Production of livestock and poultry of the project area are mainly constrained due to diseases and death of the population. The outbreak of disease is causing considerable economic loss in livestock farming. Every year livestock population is affected by different diseases like Badla, Foot and Mouth (FMD), diarrhea and Pest Des Petits Ruminants (PPR). Major poultry diseases include Ranikhet (New Castle), Coccidiosis and duck plague. Throughout the year livestock and poultry population remain vulnerable to disease spreading.

6.6 Fisheries

6.6.1 Introduction

Bangladesh is a densely populated country of 147 570 km^2 with a population of 130 million people. It is fortunate in having an extensive water resource in the form of ponds, natural depressions. *Haors*and beelsare local terms for natural depressions on a floodplain. There is no clear-cut distinction between *Haors* and beels; larger ones are called *Haors* and smaller ones *beels*. *Haors* normally connectto a neighboring river system but do not represent dead rivers. Beelsare defined as any definable water body or old riverbeds except oxbow lakes.

Bangladesh is one of the world's leading inland fisheries producer with a production of 1 646 819 tones during 2003–4, with marine catch total of 455 601 tones and a total production from aquaculture of 914 752 tonnes during 2003–4. Bangladesh's total fish production for the year totaled above 2.1 million tonnes (DoF, 2005). FAO (2005) ranked Bangladesh as a sixth largest aquaculture producing country with its estimated production of 856 956 tonnes in 2003 (FAO, 2005). Aquaculture accounted for about 43.5 percent of the total fish production during 2003–4, with inland open water fisheries contributed 34.8 percent (DoF, 2005).

The present per capita annual fish consumption in Bangladesh stands at about 14 kg/year against a recommended minimum requirement of 18 kg/year; hence, there is still need to improve fish consumption in the country.

Fisheries in Bangladesh are diverse; there are about 795 native species of fish and shrimp in the fresh and marine waters of Bangladesh and 12 exotic species that have been introduced. For the cause of above discussion, it is safely stated that the fisheries sector is very important for Bangladesh.

The water body is a significant source of fish as well as other aquatic resources e.g. aquatic invertebrate, phytoplankton, zooplankton etc. 132 KV transmission line started from Chakaria and closing point is Matarbari of Cox's Bazar district. A sub-station will be implemented in the Matarbari mauza under this project. The total distance of the transmission line is 18.706 km from starting point to end point. The alignment of the proposed transmission line will pass through mainly agricultural and fallow lands avoiding major settlements. There are no remarkable water bodies in the study area which will be affected by project intervention. Hence, there will be no significant negative impact on fisheries in the project areas.

6.6.2 Present status of fisheries

The project area is situated on the eastern side of the Bay of Bengal and the Maheshkhali Channel. The area is highly potential for shrimp farming during the wet season and in the dry season it is replaced by the salt pan. Shrimp is a highly valued foreign currency earning product and it earned 2.12% of country total export earnings in 2011-12 fiscal years while country's export earnings from the fisheries sector are 2.46%. This sector contributes 4.39% to the national GDP and almost one-fourth to the agriculture GDP, 22.76% (Bangladesh Economic Review, 2012). The study area, from the stack point, falls in both Chittagong and Cox's Bazar districts has alone the potential of contributing to 0.07% of export earnings through shrimp. The growth rate of this sector over the last 10 years is almost steady and encouraging, varying from 4.76% to 7.32% with an average 5.61%. From the image based land use information and field investigation following habitats have been identified in the study area. These are: (i) Canal/Khal/Chhara, (ii) Mangroves and (iii) Intertidal area broadly under inland capture fishery; (iv) Pond, (v) Lake, (vi) Ditch, and (vii) Shrimp farms, broadly under inland culture fishery; and (viii) Marine capture fishery. Habitats are highly diversified in the range of freshwater to saline water condition having variety fish species.

6.6.3 Problem and issue

Major fisheries' problems and issues identified during the study are as follows:

- Tidal flood-induced risk discourages pond owner to adopt large-scale culture fisheries.
- Deteriorated water quality and fish diversity due to use of pesticides
- Limited numbers of the fish pond due to flood and cyclone vulnerability.
- Salinity sometimes intrudes in the study area and causes problems to freshwater fishes.
- Over-exploitation of brood fish species, use of current net and indiscriminate fishing.
- Poor extension services with modern fish culture technology.
- Unavailability of easy credit facilities for improving fisheries sector.
- Lack of hatchery and nursery under the government enterprise.

6.6.4 Capture and Culture Fish Habitat Description

(a) Habitat Characteristics

An important channel Maheshkhali and Matamuhuri river pass across the study area in the southeast west direction. This channel carries saline water during high tides, feeds smaller canals

and collect drainage water from the land and returns to the Channel during neap tides. The habitat created amid of the ups and downs of tidal surge water in the canals is called intertidal area. This area has natural and planted mangrove forest which supports a wide variety of marine and freshwater fish species. The Bura matamuhuri Khal feeds fresh water to the channel and a brackish water ecosystem is created in the confluence and along the near shore. This ecosystem supports mangrove forest, a potential breeding grounds for both marine and freshwater fish species by maintaining the biological balance of the major fish groups. It functions as breeding and nursery grounds for most of the brackish water fish species. Another prominent hydrological feature is the contribution of fresh water by the hill streams situated on the northern edge of the study area. Almost a significant portion of the study area falls into the sea and Maheshkhali Channel which is considered as a marine habitat.

Aquaculture practice in the ponds is done following different techniques of fish culture based on pond size, depth, water retention period etc. Derelict ponds and roadside pits that are not managed mainly due to shortfall of water during the dry season are considered as ditches. Shrimp culture is done in the wet season on land in trapped saline water environment which is nourished by tidal flow at times when required. Bagda (Peneaus monodon) is the key species in such culture system. Mainly, wild seeds are used in shrimp farms of this area as it is adjacent to the sea. Mortality of those seeds is 50% which is less than the hatchery seeds. Shrimp culture usually starts in May/June and harvested at different times in five months and ended in October. Wild fish or shrimp that enter into the culture system and become trapped include but not limited to Chaka Chingri, Loli Icha, Bata, Choikhya, Koral, Datina, Ghoinya, Chiring etc. The major risks that encounter by the farmers in shrimp farms include the followings: (i) Water quality; (ii) Tidal surge; and (iii) Viral infection.

Fish Habitat Classification

Fish habitats of the project area are classified into khal, beelfloodplain culturable pond and fish pond. Different fish habitats of the study area are shown in the **Figure-17**.

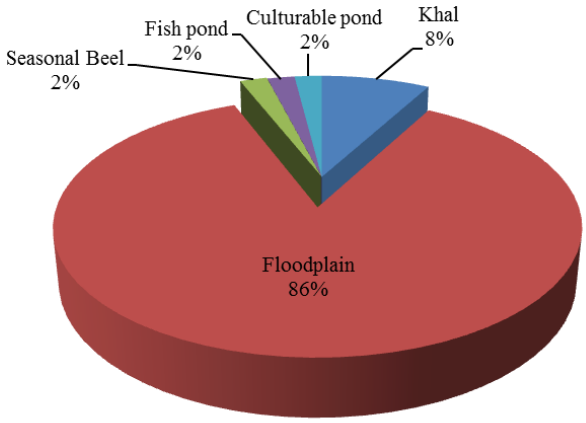


Figure 17: Fish habitats distribution of the study area

6.6.5 Fish production and effort

Fish Production

Major climatic parameters that have an influence on fisheries both capture and culture include temperature and rainfall. From the trend analysis of the following climatic data fisheries production situations are observed:

- Matarbari is highly dominant with monsoon rainfall and it plays vital role in supplying nutrient, getting fish sexually matured, facilitating grazing area, spawning, algal blooming through run-off with excess nutrient of fertilizer used in agriculture land etc.
- Temperature rising of water effects water stratification and reduces the level of Dissolved Oxygen (DO) and increases the metabolic rate of fish. Thus temperature rising increases Biological Oxygen Demand (BOD) in water for fish, increases the risk and spreads of disease. Thus, fish production is affected by temperature rising. Table 20 shows the potential impact of temperature on fish.

Table 20: Temperature effect on fish

Temperature	Effect
$>21^0$C	Fish will not spawn
15- 35^0C	Optimum temperature for carp in tropical areas (FAO)
$>33^0$C	Embryos will die
$>36^0$C	Fish die

- Wind strength stirs up deep water and increases the upwelling of nutrients into surface waters where it supports increased phytoplankton (algae) production. Increased phytoplankton production supports the food web for fish. Thus, fish production is increased.
- When evaporation rate is high then the flow rate will be low and water temperature will rise. This phenomenon creates stress for fish and less tolerable fish die in a critical situation. Stressed fish are more likely to succumb to disease organisms.
- High humidity lowers the fraction of oxygen in the air, and lowers saturated dissolved oxygen levels slightly. During cloudy weather, the intensity of light reaching surface waters is greatly diminished, resulting in a marked decrease in oxygen production from photosynthesis.
- Some aspects which have a considerable role in fish production include turbidity, watercolor, etc. The high turbid water affects fish growth and survival interfering with gill function or the quality of sub-strata for egg laying. Turbidity also limits fish vision, which can interfere with social behavior, foraging and predator avoidance.

Table 21: Fish production parameters condition in the study area

Parameters	Project area range	Desirable range of DoE	Measurement method
pH	7.6	6.5-8.5	pH meter
Dissolved oxygen	6.50	5.0 mg/L or more	DO meter
Biological Oxygen Demand	10	6.0 mg/L or Less	Using DO meter

Source: Field data June, 2015

Fishing Effort

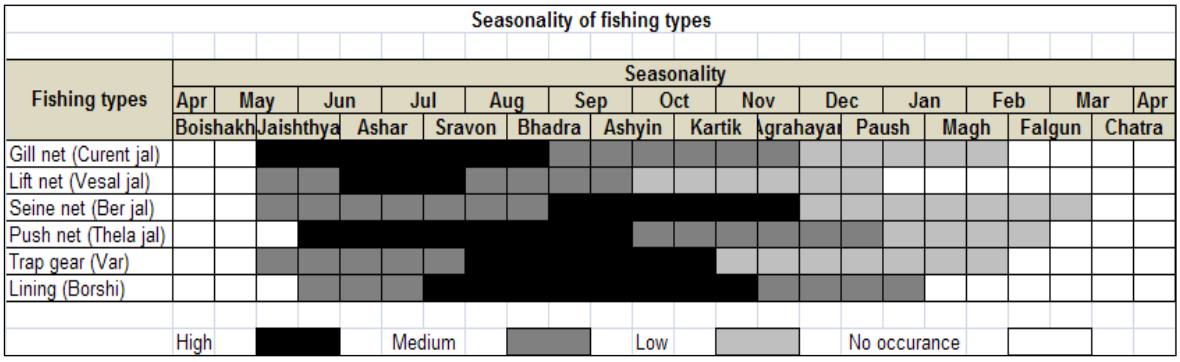
(a) Fisher number

The number of commercial fisher households, which locate in the nearby of the project area, is 250 depends on the fish habitats of the project area for carrying out their livelihoods. Almost all of the fishers are from the Hindu community. About 25% of total households (total households are mentioned in social part) engage in part-time fishing and 15% households are engaged in subsistence fishing. They usually catch fish in the nearby khals, beels, floodplains and rivers using the country boat and dingi boats particularly during the wet season.

(b) Fishing Season

Fishing in the floodplain, seasonal water bodies and khals continue from May to September. The seasonality of major fishing is furnished in the Table-22.

Table 22: Fishing seasonality of the study area



(c) Fishing Crafts and Location

Country fishing boats are widely used to catch the fish in the project area. The fishers catch fish in the Kohelia river round the year, but in the floodplain during monsoon only. The subsistence fishers catch fish in same water bodies in the project area both a monsoon and dry season.

(d) Fishing Gears

The study area has the characteristics of a mixture of marine, coastal and inland fishing. Fishing in such habitats is carried out using diversified gears and appliances for catching different fish species. Gears and gear specific fish species are as follows: (i) Ilish jal (Chikon)- Ilish, Mittya, Surma Mittya, Chhuri, Loitya, Lakhya etc.; (ii) Behundi jal- Gura chingri, Bele etc.; (iii) Sori jal/Ber jal- Icha, Ulua mach, Kachki etc.; (iv) Current jal- Koral, Tailla etc.; (v) Tounga jal/Thela jal- Baishat jal- Post Larvae of shrimp, other hatchlings; (vi) Sot jal/Charpata jal- Guli tengra, Bhol, Kala Poa, Icha, Bele etc.; (vii) Jhaki jal- Chiring, Icha, Bata, Telapia, Koral etc.; (viii) Kondra jal- Loitya, Parsa, Bele, etc; (ix) Lal jal- Chhaba Mitya, Keda, Bom mach etc.; and Borshi- Koral, Kain magur, Kala Poa, Koir mach, etc. Ilish fish is caught in warm weather in Boishakh (i.e. first month of Bengali year) when the habitat experiences more salinity. Fishing and fishing gears of the project area are shown in the **Photograph-2**.

Photograph 2: Different types of fishing in the study area

6.6.6 Fish Migration

Fish migration

The Maheshkhali Channel, Matamuhuri River, Bura Matamuhuri Khal and other internal khals having tidal influence serve as a major corridor for fish and shrimp migration of the study area. Both anadromous and catadromous fishes migrate through these khals for meeting different biological requirement throughout the year at each stage of their lifecycle. The major migratory fish species of the study area are Ilish, Koral, Mochh, Gula, Bata/Khorsula, Tailla, Bagda, etc.

Brackish to saline water fish migration in the study area occurs mainly through the Matamuhuri River and Bura matamuhuri Khal from the marine habitat perennially but lateral migration to the inundated land occurs in the wet season. Forced movement of freshwater fishes occurs through the hill streams to the study area from the nearby fish habitats within the forest.

6.6.7 Fish Biodiversity

The study area fish habitats are still moderate to rich in species diversity and composition as represented by the low species dominance. This area is believed to have about 90-100 species of

fish and shrimp. Among the saline and brackish water fishes like Hilsa, Choikka, Loitya, Surma, Puka (Poa), Keda/Chamfula, Pairsa (Chouka), Dome Machh, Bhara, Kauwa, Tek Chanda, Ayer Chanda, Foilya/Rupchanda, Bagda, Lobster, Chhuri, Koral, Sada Datina, Chiring etc. are abundant in the study area.Fish species like Koral, Bata (Kharul), Gula Tengra (Guillya), Bhol, etc and shrimp species such as Chaka Chingri, Loilya Chingri, and Bagda PL are regularly caught in different nets set at the confluence of the Jal Kadar Khal and Kutubdia Channel. Bagda post larvae(PL) are still abundant in the Channel and sea shore. Crabs are also harvested from the Kutubdia Channel using bamboo made small cages locally called chai/doghair. The crab harvesters set crab trap in spring tide and harvest crab in the neap tide. Crabs are caught largely in warm weather while less in the cold weather. Small fish species like Punti, Kholisha, Bele, Kakila, Taki, Shingh etc. are the main species of the khals and chharas which are mainly concentrated in the southern part of the study area along with the Maheshkhali Channel. Fishes are mostly harvested during therainy season in the study area. It is also observed that exotic carp and perch (Tilapia) species are available in the culture system in the study area.

The dominating fish species of the open water habitat around the proposed plant site are Ilisha megaloptera, Hilsa kelee, Chanos chanos, Harpadon nehereus, Mystus gulio, Mugil cephalus, Epinephelus sp., Leiognathus brevirostris, Gerres filamentosus, Acanthopagrus latus, Acanthopagrus berda, Acanthopagrus latus, Polydactylus sextarius etc.

The shrimp gher/ghona is intruded naturally by a number of commercially important fish species like Koral, Bata, Guli tengra, Chaka Chingri, Loillya chingri, crab etc. while water is entering into the Ghona. Water is generally exchange in the Ghona in every 15 days interval in 'Full moon-Bharagonn'. Fish diversity in the study area is shown in the following **Photograph 3**.


Photograph 3: Fish biodiversity in the study area

Checklist of the fishes of different habitats reported by local fishermen is analyzed to draw a tentative scenario of the local fish biodiversity of the study area. List of the fishes of different habitats of the study area is presented in **Table-23**.

Table 23: Common Fish species diversity of different fish habitats in the study area

Sl. No.	Scientific name	Local name	Common English name	Status IUCN	Habitat				Breeding period
					Sea shore /channel	Mangrove	Khal	Pond	
1	*Ilishamegaloptera*	Choikka	Big eye Hilsa	-	P	A	A	A	Aug-Sep
2	*Hilsa kelee*	Beng ilish	Kelee shad	-	P	A	A	A	Aug-Sep; Jan-Feb
3	*Chanos chanos*	Akharul/ Chela	Milk fish	-	P	P	A	A	-
4	*Harpadonnehereus*	Loitya	Bombay duck	-	P	P	A	A	-
5	*Mystus gulio*	Guilla	Long whiskers catfish	-	P	P	P	A	-
6	*Mugil cephalus*	Kharul bata	Flathead mullet	-	P	P	A	A	-
7	*Epinephelus spp.*	Bole	Grouper	-	P	P	A	A	-
8	*Leiognathus brevirostris*	Tek chanda	Shortnose pony fish	-	P	P	A	A	-
9	*Gerres filamentosus*	Dome machh	Whipfinsilverbiddy	-	P	A	A	A	-

Sl. No.	Scientific name	Local name	Common English name	Status IUCN	Habitat				Breeding period
					Sea shore /channel	Mangrove	Khal	Pond	
10	*Acanthopagrus latus*	Sada Datina	Yellow fin sea bream	-	P	P	A	A	-
11	*Acanthopagrus berda*	Kala Datina	Picnic sea bream	-	P	A	A	A	-
12	*Acanthopagrus latus*	Datina	Yellow Sea Bream		P	P	A	A	-
13	*Polydactylus sextarius*	Surma/Tailla	Blackspot threadfin	-	P	P	A	A	-
14	*Johnius amblycephalus*	Puka/Poa	Bearded craoker	-	P	P	A	A	-
15	*Scartelaos histophorus*	Chiring	Walking goby	-	P	P	A	A	-
16	*Lepturacanthus savala*	Chhuri	Savalani hairtail	-	P	A	A	A	-
17	*Euthynnus affinis*	Maitta/ Kawa	Kawakawa	-	P	A	A	A	-
18	*Pampus argenteus*	Foli chanda	Silver pomfret	-	P	P	A	A	-
19	*Pampus chinensis*	Rupchanda	Chinese silver pomfret	-	P	A	A	A	-
20	*Acentrogobius caninus*	Bailla	Tropical Sand Goby	-	P	P	A	A	-
21	*Catla*	Catla	Katla	-	P	A	P	P	-
22	*Cirrhinus mrigela*	Mirka	Mrigel	-	P	A	P	P	-
23	*Ctenopharyngodon idellus*	Grass carp	Grass carp	-	A	A	A	P	-
24	*Cyprinus carpio*	Carpio	Common carp	-	A	A	A	P	-
25	*Hypopthlmichthes molitrix*	Silver carp	Silver carp	-	A	A	A	P	-
26	*Labeo boga*	Bhangon	Boga Labio	-	P	A	A	A	-
27	*Labeo calbasu*	Calbaus	Black Rui	EN	A	A	P	P	-
28	*Labeo rohita*	Rui	Rohu	-	A	A	P	P	April-August
29	*Lates calcarifer*	Koral	Sea Bass	-	P	P	A	A	June-July
30	*Lepidosephalus guntia*	Gutum	Guntia Loach	-	P	A	P	A	-

Sl. No.	Scientific name	Local name	Common English name	Status IUCN	Habitat				Breeding period
					Sea shore /channel	Mangrove	Khal	Pond	
31	*Liza parsia*	Parse	Goldspot Mullet	-	P	P	A	A	-
32	*Mystus tengara*	Bajari-tengra	Tengara Mystus	-	P	A	A	A	-
33	*Oreochromis niloticus*	Tilapia	Tilapia	-	A	A	P	P	-
34	*Plotosus canius*	Gang magur	Canine Catfish	VU	P	P	A	A	-
35	*Polynemus paradiseus*	Tapsi	Paradise Threadfin	-	P	P	A	A	-
36	*Thrssa mystex*	Faisha	Anchovy	-	P	P	A	A	-

Here, A=Absent and P=Present

Sources: Red Book of threatened Fishes of Bangladesh, IUCN and fishermen consultation

Species of Conservation Significance

Fish species variety which are locally unavailable for last 10 to 15 years or have become rare as reported by the local fishers and concerned elderly people are given in the following **Table 24.**

Table 24: List of species of conservation significance

Sl	Local Name	Scientific Name	Local Status	
			Rare	Unavailable
1	Boal	*Wallaguattu*		✓
2	Pabda	*Ompok pabda*		✓
3	Gojer	*Channa marulius*		✓
4	Tara Biam	*Macrognathus aculeatus*		✓
5	Bata	*Labeo bata*	✓	
6	Rita	*Rita rita*	✓	
7	Khalla	*Liza parsia*	✓	

Area of Conservation Significance

Some deep parts of *Bara Matamuhuri khal* other important fish migrationkhalsand the deepest portions of the seasonal *beels* of the project area have the conservation significance.

Fish Marketing and Post Harvest Facilities

Fish edible quality is still in quite a good condition for human intake. But due to the use of agrochemicals and pesticides the fish edible quality is deteriorating causing fish diseases especially during November-December. The fish storage facility is insufficient in the study area. Transportation facility is sufficient and cell phone network is well established. Auto-rickshaw, *van* and on foot are the fish transportation facilities at the route level.

Local fishermen sell their fish to the local markets. Fishermen, in case of alarge catch, sell their fish to fish suppliers who supply fish from the local area to city area by icing. Fish traders/Retailers collect fish from fish Aratdars and sometimes from fishermen and sell in local markets directly to consumers. Hatchery is not found in the study area. Availability of fish feeds for culture ponds are insufficient.

Fisher's lifestyle

There are commercial, part time and subsistence fishermen exist in the project area. Average daily incomes of commercial fishermen, part-time fishermen and subsistence level fishermen are Tk. 900-1000, Tk. 500-700 and Tk. 200-300 respectively. Income level of traditional fishermen is decreasing due to declining trend of fish production of open water fish habitats, declining of fish population etc. Most of the fishermen educational level is up to the primary.

6.6.8 Fisheries Management

There is no fishery based community association found in the study area during afield visit. Fishing right on existing fish habitats is limited. Enforcement of fisheries regulation is also weak. No fish sanctuary is found in the study area during afield visit.

6.7 Ecological resource

6.7.1 Bio-ecological zones

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

Chittagong Hills, Cox's Bazar and the CHTs

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

Offshore Islands

This zone covers mostly mudflats. Moreover, there are extensive inter tidal mudflats composing parts of the islands. Most of these mudflats occur along the inland creeks. There are also large shoals in this area; these may consolidate into large islands by the end of this century. The vast amount of sediment brought down by the Meghna made the estuary shallow for a considerable distance (Rashid, 1991). Among the rich vegetation observed in this zone, there are man-made plantations of mangroves, such as the Keora (*Sonneratia apetala*), and Tiyan baen (*Avicennia officinale*) in the Nijhum dweep, Ghasiar char and Char batao.The vegetation in the interiors of Hatiya is similar to that of the mainland and includes: the Sada koroi (*Albizia procera*), Shaora (*Streblus asper*), Gab (*Diospyros peregrina*), Babla (*Acacia nilotica*), Kadam (*Anthocephalus chinensis*), Banyan (*Ficus bengalensis*), Jam (*Syzygium sp)*, Mandar (*Erythrina indica*), Sonalu (Cassia fistula), Date palm (Phoenix sylvestris), Toddy palm (*Borassus flabellifer*), Coconut (*Cocos nucifera*) and various bamboo species. The islands of this zone are very important staging and wintering areas for a wide variety of waterfowl, particularly the migratory shorebirds. Rashid (1989) recorded over 108,000 waterfowl of 49 species, together with 5,500 unidentified ducks and 56,500 unidentified shorebirds. Besides, some of the common reptiles of the zone include: the Common garden lizard (*Calotes versicolor*), Common skink (*Mabuya carinata*), Bengal monitor (*Varanus bengalensis*), Yellow monitor (*V. flavescens*), Checkered keelback (*Xenochrophis piscator*), Binocellate cobra (*Naja naja*) and Spotted flapshell turtle (*Lissemys punctata*).Likewise, common mammalian species of this zone include: the Ganges river dolphin (*Platanista gangetica*), Jackel (*Canis aureus*), Small Indian mongoose (*Herpestes auropunctatus*), Clawless otter (*Aonyx cinerea*), Large Indian civit (*Viverra zibetha*) and Greater bandicoot rat (*Bandicota indica*).

Coastal and Marine Waters

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

Coastal Plains

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

6.7.2 Ecosystem

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

6.7.3 Terrestrial Ecosystem

Terrestrial flora

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

i) Homesteads vegetation

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

Table 25: Major tree species within the homestead in the project area.

Tree species name	Family name	Abundance
Kola*(Musa sp)*	Musaceae	H
Narikel*(Cocosnucifera)*	Palmae	H
Suparee*(Areca catechu)*	Palmae	H
Aam*(Mangiferaindica)*	Anacardiaceae	M
Kathal*(Artocarpusheterophyllus)*	Moraceae	M
Payra*(Psitiumguajava)*	Myrtaceae	M
Khajur*(Phonixsylvestris)*	Palmae	L
Amra*(Spondiasdulcis)*	Anacardiaceae	M
Tal*(Boassusflabelifer)*	Palmae	H
Bash*(Bamboosa sp.)*	Gramineae	M

Tree species name	Family name	Abundance
Siso*(Dalbergiasissoo)*	Fabaceae	H
SilKoroi*(Albiziaprocera)*	Leguminosae	H
Gamari*(Gmelinaarborea)*	Verbenaceae	H
Akasmoni*(Acacia moniliformis)*	Mimosaceae	M
Eukalyptus*(Eukalyptuscitriodora)*	Elaeocarpaceae	M
Telsur *(Ho peaodorata)*	Dipterocarpaceae	M
Raintree*(Albizasaman)*	Leguminosae	H
Hijal*(Barringtoniaacutangula)*	Barringtoniaceae	L
Mahogoni*(Swieteniamahogoni)*	Meliaceae	M
Sirish*(Albizialebbeck)*	Leguminosae	H

(Note: Rank, H= High, M= Medium, L= Low)

ii) Cropland vegetation

The cropland vegetation is exclusively dominated by cultivated crop varieties. The crop varieties are rice and some vegetables. Different varieties of paddy are cultivated once or twice a year. Except crop varieties, numerous species of herbs and shrubs are grown with crop field which are called weeds. The cropland vegetation provides support to food-web and maintaining ecosystem function. Existing cropland vegetation generally known as aweed in the study area are Shyama Gash, AraliGhash, Katanotey, DurbaGhash etc. Cropland vegetation means the plants grow in the crop field naturally as weeds and the plants that are cultivated by the farmers. The farmers mostly grow rice in the crop fields. It develops a new ecosystem with the interaction of rice plant, weeds and wild organisms live on plant leaves and other soil products. The weeds that play major role in this ecosystem include the following species, Chapra (*Elusina indica*), Shama (*Echinochloa colonum*), Durba grass (*Chynodon dactylon*), Torpado grass (*Panicum repens*), Katanata (*Amaranthus spinosus*), Centipeda orbicularis, Cyperus sp., Bonjal (*Croton bonplandianum*) etc. (Photograph 4 to 6**).**

Photograph 4: Homestead vegetation

Photograph 5: Agricultural land

Photograph 6: Aquatic Ecosystem

iii) Roadside, Coastal and embankment vegetation

Roadside and embankment vegetation are generally planted and develop an ecosystem which is dominated by hardwood tree species. These species are Raintree, Babla, Mahogoni, Acacia, Koroi, Neem, etc. Some plants also grow naturally in-between the planted plants and remain at the bottom levels on either side of the road function as a barrier of soil weathering. The small-sized herbs are also available and Bhat, Croton, Bondhona, Daton are found commonly everywhere in the area. A large number of Jhau tree are present within the project area.

6.7.4 Wildlife (Terrestrial fauna)

The study area has limited faunal diversity due to lack of vegetation. Land encroachment leading to expansion of settlements and agriculture, tree poaching, hunting, collection of fuel wood, bamboo and cane, and other forest products are the major causes for the degradation of the forest and its resources. The homestead and roadside vegetation are considered as secondary habitats for the terrestrial fauna. The cropland vegetation also supports insects, amphibians and some reptiles. Some small to medium-sized mammals are reported to be available in this area: Field Rat, House Rat and Indian Flying Fox etc.

The major fauna of different species with their habitat is shown in the following Table 26.

Table 26 : List of terrestrial fauna of the project area

Types of Species	Name (generic name)	Habitat
Mammals	Indian Jackal *(Canisaureus),* Mole Rat *(Bandicotabengalensis)*, Common House Rat *(Rattusrattus),* Short-nosed Bat *(Cynopterus sphinx),* Flying fox *(Pteropusgiganteus),* Common mongoose *(Herpestesedwardsi)*, Large Indian Civet *(Viverrazibetha) and* Jangle Cat *(Felischaus)*	Mostly in bamboo thickets, cropped fields or broken, bushy areas.
Birds	Sparrow *(Passer domesticus)*, Common myna *(Acridotherestristis)*, Asian pied Starling *(Sturnus contra),* House Crow *(Corvussplendens),* Spotted Dove *(Streptopeliachinensis),* Black Drungo*(Dicrurusmacrocercus),* Fulvous Breasted Woodpecker *(Dendrocoposmacei),* Spotted Owlet (Athenebrama) Little Egret(Egrettagarzetta)	All types of vegetation

Types of Species	Name (generic name)	Habitat
Reptiles	Common Vine Snake *(Athaetullanosuta),* Common Wolf snake *(Lycodonaulicus),* Common Grass Skink *(Mabuyacarinata),* Stripped Keelback*(Amphiastmastolatum),* Garden Lizard *(Calotesversicolor)*, House Lizard *(Hemidactylusbrooki).*	Both wetland and dry areas
Amphibians	Common toad *(Bufomelanostictus),* Cricket Frog *(Fejervaryalimnocharis),* Jerdon's Bull Frog *(Hoplobactruchuscrassus)*	Wetland areas and the dried areas

6.7.5 Aquatic ecosystem

The study area and its tributaries support different types of wetlands both perennial and seasonal in nature. The wetlands consist of different aquatic ecosystems. Aquatic habitat in this area includes the Bay of Bengal and some seasonal wetlands and homestead ponds. The area becomes flooded during the monsoon period and these play great roles for theaquatic ecosystem. The seasonal wetland is mainly floodplains, which is inundatedduring the monsoon.

Aquatic Flora

Diversity and density of floral species are varied according to wetland types as well as water depth and velocity. Kochuripana (Eicchorniacrassipes) is the most common free floating hydrophyte that covers amaximum portion of thewater area of the ponds and ditches. Topapana (Pistia strateotes) are found in most of the ditches as well as ponds mixed with hyacinth. Shapla (Nymphaea stellata), Chandmala (Nymphoides sp.) are dominating the floodplain vegetation. Sedges are quite common during monsoon inside all types of wetlands. Hydrilla, valesnaria, Helencha (Enhydra fluctuans), Ludwgjia, Echinocola, Hygrorhyza, Ficus heterophylla are the main components of the floral composition of aquatic vegetation.

Aquatic Fauna

The population of aquatic faunal species is varied according to wetlands characteristics and surface area of water inside the water bodies. Fishes are holding the major populations among aquatic faunal species those are describe in fisheries section of this report. Among the amphibians, the green frog, skipper frog, etc. are common all over the year. They have been the most successful fauna in adapting to the all kinds of wetlands. The abundance of Bullfrogs (Hoplobactruchus tigerinus) is generally increased in rainy season at paddy fields, ditches and other marshy places. Common aquatic snakes include the checkered keel back (Xenocrophis piscator) and smooth water snake (Enhydris enhydris) are observed in the area.

Different species of local birds roam on the salt field and shrimp farm within the study area during winter. The wetland dependent birds of the area are: Common Kingfisher, Little Heron, Lesser Whistling Duck, Indian Pond Heron, Little Egret, Yellow Bittern, Great Egret, Pheasant-tailed Jacana etc. Common and uncommon bird species found in the study area are India Pond Heron, Little Egret, Cinnamon Bittern, Cotton Pigmy Goose, Little Cormorant, White breasted Water Hen, Common Kingfisher, Lesser Whistling Duck, Bronzed-winged Jacana, Brhaminy Kite, Pied Kingfisher etc.The existence of Fishing Cat has been found within the area. The commonly observed snake population in water bodies are Checkered Keelback (Xenochropis piscator), Common Wolf Snake (Lycodon aulicus) in the area. Skipper Frog is available in water body like hillstream. Among amphibians, the Skipper Frog (Euphlyctis cyanophlyctis) is common and found in all wetland habitats and has been the most successful in adapting to the altered habitat.

6.7.6 Marine Ecosystems

Coastal area is far from transmission line area but the south of the study area near to Matarbari is located directly on the face of Bay of Bengal and characterizes with Marine ecosystem. So marine ecosystem is important to discuss. They include mudflats, salt marsh, sandbar, sea-shore, and in-shore, intertidal ecology, estuaries, lagoons, coral reefs, deep sea and the sea floor. Marine ecosystems are very important for the overall health of both marine and terrestrial environments.

