Draft Environmental Impact Assessment

Project Number: 44951-01
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BAN: Bibiyana I and II Gas Power Project

Prepared by Bangladesh Centre for Advanced Studies for Summit Bibiyana I Power Company Limited and Summit Bibiyana II Power Company Limited

Final Report

Summit Bibiyana I Power Company Limited
&
Summit Bibiyana II Power Company Limited

Social and Environmental Impact Assessment (SEIA) Report




Project Site:
Parkul, Nabigonj, Habigonj, Bangladesh

Date of Submission: June 2011

Prepared by

BANGLADESH CENTRE FOR ADVANCED STUDIES
House 10, Road 16A, Gulshan-1, Dhaka-1212, Bangladesh
Tel: (880-2) 8818124-27, 8852904, 8851237, Fax: (880-2) 8851417
E-mail: info@bcas.net Website: www.bcas.net

Summit Bibiyana I Power Company Limited
and
Summit Bibiyana II Power Company Limited

Social and Environmental Impact Assessment (SEIA) Report

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List of Acronyms

APSCL	:	Ashuganj Power Station Company Ltd.
AQM	:	Air Quality Monitoring
BBS	:	Bangladesh Bureau of Statistics.
BIPP	:	Bibiyana Independent Power Project.
BOT	:	Build, Operate and Transfer
BOI	:	Board of Investment
BCAS	:	Bangladesh Centre for Advanced Studies
BERC	:	Bangladesh Energy Regulatory Commission
BPDB	:	Bangladesh Power Development Board
CCGT	:	Combined Cycle Gas Turbine
CCPP	:	Combined Cycle Power Plant
CDM	:	Clean Development Mechanism
CDO	:	Community development Officer
DESA	:	Dhaka Electric Supply Authority.
DESCO	:	Dhaka Electric Supply Company
DLAO	:	District Land Acquision Officer
DMP	:	Disaster Management Plan
DoE	:	Department of Environment
EGCB	:	Electric Generation Company of Bangladesh
EMP	:	Environment Management Plan
EE	:	Energy Efficiency
GOB	:	Government of Bangladesh
GNI	:	Gross National Income.
GDP	:	Gross Domestic Products
HRSG	:	Heat Recovery Steam Generator
IEE	:	Initial Enviromental Examination
IFC	:	International Finance Corporation
IPP	:	Independent Power Producer
MPEMR	:	Ministry of Power Energy & Mineral Resources.
MW	:	Mega Watt
MOF	:	Ministry of Finance
NEP	:	National Energy Policy
NGO	:	Non Government Organization.
NEMAP	:	National Environment Management Action Plan
N2	:	National Hyghway-2
PAP	:	Project Affected Person
PPA	:	Power Purchase Agreement
PDB	:	Power Development Board
RAP	:	Resettlement Action Plan
RE	:	Renewable Energy
REB	:	Rural Electrification Board.
ROW	:	Right of Way
SBC	:	Sadharan Bima Corporation
SBU	:	Strategic Business Units
SBPCL	:	Summit Bibiyana Power Company Limited
SPM	:	Suspended Particulate Matters
SEIA	:	Social and Environmental Impact Assessment
UNFCCC	:	UN Framework Convention on Climate Change
WZPDCL	:	West Zone Power Distribution Company Limited.

Summit Bibiyana I Power Company Limited
and
Summit Bibiyana II Power Company Limited

Social and Environmental Impact Assessment (SEIA) Study

EXECUTIVE SUMMARY

***Introduction*:**

This Social and Environmental Impact Assessment (SEIA) report has been based on the findings of the baseline environmental and socio-economic conditions pertaining to the area of the proposed Summit Bibiyana 1 Power Company Limited and Summit Bibiyana II Power Company Limited Project and on the impacts that are anticipated due to the project upon the baseline conditions. The project site situated to the south of the river Kushiara at Bibiyana in the district of Habiganj. The exercise undertaken in the SEIA process has thus identified the anticipated impacts and come out with mitigation/enhancement measures and environmental and socio-economic management plan in view of those impacts.

As the name of the proposed project and, hence, that of this SEIA Report implies, environmental and socio-economic impact perspectives of both the power plants having a combined capacity of 682 MW proposed to be set up in the project area by Summit Bibiyana 1 & II Power Co. Ltd. have been analyzed and results of those analyses have been put together in various chapters of this Report.

***Background of the Project*:**

The Summit Bibiyana I & II Power Company Limited Project comprising two 341 MW Combined Cycle Turbine power plants has been following the decision of the Government toward partial fulfillment of the objectives of meeting the existing power crisis throughout the country. To this end, an award by the Government has been made in favor of Summit Bibiyana 1&II Power Company Limited (SBPCL1&II), an enterprise of the Summit Group of Bangladesh, to mobilize its resources toward construction, ownership, management, operation and maintenance of a power generation facility has been granted. The proposed project will be built in an area measuring 67 acres of land to the south of river Kushiara in the village Parkul at Bibiyana under union Aushkandi in Nabiganj upazilla of Habiganj district about 180 kilometers north-east of the capital city Dhaka with an investment of approximately US $ 550m. The Summit Group is an established firm in Bangladesh with sound financial standing and of significant experience in the efficient management, operation and maintenance of similar facilities in Bangladesh.

***Nature and Objective of SEIA*:**

This SEIA has been based on the environmental and socio-economic perspectives of the project site and that of the area with airshed as well as command area radii of 2km, 7km and 10km and the impacts of the project upon the existing environmental and socio-economic

system pertaining to the project area. Broad objective of this study has been to assess the environmental and socio-economic impacts of the proposed project, suggest mitigation measures for minimizing adverse impacts and enhancement measures of beneficial impacts, formulate environmental management and monitoring plans and plans for addressing health and safety issue**s.**

***Scope of Work*:**

Scope of work included : (i) conducting a baseline environmental study for the proposed plant site, (ii) performing an initial environmental examination (IEE) of the site for the two 341 MW gas-fired, combined cycle plants at the proposed site, (iii) undertaking identification and analyses of socio-economic and environmental impacts during pre-construction, construction and post-construction as well as operation stages of the power plants at and around the proposed site, suggesting mitigation measures vis-à-vis anticipated each impact along with formulating requisite Environment Management Plan (EMP) and estimated financial implications for EMP through a detailed Environmental Impact Assessment process.

Of the above three aspects of the scope of work, the first two have already been accomplished during the IEE process. The IEE Report along with necessary enclosures have been submitted to DOE and Site Clearance specifying various conditions to be fulfilled during the activities related to the project have also been obtained. DOE has also approved the ToR for EIA based on the draft submitted along with the IEE.

Based on the DOE approved ToR for SEIA, details of the scope of work pertaining to the study had been as under:

i. Establishment of the environmental and social baseline conditions of the Project.
ii. Carrying out Social and Environmental Impact Assessment (SEIA) for Summit Bibiyana I& II Power Company Limited Project as per ToR approved and prescribed by the Department of Environment (DOE) through assessment of anticipated environmental and social impacts due to interventions, including laying of natural gas pipeline from the nearest source to the power plant site, in the area by the proposed project.
iii. Obtaining Environmental Clearance Certificate by the project proponent (SBPCL 1&II)
iv. Formulation of an environmental management plan emphasizing mitigation plan for adverse impacts, enhancement plan for beneficial impacts, compensation plan, contingency plan and monitoring plan.

***Methodology*:**

Based on the above Scope of Work, the study used the baseline survey carried out previously by BCAS as Environment and Social Consultant for the IFC in 2008-2009 and the Initial Environmental Examination (IEE) conducted by BCAS during February-March, 2011. The IEE exercise resulted in a stand-alone report together with a filled-in formatted schedule devised by and as per the requirement of DOE.

This SEIA was carried out as a follow up study of IEE and has been based on the primary data generated during the study period, secondary data from various sources and information from field visits and the project proponent. Several field visits had been undertaken to the

project location with a view to updating the findings of the baseline study carried out by BCAS in 2009. During this process, the following steps were followed:

- Confirmation of survey/monitoring data in the baseline study and IEE carried out by BCAS during, respectively, 2008-2009 and February-March, 2011 and generating primary data.
- Understanding the technical aspects of the proposed power plants;
- Identification of potential environmental impacts
- Evaluating the consequences.
- Identification of impacts using Checklist method;
- Review of the adequacy and efficiency of proposed mitigation measures for the proposed power plant project;
- Development of an Environmental Management Plan (EMP) for possible mitigation/ enhancing measures, respectively, for negative and beneficial impacts;
- Suggestion of mitigation measures for residual impacts.
- Formulation of compensation plan, contingency plan and monitoring plan

This report has been prepared following the IEE/EIA methodology as described in the Asian Development Bank (ADB, 1988) manual of IEE/EIA guidelines, World Bank Environment guidelines (WB, 1992), IFC Guidelines and also EIA Guidelines for Industries (DOE, 1997) to a certain extent, but not limited to those. In particular, the eight performance standards set by IFC in 2006 has also been strictly adhered to in exercises undertaken during the course of the entire study and preparation of this report. The above eight performance standards of IFC correspond to eight various parameters as under:

Performance Standard 1: Social and Environmental Assessment and Management System
Performance Standard 2: Labor and Working Conditions
Performance Standard 3: Pollution Prevention and Abatement
Performance Standard 4: Community Health, Safety and Security
Performance Standard 5: Land Acquisition and Involuntary Resettlement
Performance Standard 6: Biodiversity Conservation and Sustainable Natural Resource Management
Performance Standard 7: Indigenous Peoples
Performance Standard 8: Cultural Heritage.

Of the above eight performance standards set by IFC, the Performance Standard 1 envisages establishing the importance of: (i) integrated assessment to identify the social and environmental impacts, risks and opportunities; (ii) effective community engagement through disclosure of project-related information and consultation with local communities on matters that directly affect them; and (iii) the client‘s management of social and environmental impacts throughout the life of the project.

The rest seven of the performance standards, i.e., Performance Standards 2 through 8 seek to ascertain establishing requirements to avoid, reduce, mitigate or compensate the impacts on people and the environment, and to improve conditions where appropriate.

All the relevant social and environmental risks and potential impacts have been taken due care of as part of the assessment in compliance of the aspects mentioned in IFC Performance Standards 2 – 8, besides following the guidelines set forth by DOE.

***Geographic Location of the Project Site**:*

The proposed Summit Bibiyana I & II Power Company limited Project (SBPCL 1&II) site is located at 91° 39′ 37″ E. longitude and 24° 38′ 18″ N. latitude on the south bank of the river Kushiyara. The site is about 2 kms from the Sherpur Bridge point to the west of the Dhaka - Sylhet National Highway N2, about 180 kms north-east of Dhaka and about 45 kms south-west of Sylhet district headquarters. Administratively, it is located in the village of Parkul in Aushkandi Union under Nabiganj Upazila of Habiganj district.

Topography: The land within the 10km project command area radius is part of the Surma floodplain and is composed of older and more developed soil. The landscape is very gentle undulating or nearly level. The main soil consist of grey silty to loamy top soils along with black structured greyey silty to clayey subsoils. The project command area comprises agricultural land, homestead land, dykes, mudroads, the river Kushiara, and principal tributaries to the river – the Langai, the Manu, the Juri, the Gopla, the Khowai and the Sutang – all originating in the Tripura hills.

Technology to be employed in the Proposed Project:
The proposed SBPCL I&II Project envisages employing multi-shaft combined cycle technology based on two gas turbine generator units and two steam turbine generator units, each having a separate power connection to the grid. The type of gas turbine suitable for the Project could be: (i) sound and have a successful track record for use in an environment typical of the project area; (ii) capable of meeting the international standards, specifically those of the IFC with 75 milligrams (mg) per m^3 for NOx emissions; and (iii) capable of reducing the consumption of natural gas to a significant extent compared to that in other technologies available for power generation. The Combined Cycle Gas Turbine (CCGT) technology which is being considered to be adopted for the Summit Bibiyana 1 & II Power Plant Project, would be capable of meeting the above three requirements.

Consideration of Alternatives:

While making consideration of alternatives to the project, technology, design, no-project and locational – all the options had been explored. The proposed project stands out to have the best option in view of (i) the type of energy (natural gas) to be utilized for electricity generation, (ii) type of fossil fuel-fired technologies in respect of competitive edge among them, (iii) relative consumption of fuels and (iv) climate-friendly emissions (GHG emissions) and, based on (i) through (iv), the proximity of the project site to all the necessary infrastructure like natural gas field, high tension electricity transmission line and natural facilities like access to main highway and year round navigability of the river Kushiara are all conducive for pragmatic and smooth operation of the power plant.

Environmental Baselines:

Physical Environment:
Mean monthly temperatures vary from about 6.5°C. in January to 35.8°C. in April. The mean annual temperature is about 25°C. About 92% of the annual rainfall occurs in the seven months from April to October in the project area. Within the surrounding areas of the project site in the Kushiyara valley and neighboring hills, the rainfall is very high. Mean monthly relative humidity ranges from 77% in the dry season (November to February) to about 84%

in the rainy season (June to October). In the area, fog is very common in winter and also it is the cloudiest part of Bangladesh.

Air quality at the project-site is typical of a rural environment. Ambient concentrations of air pollutants are seemingly very low to practically non-existent. SPM increases intermittently in some areas when winds pick up dust over unpaved roads and exposed surfaces. Sources of emissions, however, have been the vehicles plying along the Dhaka-Sylhet National Highway, N2 running along the south and western direction from the project site.

Air quality monitoring at the site completed over a three months period in March 2011 to May 2011 showed that concentration of nitrogen dioxide (NO_2), sulphur dioxide (SO_2), carbon monoxide (CO) and Particulate Matter (PM) were all within recognized air quality standards for these combustion by-products and common air pollutants.

Air dispersion modeling was completed using an USEPA approved computer software and inputted data on emissions and meteorological conditions. This was used to predict ground level concentrations that would occur with the proposed Bibiyana Power Plants 1 and II operating on full load using natural gas. The modeling results indicate that the maximum predicted ground level concentrations of NO_2, CO and PM-10 will not exceed any of the reference standards and guidelines for ambient air quality i.e. the cumulative concentration above the baseline concentrations of the key parameters will not exceed the standards set by IFC as an example as a result of the project activities within 7.5 kilometer air shed of the project.

Principal aspects of hydrology and drainage system of the proposed project area are highly influenced by the river Kushiyara which passes through the northern side of the project site. The flood period is generally from the last week of May to the middle of October. The principal tributaries of this locality are the Langai, the Manu, the Juri, the Gopla, the Khowai and the Sutang, all originating from Tripura hills. The river is navigable almost throughout the year although sand bars often create difficulties for smooth navigation.

Surface water quality, viz., that of ponds, nearest wetlands and the river Kushiyara in the project area and its surroundings do not seem to have undergone changes beyond acceptable levels as there have been no polluting industry or similar other activity. Baseline water quality had been determined taking into consideration that water for cooling purposes will be utilized from the surface water system in closest vicinity of the project area.

The cooling water requirements for the close-circuit cooling system will be drawn from the river Kushiara. The initial charge amounting to 60,000 cubic meters will be pumped in the system. It is estimated that approximately 10,000 cubic meter per hour will be pumped on a daily basis as make-up water to compensate for the losses during normal opereation of both Bibiyana 1&II power projects. A thermal dispersion modeling work has been carried out and it was found that at the point of discharge the temperatutue were much below the WB/IFC recommended temparatuture gradient standards not exceeding 3deegrees centigrade.

Existing noise level of the project area was measured over periods of 12 hours each day during state of noise level obtaining throughout the project area and in areas in immediate vicinity and beyond is well within acceptable limits. The baseline sound levels measured indicate that the sound levels are within the limits set by the IFC guidelines for the nearest households in the project area.A sound modeling exercise was carried out based on a model

developed by the International Energy Agency (IEA). A GIU software model was built based on the model using MATLAB programming language for the calculations and analysis. The results show that the level of sound for the nearest houses in the adjacent villages is much below the World Bank standards for residential areas and the Bangladesh standards for mixed zone. It is expected that with adequate sound proofing devises for the turbines like sound reduction devices and construction of adequate sound proofing walls of the generator buildings as outlined in the EMP the sound levels for the nearest residential areas will not exceed the IFC standards both during the construction period and operation period of the project.

The proposed project area being part of the high flood and flood plain zone of the Sylhet trough, the main soils of the area have grey silty to loamy top soils and grey silty to clayey sub-soils with black structure. The basin soils are very similar, but more clayey. Most soils overlie stratified material at 2 – 5 feet depth. Almost all of the soils are seasonally flooded, and dry out by the middle of the dry season. The proposed project area is also in the most active seismic zone and has experienced earthquakes of moderate/high intensity, especially, during 1885, 1897 and 1918.

Landuse survey was undertaken during the course of SEIA process toward establishing the current status of the landuse pattern in the project area. 73% of the landuse in the proposed project area corresponds to agricultural land, 12% to settlement area and the rest to fallow land, rural roads, ponds and ditches, vegetation land, etc.

Biological Environment:
Natural vegetation is represented by open water aquatic vegetation. Freshwater swam forest and terrestrial forest types are different in their physiognomy, species composition and ecological characteristics. Many trees and shrubs including indigenous and exotic flowers, fruit-bearing and medicinal trees were observed in the area. These shrubs & herbs and fruit bearing trees are found in patches covering patches of lands in and around the project areas or in the homestead areas.

The area is extremely rich in their faunal diversity. These are some 75 species of fishes in the locality. Out of these 43 species are not threatened, 23 critically endangered, 9 of lower risk and vulnerable.

Socio-economic Environment:
The airshed of SBPCL I&II Project has a population 1,31,084 and of which 66,025 are males and 65,025 are females. There are 21,769 households in the same air shed area and the average family size estimated 6.02 persons. Religion-wise population of the project area could broadly be grouped as Muslims and Hindus. Most of the village houses are kutcha construction, and materials used for roofs and walls are corrugated iron-sheets. Houses with brick walls are also common in this airshed. Muslims comprise 92% of the total population of which 85% belong to the fishing community.

The socio-economic and poverty assessment carried out within the surveyed area reveals that the incidence of poverty prevails among the landless agricultural labourer and the fishing community with their income being below the national average and lower than the other communities of the region. Therefore adequate compensation for these groups has been proposed ensuring them of reasonable financial safety net in case of any adverse effect due to the project in the resettlement action plan.

The Resettlement Action Plan (RAP) has been proposed based on the number of involuntary resettlement required as a result of the land acquisition required for the project. While the land acquisition is the responsibility of the Government of Bangladesh but a critical review of the process has been carried out under this SEIA study. A 100% survey was conducted based on the list of Project Affected People (PAP) provided by the local land administration responsible for the land acquisition. The number of PAPS is 372 including the 8.8 kilimeter gas pipeline and 2 kilometer of approach road. A livelihood restoration compensation package including livelihood support equivalent to two years or more of the lost income due to the project activites for the displaced people from government owned (Khas land), daily laborers on acquired land, share croppers and displacement cost of the homestead of the PAPs cost has been considered. The compensation for loss of trees and vegetable gardens has also been considered. The PAPs has been categorized into six categories depending on the intensity of the impact and compensation packages has been computed for each category.

Community development activities have been identified based on FGDs and consultation meeting. A monitoring plan has also been proposed to keep track of the implementation of the RAP.

***Identification of Significant Environmental Impacts due to the Project, Mitigation/Enhancement Measures and Environmental Management Plan (EMP)*:**

Significant Environmental Impacts due to the project had been identified during the IEE process and substantiated during the SEIA. Management of such impacts has been proposed in three ways depending upon the nature of the impacts (viz., adverse and beneficial) and also the nature of mitigation measures. The impact issues has been divided into the pre-construction, construction phase and normal operation stages of the project indicating the activities and the resulting adverse impacts and the mitigation measures that needs to be taken.

Integration of EMP with Overall Project:

Implementation of EMP is to take effect simultaneously with the planning and development of the proposed SBPCL I&II. Specific responsibilities to carryout the various programs and plans of EMP will be assigned to project personnel and an established as well as accountable management system. Management will also provide the essential resources for the purpose.

An environmental compliance manual with a clear statement of the environmental policies and responsibilities of SBPCL I&II Project, the entrepreneur of the project, will be prepared by the entrepreneur.

CHAPTER I

INTRODUCTION

1. Introduction

This Social and Environmental Impact Assessment (SEIA) report has been based on the findings of the baseline environmental and socio-economic conditions pertaining to the project area situated in an area to the south of the river Kushiara at Bibiyana of the district of Habiganj and the environmental and socio-economic impact anticipated on the project area together with mitigation/enhancement measures and environmental and socio-economic management plan.

1.1 Background of the Project

The SBPCL I&II Project proposes to set up two (341x2)= 682MW Combined Cycle Gas Turbine power plants at Bibiyana as per decision of the Government toward awarding the task in favour of the project proponent SBPCL I &II, an enterprise of the Summit Group of Bangladesh,. The decision toward implementation of these power plants in Bibiyana has been reached upon in partial fulfillment of the objectives of an award by the Government of Bangladesh through the Ministry of Energy, Power and Mineral Resources and the Bangladesh Power Development Board. SBPCL I&II, hence, has been entrusted with the responsibility of mobilizing its resources toward construction, ownership, management, operation and maintenance of a couple of Combined Cycle Gas Turbine Power Generation Plants in an area comprising 67 acres of land to the south of river Kushiara in the village Parkul at Bibiyana under union Aushkandi in Nabiganj upazilla of Habiganj district with an investment of US $ 550m. The Summit Group is an established firm with strong financial standing and is experienced in the efficient management, operation and maintenance of similar facilities in Bangladesh.

SBPCL I&II project, hence, seeks to construct and operate two (341x2) = 682MW natural gas-fired thermal power combined cycle plants at Bibiyana in the district of Habiganj about 180 kms north-east of the capital city Dhaka.

1.2 Project Rationale

The policy of the Government of Bangladesh has been to ensure extension and stabilization of the power sector through both public and private sector undertakings toward not only meeting the currently existing power deficiency throughout the country but also ensuring unhindered power provision in view of the projected future demand. Current undertaking by the Summit Group toward constructing a couple of closed circuit combined cycle gas turbine (CCGT) power plants at Bibiyana has been toward implementation of this policy.

The highly efficient CCGT technology that will be installed in the proposed power plant complex at Bibiyana will significantly reduce natural gas consumption, thereby making available capacity for use elsewhere in the country for future power plants or for industrial or other uses. It has long been recognised that emissions of certain gases such as oxides of nitrogen (NO_x) and sulphur dioxide (SO_2) can contribute to acid rain which can cause acidification and degradation of ecosystems. As emissions of these pollutants have

transboundary effects there have been a number of international agreements to reduce emissions. Power generation from natural gas using CCGT technology has been widely known as the cleanest form of power generation from fossil fuels. Therefore, the proposed project will contribute significantly to reducing national emissions from stationary sources. CCGT plants burning natural gas produce significantly less greenhouse gases than traditional coal, oil or natural gas fired thermal power stations as a result of both the less greenhouse gas intensive nature of natural gas and the greater energy efficiency of CCGT technology.

1.3 Nature and Objective of the Study

1.3.1 Specific Objective:

The study has been based on the environmental and socio-economic perspectives of the project site and that of the area with 10km airshed as well as command area radius and the impacts of the project upon the existing environmental and socio-economic system pertaining to the project area.

1.3.2 Broad Objective:

The broad objectives are:

- to assess the environmental and socio-economic impacts of the proposed project
- to suggest mitigation measures for minimizing adverse impacts and enhancement measures of beneficial impacts
- to formulate environmental management and monitoring plans and plans for addressing health and safety issues.

1.4 Scope of Work

The area falling within 10 km distance from the proposed site has been considered as the study area for conducting detailed studies. The major scopes of the Environmental Impact Assessment study have been as under: -

- A brief description of the project.
- A detailed characterization of the existing environment within the area of 10 km radius from the project site for environmental components viz. air, noise, water, land, soil, biological and socio-economic aspects.
- Prediction and evaluation of positive and negative impacts that may result from proposed power plant project.
- Formulation of environmental management plan (EMP) to eliminate or minimize the adverse impacts of the project on the surrounding environment.
- Preparing occupational health and safety as well as Disaster Management Plan (DMP) to minimize any accident or emergency situation.
- To propose plans for post project monitoring.

Scope of work included:

(i) conducting a baseline environmental study for the proposed plant site,
(ii) performing an initial environmental examination (IEE) of the site for the two (341x2)= 682MW gas-fired, combined cycle plants at the proposed site,

(iii) undertaking identification and analyses of socio-economic and environmental impacts during pre-construction, construction and post-construction as well as operation stages of the power plants at and around the proposed site

(iv) suggesting mitigation measures vis-à-vis anticipated each impact along with formulating requisite Environment Management Plan (EMP) and estimation financial implications for EMP through a detailed Environmental Impact Assessment process.

Of the above three aspects of the scope of work, the first two have already been accomplished during the IEE process. The IEE Report along with necessary enclosures have been submitted to DOE and Environmental Site Clearance specifying various conditions to be fulfilled during the activities related to the project have also been obtained. DOE has also approved the ToR for EIA based on the draft submitted along with the IEE.

Based on the DOE approved ToR for EIA, details of the scope of work pertaining to the study had been as under:

v. Establishment of the environmental and social baseline conditions of the Project.

vi. Carrying out Social and Environmental Impact Assessment (SEIA) for Summit Bibiyana Power Project 1 & 2 as per ToR approved and prescribed by the Department of Environment (DOE) through assessment of anticipated environmental and social impacts due to interventions, including lying of natural gas pipeline from the nearest source to the power plant site, in the area by the proposed project.

vii. Obtaining Environmental Clearance Certificate by the project proponent (SBPCL I & II)

viii. Formulation of an environmental management plan emphasizing mitigation plan for adverse impacts, enhancement plan for beneficial impacts, compensation plan, contingency plan and monitoring plan.

1.5 Methodology

Based on the above Scope of Work, the study used the baseline survey carried out previously by BCAS as Environment and Social Consultant for the IFC in 2008-2009 and the Initial Environmental Examination (IEE) conducted by BCAS during March-April, 2011. The IEE exercise resulted in a stand-alone report together with a filled-in formatted schedule devised by and as per the requirement of DOE.

This SEIA was carried out as a follow up study of IEE and has been based on the primary data generated during the study period, secondary data from various sources and information from field visits and the project proponent. Several field visits had been undertaken to the project location with a view to updating the findings of the baseline study carried out by BCAS in 2009 and 2011. During this process, the following steps were followed:

- Confirmation of survey/monitoring data in the baseline study and IEE carried out by BCAS during, respectively, 2008-2009 and March-April, 2011 and generating primary data.
- Understanding the technical aspects of the proposed power plants;
- Identification of potential environmental impacts and evaluating the consequences. Identification of impacts was done using Checklist method;
- Review of the adequacy and efficiency of proposed mitigation measures for the proposed power plant project;

- Development of an Environmental Management Plan (EMP) for possible mitigation/ enhancing measures, respectively, for negative and beneficial impacts;
- Suggestion of mitigation measures for residual impacts.
- Formulation of compensation plan, contingency plan and monitoring plan

This report has been prepared following the IEE/EIA methodology as described in the Asian Development Bank (ADB, 1988) manual of IEE/EIA guidelines, World Bank Environment guidelines (WB, 1992), IFC Guidelines (2006) and also EIA Guidelines for Industries (DOE, 1997) but not limited to those. In particular, the eight performance standards set by IFC in 2006 has also been strictly adhered to in exercises undertaken during the course of the entire study and preparation of this report. The following eight performance standards of IFC correspond to eight various parameters as under:
Performance Standard 1: Social and Environmental Assessment and Management System
Performance Standard 2: Labor and Working Conditions
Performance Standard 3: Pollution Prevention and Abatement
Performance Standard 4: Community Health, Safety and Security
Performance Standard 5: Land Acquisition and Involuntary Resettlement
Performance Standard 6: Biodiversity Conservation and Sustainable Natural Resource Management
Performance Standard 7: Indigenous Peoples
Performance Standard 8: Cultural Heritage.

Of the above eight performance standards set by IFC, the Performance Standard 1 envisages establishing the importance of:

(i) integrated assessment to identify the social and environmental impacts, risks and opportunities;
(ii) effective community engagement through disclosure of project-related information and consultation with local communities on matters that directly affect them; and
(iii) the client's management of social and environmental impacts throughout the life of the project.

The rest seven of the performance standards, i.e., Performance Standards through 2-8 seek to ascertain establishing requirements to avoid, reduce, mitigate or compensate the impacts on people and the environment, and to improve conditions where appropriate.

All the relevant social and environmental risks and potential impacts have been taken due care of as part of the assessment in compliance of the Performance Standard 1 besides following the guidelines set-forth by DOE.

1.6 SEIA Team

The SEIA Team comprised the following:

1.	Dr. M. Eusuf, Air Dispersion Modeling Expert	Team Leader
2.	Syed Md. Iqbal Ali, EIA and Resettlement Expert	Member
3.	Dr. Moinul Islam Sharif, Energy Expert	Member
4.	Mr. Ahmed Al Farouq, IEE/EIA Expert	Member
5.	Mr. Khandoker Mainuddin, Socio-economic Expert	Member

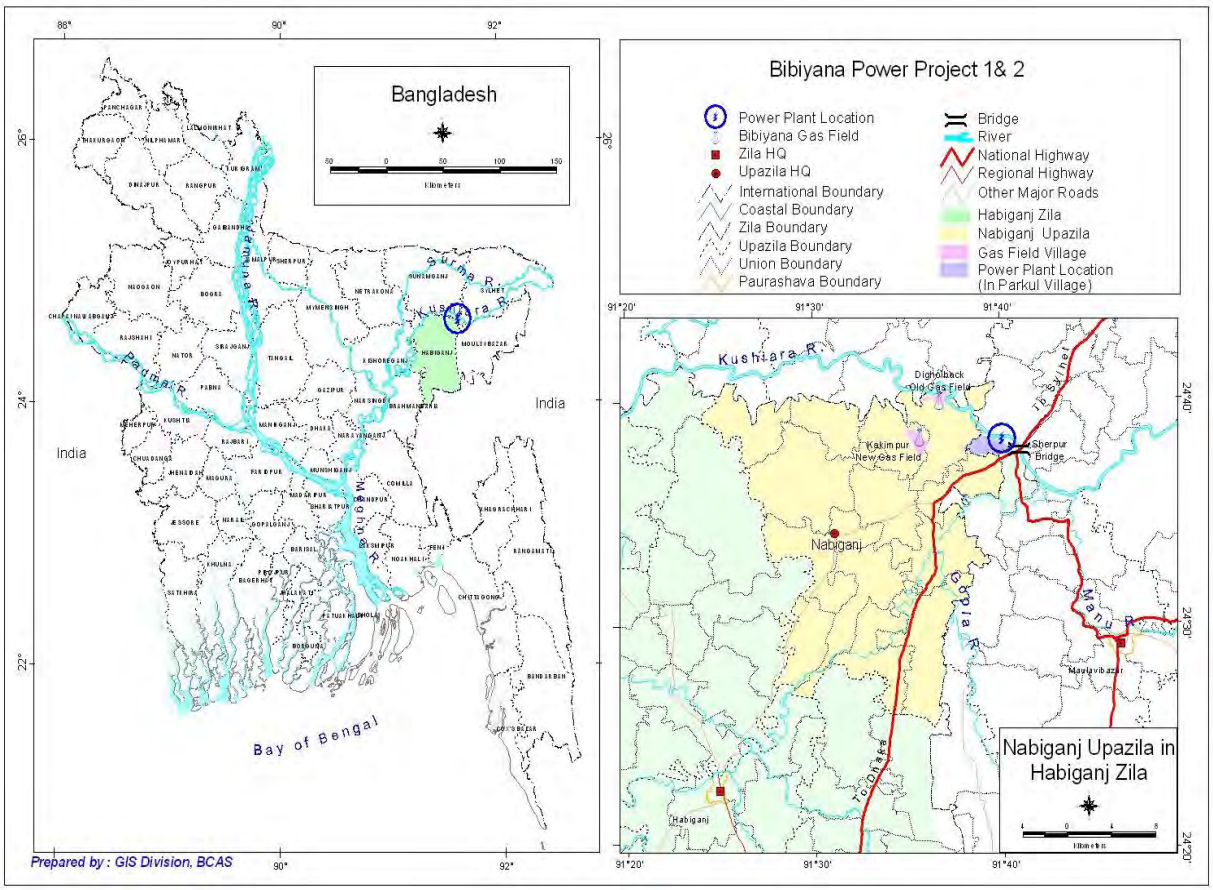
6. Ms. Olena Reza, Gender Expert	Member
7. Dr. J. C. Shaha, Air Quality Monitoring Expert	Member
8. Mr. M. A. Mahmood, Mechanical Engineer	Member
9. Mr. Md. Osman Gani Shawkat, Field Coordinator	Member
10. Mr. Mohammed Ikbal Hossain, PAPs and RAP Expert	Member
11. Ms. Mirza Arifah Ahmed, Land use and GIS Expert	Member
12. Mr. Iqubal, Water Modeling Expert	Member
13. Ms. Ismot Ara, GIS Analyst	Member
14. Mr. Md. Mizanur Rahman, Field Surveyor	Member
15. Md. Idrish Hossain, Field Surveyor	Member
16. Syed Shaker Md. Iqbal, Noise Modelling Expert	Member

CHAPTER II
PROJECT AREA

2. Description of Project Site

2.1 Geographic Location

The proposed SBPCL I &II project site is located at 91° 39′ 37″ E. longitude and 24° 38′ 18″ N. latitude on the south bank of the river Kushiyara. The site is about 3 kms from the Sherpur Bridge point to the west of the Dhaka - Sylhet National Highway N2, about 180 kms north-east of Dhaka and about 45 kms south-west of Sylhet district headquarters. Administratively, it is located in the village of Parkul in Aushkandi Union under Nabiganj Upazila of Habiganj district (Project location Map shown in Map – 2.1 & Map – 2.2).

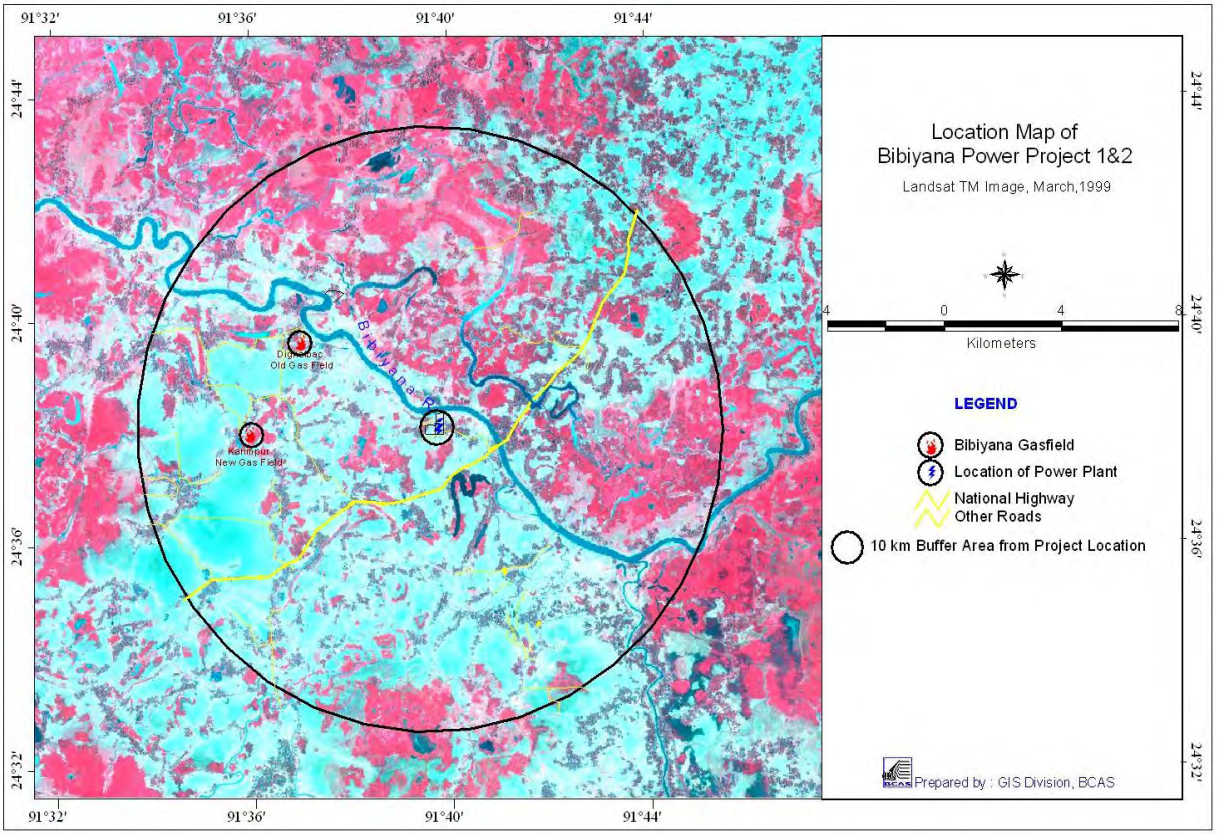


Map-2.1: Location Map of Summit Bibiyana I & II Power Company Limited

2.2 Topography

The land within the 10km project command area radius is part of the Surma floodplain and is composed of older and more developed soil. The landscape is very gentle undulating or nearly level. The main soils consist of grey silty to loamy top soils along with black structured grey-silty to clayey sub-soils. The project command area comprises agricultural land, homestead land, dykes, mud roads, the river Kushiara, principal tributaries to the river –

the Langai, the Manu, the Juri, the Gopla, the Khowai and the Sutang – all originating in the Tripura hills.



Map-2.2: Location Map of Summit Bibiyana I & II Power Company Limited in Land set Image

Topographic features of the project command area are depicted in the map (Map-2.2) derived out of topographical survey of the area.

2.3 Means of Access

SBPCL I&II Project site is at about 3 kms mud road distance from the Sherpur Bridge point. Sherpur is on the Dhaka to Sylhet national highway (N2). Therefore, the power project site can be reached by road from Dhaka or from Sylhet. Sylhet is also linked with Dhaka by air and railway services. Significant volumes of heavy goods can also transported by the river, which passes by northern side of the project location.

CHAPTER III
LICENSING AND APPROVALS

Section-1: Relevant Policies, Laws and Regulations

3.1 Environment Policy, Law and Rules

Regulatory requirements toward protection and conservation of environment and various environmental resources and also toward protection of social environment from adverse impact of projects and activities associated with them have been enunciated by the GoB as well as the IFC Pertinent among these requirements are summarized as under.

3.1.1 Bangladesh Environmental Policy, Regulations, and Guidelines

3.1.2 National Environmental Policy, 1992

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

- Maintaining ecological balance and ensuring sustainable development of the country through protection and conservation of the environment
- Protecting the country from natural disasters
- Identifying and regulating all activities that pollute and destroy the environment
- Ensuring environment-friendly development in all sectors
- Ensuring sustainable and environmentally sound management of the natural resources
- Maintaining active association, as far as possible, with all international initiatives related to environment

Besides, the Policy, *inter alia*, seeks to ensure that transport systems, including roads and inland waterways, do not pollute the environment or degrade resources. The Policy states that Environmental Impact Assessments (EIA) should be conducted before projects are undertaken.

3.1.2.1 National Environment Management Action Plan (NEMAP), 1995

The National Environmental Management Action Plan (NEMAP) is a wide-ranging and multi-faceted plan, which builds on and extends the statements, set out in the National Environmental Policy. NEMAP was developed to address issues and management requirements during the period 1995 to 2005, and set out of the framework through which various decisions, plans, legislative measures, rules and regulations toward safeguarding the environment and natural resources including those of biological diversities are to be implemented. NEMAP was developed based on the following broad objectives:

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

To this end, it has grouped all the relevant necessary actions under four heads: institutional, sectoral, location-specific and long-term issues. The *institutional* aspects reflect the need of inter-sectoral cooperation to tackle environmental problems those need new and appropriate institutional mechanisms at national and local levels. The *sectoral* aspects reflect the way the Ministries and agencies are organized and make it easier to identify the agency to carry out the recommended actions. The *location-specific* aspect focuses on particularly acute environmental problems at local levels that need to be addressed on a priority basis. The *long-term* issues include environmental degradation of such degree that it might become more serious and threatening than they seem to be if their cognizance is not immediately taken.

3.1.2.2 The Environment Conservation Act, 1995 (subsequent amendments in 2000 and 2002)

The provisions of the Act authorize the Director General (DG) of Department of Environment to undertake any activity he deems fit and necessary to conserve and enhance the quality of environment and to control, prevent and mitigate pollution. The main highlights of the act are:

- Declaration of Ecologically Critical Areas;
- Obtaining Environmental Clearance Certificate;
- Regulation with respect to vehicles emitting smoke harmful for the environment;
- Regulation of development activities from environmental perspective;
- Promulgation of standards for quality of air, water, noise, and soils for different areas and for different purposes;
- Promulgation of acceptable limits for discharging and emitting waste;
- Formulation of environmental guidelines relating to control and mitigation of environmental pollution, conservation and improvement of environment

3.1.2.3 Environment Conservation Rules, 1997 (subsequent amendments in 2002 and 2003)

The Environment Conservation Rules, 1997 are the first set of rules promulgated under the Environment Conservation Act, 1995. These Rules provide for, *inter alia*, the following:

- The national Environmental Quality Standards (EQS) for ambient air, surface water, groundwater, drinking water, industrial effluents, emissions, noise and vehicular exhaust;
- Categorization of industries, development projects and other activities on the basis of actual (for existing industries/development projects/activities) and anticipated (for proposed industries/development projects/activities) pollution load;
- Procedure for obtaining environmental clearance;
- Requirement for undertaking IEE and EIA as well as formulating EMP according to categories of industries/development projects/activities;
- Procedure for damage-claim by persons affected or likely to be affected due to polluting activities or activities causing hindrance to normal civic life.

Depending upon location, size and severity of pollution loads, projects/activities have been classified in ECR, 1997 into four categories: Green, Orange A, Orange B and Red respectively, to nil, minor, medium and severe impacts on important environmental components (IECs). Corresponding category related to power plants and associated facility

(e.g., laying of natural gas pipeline from nearest distribution point up to the power plant) are as under:

- Schedule-1, *Red Category*
- Item 6: power plants.
- Item 64: includes construction / replacement / extension of natural gas pipelines.

The Rules also incorporate ―inclusion lists" of projects requiring varying degrees of environmental investigation e.g. all the new projects under red category generally will require two-steps assessment procedure, firstly an Initial Environmental Examination (IEE) for site clearance, and secondly, if warranted, a full Environmental Impact Assessment (EIA) for technical clearance. This SEIA has been carried out following the previous IEE of the project and also on the basis of ToR for EIA approved by DOE, as part of fulfilling the requirements of ECR, '97 toward obtaining ‗Environmental Clearance Certificate' in favor of the proposed project.

3.1.2.4 The EIA Guidelines for Industry, 1997

The EIA Guidelines is a handbook for procedures for preparing the EIAs and for reviewing them for the benefit of the development partners, EIA Consultants, reviewers, and academicians. While preparing these guidelines, the present environmental status as well as the need for rapid economic development of Bangladesh has been kept in view. These considerations have essentially resulted in simpler procedures to be followed for preparing the EIAs and their review.

3. 2 Environmental Requirements of the Asian Development Bank (ADB)

The ADB Safeguard Policy Statement 2009 sets out the requirements for ADB's operations to undertake an environmental assessment for projects funded by the bank. The environmental assessment requirements for projects depend on the significance of impacts. Each proposed project is scrutinized as to its type; location; the sensitivity, scale, nature, and magnitude of its potential environmental impacts; and availability of cost-effective mitigation measures. The proposed Summit Bibiyana I & II CCGT Power Plant falls under Category A according to ADB categorization of projects as it could have significant adverse environmental impacts. An environmental impact assessment (EIA) is, therefore, essential for this project as required by ADB.

ADB requires public consultation in the environmental assessment process. For Category A projects, the borrower needs to consult with groups affected by the proposed project. The consultation needs to be carried out as early as possible in the project cycle so that views of affected groups are taken into account in the design of the project and its environment mitigation measures. For category A projects, ADB ensures that the borrower or private sector sponsor carries out public consultation at least twice, during the development of the EIA and then to present the conclusions of the report.

The EIA must include an Environmental Management Plan (EMP) that outlines specific mitigation measures, environmental monitoring requirements, and related institutional arrangements, including budget requirements. Loan agreements include specific environmental covenants that describe environmental requirements, including the EMPs. The provisions for the EMPs must also be fully reflected in the project administration memorandums. To ensure proper and timely implementation of the EMPs and adherence to the agreed environmental covenants, ADB requires borrowers or executing agencies to

submit semi-annual reports on implementation of EMPs, and that this requirement be reflected in the loan agreements.

3. 2. 1 Environmental and Social Guidelines of the International Finance Corporation (IFC)

As a member of the World Bank Group, the International Finance Corporation (IFC) has the environmental and social guidelines for projects funded by it following those of the World Bank. The World Bank procedures for EA study cover policies, guidelines and good practices. Such guidelines therefore follow the national best practices in undertaking any development project in Bangladesh. The environment safeguards policies applicable to the proposed SBPCL I&II Project are the following:

- *Environmental Assessment (EA) (OP 4.01/BP/GP 4.01)*: An Environmental Assessment is conducted to ensure that IFC-financed projects are environmentally sound and sustainable, and that decision-making is improved through appropriate analysis of actions and of their likely environmental impacts. Any IFC-funded project that is likely to have potential adverse environmental risks and impacts in its area of influence requires an EA indicating the potential risks, mitigation measures and environmental management framework or plan.

- *Natural Habitats (OP/BP 4.04)***:** Natural habitats are land and water areas where most of the original native plant and animal species are still present. Natural habitats comprise many types of terrestrial, freshwater, coastal, and marine ecosystems. They include areas lightly modified by human activities, but retaining their ecological functions and native species. The Natural habitats policy is triggered by any project (including any subproject under a sector investment or financial intermediary loan) with the potential to cause significant conversion (loss) or degradation of natural habitats, whether directly (through construction) or indirectly (through human activities induced by the project). The policy has separate requirements for critical (either legally or proposed to be protected or high ecological value) and non-critical natural habitats. World Bank‘s interpretation of ―significant conversion or degradation" is on a case-by-case basis for each project, based on the information obtained through the EA.

- *Forestry (OP/GP 4.36)*: This policy is triggered by forest sector activities and World Bank-sponsored other interventions, which have the potential to impact significantly upon forested areas. The World Bank does not finance commercial logging operations but aims to reduce deforestation, enhance the environmental contribution of forested areas, promote afforestation, reduce poverty and encourage economic development.

- *Cultural Property (OPN 4.11)*: Physical cultural resources are defined as movable or immovable objects, sites, structures, groups of structures, natural features and landscapes that have archaeological, paleontological, historical, architectural, religious, aesthetic, or other cultural significance. Physical cultural resources may be located in urban or rural settings, and may be above ground, underground, or underwater. The Bank seeks to assist countries to manage their physical cultural resources and to avoid or mitigate adverse impact of development projects on these resources. This policy is triggered for any project that requires an EA.

- *Policy on Disclosure of Information, 2002*: There are disclosure requirements at every part of the project preparation and implementation process. Consultation with affected groups and local community should take place during scoping and before Terms of references (ToRs) are prepared; when the draft EA is prepared; and throughout project implementation

as necessary. The Borrower makes the draft EA and any separate EA report available in country in a local language and at a public place accessible to project-affected groups and local community prior to appraisal.

Besides, IFC has set out 8 (eight) performance standards in respect of various parameters pertaining to a proposed project. These eight performance standards of IFC with their corresponding parameters as under:

- Performance Standard 1: Social and Environmental Assessment and Management System
- Performance Standard 2: Labor and Working Conditions
- Performance Standard 3: Pollution Prevention and Abatement
- Performance Standard 4: Community Health, Safety and Security
- Performance Standard 5: Land Acquisition and Involuntary Resettlement
- Performance Standard 6: Biodiversity Conservation and Sustainable Natural Resource Management
- Performance Standard 7: Indigenous Peoples
- Performance Standard 8: Cultural Heritage.

Of the above eight performance standards set by IFC, the Performance Standard 1 envisages establishing the importance of: (i) integrated assessment to identify the social and environmental impacts, risks and opportunities; (ii) effective community engagement through disclosure of project-related information and consultation with local communities on matters that directly affect them; and (iii) the client's management of social and environmental impacts throughout the life of the project.

The rest seven of the performance standards, i.e., Performance Standards 2 through 8 seek to ascertain establishing requirements to avoid, reduce, mitigate or compensate the impacts on people and the environment, and to improve conditions where appropriate.

3.2.2 Land Acquisition Policies

3.2.3 International Finance Corporation (IFC): Performance Standard 5, Land Acquisition and Involuntary Resettlement

Introduction

1. Involuntary resettlement refers both to physical displacement (relocation or loss of shelter) and to economic displacement (loss of assets or access to assets that leads to loss of income sources or means of livelihood) as a result of project-related land acquisition.[1] Resettlement is considered involuntary when affected individuals or communities do not have the right to refuse land acquisition that results in displacement. This occurs in cases of: (i) lawful expropriation or restrictions on land use based on eminent domain;[2] and ii) negotiated settlements in which the buyer can resort to expropriation or impose legal restrictions on land use if negotiations with the seller fail.

2. Unless properly managed, involuntary resettlement may result in long-term hardship and impoverishment for affected persons and communities, as well as environmental damage and social stress in areas to which they have been displaced. For these reasons, involuntary resettlement should be avoided or at least minimized. However, where it is unavoidable, appropriate measures to mitigate adverse impacts on displaced persons and host communities[3] should be carefully planned and implemented. Experience demonstrates that

the direct involvement of the client in resettlement activities can result in cost-effective, efficient, and timely implementation of those activities, as well as innovative approaches to improving the livelihoods of those affected by resettlement.

3. Negotiated settlements help avoid expropriation and eliminate the need to use governmental authority to remove people forcibly. Negotiated settlements can usually be achieved by providing fair and appropriate compensation and other incentives or benefits to affected persons or communities, and by mitigating the risks of asymmetry of information and bargaining power. Clients are encouraged to acquire land rights through negotiated settlements wherever possible, even if they have the legal means to gain access to the land without the seller‘s consent.

Objectives

- To avoid or at least minimize involuntary resettlement wherever feasible by exploring alternative project designs.
- To mitigate adverse social and economic impacts from land acquisition or restrictions on affected persons‘ use of land by: (i) providing compensation for loss of assets at replacement cost; and (ii) ensuring that resettlement activities are implemented with appropriate disclosure of information, consultation, and the informed participation of those affected
- To improve or at least restore the livelihoods and standards of living of displaced persons
- To improve living conditions among displaced persons through provision of adequate housing with security of tenure[4] at resettlement sites

Scope of Application

4. The applicability of this Performance Standard is established during the Social and Environmental Assessment process, while implementation of the actions necessary to meet the requirements of this Performance Standard is managed through the client‘s Social and Environmental Management System. The assessment and management system requirements are outlined in Performance Standard 1.

5. This Performance Standard applies to physical or economic displacement resulting from the following types of land transactions:

* Type I: Land rights for a private sector project acquired through expropriation or other compulsory procedures
* Type II: Land rights for a private sector project acquired through negotiated settlements with property owners or those with legal rights to land, including customary or traditional rights recognized or recognizable under the laws of the country, if expropriation or other compulsory process would have resulted upon the failure of negotiation[5]

1 Land acquisition includes both outright purchases of property and purchases of access rights, such as rights - of way.
2 Such restriction may include restrictions of access to legally designated nature conservation areas.
3 A host community is any community receiving displaced persons.

6. This Performance Standard does not apply to resettlement resulting from voluntary land transactions (i.e., market transactions in which the seller is not obliged to sell and the buyer cannot resort to expropriation or other compulsory procedures if negotiations fail). In the event of adverse economic, social, or environmental impacts from project activities other than land acquisition (e.g., loss of access to assets or resources or restrictions on land use), such impacts will be avoided, minimized, mitigated or compensated for through the process of Social and Environmental Assessment under Performance Standard 1. If these impacts become significantly adverse at any stage of the project, the client should consider applying the requirements of Performance Standard 5, even where no initial land acquisition was involved.

General Requirements

Project Design

7. The client will consider feasible alternative project designs to avoid or at least minimize physical or economic displacement, while balancing environmental, social, and financial costs and benefits.

Compensation and Benefits for Displaced Persons

8. When displacement cannot be avoided, the client will offer displaced persons and communities compensation for loss of assets at full replacement cost and other assistance[6] to help them improve or at least restore their standards of living or livelihoods, as provided in this Performance Standard. Standards for compensation will be transparent and consistent within the project. Where livelihoods of displaced persons are land-based, or where land is collectively owned, the client will offer landbased compensation, where feasible.[7] The client will provide opportunities to displaced persons and communities to derive appropriate development benefits from the project.

Consultation

9. Following disclosure of all relevant information, the client will consult with and facilitate the informed participation of affected persons and communities, including host communities, in decision-making processes related to resettlement. Consultation will continue during the implementation, monitoring, and evaluation of compensation payment and resettlement to achieve outcomes that are consistent with the objectives of this Performance Standard.

Grievance Mechanism

10. The client will establish a grievance mechanism consistent with Performance Standard 1 to receive and address specific concerns about compensation and relocation that are raised by displaced persons or members of host communities, including a recourse mechanism designed to resolve disputes in an impartial manner.

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4 A resettlement site offers security of tenure if it protects the resettled persons from forced evictions.

5 These negotiations can be carried out by the private sector company acquiring the land or by an agent of the company. In the case of private sector projects in which land rights are acquired by the government, the negotiations may be carried out by the government or by the private company as an agent of the government.

Resettlement Planning and Implementation

11. Where involuntary resettlement is unavoidable, the client will carry out a census with appropriate socio-economic baseline data to identify the persons who will be displaced by the project, to determine who will be eligible for compensation and assistance, and to discourage inflow of people who are ineligible for these benefits. In the absence of host government procedures, the client will establish a cut-off date for eligibility. Information regarding the cut-off date will be well documented and disseminated throughout the project area.

12. In the case of Type I transactions (acquisition of land rights through the exercise of eminent domain) or Type II transactions (negotiated settlements) that involve the physical displacement of people, the client will develop a resettlement action plan or a resettlement framework based on a Social and Environmental Assessment that covers, at a minimum, the applicable requirements of this Performance Standard regardless of the number of people affected. The plan or framework will be designed to mitigate the negative impacts of displacement, identify development opportunities, and establish the entitlements of all categories of affected persons (including host communities), with particular attention paid to the needs of the poor and the vulnerable. The client will document all transactions to acquire land rights, as well as compensation measures and relocation activities. The client will also establish procedures to monitor and evaluate the implementation of resettlement plans and take corrective action as necessary. A resettlement will be considered complete when the adverse impacts of resettlement have been addressed in a manner that is consistent with the objectives stated in the resettlement plan or framework as well as the objectives of this Performance Standard.

13. In the case of Type II transactions (negotiated settlements) involving economic (but not physical) displacement of people, the client will develop procedures to offer to the affected persons and communities compensation and other assistance that meet the objectives of this Performance Standard. The procedures will establish the entitlements of affected persons or communities and will ensure that these are provided in a transparent, consistent, and equitable manner.

The implementation of the procedures will be considered complete when affected persons or communities have received compensation and other assistance according to the requirements of this Performance Standard. In cases where affected persons reject compensation offers that meet the requirements of this Performance Standard and, as a result, expropriation or other legal procedures are initiated, the client will explore opportunities to collaborate with the responsible government agency, and if permitted by the agency, play an active role in the resettlement planning, implementation, and monitoring.

3.2.4 Displacement

14. Displaced persons may be classified as persons:
(i) who have formal legal rights to the land they occupy;
(ii) who do not have formal legal rights to land, but have a claim to land that is recognized or recognizable under the national laws[8]; or
(iii) who have no recognizable legal right or claim to the land they occupy.[9] The census will establish the status of the displaced persons.

6 As described in paragraphs 18 and 20.
7 See also footnote 9.

15. Land acquisition for the project may result in the physical displacement of people as well as their economic displacement. As a result, requirements for both physical displacement and economic displacement may apply.

3.2. 5 Physical Displacement

16. If people living in the project area must move to another location, the client will: (i) offer displaced persons choices among feasible resettlement options, including adequate replacement housing or cash compensation where appropriate; and (ii) provide relocation assistance suited to the needs of each group of displaced persons, with particular attention paid to the needs of the poor and the vulnerable. Alternative housing and/or cash compensation will be made available prior to relocation. New resettlement sites built for displaced persons will offer improved living conditions.

17. In the case of physically displaced persons under Sub-sections 14 (i) or (ii) above, the client will offer the choice of replacement property of equal or higher value, equivalent or better characteristics and advantages of location, or cash compensation at full replacement value where appropriate.[10]

18. In the case of physically displaced persons under Sub-section 14 (iii) above, the client will offer them a choice of options for adequate housing with security of tenure so that they can resettle legally without having to face the risk of forced eviction. Where these displaced persons own and occupy structures, the client will compensate them for the loss of assets other than land, such as dwellings and other improvements to the land, at full replacement cost, provided that these people occupy the project area prior to the cut-off date for eligibility. Compensation in kind will be offered in lieu of cash compensation where feasible.

Based on consultation with such displaced persons, the client will provide relocation assistance sufficient for them to restore their standards of living at an adequate alternative site.[11] The client is not required to compensate or assist those who encroach on the project area after the cut-off date.

19. Where communities of Indigenous Peoples are to be physically displaced from their communally held traditional or customary lands under use, the client will meet the applicable requirements of this Performance Standard, as well as those of Performance Standard 7 (in particular paragraph 14).

3.2.6 Economic Displacement

20. If land acquisition for the project causes loss of income or livelihood, regardless of whether or not the affected people are physically displaced, the client will meet the following requirements:

- Promptly compensate economically displaced persons for loss of assets or access to assets at full replacement cost

8 Such claims could be derived from adverse possession or from customary or traditional law.
9 Such as opportunistic squatters and recently arrived economic migrants who occupy land prior to the cut-off date.

- In cases where land acquisition affects commercial structures, compensate the affected business owner for the cost of reestablishing commercial activities elsewhere, for lost net income during the period of transition, and for the costs of the transfer and reinstallation of the plant, machinery or other equipment
- Provide replacement property (e.g., agricultural or commercial sites) of equal or greater value, or cash compensation at full replacement cost where appropriate, to persons with legal rights or claims to land which are recognized or recognizable under the national laws (see paragraph 14 (i) and (ii))
- Compensate economically displaced persons who are without legally recognizable claims to land (see paragraph 14 (iii)) for lost assets (such as crops, irrigation infrastructure and other improvements made to the land) other than land, at full replacement cost. The client is not required to compensate or assist opportunistic settlers who encroach on the project area after the cut-off date

- Provide additional targeted assistance (e.g., credit facilities, training, or job opportunities) and opportunities to improve or at least restore their income-earning capacity, production levels, and standards of living to economically displaced persons whose livelihoods or income levels are adversely affected
- Provide transitional support to economically displaced persons, as necessary, based on a reasonable estimate of the time required to restore their incomeearning capacity, production levels, and standards of living

21. Where communities of Indigenous Peoples are economically displaced (but not relocated) as a result of project-related land acquisition, the client will meet the applicable requirements of this Performance Standard, as well as those of Performance Standard 7 (in particular paragraphs 12 and 13).

3.2.7 Private Sector Responsibilities under Government-Managed Resettlement

22. Where land acquisition and resettlement are the responsibility of the host government, the client will collaborate with the responsible government agency, to the extent permitted by the agency, to achieve outcomes that are consistent with the objectives of this Performance Standard. In addition, where government capacity is limited, the client will play an active role during resettlement planning, implementation and monitoring, as described below in paragraphs 23 through 25.

23. In the case of Type I transactions (acquisition of land rights through expropriation or other legal procedures) involving physical or economic displacement, and Type II transactions (negotiated settlements) involving physical displacement, the client will prepare a plan (or a framework) that, together with the documents prepared by the responsible government agency, will address the relevant requirements of this

10 Payment of cash compensation for lost assets may be appropriate where: (a) livelihoods are not land-based; (b) livelihoods are land-based but the land taken for the project is a small fraction of the affected asset and the residual land is economically viable; or (c) active markets for land, housing, and labor exist, displaced persons use such markets, and there is sufficient supply of land and housing. Cash compensation levels should be sufficient to replace the lost land and other assets at full replacement cost in local markets.

11 Relocation of informal settlers in urban areas often has trade-offs. For example, the relocated families may gain security of tenure, but they may lose advantages of location.

Performance Standard (the General Requirements, except for paragraph 13, and requirements for Physical Displacement and Economic Displacement above). The client may need to include in its plan: (i) a description of the entitlements of displaced persons provided under applicable laws and regulations; (ii) the measures proposed to bridge any gaps between such entitlements and the requirements of this Performance Standard; and (iii) the financial and implementation responsibilities of the government agency and/or the client.

24. In the case of Type II transactions (negotiated settlements) involving economic (but not physical) displacement, the client will identify and describe the procedures that the responsible government agency plans to use to compensate affected persons and communities. If these procedures do not meet the relevant requirements of this Performance Standard (the General Requirements, except for paragraph 12, and requirements for Economic Displacement above), the client will develop its own procedures to supplement government action.

25. If permitted by the responsible government agency, the client will, in collaboration with such agency: (i) implement its plan or procedures established in accordance with paragraph 23 or 24 above; and (ii) monitor resettlement activity that is undertaken by the government agency until such activity has been completed.

3.3 Legal Framework under which GOB Acquired the Land

3.3.1 Acquisition and Requisition of Immovable Property Ordinance, 1982.

This Ordinance provides the Deputy Commissioner (DC) with the power to initiate the acquisition of any property in any locality within his district that is likely to be needed for a public purpose or in the public interest. In this event, the DC shall cause a notice to be published at a convenient place in or near the property to be acquired. Any person having interest in such property may object to the proposed acquisition to the Deputy Commissioner in writing within 15 days. The DC will prepare a report and refer the case to higher authorities for decision. If the property exceeds 10 standard bighas of land, the final decision will be made by the Government. In case of property up to 10 bighas, the final decision will be made by the Divisional Commissioner. However, if no objections are raised with the 15 days time limit, the final decision may be made by the DC in case of properties up to 10 standard bighas of land, otherwise the Divisional Commissioner will take the decision in case of dispute.

After a decision of acquisition of a property has been made, the DC issues a second notice, again to be published at convenient places at or near such property. The public notice shall state the intention of the authorities to take possession of the property. It shall also invite all persons with interests in the property to appear in person or by agent before the DC not later than 15 days after the publication of the notice to state the nature of their interest in the property and submit claims to compensation.

In determining the amount of compensation, the DC shall take into consideration the market value of the property on the date of the publication of the first notice. In this process, the DC shall take into account the average value of similar properties in the vicinity during the preceding twelve months. In addition to the market value of the property, the DC shall in every case award a sum of fifty percent on such market value in consideration of the compulsory nature of the acquisition.

Among the matters to be considered in determining compensation are the following:

1. The damage that may be sustained by the person interested, by reason of the taking of standing crops or trees which may be on the property at the time of taking possession thereof by the Deputy Commissioner,
2. The damage that may be sustained by reason of the acquisition injuriously affecting his other properties, movable or immovable, in any other matter, or his earnings;
3. If in consequence of the acquisition of the property, the person interested is likely to be compelled to change his residence or place of business, the reasonable expenses, if any, incidental to such change;

In terms of compensation, the Ordinance explicitly states that the DC, when determining compensation, shall neither consider any disinclination of the person to part with the property, nor any increase in the value of the property to be acquired likely to accrue from the use of it after it has been acquired.

Payments of compensation must be made before the authorities take possession of the property.

The property acquired under the ordinance must not, without prior approval of the Government, be used for any purpose other than the purpose for which it has been acquired. After compensation has been paid or deposited in the Public Account, the property shall stand acquired and vest absolutely with the Government free from all encumbrances. The DC can take possession of the property after a declaration has been made in the Official Gazette. Compensation must be paid or deposited within a period of one year from the date of decision of acquisition. All proceedings shall stand abated on the expiry of that period. In addition, the Deputy Commissioner may, with the approval of the competent authorities, revoke all proceedings in respect of the acquisition of any property at any time before the payment of compensation.

The Ordinance also covers the case of temporary acquisition of property for a public purpose or in the public interest. (Often these are areas only temporarily needed for construction purposes.) With prior approval of the Government, the DC can decide on the requisition of any property for a period of two years of more. However, no prior approval will be required for emergency requisition for the purpose of maintaining a transportation or communication system.

The DC may take possession of the requisition after serving the requisition order. The amount of compensation will be equal to the estimated rent which would have been payable for the use and occupation of the property if it has been taken on lease for that period, plus compensation for estimated expenses for vacating and re-occupying the property. If a person is not satisfied with the amount of compensation, or there is a dispute over ownership, the DC may deposit the money in the Public Account.

A person who does not accept the award made by the DC, in any case under the Ordinance, may submit an application seeking revision of the award to the Arbitrator, within 45 days from the date of notice of the award. The Arbitrator is a government appointed Judicial Officer, not below the rank of Subordinate Judge. A determination by the Arbitrator takes precedence over that of the DC.