Marine flora and fauna

In the sea, many kinds of marine vegetation such as algae and other aquatic plant are found. In coastal mudflat, particular plants are Ipomea pescapre, Vitex trifolia, Pandanus odoratissimus and Calotropis gigantia. Shore birds feed on mudflats and sand bars of the study area. These shore birds lay eggs on undulated mudflat during the dry season (March/April). Migratory birds gather in the on shore mudflat during the winter season. The offshore areas support four species of globally threatened coastal and marine cetaceans including Finless porpoise (Neophocaena phocaenoides), Irrawaddy dolphin (Orcaella brevirostris), Bottlenose dolphin (Tursiops aduncus) and Indo-Pacific Humpback Dolphin (Sousa chinensis). Different species of peneaid, solenocerid, sergestid and careidean prawn species have been found. The beaches and shallow shoals surrounding the site provide an excellent staging area and wintering ground for migratory waterfowl and shorebirds. The common shore bird is Bar tailed Godwit, Whimbrel, Eurasian Curlew, Common Redshank, Marsh Sandpiper, Common Greenshank, Green Sandpiper, Grey Plover, Kentish Plover, Lesser sand Plover, Grater sand plover etc. The mudflats are important habitat for migratory and resident birds and mud crab. Sea turtles in the territorial area of Bangladesh are on the verge of extinction, the population having declined sharply over the past two decades. The study area is also important for globally threatened marine turtle such as Olive Ridely and Green Turtle. Benthos is a community of organisms which live on, in, or near the seabed (known as benthic zone). This community lives in or near marine sedimentary environments from tidal pools along the foreshore, out to the continental shelf, and down to the abyssal depths. Many organisms adapted to deep water pressure cannot survive in the upper parts of the water column. Animals ecologically linked to bottom include echinoderms, fishes (Tade Mullet Liza tade, Speigler's Mullet Valamugil speigleri, Flathead Mullet Mugil cephalus),

crustaceans, molluscs (Granular Ark Anadara granosa, Mud Crab Scylla serrata, Girdled horn shell, Cerithidea cingelata, Moon Shail Polinices Sp), poriferans and annelids in the study area. No seaweeds or coral reef found in marine ecosystems along the project site.

6.7.7 Ecosystem services

Output of ecosystem services:

Fruit, fuel wood and timber vegetations are the major ecosystem services provided to the local people. They provide mostly cash to the households. The dominant fruit species are Narikel (*Cocosnucifera*), Supari (*Areca catechu*), Kola (*Musa* Spp.), Aam (*Mangiferaindica*), Kanthal (*Artocarpusheterophyllus*) and Peyara (*Psidiumguajava*). Of the timber, Gamari*(Gmelinaarborea)*, Siris *(Albizialebbeck)*, ShilKoroi *(Albiziaprocera)*, Mahogani *(Swieteniamahogoni)*, Siso*(Dalbergiasissoo)* are dominant. In addition, the homestead vegetation including fruit trees is also a source of fuel wood in this project area.

Evaluation of ecosystem services

A small number of the household owner earn a bulk amount of cash each year by selling their fruits like Narikel, Supari, Aam, Kanthal, Payara, etc. (1500-2000Tk/year), and heartwood timber (Tk. 500-1200 /CFT) each year.

6.7.8 Existence of Protected area/Important Habitat

Chunati Wildlife Sanctuary

A small portion of the plantation and natural forest exist in the study area are of Bashkhly Eco-park range and Napora and Chambol bit. It is about 352 hac. The forest area is about 17.0 Km North from the project site. The forest vegetation is covered by natural and planted vegetation described under earlier terrestrial flora section.

6.8 Environmental Quality

6.8.1 Air quality

Air pollution is a primary social and environmental concern for health and sustainability of the ecosystem. When the presence of solid particles, liquid droplets or gaseous compounds in the air is higher than normal, it becomes harmful to living organisms and the air becomes polluted. There are five primary pollutants which together contribute more than 90% of global air pollution. These are: CO_2, NOx, Sox, and PM. Standards of ambient air quality parameters by DoE & IFC and baseline concentrations (during rainy season) in the study area (Matarbari) are stated in Table 27.

There will be some negative impacts on air quality during the construction phase of the project such as dust. These can be mitigated, at least to some extent, if the EMP (Environmental Management Plan) is followed and its implementation monitored during construction. The cause of pollution and its mitigation measures are stated in the EMP later in this document.

Table 27: Standards of ambient air quality parameters by DoE & IFC and baseline concentrations (during rainy season) in the study area

Parameter	Unit	Baseline concentration			Ambient Air Quality Standards	IFC EHS Guideline (General: 2007)
		Sample Point one	Sample Point two	Sample Point three		
SPM	µg/m^3	54	56	42	200 (8hr) PM10: 150 (24hr) PM10: 50 (year)	SPM: - PM10: 150 (24hr) PM10: 70 (year)
SO_2	ppm	0.001	0.001	0.001	0.14 (24hr) 0.03 (year)	0.191 (10min) 0.048 (24hr)
NO_2	ppm	0.002	0.002	0.002	0.038 (year)	0.076 (1hr) 0.015 (year)

(Source: JICA Study Team)

As per baseline concentration of ambient air quality shown in table 27 & 28, it is stated that the values of all parameters have remained under critical limit of standard range.

Standards of ambient air quality parameters by DoE & IFC and baseline concentrations (during dry season) in the study area (Matarbari) are stated in Table 28.

Table 28: Standards of ambient air quality parameters by DoE & IFC and baseline concentrations (during dry season) in the study area.

Parameter	Unit	Baseline concentration			Ambient Air Quality Standards	IFC EHS Guideline (General: 2007)
		SPN1	SPN2	SPN3		
SPM	µg/m^3	59	62	45	200 (8hr) PM10: 150 (24hr) PM10: 50 (year)	SPM: - PM10: 150 (24hr) PM10: 70 (year)
SO_2	ppm	0.001	0.001	0.001	0.14 (24hr) 0.03 (year)	0.191 (10min) 0.048 (24hr)
NO_2	ppm	0.003	0.003	0.002	0.038 (year)	0.076 (1hr) 0.015 (year)

(Source: JICA Study Team)

The transmission line will avoid rural and urban settlements. In operation phases, normally transmission line will have allow lasting impact on air quality but in the construction phase, it has somewhat potential impact on air quality though it is temporary.

Heating is the main biological effect of the electromagnetic fields produced by the high voltage transmission line.

6.8.2 Water quality

The catchment areas of the Project in the studied District has some ponds/reservoirs but most of them are relatively shallow, with only a limited amount of water remaining during the winter season The Project could not directly pass through any water bodies and contaminate the environment but beside the project some natural water courses are appeared. There will be some negative impacts on the surface water during project implementation. However mitigation measures have been designed and these can be implemented following the EMP.

Mostly surface water will be used in construction by the Project. However, this will have no substantial negative impacts on implementing the Projects, nor have any significant effect on the environment.

Standards of inland water quality parameters by DoE & IFC and baseline concentrations (during rainy and dry season) in the study area (Matarbari) are stated in Table 29.

Table 29: Inland water quality standards along with baseline concentration in the study area

parameter	unit	Baseline results		Standard for inland surface water						method
		Rainy season' 2012	Dry season' 2013	A	B	C	D	E	F	
Depth	m	0.5	0.5	-						
Temperature	^{0}C	30.6	18.0							Measuring by Temperature meter (3 ^{0}C-100^{0}C)
Salinity	ppt	9.8	35.8							Salinity meter (Range 0.00-100 ppt)
pH	-	7.82	8.0	6.5-8.5	6.5-8.6	6.5-8.6	6.5-8.8	6.5-8.9	6.5-8.9	pH meter (1-15)
DO	mg/L	5.5	5.8	6 or above	5 or above	6 or above	5 or above	5 or above	5 or above	DO meter (0-15)
BOD	mg/L	0.8	0.4	2 or less	3 or less	3 or less	6 or less	10 or less	10 or less	Using DO meter (0-15)
COD	mg/L	97	241							Titrimetric method
Oil & grease	mg/L	4.2	-							Titrimetric method
SS	mg/L	613	-							Titrimetric method
Total Coliform	N/100	-	-	50 or less	200 or less	5000 or less	-	5000 or less	1000 or less	Membrane filtration

(Source: JICA Study Team)

Notes: Category of water body is as below.
A: Potable water source supply after bacteria freeing only
B: Water used for recreational purposes
C: Potable water source supply after conventional processing
D: Water used for pisciculture
E: Industrial use water including chilling and other processes
F: Water used for irrigation

The ground water is extensively used for drinking purposes and sometimes it is used for irrigating the aman & boro crops through a small number of deep tube wells. Presence of heavy metals like

'Arsenic (As)' was not reported in the study area. The depth of the groundwater or water table in the districts varies from 15ft to 20ft. The water level drops 1m to 2m before the monsoons, which is offset by a rise of the same order after the monsoons.

The following table (30) shows the baseline concentrations in the study area (Matarbari) along with Bangladesh drinking water quality standards.

Table 30: Ground water quality standards along with the baseline concentrations

Parameter	Unit	Baseline results		Bangladesh Standards for drinking water	Method
		Rainyseason'2012	Dry season'2013		
Temperature	^{0}C	29.7	20.1	20-30	Measuring by Temperature meter (Range: 3 ^{0}C-100^{0}C)
pH	-	7.48	7.20	6.5-8.5	pH meter (Range:1-15)
Chloride	mg/L	167	167	150-600	Titrimetric
NH_3	mg/L	0.04	0.04	0.5	Titrimetric
Iron (Fe)	mg/L	0.92	0.92	0.3-1.0	AAS
Hardness	mg/L	164	164	200-500	Hardness meter
Arsenic	mg/L	0.01	0.01	0.05	AAS
DO	mg/L	3.5	4.7	6.0	DO meter (0-15)
BOD	mg/L	0.4	0.2	0.2	Using DO meter (0-15)
COD	mg/L	0	0	4.0	Titrimetric
SS	mg/L	0.2	-	10	Titrimetric
Coliform	N/100 mL	0	-	0	Membrane filtration method
Salinity	ppt	0.3	0.7	-	

As per baseline concentration of water quality shown in table 29 & 30, it is stated that the values of all parameters have remained under critical limit of standard range. So, water quality of the study area is not bad at all.

6.8.3 Noise Quality

Site work activities for the Project will be restricted for people from the local communities. Attempts will also be made to limit unnecessary noise during the day because of its negative impact on adjoining households. This is a short-term impact which can be mitigated, measures of which are included in the EMP.

The noise levels have not exceeded the standard noise levels (Table 31). This table has also contained the baseline concentration of noise level of project sites. It could be mentioned that the noise level of the nearest village shall be kept within 50 dBA during daytime and 45 dBA during night time.

Table 31: Noise Standards along with baseline concentration in the study area

Sampling period	Baseline concentration			Time	Unit	IFC Guidelines	Bangladesh Standards	
	SPN1	SPN2	SPN3				Residential area	Industrial area
Rainy season	57.0	57.3	49.5	Day time	dBA	70 (7:00 – 22:00)	50 (6:00 – 21:00)	75 (6:00 – 21:00)
Dry season	56.0	57.0	45.3	Night time	dBA	70 (22:00 – 7:00)	40 (21:00 – 6:00)	70 (21:00 – 6:00)

SPN: Sample Point Number

As the transmission line will cross mainly into the barren field or agricultural land and residential areas, the standard value for ambient noise should be below 50 dBA.

Social survey data, however, indicate that the noise level in rural areas is within the allowable limits of the standard set by the DoE.

6.9 Socioeconomic condition

6.9.1 General discussion

The baseline information of the project area was collected from both primary and secondary sources. The population census report published by Bangladesh Bureau of Statistics (BBS) has been used for this purpose. The information related to demography (population both male and female, age, literacy, etc.), water and electricity facility were collected from secondary source i.e. from BBS. Data on land ownership, occupation and employment, population migration, income and expenditure pattern, condition of housing, sanitation, health status, poverty status, safety nets and poverty reduction measures, communication facility, institution and water management organization, marketing facility, social conflict and local prevailing disaster were collected from primary sources. The primary information was collected through Rapid Rural Appraisal (RRA) technique by experienced professionals. A checklist was used for collecting relevant information properly. The RRA participants (male and female) were farmers, fishermen, laborers, businessmen, service holders, etc. residing in the project area.

6.9.2 Demographic Profile

Communities (locations, composition, employment)

The socio-economic condition of Chakaria to Matarbari 132kV T/L area are discussed and presented in Environmental Impact Assessment (EIA) Report. An 80m wide area through the Right of Way (RoW) was defined as the general impacted area for 132 kV T/L. The mauzas covered across the power transmission lines were considered for environmental baseline analysis. The proposed study area has generated direct beneficiary population from 1, 35,669 in 24770 household family units (Table-32). All the peoples of the catchment areas are Bengali. Tribal communities were not found in the project areas. So, there is a possibility to affect the tribal communities by the intervention of the project. The project beneficiaries have been grouped according to different employment/ occupation types, details of which are as follow:

- Crop cultivation
- Fish cultivation
- Salt cultivation
- Agricultural labour
- Non-agricultural labour (skilled labour)
- Livestock
- Trade, business, shopkeeper
- Transport workers
- Retired person
- Woodcutter/bamboo collection
- Fisherman
- Food processing
- Craftsman
- Service
- Unemployed
- Wage earner
- Garment workers
- Others

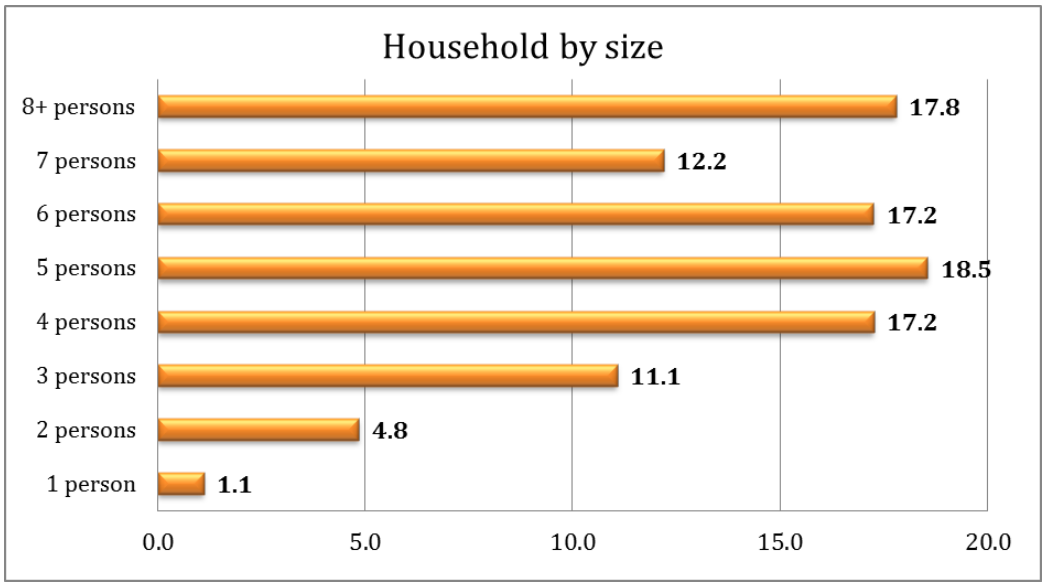
Table 32: Basic demographic profile of the study area

Upazila name	Union name	Ward No/Mauza	Total population	Male Population	Female Population	Household	Sex Ratio
Maheshkhali	Kalarmarchhara	Younuskhali	3,484	1,771	1,713	617	103
		Uttar Nalbila	7,435	3,807	3,628	1,436	105
	Matarbari	Matarbari	44,937	22,801	22,136	8,168	103
Pekua	Ujantia	Kariardiar	1,930	1,013	917	337	110
Chakaria	Ward No-06	Xhariaghona(part)	4,392	2,254	2,138	727	105
	Badarkhali	Badarkhali Ghona	30,964	15,677	15,287	5,947	103
	Chiringa	Palakata (Part)	11,282	5,710	5,572	1,968	102
	Fasiakhali	Fasiakhali	9,591	4,922	4,669	1,746	105
	Saharbil	Maizghona	5,547	2,864	2,683	924	107
		Paschim Bara Bheola	3,720	1,983	1,737	623	114
		Rampur	3,582	1,816	1,766	607	103
	Paschim Bara Bheola	Paschim Bara Bheola(Part)	8,805	4,413	4,392	1,670	100
Grand Total			**135,669**	**69,031**	**66,638**	**24,770**	

Source: Housing and Population Census, BBS, 2011

Distribution of household by size

Distributing households by some persons has been found that the highest percentage (18.5%) of household comprises of 5 persons **(figure-18).** Although average household size is 4.5, a substantial percentage (about 17.2%) of households comprises of 6 persons and over.



Source: Housing and Population Census, BBS, 2011

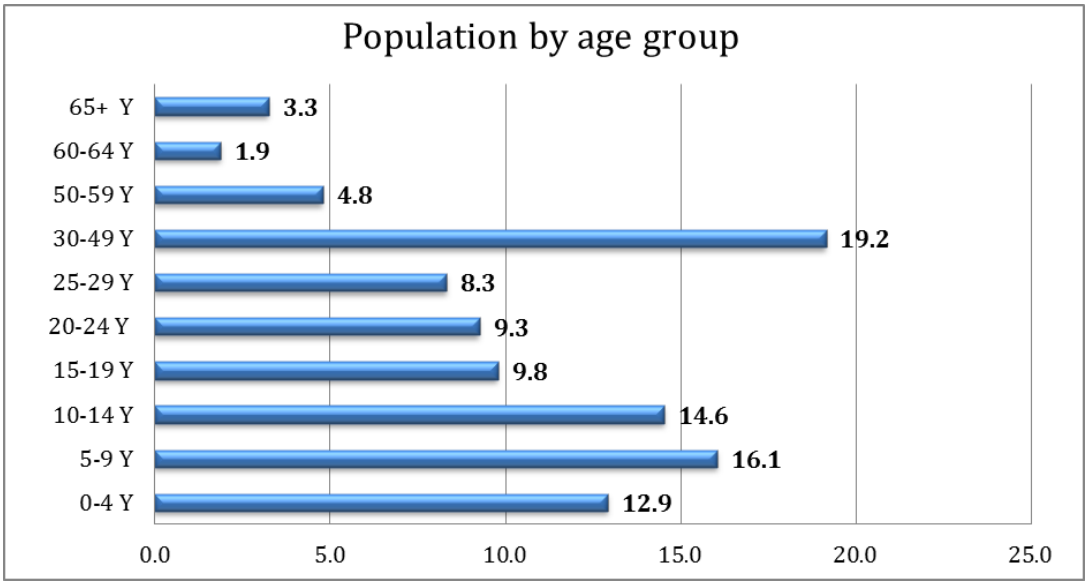
Figure 18: Distribution of households comprising member in each Age Structure

Population by age group:

In the project area a highest number of population (19.2%) belongs to the age category of 30 to 49 years old. Only 2% people are in 60 to 64 years category. Age groups of 0-14 years is defined as children, 15-24 years as early working age, 25-54 years as prime working age, 55-64 years as mature working age and 65 years and over as elderly people (source: World Fact Book, CIA1).This classification is important as the size of young population (under age 15) would deserve more investment in schools, while size of older populations (ages 65 and over) would call for more invest in health sector.

The population data when analyzed to ascertain the size of (potentially) active working population then it appears that about 54% percent population who are in the age bracket of 15-64 can be classified under this category. A small percentage about 3.3% persons is of 65 years and above. The categorization is made on the basis of ILO reference for opting out potential labor force and dependent population. The population of 15 to 64 years category is considered as labor force whereas, populations below 14 years and above 65 years are considered as dependent. Thus,

the total dependency ratio is 46 in which child dependency ratio is 43 and the aged dependency ratio is about 3. The age structure of the studied population is shown in figure 19.



Source: Housing and Population Census, BBS, 2011

Figure 19: Age structure of the studied population

6.9.3 Quality of Life Indicators

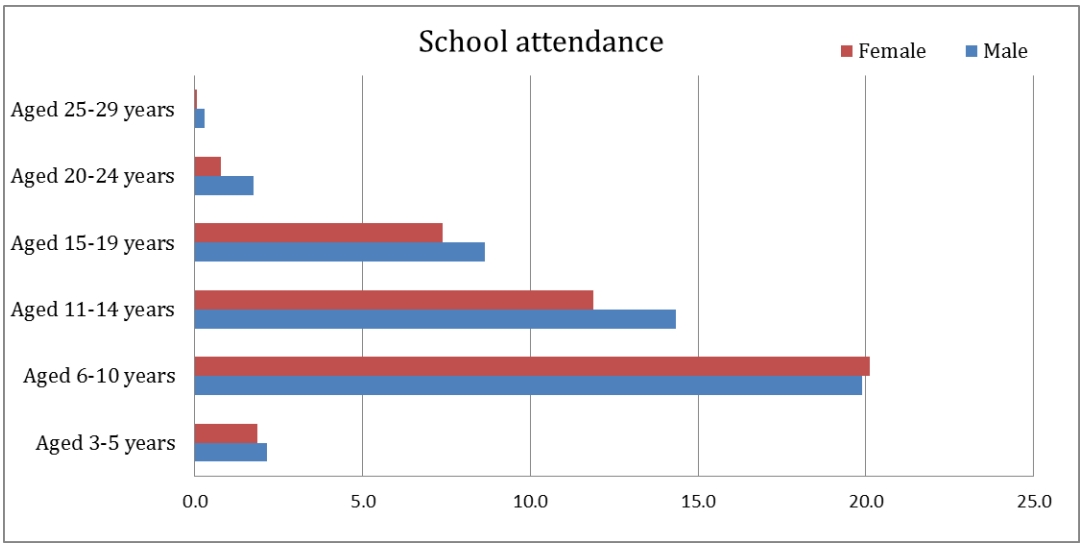
Standard indicators of the quality of life include not only wealth and employment but also the built environment, physical and mental health, education, and social belonging. Quality of Life Indicators like education, public health, occupation and livelihood in the study area are stated below-

Education

In consistent with the education policy of Bangladesh, the people of the study area have largely favorable access to education. Accessibility refers to equal opportunities to be enrolled in the educational institutions, pre-school attendance rate, and assistive technologies in institutions, adequate health care and nutrition services and communication facilities to the institutions. Accessibility is obviously higher in urban areas such as municipal town, compare to rural areas. Data on male-female attendance ratio confirms that both sexes have equal opportunities in education. Field findings show that each institution, irrespective to rural or urban, is connected with road networks giving the student opportunity to use public or private transport.

School attendance rate is measured by BBS from 3 years to 29 years by six clusters of age groups. 3 to 5 years is defined as preschool attendance, 6 to 10 as primary, 11 to 19 years as secondary and higher secondary and finally 20 to 29 years as higher as well advanced level attendance at educational institutions. Comparative picture of attending and not attending rate shows that net attendance rate is the highest (20%) at primary level then the rate starts declining. The higher secondary level shows the threshold point from which not attending rate moves upward and attending rate starts sliding. This trend is true for higher as well as advanced level studies shown

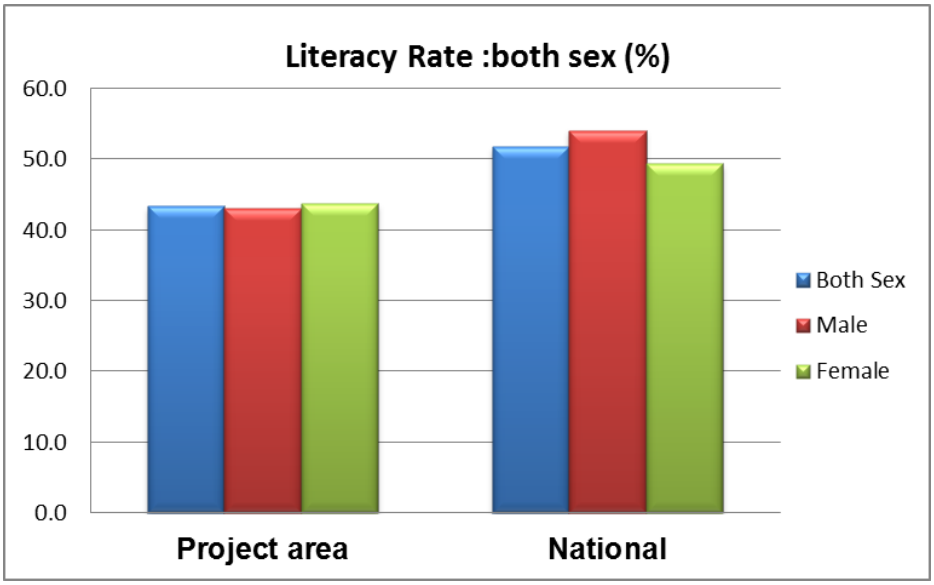
in **figure-20.**



Source: Housing and Population Census, BBS, 2011

Figure 20: School attendance among the studied population

However, as mentioned earlier that male-female attendance ratio is almost equal to a little difference at primary level in which female attendance is comparatively higher than that of males. Field findings confirm that female attendance at this stage is higher because of existing scholarship program, and the parents also consider this basic schooling as an investment for securing a good marriage of their girl child. It has also been observed and our data confirms that after completion of primary education, most of the girls get married and therefore the attendance rate gradually starts decreasing. However, the male attendance rate is decreasing due to their involvement in income generating activities. Literacy rate, based on a definition "ability to write a letter in any language" is 43.4%, where for a male it accounts for 43.1% and female 43.7%(Figure-21). The rate of literacy reported above is for population of 7 years and over ages.



Source: Housing and Population Census, BBS, 2011

Figure 21: Literacy rate among the studied population

Public Health

No major water-borne diseases are prevalent in the project areas since several years. The health service is in a moderate condition in the study areas. No negative impacts are anticipated on people's health as a result of implementing the project. Instead, the project will help increase access to health facilities by improving the township. The Population Census, 2011 identified almost six types of disabilities and their proportionate distribution in the respective areas. On average, 1.1% of Chakoria and 1.7% of Maheshkhali people suffer from all types of disabilities. They suffer from physical impediments, gastric ulcer, high blood pressure, rheumatic fever, asthma, diabetes, and kidney diseases. They requested immediate remedy for these diseases. **Table-33** shows the type of disability people in percentage.

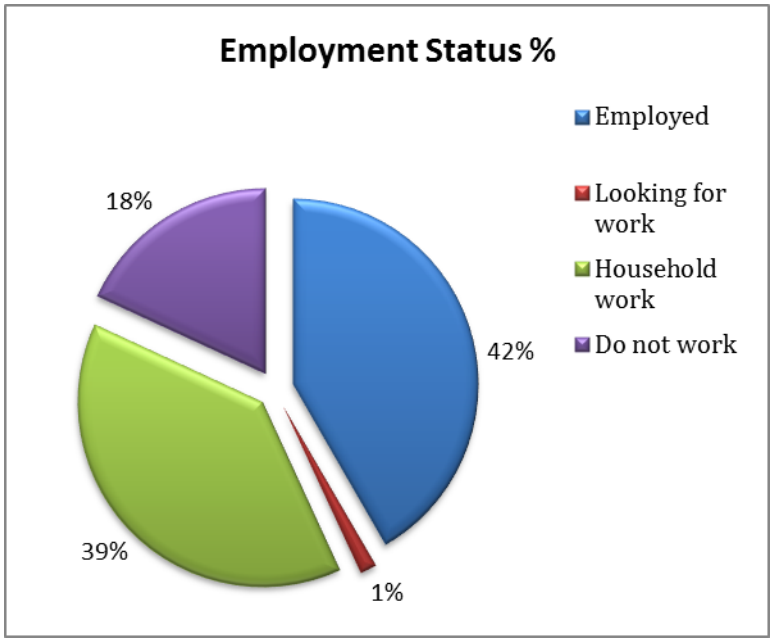
Table 33: Type of disability (%)

Upazila	Type Of Disability (%)						
	All	Speech	Vision	Hearing	Physical	Mental	Autism
Chakoria	1.1	0.2	0.2	0.1	0.4	0.2	0.1
Maheshkhali	1.7	0.3	0.6	0.1	0.5	0.2	0.1

Source: Population Census, BBS, 2011

Occupations and livelihoods

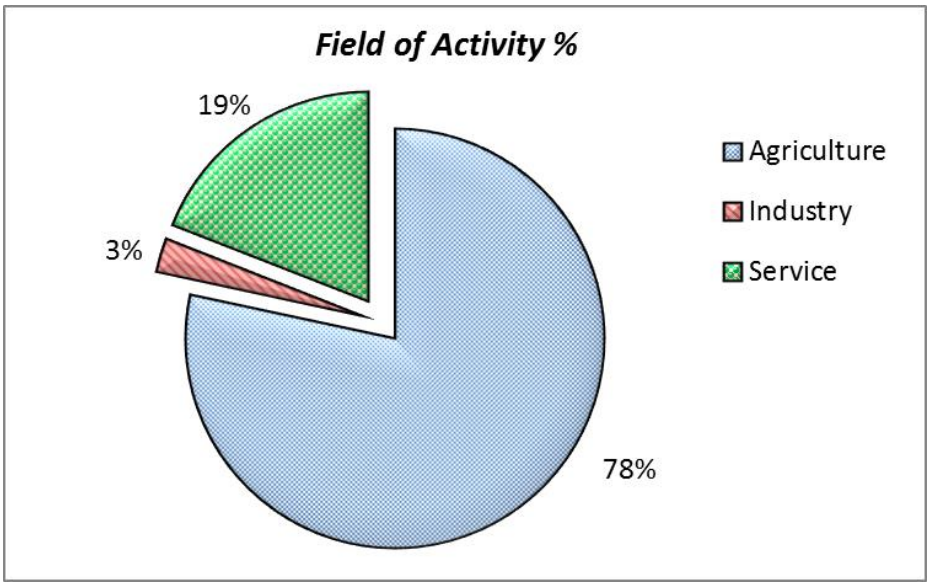
In the study about 42% of total population are employed, 39% are engaged in household work (mostly women), about 18% of total population are not working (it includes children and physically handicapped population) and 1% are looking for work.It is reported by the local people that employment status is quite satisfactory. The economically active population includes those who are aged 7 and over and not attending school at reference period of Housing and Population Census, 2011. Therefore, the definition include employed, looking for work and household work categories and exclude children below 7 years, attending school population, physically impaired and elderly people who are not engaged in income generation works at reference period. Here, household work particularly for women participation is accounted in terms of household activities as well as alternative income generation such as livestock rearing, poultry farming etc. shown in **figure-22.**



Source: Housing and Population Census, BBS, 2011

Figure 22: Employment status among the studied population

Distributing employed population at reference period of the census is found that 78% are engaged in agricultural activities, 3% in industry and 19% in service. Agricultural activities include broadly crop farming, fishery and livestock and poultry farming. The scope of employment in agricultural sectors is gradually decreasing as urbanization and industrial initiatives tending to convert the lands into human settlements and industrial enterprise.

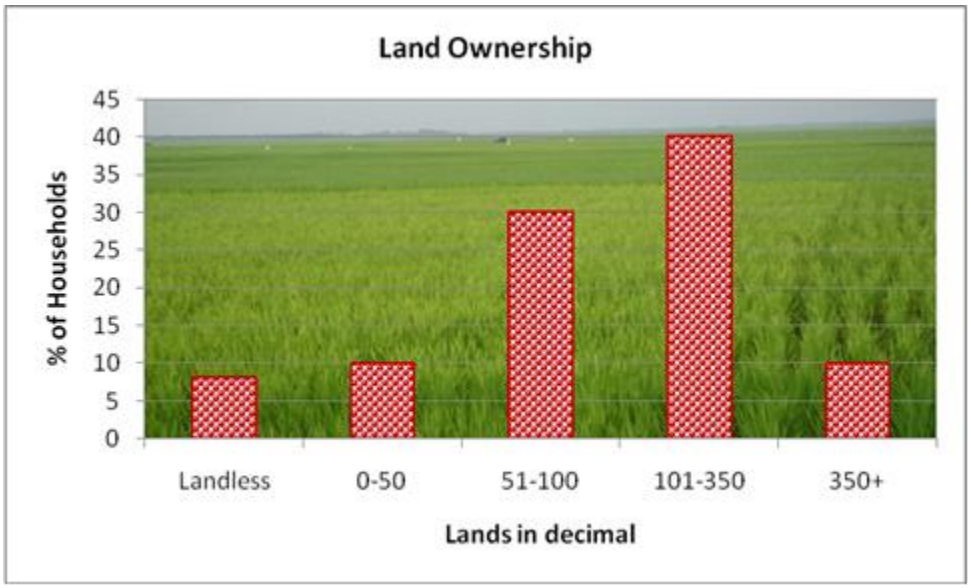


Source: Housing and Population Census, BBS, 2011

Figure 23: Percentage of field of activity

Land ownership

In the study area, it is found that most of the landholders belong to marginal and small ownership category. Here marginal land holding (50-100 decimal) comprises 30% and small holding comprises (101-249 decimal) 40%. There are 8% households belonging to the absolute landless category. Only 2% household are belonging to large category (501+ decimal). The distribution of households according to land ownership categories is given in Figure 24.



Source: Field survey, 2015

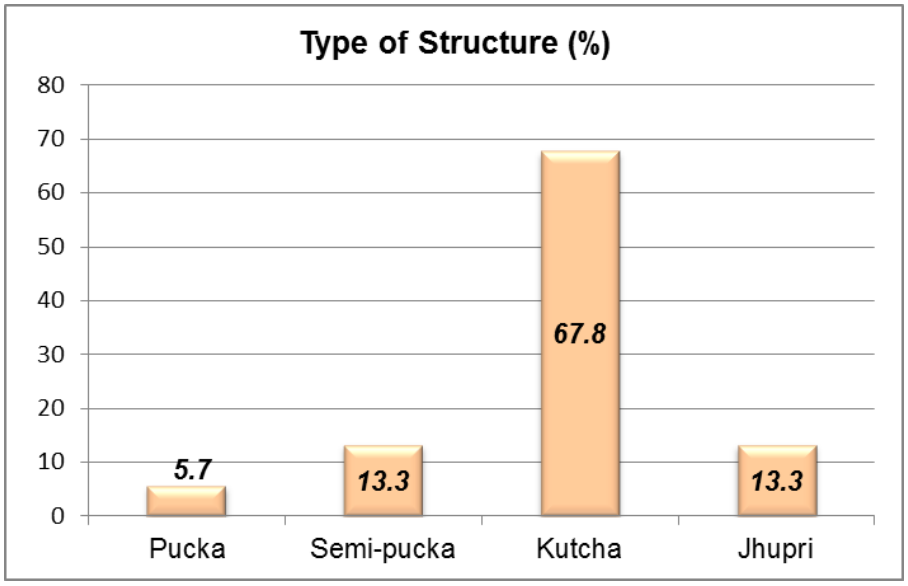
Figure 24: Distribution of households in terms of land ownership

Standard of living

Standard of living indicates the level of wealth, comfort, material goods and necessities available to the studied population. This section defines it narrowly and necessarily includes people' access to electricity, sanitation facilities, safe drinking water availability, housing condition and fuel consumption.

Housing Structure

The study area shows the predominance of kutcha houses (67.8%) over other three types. Semi-pucka household is 13.3%, pucca is 5.7% and about 13.3% is still jhupri houses. It can be concluded here that the people living in the study area belong to the poorer category in term of housing pattern. Housing condition in the study area is illustrated in figure-25.



Source: Housing and Population Census, BBS, 2011

Figure 25: Housing condition in the study area

Photograph-7: Housing status in the project Beneficiary area

Sanitation

Sanitation facilities in the study area show that about 40.4% households use non-sanitary latrines, 41.7% use nonwater-sealed sanitary latrines and 9.6% use sanitary water-sealed latrines. Field findings confirm that non-sanitary latrines are predominant among kutcha houses. As nonwater-sealed sanitary latrines are used by Kutcha, semi-pucka and pucca households. This contains the highest coverage (42%). Water-sealed sanitary latrines are available predominantly in

puccahouses. However, there are 8.4% houses, which have no sanitation facilities but tend to use on shared basis and in some cases uses open spaces (**Figure-26**). Distribution of households by sources of drinking water facilities is illustrated in figure-30.

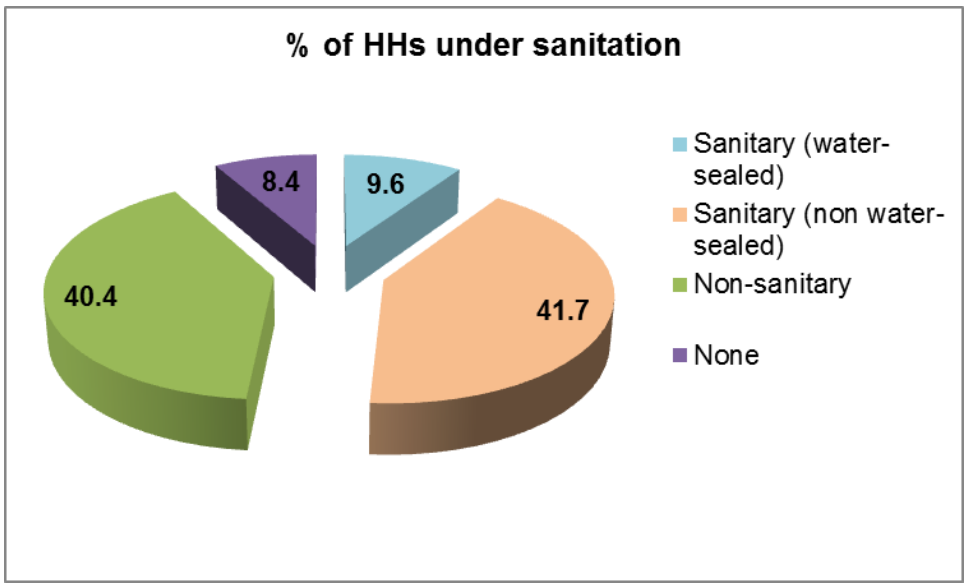
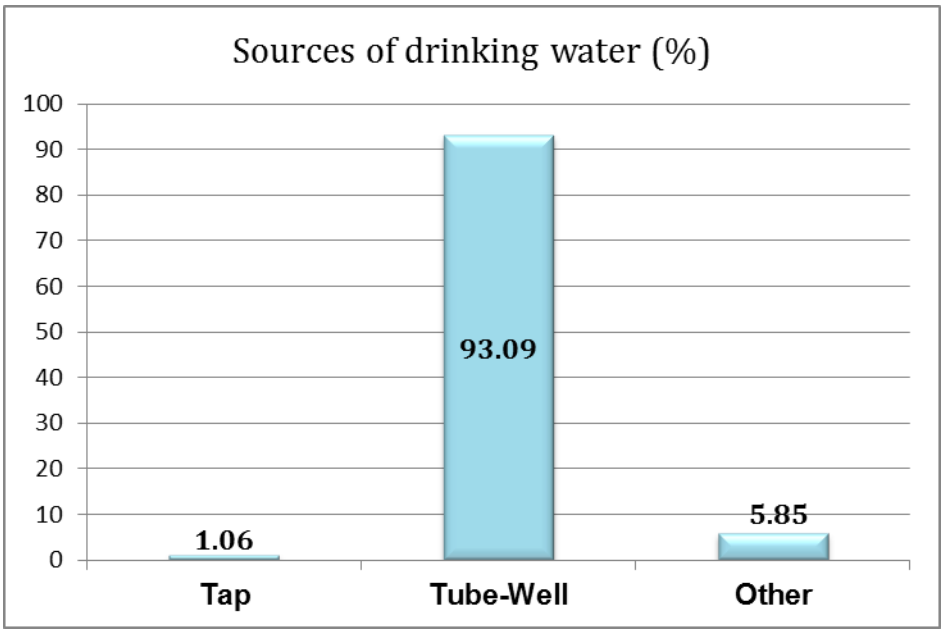


Figure 26: Distribution of households by sanitation facilities

Photograph-9: Sanitation facilities in the study area

Drinking water

Collecting drinking water from tube-well is predominant (93.06%) throughout the study area(figure-27). Supply water (source from Tap) is mainly used in municipal areas on arental basis which is also harvested from theground water. However, 5.8% households are still depending on unorthodox sources of drinking water such as waterbodies ; they are from poor classes and living in the rural areas having no access to tube-wells.



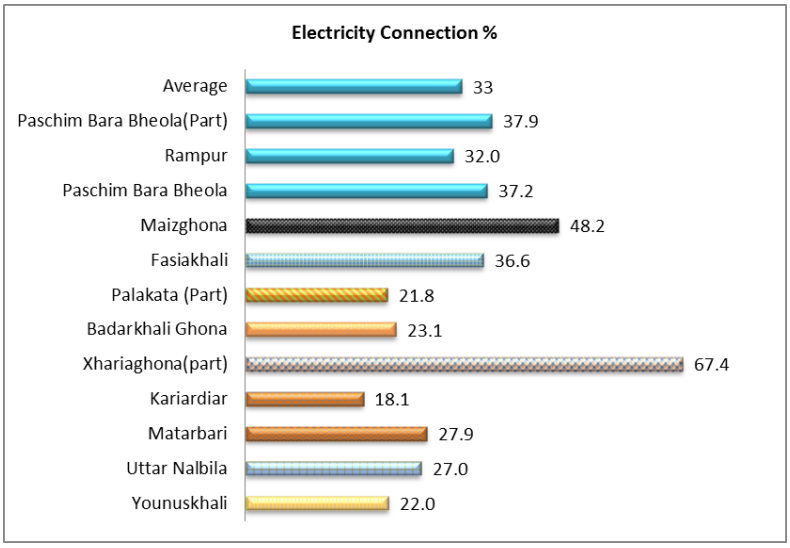
Source: Housing and Population Census, BBS, 2011

Figure 27: Distribution of households by sources of drinking water facilities

Photograph-8: Main source of drinking water

Electricity and Fuel Consumption

Electricity facility as found in Population Census is not satisfactory in the study area. On an average only 33% households are under electricity coverage. Data shows that the highest 42% electricity coverage is in Xhariaghona Mauza and only 18% coverage in Jaldi Kariardiar Mauza of PekuaUpazila (Figure 28).Almost every household in this area mainly uses cow dung sticks as fuel. People also use wood, chips naturally produced herbs and shrubs etc. to meet up their fuel needs.



Source: Housing and Population Survey, BBS; 2011

Figure 28: Percentage of electricity connection at study area

Marital Status

Analysis of marital status of both males and females (Figure 29 and Figure 30) shows that divorce/separation rate is comparatively lower with respect to the other categories and almost equal for both males (0.05%) and females (0.54%). The percentage of widow (6%) is comparatively higher than that of widower (1%).

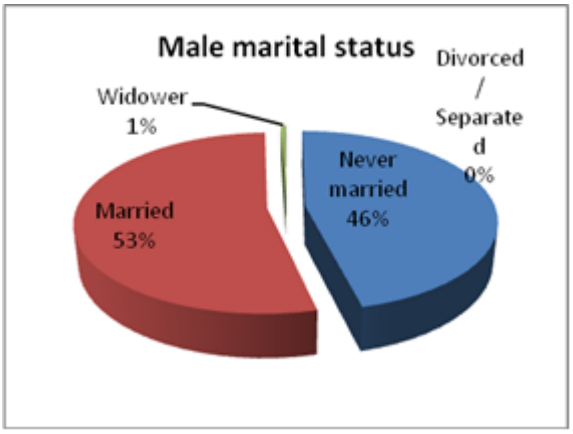


Figure 29: Distribution of males by marital status

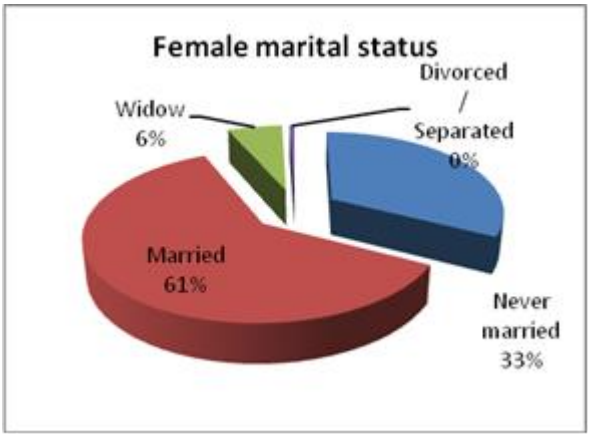


Figure 30: Distribution of females by marital status

6.9.4 Income and poverty

Poverty economic condition in which one is unable to enjoy a minimum standard of living. It is a state of existing in amounts (of earnings or money) that are too small to buy the basic necessities of life. The visible effects of poverty are malnutrition, ill health, poor housing conditions, and

illiteracy. The impoverished people suffer from unemployment, underemployment and lack of access to resources that restrict their opportunities to earn living.

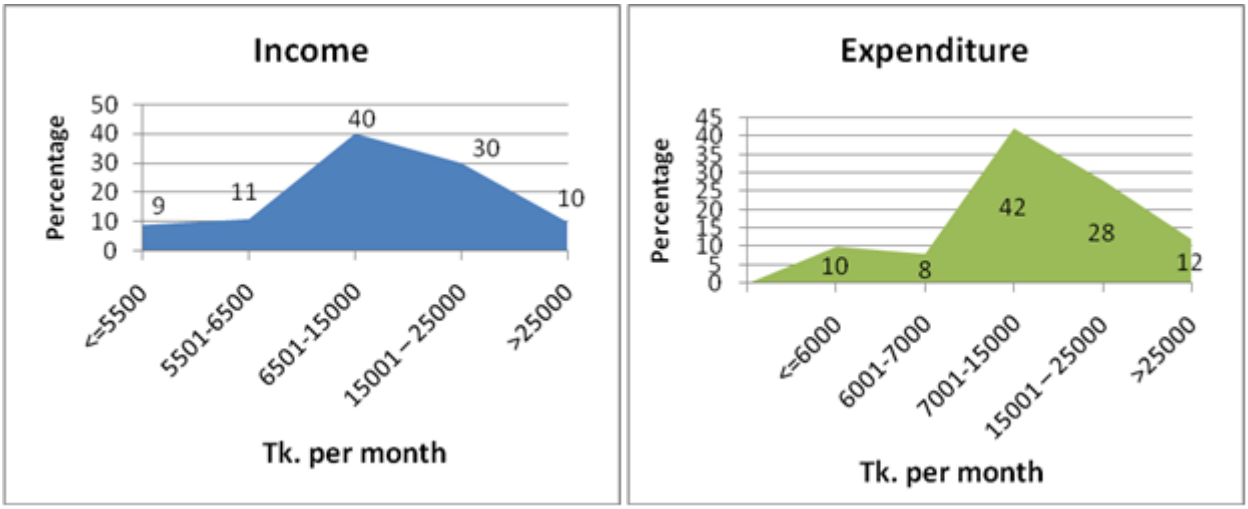
A simple unidimensional definition of poverty followed in Bangladesh during the 1980s was the level of food consumption that provides calories of energy below what was required. Indirect estimates of the proportion of people in poverty were made according to the following method. First, a bundle of food providing the specified level of nutrition (2,112 calories and 58 games of protein per capita per day) was identified based on a compromise between cost and consumer preference. Next, the families with a per capita income below 1.25 times the cost of the specified food bundle were classified as moderately poor, and families with per capita income below 85% of the threshold income for moderate poverty as extremely poor.

Income and Expenditure

Household income and expenditure of the study area was assessed on the basis of field findings. However, the range of income and expenditure was categorized following the poverty line calculated in Household Income and Expenditure Survey (HIES) by BBS, 2010.

It was found that about 9% households can earn less than or equal to Tk 5500. per month, earnings of about 11% households vary between Tk 5501 to 6500 per month. The highest earner households (40%) belong to Tk 6501 to 15000. About 30% household are belonging to the income range of Tk 15001 to 25000 per month(figure-31).

In the study area about 10% households in terms of expenditure are below Tk 6000 per month and 8% household belong to the range between Tk 6001 to 7000. The range of expenditure from Tk 7001 to 15000 are an around 42%. 28% households monthly expenditure is from Tk 15001 to 25000 per month.

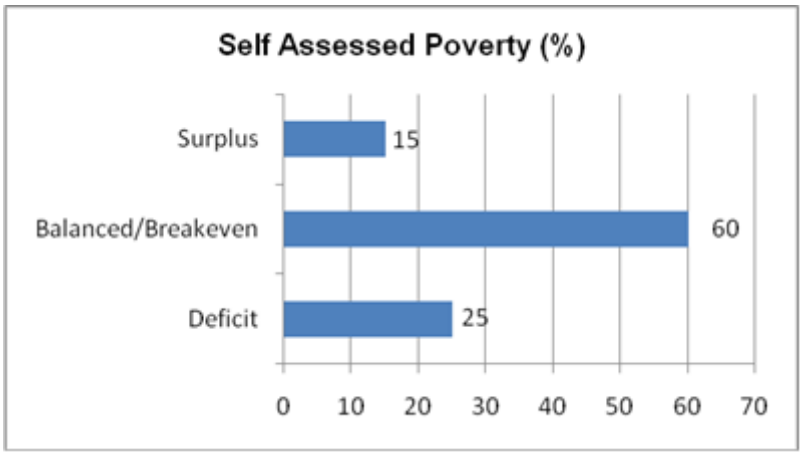


Source: Household Income and Expenditure Survey (HIES), BBS, 2010

Figure 31: Distribution of income and expenditure by rang

Poverty

Poverty has been measured through theself-assessment process in the study area. This measurement was mainly based on monetary value. In this process the respondents were asked to assess the overall condition of people living in the project area. Their responses were assembled into three categories such as deficit, balance/breakeven and surplus.



Source: RRA, 2014

Figure 32: Self-assessed poverty in the study area

Local people assessed that on an average about 60% of total population is living in the balanced or breakeven category, i.e. their economic activities are subsistence oriented. They also reported that 15% people belong to surplus category. People belonging to deficit category are 25%(figure-32).

6.9.5 Gender and Women

Gender equality is a human right but our world faces a persistent gap in access to opportunities and decision-making power for women and men. Globally, women have fewer opportunities for economic participation than men, less access to basic and higher education, greater health and safety risks, and less political representation.Guaranteeing the rights of women and giving them opportunities to reach their full potential is critical not only for attaining gender equality, but also for meeting a wide range of international development goals. Empowered women and girls contribute to the health and productivity of their families, communities, and countries, creating a ripple effect that benefits everyone.

Development cannot be delivered in a vacuum. Water, energy, agriculture and health all affect men and women differently. These differences are not barriers but opportunities to maximize the impact of our work by delivering development in a more targeted, effective and sustainable way. Simply by empowering women farmers with the same access to land, new technologies and capital as men, we can increase crop yields by as much as 30 percent.Gender roles are set of societal norms dictating what types of behaviors are generally considered acceptable, appropriate or desirable for a person based on their actual or perceived sex. These are usually centered on

opposing conceptions of femininity and masculinity, although there are myriad exceptions and variations

However, women rights, land ownership and women dependent households are not equal to man ownership and other facilities in the study areas. The picture of the gender and women has been focusedonthe table 34. The training on gender and development are required in the study area. This training has been included in income loss restoration program which has been planned to implement it as a project work.

Table 34: Gender issues in the study areas

Indicators	**Unit %**	**Quantity**
Women rights are respected	1	45
Land are titled to women	0.5	22
Households depend on women income earner	2	89
Divorced women in the villages	0.1	5

6.9.6 Common properties resources

Common property resources (environmental) are natural resources owned and managed collectively by a community or society rather than by individuals. A resource, such as water or pasture, that provides users with tangible benefits. A major concern with common resources is overuse, especially when there are poor socialmanagement systems in place to protect the core resource. Overuse of common resources often leads to economic problems such as the tragedy of the commons, where user self-interest leads to the destruction of the resource in the long term, to the disadvantage of everyone.

The best examples of common-property goods come from the natural environment. The atmosphere, oceans, other large bodies of water, and wilderness areas are common-property goods. These goods are readily accessible to all users. No one can be excluded from using the air or the oceans. However, the use by one person can impose an opportunity cost on other uses. For example, air pollution can impose an opportunity cost on others through respiratory problems. Or the fish caught by one person cannot be caught by another.

Near the project, there are common property resources like river, groundwater and air. The project has the option to care on "not to pollute air and water or not to consume it excessively".

6.9.7 Conflict of Interest and Law and Order Situation

A conflict of interest occurs when a social worker's services to or relationship with a client is compromised, or might be compromised, because of decisions or actions in relation to another client, colleague, him or herself, or some other third party.Actually, it is a conflict of interest as a situation where regard for one duty leads to disregard of another. When faced with a potential or actual conflict of interest, it is important that social workers consider, even if they feel that they can manage the potential conflict or feel that there are no significant issues, the perception that others (clients, colleagues, the community, employers etc.) may have when/if a conflict of interest comes to light. It is important, therefore, that social workers are proactive in discussing any potential/actual conflicts of interests with supervisors or employers so that all possible outcomes and interpretations of actions and situations can be explored. There have been instances where complaints had been made against social workers when they have failed to

consider all possible outcomes and failed to consider how a seemingly innocent action could be perceived in quite the opposite way by another person.

The project has the option to hire local employees, technical and general, including labors for escaping from conflict among the local people and project administrators. For minimizing the conflicts, there would be established a grievance redress committee in the project area.

Law and order situation of a country is dependent not only on a stronger police force but also on a general improvement in the economy and an increase in civic responsibility. People are not born criminals but turn to crime when there are no alternative employment sources or the discrepancy between the rich and the poor is too large to breach. One of the Awami League's election promises was to improve the law and order situation in the country after assuming power.

Crime is perceived to be not increasing in the study areas. The news of serious crimes like hijacking and murder are not heard in the project area. Overall law and order situation is good in the study area. Present Government has initiatives to improve the law and order situation in every District of the country. So, implementation of any project will get benefit from this initiatives.

6.9.8 Historical, Cultural and Archaeological Sites

There are no Historical, Cultural and archeological sites within the proposed Project areas. Even, the Department of Archaeology under the Ministry of Cultural Affairs has no designated archeological site within the Project areas.

Cultural Heritage:

Bangladesh's cultural history stretches a long way back into past eras. Bengal (including East Bengal which is now Bangladesh) was probably the wealthiest part of the subcontinent up until the 16th century. "The area's early history featured a succession of Indian empires, internal squabbling, and a tussle between Hinduism and Buddhism for dominance. All of this was just a prelude to the unstoppable tide of Islam, which washed over northern India at the end of the12th century." (SAARC Tourism, 2009).

All of these historical and political overlays, have merged into the rich variety of physical features such as the land (flat plains cross-stitched by 700 river systems; mountains bordering neighboring India and Myanmar; and the coastal region and world famous mangrove forests) which has fashioned the lives of the common people; their beliefs, their traditions and their way of life to form a rich heritage with significant marked differences from neighboring regions.

The culture of the study areas is composite and has assimilated influences of Hinduism, Islam, and Christianity. It is manifested in various cultural forms, including music; dance and drama; art and craft; folklore and folktales; literature, philosophy and religion; festivals and celebrations; and, not least, an amazing culinary tradition. The Project will in no way interfere in this rich, unique and valuable physical and cultural heritage.

6.9.9 Current use of land and resources for traditional purposes by indigenous peoples

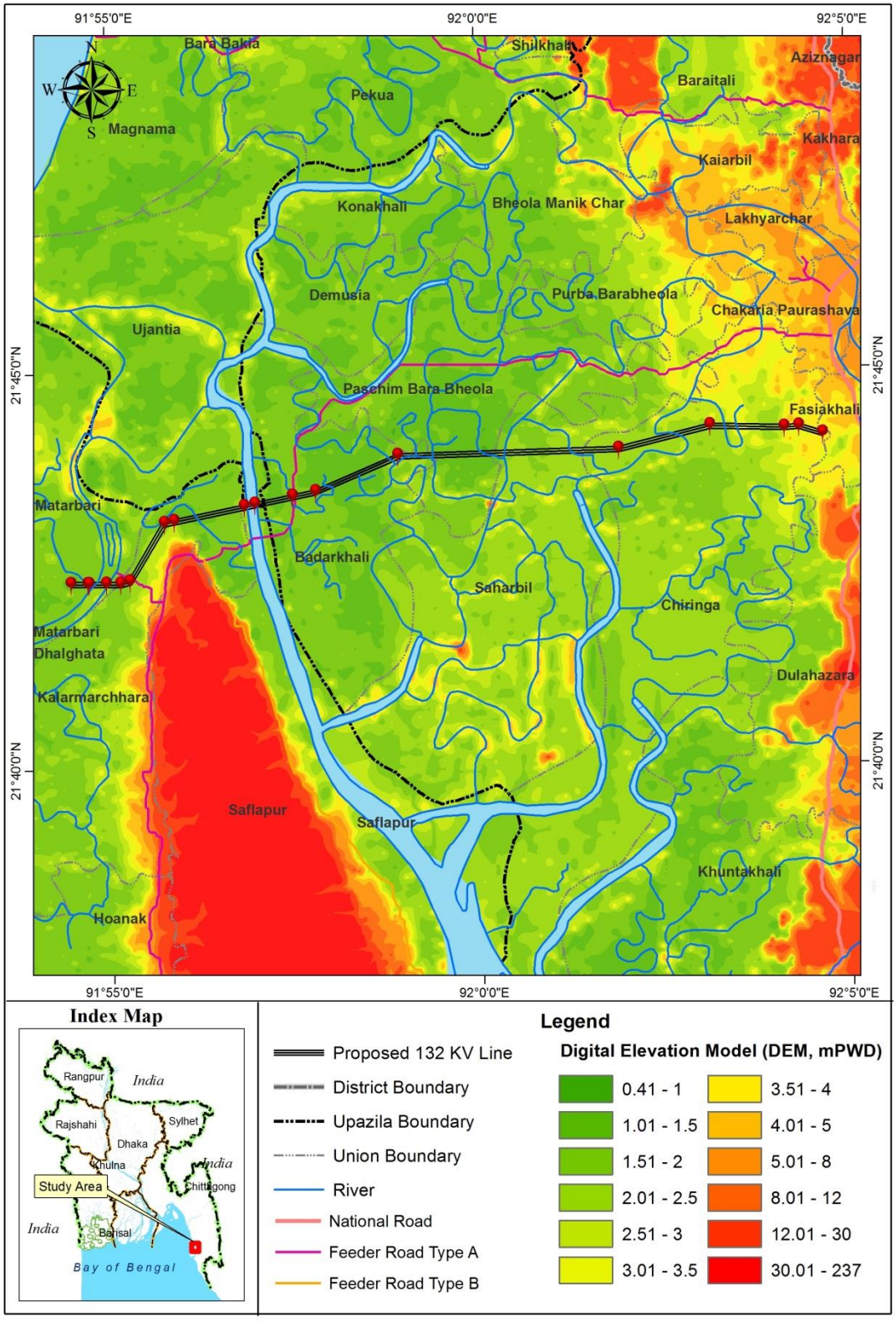
There are no indigenous minority people in the proposed project areas. So, indigenous minority people will not in any way be negatively impacted by the Project. Even, the infrastructures do not pass through his type of the communities. Rather, the project will benefit all the peoples in the study areas as a result of the construction of Chakaria-Matarbari 132 KV Transmission line.

6.10 Topography, Geology & Seismicity

6.10.1 Topography

Topographic data is very important for the assessment of land classification and inundation pattern. Topographic information from the study area was collected from the BWDB contour maps and SoB Topographic maps. The map has been updated incorporating other features such as alignment of the khals, river, road, beels etc. and a Digital Elevation Model (DEM) has been developed using the spatial analysis tool in ArcGIS.

The proposed Chakaria-Matarbari 132 KV Transmission line is locatedin the Cox's Bazar coastal area where the land is gently sloped towards the sea. This site is about 9.0 km northwesterlyfrom Kutubdia Island and 3 km southward from Chakaria Upazila. From digital elevation model (DEM) analysis it is found that the study area of the proposed Chakaria-Matarbari 132 KV Transmission line has an elevation of 2.5 m ~ 5 m above MSL (Map 9), where land elevation increases towards the hills and decreases towards the Bay of Bengal.

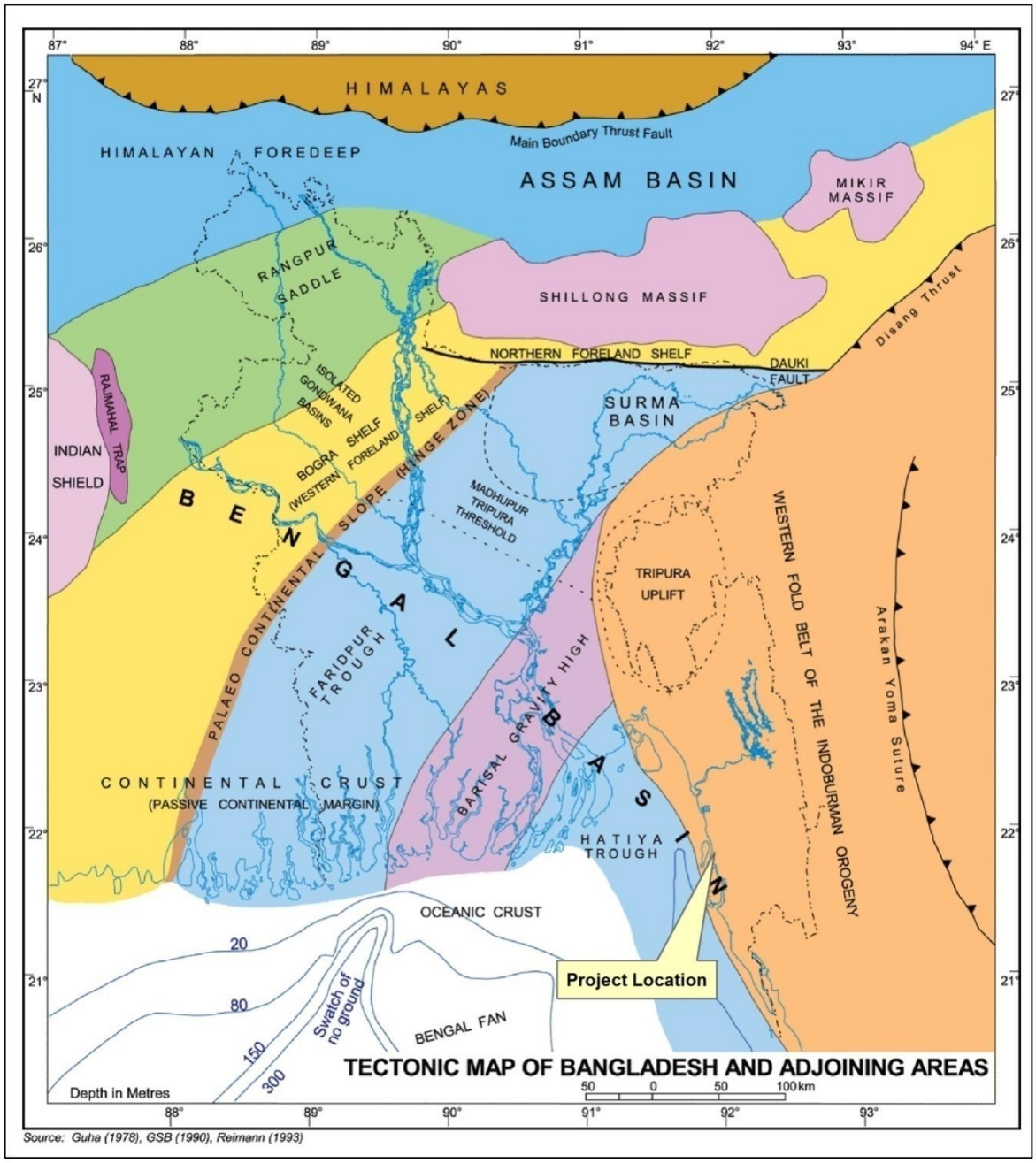


Map 9: Digital Elevation Map of the study area

6.10.2 Geology

High hill ranges striking towards North-south occupy the entire districts of Chittagong, Cox's Bazar and the three Hill Tract districts. The anticlines form the hills and synclines the valleys. The lowest ranges generally follow the eastern coast of the Bay of Bengal from Feni River to Naf River. However, a narrow strip of coastal plain about 96.5 km long averaging about 9.66 km wide, developed due to a fault along the Sitakund anticline (Hussain and Abdullah, 2001).
The project area falls under the Chittagong plain as per thephysiographical classification of Bangladesh (Rashid 1991). The coastal plain includes generally narrow strip of land between the Chittagong hills and the sea, together with the Halda, lower Karnaphuli and lower Sangu river floodplains, and the greater part of the off-shore islands. The unit consists of gently sloping, mainly loamy, alluvial flats adjoining the hills, and extensive level clay plains adjoining the three main rivers. Tidal clay plains occupy most of the off-shore islands in the south. Most of the area is subject to shallow flooding and to flash floods from the hills. It is also exposed to thecyclone.

The Neogene sedimentary sequence developed here are largely unfossiliferous and consists mainly of the alteration of shales, clays, clay stones, siltstones and sandstones with occasional intra-formational conglomerates. Generalized tectonic map of Bangladesh is shown in map-10.



Map 10: Generalized tectonic map of Bangladesh

6.10.3 Seismicity

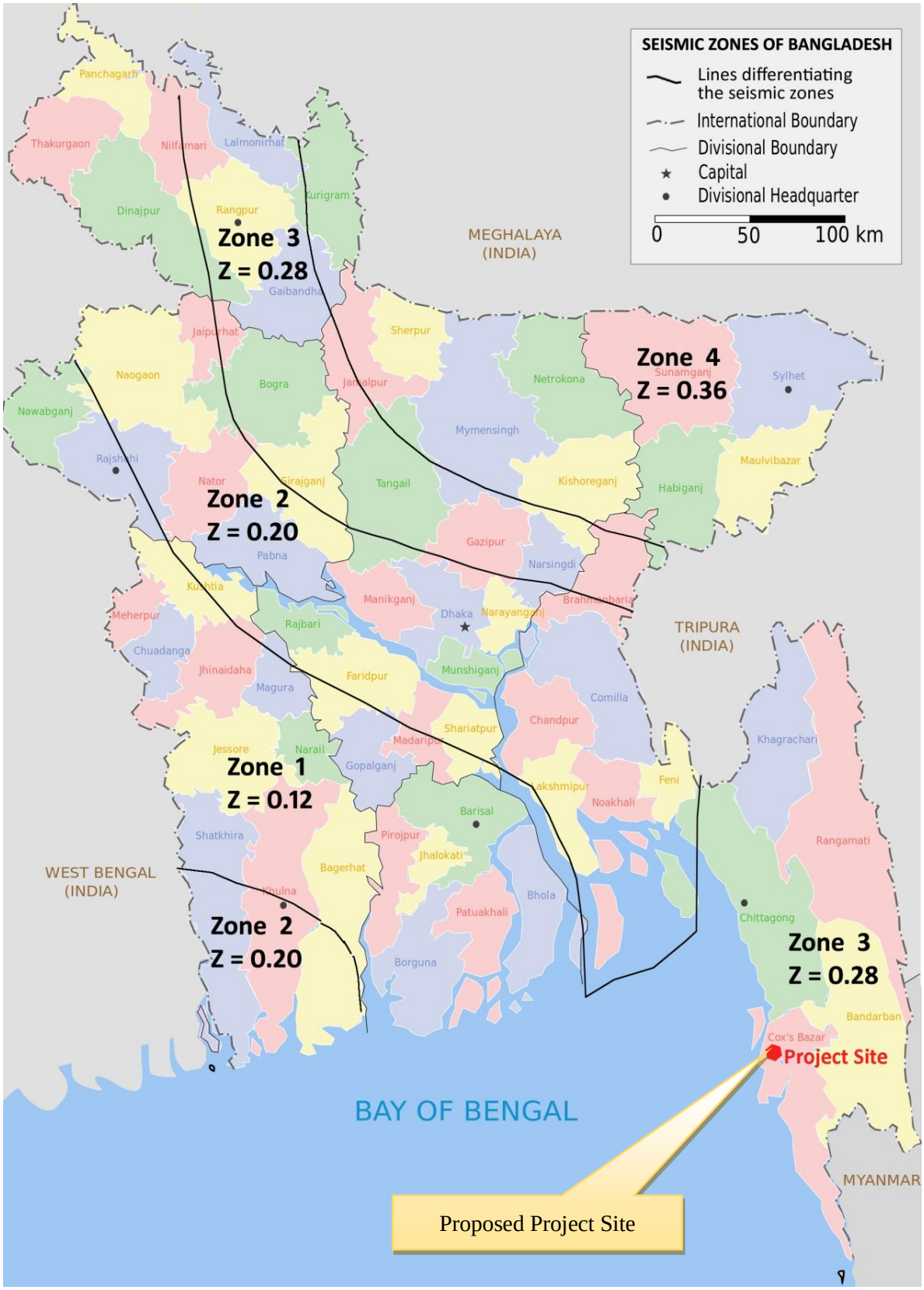
Earthquake is one of the most deadly natural disasters that may affect the human environment. Even a relatively moderate earthquake can cause a very large number of deaths. Although in recent past no major earthquake has affected this country, a major event may affect the country at any moment. Details of seismic intensity and the historical

records of major earthquakes in and around Bangladesh that occurred during last 250 years are presented in **Table-35.**

Table 35: List of Major Earthquakes in Last 250 Years

Sl. No.	Year	Source Area	Magnitude (Richter Scale)	Depth (Km)
1	1548	Sylhet	-	-
2	1664	Shillong-Plateau	-	-
3	1762	Chittagong-Arakan	-	-
4	1858	Sandway, Myanmar	6.5	-
5	1869	Cachar, India	7.5	48
6	1885	Sirajganj, Bangladesh	7	72
7	1897	Assam, India	8.1	60
8	1906	Calcutta, India	5.5	-
9	1912	Mandalay, Myanmar	7.9	25
10	1918	Srimangal, Bangladesh	7.6	14
11	1930	Dhubri, India	7.1	60
12	1934	Bihar, India-Nepal	8.3	33
13	1938	Mawlaik, Myanmar	7.2	60
14	1950	Assam, Himalaya	8.6	25
15	1954	Manipur, India	7.4	180
16	1975	Assam, India	6.7	112
17	1984	Cachar, India	5.7	4
18	1988	Bihar, India-Nepal	6.6	65
19	1997	Sylhet, Bangladesh	5.6	35
20	1997	Bangladesh-Myanmar	5.3	56
21	1999	Maheskhali, Bangladesh	4.2	10

To analyze the earthquake entire Bangladesh is subdivided into four seismic zones where Banshkhali is located in the earthquake zone III (Map 11) according to the draft of Bangladesh National Building Code (BNBC) updated in 2012 (Sarraz A., et. al. 2015). This zone –III comprise of NNW-SSE area including Chittagong – Tripura folded belt where the basic seismic coefficient is 0.28. There is a possibility of an earthquake in this region as because the region is located adjacent to the Burmese Arc, where a large number of shallow depth earthquakes originate. On 22 July, 1999 a notable earthquake occurred at Maheshkhali Island with the epicenter in the same place. The Richter scale magnitude of that earthquake was 5.2 and the surface wave magnitude was 4.2 feeling severely around Maheshkhali Island and adjoining areas. In that incident fatalities were explored as: death 6 persons, injury 200 persons, a number of houses faced crack while some havecollapsed (SADKN, 2012).