An appeal against the decision by the Arbitrator can be made to an Arbitration Appellate Tribunal which consists of a member appointed by the Government from among persons who are or have been District Judges. A decision of the said Tribunal shall be final (Sec. 34). 6.2 Property (Emergency) Acquisition Act, 1989

In the wake of the devastating floods of 1987 and 1988, the government decided to promulgate a new Land Acquisition Act entitled: Property (Emergency) Acquisition Act (Act IX of 1989). The Act was formulated to expedite the emergency acquisition of land to enable the Government 'to control inundation, flood and upsurge caused by natural calamity and to prevent river erosion." The 1989 Act was not meant to replace the 1982 Ordinance, but to

complement it for special circumstances. Normally, acquisition of land for development purposes would not come under the 1989 Act. Use of this Act to acquire land for development would require extremely compelling reasons.

3.3.2 Administrative and Regulatory Guidelines and Instructions

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

In 1976, the Government constituted land allocation committees at the district, divisional and central levels to control what was regarded as too lavish taking of land for public purposes. The committees were charged with ensuring 'the most rigid measures of economy in the use of land for purposes other than agriculture."

The District Land Allocation Committees (DLACs) are chaired by the DC and have seven other members. These member include Executive Engineers of the R&H Department and the Public Works Department, and the Civil Surgeon. They are entrusted with land allocation within the district not exceeding two acres. The Divisional LACs are chaired by the Divisional Commissioner and have technical representation at the Superintending Engineer and Deputy Director level. These committees consider land acquisition cases involving between two and five acres of land. All cases of more than five acres, and all cases of land belonging to Dhaka City, go to the Central Land Allocation Committee (CLAC). This committee is chaired by the Minister of Land Administration and has technical representation at the Secretary level. In 1989, the Government ordered that in all cases involving the acquisition of land exceeding 10 bighas, the President would have to give consent.

3.3.3 Land Acquisition Procedures

Land acquisition requires interaction between, on the one hand, the Requiring Body (RB), which usually is a national infrastructure development agency, such as the Water Development Board, Power Development Board, Titas Gas, etc., and, on the other, the Acquiring Body (AB), which normally is the Ministry of Land. The Ministry of Land usually delegates its authority to the Deputy Commissioner or the Divisional Commissioner, depending on the magnitude of the land taking, or other considerations. The division of responsibilities between the RB and the AB consists in that the RB provides the technical input and the AB the legal input in the land acquisition process. The Requiring Body must ensure that the Project, for which the land must be acquired, is approved by the competent authorities and that funds are available. The RB must also justify the need for land and other property on the basis of field surveys, including detailed engineering design, and must prepare all necessary documents required for decision making. At this stage, the AB undertakes to process the land acquisition case.

The procedural aspects of land acquisition begin when the RB submits an application to the Deputy Commissioner with a request to acquire land for a specific public purpose. The procedures for dealing with land acquisition matters are laid out in a Government Memorandum, dated October, 1985. With respect to proposals in the water resources sector, additional guidelines are issued by the Water Development Board. The proposal must contain the following items:

* A Proforma indicating the amount of land required, a timetable for the acquisition of land and a purpose for which the land is to be acquired;
* A Layout Plan, which shows the location of the Project on a map;
* A Site Plan, showing the alignment in red ink on a Mouza Map;

* A Land Schedule, showing the classification of the land and the ownership of the plots to be acquired;
* A Certificate of Minimum Requirement, issued by the Requiring Body, stating that the quantity of land proposed for acquisition is the absolute minimum for a proper implementation of the Project; and
* Administrative Approval, comprising a copy of the approved Proforma.

After receiving the proposal, the DC will arrange for field verifications jointly with the staff of the Requiring Body. This includes a classification of the land to be acquired and an identification of trees and standing crops, which are involved.

The Requiring Body‘s application is then submitted to the appropriate Land Acquisition Committee. After clearance by the LAC, the DC issues the preliminary notice and, if required, hears objections against the proposed acquisition. If there is no objection, and if the area is less than ten standard bighas, the DC may give the formal approval for land acquisition. If there are objections, and if the area is greater than ten standard bighas, the DC submits the application to the Commissioner or the Ministry of Land for final approval. The DC's submission shall include the clearance by the relevant LAC, a report on the objection petitions, and information on the likely number of households to be affected.

After the final approval of the President, Commissioner/Deputy Commissioner (as the case may be), the case is referred back to the DC for the assessment of compensation and the identification of the owners of the plots to be acquired. With the final approval to acquire the land, the RB must place the required funds for payment of compensation with the DC. If the RB fails to do that within one year of the date of final approval, all proceedings shall stand abated and a declaration to that effect by the DC will be published in the Official Gazette.

Compensation is paid by the DC's office. There are no specific rules on where and in what form compensation should be paid. Normally, smaller amounts appear to be paid in cash, whereas larger amounts are paid by cheques to persons who are identified by the Chairman or members of the Union Parishad or by gazetted officers. In the event the rightful owner of the land cannot be found, or there is a conflict over ownership, or the distribution of compensation, funds are deposited in the Public Account.

In the event the owner of the land does not accept the award of compensation, the person can go for Arbitration according to the provisions of the 1982 Ordinance. After payment of compensation, the ownership of the land is formally transferred to the Requiring Body by mutation in favour of the RB in the government's revenue record, which is maintained at the concerned Thana Land Office. The transfer also is published in the Government Gazette.

3.3.4 Institutional Arrangements

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

3.3.5 Time Frames

Time Frame for Payment of Compensation. The following are time frames relevant to the payment of compensation:

a) Payment of compensation must be made before the authority takes possession of the property (Ordinance of 1982).

b) Compensation must be paid or deposited within a period of one year from the date of final decision of acquisition by the DC. All proceedings shall stand abated on the expiry of that period (Ordinance of 1982).

c) Persons with an interest or right over the property to be acquired have 10 days in the 1989 Act and 15 days in the 1982 Ordinance to submit claims for compensation.

d) The 1989 (Emergency) Act provides for quicker compensation by introducing the concept of 'provisional compensation' which is to be determined within 10 days of the order of acquisition. Land can be acquired on payment of provisional compensation. However, the final compensation is to be determined within three months from the date of acquisition.

Time Frames for Legal Procedure and Appeal. The following are time frames applying to the legal process:

a) The aggrieved party may raise objection in writing against the decision of acquisition within 15 days from the date of serving the notice of acquisition. It may take about a month to make a final decision.

b) If a land owner is dissatisfied with the amount of compensation offered, he may apply for arbitration to an Arbitrator not less than the level of a Subordinate Judge within 45 days of the award.

c) Subject to the decision of the arbitration, either party may appeal against the decision to the Arbitration Appellate Tribunal within the stipulated period allowed by the court.

3.3.6 Framework for Leasing of Government (Khas) Agricultural Land

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

Under these regulations, the Government leases cultivable agricultural land in the rural areas to landless farming households. The allotments cannot be more than one acre, except in the southern districts where up to 1.5 acres of char land can be allotted. A landless family is defined as one that works in agriculture and may own a homestead, but has no arable land of its own.

Given this basic definition, five groups of landless families are given priority in the allotment of leases: (i) families of freedom fighters; (ii) families who have lost all their land due to erosion; (iii) widows with an adult son capable of working the land; (iv) farmers with homesteads but no land;' and (v) farmers who have lost all their land due to land acquisition under the eminent domain laws.

The regulations provide for a three tiered structure, with Committees for the Management and Leasing of Khas Land at the National, District, and Thana levels. While the upper committees have oversight and appeal functions, the key operations occur at the Thana level. The Thana Committee is chaired by the Thana Nirbahi Officer (TNO, or Thana Administrative Officer) and is advised by the local Member of Parliament. The members of the committee are the

Thana Agricultural Officer, Thana Police Commander, the Cooperative Officer, Forest Range Officer, Union Pafishad Chairman, representative of lower income groups (appointed by the Deputy Commissioner), one representative of an organised peasant organisation (appointed by the Ministry of Land), one local notable/philanthropist (appointed by DC with advice of MP), a scholar/educator (appointed by DC with advice of MP), NGO representative (appointed by ADB), and a freedom fighter representative (appointed by Ministry of Land). The AC Land (Thana level land officer) acts as Secretary of the Committee.

The Thana Committee for the Management and Leasing of Khas Land is charged with recovering khas land that is out of Government management, dividing it into plots, and informing the population in the mauza (revenue village) about the leasing programme. Once applications have been made and the fee of one Taka paid, the committee vets the applicants, makes a priority list and passes its recommendations to the District level committee. Applicants have 30 days to appeal over the make up of the list. Normally, the District committee finalises the list of allottees. However, if there are disputes, the National level committee examines the circumstances and makes the final determination.

The actual leasing of the land is carried out under the AC/Land at the Thana, where leaseholders sign a lease agreement. The lease is for the number of years decided upon by the Thana Committee for the Management and Leasing of Khas Land. Normally, rural agrarian or homestead land is leased for three years. These are temporary leases. There are instances, however, in which land can be leased for fifteen years, after which the lease becomes *permanent," that is for 99 years. In practice, once even temporary leaseholders are in the system they may stay on the same land for years. Upon their retirement, disability or death, the transfer of the lease is allowed only to their descendants. The leaseholders pay a small annual fee to the Government of Tk 5/- per decimal. No land tax is collected in Bangladesh on any agrarian land up to 25 bighas in extent (25 bighas equals 8.25 acres.).

The current reworking of the leasing system in the regulations of 1997 and 1998 is not meant to recover khas land leased under previous rules. It covers only that khas which has been occupied illegally or has been out of government management control for some other reason.

Undoubtedly, some ineligible people slip through the leasing system, but in the experience of the Project so far, the leaseholders were genuinely landless peasants, who had lost their land to erosion, and who were living on homestead land and cultivating agrarian land on temporary leasehold status.

The Government has the right to cancel the leases and resume the land, if it is needed for a public purpose. All khas land that is held under a permanent lease (99 years), if resumed by the Government, is compensated as if the leaseholder were the owner of the land. In the event of the involuntary resumption of temporary leases, however, there is no provision in the regulations for payment of compensation. Under other regulations, the administration is liable to pay for the loss of standing crops.

3.3.7 Comparision of Bangladesh Laws with IFC Performance Standards

According to Bangladesh laws, the matters to be considered are:

- the market values of property
- damage to standing crops and trees
- damage to severance of the acquired property from other property
- damage to other properties and earnings
- expenses for relocation of residence

According IFC Performance Standards, the matters to be considered are:

- Payment of compensation for various losses at replacement value
- Rehabilitation to ensure improvement/restoration of the standard of living
- Public consultation during the entire process of assessment and disclosure of information
- Resettlement Action Plan

In cases of discrepancies between GoB laws and IFC Performance Standards, matters have to be referred to the line Ministry (Ministry of Power, Energy and Mineral Resources in this case) for settlement.

Section -2: Harmonized Operational Framework for SEIA of Summit Bibiyana I & II Power Project

In view of the possibilities of support from the regional and global financing institutions, viz., the Asian Development Bank (ADB) and the International Finance Corporation (IFC), and the Equator Principle Financing Institution (EPFI), viz., the Standard Chartered Bank (SCB), the environmental assessment of the Project will need to satisfy the requirements of the Government of Bangladesh as well as those of ADB, IFC and SCB. It is appropriate, therefore, to develop a harmonized operational framework for conducting the EIA study for the proposed SBPCL I & II Project. Accordingly, based on the policy requirement of the above financing institutions, a harmonized operational framework has been developed and presented in the following pages. The terms-of-reference for the environmental assessment (EA) study was prepared on this basis. These ToRs have been reviewed and approved by the project entrepreneur and, finally, by DOE.

The Harmonized Operational Framework developed as above has duly been taken into consideration while undertaking this SEIA exercise. Requirements of ADB, WB, IFC, EPs and Environment Conservation Act, 1995 (ECA, _95), Environment Conservation Rules (ECR, _97), 1997 and EIA Guidelines for Industries, 1997 of the Government of Bangladesh have been mentioned in Chapter III of this SEIA Report. This Section—II of the current chapter presents through Table-3.1, a harmonization of the requirements pertaining to ECA, '95, ECR, '97 and EIA Guidelines for Industries, '97 in force in Bangladesh and the requirements pertaining to ADB, WB and IFC guidelines with those pertaining to Equator Principles and comes out with a policy framework responsive to these requirements toward operation of various phases of the proposed Summit Bibiyana I & II Power Company Limited Project. The SEIA process complies with IFC Performance Standard 1 and Equator Principle 2 besides meeting similar requirements of WB and ADB.

Chapter IV on Social Description, i.e., the socio-economic aspects of the project and project area corresponds to ADB requirement in as much as in providing the basis of impacts of the project on the existing socio-economic conditions in the project area. It goes in line of complying with the WB guidelines OP/GP 4.36, IFC Performance Standard 1 and Equator Principle 3. Chapters VII and VIII on Identification of Impacts and Project Categorization comply with relevant requirement of ADB, WB categorization, IFC Performance Standard 1 and Equator Principle 1. Chapters XI and XII correspond to IFC Performance Standard 4 and Equator Principle 3. Annexure 4 on Public Consultation and Disclosure corresponds to IFC Performance Standard 1 and Equator Principle 5. Chapters XII comply with IFC Performance Standards 1, 2, 5 and 6 and Equator Principle 4 and 6 are reviwed.

Table-3.1: Harmonization of the Operational Principles of Multilateral Financial Institutions (viz., the International Finance Corporation (World Bank Group) and the Asian Development Bank), the Equator Principles developed by Private Sector Banks and Relevant Acts, Rules and Guidelines of the Government of Bangladesh, as Applicable to SEIA of SBPCL I & II Project.

Aspect of Operational Framework	IFC (World Bank Group)	ADB	Equator Principles	GOB	Harmonized Policy Framework
Environmental Policy and Regulations	WB Policy on Disclosure of Information, May 2002 WB Operational Policy 4.01 Environmental Assessment and associated BP 4.01	The operational policies include three safeguard policies: The Involuntary Resettlement Policy (1995), The Policy on Indigenous Peoples (1998), and The Environment Policy (2002).	Principle: 1 Review and Categorization Principle: 2 Social and Environmental Assessment Principle: 3 Applicable Social and Environmental Standards	Environment Conservation Act (1995) Environment Conservation Rules (1997) EIA Guidelines for Industries, 1997.	
Screening and Categorisation	The Bank undertakes environmental screening of each proposed project to determine the appropriate extent and type of EA Categorization into Category A, B, C, FI Categorization takes into account the type, location, sensitivity, and scale of the project and the nature and magnitude of its potential environmental impact The categorization defines the level of EIA that has to be conducted	ADB carry out project screening and categorization at the earliest stage of project preparation when sufficient information is available for this purpose. It is undertaken to (i) reflect the significance of potential impacts or risks that a project might present; (ii) identify the level of assessment and institutional resources required for the safeguard measures; and (iii) determine disclosure requirements. The environmental impacts and risks are categorized for each proposed Project as early as possible to determine appropriate extent	Principle: 1 Review and Categorization requires screening and categorizing of the proposed project according to magnitude and severity of anticipated impacts Principle: 2 Social and Environmental Assessment necessitates project sponsor to undertake environmental assessment addressing key environmental and social issues.	The Department of Environment (DOE) ECA (1995) and ECR (1977) has set out screening criteria to categorize the projects into Green, Orange A, Orange B and Red. These screening criteria are generally based on project type only irrespective of its scale and location. In some cases, order of investment is indicated to reflect on the magnitude of the impact. Categorization decides the level of EIA or environmental examination. GOB has prescribed 8 locations as Environmentally Critical Areas but these have not been factored in	Screen each proposed project as early as possible to define the scope of Environmental Assessment (EA) covering all project components. Categorization should take into account the type, location, sensitivity, and scale of the project and the nature and magnitude of its potential environmental impact. For the proposed Summit Bibiyana 1 & 2 Power Project, the category, as per IFC (WB), ADB guidelines, will be A

Aspect of Operational Framework	IFC (World Bank Group)	ADB	Equator Principles	GOB	Harmonized Policy Framework
		and type of Environmental Assessment Categorization into Category A, B, C, FI A project's category is determined by the category of its most environmentally sensitive component, including direct, indirect, cumulative, and induced impacts in the project's area of influence. Each proposed project is scrutinized as to its type, location, scale, and sensitivity and the magnitude of its potential environmental impacts.		screening.	Categorize the project according to GOB categorization (to get the ECC accordingly). For the proposed Summit Bibiyana 1 & 2 Power Project, the category will be Red
Scoping	As per WB Policy, EA evaluates project's potential environmental risks and impacts in its area of influence; examines project alternatives; identifies ways of improving project selection, siting, planning, design, and implementation by preventing, minimizing, mitigating, or compensating for adverse environmental impacts and enhancing positive impacts;	Avoid, minimize, mitigate and/or offset for adverse impacts and enhancement of positive impacts through environmental planning and management EA takes into account potential impacts and risks on physical, biological, socio-economic (including health and safety), and physical cultural resources in the context of the project's area of influence Assessment of potential trans-boundary and global impacts, including climate	Principle 3: Applicable Social and Environmental Standards. The environmental assessment report needs to address baseline environmental and social conditions, requirement under host country laws and regulations, applicable international treaties and agreements, sustainable development and use of renewable natural resources, protection of human health,	The impacts assessed in the GOB's EIA system include components such as Air, Noise, Land, Water, Biological and Socio-Economic aspects. Scoping is however not a requirement under the law and is not an identified milestone in the EC process. EIA Guidelines consider IEE as the milestone where scoping is to be carried out.	Conduct a process of Environmental Assessment that will consider in an integrated manner the potential environmental (including labor, health, and safety) risks and impacts of the project. EA must take into account natural environment (air, water, and land); human health and safety; social aspects (involuntary resettlement, indigenous peoples, physical

Aspect of Operational Framework	IFC (World Bank Group)	ADB	Equator Principles	GOB	Harmonized Policy Framework
	includes the process of mitigating and managing adverse environmental impacts throughout project implementation EA takes into account natural environment (air, water, and land); human health and safety; social aspects (involuntary resettlement, indigenous peoples, physical cultural resources; transboundary and global environmental aspects It also takes into account variations in project and country conditions; findings of country environmental studies; national environmental action plans; the country's overall policy framework, national legislation, and institutional capabilities related to the environment and social aspects obligations of the country, pertaining to project activities, under relevant international environmental treaties and agreements	change Use strategic environmental assessment where appropriate Consideration of no project alternative	cultural properties, biodiversity, endangered species, sensitive ecosystem, etc.		cultural resources; trans-boundary and global environmental aspects Under global aspects, EA should address impact of climate change on the project design, alternatives and operations. Given the scale and complexity of the project, especially regarding the associated components (e.g. widening of national highway, rail connectivity etc), EA should be applied at regional and strategic levels Ensure that the project is designed and carried out in compliance with environmental laws and regulations of the country where the operation is being implemented.
Environmental Assessment (EA)	Performance Standards 1and 3 specify such an assessment covering environmental and	Spells out such an unavoidable requirement	Principle 2: Social and Environmental Assessment necessitates project sponsor to undertake environmental	Full-scale EIA is a must for Orange B and Red Categories of projects	Carry out EIA as per procedures followed internationally with special focus on

Aspect of Operational Framework	IFC (World Bank Group)	ADB	Equator Principles	GOB	Harmonized Policy Framework
	social issues.		assessment addressing key environmental and social issues.		country-specific requirement.
Occupational and Community Health and Safety	Performance Standards 2 and 4 provide for compliance of such safety aspects	Necessitates ensuring safety aspects.	Principle 3: The EA report needs to address, inter alia, such safety aspects.	The EIA report has to incorporate such safety aspects.	Carry out EIA as per safety aspects followed internationally with specific focus on national environmental and socio-economic needs.
Exclusions and Sensitivities	Avoid or mitigate adverse impacts on physical cultural resources from development projects that it finances (OP 4.11). The impacts on physical cultural resources resulting from project activities, including mitigating measures, should not contravene either the borrower‘s national legislation, or its obligations under relevant international environmental treaties and agreements. Performance Standards 6, 7 and 8.	Do not implement project activities that involve or are likely to result directly or indirectly in the significant conversion or degradation of critical habitats If a project is located within a legally protected area, implement additional programs to promote and enhance the conservation aims of the protected area In an area of natural habitats, there must be no significant conversion or degradation, unless it is appropriately mitigated and the overall benefits from the project substantially outweigh the environmental costs. .Use a precautionary approach to the use, development and	Principle 3: Application of Social and Environmental Standards makes environmental assessment address cultural properties, biodiversity including endangered species, occupational health and safety, impacts on indigenous peoples and communities, etc., and, hence, related exclusions and sensitivities.	Exclusions and sensitivities comprise indispensable aspects of EIA as per ECR, ‘97.	Do not implement project activities that involve or are likely to result directly or indirectly in the significant conversion or degradation of critical habitats If a project is located within a legally protected area, implement additional programs to promote and enhance the conservation aims of the protected area Proceed only if there are no technically and financially feasible alternatives, overall benefits from the project substantially outweigh the environmental costs, and any conversion or

Aspect of Operational Framework	IFC (World Bank Group)	ADB	Equator Principles	GOB	Harmonized Policy Framework
		management of renewable natural resources Conserve physical cultural resources (PCR) and avoid their destruction or damage by using field based surveys with qualified and experienced expert(s) during environmental assessment			degradation is appropriately mitigated Use a precautionary approach to the use, development and management of renewable natural resources Conserve physical cultural resources (PCR) and avoid their destruction or damage by using field based surveys with qualified and experienced expert(s) during environmental assessment
Alternatives	EA is initiated as early as possible in project processing and is integrated closely with the economic, financial, institutional, social, and technical analyses of a proposed project The EA may recommend alternative emission levels and approaches to pollution prevention and abatement for the project taking into account borrower country legislation and local conditions The EA report must provide	EA is initiated as early as possible in project Examination of financially and technically feasible alternatives to the project location, design, technology and components, their potential environmental and social impacts Documentation of the rationale for selecting a particular alternative(s) proposed, where relevant Consider no project alternative.	Principle 3: Applicable Environmental and Social Standards. Provides for consideration of feasible environmentally and socially preferable alternatives to the project. Alternatives or mitigation measures to avoid or minimize adverse impact must be examined and incorporated into the project plan..	ECA (1995) and ECR (1977) do not explicitly ask for identification and assessment of alternatives. EIA Guidelines however include identification and assessment of alternatives under IEE (page 12 of EIA Guidelines for Industrial Projects). In the preparation of EIA, alternatives (site/routes/process/raw materials) are looked at as part of the mitigation measures (page 28 of EIA	Examination of financially and technically feasible alternatives to the project location, design, technology and components, their potential environmental and social impacts Documentation of the rationale for selecting a particular alternative(s) proposed, where relevant

Aspect of Operational Framework	IFC (World Bank Group)	ADB	Equator Principles	GOB	Harmonized Policy Framework
	full and detailed justification for the levels and approaches chosen for the particular project or site			Guidelines for Industrial Projects)	
Standards	The Pollution Prevention and Abatement Handbook describes pollution prevention and abatement measures and emission levels	Apply pollution prevention and control technologies and practices consistent with international good practice, as reflected in internationally recognized standards such as the World Bank Group's Environmental, Health and Safety (EHS) Guidelines. Adopt cleaner production processes, and good practices of energy efficiency. Avoid or, when avoidance is not feasible, minimize or control the intensity or load of pollutants emissions and discharges, including direct and indirect greenhouse gases emissions, waste generation, and release of hazardous material from their production, transportation, handling and storage. Avoid the use of hazardous materials subject to international bans or phase-outs. Use, purchase and manage	Projects must comply with laws, ordinances and standards relating to E&S considerations established by the governments that have jurisdiction over the project site (including both national and local governments). It also refers to international standards, treaties and declarations and good practices. When it recognizes that laws and regulations regarding E&S of host countries are substantially inferior to these standards and good practices, it encourages the recipient governments to take more appropriate considerations through a series of dialogues, and confirms background and justification for that.	GOB has issued emission as well as ambient standards under ECA and ECR. These standards are in general at par with the international standards and in some cases even stricter. The workspace or occupational standards are directed under the Factories Act. DOE has updated their air quality (only ambient air quality) standards and set some new standards for motor vehicles emission on July 2005 by a GOB Gazette notification.	Achieve environmental standards that are stricter (either GOB's or international), and justify deviations in the EA report when alternatives to the standards for the project or site are selected.

Aspect of Operational Framework	IFC (World Bank Group)	ADB	Equator Principles	GOB	Harmonized Policy Framework
		pesticides based on integrated pest management approaches and reduce reliance on synthetic chemical pesticides			
EMP	EMP consists of the set of mitigation, monitoring, and institutional measures to be taken during implementation and operation to eliminate adverse environmental and social impacts, offset them, or reduce them to acceptable levels Preparation of Management Plan includes identification of responses to potentially adverse impacts; determining requirements for ensuring that those responses are made effectively and in a timely manner; describing the means for meeting those requirements EMP includes the following components Mitigation Monitoring Capacity Development and Training implementation Schedule and Cost Estimates	Preparation of an environmental management plan (EMP) or equivalent planning document(s) that includes the proposed mitigation measures, environmental monitoring and reporting requirements, related institutional or organizational arrangements, capacity development and training measures, implementation schedule, cost estimates and performance indicators. Key considerations for EMP preparation include mitigation of potential adverse impacts to the level of no significant harm to third parties, and the polluter pays principle. EMP also provide for workers - safe and healthy working conditions, and prevent accidents, injury, and disease Establish preventive and emergency preparedness and response measures to avoid,	Principle 4: Action Plan and Management System. Based on the Environmental Assessment, Equator Banks will make agreements with their clients on how they mitigate, monitor and manage risks through a ‗Social Environment Management Plan'.	DOE requires Environmental Management Plan (EMP) as an outcome of EIA. Under the guidelines, DOE prescribes conduct of special studies as relevant. These studies include aspects such as Risk analyses (when there is storage and handling of hazardous and toxic substances), Resettlement and Rehabilitation (when more than 1000 people are displaced), Compensatory Afforestation (when deforestation involves more than 5 ha area), Severance etc. Prevention and recycling are to be followed as the first options. (Pages 29 and 30 of EIA Guidelines for Industrial Projects) In addition to this EMP must be supplied with the work plan, implementation schedule and monitoring requirements (Page 31 of EIA Guidelines for Industries) monitoring plan and project	EMP consists of the set of mitigation, monitoring, and institutional measures to be taken during implementation and operation to eliminate adverse environmental and social impacts, offset them, or reduce them to acceptable levels Preparation of Management Plan includes identification of responses to potentially adverse impacts; determining requirements for ensuring that those responses are made effectively and in a timely manner; describing the means for meeting those requirements EMP includes the following components Mitigation

Aspect of Operational Framework	IFC (World Bank Group)	ADB	Equator Principles	GOB	Harmonized Policy Framework
		minimize the adverse impacts and risks to the health and safety of the local communities		scheduling.	Monitoring Capacity Development and Training implementation Schedule and Cost Estimates EMP also provide for workers - safe and healthy working conditions, and prevent accidents, injury, and disease Establish preventive and emergency preparedness and response measures to avoid, minimize the adverse impacts and risks to the health and safety of the local communities For the proposed Summit Bibiyana 1 &II Power Company Limited Project, EMP should be presented for pre-construction, construction and operational phases. It should include construction safety and emergency preparedness plan to address gas leaks/explosion as well as spills due to accidents on the project site.

Aspect of Operational Framework	IFC (World Bank Group)	ADB	Equator Principles	GOB	Harmonized Policy Framework
					EMP should not just address mitigative measures but enhancement measures as well e.g. green belt development plan, etc. EMP should also address regional level planning and policy issues considering cumulative impacts of the associated components (especially the air emissions), too.
Consultation	For all Category A and B projects proposed for IBRD or IDA financing, during the EA process, the borrower consults project-affected groups and local nongovernmental organizations (NGOs) about the project's environmental aspects and takes their views into account The borrower initiates such consultations as early as possible For Category A projects, the borrower consults these groups at least twice: (a) shortly after environmental screening and before the terms of reference for the EA are finalized (b)	Carry out meaningful consultation with affected people and facilitate their informed participation Ensuring women's participation in consultation Involving stakeholders, project-affected people and concerned NGOs early in the project preparation and ensure that their views and concerns are made known and understood by decision makers and taken into account For category-A projects, ADB ensures that the borrower or private sector sponsor carries out public consultation at least twice: (a) once during the early	Principle 5: Consultation and Disclosure. Provides for the borrower to consult with stakeholders (NGOs and PAPs) and provide them with information on risks of the project..	The EIA Guidelines of DOE states that a Not technical Summary should be prepared for the purpose of communication to public (Page 32 of EIA Guidelines for Industries). Section 4.11 of the Guidelines encourages Public Participation in EIA. However as per ECA (1995) or ECR (1997), public consultation and participation is not mandatory. No records are asked. No time-frames are however fixed for prior disclosure of EIA to the public. No Grievance mechanism	Free, prior and informed consultation with affected people and informed participation as early as possible and throughout the project implementation. Disclosure in local language with understandable content during public consultation. Ensure community engagement free of external manipulation, interference, or coercion, and intimidation, and conducted on the basis of timely, relevant, understandable and

Aspect of Operational Framework	IFC (World Bank Group)	ADB	Equator Principles	GOB	Harmonized Policy Framework
	once a draft EA report is prepared In addition, the borrower consults with such groups throughout project implementation as necessary to address EA-related issues that affect them The borrower provides relevant material in a timely manner prior to consultation and in a form and language that are understandable and accessible to the groups being consulted For the initial consultation a summary of the proposed project's objectives, description, and potential impacts is provided by the borrower For consultation after the draft EA report is prepared, the borrower provides a summary of the EA's conclusions In addition, the borrower makes the draft EA report available at a public place accessible to project-affected groups and local NGOs	stages of EIA field work; and (b) once when the draft EIA report is available, and before loan appraisal by ADB. Continue consultations with stakeholders throughout project implementation as necessary to address environmental assessment-related issues. Establishment of a grievance mechanism to receive and facilitate resolution of the affected people‘s concerns and grievances regarding the project‘s environmental performance Disclosure of draft environmental assessments (including EMP) before project appraisal, in a form, manner and language(s) accessible to affected people and other stakeholders		facility is mentioned in the regulations The DOE makes the minutes of the meetings on Environmental Clearance available at its website (http://www.doe-bd.org/minutes.php)	accessible information. Establish a grievance mechanism to receive and facilitate resolution of the affected communities‘ concerns and grievances about the borrower‘s environmental performance.
Independent Review	The borrower is responsible for carrying out the EA For Category A projects, the borrower retains independent	The borrower use qualified and experienced expert(s) in the preparation of EA and management plan.	Principle 7: Provides for assessment, assessment plan and consultation process.		

Aspect of Operational Framework	IFC (World Bank Group)	ADB	Equator Principles	GOB	Harmonized Policy Framework
	EA experts not affiliated with the project to carry out the EA. For Category A projects that are highly risky or contentious or that involve serious and multidimensional environmental concerns, the borrower should normally also engage an advisory panel of independent, internationally recognized environmental specialists to advise on all aspects of the project relevant to the EA	For highly complex and sensitive projects, independent advisory panels during preparation and implementation of projects are used.			
Monitoring and Disclosure	The borrower reports on compliance with measures agreed with the Bank on the basis of the findings and results of the EA, including implementation of any EMP, as set out in the project documents; status of mitigatory measures; and findings of monitoring programs	Monitoring the effectiveness of EMP implementation Documentation of monitoring results, including development and implementation of corrective actions Disclosure of periodic progress reports	Principle 9: Provides for independent monitoring and reporting of the project over the project life.	EIA Guidelines for Industrial Projects recommend preparation of a Post-Project Monitoring Programme. This programme is to be included in the EIA report and on review gets reflected as a condition in granting ECC. There is a process of renewable of ECC that requires monitoring and assessment. DOE has the responsibility of follow up and monitoring of ECC conditions. DOE makes the proponent compliance reports available on its	Compliance with measures agreed with the Bank on the basis of the findings and results of the EA, including implementation of any EMP, as set out in the project documents; Status of mitigatory measures; and findings of monitoring programs Monitoring the effectiveness of EMP implementation Documentation of monitoring results, including development and implementation of corrective actions

Aspect of Operational Framework	IFC (World Bank Group)	ADB	Equator Principles	GOB	Harmonized Policy Framework
				website to the public There are no formal provisions to obtain independent assessment of EIA report if found necessary. There is also no formal mechanism or a programme at DOE that conducts independent audit of approved projects. Third party monitoring is recommended through approved laboratories. GOB passed The Environment Court Act, 2000 (Act No. 11 of 2000) to allow making of appeals from public on non-compliance with the ECA (1995) and ECR (1977).	Disclosure of periodic progress reports

CHAPTER IV
DESCRIPTION OF THE PROPOSED PROJECT

4.1 Description of the Technology to be employed

SBPCL I & II Project envisages employing multi-shaft combined cycle technology based on two gas turbine generator units and one steam turbine generator unit, each having a separate power connection to the grid.

4.1.1 Combined Cycle Gas Turbine (CCGT) Technology:

As informed by SBPCL I & II, the type of gas turbine suitable for the Project could be:

(i) sound and have a successful track record for use in an environment typical of the project area;
(ii) capable of meeting the international standards, specifically those of the European Union (EU) with 75 milligrams (mg) per m^3 for NO emissions; and
(iii) capable of reducing the consumption of natural gas to a significant extent compared to that in other technologies available for power generation. In addition, the turbine supplier needs to be capable of offering a long-term spare parts and services agreement for their turbines. The Combined Cycle Gas Turbine (CCGT) technology which is being considered to be adopted for the Summit Bibiyana 1 & II Power Plant Project, would be capable of meeting the above three requirements. A simplified schematic of a typical CCGT unit appears in Figure-4.1 below.

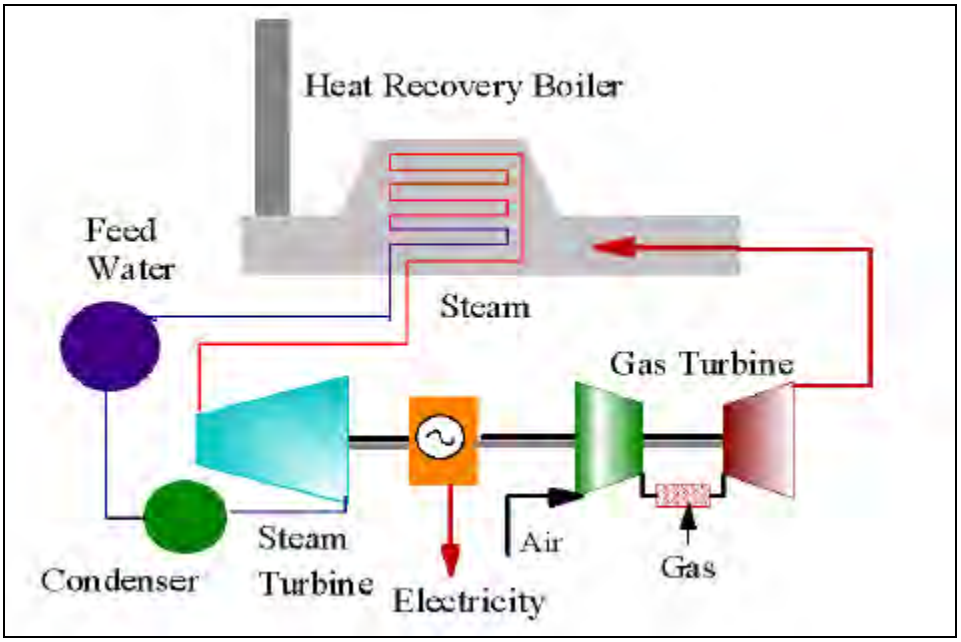


Figure-4.1: Simplified schematic of a typical CCGT unit

The turbine could basically consist of an input air system, a compressor, a combustion chamber, turbines, an exhaust system, an auxiliary (backup) system, a control system, and others auxiliaries. In such a turbine system, air enters the compressor through input air filters and sound attenuators and enters the combustion chamber from the compressor after getting mixed with fuel. Such a mix of fuel and compressed air undergoes combustion producing high pressure and temperature, and then the gas undergoes expansion in the turbine, releasing energy. After

expansion, the exhaust can enter the recovery boiler or be released into the atmosphere through the exhaust system. Tables 4.1 and 4.2 summarize respectively, the expected gas turbine functional specifications and the gas turbine main design parateters.

Table 4.1: Expected Gas Turbine Functional Specifications

Parameter	Detail
Contracted facility dependable capacity	341MW net electrical capacity of the facility at Reference Site Conditions (specified below), without auxiliary firing and with apower factor at the high voltage side of the main step-up transformer of 0.85 lagging, 0.95 leading at a frequency of 50 hertz.
Contracted simple cycle dependable capacity	222 MW net electrical capacity of the facility at Reference Site Conditions (specified below), with a power factor at the high voltage side of the main step-up transformer of 0.85 lagging, 0.95 leading at a frequency of 50 hertz.
Reference site conditions	
Ambient air temperature, °C	32
Relative humidity	85%
River cooling water temperature, ^{o}C	28.5
Barometric pressure, bar	1.013
Design conditions for the facility	
Ambient air temperature range, ^{o}C	7 to 42
Relative humidity range	40% to 100%
River cooling water temperature range, ^{o}C	18 to 32
Minimal gas pressure, bar	24.0
Maximum wind speed, km/h	200
Seismic zone: per Bangladesh Building Code, 1976	Zone III
Basic Seismic coefficient	0.25g
Gas turbine nominal capacity of electric power, MW	124.6
Gas turbine gross efficiency %	33.46%
NO_X, (NO_2)	51.3
CO, mg/m^{3}n	18.8
C = Celsius, MW = megawatt, NO_X = nitrogen oxide, NO_2 = Nitrogen dioxide, CO = carbon oxide, mg = milligram per cubic meter.	

Source: SBPCL

In operating conditions the main parameters could be as under:

Table 4.2: Gas Turbine Main Design Parameters

Construction of Turbines	Standard	Standard	Standard	By Warming and Airing
Fuel	Gas	Diesel	Black oil	Gas
Output power	126,100 kW	123,300 kW	115,300 kW	125,400 kW

Construction of Turbines	Standard	Standard	Standard	By Warming and Airing
Fuel consumption	10,650 kJ/kWh	10,730 kJ/kWh	10,960 kJ/kWh	10,700 kJ/kWh
Heat	1,343 × 106 kJ	1,326 × 10^6 kJ	1,263.7 × 10^6 kJ	1,341.8 × 10^6 kJ
Exhaust gas temperature	543°C	543°C	520°C	543°C
Gas leakage	1,505 × 10^3 kg/s	1,509 × 10^3 kg/s	1,508,6 × 10^3 kg/s	1,504 × 10^3 kg/s
Turning speed cycle/minute	3,000	3,000	3,000	3,000
C = Celsius, kg = kilogram, kJ = kilo Joule, kW = kilowatt, kWh = kilowatt-hour, s = second				

Source: BCAS.

4.1.2 Guaranteed Unit Performance of Power Plant on Natural Gas Fuel

Guaranteen unit performance of the proposed Bibiyana I & II Power Plants is as under (Table-4.3):

Table-4.3: Guaranteed Unit Performance on Natural Gas Fuel

Measurement	Value
Net output (base)	228692KW
Net heat rate (base)	9953kJ/kWh
Exhaust energy (base)	1408.5GJ/h
Exhaust temperature (base) (+/- 6 ^oC)	618 ^oC

The unit performance guarantees listed above are based on the scope of equipment supply as defined in the proposal and as stated for the following operating conditions and parameters (Table-4.4):

Table-4.4: Basis for Unit Performance Guarantee

Measurement	Value
Elevation	10m
Ambient pressure	1013mbar
Ambient temperature	32 ^oC
Ambient relative humidity	85%
Inlet system pressure drop	76.2mm H_2O
Exhaust system pressure re. ISO	381mm H_2O
Natural gas fuel heating value (LHV)	49,278kJ/kg
Combustion system type	Dry Low NO_x
Turbine shaft speed	3000 rpm
Generator terminal power factor	0.80 Lagging

4.1.3 Heat Recovery Steam Generator :

The unfired heat recovery steam generator (HRSG) will be either horizontal or vertical design, with natural circulation, and will be operated at sliding pressure rather then constant pressure.

Vibrations caused by the flue gas flow in the structures will be prevented by suitable construction

The HRSG will be capable for the operation on continuous partial and base load and the design will assure that the following requirements are met:

(i) Low thermal inertia to allow a fast start-up,
(ii) High resistance to thermal shocks,
(iii) The design provided will meet the specified noise limits,
(iv) The height of the HRSG flue gas stack will be sufficient to meet all applicable environmental regulations,
(v) The flue gas stack will be equipped with emission monitoring connections, aviation lights, ladders, and service platforms.
(vi) The HRSG will be equipped with a flue gas damper[1] located between the HRSG and the flue gas stack to keep the HRSG warm during shutdown.
(vii) A noise silencer will be provided to reduce noise to the required level.

The HRSG construction may be of ―outdoor or semi-outdoor" INSTALLATION TYPE. However, local circumstances will be taken into account when designing dust, noise, and weather protections; in particular, icing conditions when the turbine is not operating will be considered by the contractor. The façade of the HRSG house will fulfill the requirements of local authorities. The key components and equipment, and main gateways and stairs around the HRSG will be protected from any adverse weather conditions, including freezing and rain.

4.1.4 Steam Turbine Unit:

The Project will include steam turbine generator units. The steam turbines will be capable of operating in both fixed and sliding-pressure modes, and in a modified sliding-pressure mode.

During normal operation the steam turbine operates without throttling the main steam flow (sliding-pressure mode).

Overloading requirements specified in International Electro-technical Commission standard (IEC) 60045 will be taken into account.

4.1.5 Configuration of the Project:

A combined-cycle facility could consist of four main components: control, auxiliary components, gas turbine, and generator. The plant can work both in open and in locked configuration. A gas turbine could function in simple cycle, in combined cycle or in both cycles. In simple cycle, high-temperature exhaust gases are released directly into the atmosphere, while in combined cycle exhaust gases enter the recovery boiler for production of steam. The steam then enters the steam turbine for production of electric energy and/or for co-generation.

Combined steam-gas cycle has some advantages:
(i) Energy generation is clean—i.e. it's the most acceptable technology from an ecological standpoint.
(ii) High efficiency factor, more than 50%.
(iii) Minimal land requirement.
(iv) Minimal water requirements.
(v) Fast operations: The station starts and shuts downs quickly, so it is possible to operate the facility both for base and peak load.

[1] Dampers are used to control the flow of air.

(vi) Facility construction time is short; accordingly, less time is required to repay the investment.
(vii) High level of automation and smaller number of staff required.
(viii) A wide range of fuels can be used, including natural gas, diesel oil, and fuel oil.

4.1.6 Process Flow Diagram:

A generic process flow diagram of the proposed project with the above configuration is as under (Figure-4.2).

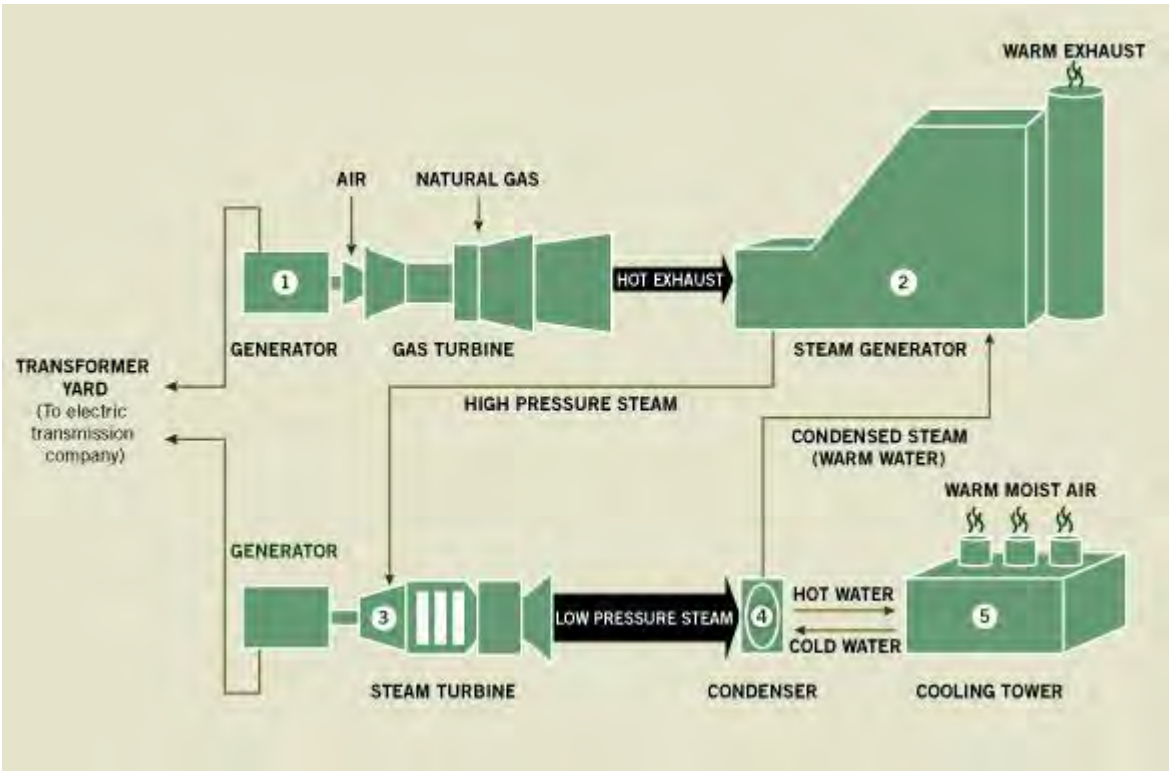


Figure-4.2: Typical Process Flow Diagram for proposed Summit Bibiyana I & II Power Project

4.1.7 Combined-Cycle Power Plant Cooling Water System:

The proposed SBPCL I & II Project Project will extract its cooling water from the Kushiara River.

(a) Direct Cooling Water System: It is anticipated that a direct cooling water system with the following characteristics will be used for the Project.

(i) Cooling water is taken from the Kushiara River;
(ii) Water surface level: 19.42 meters (m) +/–0.5m;
(iii) Condenser top level: 1m;
(iv) Ground level of the power plant: 17m – 18m (Mean Sea Level);
(v) River water temperature: >25°C;
(vi) Cooling water temperature in the condenser: 25°C.

4.1.8 Simple Parameters of the Saturated Steam Cycle:

Selection of main parameters depends on the main standards of the supplier‘s equipment available for the Project.

(a) High and Low Pressure Steam System:

The system design using both high and low pressure allows the steam generator and steam turbine to function without any limitations under full load.

(b) Feed water System and Main Condensate System:

The feed water pumps will be designed according to the boiler code. The Project will be used as base-load to the grid thus it will be possible to use the main condensate pumps and feed water pumps with constant speed.

- The capacity of the feed water tank will be sufficient to provide error-free operation.
- Performance of steam generator installation is provided even if the quantity of returning condensate and make-up water (feed water) changes.
- The plant will be supplied with a condensate filter.

(c) Auxiliary Boiler and Auxiliary Steam Supply System:

The auxiliary boiler will be of standard type and will be completely automated. The boiler will be controlled from the control room.

(d) Feed water Treatment System:

The facility for treatment of feed water will consist of, but not be limited to the following systems and equipment: (i) raw-water pumps, (ii) demineralization lines, (iii) raw-water tanks, and (iv) feed water pumps.

(e) Tests for Water and Steam Cycle:

Samples will be taken from different plants of the system and tested to control the water and steam circulating system. Continuous and periodic sampling will be performed and tested in the laboratory. Samples in the cooling chamber must be kept in a building near the laboratory.

(f) Chemical Dosimeters System:

- The main function of the chemical dosimeters system is to maintain the power station‘s water chemistry mode to standard levels.
- The Project will use chemicals that are economical, and safe. Fully automatic measuring system will be used to monitor levels. The use of hydrazine will be forbidden.

(g) Treatment and Discharge of Wastewater:

- The power station design will minimize the quantity of consumables and wastewater. Waste water from the water treatment facility will be mixed separately and neutralized to pH 6–9. The sewage pond will be protected against overeating. Sewage effluent quality will be monitored against Government standards.

4.1.9 Generators and Systems for Power Output:

(a) Generator Facilities:

- The Project will be based on two gas turbine generators, two steam generators and one steam turbine generator. Each generator‘s output is about 341MW.

- Each generator will have an air-conditioning system and an air-water cooling system.

4.1.10 Control of Gas Turbine Generators, Steam Turbine Generators, and Electrical System:

The control of gas and steam turbine generators and plant electrical systems will be performed by the automation system of the plant via its digital control system (DCS), i.e., the man-machine interface will be through the monitors and keyboards of the DCS in the control room of the plant. Each of the transmission line switchgears will have separate control systems with monitors in the control room. These control systems will be linked to the DCS for information exchange.

- The daily control of the electrical system during normal operation concern mainly generator plants operations, like synchronizing and adjusting the reactive output and voltage.

4.2 Technological Specification

The proposed power plant will consist of two combined-cycle gas turbine power generation plants each with an individual gross capacity of 341MW and a combined gross capacity of 682MW (341MW × 2) of power generation. The plants will run on natural gas from Bibiyana gas field situated at about 7 kms from the site. Several various configuration options are available to produce the output mentioned above. The option suggested to the consultant is

Stack Height:	50 meters
Effective Stack Height:	50 meters
Stack diameter	3 meters
Exit gas velocity:	not less than 15 m/sec.
Fuel consumption per unit power production	8042 BTU/kWh
Mass of pollutant emission per unit power production:	0.697 g/kWh
Mass of pollutant emission per unit time:	87 g/sec NOx
Emission control system used if any:	Low NOx burners (<25 ppm)

The plant will be built on the southern Bank of river Kushiyara and, as such, the availability could be ascertained of fresh water to the proposed site. Water for all cooling purposes will be drawn from this river and will be discharged (after being brought to or nearest to river temperature) to the Kushiyara River at a point downstream to the intake point.

As detailed in Chapter 1, the proposed plant will play a significant role in addressing the present shortfalls in electricity requirements in Bangladesh. The extent of load shedding has reached such a stage that build up of additional capacity has became a matter of urgent necessity.

4.3 Basis of Operation:

The combined cycle power plant process is recognized as being the most environmentally benign system of power generation from fossil fuels. Such a system utilizes the following process.

Step 1: Air is drawn into a compressor and, thereafter, is fed to a gas turbine.

Step 2: The compressed air is mixed with natural gas (fossil fuel) in the combustion chamber and subjected to ignition.

Step 3: The hot gas produced is passed through a gas turbine and, as it expands, causes the turbine to rotate at high speed.

Step 4: The rotating turbine is coupled to an electrical Generator, which as it spins produces electricity.

Step 5: The hot gases from the gas turbine are directed to a heat recovery steam generator (HRSG) where high pressure steam is produced.

Step 6: The high pressure steam is passed through a steam turbine and as it expands causes the turbine to rotate at high speed.

Step 7: The rotating turbine is again coupled to an electrical generator which, as it spins, produces electricity.

Step 8: The spent steam is condensed to water in a condenser at the end of the turbine and recycled to the heat recovery steam generator (HRSG).

Step 9: The waste gases from the heat recovery steam generator (HRSG) are discharged through a chimney in to the air.

Step 10: The electricity generated is fed to a electrical transformers where the voltage is adjusted to allow the transmission to the national grid.

Water from river will be used in a closed cicuit system to condense the exhaust steam from the steam turbine. The steam is condensed to hot water which is then reused in the HRSG. Water cooling is the most energy efficient method of cooling available. Moreover, as has been said earlier elsewhere, the closed circuit cooling water use will not necessitate release used cooling water to the river.

The plant will operate continuously 24 hours per day, 365 days per year (except down time maintenance). The plant will operate on natural gas but will also be capable of operating on Furnace oil in case of interruption in the gas supply.

The contract to supply and construct this plant will be open to international competition. The exact plant output and layout can not be specified at this stage without prejudice or favour to a particular manufacturer.

4.4 Kind of Emissions and Effluents

Emission due to the two combined cycle power plants will comprise particulates and oxides of nitrogen. Effluent will be only water after passing through a series of systems of water use.

4.5 Consideration of Alternatives

4.5.1 Technology Options:

Current technology options for large scale generation of base load electricity in Bangladesh are limited to thermal plants utilizing fossil fuels and a large scale hydro-electrical scheme at Kaptai. The potential for large scale hydro-electrical generation has already been exhausted. Although nuclear and solar options as source of electricity are being explored, the country does not have the expertise and infrastructure for large scale generation.

Renewable energy currently attracts significant political and media attention. However, outside of large scale hydro, the power generation of which has already reached its limiting value in respect of meeting the ever-expanding power deficit in the country, it remains a niche area that does not have the capacity to provide the power delivery at the scale and reliability in view of the existing power deficit scenario. Other renewable energy sources, e.g., biomass production and wind output would still be unable to produce and supply sufficient quanta of power toward meeting the existing enormous demand. Even in countries with a high wind output, the power delivery of a wind turbine over a year rarely exceeds 30%.

Within the scope of fossil fuelled thermal power plant technologies, the considered options have been:

- Coal fired thermal plant.
- Oil or gas fired steam turbine.
- Oil or gas fired open cycle gas turbine.
- Combined Cycle Gas Turbine (CCGT).

Coal fired technology could not be thought of as being a pragmatic option for the proposed project in view of reasons of emission qualities and flue gas cleaning as well as ash disposal aspects in comparison with the power generation process involving gas fired one.

Oil fired technology is less favoured than gas-fired one as the former leads to higher emissions of particulates, nitrogen oxides, sulphur dioxide and carbon dioxide. However, the technology preferred for the proposed project involves oil to be used only as a back-up fuel. Steam turbine plants, such as the existing thermal blocks built in the 1960s, are only competitive economically when there is a user for the waste heat, such as a very large district heating system.

Open cycle plants are considerably less efficient than closed cycle plants, typically 40 to 45% efficient as opposed to 52 to 57% efficiency. This is reflected in their higher operating cost which is related to increased fuel consumption, e.g. typical costs (i) open cycle gas turbine $0.062 per kWh; (ii) CCGT $0.044 per kWh and (iii) coal, pulverized fuel (most economic

option) $0.05 per kWh. Thus, the option of CCGT technology is clearly ahead other three of the four options considered above as it consumes significantly lesser quantum of natural gas in power generation process.

A comparative study (Figure 4.3) on emissions of greenhouse gases (GHGs) from various fuel sources reveal that GHG emission from a power plant with combined cycle gas turbine (CCGT) system is significantly lower than that from coal-fired, oil and gas fired steam turbine steam turbine, and oil and gas fired open cycle gas turbine systems which will enable the project to be included in the CDM mechanism of the United Nations Framework Convention on Climate Change (UNFCCC).

Based on the above points vis-à-vis (i) type of energy to be utilized for electricity generation, (ii) type of fossil fuel-fired technologies in respect of competitive edge among them, (iii) relative consumption of fuels and (iv) climate-friendly emissions (GHG emissions), the selection of CCGT technology for the Summit Bibiyana 1 & 2 Power Plant Project appears justifiable

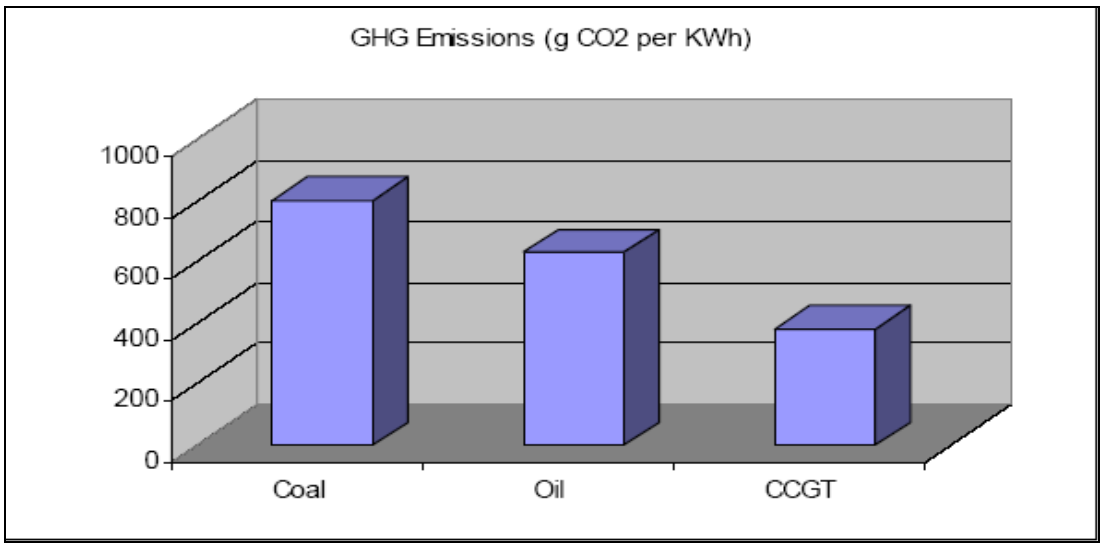


Figure-4.3: Comparison of Green House Gas (GHG) emissions from various power generation options.

4.5.2 Design Option:

CCGT technology is well established and of remarkable performance the world over. Cooling systems for such power plants are designed according to the local conditions. The lower the temperature that can be obtained in the cooling system, the greater is the resulting efficiency of the power plant. This is best realized when requisite quantity (initially a maximum of 60,000m^3 to the system) of cold water, e.g., that of the nearby river Kushiyara, and can be used for once through cooling and, thereafter, 10,000m^3/h as mark-up. A cooling circuit can also be used in which the cooling water is circulated from the plant through a cooling unit and then at the resulting lower temperature back to the power plant again.

4.5.3 Zero Option (the "No-Go Alternative"):

The "Zero Option" means that the Summit Bibiyana I & II Power Company Limited decides not to construct any power plant at the Bibiyana site or, to be more precise, abandons the

construction that is already underway. As the existing power situation has already entered into an alarmingly deficit state with adverse impact on undertaking industrial entrepreneurship and other socio-economic sectors, the proposed power plant project assumes considerable significance. Hence, dropping of such a project will further deteriorate the situation. The consequences of an undersupply would harm the sustainability of the already existing industrial production in the country as well as impact upon the quality of life of those affected by the power outages. Furthermore, under the zero option, the considerable advantages with the current site vis-à-vis construction of the power plant and power generation and, through it, creation of employment facilities in the proposed project area would be lost.

4.5.4 Consideration of Site Location and Related Other Facts:

Based on the above consideration of technology and design options, following facts had been taken into consideration during selection of the project site and exploring alternatives to it:

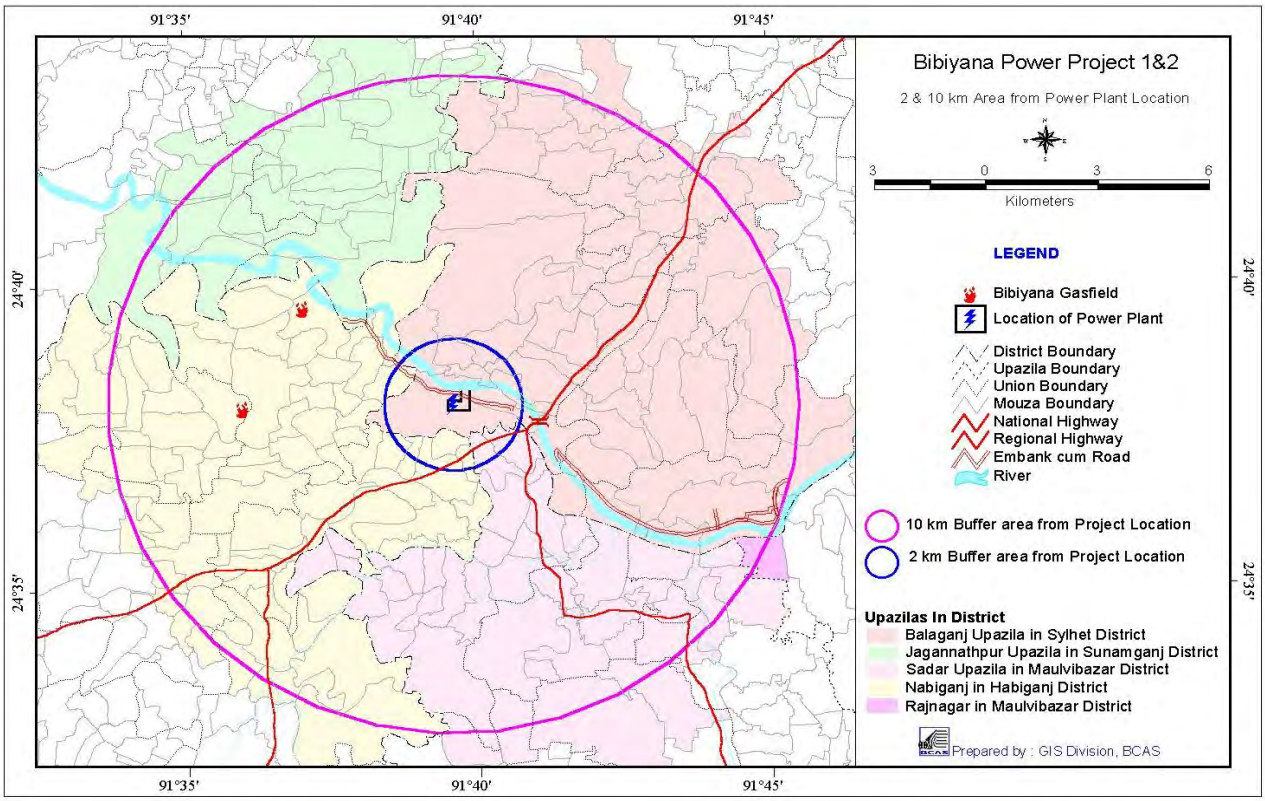
i) The country is flat having relatively limited potential for hydroelectricity.
ii) No active geothermal site has been found.
iii) The country has about 1700 million tones of bituminous coal, most of which lie buried at depth of over 900 meters thus making extraction relatively expensive. However, coal from low-lying structure (Barapukuria) is being dug out for power generation. Coal is environmentally less friendly as it gives high emission of carbon dioxide and leads to acid rain because of high sulphur content.
iv) No oil field worth the name has yet been discovered.
v) But the country has a sizable deposit of natural gas. The composition of Bibiyana gas is given in Appendix 11. This gas will generate very low quantities of particulates and, with a suitable burner, significantly low volumes of oxides of nitrogen.
vi) The proximity of the Bibiyana gas field (about 7 kms) offers a big advantage in that the cost of pipe-laying will not be significant.
vii) As shown in subsequent chapters, environmental pollution during the period of construction and also during the period of operation will be mostly insignificant.
viii) The proposed site is less than a kilometer from the river Kushiara. The project activity during the construction phase will involve safe transportation of heavy equipment, e.g., cooling towers, steam generators, etc., through river routes to the proposed site. As such, the proposed site is the only feasible way for such transportation. In addition, river transportation will be cheaper.
ix) Availability of large volumes of cooling water required to be withdrawn from the river Kushiara will be yet another advantage of the proposed site in view of the proximity of the source (i.e., the river Kushiara) at less than 1km and cost effectiveness.

In consideration of the above facts, the proposed plant option with the site looks ideal.

Photo-4.1: Boundary of the power plant project

4.6 The Project Airshed

A buffer area with 2km radii and with 10km radii airshed as well as project command area of the project location has been taken into consideration. Administratively, the airshed spreads over 225 Mouzas of 20 Unions under five Upazilas of four districts (shown in Map 4.2 below). Name of districts, Upazilas, unions and Mouzas under the project airshed are shown in the Table -4.5.



Map – 4.2: Buffer zone within 2km and 10km Project Airshed and Command Area radii

Table -4.5: Name of Districts, Upazilas and Unions, and Mouzas in the Project Airshed.

District	Upazila	Union	Number of Mouzas
Sylhet	Balaganj	Burunga	5
		Goula Bazar	11
		Omarpur	11
		Sadipur	21
		Paschim Pailanpur	14
		Purbo Pailanpur	5
Sunamganj	Jagannatpur	Asharkandi	32
		Paligaon	8
Habiganj	Nabiganj	Digholbak	24
		Auskandi	22
		Inathganj	16
		Devpara	8
		Kargaon	1
		Kurshi	9
Maulvibazar	Maulvibazar Sadar	Khalilpur	20
		Manumukh	8
		Upper Kagabala	2
		Akhailkura	7
		Kamalpur	2
	Rajnagar	Fatehpur	1
Estimated total number of villages within the SBPP airshed			**225**

CHAPTER- V
BASELINE ENVIRONMENTAL CONDITIONS

A. Physical Environment

5.1 Climate: The project area has a pronounced tropical monsoon climate. There are three main seasons: the monsoon (or rain) season from May to October during which about 90% of the total annual rainfall is received; the dry season (or winter) from November to February which has the lowest temperature and humidity of the year and the pre-monsoon (or hot) season from March to April.

(a) Temperature: Mean monthly temperatures vary from about 6.5°C. in January to 35.8°C. in April. The mean annual temperature is about 25°C

(b) Rainfall: About 92% of the annual rainfall occurs in the seven months from April to October in the project area. Within the surrounding areas of the project site in the Kushiyara valley and neighboring hills, the rainfall is very high. At Srimangal (37 kilometers south-east of SBPCL I & II), the average annual rainfall is 242 cm. and at Sylhet (35 kilometers north-east of the SBPCL I&II site) the rainfall average is 418 cm. and near the foot at the abrupt Meghalaya plateau at Sunamganj it is 533 cm. (Cherapunji, barely 16 kilometers across the border in straight line to the north of Chhatak, records an astonishing average of 1082 cm. annually).