Map 11: Project site shown on seismic zone map

6.11 Economic Development

6.11.1 Industries

There are minor industrial activities in or around the Project areas. So, no local industries will be affected by the Project activities.

6.11.2 Infrastructure facility

Economic Development of an area can be influenced by many factors, particularly geographic location; resource availability; and infrastructure. Significant infrastructural facilities such as water supply, sewerage lines, and drainage system are generally poor in the catchments areas of the Project principally because the Project is located in rural areas. Therefore, in their absence no analysis has been made for this aspect of community services. However, it should be noted that the Project would help to improve other infrastructure facilities.

6.11.3 Transportation System

The transportation system is one of the important indicators of regional infrastructure development. Promotion and development of transportation systems directly or indirectly imply the socio-economic development of a region. At present, road and river are the only means to reach the project site. The communities are using the rural pucca and brick soling road for their communication inside the study area.

6.11.3.1 Road Communication System

The project site is locatedon the south-eastern side of Chakaria Upazila Headquarter. To reach the Chakaria Upazila, Chittagong – Cox's Bazar national highway have to be selected. The overall condition of the road is relatively good and buses, trucks and CNG regularly pass over this road between Chakaria to Chittagong. A number of feeder roads join with the Chittagong – Cox's Bazar national highway. Among these feeder roads, the Chakaria - Moheshkhali road will be used as a main access road for the project.

6.11.3.2 Water Communication/Navigation System

Western part of the project site is open sea where vessels move regularly. The residents of Matarbari union use the Maheshkhali Channel and Matamuhuri River significantly for transportation. Waterway is also important transport systems for communication with far places from the study area. In addition, a number of formal and informal boat stations (ghat) are found at different places across the Maheshkhali Channel and Matamuhuri River. Engine boat, sea going fishing boat is found during field survey. Gentle slope of the project onshore area retards boat or other vessel to the project site during low tide period. Therefore, use of tidal movement is important for waterways transportation in the study area.

6.11.3.3 Railway Communication System

No rail communication system has yet been developed in the study area. Only a single meter gauge train route goes up to Dohazari of Satkania Upazila, which is almost 50 miles far away

from Cox's Bazaar. However, Bangladesh Railway has a plan for extending the rail network in Chittagong-Cox's Bazar region.

6.11.3.4 Air Communication System

Shah Amanat International Airport, Chittagong is located at the north of the project site. The direct distance of the international airport from the project site is 75 Km. International and the domestic flight is available to carry passengers and commodities. Moreover, the Cox's Bazaar domestic airport is located at 35 Km south from the project site.

6.12 Coastal Resources

The proposed project is adjacent to the Bay of Bangle which is about 5.0 km eastern side of the proposed project site.

6.13 Power Sources and Transmission:

The national power grid provides electricity directly to the district and the Power Development Board (PDB) supplies electricity to limited areas of the project through its distribution lines. Some landowners generate solar energy; produced energy with diesel generators are using as the energy for their household needs when load shedding occurs. In most cases, electricity is partially available in the proposed project areas. In a very few cases, electricity is being supplied by Power Development Board(PDB) but load- shedding is carried out on an average of about 3-4 hours per day.

No potential negative impacts were identified regarding the interrelation of the project and other power generation and its transmission. Because the project will help to produce electricity which is required to start the constructing work of Matarbari coal based 1250 MW power plant. This power plant will supply electric power to the national grid, thus our nation will be benefited. So, the project is very much helpful to supply electricity in the locality as well as help to start the constructing work of Matarbari coal based 1250 MW power plant. Thus, electricity problems over the country including local demands of electricity would be overcome partially after completion of the project. The Project will create a positive impact on the quality of livelihood in the project areas which is one of the major objectives of the scheme.

6.14 Mineral Resources:

The project areas do not have any major mentionable mineral deposits. Thus, apart from not using any locally available mineral deposits, it is anticipated that the proposed project will not generate significant demands for using any of the natural resources of the surrounding area.

6.15 Tourism Facilities:

The project area is located 40 km North side from the largest sea beach Cox's Bazar of Bangladesh. It is anticipated that the proposed project will not createa significant negative impact on tourism facilities. Rather, the project will help to increase tourism facility in Matarbari sea beach area through thecontinuous power supply.

7 IDENTIFICATION AND ANALYSIS OF KEY ENVIRONMENTAL ISSUE

7.1 Environmental Sensitivity Investigation

The environmental threats like Flood, Drought, River bank erosion, cyclone, deforestation etc. are enormous sensitive to the natural environment and also human and other organism's habitats. The probable threats with their sensitivity observed in the study area have shown in Figure 33. Sensitivity has been determined on the basis of score obtained. Sensitivity categories are divided into 3 types namely low sensitivity (0-4 score), medium sensitivity (4-8), high sensitivity (8-10) and very high sensitive (above 10). The figure has shown that only Flood is medium sensitive and Cyclone is high sensitive but other threats are low sensitive to the natural environment. So, Flood and Cyclone sensitivity should be considered in the design of the environmental requirement of the project.

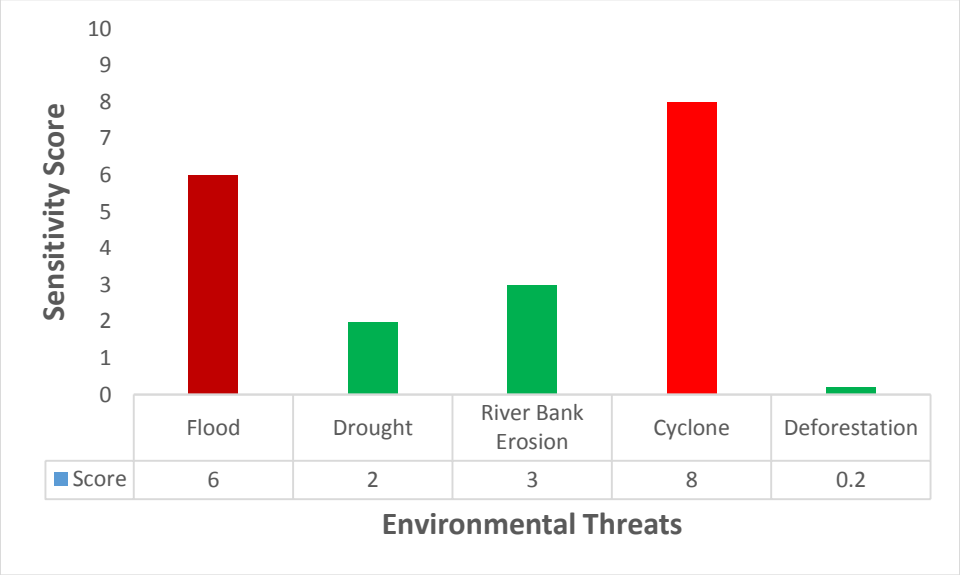


Figure 33 : Graphical presentation of environmental sensitivity against different threats occurred in the study area.

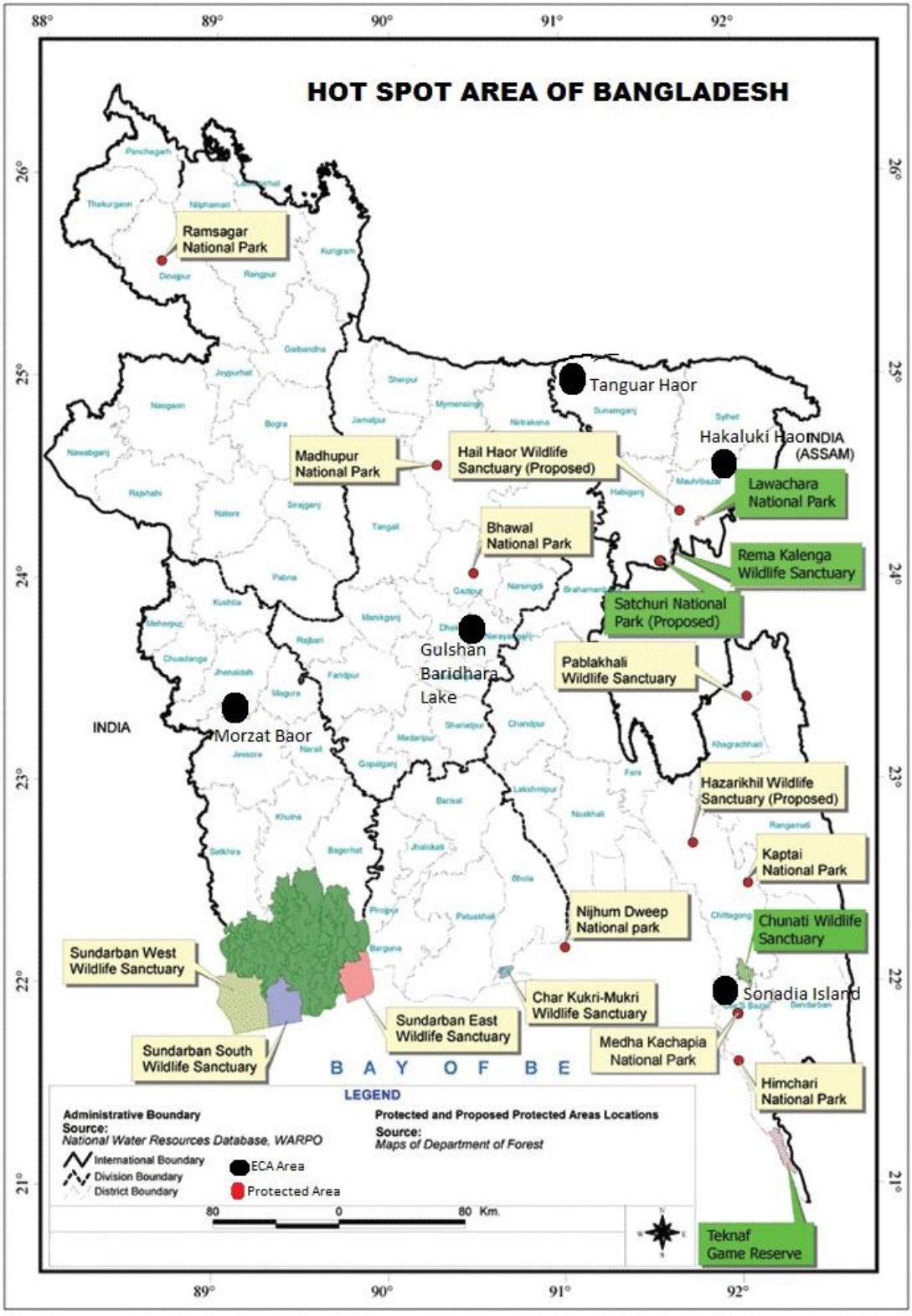
7.2 Environmental Asset

Environmental assets are assets of the natural environment. These consist of biological assets (produced or wild), land and water areas with their ecosystems, soil assets and air etc.

Environmental assets are naturally occurring entities that provide environmental "functions" or services. Environmental assets cover all assets including those which have low economic values, but bring indirect uses benefits, options and bequest benefits or simply existence benefits which cannot be translated into a present day monetary value. However, the environmental assets of the study area specially land resource, water resource, agriculture resource and fisheries resource are stated in details in the chapter -6 of this report.

7.3 Environmental Hot Spot

Environmental Hot Spots like protected area, ECA (Ecologically Critical Area) and other areas which is sensitive to the ecosystemare shown in the Map 12. As per the investigation, there is no hot spot in the study area. The nearest ECA area, Sonadia Island, is far from the project which is above 15 km. So, no analysis is required for the subject mentioned to establish the project.



Map 12 : Hot spot areas of Bangladesh

7.4 Beneficial Impact

The beneficial impacts for the project implementation is many things like poverty eradication of the local people through increasing their incomes by means of increased power supply ; GDP increasing, Industrial & Agricultural Development, Creating job opportunity; Increasing social service etc. The below figure (34) has shown the probable project benefits that would be after implementing the project works.

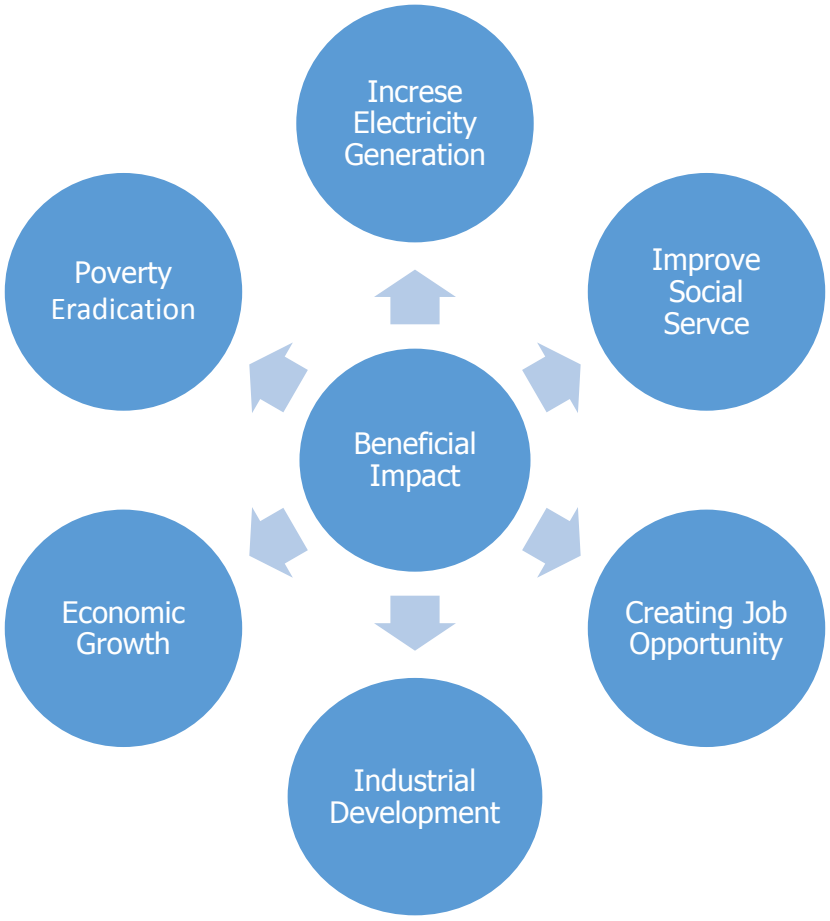


Figure 34: Beneficial impacts of the project

8 ENVIRONMENTALAND SOCIAL IMPACTS AND MITIGATION

8.1 Introduction:

This section of the report presents the potential environmental impacts and mitigation associated with construction and operation of the project and is based on 'superimposing' the project components onto the compiled baseline during the various studies.

All activities related to the lifecycle of the project will include appropriate mitigation measures to ensure that negative impacts are properly mitigated and managed. Mitigation involves identifying the best options to be adopted to minimize or eliminate negative impacts, highlighting the benefits associated with the proposed project and the protection of public and individual rights. Practical measures are therefore sought to reduce adverse impacts or enhance beneficial impacts of the project.

Overall, the project is designed to be very beneficial to the people of the project area through theprovision of power supply and also economic development. The majority of potential adverse impacts are associated with the disruption of environmental factors during construction of the infrastructure within the project area. An Environmental analysis has been done for the impact valuation and also project feasibility where total Environmental Impact Value (EIV) of the proposed project is shown +40 which will improve to +53 with proper implementation of the recommended EMP including mitigation and enhancement measures (Appendix-08).

The baseline knowledge stated before permits identification of environmental parameters that may be affected by the proposed project. The potential positive and negative changes resulting from the project activities are predicted for the project area during the construction phase and into operations. These predicted changes (impacts) are then evaluated using a significance ranking. An outline of the impact assessment procedure is as follows:

- Identification of the baseline receptors;
- Identification of the key project activities;
- Impact evaluation; and significance ranking.

In a project of this magnitude and complexity there are some impacts which could affect soil, and water quality, and which could cause hindrance (noise, dust, traffic) or pose safety hazards (health and safety). The majority of these impacts is less significant and could be avoided, prevented or mitigated by contractors adopting good operational practices and environmental management guidelines and by continuous monitoring and inspection. Mostly, all impacts could be prevented or mitigated by exercising of the Environmental Code of Practices and Environmental Management Guidelines.

8.1.1 Screening of Potential environmental Impacts and Control Option

Using the 'Sectoral Environmental Checklist' of the Department of Environment and the Donors requirement for Environmental Assessment, all negative environmental impacts of the Project has been screened out. Those negative impacts that could have resulted in significant adverse effects were identified, assessed with recommendations for corresponding mitigation measures.

In order to mitigate any anticipated biotic and abiotic pollution problem and in order to comply with Financing Entity and DoE environmental safeguard policies, special attention will be given in formulating and implementing protective measures for the preservation of natural environmental features in and around the Project areas.

Nevertheless, it is important that the monitoring and evaluation of the project should ensure that appropriate measures are properly taken to protect both the physical and human environment from any possible negative impacts, such as various types of pollution, any disruption to the normal daily life of people and fail to improve the quality of life from power supply and economic interventions of the project.

Resettlement and land asset (agricultural land) acquisition and resettlement are always the significant issues in the project of this nature. It is planned to keep these to an absolute minimum. The project has options to take over the private land through acquisition from the inhabitants of the study area.

Potential environmental impacts of the project have been assessed by considering the cause-effect relationship between the proposed engineering interventions and the existing environmental conditions. The assessed results in terms of Project's stages, negative impact issues, impact types, and mitigation measures against anticipated issues are listed and discussed shortly below:

I) **Temporary warehouse or stack yard and labor shed construction-**There will be the need for the temporary construction of warehouses for storing and staking construction materials and labor sheds for accommodating laborers;

ii) **Drinking water and sanitation problems-**Drinking water and sanitation arrangements will be required to be set up for workers.

iii) **Infrastructures construction or soil filling-**In case of infrastructures construction or soil filling during monsoon, there should be a scope for the aquatic fish and other fauna to release to the nearby aquatic reservoirs.

iv) **Environmental pollution due to construction site waste–** There may be some water pollution; separate facilities will be required for men and women. Specific attention is needed for the potential problem arising from unplanned disposal of waste materials from construction activities and oil and fuel leakage from machinery and equipment;

v) **Noise, vibration and dust–** It is likely that some noise, vibration and dust will be generated from running equipment at the construction sites; these types of hazards, especially noise and vibration, might also be occurred in operational stages of the project. To protect and mitigate the hazards, EMP should be followed strictly.

vi) **Loss of land and assets-** These losses might be happened in the pre and post-construction phases of the project; to overcome the problem, proper compensation including cash compensation for land acquisition and other assets, livelihood and income restoration initiatives etc. have to be undertaken.

vii) **Soil erosion and loss of soil fertility-**Soil erosion and loss of soil fertility due removal of top layer soil by cutting for construction; to avoid this threat situation, EMP recommendation provided in the relevant section should be followed.

Viii) **Pollution for Solid and liquid waste disposal-** This type of pollution might be occurred during construction and operation phases of the project. This project has an option to implement the waste management plan that will be made before the construction to minimize the pollution.

The nature and scope of the environmental impacts which are attributable to the project include:

(I)**Temporary warehouse or stack yard and Labour shed Construction –** The construction of temporary structures is expected to have an insignificant impact due to its small scale and co-terminus with the construction phase.

(ii) **Drinking water and sanitation arrangements–** The supply of drinking water for workers at the construction site will be arranged by the sinking of tube wells. Temporary latrines connected with theseptic option will be provided. This consists of three main parts: the septic system, the drain field (Soak pit), and the soil beneath the drain field (Soak-pit). Care will be taken to ensure that no effluence affects the communities in the area.

(iii) **Environmental pollution due to construction site waste–** It is likely that solid waste, such as construction debris and excavated/dredged materials might be generated during the project implementation process. Without legally and hygienically approved disposal methods, this waste could become a source of pollution of the natural environment. Contractors must guarantee to take away all solid waste, both non-hazardous as well as hazardous according to ECR 97.

(iv)**Vegetation removal and terrestrial biodiversity loss–** During the construction of infrastructure, it might be necessary to remove some trees though it is very small numbers, shrubs and/or other vegetation in the study area. The nature of this inconvenience will be temporary as these effects would be mitigated by implanting and replacing trees, shrubs and/or other vegetation. The loss of assets will be compensated, if occurred.

(v) **Noise, vibration and dust–** Noise, vibration and dust might be generated from construction works especially from the operation of motors/generators; being diesel or petrol. The sources of most of the pollutants are usually the brick/stone crushing machines; when used for producing brick/stone or gravel chips. These types of hazards, especially noise and vibration, might also be occurred in operational stages in the power sub-station area. To protect the hazards, EMP should be followed strictly. The emissions from equipment during transportation, construction and operation phases will be substantial, however, since the Project is located in a rural environment and construction sites are somewhat far from the residences, it is likely that, in the most cases, a minimal negative environmental impact during construction and operation phases are anticipated.

(vii) **Eutrophication and unwanted weed growth in the closed water bodies–** These potential problems will be minimized during construction and operational phases by avoiding the discharge of wastes into the water bodies.

(viii) **Soil erosion–** The Proposed Project may be responsible for creating a cause for soil erosion. This may occur particularly on the slopes of each side of the sub-station. This problem will be mitigated by adapting correct design including adequate compaction of

soil and planting trees on the internal road and around the sub-station followed by placing turfing and introducing effective maintenance procedures.

(IX) **Natural habitat and Land use change-** A few negative impacts might be occurred on the land use pattern and natural aquatic habitat of the study area, because all ground area for proposed infrastructures' construction, presently using as agricultural land, would be changed into a raised land as sub-station or foundation of electric towers.

In case of infrastructures construction or soil filling during monsoon, there should be a scope to release or let out the aquatic fish and others fauna to contiguous aquatic reservoirs for overcoming the damage of aquatic flora and faunas of the natural aquatic habitats. It is noted that all specified filling soil will be supplied by contractors and this soil will be collected from designated disposed area or barren areas or non-agriculture land.

Steps to be taken to mitigate the identified potential adverse environmental impacts (according to ECR 97) will include:

(i) **Temporary warehouse and labor shed construction–** upon completion of the construction work these temporary structures will be carefully demolished and removed without any residual impact on the environment;

(ii) **Drinking water and sanitation arrangements–** temporary facilities will be removed later without any residual adverse impact. Septic tanks will be de-sludged and produced decomposed waste will be disposed of after meeting acceptable effluent standards.

(iii) **Environmental pollution due to construction waste-** It can include several sources for the damages. One of the principal sources could be waste water run-off from vehicle and plant washing, which, combining with oil could have leaked from machinery or motors would have a serious effect on both the water table as well as on the surface water of the surrounding land areas including the soil. It is mandatory for the contractor to plan and implement a sustainable drainage system (SUDS) prior to the commencement of construction work. There are a variety of copes for SUDs from which to be selected some like; Infiltration trenches, Infiltration drain, Filter drains (French drains), etc. All types of project work including bunding work will be undertaken to ensure that pollutants do not drain into waterways. Solid wastes, including construction debris and dredged materials will be disposed on government-approved sites only.

(iv) Tree removal and terrestrial biodiversity loss– tree removal will be almost zero, however other relevant vegetation if found necessary to cut, will be replaced at least at the level of existing vegetation prior to the commencement of the project activities.

(v) Noise, vibration and dust– earmuffs will be supplied for workers to wear when working close to machinery to protect them from any negative health impact created by the excess noise. Water will be sprayed on any surface areas related to project activities on a regular basis to suppress the dust created over and above normal levels prior to the commencement of the project. Vibrator insulator/pad will be utilised for machines, power transformers, diesel pumps/motor as well as diesel generator to protect /minimize vibration.

(vi) Waste management–Wastes produced during the construction and operational phages include i) Solid ii) Semisolid iii) Liquid and iv) hazardous. Over all wastes can be classified as hazardous or non-hazardous. Disposable Biodegradable wastes produced from the project area will be transferredto composting pits/chambers to make bio-fertilizer for forest land and other liquid waste will be transferred into theseptic tank with soak well. Hazardous wastes will be transferred to a safe location as mentioned in the Environment and Conservation Act 1995 and the Environment and Conservation Rule, 1997.

8.2 Ascertaining or Identification of Potential Impacts and its analysis in details

General Considerations

As it is the case for most projects development activities, potential negative impacts sometimes could be far more numerous than beneficial impacts. The regional and national economic benefits associated with the implementation of any development are considered to run the project. However, it is generally expected that these long-term benefits will ultimately trickle down to the local population and will make a contribution for the improvement in the quality of life.

Likewise, the indirect benefits of strengthening of technical capabilities of local persons through association with foreign experts and other training elements, which may form part of a project, have been considered to fall outside the scope of impact.

Scope of Impacts

The potential impacts due to implementation of the project are identified by Using Simple Checklists and Graded Matrix Methods. These two methods are described below:

Checklist Method

Checklist is a comprehensive list of environmental effects and impacts indicator designed to stimulate the analysis to think broadly about possible consequences of contemplated actions (Munn, 1979). In this checklist, actions, which may affect at the various stages of the project activities, are listed and the degrees of Significant Environmental Impacts (SEIs) are shown. The terms none, minor, moderate and major are used in the checklists to evaluate the magnitude of SEIs. In the checklists, both the construction and operational phase of the proposed development are considered separately in order to distinguish the short-term and long-term impacts. As can be observed from the checklists, major environmental components which will be adversely affected by activities of the project are water quality and socio-economic environment. All these impacts will arise in the operational phase of the project.

Matrix Method

In matrix method, a basic checklist is developed into a form of more easily examined and graphic activity-component interaction. The matrix consists of a horizontal list of development activities displayed against a vertical list of environmental factors. The matrix is used to identify impacts by systematically checking each development activity against each environmental parameter. It provides cause-effect relationships between the various project activities and their impacts on the numerous environmentally important sectors or components.

Having set up the activity-component linkages of "suspected impact relationship" it is possible to do some more speculation about:

- ✓ Adverse or beneficial impacts
- ✓ Size of the impact (High, Moderate , negligible)
- ✓ Duration of impact (short term, long term or continuous)
- ✓ Nature of impact (reversible or irreversible)
- ✓ Present understanding of the impact (i.e. adequate, not adequate or even impossible)

All above are basically impacted attribute or impact characteristics

The significance of an impact depends on:

- ✓ The number of people affected
- ✓ The duration of an effect
- ✓ The proportion of natural resources which are damaged or consumed
- ✓ The relationships with the other components of the project or other projects in the region, and
- ✓ The intensity of severity of the impact.

The matrix method is very much suitable for indicating the impact characteristics. This can be done either at the level of group activities versus group components, or individual activities against individual components. It must be remembered that matrix presentation essentially aims at improving the communication between the impact analysis, decision- makers and the people.

However the checklist and matrix approach have limitation, which are as follows:

- ✓ Impact characteristics are a kind of subjective prediction as well as assessment.
- ✓ They do not consider component to component or secondary impacts

In spite of the above-mentioned drawbacks, checklists and matrices are extensively used as assessment methods, due to their simplicity.

8.3 Prediction and Evaluation of Impacts

8.3.1 Impact on Water Resources

8.3.1.1 Pre-construction phase

Impact on Surface water

Impact origin

Impact on surface water may be originated from different sources such as (i) sewage water from the project field camp

Hydrology

Runoff from field camp, obstacle of flow of stream etc. may have asomewhat impact on the hydrology.

Impact analysis

The project will not generate a large amount of solid and liquid waste at this stage and therefore, will not discharge any liquid waste to the surrounding waterways and other areas.

CPGCBL, executing agency has designed programs to ensure that there will be no chance of run-off or any kind of adverse impact on the earth cuttings and hydrology within the project area.

Impact on Groundwater

Impact origin

Ground water may be contaminated due to infiltration of sewage waste water if it is not managed.

Impact analysis

The ground water will be in good condition at this stage because the project will not take any activity at this stage; so, there is little chance to cause adverse effect on the ground water quality. The main worker's site camp at theproject site will have septic facilities and therefore will not contaminate ground water with sewage waste.

8.3.1.2 Construction Phase

Impacts on surface water

Impact origin

The major sources of impacts on surface water are Pile works, mud water from earthwork, domestic wastes, waste water liquid from worker's camp and oil leaking from electric transformers, vehicles, generators etc.

Impact analysis

The overall construction will be conducted in confined techniques which will not generate any run off of mud and drain in the surrounding water ways while establishing the scheme. All fittings will be air tight so that leakage will not occur. On the other hand, during work, the surface drains will be kept clean for free flow. No overflow will be allowed.Generated construction sludge from pilling works, and the concrete plant should be treated by silt basin and remaining sludge is to be disposedto a designated dumping site. Impermeablewall shall be used with cast-in-place pile. Turbid water from construction work area is treated in silt basin for satisfying water quality standard and drain away to the nearest drainage or river through proper treatment.

Impact on Groundwater

Impact origin

Major sources are from leaks, spills, releases of fuels, oils, etc. and piling works; soil compaction will be made in a safe manner in the project site, sub-station area, Spillage of transport vehicle and transformers onto ground surface may cause pollution of the GW.

Impact Analysis

Civil works with piling action for construction is conducted here, so there might be a possibility of contaminating the ground water through the generation of any mud or leaching of mud water. More any kind of construction equipment related fuels should not be stored at the project site near to the river or water courses. Equipment and vehicles should be maintained properly not to cause leaking of fuel onto the ground surface. Inspection sheet of maintenance record shall be submitted regularly. Batteries, if remains, containing the liquid inside shall be kept on the impervious surface to prevent battery liquid that containing hazardous heavy metals leaks and percolate into the sub-ground.

8.3.1.3 Post Construction Phase

Impact on surface water and ground water

Impact origin

During operation there may have a chance of releasing less treated solid and liquid wastes, chemicals etc. from wash room, latrine, storage site, etc. into surface and ground water.

Impact analysis

This project has the option to dispose wastes properly away from site to a safe location and alternative choice to install Septic tanks and soak-pits with proper design.

However, CPGCBL will follow international maintenance and product vendor recommended practices for the project and there corporate operations and maintenance guidelines to ensure waste handling practices to minimize the effectto the surrounding environment. The project will have routine check up to see the surface and ground water quality, which will meet international and DoE standards. Therefore, there will not be any chances of releasing of improperly treated wastes into the surrounding environment and natural waterways from the infrastructures of the schemes.

8.3.2 Impact of Land Resource

8.3.2.1 Pre- Construction Phase

Impacts on land and soil

Impact origin:

During the land development phase, the main impact may occur due to excavating of soil and also filling with land in the sub-station area by the soil nearby. The project will have somewhat

considerable negative impact on agricultural and fisheries development, because all areas for tower installation is mostly located on medium low land which has been used as agricultural, shrimp and salt cultivation purposes in all seasons.Another impact might occur in the construction of project temporary site camp. In this stage, soil erosion, somewhat vegetation disruption and somewhat changes of terrestrial ecosystem might occur.

Impact analysis:

As the acquired land for the project is mostly agricultural medium lowland, therefore there will be a chance of land use changes in the surrounding environment and subsequently there will be small damage of vegetation. To alleviate the poverty, if occurred due to land loss, income restoration program has to be taken strongly in the locality. For land acquisition and resettlement works in the project, the LARAP has been prepared to compensate the losses for APs. On the other hand, the impact of land clearing for the project would be overcome somewhat by implementing the EMP.

Impact on Air

Impact origin

During development phase, air pollution may occur from different sources which include: (i) Exhaust emission such as oxides of nitrogen (NOx) & Sulphur (SOX) from supply and construction materials/ carrying vehicles/ equipment (ii) dust such as particulate matter from earth work, excavation etc. (iii) VOCs from refueling and fuel storage if any at the site.

All these activities will increase contents of particulate matters, dust and vapor in the air, though it is a small amount, and will reduce air quality somewhat. In this phase, this type of pollution is very negligible because the possibilities to release exhaust emission from the scheme during that time is about to zero.