(c) Humidity: Mean monthly relative humidity ranges from 77% in the dry season (November to February) to about 84% in the rainy season (June to October). In the area, fog is very common in winter and also it is the cloudiest part of Bangladesh

Section- 1: Air Quality Measurement and its Dispersion Modeling

5.2 Air Quality: Air quality at the project-site is typical of a rural environment. Ambient concentrations of air pollutants are seemingly very low to practically non-existent. SPM increases intermittently in some areas when winds pick up dust over unpaved roads and exposed surfaces. Sources of emissions, however, have been the vehicles plying along the Dhaka-Sylhet National Highway, N2 running along the south and western direction from the project site.

Recent survey of the existing ambient air quality of the project area and its surroundings reveal that various pollutants could be detected with their respective concentrations well below the standards applicable to industrial/mixed areas as specified in the Environment Conservation Rules, 1997 (Table-5.1).

Table-5.1: Test Results of Existing State of Ambient Air Quality in the Project Area

24 samples have been collected from the Summit Bibiyana 1&II Power Company LimitedProject Sites during March 2011 to May 2011 and each sample takes time 24 hours. Details are given bellow:

5.1 Description of Analysis

Date of sample collection	Location	Ambient Air Pollutants Concentration in µg/m3				
		PM_{10}	SPM	SO_2	NO_x	CO
March 2011	Power plant site	102.13	144.28	4.01	9.74	ND

Date of sample collection	Location	Ambient Air Pollutants Concentration in µg/m3				
		PM_{10}	SPM	SO_2	NO_x	CO
March 2011	Power plant site	104.14	149.22	3.28	10.65	ND
March 2011	Power plant site	106.37	157.42	2.69	10.54	ND
March 2011	Power plant site	104.24	149.21	4.36	9.95	ND
March 2011	Power plant site	94.51	146.45	3.18	7.08	ND
March 2011	Power plant site	92.29	146..5	3.80	8.24	ND
March 2011	Power plant site	112.74	156.32	3.43	13.47	ND
March 2011	Power plant site	124.77	169.85	4.08	15.01	ND
April 2011	Power plant site	156.93	201.52	4.03	10.05	ND
April 2011	Power plant site	122.84	179.32	3.75	14.20	ND
April 2011	Power plant site	82.54	126.13	4.33	9.11	ND
April 2011	Power plant site	96.47	142.41	3.83	9.72	ND
April 2011	Power plant site	101.22	146.73	3.77	8.84	ND
April 2011	Power plant site	104.30	150.44	4.16	10.66	ND
April 2011	Power plant site	98.72	139.60	3.48	10.38	ND
April 2011	Power plant site	48.00	68.85	0.66	2.53	ND
May 2011	Power plant site	78.72	135.69	0.72	2.75	ND
May 2011	Power plant site	89.98	137.60	1.07	7.88	ND
May 2011	Power plant site	66.93	132.71	4.65	8.22	ND
May 2011	Power plant site	58.84	88.04	4.44	7.51	ND
May 2011	Power plant site	72.49	101.68	4.10	15.01	ND
May 2011	Power plant site	63.35	108.2	2.98	11.08	ND
May 2011	Power plant site	42.00	85.56	2.99	11.08	ND
May 2011	Power plant site	46.67	88.73	2.80	10.01	ND
DoE (Bangladesh)Standard for Industrial and Mixed Zone		**150**	**200**	**120**	**100**	**10000**
WB Standard		**150-230**	**500**	**20**	**150**	**10000**
Method of Analysis		**Gravimentric**	**Gravimetric**	**West-Geake**	**Jacob& Hochheiser**	**CO Meter**

Source: BCAS Survey, March, 2011.

Legends:

1. PM_{10} - Respirable Dust Content <10µm
2. SPM - Suspended Particulate mateer
3. NO_x - Oxides of Nitrogen
4. SO_2 -Sulphur Di-oxide
5. CO - Carbon Monoxide
6. ND -Not Detected

5.3 Air Dispersion Modelling

5.3.1 Introduction

ISC3P model is an improved version of the ISCST3 model of the EPA (USA) containing two special features of the Plume Rise Enhancement Model (PRIME). The two features are-

1. Enhanced plume dispersion coefficients due to the turbulent wake
2. Reduced plume rise caused by a combination of the descending streamlines in the lee of the building and the increased entrainment in the wake.

This model is therefore suited to a wide range of applications.

5.3.2 Background

As per terms of the project for the EIA study for the proposed 450 MW (later 2 × 450 = 900 MW) natural gas-based power plant at Bibiyana, Nabiganj in the district of Habiganj, an air dispersion modelling was completed to predict ground level concentrations (GLCs) of different pollutants (NOx, CO, PM10) for the required averaging period across modelled domain (7.5km × 7.5 km around the stack). The predicted GLCs were assessed in isolation and also the cumulative impact of emissions from the proposed power plant and from the background values determined at the plant location in March 2011.

5.3.3 Modelling Methodology

1. Air dispersion model

   As stated above, ISC3P model of the USEPA was used to estimate GLCs of the pollutants emitted from the proposed power station at Bibiyana.

2. Model Setup

   ISC3P was used with the following setup:

   a) A model domain of 7.5 km by 7.5 km centred on the stack (0.0, 0.0) and 500m grid spacings using Cartesian Co-ordinates. The second stack was 500 m to the north of the first stack.
   b) Assumption of no terrain as the site surrounding the proposed plant is essentially flat with no hilly areas.
   c) A surface roughness length of 0.1m was used to account for the primary flows of concern across relatively flat areas.
   d) Building wake effects were not included as the height of the nearest buildings was not sufficient to influence emissions.

5.3.4 Ambient Air Quality Standards

National Ambient Air Quality Standards (NAAQS) for Bangladesh is given in Table 5.2

Table 5.2: National Ambient Air Quality Standards (NAAQS) for Bangladesh

Pollutant	Objectives	Averaging period
CO	10 mg/m^3	8 hours(a)
	40 mg/m^3	1 hour(a)
Pb	0.5 μg/m^3	Annual
NO_2	100 μg/m^3	Annual
PM10	50 μg/m^3	Annual (b)
	150 μg/m^3	24 hours (c)
PM2.5	15 μg/m^3	Annual
	65 μg/m^3	24 hours
O_3	235 μg/m^3	1 hour (d)
	157 μg/m^3	8 hours
SO_2	80 μg/m^3	Annual
	365 μg/m^3	24 hours (a)

Notes:

(a) Not to be exceeded more than once per year

(b) The objective is attained when the annual arithmetic mean is less than or equal to 50 μg/m^3

(c) The objective is attained when the expected number of days per calendar year with a 24-hour average of 150 μg/m^3 is equal to or less than 1

(d) The objective is attained when the expected number of days per calendar year with the maximum hourly average of 235 μg/m^3 is equal to or less than 1 (Source: AQMP, DOE).

5.3.5 Emission estimates and stacks parameters for the proposed plant at Bibiyana

Emission estimates and stack parameters used in the present modelling are presented in Table 5.3 **Emissions have been calculated for two stacks** – one for each plant. Both the stacks are assumed to have same parameters and same emission rates:

Table 5.3 : Emission rates and stack parameters

Source	Stack height (m)	Stack diameter (m)	Exhaust temp (°C)	Vel. Flowrate (m^3/sec)	Exit velocity (m/sec)	Emission rates (g/sec)			
						NO_X as NO_2	SO_2	PM10	CO
Gas Unit 1	50	3	145	275	25	9.40	NA	0.07	3.43
Gas Unit 2	50	3	145	275	25	9.4	NA	0.07	3.43

5.3.6 Modelling results

As sulphur content in the natural gas input is nil, emission of SO_2 is not included in the modelling. Maximum 50 values for NO_X, PM10 and CO are presented in Tables 3, 4 and 5 respectively. The predicted highest values with two stacks for NO_X, PM10 and CO are 5.23, 0.053 and 3.82 μg/m^3 respectively.

The measured background concentrations (maximum) for NO_X, PM10 and CO_2 are 15.01 μg/m^3 (24hr), 156.93 μg/m^3 (24hr) and 4.36 μg/m^3 (8hr), respectively. Background CO concentrations were not measured. Summary of maximum GLCs over the model domain is given in Table 5.4.

Table 5.4: Summary of predicted maximum GLCs over the model domain

Pollutant	Averaging period	Std (μg/m^3)	Background cone (μg/m^3)	Predicted Maximum control building by the plant (μg/m^3)	Combined value (μg/m^3)	% of Std.
NO_2	24hr	100	15.01	5.23	20.24	20.24%
PM10	24hr	150	156.93	0.05	156.98	104.65%**
CO	8hr	10.000	131*	3.8	134.8	1.35%

* As local value is not available, literature value is used.

** PM10 emission is dominated by the fugitive emission from the plant site. Emission from the power plant is predicted to be less than 0.03%.

Conclusion

Modelling results indicate that emission around the power plant site during the operation of the plant will remain much below the DOE standards except PM10. However, exceedences of PM10 are due to fugitive dust generated at the plant site. Contribution of the power plant in respect of PM10 is negligibly small (<.03%).

5.4 Simulation results of maximum ground-level concentrations of NO_X against stack heights at the proposed Power Plants

Type of Plant : CCGT
No of stacks : 2
Volumetric flow rate (each stack) : 275 m^3/sec
Stack diameter (each stack) : 3.0 m
NO_X emission discharge rate (each stack) : 9.4 gm/sec

Using the above inputs, ISC3P air dispersion model (USEPA approved) furnished the following simulation results for ground-level NO_X concentrations with different stack heights.

Table 5.5: Stak height and ground level NOx concentration

Stack height (m)		Ground level NO_X Conc ($\mu g/m^3$)
20	……..	8.05
30	……..	6.73
40	……..	5.90
50	……..	5.23
60	……..	4.62
70	……..	4.28
80	……..	4.01

The results are plotted graphically in Fig.5.1. It is seen from the figure that ground-level concentration of a pollutant decreases significantly with increasing stack heights – at lower heights sharply and at higher heights showing a leveling off tendency. 10m rise from 20m to 30m brings down concentration by 16.4%, a 10m rise from 70m to 80m by 6.3% and a 10m rise from 60m to 70 by 7.3%. Comparison of pollutant concentration with stack heights above

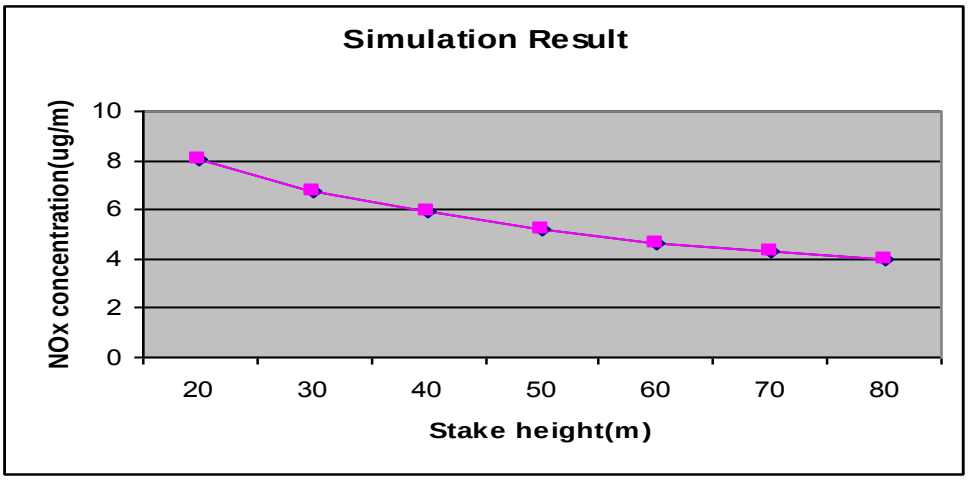


Fig-5.1 : Simulation results of maximaum ground concentration of NOx against stack height.

60m shows that a 10m increase in height lowers the ground concentration from 7.3% to 6.3% i.e. only 1%.
Other pollutants are expected to show similar trends.

Conclusion:

As 10m increase above 60m brings down the change of ground level concentration by about 1% only, a stack height of 60m for the Bibiyana power Plants is recommended.

5.5 Hydrology and Drainage System: The Barak river divides itself into two branches (Surma and Kushiyara) within Cachar district of Assam (India). The second branches of the Barak is known as the Kushiyara, which flows in a westerly direction for some distance then towards the south and south-west to Fenchuganj where it is joined by Juri river originating from the Tripura hills having a catchment area of 1841 sq. kilometers with a rainfall between 229 cm-305 cm. Continuing a south-westerly course, it passes Balagonj, once the largest trading mart in the Sylhet district. The Manu river, which originates in the Tripura hills and follows a meandering north-westerly course between Rajkandi and Ita hills and along the

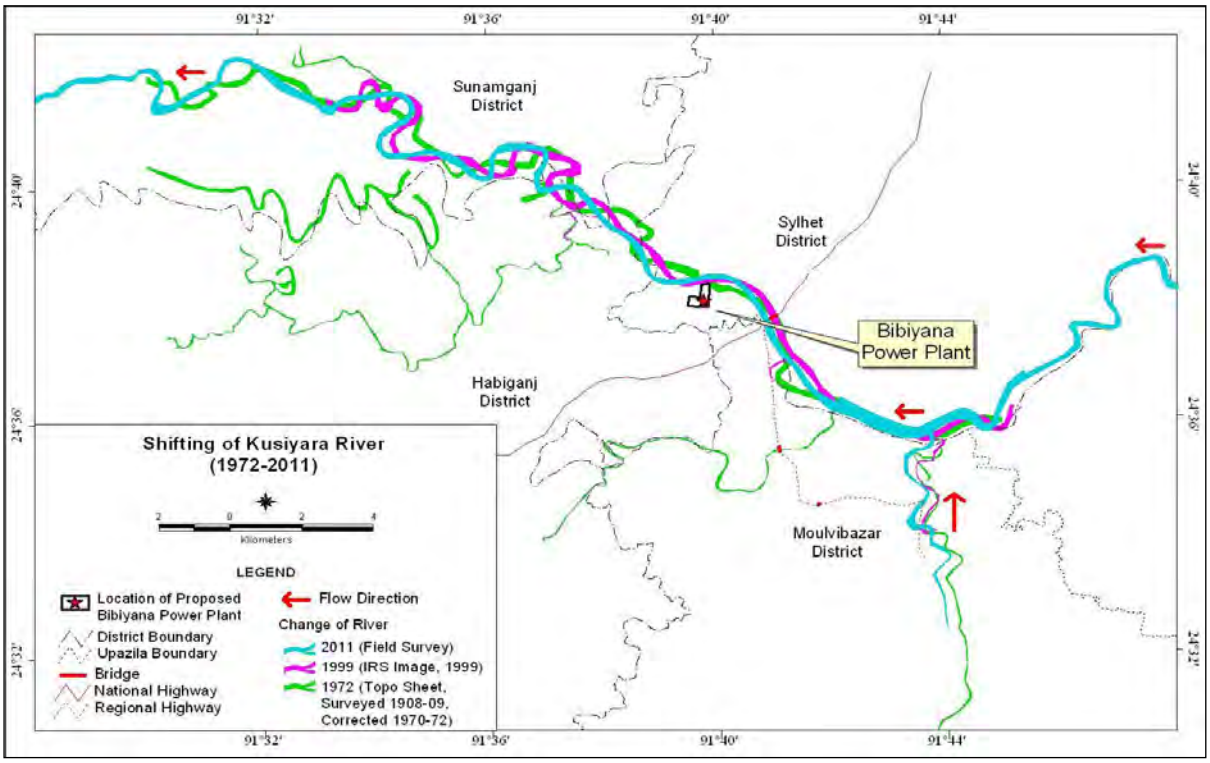
northern face of Balisira range past Maulvibazar it meets the Manu river near Bahadurpur. The Manu has a catchment area of 1000 sq. kilometers. It bifurcates into two branches, the southern branch is called the Bibiyana which meets the Surma at Markuli and the combined flow as the Kali river falls into the Meghna. The southern stream resumes the original name of Barak and flows westward to Nabiganj and then south-west to Habiganj, where it is joined by the Khowai from the mountainous country beyond the southern frontier which has a catchment area of 450 sq. miles and meets the Kalni river. The combined course takes the name of Dhaleswari which forms the western boundary of the Habiganj district for a short distance and ultimately falls into the Meghna river. The Kushiyara passes through the northern side of the project site. The flood period is generally from the last week of May to the middle of October. The principal tributaries of this locality are the Langai, the Manu, the Juri, the Gopla, the Khowai and the Sutang, all originating from Tripura hills. The river is navigable almost throughout the year although sand bars often create difficulties for smooth navigation.

Monsoon floods and flash floods occur in the lower parts of the area. There is a small water body adjacent to the western side of the project area which floods the proposed power plant site. Beside this small water body, there are beels and canals around the project sites that add to the floods during monsoon season. Flash floods occur during April to May in the area. There is a flood protection embankment acting as barrier to normal floods against inundation of the project sites. However, the devastating floods of 1977, 1987, 1988 and 2004 had inundated the area causing considerable loss to livelihoods and and damages to physical infrastructure.

The area is characterized by fresh water; but water reportedly, gets polluted from the fertilizer plant located upstream (Fenchuganj Fertilizer Factory) and nearby rice mills. The fish resources of Kushiyara River decrease and get foul odor due to polluted water.

Most of the canals flowing intermittently (drying up in the dry season) have narrow drainage system and have no salinity. The canals are used for irrigation and habitat for local fish resources. But due to low flow of water from upstream day by day, siltation increases in the canal beds and depth of water reduces in alarming rate. Besides, bank erosion is also another cause of siltation of canals.

(a) Kushiyara River: Kushiyara river located on the northern side flows from the east to the west and occupies 9% of total area. Water flow is high during the rainy season and brings a lot of silt. In other seasons, there is low water flow and water is more or less clear. Motor launches and all kinds of boats ply in all the seasons. Because of the erosion of the north bank by Kushiyara river, the channel shifted towards north of the Lama Tajpur village and silt deposited on the south bank, and thus village Dakhin Tajpur was formed. Lama Tajpur suffers most where during the last few decades the Kushiyara river eroded most part of the village and divided the village in two major parts. The following map indicates the same.



Map 5.1 : Shifting of Kushiara River

(b) Canals: Water body including canals, ponds and beels occupied only 2% of the total surveyed area. Most of the canals get dried up during winter season and show water flows during monsoon season. There is a big water body on the eastern side of the village Majlispur. Originally, this water body known as Buro river used to flow into the Kushiyara river. At present, both sides are closed. On one side, Dhaka Sylhet highway (N_2) is situated and on the other side Sherpur-Moulvibazaar road. This water body is 10-12 meters deep. DC office leases out this water body to the local fishermen.

(c) Beels: A beel is a comparatively large cultivable land without any settlement. There are three degraded beels namely Bagber beel, Ari beel and Dakriar beel in the surveyed area. Most of the area in winter becomes dry.

(d) Ponds: There are ponds within the settlement areas. Most of the families have one or two ponds used for aquaculture and household purposes. The area of a pond varies from 10 decimal to 1 acre.

(e) Ground Water: As other parts of the country, this area also receives sufficient amount of rainfall and there is a good availability of ground water that is being used by hand pumps for drinking and domestic purposes. Some industries are using deep rube wells within their premises to meet the requirement of good quality water for various purposes. Industries within the BSCIC area meet their requirements of water through facilities within their own set up. The scattered homesteads are using hand tube well (HTW) to meet their domestic demand. During site visit it was observed that sufficient quantity of water was coming out from the HTW. However, there is no specific complaint about non-availability of ground water. As other parts of the country, this area also receives sufficient amount of rainfall and there is a good availability of ground water that is being used by hand pumps for drinking and domestic purposes.

Section-2: Water Quality

Surface water quality, viz., that of ponds, nearest wetlands and the river Kushiyara in the project area and its surroundings do not seem to have undergone changes beyond acceptable levels as there have been no polluting industry or similar other activity. Baseline water quality had been determined taking into consideration that water for cooling purposes will be utilized from the surface water system in closest vicinity of the project area. Existing surface water quality, specifically, the quality of the cooling water (as in March, 2008) to be drawn from the point of the project area along river Kushiyara appears in the following Table (Table-5.6).

Table-5.6: Existing State of the Quality of Cooling Water to be drawn for the Project

Particulars of the Tested Sample	Parameter	Unit	Concentration ()
Cooling Water (Source: River Bibiyana near the project site)	Total Hardness as $CaCO_3$	mg/L	60
	Alkalinity as $CaCO_3$	mg/L	72
	Total acidity as $CaCO_3$	mg/L	45
	Arsenic	mg/L	Less than 0.01
	Ca	mg/L	10.6
	Chlorine	mg/L	Not detectable
	COD	mg/L	13
	Iron	mg/L	0.73
	Phosphorus	mg/L	0.38
	Phosphate	mg/L	0.45
	Manganese	mg/L	Less than 0.05
	Mercury	mg/L	0.01
	Nitrate	mg/L	2.7
	Nitrites	mg/L	Less than 0.07
	Ammonia Nitrogen	mg/L	Less than 0.05
	Dissolved Oxygen (DO)	mg/L	3.98
	Lead	mg/L	Less than 0.1
	Potassium	mg/L	1.96
	*p*H at 24.5^0C		7.64
	TSS	mg/L	13.6
	TDS	mg/L	128
	Total Solid	mg/L	142
	Sulphate	mg/L	6.2
	Turbidity	NTU	16.3
	Conductivity	µS/cm	157

Source: BCAS Field Survey 2009

Section 3: Noise Level Measurement and its Modelling Results

5. 6 Noise Quality: Existing noise level of the project area was measured over periods of 9 hours each day and night during. The state of noise level obtaining throughout the project area and in areas in immediate vicinity and beyond is depicted in Annexure 7

The noise pollution is not a widely mentioned problem in the proposed Summit Bibiyana Power Project 1&II (SBPP) area; some respondents have attributed noise pollution to different types of vehicles that ply over the roads in the study area.

Average noise levels (dB) in the daytime at the plant site have been measured 60 dB (approximate). The average noise level at night is approximately 52 dB in the same place. After setting up the plant, the area will be considered as an industrial zone. They meet the National Ambient Air Quality Standards (NAAQS) level except some stray cases because of the honking of the buses and trucks passing through Sherpur, Bongaon and Pharpur commercial centre about 2.5 km to the east of the proposed SBPCL 1&II plant site. NAAQS levels for industrial zone are 70 dB (night) and 75 dB (day).

5.6.1 Measurements and Results:

Existing noise level of the project area was measured over periods of 9 hours each day during. The state of noise level obtaining throughout the project area and in areas in immediate vicinity and beyond is well within acceptable limits. Noise levels (dB) in the daytime and midnight on March –April 2011 are presented in Figure 5.2 to 5.3 and detailed data were presented in the Annexures.

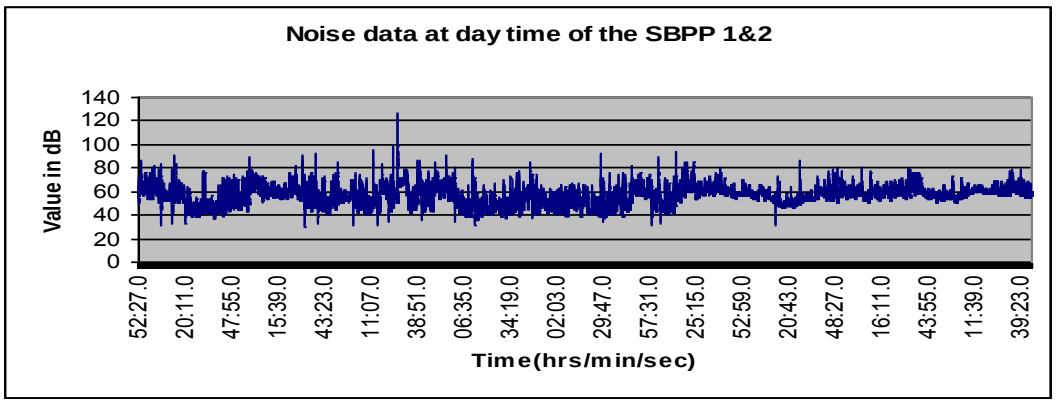


Figure 5.2: Existing Noise Quality Data in the Project Area at day time

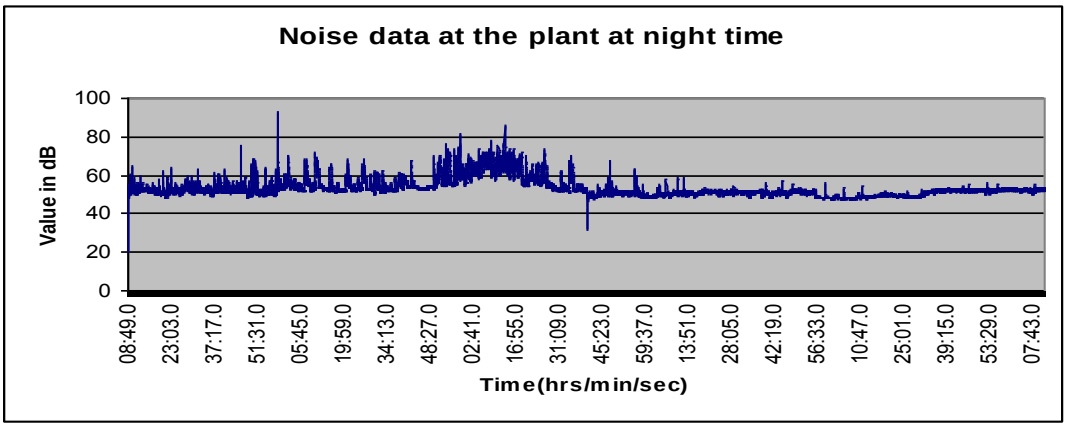


Figure 5.3: Existing Noise Quality Data in the Project Area at night time

Results:

The above figures show that noise level data varies place to place along with the time and distance. The noise level data has been measured during mid April, 2011. Five points have taken for the noise level data measurements at the Summit Bibiyana I&II Power Company Limited Project (SBPCL I&II) site. Sherpur point is the most vulnerable one where the average noise level data has been measured 60 dB at day time and 70 dB at night (see the Annexure). The average noise level of the plant site has been measured 50 dB. At day time, the average level of noise is 45 dB whereas it is 55 dB (approximately) at night.

5.7 Noise Modelling

The noise modeling is based upon the method documented by the International Energy Agency. It is a simple model which assumes spherical spreading from a point source either in free space (spherical) or over a reflective plane (hemi-spherical). It can also take into account atmospheric attenuation, using an attenuation rate entered by the user. The source sound power and the absorption coefficient are both assumed to be broad band. Source to receiver distances are calculated by simple geometric means and the total received noise from each turbine logarithmically added.
The Model does not take into account

- Uneven topography
- Large obstructions in the propagation path, e.g. barriers etc
- Refraction of noise, e.g. due to atmospheric effects such as temperature inversion
- Wind speed or direction effects
- Any change in the propagation with changing frequency

The mathematical formulae for the noise model is shown below

$$L_p = L_w - 10Log_{10}\left(2\pi r^2\right) - ar$$

$$L_p = L_w - 10Log_{10}\left(4\pi r^2\right) - ar$$

Where,
r is the distance from source to receiver
a is the absorption due to the atmosphere (dB/m),which is most commonly used as 0.005dB/m
$\mathbf{L_w}$, the sound power level of the turbine
Lp the output sound power level of the turbine at different radius away from the source

The first equation is for Hemi-Spherical radiation and the second for Spherical. Due to our site location we have chosen the equation for spherical [ref: http://resource.npl.co.uk/acoustics

A GUI software was built based upon the model using MATLAB programming language for our enhancement in calculation and analysis. The screenshot for and the sample MATLAB code is given below

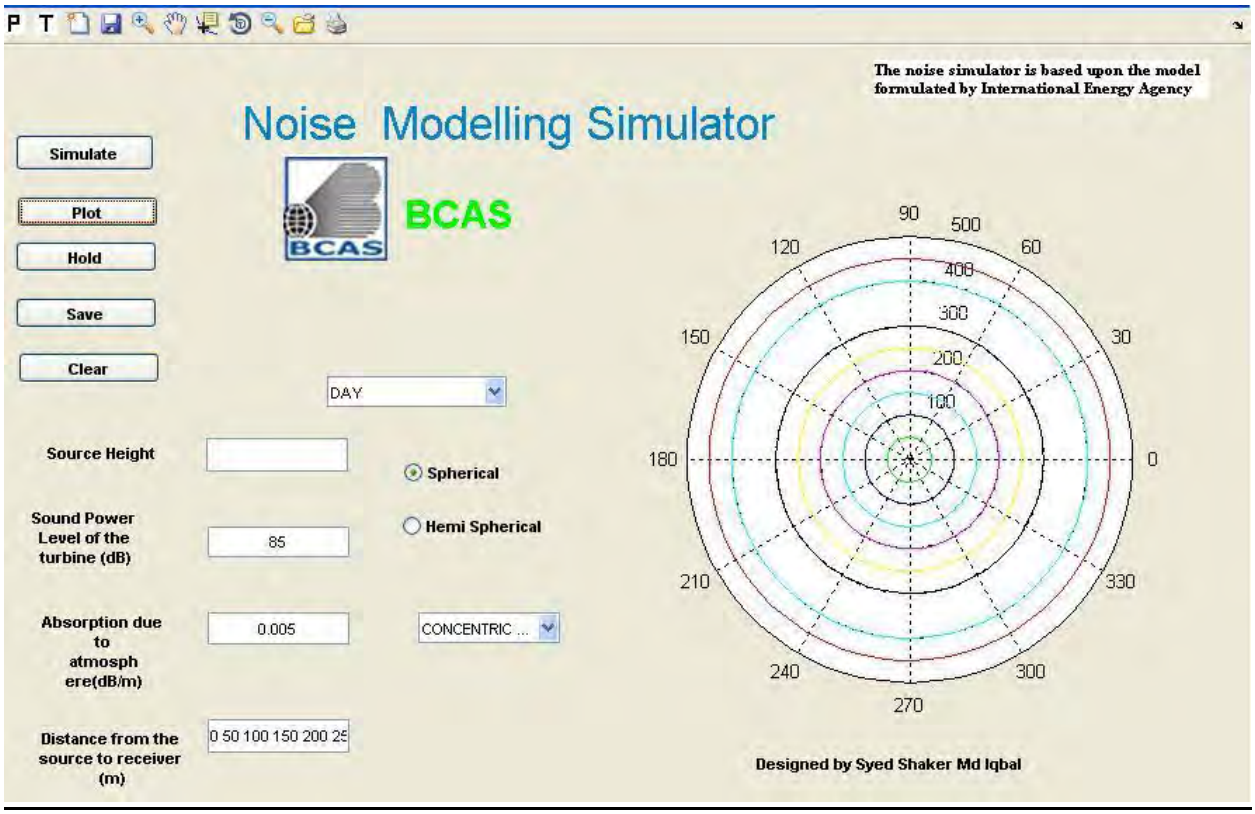


Fig 5.4: Screenshot GUI for the noise modeling simulator

5. 7. 1 Noise Modelling Results

At 85 dB noise input, predicted noise output

Radius	1	50	100	150	200	250	300	350	400	450
Output Sound power level in dB	85	39.7	33.50	29.73	26.98	24.79	22.96	21.37	19.96	18.69

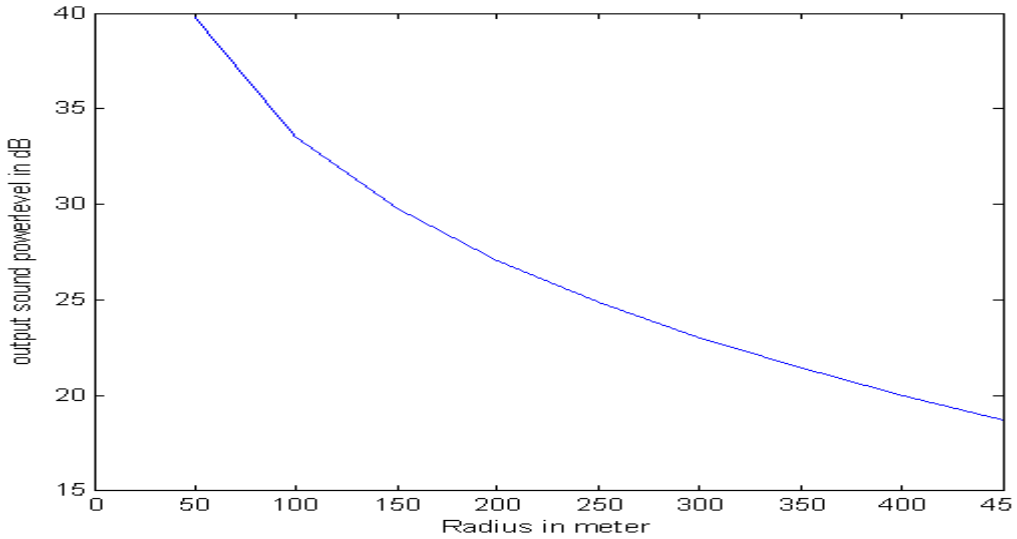


Fig 5.5: Plot of output noise power level in dB VS Radius in meter

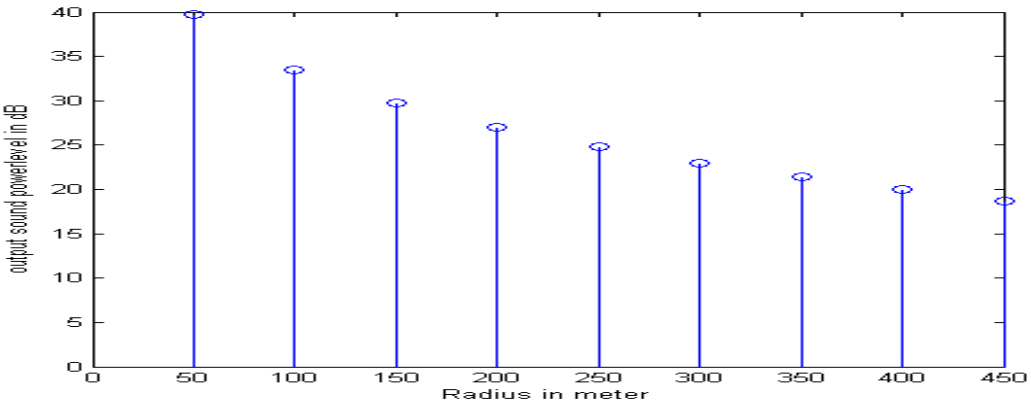


Fig 5.6: Stem plot of output noise power level in dB VS Radius in meter

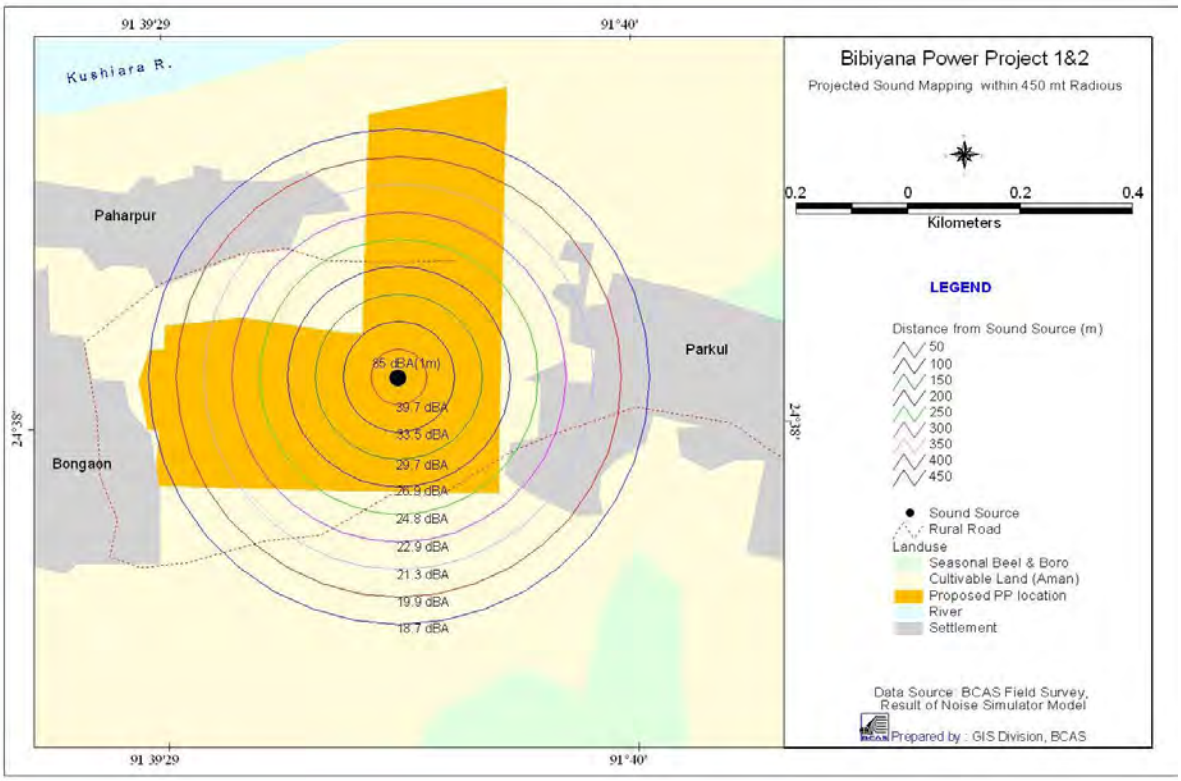


Fig 5.7: Contour plot showing noise power level in dB at different concentric for 450m radius (note: 85 dB is the noise source i.e the plant location)

5.7.2 Potential impact and mitigation measures

Causes of the noise emissions are due to:

1. Clearing of vegetation, removal and stockpiling of topsoil and bulk earthworks
2. Establishing and preparing concrete foundations for major plant and buildings
3. Construction of buildings
4. Pipe line route excavation and construction
5. Once the plant is running noise from the turbines, transformers, turbines, generator, pump house and maintenance activities will also be huge

The potential impact can be sleep disturbance. In the event that the operating hours of the power plant are extended into the night time period there could potentially be sleep disturbance reactions at nearby residences. According to World Health Organization (WHO) if negative effects on sleep are to be avoided the equivalent sound pressure level should not exceed 30 dB indoors for continuous noise .If the noise is not continuous effects have been observed at 45dB or less.

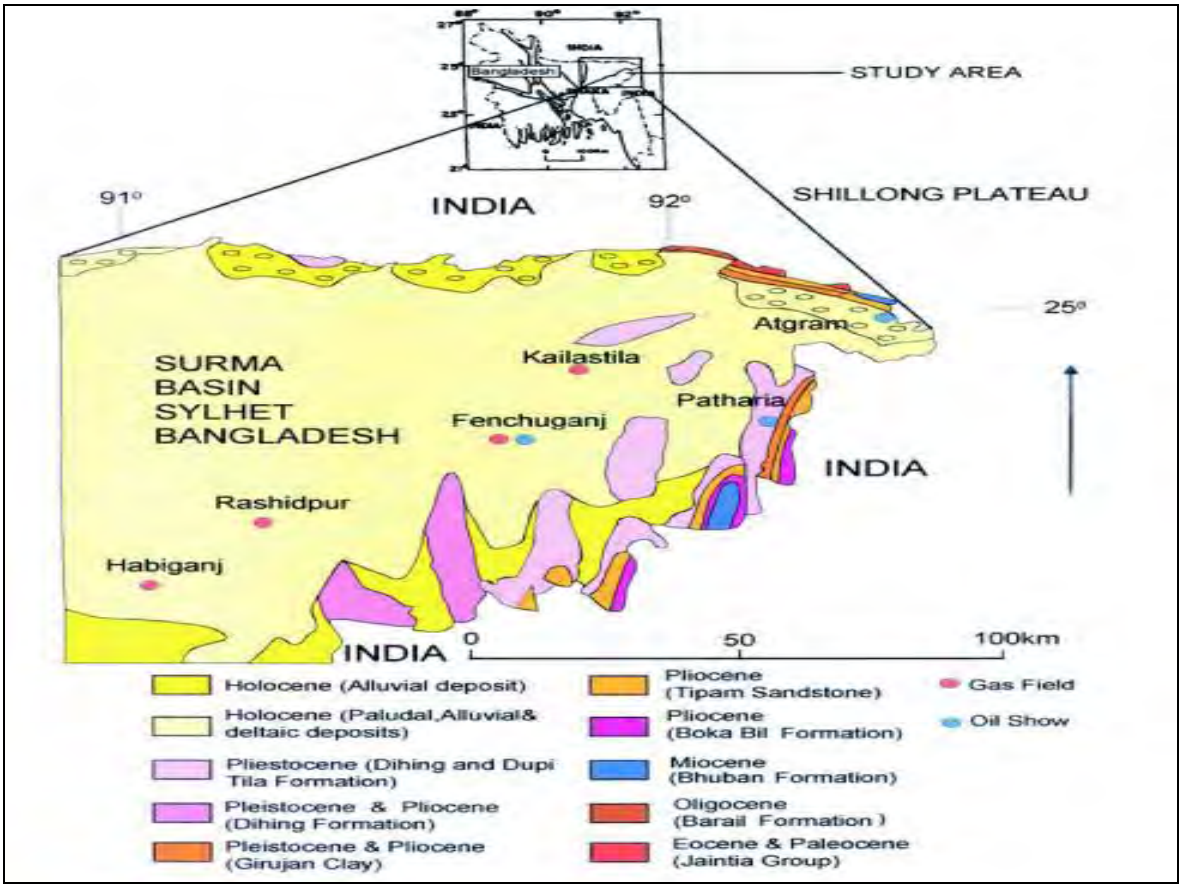
As far as the mitigation is concerned certain actions are taken

1. Fit residential grade mufflers and silencers to machines
2. Use rubber tyred machinery rather than metal tracked dozers etc where possible.
3. Limit operation of earthmoving machinery to between 9am and 4pm when residences are less sensitive to noise and ambient levels are greatest.
4. Keep neighbours informed when noisy equipment is introduced to site and the likely duration of its use.
5. Ensure a site contact number is circulated to neighbouring residences to allow a swift response to complaints
6. Introduce a management strategy to monitor noise emission, assess and record noise complaints and track performance in limiting and managing noise.
7. Enclose or shield engines of concrete mixers where practical

5.8 Geology, Soils and Groundwater

5.8.1 Geology and Soils:

The Sylhet Trough comprising a sub-basin of the Bengal Basin lies in the north-eastern flank of Bangladesh. It is bound on the west by the Indian platform, on the north by the Indian Shillong plateau, on the east and southeast by the Chittagong-Tripura fold belt of the Indo-Burman Ranges, and to the south and southwest by the main part of the Bengal Basin. This east–west trending trough is 120 km (75 mi) long, 50 km (31 mi) wide and 13 to 17 km (8.1 to 11 mi) thick.
The basin gradually deepens toward the center, and undergoes active subsidence. Deposition of the Sylhet Trough sediments has been in a large, mud-rich delta system that had drained the eastern Himalayas. The north-eastern part of the basin was affected by tectonic loading, both from the northeast – eastern Himalayas – and east – Indo–Burman Ranges – causing nearby parts of the basin to subside further which accommodated the thick Surma Group sediments. The above could be represented through statigraphic sequence as follows (Table-5.2 and Map-5.2)



Map-5.2: Statigraphy of the Surma Basin

In most of the Surma flood plain, there is no annual deposition of new sediment; however, the soils are older and more developed, and in rainy season, flood water is clear. The landscape is very gentle undulating or nearly level. The main soils on the high flood areas and flood plain rides have grey silty to loamy top soils and grey silty to clayey sub-soils with black structure. The basin soils are very similar, but more clayey. Most soils overlie stratified material at 2 – 5 feet depth. Almost all of the soils are seasonally flooded, and dry out by the middle of the dry season.

5.8.2 Seismicity: Bangladesh has been divided into four seismic zones. The north-eastern part of Bangladesh is in the most active seismic zone and has experienced earthquakes of moderate/high intensity. The great earthquake of 1897, which had its epicenter in Shilong Plateu in India, caused widespread damages. Two major earthquakes – the Bengal earthquake of 1885 and Srimangal earthquake of 1918 – caused severe damages on limited areas surrounding their epicenters. Earthquakes with magnitudes between 7.0 and 8.7 on the Richter scale have been experienced, but they are rare events (Brammer and Khan 1990 cited in A Atiq Rahman *et al* (1994) v.1, p. (166).

B. BIOLOGICAL ENVIRONMENT

5.9 Vegetation and Floral Diversity: Human intervention and extension of the settlement areas have a compounding effect resulting in a rapid depletion of the natural resources in the project area. The following macro ecosystem types are found in the area: cultivated land, roadside vegetation, exotic wood plantation, local species, homestead vegetation and wetland areas. There is no ecologically critical area or other designated protected areas located within the project boundaries and adjacent areas.

Natural vegetation is represented by open water aquatic vegetation. Freshwater swam forest and terrestrial forest types are different in their physiognomy, species composition and ecological characteristics. Many trees and shrubs including indigenous and exotic flowers, fruit-bearing and medicinal trees were observed in the area. This shrubs& herbs and fruit bearing trees are found in patches covering patches of lands in and around the project areas or in the homestead areas. Fruit bearing trees are Mango, Jackfruit, Coconut, Payara, Jam, Lichi, Amra Jambura, Kamranga, Gab, Bel etc. (all local names). Baseline status of flora composition of each of vegetation type is given in Appendix-6.Once the study area was rich in floral and faunal resources.

5.9.1 Faunal Diversity: The area is extremely rich in their faunal diversity. These are some 75 species of fishes in the locality. Local status and distribution according to IUCN Red Book are also shown in the same table. Out of these 43 species are not threatened, 23 critically endangered, 9 of lower risk and vulnerable. In spite of this fact, the area still remains an internationally important wintering area for migratory waterfowl, principally ducks and shore birds.

As shown in Appendix 8, there are 18 kinds of reptiles, 7 kinds of domestic animals and 77 kinds of birds. Out of 18 species of reptiles, 6 are vulnerable. Number of vulnerable domestic animals is one and those of birds are 21.

C. SOCIO-ECONOMIC ENVIRONMENT

5.10 Landuse Pattern: Landuse survey was undertaken during the course of SEIA process toward establishing the current status of the landuse pattern in the project area.

5.10.1 Objectives of the Landuse Survey: Objectives of the Landuse survey had been as under

- To understand the present baseline landuse pattern in the high impact zone and low impact zone in the power plant site.
- To show the settlements, agricultural lands, markets, roads, bridges and other important infrastructures in the maps along with present landuse pattern and development of environmental base map
- To identify location of the proposed approach road and power plant site and to find out any future development plan or any historic or protected sites in and around the project site.

5.10.2 Methods followed during Landuse Survey: Results of landuse survey conducted during the period of May to June, 2008 was revalidated through the one conducted during the SEIA process undertaken in April, 2011. Detailed survey work was carried out throughout the high impact zone (2km radius), medium impact zone (7.5km radius) and low impact zone (10km radius) of the project airshed toward preparing the landuse map. During the mapping exercise, in-depth consultations with the local stakeholders were carried out for accurate identification of the plots in the maps and also utilization of the old maps was done for identifying the plots and ground level. Field verification was done by the Team leader after the field data collection. Updated GIS version was applied to finalize the landuse map. Various maps were used to identify the landuse categories during landuse survey. Surveyed villages along with Mouzas, Unions, Upazillas and District and their location appear, respectively, in Table-5.4 and Map-5.1.

Total ten villages (five villages from high impact area, two villages from near approach road and three villages from low impact areas of the SBPP) were selected for collection of household level information. List of study villages are given below:

Table 5.7: Name of study villages by Union, Upazila and District

Village	Mouza	Union	Upazila	District
Parkul Paharpur Bangaon	Tajabad	Aushkandi	Nabiganj	Habiganj
Mazlishpur	Mazlishpur			
Bhabanipur	Bhabanipur			
Swastipur	Swastipur	Dighalbag		
Lama Tajpur Dakhin Tajpur	Tajpur	Sadipur	Balaganj	Sylhet
Purba Kalnichar	Sanmanpur			
Brahmangaon	Brahmangaon	Khalilpur	Maulvibazar Sadar	Maulvibazar

5.10.3 Coverage of Survey Area: Survey was carried out in the plant site and its surroundings on all sides of 2 km area including approach road area in high impact zone, 7.5km in medium impact zone and 10km in low impact zone showing the features on the ground like homesteads, rivers, brick soling roads, mud roads, shops, religious institutes, educational institutions, agricultural lands, proposed power plant, approach road and other features which occupy space on the ground and are subject of consideration from the environmental point of view.

5.10.4 Landuse Survey Team: With a view to completing the survey work in the field smoothly and accurately, a team consisting of eight members was mobilized with the assistance of local assistants.

5.10.5 Orientation of the Survey Team: Before mobilization of the team in the field, an orientation course was organized for the team and a pre-testing was performed so that the team could do the assignment correctly.

5.10.6 Team Mobilization in the Field: The full team has devoted their efforts in the field to identify the important features, landmarks and other objects and then to plott them on the base mouza maps which were supplied earlier. Before that, a reconnaissance survey was performed in the field.

5.10.7 Preparation of Landuse Map and Analysis: According to the guidelines of the Department of Environment (DOE), the desired data like the location of settlements, industries, shops, growth centers, markets, agricultural lands, water bodies, bridges, educational institutions, religious institutions and other sites were drawn on the final landuse map (Map 6.2) with the help of modern cartographic instruments of GIS section of BCAS.

5.10.8 Description of the Major Landuse Categories: Major landuse categories as identified during the survey are depicted in the Table (Table-5.8) as under:

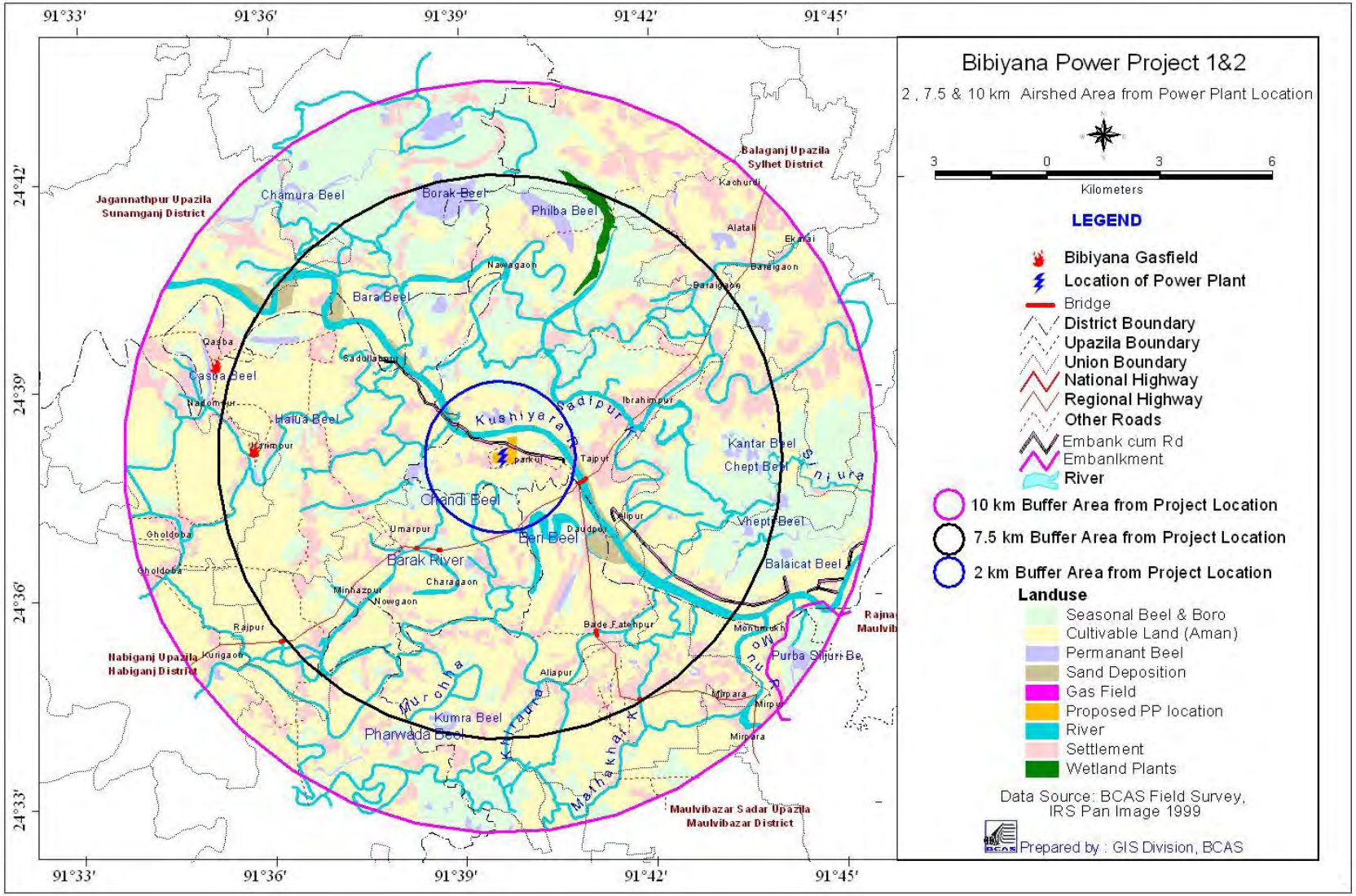
Table-5.8: Present Landuse Pattern of Surveyed Areas

Sl. No.	Landuse Pattern	Number	% of Total
01	Agricultural lands	-	73%
02	Settlement area	-	12%
03	Power plant site (Acquired land)	-	2.5%

04	Proposed approach road	-	0.5%
05	School	3	-
06	Clinic	2	-
07	Road (earthen/Semi pacca)	-	1%
08	Shops	15	-
09	Mosque	9	-
10	Moqtab	4	-
11	Eidga	2	-
12	Graveyard	4	-
13	Mazar (Spiritual graves)	4	-
14	Rice mill	5	-
15	River Kushiyara	-	9%
16	Canals, Ponds, Beels, etc.	-	2%
	Total		**100%**

5.10.9 Agricultural Lands: The project area has agricultural cultivable land (73%, Table 5.8). There are two main crops grown in a year depending on the water availability. Irrigation water is taken from the Kushiyara river, surface water and nearby water bodies. Paddy (aus, aman and boro), potato and vegetables are the main crops. A small amount belongs to fallow land in the surveyed area. There is no mineral or forest coverage reserve in the close vicinity of plant site.

5.10.10 Settlement Area: Settlement area occupies 12% (Table 5.8) of the surveyed area and consists of homesteads and vegetation with local, indigenous fruits bearing trees. Besides, some exotic species and medicinal plants could also be observed during the survey process. Various occupation groups comprising farmers, sharecroppers, day laboures, businesses men, service holders, rickshaw/van pullers, transport workers live in the area. A major settlement enclave has been developed in the north–eastern part of the project area with easy access to the Sherpur town. The settlement area is overwhelmingly covered with various species of fruit and other trees. Each homestead is associated with a kitchen garden where seasonal vegetables and spices are grown for domestic consumption.



Map-5.3: Landuse map of Summit Bibiyana 1 & II Power Company Limited (SBPCL) Project

5.10.11 Power Plant Site: The proposed power plant site has acquired 67 acres (11 acres Phase I, 12 acres Phase II, 14 acres for phase III, 26 acres for PGCB and the 4 acres for approach road) of land. 29 homesteads including 6 ponds are located in the proposed power plant site and gas pipeline. Most of the part of the selected site is relatively high land compared to the surrounding areas. On the northern side of the site is the Kushiyara river.

5.10.12 Approach Road: The approach road passes through Majlispur, Pitua, Bata, Tajpur mouza and Parkul village. It is about 2km from the highway (N_2). A partial homestead land including a pond (socially recognized) has fallen into the approach road.

5.10.13 General Findings of the Landuse Survey: The project area is comparatively on medium high lands around which villages lie to the east and the west. Farmland and Sherpur town are situated to the east, Kushiyara (one of the major rivers in north eastern zone of Bangladesh) river on the north.

Landuse within the project area is dominated by the agricultural purposes. Most of the crops are harvested two to three times per year and the main crop is paddy. The paddy area is situated in a localized zone mainly in the middle part of the project area. In monsoon season, the project area is favorable for cultivation of paddy. Taking this natural advantage, the farmers have adjusted the area with the cultivation of transplanted Aman paddy which is the principal cereal crop produced in the project area. After the harvest of paddy, the entire paddy field is kept fallow. For crop production in the project areas There are some limitations which are given below:

- Limitations of crop production due to irrigation facilities
- Limitations of crop production due to absence of landowner
- Limitations of crop production due to dryness of soil
- Limitations of crop production due to poor texture and poor physical condition of soil profile

5.11 Population and Family Size: The airshed of Summit Bibiyana I & II Power Company Limited Project has a population 1,31,084 and of which 66,025 are males and 65,025 are females. There are 21,769 households in the same air shed area and the average family size estimated 6.02 persons.

In 2 kms. Radius of the Summit Bibiyana 1 & 2 Power Project location, total population was 18195 of which 9,293 are males and 8,903 are females. There are 3051 families in the high impact zone and the average family size found 5.96 persons.

5.12 Religious and Dwelling Houses: Religion-wise population of the project area could broadly be grouped as Muslims and Hindus. The Muslims dominate in the airshed, followed by Hindus. Most of the village houses are kutcha construction, and materials used for roofs and walls are corrugated iron-sheets. Houses with brick walls are also common in this airshed. Throughout the three kinds of impact zone (high, medium and low) muslims comprise 92% of the total population of which 85% belong to the fishing community. Corresponding figures for the Hindu community are 7.8% and 15% (Table-5.9).

Table-5.9: Percentage Distribution of Household Heads by Religion

Population by Religion	Study Area			Fishing	All
	High	Medium	Low		
Muslim	95 (96.0)	37 (92.5)	39 (86.7)	17 (85.0)	188 (92.2)
Hindu	4 (4.0)	3 (7.5)	6 (13.3)	3 (15.0)	16 (7.8)
Total	**99 (100.0)**	**40 (100.0)**	**45 (100.0)**	**20 (100.0)**	**204 (100.0)**

5.13 Educational Status: About 14.1% of the population in the study area is illiterate. Another 15.3% of the population is able to sign although they can neither read nor write. The population having primary level education (upto 5 years of schooling) and secondary level education (up to 10 years of schooling) are 39.0% and 25.2% respectively. Only 3.5% of the population have SSC or equivalent, 2.5% HSC or equivalent and 0.4% have academic attainment up to the levels of Bachelor and higher degrees (Table-5.10).

Table-5.10: Educational Status of Household Members by Study Area (%)

Educational Status	Percentage				
	High	Medium	Low	Fisherman	All
Illiterate	15.7	12.5	8.3	23.5	14.1
Can sign only	16.9	13.0	16.2	9.8	15.3
Primary	38.0	36.0	42.3	42.2	39.0
Secondary	24.2	29.5	26.9	17.6	25.2
S.S.C and equivalent	2.8	4.0	4.0	4.9	3.5
H.S.C and equivalent	1.7	5.0	2.3	2.0	2.5
Degree and above	0.7	-	-	-	0.4
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Source : BCAS field survey through questionnaire

5.14 Average Family Size and Sex Ratio Among Household Members: The study area within high, medium and low impact zones have respective family sizes of 6.1, 5.9 and 6.5 with ratio of male and female being, respectively, 96.1, 121.5 and 104.9. Among the fishermen, corresponding fogures were found to be 6.6 and 106.2. The overall picture in respect of the above parameters had been 6.2 and 103.5 (Table-5.11).

Table-5.11: Average Family Size and Sex Ratio of Household Members by Study Area

Study Area	Average Family Size (number)	Sex Ratio
High	6.1	96.1
Medium	5.9	121.5
Low	6.5	104.9
Fisherman	6.6	106.2
All	6.2	103.5

Source : BCAS field survey through questionnaire 2011

5.15 Main Activities of the Population over the Last 10 years and more: According to the 2001 census, the main activities of the population 10 years and over in the air shed area are household works, agriculture, business, service, transport, construction and others.

People in the study villages are engaged in different types of primary and secondary occupations such as farming, wage labour, business, services (govt. & non-govt.), fishing, household work, overseas employment, rickshaw/ van driving etc. (Table-5.12). The survey reveals that the highest percentage (40.7%) of the workforce are engaged in agricultural activities followed by other occupations including wage labor (16.2%), business (14.7%), household work (13.2%), services (4.9%), overseas employment (2.5%), fishing (2.5%), van/rickshaw pulling (2.5%). Other occupations such as carpenter, blacksmith, handicrafts constitute yet another smaller section of the working population (2.8%).

Aside from primary occupation, a significant proportion of the population also adopt a secondary occupation to enhance the household income. Agriculture, wage labour and business are found to be the dominant secondary occupation in the study area.

Table-5.12: Primary Occupation of Household Heads by Study Area (%)

Primary Occupation	Study/Impact Area				
	High Impact	Medium Impact	Low Impact	Fishermen Village	All (%)
Agriculture/Farming	15.4	18.0	8.2	1.2	13.2
Wage labour	7.1	1.9	12.9	4.8	7.1
Household work	32.2	37.2	34.8	29.5	32.6
Working in abroad	2.7	3.4	1.6	1.5	2.5
Fishing	0.3	-	-	10.5	1.4
Van/Rickshaw puller	0.4	-	0.3	0.6	0.4
Service	1.8	2.7	2.5	3.6	2.2
Business	4.2	2.7	7.9	13.0	5.4
Student	31.9	29.9	27.9	31.6	31.2
Unemployed	1.8	0.8	1.9	1.8	1.7
Handicrafts	0.3	0.4	-	0.3	0.3
Carpenter/black smith	0.6	1.5	0.5	-	0.6
Others	1.3	1.5	1.5	1.6	1.4
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Figures in parentheses indicate percentages.
Source : BCAS field survey through questionnaire 2011

5.16 Sources of Household Income: According to the 2001 census, the main sources of income of the airshed area are agriculture/forestry and livestock, agriculture labour, non-agriculture labour, handloom, industry, business, hawker, transport, construction, religious, service, rent, remittance, and others.

The survey reveals that households derive their income from multiple sources including agricultural crops (rice and wheat), wage, salary, business, livestock, remittance, etc.

Agro crops especially rice/wheat is the largest source accounting for 32.4% of household income in the study area. The next important source is remittance which contributes 19.7% to household income. Other sources are business, wage labour, livestock and services contributing 14.6%, 12%, 5.1% and 4.2% respectively to household income.

The contributions of different sources to household income are marked by noteworthy variations among the impact zones. Fisheries, for example, contribute 25.7% to household income in the fishermen village; whereas its contribution is less than one percent in medium impact area. Livestock contributes 6.3% to household income in low impact area compared to only 0.6% in fishermen village. The contribution of business/trade to household income varies from 9.2% in medium impact area to 36% in fishermen village (Table-5.13).

Table-5.13: Percentage of Annual Household Income from Different Sources

Source	Percentage				
	High	Medium	Low	Fisherman	All
Rice/Wheat production	22.9	24.5	24.7	2.6	21.9
Vegetables	1.2	0.8	1.3	-	1.1

Daily wages	8.1	10.1	9.6	6.1	8.6
Service	3.0	4.3	4.9	11.4	4.3
Business	7.5	22.2	19.1	53.3	16.3
Fruits	1.6	0.8	1.0	2.0	1.4
Timber and timber products	0.8	0.5	0.1	-	0.5
Fuel wood	2.1	2.1	1.2	1.2	1.8
Fish	2.6	1.0	2.2	10.5	2.9
Livestock	3.2	2.4	3.2	-	2.8
Poultry	0.7	0.6	0.7	0.2	0.7
Handicrafts	-	2.3	0.3	-	0.4
Foreign remittance	31.4	18.3	21.4	6.7	24.9
Milk/egg	0.9	1.6	3.0	0.1	1.4
All type of mistri	5.0	1.4	2.4	-	3.4
Share out land	1.1	1.7	-	-	0.9
Aid	4.7	1.0	3.7	1.3	3.6
Others	3.2	4.4	1.2	4.6	3.1
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Source : BCAS field survey through questionnaire 2011

5.17 Land Use Pattern: Total area is located in the river basin, which is in the foot-hills of Tripura. Most of the land is under crop cultivation. People are cultivating mainly rice in Boro and Aman seasons. In Rabi season, people mainly cultivate different vegetables only in some portions of their crop fields. Homesteads, perennial water bodies like river, beels and haors, roads & embankment and markets are other categories of land use in the airshed.

Significant changes have, however, occurred in the landuse pattern in the recent past and some agricultural lands have been converted into settlement areas. The Sherpur town is extending its periphery at a higher rate now than in the past. Basically, Sherpur town extended towards the project sites. People are building their brick houses. People also purchase lands on the road side to build houses. The land price is also getting higher. In 2000, price per decimal was Tk. 7000 only now it stands around Tk 1,00,000.

5. 18 Roads and Communication

Through the plant site there is road – only 2 km brick soling and the rest mud built. There are Kushiyara dykes along the Kushiyara river starting from Sherpur bridge passing through Parkul and Paharpur villages. It is the main road in and around the project area. Besides this, there are some earthen roads passing through the villages (adjacent to the project site) to connect the Sherpur commercial centre. Vehicle movement during the rainy season becomes difficult and prone to accident. Earthen roads are used only in dry season and most of the time villagers use boat for their movement. Plantation programme has been initiated along the roadside with local and exotic species by different organizations.

5.19 Educational and Religious Institutes

There are 3 schools located in the surveyed area. Beside these, 9 mosques, 4 Moqtabs (religions school), 2 Eidgahs, 4 graveyards and 4 spiritual graves were found during the survey.

5.20 Infrastructures

Dhaka - Sylhet national highway and several paved roads have been constructed in the air shed for travel and communication. Regular bus and other transport services (including rental cars, auto rickshaws, rickshaw/rickshaw vans) are being used for peoples‘ movement from

one place to another. People also use regular service launch and engine boat and country boats for their movement and transporting their products.

Bangladesh Water Development Board has constructed embankment on the banks of the river in the area to protect agriculture from flood damage. This embankment is also used as village roads for movement.

Bibiyana gas fields, Union Parishad Offices, Markets & Hats, educational institutes, religious centres (Mosques, Temples and Churches) are located in this airshed. The area is connected with grid electricity, but no telephone for the village people. There is no pipeline for gas supply to local community, although the Bibiyana gas field located in the airshed supplies gas to the national gas pipe line.

5.21 Urbanization

No urban centre has yet developed within this airshed.

Sherpur, the village business centre, is about 2.5 kms to the east of the project site. Dhaka-Sylhet highway (N2) passes through this centre. Buses and trucks pass through this highway and the honking of buses and trucks reach the plant site also.

5.22 Energy Use in the Locality

This locality is connected with grid electricity for use in domestic and business purposes. Land base biomass fuels obtained from trees, field crops and livestock play an important role in meeting cooking energy demand. At present, in the localities, people are using only biomass fuel for cooking food. None of the areas is connected with natural gas supply for domestic use or for use in industries in the locality.

5.23 Industries

Types of industries that are at present in operation in the airshed are shown in the 2nd column of Table 5.14. Against each type industry, types of fuel used and probable nature of pollution caused are also given.

Table-5.14: Industries Available in the Airshed

Sl. No.	Type of industry	Biomass fuel		Conventional Fuel		Probable nature of pollution caused
		Wood	Non-woody biomass	Diesel/ coal	Electrical	
1	Rice husking	-	Rice husk	Diesel	-	NO_x, SO_2, P.M. Noise
2	Flour Mill	-	-	Diesel	-	NO_x, SO_2, P.M. Noise
3	Bakery	√	-	-	-	Smoke from wood firing
4	Manufacture of wood products	-	-	-	√	P.M.
5	Tobacco	√	√	-	-	PM
6	Tea	√	√	-	-	PM
7	Bricks	√	-	Coal	-	NO_x, SO_2, P.M.
8	Pottery	√	-		-	P.M.

CHAPTER VI

ECONOMY AND ENERGY SCENE

Section A: State of Economy

6.1 Size of the Economy Structure and Growth

According to the World Development Indicators (2009) of the World Bank, the Gross National Income (GNI) of Bangladesh stood at $74.9 billion and the per capita GNI at $470 in 2007. Growth of GDP of the country had been by 6.4% while that in respect of per capita GDP had been by 4.7% during the year 2006-07. According to the Finance Division of the Ministry of Finance (Bangladesh Economic Review, 2008), per capita GNI and per capita GDP during the year 2006-2007 had been Tk36116 and Tk33607, respectively with corresponding provisional values of Tk41103 and Tk38056 for the year 2007-2008. At constant prices, the estimated per capita GNI for FY2007-2008 had been higher by 13.81% compared to that during the previous FY2006-2007.

During FY2007-2008, the projected growth rate of per capita GDP had been estimated at 12.10% higher than the corresponding value during 2006-2007.Gross Domestic Savings was 20.25% of GDP and Gross National Savings was 27.67% of GDP in the year 2005-2006 (BBS 2007). Investment as percentage of GDP stood at 24.65 of which the shares of private and public investment were 18.65 and 6.0 respectively.

Export earning of the country increased more than 100% in a decade from $4.4 billion in 1996-97 to $10.5 billion in 2005-2006. Garment products alone account for more than 70% of the total export earning. In spite of significant growth in export, the country has been experiencing a trade deficit as the value of import has always exceeded the value of export over the years. The country, however, enjoys a favourable balance of payment due to workers‘ remittance from abroad. The foreign exchange position of Bangladesh Bank has also improved as it recorded a rise from $2.4 billion in 2003/04 to $4.3 billion in 2006/07.

Agriculture, industry and commercial activities are the dominant sectors of the economy in terms of their contribution to GDP. Besides, other sectors/sub-sectors such as housing/real estate, fisheries and services sector (social, community and personnel) also make significant contribution to GDP. The share of agriculture (including crop, livestock and forestry) in GDP in the year 2005-2006 was 16.98% and that of industry was 17.79%.

The commercial sectors (whole sale and retailing) and the social /personal service sectors contributed 14.08% and 7.25% to GDP. The share of construction sector in GDP was 9.14% in the same year. The shares of power and gas sub-sectors in GDP were 1.38% and 0.19% respectively in the year 2005/06.

The annual growth rates in agriculture sector were 5.23% and 1.80% in the years 2004-2005 and 2005-2006 respectively. The growth rates in the industrial sector were 8.19% and 10.77% respectively during the same period. The power sub-sector witnessed 8.58% and 7.45% growth rates and the gas sub-sector recorded 8.87% and 9.37% growth rates during 2004-2005 and 2005-2006 respectively. The growth rates in agriculture has generally been lower than overall GDP growth rates whereas growth rates in industrial, in power and gas sectors have been higher than the growth of GDP over the years.

6.2 Employment Status

The Labour Force Survey of 2002-03 revealed that 44.3 million people above 15 years of age were employed in different occupations. The employed population comprised 34.5 million males and 9.8 million females.

Agriculture alone accounted for 51.69% of the employed labour force. Employment in other sectors include 9.71% in industrial, 15.34% in commercial (hotel and restaurants), 3.64% in community and personal services.

Besides the active labour force (15 years and above), child labour (5-14 years) in the country is estimated at 4.7 million (BBS Statistical Pocket Book Bangladesh, 2006). The unemployment rate excluding underemployment is 4.8%. The unemployment rates of males and females are 4.0% and 7.6% respectively. Although the unemployment is relatively low, the underemployment rate is quite high–16.6% in the year 2000. The underemployment rates among the males and females were 7.4% and 52.8% respectively.

6.3 Income Distribution

Household Income and Expenditure Survey of 2005 reveals that the gap between the poorest of the poor (bottom 5%) and the richest of the rich (top 5%) is extremely high. The income accruing to top 5% of the household was 26.93% whereas the same was 0.77% for the bottom 5% household. The income distribution pattern shows a greater disparity in the urban area than in the rural area. In the urban area, the shares in income of bottom 5% and top 5% households were 0.67% and 30.37% respectively. In the rural area, the shares of income to bottom 5% and top 5% household were 18.8% and 23.03% respectively.

The share of income accruing to bottom decile of households was 2% and that accruing to top decile of households was 37.64%. Average monthly income per household is Taka 1,605 for bottom 5% household and Taka 33,471 for top 5% household.

The Gini coefficient of income increased to 0.467 in 2005 from 0.451 in 2000. This increase of Gini coefficient shows a greater disparity in income distribution during the period 2000 to 2005. The Gini coefficients for rural and urban areas are 0.428 and 0.497 respectively, which imply a greater income inequality in the urban than in the rural area.

Section B: Energy Scene

6.4 Energy and Major Related Issues in Bangladesh

Since energy is used in domestic cooking, food processing and lighting, industries, transport, agriculture and other economic activities, energy-related problems now facing the country must be clearly identified. The current pressing problems are:

a. Consumption of huge amount of biomass (about 51.20 million tonnes per year (GOB, 2005) leading to shortage of organic matter needed for productivity of soil, feed for cattle, raw material for industries, fuel for domestic and industrial use.

b. Consumption of crop residues and cattle-dung as fuel in increasing amounts (about 50% of the total biomass) leading to deficiency of organic matter and micro-nutrients in soil.

c. Rapid deforestation leading to erosion and change in climatic patterns.

d. Shortage of import-based diesel affecting irrigation leading to less agricultural production than expected.

e. Inadequate availability of energy affecting growth and even maintenance of industries leading to unemployment.

f. Inadequate availability of electricity is hampering the growth of GDP and thus improvement of living quality.

Other pertinent issues are

a. Over 90 million people of the country are without access to electricity.

b. People living in poverty pay a higher price per unit of energy services than do the rich.

c. Improvements in energy efficiency have considerable potential to reduce poverty.

d. Women and children‘s time spent in fuel and water collection represents a high social and economic cost.

e. The pattern of energy use influences population growth.

f. Energy measures to contribute to the solution of under-nutrition must be built into development strategies.

g. Women and children have the highest exposures to indoor air pollution.

h. Energy can play a major role in stemming and reversing the problem of land degradation.

i. Energy imports represent a significant fraction of foreign exchange earnings.

j. Current energy consumption patterns contribute to unsustainability.

k. Energy must be an instrument for the achievement of sustainable development.

These facts make it imperative for GOB to go for an effective action plan for generation of electricity from whatever sources available especially city wastes, renewable sources, natural gas, etc. and for efficiency improvement in generation and consumption keeping protection of clean environment in view. In the National Energy Policy (NEP, 1996) and the Fifth Five Year Plan (FFYP, 1997), GOB has placed special emphasis on electricity generation in addition to development and utilization of renewable energy (RE) and improvement of energy efficiency (EE). Considering the current energy source situation, GOB policies & initiatives and private sector participation, natural gas based electricity generation using an efficient technology is the mast feasible and environmentally friendly option.

6.5 National Energy Availability

Biomass, gas, oil, electricity and coal are the main sources of energy used in Bangladesh, Biomass comprises wood fuels such as fuel wood, charcoal, twigs and leaves, agricultural residues such as plant residues, paddy husk and bran, bagasse, jute sticks and animal dung such as cattle-, buffalo-, goat- and sheep dung. The total amount of biomass fuel consumed in the country is about 51.20 million tonnes (GOB, 2007).

The country has a sizable deposit of natural gas. In the 23 gas fields so far discovered the total recoverable amount of gas is estimated at 20.51 TCF (MOF, 2006). The country uses 1.5 – 2.0 million tonnes of petroleum and petroleum products per year, almost the entire amount of which is imported claiming nearly two-thirds of the total export earnings. About 1000 million tonnes of bituminous coal in Jamalganj-Jaipurhat area and also a deposit of 300 million tons similar quality coal at Barapukuria (Dinajpur) and 450 million tonnes at Khalashpur (Rangpur) have been discovered (PSMP, 1995). Being situated at a depth of over 900 meters and thus mining cost being high, any sizable quantity of Jamalganj-Jaipurhat coal may not be available

in the near future for widespread use. Barapukuria coal, being situated at a depth of around 160 meters, is being mined for use in a power plant. The present demand of 0.1 to 0.15 million tonnes for coal is met by import and is almost exclusively used for brick burning.

The country, being flat, is not in a very favourable position is respect of hydroelectricity. At present, 230 MW is being harnessed from the Kaptai Dam.

There is an estimated reserve of 171 million tonnes of peat spread over large areas in Faridpur (150 million tonnes), Khulna (8 million tonnes) and Sylhet (13 million tonnes) regions. As these areas remain under water during almost half of the year, winning cost of the peat will be rather high unless a technology suited to the local conditions be developed.

The important points regarding the relative contributions of the commercial and biomass fuels in the national energy scene are:

1. Domestic sector consumption decreased from 64.8% in 1990 to 60.4% in 2000.
2. Contribution of biomass fuels decreased from 73.1% in 1990 to 68.0% in 2000.
3. Industrial and commercial use of biomass fuels account for 13.8% in 1995 and 13.7% in 2000 of the total national energy consumption.
4. In the industrial sector in 2000, out of the total of 206.4 PJ (Petajoule), 128.6 PJ (62.3%) comes from biomass fuels and the remaining 37.7% from commercial fuels showing that close to two-thirds of the energy consumed in industries are derived from biomass fuels. The industrial consumption is almost one-third (35.7%) of the energy consumed in the domestic sector.

Domestic sector accounts for the major share (60.4%) of total energy consumption and energy is used (mainly for cooking) in this sector in a very inefficient way (efficiency varying between 5 and 15%) necessitating immediate intervention in respect of EE or some alternatives. Inefficient use of biomass leads to higher cost of production in the industrial sector.

6.6 Power

6.6.1 Electricity: At Present, 42% of the population has access to electricity and per capita generation is only 164 kWh which is very low compared with other countries. The government has declared its vision to provide electricity to all by the year 2020. A number of reform and restructuring programmes have been undertaken accordingly.

In FY 2005-2006, total installed generation capacity was 5208 MW including 3918 MW in public sector and 1290 MW in private sector. Commissioned in February 2000, Barapukuria coal-based 2 × 125 MW power plant contributed a lot in managing load shedding in the northern region of the country. In the public sector, a good number of generation units have become very old and have been operating at a much-reduced capacity. As a result, their reliability and productivity are also poor. Over the last few years, actual demand could not be met due to shortage of available generation capacity. In FY 2005-2006, maximum generation was recorded 3812 MW (PDB 259 IMW and IPP 122 IMW).

6.6.2 Power Generation: About 22,976 million kilowatt hour (MkWh) net power was generated during FY 2005-2006 which includes 14,455 MkWh from public sector and 8,521 MkWh from private sector. Of the total net power generation, 62.91% was generated from public sector and 37.09% from private sector. This power generation was 7.32% higher than the total generation of previous fiscal year. Of the total power generation, 88.56% was gas-based. 2.71% hydro-1.65% coal and 7.08% oil-based.

In FY 2005-2006, natural gas consumption by BPDB power plants was 153920 million cubic feet. Total electricity sale through PDB system stood at 20954.27 MkWh in FY 2005-06. Of the total PDB's sale, 25.36% was sold to DESA, 9.69% to DESCO, 38.48% to REB, 6.55% to WZPDCL and 19.92% to BPDB's own retail consumers.

6.6.3 Maximum Generation: Though the installed capacity has increased considerably, but due to shortage of available generation capacity, the actual demand could not be met in the last few years.

6.6.4 Power Development Programme: As per Basic Forecast of Power System Master Plan (2005), the maximum demand in 2007, 2012 and 2015 would be about 5,112 MW, 7,732 MW and 9,786 MW respectively. The demand is expected to rise to 13,993 MW in 2020. To meet the demand with quality supply and reliability, a power development plan including reform strategy has been developed.

6.7 Transmission System

6.7.1 Power Grid Company of Bangladesh (PGCB): Power Grid Company of Bangladesh Ltd was created in 1996 under the Power Sector Reform Programme of the government. Since then, PGCB is running as a single power transmission entity in the country under the Company Act, 1994. With the creation of this company, the existing transmission system has been handed over to PGCB from PDB and PGCB has taken over the full responsibility of the total transmission system. In 1996, when PGCB was formed, the total length of 230 kV and 132 kV line stood at 838 circuit (ckt) km and 4755 ckt km respectively and by June 2006, the length increased to 1466 km and 5377 ckt km respectively. PGCB has started off loading its share to the stock market by direct listing for collecting capital from the market recently.

6.7.2 Power Distribution System: Distribution System comprises 33 kV, 11 kV and 0.4 kV lines. In FY 1991-1992, the total distribution line was 32,780 kms, which have increased to 45,644 kms in FY 2005-2006. The number of consumers have also increased to 15,18,891 in FY 2005-2006 from 9,03,001 of FY 1991-1992.

6.8 BPDB System Loss, Accounts Receivable and Accounts Payable

In FY 2005-2006, the system loss stood at 8.76% (on net generation), which is 1.43% lower than what stood in the previous year. Also the distribution loss in BPDB system came down to 19.06% in FY 2005-2006 from 20% in the previous year. On the other hand, the accounts receivable in FY 2005-2006 amounts to Tk. 4,500.94 core, which is equivalent to 10.95 months' bill.

6.9 Dhaka Electric Supply Authority (DESA)

Dhaka Electric Supply Authority (DESA) was created by separating the former Dhaka Electric Supply from Bangladesh Power Development Board (BPDB) on March 06, 1990. System loss of the former Dhaka Electric Supply was 38.26%. However, DESA's system loss went down to 20.13%, in June 2006.

6.10 Dhaka Electric Supply Company Ltd. (DESCO)

In order to disconnect illegal electricity connections, prevent electricity pilferage and reduce system loss, DESCO, over the last few years, has taken a range of steps like supervision, through

Monitoring Cell, disconnection and filing cases through Magistrate courts. Aside from these, the development activities that have been completed are Decentralisation of Operational Activities, Introducing One Point Service, Electronic Bill Payment System, Spot Metering etc. Technical and commercial programmes taken up in FY 2005-2006 are as follows:

6.10.1 Pre-paid Metering System: DESCO seeks opportunities to create and promote consumer convenience as well as enhance income potential of the company. In this context, DESCO has undertaken ‗Pre-paid Metering Pilot Project' with consumer-friendly facilities and accordingly, installation of pre-paid maters started in August 2005. DESCO installed 5000 user-friendly pre-paid meters to initially cover the consumers residing at Sector-4 & -6 under Uttara Model Town in Dhaka with the technical assistance of Bangladesh University of Engineering & Technology (BUET). Besides, in phase-II, a contract agreement has been signed with BUET to install another 5000 single-phase and 1000 three-phase meters in the FY 2005-2006. The customers of pre-paid meters will enjoy government declared 2% rebate on electricity sales rate and monthly minimum charge is not applicable for the pre-paid customers.

6.10.2 System Loss Reduction and Collection of Outstanding Bill: DESCO has succeeded in lowering system loss to 16.20% in FY 2005-06. It may be noted that the entity's bill collection ratio in FY 2005-06 is 96.63% and C.I. Ratio 80.98%. DESCO is trying to achieve 100% collection of electricity bill. Measures have therefore been taken to prepare and dispatch electric bill to every consumers as well as a number of collection accounts have been opened in different banks within and outside DESCO's area in order to help the consumers to pay their bills more conveniently. Besides, DESCO has introduced Easy pay, Ready cash, Auto debit system etc. to collect bills. Measures have been taken so that the outstanding bills of government/semi-government/autonomous bodies do not exceed 3 months.

6.10.3 Capacity Enhancement of Substations: With a view to ensuring uninterrupted power supply as well as to catering to the increased demand of the consumers, the capacity of the following sub-stations has been enhanced:

(1) 33/11 kV Substation at Gulshan-1
(2) 33/11 kV Substation at Gulshan-2
(3) 33/11 kV Substation at Nikunja
(4) 132/33/11 kV Substation at Uttara
(5) 33/11 kV Substation at Mirpur-2

Moreover, DESCO has inter-linked the Digum-Kafrul, Digun-Mirpur Old Mirpur-2, Mirpur Old Kafrul and Baridhara-Gulshan sub-stations to under ground cables with view to supplying power through alternative sources in case of emergency as well as for efficient load management.

6.10.4 Off-loading of Shares: As part of continuous restructuring of power sector as well as to ensure private participation, DESCO has offered 25% of its shares for public in the stock market through direct listing system.

6.11 Rural Electrification Board (REB)

Up to June 2006, by constructing 207,130 kms distribution lines, REB has given a total of 6,870,912 connections in 45,794 villages, of which 5,807,713 domestic, 198,662 irrigation, 736,013 commercial, 114,744 industrial and 13,781 other connections.

6.11.1 On-going projects under REB: RADP of FY 2005-2006 provides an allocation of Tk. 75,785 million (of which Tk. 54,784 million in local currency and Tk. 21,001 million in Project aid) for implementation of 18 projects (13 investment projects and 5 technical

assistance projects). Achievement of financial progress in FY 2005-06 is 89% of the total allocation.

During the period between 1996-97 to 2000-2001, a total of 1,996,795 consumer connections have been given through construction of 54,545 km line by REB. On the other hand, during FY 2001-02 to June 2006, 77,702 kms line has been constructed through which 3,475,191 consumers got electricity connections. Besides, in the remote areas where power can not be distributed in a conventional way, REB has taken 2 renewable energy projects with a target to provide 22,000 domestic connections through Solar Home Systems. Up to June 2006, 1618 domestic connections have been given. REB purchases electricity from PDB and distributes electricity to the consumers.

6.12 Reforms and Efficiency Improvement measures

Government is committed to implement reform programmes for the overall improvement in the power sector. For the improvement of management efficiency in generation, transmission and distribution, a number of reform programmes have been taken up. Several of them have already been implemented. The implementation status till date is as follows:

(1) Ashuganj Power Station has been converted into Ashuganj Power Company Ltd. (APSCL) and it started functioning since June 2003.

(2) Electricity Generation Company of Bangladesh (EGCB) has been created to look after the generation in Siddhirganj Power Station area.

(3) Under the reform programmes. Power Grid Company of Bangladesh (PGCB) and Dhaka Electric Supply Company (DESCO) were created in 1996. PGCB has taken over total transmission system from BPDB in December 2002.

(4) West Zone Power Distribution Company has taken over distribution business from BPDB and started functioning since October 2003.

(5) Creation of North-West Zone Power Distribution Company is under way and expected to be operational soon.

(6) Bangladesh Power Development Board will be converted into a holding company under the Company Act. 1994. Foreign consultants have already been engaged for this purpose.

(7) Haripur Power Station has been converted to Strategic Business Units (SBU). Based upon the satisfactory performance of Haripur SBU, Baghabari Power Station has also been converted into SBU. In future, more power stations will be converted into SBUs.

(8) In order to increase the efficiency of distribution management, distribution circles have been reorganized into Strategic Business Units (SBUs) introducing modern management.

6.12.1 Project of Power Division included in REDP: RADP of FY 2005-06 provides an allocation of Tk. 33.97 billion (GOB Tk. 21.44 billion and Project Aid Tk. 12.54 billion) for implementation of 63 development projects (54 investment projects and 9 Technical Assistance Projects) of the Power Division. This budget includes GOB fund of Tk. 150.0 million for implementation of 2 projects of BPDB under Japan Debt Cancellation Programmes.

6.12.2 Private Participation in Power Sector: In order to provide electricity service to all by the year 2020, government has taken various programmes. Power sector development

involves huge amount of investment which is very difficult for the government alone to manage. Realising this fact, Private Sector Power Generation reform programmes taken up by the government includes creation of Power Grid Company of Bangladesh (PGCB) and Dhaka Electric Supply Company (DESCO) in 1996 under the Companies Act. 1994. Moreover a contract has been signed between BPDB and BON Consortium Power Co. Ltd. to construct Meghnaghat 450 MW Combined Cycle Power Station (2nd Phase) on the basis of BOT. It is expected that in 37 months from the date of signing contract the plant will start its commercial operation. Besides, the establishment of a number of 10-30 MW small power plants is under way.

6.12.3 Tariff for Bulk Purchase of Power at Busbar:

- The power produced by the IPP shall be purchased (as per Power Purchase Agreement) by BPDB/DESA/REB or any other transmission or distribution company which may be established in future, or any large consumer. The Power Cell as the GOB agent will indicate which organization will be the power purchaser at the time of issuance of RFP.

  The tariff structure would consist of two parts:

  a) Capacity Payment: This will cover debt service, return on equity, fixed operation and maintenance cost, insurance and other fixed costs. The capacity payment would be further divided into an escalating & non-escalating portions. The capacity payment will be made in Bangladesh currency (Taka), but denominated in both dollars (to repay foreign loans and fixed costs) and local currency (to repay local loans and investment and local fixed costs). The capacity payment will be linked to a certain level of availability of the power plant which will be made known to the bidders at the time of issuance of RFP.

  b) Energy Payment: This will cover the variable costs of operation and maintenance, including fuel and be paid in Taka. The payment would be further divided into fuel component which would be a pass-through and a non-fuel component which escalates.

The energy payment will be denominated in local currency to the extent to which the variable costs are in local currency.

- In the solicited bids, the bidders shall offer bulk power tariff based on the capacity payment and energy payment and also provide the equivalent levelized tariff over the contract period in US cents/Kwh (to be paid in Taka), based on discount rate, Tariff profile restriction and plant factor to be specified during the solicitation of bids. The evaluation will be based on the criteria to be provided in the REP.
- The sponsors of private power project will provide year-wise tariff profile over the contract period in a manner that will match their annual debt service requirements.
- A mechanism shall be provided for the adjustments of certain tariff components to variations in Taka/ Dollar exchange rate, fuel price and inflation rates. In determining this adjustment/indexation, the issue of efficiency gains would be taken into consideration.

- Interconnection of IPP to Transmission System:
  The power will be purchased from the IPP at a specified voltage at the outgoing terminal (interconnection point) of the sub-station of the power plant. The transmission line for interconnection with the national grid will be provided by the appropriate agency. The costs of interconnecting facilities up to outgoing terminals of the private power projects (including step up auto transformers, circuit breakers and associated switchgear) will be borne by the private power producers.

6.12.4 Fiscal Incentives:

- The private power companies shall be exempt from corporate income tax for a period of 15 years.
- The companies will be allowed to import plant and equipment without payment of customs duties, VAT (Value Added Tax) and any other surcharges as well as import permit fee except for indigenously produced equipment manufactured according to international standards.
- Repatriation of equity along with dividends will be allowed freely.
- Exemption from income tax in Bangladesh for foreign lenders to such companies.
- The foreign investors will be free to enter into point ventures but this is optional and not mandatory.
- The companies will be exempted from the requirements of obtaining insurance/reinsurance only from the National Insurance Company, namely Sadharan Bima Corporation (SBC). Private power companies will be allowed to buy insurance of their choice as per requirements of the lenders and the utilities.
- The Instruments and Deeds required to be registered under local regulations will he exempted from stamp duty payments.
- Power generation has been declared as an industry and the companies are eligible for all other concessions which are available to industrial projects
- The private parties may raise local and foreign finance in accordance with regulations applicable to industrial projects as defined by the Board of Investment (BOI).
- Local engineering and manufacturing companies shall be encouraged to provide indigenously manufactured equipment of international standard to private power plants.

6.12.5 Other Facilities and Incentives for Foreign Investors: The following facilities and incentives would be provided to private power producers:

- Tax exemption on royalties, technical know-how and technical assistance fees, and facilities for their repatriation.
- Tax exemption on interest on foreign loans.
- Tax exemption on capital gains from transfer of shares by the investing company.

- Avoidance of double taxation in case of foreign investors on the basis of bilateral agreements.
- Exemption of income tax for upto three years for the expatriate personnel employed under the approved industry.
- Remittance of upto 50% of salary of the foreigners employed in Bangladesh and facilities for repatriation of their savings and retirement benefits at the time of their return.
- No restrictions on issuance of work permits to project related foreign national and employees.
- Facilities for repatriation of invested capital, profits and dividends.
- Provision of transfer of shares held by foreign shareholders to local shareholders investors.
- TAKA, the national currency, would be convertible for international payments in current account.
- Re-investment of remittable dividend to be treated as new foreign investment.
- Foreign owned companies duly registered in Bangladesh will be on the same footing as locally owned companies with regard to borrowing facilities.

6.13 Natural Gas Status

At present, 67 wells in 16 gas fields are in production. These include: Titas (16wells), Bakharabad (4 wells), Habiganj (9 wells), Rashidpur (7 wells), Kailastilla (3 wells), Sylhet (2 wells), Narsingdi (1 well), Meghna (1 well), Saldanadi (2 wells), Fenchuganj (2 wells), Sangu (6 wells), Jalalabad (4 wells), Beanibazar (2 wells) Feni (3 wells), Moulavibazar (4 wells) and Bangura (1 well). A total of 486.75 billion cubic feet (BCF) gas was produced in the FY 2004-2005, while in the FY 2005-2006, total gas production was 526.72 BCF (Provisional). Natural gas is the key energy source of power generation, fertilizer production, industrial and domestic purposes.

6.14 Bangladesh Energy Regulatory Commission (BERC)

For the long term development of energy and gas sector, Bangladesh Energy Regulatory Commission (BERC) was established in 2004 as an independent organization to create an atmosphere conducive to private investment in the generation, transmission, transportation, storage and marketing of energy; to assure transparency in the management, operation and tariff determination in this sector, to protect consumer‘s interest and to promote the creation of a competitive market.

The BERC has already framed a set of important regulations and drafted other necessary and important regulations. The Licensing Regulations, 2006 is at the final stage for gazette notification. The approval of the organizational ser up is under active consideration of the government.

Chapter VII
Poverty and Socio-Economic Assessment Study

Section-A: Socio-economic Assessment Study

A Poverty and Socio-Economic assessment study has been carried out to generate demographic and socioeconomic data and indicators for assessing the poverty level and the present livelihood condition and related aspects of the population living in the impact zone of Summit Bibiyana Power Company Limited to be set up at Parkul village of Aushkandi union of Nabiganj Upazila under Habiganj district.

7.1 Study Methodology

The methodology for the social baseline study includes different methods and tools, which are as follows:

- Collection of Secondary Data through literature survey
- Household Survey
- Focus Group Discussion (FGD) with fisherman group, day labourer, women group and the land owner who have lost the land by the power plant project.
- Consultations with project affected persons, local elite, local government, local administration, local union parishad chairman and members.

7.2 Collection of Secondary Data

Secondary data on demographic and socioeconomic issues of the study area have been collected from various sources including the population census of Bangladesh Bureau of Statistics (BBS) and from upazila level offices and union parishads.

7.3 Household Survey

Households in the project impact area have been surveyed using a questionnaire designed for collecting demographic, socioeconomic and other relevant data/information. For the household survey, the impact area was divided into four zones viz: high impact zone, medium impact zone, low impact zone and fishermen village. The geographical area within a radius of 10kms from the power plant site has been defined as the impact area (airshed) for the baseline survey. The high impact zone covers the area within 2 km radius of the plant site and includes most of the people who would be affected through losing their land that would be acquired by the project. Medium impact zone include the area beyond the high impact zone but within 5 km radius of the plant site and are likely to loose some of their land to be acquired for the construction of a new approach road. The rest of the impact zone has been categorized as the low impact zone. As the fishermen constitute a distinct livelihood group that may face a consequence quite different from that of other occupational groups (agriculturists, for example), they have been treated as a separate group under the analytical framework for a better appreciation of the problems and issues to be encountered by them.

Photo-1: Field Enumerator at the respondent premises

7.3.1 Coverage of the survey

Altogether 14 villages have been covered by the survey of which 99 are from high impact zone, 40 from medium impact zone, 45 from low impact zone and 20 fishermen village.

The complete lists of all households located in 14 sample villages have been prepared to generate sampling frame of the study population. The sampling frame has enumerated 604 households in 14 villages. Based on the sampling frame, 30% of households have been randomly selected from the study villages. Each sample household has been interviewed by a Field Investigator and data/information has been gathered from the sample households using a questionnaire (Annexure 2). Zone wise distribution of households surveyed is:

High impact	……..	99
Medium impact	……..	40
Low impact	……..	45
Fisherman village	……..	20
Total	……..	204

7.3.2 Data Processing and Analysis

Survey data have been processed and analyzed using SPSS package programme. Statistical outputs such as one way and two-way tables and descriptive statistics including mean, median, and percentage have been calculated for interpretation of results obtained from survey data.

7.3.3 Socio-Demographic Characteristics of Project Area

7.3.3.1 Household size and Sex-ratio

According to the household survey, the household size i.e. the average number of persons per household is 6.2. The household size ranges from 6.1 in the high impact zone to 6.5 in the low impact zone (Table-7.1). The average household size in the medium impact zone and the fishermen are 5.9 and 6.6 respectively. The household size in the project area is higher than the national household size which is 4.9 (*BBS, 2006*).

Table-7.1. Average Household Size and Sex Ratio in the Study Area.

Study Area	Average Household Size (number)	Sex Ratio
High	6.1	96.1
Medium	5.9	121.5
Low	6.5	104.9
Fisherman	6.6	106.2
All	6.2	103.5

Source : BCAS field survey through questionnaire, 2011.

The male and the female constitute 50.9% and 49.1% respectively of the population in the study area. The sex-ratio (i.e. the number of males per 100 females) in the project area is 103.5. The national sex-ratio was found to be 103 according to the population census of 2001. The sex-ratios do not reflect any significant variations among the four impact zones covered by the survey (Table-7.2).

Table- 7. 2 Percentage Distribution of Household Members by Sex in the Study Area

Study Area	Percentage		
	Male	Female	**Total**
High	49.0	51.0	**100.0**
Medium	54.9	45.1	**100.0**
Low	51.2	48.8	**100.0**
Fisherman	51.5	48.5	**100.0**
All	50.9	49.1	**100.0**

Source: BCAS field survey through questionnaire, 2011.

7.3.3.2 Age Distribution of the Population

Age distribution of the population obtained from survey data shows that 11.2% of the population is children (0-4 years), 27.5% are in the working age group (5-14 years), 31.9% are 15-30 years of age, 15.6% are of age 31-45, 8.8% are of age 46-60 and the rest 5% are above 60 years. However, majority of the fishermen aged between 5-14 (27.2%) and 15-30 (29.2%). The age structure of the population is marked by more or less a similar pattern in the four impact zones under the study area (Table-7.3).

Table-7.3. Age Distribution of Household Members in the Study area

Age Group (Year)	**Percentage**				
	High	**Medium**	**Low**	**Fisherman**	**All**
Up to 4	10.0	11.0	16.5	12.6	11.2
5-14	28.2	26.2	24.9	27.2	27.5
15-30	32.1	31.1	33.3	29.2	31.9
31-45	15.3	16.5	14.1	18.4	15.6
46-60	9.2	10.0	6.6	7.9	8.8
Above 60 Year	5.2	5.2	4.6	4.7	5.0
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Source: BCAS field survey through questionnaire, 2011.

7.3.3.3 Educational Status

There are about 14.1% of the population in the study area who are illiterate. Hence, another 15.3% of the population is able to sign, although they can neither read nor write. The population having primary level education (upto 5 years of schooling) and secondary level education (up to 10 years of schooling) are 39.0% and 25.2% respectively. Only 3.5% of the population has SSC and higher academic attainment. It has been found that in the high impact zone only 0.7% of population have higher academic degrees (Table-7.4).

Table- 7. 4. Educational Status of Household Members by Study Area

Educational Status	Percentage				
	High	Medium	Low	Fisherman	All
Illiterate	15.7	12.5	8.3	23.5	14.1
Can sign only	16.9	13.0	16.2	9.8	15.3
Primary	38.0	36.0	42.3	42.2	39.0
Secondary	24.2	29.5	26.9	17.6	25.2
S.S.C and equivalent	2.8	4.0	4.0	4.9	3.5
H.S.C and equivalent	1.7	5.0	2.3	2.0	2.5
Degree and above	0.7	-	-	-	0.4
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Source: BCAS field survey through questionnaire, 2011.

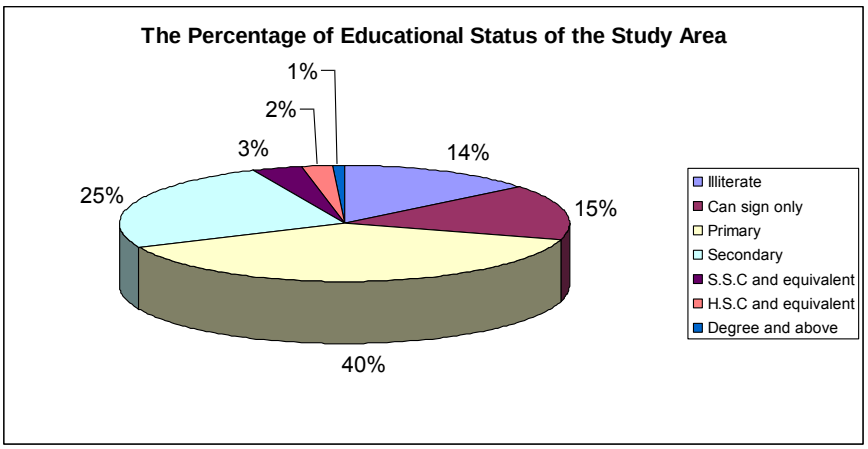


Figure-7.1: The Educational Status for the Four Impact Zones of the Study Area

7.3.3.4 Occupation and Employment

People in the study villages are engaged in different types of primary and secondary occupations such as farming, wage labour, business, services (govt. & non-govt.), fishing, household work, overseas employment, carpenter/black smith, rickshaw/ van driving etc. The survey reveals that the highest percentage (32.6%) of the workforce are engaged in household work followed by other occupations including agriculture/farming (13.2%), wage labour (7.1%), business (5.4%), overseas employment (2.5%), services (2.2%) and fishermen (1.4%). However, other occupations such as carpenter, blacksmith, handicrafts constitute a smaller section of the working population. Students comprise 31.2% of the population. Other than students, farming, household works, wage labour etc. are the main occupations in all the impact zones excepting the fisherman village. Fishing activities happen to be an important occupation in the village (Table-7.5).

Aside from primary occupation, a significant proportion of the population also adopts a secondary occupation to enhance the household income. Consequently, agriculture, wage labour and business are found to be the dominant secondary occupation in the study area.

Table-7.5. Primary Occupation of Household Members by Study Area

Primary Occupation	Study/Impact Area				
	High Impact	**Medium Impact**	**Low Impact**	**Fishermen Village**	**All (%)**
Agriculture/Farming	15.4	18.0	8.2	1.2	13.2
Wage labour	7.1	1.9	12.9	4.8	7.1
Household work	32.2	37.2	34.8	29.5	32.6
Working in abroad	2.7	3.4	1.6	1.5	2.5
Fishing	0.3	-	-	10.5	1.4
Van/Rickshaw puller	0.4	-	0.3	0.6	0.4
Service	1.8	2.7	2.5	3.6	2.2
Business	4.2	2.7	7.9	13.0	5.4
Student	31.9	29.9	27.9	31.6	31.2
Unemployed	1.8	0.8	1.9	1.8	1.7
Handicrafts	0.3	0.4	-	0.3	0.3
Carpenter/black smith	0.6	1.5	0.5	-	0.6
Others	1.3	1.5	1.5	1.6	1.4
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Source : BCAS field survey through questionnaire, 2011.

7.3.3.5 Land Use Pattern

According to the household survey, about 78.6% of household land is devoted to cultivation of crops. Other uses of household land includes: 8.7% for homestead, pond/ditches and agro-forestry acquire 3.7% and 0.01% respectively, however, horticulture/nursery obtain 0.8%. Kitchen garden accounts for 6.3% of the homestead land in the project impact area. The shares of household land such as bushes/jungles and fallow land are relatively small (Table-7.6).

Table-7. 6. Percentage Distribution of Household Land for Different Uses

Pattern	Study/Impact Area				
	High	Medium	Low	Fisherman	All
Homestead	7.3	7.3	11.8	33.3	8.7
General garden/bamboo bushes	6.8	4.6	5.5	24.0	6.3
Fruits garden/plants/seed nursery	1.0	0.6	0.4	-	0.8
Agricultural land	77.5	85.2	78.8	27.7	78.6
Pond/Ditch	4.2	2.3	3.2	14.1	3.7
Market/Hat/Bazaar	-	-	-	0.9	0.01
Agro-forestry	0.02	-	-	-	0.01
Bushes/Jungle	0.1	-	0.05	-	0.1
Fallow land	3.1	-	-	-	1.7
Others	-	-	0.3	-	0.1
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Source: BCAS field survey through questionnaire, 2011

The survey shows that 36.1% households have homestead land where 14.7% households have agricultural land, 27.7% households have kitchen garden and 17.9% households have ponds/ditches. 2.0% households have fruit garden/plants/seed nursery. There is only 1 market/hat/bazaar and an agro-forestry in the study area.

Land use pattern among different impact zones are marked by noteworthy variations; especially the fishermen village where homestead land accounts for 42.9% of the household land. Land under agriculture is only 4.8% in the fishermen village. About 14.3% of the household land in the fishermen village is used for ponds/ditches. 34.0% households have homestead land in the high impact zone where as 40.0% and 35.5% have homestead land in the medium and low impact zone respectively. There are 13.9% households have agricultural land in the high impact zone (Table-7.7).

Table-7.7 Percentage Distribution of Households Surveyed by Different Pattern of Land Use

Pattern	Study Area				
	High	Medium	Low	Fisherman	All
Homestead	98 (34.0)	38 (40.0)	43 (35.5)	18 (42.9)	197 (36.1)
General garden/bamboo bushes	80 (27.8)	26 (27.4)	30 (24.8)	15 (35.7)	151 (27.7)
Fruits garden/plants/seed nursery	9 (3.1)	1 (1.0)	1 (0.9)	- (-)	11 (2.0)
Agricultural land	40 (13.9)	17 (17.9)	21 (17.4)	2 (4.8)	80 (14.7)
Pond/Ditch	55 (19.1)	13 (13.7)	24 (19.8)	6 (14.3)	98 (17.9)
Market/Hat/Bazaar	- (-)	- (-)	- (-)	1 (2.3)	1 (0.2)
Agro-forestry	1 (0.4)	- (-)	- (-)	-	1 (0.2)
Bushes/Jungle	2 (0.7)	- (-)	1 (0.8)	-	3 (0.5)
Fallow land	3 (1.0)	- (-)	- (-)	-	3 (0.5)
Others	- (-)	- (-)	1 (0.8)	-	1 (0.2)
Total	**288 (100.0)**	**95 (100.0)**	**121 (100.0)**	**42 (100.0)**	**546 (100.0)**

Note: 1. Figures within parentheses represent percentages
2. Use of multiple patterns by the same Household (HH)

Source: BCAS field survey through questionnaire, 2011.

7.3.3.6 Household Land Ownership

According to the survey, average land ownership per household is more than one acre (114.6 decimal) in the impact area. There is wide variation in household land ownership among the different impact zones. It is more than one acre (118.7 decimals) in low impact area followed by 127.0 decimals in high impact area and 120.5 decimals in medium impact zone. The average land per household in fishermen village is only 19.1 decimals (Table-7.8).

Table-7. 8 Average Land Size per Household in the Study Area

Study Area	Average Land Size (decimal)	Standard Deviation (decimal)
High	127.0	315.6
Medium	120.5	252.5
Low	118.7	171.6
Fisherman	19.1	25.6
All	114.6	262.6

Source: BCAS field survey through questionnaire, 2011.

The survey reveals that size of land holding is upto 50 decimals for more than 67.7% of the households in the project impact area. In other words, more than 0.50 acres of land are owned by less than 30% households. However, only 2.9% households possess more than 7.5 acres. It is evident that the distribution of land is highly skewed in the project area (Table-7.9).

Table-7.9. Percentage Distribution of Households Surveyed by Land Holding

Land Group (decimal)	Study Area				
	High	Medium	Low	Fisherman	All
Land less (up to 49)	66 (66.7)	26 (65.0)	28 (62.2)	18 (90.0)	138 (67.7)
Marginal (50-149)	15 (15.1)	7 (17.5)	6 (13.3)	2 (10.0)	30 (14.7)
Small (150-249)	6 (6.1)	1 (2.5)	4 (8.9)	- (-)	11 (5.4)
Medium (250-749)	8 (8.1)	4 (10.0)	7 (15.6)	- (-)	19 (9.3)
Large (750+)	4 (4.0)	2 (5.0)	- (-)	- (-)	6 (2.9)
Total	**99 (100.0)**	**40 (100.0)**	**45 (100.0)**	**20 (100.0)**	**204 (100.0)**

Note: Figures within parentheses represent percentages

Source: BCAS field survey through questionnaire, 2011.

7.3.3.7 Share-cropping/Leasing of Land

A significant number of households are engaged in share cropping of agricultural land. The survey reveals that share-out agricultural land is 410.3 decimal and 257.4 decimal share-in agricultural lands for cultivation. The average leasing-in and leasing-out agricultural land have been found to be 185.4 decimal and 87.0 decimal respectively in the study area (Table-7. 10).

Table-7.10. Average of Households engaged in share cropping and leasing of Agricultural Land

Type of Land	Decimal									
	High		Medium		Low		Fisherman		All	
	Average	Std. Deviation	Average	Std. Deviation	Average	Std. Deviation	Average	Std. Deviation	Average	Std. Deviation
Share in	240.0	303.5	235.4	223.1	238.6	194.5	150.0	-	237.5	257.4
Share out	577.5	436.2	480.0	524.8	300.0	215.3	45.0	21.2	410.3	393.5
Lease in	171.5	262.3	-	-	206.2	113.9	-	-	185.4	211.9
Lease out	180.0	84.9	70.6	40.9	16.0	-	-	-	87.0	67.9

Note: Values in columns 2-5 report percentages of HH in respective zones. Values in column 6 shows the percentages of total HH surveyed

Source: BCAS field survey through questionnaire, 2011.

7.3.3.8 Sources of Irrigation

Different crops are grown with irrigation water from various water sources including canal, beel (lake), pond and rivers. Boro paddy is the dominant crop grown with irrigation water. Beels and rivers are the main sources of irrigation. Beels and rivers have the highest percentage of sources of irrigation water for 62.68% households. Deep tube-well and shallow tube-well are used as a source of irrigation by relatively small percentages of the households. Beels and rivers cover 66.7% of the irrigation water for the dry season crop such as Aus.

Meanwhile, beels and rivers contribute 100% of water during the Aman season (winter/wet season) where as 61.1% during Boro season (winter season). (Table-7.11)

Table- 7. 11. Percentage Distribution of Households Surveyed by Source of Irrigation by Type of Crops (All) (pi chart if possible, one each for high, medium and low impact zones)

Crops	Source														
	High			Medium			Low			Fisherman			All		
	Deep tube well	Shallow tube well	River/ khal/ pond/ beel	Deep tube well	Shallow tube well	River/ khal/ pond/ beel	Deep tube well	Shallow tube well	River/ khal/ Pond /beel	Deep tube well	Shallow tube well	River/ khal/ pond/ beel	Deep tube well	Shallow tube well	River/ khal/ pond/ beel
Aus (Dry season)	-	50.0	50.0	-	-	100.0	-	-	-	-	-	-	-	33.3	66.7
Aman (wet/winter crop)	-	-	100.0	-	-	-	-	-	-	-	-	-	-	-	100.0
Boro (winter crop)	-	33.3	66.7	-	50.0	50.0	-	40.0	60.0	-	-	-	-	38.9	61.1
Potato	50.0	50.0	-	-	-	100.0	-	100.0	-	-	-	-	25.0	50.0	25.0
Mustard	-	100.0	-	-	-	-	-	-	-	-	-	-	-	100.0	-
Chili	25.0	25.0	50.0	-	100.0	-	-	-	-	-	-	-	20.0	40.0	40.0
Vegetable	-	-	100.0	-	-	100.0	-	100.0	-	-	-	-	-	16.7	83.3
Others	50.0	50.0	-	-	-	-	-	100.0	-	-	-	-	33.3	66.7	-

Table-7.12. Average Agricultural Lands under Irrigation

(%)

Crops	Average Irrigation Land Size (decimal)									
	High		Medium		Low		Fisherman		All	
	Rabi	Kharif	Rabi	Kharif	Rabi	Kharif	Rabi	Kharif	Rabi	Kharif
Aus	120.0	45.0	180.0	120.0	270.0	-	-	-	210.0	82.5
Aman	300.0	60.0	-	-	585.0	120.0	-	-	490.0	90.0
Boro	145.4	200.8	142.0	285.0	141.3	184.6	150.0	-	143.5	207.8
Potato	20.3	-	7.0	-	-	-	-	-	17.0	-
Mustard	-	30.0	-	-	-	-	-	-	-	30.0
Chili	3.0	8.5	5.0	-	-	-	-	-	3.7	8.5
Vegetable	15.0	14.3	-	60.0	15.0	7.0	-	-	15.0	20.7
Others	15.5	75.0	-	-	-	7.0	-	-	15.5	41.0

Source: BCAS field survey through questionnaire, 2011.

It is found from the household survey that 36.5% agricultural land is under irrigation and 63.5% of agricultural land is rain fed. Irrigation is more extensive in the case of rabi crops (dry season) than the kharif season. (Table-7.12).

The proportion of irrigated land is high (79%) in the low impact zone compared to high and medium impact zones having irrigated land of 28.2% and 36.2% respectively.
(Note: All the data of above table 11 and 12 have been converted to percentage in the analysis.)

7.3.3.9 Household Income and Expenditure

According to the survey, average annual income per household is Taka 2, 02,692 (2895.5 US$) in the study area. Average annual household income differs among the different impact zones. It is Taka 1, 75,715 in medium impact zone followed by Taka 2, 18,831in high impact zone and Taka 2, 07,757 in low impact zone. Household income is found to be the least (Taka 1, 65,367) in the fishermen village (Table-13). However, the average annual expenditure per household is Taka 1, 56,817 (2240 US$) for the three impact zones.

Table-7.13. Average Annual Income and Expenditure Per Household by Study Area

Study Area	Average Annual Income Per Household (Tk.)	Average Annual Expenditure Per Household (Tk.)
High	2,18,831	1,71,286
Medium	1,75,715	1,37,599
Low	2,07,757	1,48,468
Fisherman	1,65,367	1,42,409
All	2,02,692 (2895.5 US$)	1,56,817 (2240 US$)

Source: BCAS field survey through questionnaire, 2011.

7.3.3.10 Sources of Household Income

The survey reveals that households derive their income from multiple sources including agricultural crops (rice and wheat), wage, salary, business, livestock, remittance, etc.

Agro crops especially rice/wheat is the second largest source accounting for 21.9% of household income in the study area followed by the largest income source remittance that contributes 24.9% to household income. Other sources are business, wage labour and services contributing 16.3%, 8.6%and 4.3% respectively to household income.

The contributions of different sources to household income are marked by noteworthy variations among the impact zones. Business, for example, contributes 53.3% to household income in the fishermen village; whereas its contribution is less than 25% in medium impact zone. Fisheries contribute 10.5% to household income in fishermen village compared to only 1.0% in low medium impact area. The contribution of services to household income varies from 11.4% in fishermen village to 3.0% in medium impact area (Table-7.14).

Table-14. Percentage of Annual Household Income from Different Sources

Source	**Percentage**				
	High	**Medium**	**Low**	**Fisherman**	**All**
Rice/Wheat production	22.9	24.5	24.7	2.6	21.9
Vegetables	1.2	0.8	1.3	-	1.1
Daily wages	8.1	10.1	9.6	6.1	8.6
Service	3.0	4.3	4.9	11.4	4.3
Business	7.5	22.2	19.1	53.3	16.3
Fruits	1.6	0.8	1.0	2.0	1.4
Timber and timber products	0.8	0.5	0.1	-	0.5

Source	Percentage				
	High	**Medium**	**Low**	**Fisherman**	**All**
Fuel wood	2.1	2.1	1.2	1.2	1.8
Fish	2.6	1.0	2.2	10.5	2.9
Livestock	3.2	2.4	3.2	-	2.8
Poultry	0.7	0.6	0.7	0.2	0.7
Handicrafts	-	2.3	0.3	-	0.4
Foreign remittance	31.4	18.3	21.4	6.7	24.9
Milk/egg	0.9	1.6	3.0	0.1	1.4
All type of mistri	5.0	1.4	2.4	-	3.4
Share out land	1.1	1.7	-	-	0.9
Aid	4.7	1.0	3.7	1.3	3.6
Others	3.2	4.4	1.2	4.6	3.1
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Source: BCAS field survey through questionnaire, 2011.

7.3.3.11 Income Distribution

The distribution of household income as obtained from the survey, reflect that annual household income is upto Taka 50,000 for about 4.4 percent households in the study area. Annual household income is more than Taka 2, 00,000 for about 32.4% households. Majority of the households (65.2%) belong to the income bracket ranging from Taka 50,000 to Taka 2, 00,000. Among the different impact zones, high income households (above Taka. 2, 00,000) are more in the high and medium impact areas than in low impact area and fishermen village. About 27.5% households in medium impact area and 30.3% households in high impact area have annual income more than Taka 2, 00,000. The corresponding percentages are 25.4% in low impact area and 17% in fishermen village (Table-7.15).

Table-15. Percentage Distribution of Households Surveyed by Annual Income

Total Annual Income (Tk)	Study Area				
	High	Medium	Low	Fisherman	All
Up to 50000	6 (6.1)	3 (7.5)	- (-)	- (-)	9 (4.4)
50000-100000	35 (35.3)	15 (37.5)	11 (24.4)	6 (30.0)	67 (32.9)
100000-150000	15 (15.2)	7 (17.5)	9 (20.0)	7 (35.0)	38 (18.6)
150000-200000	13 (13.1)	4 (10.0)	9 (20.0)	2 (10.0)	28 (13.7)
200000-250000	9 (9.1)	- (-)	6 (13.3)	2 (10.0)	17 (8.3)
250000-300000	6 (6.1)	4 (10.0)	1 (2.2)	1 (5.0)	12 (5.9)
300000-350000	2 (2.0)	- (-)	2 (4.4)	- (-)	4 (2.0)
350000+	13 (13.1)	7 (17.5)	7 (15.5)	2 (10.0)	29 (14.2)
Total	**99 (100.0)**	**40 (100.0)**	**45 (100.0)**	**20 (100.0)**	**204 (100.0)**

Note: Figures within parentheses represent percentages

Source: BCAS field survey through questionnaire, 2011

7.3.3.12 Household Expenditure

The survey reveals that annual expenditure is upto Taka 50,000 for only about 4.4 percent of the households in the study area. Annual expenditure is more than Taka 2, 00,000 for about 21.5% of the households although about 34.4% households have the same level of income. This implies that such households save a substantial portion of their income (Table-7.16).

Table-7. 16. Percentage Distribution of Households Surveyed by Annual Expenditure

Total Annual Expenditure (Tk)	Study Area				
	High	Medium	Low	Fisherman	All
Up to 50000	5 (5.0)	2 (5.0)	2 (4.4)	- (-)	9 (4.4)
50000-100000	35 (35.4)	15 (37.5)	10 (22.2)	6 (30.0)	66 (32.4)
100000-150000	21 (21.2)	10 (25.0)	13 (28.9)	6 (30.0)	50 (24.5)
150000-200000	18 (18.2)	2 (5.0)	12 (26.8)	4 (20.0)	36 (17.6)
200000-250000	8 (8.1)	7 (17.5)	6 (13.3)	3 (15.0)	24 (11.8)
250000-300000	2 (2.0)	4 (10.0)	1 (2.2)	1 (5.0)	8 (3.9)
300000-350000	2 (2.0)	- (-)	- (-)	- (-)	2 (1.0)
350000+	8 (8.1)	- (-)	1 (2.2)	- (-)	9 (4.4)
Total	**99 (100.0)**	**40 (100.0)**	**45 (100.0)**	**20 (100.0)**	**204 (100.0)**

Note: Figures within parentheses represent percentages

Source : BCAS field survey through questionnaire, 2011.

7.3.3.13 Economic Status

The economic status of households has been focused in terms of their accessibility to and affordability for food, clothing, educational facilities, medical facilities, transport facilities etc.

With respect to availability of food, it is considered ―satisfactory" by more than half (40.2%) of the households under the survey. Food availability is considered good by only 28.4% of the households and it is found unsatisfactory by another 31.4% of the households in the study area. The situation with respect to clothing is similar to that of food. So far as housing /accommodation facilities are concerned, it is found satisfactory by 43.1% of the respondents while this is viewed good and satisfactory by 27.5% and 27.9% respectively of the respondents. However, 1.5% people did not response for the corresponding status. Educational facilities are considered good, satisfactory and unsatisfactory by 16.2%, 37.2% and 29.9% of the respondents. Medical facilities are considered unsatisfactory by the highest percentage (60.3%) of the respondents followed by entertainment facilities which are considered unsatisfactory by 41.2% of the respondents in the study area. However, transportation facilities obtain 44.1% as satisfactory meanwhile, 18.1% and 36.3% are considered as good and unsatisfactory respectively (Table-7.17).

Table-7.17. Economic Status of Households (All)

Sector	Percentage				
	Good	Satisfactory	Unsatisfactory	No responses	**Total**
Food availability	58 (28.4)	82 (40.2)	64 (31.4)	- (-)	**204 (100.0)**
Clothing	45 (22.1)	102 (50.0)	57 (27.9)	- (-)	**204 (100.0)**
Accommodation/houses	56 (27.5)	88 (43.1)	57 (27.9)	3 (1.5)	**204 (100.0)**
Educational facilities	33 (16.2)	76 (37.2)	61 (29.9)	34 (16.7)	**204 (100.0)**
Medical facilities	20 (9.8)	60 (29.4)	123 (60.3)	1 (0.5)	**204 (100.0)**
Transport facilities	37 (18.1)	90 (44.1)	74 (36.3)	3 (1.5)	**204 (100.0)**
Entertainment	23 (11.3)	77 (37.7)	84 (41.2)	20 (9.8)	**204 (100.0)**

Note: Figures within parentheses represent percentages of total HH surveyed

Source : BCAS field survey through questionnaire

Among the four impact zones, medical facilities are considered unsatisfactory by the highest percentage of the respondents (71.1%) in the low impact area. Accommodation/houses are viewed unsatisfactory by the highest percentage (60.0%) of the respondents in the fishermen village.

7.3.3.14 Access to Common Property Resources:

Households in the study area have access, to a various extent, to different common property resources, amenities and infrastructural facilities. The survey shows that households having access to grazing land are 33.8%, educational facilities are 92.60%, medical facilities are 77.5%, mosque/temple are 99.5%, post office are 98.0% and market place are 98.0%.

Almost all the households (100%) have access to bus stand. Moreover, a high percentage of the households have access to other common facilities such as community centre (76.0%), graveyard (80.0%) etc. Community sharing of drinking water source and sanitation facilities has been reported 64.7% and 27.9% respectively.

Accessibility to common property resources, amenities and infrastructure is more or less similar in the different impact zones excepting the case of community centre in low impact area. Accessibility to community centre has been reported by 80.8% households in high impact zone, 72.5% households in medium impact zone viz-a-viz only 68.9% households in low impact zone (Table-7.18).

Table-7. 18. Percentage of Households Having Access to Common Property Resources, Amenities and Infrastructure

	Study Area				
	High	**Medium**	**Low**	**Fisherman**	**All**
Pasture land	37.4	40.0	35.6	-	33.8
Source of drinking water	66.7	57.5	57.8	85.0	64.7
Sanitation	32.3	35.0	22.2	5.0	27.9
Bus stand	99.0	100.0	100.0	100.0	100.0
Rail station	88.9	97.5	88.9	80.0	89.7

	Study Area				
	High	**Medium**	**Low**	**Fisherman**	**All**
Place of worship/mosque/temple	99.0	100.0	100.0	100.0	99.5
Post office	97.0	100.0	97.8	100.0	98.0
Vet nary hospital	80.8	75.0	75.6	70.0	77.5
Graveyard/cremation ground	76.8	80.0	84.4	90.0	80.4
Market	98.0	100.0	100.0	90.0	98.0
Primary school	97.0	100.0	97.8	95.0	97.5
High school	81.8	97.5	91.1	90.0	87.7
Club	32.3	27.5	13.3	5.0	24.5
Community center	80.8	72.5	68.9	75.0	76.0
Others	-	-	4.4	-	1.0

Note: Values represent percentages of total HH surveyed

Source: BCAS field survey through questionnaire, 2011.

7.3.3.15 Household Ownership of Livestock Animal

Households in the study area are engaged in rearing of different livestock animals and birds to support their livelihoods and income. Majority of the households (53.9%) own one or more cows in the study area. Rearing of poultry birds is being practiced by 72.5% households. Other livestock animals/birds are owned by relatively few households. Goat rearing, for example, has been reported by 11.3% households. Besides, only a small number of household (less than one percent) keep buffalo and pigs are kept by 1.5% of the households.

Of the four impact zones, rearing cows and poultry birds is more widespread in high impact zone and it is found to be the least in fishermen village. Rearing cow and poultry birds has been reported by 60.6% and 79.8% households respectively in the high impact zone vis-à-vis only 15.0% and 70% households in the fishermen village (Table-7.19).

Table-7.19. Percentage of Households Surveyed Having Different Livestock in Study Area

Livestock	Study Area				
	High (n=99)	Medium (n=40)	Low (n=45)	Fisherman (n=20)	All (N=204)
Cow	60 (60.6)	21 (52.5)	26 (57.8)	3 (15.0)	110 (53.9)
Buffalo	1 (1.0)	1 (2.5)	- (-)	- (-)	2 (1.0)
Goat	12 (12.1)	5 (12.5)	5 (11.1)	1 (5.0)	23 (11.3)
Pig	- (-)	1 (2.5)	- (-)	- (-)	1 (0.5)
Duck/Poultry	79 (79.8)	30 (75.0)	25 (55.6)	14 (70.0)	148 (72.5)
Bullock	8 (8.1)	- (-)	3 (6.7)	- (-)	11 (5.4)
Pigeon	6 (6.1)	1 (2.5)	1 (2.2)	- (-)	8 (3.9)
Others	1 (1.0)	- (-)	3 (6.7)	- (-)	4 (2.0)

Note: Figures within parentheses represent percentages

Source: BCAS field survey through questionnaire, 2011.

The average number of cows per households is 3.2 in the study area while the average number of poultry birds and goats per households are 14.8 and 2.3 respectively (Table-7.20).

Table-7. 20. Average Number of Livestock Per Household

Livestock	*Average Number of Livestock Per Household*				
	High	Medium	Low	Fisherman	All
Cow	3.0	3.2	3.8	2.3	3.2
Buffalo	1.0	1.0	-	-	1.0
Goat	2.7	1.8	2.2	1.0	2.3
Pig	-	6.0	-	-	6.0
Duck/Poultry	13.5	9.4	30.9	5.1	14.8
Bullock	1.7	-	3.3	-	2.2
Pigeon	7.4	7.0	2.0	-	6.8
Others	2.0	-	3.0	-	2.7

Source: BCAS field survey through questionnaire, 2011.

7.3.3.16 Involvement with NGOs/CBOs

About 25.0 percent households in the study area are involved with NGOs/CBOs through various activities such as soft loans/micro-credits. Among the four impact zones, more people are involved with NGOs in fishermen village. About 35.0 percent households are reportedly involved with NGO activities in the fishermen village. The corresponding figure in the low impact zone is 15.6% followed by high impact zone (24.2%) and medium impact zone (32.5%) (Table-7.21).

Table- 7. 21. Percentage Distribution of Households Surveyed Having Family Member Involvement in NGOs/CBOs

Study Area	Yes	No	**Total**
High	24 (24.2)	75 (75.8)	**99** **(100.0)**
Medium	13 (32.5)	27 (67.5)	**40** **(100.0)**
Low	7 (15.6)	38 (84.4)	**45** **(100.0)**
Fisherman	7 (35.0)	13 (65.0)	**20** **(100.0)**
All	51 (25.0)	153 (75.0)	**204** **(100.0)**

Note: *Figures within parentheses represent percentages*

Source: BCAS field survey through questionnaire, 2011.

7.3.3.17 Household Loan

The survey shows that about 12.6% households have taken loan from different sources. NGOs are the major source of loan in terms of the number loan recipients. Of the total loaned households, 27.8% have received loan from NGOs, 10.3% from banks, 15.1% from money lenders and 34.1% from relatives (Table-7. 22, and 7. 23).

Table-7.22. Percentage of Households Received Loan from Bank or Other Sources

Study/Impact Area	Percentage		
	Yes	**No**	Total
High Impact	43 (11.1)	345 (88.9)	388 (100.0)
Medium Impact	4 (7.3)	51 (92.7)	55 (100.0)
Low Impact	11 (12.6)	76 (87.4)	87 (100.0)
Fisherman Village	18 (25.0)	54 (75.0)	72 (100.0)
All	76 (12.6)	526 (87.4)	602 (100.0)

Note: Figures within parentheses represent percentages

Source: BCAS field survey through questionnaire, 2011.

Table-7. 23. Percentage Distribution of Households Surveyed by Sources of Loan

Sources of Loan	Study Area				
	High	Medium	Low	Fisherman	All
Bank	3 (5.3)	2 (6.4)	7 (28.0)	1 (7.7)	13 (10.3)
NGOs	16 (28.1)	9 (29.0)	3 (12.0)	7 (53.8)	35 (27.8)
Money lender	11 (19.3)	3 (9.7)	4 (16.0)	1 (7.7)	19 (15.1)
Relatives	19 (33.3)	14 (45.2)	8 (32.0)	2 (15.4)	43 (34.1)
Others	8 (14.0)	3 (9.7)	3 (12.0)	2 (15.4)	16 (12.7)
Total	**57 (100.0)**	**31 (100.0)**	**25 (100.0)**	**13 (100.0)**	**126 (100.0)**

Note: Figures within parentheses represent percentages

Source: BCAS field survey through questionnaire, 2011.

7.3.3.18 Household Stock of Durable Assets

Households, to a various extent, possess different durable assets such as bicycle, car, motor cycle, furniture, refrigerator, T.V., radio, computer, mobile set, boat, tube-well, power tiller-tractors, water lifting pump, VCD, fishing net etc.

The survey shows that 98% households possess furniture. However, 77.4% have at least a mobile set and T.V. is owned by 41.2%. Bicycle, motor cycle and car are possessed by 5.9%, 1.0% and 2% households. Besides, radio and refrigerator are owned by 19.1% and 17.6% households respectively. Households having a power tiller/tractor are 3.9% in the project area. However, there is about 33.3% households‘ posses tube-well in their back yard (Table-7. 24).