Impact analysis

The project area will be kept dust free by spraying water within the project site, if occur. All vehicles and equipment will be maintained properly to avoid excess emission proper graded fuel will be used for the operation of vehicle and mechanical equipment. Access roads will be sprayed if necessary to avoid excessive dust emission during the day time.

8.3.2.2 Construction Phase

Impacts on land and soil

Impact origin

During the construction phase the major pollution sources may be due to the construction of (i) foundation of electric towers (ii) soil compaction works on the site. Each activity will have an impact on the environment.

Impact analysis

In the project site, there might be occurred some land and soil erosion in this stage if any initiatives are not taken properly according to EMP. Soil erosion might be happened slightly due to clearing vegetation/excavation operations on proposed construction land. To overcome the

situation, slope protection with vegetative stabilization around the sub-station, would be established. However, CPGCBL has a commitment not to release any construction materials/ loose soils including construction run off on the surrounding land.

Impacts on Air

Impact origin

Diesel generators (if required), chemical mixing, excavator, construction vehicles, fugitive emissions like storage, refueling etc. are the major sources of exhaust emission and discharge of chemicals or wastes during project activities. Dust suspension due to frequent vehicle movement on unpaved roads & construction works might occur in this stage.

Impact analysis

Vehicle speed to lessen suspension of road dust should be controlled properly. And to prevent the load from being blown, cover the entire load with tarpaulin.

The construction of the scheme will be completed within a short time. There will be regular spraying of water on the approach roads, and bricks/stone aggregate to control dust during the construction period when required. The excess soil and sands for the earth work that might pollute the air will be kept in a designated place. Details measures against such pollution have been explained in EMP table.

8.3.2.3 Post-Construction Phase

Impact on land

Impact Origin

During operation period, various activities will be involved such as operation, maintenance etc. The activities may release solid/liquid waste, resulting in land and water pollution, in the surrounding environment unless it is properly carried out and mitigated.

Removal of top soil, pollutant materials such as fuels and lubricants of construction vehicles and equipment, paints, generation of construction sludge, battery containing acidic liquid, pollution from field camp, construction waste etc. are the main cause of land and soil pollution,

Impact Analysis

Removal of top soil result degradation of fertility of soil; fuel and lubricant of an electric transformer, vehicles and construction equipment may contaminate the soil by leaking and spilling. Paints might contaminate the soil. Construction and field camp sludge if directly discharge to soil would contaminate the land and also soil.

Area of removed top soil will be silted every year by the silt of flood water as this area located in the flood plan. Besides, the owner of the land would be compensated properly. Electric transformer, vehicles and equipment would be maintained properly so that no oil, fuel and lubricant could be leaked and spill. Careful handling of transformer, vehicle and equipment would be done. Construction and field camp would be treated and conveyed to the outlet with proper treatment. For the internal roads of sub-station, carefully handle would be maintained during storing of bitumen drum, pouring bitumen to the bitumen tanker, heating, mixing and laying so that no bitumen can mix with the soil. Construction waste would be disposed off to safe location where soil will not be contaminated.

Without proper management of waste, land and soil might be polluted. CPGCBL/PGCB will follow their own safety Health and Environment guidelineswhich are in line with International guidelines and therefore there will not be any accidental release of chemicals in the surrounding environment especially on land and soil.

Impact on Air

Impact origin

During operation, emission of gasses like greenhouse gasses including Sox and NOx may occur mainly from the vehicular exhaust.

Impact analysis

The generators may exhaust little amount of CO_2, CO, and traces of sulfur. Contractors will follow its own corporate guideline to minimize any exhaust emission including greenhouse gasses and will abide by the safety measures on gas generated. There should be an opportunity to check gases emission from the vehicles and other equipment so that the exhaust emission including above noted gases will not cross the limit and will meet the DOE (Bangladesh) and International standards.

8.3.3 Impact on Agriculture Resource

8.3.3.1 Pre-Construction phase

Normally agricultural land will not be lost or crop production will not be hampered in this phase. Crop production in the project area might be slightly damaged owing to survey activities for line routes selection if some cares are not taken properly.

8.3.3.2 Construction Phase

Impact origin

Agricultural land and crop production would be lost due to constructing the infrastructures of the project on the land. Income loss due to the destruction of agricultural land and crop production would be significant.

Impact analysis

Total proposed construction area is covered with agricultural medium lowland. To recover the loss, income loss restoration program would be implemented in the locality. For the affected people, agriculture extension training, good quality seed and fertilizer supply and credit facilities should be included in the income loss restoration program. The project has the option to create employment opportunity. So, local unemployed people can easily take the opportunity.

8.3.3.3 Post-Construction Phase

In this stage, there will be no loss of theagricultural resource. To recover the previous damages caused by land and crop destruction, income loss restoration program will have been continued in the locality among the farmers involved in the acquired land.

8.3.4 Impact on Fisheries

8.3.4.1 Pre-Construction phase

Normally fisheries in the project area will not be hampered in this phase. During construction of infrastructures of the project, some fisheries resource might be hampered. So, no analysis is required on fisheries resources for this phase.

8.3.4.2 Construction Phase

During monsoon, the water coming from river and beel nearby goes to the land proposed for tower development and the different fish Species live on that land. During winter, the proposed land is completely dried up. Before winter, the fish species can easily move to another aquatic reservoir like river.

8.3.4.3 Post-Construction Phase

In this stage, there will be no loss of fisheries resource. To recover the previous damages caused by land filling from lowland to high land, income loss restoration program will have been continued in the locality among the fish farmers.

8.3.5 Impact on Ecosystem

8.3.5.1 Pre-Construction phase

Normally eco-system in the project area will not be hampered in this phase. During land filling and construction works of the infrastructures of the project, some vegetation and aquatic habitat might be disturbed. So, no analysis is required on eco-system for this phase.

8.3.5.2 Construction Phase

Impact origin

In this phase, there is possibilityto damage the aquatic flora –fauna and also disturb the local ecosystem during monsoon.

Impact Analysis

Due to some land filling, the medium lowland will be transferred into themediumhighland. So, some aquatic environment especially in the time of monsoon might be damaged. During land filling and construction works of the infrastructures of the project, some vegetation and aquatic habitat might be disturbed. During winter, the proposed land is completely dried up. Before winter, the fish species can easily move to another aquatic reservoir like river. For the protection of ecosystem, all land filling and construction work should be done in winter.

8.3.5.3 Post-Construction Phase

Impact origin

During operation, emission of gases like greenhouse gases including Sox and NOx may occur mainly from the vehicular exhaust though it is a minimum level. This emission can break the ecosystem services. The polluted water that might be produced from project area could also be damaged the local ecosystem.

Impact analysis

The generators (required for the emergency supply of power) may exhaust little amount of CO_2, CO, and traces of sulfur. The authority will follow its own corporate guideline to minimize any exhaust emission including greenhouse gases and will abide by the safety measures on gas generated. There should be an opportunity to check gases emission from the vehicles and other equipment so that the exhaust emission including above noted gases will not cross the limit and will meet the DOE (Bangladesh) and International standards.

To protect water pollution, there is scope in the project to install safety tank with soak oil for sanitary facilities for the sub-station's personnel. So, waste water produced from the sub-station will not be disturbed the local ecosystem.

8.3.6 Socio-economic Impact

8.3.6.1 Pre-Construction phase

Origin of impacts

The origins of impacts are (1) migration of workers (ii) restriction of access to the resources and (iii) social conflicts.

Impact analysis

The project at this stage will not hire any workers from outside and therefore will not create any social conflict. Only agricultural land will be lost but no houses will be displacement or dismelt. To increase the yield of agricultural crops around the acquired land, facilities for agricultural development in the locality like easy supplying of high yielding varieties with fertilizer and pesticides would be enhanced comparable to the past. Thereto, income restoration program would be implemented to alleviate poverty, owing to livelihood and income loss caused by agricultural land damage. Nonetheless, the project will create some jobs in the local area and help to generate power through the establishment of Matarbary coal-based power plant that will improve the economy of the people for the local community and also national masses.

8.3.6.2 Construction Phase

Impact origin

Construction activities will be for a short period and during operation period skilled and unskilled workers will be engaged.

Impact analysis

Most of the construction activities will be conducted by skilled and unskilled labors mostly. Most unskilled labors will be hired from local areas to avoid conflict about ajob opportunity in the locality. Therefore, local employments will be increased.

8.3.6.3 Post-Construction Phase

Impact origin

During operation both unskilled and skilled workers will be employed. There might be a conflict about hiring of workers among the community.

Impact analysis

Most unskilled workers will be hired from the local community on ad hoc basis and therefore there will be no chance of a conflict of arising interest among community workers. Besides, additional employments will be generated due to the operation of the facilities completed under the project.

8.3.7 Impact on Biological Resources

8.3.7.1 Pre-Construction Phase

Impact origin

During project setting, land selection and development stage's potential impacts are due to the development of land and minor construction for the sub-station.

Impact analysis

Near the project sites, there are existing medium high lands using as agricultural and fellow land. The project site will not allow any earthfilling of soil or construction materials in the surrounding aquatic and terrestrial environment once completed and therefore, will not affect any biological resources.

8.3.7.2 Construction Phase

Impact origin

Filling of land with excavated soil and runoff from construction activities including sewage discharges of workers may cause disturbance to the wetland species. Noise due to construction activities may cause disturbance to the people or animal of the projects area.

Impact analysis

Out of the construction areas of the project is used as road communication and commercial, agriculture, shrimp and salt cultivation, as well as residential option. The workers will use toilets with septic tank facilities and therefore, there will be no sewage discharges outside the scheme site. The construction activities, movement of construction equipment will be confined within construction compound and for day period. Although, the noise pollution produced by construction activities is for short time, and original condition will be restored after the major construction operation is over.

8.3.7.3 Post-Construction Phase

Impact origin

The treated waste (solid and liquid, if occur) will always meet the DoE and international guidelines and their standards. But any accidental release of discharges may damage surrounding waterways and eco-system.

Impact analysis

Normally in this stage, there is little chance to pollute the biological resources in the project area. Yet, CPGCBL/PGCB/REB will have a routine checkup on the wastes produced from the project

site, which will meet international and DoE standards. So, waste should be treated before releasing into the natural environment. All vehicles used in the activities will be properly maintained to avoid any kind of spills and human activities will be confined to scheduled time to avoid any impacts on the flora and fauna.

8.3.8 Impact due to sound pollution on human, livestock and another impact due to establishment of transmission line on Bird species.

8.3.8.1 Pre-Construction phase

Impact origin

It is a requirement of the project authority, to keep the level of noise emission below 70 dB(A). At this stage of the project, major noise and vibration may occur due to vehicular movement, land filling activities and also for minor construction works.

Impact analysis

These activities may cause some sound, but it will be conducted for short period and the sound created due to those operations will also be remain low/moderate level and therefore, will not have much impact on human, livestock and wildlife.Yet, there is an option to minimize noise and vibration occurring at the project site by the execution of EMP properly.

8.3.8.2 Construction phase

Impact origin

Steel works for the fitting of sub-station and buildings, Vehicles, piling on land for infrastructures, pumps, motors, and generators will be run that will contribute in producing some noise.

Impact Analysis

Noise, occurring in the construction area, should be kept below 80 dB (A) according to the DoE requirements. CPGCBL/REB/PGCB has instruction to use available automated machines as construction equipment that will have the relatively low intensity of noise. Therefore canopy built motors/generators should be preferred to install to protect sound pollution.

8.3.8.3 Post-Construction Phase

Impact origin

During operational phase there will be movements of vehicles and drive other machinery. Transformers vibrant will make a humming sound. All these activities may create some noise. On the other hand, transmission line and electric tower might inhibit the movement of migratory birds or local birds. Even, the birds might be fallen in accidents within the phase conductors.

Impact analysis

All vehicles will be moved according to relevant rules. The maintenance workers for the infrastructure will use a safety device for protection of their ears following DoE and International guidelines. All of the machinery including electric transformer would have silencing devices and canopy built generator would be provided to reduce noise.

The distance between the two electric towers is about 350 m (the average running span of 132 KV transmission line is 300 to 350m) and phase conductor to phase conductor distance is about 12ft, So, these space is enough for passing any birds safely.

In other words, as the phase conductor to phase conductor is planned to remain enough space, so there is no possibility to short circuiting result in accident of birds. Normally, the migratory birds fly above 100 m from the ground. The average height of the river crossing tower is about 60m. So, the transmission line is not inhibit the migratory birds flying. Local people informed that the migratory birds are not found in the proposed transmission line area. It could be mentioned that the tower height has been considered according to normal phenomenon used in transmission line authority like 55m to 60m height is considered for a width of 300m to 400m river if there is navigation route in the line crossing area.

The distance between the two electric towers is about 350m and phase conductor to phase conductor distance is about 16ft. So, these spaces are enough for passing any birds safely.

In other words, as the phase conductor to phase conductor is planned to remain enough space, so there is no possibility to short circuiting result in accident of birds. Normally, the migratory birds fly above 100 m from the ground. The average height of the tower is about 60m. So, the transmission line is not inhibit the migratory birds flying. Local people informed that the migratory birds are not found in the proposed transmission line area.

8.3.9 Overall Environmental Impacts of the Project Activities

The potential impacts associated with the construction and operation of the schemes' will be evaluated with respect to the National and International standards and criteria. Large numbers of Important Environmental Components (IECs) have been selected following the guidelines of the DoE and their negative impacts in respect to the different activities of the proposed project component are shown in Table-36.

Table 36: Activities and relevant potential positive and negative impacts of the construction & operation of the infrastructures of GIP project

Issues	**Effect of the Environment/ecology/social life**	**Type of Impact**	**Duration of Impact**	**Intensity /degree of Impact**
Land Development & Construction Phase				
i. Labor movement	i. Spreading of disease to human	A	Short	L

Issues	Effect of the Environment/ecology/social life	Type of Impact	Duration of Impact	Intensity /degree of Impact
ii. Dust emission due to construction equipment, construction vehicles and construction works.	ii. Impact on air quality, impact on flora, fauna and human health	A	Short	L
iii. Exhaust emission and smoke from construction equipment and vehicles during construction works	iii. Impact on air quality and human health	A	Short	L
iv. Oil spillage & leakage from construction vehicles, and construction equipment during construction works	iv. Impact on water quality, soil quality, flora fauna and human health including eco-system	A	Short	L
v. Noise emission from construction vehicles, construction equipment during construction of the infrastructures of the project	v. Sound pollution-nuisance to human, wildlife, livestock	A	Short	L
vi. Soil erosion due to excavation works and disturbed soil during construction	vi. Turbidity and sedimentation	A	Short	L
vii. Pollution of water resources due to direct discharge of construction run-off and washout water from office and labor camp.	vii. Contamination of water/soil and impact on flora, fauna	A	Short	L
viii. Socio-economic impacts and sharing of natural resources and facilities	viii. Employment opportunity	B	Short	L
ix. Land filling with soil	ix. Dust, Turbidity and sedimentation	A	Short	L
Operational Phase				
i. Exhaust emission & smoke from transportation vehicles, electric transformers and generators.	i. Impact on air quality and human health	B	Short	L
ii. Noise from vehicle movement, generators	ii. Nuisance to local people, livestock, wildlife	A	Short	L
iii. Discharge sewage/domestic waste	iii. Contamination of water/soil	A	Short	L

Issues	Effect of the Environment/ecology/social life	Type of Impact	Duration of Impact	Intensity /degree of Impact
iv. Project operation	iv. Opportunity for local employment	B	Short/long	L
v. Movement vehicle	vi. Soil compaction and dust	A	Short	M
vi. Pollution of water resources due to direct discharge of washout water from office and labor camp.	vii. Contamination of water/soil and impact on flora, fauna	A	Short	L

Type of Impact:
A = Adverse effect
B = Beneficiary effect
Intensity of impact:
L = low intensity, M = Moderate intensity, H = High intensity
Duration of impact:
Long = long -term effect on the environment, short = short -term effect on the environment

8.3.10 Necessary recommendations against overall potential impacts

In short, necessary recommendations against overall impacts on the project are stated below:

Since the project may cause somewhat pollution of water due to improper disposal of construction wastes or wastes from labor camps of the area and washing out of camps may act as media to cause pollution of shallow ground water. The supervisors need to be vigilant and ensure that the wastes will be disposed properly and soak well are of proper design not to pollute ground water. This hasbeen mentioned in the environmental management plan. The project would not create drainage congestion or water logging in the area and would not be a cause for any risk to natural systems as will be undertaken following the guidelines of co-financer and DoE. The project would not create any obstacle to annual natural flushing of the area too. Although, the dust pollution is an important issue for the laborers and community during the construction period of the project. This may cause health hazard due to air pollution emanated from machinery, especially from the power plant, or dust generated during construction works especially in the area of the access road. EMP has been incorporated this for such pollution. Another issue, the increased noise from the movement of machinery, pile driving, and operation of diesel generators and power plant as well as day to day construction may cause a health problem. EMP has incorporated these issues for such pollution. Garbage disposal/ ash handling management is another issue for environmental protection as it may pollute the area. The project implementation Unit will plan to dump the rubbish produced in construction and operation phases for making compost fertilizer. For liquid/ semisolid/ waste, they have planned to dispose it through into the channel of sewerage drain which will finally reach into ETP for treatment.

According to the condition of the contract, the contractors are obliged to guarantee and ensure the proper disposal of waste. This needs continuous monitoring by site supervisors. Care must be taken not to expose or drop any debris while transporting. This project would not affect the ecosystem of any wildlife habitat, populations, corridors and movement nor would they cause negative effects on rare, threatened or endangered species, flora or fauna or their habitat. The contractors are liable to compensate if any damage occurs during pre-operation, operation and construction phase of the project. Stakeholders are obliged to maintain the ecosystem and biodiversity of the area.

The project creates an additional burden on the existing systems of utilities like sewerage, gas, telephone. However, it will not cause stress on the use of land, material and other resources. Adequate provisions for O&M of environmental utilities are a necessity for the sustenance of the project's development. The project authority will need to coordinate to ensure operation and maintenance with the concerned organizations like DPHE/DoE to whom the structure belongs to.

9 PUBLIC CONSULTATION AND DISCLOSURE

9.1 Introduction

Public consultation assists in building strong relationships with stakeholders, based on mutual respect and trust, and increases the likelihood that projects are well designed and responsibly implemented. It reduces the risk of delays in Project approval and permitting processes, or the need for costly redesign of operations/facilities.

Formal public consultations meetings are held with local area leaders, NGOs, and national and local government representatives. Attendants proposed that they have theemergency demand to establish the project. Concerning issues and concerns of the proposed project, the universal concern raised by stakeholders was for the quick implementation of the proposed works. The local people of the project area are eagerly waiting for the project's completion.

The consultations contributed to the mitigation measures designed for temporary blockage to traffic such as advanced notifications, putting up signs, taking up civil works during weekends and after working hours. The recommendations from the public consultations have been incorporated in the engineering design.

9.2 Objectives of Public Consultation and Disclosure Meeting

Public consultation, or simply consultation, is a regulatory process by which the public's input on matters affecting them is sought. Its main goals are in improving the efficiency, transparency and public involvement in large-scale projects or laws and policies. It usually involves *notification* (to

publicize the matter to be consulted on), *consultation* (a two-way flow of information and opinion exchange) as well as *participation* (involving interest groups in the drafting of policy or legislation).

Public Consultation and Disclosure Meeting are for the following objectives:

- Identification of all Project stakeholders and gain an understanding of the nature of their interest and influence in Project development, and impact management.
- Provision of culturally appropriate, adequate and timely information on Project development and impact assessment to Project stakeholders.
- Providing culturally appropriate and timely opportunities for Project stakeholders to express their opinions and concerns about the ESIA and Project development and for these to be reflected in the ESIA and management decisions where considered appropriate.

Providing feedback from stakeholders

- Establishing a foundation of effective and broad stakeholder engagement that is conducive to the emergence of stakeholder support for the Project and impact management programs.
- Ensuring that Project decisions consider, to the extent feasible, stakeholder needs, priorities and concerns.
- Reducing the potential for delays in decision-making times for issue of Project approvals and permits or the need for costly redesign of operations/facilities. The consultation process will help to ensure continuity in Project development and the implementation of agreed impact management strategies.
- To present the Environment and Social Safeguards and seek suggestions for revisions.

9.3 Approach and Methodology

Approach and Methodologies done for the public consultation in the project area are stated below table-37.

Table 37: Approach and Methodologies done for the public consultation

SL. No.	Stakeholder	Methodologies/ Type of consultation
1	National and regional relevant governmental personnel	Face-to-face meeting with the stakeholders
2	Local government (e.g. Regional/municipality/officials/ UP members and community leaders)	Face-to-face consultation meetings at local government level, ESIA public disclosure meetings

3	Local community people	Consultation meetings with key community representatives from all Project affected communities , FGD
4	Non-governmental organizations	A consultation workshop for NGOs was held in project area, ESIA public disclosure meetings
5	Media	National and regional media was consulted while the draft ESIA report is done
6	CPGCBL/REB/PGCB members	Face-to-face consultation meetings at different levels,

9.4 Public Consultation Meeting

Consultations with various groups of experts were held during the detailed design. The objective was to share information on the project and to obtain feedback on important social and environmental issues to be considered in the Environmental and Social Impact Assessment.

The results of the public consultation showed that the people wanted the project as it would very beneficial to the area, with minimum negative environmental impacts. Many people were interested in the project implementation and its environmental effects and potential usage. The design of the project was explained and the stakeholders were satisfied.

The local people are very much concerned about the possible impacts of the project on the environment. The local people have no major objection about the goals and objectives of the project. They propose consideration of their well-being and development for a better future in project planning. The people who had land in the project area, affected agricultural and other livelihood groups are agreeable to give land and other assets as a voluntary donation. But the project has the option to give compensation to APs. Preference of local people in project's employment is another prime demand of the local people that should be considered by the project proponent. Local people presume that for the great interest of the areas the proposed project may be constructed in the proposed location but it has to be planned, installed and operated ensuring minimum impact on and surrounding environment. Documentation of public consultation with Photographs on the project implementation in the catchment area of the project is illustrated in **Appendix-10**.

9.5 Public Discloser Meeting

A Discloser Meeting was held in the project area among the APs (Affected People) and CPGCBL personnel. In discussions with the CPGCBL personnel, it was decided to hold additional public consultations and press releases that will be disclosed at all stages of the project implementation. The ESIA, including a Bangla-language executive summary (to include a summary of the EMP), will be uploaded to the contractor's company website, and will be made available locally.10. Environmental Management Plan, Environmental Monitoring plan with Indicators and other related plans.

10 ENVIRONMENTAL MANAGEMENT PLAN, ENVIRONMENTAL MONITORING PLAN WITH INDICATORS AND OTHER RELATED PLANS.

10.1 Introduction

Environmental management is a process that industries, companies, and individuals undertake to regulate and protect the health of the natural world. In most cases, it does not actually involve managing the environment itself, but rather is the process of taking steps and promoting behaviors that will have a positive impact on how environmental resources are used and protected. Most management plans roughly follow a "plan, do, check" model. The first step, planning, requires the organization to set out specific goals, like reducing wastewater, implementing new standards for toxin disposal, or better managing erosion.

Importance of EMP is as follows-

- An instrument for implementing environmental management commitments, conditions, and requirements of the project.
- Promotes self-regulation & integration of environmental issues in planning and operations.
- Addresses relevant environmental management issues,
- Can be drafted in a consultative manner.
- Incorporates regulatory requirements.
- Good Environmental Management means good project management. The figure 35 shows the process of environmental management

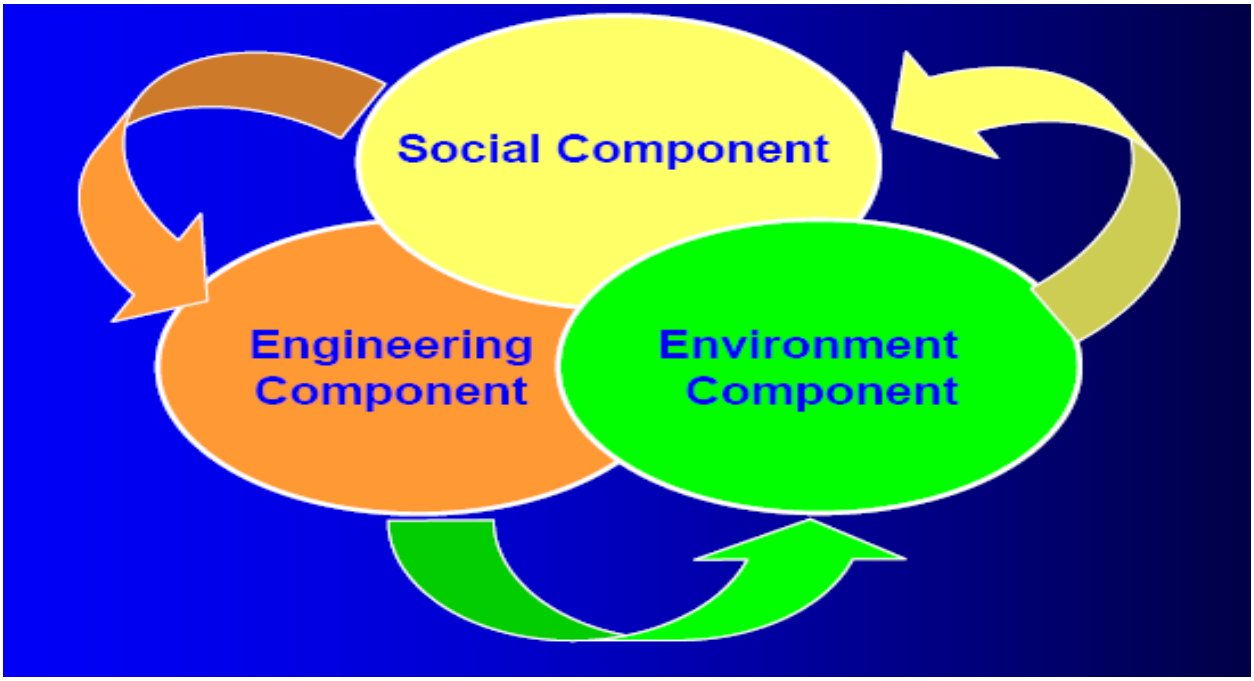


Figure 35: Schematic diagram of environmental management

10.2 Environmental Impact Mitigation Plan

Environmental mitigation, defined as *the implementation of measures designed to reduce the undesirable effects of a proposed action on the environment*, is central to the environmental compliance process, and is essential to achieving environmentally sound activity design and implementation. Mitigation can reduce impacts in three ways:

1. Prevention and control measures, which fully or partially prevent an impact/reduce a risk by:

    - Changing means or technique;
    - Changing the site; or
    - Specifying operating practices;

2. Compensatory measures, which will offset adverse impacts in one area with improvements elsewhere; and
3. Remediation measures, which repair or restore the environment after thedamage is done.

Prevention of impacts by changes to activity design, site, or technique is the most reliable approach to mitigation.
Environmental Management Plan including impact mitigation measures is stated in below table (38).

Table 38 : Environmental Management Plan including impact mitigation plan

EMP							
Sl. #	**Issues**	**Potential Impact**	**Mitigation Measures**	**Phase**	**Budget/ Cost**	**Responsible Organization/ Person**	
						Implementation	**Monitoring/supervision**
1	Land acquisition, resettlement and changes in land use	Persons with their assets including agricultural land etc. might be affected. The proposed project has an option to work on land acquisition and resettlement. So, there will be no bad impact on those issues.	• To minimize the impact, Land Acquisition and Resettlement Action Plan (LARAP) should be prepared for the area of the project. • Secure Deed of Donation or Quit Claim on land.	Pre-construction	Included in the project cost	Contractors	Environmentalist/ Environmental Engineer of REB/CPGCBL
2	Loss of land, livelihood and income source.	Somewhat people's poverty might be increased if the LARAPisnot implemented properly.	• Livelihood and income restoration program would be conductedin accordance with the project Resettlement Policy Framework	Pre-construction	Included in the project cost	Contractors	Environmentalist/ Environmental Engineer of REB/CPGCBL
3	Land clearing and losses of terrestrial flora and fauna	Soil erosion, Vegetation disruption, changes of terrestrial eco-system, Damage to flora and disturbance to fauna are a common impact though the intensity of the impact is very low since most of the towers have been proposed in a location of cleared barren field.	• Re-vegetation, tree plantation and soil compaction can minimize the effects where it is needed. • Secure Special Land Use Permit	pre-construction	Included In the project cost	Contractors	Environmentalist/ Environmental Engineer of REB/CPGCBL

EMP							
Sl. #	**Issues**	**Potential Impact**	**Mitigation Measures**	**Phase**	**Budget/ Cost**	**Responsible Organization/ Person**	
						Implementation	**Monitoring/supervision**
4	Loss of agricultural land	Destruction of top soil, degradation of fertile soil though the single tower area is small as only 10m x 10m.	Cash compensation for the crop and land loss, additional support in the income and livelihood restoration, assistance to the farmer by agricultural extension worker etc.	Pre-construction	Included in the project cost	Contractors	Environmentalist/ Environmental Engineer of REB/CPGCBL
5	Protected Areas/ natural/critical habitats, if arise	Encroachmenton Protected Areas/ natural/critical habitats. Or, Inconsistent with protected area zoning. Noted that, there are little possibilities to hamper the natural habitats in the studied project.	Consider alternative site or design to be compatible with the appropriate zoning.	Pre-construction	Included in the project cost	Contractors	Environmentalist/ Environmental Engineer of REB/CPGCBL
6	If incidence o of the damage of Cultural Heritage arises	Damage or cause of disturbance to adjacent or nearby sites of Cultural Heritage. Though, there are no possibilities to hamper the Cultural Heritage in the studied project.	Secure clearance from relevant organization & coordinate on design/ construction works	Pre-construction	Included in project cost	Contractors	Environmentalist/ Environmental Engineer of REB/CPGCBL
8	Reactions from the public due to project implementation	Negative reactions from the public due to lack of information dissemination and coordination	Hold consultative meetings with project beneficiaries/stakeholders and affected persons on the project components and make a plan	Pre-construction	Included in the project cost	Contractors	Environmentalist/ Environmental Engineer of REB/CPGCBL
9	Legal Procurement	Illegal or unauthorized sourcing of raw/ construction materials might a cause of disqualification for the project success.	Procure construction materials from licensed sources, i.e. for sand and gravel from those with valid EC permits;	Pre-construction	Included in the project cost	Contractors	Environmentalist/ Environmental Engineer of REB/CPGCBL

EMP							
Sl. #	**Issues**	**Potential Impact**	**Mitigation Measures**	**Phase**	**Budget/ Cost**	**Responsible Organization/ Person**	
						Implementation	**Monitoring/supervision**
10	Increase of employment opportunity and community income	Increased employment opportunity and community income can be possible to eradicate somewhat the local poverty.	Give hiring preference to qualified local community residents, particularly those who will be displaced and affected.	Pre-construction, construction and post construction	Included in the project cost	Contractors	Environmentalist/ Environmental Engineer of REB/CPGCBL
13	Safety and health risks	Possibility of increased number of accident in the area during construction, possible increase of infectious diseases	Public health action plan should be implemented such as improved sanitation, vector born disease prevention, improved child care etc.	Construction	Included in the project cost	Contractors	Environmentalist/ Environmental Engineer of REB/CPGCBL
14	Loss of income and livelihood	Increase of poverty in the locality; there is a possibility of loss of agricultural land, though it is very small area for an electrically supported tower, and also income for the people in the proposed project	• Short-term measures for the impact will be for immediate assistance and include the following: (I) Compensation for land and other lost assets (ii) Temporary or short-term employment in construction activities at the resettlement or project construction sites; (iii) Special assistance for vulnerable groups such as women, the aged and disabled.	Pre-construction &construction	Included in the project cost	Contractors	Environmentalist/ Environmental Engineer of REB/CPGCBL
15	Surface and ground water pollution	• Contamination of surface water or ground water. • Pollution might be occurred from Pile	• Wastes should be disposed properly away from the site.	Construction and operation/	Included in the project cost	Contractors	Environmentalist/ Environmental Engineer of REB/CPGCBL

EMP							
Sl. #	**Issues**	**Potential Impact**	**Mitigation Measures**	**Phase**	**Budget/ Cost**	**Responsible Organization/ Person**	
						Implementation	**Monitoring/supervision**
		driving needed for the foundation of electrically supported tower, mud water from earthwork, domestic waste liquid from worker's camp and transformer oil leaking from substation area • Ground water in shallow depth can be contaminated if any toxic material is used in pile construction.	• Septic tanks and soak wells needed for sanitation structures for worker's camp should be with the proper design. • Pollutant materials such as fuels, lubricants, paints, cement and others must be handled properly to avoid spills and not be stored near water course; • Oils, fuels and liquids will be stored securely. • Drums and barrels, including those for fuel oils will be confinedwithin a bund and sited away from watercourses; • An emergency response plan will be keptin place to deal with instances of accidental spillages and leakages; • Spill kits will be located near to the sub-station area and within storage compounds off site, with staff being trained in their use; • Generated construction sludge by pile	post construction			

EMP							
Sl. #	**Issues**	**Potential Impact**	**Mitigation Measures**	**Phase**	**Budget/ Cost**	**Responsible Organization/ Person**	
						Implementation	**Monitoring/supervision**
			driving, concrete plant should be treated by silt basin and remaining sludge is to be disposed at designated dumping site; • Turbid water from construction work area is treated in silt basin for satisfying water quality standard and drain away to the nearest drainage or river; • Minimizing disturbance of the groundwater level; • Water quality including contents of arsenic will be checked before using groundwater as potable water for construction workers; • Equipment and vehicles are properly maintained not to cause leaking of fuel onto the ground surface. Inspection sheet of maintenance record shall be regularly submitted; • Batteries, if it is used, containing liquid inside shall be kept on impervious				

EMP							
Sl. #	**Issues**	**Potential Impact**	**Mitigation Measures**	**Phase**	**Budget/ Cost**	**Responsible Organization/ Person**	
						Implementation	**Monitoring/supervision**
			surface to prevent battery liquid that contains hazardous heavy metals leaks and percolate into sub-ground; • Washing of vehicles and equipment on the site shall be restricted; • The contractor should ensure that operations do not give rise to the discharge of large quantities of dirty water into the water courses; • Mixers and hand tools will not be washed off in the stream or near to watercourses; • To prevent runoff from stripperd ground bundsare to be placed on the downstream side of stockpiles; • Water from excavations, if it occurs, shall be pumped to land and allowed to settle, or passed through silt traps, before allowed to return to the watercourse; • Portable toilets and sanitary facilities will be provided for site use; • Drilling plant(if needed) will use				