Table-7.24. Percentage of Households Having Different Durable Assets

Assets	Percentage				
	High (n=99)	Medium (n=40)	Low (n=45)	Fisherman (n=20)	All (N=204)
Bicycle	5.0	-	11.1	10.0	5.9
Motorcycle	-	-	4.4	-	1.0
Furniture	96.0	100.0	100.0	100.0	98.0
Car	2.0	5.0	-	-	2.0
Refrigerator	23.2	12.5	13.3	10.0	17.6
T.V	44.4	35.0	35.6	50.0	41.2
Radio	21.2	12.5	20.0	20.0	19.1
Computer	4.0	7.5	2.2	-	3.9
Mobile set	74.7	70.0	84.4	90.0	77.4
Boat	5.0	10.0	11.1	-	6.9
Power tiller/Tractor	6.1	-	2.2	5.0	3.9
Tube well	30.3	32.5	37.8	40.0	33.3
Water lifting pump	1.0	5.0	2.2	-	2.0
VCD	-	2.5	-	-	0.5
Fishing net	-	-	-	5.0	0.5
Others	5.0	2.5	4.4	-	3.9

Note: (1) Multiple asset ownership
(2) Figures within parentheses represent percentages

Source: BCAS field survey through questionnaire, 2011.

Households' possessions of different durable items are marked by some variations among the different impact zones under the study area. The average number of durable items per household is as follows: Furniture 8.8, Fishing gear 2.0, Car 1.5, Mobile set 1.8 (Table-7. 25).

Table-25. Average Number of Durable Assets Per Household

Assets	*Average Number of Durable Assets Per Household*				
	High	Medium	Low	Fisherman	All
Bicycle	1.2	-	1.2	1.0	1.2
Motorcycle	-	-	1.0	-	1.0
Furniture	8.9	9.0	9.0	7.7	8.8
Car	1.5	1.5	-	-	1.5
Refrigerator	1.0	1.2	1.2	1.0	1.1
T.V	1.1	1.1	1.1	1.0	1.1
Radio	1.0	1.0	1.1	1.0	1.0
Computer	1.0	1.3	1.0	-	1.1
Mobile set	1.8	2.1	1.8	1.6	1.8
Boat	1.0	1.2	1.0	-	1.1
Power tiller/Tractor	1.0	-	1.0	1.0	1.0
Tube well	1.0	1.0	1.1	1.0	1.0
Water lifting pump	1.0	1.0	1.0	-	1.0
VCD	-	1.0	-	-	1.0
Fishing gear	-	-	-	2.0	2.0
Others	1.0	1.0	1.0	-	1.0

Source: BCAS field survey through questionnaire, 2011.

7.3.3.19 Housing Structures

Housing structures in the project impact area are of different types in terms of construction materials. Most of the housings (34.6% HH) are built of tin-roof with thatched wall and earthen floor. Housings with tin roof plus brick wall and brick floor come next accounting for about 25.2% of all HHs. About 15.4% structures are built of tin-roof with tin wall and earthen floor. Besides, buildings account for 11.4% of the HHs which are generally owned by the richer class. Thatched structures constitute 4.3% of all housings in the project impact area.

Table- 7.26. Percentage Distribution of Households Surveyed by Housing Structure

Housing Structure	Study Area				
	High	Medium	Low	Fisherman	All
Building (Brick floor+wall+roof)	15 (12.0)	6 (12.8)	6 (10.5)	2 (8.0)	29 (11.4)
Brick floor+brick wall+tin roof	28 (22.4)	14 (29.8)	17 (29.8)	5 (20.0)	64 (25.2)
Brick floor+tin wall+tin roof	6 (4.8)	3 (6.4)	6 (10.5)	1 (4.0)	16 (6.3)
Earthen floor+tin wall+tin roof	17 (13.6)	6 (12.8)	7 (12.3)	9 (36.0)	39 (15.4)
Earthen floor+thatch wall+tin roof	51 (40.8)	16 (34.0)	16 (28.1)	5 (20.0)	88 (34.6)
Thatch	4 (3.2)	2 (4.2)	3 (5.3)	2 (8.0)	11 (4.3)
Others	4 (3.2)	- (-)	2 (3.5)	1 (4.0)	7 (2.8)
Total	**125 (100.0)**	**47 (100.0)**	**57 (100.0)**	**25 (100.0)**	**254 (100.0)**

Note: Figures within parentheses represent percentages
Source: BCAS field survey through questionnaire, 2011.

Despite some variations, housing structures are, more or less, of similar types in the four impact areas. Buildings constitute 12.8% of the structures in medium impact area followed by 8.0% in fishermen village, 12.0% in high impact area and 10.5% in low impact area (Table-26).

7.3.4 Household Energy Use

7.3.4.1 Energy for cooking

Households in the study area use different biomass resources including one or more of wood, tree branches, tree leaf, straw, dung etc for cooking purposes by the same household (HH). The percentage distribution of households using different biomass resources are: tree leaf (20.2%), tree branches (20.9%), wood (16.6%) and cow dung (14.9%). The survey also reveals that the 0.4% and 13.7% of households use LPG and straw for cooking respectively.

Table- 7. 27. Percentage Distribution of Households Surveyed by Type of Fuel Used for Cooking

Type of Fuel	Study Area				
	High	Medium	Low	Fisherman	All
Wood	71 (15.6)	26 (15.5)	33 (18.3)	17 (20.6)	147 (16.6)
Tree branches	91	37	37	20	185

Type of Fuel	Study Area				
	High	Medium	Low	Fisherman	All
	(20.0)	(22.0)	(20.6)	(24.1)	(20.9)
Tree leaf	88 (19.3)	37 (22.0)	34 (18.9)	20 (24.1)	179 (20.2)
Straw	63 (13.8)	22 (13.1)	30 (16.7)	7 (8.4)	122 (13.7)
Dung	73 (16.0)	25 (14.9)	26 (14.4)	8 (9.6)	132 (14.9)
Bushes	30 (6.6)	10 (5.9)	10 (5.6)	6 (7.2)	56 (6.3)
LPG	3 (0.6)	- (-)	1 (0.5)	- (-)	4 (0.4)
Kerosene	34 (7.4)	10 (6.0)	7 (3.9)	5 (6.0)	56 (6.3)
Others	3 (0.7)	1 (0.6)	2 (1.1)	- (-)	6 (0.7)
Total	**456 (100.0)**	**168 (100.0)**	**180 (100.0)**	**83 (100.0)**	**887 (100.0)**

Note: **(1)** Figures within parentheses represent percentages
(2) Use of multiple types of fuel by the some HH

Source: BCAS field survey through questionnaire, 2011.

Of the four impact areas, wood is used by the highest percentage of the households (20.6%) in the fishermen village followed by medium impact area (15.5%), high impact area (15.6%) and low impact area (18.3%). The percentage for tree leaf varies from 24.1% in fishermen village to 19.3% in high impact area (Table-7.27).

7.3.4.2 Availability of Biomass Resources

The supply of biomass especially for cooking is increasingly being constrained in the study area. According to the survey, supply of fuel wood is considered insufficient by 71.5% of the households while it is found to be sufficient by 28.5%. Availability of tree leaf, tree branches and rice straw are considered insufficient by 56.3%, 63.1% and 67.9% of the households respectively. However, dung and bushes are considered insufficient by 44.9% and 71.8% respectively (Table-7.28).

Table-7.28. Percentage Distribution of Households Surveyed Showing Adequacy of Fuel Supply by type of Fuel for Cooking (All)

Type of Fuel	Adequacy of Fuel Supply		
	Sufficient	In-sufficient	**Total**
Wood	39 (28.5)	98 (71.5)	**137 (100.0)**
Tree branches	62 (36.9)	106 (63.1)	**168 (100.0)**
Tree leaf	70 (43.7)	90 (56.3)	**160 (100.0)**
Straw	44 (32.1)	93 (67.9)	**137 (100.0)**
Dung	75 (55.1)	61 (44.9)	**136 (100.0)**
Bushes	22 (28.2)	56 (71.8)	**78 (100.0)**
Others	5 (45.5)	6 (54.5)	**11 (100.0)**

Note: Figures within parentheses represent percentages

Source: BCAS field survey through questionnaire, 2011.

7.3.4.3 Energy for Household Lighting

Households depend on different energy sources for lighting including kerosene, electricity, candle etc. Use of kerosene for lighting has been reported by 94.6% of the households in the study area. Electricity and candles are being used by 57.4% and 33.3% of the households. About 3.9% households have solar PV systems for lighting purposes. It is evident from the survey that a high percentage of the electrified households also use kerosene and candle for lighting as load-shedding is a very common phenomenon in the study area.

Table. 7.29. Percentage of Households Surveyed by Sources of Lighting

Source	Study Area				
	High (n=99)	Medium (n=40)	Low (n=45)	Fisherman (n=20)	All (N=204)
Electricity	66 (66.7)	18 (45.0)	20 (44.4)	13 (65.0)	117 (57.4)
Kerosene	94 (94.9)	38 (95.0)	41 (91.1)	20 (100.0)	193 (94.6)
Candle	42 (42.4)	7 (17.5)	16 (35.6)	3 (15.0)	68 (33.3)
Solar PV	5 (5.1)	1 (2.5)	1 (2.2)	1 (5.0)	8 (3.9)
Charge light	24 (24.2)	7 (17.5)	1 (2.2)	4 (20.0)	36 (17.6)
Others	1 (1.0)	- (-)	2 (4.4)	- (-)	3 (1.5)

Note: **(1)** Figures within parentheses represent percentages
(2) Use of multiple sources

Source: BCAS field survey through questionnaire, 2011.

Of the four impact areas, use of household electricity varies from 45.0% in the medium impact area to 65.0% in the fisherman village. The percentage of households using kerosene ranges from 100% in fisherman village to 91.1% households in low impact area (Table-7.29).

7.3.5 Perceived Environmental Problems

Environmental problems that are perceived by the respondents in the study area includes flash floods, diseases, poor sanitation, arsenic contamination of ground water, river bank erosion, water pollution, sedimentation of water bodies etc.

According to the survey, the most pressing problems are flash floods and diseases in terms of the percentages of responses. Flash flood has been mentioned by 24.0%. Flash flood is followed by over population (12.3%), river bank erosion (11.3%) and noise pollution (6.9%). Besides, arsenic contamination of ground water, sedimentation of water bodies, water pollution has also been mentioned by 4.9%, 2.9% and 2.9% respectively. Other problems such as land erosion, deforestation, noise pollution and over population have been mentioned with relatively low percentages.

Of the four impact areas, river bank erosion is most pronounced in the high impact zone (20.2%). Flash flood, diseases, health and sanitation all these have been strongly pronounced in all the four impact areas (Table-7.30).

Table-7.30. Percentage Distribution of Households Surveyed by Source of Environmental Problem

	Status of Environmental Problem				
	No problem	Severe	Moderate	Low	**Total**
Water pollution	18 (8.8)	6 (2.9)	100 (49.1)	80 (39.2)	**204 (100.0)**
Air pollution	61 (29.9)	2 (1.0)	42 (20.6)	99 (48.5)	**204 (100.0)**
Industrial pollution	182 (89.2)	- (-)	4 (2.0)	18 (8.8)	**204 (100.0)**
Burning fuel, trees and agriculture residue	111 (54.4)	- (-)	16 (7.8)	77 (37.8)	**204 (100.0)**
Over population	81 (39.7)	25 (12.3)	51 (25.0)	47 (23.0)	**204 (100.0)**
Deforestation	139 (68.1)	1 (0.5)	24 (11.8)	40 (19.6)	**204 (100.0)**
River/canal bank erosion	137 (67.2)	23 (11.3)	17 (8.3)	27 (13.2)	**204 (100.0)**
Land erosion	164 (80.4)	4 (2.0)	16 (7.8)	20 (9.8)	**204 (100.0)**
Flash floods	61 (29.9)	49 (24.0)	58 (28.4)	36 (17.7)	**204 (100.0)**
Arsenic contamination	125 (61.3)	10 (4.9)	37 (18.1)	32 (15.7)	**204 (100.0)**
Sedimentation of water bodies	135 (66.2)	6 (2.9)	22 (10.8)	41 (20.1)	**204 (100.0)**
Health and sanitation problem	47 (23.0)	8 (3.9)	76 (37.3)	73 (35.8)	**204 (100.0)**
Disease	31 (15.2)	7 (3.4)	85 (41.7)	81 (39.7)	**204 (100.0)**
Noise pollution	98 (48.0)	14 (6.9)	28 (13.7)	64 (31.4)	**204 (100.0)**

Note: **(1)** Figures within parentheses represent percentages
(2) Choosing multiple sources by the same HH

Source: BCAS field survey through questionnaire, 2011.

With regard to the intensity of environmental problems, flash flood is categorized as a ―moderate problem" by most of the respondents (27.2%) in the study area while it is viewed as ―lowproblem" and ―severe problem" by 16.2% and 27.2% of the respondents.

Diseases are considered as ―no problem" by 13.1%, ―low problem" by 36.4%, ―moderate problem" by 44.4% and ―severe" problem by only 6.1% of the respondents.

Other environmental issues such as river bank erosion, arsenic contamination, over population and noise pollution are considered as ―severe problem" by 20.2%, 10.1%, 15.2% and 8.1% of the respondents respectively (Table-7.31).

Table-7. 31. Percentage Distribution of Households Surveyed Showing the Intensity of Environmental Problem (All)

Source	Status of Environmental Problem				
	No problem	Severe	Moderate	Low	**Total**
Water pollution	5 (5.1)	2 (2.0)	51 (51.5)	41 (41.4)	**99 (100.0)**
Air pollution	36 (36.4)	1 (1.0)	15 (15.1)	47 (47.5)	**99 (100.0)**
Industrial pollution	90 (90.9)	- (-)	4 (4.0)	5 (5.1)	**99 (100.0)**
Burning fuel, trees and agriculture residue	56 (56.5)	- (-)	6 (6.1)	37 (37.4)	**99 (100.0)**
Over population	38 (38.4)	15 (15.2)	23 (23.2)	23 (23.2)	**99 (100.0)**
Deforestation	58 (58.6)	1 (1.0)	15 (15.1)	25 (25.3)	**99 (100.0)**
River/canal bank erosion	55 (55.5)	20 (20.2)	8 (8.1)	16 (16.2)	**99 (100.0)**
Land erosion	79 (79.8)	2 (2.0)	8 (8.1)	10 (10.1)	**99 (100.0)**
Flash floods	28 (28.3)	27 (27.2)	28 (28.3)	16 (16.2)	**99 (100.0)**
Arsenic contamination	51 (51.5)	10 (10.1)	19 (19.2)	19 (19.2)	**99 (100.0)**
Sedimentation of water bodies	61 (61.6)	2 (2.0)	11 (11.1)	25 (25.3)	**99 (100.0)**
Health and sanitation problem	19 (19.2)	5 (5.0)	45 (45.5)	30 (30.3)	**99 (100.0)**
Disease	13 (13.1)	6 (6.1)	44 (44.4)	36 (36.4)	**99 (100.0)**
Noise pollution	53 (53.5)	8 (8.1)	5 (5.1)	33 (33.3)	**99 (100.0)**

Note: Figures within parentheses represent percentages

Source: BCAS field survey through questionnaire, 2011.

7.3.6 Sources of Water Pollution

Respondents attribute water pollution to different sources including human waste, water transport, animal waste, siltation etc. Siltation has been identified by 3.4% of the respondents as a source of water pollution; other sources identified as moderate by the respondents include human waste (9.3%), Chemical feature/personnel (28.9%), and pollution from upstream (15.7%) (Table-7.32).

Table-7.32. Percentage Distribution of Households Surveyed by Source of Water Pollution

Source	Status of Water Pollution Problem				
	No problem	Severe	Moderate	Low	**Total**
Industrial waste	156 (76.5)	2 (1.0)	15 (7.3)	31 (15.2)	**204 (100.0)**
Human waste	78 (38.2)	2 (1.0)	19 (9.3)	105 (51.5)	**204 (100.0)**

Water transport	142 (69.6)	1 (0.5)	10 (4.9)	51 (25.0)	**204 (100.0)**
Chemical feature/personnel	46 (22.6)	2 (1.0)	59 (28.9)	97 (47.5)	**204 (100.0)**
Siltation	142 (69.6)	7 (3.4)	14 (6.9)	41 (20.1)	**204 (100.0)**
Animal waste	150 (73.5)	2 (1.0)	9 (4.4)	43 (21.1)	**204 (100.0)**
Pollution from up stream	112 (54.9)	2 (1.0)	32 (15.7)	58 (28.4)	**204 (100.0)**
Urban waste	171 (83.9)	- (-)	6 (2.9)	27 (13.2)	**204 (100.0)**

Note: **(1)** Figures within parentheses represent percentages
(2) Choosing multiple sources by the some HH

Source: BCAS field survey through questionnaire, 2011.

7.3.7 Sources of Noise Pollution

Although noise pollution is not a widely mentioned problem in the study area, some respondents have attributed noise pollution to different types of vehicles that ply over the roads in the study area. 2.9% of the respondents mentioned vehicles attribute to noise pollution whereas 2.4% each mentioned about big industries and gas field as the source of noise pollution (Table-7.33).

Table-7.33. Percentage Distribution of Households Surveyed for Status (in the 10km radii) of Noise Pollution Problem (All)

Source	Status of Noise Pollution Problem				
	No problem	Severe	Moderate	Low	**Total**
Vehicles	107 (52.5)	6 (2.9)	24 (11.8)	67 (32.8)	**204 (100.0)**
Big industries	194 (95.1)	5 (2.4)	2 (1.0)	3 (1.5)	**204 (100.0)**
Small industries	191 (93.6)	- (-)	4 (2.0)	9 (4.4)	**204 (100.0)**
Construction work	198 (97.0)	1 (0.5)	1 (0.5)	4 (2.0)	**204 (100.0)**
Households sources (Generator)	199 (97.5)	- (-)	1 (0.5)	4 (2.0)	**204 (100.0)**
Power supply (irrigation engine)	202 (99.0)	- (-)	- (-)	2 (1.0)	**204 (100.0)**
Commercial areas	204 (100.0)	- (-)	- (-)	- (-)	**204 (100.0)**
Gas field	182 (89.2)	5 (2.4)	14 (6.9)	3 (1.5)	**204 (100.0)**

7.3.8 Sources of Air Pollution

Various sources which contribute to air pollution, identified as moderate by the respondents, include; open defecation (42.2%), vehicles (6.4%), gas field (7.8%), and diesel engine (2.4%), brick field (5.4%) (Table-7.34).

Table-7.34. Percentage Distribution of Households Surveyed by Source of Air Pollution Problem

Source	Status of Air Pollution Problem				
	No problem	Severe	Moderate	Low	**Total**
Brick field	166 (81.4)	2 (1.0)	11 (5.4)	25 (12.2)	**204 (100.0)**
Vehicles	131 (64.2)	4 (2.0)	13 (6.4)	56 (27.4)	**204 (100.0)**
Construction work	199 (97.5)	- (-)	2 (1.0)	3 (1.5)	**204 (100.0)**
Small industries	199 (97.5)	- (-)	- (-)	5 (2.5)	**204 (100.0)**
Big industries	197 (96.5)	- (-)	3 (1.5)	4 (2.0)	**204 (100.0)**
Diesel engine	187 (91.7)	- (-)	5 (2.4)	12 (5.9)	**204 (100.0)**
Commercial areas	204 (100.0)	- (-)	- (-)	- (-)	**204 (100.0)**
Gas field	177 (86.8)	1 (0.5)	16 (7.8)	10 (4.9)	**204 (100.0)**
Burning fuel, trees and agriculture residue	107 (52.4)	2 (1.0)	10 (4.9)	85 (41.7)	**204 (100.0)**
Open defecation	66 (32.3)	2 (1.0)	86 (42.2)	50 (24.5)	**204 (100.0)**

Note: **(1)** Figures within parentheses represent percentages
(2) Choosing multiple sources by the same HH

Source: BCAS field survey through questionnaire, 2011.

7.3.9 Respondents' Awareness and Perception about the Bibiyana Power Project.

7.3.9.1 Respondents' Awareness about the project

The survey reveals that 83.8% respondents in the study area are generally aware and have heard of the project. In the high impact area, 99% of the respondents are informed while the remaining one percent is not informed about the project. In the medium impact area, the percentages of the ~~"in~~formed" and ~~"un~~informed" respondents are 97.5% and 2.5% respectively. In the low impact area, only 31.1% of the respondents have heard of the project (Table-7.35).

Table-7.35. Percentage Distribution of Households having knowledge about the Proposed Bibiyana Power Project

Study Area	Percentage		
	Yes	No	**Total**
High	98 (99.0)	1 (1.0)	**99 (100.0)**
Medium	39 (97.5)	1 (2.5)	**40 (100.0)**
Low	14 (31.1)	31 (68.9)	**45 (100.0)**
Fisherman	20 (100.0)	- (-)	**20 (100.0)**
All	171 (83.8)	33 (16.2)	**204 (100.0)**

Note: Figures within parentheses represent percentages

7.3.9.2 Project Affected People

From the survey of households in the project impact area, it turns out that 129 (63.2%) out of 204 households would be adversely affected to various extents due to implementation of the project. The remaining 36.8% households are reportedly not exposed to any negative impacts.

Losses would primarily be incurred by the affected households due to acquisition of existing crop land for the power plant. The affected groups include owners of crop land, share croppers, lease holders, agricultural wage earners etc. It is found that 86 households (42.2%) of the impact area may have an adverse impact on health. (Table-7.36 & 7.37).

Table- 7. 36. Percentage of Potential Affected Households Due to Power Plant Project

Study Area	Percentage		
	Yes	No	**Total**
High	97 (98.0)	2 (2.0)	**99 (100.0)**
Medium	15 (37.5)	25 (62.5)	**40 (100.0)**
Low	3 (6.7)	42 (93.3)	**45 (100.0)**
Fisherman	14 (70.0)	6 (30.0)	**20 (100.0)**
All	129 (63.2)	75 (36.8)	**204 (100.0)**

Source: BCAS field survey through questionnaire, 2011.

Table-7. 37. Percentage Distribution of Households Surveyed by Type of Negative Impact

Type of Negative Impact	Study Area				
	High (n=99)	Medium (n=40)	Low (n=45)	Fisherman (n=20)	All (N=204)
Loss of homestead land	7 (7.1)	- (-)	- (-)	1 (5.0)	8 (3.9)
Loss of cultivable land	15 (15.2)	4 (10.0)	- (-)	- (-)	19 (9.3)
Loss of crops	7 (7.1)	1 (2.5)	- (-)	1 (5.0)	9 (4.4)
Loss of share/lease crops	22 (22.2)	2 (5.0)	- (-)	1 (5.0)	25 (12.2
Loss of trees	9 (9.1)	- (-)	- (-)	3 (15.0)	12 (5.9)
Stop fishing from river	9 (9.1)	- (-)	- (-)	4 (20.0)	13 (6.4)
Local service lost	3 (3.0)	- (-)	- (-)	- (-)	3 (1.5)
Decrease income	33 (33.3)	1 (2.5)	- (-)	4 (20.0)	38 (18.6)
Negative impact on health	57 (57.6)	12 (30.0)	2 (4.4)	15 (75.0)	86 (42.2)
Communication problem	38 (38.4)	1 (2.5)	- (-)	1 (5.0)	40 (19.6)
Livestock and poultry problem	35 (35.3)	- (-)	-	-	35 (17.2)

Type of Negative Impact	Study Area				
	High (n=99)	Medium (n=40)	Low (n=45)	Fisherman (n=20)	All (N=204)
			(-)	(-)	
Noise pollution	85 (85.9)	22 (55.0)	4 (8.9)	14 (70.0)	125 (61.3
Air pollution	80 (80.8)	24 (60.0)	7 (15.6)	17 (85.0)	128 (62.7)
Water pollution	65 (65.7)	22 (55.0)	6 (13.3)	15 (75.0)	108 (52.9)
Loss of business	- (-)	1 (2.5)	- (-)	- (-)	1 (0.5)
Lack of khas land/river using	12 (12.1)	9 (22.5)	- (-)	- (-)	21 (10.3)
Others	4 (4.0)	- (-)	- (-)	- (-)	4 (2.0)

Note: Figures within parentheses represent percentages
Source: BCAS field survey through questionnaire, 2011.

7.3.9.3 Perceived Positive Impacts of the Project

Respondents, in general, perceive of various benefits that are expected to result from implementation of the project. These benefits, as perceived by the respondents, include; creation of employment opportunity, access to electricity, access to roads, enhanced socio-economic activities, availability of water for irrigation, overall national development, and reliable supply of electricity in the area.

According to the survey, creation of employment opportunity due to the project is perceived by 79.9% of the respondents. The implementation of the project will lead to national development, according to the opinion of 53.9% of the respondents. Moreover, enhanced socio-economic activities, access to road infrastructure and reliable supply of electricity in the local area as outcome of the project have been mentioned by 40.7%, 78.9% and 61.8% of the respondents respectively. The project will contribute to availability of irrigation water, according to the opinion of 23.0% of the respondents under the study area (Table-7.38).

The perceived benefits are found to be, more or less, similar in the four impact area under the survey.

Table-7. 38. Percentage of Respondents Surveyed Expecting Positive Impacts of Power Plant Project

Positive Impact	Study Area				
	High (n=99)	Medium (n=40)	Low (n=45)	Fisherman (n=20)	All (N=204)
More employment opportunity	80 (80.8)	33 (82.5)	32 (71.1)	18 (90.0)	163 (79.9)
Access to electricity	74 (74.7)	28 (70.0)	31 (68.9)	13 (65.0)	146 (71.6)
Access to infrastructure road	96 (97.0)	24 (60.0)	24 (53.3)	17 (85.0)	161 (78.9)
More local socio economic activities	49 (49.5)	15 (37.5)	9 (20.0)	10 (50.0)	83 (40.7)

Positive Impact	Study Area				
	High (n=99)	Medium (n=40)	Low (n=45)	Fisherman (n=20)	All (N=204)
Availability of irrigation water	28 (28.3)	- (-)	17 (37.8)	2 (10.0)	47 (23.0)
National development	55 (55.6)	21 (52.5)	20 (44.4)	14 (70.0)	110 (53.9)
Reliable supply of electricity in the area	65 (65.7)	13 (32.5)	33 (73.3)	15 (75.0)	126 (61.8)
Business facilities	62 (62.6)	20 (50.0)	11 (24.4)	15 (75.0)	108 (52.9)
To build school/madrasa	71 (71.7)	20 (50.0	17 (37.8)	13 (65.0)	121 (59.3)
To build college	52 (52.5)	14 (35.0)	14 (31.1)	11 (55.0)	91 (44.6)
To build technical school	26 (26.3)	11 (27.5)	1 (2.2)	1 (5.0)	39 (19.1)
To build health centre	57 (57.6)	10 (25.0)	10 (22.2)	10 (50.0)	87 (42.6)
Hospital	91 (91.9)	37 (92.5)	29 (64.4)	15 (75.0)	172 (84.3)
Community centre	29 (29.3)	2 (5.0)	4 (8.9)	4 (20.0)	39 (19.1)
Others	7 (7.1)	1 (2.5)	3 (6.7)	- (-)	11 (5.4)

Note: (1) Figures within parentheses represent percentages
(2) Choice of multiple positive impacts

Source: BCAS field survey through questionnaire, 2011.

7.3.9.4 Expectation for Assistance from the Government/Project to Mitigate Losses

Potential affected people, in general, have expressed their willingness to get assistance/help from the government/project to mitigate the possible losses due to the project. Most of the (31.5%) households demand a job in the power plant. 15.8% wants hospitals or doctor in their area. However, 17.6% demand financial support whereas 9% demand to have real value for land and crops (Table-7.39).

Table-7.39. Percentage Distribution of Households Demanding Help from Government or Project to Make up the Loss as follows

Type of Help	Study Area				
	High	Medium	Low	Fisherman	All
To give advantage for business	5 (3.2)	1 (4.0)	1 (7.1)	1 (3.8)	8 (3.6)
To get financial support	30 (19.1)	2 (8.0)	2 (14.3)	5 (19.3)	39 (17.6)
To give real value for land and crops	16 (10.2)	4 (16.0)	- (-)	- (-)	20 (9.0)
To want same size of land	4 (2.6)	1 (4.0)	- (-)	- (-)	5 (2.2)
To get a job in the power plant	45 (28.7)	7 (28.0)	7 (50.0)	11 (42.4)	70 (31.5)
To want school, college and madrasa	1 (0.6)	3 (12.0)	- (-)	1 (3.8)	5 (2.2)

Type of Help	Study Area				
	High	Medium	Low	Fisherman	All
To want hospital/doctor	25 (15.9)	5 (20.0)	- (-)	5 (19.3)	35 (15.8)
To manage increasing fisheries resources	1 (0.6)	- (-)	- (-)	1 (3.8)	2 (0.9)
To get current supply regularly	4 (2.6)	- (-)	4 (28.6)	1 (3.8)	9 (4.1)
To want new road/development of roads	9 (5.7)	1 (4.0)	- (-)	- (-)	10 (4.5)
To need pasture land	6 (3.8)	- (-)	- (-)	- (-)	6 (2.7)
To stop noise pollution	3 (1.9)	- (-)	- (-)	- (-)	3 (1.4)
To stop air pollution	2 (1.3)	- (-)	- (-)	- (-)	2 (0.9)
Others	6 (3.8)	1 (4.0)	- (-)	1 (3.8)	8 (3.6)
Total	**157 (100.0)**	**25 (100.0)**	**14 (100.0)**	**26 (100.0)**	**222 (100.0)**

•

Note: Figures within parentheses represent percentages

Source: BCAS field survey through questionnaire, 2011.

Respondents have expressed the need for various help from the government/the project. To mitigate their losses and restore livelihoods, creation of new job opportunity has been given priority by the highest percentage of the respondents. The percentage for new job opportunity is 22.6% followed by construction of new road (15.1%) and establishment of new school, college (12.3%). Demands for other facilities include establishment of hospital (11.5%), job opportunity with the power plant (10.1%) and fair value of land 7.8%. Demand for other facilities is rather small (Table-7. 40).

Table-7. 40. Percentage Distribution of Households demanding different types of Help from the Government or the Project to make up the Loss

Type of Help	***Study Area***				
	High Impact (n=388)	**Medium Impact (n=55)**	**Low Impact (n=87)**	**Fisherman Village (n=72)**	**All (N=602)**
To give advantage for business	16 (4.1)	1 (1.8)	-	-	17 (2.8)
To create job opportunity	112 (28.9)	21 (38.2)	-	3 (4.2)	136 (22.6)
To get financial support for cow rearing	12 (3.1)	9 (16.4)	-	7 (9.7)	28 (4.6)
To give real value for land	33 (8.5)	14 (25.5)	-	-	47 (7.8)
To get a job in the power plant	52 (13.4)	9 (16.4)	-	-	61 (10.1)
Training on different matters	9 (2.3)	4 (7.3)	-	-	13 (2.2)
To want school, college and madrasa	73 (18.8)	1 (1.8)	-	-	74 (12.3)
To want hospital	66 (17.0)	3 (5.4)	-	-	69 (11.5)

To want gas line	15 (3.9)	3 (5.4)	-	2 (2.8)	20 (3.3)
To get financial support	62 (16.0)	6 (10.9)	-	-	68 (11.3)
To get current supply regularly	9 (2.3)	1 (1.8)	-	1 (1.4)	11 (1.8)
To want new/develop roads	87 (22.4)	3 (5.4)	-	1 (1.4)	91 (15.1)
To get safe drinking water	13 (3.3)	-	-	-	13 (2.2)
Others	10 (2.6)	5 (9.1)	-	3 (4.2)	18 (3.0)

Note: **(1)** Figures within parentheses represent percentages
(2) Choosing multiple types

Source: BCAS field survey through questionnaire, 2011.

7.3.10 Disease Profile for the Study Area

The survey has dealt with information on diseases as experienced by the study population during the last one year. It has been found from the survey that the incidence of cold fever is very common among the study population. Cold fever responses came from more than 34.7% of all HH during the last one year. Other diseases that come next include gastric/ulcer 15.2%, diarrhoea 15.9%, jaundices 6.0%, skin diseases 5.8% and blood pressure 7.4%. Cold fever responses came more than 40% in the fisherman village whereas 30.9% in low impact area compare to 34.4% and 37.6% in the high and medium impact zone (Table-7.41).

Table-7.41. Percentage Distribution of Households Affected People by Different Diseases

Name of Disease	Study Area				
	High	Medium	Low	Fisherman	All
Cold fever	34.4	37.6	30.9	40.8	34.7
Skin disease	6.4	5.9	5.8	2.0	5.8
Jaundice	5.7	4.0	7.9	6.1	6.0
Pneumonia	0.4	-	-	-	0.2
Diarrhea	15.2	18.8	13.7	20.4	15.9
Dysentery	0.4	-	-	-	0.2
Typhoid	4.6	6.9	2.2	-	4.0
Gastric/Alser	15.2	9.9	18.0	18.4	15.2
Chicken Pox	1.4	1.0	0.7	-	1.1
Jakkha	0.4	1.0	0.7	-	0.5
Heart disease	3.9	2.0	3.6	-	3.2
Blood pressure	6.4	4.0	11.5	8.2	7.4
Diabetes	1.4	3.0	0.7	-	1.4
Others	4.2	5.9	4.3	4.1	4.4
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Note: Multiple responses by the same HH

Source: BCAS field survey through questionnaire, 2011.

7.3.10.1 Sources of Treatment

For the purpose of medical treatment, people in the study area depend on different sources including private practitioner, upazila health complex, village physician, medicine shop, homeopath, kabiraj (traditional herbal physician) etc. The survey shows that medicine shop is the main source of treatment accounting for about 54.3% of the HH in the study area. Other sources of treatment services that come next are village physician (9.4%), private practitioner (12.0%), upazila health complex (10.4%), kabiraj (6.2%) and homeopath (0.6%).

Village physician is the main source of treatment in low impact area and fishermen village, while medicine shop is the main source in high and medium impact area. 1.6% of the disease affected people have not received any treatment facilities from any source (Table-7.42).

Table-7.42. Percentage Distribution of Households Surveyed by Source of Treatment

Source of Treatment	Study Area				
	High	Medium	Low	Fisherman	All
No treatment	2.7	1.5	-	-	1.6
Medicine shop	53.3	50.8	54.0	66.8	54.3
Upazila health complex	12.0	16.9	3.2	3.3	10.4
Private practitioner doctor	12.7	10.8	11.1	13.3	12.0
Village doctor	9.3	7.7	14.3	3.3	9.4
Homeopathy	1.3	-	-	-	0.6
Kabiraj	4.0	3.1	11.1	13.3	6.2
Others	4.7	9.2	6.3	-	5.5
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Source: BCAS field survey through questionnaire, 2011.

7.3.10.2 School Days Lost Due to Ailments

Many students fail attend school due to various ailments in the study area. The survey reveals that each student, on average, has lost 5 school days during the last one year. The losses of annual school days are more or less the same for both boys and girls. The four impact areas are marked by little variation in terms of school days lost per student during the last one year. The average annual school days lost due to illness is 20.2. The tendency of losing school days for both boys and girls in the fisherman village is 22.2 which is higher than the other impact zones. The average number girls (16.8) in the fisherman village cannot attend the school whereas 14.2 in the high impact zone for the boys (Table-7.43).

Table-7.43: Average Annual School Days Lost due to Illness

Family Member	Average Annual School Days Lost due to Illness				
	High	Medium	Low	Fisherman	All
Boys	14.2	12.8	15.8	15.1	14.5
Girls	15.2	12.0	15.6	16.8	14.9
Both	21.6	15.3	20.1	22.2	20.2

Source: BCAS field survey through questionnaire 2011

Average Annual Working Days Lost due to Illness is 28.1. The loss of working days for male and female are 21.1 and 16.1 respectively. The loss for the male in the high impact area is

21.7 whereas it is 17.9 in the medium impact area. In the fisherman village, average number of lost working days for the male and female are 22.2 and 13.9 respectively (Table-7.44).

Table-7.44: Average Annual Working Days Lost due to Illness

Family Member	Average Working Days Lost due to Illness				
	High	Medium	Low	Fisherman	All
Male	21.7	17.9	21.6	22.2	21.1
Female	16.6	14.9	16.7	13.9	16.1
Both	29.3	23.3	28.0	29.9	28.1

Source : BCAS field survey through questionnaire 2011

CHAPTER VIII

IDENTIFICATION OF SIGNIFICANT ENVIRONMETAL IMPACTS DUE TO PROPOSED SUMMIT BIBIYANA 1 & II POWER PLANT PROJECT AND MITIGATION MEASURES

8.1 Introduction

An effective environmental impact assessment (EIA) of a proposed project calls for establishing background data on various environmental components through reconnaissance survey, sampling, available literature sources etc.; identifying project features which are likely to have impacts on the environment; predicting impacts; superimposing impacts on the existing baseline scenario and developing suitable Environmental Management Plan. The impact identification of each of the environmental parameters is the first step of assessment. In order to identify the impact comprehensively, all the activities associated with the proposed project during the pre-construction, construction and post-construction as well as operational phase need to be identified.

This chapter describes the anticipated significant and environmental impacts of the proposed Summit Bibiyana 1 & II Power Project upon the project area. Identification of such impacts has been followed by measures toward mitigating them. Enhancement measures of beneficial impacts and compensation to project affected persons have also been proposed. This chapter, hence, complies with the envisaged portion of *„integrated assessment to identify the social and environmental impacts, risks and opportunities'* pertaining to *IFC Performance Standard 1* and *Performance Standards 2 and 3* through proposing creation of *congenial labor and working conditions* and measures for *pollution prevention and abatement*, respectively.

Identification of anticipated significant environmental impacts due to the activities during the pre-construction, construction and post-construction as well as operation stages of the proposed power plant project on the project area at Bibiyana at village Parkul under Nabiganj Upazilla of the Habiganj district had been done using the Checklist method during the course of IEE exercise. Such anticipated impacts without any mitigation measure had been characterized as being of varied intensities – minor, medium and major and were mostly of adverse nature. Beneficial impacts, although very few, were characterized as significant. Based on the above Checklist of the IEE process, identification of significant environmental impacts due to the activities during various stages of the proposed power plant project and proposing corresponding mitigation measures have been done through a detailed matrix developed for purpose of EIA. The detailed matrix appears at Table 8.1.

The proposed site, comprising of 67 acres of land, is in possession of project proponent. It has been selected taking into consideration the guidelines of MoEF. There is no ecologically sensitive area such as biosphere reserve, national park and wildlife sanctuary within a radius of 10 km from the project site. Further, there is no archaeological/ cultural/ historically important monument or place within the 10 km radius. The project site does not involve forest or prime agricultural land.

As natural gas is the fuel with incorporation of Dry Low NOx (DLN) burners, NOx emission from the stacks and resulting increments of ground level concentration of this pollutant will be less. There will be no emission of particulate matter from the stacks. There will be no emission of sulphur dioxide from the stacks. For the effluent streams, suitable treatment is provided in the project proposal for compliance with prescribed norms.

Table-8.1: Matrix of Significant Environmental Impacts (SEIs) due to Proposed Summit Bibiyana I & II Power Company Limited on the Proposed Project Area.

Project Stages/Source of Impacts	Anticipated Impact on Important Environmental Components																											Comments
	Natural Environment																		Socio-economic Environment									
	Land			Air			Hydrology & Drainage			Noise			Vegetation			Wildlife			Human Health			Homesteads			Employment		
	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Adverse	Beneficial	
I. Pre-construction																												
i) Land Development through Landfill																												
a) Deposition of sandy materials			✓																							✓		Permanent changes in soil quality and landuse pattern; Adverse Impact **Mitigation Measures:** Adequate compensation to affected persons in a manner that conforms with *existing govt. rules as well as requirements of World Bank, IFC, ADB and Equator Principles of Financing Institutions.* Temporary employment generation for the local people; Beneficial impact. **Benefit Enhancement Measures:** Local people, with special emphasis on women, should be employed.
b) Deterioration of soil quality			✓																									Permanent deterioration in the soil quality; Adverse Impact.
c) Dust Emission						✓															✓			✓				Temporary disturbance to air quality; residents in immediate vicinity of the project area will be subject to respiratory

Project Stages/Source of Impacts	Anticipated Impact on Important Environmental Components																											Comments
	Natural Environment																		Socio-economic Environment									
	Land			Air			Hydrology & Drainage			Noise			Vegetation			Wildlife			Human Health			Homesteads			Employment		
	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Adverse	Beneficial	
																												deseases; Adverse Impact. **Mitigation measures:** i) Periodic sprinkling of water throughout the area under land development process to arrest dust emission; ii) Plantation of trees to create green belt around the area. *Mitigation measures need to follow, where applicable, existing procedures that comply with existing govt. rules and needs of WB, IFC, ADB guidelines and Equator Principles of Financing Institutions.*
d) Disruption to local drainage pattern								✓																				Loose soil during land development process is likely to cause disruption to local drainage pattern; adverse impact. **Mitigation measures:** Land-fill activities during land development process should be undertaken with simultaneous land compacting activities and the area should be surrounded by protective wall. *Mitigation measures need to follow, where applicable, existing procedures that comply with existing govt. rules and needs of WB, IFC, ADB*

Project Stages/Source of Impacts	Anticipated Impact on Important Environmental Components																											Comments
	Natural Environment																		Socio-economic Environment									
	Land			Air			Hydrology & Drainage			Noise			Vegetation			Wildlife			Human Health			Homesteads			Employment		
	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Adverse	Beneficial	
																												guidelines and Equator Principles of Financing Institutions.
e) Loss of and displacement from agricultural land		✓																							✓		Although to a limited scale, there will be permanent loss of single crop agricultural productivity in the area leading to loss of employment and income; adverse impact. **Mitigation measures:** i) Adequate compensation to marginalized peasants (if any). *Mitigation measures need to follow, where applicable, existing procedures that comply with existing govt. rules and needs of WB, IFC, ADB guidelines and Equator Principles of Financing Institutions.*
f) Loss of and displacement from homestead land																								✓			13 homesteads already existing within the project acquired land will need removal and, to the west of the plant location also within the plant acquired land,, a homestead with a pond and homestead vegetation and part of another homestead will be adversely impacted upon resulting in displacement of the residents. **Mitigation measures:**

Project Stages/Source of Impacts	Anticipated Impact on Important Environmental Components																										Comments
	Natural Environment																		Socio-economic Environment								
	Land			Air			Hydrology & Drainage			Noise			Vegetation			Wildlife			Human Health			Homesteads			Employment		
	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Adverse	Beneficial	
																											Adequate resettlement and compensation should be ensured to affected homestead dwellers. *Mitigation measures need to follow, where applicable, existing procedures that comply with existing govt. rules and needs of WB, IFC, ADB guidelines and Equator Principles of Financing Institutions.*
II. Construction																											
i)Excavations, handling and transport of earth and construction materials																											
a) Release of particalte matters in the ambient air of the construction area.						✓																				✓	Temporary air pollution in the construction area; adverse impact. Temporary employment generation for the local community; Beneficial impact. **Mitigation measures:** i) Area should be provided with dust sreen to arrest particulate matters; ii) sprinkling of water throughout the exacavation sites. *Mitigation measures need to follow, where applicable, existing procedures that comply with existing govt. rules and*

Project Stages/Source of Impacts	Anticipated Impact on Important Environmental Components																											Comments
	Natural Environment																		Socio-economic Environment									
	Land			Air			Hydrology & Drainage			Noise			Vegetation			Wildlife			Human Health			Homesteads			Employment		
	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Adverse	Beneficial	
																												needs of WB, IFC, ADB guidelines and Equator Principles of Financing Institutions.
b) Run-off erosion							✓																					Land excavation and filling involved in the construction process will cause run-off erosion during rainy season. Adverse impact. **Mitigation measures**: Protection wall around the construction sites to arrest run-off erosion.
ii) Operation of construction equipment and traffic movement																												
a. Temporary and short duration emission of NOx_x						✓																						Emission of NO_x will be temporary and of short duration and will be felt close to construction site only and will persist so long the construction goes on. *Mitigation measures need to follow, where applicable, existing procedures that comply with existing govt. rules and needs of WB, IFC, ADB guidelines and Equator Principles of Financing Institutions.*

Project Stages/Source of Impacts	Anticipated Impact on Important Environmental Components																											Comments
	Natural Environment																			Socio-economic Environment								
	Land			Air			Hydrology & Drainage			Noise			Vegetation			Wildlife			Human Health			Homesteads			Employment		
	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Adverse	Beneficial	
iii) Operation of construction equipment like, bulldozers, trucks, scrappers, concrete mixers, cranes, generators, pumps, compressors, rock drills, pneumatic tools, vibrators etc.																												
a. Generation of noise												✓																Adverse impact. **Mitigation measures:** Effective noise-baffling barriers should be created to keep the noise level within acceptable limits. *Mitigation measures need to follow, where applicable, existing procedures that comply with existing govt. rules and needs of WB, IFC, ADB guidelines and Equator Principles of Financing Institutions.*
b. Generation of construction solid wastes			✓						✓																			Construction solid wastes will adversely impact upon soil quality and land aesthetics. **Mitigation measures:** Generated construction solid wastes should be stored and used

Project Stages/Source of Impacts	Anticipated Impact on Important Environmental Components																										Comments
	Natural Environment																		Socio-economic Environment								
	Land			Air			Hydrology & Drainage			Noise			Vegetation			Wildlife			Human Health			Homesteads			Employment		
	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Adverse	Beneficial	
																											as landfill of the excavated construction land. *Mitigation measures need to follow, where applicable, existing procedures that comply with existing govt. rules and needs of WB, IFC, ADB guidelines and Equator Principles of Financing Institutions.*
c. Generation of liquid wastes.			✓																								Liquid waste generated during construction process will deteriorate soil and sub-soil water quality if disposed overland. **Mitigation measures:** Such liquid wastes should be collected in sumps and pumped to the RTP for treatment and, thereafter, for onward disposal to soakwells. *Mitigation measures need to follow, where applicable, existing procedures that comply with existing govt. rules and needs of WB, IFC, ADB guidelines and Equator Principles of Financing Institutions. .*
d. Worker accident																					✓						High probability of occurrence in all construction work; major adverse impact. **Mitigation measures:** Effective safety measures to

Project Stages/Source of Impacts	Anticipated Impact on Important Environmental Components																											Comments
	Natural Environment																		Socio-economic Environment									
	Land			Air			Hydrology & Drainage			Noise			Vegetation			Wildlife			Human Health			Homesteads			Employment		
	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Adverse	Beneficial	
																												prevent worker accident, e.g., fall from high altitudes, exposure of workers to injuries due to construction materials, etc. *Mitigation measures need to follow, where applicable, existing procedures that comply with existing govt. rules and needs of WB, IFC, ADB guidelines and Equator Principles of Financing Institutions.*
e. Sanitation diseases hazard																					✓							Concentration of labor force create un-hygienic condition. Major impact. **Mitigation Measures:** Ensuring proper sanitary conditions in work places and workers' sheds. *Mitigation measures need to follow, where applicable, existing procedures that comply with existing govt. rules and needs of WB, IFC, ADB guidelines and Equator Principles of Financing Institutions.*
f. Blockage of wildlife passage																✓												Minor hindrance to wildlife mobility during construction; temporary adverse impact. **Mitigation Measures:** The project site-area should be

Project Stages/Source of Impacts	Anticipated Impact on Important Environmental Components																										Comments
	Natural Environment																		Socio-economic Environment								
	Land			Air			Hydrology & Drainage			Noise			Vegetation			Wildlife			Human Health			Homesteads			Employment		
	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Adverse	Beneficial	
																											surrounded by fences and walls toward facilitating wildlife mobility choosing alternative routes. *Mitigation measures need to follow, where applicable, existing procedures that comply with existing govt. rules and needs of WB, IFC, ADB guidelines and Equator Principles of Financing Institutions.*
g. Traffic congestion						✓						✓									✓			✓			Movement of vehicles, e.g., bulldozers, trucks, etc., involved in the construction process will create traffic congestion within and around the project area and will have adverse impact on the air quality, noise quality, human health and homesteads. **Mitigation measures**: Vehicles involved in the construction process need to ply to and from the construction area preferably at night. *Mitigation measures need to follow, where applicable, existing procedures that comply with existing govt. rules and needs of WB, IFC, ADB guidelines and Equator Principles of Financing*

Project Stages/Source of Impacts	Anticipated Impact on Important Environmental Components																										Comments
	Natural Environment																		Socio-economic Environment								
	Land			Air			Hydrology & Drainage			Noise			Vegetation			Wildlife			Human Health			Homesteads			Employment		
	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Adverse	Beneficial	
																											Institutions.
h. Employment																										✓	Temporary employment generation for the local community; Beneficial impact. **Benefit enhancement measures:** Preference should be given to employing the local communities in various positions, e.g., contractors, supervisors, workers, etc., in construction work.
III. Post-construction and Operation																											
i) Process operation																											
a. Generation of solid wastes			✓						✓																		Such a waste will degrade the quality and aesthetics of land and degrade soil quality. **Mitigation measures:** Generated process solid wastes, mostly in form of sludge collected in centrifuges associated with clarifier in water pre-treatment and ETP, should be taken to solid disposal area for mixing with compost for further use as fertilizer. *Mitigation measures need to follow, where applicable, existing procedures that comply with existing govt. rules and needs of WB, IFC, ADB*

Project Stages/Source of Impacts	Anticipated Impact on Important Environmental Components																										Comments
	Natural Environment																		Socio-economic Environment								
	Land			Air			Hydrology & Drainage			Noise			Vegetation			Wildlife			Human Health			Homesteads			Employment		
	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Adverse	Beneficial	
																											guidelines and Equator Principles of Financing Institutions.
b. Uptake of Cooling Water							✓																				Minor to insignificant impact is anticipated. Uptake of cooling water would be around 10.5 m^3/sec. **Mitigation measures:** No mitigation is necessary as the river maintains continuous flow throughout the year.
c. Generation of liquid waste			✓						✓																		Generated process liquid waste will degrade the land quality and quality of sub-soil water. **Mitigation measures:** Such liquid wastes should be collected in sumps, pumped to ETP and, thereafter, led to soakwell.
ii) Stack emission																											
a. Emission of particulate matter						✓															✓						Permanent disturbance to air quality; residents in immediate vicinity of the project area will be subject to respiratory diseases; adverse impact. **Mitigation measures:** i) Provision of efficient filters at various heights of the emission stack to arrest particulate matters, ii) Plantation of trees to create green belt around the plant area. *Mitigation measures need to follow, where applicable,*

Project Stages/Source of Impacts	Anticipated Impact on Important Environmental Components																										Comments
	Natural Environment																		Socio-economic Environment								
	Land			Air			Hydrology & Drainage			Noise			Vegetation			Wildlife			Human Health			Homesteads			Employment		
	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Adverse	Beneficial	
																											existing procedures that comply with existing govt. rules and needs of WB, IFC, ADB guidelines and Equator Principles of Financing Institutions.
b. Emission of NO_x.						✓															✓						Emission of NO_x will be permanent and will persist so long the power plant is in operation. **Mitigation measures:** The stacks should be of adequate height to permit wide dispersion of the emission. *Mitigation measures need to follow, where applicable, existing procedures that comply with existing govt. rules and needs of WB, IFC, ADB guidelines and Equator Principles of Financing Institutions.*
iii) Process Effluent																											
							✓																				
a. Generation of Floor Washings								✓																			Generation of floor washings will adversely impact upon the local hydrology and drainage system. Medium impact. **Mitigation measures:** Such effluents will be to soak-well through constructed drains. *Mitigation measures need to follow, where applicable, existing procedures that comply*

Project Stages/Source of Impacts	Anticipated Impact on Important Environmental Components																										Comments
	Natural Environment																		Socio-economic Environment								
	Land			Air			Hydrology & Drainage			Noise			Vegetation			Wildlife			Human Health			Homesteads			Employment		
	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Adverse	Beneficial	
																											with existing govt. rules and needs of WB, IFC, ADB guidelines and Equator Principles of Financing Institutions.
c. Noise and vibration hazard												✓									✓						Continuous noise hazard due to power plant operation will, consequently lead to hearing impairment and hypertension among the locals in the project area and its surroundings. **Mitigation measures:** Floor of the generator room should be separated from the base of the generator with gaps filled with wax; and the walls should be lined with noise and vibration resistant materials. Moreover, effective noise-baffling barriers should be created through plantation of at least three layers of trees and construction of walls surrounding the power plant area to keep the noise level within acceptable limits. *Mitigation measures need to follow, where applicable, existing procedures that comply with existing govt. rules and needs of WB, IFC, ADB guidelines and Equator Principles of Financing Institutions.*
III. Associated other significant aspects during																											

Project Stages/Source of Impacts	Anticipated Impact on Important Environmental Components																										Comments
	Natural Environment																		Socio-economic Environment								
	Land			Air			Hydrology & Drainage			Noise			Vegetation			Wildlife			Human Health			Homesteads			Employment		
	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Adverse	Beneficial	
operation stage																											
a. Traffic congestion						✓						✓									✓			✓			Movement of vehicles to and from the operating power plant area will create traffic congestion around the adjacent areas and will have adverse impact on the air quality, noise quality, human health and homesteads. **Mitigation measures:** The power plant authorities need to have its own system of traffic management. *Mitigation measures need to follow, where applicable, existing procedures that comply with existing govt. rules and needs of WB, IFC, ADB guidelines and Equator Principles of Financing Institutions.*
b. Employment																										✓	Medium to significant employment opportunity during operation period. Beneficial impact. **Benefit enhancement measures:** Local community, specifically, women, should, preferentially, be employed in suitable positions.
c. Occupatioal health hazards																					✓						Occupational health risks to employees are inherent of power plants. **Mitigation measures:** A permanent health care cell with trained personnel and ambulance services should be created within the premises of the power plant to respond to emergency health

Project Stages/Source of Impacts	Anticipated Impact on Important Environmental Components																										Comments
	Natural Environment																		Socio-economic Environment								
	Land			Air			Hydrology & Drainage			Noise			Vegetation			Wildlife			Human Health			Homesteads			Employment		
	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Minor	Medium	Major	Adverse	Beneficial	
																											situations. *Mitigation measures need to follow, where applicable, existing procedures that comply with existing govt. rules and needs of WB, IFC, ADB guidelines and Equator Principles of Financing Institutions.*

8. 2 Impacts During Pre-construction Stage and Mitigation Measures.

8.2. 1 **Activity**: *Land Development through Landfill*: The project land will be developed through landfill.

8.2.2 Impacts:

(a) Deposition of Sandy Materials: Sandy materials will be deposited throughout the land of the project area with consequent major permanent deterioration of the soil quality and alteration in landuse pattern.

Mitigation measures: No mitigation could be undertaken since the entire developed land will be utilized for construction of the project and related facilities.

(b) Dust Emission : Temporary dust emission will occur during the land development process with consequent adverse impact on the air quality impairing human health and dust deposition in homesteads within and in immediate vicinity of the project area.

Mitigation Measures: i) Periodic sprinkling of water throughout the area under land development process to arrest dust emission; and ii) Plantation of trees to create green belt around the area should be undertaken.

(c) Disruption to Local Drainage Pattern: Deposition of loose soil during landfill process will cause disruption to local drainage pattern.

Mitigation Measures: Land-fill activities during land development process should be undertaken with simultaneous land compacting activities and the area should be surrounded by protective wall.

(d) Loss of and Displacement from Agricultural Land: Although to a limited scale, the land development process through landfill will lead to permanent loss of single crop agricultural productivity in the area leading to loss of employment and income.

Mitigation Measure: Such an adverse permanent impact could be mitigated through adequate compensation to marginalized peasants.

(e) Loss of and displacement from homestead land: 25 homesteads already existing within the project acquired land will need removal and, to the west of the plant location also within the plant acquired land, a homestead with a pond and homestead vegetation and part of another homestead will be adversely impacted upon resulting in displacement of the residents.

Mitigation Measures: Adequate resettlement and compensation should be ensured to affected homestead dwellers.

8.3 Impacts During Construction Stage and Mitigation Measures.

8.3.1 **Activity**: *i)Excavations, handling and transport of earth and construction materials*: The construction stage will start with activities involving excavation of the developed land and handling as well as transportation of earth and construction materials.

8.3.2 Impacts

(a) Release of Particulate Matters: Particulate matters will be released to the ambient air of the project area during activities involving excavation of the developed land and handling as

well as transportation of earth and construction materials in the construction site resulting in temporary air pollution in the construction area.

Mitigation Measures: Mitigation measures need to comprise provision of dust screen and sprinkling of water throughout the excavation site.

(b) Run-off erosion: Land excavation and filling involved in the construction process will cause run-off erosion during rainy season.
Mitigation Measures: Protection wall needs to be provided around the construction sites to arrest run-off erosion.

8.4 Activity: *ii) Operation of Construction Equipment and Traffic Movement*

8.4.1 Impacts

(a) Temporary and Short Duration Emission of NOx: Emission of NO_x will be temporary and of short duration and will be felt close to construction site only and will persist so long the construction goes on.

Mitigation Measures: No mitigation measure is suggested.

8.5 Activity: *iii) Operation of Construction Equipment, e.g., Bulldozers, Trucks, Scrappers, Concrete Mixers, Cranes, Generators, Pumps, Compressors, Rock Drills, Pneumatic Tools, Vibrators, etc.*

8.5.1 Impacts

(a) Generation of Noise: Noise will be generated during operation of above construction equipment.

Mitigation Measures: Effective noise-baffling barriers should be created to keep the noise level within acceptable limits.

(b) Generation of Construction Solid Wastes: Construction solid wastes will adversely impact upon soil quality and land aesthetics.
Mitigation Measures: Generated construction solid wastes should be stored and used as landfill of the excavated construction land.

(c) Generation of Liquid Wastes: Liquid waste generated during construction process will deteriorate soil and sub-soil water quality if disposed overland.

Mitigation Measures: Such liquid wastes should be collected in sumps and pumped to the RTP for treatment and, thereafter, for onward disposal to soakwells.

(d) Worker Accident: Probability of occurrence of worker accidents is anticipated to be high in all construction works.

Mitigation Measures: Mitigation measures need to comprise effective safety provisions to prevent worker accident, e.g., fall from high altitudes, exposure of workers to injuries due to construction materials, etc.

(e) Sanitation Diseases Hazard: Concentration of labor force in the work area is anticipated to create unhygienic conditions.

Mitigation Measures: Proper sanitary conditions in work places and workers‘ sheds need to be ensured.

(f) Blockage to Wildlife Passage: Minor hindrance to wildlife mobility is anticipated during construction.

Mitigation Measures: The anticipated impact is temporary and will be over as the construction process is over. However, boundary fencing of the construction area will make wildlife passage choose alternative routes.

(g) Traffic Congestion: Movement of vehicles, e.g., bulldozers, trucks, etc., involved in the construction process will create traffic congestion within and around the project area and will have adverse impact on the air quality, noise quality, human health and homesteads.

Mitigation Measures: Vehicles involved in the construction process need to ply to and from the construction area preferably at night.

(h) Employment: Employment generation for the local community during the construction stage of the proposed project will be temporary and beneficial in nature.

Benefit Enhancement Measures: Preference should be given to employing the local communities in various positions, e.g., contractors, supervisors, workers, etc., in construction work.

8.6 Impacts during Post-construction and Implementation Stage.

8.6.1 Activity: *i) Process Operation*

8.6.2 Impacts

(a) Generation of Solid Wastes: Such a waste will degrade the quality and aesthetics of land and degrade soil quality.

Mitigation Measures: Generated process solid wastes, mostly in form of sludge collected in centrifuges associated with clarifier in water pre-treatment and ETP, should be taken to solid disposal area for mixing with compost for further use as fertilizer.

(b) Generation of Liquid Wastes: Generated process liquid wastes will degrade the land quality and quality of sub-soil water.

Mitigation Measure: Such liquid wastes should be collected in sumps, pumped to ETP and, thereafter, led to soakwell.

8.7 Activity: *ii) Stack emission*

Emission estimates of pollutants (NO_x as NO_2, SO_2, PM_{10} and CO) vis-a-vis stack parameters (viz., stack height, stack diameter, ehaust temperature flow-rate velocity, exit velocity) used in the air dispersion modeling are as under (Table-8.2). Stacks of both the units 1 &2 were, during modeling, assumed to have the same parameters and the same emission rates.

Table-8.2: Emission rates and stack parameters

Source	Stack Height (m)	Stack Diameter (m)	Exhaust Temperature (^oc)	Vel. Flowrate (m^3/sec)	Exit Velocity (m/sec)	Emission rates (g/sec)			
						NO_x as NO_2	SO_2	PM_{10}	CO
Gas unit 1	50	3	145	275	25	9.40	NA	0.07	3.43
Gas unit 2	50	3	145	275	25	9.40	NA	0.07	3.43

As sulphur content in the input Bibiyana natural gas is nil, emission of SO_2 had not been included in the modeling. Maximum 50 values for NO_x, PM_{10} and CO have been presented in Tables 8.3, 8.4 and 8.5. The predicted highest values with two stacks for NO_x, PM_{10} and CO have been 5.23, 0.053 and 3.82µg/m^3, respectively.

The measured background concentration (maximum) for NO_x, PM_{10} and CO has been 15.01µg/m^3 (24hr), 156.93µg/m^3 (24hr) and 4.36µg/m^3 (8hr), respectively. Bacground CO concentrations were not measured. Summary of maximum gound-level concentrations (GLCs) over the model domain has been as under (Table-8.3):

Table-8.3: Summary of predicted maximum GLCs over the model domain

Pollutant	Averaging Period	Std. (µg/m^3)	Background Conc. (µg/m^3)	Predicted maximum control building by the plant (µg/m^3)	Combined value (µg/m^3)	% of STD.
NO_x	24hr	100	15.01	5.23	20.24	20.24
PM_{10}	24hr	150	156.93	0.05	156.98	104.65**
CO	8hr	10,000	131*	3.8	134.8	1.35

* Due to unavailability of local value, literature value has been used

** PM_{10} emission has been determined by the fugitive emission from the plant site. Emission from power plant is predicted to be less than 0.03%.

8.7. 1 Impacts

(a) Emission of Particulate Matter: Stack emission of particulate matter will cause permanent disturbance to air quality; residents in immediate vicinity of the project area will be subject to respiratory diseases.

Mitigation Measures: Mitigation measures in respect of such an impact on the air quality need to comprise:

- Provision of efficient filters at various heights of the emission stack to arrest particulate matters,
- Plantation of trees to create green belt around the plant area.

(b) Emission of NO_x : Emission of NO_x will be permanent and will persist so long the power plant is in operation.

Mitigation Measures: The stacks should be of adequate height to permit wide dispersion of the emission.

8.8 Activity iii*) Process Effluent*

Water for the overall process and for the cooling towers of the proposed CCGT plant of the Summit Bibiyana 1 & II Power Project will be drawn from the river Kushiyara. Nature of impacts will depend upon the activities related to the cooling process and the mode of utilization and disposal of the process water. While cooling water will be used in the cooling process as well as in boilers of the proposed power plant, the remaining portion of the process water will be used in cleansing and washing purposes. There will be no discharge of used cooling water from the power generation system, as the cooling process will be once through and closed one. Effluents, hence, would be of two categories: Thermal effluent to be recycled and washing effluent for disposal.

8.8.1 Impacts

Generation of floor washings will adversely impact upon the local hydrology and drainage system. Medium impact.

Mitigation measures: Such effluents will be to soak-well through constructed drains.

Mitigation measures need to follow, where applicable, existing procedures that comply with existing govt. rules and needs of WB, IFC, ADB guidelines and Equator Principles of Financing Institutions.

(c) Occupational Health Hazard: Occupational health risks to employees are inherent of power plants.

Mitigation Measures: Mitigation measures should comprise the following:

- A detailed and pragmatic emergency response plan in respect of exposure of employees to various occupational health risks characteristic of power plants;
- Provision of safety gears, e.g., helmets, gas masks complete with protective eye-glasses, portable oxygen cylinders and ear-plugs/ear-covers, fire and heat-proof hand gloves, fire and heat-proof electricity insulated outfits, electricity insulated and fire-proof boots and gum-boots, etc, for employees working at on-site location of the power plant;
- A medical centre, working on 24-hour basis, complete with trained medical personnel, appliances and ambulance facilities.