EMP							
Sl. #	**Issues**	**Potential Impact**	**Mitigation Measures**	**Phase**	**Budget/ Cost**	**Responsible Organization/ Person**	
						Implementation	**Monitoring/supervision**
			biodegradable drilling oils; • Concrete washout facilities shall be established away from water courses; • Pollution from field camps and construction yards should be controlled following by SPS (safeguard policy statement); • Use a deep water source for drinking water for the labors to avoid shallow deep contaminated water. • Seal the leakage of transformer oil on the outer surface of the transformer, if needed.				
16	Soil pollution	leakage of oil, and borrow can contaminate soil	• Do test for Soil quality; • Refueling on the place having concreted floor, if needed; • Preserved fuel in the tank surrounded with concrete fence; • Batteries containing the liquid inside, if it is used, shall be kept on an impervious surface.	Construction	Included in the project cost	Contractors	Environmentalist/ Environmental Engineer of REB/CPGCBL

EMP							
Sl. #	**Issues**	**Potential Impact**	**Mitigation Measures**	**Phase**	**Budget/ Cost**	**Responsible Organization/ Person**	
						Implementation	**Monitoring/supervision**
17	Air/Dust pollution	• Dust suspension due to frequent vehicle movement in unpaved roads & construction works. • Health hazard to labors and residents/ workers due to dust spreading. • Obnoxious gas& particulate emissions from vehicles, heavy equipment like mobile power generator for welding of tower materials.	• Watering of dusty roads; sprinkling and covering stockpiles; water will be sprayed to suppress dust on an as required basis in construction phase; • Wet areas of dust sources to minimize discomfort to nearby residents; • Control of vehicle speed to lessen suspension of road dust. • Cover entire load with tarpaulin to prevent the load from being blown; • Use scrubber for power generator to minimize So_x and $NO_{x;}$ • Gas emission prevention • Periodic maintenance and management of all the construction machinery and vehicles; • Waste management - Prohibit open burning of any gavage's; • Unnecessary vehicle movement should be avoided • Switch off the engines while it remains unused.	Pre-construction & operation	Included in the project cost	Contractors	Environmentalist/ Environmental Engineer of REB/CPGCBL

EMP							
Sl. #	**Issues**	**Potential Impact**	**Mitigation Measures**	**Phase**	**Budget/ Cost**	**Responsible Organization/ Person**	
						Implementation	**Monitoring/supervision**
			• Certified vehicles from BRTA are suggested to be used to carry the filling materials.				
18	Noise/ vibration pollution	• Sound pollution may occur during pile driving and in the time of movement of heavy construction vehicles and equipment which might cause hearing hazards to labors and residents. • Transformer vibrant may cause electric humming sound	• Scheduling of transportation not to disturb the community; • The vehicles and equipment should regularly be inspected to ensure its proper functioning and limit the release of fumes/noise; • The machinery should have silencing devices; • Earmuffs will be suppliedfor workers to wear, when working close to machinery to protect against noise; • Canopy built generator should be used; • Monitoring the equipment regularly. • Provide silencers for heavy equipment. • Installation of sound insulation cover on boundary near residential area; • Vibrator insulator/ rubber pad will be placedunder electric pump/	Pre-construction & construction	Included in the project cost	Contractors	Environmentalist/ Environmental Engineer of REB/CPGCBL

EMP							
Sl. #	**Issues**	**Potential Impact**	**Mitigation Measures**	**Phase**	**Budget/ Cost**	**Responsible Organization/ Person**	
						Implementation	**Monitoring/supervision**
			motor as well as diesel generator to protect / minimize the vibration; • Canopy built stone /brickcrusher or generator should be provided; • Performing construction work during daytime, especially piling work; • The adequate enclosure of equipment to be used to reduce noise. • The electric humming sound of the transformer should be within the standard limit.				
21	Waste disposal management	Contamination of biotic environment	• Wastes and debris should be disposed properly; • Construction debris must be stockpiled and removed to a safe site; • Do not drop or expose any debris while transporting;	Construction	Included in the project cost	Contractors	Environmentalist/ Environmental Engineer of REB/CPGCBL
22	Soil erosion	Rain-cut might occur.	• Re-vegetate and restore disturbed soil;	Construction	Included in the project cost	Contractors	Environmentalist/ Environmental Engineer of REB/CPGCBL

EMP							
Sl. #	**Issues**	**Potential Impact**	**Mitigation Measures**	**Phase**	**Budget/ Cost**	**Responsible Organization/ Person**	
						Implementation	**Monitoring/supervision**
23	Loss of soil fertility due to cut oftop soil layer for construction	The top soil (6 inches) contains the elements of essential soil nutrients. If the cut of the top soil layer occurs for construction, soil fertility might be reduced hampering the normal life pattern of plants or organisms.	To avoid loss of soil fertility, due to cuts of top soil layer for construction, the surface soil should not remain at a lower level of the soil profile where it was but be on the top.	Construction	Included in the project cost	Contractors	Environmentalist/ Environmental Engineer of REB/CPGCBL
24	Natural drainage system and river ecology	• Drainage disposal works might hamper the river ecology and natural system.	• Permanent monitoring system should be established to avoid illegal disposal	Construction	Included in the project cost	Contractors	Environmentalist/ Environmental Engineer of REB/CPGCBL
25	Increased traffic	• Increased traffic due to frequent heavy equipment/ vehicle movement	• Traffic management and settlement planning should be done properly; • Repair damage of roads; • Maintain uninterrupted traffic flows; • Provide traffic aides/flagmen, traffic signs to help ensure the free and safe flow of traffic in road • Maintain & repair temporary alternative route of vehicles.	Construction phase	Included in the project cost	Contractors	Environmentalist/ Environmental Engineer of REB/CPGCBL

EMP							
Sl. #	**Issues**	**Potential Impact**	**Mitigation Measures**	**Phase**	**Budget/ Cost**	**Responsible Organization/ Person**	
						Implementation	**Monitoring/supervision**
27	Increased accident risks	• Increased community hazards of vehicular accidents and construction works. • The risk of an accident during tower construction and pile driving might be increased.	• Emergency response plan should be prepared and be implemented properly; • Provide appropriate warning signs, lighting and barricades, whenever practicable; • Provide on-site medical services and supplies for any emergency	Construction and O&M phase	Included in the project cost	Contractors	Environmentalist/ Environmental Engineer of REB/CPGCBL
28	Trees and vegetation.	Vegetation disruption might occur though it may be in the small area	• Enhance environment by tree plantation in the proper place of the sub-station premises.	Construction phase	Included in the project cost	Contractors	Environmentalist/ Environmental Engineer of REB/CPGCBL
29	The additional burden on utilities.	Stress on water supply and sewerage	• Ensure adequate provisions for the facilities with concerned organizations;	Construction and O&M phases	Included in the project cost	Contractors	Environmentalist/ Environmental Engineer of REB/CPGCBL
30	Health and safety	Occupational health hazards to workers	• Arrange training for contractors and workers; • Workers involved with the operation should use personal protective equipment compatible with the work to be performed; • Make mandatory the use of personal protective	Construction and O&M phases	Included in the project cost	Contractors	Environmentalist/ Environmental Engineer of REB/CPGCBL

EMP							
Sl. #	**Issues**	**Potential Impact**	**Mitigation Measures**	**Phase**	**Budget/ Cost**	**Responsible Organization/ Person**	
						Implementation	**Monitoring/supervision**
			equipment (uniforms, fluorescent vests, boots, gloves, ear protection plugs, protective glasses, etc.); • The water supply provided to the construction site must comply with the standards of potable water; • Ensure that adequate first aid equipment is available and that all workers are properly trained to use; • Permanent fencing will be established around the sub-station; • Provision and inspections of firefighting equipment and fire hydrant system in all sections of the project; • Require all workers to strictly observe safety standards; • Provide potable water & sanitary facilities for construction workers.				

EMP							
Sl. #	**Issues**	**Potential Impact**	**Mitigation Measures**	**Phase**	**Budget/ Cost**	**Responsible Organization/ Person**	
						Implementation	**Monitoring/supervision**
31	The impact to **Aps,** women & other vulnerable groups for construction works.	Impact to APs, women& other vulnerable groups who may be affected by the project construction	• Prior consultation & coordination to minimize disruption of daily domestic activities & avoid violation of human rights.	Construction and O&M phases	Included in the project cost	Contractors	Environmentalist/ Environmental Engineer of REB/CPGCBL
32	Over-flooding of the project area	Over-flooding of the project area due to excessive accumulation of rainwater	There should be the provision of the adequate drainage system and proper grading so that project, especially for substation area, and its surrounding area will not be prone to flooding.	Construction	Included in the project cost	Contractors	Environmentalist/ Environmental Engineer of REB/CPGCBL
34	Obstruction of water flow	Obstruction of water flow might appear due to produce debris from the project	• Regular removal of debris, logs and other materials that may obstruct water flow in the project area.	Construction phases	Included in the project cost	Contractors	Environmentalist/ Environmental Engineer of REB/CPGCBL
35	Offensive Odor	Open burning of construction waste, improper treatment of human liquid waste, exhausted smoke from heavy equipment etc. can make offensive odor.	• Prohibition of open burning • Proper treatment of camp waste. • Proper maintenance of heavy equipment.	Construction and O&M phases	Included in the project cost	Contractors	Environmentalist/ Environmental Engineer of REB/CPGCBL

10.3 Gender Action Plan (GAP)

Gender action plan has been prepared to comply with gender-related policies of Bangladesh Government and international related agencies for the project. All activities related to gender issues have been addressed in GAP which will reflect on the physical and institutional works of the project. Detail GAP for the project is described in **Appendix-3.**

10.4 Compensation or Resettlement Plan

Land acquisition with resettlement plan and the associated impact mitigation principles and guidelines have been prepared with the objectives to consider alternative engineering design to avoid or minimize land accusation in order to minimize its adverse socioeconomic impacts on the people and communities. Land acquisition and resettlement works will be required for project implementation. LARAP (Land Acquisition & Resettlement Action Plan) has been made, in another objective, if the issue is raised suddenly in future and prepared it to comply with relevant laws of Environment and land acquisition. Detailed LARAP which might be followed in the project has been mentioned in **Appendix-4**.

10.5 Safety and Hazard Mitigation Plan

Workers are required to abide by the health and safety measures to save their life from any danger arising from construction works of the project. To satisfy the safety rules, Safety and Hazard Mitigation plan has been prepared. Detailed of Safety and Hazard Mitigation plan has been stated in **Appendix-5.**

10.6 Enhancement and Contingency Plan

Any project must have adequate measures against accidents or incidents to meet the emergency. Consequently, the project has prepared Emergency Response with enhancement and contingency plan as well as Disaster Management Plan to comply with national and international laws and regulations which will be implemented in the project. Details of Emergency Response and Disaster Management Plan are stated in **Appendix-6.**

10.7 Monitoring Plan with Indicators.

Environmental monitoring is defined as:

- *The systematic measurement of key environmental indicators over time, within a particular geographic area*; and
- *The systematic evaluation of the implementation of mitigation measures*.

Environmental monitoring is a necessary complement to mitigation, and should be a normal part of monitoring results.

Environmental indicators are simple measures that tell us what is happening in the environment. Since the environment is very complex, indicators provide a more practical and economical way to track the state of the environment than if we attempted to record every possible variable in the environment.

In other words, "An environmental indicator is a numerical value that helps provide insight into the state of the environment or human health. Indicators are developed based on quantitative measurements or statistics of environmental condition that are tracked over time. Environmental indicators can be developed and used in a wide variety of geographic scales, from local to regional to national levels". Monitoring Plan with Indicators is stated in table-39.

Table 39: Monitoring Plan with Indicators

SI. no.	Potential impact to be monitored	Source of potential impacts	Standard of monitoring parameter/ Laws	Purpose of the monitoring	Monitoring Indicator/ data	Location	Period of monitoring/ Frequency	Responsible organization	Cost
Pre-construction phase									
1	Land acquisition	• Loss of land entitlements • Loss of residential and commercial structures • Loss of trees, homestead gardens etc. • Loss of fish area	➢ The Land Acquisition and Requisition of Immovable Property Ordinance of 1982 ➢ World Bank Environmental Guideline	Compensation confirmation	➢ Compensation list of the Office of the Deputy Commissioners ➢ Attendance during compensation payment	Project site	During land acquisition process	Office of the Deputy Commissioners and REB/PGCB/CPGCBL	Expenses by CPGCBL Cost: 2000Tk./ Person/day
2	Losses of land, livelihood and income source.	• Poor households to be resettled • Loss of income generating activities and crop cultivation related works	• JICA/WB Environmental Guideline	Compensation confirmation	Results of the consultation with the affected people	Project site	During resettlement stage	- Implementation: Contractor/Environmental Consultant -Supervision: REB/CPGCBL Supervision Consultants	Expenses by CPGCBL Cost: 2000Tk./ Person/ day
3	Land clearing and losses of terrestrial flora and fauna	Different stakeholders those who are to be impacted	Consultation approach	Compensation confirmation	Consultation meeting	Project site	During compensation	- Implementation: Contractor/Environmental Consultant -Supervision: REB/PGCB/CPGCBL Supervision Consultants	Expenses by CPGCBL Cost: 2000Tk./ Person/ day
4	Loss of agricultural land	Among local residents, farmers workers those who are to be impacted.	Consultation approach	Compensation confirmation	➢ Compensation list of the office of the Deputy Commissioners ➢ Attendance during compensation payment	Project site	During land acquisition process	- Implementation: Contractor/Environmental Consultant -Supervision: REB/PGCB/CPGCBL Supervision Consultants	Expenses by CPGCBL Cost: 2000Tk./ Person/ day
Construction phase									

SI. no.	Potential impact to be monitored	Source of potential impacts	Standard of monitoring parameter/ Laws	Purpose of the monitoring	Monitoring Indicator/ data	Location	Period of monitoring/ Frequency	Responsible organization	Cost
1	Air quality	1) Dust resulting from Construction work. 2) Exhaust gas from construction machinery and vehicles used for Mobilization of equipment. 3) Air pollution arising from incineration of construction materials and waste	-Bangladesh Ambient Air Quality Standard -IFC guideline values for ambient air quality(General/ 2007)	Evaluation of effect of the mitigation measures towards air pollution	$So_{x,}$ $NO_{x,}$ TPM, CO_2, CO, Dust	Selected points of transmission line and electric sub-station and residential area nearby. 1. For ambient air: Three (3) samples (for all parameters) in three Selected points 2. For flu gas measurement: gase exhaust or discharge point of every engine/machinery equipment to be performed in construction site.	Once for every three months	- Implementation: Contractor/Environmental Consultant -Supervision: REB/PGCB/CPGCBL Supervision Consultants	Expenses included in contract cost by Contractor - Sampling & analyzing: 2000 Tk./ sample
2	Water quality	1) Runoff water from construction area 2) Domestic wastewater of workers 3) Inappropriate disposal of waste 4) Leakages of oil and chemical materials from construction activity	- Bangladesh Wastewater Standards - Bangladesh Ambient water quality standards (inland surface water) - Bangladesh Groundwater (Drinking water Quality standards) all standards would be	Evaluation of effect of the mitigation measures towards water pollution	**Surface water:** pH, BOD, TSS, Oil, Grease, COD, TP, DO, Nitrate Fecal Coliforms, etc. **Ground Water:** pH, Nitrate, TSP, Arsenic, Cd, Pb, Fe, Mn, S, Cl, FC	**3 points,** one point from drainage outlet, one point from surface water near the construction area, one point ground water from existing wells	Once for every three months	- Implementation: Contractor/Environmental Consultant -Supervision: REB/PGCB/CPGCBL Supervision Consultant	Expenses included in contract cost by Contractor - Sampling &analyzing: 2000 Tk./ sample

SI. no.	Potential impact to be monitored	Source of potential impacts	Standard of monitoring parameter/ Laws	Purpose of the monitoring	Monitoring Indicator/ data	Location	Period of monitoring/ Frequency	Responsible organization	Cost
			completed with ECR'1997						
3	Soil quality	Wastewater containing oil, oil and chemical substances	Bangladesh Environment Protection Act, 1995	Evaluation of effect of the mitigation measures towards soil pollution	Soil nutrients test including heavy metals	Two sampling points should be tested that points are within the construction area	Once for every three months	- Implementation: Contractor/Environmental Consultant -Supervision: REB/PGCB/CPGCBL Supervision Consultants	Expenses included in contract cost by Contractor - Sampling& analyzing: 2000 Tk./ sample
4	Wastes Pollution	1) Construction waste from construction work 2) Domestic waste from workers 3) Hazardous waste such as dry batteries, etc.	3R (reduce, reuse, recycle) Waste Management Rules	Evaluation of effect of the mitigation measures for waste pollution	Record of kinds and quantity of waste, and the disposal method	Two points: One solid waste sampling observation points whichare in and around the offices' waste disposal site and another sampling point is in leachate area of asolid waste dumping area.	Continuous records	- Implementation: Contractor/Environmental Consultant -Supervision: REB/PGCB/CPGCBL Supervision Consultants	Expenses included in contract cost by Contractor
5	Noise and vibration	1) Noise and vibration caused by construction machinery 2) Noise caused by vehicles used for mobilization of equipment and workers	- Bangladesh Noise level standards - IFC guideline values for noise (General/ 2007)	Evaluation of effect of the mitigation measures being taken towards noise levels	Measurement from the noise level determining meter	--One is middle of the project for noise and vibration -two points are residential areas near the construction site for noise and vibration -another one point is near construction	Once for every three months;	- Implementation: Contractor/Environmental Consultant -Supervision: REB/PGCB/CPGCBL Supervision Consultants	Expenses included in contract cost by Contractor - Sampling& analyzing: 2000 Tk./ sample

SI. no.	Potential impact to be monitored	Source of potential impacts	Standard of monitoring parameter/ Laws	Purpose of the monitoring	Monitoring Indicator/ data	Location	Period of monitoring/ Frequency	Responsible organization	Cost
						machinery for noise and vibration			
6	Ecosystem (Flora and Fauna)	1) Existence of endangered species	- Bangladesh Wildlife (Preservation) (Amendment) Act,1974	1) Evaluation of existence of endangered species	Species, Number	- Construction area	Twice a year in dry and rainy seasons	- Implementation: Contractor/Environmental Consultant -Supervision: REB/PGCB/CPGCBL Supervision Consultants	Expenses included in contract cost by Contractor - Sampling (Lam sum): 5000 Tk.
	Fisheries ecosystem	1) Potential impact due to the degradation of water quality caused by civil engineering work 2) Domestic wastewater of workers 3)Inappropriate disposal of solid waste	- Status of Benthos - Status of Fish and Nekton	- Evaluation of effect of the mitigation measures towards water pollution - Confirming the population and change in types of organisms	Species, Number, Weight	-For fish/nekton 2 sampling points in reservoir at the area near construction site -One sampling of benthos in reservoir in front of the construction site	- Twice a year in dry and rainy seasons	- Implementation: Contractor/Environmental Consultant -Supervision: REB/PGCB/CPGCBL Supervision Consultants	Expenses included in contract cost by Contractor - Sampling& analyzing: 2000 Tk./ Sample
7	Land use and utilization of local resources	- Changing the traditional land use patterns and utilization of local resources	Employment and businesses opportunities around the construction area	- Improvement of the local economy - Improvement of living standards of local residents - Consideration tolocal residents' feelings	Number of income generating opportunities	Site location	Intermittent way	- Implementation: Contractor/Environmental Consultant -Supervision: REB/PGCB/CPGCBL Supervision Consultants	Expenses by CPGCBL - Interviewer : 5,500Tk./ researcher
8	Disturbance to existing social services	1) Traffic jams caused by increase in the number of vehicles		-Evaluation of effect of construction schedule	- Traffic volume by construction	- Project site	- Continuous records	- Implementation: Contractor/Environmental Consultant -Supervision: REB/PGCB/CPGCBL Supervision Consultants	Expenses by CPGCBL - Interviewer : 5,500Tk./ researcher

SI. no.	Potential impact to be monitored	Source of potential impacts	Standard of monitoring parameter/ Laws	Purpose of the monitoring	Monitoring Indicator/ data	Location	Period of monitoring/ Frequency	Responsible organization	Cost
9	Local conflicts of interest	-Conflict between local residents and external workers	-Change in local customs	Confirmation of the attitudes of local residents to the project	Change in behavioral attitude	- Project site	Once a year	- Implementation: Contractor/Environmental Consultant -Supervision: REB/PGCB/CPGCBL Supervision Consultants	Expenses by CPGCBL- Interviewer: 5,500Tk./ researcher
10	Gender	-Gender among those who are to be resettled -Loss of salt fields, shrimp farms and fishing sites	According to Bangladesh Gender Policy 2012	Compensation confirmation	Number of affected people	Project site	During resettlement	- Implementation: Contractor/Environmental Consultant -Supervision: REB/PGCB/CPGCBL Supervision Consultants	Expenses by CPGCBL - Interviewer: 5,500Tk./ researcher
11	Children's right	- Child labor	The Bangladesh Labor Act, 2006	- Evaluation of effect of banning child labor	- Checking the labor contracts between sub-contractor and workers - Patrolling construction area for child labor	- Construction area	- Once a year	- Implementation: Contractor/Environmental Consultant -Supervision: REB/PGCB/CPGCBL Supervision Consultants	Expenses by CPGCBL - Interviewer: 5,500Tk./ researcher
12	Work environment (Including Work Safety)	- Labor accidents	-The Bangladesh Labor Act, 2006 -IFC environment, health and safety guideline	- Evaluation of effect of the work safety plan	- Record of accidents	- Contractor's office	- Continuous records	- Implementation: Contractor/Environmental Consultant -Supervision: REB/PGCB/CPGCBL Supervision Consultants	Expenses by CPGCBL - Interviewer: 5,500Tk./ researcher
13	Accidents	- Traffic accidents	-Road Transport And Traffic Act, 2011 -The Motor Vehicle Ordinance 1983 -The Inland Shipping (Amendment) Act, 2005	- Evaluation of effect of traffic schedules	- Record of accidents	- Contractor's office	- Continuous records	- Implementation: Contractor/Environmental Consultant -Supervision: REB/PGCB/CPGCBL Supervision Consultants	Expenses by CPGCBL - Interviewer: 5,500Tk./ researcher
Operation Stage									
1	Air quality	-Exhaust gas from vehicles used for mobilization of equipment and workers	- Emission gas standards - Ambient air quality standards - IFC guideline values	- Evaluation of effect of the mitigation measures towards air pollution	Result of So_x NO_x,TPM, CO_2, CO, Dust	--one sample point near generator used for the construction	- Once for every three months	- Implementation: Contractor/Environmental Consultant -Supervision: REB/PGCB/CPGCBL Supervision Consultants	- Expenses included in contract cost by Contractor - Sampling& analyzing:

SI. no.	Potential impact to be monitored	Source of potential impacts	Standard of monitoring parameter/ Laws	Purpose of the monitoring	Monitoring Indicator/ data	Location	Period of monitoring/ Frequency	Responsible organization	Cost
			for gas emission						2000 Tk./ Sample
2	Water quality	-Domestic wastewater from campsite -Leakages of transformer oil and chemical materials near sub-station	- Wastewater Standards - IFC guideline values for wastewater (Thermal power plant/ 2008) - Groundwater (Drinking water quality standards)	- Evaluation of effect of the mitigation measure towards water pollution	**Surface water:** pH, BOD, TSS, Oil, Grease, COD, TP, DO, Nitrate, Faecal Coliforms, etc. **Ground Water:** pH, Nitrate, TSP, Arsenic, Cd, Pb, Fe, Mn, S, Cl, FC	**Selected points at:** -**One** sample in River/pond area near the camp site **-one sample for** Ground water from existing well **- one sample for** Drain outlet of the electric sub-station	- Continuous measurement	- Implementation: Contractor/Environmental Consultant -Supervision: REB/PGCB/CPGCBL Supervision Consultants	- Expenses included in contract cost by Contractor - Sampling& analyzing: 2000 Tk./ Sample
3	Soil quality	Seepage from disposal site and oil and chemical substances from storage area are susceptible to contaminate the soil environment result in damaging the soil microorganisms and depletion of soil fertility	Bangladesh Environment Protection Act, 1995	- Evaluation of effect of the mitigation measure towards soil pollution	Soil nutrients tests including heavy metals with chemical substances	-One sample near to sub-station sites - One sample in waste disposal site near to campsite	Once for every three months	- Implementation: Contractor/Environmental Consultant -Supervision: REB/PGCB/CPGCBL Supervision Consultants	Expenses included in contract cost by Contractor - Sampling& analyzing: 2000 Tk./ Sample
4	Waste pollution	waste oil from equipment, -Sewage and garbage from workers	3R (reduce, reuse, recycle) Waste Management Rules, 2009	- Evaluation of effect of the handling of garbage	- Record of the amount of waste generation and disposal	- Campsite and sub-station area	- Continuous records	- Implementation: Contractor/Environmental Consultant -Supervision: REB/PGCB/CPGCBL Supervision Consultants	Expenses by CPGCBL Cost: 2000Tk./ Person/ Day

SI. no.	Potential impact to be monitored	Source of potential impacts	Standard of monitoring parameter/ Laws	Purpose of the monitoring	Monitoring Indicator/ data	Location	Period of monitoring/ Frequency	Responsible organization	Cost
5	Noise and Vibration	-Noise and vibration from generators, and pumps. -Noise for making steel structures of tower -Noise caused by vehicles used for mobilization of equipment and workers -Transformer vibrant may cause electric humming sound	**Noise level** - Noise standards - IFC guideline values for noise (Thermal power plant/ 2008) (General/2007)	- Evaluation of effect of the mitigation measures towards noise levels	- Noise measurement using noise determining level meter	**-** Selected points at near to power generator, power substation	- Once for every 3 months	- Implementation: Contractor/Environmental Consultant -Supervision: REB/PGCB/CPGCBL Supervision Consultants	Expenses included in contract cost by Contractor - Sampling& analyzing: 2000 Tk./ Sample
12	Gender	-Loss of employment in agricultural field, salt fields, shrimp farms and fishing sites -Engage of female worker in the project	National action plan for national women development policy (2011)	Involvement of affected people about gender in services	Gender equity in number of services and involvement	Project area	Once for a year	- Implementation: Contractor/Environmental Consultant -Supervision: REB/PGCB/CPGCBL Supervision Consultants	Expenses by CPGCBL - Interviewer : 5,500Tk./ researcher
13	Children's Rights	-Child labor involvement in the project	The Bangladesh Labor Act, 2006	-Evaluation of effect of banning child labor	Child labor - Checking labor contracts between subcontractor and workers - Patrolling operation area for child labor	Working area	Once a year	- Implementation: Contractor/Environmental Consultant -Supervision: Supervision Consultant	Expenses by CPGCBL - Interviewer : 5,500Tk./ researcher
14	Work Environment (Including Work Safety)	- Labor accidents	-The Bangladesh Labor Act, 2006 -IFC environment, health and safety guideline	- Evaluation of effect of the work safety plan	- Record of accidents	-Working area	- Continuous records	Implementation: Contractor/Environmental Consultant Supervision: REB/PGCB/CPGCBL Supervision Consultants	Expenses by CPGCBL - Interviewer : 5,500Tk./ researcher

SI. no.	Potential impact to be monitored	Source of potential impacts	Standard of monitoring parameter/ Laws	Purpose of the monitoring	Monitoring Indicator/ data	Location	Period of monitoring/ Frequency	Responsible organization	Cost
15	Accidents	-Traffic accidents -Fire	-Road Transport And Traffic Act, 2011 -The Motor Vehicle Ordinance 1983 -The Inland Shipping (Amendment) Act 2005	-Evaluation of effect of the work safety plan	Record of accidents and fire	Project area	- Continuous records	- Implementation: Contractor/Environmental Consultant Supervision: REB/PGCB/CPGCBL Supervision Consultants	Expenses by the CPGCB - Interviewer : 5,500Tk./ researcher

11 COST ESTIMATION FOR ENVIRONMENTAL MONITORING

Cost Estimation for Environmental Monitoring is a must for the project smooth running. The total cost for Environmental Monitoring with its essential segments of the project is stated in Table 40.

Table 40: Cost estimation for Environmental Monitoring

SI. no.	Potential impact to be monitored	Cost (Tk.)
Construction phase		
1	Air quality	2000.00Tk x 4 sample x 6 parameters x 3 quarters =144000.00
2	Water quality	2000.00Tkx 3 sample x 21 parameters x 3 quarters =378000.00
3	Soil quality	3000.00Tkx 2 sample x 5 parameters x 3 quarters =90000.00
5	Noise and vibration	3000.00Tkx 4 sample x 1 parameters 3 quarters =36000.00
6	Ecosystem (Flora and Fauna)	Lam sum=20000.00
	Fisheries ecosystem	3000.00Tkx 4 sample x2 parameters 6 quarters =144000.00
7	Land use and utilization of local resources	Lam sum=20000.00
8	Disturbance to existing social services	Lam sum=20000.00
9	Local conflicts of interest	Lam sum=20000.00

SI. no.	Potential impact to be monitored	Cost (Tk.)
10	Gender	Lam sum=20000.00
11	Children's right	Lam sum=20000.00
12	Work environment (Including Work Safety)	Lam sum=20000.00
13	Accidents	Lam sum=20000.00
	Sub-total	**952000.00**
Operation Stage		
1	Air quality	2000.00 Taka x 1 sample x 6 parameters x 3 quarters =36000.00
2	Water quality	2000.00Tk x 3 samples x 21 parameters x 3 quarters =378000.00
3	Soil quality	2000.00Tk x 2 samples x 5 parameters 3 quarters =60000.00
5	Noise and Vibration	2000.00Tkx 2 samples x 1 parameters 3 quarters =12000.00
6	Gender	Lam sum=20000.00
7	Children's Rights	Lam sum=20000.00
8	Work Environment (Including Work Safety)	Lam sum=20000.00
9	Accidents	Lam sum=20000.00
	Sub-total	**566000.00**
	Grand total	**1518000.00**

12 BENEFICIAL IMPACTS

Government of Bangladesh has given highest priority for the supply of electricity to the different zones of Bangladesh. The electricity supply is important both for industrial, agricultural and commercial activities. To increase power generation capacity of Bangladesh, GoB/Coal Power Generation Company Bangladesh Limited (CPGCBL) has decided to establish a coal-based 2x600 MW Power Plant project in Matarbari. The present project is very important to supply initial power to 132 KV PGCB sub-station to start the construction of power plant. During operation of the Coal power project, 1200MW electricity will be added to thenational grid that will bring ultimately enhanced economic growth of the country. On the other hand, 4000 nos. of various type of consumers including residential, commercial, irrigation project, salt farms, and small industries' people are eager to connect the power in the locality which will bring enhanced local economy and also livelihood status in the region.

13 CONCLUSION AND RECOMMENDATION

EIA or ESIA report has been preparedby identifying the potential impacts, assessing them and recommending possible mitigation and enhancing measure for negative and positive impacts, respectively. Construction of proposed infrastructures, are the major source of adverse impacts to be associatedwith different phases of the project at premises of the proposed area. This may create long and short term as well as irreversible effects to a limited degree on the receiving environment if no mitigation measure is adopted.

On the other hand, the project has a positive impact in terms of electricity supply with generation (indirectly) and employment in the operation phase and construction phase. An outline of EMP has been prepared in the present report to mitigate the impacts which are expected to occur during different phases of the project.

The findings of this ESIA suggested that the project involves the potential but limited environmental impacts to which further careful attention should be given to the construction, operation and maintenance of the project in order to minimize and offset the adverse effects. The possible negative impacts are not severe and the adverse impacts if duly addressed could be minimized without much effort though they would require attention and positive commitment from project management. In consideration of implementing the recommended impact mitigation measures, it is concluded that the anticipated adverse impacts of the project will remain within acceptable limits. Public consultation and have been held in the catchment/beneficiary area of the project and the advice come from stakeholders are incorporated in the refining the project plan or environmental management plan.

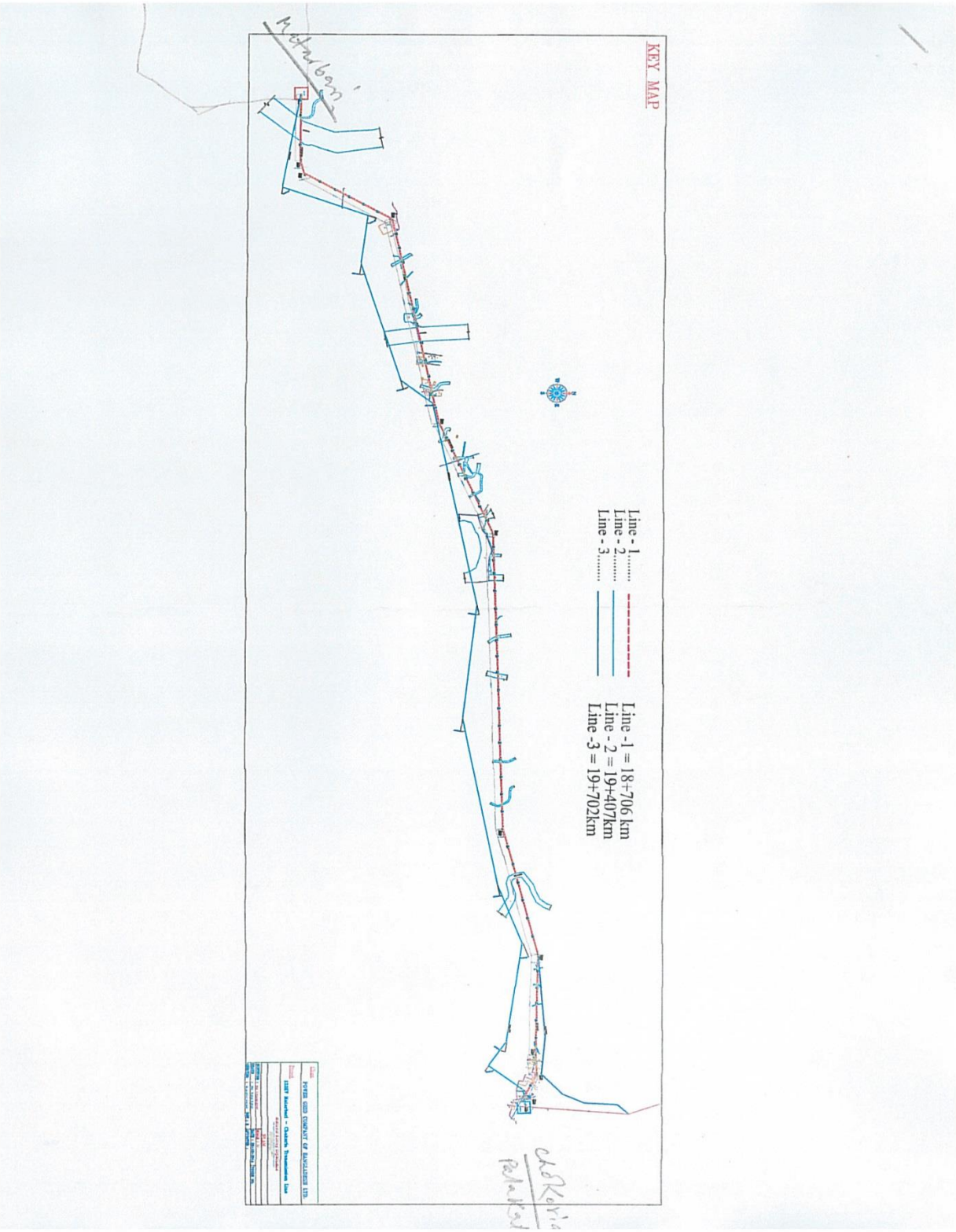
The direct and indirect beneficial impacts from the establishment of the project are expected to outweigh the adverse impacts. Therefore, the project is environmentally sustainable and is accepted for implementation from an environmental point of view.

It is finally concluded that project preparation and detailed design of the project are in full compliance with the harmonized safeguard policies of the Co-financers and the Government of Bangladesh. Consultations with various groups of experts were held during the detailed design. The objective was to share information on the project and to obtain feedback on important social and environmental issues to be considered in the Environmental and Social Impact Assessment.

The results of the public consultation showed that the people wanted the project as it was very beneficial to the area, with minimum negative environmental impacts. Many people were interested in the project implementation and its environmental effects and potential usage. The design of the project was explained and the stakeholders were satisfied.

In discussions with the REB/PGCB/CPGCBL personnel, it was decided to hold additional public consultations and press releases that will be disclosed at all stages of the project implementation. The ESIA, including a Bangla-language executive summary (to include a summary of the EMP), will be uploaded to the contractor's company website, and will be made available locally.

Appendix 1: Layout of the transmission line of the project and survey report done by PGCBon route alignment of the transmission line



Evaluation of Alternative Route Alignments of 132KV Matarbari - Chakaria Transmission Line :

Three different alignments were studied with the help of published data/maps and walkover survey to arrive at most optimum route for detailed survey. The river crossing over **Kohalia River, Matamuhuri River** are common for all the three routes The comparative details of these three alternatives are as follows:

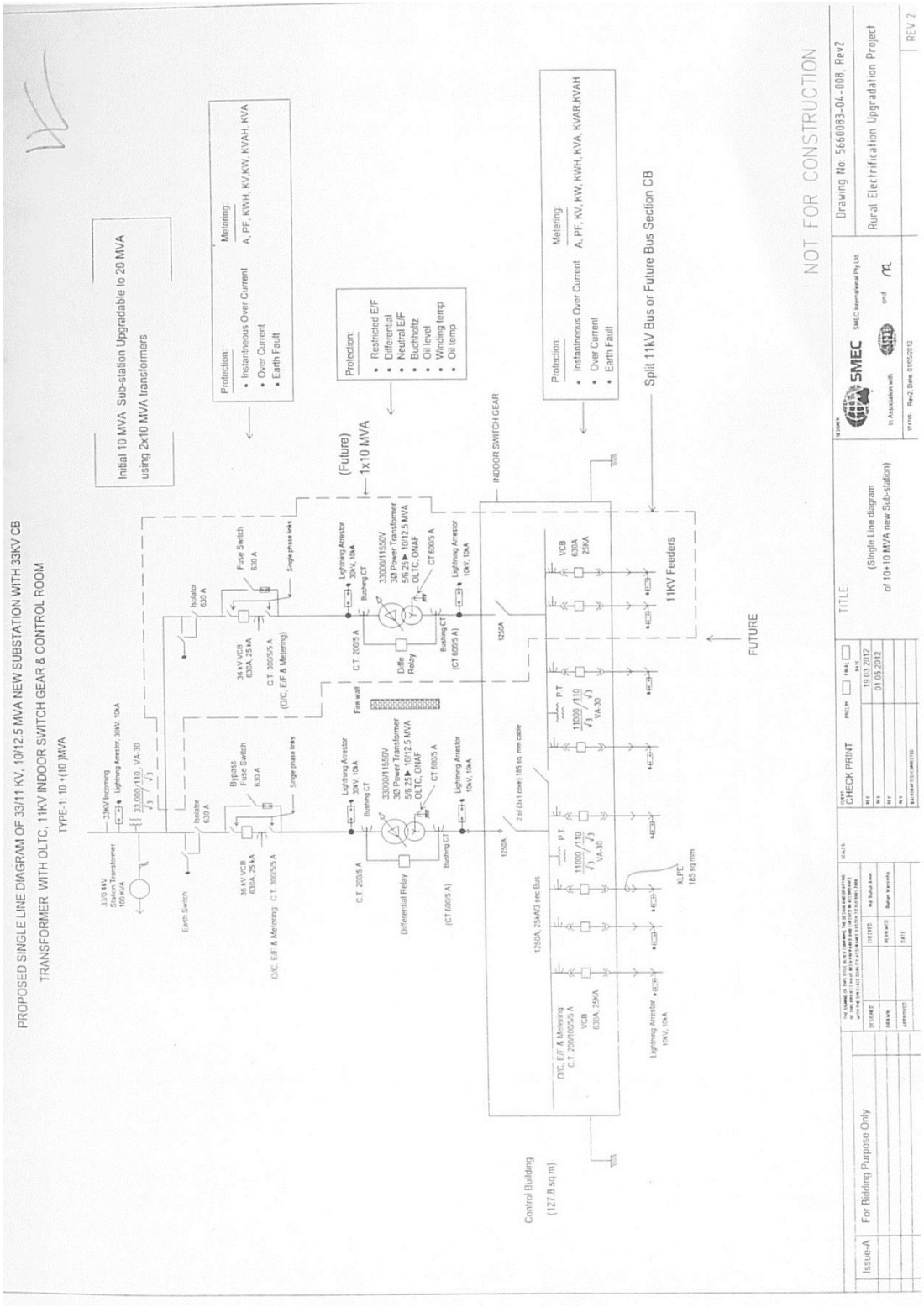
Sl.	Description	Alternative-I	Alternative-II	Alternative-III
1.	**Route particulars**			
	I) Angle Tower No	**11**	**13**	**13**
	ii) Angle Type	0°-10°**(02)**	0°-10°**(01)**	0°-10°**(02)**
		10°-25°**(05)**	10°-25°**(03)**	10°-25°**(07)**
		25°-90°**(04)**	25°-90°**(09)**	25°-90°**(04)**
	iii) Length in Kms	18+706	19+407	19+702
	iv) Terrain (Km)– (a) Plain (b) Hilly	Plain	Mixed	Majority Plain
2.	**Environmental impact**			
	i)Towns in alignment	Chakaria	Chakaria	Chakaria
	ii) Forest involvement	Nil	Nil	Nil
	ii) Historical/Cultural monument	Nil	Nil	Nil
	iv) Type of Flora & Fauna	NA	NA	NA
	v) Endangered species, if any	Nil	Nil	Nil
3.	**Major Crossings:**			
	i) River (Nos.)	3	3	4
	ii) Power line (Nos.)	(11 kV – 7 nos.)	(11 kV – 8 nos.)	(11kV – 7 nos.)
	iii) Railway line(Nos.)	Nil	Nil	Nil
	iv) Pucca Road/ Katcha Road	6+5	6+7	7+6
	v) Khal (Nos.)	23	27	25z e
4.	**Construction problems**	Line route passes through mostly plain area and also involve less khal area and river & road crossing span is minimum	Passes through relatively hilly/ undulating terrain and also involve more no. of river/Khal crossing	Passes through mostly plain area but involve more Khal crossing and also river crossing span is more
5.	**O&M problems**	O&M shall be comparatively easier due to better accessibility of line route	Moderate accessibility to line route	Moderate accessibility to line route

From the above comparison it is evident that although all 3 alternatives are almost similar line length, the line route of Alternative-I passing through mostly plain area with easy accessibility having minimum road crossing, less Khal area and also span on river crossings are less as compared to other two alternatives. Hence, **Alternative-I** has been found to be most optimum alignment and recommended for detailed survey.

GPS Co-ordinate of
Proposed Chakaria-Matarbari Single Circuit Transmission Line

	Matarbari - Chakaria 132 kv Transmission Line				
SL.	Easting	Northing	Elivation (PWD)	Feature Code	Comments on Plan
1	386803.6947	2400659.554	3.33	N	
28	387963.4057	2400661.008	3.34	AP-1	15°0'34"LT
33	388181.0777	2400719.669	3.5	AP-2	44°27'3"LT
69	388979.2833	2402076.422	3.65	AP-3	47°31'15"RT
185	392503.4349	2402825.943	3.75	AP-4	11°28'29"LT
249	394428.4444	2403662.235	3.72	AP-5	21°33'50"RT
371	399575.9421	2403834.748	4.26	AP-6	12°24'8"LT
418	401707.22	2404378.91	4.06	AP-7	15°18'31"RT
470	403443.0046	2404348.938	4.59	AP-8	5°14'1"LT
485	403782.8274	2404374.286	4.58	AP-9	30°16'44"RT
508	404343.9058	2404211.57	4.6	N	

Appendix 2 : Layout of the power sub-station of the project



Appendix 3: Gender Action Plan

WOMEN IN BANGLADESH: AN OVERVIEW

Bangladeshi women contribute substantially to households chores and the country's development The prescribed social roles have limited their access to economic resources as well as their participation in political, social and other forms of decision-making aspects. Women have very high levels of underemployment and unemployment. The majority of women workers are primarily involved in the informal sector of the economy. Seventy percent of women and children are suffering from nutritional deficiency and 30% suffer from calorie deficit (pregnant and lactating women). Morbidity among women is very common due to poor nutrition and double work burdens.

Maternal mortality and infant mortality rate per 1000 Live Birth is 3.37 and 52 respectively (Ministry of Health and Family Welfare; successive Bangladesh Demography and Health Surveys).Women's life expectancy is 66; delivery of pregnant women by trained person is 18%. Gender inequality is also prevalent in the context of literacy rate which is 40.8% for women and 49.6% for men in the age group of 7 years & above (Bangladesh Bureau of Statistics 2001).

A woman, on an average, is married before reaching the age of 20 years. In general, as head of the household, the husband makes most of the important decisions. A large number of women work in export-oriented industries (e.g. garments) which is the source of 70 percent of Bangladesh's foreign exchange.

The female labor force in waged employment is more than doubled during the last 15 years (4.9 million in 1991 to 10 million in 2000) but is still much lower than the male labour force (31 million in 1991 to 35 million in 2000). The difference between waged employment for rural men and women is much higher than the national average. The share of women in waged employment in the non-agricultural sector was estimated at 22 percent (2000 – UNDP). Female employment is concentrated in sectors with low-paying jobs and is often temporary due to low skill levels and discriminatory attitudes regarding 'suitable' work for women. Women are mostly engaged in unpaid agricultural work in rural areas.

One of the positive developments in the economic realm has been the micro-credit programswhich have helped females enormously through enhanced capacity for income generation and decision-making power in the family and the community. The total number of female micro-credit borrowers has reached 13 million, constituting 95% of the borrowers, with loans reaching BDT 616 million and a repayment rate of above 90 percent (Palli Karma Sahayak Foundation 2003).

In spite of these achievements, the majority of women in the Bangladesh have yet to be empowered to participate actively in the social, cultural, economic, and political life of the country due to widespread Gender discrimination in all spheres and at all levels.

WOMEN IN THE PROJECT AREA

The project influenced area has nearly 14500 female populations. About 3500 women are currently involved in economic activities outside their home. Implementation of the project will create new jobs for nearly 700 women. In the project influenced area, married population at the age of 15 years and above was observed 53.8%.

THE PROJECT INTERVENTION

The project will provide all possible supports to address the gender issues in its different activities of the project components with focus on two major dimensions e.g. (i) reduction of poverty and(ii) gender mainstreaming in the national economy within the context of MDGs Goal 1: Eradicate extreme poverty and hunger,2: Promote gender equality and empowerment of women as well as the poverty reduction strategy(PRS).

The project in its' broad-based objectives will address gender issues in the following manner:

- create scope for women's participation in the activities like the project planning, implementation, monitoring and evaluation;
- generate employment opportunities for women by involving them in different construction, maintenance and tree plantation activities thus, helping them in their efforts of poverty reduction;
- facilitate linkages with women stakeholders with different resources for the ultimate sustainability of their livelihood;
- facilitate social and economic development programs aiming at women as the user groups to increase their access to the infrastructure development activities and other production and services activities
- Establish gender friendly working condition for all possible activities in the project.
- work for promoting gender equality in the context of PRSP (Poverty Reduction Strategy Paper) Millennium Development Goal (MDGs) addressing gender issues within the context of rural development.

IMPROVEMENT OF INFRASTRUCTURE WITH GENDER DEVELOPMENT

- Ensure 30% women participation in consultation on infrastructure planning, implementation and monitoring
- Employ 30% women as employee/worker in the infrastructures construction works and other productive and service-oriented works
- Contractor and the project staff on core labor standard in terms of employment of women labors, pay an equal wage for women including providing men and other facilities.
- Provide supports including separate toilets, safe drinking water supply for women working at different stages of work;

IMPROVEMENT OF INFRASTRUCTURE MANAGEMENT

CAPACITY BUILDING OF THE PROJECTT'S AUTHORITY:

- Recruit/promote more women at various levels of the project
- Organize Training on Gender and Development for the female workers and staff who will be engaged in working with the project;
- Integrate gender issues in all level of the project
- Ensure that female are not repressed

OBJECTIVES OF THE GAP: The Gender Action Plan (GAP) will contribute to:

- Reduce Women's poverty
- Facilitate Women's Empowerment
- Create economic opportunities in construction, operation and maintenance
- Improve their wellbeing
- Employ poor indigenous women, if in project area
- Include female Union Council members in the land requisition and resettlement
- Provide separate toilets, safe water supply for women in the construction sites and working places.
- Arrange mainstream gender equality into training
- Promote women's involvement in the project implementation
- Gender consultant & financial resources for GAP implementation
- Project tools, formats, documents are gender sensitive &sex-disaggregated data maintained in project
- Conduct, monitoring to assess changes in their livelihoods & socio-economic status of the women who will be involved in construction, operation and maintenance stages
- Introduce Gender Inclusive M & E and reporting ofsex-disaggregated data.

GENDER ACTION PLAN FOR THE POWER TRANSMISSION LINE PROJECT

Improvement of Road/Approach Roads including other Infrastructure

Area of Focus	Objectives	Activities	Target Group	Indicators	Quantitative target	Action by	Time schedule	Monitoring mechanism
Women's Participation in workshop and meeting	-Ensure women's participation in the planning, design, implementation and maintenance of the infrastructure	-Involve women during planning period by conducting participatory workshops, meetings with the stakeholders and beneficiaries; -Emphasize women's opinion at the time of discussion;	Women stakeholders and beneficiaries at project locations	In all infrastructures	-A number of participatory workshop/meetings conducted and number of women participating in the workshop/meetings (at least 30%) participated actively in the workshop/meetings).	Project Management Office (PMO) of the project	During planning, design, implementation and maintenance	Workshop report, meeting minutes, attendance register etc.
Women's access and control over resources	-Ensure women's access to and control over the resource as users;	-Address women's needs in the design of all infrastructures (toilet and water for all and temporary shed for lunch for women and mother of breastfeed babies recruited as construction labor);	All women stakeholders, workers and beneficiaries	-In all infrastructures	-Women's opinions have been taken care off	PMO of the project	During design, implementation, maintenance and operation	Construction, maintenance and operation progress report
Employment opportunities	-Create employment opportunities for poor women during construction, maintenance and operation;	-Employ women labors at the time of construction and maintenance; -Select disadvantaged and vulnerable poor women to work for Routine maintenance &Tree	-Poor women including female headed household; project affected poor women, indigenous people if living in the project area	Women comprise at least 30% of the construction and maintenance laborers;	-30% women laborers are employed in all construction and maintenance works; -At least 50% workers are female	PMO of the project PMO of the project	During construction and maintenance -During operation of the project	Contract award, work order, progress report, job report

		Plantation as per selection criteria of the project; -Recruit more women as workers -Recruit more female women officers at various level of the offices	-More women as the workers -More female women officers at various level of the offices of the project		-		after construction of infrastructure	
Women's participation in decision-making process	-Ensure women's participation in different committees and contribute indecision-making process	-Involve women in Infrastructure Management Committee; construction supervision committee; Operation & Maintenance (O & M) Committee of infrastructures;	-Female Workers , officers and staff;	-Number of female increased	In all Committees;	PMO of the project	During implementation , maintenance and operation of offices of the project	Meeting minutes and reports
Equal wage and salary	-Minimize wage difference between male and female labors for equal works. -Equal wage and salary for female construction workers, staff and officers	-Orient contractors to engage female labors and provide equal wage for equal works; -Provide equal wage and salary for female construction workers, staff and officers	Female labors -Factory level female workers, staff and officers	-At least 30% women are engaged in the construction and maintenance works. -Wage difference in all cases works are minimized	-The difference in wage for equal works is minimized below 5%.	Contractors and executing agency	During implementation of construction works and operation of factory	Construction site visit report, Bill payment receipts, workers and officers salary registers

Land Acquisition, Compensation and Resettlement (IF ANY)	-To ensure actual compensation package to affected female persons (if any).	-Include local female UP members in case of land acquisition and resettlement. -Public announcement to include affected women.	-Female UP members**;** -Affected women	All affected women (if any)	-Women received full compensation	PMO of the project	During land acquisition	Resettlement Action Plan, Progress reports
(ii). Improvement of Infrastructure Management: The project Capacity Building, Climate change resilient infrastructure management								
a) *Capacity Building of project's authority*	-Increase number of Female staff -Ensure that all training are offered keeping in view the GAD perspectives	-Recruit/promote more women at various levels of the project -Promote participation of female staff in all formal and informal training; -Integrate gender issues and identify ways to address them in all training; -Develop and review training curriculum and modules with gender perspectives;	Women workers and Female staff and officers PMO training team	The number of female staff increased in the project, Gender inclusive Training policy implemented and Gender issues incorporated, Training curriculum and modules developed from gender perspectives	-At least 30% Female represents in all training	PMO of the project	During recruitment During training design and implementation	Human resource database Training report and attendance sheet Training curriculum & modules
	-Develop training capacity within the project	-Impart training of trainers (TOT) to selected staff on GAD, -Develop a group of trainers within the project (50% trainers would be female)	Number of project staff in HQ and regions.	-At least 30 project staff of PMO and regional levels including women;	-Number of TOT conducted and training capacity of number of staff at various level of the	PMO		Training reports

				-Number of courses	project operation developed;			
	-To sensitize and train all project staff on GAD concept related to project and their own work responsibilities	-Impart training on GAD and gender sensitization to all project personnel associated with project activities; -Introduce and orient Gender Action Plan to the staff; -Develop curriculum, manuals and contents; -Organize training/workshops for project personnel at project offices; -Arrange refresher's course periodically	Staff at the Project offices associated with project activities.	-At least 4 GAD Training courses per year -Refresher's courses annually	-Training workshops conducted; -Project staff understand GAD concepts and become gender responsive; -Project Staffs address GAD issues in work.	PMO	During operation of project and ongoing.	Training report;
Capacity building of stakeholders and female staff	-Improve skills of female staff -Provide need-based skill training	-Prepare Training curriculum; -Arrange skill training for female staff -Monitoring, supervision and strengthening of female skill;	Female staff	All female staff and their male colleague	-Curriculum and Training manual prepared and approved; -Female staff know and follow their input in their jobs. -Supervision and monitoring done by the project staff after training;	PMO	-Within 6 months of recruitment -After receiving training	Monitoring report, progress report
	-Enable female staff in voicing their rights.	-Establish network among female staff to support each other in each level of jobs; -provide backup support for their existence, empowerment and sustainability;	Female staff and workers	In all level of the project jobs	-Number of female staff and workers ' association established;	PMO	Within 3months of starting of project operation	Progress reports

Monitoring and Evaluation	-Monitoring of the implementation status of GAP on a regular basis	-Monitor GAP implementation; -Collect information on progress of implementation of GAP; -Arrange periodic review meeting;	PMO	-Monthly meeting -Quarterly meeting -Annual meeting	-Gender-based monitoring and supervision in practice; -Reports include gender-based information;	PMO		Monthly, Quarterly and Annually Reports and Proceedings
	-Generate monitoring, evaluation, and reporting system withsex-disaggregated data concerning involvement of women in various components of project as change agents	-Prepare the questionnaire, formats, and tools for component specific gender inclusive indicators to highlight actions taken in respect of women as change agents and beneficiaries.	PMO	PBME/Formats are gender inclusive -Software developed	-Data/information generated having implications for women concerned issues	PMO	Regular	PBME reports, Management Information System (MIS) reports
	-Conduct benefits monitoring of female staff and workers to assess the changes in their livelihood and socio-economic status due to project interventions.	-Prepare Project Benefit Monitoring and Evaluation (PBME) activities to orient itself towards the gender issues;	PMO	Gender inclusive PBME tools and Formats developed	-Data/information generated having implications for women concerns issues -Software developed	PMO	Regular	Survey and periodic reports

Appendix 4: Social Management & Resettlement Policy Framework

Social Management & Resettlement Policy Framework

The Social Management and Resettlement Policy Framework intends to deal with resettlement issues that may arise from the area and activities under the project. SMRF would be developed and use to assess social and resettlement aspect of the project and develop appropriate measures to mitigate the consequent potential negative social impact. The Framework will serve as a guideline to assess the social impact and develop asocial plan to mitigate adverse social aspect in different phases of the project and formulate resettlement plans. With the financial assistance from the Co-financer and Govt., the project has been prepared and is being implemented by implementing agency. A safeguardissue relates to Rules and regulation of the government and the Co-financers' operational policies on involuntary resettlement if any.

The policy objectives of SMRPF are as follows:

1) Assist the affected person of the project in such a manner either to improve or at least restore the previous standard of living.
2) In addition to country's existing legal framework for the land acquisition, ensure compliances of social safeguard policies of the Co-finance if any.
3) Implementation of the project following the SMRPF will improve the social outcome of the locality.

The Contents of SMRPF are stated below:

a) A legal framework which will be used to acquire lands and mitigate the adverse impact.
b) A detailed policy matrix defining the loss of categories, compensation principle, application guideline and organizational responsibility.
c) An organizational framework to plan and implement the resettlement activities in general, and in particular identifying the locations- specific impact details, as well as the task related to policy revisions, budgeting and work planning.
d) A grievance redress procedure to deal with disputes and complaints related to planning and implementation of the resettlement activities.
e) A monitoring and evaluation framework to use during and after implementation of the resettlement activities.
f) A planning process defines task leading to preparation of the location, specific land acquisition proposal, identification of impact details, policy review, budgeting, task scheduling etc.

Resettlement in the Legal Context of Bangladesh

The legal framework presently in use in Bangladesh is not adequate to deal with the adverse impacts associated with land acquisition and involuntary displacement. Lands are acquired according to the 1982 Acquisition and Requisition Ordinance, but its provisions do not fully satisfy the requirements of the policy on involuntary resettlement. In essence, the law is largely indifferent to the landowners' present socioeconomic conditions, or the long-term changes the acquisition and displacement may cause on the landowners. Also, no other policies are there to complement the acquisition law in ways to assess, mitigate and monitor the adverse impacts that the affected landowners may suffer.

To highlight some of the salient provisions of the law that requires added mechanisms to meet the Co-financer's requirement:

Avoiding/Minimizing Land Acquisition: The law only implicitly discourages unnecessary acquisition, as lands acquired for one purpose cannot be used for a different purpose. However, there are no mechanisms to monitor if this condition is actually adhered to.

Eligibility for Compensation: The law stipulates compensation only for the persons who appear in the land administration records as the owners. It does not recognize the rights of those, such as squatters, who do not possess legal title to the lands they live in or make a living from.

Compensation Paid For: Provides for compensation for lands and other objects built and grown on them (structures, trees and orchards, crops and any other developments like ponds, built amenities, etc.). No provisions are there to assess and restore lost income stream or income sources that acquisition causes to the affected persons, be they legal titleholders or others like squatters, tenants and employees of affected businesses.

Compensation Standards: Although the law stipulates 'market prices' of the acquired lands as the just compensation, the legal assessment method almost always results in prices that are far below the actual market prices. Certain pricing standards, which are regarded as unrealistic, are used to assess other losses like structures and various built amenities, trees, crops, and the like.

Relocation of Homestead Losers: No legal obligation is there to relocate, or assist with there location of, those whose homesteads have been acquired. Such persons/households be the title-holders or squatters, are left on their own.

Ensuring Payment/Receipt of the Compensation: The compensation process is lengthy. Lands are legally acquired and handed over to the project execution agency as soon as the acquisition authority identifies the owners (or 'awardees'), by examining the records, and sends a legal notice advising them to claim the compensation (or 'awards'). Here ends the legal obligation, and now it is the obligation of the affected landowners to prove, by producing an array of documents that the acquired lands legally belong to them. As gathering these documents is a long, expensive and cumbersome process, many landowners may remain unable to claim their awards. The project has meanwhile started to use the lands.

Socioeconomic Rehabilitation: Finally, the provisions are so restricted that the law shows no concern whatsoever about the long-term socioeconomic changes the affected persons and households might undergo in the post-acquisition period. Except for the compensation at the legal 'market price', there are no other provisions for the acquisition or other- laws that require the government to mitigate the resultant adverse impacts caused by the acquisition. Socioeconomic rehabilitation of the involuntarily displaced persons is totally absent in the legal regime of the country.

In fact, the law is too long on the acquisition process and far too short in recognizing and dealing with the variety and severity of impacts the land-based development projects usually cause at the household and community levels, and even implementing the stipulations enshrined in it. As a consequence, the authorities are seldom aware of whether or not, or the extent to which, development projects are making certain people worse-off, out of the resettlement budgets and the implementation schedules**.** In keeping with the principles and provisions adopted in these RAPs, as well as the experiences gained so far in planning and implementation of land acquisition and resettlement the following framework is proposed to mitigate the adverse impacts expected to arise from the project as a whole. This RPF will be

treated as a live document and remain open to revisions and refinements as and when warranted during planning and implementation of the phase-wise RAPs. With this framework in place, RAP preparation tasks will consist of identifying specific impact details, reviewing the mitigation policies to address any impacts that have remained unforeseen until now, and working.

Guide Lines for Using Private and Public Land

Public lands under authorized use: If the land is required which is under lease from any government or autonomous bodies, Project authority may seek to use these lands for fulfilling the lease condition.

Public land under unauthorized use: where the lands are used for living and livelihoods by the poor and vulnerable, Project Authority can take the land only by mitigating the associated adverse impact consisting with the GOB and Financer's policies if any.

Private Land: Wherever found private land is absolutely necessary for the Project, Authority may use the following means to obtain the land.

Acquisition: Under the present acquisition and requisition of immovable properties ordinance1982, and mitigating the associated adverse impact in compliance with the GoB and Co-financer's policy on Involuntary Resettlement and indigenous people

Direct purchase: The implementation authority can purchase the lands directly from the owner on a willing buyer seller basis at a price acceptable to the owner. Price will be negotiated transparently.

Voluntary donation: where the land owner agrees to donate the lands without the fear of adverse consequences. Donated land should be free of disputes and claims. Where these land are used by squatters and others in that case implement applicable mitigation measures adopted in the SMRPF

Principles to avoid or minimize land acquisition and displacement:

1) Alternative design of the construction/Development works will be considered to avoid or minimize land accusation in general, and particular attention will be paid to use minimum amount of private land and as much of public land as possible.
2) The alternative design will also be considered to avoid or minimize displacement from the homestead.
3) Wherever feasible, construction and improvement of the existing shelters will be designed to use lands that are of lower value in terms of uses and productivity.
4) Construction/Development works will be designed to avoid or minimize displacement from building/ structures that are used for permanent business and commercial activities.
5) Where land holdings or structures are remaining after accusation become economically unviable, the landowners will be given the option to offer the entire holding for accusation and compensated for the whole piece of land or structure.
6) The lands that are "khas" or under the ownership of other public entities will be procured through the inter-ministerial negotiation process.
7) More options to avoid/minimize displacement will be explored during social screening and social impact assessment of the specific locations where the project components will be implemented, actual design of the construction/development works and there implementation on the ground.

Principles to mitigate adverse impact

The guideline proposed in the SMRPF will apply to the project activities that will involve land acquisition from private owners and displaced persons from the public lands. Where impacts are unavoidable the following principles and guideline may be adopted to mitigate them:

1) Resettlement of project affected people will be planned and developed as an integral part of the project design.
2) The absence of legal title will not be considered a bar to assistance, especially socio-economically vulnerable.
3) Vulnerability in terms of socioeconomic characteristic of the affected person will be identified and mitigated according to the provision adopted in SMRPF
4) Homestead loser, including the poor and vulnerable households squatting on public lands will be assisted with physical relocation and provision of the basic amenities like water and sanitation.
5) People who are economically well off and use the public land/properties for free will not qualifies for financial or any other forms of assistance.
6) No compensation will be paid for facing temporary inconveniences by business operators and traders, unless they required completely stop their operation during the construction period.
7) The resettlement component will not be used to collect arrear land development taxes, or any other forms of taxes
8) Where the project causes community wide impact, such as community facilities, access to common property resources etc. Project Authority will rebuild them with their own resources or provide alternatives in consultation with the user communities.

Land Acquisition

Land acquisition and the associated impact mitigation principles and guidelines have been proposed with the objectives to consider alternative engineering design to avoid or minimize land accusation in order to minimize its adverse socioeconomic impacts on the people and communities.Consideration will be made to (i) avoid or minimize displacement from private and public land and homesteads (ii) avoid or minimize displacement due to building structure used for permanent business/ commercial activities (iii) use least productive land (iv) avoid accusation of community facilities like educational institution, place of worships, cemeteries, buildings structures that are historically culturally significant and the like. Attempts will also be made to minimize displacement during the implementation of civil work.

Procedure for Acquisition

The selection of sites for development work to be done on the ground, Carry out detail and design and lay on the Mouza map. This will provide the basis to prepare the land acquisition proposal which require administrative approval by the relevant ministry before the submission of a proposal to Deputy Commissioner for acquisition.

On receipt of the LAPs, the concerned DC will register the cases, and organize a physical verification to make sure that the information is correct. The authority, supported by the consultants, if any, will answer any queries from the concerned DC office and assist in resolving any issues and problems with the LAPs. Physical verification will be done following the steps below in the acquisition process:

The concerned DC will issue the legal notice-3 (under section-3 of the law), which will contain the plot numbers from which lands will be acquired. The notice, which will be displayed in public places, will give the concerned landowners a fixed period of 15 days to lodge objections to the acquisition, and another 30 days (maximum, if Divisional Commissioner allows) for the concerned DC to hear them. Upon resolution of the objections, if any, the DCs will then submit the cases to the District Land Acquisition Committee for approval.

Following the issuance of notice-3, and while the approval is being processed, an on-site inventory and verification will be carried out jointly by the acquisition officials and the project authority in presence of the concerned PAPs, to classify and document the assets that will be acquired and compensated for.

While the district land acquisition officials will themselves assess, according to the legal method, the compensation for the land, other built structures, trees, standing crops, etc. will be assessed by the representatives of the concerned GOB departments, such as Public Works, Agriculture, Forestry, etc. by using departmental standards. The compensation so determined is the compensation-under-law or CUL, which may or may not be the replacement values/current market prices of the acquired assets.

Upon receipt of the Divisional Commissioners approval, hearing of any objections by concerned DC, and completion of the joint on-site inventory and verification, the concerned DC will issue notice-6 to the individual property owners stating that the inventoried assets will acquire and taken possession of, and that all claims for compensation be made to the concerned DC. The claims will be made and reviewed on the basis of this on-site inventory and verification.

- Once valuation of all assets is completed, the concerned DC will prepare the compensation assessment rolls or compensation budgets for the individual acquisition cases and submit them to concern authority requesting funds within a maximum of 60 days. After its review, the concern authority will send them for approval of the concerned Ministry.
- On concerned Ministry's approval Implementing authority will place the funds with the concerned DC who will in turn issue notice-7 indicating the amount of compensation, and advising the landowners to make the compensation claims, with the evidence that they are the legal owners or have an interest in the lands. The following evidence is required:
- Record of Right (ROR) or porcha as proof of ownership to the lands.
- Rent Receipt (RR), commonly known as Dakhila provided that the affected person owns agricultural lands excess of 25 standard bighas.

The claims for compensation are accepted if the ownership evidence is found satisfactory. The CUL is then paid by cheque drawn on the GOB treasury at the district HQs. If a landowner losses lands in more than one mouza (land administration unit) or acquisition case, CUL payments are made by as many cheques.

Implementation authority assisted by the consultants, if any, will play a critical role by liaising with the concerned DC and acquisition officials, including other public departments, and by following through every step of the process and monitoring the progress. Implementation authority will also assist to provide any logistical support considered essential by the acquiring body.

Market Value Assessment Procedure

In line with the proposed compensation principle, Implementation Authority assisted consultants will conduct market surveys to determine the replacement value/current market prices of the affected properties. The survey will take into account the quality of land, cropping

intensity and value of the crops produced, accessibility from the existing roads and other characteristics that influence the land market value.