CHAPTER IX

Identification of Significant Social and Environmental Impacts due to Laying of Natural Gas Pipeline for the Proposed Summit Bibiyana I & II Power Company Limited Project and Mitigation Measures

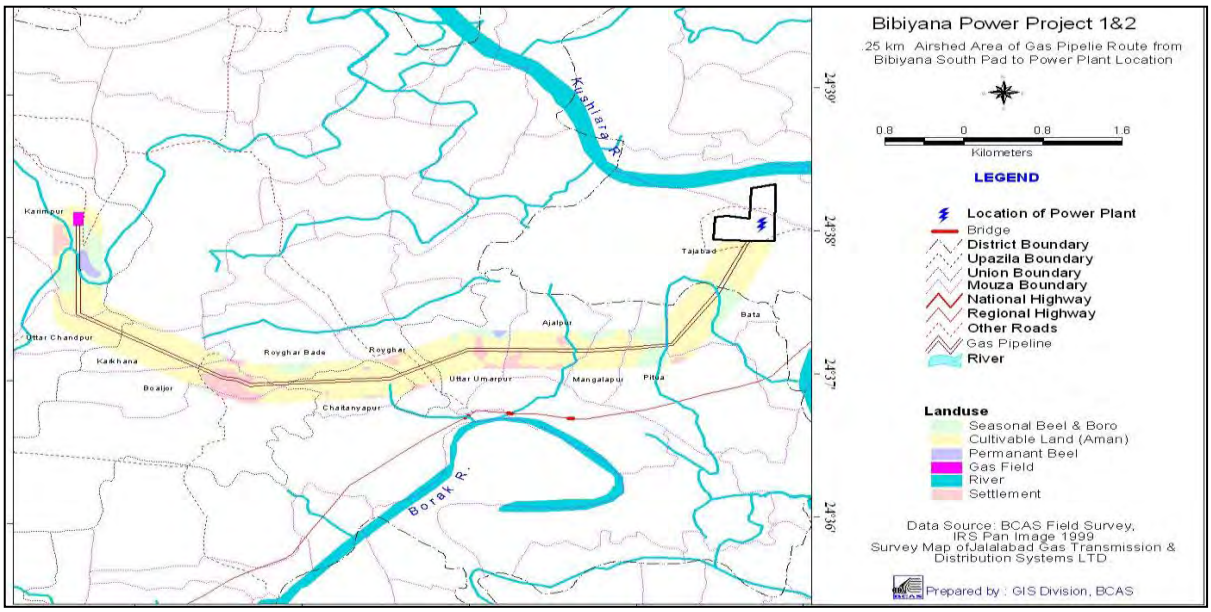
9.1 Introduction

This chapter describes the anticipated significant social and environmental impacts of the activities in connection with laying of natural gas pipeline for the proposed Summit Bibiyana I & II Power Company Limited Project Project. Identification of such impacts has been followed by measures toward mitigating them. Enhancement measures of beneficial impacts and compensation to project affected persons have also been proposed. Hence, this chapter, too, complies with the envisaged portion of *„integrated assessment to identify the social and environmental impacts, risks and opportunities'* pertaining to *IFC Performance Standard 1* and *Performance Standards 2 and 3* through proposing creation of *congenial labor and working conditions* and measures for *pollution prevention and abatement*, respectively.

The proposed Summit Bibiyana I & II Power Company Limited Project Project will utilize natural gas as fuel for power generation. For the purpose, the Summit Bibiyana Power Company Limited (SBPCL I&II) has entered into an agreement with the Jalalabad Gas Transmission and Distribution System Ltd (JGTDSL) toward supply of Jalalabad gas for the proposed two combined cycle power plants through an 8.8km pipeline to facilitate flow of gas from the nearest distribution point, the Bibiyana South Pad, to the proposed power plant site.

9.2 Proposed Route of the Pipeline

The proposed 8.8km natural gas pipeline will pass through Mouzas Tajabad (Union: Sadipur, Upazilla: Balaganj, District: Sylhet), Karimpur and Uttar Chandpur (Union: Inathganj, Upazilla: Nabiganj, Ditrict: Habiganj); Boaljor, Royghar Bade, Karkhana and Royghar (Union: Digalbak, Upazilla: Nabiganj, District: Habiganj); and Chaitanyapur. Mangalapur, Uttar Umarpur, Bata, Ajalpur and Pitua (Union: Aushkandi, Upazilla: Nabiganj, District: Habiganj). The route alignment of the proposed pipeline appears at Map-9.1



Map-9.1: Route alignment of the Natural Gas Pipeline

9.3 Landuse Type of the Pipeline Area

The proposed pipeline stretches from the gas-field at Karimganj upto the connecting point of the proposed power plant at Bibiyana. The pipeline will pass through a basically agricultural land. It will also pass through seasonal beels where boro cultivation is practiced. The type of landuse of the proposed pipeline area within 2.5km project airshed is depicted in the following Table (Table-9.1).

Table-9.1: 2.5 km airshed area of proposed gas pipeline route

Sl No.	Type	Area in sq. km.
1	Cultivable Land	3.532
2	Boro/Seasonal Beel	0.620
3	Settlement	0.383
4	Waterbody	0.051
5	Gas Field	0.017

9.4 Land Acquisition and Displacement

The distribution pipeline will cross a canal and pass-by Aushkandi Bazar, and Saidpur Bazar, and cross another canal before crossing the Hai river, the Hai river itself, agricultural lands in village Petua before finally reaching the connecting point at the proposed power plant site. Acquisition of requisite land as well as procurement of land, on a temporary requisition basis, have been in process for the proposed pipeline laying. Persons to be affected (PAPs) due to the proposed pipeline laying process would, hence, need to be taken into consideration. Overall volume of PAPs will comprise 206 persons.

Three homesteads with 21 persons, on the right of way (ROW), will suffer temporary displacement as a result of the natural gas pipeline process for the proposed Summit Bibiyana I & II Power Company Limited Project. The impact anticipated would be in terms of disruption of homesteads for a week or so during the laying of the pipeline.

9.5 Scope of Land Acquisition & Impacts

Development in the north-eastern region of Bangladesh, i.e., the greater Sylhet region including the Nabiganj upazilla of the Habiganj district, has taken place aftermath of a number of gas-field operations, and has been a reliable local source of energy. Quite a sizeable number of industries have cropped up with utilization of such an economic source of energy. This development intervention will bring about bright prospect for the currently proposed and future power plants, industries and commercial and domestic consumers of the project area and, in turn, help further development of industries throughout the locality as well as create ample scope of wider employment opportunities, thereby improving the overall quality of life of the people in the region.

9.6 Significance of Impact, Mitigation Measures and Resettlement Plan

As has been apparent during on-field study of the proposed gas pipeline laying route alignment area, any form of severe and significant environmental impact is most unlikely to be over the respective localities through which the proposed pipeline is expected to pass. Environmental impacts anticipated over the respective areas of the route alignment will be

temporary and non-severe in nature as well as in dimensions. Conventional mitigation measures in respect of such environmental impacts will also be few (as in case of 107 trees along the proposed route alignment necessitating felling). Most of such environmental mitigation measures will comprise financial compensation.

Moreover, the adverse impact anticipated upon affected persons (APs) due to the proposed natural gas pipeline laying activities will be temporary and non-severe in nature. A short Resettlement Plan (RP), as per the ADB policy on *Involuntary Resettlement* could, therefore, be proposed to be undertaken. The RP could focus only on financial compensation of APs to address the above temporary and non-severe socio-economic impacts likely to arise from shifting and re-shifting of temporary structures for a week or so. There are no indigenous people (tribal or ethnic minority) with the AP population and there is no vulnerable group, women, common property resources (CPR) to suffer any significant impact due to construction of the gas transmission line.

9.7 Impact during Land Excavation and Mitigation Measures.

Identification of Significant Environmental Impacts (SEIs) due to natural gas pipeline laying for the proposed Summit Bibiyana I & II Power Company Limited Project Project has been done through developing a matrix. The matrix so developed appears in Table-9.2. Following are the details of the environmental components that are anticipated to be affected by the pipeline activity.

9.7.1 Impacts

9.7.1.1 Dust Emission: Temporary disturbance will occur to local air quality; residents in immediate vicinity will be subject to respiratory deseases; adverse impact.

Mitigation measures: Periodic sprinkling of water needs to be done throughout the area under pipeline laying process to arrest dust emission.

9.7.1.2 Disruption to Local Drainage Patterns: Loose soil during land excavation is likely to cause temporary disruption to local drainage pattern; minor adverse impact.

Table-9.2: Matrix of Significant Environmental Impacts (SEIs) due to Proposed Natural Gas Pipeline Laying for Summit Bibiyana 1 & 2 Power Plant Project on the Proposed Project Area.

Project Stages/Source of Impacts	Anticipated Impact on Important Environmental Components																									Comments
	Natural Environment																		Socio-economic Environment							
	Land/ Agriculture			Air			Hydrology & Drainage			Noise			Vegetation			Terrestrial/ Aquatic Fauna			Human Health			Homesteads			Employment		
	Non-severe	Insignificant	Minor	Non-severe	Insignificant	Minor	Non-severe	Insignificant	Minor	Non-severe	Insignificant	Minor	Non-severe	Insignificant	Minor	None	Insignificant	Minor	Non-severe	Insignificant	Minor	Non-severe	Insignificant	Minor	Adverse	Beneficial	
I. Pre-construction																											
i) Land Excavation																											
a) Dust Emission				✓															✓			✓					Temporary disturbance to air quality; residents in immediate vicinity will be subject to respiratory deseases; adverse impact. *Mitigation measures:* Periodic sprinkling of water needs to be done throughout the area under pipeline laying process to arrest dust emission.
d) Disruption to local drainage pattern							✓																				Loose soil during land excavation is likely to cause temporary disruption to local drainage pattern; minor adverse impact. **Mitigation measures:** Land-excavation should be undertaken cautiously and the excavated soil should be kept covered by tarpaulin and surrounded by protective boundary.
e) Loss of and displacement	✓																										Termporary and minimal loss of single

Project Stages/Source of Impacts	Anticipated Impact on Important Environmental Components																										Comments
	Natural Environment																		Socio-economic Environment								
	Land/ Agriculture			Air			Hydrology & Drainage			Noise			Vegetation			Terrestrial/ Aquatic Fauna			Human Health			Homesteads			Employment		
	Non-severe	Insignificant	Minor	Non-severe	Insignificant	Minor	Non-severe	Insignificant	Minor	Non-severe	Insignificant	Minor	Non-severe	Insignificant	Minor	None	Insignificant	Minor	Non-severe	Insignificant	Minor	Non-severe	Insignificant	Minor	Adverse	Beneficial	
from agricultural land																											crop agricultural productivity in the area.. **Mitigation measures:** i) Adequate compensation to affected peasants (if any).
f) Loss of and displacement from homestead land																						✓					Absolutely temporary and non-severe impact on homesteads resulting in temporay shifting. **Mitigation measures:** Adequate compensation should be ensured to affected homestead dwellers.
g) Loss of vegetation and tree-cover															✓												Around xxx number of trees are anticipated to be felled in certain areas along the route alignment of the proposed pipeline laying during excavation for the purpose resulting in a temporary and minor environmental impact. **Mitigation Measures**: Adequate financial compensation to respective PAPs for re-plantation of the lost trees.
II. Pipeline Laying																											
i)Cutting of pipes to be laid																											
a. Generation of noise										✓																	Temporary and non-severe impact.

Project Stages/Source of Impacts	Anticipated Impact on Important Environmental Components																									Comments
	Natural Environment																		Socio-economic Environment							
	Land/ Agriculture			Air			Hydrology & Drainage			Noise			Vegetation			Terrestrial/ Aquatic Fauna			Human Health			Homesteads			Employment		
	Non-severe	Insignificant	Minor	Non-severe	Insignificant	Minor	Non-severe	Insignificant	Minor	Non-severe	Insignificant	Minor	Non-severe	Insignificant	Minor	None	Insignificant	Minor	Non-severe	Insignificant	Minor	Non-severe	Insignificant	Minor	Adverse	Beneficial	
																											Mitigation measures: Homestead dwellers to be affected should be informed beforehand.
ii) Laying of pipeline across rivers, canals, beels																											
a) Impact on aquatic habitat																✓											No impact is anticipated. Hence, no mitigation could be proposed.
b) Impact on Boro cultivation in seasonal beels.	✓																										Absolutely temporary and non-severe impact. **Mitigation measures:** Only requisite financial compensation is proposed
c) Impact on agriculture	✓																										Absolutely temporary and non-severe impact. **Mitigation measures:** Only requisite financial compensation is proposed
d. Employment																										✓	Temporary employment generation for the local community; Beneficial impact. **Benefit enhancement measures:** Preference should be given to employing the local communities in various positions, e.g., contractors, supervisors, workers, etc., in related work.

Mitigation measures: Land-excavation should be undertaken cautiously and the excavated soil should be kept covered by tarpaulin and surrounded by protective boundary.

9.7.1.3 Loss of and displacement from agricultural land: There will be temporary and minimal loss of single crop agricultural productivity in the area..

Mitigation measures: Adequate compensation to affected peasants (if any).

9.7.1.4 Loss of and displacement from homestead land: Such an impact will be absolutely temporary and non-severe in nature on homesteads resulting in temporary shifting. Census survey of areas along the route alignment of the proposed pipeline laying has identified (shown in the Table-10.3 below), a total of 3 homesteads with 21 dwellers will be affected for the time being due to shifting from the right of way of the road alignment. Impacts will be due to dust emission during excavation process and will be absolutely temporary and non-severe in nature.

Mitigation Measures: Adequate compensation should be ensured to affected homestead dwellers.

9.7.1.5 Loss of Trees and Vegetation Cover: Around xxx number of trees are anticipated to be felled in certain areas along the route alignment of the proposed pipeline laying during excavation for the purpose resulting in a temporary and minor environmental impact.

Mitigation Measures: Adequate financial compensation to respective PAPs for re-plantation of the lost trees.

9.8 Impact During Pipeline Laying and Mitigation Measures.

A. Cutting of Pipes to be Laid

9.8.4 Impacts

9.8.1.1 Generation of noise: Such an impact will be temporary and non-severe in nature.

Mitigation measures: Homestead dwellers to be affected should be informed beforehand.

B. Laying of Pipeline Across Rivers, Canals, Beels, etc.

9.8.2 Impacts

9.8.2.1 Impact on Aquatic Habitat: Related activity will not involve any kind of earthwork while laying the pipeline across rivers, canals and beels. Hence, no impact is anticipated and, as such, no mitigation measure could be proposed.

9.8.2.2 Impact on Boro Cultivation in Seasonal B eels: Absolutely temporary and non-severe impact is anticipated.

Mitigation Measures: Only requisite financial compensation is proposed.

9.8.2.3 Impact on Agriculture: Absolutely temporary and non-severe impact is anticipated.

Mitigation Measures: Only requisite financial compensation is proposed.

9.8.2.4 Employment: Temporary employment generation for the local community; Beneficial impact.

Benefit Enhancement Measures: Preference should be given to employing the local communities in various positions, e.g., contractors, supervisors, workers, etc., in related work.

CHAPTER X

HAZARD AND RISK ASSESSMENT AND EMERGENCY RESPONSE

10.1 Introduction

According to classical definition, hazard could be regarded as among the adverse consequences of an activity or a combination of several activities or involvement of the use of certain materials in an activity or in a combination of several activities that has the potential of initiating or propagating an unanticipated event/sequence of events that can be termed as an accident. Identification of hazard involves knowing how such a material is likely to behave in the process of related activities, its storage and its transport.

Materials being used in power plant processes include chemicals as well. Apart from the chemical and process characteristics of the material, the size and layout of the plant and equipment need specific consideration in order to assess the hazard potential. Similarly, natural calamities such as floods, earthquakes etc. cannot be ignored, in the same way as domino or secondary effects of accidents occurring in the surroundings cannot be totally disregarded or ignored.

Identification of hazards in a power plant is of primary significance in the analysis, quantification and cost effective control of accidents involving the raw materials and/or chemicals utilized in the power generation process. The type, quantity, location and conditions of release of a toxic or flammable substance have to be identified in order to estimate its damaging effects, the area involved, and the possible precautionary measures required to be taken. In the proposed project, hazard identification during storage and transport are relevant.

10.2 Hazard Criteria

The criteria, that could be employed for preliminary identification and evaluation for hazard potential, are:

a) Potential for uncontrolled exothermic reactions.
b) Potential for loss from containment.
c) Potential for possible ignition sources.

10.2.1 Criteria in respect of Flammability, Instability and Toxicity

Hazardous substances could be classified into the following three main classes:

i. *Flammable substances*: Such substances require identification with air for their hazard to be realized. Under certain circumstances the vapors arising from flammable substances when mixed with air may be explosive, especially in confined spaces. However, if present in sufficient quantity such clouds may explode in open air also.

ii. *Unstable substances*: Such substances are liquids or solids, which may decompose with such violence so as to give rise to blast waves.

iii. *Toxic substances*: As the class refers to, such substances are toxic in nature causing danger and substantial damage to life when released into the atmosphere.

10.3 Risk Criteria

Natural gas, due to its highly inflammable and explosive properties, could cause jet fire as well as explosion when released. Similarly, chlorine gas is highly toxic to exposure, and the scenario may develop due to leakage valve bodies, corroded pipeline, snapping of pipe line etc. In case of partial failure of pressurized pipelines, natural gas will be released in the form of jet and will lead to jet fire when in contact with naked flame or hot material. Explosion may also occur due to release of natural gas through leakage. Such a situation, more than often, leads to damages, mainly to property.

10.3.1 Thermal radiation

Thermal radiation due to jet flame may cause various degrees of burn on human bodies. Also its effect on inanimate objects like equipment, piping, building and other objects need to be evaluated. Physiological effects vis-à-vis degrees of burns caused due to thermal radiation are as under:

1st Degree Burn: Involve only epidermis, blister may occur; e.g., sunburn.

2nd Degree Burn: Involve whole of epidermis over the area of burn plus some portion of dermis.

3rd Degree Burn: Involve whole of epidermis and dermis; subcutaneous tissues may also be damaged.

10.3.2 Blast overpressure

As mentioned above in the beginning of this sub-section, release of natural gas through leakage may also cause explosion leading to blast over-pressure.

10.3.3 Toxic exposure

Damaging consequences may also be due to exposure to toxicity of chlorine gas. The physiological responses of human bodies to exposure to chlorine are: Slight symptom after several hours (concentration 1.0 ppm/3.0 mg/m^3), coughing (concentration 30 ppm/87 mg/m^3), lethal for 50% of population after 30 minutes exposure (concentration 500 ppm/1450 mg/m^3), Fatal in 30 min or less (concentration 1000 ppm/2900 mg/m^3) and Fatal in 10 minutes (concentration 1800 ppm/5200 mg/m^3).

10.4 Hazard and Risk Assessment (HRA)

(a) Objective: The objective of carrying out Risk Assessment Study for proposed Summit Bibiyana 1 & II Power Plant project is to study the risks involving hazardous materials and their consequences. In this exercise, the study objectives are outlined hereunder.

HRA process includes the following sequential steps:

i. Hazard and Risk Identification
ii. Release Assessment
iii. Exposure Assessment
iv. Consequence Assessment
v. Risk Estimation

(i) Hazard Identification and Visualization of Maximum Credible Accident (MCA) Scenarios: Identification of potential hazards due to construction and operation of power generation plants and visualization MCA scenarios are carried out toward the following purposes:

a) To identify major hazards relating to fire, explosion and toxic release due to failure of pipeline/ containment.

b) To visualize the MCA scenarios.

c) To assess the consequences of these accidents.

d) To study past accident information in order to visualize worst accident situations.

(ii) Visualization of MCA Scenarios and Assessment of their Consequences: Such an aspect of HRA is undertaken toward analyzing and quantifying the primary and secondary effects as well as the damage potential of identified MCA scenarios with recourse to mathematical and analytical models.

(iii) Consequence Analysis: The scope of work for study of the consequences of MCA scenarios due to nature of exposures and characterization of risk levels on-site and off-site population and environment involves the following aspects:

a) Detailed study of engineering information, diagrams, and lay out plans for the plants as well as chlorine storage facility.
b) Identification of chemical and process hazards
c) Preliminary identification of hazardous section of the plant and storages with resources to Fire-Explosion and Toxicity Index (FETI).
d) Past accident data analysis to identify possible worst accident scenarios.
e) Visualization of Maximum Credible Accident (MCA) scenarios.
f) Analysis of identified MCA scenarios and quantification of primary and secondary effects with recourse to mathematical models pertaining to cases of:
    i. Toxic Dispersions
    ii. Heat Radiations
    iii. Vapour Cloud Explosion
g) Determination of damage criteria for heat radiation, pressure wave and toxic concentration levels with respect to health criteria, dose-response relations and vulnerability models.
h) Study of on-site and off-site population characteristics.
i) Characterization of risk analysis through study of nature of exposures, pathways and consequences of MCA scenarios and presentation of results in terms of damage distances.

10.5 Hazard Awareness

Awareness should be built up among the various strata of employees the proposed power plant about the various types of hazards associated with power plants, their consequences and means to avoid them. All the sections of the power plant premises where hazardous activities are to be carried out or in which materials that could lead to various hazards are to be used should be labeled with stickers.

10.6 Hazard Materials and Wastes

Hazardous materials related to power plants could be classified into the following four groups on the basis of their respective threshold quantities for safe use
Group1 – Toxic substances
Group 2 – Highly reactive substances
Group 3 – Explosive substance
Group 4 – Flammable substances

The following Table 10.1 shows the list of major chemicals which could be identified as hazardous chemicals in respect of their manufacture, storage and use which are to be considered as major accidental hazard (MAH).

Table-10.1: Various Types of Hazardous Materials.

Materials	Use	Nature of Material	Storage Quantity	Threshold Quantity for MAH
Fuel Oil	Supporting fuel	Highly flammable	3750KL[#]	2500 tonnes
Transformer oil	Transformer	Highly flammable	15KL	2500 tonnes
Chlorine	Cooling tower	Toxic (Group1)	25 tonnes[#]	10 tonnes
Sulphuric Acid	Water treatment	Hazardous	24 tonnes	Not considered
Caustic Soda	Water treatment	Hazardous	24 tonnes	Not considered

[#] To be considered as MAH

10.7 Hazard Identification and Control

Functional or operational aspects of a power generation process that are capable of initiating hazardous events could be considered along with the respective consequences in the exercise of identification of hazards and proposing control measures as depicted in Table 10.2 as under.

Table-10.2: Hazard Identification and Control

Operational/Functional Aspects	**Possible Initiating Events**	**Possible Consequences**	**Preventive/Control Measures**
Raw Materials			
Supply of Natural Gas through pipeline	• Pipeline leak (usually prolonged) • Pipeline rupture (usually instantaneous)	• Fire (flash or jet) • Uncontrolled Vapor Cloud Explosion	• Quality control in pipeline fabrication • Quality control in pipeline laying operation • Adequate depth of cover • Clearly marked pipeline route • Regular patrol to watch for excavation work in the vicinity of the pipeline • Protective coating to inhibit corrosion (also cathodic protection) • Installation of protective devices (e.g., emergency isolation valves, cut-off

Operational/Functional Aspects **Raw Materials**	Possible Initiating Events	Possible Consequences	Preventive/Control Measures
			valves and one-way valves) • Leak detection by automatic sensing devices • Evacuation of adjacent areas • Barricading of roads; • Emergency Response Plan.
Caustic Soda and Sulphuric Acid (demineralization plant)	• Traffic congestion • Spillage and leakage • Contact with reactive and/or corrosive materials	• Corrosive fumes • Chemical burns • Damage to Plant and equipment • Reactions – heat/corrosive fumes and vapor • Toxic gases/vapors (e.g., sulphur trioxide)	• Ensuring safe transportation of goods and materials • Safe packaging and handling of drums • Regular check of drums for weakening by corrosion • Spill control kit for acid and alkali • Emergency Response Plan including inert bunding to contain any apillage or leakage. • Adequate personal protection equipment for corrosive spills and clean-ups; • Neutralization of wastes/spillages and disposal by liquid waste contractor.
Power Generation			
Natural Gas Fuel	• Turbine failure • Leak of rupture	• Flame out • Concentration of methane reaches lower flammability limit at gound-level • Potential flash-fire	• Stack dispersion of gas • Installation of quick response emergency isolation valves • Remotely actuated shut-off system
Caustic Soda and Sulphuric Acid (demineralization plant)	• Spillage and leakage • Contact with oxidisable materials	• Chemical burns • Damage to plant and equipment • Reactive (caustic + acid) • Contamination of soil and storm-water run-off	• Regular checks of drums for weakening due to corrosion • Bunding to contain spillage or leakage

10.8 Risk Assessment

The risk assessment determines whether the risks are tolerable or if risk mitigation measures are required to reduce the risk to a level which can be considered to be as low as reasonably practicable. Risk assessment depends on failure frequency of the system and probability of ignition and explosion. These could be assessed as under.

Failure frequency: The range of possible releases for a given component covers a wide spectrum – from a pinhole leak to a catastrophic rupture (of a vessel) or, even, to a full-bore rupture (e.g., that of a pipe). It is both time-consuming and unnecessary to consider every part of the range; instead, representative failure cases could be considered. For various types of component and for each of the representative hole sizes, failure frequencies during a give year need to be noted under three heads, viz., Failure Type (e.g., pipe damages, Liquid Storage Tank, Pressurized Vessel, etc.), Failure Cases (damage types, viz., leaks, holes, ruptures, significant leaks, etc.) and Failure per year, and summarized in a tabular form, typical of which is shown as under (Table 10.3).

Table-10.3: Failure Frequency

Type	Failure cases	Failure per year
Pipe damages		
	Leaks	
	Holes	
	Ruptures	
Total		
Liquid Storage Tank	Significant Leak	
Pressurized Vessel		

Ignition Probability: Ignition probability data is important in quantification of risks. Historical data on ignition of flammable releases could be used as a basis for determining suitable ignition probabilities. As probability of ignition depends upon availability of source of ignition, it also depends on the maintenance of safety level.

10.9 On-site Emergency Plan

In recent years public awareness of hazards from industry have increased considerably. Local people and employees have now better legal safeguards against industrial disasters. The management today has more responsibilities in respect of any kind of disaster in its project. So specific management plan to encounter a disaster situation is of utmost importance. As disaster types, sources, effects are different, it needs multidisciplinary and multi-organizational approach to tackle such situation.

Types of Disaster: Disaster is an event which causes severe disruption to life of number of people or to the project activities resulting in suffering and loss of life and property. Disasters can be one or several of the types as under:

i) Plant oriented- due to design errors, operational defects, chemical changes, failure of equipments human errors etc. (in the plant area).
ii) Natural- flood, cyclone, fire, earthquakes, biological disaster.
iii) Manmade- war, riot, sabotage.

Degrees of Disaster: Disaster can be classified into 3 types as under depending on its effects:

a. Low – Such disasters are capable of causing injury, illness and equipments damage, but, are not, however, very serious and could be quickly manageable.

b. Medium – Disasters of this type can give rise to critical situations, can cause serious injuries to personnel, serious illness property and equipment damage.

c. High – Disasters of this extreme type lead to catastrophic situations, pose major danger to life and property. Such disasters cannot be immediately controlled. These can cause deaths, major widespread illness, injuries, loss of major property and equipments.

The contingency plan should provide for a Chief Coordinator. The Chief Coordinator will declare the contingencies arising out of the type of disaster that has taken place along with the mode of action in respect of the disaster type. The following could be prescribed as the mode of action during various degrees of disaster.

High Disaster- Catastrophic condition. All employees need to be evacuated. Local administration is to be properly informed and interacted with.

Medium Disaster- All project activities should be stopped. All employees are to be in safe place. To be ready for High disaster situation. Inform Local administration should be properly informed and interacted with.

Low Disaster- Activities in the affected area stopped. To be ready for Medium type of disaster condition.

10.9.1 Objective of On-site Emergency Plan

On site Emergency Plan is required to meet the emergency condition during disastrous event in the plant. Its objectives are to:
• Rescue and treat casualties
• Safeguard other people & Installations
• Minimize damage
• Control initially and restore ultimately to normal situation
• Arrange rehabilitation of the affective people

10.9.2 Execution of Emergency Plan

Based on the nature of disasters anticipated during the three phases (pre-construction, construction and post-construction) of the project and the objectives of the emergency plan, necessary human resource and infrastructural facilities need to be made available on board toward effective operation and execution of the plan. . The plan could be revised and detailed after the commissioning of the plant when all the units are in final shape. Exact name and designations of all personnel could be then accommodated in the plan.

Actions during Emergency: At times of emergency due to any of the above types of disaster, the general employees of the proposed power plant should proceed to/contact the Emergency Assembly Point in their area. Designated persons will carry out the actions detailed in the Individual Plant Emergency Procedure. Their presence at the Emergency Assembly Point should verified and ascertained through roll-calls. Personnel not at their normal work place must also move to the emergency assembly point and await necessary safety instructions.

Contractor's employees should also be instructed of the Emergency Procedures before commencing work on this site. They will report to the emergency assembly point on this site.

Personnel Manager will guide them in case a major decision like evacuation from the factory is taken.

Infrastructure for Execution of Emergency Plan:

a) Fire Fighting Facilities: The plant will have adequate fire fighting aids including fire hydrants close to the various sections of the power generation area and Portable Fire Extinguishers of various types and sizes need to be installed at conveniently reachable locations.

b) Disaster signalling Siren: Siren to be used for raising the alarm and also for ALL CLEAR signal should be installed within the power plant premises.

c) First Aid Boxes should provided at specific locations including at the Assembly point for administering preliminary treatment. A number of employees are trained for first aid use.

d) Emergency Control Centre should be at a central as well as safe location in the plant premises wherefrom the Site Controller could direct the movements of Personnel and Equipment during an Emergency.

e) Contents of Emergency Control Centre should be as under:

i) External telephone line and a list of relevant telephone numbers to contact at times of emergency.
ii) Internal telephone and telephone list of Emergency Assembly Points.
iii) List of Emergency Control Team, who must be called showing addresses and telephone numbers.
iv) Emergency Controller's Red & White Helmet.
v) A list of all persons (by title) responsible for groups of employees.
vi) Logs and Emergency Controller's checklist.
vii) Emergency lighting.
viii) Copy of the emergency plan.
ix) List of persons trained in First Aid & Fire Fighting.
x) List of safety cabinets and their contents & locations.
xi) Battery operated torches.
xii) Detailed site plan.
xiii) First aid equipment including stretchers (in surgery).

Assembly Point is a place containing an internal telephone and paging system, where people can wait in a group during emergency to receive instructions from the Emergency Controller. External Communication will be done by Site Controller. The following persons and offices may be given updated information as necessary and ask for necessary help.

- Upazilla Nirbahi Officer (UNO)
- Police
- Fire Brigade
- Upazilla Health Complex/District Hospital
- Factory Inspector
- Local Media
- Upazilla Magistrate

CHAPTER XI

ENVIRONMENTAL MANAGEMENT PLAN (EMP)

11.1 Introduction

This chapter deals at length on the measures that the project entrepreneur will undertake toward biodiversity conservation and sustainable natural resource management in various phases of the proposed project and also toward management of social and environmental impacts and also toward addressing grievances that the various communities might have, in respect of various stages of project implementation, throughout the life of the proposed project. The chapter, hence, complies with the *IFC Performance Standard 1* (*client's management of social and environmental impacts…*) and *Performance Standard 6* (*Biodiversity Conservation and Sustainable Natural Resource Management*).

The mitigation measures proposed in Chapters IX and X of this EIA Report to avoid or minimize impacts due to various activities during pre-construction, construction and post-construction as well as operation stages of the proposed Summit Bibiyana 1 & II Power Project and also due to the activities pertaining to those three stages of laying of natural gas pipeline, form the basis of this Chapter.. This Chapter presents the specific plan for implementing the mitigation and monitoring requirements and addressing community grievances within the framework of an Environmental Management Plan (EMP). The following principles were used to guide the preparation of EMP:

- focus on occupational health, safety, and environment risk prevention;
- affordable, safe technologies are used wherever failure of equipment would have a significant effect on safety, health, or the environment;
- conformance with relevant standards, codes, and practices will be considered in the application of the safe technologies;
- all activities will be performed in a safe and effective manner and all equipment will be maintained in good operating conditions for the protection of health and safety of all persons and the conservation of the environment and property;
- all necessary precautions are carried out to control, remove, or otherwise correct any hazardous materials leaks and/or spills, or other health and safety hazards; and
- all activities and components related to construction of the power station will meet relevant international standards which ensure sufficient technical levels of safety;
- necessary measures will be ensured to redress grievances that the communities within and in the proximity of the project site might experience.

At the time of completion of EIA exercise, certain detailed planning and design activities pertaining to the proposed Summit Bibiyana 1 & II Power project were still to be completed. Thus, this Chapter describes EMP at the level of detail available during the time of undertaking and completion of the EIA exercise and, subsequently, writing this part of the EIA Report.

The above-mentioned detailed actives when completed, will be integrated within the framework of the EMP. Hence, EMP at this stage, addresses the following key components:

- management activities and systems;
- plans, procedures, and programs;
- monitoring activities;
- implementation schedule and cost estimate; and
- plans for integrating the EMP within the overall development plan for the project.

11.2 Environmental Management

The Summit Bibiyana I & II Power Company Limited Project., the sponsor of the project is committed to constructing and operating the power plant in an environmentally responsible manner and in compliance with relevant environmental laws, regulations, and guidelines in force in the country and also those prescribed by international agencies and donor groups. The Project Entrepreneur will adopt an environmental policy that states the principles and intentions of the enterprise in relation to its overall environmental performance. Such principles and intentions will be communicated to each employee as well as the nature of their individual environmental responsibilities. Where appropriate, staff training will be undertaken to ensure their continued environmental performance.

The Project Entrepreneur is also committed to the creation and implementation of programs to reduce the probability of occurrence of adverse impacts upon the environment. As required, contingency plans will be developed for mitigating such adverse incidents, should they occur. The Project Sponsor will expect the same level of environmental performance from its agents, suppliers, and contractors and will stipulate this in any legally binding agreements it enters with these parties.

The Project Entrepreneur will also ensure that appropriate corporate resources, personnel and reporting and accountability systems, are in place for the successful implementation of the EMP. They will, on a continuing basis, review the objectives of the EMP as well as the company's success in achieving them.

Where objectives are not being achieved corrective action will be taken. The Environmental Managemenet Plan(EMP objectives will also be modified over the life of the project, as appropriate, to reflect changing environmental laws, regulations, standards, and technologies.

11.3 Plans, Procedures, and Programs

As part of the EMP objectives outlined above, several plans, procedures, and programs will be developed to guide every stage of project construction, operation, and decommissioning so that the environmental performance of the power plant is optimized. While formulating a detailed EMP for the proposed Summit Bibiyana I & II Power Company Limited Project, the pertinent impact aspects during the three stages, i.e., pre-construction, construction and post-construction as well as the operation stages have to be taken into due consideration. The pertinent impact aspects during the three project stages, as applicable, have been as under the following major heads:

i) Health and Safety (covering both occupational and general, worker accident, sanitation diseases hazard, etc.),
ii) Air Quality (dust and other particulate matter generation, stack emission),
iii) Disruption of Local Drainage Pattern,
iv) Land Value Degradation,
v) Run-off Erosion,
vi) Wildlife Mobility,
vii) Waste Generation (construction solid wastes, process solid wastes, liquid wastes),
viii) Noise and Vibration,
ix) Thermal and Flash Radiation,
x) Blast Over-pressure (due to sudden release of natural gas through pipeline leakage and rupture),
xi) Traffic Congestion,
xii) Employment Generation,

xiii) Loss of Homestead Land,
xiv) Loss of Agricultural Land.

Based upon the previous Chapter on Hazard and Risk Assessment and Emergency Response, and impacts identified and mitigation measures proposed in Sections 8.2, 8.3, 8.4, 9.7 and 9.8 of this SEIA Report, the above pertinent impact aspects have been taken into consideration in EMP for each of the three project phases.

The following sections present an overview of the plans, procedures, and programs that will be developed for the power plant.

11.3.1 EMP for Pre-construction Phase

As discussed in the previous Sub-section, pertinent impact aspects to be considered are the ones corresponding to adverse impacts that need to be mitigated and compensated under the major heads (ii), (iii), (v), (xiii) and (xiv) (Table-11.1):

Table-11.1: EMP for Pre-construction Phase.

Project Component	Activity/Events	Adverse Impacts	Mitigation Measures/Compensation	Monitoring Parameters	Frequency of Monitoring
Power Plant	Land Development and Land-fill	Dust Emission	Periodic sprinkling of water throughout the area under land development process to arrest dust emission; and Plantation of trees to create green belt around the area.	PM_{10}	As per DOE Guideline
		Disruption to Local Drainage Pattern	Land-fill activities during land development process should be undertaken with simultaneous land compacting activities and the area should be surrounded by protective wall.	Drainage pattern	As per DOE Guideline
		Loss of and Displacement from Agricultural Land	Adequate compensation to marginalized peasants.	Compensation	Regularly during the project phases till compensation is fully made.
		Loss of and displacement from homestead land	Ensuring adequate resettlement and compensation to affected homestead dwellers	Compensation	Regularly during the project phases till compensation is fully made.
Natural Gas Pipeline Laying	Land Excavation	Dust Emission	Periodic sprinkling of water throughout the area under pipeline laying process to arrest dust emission.	PM_{10}	As per DOE Guideline

Project Component	Activity/Events	Adverse Impacts	Mitigation Measures/Compensation	Monitoring Parameters	Frequency of Monitoring
		Disruption of local drainage pattern	Cautious excavation of land and keeping the excavated soil covered by tarpaulin and surrounded by protective boundary.	Drainage pattern	During every land excavation activity
		Temporary loss of and displacement from agricultural land	Adequate compensation to affected peasants (if any).	Compensation	Regularly during the project phases till compensation is fully made.
		Temporary loss of and displacement from homestead land	Ensuring adequate compensation to affected homestead dwellers.	Compensation	Regularly during the project phases till compensation is fully made.
		Loss of Trees and Vegetation Cover	Adequate financial compensation to respective PAPs for re-plantation of the lost trees.	Compensation	Regularly during the project phases till compensation is fully made.
	Laying of Pipeline Across Rivers, Canals, Beels, etc.	Impact on Boro Cultivation in Seasonal Beels	Requisite financial compensation to affected peasants.	Compensation	Regularly during the project phases till compensation is fully made.
		Impact on Agriculture	Requisite financial compensation to affected peasants.	Compensation	Regularly during the project phases till compensation is fully made.

11.3.2 EMP for Construction Phase

Pertinent impact aspects to be considered are the ones corresponding to adverse impacts that need to be mitigated under the major heads (i)-(xii) (Table-11.2):

Table-11.2: EMP for Construction Phase.

Project Component	Activity/Events	Adverse Impacts	Mitigation/Benefit Enhancement Measures	Monitoring Aspects/ Parameters	Frequency of Monitoring
Power Plant	i) Accumulation of around 1000 workers in the project area	i) Incidence of social problems within and around the project area due to influx of non-local workers coming from outside.	Strict vigilance should be ensured toward non-occurrence of any kind of social problems.	Incidence of social problems.	Continuously throughout the construction phase
		ii) Incidence of contagious diseases within and around the project area.	a) Regular medical check-up of workers. b) Prohibiting non-local workers from making any kind of social contacts with the local population.	Incidence of contagious diseases	Continuously throughout the construction phase
	ii)Excavations, handling and transport of earth and construction materials	Release of Particulate Matters	Providing for dust screen and sprinkling of water throughout the excavation site.	PM_{10}	As per DOE Guideline
		Run-off erosion	Protection wall around the construction sites to arrest run-off erosion.	Run-off erosion	Throughout the construction period
		Worker Accident	Effective safety provisions to prevent worker accident, e.g., fall from high altitudes, exposure of workers to injuries due to construction materials, etc.	Worker Accident	Throughout the construction period
		Sanitation Diseases Hazard	Ensuring proper sanitary conditions in work places and workers‘ sheds.	Sanitation Diseases	Throughout the construction period
		Blockage to Wildlife Passage	Boundary fencing of the construction area to make wildlife passage choose alternative routes	As proposed in mitigation measures	Throughout the construction period
	iii) Operation of Construction Equipment, e.g., Bulldozers, Trucks, Scrappers, Concrete	Generation of Construction Solid Wastes	Generated construction solid wastes should be stored and used as landfill of the excavated construction land.	As proposed in mitigation measures	Throughout the construction period

Project Component	Activity/Events	Adverse Impacts	Mitigation/Benefit Enhancement Measures	Monitoring Aspects/ Parameters	Frequency of Monitoring
	Mixers, Cranes, Generators, Pumps, Compressors, Rock Drills, Pneumatic Tools, Vibrators, etc.	Generation of Liquid Wastes	Generated liquid wastes should be collected in sumps and pumped to the RTP for treatment and, thereafter, for onward disposal to soak-wells	As proposed in mitigation measures	Throughout the construction period
		Traffic Congestion	Making vehicles involved in the construction process ply to and from the construction area preferably at night.	As proposed in mitigation measures	Throughout the construction period
	Overall construction work	Employment	Preferential employment of the local communities in various positions, e.g., contractors, supervisors, workers, etc., in construction work.	As proposed in enhancement measures	Throughout the construction period
Natural Gas Pipeline Laying	i) Cutting and joining of Pipes to be Laid	i) Generation of noise	Homestead dwellers to be affected should be informed beforehand.	As proposed in mitigation measures	Throughout the activity
		ii) Thermal and flash radiation due to jet flame may cause various degrees of burn on human bodies and impaired vision.	Ensuring heat protecting outfits, e.g., heat insulating hand-gloves, aprons and boots and flash-protecting eye-covers to workers	As proposed in mitigation measures	Throughout the activity
	ii) Supply of natural gas through the laid pipeline	Sudden release of natural gas through leakage followed by explosion leading to blast over-pressure	• Installation of protective devices (e.g., emergency isolation valves, cut-off valves and one-way valves) • Leak detection by automatic sensing devices • Evacuation of adjacent areas • Barricading of roads; • Emergency Response Plan	As proposed in mitigation measures	Throughout the activity
	Overall process of pipeline	Employment	- Preferential employment of the	As proposed in enhancement	Throughout the natural gad

Project Component	Activity/Events	Adverse Impacts	Mitigation/Benefit Enhancement Measures	Monitoring Aspects/ Parameters	Frequency of Monitoring
	laying		local communities in various positions, e.g., contractors, supervisors, workers, etc., in construction work	measures	pipelaying period

11.3 .3 EMP for Post-construction and Implementation Phase

Pertinent impact aspects to be considered are the ones corresponding to adverse impacts that need to be mitigated under the major heads (i), (ii) and (vii)-(xiv) (Table-11.3):

Table-11.3: EMP for Post-construction and Implementation Phase.

Activity/Events	Adverse Impacts	Mitigation/Benefit Enhancement Measures	Monitoring Aspects/ Parameters	Frequency of Monitoring
i) Process Operation	Generation of process solid wastes, mostly in form of sludge collected in centrifuges associated with clarifier in water pre-treatment and ETP.	Generated process solid wastes should be taken to solid disposal area for mixing with compost for further use as fertilizer.	As proposed in mitigation measures	Throughout plant operation on a quarterly basis
	Generation of liquid wastes	To be collected in sumps, pumped to ETP and, thereafter, led to soak-well	As proposed in mitigation measures	Throughout plant operation on a quarterly basis
	Traffic Congestion	The power plant authorities need to have its own system of traffic management toward ensuring smooth traffic movement within and around the power plant area.	As proposed in mitigation measures	Throughout plant operation on a quarterly basis
	Noise and Vibration Hazard	• Effective noise-baffling barriers through plantation of at least three layers of trees and construction of walls surrounding the power plant area to keep the noise level within acceptable limits • Separating the floor of the generator room from the base of the generator with gaps filled with wax; generator walls lined with noise and vibration resistant materials.	Noise quality	Throughout plant operation on a quarterly basis
	Occupational Health Hazard	▪ A detailed and pragmatic emergency response plan	As proposed in mitigation measures	Throughout plant operation on a

Activity/Events	Adverse Impacts	Mitigation/Benefit Enhancement Measures	Monitoring Aspects/ Parameters	Frequency of Monitoring
		in respect of exposure of employees to various occupational health risks characteristic of power plants; ▪ Provision of safety gears, e.g., helmets, gas masks complete with protective eye-glasses, portable oxygen cylinders and ear-plugs/ear-covers, fire and heat-proof hand gloves, fire and heat-proof electricity insulated outfits, electricity insulated and fire-proof boots and gum-boots, etc, for employees working at on-site location of the power plant;		quarterly basis
ii) Stack emission	Emission of Particulate Matter	○ Provision of efficient filters at various heights of the emission stack to arrest particulate matters, ○ Plantation of trees to create green belt around the plant area.	Concentration of nitrogen oxides in µgm/m^3 exhaust flue gas.	• Regular monitoring during start-up, shut-down and operation at low loads (i.e., at <50% load) for the first quarter • Intermittent annual monitoring throughout the life of the project.
	Emission of NO_x	Stacks of adequate height to permit wide dispersion of the emission.	As proposed in mitigation measures	Throughout plant operation on a quarterly basis
	Loss of and impaired vegetation growth	Plantation of trees and vegetation within and around the plant-site.	Success of tree planting activities	Once annually for the 1st five years of operation.
• Turbine failure • Leak or rupture in gas pipeline	Flame-out Concentration of methane reaches lower flammability limit at gound-level Potential flash-fire	• Ensuring stack dispersion of gas • Installation of quick response emergency isolation valves • Provision of remotely actuated shut-off system	As proposed in mitigation measures	Throughout plant operation on a quarterly basis
Intake of cooling water from river Kushiyara	Adverse impact on mobility and sustenance of fisheries/	Protection of fisheries movement at the intake point	Species composition	Once in every three years
Employment	Beneficial impact	Preferential employment should be made from among the local community, with emphasis on the women, in	As proposed in enhancement measures.	Throughout plant operation on a six monthly basis

Activity/Events	Adverse Impacts	Mitigation/Benefit Enhancement Measures	Monitoring Aspects/ Parameters	Frequency of Monitoring
		suitable positions.		

11.3.4 Compensation Plan

Resettlement Action Plan: The Project Sponsor will implement the RAP as discussed in ChapterVII. For reference, the RAP was finalized following the public consultations that were completed during the process of this SEIA. Revisions, if any, to be made on the basis of comments of the lending agency, will be incorporated into the RAP at a later stage.

11. 3.5 Contingency Plan

During pre-operational mobilization the Project Sponsor will develop a *Contingency Plan*, i.e., an *Emergency Response Plan (ERP)* for the operational activities. The ERP will address, inter alia, a Chemical and Petroleum Spills Contingency Plan (e.g., chemical handling, storage, and spill management); a Natural Hazards Management Plan (e.g., cyclones and flooding); civil unrest; and fire and explosions.

CHAPTER XII

EMP IMPLEMENTATION STRATEGY

12.1 Introduction

Strategy of effective implementation of an EMP along with redress of grievances lies in scheduling its implementation as well as estimating the cost involved and integrating it with the overall activities in relation to the main project. Implementation schedule and cost estimate comprise an integral part of an EMP. Every EMP unless accompanied by its corresponding strategy of implementation and estimated cost of the implementation process is without any effect. All the issues and events in terms of impacts of the various stages of a project anticipated upon the environmental and socio-economic profile of the project area as identified whereupon requisite mitigation measures prescribed in the SEIA process and taken due note of in EMP, need to be specifically addressed in this implementation schedule with approximate cost involvement.

12.2 EMP Implementation Schedule and Cost Estimate

The entrepreneur of the project, the Summit Bibiyana I & II Power Company Limited Project., hence, needs to prepare the schedule of implementation of the EMP and redress of grievances and make a cost estimate for the purpose. The list of events of EMP to be implemented should also include the mitigation and monitoring programs included in the RAP along with their approximate implementation costs. The EMP implementation schedule and cost estimate could be as under (Table-12.1):

Table-12.1: EMP Implementation Schedule and Cost Estimate

Events	Mitigation	Implementation Procedure	Responsibility	Capital Cost (Tk)	Recurrent Cost/Year (Tk)
NO_x Emissions	Dry, low NO_x burners	Installation during construction	Construction Contractor	-	-
	NO_x emissions monitoring	Developing operations monitoring program	Project Entrepreneur	21,30,000/-	4,47,000/-
Ambient Air Quality	50m stack height	Installation during construction	Construction Contractor	-	-
	Exhaust exit velocity	During manufacture	Construction Contractor	-	-
	Establishing a 6-month ambient air quality monitoring program	As per Table-11.3	Project Entrepreneur	4,85,000/-	1,00,000/-
Noise	Compliance with regulatory emission levels	Installation during construction	Construction Contractor	-	-
	Hearing protection and signage	Distribution among employees and at appropriate locations	Project Entrepreneur	1,42,000/-	-
	On- and off-site monitoring	Developing operations monitoring program	Project Entrepreneur	2,10,000/-	47,000/-
Water quality	Establishing an appropriate monitoring	Selected thermal and water quality parameters	Project Entrepreneur	2,75,000/-	55,000/-

Events	Mitigation	Implementation Procedure	Responsibility	Capital Cost (Tk)	Recurrent Cost/Year (Tk)
	program				
Vegetation Growth	Plantation of trees and vegetation lost during land development and pipeline laying process	Designing afforestation program	Project Entrepreneur	1,10,000/-	48,500/-
Social	Nominating a Community Liaison Officer (CDO)	CDO to follow up the social and development issues	Project Entrepreneur	1,44,80,000/-	-
		Legal Advisor to follow-up the land disputes	Project Entrepreneur		
	Resettlement Action Plan (RAP)	Contained in RAP in the SEIA Report	Project Entrepreneur		
Project Plans	Developing an Emergency Response Plan	Staff training and awareness	Project Entrepreneur	1,65,000/-	Included in employee training
	Developing an operation and maintenance plan	Staff training and awareness	Project Entrepreneur	35,50,000/-	I bid
	Developing an occupational health and safety plan	Staff training and awareness	Project Entrepreneur	4,260,000/-	I bid
Employee Training	Training on SEIA issues and commitmtnts	Policy and procedures, environmental management and analytical techniques	Project Entrepreneur	2,48,500/-	7,10,000/-
Aesthetics	Site landscaping	Vegetation planting	Project Entrepreneur	6,670,000/-	165,000/-
Community Grievances	Nominating a Community Development Officer (CDO)	CDO to respond to on-going public concerns	Project Entrepreneur	Cost is included in the row related to social aspects-	Cost is included in the row related to social aspects
			Total	**3,27,25,500**	**15,72,500**

12.3 Integration of EMP with Overall Project

Implementation of EMP is to take effect simultaneously with the planning and development of the proposed Summit Bibiyana I & II Power Company Limited Project. Specific responsibilities to carryout the various programs and plans of EMP will be assigned to project personnel and an established as well as accountable management system. Management will also provide the essential resources for the purpose.

Contractors will be responsible and accountable for the actions of their company and employees. These responsibilities will be incorporated into the contract documents consistent with the recommendations of EMP.

12.4 Institutional Aspects of EMP Implementation.

Implementation of EMP along with redress of grievances will depend largely upon the Summit Bibiyana I & II Power Company Limited Project in as much as it will ensure environmentally sound efficient working conditions of the project during all the three stages, viz., the pre-construction stage, the construction stage and the post-construction as well as operational stage. The entrepreneur, to this end, needs to set up an efficient institutional mechanism through deploying its own groups of personnel – the electro-mechanical group, the group consisting of personnel trained in environmental monitoring and compliance procedures, the social safeguard group and a group of security personnel – along with the contractor to be engaged in construction and initial phases of operation of the project. Personnel to be deployed by the entrepreneur and those of the contractor have to collaborate among themselves through a set of guidelines to be developed in line with the Environmental Management and Monitoring Programs as detailed in the EMP.

Based on the above-proposed institutional arrangement, the organizational set-up for EMP implementation could be schematically presented as under (Figure-12.1):

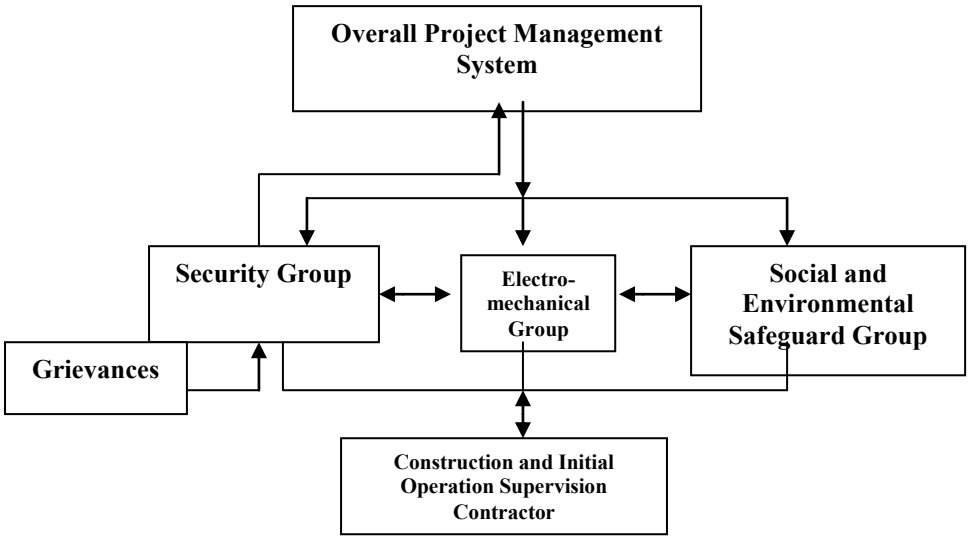


Figure-12.1: Proposed Schematic of Institutional Mechanism for EMP Implementation

Reference:

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BBS (2006): Bangladesh Population Census, Community Series Zila: Sylhet, Bangladesh Bureau of Statistics (BBS), Planning Division, Ministry of Planning, Government of the Peoples‘ Republic of Bangladesh.

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Rahman, A. Atiq and Haider R. (1994) Environment and Development in Bangladesh, Vol. 1, University Press Limited, Dhaka.

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ANNEXURE- 1: Terms of Reference (TOR)

Context:

The Government has decided to implement two 341MW Combined Cycle Gas Turbine Power Plants in Bibiyana. The project has been awarded to an Independent Power Producer (IPP) consortium consisting of Summit Power Bangladesh and General Electric (GE) of USA.

The environmental legislation in Bangladesh, particularly, The Bangladesh Environment Conservation Act, 1995 (Amended in 2002), states that any development project shall require environmental clearance from the Department of Environment (DoE), Ministry of Environment and Forest, Government of the People's Republic of Bangladesh.

The Bibiyana 341MW Combined Cycle Gas Turbine power plants falls under the "Red Category" as per The Environment Conservation Rules, 1997, which requires submitting report to the DOE on the Initial Environmental Examination (IEE) relating to power Generation and also the Terms of Reference (ToR) for the Environmental Impact Assessment (EIA) of the 450 MW power plant Project for site clearance. This will have to be followed by the submission of report on the Social and Environmental Impact Assessment (SEIA) of the 341 MW power plant project including detail Environmental Management Plan (EMP) to obtain Environmental Clearance from the DoE for both Bibiyana 1 and II.

IFC Guidelines on Performance Standard 2006 and Environmental Health and Safety guidelines 2007 and 2008 will be followed.

Project Area

The geographic location of the proposed Bibiyana Independent Power Project (BIPP) site is at 91° 39′ 37″ E. longitude and 24° 38′ 18″ N. latitude. The site location is on the south bank of the Bibiyana (Kushiyara) river. The site is about 2 kms west of the N2 road (Dhaka - Sylhet National Highway) or from the Sherpur Bridge point. The site location is about 180 kms north-east of Dhaka and about 45 kms south-west of Sylhet district headquarter. Administratively, it is located in the village of Parkul in Aushkandi Union under Nabiganj Upazila of Habiganj district.

Objectives of the assessments:
The environmental and social components of the project area may be impacted by the proposed Bibiyana 682 MW power plant projects. Objective of the study will be to assess the environmental and social impacts of the proposed project for preparing an environmental management plan suggesting mitigation measures for minimizing the effect of the negative impacts, enhancement plan for increasing the benefits of the positive impacts and an environmental monitoring plan which will include health and safety issues.

***Proposed Activities*:**

Bangladesh Centre for Advanced Studies (BCAS) in consultation has greed to carry out the following tasks:

- Carry out the Initial Environmental Examination (IEE) for Bibiyana I and Bibiyana II power projects.

- On obtaining the site clearance by the project sponsors (IPP consortium), BCAS will carry out a detailed Social and environmental Impact Assessment (SEIA) for both Bibiyana 1 and 2.

Methodology:

One of the requirements of initiating the implementation of the project is to obtain an Environmental Clearance Certificate from the Department of Environment under the Ministry of Environment and Forest of the Government of Bangladesh.. According to the Environmental Conservation Act 1995 and the Environmental Conservation Rules of 1997 of the Government of Bangladesh, all power generation projects fall under the red category and as such will require a detailed Environment Impact Assessment (EIA) for the projects after obtaining the site clearance on submission of the Initial Environment Examination (IEE). The IIEE provides an initial understanding on the potential impact on the environment in undertaking the proposed power generation projects and is also a requirement for obtaining the site clearance from the Department of Environment of the GOB. The site clearance will be issued with a condition that the project sponsors submit an EIA report which will provide a more comprehensive analysis of the impacts on the environment.

For the preparation of the IEEs and EIAs the performance standards set by IFC in 2006 will be followed,

Performance Standards of IFC 1 through 8 establish requirements to avoid, reduce, mitigate or compensate for impacts on people and the environment, and to improve conditions where appropriate. While all relevant social and environmental risks and potential impacts will be considered as part of the assessment. For social or environmental impacts the assessment will include Social and Environmental Management System consistent with Performance Standard 1 of the IFC guidelines. The assessment will also follow the guidelines set by the Department on Environment under the Ministry of Environment and Forest of the Government of Bangladesh.

For the preparation of the IEEs and EIAs the performance standards set by IFC in 2006 will be followed, The Performance Standards includes the following:

Performance Standard 1: Social and Environmental Assessment and Management System
Performance Standard 2: Labor and Working Conditions
Performance Standard 3: Pollution Prevention and Abatement
Performance Standard 4: Community Health, Safety and Security
Performance Standard 5: Land Acquisition and Involuntary Resettlement
Performance Standard 6: Biodiversity Conservation and Sustainable Natural Resource Management
Performance Standard 7: Indigenous Peoples
Performance Standard 8: Cultural Heritage

Performance Standard 1: Social and Environmental Assessment and Management System:

This will establish the importance of: (i) integrated assessment to identify the social and environmental impacts, risks, and opportunities of projects; (ii) effective community engagement through disclosure of project-related information and consultation with local communities on matters that directly affect them ; and (iii) the client‘s management of social and environmental performance throughout the life of the project.

Performance Standard 2: Labor and Working Conditions
This performance standard will establish and improve worker- management relationship in order to fair treatment, non discrimination and equal opportunity for workers. The standard will outline the national labor and employment laws and the measures to be taken by the sponsors of the project like protection of the workforce from child and forced labor and promote safe and healthy working conditions.

Performance Standard 3: Pollution Prevention and Abatement
Air Pollution:

The requirement of IFC for air quality measurement is that a minimum of two samples is to be taken per week over a minimum period of three months. For this project the measurements will have to be taken in the pre monsoon period starting from February. The following parameters will be measured covering 10 km air shed:

- Sulphur Oxides (Sox)
- Nitrogen Oxides (NOx)
- Suspended Particulate Matter (SPM)
- Particulate Matters of 10 micron diameter (PM10)
- Carbon Monoxide (CO)

During the air quality sampling identification of any new industries being constructed within the air shed should be made. If the nature of these industries being constructed significantly contributes to the local air pollution the extent should be assessed and reported in the SEIA.

Water pollution:

The Environment Conservation Rules 1997 of the Government of Bangladesh requires that the following parameters in any waste water from industries are within the set standards.

- Alkalinity as CaCO3,
- Acidity as Ca CO3,
- Arsenic,
- Calcium,
- Chlorine,
- Chemical Oxygen Demand (COD),
- Biological Oxygen Demand (BOD)
- Iron,
- Phosphorus,
- Phosphate,
- Manganese,
- Mercury,
- Nitrate, Nitrites,
- Ammonia Nitrogen and
- Dissolved Oxygen

For thermal power plants the difference between intake temperature of cooling water and discharge temperature should not exceed 3 degrees centigrade. The proposed project will have installed closed cycle water cooling system. The study will also provide information on other major users of the river water to be used for the proposed project and assess the impact on the availability of river surface water for the proposed project. The assessment will include the impact on the tributaries as a result of withdrawal of water from the main river

Kushiara especially in the dry season. The percentage of the main river flow used for the proposed project will also be determined.

Solid waste management: An assessment of the solid waste generation from the project in terms of hazardous waste like spent lube and sludge will be made. The waste generated from chemical stores and packing materials and the solid waste generated from Project Township during construction and normal operation will be assessed. A comprehensive waste management plan will be made.

Performance Standard 4: Community Health, Safety and Security

The following will be considered under this performance standard:

- Effects due to influx of Labor during construction phase on the local community
- Project security management and security personnel interaction mode with workers and communities
- Increased traffic both on river and road and its impact on the local community and in case of river transport the impact of fishing by the local community.
- Timing for transportation especially heavy equipment to be recommended
- Assess noise during construction
- Community support assessment through press briefing and through meetings
- Community disclosure and consultation during construction and operation period
- Community grievance: identify institutional framework in terms of flow of information in terms of who will address the grievances of the local community and establish the communication chain with the management of the proposed project.
- Past natural vulnerabilities and impact, like flooding, and assessing potential increased risks due to the project.
- Identify project alternative

.

Performance Standard 5: Land Acquisition and Involuntary Resettlement

The following will be considered under this performance standard:

- A 100% census will be carried out for the people directly displaced due to the project. The survey will include alternative livelihood.
- Sample survey will be carried out on the people not displaced due to the project activity. The sample survey will update the baseline study carried out by BCAS in 2009.
- Review of the land transfer process
- Report on the compensation received by displaced people (Market price + transaction cost)
- Identify khashland (Government owned land) within the project area and livelihood dependence of people within the radius of 2 km from the battery limits of the power plants.

Performance Standard 6: Biodiversity Conservation and Sustainable Natural Resource Management

In order to assess the impact on Biodiversity conservation the following will be carried out**:**

- Use the IUCN red list on ecological conservation to assess the impact on the local biodiversity as a result of the project. Other international guidelines will be used.
- A habitat maps within 10km showing temporal geographical habitats. Special emphasis on possibilities of river Kushiara fish species population impacts.

Performance Standard 7 and 8: Indigenous Peoples & Performance Standard 8: Cultural Heritage

The study will carry out the impacts on the following:

- Impact on tribal communities,
- Vulnerable groups (women, children, old age and crippled)

The study will take into account whether as a result of the project any buildings, institutions, habitats or otherwise considered as cultural heritages are affected

Additional Activities:

1. Carry out an assessment of associated facilities, for example HT transmission line (in consultation with PGCB) to be finalized in consultation with the project proponents.
2. Carry out a Right of Way (ROW) for 8.8 km natural gas pipe line from the Bibiyana gas field to be included in the SEIA of the pipe line
3. Carry out a Right of Way (ROW) for 2 km approach road including economic resettlement action plane for the affected people to be included in the SEIA.

The additional activities will be carried out in consultation with the project sponsors and the funding agencies.
BCAS will use the baseline survey it carried out as Environment and Social Consultant for the IFC in 2008-2009. The scope of the work was 1) conducting a baseline environmental study, 2) performing an initial environment impact assessment for a 330- 450MW gas fired, combined cycle plant at the proposed site and 3) assessing any social impacts of the construction of the plant at the proposed site. BCAS will compile the IEE report as per the requirement of the Department of Environment. The checklist provided by the DOE is shown as Annex1.

The social environmental study called SEIA will be carried out as a follow up study of IEE. The reports will be based on the primary data generated during the study period, secondary data from various sources and information from field visits and the project proponent. Several field visits will be undertaken to the project location with a view to update the findings of the baseline study carried out by BCAS in 2009. During this process, the following steps will be followed:

- Compilation of survey/monitoring data. Field survey using a prepared questionnaire covering a wide cross-section of people in the study area to acquire field-level data on the existing environment and socio-economics and apprehended impacts due to the project. Monitoring of water quality (both ground and surface water) of adjoining areas was done. This has been covered in the baseline study previously carried by BCAS;
- Understanding the process involved in the plant;

- Identification of potential impacts and evaluation. Identification of impacts was done using Checklists method;
- Review of the adequacy and efficiency of proposed mitigation measures for the plant;
- Development of an Environmental Management Plan (EMP) for possible mitigation/ enhancing measures for negative and beneficial impacts;
- Suggestion of mitigation measures for residual impacts.

Output:

A social and environmental impact assessment (SEIA) report will focus on the significant issues of a project. The report's scope and level of detail will be commensurate with the project's potential impacts and risks. The SEIA report will include the following items:

⇒ *Non-technical executive summary*.
⇒ *Policy, legal, and administrative framework*.
⇒ *Project description*.
⇒ *Baseline data*.
⇒ *Analysis of Alternatives*..
⇒ *Management Program*.

A proposed table of contents for the SEIA _s is as follows:

Acknowledgement
- *Executive Summary*

*Abbreviations*Chapter 1: Introduction
- Background
- Objectives
- EIA team
- Report Format

Chapter 2: Approach and Methodology
- EIA Process
- Land Use Survey
- Data collection Method
- Data processing, analysis and interpretation

Chapter 3: Analysis of Project alternative
-Description of the Bibiyana 450 MW power plants Project
- Project Location
- Rationale
- Site Alternative
- Power generation Method
- Alternative Technology
- Doing nothing Scenario

Chapter 4: Policy and legal considerations
- Introduction
- Relevant national policies and legislation
- Compliance with DOE Guidelines
- Compliance with IFC and WB Guidelines
- Procedure for obtaining environmental clearance from the DOE

Chapter 5: Environmental and Social Baseline Condition

- Atmosphere
- Water Resources
- Agriculture
- Fisheries
- Ecosystems (Flora, Fauna)
- Socio-economic conditions

Chapter 6: Important Environmental and Social Components (likely to be impacted)

- Ambient Air Quality
- Noise Quality
- River Water Level
- River water Quality
- Land Use
- Aquatic Ecosystem
- Social Impacts (Project Affected peoples, compensation for land aquisition)

Chapter 7: Environmental and Social Impacts

- Pre-project Phase
- Construction Phase
- Operational Phase

Chapter 8: Hazard and Risk Assessment and Emergency Response

- Introduction
- Hazard Awareness
- Hazard Materials and wastes
- Safety from Potential Hazards
- Hazard Inspection and Control
- Hazard Identification
- Risk Assessment
- Risk Management and Prevention Program
- Hazard Review and Control Measures
- Standard Work Operating Practices

Chapter 9: Environmental, Health, and Safety

-Air Emissions and Ambient Air Quality.
-Energy Conservation
-Wastewater and Ambient Water Quality
-Hazardous Materials and Waste Management
-General Facility Design and Operation
-Communication and Training
-Physical Chemical and Biological Hazards
-Personal Protective Equipment (PPE)
-Special Hazard Environments
-Structural Safety of Project Infrastructure
-Life and Fire Safety (L&FS)
-Transport of Hazardous Materials
-Disease Prevention Emergency Preparedness and Response
-Occupational Health & Safety Community Health & Safety
-Monitoring

Chapter 10: Public Disclosure
- Introduction
- Methodology
- Public Consultation
- People's Expectations and Suggestions

Chapter 11: Environnemental Management Plan
- Mitigation Plan
- Enhancement Plan
- Compensation Plan
- Contingency Plan
- Monitoring Plan

Chapter 11: Conclusion and Recommendations

Work Plan:

The work plan shown below indicated that the assessment reports will be completed within four and half months i.e. 15th of May 2011.