- **Lands:** It includes all kinds of lands, such as agriculture, homestead, commercial etc. The survey will be conducted on following three groups of respondents: (i) a random sample of 10-15 landowners in Mouzas in which the project components are located and in adjacent to them; (ii) if available, a number of recent buyers and sellers of similar lands in such Mouzas; and (iii) a number of deed writers at the land registration offices, who recently handed transactions in those adjacent Mouzas.
- **Houses and other built structures:** The Current market will be determined based on the current market price of the different kinds of building materials in the local markets. The replacement cost of the house and structure will be based on the lowest quoted price for each type of material, plus their carrying cost to the sites.
- **Trees:** Compensation will be determined by surveying the current prices of different variety of trees in the local markets. Compensation for trees will be fixed at the highest price offered by the traders.
- **Fruits and other crops-seasonal and perennial:** Survey of current prices in the local markets. For the seasonal crops, compensation will be paid for only one crop, and that for the perennial crops will be paid for three crops (three times the value assessed during joint verification).
- **Vested (Enemy) properties:** The owner/users of the vested lands will be interviewed to determine the number and types of crops grown in a given year will then be verified with the neighboring farmers. The compensation will be determined by using the same methods applied for crops on other lands.
- **Unforeseen losses:** Compensation for any unforeseen losses will be determined by using methods that will be considered most appropriate.

Eligibility for Compensation /Assistance

According to proposed mitigation principles and modalities, the following persons/ households/entities will be entitled to financial and other forms of compensation and assistance. An affected person may be entitled to get more than one form of compensation depending on type ofloses:

a) ***Private land /other property owners:*** The owners of the affected private land and other assets built and grown on the acquired lands. Legal owners will be identified by the Deputy Commissioner of the district.

b) ***Vested property owners/users:*** The owners/users of the acquired lands and other properties that are designated as vested properties.

c) ***Squatters:*** Residing on public land and/or using such lands for commercial purposes like operating small business.

d) ***Persons with usufruct right:*** Owners of privately-owned business activities on leased-in public lands.

e) ***Sponsors/beneficiaries of development programs using public lands:*** These include social/community afforestation and other land-based income generation programs for socio-economically vulnerable groups, implemented under the auspices of government and non-government organizations.

f) ***Community groups:*** Community or any vulnerable groups will suffer from loss of opportunity of income, or access to parks, protected area, and natural resources will be eligible for compensation.

g) ***Tenants:*** living in rented accommodation will be duly notified and given assistance for new premises and shifting.

h) ***Rental income earner:*** From premises situated on the private land subject to ascertain condition as per matrix.

i) ***Owners and employees of displaced business:*** For a reasonable period of time, subject to certain condition as per matrix.

Entitlement Matrix

On the basis of proposed principles for impact mitigation the following matrix defines the specific elements for different types of loses, entitled person, application guideline and the institutional responsibility to implement them.

1. LOSS OF AGRICULTURAL AND COMMERCIAL LAND

Ownership Type	**Entitled person**	**Entitlement**	**R responsibility**
Private	Legal owners, as determined by concerned DC or by courts in cases of legal disputes.	Compensation-under-law (CUL) or replacement costs, whichever is greater If applicable • Top-up equal to the differences between CUL and replacement costs; • Transition allowance (TA) for income loss (Loss Category 5 below)	• CUL paid by concern neck. • Top-up and TA paid by EA.
Public lands under lease	Leaseholders	Contractual obligations with the public agencies, as determined by concerned DC.	Paid by concerned DC.
Vested non-resident	Current owners/users	Transition allowance for income loss (Loss Category 5).	Paid by EA.

2. LOSS OF HOMESTEAD LANDS

Ownership and Location	**Entitled Persons**	**Entitlement**	**Responsibility**
Homesteads on private lands	Legal owners, as determined by concerned DC or by courts in cases	In addition to CUL and applicable top-up (as for agricultural and commercial lands) : • Relocation assistance, including land development, where household is	EA

	of legal disputes.	required to physically relocate their homes elsewhere; • Restoration of pre-acquisition basic utilities (water supply and sanitation, electricity, etc.)	
Homestead on public lands	Vulnerable Squatters	• Relocation assistance including land development, where squatters are required to relocate their homes; • Provisions of water supply and sanitation facilities	EA
Homestead on VNR lands	Present Owners/Users	• Relocation assistance, including land development where the present owners/ users are required to relocate their homes.	EA

3. LOSS OF HOUSES/STRUCTURES USED FOR LIVING, BUSINESS ANAD OTHER ACTIVITIES

Types and Location	**Entitled person**	**Entitlement**	**Responsibility**
All houses/ structures on acquired private lands.	Legal owners, as determined by concerned DC or by courts in cases of legal disputes	• Compensation-under-law (CUL) or replacement costs, whichever is greater. • Transfer Grant (TG) to cover the carrying costs of household goods, at one-eighth of the replacement costs of the affected structures. • Owners retain the salvageable building materials.	CUL paid by concerned DC. TG paid by EA
Shiftable and non-shift able structures on acquired public lands.	Vulnerable Squatters	• Shiftable structures: House Transfer grant (HTG) and House Construction Grant (HCG) at TK. 20 per sft of floor area with minimum of TK, 2000 and maximum of TK. 3000; • Non-shift able structures: HCG at TK. 30 per sft of floor area with minimum of TK. 3000 and maximum of TK. 4000.	HTG and HCG paid by EA
Houses/ structures on VNR Lands.	Present Owners/Users	HTG and HCG (Amounts are to be determined in consultation with the current owners/users.)	HTG and HCG paid by EA.

4. LOSS OF TREES ON ACQUIRED PRIVATE AND PUBLIC LANDS

Location	**Entitled person**	**Entitlement**	**Responsibility**
On private lands	Legal owners, as determined by concerned DC or by courts in cases of legal disputes	• Current market value of trees, based on species, size and maturity • Current market prices of fruits on trees if they fall before harvest. • Owners will fall and retain the trees and fruits, after payment of compensation.	concerned DC(include in CUL) EA (include in top-up)
On public lands	• Squatters • Private groups, NGOs, etc.	As those stipulated above for trees and fruits.	EA
On VNR lands	Present owners/users	As those stipulated above for trees and fruits.	EA

5. LOSS OF AGRICULTURAL, BUSINESS, EMPLOYMENT AND RENTAL INCOME

Impact Types	Entitled person	Entitlement	Responsibility
Agricultural:			
• If acquisition amounts to 20% or more of the total productive area.	Legal owners	Transition allowance equivalent to three times the harvest prices of crops produced in a year on the acquire lands.	EA
• If acquired VNR lands are agricultural.	Present owners/ users	Three times the harvest prices of crops produced in a year on the acquired lands.	
Business:			
• Permanent closure of business in the existing premises	Business owners (premises /land owners and tenants)	• Rental accommodation in existing or new municipal business premises, plus compensation based on average daily net income prorated for a period needed to reopen the individual business, or • Compensation calculated as above for the number of days the business owners find alternative accommodations themselves, which will be paid for a maximum of 90 days. • Compensation calculated as above for the actual number of days the business remain closed.	EA
• Temporary closure of business in existing premises	Business owners (premises/ land owners and tenants)	• Compensation at the current daily wage rate for the period needed to reopen the business or for a maximum of 30 days.	EA
• Loss of employment income	Business employees	• Three months' rent at the current rates to the owners of the premises.	EA

• Loss of income from rented out premises.	Legal owners.		EA

6. UNFORESEEN LOSSES

Impact Types	**Entitled person**	**Entitlement**	**Responsibility**
As may be identified during project preparation and implementation	As identified	As determined in consultation with IDA	EA

Preparation of Resettlement Action Plan

Detailed measurement survey,(DMS,) census/socioeconomic survey (SES)will have to be undertaken upon completion of the project's detailed design (DD) to identify all affected persons (APs), their socioeconomic status, and the extent to which they will be affected, including an assessment of their residual properties/assets in the locality. Based on the DMS, census and socioeconomic survey resettlement plan for an individual component of the projects will then be prepared. Resettlement action plan (RAP) for the project to be prepared following the guideline of SMRPF. RAP will contain information, on the amount of land required for private and public ownership; details of the impact/losses and the number of landowners and others being affected; the alternatives/measures considered to minimize displacement; review the applicable mitigation measures; a detailed budget to implement the mitigation measures; and a time schedule for RAP implementation.

A. Resettlement Plan: Where more than 200 people affects in a project due to acquisition and resumption of public lands the Resettlement plan may be prepared.

- A census survey of PAPs and inventory lost asset
- Cutoff dates established by EA
- Census data processed
- Mitigation policies reviewed
- JVT verified and assessed nonlandloss for PAPs
- Replacement values/market price reconciled
- Preparation of individual entitlement file
- GRC establishment and made it operational
- Compensation budget prepared and approved
- Land hand over for civil work
- Arrangements for M & E
- Homestead loser relocated
- Payment of compensation

B. **Abbreviated Resettlement Plan:** Where the number of affected peoples become 200, an Abbreviated Resettlement plan may be prepared in place of full (RAP) which may cover the following minimum elements :

- A census survey of PAPs and inventory of asset lost
- Valuation of lost asset at market price
- Description of compensation as per entitlement.
- Consultation with PAPs.
- Implementation arrangements
- Grievance redresses implementation.
- Arrangements for M& E
- Timetable and budget

Community Consultation

The main objectives of consultation would be gaining support and cooperation from all stakeholders and will continue throughout the project preparation and implementation period to minimize the adverse project impacts at any stages of the project cycle.

Grievance Redress Procedures

A procedure to establish to answer to the project component related queries and to address complaints and grievances about any irregularities in application of the guide line, disputes over ownership and inheritance of the affected assets, distribution of compensation among the heirs, missing affected assets and persons in the census . The procedure will help to resolve issues and conflicts amicably and quickly without expensive and time consuming legal actions. Grievances redress committee (GRC) to be formed in the project. The composition GRC will include a assigned person from the Executing agency as chairman of the committee, one representative member of local union praised, one male and one female representative from the affected persons, one representative from NGO who will act as member secretary. GRC will ensure proper presentation of complaints and grievances, as well as impartial hearing and transparent decision.

Documentation

While resettlement action plan will present the summary of the impacts, EA will ensure the availability of the following documentationwhich may be required by financer.

- Minutes of stakeholder consultation on matters like selection of the components of the projects; social safeguards implications of using private and public lands; alternative means of obtaining the required lands; mitigation measures adopted in the SMRPF etc.
- Legal records of lands donated by private owners, if any, as well as of those purchased by EA on "willing buyer-seller" basis with prices and names and addresses of peoples present during price negotiations and payment.
- Inventory of different types of PAPs, based on the census of affected persons/households and assets.
- Replacement costs and current market prices of different types of assets, as determined by market prices surveys.
- Records of compensation payment to individual PAPs.
- Records of complaints and grievances and the decisions given by Grievance Redress Committees.

Preparation of Resettlement Budget

It is essential for the implementing agency to estimate all costs carefully and include it into the detailed RP budget. The project planners cannot determine the real cost of the project without an accurate assessment of the costs of land acquisition, compensation for lost assets, and physical displacement. The budget will have a breakdown for different types of losses with their replacement cost and detail description of the persons and numbers who will be compensated for losses. EA will ensure RP/ARP for each of the component and items of the project are included in the full-fledged budget for land acquisition and resettlement activities which is subjected to review and clearance by GOB and Financer.

Monitoring and Reporting

The project will have a provision for monitoring the steps related to land acquisition, and preparation and implementation of resettlement plan and report on the effectiveness of RP and ARP implementation, including the physical progress of resettlement and rehabilitation activities, the disbursement of compensation, the effectiveness of public consultation and participation activities, and the sustainability of income restoration and development efforts among affected communities. The objective of monitoring is to provide the sponsor with feedback on RP and ARP implementation and to identify problems and successes as early as possible to allow timely adjustment of implementation arrangements.

Approval and Disclosure SMRPF

The draft SMRPF to be made available for public and after having the comments from the affected people and members of the civil society the document need to be reviewed for clearance by the GOB and Cofinancers. The approved version of the documents to be translated into Bangla and disclose to the public in Bangladesh by the Financer at its own country office information centre and by concerned. The impact mitigation plan (RP/ARP), where ever required and prepared for the project will also be subjected to review and clearance by the GOB and Cofinancers if necessary.

Appendix 5: Safety and Hazard Mitigation Plan

Safety and Hazard Mitigation Plan

Safety and Hazard Mitigation plan are intended to raise awareness of the contractor about their obligations to safeguard and protect the environment and create a safe and healthy atmosphere for their workers. Workers are also required to abide by the health and safety measures. Training sessions should be organized for this purpose.

Introduction

The accident rate and the incidence of occupational health in the construction industry are serious national problems. These problems will persist forever unless we can change everyone's mind who works a vivid awareness of the hazards and a keenness to put into practice the essential action that is necessary to eliminate or control these hazards. Though the basic requirements health and safety measure are universal, these are to cope with the technological, social and economic realities of a country. The recommendations on those requirements should be relevant, simple, practical and easy to implement.

The executing agencies should set activities in line with the National Environmental Policy, 1992. The Environment Conservation Act 1995 provides legal framework for implementation of the projects in consistent with the Policy, These health and safety measures are prepared keeping consistency with the Policy and the Act and using the information available in the guidelines and manuals available on the project.

The main responsibility of ensuring health and safety measures lies with the authority of the contractor in executing the projects. In general conditions of the contract the statutory obligations of the authority of the contractor are clearly delineated on the environmental aspects including health and safety. Authority of the contractor shall comply with all laws, regulations and orders of the government related to safety, security and protection of the site and environment and welfare of the laborers, and shall make such rules and regulations, as well as all contents of this EMP applicable to the work being undertaken, known to and require of any subcontractor or employee working on the project. When subcontractors are used, the contractor maintains the responsibility to supervise and enforce their compliance with applicable laws, regulations, and conditions of the EMP.

The contractor shall concentrate all efforts for maintaining, safety, security and protection of sites, environment and the laborers throughout the execution and completion of the works and remedying of any defects therein. The contractor shall provide proper accommodation to the laborers; arrange proper water supply, conservancy and sanitation arrangements at the site in accordance with relevant regulations, rules and orders of the government.

The contractor should consider health and safety for both their own workers and the general public as their obligations by law and provide necessary support to an environmentally friendly atmosphere in the working place. The investment in the health and safety requirements in the execution of a project is meager when compared to the enormous benefits. The awareness and willingness of a Contractor are of prime importance, followed by proper orientation training of the workers to abide by.

Remember it is the worker who actually builds and bears most of the pains of the construction, be it an internal road or buildings. Labor health and safety is of paramount importance. Safety hazards should be explained to workers prior to commencement of the construction workers.

Personal Responsibility

It is workers who create a safe, or an unsafe place of work. Individuals must work in a manner that does not put them or anyone else in danger. It is important that:

- Both the implementing authority and workers must comply with all safety and health requirements.
- Concern authority should supply the materials of safety; for example protective clothing or helmets.
- Workers must not misuse or abuse any article supplied for safety purposes

It is the worker's duty while at work:

- To take reasonable care for their health and safety and that of any persons who may be affected by their acts or omissions at work.
- To cooperate with their employer about health and safety matters
- Not intentionally or recklessly interfere with or misuse the facilities provided for the interest of health, safety or welfare

Health Measures

First Aid Requirements: First Aid is a basic requirement for most health and safety measures.

The following facilities are, therefore to be available at the site.

The contractor is required to provide proper first aid equipment to enable first aid to be given to any worker who is injured or becomes ill at work.

- All workers must be informed of such arrangements.
- The contractor should depute one person who will be responsible for the equipment and take charge of any situation (e.g. call an ambulance) if a serious injury or major illness occurs.
- A First Aid Room for every site with a well-stocked first aid box is required.
- It is in the interest of the workers to use the facilities provided when needed and keep them neat and tidy.

Accident Reporting: In the event of a serious accident or illness, the Contractor should carry out the following procedures:

- Report immediately to the supervisor
- Make sure to call First Aid assistance
- Ensure in case of serious personal injury that the accident site is left undisturbed until supervisor gives clearance.
- Prepare a report on the accident

Water and Sanitary Facilities: Water is life. Clean drinking water should be available to the workers at every site. Sanitary facilities must be accessible from all workplaces, under cover, ventilated and provided with lighting. Sanitary latrines must be kept clean and it is up to the worker to help achieve this by putting enough water and not abusing the facilities. Separate conveniences must be provided for men and women. Urinals must be screened from outside.

Safety Measures

The following is a list of practical measures that Contractors and workers should be aware of

and abide by:

- **Safety Signs:** Ensure that safety signs such as Prohibition Signs, Warning Signs, Mandatory Signs and Safe Condition Signs are put in place of work
- **Protective Clothing:** Workers should put on suitable protective clothing for working in therain and with materials such as asbestos, cement or concrete etc.
- **Head Protection:** Workers should wear safety helmets when there is a danger of falling from a height.
- **Foot Protection:** Workers should use proper safety footwear to minimize foot injury. Unsuitable footwear such as sandals, which offer no protection, should ideally not be permitted on construction sites.
- **Hand Protection:** Workers should protect their hands with gloves while breaking bricks. Ensure guards are in place on moving machinery, use push sticks on saw benches while working with saws or cutting wheels, and replace/repair any defective tools like hammers and chisels. While using harmful materials such as mound oil, workers should avoid skin contact by wearing suitable gloves. If not possible, it is important to wash and dry hands to remove any substance from the skin.
- **Eye Protection:** Workers, for their own safety, should wear protective goggles or glasses supplied by the Contractors when instructed to do so (e.g. welding at the site).
- **Excavations:** The sides of all excavations over 1.2m deep must be supported or battered back. In case of deeper excavations, tools or materials should not be thrown down to someone in an excavation because of the possibility of injury. Workers should wear safety helmets, as even small stones falling from above can injure them. Materials and equipment must not be stacked close to the edge of excavations. Workers should take care, while working close to the edge of excavations, not to jump over excavations especially during or after rain and do not store sheet piles and construction materials nearby.
- **Working near underground cables:** Workers should assume all cables are 'live' unless told otherwise. They should avoid over-penetration while working with tools to break paved areas
- **Working near overhead lines:** Workers should consider all overhead lines 'live' unless specifically instructed otherwise. They must not bypass barriers and other warnings. If scaffolding is being erected adjacent to power lines, they should see that the poles are safe distance away, do not stack materials or tip under overhead lines. This is dangerous especially in wet weather.
- **Working near water mains:** Worker should work adjacent to and around water mains with care, using hand tools and following backfilling procedure.
- **Working near sewers:** Workers should always wear protective clothing and wash their hands before eating. A danger involved in working in and around sewers is Leptospirosis (Weils Disease). The disease comes from rats. If a worker feels unwell, with flu like symptoms immediately take them to a doctor for a check-up.
- **Working on Structures:** Safety barriers should be erected to keep the general public away from the construction site. Signs warning of dangers should be prominently displayed. Formwork and Scaffolding should be safe and provided with handrails. Helmets should be provided to workers to prevent injury from falls.

Appendix 6: Emergency Response and Disaster Management Plan

Emergency Response and Disaster Management Plan

The initial response to an incident is a critical step in the overall emergency response. Like all other industries and installations; the plant facilities must have adequate measures against accidents or incidents to meet the emergency. The purposes of having an Emergency Response Plan (ERP) are to:

- Assist personnel in determining the appropriate response to emergency situations.
- Provide personnel with established procedures and guidelines.
- Notify the appropriate Company Emergency Response Team personnel and regulatory/ Govt. Agencies.
- Manage public and media relations.
- Notify the next-to-kin of accident victims.
- Promote inter-departmental communications to ensure a 'Companywide" cooperation emergency response.
- Minimize the effects that disruptive events can have on company operations by reducing recovery times and costs.
- Respond to immediate requirements to safeguard the subtending environment and community.

As a general rule the initial response is guided by three priorities ranked based on the importance the priorities are:

- People
- Property
- Environment

Responsibility for who is in charge and coordinating the emergency actions at the site lies with the contractor. For all work shifts, there shall be a designated emergency manager on site, who will be delegated the primary responsibility to implement and coordinate Emergency Management procedures and measures in accordance with this plan, including liaising with relevant other authorities as needed. Contractors' Emergency Management Plan as well as implementing authority's emergency response procedures that will apply to the project shall be posted in a visible location on the facility premises.

Following any threat or actual emergency, the designated emergency manager will be responsible for documenting the incident and actions taken in an official register to be maintained by the contractor on the premises.

Nature of Emergency & Hazardous situation may be of any or all of the following categories:

- Emergencies
- Fire
- Explosion
- Medical emergency
- Leaks
- Spillage
- Natural Disasters

- Flood
- Earthwork/cyclone
- Storm/typhoon/tornados/ lightning
- External Factors
- Food poisoning/water poisoning
- Sabotage/civil commotion

Six steps in Emergency Response

Step-1:

- Determine the potential hazards associated with the incidents, substance or circumstances and take appropriate action identify the type and qualities of dangerous goods involved and any known associated hazards.
- Determine potential hazards stemming from local conditions such as inclement weather water bodies etc. ensure that the initial response team is aware of these conditions.

Step-2

- Determine the source/cause of the event resulting in the emergency and prevent further losses

Step-3

- Conduct an assessment of the incident site for further information on hazards or remedies.

Step-4

- Initial response procedures

Step-5

- Report the incidence its nature cause impact applied redress procedures any further assistance required to the appropriate company/Govt./or Land owner.

Step-6

- Take appropriate steps with respect to hazards to wildlife, other resources and addressing public and media concern and issues, as applicable. Response priorities are to protect human lives, property and the environment.

Appendix 7: Documentation of public consultation

Some Photographs of general feature and public consultation events in the study area

Collected information regarding the impacts of proposed project in the locality

Public consultation meeting with the beneficiary people of the project

Public consultation with the beneficiary people of the project

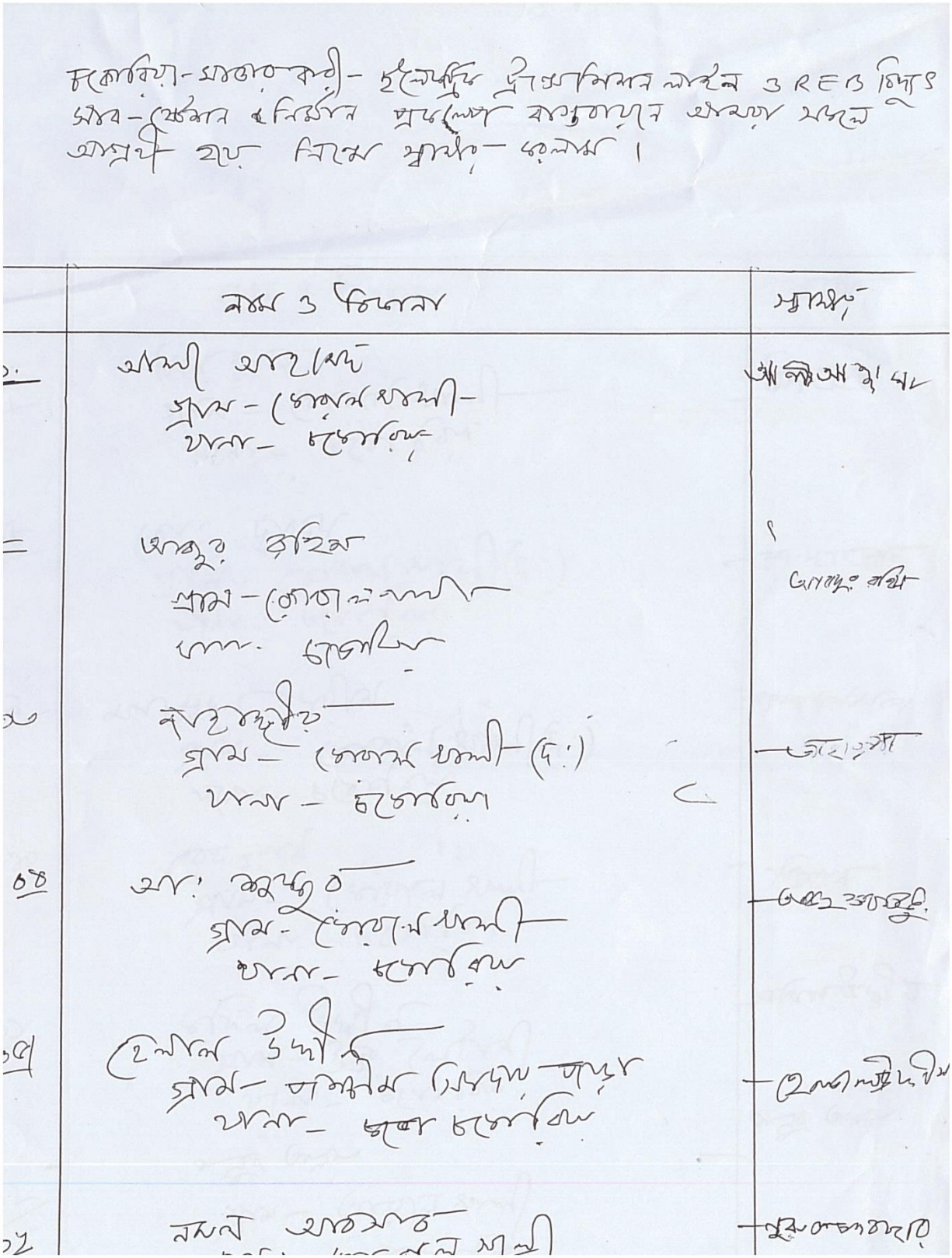
Consultants are observed the proposed transmission line routs with the help of beneficiaries of the project

Connecting point of transmission line of the project in Chakoria

Agricultural lands of the project area

Proposed land for proposed REB electric sub-station

Local people those who were involved to take part in the Focus Group discussion regarding the project implementation have signed below for the documentation of participation:



নাম ও ঠিকানা	স্বাক্ষর
মিনহুর গ্রাম - কোনাখালী [illegible] থানা - চকোরিয়া	মিনহাজ
মো: ইউসুফ গ্রাম - কোনাখালী [illegible] (পূ:) থানা - চকোরিয়া	মো: ছাদেক
মাহমুদুল করিম গ্রাম - কোনাখালী [illegible] (পূ:) থানা - চকোরিয়া	মাহমুদুল করিম
[illegible] গ্রাম - কোনাখালী [illegible] থানা - চকোরিয়া	[illegible]
রশিদ উদ্দীন গ্রাম - উত্তর [illegible] থানা - চকোরিয়া	রশিদ উদ্দীন
মনুর আলম গ্রাম - কোনাখালী [illegible] থানা - চকোরিয়া	মনুর আলম

	নাম ও ঠিকানা	স্বাক্ষর
৩।	[illegible]	[illegible]
৪।	[illegible]	[illegible]
৫।	[illegible]	[illegible]
৬।	[illegible]	[illegible]
৭।	[illegible]	[illegible]
৮।	[illegible]	[illegible]
৯।	[illegible]	[illegible]

	নাম ও ঠিকানা	স্বাক্ষর
৯।	মো: আওলাদ -ঐ-	মো: আরিফুল
০।	আজিজুল ইসলাম -ঐ-	[illegible]
১।	নুর আলম -ঐ-	নুর আলম

Appendix 8: : Environmental impact Valuation of the Proposed Project

Parameters	Relative Importance Value	Degree of Impact	Relative Impact		EIV
			Positive	Negative	
1. Physical					-7
Regional hydrology and flooding	4	0			
Erosion	2	0			
Water pollution	2	-1		-2	
Air quality	2	-1		-2	
Soil pollution	1	-1		-1	
Noise pollution	2	-1		-2	
2. Ecological					-8
Fish	8	-1		-8	
Mammals	1	0			
Birds	1	0			
Trees and vegetation	2	0			
3. Human Interest					+26
Loss of lands	6	-1	-6		
Industrial Activities	3	0			
Employment opportunity	6	1	+6		
Transportation and communication	6	2	+12		
Electricity supply	4	3	+12		
4. Quality of Life					+24
Travel safety	3	+2	+6		
Health	3	+2	+6		
Education and literacy	3	+2	+6		
Living standards	3	+2	+6		
Cultural Heritage	3	0			
Total EIV					+35

Appendix 9 : Google earth maps showing electric tower to river bank line, river crossing point and different google earth images of the rivers in different time

The above image showed electric tower point beside Kohalia River near to Bodorkhali. This image is taken at the Year of 2014. Yellow pin is treated as tower point.

The above image showed electric tower point beside Kohalia River. This image is taken at the year of 2014

The above image showed electric tower point beside Matamuhuri River. This image is taken at the year of 2014

SL. No.	Name of River	Tower Position		Span Length (m)
		Easting	Northing	
1	Kohalia River LB	91°54'31.36"E	21°42'20.90"N	561
	Kohalia River RB	91°54'50.86"E	21°42'21.11"N	
2	Kohalia River (Badarkhali) LB	91°56'38.89"E	21°43'20.47"N	252.09
	Kohalia River (Badarkhali) RB	91°56'50.92"E	21°43'22.86"N	
3	Matamuhuri River LB	92° 2'8.95"E	21°44'12.66"N	80.64
	Matamuhuri River RB	92° 2'14.90"E	21°44'14.64"N	

The table showed the River's name and GPS points with span length of river crossing tower.

Appendix 10 : TOR of the EIA approved by DoE

Government of the People's Republic of Bangladesh
Department of Environment
Head Office, E-16 Agargaon
Dhaka-1207
www.doe.gov.bd

Memo No: DoE/Clearance/5479/2015/384 Date: 26/07/2015

Subject: Approval of Terms of Reference (TOR) for Environmental Impact Assessment (EIA) of proposed the sub project of 20km 132 kv transmission line from Chakaria to Matarbari CPGCBL power plant proposed and 10 MVA 33/11 kv REB distribution sub-station with renovation of existing 33kv, 11kv & 0.415 k distribution network Project.

Ref: Your Application dated 24/06/2015.

With reference to your letter dated 24/06/2015for the subject mentioned above, the Department of Environment hereby gives approval of TOR for Environmental Impact Assessment (EIA) of proposed the sub project of 20km 132 kv transmission line from Chakaria to Matarbari CPGCBL power plant and 10 MVA 33/11 kv REB distribution sub-station with renovation of existing 33kv, 11kv & 0.415 k distribution network project subject to fulfilling the following terms and conditions:

I. The Project authority shall submit a comprehensive Environmental Impact Assessment (EIA) report considering the overall activity of the proposed the sub project, of 20km 132 kv transmission line from Chakaria to Matarbari CPGCBL power plant and MVA 33/11 kv REB distribution sub-station with renovation of existing 33kv, 11kv & 0.415 k distribution network Project in accordance with the TOR and time schedule submitted to the Department of Environment (DOE) and additional suggestions provided herein.

II. The EIA report should be prepared in accordance with following indicative outlines:

1. Executive summary
2. Introduction: (Background, brief description, scope of study, methodology, limitation, EIA team, references)
3. Legislative, regulation and policy consideration (covering the potential legal, administrative, planning and policy framework within which the EIA will be prepared)
4. The Project (Location detail and concise description of the project/interventions and relevant activities)
5. Baseline Environmental Condition should include, inter alia, following:

1

- Physical Environment: Geology, Topology, Geomorphology, Soils, Meteorology, Hydrology, Seabed Morphology and Seismic activity.
- Biological Environment: Habitats, Aquatic life and fisheries, Terrestrial Habitats and Fauna
- Environment Quality: Air, Water, Soil and Sediment Quality and Noise

6. Socio-economic environment should include, inter alia, following:

- Population: Demographic profile and ethnic composition
- Settlement and housing
- Traffic and transport
- Public utilities: water supply, sanitation and solid waste
- Economy and employment: employment structure and cultural issues in employment
- Fisheries: fishing activities, fishing communities, commercial important species, fishing resources, commercial factors

7. Identification and Evaluation of Potential Impacts (identification and assessment positive and negative impacts likely to result from the proposed project)

8. Management Plan/Procedures:
For each significant major impact, proposed mitigation measures will be set out for incorporation into project design or procedures and those which are not mitigable, will be identified as residual impacts. Both technical and financial plans shall be incorporated for proposed mitigation measures..

An outline of the Environmental Management Plan shall be developed for the project.

In Environmental Monitoring Plan, a detail technical and financial proposal shall be included for developing an in-house environmental monitoring system to be operated by the proponent's own resources (equipments and expertise).

9. Consultation with Stakeholders/Public Consultation (ensures that consultation with interested parties and the general public will take place and their views taken into account in the planning and execution of the project)

10. Beneficial Impacts (summarize the benefits of the project to the Bangladesh nation, people and local community and the enhancement potentials)

11. Conclusion and Recommendations

Without approval of EIA report by the Department of Environment, the Project authority shall not be able to open L/C in favor of importable machineries.

Without obtaining Environmental Clearance, the project authority shall not be able to start the physical activity of the project.

The Project authority shall submit the EIA along with a filled-in application for Environmental Clearance in prescribed form, the applicable fee in a treasury chalan, the no objection certificates (NOCs) from the local authority, NOCs from forest

department (if it is required in case of cutting any forested plant, private or public) and NOC from other relevant agencies for operational activity etc. to the Cox's Bazar District Office of DOE with a copy to Head Office of DOE in Dhaka.

23.04.2015

(Syed Nazmul Ahsan)
Director (Environmental Clearance,c.c)
Phone # 02-8181778

Managing Director
Coal Power Generation
Company Limited (CPGCL)
Unique Heights (Level-17)
117, Kazi Nazrul Islam Avenue, Dhaka-1217.

Copy Forwarded to :

1) Private Secretary to the Hon'ble Secretary, Ministry of Environment and Forests, Bangladesh Secretariat, Dhaka.
2) Private Secretary to the Hon'ble Secretary, Power Division, Ministry of Power, Energy & Mineral Resources, Bangladesh Secretariat, Dhaka.
3) Director, Department of Environment, Chittagong Divisional Office, Chittagong.
4) Deputy Director/Office In-charge, Department of Environment, Cox's Bazar District Office, Cox's Bazar.
5) Assistant Director, Office of the Director General, Department of Environment, Head Office, Dhaka.