SI. No	Description of the activities	Months			
		February, 2011	March, 2011	April, 2011	May, 2011
1	Mobilization				
2	Air quality monitoring				
3	Field Survey				
4	Completion of IEE				
5	First draft SEIA				
6	Final SEIA Report				

Initial Environmental Examination (IEE) checklist

IEE Check list for Orange –B and Red category projects

Give information in the open space / put tick mark (✔) enclose necessary paper wherever necessary

1.0 General Information

1.1 Name of the Company t _____

a. Entrepreneurs Name t _____

b. Contact Address t _____

_____

1.2 Name of the project t _____

_____

. Location of the Industry t _____

_____

b. Present address t _____

_____

c. Telephone/ Fax t _____

d. E-mail t _____

Include detail map of the project showing road, canal, beel ,river and key point Installations . Show General Map as annexure -1

2.0 Description of the proposed project

2.1 Total Amount invested t _____

2.2 Detail of Land used

Total Amount invested t _____

Detail of Land used _____

a. Total amount of Land under project _____ Square meter

b. Amount of land developed

- **.3 Use of land in the prposed project**

2.3.1 Present use of land

2.3.2 Use of land within radius of 1 km :

2.3.3 Width of nearest main road from the project **Meter**

2.3.4 Items situated within one kilometer distance of the project

o Wetland	o Natural Stream	o Flood control project	o Forest
o Park/playground	o Hill/Hillock	o Others	o Residential Area

2.3.5 Items situated within 500 meter distance

o Historical Place	o Military installations	o Special area	o Environmentally critical Area
o Key Point Installation	o Hospital/Clinic	o Educational Institutions	o Restricted Area
o Air Polluting Industry	o Residential Area	o Food Silo	o Others

2.3.6 Project site

North

South

East

West

- **2.4** Description of Project Phases

2.4.1 Construction Phase

2.4.1.1 Building for the project

☐ **To be constructed** ☐ Rented

•	**Use of different floors of building**	**Number of Floor**	**Area of Floor (square Meter)**
☐	Administrative/ Office	• _____	_____
☐	Factory/Production program	_____	_____
☐	Raw Materials warehouse	_____	_____
☐	Resthouse /Day care	_____	_____
☐	Canteen	_____	_____
☐	Toilet Facility	_____	_____
☐	• Effluent Treatment Plant	_____	_____
☐	Water Treatment Plant	_____	_____
☐	Generator	_____	_____
☐	Toxic waste store	_____	_____
☐	Solid waste store	_____	_____
☐	Others	_____	_____

2.4.1.2 Services for Building Construction

a) Water

Source _____ Daily consumption t _____ Cubic meter

b) **Power**

Sourcet _____ Daily Consumption _____ KWH

2.4.2 Operation Phase

2.4.2.1 Factory production Program/Process Description (Use extra page and enclose Flow diagram as Annexure :2D

_____

2.4.2.2 Time of factory operation t

Average _____ Hour/Day _____ Day/Week

Maximum _____ Hour/Day _____ Day/Week

2.4.2.3 Raw material and Final product (List of all the raw materials and chemicals use for production process and extra page may be used, if required)

Raw material	**Source of raw material**	**Quantity (Yearly)**

2.4.2.4 Production capacity (List of all the products and extra page may be used, if required)

Final product	Quantity (Yearly)

2.4.2.5 Description of manpowert

Administrative : _____

Production process : _____

Environmental management : _____

Total : _____

2.4.2.6 Description of machinery and equipment t (Provide list of all the machinery and equipment and extra page may be used, if required)

machinery and equipment	**Quantity**
•	

2.4.2.7 Power supply

	Supplier	Production capacity (kVA)	Demand (kW)
o	National power grid line		
o	Own generator		
o	Others	•	

2.4.2.8 Water supply

Source	Description	Water consumption	
		Residence	Industry
o Supply water			
o Surface water			
o Won Deep tube well			
o Recycled water			
o Others			

2.4.2.8 Fuel Supply (gas/coal/furnace oil etc)

Source t _____ Daily consumption t _____ m^3/ton/lit

3.0 List of industrial waste (Identification waste during production process)

- ☐ Acidic waste (Example t Hydrochloric acid, Sulfuric acid, Nitric acid etc)
- ☐ • Alkaline waste (NaOH, KOH, alkaline cleaner etc)
- ☐ Asbestos waste
- ☐ Ceramic/mineral waste
- ☐ Polluted container (Previously used for chemicals and paints)
- ☐ Chemical fertilizer/ pesticide waste
- ☐ Raw waste
- ☐ Fixed waste (Solidified, Chemically fixed and encapsulated waste¨)
- ☐ Inorganic chemical waste (Example: Arsenic, copper, cadmium etc)
- ☐ Waste from leather
- ☐ Metallic waste
- ☐ Oil (Example: waste oil, oil/mixed with water)
- ☐ Organic sludge
- ☐ Organic solution (Example: Helogenated, aliphatic, aromatic compound)
- ☐ Dye/Ink/Paint waste
- ☐ Paper waste
- ☐ Pathogenic / infectious waste
- ☐ Pharmaceutical waste
- ☐ Plastic waste
- ☐ Electroplating waste
- ☐ Rotten waste (Example: Grease trap, animal waste)
- ☐ Reactive chemical waste (Example: Explosive, Reducing and oxidizing agent)

- ☐ Resin/ Lattice / Adhesive
- ☐ Rubber waste
- ☐ Styrofoam waste
- ☐ Tannery waste
- ☐ Textile waste
- ☐ Others

- **4.0 Liquid effluent t** (source of liquid effluent, nature of pollution and approximate quantity and use extra page if necessary)

• source of liquid effluent	• approximate quantity	• nature of pollution **Poisonous**	**nonpoisonous**
☐ • Production process	_____	☐	☐
☐ • washing/cleaning	_____	☐	☐
☐ cooling	_____	☐	☐
☐ Residential swages	_____	☐	☐
☐ Retreating water	_____	☐	☐
☐ others _____	_____	☐	☐

4.1 Treatment Process of Effluentt

• **Source of Effluent**	• **EffluentTreatment Process** **Own ETP**	• **Joint ETP**	• **Direct Discharge**
☐ • Production Process	☐	☐	☐
☐ • Washing/Cleaning	☐	☐	☐
☐ Cooling Process	☐	☐	☐
☐ Sewerage	☐	☐	☐
☐ Recycled Water	☐	☐	☐
☐ Others _____	☐	☐	☐

Total Quantity

• Final destination of Effluent • _____

4.1.1 Proposed Effluent treatment Plant (ETP layout enclose Annexure -4A**)**

Treatment Capacity of ETP _____ Meter cube/day

Units of ETPt

Infrastructure	☐ Screening	☐ Equalization	☐ Grit Removal
	☐ Oil-Water Separator	☐ Sedimentation	☐ _____
Chemical	☐ Absorption	☐ Disinfection	☐ pH Correction
	☐ Flocculation/ Coagulation	☐ Chemical Oxidation	☐ _____
	☐ Sequenching batch reactor	☐ Activated Sludge	☐ Aerated Lagoon

Biological	☐ Biological Contactor ☐ Stabilization Pond	☐ Trickling Filter ☐…..Digestion	☐ , _____
Sludge Treatment	☐ Thickening ☐ Digestion	☐ Heat Drying ☐ Dewatering	☐ Burning in Brick field ☐ _____
Others	☐ Ion exchange ☐ Activated Carbon adsorption	☐Membrane Filtration ☐ Septic tank &Soak well	☐ Reverse Osmosis

4.1.2 Sewerage disposal / Treatm,ent process(Sewerage treatment layout should be enclosed: Annexure 4B

Capacity _____

☐ Existing Sewerage line

☐ Self Sewerage treatment Plant

☐ Self Septic Tank & Soak well

☐ Others

4.1.3 Water purification system

- o Chlorination
- o
- De Ionization

o Reverse Osmosis o Others

5.0 Drainage system(Enclose drainage lay out plan)

Type ☐ Open drain ☐ Covered /Underground design.

Where the drain will be connected ?

☐ Public drainage ☐ Canal/river ☐ others _____

- **6.0 Particulate matter and gaseous discharge**

	Source	Types of particulate matter & Gaseous discharge					
		Particle		Particle		Particle	

☐ • Power Plant • • • • • •

☐ Own Generator

☐ Furnace

☐ Woven

☐ Varnish kettle

☐ Paint booth

☐ boiler

☐ incinerator

☐ Rotary kiln

☐ others

6.1 Gaseous discharge Management (Put tick mark on item which will be implemented.)

☐ Chimney ☐ Dust Collector ☐ Scrubber ☐ Exhaust Fan
☐ Toxic Gas Filtration ☐ Gas Absorption ☐ Cyclone (Duct, id fan and Stack)
☐ **Electrostatic Precipitator** ☐ Houses/Fabric Filtration ☐ Others, ____

7 Sound Pollution Control system(put tick mark on item which will be installed)

- ☐ Insulator
- ☐ Muffler
- ☐ Silencer
- ☐ Thick Wall
- ☐ Glasswool
- ☐ Canopy
- ☐ Others

8 Action to be taken against Occupational Health Hazard (Put tick mark)

- ☐ Mask
- ☐ Safety Spectacle
- ☐ Gloves
- ☐ Gumboot
- ☐ Helmet
- ☐ Ear Plug
- ☐ Others

9.0 Impact assessment &Mitigation

Legend D – Direct impact In – Indirect impact
L – Long term impact S – Short term impact
R – Changeable I – Not changeable

9.1 Construction Phase

Possible Influence	**Importance of Influence**			**Mitigation**
	D/In	L/S	R/I	
☐ Dust created due to land cleaning , civil work and earth work.				○ Regular spray of water on earthen road or open field/ land ○ Cleaning of Truck and other equipment from soil/mud nbefore leaving the project area ○ Transportation of goods covered by tripol on the truck ○ Temporary Fence around the construction area ○ Others
☐ Removal of soil due to construction of Road and other earth work				○ Storing top soil in a safe place and placing the same as top soil in the land fill area. ○ Planting trees in the construction area as soon as possible .
☐ Erosion of land due to soil removal and digging work .				○ Start construction work in dry season ○ Providing barrier net

☐ Siltation due to soil removal and open earth work				○ Building temporary silt trap/ digging pond ○ Piling up spoil soil at a distance place from drain ○ Use spoil soil for filling land
☐ **Pollution in nearest wet land due to removal construction waste .**				○ Making Temporary arrangement within construction area for disposal of waste and disposal of solid waste properly ○ Arranging adequate wash room ○ Proper disposal system & sanitation system to be followed by Contractor and workers
☐ **Employment**				○ Priority of Local peoples for employment
☐ **Increased number of accidents**				○ Following safety rules by the contractor and workers during construction period

9.2 Operation and Maintenance Phase

Probable impact	**Significance of Impact**			**Mitigating / Enhancement Measures**
	D/In	L/S	R/I	
☐ **Creation of problem for adjacent people and their wealth**				○ Keeping adequate buffer area ○ Planting trees in buffer area ○ Building side wall around the project ○ Others _____
☐ **Air Pollution due to dust and smoke**				○ Taking measure to to avoid air pollution ○ Others _____
☐ **Surface / underground Water pollution due to household waste**				○ Workable septic tank and soak pit making ○ Installation of Right type of swerage treatment plant ○ Others _____
☐ Surface /underground water pollution from factory's effluent				○ Appropriate effluent treatment Plant for industrial effluent ○ Others _____
☐ **Environmental Pollution /workplace pollution due to toxic waste**				○ Dangerous /Toxic waste would be treated ○ Will be burnt in the incinerator ○ Will be preserved. ○ Others_____
☐ **Sound Pollution**				○ Necessary measures to be taken for controlling sound pollution (e.g Insulator, Muffler, Silencer) ○ Others_____
☐ Bad smell				○ Arranging perfect shield container, Masking agent etc Others

☐ **Vibration due to operation of machinery**				○ Arrangement for controlling vibration (e.g Shock Absorber, damper/isolator, Spring isolator) ○ Others_____
☐ Problem due to solid waste				○ Adequate measure to separate solid waste/ preserve solid waste ○ Arranging training for the worker on waste management. ○ Regular collection of waste as per environmental rule for disposal ○ Used Lead Acid battery to be returned to the specific dealer ○ Solid waste disposal in the particular dumpsite or sanitary landfill ○ Others _____

10 Environmental management and monitoring plan (EMP)

Project program	Monitoring site	Monitoring parameter	Monitoring frequency	Responsible person for monitoring/ monitoring unit
Construction Example t Solid waste collection	Construction area	Wastage material	Weekly/Daily	
Operation • Example t Solid waste produce Industrial effluent discharge Air pollution discharge Hazardous waste produce Working environment	Production/packaging/storage area Effluent treatment plant Air pollution discharge place/specify the place Production area Hazardous waste storage area Production area	Packaging material /Scraped weight pH, BOD, COD, Temp, TSS, TDS,SS etc SMP/PM, NO_x, SO_x Quantity, Storage, Labeling Quantity, Storage, Labeling Light, air, humidity, sound, temperature	Daily Quarterly Quarterly Daily Daily Quarterly	

11.0 Emergency Management

11.1 Probable Risk Situation

- ☐ • Fire
- ☐ Explosive
- ☐ Death or seriously injury of workers for any harmful work
- ☐ Poisonous material or gas flow/discharge
- ☐ Harmful material discharge for environment
- ☐ Others

11.2 Protection of hazardus situation and steps taken for encountering the same

Risk situation	Steps taken for protection	Encountering/controling steps

Fire hazard	○ Fire exite ○ Water store in the water tank or pond ○ Fire hydrent ○ Emergency light/pw-La ○ Regularly fire drill ○ Others, _____	○ Quickly close the factory ○ Safe transfer of the worker ○ Contacting hospital/ civil defense authority ○ Others, _____
Risk situation	**Steps taken for protection**	**Encountering/controling steps**
Explosion	○ Regular testing of machinary and equipments ○ Instalation of signaling instrument ○ Preparation of operation manual and providing traing on it ○ Arrenging safe place for transfer in case of emergance ○ First aid ○ Others, _____	○ Quickly close the factory ○ Safe transfer of the worker ○ Providing required health service in a safe place ○ Contacting hospital/ civil defense authority ○ Others, _____
Discharge of Poisonous material or gas flow	○ Regular testing of machinary and equipments ○ Instolation of automatic equipment and signal provide equipment when discharge of poisonous material or gas exeedes particular standards ○ Preparation of manual precotionary measures and providing training on it ○ Storing required medicine incase of discharge of poisonus material or gas ○ Others, _____	○ Quick shut down of the plant ○ Safe transfer of the worker ○ Providing required health service in a safe place ○ Contacting hospital/ civil defense authority ○ Others, _____
Discharge of liquid/ volatile mater endangering environment	○ Regular chacking of discharge line ○ Regular monitoring and maintanance of ETP ○ Regular monitoring of air pollution instruments ○ keeping reagents and spare parts and alternative power suply ○ Others, _____	○ Quick shut down of the plant ○ To inform the DoE ○ To inform local authority ○ To provide compensation ○ Steps taken in consultation with DoE to reduce polution ○ Others, _____
Death or injury of employees	○ Implementation of automation system where possibility of death or injury exists ○ Preparation of training manual and providing training to reduce professional risk Others, _____	○ Primary health service ○ Quick transfer to hospital ○ Compensation as per low ○ Others, _____
Others	○	○

12. Public Consultation

12.1 Have any public consultation for project program?

☐ Yes ☐ No

12.2 Public opinion after consultation (Name of the participants, address and minutes given in an annexure)

☐ Positive ☐ Negative ☐ Others, _____

I hereby declare that information submitted in IEE form is true to my knowledge and no information has been hidden or distorted.

13.0 Annexe t

		Documents	Yes	No
1	Annexe- 1	General map of project area	o	o
2	Annexe-2K	Lay out plan of Project	o	o
3	Annexe-2L	Map of beside the project area with distance	o	o
4	Annexe-2M	Photo of project area	o	o
5	Annexe-2N	Process flow diagram	o	o
6	Annexe-4K	Lay out of ETP	o	o
7	Annexe-4L	Sewage treatment plant/lay out of safety tank and soakwell	o	o
8	Annexe-5	Lay out plan of dranage system	o	o
9	Fill up IEE check list		o	o

Annexure- 2: Household Survey Questionnaire

Summit Bibiyana I&II Power Company Limited

Bangladesh Centre for Advanced Studies (BCAS)

Section-1: Identification of the Interviewee

Interview Sl. No.: …....., Name of Household Head:..... Religion (code): ……...

Father's /Husband's Name: .....Village: .....

Union: ....., Upazila: ....., District: .....

Name of the Respondent: ....., Relationship with HH. Head: .....

Strata: High Impact Zone------ Medium Impact Zone---- Low Impact Zone----Fishing Community-----

Section-2: Socio-Demographic characteristics

1. Household profile (Start with Head of Household)

SL	Names of the household members	Sex Male=1 Female =2	Relation with HH (code)	Age	Marital Status (code)	Education (code)	Occupation (code)	
							Primary	Secondary
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								

Code of Religion: Muslim – 1, Hindu – 2, Buddhist – 3, Christian – 4, Others (specify)

Marital Status: Married – 1, Unmarried - 2, Divorced – 3, Widower - 4, Widow – 5 Separated – 6, Others (specify) – 6

Education: Illiterate - 1, Can sign only – 2, Primary – 3, Secondary -4, S.S.C and equivalent- 5, H.S.C and equivalent - 6, Degree and above - 7.

Relationship: Father – 1, Mother - 2, Husband – 3, Wife - 4, Son - 5, Son in-law - 6, Daughter – 7, Daughter in-law – 8, Brother - 9, Brother in-law –10, Sister - 11, Sister in-law – 12, Nephew - 13, Niece -14, Grandson - 15, Granddaughter - 16, Uncle - 17, Aunt -18, Grand father-19, Grand mother-20, Cousin-21, Others (specify) -22.

Occupation: Agriculture – 1, Wage labor – 2, Household work-3, Work in abroad-4, Fishing – 5, Van /Rickshaw puller – 6, Service – 7, Business – 8, Handicraft – 9, Student – 10, Unemployed – 11, Carpenter\ blacksmith – 12, Others (specify)

2. Amount of Household Own Land by Use Pattern

Land Use Pattern	Area (decimal)	Average sale price (per decimal)
Homestead		
Kitchen garden/Homestead garden		
Horticulture/Nursery		
Agricultural land		
Pond /Ditch		
Market/Hat/Bazar		
Agro-forestry		
Bushes/Jungle		
Fallow land		
Others (Specify)		

3. Share cropping/leasing of land

Type	Decimal	Mode of sharing (by value)
Share-in		
Share-out		
Leasing-in		
Leasing-out		
Others(specify)		

4. Employment Status

Sex of Household Member	Employment (No. of HH. Members)			
	Full-time employment	Part-time employment	Un-employment	Remarks
Male				
Female				
Children				
Others (Specify)				

5. Annual Household Income and Expenditure

Source of income	Annual gross income (TK)	Cash sale income (TK)	HH consumption expenditure Item	Annual cash expenditure (TK)
Rice/Wheat production			Rice/Wheat	
Vegetables			Pulse	
Daily wages			Meat	
Service			Fish	
Business/shop owner			Vegetables and Fruits	
Fruits			Cloths	
Timber and Timber products			House construction/ Repairs	
Fuel wood			Social Entertainment	
Fish			Education	
Livestock			Transport	
Poultry			Health/Medicine	
Handicrafts			Kerosene	
Remittance			Electricity/Lighting	
			Fuel wood + straw+ cow dung+ biogas	

Source of income	Annual gross income (TK)	Cash sale income (TK)	HH consumption expenditure Item	Annual cash expenditure (TK)
			Labor employment	
Others (specify)			Others (Specify)	

6. Economic status of the households

Sectors	Status (code)	Remarks
Food availability		
Clothing		
Accommodation/ houses		
Educational facilities		
Medical facilities		
Transport facilities		
Entertainment		
Others (Specify)		

Status Code: Good = 1, Satisfactory = 2, Unsatisfied = 3.

7. Identify your family problems with duration and intensity (use problem code) you face during crisis.

Factors	Duration (month)	Intensity of the problem	Remarks
Employment Opportunity			
Availability food			
Availability of safe water			
Problems for purchasing cloths			
Problem for treatment			
Problem for children education			
House construction			
Others (Specify)			

Intensity of the problem code: Severe = 1, Moderate = 2, Low= 3, No problem = 4.

8. Involvement of household members involved in NGOs/CBOs

Yes - 1 No - 2

9. If yes, how many persons of your HH are involved in NGOs/CBOs?

Number of persons involved:……

10. What benefits are you getting from NGOs/CBOs?

Subject	Received Training	Source of fund	Others
Poultry rearing			
Livestock rearing			
Nursery/ Kitchen Gardening			
Handicrafts (specify)			
Pond Fishing			
Small enterprise			
Tailoring			

Fish drying			
Net weaving			
Health, Sanitation and Water supply			
Others (specify)			

11. Did you receive any loan from bank or other sources?

Yes - 1 No - 2

12. If yes, describe your loan receiving status by sources

Sources of loan/facilities	Amount of total loan(TK)	Present of amount loan(TK)	Purpose of loan	No. of loans received
Bank				
NGOs				
Money lender				
Relatives				
Others(specify)				

13. Household Stock of Durable Assets

Assets	No.
Bicycle	
Motorcycle	
Cot/Khat	
Table	
Chair	
Car	
Refrigerator	
T.V.	
Radio	
Computer	
Mobile set	
Boat	
Power tiller /Tractor	
Tube well	
Others (specify)	

14. Housing Structure

Status of Housing	No
Building (Brick floor+ wall + roof)	
Brick floor + tin wall + tin roof	
Earthen floor + tin wall + tin roof	
Earthen floor + thatch wall + tin roof	
Thatch	
Others (specify)	

15. Sources of fuel for cooking

Types	Source			
	Own land	Collect from other land	Common property resources	Market
Wood				
Tree branches				
Tree leaf				
Straw				
Dung				
Bushes				
LPG				
Others(specify)				

16. Status of biomass fuel supply

Types	Status of Supply
Wood	
Tree branches	
Tree leaf	
Straw	
Dung	
Bushes	
Others (specify)	

Status Code: Sufficient -1, Insufficient -2

17. Sources and availability status of lighting (please √)

Sources of lighting	Status of availability	Remarks
Electricity		
Kerosene		
Candle		
Solar PV		
Others (specify)		

Availability status code: Adequate -1: Inadequate – 2 Not available - 3

18. Extent of environmental problems, which affect livelihood (by source and status of problem)

Factors	Status of Problem
Water pollution	
Air pollution	
Industrial pollution	
Burning fuel, trees and agriculture residue	
Over population	
Deforestation	
River/canal bank erosion	
Land erosion	
Flash floods	
Arsenic contamination	
Sedimentation of water bodies	

Health and Sanitation problem	
Disease	
Noise pollution	
Others (specify)	

Environmental problem status code: No problem -1, Low problem -2, Moderate problem -3, Severe problem -4

19 Sources of water pollution and status of problem

Source	Status of Problem
Industrial waste	
Human waste	
Water transport	
Chemical feature/personnel	
Siltation	
Animal waste	
Pollution from upstream	
Urban waste	
Others (specify)	

Water Pollution problem status code: No problem -1, Low problem -2, Moderate problem -3, Severe problem -4

20. Sources of noise pollution and status of problem

Factors	Status of Problem
Vehicles	
Big industries	
Small industries	
Construction work	
Households sources (Generator)	
Power supply(Irrigation engine)	
Commercial areas	
Others (specify)	

Noise Pollution problem status code: No problem -1, Low problem -2, Moderate problem -3, Severe problem -4

21. Sources of air pollution and status of problem

Factors	Status of Problem
Brick field	
Vehicles	
Construction work	
Small Industries	
Big Industries	
Diesel engine	
Commercial areas	
Gas Field	
Burning fuel, trees and agriculture residue	
Open defecation	
Others(specify)	

Air pollution problem status code: No problem -1, Low problem -2, Moderate problem -3, Severe problem -4

Perception about the Bibiyana Power Project and its Impact on Household

22. Do you know about the proposed Bibiyana Power Project?

Yes – 1 No – 2

23. If yes, would you (your family) be personally affected due to the project ?

Yes – 1 No – 2

24. If yes, identify the Negative Impacts on your family livelihood, economic assets and others.

Expected Negative Impacts/loss items of family	Please (√) appropriate places	Quantity of loss	Amount loss (present value Tk)
Loss of homestead land			
Loss of cultivable land			
Loss of annual crops			
Loss of trees			
Loss of annual fish catch from river			
Employment loss per year			
Income loss per year			
Health loss per year			
Communication problem			
Livestock loss per year			
Noise pollution			
Air pollution			
Water pollution			
Others(specify)			
Business (shop keeper) loss			

25. If your family lose any assts or is negatively impacted by the power project, how will you mitigate the loss?

26. Will you expect any help from government or project to mitigate your loss?

Yes – 1 No – 2

27. If yes, please describe.

28. Expected Positive Impact of the Power Project.

Positive Impact	Please (√) appropriate places
More employment opportunity	
Access to electricity	
Access to infrastructure road	
More local socio economic activities	
Availability of irrigation water	
National development	
Reliable supply of electricity in the area	
Others(specify)	

29. Health situation of Household Members (During last 1 year)

Name of Diseases	No. of affected members				Source of Treatment	Level of satisfaction with medical treatment
	Male	Female	Children			
			Boy	Girl		
Cold fever						
Skin disease						

Jaundice						
Asthma						
Diarrhoea						
Typhoid						
Chicken Pox						
Tuberculosis						
Viral Hepatitis						
Malaria						
Hypertension						
Stroke						
Diabetes						
Others (specify)						

Source of Treatment Code: No treatment =1, Kobiraj = 2, Homeopathy = 3, Medicine Shop = 4, Upazila Health Complex = 5, Private Practitioner Doctor = 6, Village Doctor = 7, Others = 8.

Level of satisfaction with medical treatment: Good = 1, Satisfied = 2, Unsatisfied = 3

Annual School days lost due to illness : Boy: …….Girls: …… (persons)

Annual working days lost due to illness : Male: …….Female: …… (persons)

Name of the interviewer:

Name of the Supervisor:

Remarks:

Date of Interview:

Annexure -3: PAPs/ Resettlement Survey – Household Questionnaire

Initial Environment Examination (IEE) and Environmental Impact Assessment (EIA)
for Summit Bibiyana I&II Power Company Limited
PAPs/ Resettlement Survey – Household Questionnaire
SECTION A: IDENTIFICATION AND LOCATION OF HOUSEHOLD

Q1 (a) Household Serial Number:
This must be the same number as on the Joint Commission Survey Report (JCSR)
(b) HH Serial Number:

Q2 (a) Full Name of Household Head (HH):

Q3a Detailed Address: Village: Union:
Upazilla: District

Q3b. Category of PAPs (Pls. put ✓mark)

A : Resettlers (fully resettlement of the H/H)
B : PAPs having cropland and Homestead land in the acquired land
C : Landowners who have cropland only in the acquired land
D : PAPs having trees only on the acquired land and do not own any land in the acquired area
E : Sharecroppers who do not own land in the acquired area

Q4. (a) Total number of household members : _____
(b) Household profile (Start with Head of Household)

SL	Names of the household members	Sex Male=1 Female =2	Religion (Code)	Relation with HH (code)	Age	Marital Status (code)	Education (code)	Occupation (code)	
								Primary	Secondary
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									

Code of Religion: Muslim – 1, Hindu – 2, Buddhist – 3, Christian – 4, Others (specify)
Marital Status: Married – 1, Unmarried - 2, Divorced – 3, Widower - 4, Widow – 5 Separated – 6, Others (specify) – 7
Education: Illiterate - 1, Can sign only – 2, Primary – 3, Secondary -4, S.S.C and equivalent- 5, H.S.C and equivalent - 6, Degree and above - 7.
Relationship: Father – 1, Mother - 2, Husband – 3, Wife - 4, Son - 5, Son in-law - 6, Daughter – 7, Daughter in-law – 8, Brother - 9, Brother in-law –10, Sister - 11, Sister in-law – 12, Nephew - 13, Niece -14, Grandson - 15, Granddaughter - 16, Uncle - 17, Aunt -18, Grand father-19, Grand mother-20, Cousin-21, Others (specify) -22.
Occupation: Agriculture – 1, Wage labor – 2, Household work-3, Work in abroad-4, Fishing – 5, Van /Rickshaw puller – 6, Service – 7, Business – 8, Handicraft – 9, Student – 10, Unemployed – 11, Carpenter\ blacksmith – 12, Others (specify)

Q5 Does the household have access to the following on-site utilities?

Electricity	Yes	No
Land telephone	Yes	No
Satellite TV	Yes	No

Q6 Does the household own any of the following items *in working condition?*

	Items	**Number**
i)	Television	
ii)	Refrigerator	
iii)	Cassette player/two in one	
iv)	DVD/VCD player	
v)	Motor cycle	
vi)	Bicycle	
vii)	Power tiller / tractor	
viii)	Rickshaw / rickshaw van	
ix)	Shallow tube well for irrigation	
x)	Mobile phone	
xi)	Others	
xii)	Others	
xiii)	Others	

SECTION B: BUILDINGS AND STRUCTURES AND IMPROVEMENTS

Q7 (a) List all the buildings/ structures of the household. ***Please emphasise that information on buildings that is being collected in the resettlement survey is only for impact assessment purposes. A proper valuation exercise will be undertaken if the project is approved by the government.***

	Use	Owner-ship	Dimension ft x ft)	Description			No. of Storeys	Approximate Value
				Roof	Wall	Floor		

Coding Instruction:

Use
1=Residential
2=Business enterprise
3=Combined business & residential
4=Education
5=Health
6=Recreation
7=Livestock shed
8=Storage for crops, etc.
9=Kitchen
10=Other (specify)

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Main Roof Material
1=Straw/Thatch,/Leaves
2=Tiles
3=Tin
4=Concrete/Brick
5=Bamboo
6=No roof
7=Other (specify)

Main Wall Material
1=Brick, Concrete
2=Mud
3=Tin
4=Bamboo
5=Timber
6=No wall
7=Other (specify)

Main Floor Material
1=Concrete, Brick
2=Mud
3=Tiles
4=Other (specify)

SECTION C: LAND

Q8a (a) Total Area of cultivation land? ……. (in decimal)

Total area of cultivable land (in decimal) acquired by the Project

Mouza:……Plot Number……Area (dec)……
Mouza:……Plot Number……Area (dec)……
Mouza:……Plot Number……Area (dec)……
Mouza:……Plot Number……Area (dec)……

Q8b (b) Total Area of homestead land? ……. (in decimal)

Total area of homestead land acquired by the Project

Mouza:……Plot Number……Area (dec)……
Mouza:……Plot Number……Area (dec)……

Q9a (c) Total Area of Abandonment land? ……. (in decimal)

Total area of Abandonment land acquired by the Project

Mouza:……Plot Number……Area (dec)……
Mouza:……Plot Number……Area (dec)……

Q9b (d) Total Area of Khas (DC) land? ……. (in decimal)

Total area of Khas (DC) land acquired by the Project

Mouza:……Plot Number……Area (dec)……
Mouza:……Plot Number……Area (dec)……

Q9c Total Acquired land (all categories)? (in decimal)

Q10 a Does your household ***currently*** have a lease arrangement with someone else (renters) for the use of the building/structure?

	Yes	No
Monthly Rental Fee		
Use of building/house/structure		
Total Area Affected by the Power Plant Project facilities	Permanent	Temporary

Q 10 (b) Does your household ***currently*** have a sharecropping arrangement with someone else (acquired land)? Y/N

Status of acquired land (Share cropping)	Area (dec)
Yes, household is sharecropping land that belongs to another person / household (share-in)	

Yes, another person / household is sharecropping land that belongs to this household (share-out)	
Yes, household is involved in both share-in and share-out sharecropping	
Total (dec)	

Q 10 (c) Does your household ***currently*** have a lease arrangement on ***cultivation land*** with someone else (acquired land)? Y/N

Types	Area(dec)
Yes, household is leasing cultivation land that belongs to another person / household (lease-in)	
Yes, another person / household is leasing cultivation land that belongs to this household (lease-out)	
Total (dec)	

Q11 What are the crops grown: (please enumerate) and what is the annual value of crops grown in the land to be acquired by the project.

Type of Crop	Market Value (Tk.)

Q12 Does your household employ any ***permanent*** labourers (*all types*)?

Yes	No

Q13 If yes, please provide the following details for each labourer that you employ ***permanently***:

Type of Labourer	**Total number of *permanent* labourers employed in a year**		**Average monthly wage per labourer (Tk)**		**Approximate monthly value of in-kind payment (e.g. food and accommodation)**
	Male	**Female**	**Male**	**Female**	
i) Household/Domestic					
ii) Agricultural					
iii) Other					

Q14 Does your household employ ***agricultural*** laborers on a ***seasonal / temporary*** basis?

Yes	No

Q15 If yes, please provide the following details for seasonally / temporarily employed labourers:

Seaso	**Approximate number of *seasonal* labourers employed in a year**		**Total labour days for all *seasonal* labourers per year**	**Average daily wage per labourer (Tk)**	
	Mle	**Fmale**		**Male**	**Female**

Q16 List up to three villages where the workers come from:

Village	**Union/Paurashava**	**Upazila**

SECTION D: TREES

Q17 Does your household own any trees?

Yes	No

Q18 If yes, please provide the following information on the trees standing in the land to be acquired:

Timber trees:

Name of Tree	Number			
	Sapling	Immature	Mature	Total
• i) Eucalyptus				
• ii) Mahogany				
iii) Akasmony				
iv) Neem				
v) Shishu				
• vi) Rain tree / Koroi				
vii) Patasi				
viii) Palash				
ix) Babla				
x) Teak / Shegun				
xi) Bakul				
xii) Palm / Tal				
xiii) Silk cotton / Simul				
xiv) Sal				
xv) Chatim				
xvi) Sajna				
xvii) Pakur				
xviii) Kadam				
xix) Koroi				
xx) Tal				
xxi) Chambol				
xxii) Chalta				
xxiii) Manjori				
xxiv) Other (specify):				
xxv) Other (specify):				

Fruit / nut trees:

Name of Tree	Number			
	Sapling	Immature	Mature	Total
•) Banana / Kola				
ii) Mango / Am				
iii) Coconut / Narikel				
iv) Jackfruit / Kathal				
v) Litchi / Litchu				
• i) Guava / Payara				
vii) Olive / Jalpi				
viii) Lemon / Lebu				
ix) Jambura				
x) Blackberry / Jam				
xi) Ambra / Amra				
xii) Papaya / Pepe				
xiii) Tamarind / Tetul				
xiv) Marmelos / Wood-apple / Bel				
xv) Custard apple / Ata				
xvi) Pomegranate / Dalim				
xvii) Other (specify):				
xviii) Other (specify):				
xix) Other (specify):				
xx) Other (specify):				

Number of bamboo sticks: | |

Q 19 What is the value of annual fruits/ timber products reproduced from the house in the lands acquired by the project (Tk.)--------

Q20 Are any of your trees located on land owned by Government or any other organization?

Yes	No

Q21 If yes, please provide the following information:

	1	2	3	4
Name of department or agency:				
Number of trees belonging to household:				
Is there any contract (Yes/No)?				
f yes, expiry date of the contract:				

SECTION E: LIVESTOCK AND FISHERIES

Q22 Does your household own any livestock?

Yes	No

Q23 If yes, please provide the following information on your livestock:

	Type	Total Owned by Household	Total Share In	Total Share Out

Q24 Does your household have a pond under pisciculture?

Yes	No

Q25 Total area of pond (dec) :

Q26 Acquired area (dec) :

Q27 Types of Pond *1. Mono culture* *2. Homestead pond* *3.Others (Specify)*

Q28 Use of pond: *1. Drinking water* *2. Bathing* *3. Others (specify)*

Q29 If yes, please indicate the names of species cultivated:

i) Katal (catla catla)	vi) Pangas	xi) Minar carp
ii) Rui (robeo rohita)	Vii)Silver carp	xii) Other:
iii) Mrigal	viii) Telapia	xiii) Other:
iv) Grass carp	ix) Magor	xiv)Other:
v) Shorpoti	x) Sole	xv) Other:

Q 30 Current value of fish (Tk.)……

SECTION F: INCOME AND EXPENDITURE

Q31 Please indicate the household's annual ***gross*** income:

Income source	Annual Income (Taka)
i) Service holder	
ii) Local wage labour (worker sleeps at home every night), incl. employed in trade such as tailor	
iii) Wage labour elsewhere in Bangladesh	
iv) Wage labour – foreign countries	
v) Rickshaw / rickshaw van puller	
vi) Sale of household agricultural products (rice, vegetables, etc.)	
vii) Sale of fish *(from open water)*	
viii) bSale of fish from own pond *(pisciculture / aqua-culture)*	
ix) Sale of household livestock products (milk, meat, etc.)	
x) Sale of tree and forest products (timber, bamboo, fruit, etc.)	
xi) Sale of irrigation water	
xii) Income from own business (store, tea shop, rice mill, etc.)	
xiii) Renting of land/housing to other people	
xiv) Pension or retirement benefit	
xv) Other income (specify)	
xvi) Other income (specify)	

Q32 What is the household's average ***gross*** monthly income (Tk)? |

Q33 What is the household's average monthly expenditure (Tk)? |

Q34 Does your household ***currently*** have a loan or loans? | Yes | No |

Q35 If yes, please provide the following information:

	Loan Number				
	1	2	3	4	5
Source of loan:					
Name of lender:					
Original amount borrowed (Tk):					
Loan repayment period (months):					
Outstanding amount (Tk):					
Outstanding payment period (months):					

Code for source of loan: 1=money lender; 2=NGO; 3=family/relative; 4=other individual; 5=bank; 6=Government office.

SECTION G: RESETTLEMENT, COMPENSATION AND LIVELIHOOD RESTORATION

Note: Explain to respondents that we need their preliminary resettlement and compensation preferences for assessment and planning purposes only. They will in no way be bound to the answers that they provide in this section.

Q36 If the project is approved by Government, it is likely that the following resettlement options would be made available to households that would have to move:

If your household had to be resettled for the development of the Bibiyana Power Plant Project, which of these options would you prefer?

i) Resettlement to a designated relocation site	
ii) Individual resettlement to area of own choice	
iii) Don't know / too early to say	

Q37 If you had to relocate, which of the following factors would be the most important in deciding on a relocation site *(let respondent choose a maximum of three factors)?*

Close to relatives	
Close to business opportunities	
Close to employment opportunities	
Close to services and facilities (e.g. clinic, schools)	
Close to an area where agricultural production can be re-established (e.g. sharecropping)	

Q38 If you had to relocate, do you already have an area or location in mind where you would wish to move?

Yes	No

Q39 If yes, please provide details of where the area is located:

Detailed Address:

Q40 If you had to relocate, what would be your preference with regard to the loss of your buildings?

i) Cash compensation

ii) Provision of replacement buildings/structures by the Project

iii) Don't know / too early to say

Q41 If your cultivation land is acquired by the Project and you are paid fair cash compensation for the loss of this land, will your household be able to maintain its livelihood?

Yes	No	Don't know

Q42 If you are paid cash compensation for the loss of cultivation land, what would your household prefer to do to maintain your livelihood (*let respondent choose a maximum of three options*)?

Purchase replacement cultivation land from another landowner	1
Enter into a sharecropping/leasing arrangement with another landowner	2
Start a business enterprise	3
Seek employment	4
Other (specify)	5
Don't know	6

Q43 If the cultivation land that you are sharecropping or leasing is acquired by the project, what would your household prefer to do to maintain your livelihood (*let respondent choose a maximum of three options*)?

Enter into a new sharecropping/leasing arrangement with another landowner	1
Start a business enterprise	2
Seek employment	3
Other (specify)	4
Don't know	5

Q44 If you had to relocate, what training would you and members of your household need to assist you with the reestablishment of your livelihoods (*let respondent choose a maximum of three options)*?

Establishment/running of a small business	1	Handicraft	9
Agricultural production	2	Computer operation	10
Livestock and dairy farming	3	Sales and marketing	11
Poultry production	4	Carpentry	12
Homestead vegetable production	5	Masonry/plumber	13
Tree nursery	6	Vehicle repair (mechanic)	14
Fish production	7	Food processing	15
Sewing	8	Other (specify):	16
Small business/ Hotel business			

Q 45 . Required relocation / moving assistance for housing structure (Tk.)……

Q46 a. What is the annual value of fruits collected from aquatic resources from land (seasonally flood) acquired land.
b. What is additional annual transport cost will be incurred by the project
c. What is the value of livestock/ livestock product due to acquiring of crop land.

Total land acquired by project	Name of crops	Total Quantity (Kg)	Price (Tk.)

Expected benefits:

Name of Enumerator:

Checked by Supervisor (signature):
Date:

Annexure 4: Cnsultation Meeting and FGD

Consultation Meeting with the Stakeholders/PAPs

Venue : Hafiza Community Centre at Sherpur Point
Union : Auskandi Union
Upazilla : Nabiganj, District: Habiganj
Date : 28 May, 2011

A consultation meeting was held in the conference room of Hafiza Community Centre, Sherpur point, Aouskandi, Nabigonj, Habigonj on 28 May 2011 for getting the opinion of the people residing around the proposed Bibiyana Power Plant site. The consultation meeting was organized by Bangladesh Centre for Advanced Studies (BCAS) with the collaboration of Summit Bibiyana Power Company Ltd. The meeting presided over by Mr. Dilaor Hossain, Chairman of the Aouskandi Union Council. About 115 participants of different occupation including local UP members, elite class of all villages of the Union and the representative from the client –Summit Power Company Ltd." and the representative from the consultant –BCAS" was present there. The representative list of the Summit Power and the BCAS are quoted below:

1. Dr. M I Sharif - Senior Fellow, BCAS
2. Khandaker Mainuddin - Senior Fellow, BCAS
2. Mr.Md. Zahir Uddin Mollah - General Manager, SBPP
3. Ms. Olena Reza - Senior Programme Manager, BCAS
4. Mr. Osman Goni Shawkat - Senior Research Officer, BCAS
5. Mr. Mizanur Rahman - Senior Research Officer, BCAS
6. Md. Mirza Saleh Ahmed - Manager Summit Bibiyana Power Project.
7. Mr. Mokhlesur Rahman - Assistant Officer, SBBP

In his welcome speech, Khandaker Mainuddin of BCAS welcomed all the participants to the meeting and explained what the possible benefits will be after installation of a power plant in the area. He also informed the participants of the possible harmful effects that may befall the local resident. He said that the objective of this consultation was to get the opinion of the local people about the proposed Summit Bibiyana power plant 1 & 2.

Dr. M I Sharif of BCAS, in his speech, explained the environmental aspects what will be to the audience using a multimedia presentation about (1) location of the plant, (2) adjacent villages, (3) distance from the Sherpur Bridge, (4) Kushiyara River and the location of the plant. He said, BCAS, as a consultant of Summit carried out an Initial Environmental Examination (IEE) and Social and Environmental Impact Assessment (SEIA) study to report to Summit and Government of Bangladesh (GoB) to get the present situation is and what the possible situation will be after setting up the plant. As a part of this study, this consultation meeting is being held. About 67 acres of crop and homestead land in plant site and 47 (16.23 acquired and 31.345 requisited) acres in gas pipeline site has been acquired for setting up the plant.
He mentioned about the role and responsibility of BCAS in the power project. He also informed the participants of the possible harmful effects that may befall the local inhabitants. He also said that the objective of this consultation meeting was to get the opinion of the local people about the proposed power plant.

He invited free discussion on the following aspects-

i) Advantages to be derived from the power plant
ii) Disadvantages to be faced
iii) How to remove/minimize the possible disadvantages
iv) Environmental and social aspects of the power plant sites
v) Safety and security measures to be taken
vi) Described the activities done by BCAS etc.

Comments of Golum Md. Chowdhuury Shihab, Ex Chairman of Auskandi Union -

a) Most of the people whose land acquired by the government they didn't get the land compensation due to inadequacy of papers, unaware the right way, non cooperation of the land acquisition office etc. We want compensation without any hassle and also we want same price for the additional 26 acres land.
b) Availability of power is a precondition for development nationally and locally and as such power plant installation in the village Parkul is welcome.
c) Immediate local development will include: (i) development of roads, (ii) price increase of land, (iii) development of mills, factories and business centres.
d) Erosion by the Kushiyara may increase badly affecting families living on the banks of the river. Necessary arrangement must be made for stopping the erosion.
e) We will provide 100% co-operation for setting up the plant.
f) We have no higher educational institute; therefore, we want a college
g) All the roads are in poor condition, we want carpeting road
h) People are drinking pond water; we want deep tube well for safe drinking water

Comments of Hazi abdul Wahid Londoni -

a) Measures must be undertaken so that water of Kushiyara River does not become polluted.
b) Measures for protection against emission from the plant and for proper disposal of the waste must be undertaken.
c) To control noise pollution
d) To supply electricity to the local mills and factories
e) To build up roads for better communication in the 4 villages around the plant
f) To arrange for High School in the area
g) To arrange for a 50-bed Hospital in the area
h) To arrange the jobs for the villagers who are affected by the plant.

Comments of Mr. Sujan Mia of Parkul -

a) Electricity is indispensable. Without it, production in all sectors is affected. With the setting up of this plant, there will be better supply of electricity and better road communication system.
b) Kushiara dyke may be necessary for protection against river erosion and floods.
c) Marginal farmers who will lose their land should be provided with jobs in the plant.

Comments of Mr. Tera Mia of Parkul Village -

a) To provide jobs for the affected people based on experience and educational qualification.
b) To arrange an uninterrupted supply of electricity in the area.
c) To provide gas to every family in the area.
d) To establish one college and one high school.
e) To arrange for an embankment for safety against Kushiyara river
f) To arrange for 50 bed Hospital

Comments of Mr. Mosahid Mia of Parkul Village -

a) A new power plant at Bibiyana will add to the national grid; but it will bring little advantage to the locality of the local people can not get the opportunity of utilizing the gas, though it is located in the vicinity.
b) To arrange jobs for the landless and the owners of the acquired land
c) To eliminate hassles for getting compensation; money should disbursed through the Union council.
d) To establish an EPZ utilizing Bibiyana gas and electricity for creating more jobs.

Comments of Kauser Ahmed, new chairman candidate of Auskandi union parishad-

a) To build a high and strong dyke for protection against flooding
b) To arrange for proper compensation for the affected land owners
c) To build up roads for better communication in the 4 villages around the plant
d) To arrange for High School in the area
e) To arrange for jobs of the villagers affected by the plant.
f) To establish a training centre for increasing the number of skilled manpower
g) To establish an office at local level for giving compensation to the land owner and to avoid the lengthy process for giving compensation at the DC Office

Comments of Hazi Mosaddar Londoni of Parkul Village -

a) To rehabilitate the affected families
b) To establish one hospital and one high school
c) To give preference to the people of the locality for jobs
d) Affected families should get their compensation without any hassle. To eliminate these hassles, land compensations should be distributed through an honest officer.

Comments of Mr. Sujan Mia, representative from the landless -

a) Project affected persons –Landless, land owner, persons involved in share-in and share out and other connected people (laborers) should get proper compensation
b) To rehabilitate PAPs, Khasland should be allotted for haring a cluster village
c) To set up one primary, one secondary and one college in the area.
d) Roads and dykes should be developed.
e) To make arrangements for saving Kushiyara river water from pollution caused by the power plant.
f) To create opportunities for jobs of the local people

Comments of Mr. Nixon, New Chairman candidate of Auskandi Union -

a) Local people have been deprived of Bibiyana gas. They will not tolerate if they are deprived of the Bibiyana electricity as well.
b) A portion of the Gas that will come to the plant should be diverted to the areas close by for heating purpose.
c) To set up a hospital
d) To set up a standard high school
e) To arrange for distribution of compensation fairly so that nobody face any hassle.
f) Residents around the sites of gas and electricity production should get the benefit of gas and electricity

Remarks of Delower Hossain, Chairman of the Consultation Meeting and running chairman of the Aouskandi Union council -

a) To eliminate undesirable side effects as far as possible.
b) To make the Kushiyara dyke more effective and develop
c) To construct and develop roads for better transport and movement.
d) To set up schools, colleges and hospital etc.
e) To create opportunity for jobs of the local people.
f) To set up an EPZ and give employment opportunity of the local people.
g) To arrange construction of a cluster village for rehabilitation of the landless people.

The meeting ended with thanks from the chair.

Photo-1: Union based Consultation meeting with the stakeholders of the SBPP 1&II

Photo-2: Chowdhury Golum Md. Shihab, representative from the PAPs is expressing his opinion in the consultation meeting.

Summit Bibiyana 1 & 2 Power Plant Project

FGD-1
Place : Shahjahan Member's House
Village : Bongaon
Group : Day Laborers
Date : 29 March, 2011
Time : 7: 00 PM

FGD was facilitated by Md. Osman Goni Shawkat, SRO, BCAS and assisted by Mr. Idrish Hossain and Mr. Mizanur Rahman both of BCAS. The following day laborers of Parkul village participated in the discussion.

Sl. No.	Name	Age (Years)	Occupation
1.	Mr. Sajid Mia	27	Agriculture & Day Labour
2.	Md. Bilal	35	Day Labour
3.	Abdul Kadir	45	Do
4.	Mr. Zainal Mia	33	Do
5.	Md. Zahirul Mia	33	Agriculture & Day Labour
6.	Mr. Ashik Mia	34	Do
7.	Mr. Zainullah	39	Day Labour
8.	Md. Rubel	25	Do
9.	Md. Syed Mia	35	Mason
10.	Mr. Shamim Ahmed	28	Day Labour
11.	Md. Salik Mia	42	Do
12.	Mr. Zainal Ullah	45	Do

Employment Crisis

The jobless period are March, September and October. During these months they move to other places for work.

Daily Wage

During paddy harvesting, daily wage is Tk. 300/ including two meals. During the period of employment crisis, daily wage is around Tk. 200/= with two meals.

Drinking Water and sanitation

Almost of them are drinking pond water. Although there are 7 deep tube wells in the village, water from these tube wells are used by the well-to-do families. Water from shallow tube wells contains iron and arsenic. Maximum families have no sanitary pacca latrine. Open defecation is common.

Diseases

Common diseases in the families of day laborers are cold & fever, cough, dysentery, jaundice. For treatment they go to Sherpur (2.5 kms); for hospital facilities they have to go Nabiganj (14kms), Sylhet (50 kms) or Maulvi Bazar (30 kms).

Educational systems
Their children go to primary school and couldn‘t continue to high school due to financial crisis.
Environment
There is no water pollution, noise pollution, environment pollution and they live in natural environment. All the lands are fertile and used to cultivate the land for one time and sometime 2 times in a year.

Advantage of the proposed Power Plant
According to the day labourers, the proposed SBPP 1&2 power plant will not bring any benefit to them.

Disadvantage
a) Share-in possibility will decrease
b) Cattle grazing land will lost
c) Work opportunity will be limited
d) Cattle head grazing field will be decreased
e) Environmental pollution will affect them

Suggestion
a) To arrange for job opportunity.
b) To develop roads for easy transportation and movement.
c) To create facilities for business i.e. to provide capital to the day laborers to do business.
d) To establish a hospital, a high school.
e) To arrange for deep tube well for pure drinking water.
f) To arrange for natural gas connection for cooking.

FGD-2
Place : Shahjahan Member's House
Village : Bongaon
Group : Day Laborers
Date : 29 March, 2011
Time : 7: 00 PM

A focussed group discussion(FGD) meeting was held on 22nd March 2011 at 3.30 pm in the fisherman community village of Char Tajpur, Balagonj, Sylhet. The FGD was conducted by Mr. Osman Goni Shawkat, SRO, BCAS and Facilitated by Mr. Mizanur Rahman, SRO, BCAS. The village is situated opposit north side of Kushiara river. The participants of the FGD are given bellow:

Name	Fathers name	Age	Occupation	Education
Mr. Turab Ali	Abdul Gafur	35	Fisherman	Illiterate
Mr. Mahendra	Devendra	30	Do	Only sign
Mr. Susankar	Nibaron Biswas	35	Do	Only sign
Mr. Bipin Biswas	Ramesh Biswas	48	Do	Only sign
Mr. Ashu Biswas	Thakurchan Biswas	50	Do	Illiterate
Mr. Makhan	Mahindra Biswas	60	Do	Illiterate
Mr. Sushil Biswas	Akhoiram Biswas	55	Do	Illiterate
Mr. Matindra Biswas	Kamindra Biswas	40	Do	Only sign
Mr. Harendra Biswas	Upendra Biswas	25	Do	Only sign
Mr. Satis Biswas	Nayeem Biswas	45	Do	Illiterate
Mr. Khetis Biswas	Upendra Biswas	30	Do	Only sign
Mr. Nabakishor Biswas	Nagendra Biswas	25	Do	Only sign
Mr. Samar Biswas	Harendra Biswas	26	Do	Only sign
Mr. Subas Biswas	Sudeshar Biswas	40	Do	Only sign

This is a fisherman community around 3 km from the SBPP I&II. They are about 40-45 families lying here from decades to decades. They have no own land for cultivation and have no own pond for fish culturing. They catch the fishes in the Kushiara river and in the Banoiar Haour. All the year they depend on fishing and sale it to Sherpur Market. During the peak time each of them can earn Tk 600-1000 and off peak time it becomes low about Tk.200-300. According to them if Kushiara river pollured by the plant they will loose their earning sources.

The want alternative means of way. Demanding loan, financial help and job in the plant. Although it is their fatherhood profession but they want to quit it by getting a job.

They used their time for catching fish and sometimes pay labour to neighbour's agricultural land. Their housewives rearing the poultry and ducks and at night keep themselves busy in sewing, household work and the children education.

Summit Bibiyana 1&2 Power Plant Project
FGD-3
Place : Bongaon Village
Group : Small Farmers and day laborers
Date : 1 May, 2008

This FGD, conducted by Md. Osman Goni Shawkat and assisted by Mr. Mizanur Rahman, was attended by the following 15 villagers.

Sl. No.	Name	Age (Years)	Occupation
1.	Md. Ahad	40	Agriculture
2.	Monfar Ali	45	Do
3.	Md. Faruk Mia	37	Day Laborer
4.	Md. Harun Mia	40	Do
5.	Sufi Mia	45	Do
6.	Rabin Min	25	Agriculture
7.	Altafur Rahman	50	Do
8.	Akal Mia	50	Do
9.	Kalak Mia	25	Day Laborer
10.	Said Mia	27	Do
11.	Keshan Mia	28	Do
12.	Nurul	35	Do
13.	Iskander Ali	60	Do
14.	Dulu Mia	26	Imam of a Mosque
15.	Shamsur Rahman	36	Agriculture/ Expatriate

Village Profile

This village is located on the west of Parkul village. There is a big crop field between Parkul village and Bongaon village. There are about 2500 households of which 25% cultivate their own land, about 25% live on share-in cropping and the rest are mostly day laborers including about 3% expatiates. There is no metalled road in the village. There is only one non-metalled road.

Busy months: April, June, September, November, December for paddy cultivation and harvesting. During the remaining months they sell labor.

Advantages of the plant

a) Villagers are aware that a power plant will be set up in the Parkul village located to the east of their village.
b) Job opportunities will be created
c) Less load shedding
d) Development of roads.

Disadvantage

a) Since the plant will block the only road they use for transport and movement, villagers are worried about their movement problem.
b) They remember with awe the Magur Chara incident

Expectations

a) To arrange for better road communication
b) To establish one high school and one modern hospital.
c) To arrange for gas connection to each house for cooking.

Photo-3: FGD with the women group at the plant site

Photo-4: FGD with the project affected persons of SBPP 1&II

Summit Bibiyana 1&2 Power Plant Project

FGD-4
Village : Lama Tajpur
Group : Fisherman and Day Laborers
Date : 24 March, 2011

The group discussion was conducted by Md. Osman Goni Shawkat and assisted by Mr. Mizanur Rahman of BCAS. The following persons attended the discussion.

Sl. No.	Name	Age (Years)	Occupation
1.	Satish Biswas	45	Fisherman and Day Laborer
2.	Anindra Biswas	60	Do
3.	Upendra Biswas	100	Do
4.	Gouranga Biswas	45	Do
5.	Dhirondra Biswas	35	Do
6.	Khitish Biswas	40	Do
7.	Nabakishore Biswas	25	Do
8.	Debendra Nath	80	Do
9.	Abdul Alim	27	Agriculture & Shop

Village Profile

This village is located to the north of Parkul village on the northern bank of the Kushiyara river, opposite to the power plant. There are about 2500 households in the village, of which about 40% cultivate their own land, about 40% cultivate on share-in basis, the remaining being mostly fishermen. The fishermen earn their livelihood by catching fish from the Kushiyara river-one km east and one km west of the proposed power plant. The fishermen do not have any landed property. They live in the houses built on the land of the well-to-do families. Their original houses have been eroded by the Kushiyara river. Now-a-days, fish catch is rather small and they have to go some other occupation, mainly, day labor. They said that, during the dry season (March – May), river water and fish caught from the river smelt badly. This has made their fishing occupation less attractive.

Advantages of the proposed power plant

a) They are aware about the proposed power plant.
b) They believe that power plant will help development of the country as a whole.
c) They are not sure what benefit it can bring to them.

Disadvantages

a) They are very much worried that the proposed power plant will increase erosion of their part of land and this will make them homeless and shelter less.
b) Effluent from the plant may decrease the fish population, making fishing business unprofitable.

Suggestions for remedial measures

a) To arrange for boulders along the river from Sherpur bridge upto 1 km west of this village to protect the village from erosion
b) To rehabilitate the displaced families
c) To provide jobs in the power plant
d) To make arrangement so that river water is not polluted by the plant effluent.

Summit Bibiyana 1&2 Power Plant Project

FGD-5
Place : Lama Tajpur
Group : Agriculturists
Date : 2 May, 2011

The FGD was conducted by Md. Osman Goni Shawkat and assisted by Mr. Mizanur Rahman of BCAS. 12 farmers from the village participated in the discussion. The list is given below.

Sl. No.	Name	Age (Years)	Occupation
1.	Md. Rahmon Ullah	70	Agriculture
2.	Syed Sana Mia	80	Do
3.	Montaj Ullah	60	Do
4.	Md. Ala Mia	42	Do
5.	Sri Makhan Namashudra	71	Agriculture/Fish Trader
6.	Zakir Hossain	26	Agriculture
7.	Maruf Ali	35	Do
8.	Syed Ebarat Mia	55	Do
9.	Nasiruddin	20	Do
10.	Nazrul Islam	25	Do
11.	Md. Abdul Kashem	45	Agriculture/Business
12.	Syed Nikson Ahmed	30	Do

Village Profile

As stated FGD -7, this village is located on the north of Parkul village on the northern bank of the Kushiyara river, opposite to the power plant. there are about 2500 households in the village, of which about 40% cultivate their own land, about 40% cultivate on share-in basis, the remaining being mostly fisherman.

Advantages of the power plant

a) They are aware about the proposed power plant.
b) They expect power supply to the village (present, there is no grid connection in the village)
c) Opportunity for jobs.

Disadvantage

a) Proposed power plant will increase flooding and erosion of the area.
b) They apprehend air and water pollution.

Suggestions for remedial measures

a) To protect the village from erosion by putting boulders in the concerned places.
b) On the western side of the village, the river may be made straight by digging in order to diminish the impact of the river current.

Summit Bibiyana I & II Power Company Limited Project
FGD-6
Place : Brahmangaon
Group : Fishermen
Date : 22nd May , 2011

The FGD was facilitated by Md. Osman Goni Shawkat and assisted by Mr. Mizanur Rahman of BCAS and Mr. Idrish Hossain from BCAS. The following fishermen were present.

Sl. No.	Name	Age (Years)	Occupation
1.	Biru Mia	29	Fisherman
2.	Chatai Mia	70	Do
3.	Musa Mia	80	Do
4.	Parbesh Ali	26	Do
5.	Md. Abdul Hai	50	Business
6.	Hanifullah	52	Fisherman
7.	Afiz Mia	30	Do
8.	Kalimullah	30	Do
9.	Abul Kalam	50	Do
10.	Jitu Mia	42	Fisherman & Team Leader
11.	Abdus Sabhan	45	Fisherman
12.	Monsur Mia	25	Do
13.	Md. Ziaul Huq	45	Do
14.	Abdul Ahad	45	Do

Village Profile

This village is located about 3 kms to the east of Parkul village on southern bank of Kushiyara river. Fishing is their ancestral occupation. They do fishing in the river upto about 2 kms upstream from the Sherpur bridge and also about 3 kms from the same bridge down the river. According to them, previously they could catch hilsa fish in the river. But because of the Fenchuganj fertilizer factory, Hilsa fish is now non-existent in the river. Moreover, population of other fish has decreased significantly.

Advantages

a) They are aware of the proposed power plant.
b) They are not sure about what benefit it will bring to them

Disadvantage

a) If the effluent of the plant is discharged in the river, fish population may decrease further leading to the non-availability of fish up the river in their locality.

Suggestions for remedial measures

a) To make some arrange so that river water does not become polluted.
b) To give job opportunities in the power plant.

Consultation meeting with the Project Affected Persons (Parkul, Paharpur, Bongaon and Majlishpur)

Place : Mokatab(Arabic Institution) at parkul village
Upazilla: Nabiganj, District : Habiganj

Date : 19 May 2011

In order to get the opinion of the people residing around the proposed Summit Bibiyana Power Plant site 1&2, a consultation meeting was held on 19 May 2011 in front of the Maktob of Parkul Village in Auskandi Union with. About 100 participants of the consultation included representatives of different occupations of all the nearest villages of the proposed power plant location. The consultant, BCAS, was represented by the following.

1.	Md. Osman Goni Shawkat	-	Senior Research Officer
2.	Mizanur Rahman	-	Senior Research Officer
3.	Mr. Idrish Hossain	-	Research Officer

In his welcome speech Mr. Shawkat of BCAS welcomed all the participants to the meeting and briefly described the proposed Summit Bibiyana Power Project 1&2 location, capacity of the plant, types of the plat and its importance to the national development. He mentioned about the role and responsibility of BCAS in the power project. He informed what possible benefits that will result from the installation of a power plant in the area. He also informed the participants of the possible harmful effects that may befall the local residents. He said that the objective of this consultation was to get the opinion of the local people about the proposed power plant.

Md. Osman Goni Shawkat of BCAS, in his speech, explained to the audience using a diagram showing (1) location of the plant, (2) adjacent villages, (3) distance from the Sherpur Bridge, and (4) Kushiyara River. He said, BCAS, as a consultant of Summit Group, was carrying out a social and environmental survey to report to Summit and Government of Bangladesh as to what the present situation is and what the possible situation will be after setting up the plant. As a part of this survey this consultation is being held. About 67 acres of crop land will be acquired for setting up plant. He invited free discussion on the following aspects:

i) Advantages to be derived from the power plant
ii) Disadvantages to be faced
iii) How to remove/minimize the possible disadvantages

Mr. Tara Mia of Parkul village wanted to know why his village was not selected for the study.

In reply, Mr. Shawkat said that the study team did not find his village in the high impact area of the power plant. According to survey method, BCAS included all those villages, which cover within the high impact zone.

Mushahid of Parkul village asked to know how the government will distribute compensation to the land owner.

In reply, Osman Goni Shawkat explained land acquisition processes and guidelines of GOB, IFC, WB and ADB.

Mr. Abdul Bashir of Parkul

- Demand for arrangement of gas supply and regular power to all local HHs.
- Income of many farmers from land will be reduced or even zero.

- Many people will be unable to use road for their movement
- Is there any plan for new road in absence of existing Kushiyara dyke?
- Sarder Shafiqul Alam said the project implementation organization has a plan for new alternative road for local community

Sujan Mia of Bongaon

- About 200-250 houses will be inundated after land filling of the proposed project site, particularly river side of the Kushiyara dyke. So he proposed to construct at new dike along the river side and north of all existing houses.
- Arrange gas supply at to all local HHs and free supply of electricity in affected villages.

Bakul Mia of Parkul- Proposed measures similar to those Sujan.

Dulal Mia of Parkul - Wanted to know government plan to give any compensation to those cultivators who are cultivating khas land.

Sabu Mia – The proposed power plant construction will change the course of the existing road and may create problems for school going children and others. So there is a need to arrange a new school

Sujan, current Union Parishad (UP) member of Bangaon village, said that they are happy for the proposed power project although there are many problems. His comments are:

- After establishing the power plat, load shedding of electricity will reduce
- It may create air pollution, noise pollution, water pollution and badly impact on human health.
- The project should have arrangement to prevent all those pollution problems
- Affected land owners should be paid @ Tk. 50,000.00 per decimal as compensation.
- All four villages close to the plant should have regular power supply
- One export processing zone (EPZ) should be established in their area and provide employment to unemployed people.
- The Kushiyara dike should be improved
- To arrange for a 50-bed Hospital in the area
- To arrange for a good quality high school
- To arrange for gas supply at household level

Fazlu Mia, former UP member of Bangaon agreed with the above comment of Sujan.

He also said that there should be a sub-station of power near the plant site, mainly for power supply to meet local demand of electricity.

Comments of Warish Mia of Bangaon are

- Water drainage problem may crop up and thus the project should have adequate measure for that
- Land has different categories. Land of the proposed site is the best category, so the land owner should be paid according to land category.
- For Sharecroppers these should be some arrangement for compensation.
- To establish a vocational training centre for training and alternate employment opportunity

- To arrange for a good quality school
- To arrange for regular power supply
- To provide credit for development of cottage industries
- To arrange for Deep tube-wells in the village for pure and safe drinking water
- To arrange for a health care centre
- We have formed a committee. You are requested to keep contact with that committee for getting advice
- To create employment opportunity
- Company should engage a legal advisor to help land owner for getting real compensation from government

Comments of Kawser of Parkul:

- Many land owners of Bibiyana Gas filed site did not get money for their land. In this case company should to arrange effective and simple system to give compensation among the affected land owners
- There should be some arrangement for poor farmers to get benefit
- To establish an office at local level for giving compensation to the land owner and to avoid the lengthy process for giving compensation at the DC Office
- Affected land owners should be paid @ Tk. 60,000.00 per decimal as compensation.
- The possibility of water pollution should be minimized
- A new dyke should be constructed along the river side
- To sink deep tube-well to supply safe drinking water
- To establish cluster village on the government kash land and distribute kash land among the land affected farmers for cultivation
- To arrange regular power supply free of cost in the affected villages
- To establish an EPZ on the southern side of the Kushiyara river
- To arrange for a school and a hospital
- To establish a training centre for increasing the number of skilled manpower
- To construct metal road with light post at village level

Mintu Mia of Parkul

There is no play ground of Parkul Primary school. The power project should arrange for a play ground for school children

Abdul Hamid (Nixon) of Mithapur Village

- Affected families should get their compensation without any hassle. To eliminate hassle, money should be distributed through the Union council from a camp in the area.
- To arrange for a 50-bed Hospital in the area
- To rehabilitate affected families by establishing cluster village
- The power project should not break any principle of basic human rights.
- We will help government to establish the proposed power project

Md. Osman Goni Shawkat assured the meeting that BCAS team would include in their report all comments and suggestions made by the participants.

After 3 hours discussions the meeting was concluded by the thanks.

Annexure -5: Air Quality Monitoring Report

1 Methodology

The pre-defined monitoring program has been carried out as per requirement of the client. The monitoring of environmental parameters were performed based on the primary data generation during the measurement of Air quality and Noise quality (Ambient Noise in dBa at the boundary of the plant to nearby receptor at day and night time) parameters.

Sampling Plans and Procedures
Initially a routine monitoring network has established. A short training on sampling and monitoring provided to those field officers who involved with the tasks.

The responsible personnel have established, implemented, and maintained a documented sampling plans and procedures for environmental monitoring. The Consultant maintained a high standard of sampling plan and procedures, which included the following issues:

(a) Tests to define the variability and/or repeatability of the environmental monitoring results,
(b) Measures to assure the accuracy of the method, which includes the calibrations.
(c) Measures to evaluate method capability, such as measurement uncertainty, detection limits, and quantification limits.
(d) Strictly maintain the technical holding time of all samples and samples were tested within technical holding time
(e) Selection and use of reagents and standards of appropriate quality, and use of consumables before their expiry dates

The consultant/persons responsible and established, implemented, and maintained procedures for recording relevant data and operations relating to sample collection and maintained record through chain of custody.

Sample Handling

The responsible personnel maintained predefined documented procedures for sample handling, which protected the integrity and identity of the samples.

Sample Acceptance Procedure

The persons responsible maintained a documented sample acceptance procedure that outline the circumstances and criteria under which samples were accepted or rejected.

2. Time period (dry season):

Ambient air quality monitoring has been started on 28th of February 2011 and ended on 27th of May. The monitoring program comprise of 24 days over three month period. Monitoring was done for continuous 24hrs a day. Electricity shutdown time made commensurate with extra time monitoring.

March -April as considered dry season and May as monsoon season.

No. of samples were measured: 24 Samples

Deduction of results: Nil

3. Assembly, description and the photos of the air quality monitoring instruments Parameters (SO_2, NOx, PM_{10}, SPM, CO)

Photograph -1 : Respirable Dust Sampler for SPM, PM_{10}, SO_2, NOx measurement

Photograph -2 : Carbon Monoxide meter for CO measurement

4. Presentation of Results

After monitoring of various parameters like total suspended particulates (TSP), PM_{10}, Oxides of Nitrogen (NO_X), Sulfur dioxide (SO_2) and Carbon Monoxide (CO) in the field collected samples are tested in the Enviro Quality Laboratory. The total 24 numbers of samples test result are presented in Table-1

Table 1 : Bangladesh Standards for Noise

SN	Location	Ambient Air Polluants Concentration in µg/m^3				
		PM_{10}	SPM	SO_2	NO_X	CO
1.3.11	Bangaon, Nabigonj, Habiogonj	102.13	144.28	4.01	9.74	Nil
3.3.11	Bangaon, Nabigonj, Habiogonj	104.14	149.22	3.28	10.65	Nil
5.3.11	Bangaon, Nabigonj, Habiogonj	106.37	157.42	2.69	10.54	Nil
9.3.11	Bangaon, Nabigonj, Habiogonj	104.24	149.21	4.36	9.95	Nil
13.3.11	Bangaon, Nabigonj, Habiogonj	94.51	146.45	3.18	7.08	Nil
17.3.11	Bangaon, Nabigonj, Habiogonj	92.29	146.5	3.80	8.24	Nil
21.3.11	Bangaon, Nabigonj, Habiogonj	112.74	156.32	3.43	13.47	Nil
25.3.11	Bangaon, Nabigonj, Habiogonj	124.77	169.85	4.08	15.01	Nil
29.3.11	Bangaon, Nabigonj, Habiogonj	156.93	201.52	4.03	10.05	Nil
02.04.11	Bangaon, Nabigonj, Habiogonj	122.84	179.32	3.75	14.20	Nil
05.04.11	Bangaon, Nabigonj, Habiogonj	82.54	126.13	4.33	9.11	Nil
08.04.11	Bangaon, Nabigonj, Habiogonj	96.47	142.41	3.83	9.72	Nil
12.04.11	Bangaon, Nabigonj, Habiogonj	101.22	146.73	3.71	8.84	Nil
16.04.11	Bangaon, Nabigonj, Habiogonj	104.33	150.44	4.16	10.66	Nil
20.04.11	Bangaon, Nabigonj, Habiogonj	98.72	139.60	3.48	10.38	Nil
24.04.11	Bangaon, Nabigonj, Habiogonj	48.00	68.85	0.66	2.53	Nil
29.04.11	Bangaon, Nabigonj, Habiogonj	78.72	135.69	0.72	2.75	Nil
03.05.11	Bangaon, Nabigonj, Habiogonj	89.98	137.60	1.07	7.88	Nil
06.05.11	Bangaon, Nabigonj, Habiogonj	66.93	132.71	4.65	8.22	Nil
10.05.11	Bangaon, Nabigonj, Habiogonj	58.84	88.04	4.44	7.51	Nil
14.05.11	Bangaon, Nabigonj, Habiogonj	72.49	101.68	4.10	15.01	Nil
18.05.11	Bangaon, Nabigonj,	63.35	108.2	2.98	11.08	Nil

	Habiogonj					
22.05.11	Bangaon, Nabigonj, Habiogonj	42.00	85.56	2.99	11.08	Nil
26.05.11	Bangaon, Nabigonj, Habiogonj	46.67	88.73	2.80	10.01	Nil
Duration (hrs)		24	24	24	24	8
DoE (Bangladesh) Standard for Industrial and Mixed Zone		**150**	**200**	**120**	**100**	**10000**
WB Standard		**150-230**	**500**	**50**	**150**	**10000**

5. Discussion of the Results – Existing Air Quality (PM_{10}, SPM, SO_2, NO_X and CO) of the Project Area

The result for ambient air quality monitoring shows the PM_{10}, SPM, SO_2, NO_X and CO Concentrations of the ambient air. From the analysis it is observed that the concentration of all these parameters is far below from the allowable limit except one PM_{10}. CO found is nil. The weather was Sunny during dry season and in May rain started. In the dry season the values found more than monsoon season.

The results also indicate that the value of SPM values is comparatively less than $PM_{10.}$ This fine particle matter may be generated from the surrounding area including wind flow and bio-mass burning of the project area.

6. National Ambient Air Quality Standard for Bangladesh/DoE

GoB Guidelines for Air and Noise Quality

For carrying out the production, the standard for air and noise quality of the environment shall be determined in accordance with the standard specified in Schedule 2 and Schedule 4 in the Environment Conservation Rules 1997, compiled by DoE, Ministry of Environment and Forest, GoB. Schedule 2 and 4 are presented in the Table 2 and Table 3.National Ambient Air Quality Standards Published in the Bangladesh Gazette (19 July 2005) and is shown in Table 3.

The guidelines for acceptable noise level, especially outside plant boundary have been considered as levels recommended by internationally acclaimed standards. Bangladesh has categorized the noise by the following levels.

Table 2: Bangladesh Standards for Ambient Air

Location	Unit	SPM (Suspended particulate matters)	SO_2 (Sulphur di-oxide)	NO_X (Oxide of Nitrogen)
Industrial and mix area	mg/m^3	500	120	100
Commercial and mix area	mg/m^3	400	100	100
Residential and Rural area	mg/m^3	200	80	80
Sensitive area	mg/m^3	100	30	30

*Source: *(Schedule -2, Rule 12, Environment Conservation Rules 1997*

Notes:

- Sensitive area includes national monuments, health resorts, hospital, archaeological sites, educational institutions and other government designated area (If any).
- Any industrial unit located not in a designated industrial area will not discharge such pollutants, which may contribute exceed the ambient air quality above in the surrounding areas of residential and sensitive areas.
- Suspended particulate matters mean airborne particles of diameters of 10 micron or less.

Table 3 : Bangladesh Standards for Noise

Location Category	Standards determined at dBa unit	
	Day	Night
Silent Zone	45	35
Residential Area	50	40
Mixed Area (basically residential and together used for commercial and Industrial purposes)	60	50
Commercial area	70	60
Industrial area	75	70

*Source: ECR *Schedule 4, A Compilation of Environmental Laws, DoE*

Notes:

- Limits presented are one-hour energy equivalent sound exposure limits;
- 'Daytime' is 06.00 to 21.00 hours, 'nighttime' is 21.00 to 06.00 hour; and
- Sound exposure at a receptor resulting solely from the facility, irrespective of ambient sound levels, should not exceed the presented limits.

Table 4: Bangladesh Standards for Ambient Air (Revised 19th July in 2005)

Pollutant	Objective	Averaging Time
$PM_{2.5}$	15 µg /m3	Annual (f)
	65 µg /m3	24-hour (h)
PM_{10}	50 µg /m3	Annual (b)
	150 µg /m3	24-hours(g)
SPM	200 µg /m3	8-hours
SO_2	80 µg /m3; (0.03 ppm)	Annual
	365 µg / m3; (0.14 ppm)	24-hour (a)
NO_x	100 µg /m3; (0.053 ppm)	Annual
CO	10mg/m3; (9 ppm) (a)	8-hours (a)
	40mg/m3; (35 ppm) (a)	1-hour (a)
Lead	0.5 µg/m3	Annual (i)
Ozone	157 µg /m3; (0.08 ppm)	8-hour (e)
	235 µg /m3; (0.12 ppm)	1-hour(d)

- Notes:
-
- a) Not to be exceeded more than once per year
- b) The objective is attained when the annul arithmetic mean is less then or equal to 50µg/m3.
- c) The objective is attained when the expected number of days per calendar year with a 24-hour average of 150µg/m3 is equal to or than 1.
- d) The objective is attained when the expected number of days per calendar year with the maximum hourly average of 0.12 ppm is equal to or less then 1.
- e) 3-year average of annual 4th highest concentration
- f) Spatially averaged over designated monitors
- g) The from the 99th percentile.
- h) The from is the 98th percentile
- i) Annual arithmetic average based on lead analysis of TSP samples operated on an every 6th day schedule.

7. IFC/ World Bank/ADB Standard

"World Bank Pollution Preservation and Abatement Handbook" prescribed maximum noise level for power station which is:

"Noise abatement measures should achieve either the following levels or a minimum increase in background levels of 3 dBa. Measurements are to be taken at noise receptors located outside the project property." The maximum noise allowable limit is presented in Table 4 in the unit of dBa.

Table 5: Maximum Noise Allowable Limit

Receptor Type	Daytime (07.00 -22.00 hr)	Nighttime (22.00-07.00 hr)
Residential; Institutional; Educational	55	45
Industrial; Commercial	70	70

*Source: *Thermal Power-Guidelines for NPW plants, World Bank, 1998*

8. Asian Development Bank Guidelines

"Environment Guidelines for selected industrial and power development projects" published by the Asian Development Bank suggests that:

"In the range of 55 dBa to 75 dBa, impacts are of the "annoyance" type resulting in interference with speech communication, general well being and sleep. Response to such problems varies with the receptor, for example, schools, offices and similar receptors where ease of speech is of primary concern, will not have the same response to an increase from 55 dBa to 60 dBa as a busy commercial district. Above 75 dBa, the possibility of severe health effects occurs such as loss of hearing." Protected noise levels that are presented in these guidelines are presented in Table 5.

Table 6: Protective Noise Levels

Effect	Level	Area
Hearing	79 dBa	All areas at the year
Outdoor activity interference and annoyance	55 dBa	Outdoors in residential areas and forms and other outdoor areas where people spend widely varying amounts of time and other places in which quiet is a basis for use. Outdoor areas where people spend limited amounts of time, such as school yards, playground, etc.
Indoor activity interference and annoyance		Indoor residential areas Other indoor areas with human activities such as schools etc.

**Source: US EPA 500/9-79-100, November 1978*

9. Interpretation of Guideline

All the above-mentioned guidelines present desirable objectives based on generally accepted studies on human response to noise and particulate matter. However, in certain urban environments, higher noise levels are tolerated to a greater extant due to acclimatization to existing sources. In these environments the change in sound levels, and the corresponding perception of those changes, is a more relevant measure of expected community response. Residential and institutional areas are of primary importance in assessing noise impacts (i.e., they are considered "sensitive"). Commercial and industrial areas can tolerate much higher sound environments, which is illustrated by the much higher guideline limits for these areas in both the World Bank and Bangladesh guidelines.

The Asian Development Bank Guidelines are focused on annoyance and health issues related to overall noise levels sustained in a certain type of receptor. They do not address specific limits on the relative or absolute contribution of a particular source (e.g., a power plant) at a receptor. Conversely, Bangladesh guidelines are interpreted as limiting the sound levels produced by a facility at a receptor and do not account for ambient sound levels.

10. Conclusions

Environmental monitoring of ambient air and noise quality parameters has been performed for the period of March-May, 2011. Air quality parameters were determined in the site with the help of the High Volume Sampler attached with NL411gases monitoring unit, digital carbon monoxide meter used for CO measurement and noise quality was by Noise Level Meter.

Ambient air quality were monitored and analyzed of samples in the enviro quality laboratory. From the analysis it is found that the ambient air quality is satisfactory and within the allowable limit specified by Department of Environment. SO_2, NOx and CO at all not a problem of the operation of the industry. There is a revised standard for $PM_{2.5,}$ Pm_{10}, SO_2, NOx and CO for air for industrial unit. However, these values are also found below the World Bank standard. It is found from other scientific study that PM_{10} values are increasing day by day against revised standard published in 2005 for ambient air quality. However, it will be a major concern in future.

Noise level quality of project has also been measured. According to the measurement, the noise level around the plant area found no higher (night time) than the allowable limit of mixed zone, but below the limit of commercial and industrial zone, which is normally observed everywhere

Finally it can be concluded that the proposed project have carrying capacity to accumulate SPM and other gaseous pollution and will not show detrimental impact on the environment in terms of air and noise pollution and also the proposed project will provide a good working environment for the workers due to the project is in the country side.

Annexure-6: Air Dispersion Modeling of the Proposed Power Plant at Bibiyana, Nabiganj, Habiganj

Introduction

ISC3P model is an improved version of the ISCST3 model of the EPA (USA) containing two special features of the Plume Rise Enhancement Model (PRIME). The two features are-

1. Enhanced plume dispersion coefficients due to the turbulent wake
2. Reduced plume rise caused by a combination of the descending streamlines in the lee of the building and the increased entrainment in the wake.

This model is therefore suited to a wide range of applications.

Background

As per terms of the project for the EIA study for the proposed 450 MW (later 2 × 450 = 900 MW) natural gas-based power plant at Bibiyana, Nabiganj in the district of Habiganj, an air dispersion modelling was completed to predict ground level concentrations (GLCs) of different pollutants (NOx, CO, PM10) for the required averaging period across modelled domain (7.5km × 7.5 km around the stack). The predicted GLCs were assessed in isolation and also the cumulative impact of emissions from the proposed power plant and from the background values determined at the plant location in March 2011.

Modelling Methodology

1. Air dispersion model

   As stated above, ISC3P model of the USEPA was used to estimate GLCs of the pollutants emitted from the proposed power station at Bibiyana.

2. Model Setup

   ISC3P was used with the following setup:

   a) A model domain of 7.5 km by 7.5 km centred on the stack (0.0, 0.0) and 500m grid spacings using Cartesian Co-ordinates. The second stack was 500 m to the north of the first stack.
   b) Assumption of no terrain as the site surrounding the proposed plant is essentially flat with no hilly areas.
   c) A surface roughness length of 0.1m was used to account for the primary flows of concern across relatively flat areas.
   d) Building wake effects were not included as the height of the nearest buildings were not sufficient to influence emissions.

Ambient Air Quality Standards

National Ambient Air Quality Standards (NAAQS) for Bangladesh is given in Table 1.

Table 1: National Ambient Air Quality Standards (NAAQS) for Bangladesh

Pollutant	Objectives	Averaging period
CO	10 mg/m^3	8 hours(a)
	40 mg/m^3	1 hour(a)
Pb	0.5 μg/m^3	Annual
NO_2	100 μg/m^3	Annual
PM10	50 μg/m^3	Annual (b)
	150 μg/m^3	24 hours (c)
PM2.5	15 μg/m^3	Annual
	65 μg/m^3	24 hours
O_3	235 μg/m^3	1 hour (d)
	157 μg/m^3	8 hours
SO_2	80 μg/m^3	Annual
	365 μg/m^3	24 hours (a)

Notes:

(a) Not to be exceeded more than once per year

(b) The objective is attained when the annual arithmetic mean is less than or equal to 50 μg/m^3

(c) The objective is attained when the expected number of days per calendar year with a 24-hour average of 150 μg/m^3 is equal to or less than 1

(d) The objective is attained when the expected number of days per calendar year with the maximum hourly average of 235 μg/m^3 is equal to or less than 1 (Source: AQMP, DOE).

Emission estimates and stack parameters for the proposed plant at Bibiyana

Emission estimates and stack parameters used in the present modelling are presented in Table 2. Emissions have been calculated for two stack – one for each plant. Both the stacks are assumed to have same parameters and same emission rates:

Table 2: Emission rates and stack parameters

Source	Stack height (m)	Stack diameter (m)	Exhaust temp (°C)	Vel. Flowrate (m^3/sec)	Exit velocity (m/sec)	Emission rates (g/sec)			
						NO_X as NO_2	SO_2	PM10	CO
Gas Unit 1	50	3	145	275	25	9.40	NA	0.07	3.43
Gas Unit 2	50	3	145	275	25	9.4	NA	0.07	3.43

Modelling results

As sulphur content in the natural gas input is nil, emission of SO_2 is not included in the modelling. Maximum 50 values for NO_X, PM10 and CO are presented in Tables 3, 4 and 5 respectively. The predicted highest values with two stacks for NO_X, PM10 and CO are 5.23, 0.053 and 3.82 $\mu g/m^3$ respectively.

Table 3: The maximum 50 24-hr average concentration values for source group: all
Including source(s): stack 001, stack002
Conc of NOx in micrograms/m3**

RANK	CONC	(YYMMDDHH)	AT	RECEPTOR (XR,YR) OF	TYPE
1	5.2329	(4032524)	AT	(500.00, 1500.00)	GC
2	4.85892	(4032524)	AT	(1000.00, 2500.00)	GC
3	4.76141	(3121724)	AT	(-2000.00, -5000.00)	GC
4	4.756	(3121724)	AT	(-3000.00, -7500.00)	GC
5	4.73366	(3121724)	AT	(-2500.00, -6000.00)	GC
6	4.70611	(3121724)	AT	(-2500.00, -6500.00)	GC
7	4.60992	(4032524)	AT	(500.00, 2000.00)	GC
8	4.53075	(4032524)	AT	(1000.00, 3000.00)	GC
9	4.3621	(3121724)	AT	(-3000.00, -7000.00)	GC
10	4.25456	(4032624)	AT	(0.00, 3500.00)	GC
11	4.21967	(4032624)	AT	(0.00, 3000.00)	GC
12	4.18616	(3121724)	AT	(-2000.00, -5500.00)	GC
13	4.15159	(4032624)	AT	(0.00, 4000.00)	GC
14	4.10699	(4032924)	AT	(1000.00, 2000.00)	GC
15	4.08683	(3121724)	AT	(-1500.00, -4000.00)	GC
16	4.07985	(3121724)	AT	(-2000.00, -4500.00)	GC
17	3.9927	(4032624)	AT	(0.00, 4500.00)	GC
18	3.98323	(3121724)	AT	(-1500.00, -3500.00)	GC
19	3.91767	(4032924)	AT	(1500.00, 3000.00)	GC
20	3.90291	(4032624)	AT	(0.00, 2500.00)	GC
21	3.90284	(4032924)	AT	(1500.00, 3500.00)	GC
22	3.90135	(3121724)	AT	(-2500.00, -7000.00)	GC
23	3.88988	(4032324)	AT	(500.00, 4000.00)	GC
24	3.88665	(4032924)	AT	(2000.00, 4500.00)	GC
25	3.81177	(4032624)	AT	(0.00, 5000.00)	GC

RANK	CONC	(YYMMDDHH)	AT	RECEPTOR (XR,YR) OF	TYPE
26	3.75182	(4032324)	AT	(500.00, 3500.00)	GC
27	3.74757	(4032924)	AT	(2500.00, 5500.00)	GC
28	3.72484	(4032324)	AT	(500.00, 4500.00)	GC
29	3.71145	(3121724)	AT	(-2500.00, -5500.00)	GC
30	3.64679	(4032924)	AT	(2000.00, 4000.00)	GC
31	3.63515	(4021724)	AT	(1000.00, -2000.00)	GC
32	3.62774	(4032624)	AT	(0.00, 5500.00)	GC
33	3.60042	(4032924)	AT	(3000.00, 6500.00)	GC
34	3.50569	(4032924)	AT	(1000.00, 2500.00)	GC
35	3.46805	(4021724)	AT	(1000.00, -2500.00)	GC
36	3.45491	(4032924)	AT	(3500.00, 7500.00)	GC
37	3.45104	(3121024)	AT	(-1500.00, -7500.00)	GC
38	3.44798	(4032624)	AT	(0.00, 6000.00)	GC
39	3.41556	(3122124)	AT	(0.00, 5500.00)	GC
40	3.41188	(4032324)	AT	(500.00, 5000.00)	GC
41	3.40539	(3122124)	AT	(0.00, 6000.00)	GC
42	3.39726	(3121024)	AT	(-1000.00, -5500.00)	GC
43	3.39174	(3122124)	AT	(0.00, 5000.00)	GC
44	3.38432	(4032924)	AT	(2500.00, 5000.00)	GC
45	3.37389	(3122124)	AT	(0.00, 6500.00)	GC
46	3.33658	(3121024)	AT	(-1000.00, -5000.00)	GC
47	3.32913	(3122124)	AT	(0.00, 7000.00)	GC
48	3.31422	(3122124)	AT	(0.00, 4500.00)	GC
49	3.29954	(4011724)	AT	(-4500.00, -3500.00)	GC
50	3.28873	(4021724)	AT	(1000.00, -1500.00)	GC

Table 4: The maximum 50 24-hr average concentration values for source group: all
Including source(s): stack 001, stack002
Conc of PM10 in micrograms/m3**

RANK	CONC	(YYMMDDHH)	AT	RECEPTOR (XR,YR) OF	TYPE
1	0.05297	(4022924)	AT	(-7500.00, 7500.00)	GC
2	0.04939	(4022924)	AT	(-7000.00, 7000.00)	GC
3	0.04517	(4022924)	AT	(-6500.00, 6500.00)	GC
4	0.04373	(4022924)	AT	(-7000.00, 7500.00)	GC
5	0.04356	(4031624)	AT	(-1500.00, -7500.00)	GC
6	0.04335	(4030724)	AT	(-7500.00, -4500.00)	GC
7	0.04158	(3121724)	AT	(-3000.00, -7500.00)	GC
8	0.04078	(3121724)	AT	(-2500.00, -6000.00)	GC
9	0.04048	(4022924)	AT	(-6000.00, 6000.00)	GC
10	0.04041	(3121724)	AT	(-2500.00, -6500.00)	GC
11	0.04029	(3121724)	AT	(-2000.00, -5000.00)	GC
12	0.04018	(4022924)	AT	(-6500.00, 7000.00)	GC
13	0.03955	(4032524)	AT	(500.00, 1500.00)	GC
14	0.03805	(3121724)	AT	(-3000.00, -7000.00)	GC
15	0.03743	(4030724)	AT	(-7000.00, -4000.00)	GC
16	0.03652	(4032524)	AT	(1000.00, 2500.00)	GC
17	0.03623	(4022924)	AT	(-6000.00, 6500.00)	GC
18	0.03554	(4031624)	AT	(-1500.00, -7000.00)	GC
19	0.0354	(4022924)	AT	(-5500.00, 5500.00)	GC
20	0.03502	(3121724)	AT	(-2000.00, -5500.00)	GC
21	0.03476	(4032524)	AT	(500.00, 2000.00)	GC
22	0.0344	(3121724)	AT	(-2000.00, -4500.00)	GC
23	0.03403	(4030724)	AT	(-6500.00, -4000.00)	GC
24	0.034	(4032524)	AT	(1000.00, 3000.00)	GC
25	0.03376	(3121724)	AT	(-1500.00, -4000.00)	GC

RANK	CONC	(YYMMDDHH)	AT	RECEPTOR (XR,YR) OF	TYPE
26	0.03312	(4022924)	AT	(-7500.00, 7000.00)	GC
27	0.0331	(3121724)	AT	(-1500.00, -3500.00)	GC
28	0.03302	(3121724)	AT	(-2500.00, -7000.00)	GC
29	0.03277	(4032624)	AT	(0.00, 3500.00)	GC
30	0.03247	(4032624)	AT	(0.00, 3000.00)	GC
31	0.03209	(4030724)	AT	(-7000.00, -4500.00)	GC
32	0.03203	(4032624)	AT	(0.00, 4000.00)	GC
33	0.03196	(4022924)	AT	(-5500.00, 6000.00)	GC
34	0.03164	(4032924)	AT	(2000.00, 4500.00)	GC
35	0.03163	(3121724)	AT	(-2500.00, -5500.00)	GC
36	0.03139	(4032924)	AT	(1000.00, 2000.00)	GC
37	0.03124	(4032924)	AT	(2500.00, 5500.00)	GC
38	0.03105	(4032124)	AT	(2000.00, 7000.00)	GC
39	0.03096	(4032924)	AT	(1500.00, 3500.00)	GC
40	0.03088	(4030724)	AT	(-6000.00, -3500.00)	GC
41	0.03084	(4032624)	AT	(0.00, 4500.00)	GC
42	0.03062	(4032924)	AT	(3000.00, 6500.00)	GC
43	0.03047	(4032924)	AT	(1500.00, 3000.00)	GC
44	0.03005	(4022924)	AT	(-5000.00, 5000.00)	GC
45	0.03003	(4032624)	AT	(0.00, 2500.00)	GC
46	0.02989	(4031624)	AT	(-1000.00, -6000.00)	GC
47	0.02988	(4032324)	AT	(500.00, 4000.00)	GC
48	0.02985	(4032924)	AT	(3500.00, 7500.00)	GC
49	0.02949	(4032624)	AT	(0.00, 5000.00)	GC
50	0.02918	(4031624)	AT	(-1000.00, -5500.00)	GC

Table 5: The maximum 50 8-hr average concentration values for source group: all
Including source(s): stack 001, stack002
Conc of CO in micrograms/m3**

RANK	CONC	(YYMMDDHH)	AT	RECEPTOR (XR,YR) OF	TYPE
1	3.8189	(4032516)	AT	(500.00, 1500.00)	GC
2	3.54598	(4032516)	AT	(1000.00, 2500.00)	GC
3	3.36426	(4032516)	AT	(500.00, 2000.00)	GC
4	3.30649	(4032516)	AT	(1000.00, 3000.00)	GC
5	2.88682	(4032916)	AT	(1000.00, 2000.00)	GC
6	2.83879	(4032316)	AT	(500.00, 4000.00)	GC
7	2.73803	(4032316)	AT	(500.00, 3500.00)	GC
8	2.71834	(4032316)	AT	(500.00, 4500.00)	GC
9	2.68837	(4022908)	AT	(-7500.00, 7500.00)	GC
10	2.68376	(3121708)	AT	(-3000.00, -7500.00)	GC
11	2.65289	(4021716)	AT	(1000.00, -2000.00)	GC
12	2.59496	(4032908)	AT	(3500.00, 7500.00)	GC
13	2.55821	(4032916)	AT	(1500.00, 3000.00)	GC
14	2.53094	(4021716)	AT	(1000.00, -2500.00)	GC
15	2.52115	(4022908)	AT	(-7000.00, 7000.00)	GC
16	2.5162	(4032908)	AT	(3000.00, 6500.00)	GC
17	2.5113	(3122108)	AT	(0.00, 7500.00)	GC
18	2.48995	(4032316)	AT	(500.00, 5000.00)	GC
19	2.48255	(3122108)	AT	(0.00, 7000.00)	GC
20	2.47757	(3121708)	AT	(-2500.00, -6000.00)	GC
21	2.44738	(3121708)	AT	(-3000.00, -7000.00)	GC
22	2.43959	(3122108)	AT	(0.00, 6500.00)	GC
23	2.40007	(4021716)	AT	(1000.00, -1500.00)	GC
24	2.39827	(3121708)	AT	(-2500.00, -6500.00)	GC
25	2.37926	(3122108)	AT	(0.00, 6000.00)	GC

RANK	CONC	(YYMMDDHH)	AT	RECEPTOR (XR,YR) OF	TYPE
26	2.37574	(4032916)	AT	(1000.00, 2500.00)	GC
27	2.36331	(4030816)	AT	(0.00, -1000.00)	GC
28	2.36296	(4032908)	AT	(2500.00, 5500.00)	GC
29	2.34924	(3122608)	AT	(5500.00, -7500.00)	GC
30	2.33451	(4032516)	AT	(1500.00, 4000.00)	GC
31	2.32224	(4032916)	AT	(1500.00, 3500.00)	GC
32	2.32016	(4022908)	AT	(-6500.00, 6500.00)	GC
33	2.31997	(4032516)	AT	(1500.00, 3500.00)	GC
34	2.30164	(3122608)	AT	(5000.00, -7000.00)	GC
35	2.29888	(4030708)	AT	(-7500.00, -4500.00)	GC
36	2.29748	(3122108)	AT	(0.00, 5500.00)	GC
37	2.29381	(4030608)	AT	(-7500.00, 7500.00)	GC
38	2.28623	(4030816)	AT	(0.00, -1500.00)	GC
39	2.28413	(4032316)	AT	(500.00, 3000.00)	GC
40	2.28276	(4031608)	AT	(-1500.00, -7500.00)	GC
41	2.27606	(4032616)	AT	(0.00, 2500.00)	GC
42	2.27295	(4032616)	AT	(0.00, 3000.00)	GC
43	2.27269	(4030608)	AT	(-7500.00, 7000.00)	GC
44	2.25628	(4032516)	AT	(1000.00, 3500.00)	GC
45	2.24731	(4030608)	AT	(-7000.00, 7000.00)	GC
46	2.24643	(4010708)	AT	(0.00, -7500.00)	GC
47	2.24522	(3121708)	AT	(-2000.00, -5000.00)	GC
48	2.24313	(3122208)	AT	(-7500.00, -5000.00)	GC
49	2.23418	(3120708)	AT	(-3000.00, -7500.00)	GC
50	2.22716	(4022908)	AT	(-7000.00, 7500.00)	GC

The measured background concentrations (maximum) for NO_X, PM10 and CO_2 are 15.01 μg/m^3 (24hr), 156.93 μg/m^3 (24hr) and 4.36 μg/m^3 (8hr), respectively. Background CO concentrations were not measured. Summary of maximum GLCs over the model domain is given in Table 6.

Table 6: Summary of predicted maximum GLCs over the model domain

Pollutant	Averaging period	Std (μg/m^3)	Background cone (μg/m^3)	Predicted Maximum control building by the plant (μg/m^3)	Combined value (μg/m^3)	% of Std.
NO_2	24hr	100	15.01	5.23	20.24	20.24%
PM10	24hr	150	156.93	0.05	156.98	104.65%**
CO	8hr	10.000	131*	3.8	134.8	1.35%

* As local value is not available, literature value is used.

** PM10 emission is dominated by the fugitive emission from the plant site. Emission from the power plant is predicted to be less than 0.03%.

Conclusion

Modelling results indicate that emission around the power plant site during the operation of the plant will remain much below the DOE standards except PM10. However, exceedences of PM10 are due to fugitive dust generated at the plant site. Contribution of the power plant in respect of PM10 is negligibly small (<.03%).

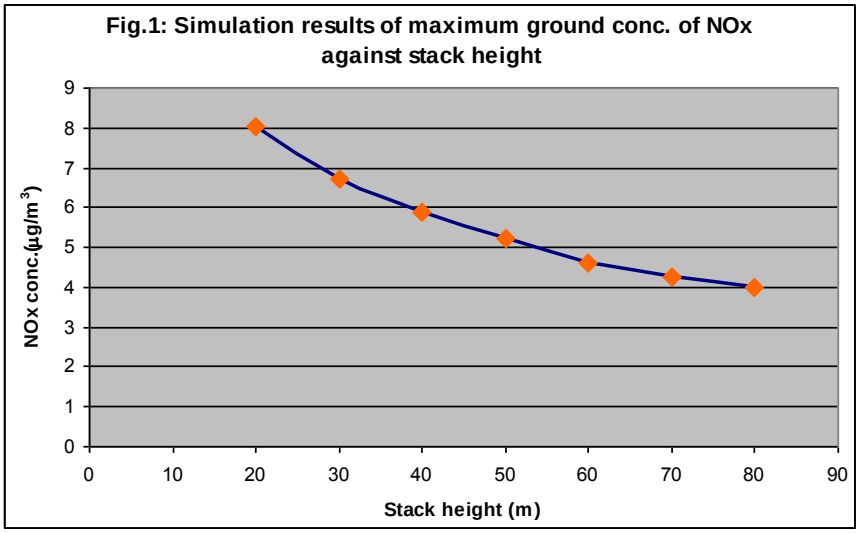
Simulation results of maximum ground-level concentrations of NO_X against stack heights at the proposed Bibiyana Power Plants

Type of Plant : CCGT
No of stacks : 2
Volumetric flow rate (each stack) : 275 m^3/sec
Stack diameter (each stack) : 3.0 m
NO_X emission discharge rate (each stack) : 9.4 gm/sec

Using the above inputs, ISC3P air dispersion model (USEPA approved) furnished the following simulation results for ground-level NO_X concentrations with different stack heights.

Stack height (m)		Ground level NO_X Conc. ($\mu g/m^3$)
20	……..	8.05
30	……..	6.73
40	……..	5.90
50	……..	5.23
60	……..	4.62
70	……..	4.28
80	……..	4.01

The results are plotted graphically in Fig.1. It is seen from the figure that ground-level concentration of a pollutant decreases significantly with increasing stack heights – at lower heights sharply and at higher heights showing a leveling off tendency. 10m rise from 20m to 30m brings down concentration by 16.4%, a 10m rise from 70m to 80m by 6.3% and a 10m rise from 60m to 70 by 7.3%. Comparison of pollutant concentration with stack heights above 60m shows that a 10m increase in height lowers the ground concentration from 7.3% to 6.3% i.e. only 1%.
Other pollutants are expected to show similar trends.



Conclusion:

As 10m increase above 60m brings down the change of ground level concentration by about 1% only, an stack height of 60m for the Bibiyana Power Plants is recommended.

Annexure-7: NOISE MEASUREMENT DATA

Noise Level

Introduction:
The noise pollution is not a widely mentioned problem in the proposed Summit Bibiyana Power Project 1&2 (SBPCL) area; some respondents have attributed noise pollution to different types of vehicles that ply over the roads in the study area.

Average noise levels (dB) in the daytime at the plant site have been measured 60 dB (approximate). The average noise level at night is approximately 52 dB in the same place. After setting up the plant, the area will be considered as an industrial zone. They meet the National Ambient Air Quality Standards (NAAQS) level except some stray cases because of the honking of the buses and trucks and motor vehicles passing through Sherpur, Bongaon and Pharpur commercial centre about 2.5 km (minimum) to the each side of the proposed SBPP 1&2 plant site and at the plant site (Parkul point). NAAQS levels for industrial zone are 70 dB (night) and 75 dB (day).

Measurements and Results:

Existing noise level of the project area was measured over periods of 9 hours each day during. The state of noise level obtaining throughout the project area and in areas in immediate vicinity and beyond is well within acceptable limits. Noise levels (dB) in the daytime and midnight on March –April 2011 are presented in Figure 1 to 8.

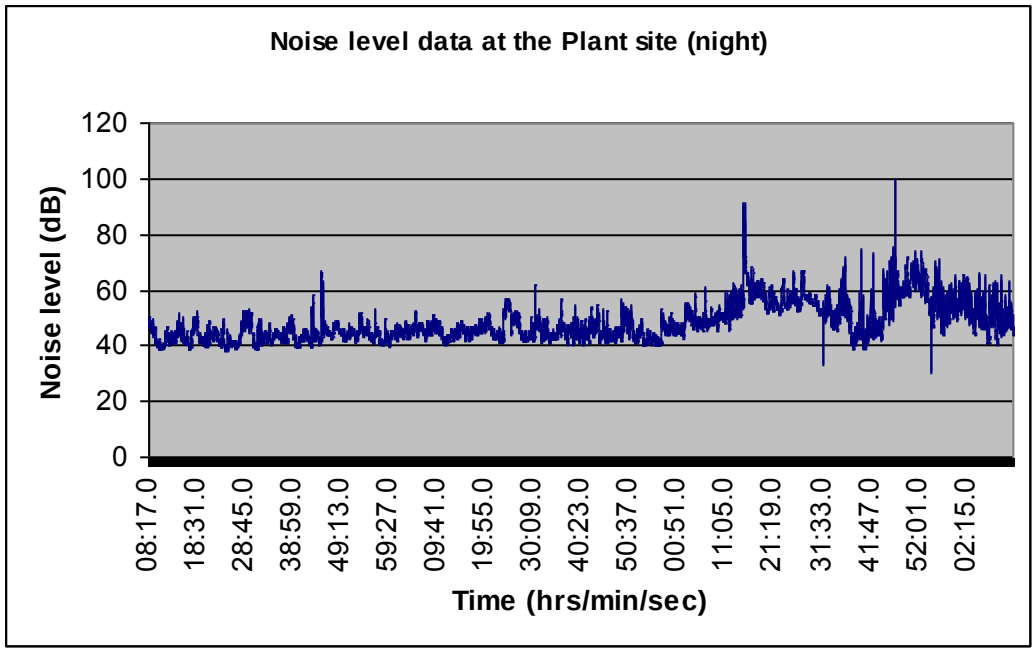


Figure-1: The result of Noise level at Plant site (night) on 15th April 2011

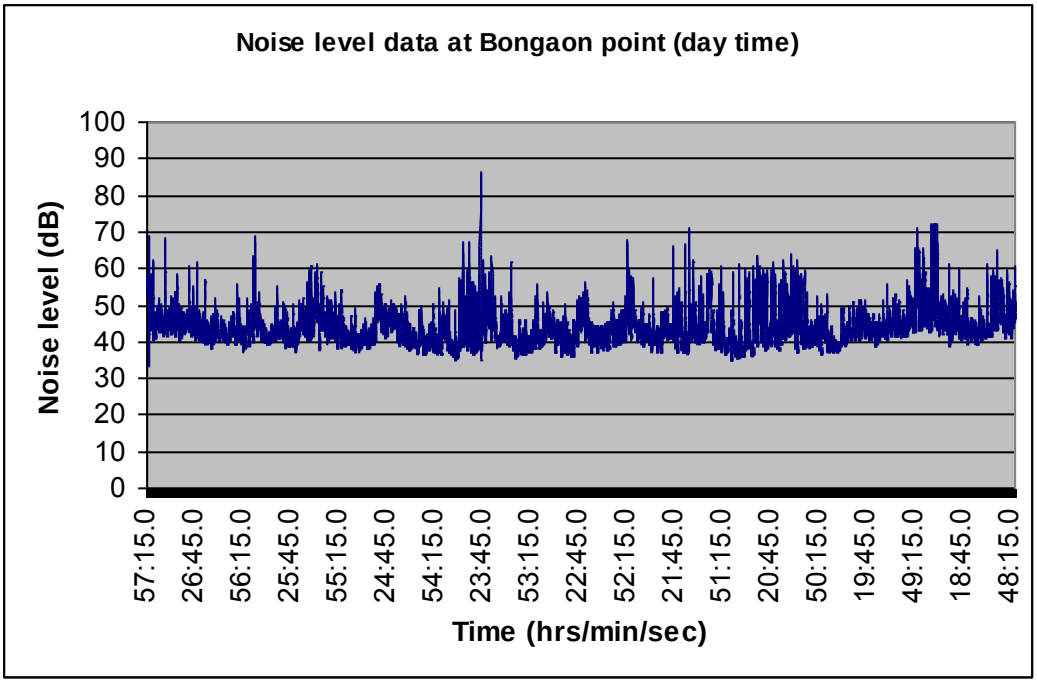


Figure-2: The result of Noise level at Bongaon Point (nearest to the plant site) on 18th April 2011

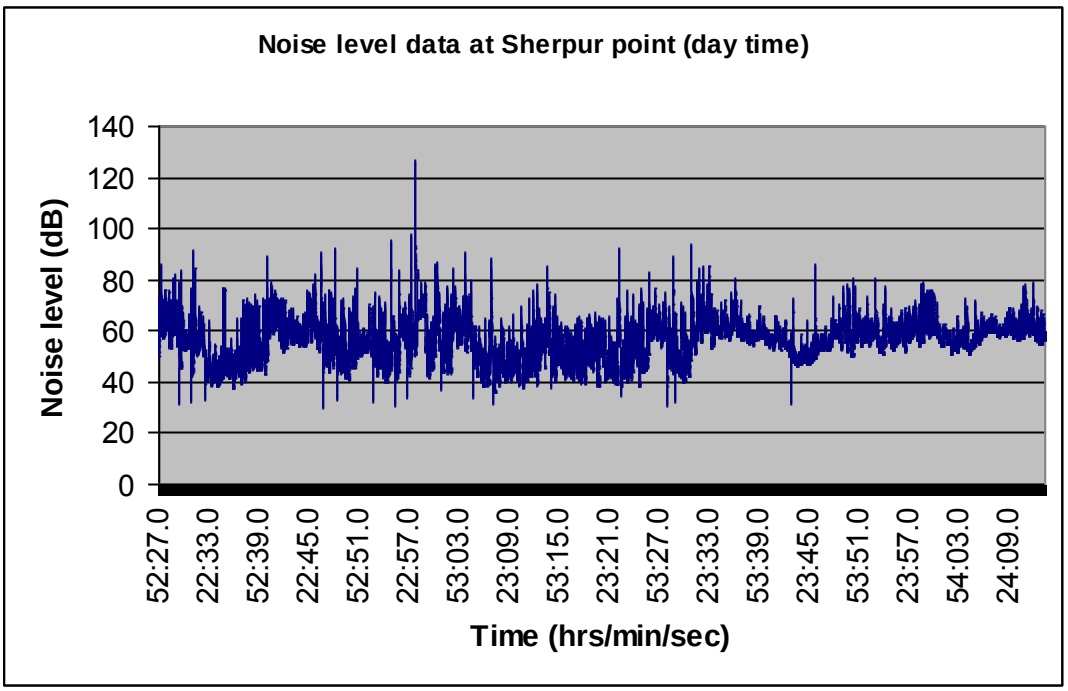


Figure-3: The result of Noise level at Sherpur Point (nearest to population centre) on 19th April 2011

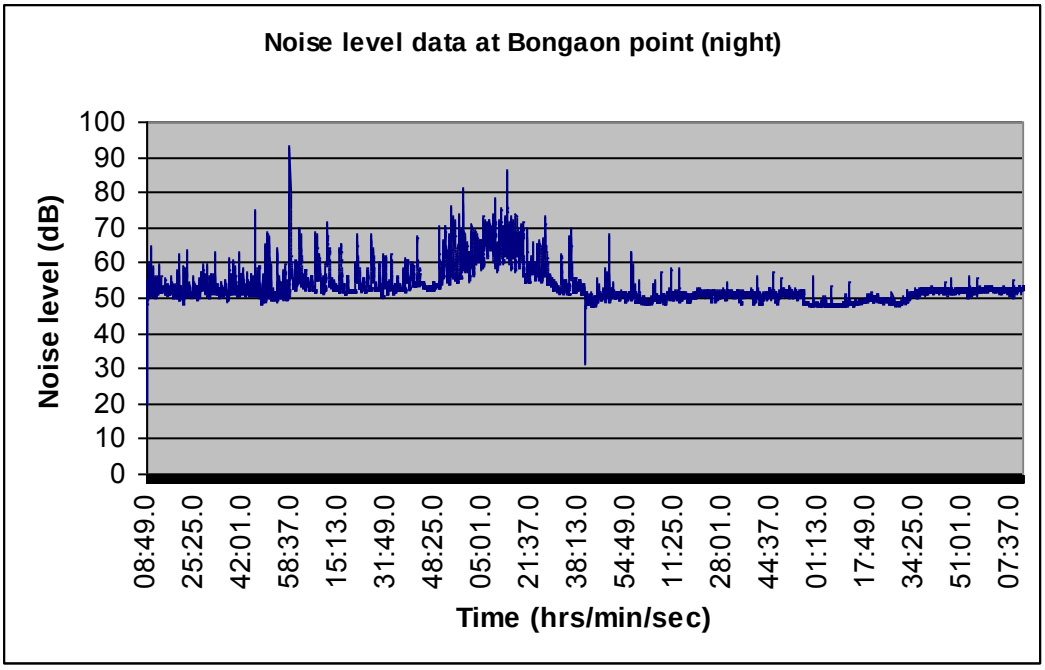


Figure-4: The result of Noise level at Bongaon Point (nearest to plant site) on the 19th April 2011

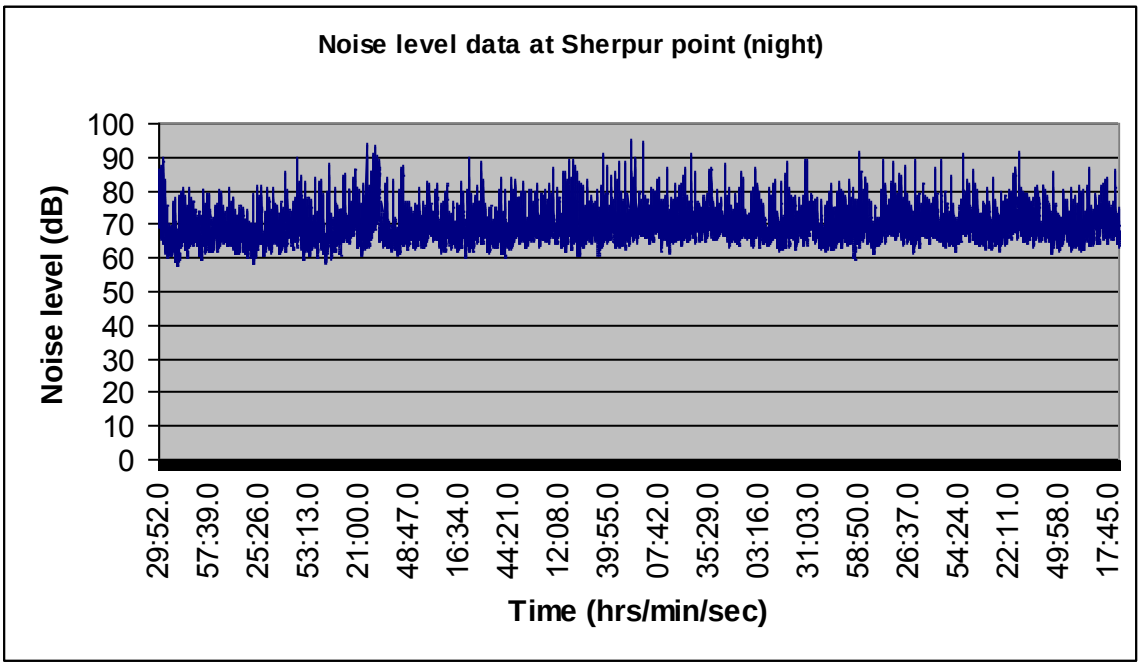


Figure-5: The result of Noise level at Sherpur Point (nearest to population centre) on the 20th April 2011

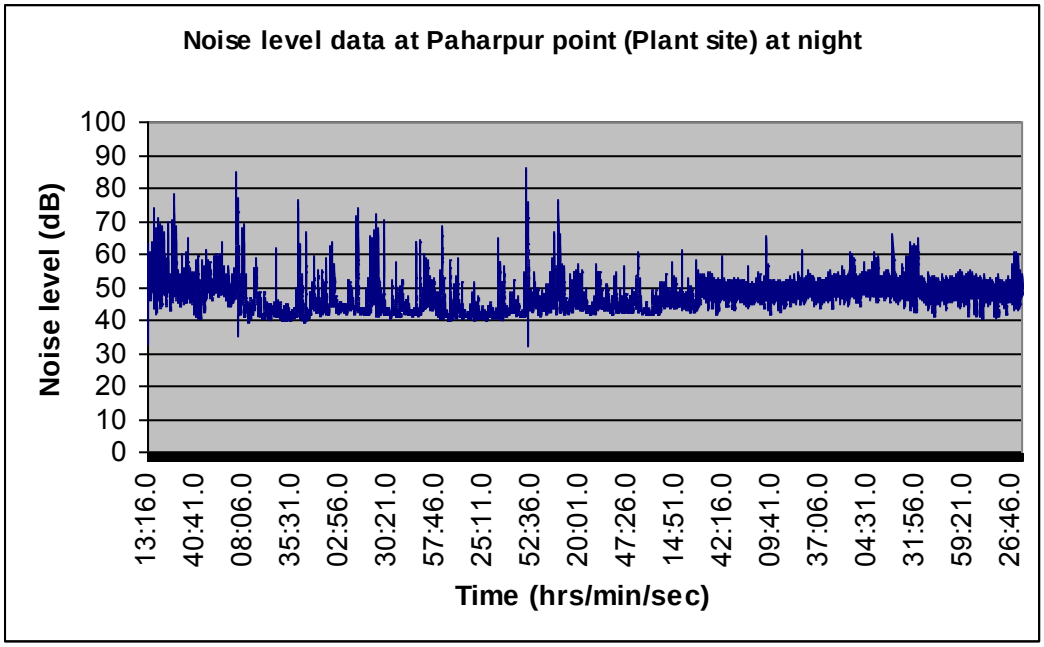


Figure-6: The result of Noise level at Paharpur Point (northern side of the plant and very closed to a passing road) on the 20th April 2011

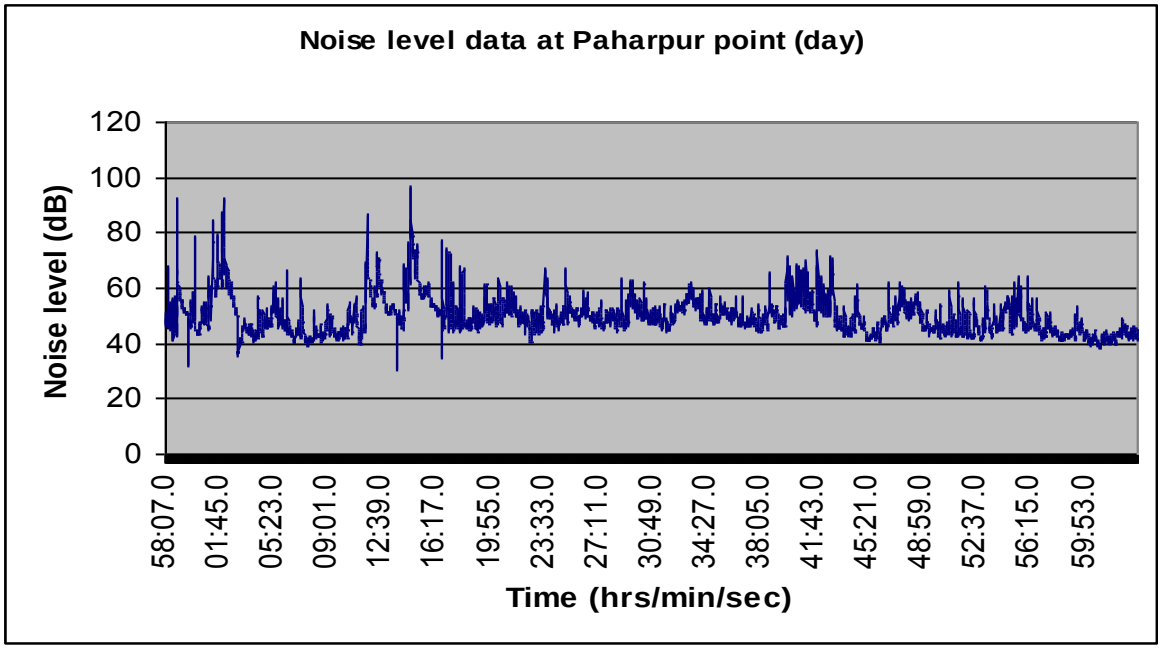


Figure-7: The result of Noise level at Pharpur Point on the 21st April 2011

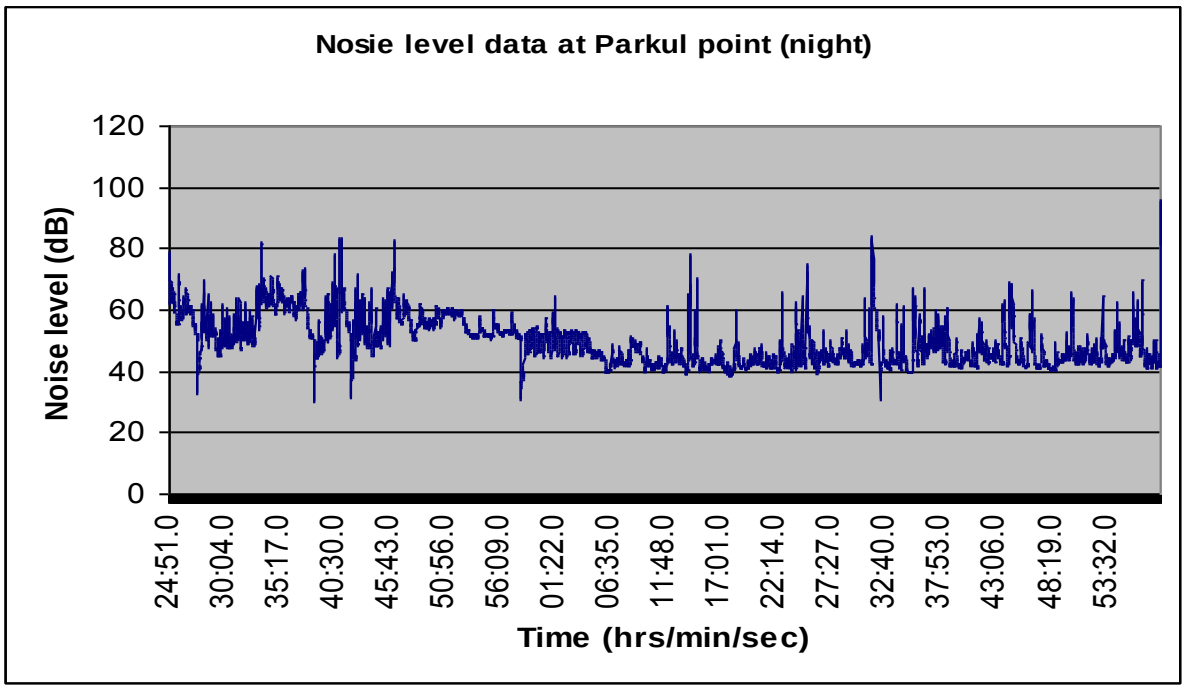


Figure-8: The result of Noise level at Southern side of the Plant (Beside a passing road) on the 21st April

Results:

The above figures show that, noise level varies place to place along with the time. The noise level has been measured during mid April, 2011 to May 2011. Three points have been taken for the noise level measurements at the Summit Bibiyana Power Project 1 & 2 (SBPP) site. Sherpur point is the most vulnerable one where the average noise level has been measured 60 dB at day time and 70 dB at night (Figures- 1, 3 and 5). The average noise level of Bongaon point has been measured 50 dB. At day time, the average level of noise at Bongaon point is 45 dB whereas it is 55 dB (approximately) at night (Figures-2 and 4). The average noise level of Pharpur has been measured 45 dB both during day and night time. The result of Noise level at Southern side of the plant has averaged 42 dB at night.

Annexure-8 : Flora and Fauna

Flora and Fauna around the Proposed Plant Site

Summit Bibiyana Power Project I& II (SBPP)
Data Collected by: BCAS

List of Faunal Resources of Bibiyana

Status code* : NT-Not Threatened, CR- Critically endangered, LR- Lower risk, VU-Vulnerable

Distribution code* : W-Wide, N-North, E-East, S-South, SE: South East, NE: North East, B-Beel, H-Haor, R-River, P-Pond, SW-South West, SB-Sundarban, Hilly Area

Sl. No.	Name of Fishes (Local Name)	Local Status	Distribution
1	Magur	NT	W
2	Koi	NT	W
3	Shing	NT	W
4	Taki	NT	W
5	Sharpunti	NT	W
6	Tit Punti	NT	W
7	Zat Punti	NT	W
8	Bujuri Tengra	NT	W
9	Bara Tengra	NT	W
10	Choto Tengra	NT	W
11	Catla	NT	W
12	Chanda	NT	W
13	Shoul	NT	W
14	Gazar	NT	W
15	Minar Cup	NT	W
16	Gras Cup	NT	W
17	Mrigale	NT	W
18	Kargu	NT	W
19	Ruie	NT	W
20	Boal	NT	W
21	Tara Bhain	NT	W
22	Choto Bhaine	NT	W
23	Buthum	NT	W
24	Mola	NT	W
25	Pholi	NT	W
26	Mini	NT	W
27	Khailsha	NT	W
28	Chata	CR	B
29	Pabdha	CR	H
30	Batashi	CR	B
31	Belichoto	CR	B
32	Aire	CR	R
33	Chitol	LR	R,B
34	Telapia	LR	P
35	Kalobouse	LR	P
36	Khakila	LR	B,P
37	Chang Taki	LR	B,P

Sl. No.	Name of Fishes (Local Name)	Local Status	Distribution
38	Prawn	LR	B,R
39	Chuchra	CR	B
40	Nanid	CR	B
41	Paria	CR	B
42	Hilsha	CR	R
43	Lobster	CR	R
44	Small Prown	NT	B,R
45	Kecki	NT	B
46	Bashpata	NT	B,H
47	Tengra	NT	B,R
48	Choto Tengra	NT	B,R
49	Kaliboush	NT	B,P
50	Bag Gutum	NT	B,P
51	Mrigel	NT	B,P
52	Bhata	NT	R
53	Kazli Anu	CR	B
54	Pangash	NT	B,P
55	Lachu	LR	B,R
56	Rani	LR	B
57	Chanda	NT	B,P
58	Cela Patha	CR	B
59	Bagoire	VU	R,B
60	Rita	CR	B,P
61	Bele	NT	R,B
62	Poa	CR	R
63	Kakinna	CR	B,H
64	Along	CR	B
65	Pewa	CR	B
66	Mati Bangi	CR	B
67	Kedhar	CR	B
68	Nanid	CR	B
69	Paria	CR	B
70	Gongi	CR	B
71	Brighet	CR	B
72	Minar cup	NT	B,P
73	Grascup	NT	B,P
74	African Magur	NT	P
75	Thai Koi	NT	P

* Codes according to IUCN Red Book

Name of Wild Animals

Sl. No.	Wild Animal (Local Name)	Local Status	Distribution
1	Jackal /Fox	LR	W
2	Beji	NT	W
3	Khatas	LR	W
4	Sojaru	VU	E
5	Rokta Khauri	LR	S
6	Ghuisaph	LR	W
7	Bon Biral	CR	NE
8	Kathbiral	VU	NE

Name of Water Animals

Sl. No.	Other water Animals (Local Name)	Local Status	Distribution
1	Snail	NT	W
2	Jhinuk	VU	W
3	Crab	NT	W
4	Panipoka	NT	W
5	Jouk	NT	W
6	Kacchab	VU	W
7	Kuchia	VU	W
8	Udd	VU	W

Name of Reptiles

Sl. No.	Name of Reptiles (Local Name)	Local Status	Distribution
1	Kalgokhra Saph	NT	Hilly area
2	Khaiya	LR	W
3	Pora	NT	Hilly area
4	Hald	VU	Hilly area
5	Dharash	LR	W
6	Patalat	LR	Hilly area
7	Sutanali	LR	W
8	Ginibura	VU	Hilly area
9	Mete Shap	LR	W
10	Darash Shap	LR	W
11	Jatshap	LR	W
12	Aujoghar	VU	Hilly area
13	Dhora	NT	W
14	Kalkewte shap	VU	Hilly area
15	Dumukhosaph	VU	W
16	Hakanishap	VU	Hilly area
17	Dudraj Saph	LR	W
18	Matiya Saph	NT	SB

Name of Domestic Animals

Sl. No.	Name of Domestic Animals	Local Status	Distribution
1	Cow	NT	W
2	Goat	NT	W
3	Duck	NT	W

Sl. No.	Name of Domestic Animals	Local Status	Distribution
4	Hen	NT	W
5	Dove	LR	W
6	Cat	VU	W
7	Dog	LR	W

Name of Terrestrial Birds

Sl. No.	Name of Terrestrial Birds (Local Name)	Local Status	Distribution
1	Pati Kak	NT	W
2	Dhan Shalik	NT	W
3	Babui	NT	W
4	Chowrui	NT	W
5	Ghugu	NT	W
6	Kabutor	NT	W
7	Kanakua	NT	Hilly area
8	Chil	NT	W
9	Bulbuli	NT	W
10	Duburi	NT	W
11	Kokil	NT	W
12	Kanakuka	VU	W
13	Hottiti	VU	S
14	Shuichora	VU	S
15	Dailacha	VU	S
16	Boigola	VU	S
17	Holdey Pakhy	VU	Hilly area
18	Madhuchakkha	VU	S
19	Fepe	VU	Hilly area
20	Nemaru	VU	Hilly area
21	Benga	VU	Hilly area
22	Vatoi	VU	Hilly area
23	Tirshul	VU	Hilly area
24	Panikapur	VU	Hilly area
25	Kechkechi	VU	Hilly area
26	Ailvarai	VU	Hilly area
27	Satvaria	VU	Hilly area
28	Darkak	NT	W
29	Dhahuk	NT	W
30	Doel	NT	W
31	Tuntuni	NT	W
32	Parrot	NT	W
33	Koak	NT	W
34	Shama	NT	W
35	Tarwa	NT	W
36	Kaththokra	NT	W
37	Gangchil	NT	S
38	Kora	NT	S
39	Laxhmi Pacha	LR	Hilly area
40	Hutum Pecha	LR	W
41	Shokun	LR	S
42	Kalophakhi	VU	Hilly area
43	Catock/Sorgom	VU	Hilly area

Sl. No.	Name of Terrestrial Birds (Local Name)	Local Status	Distribution
44	Nolkhak	VU	SB
45	Sarosh	LR	W
46	Ratchora	VU	SB
47	Moyna	VU	Hilly area
48	Kutum Pakhi	LR	W
49	Kana Khokhra	LR	Hilly area
50	Feshka	LR	Hilly area
51	Doial	LR	Hilly area
52	Bajpakhi	LR	W
53	Chockha	LR	SB
54	Chakla	LR	SB

Name of Migratory/Acquatic Birds

Sl. No.	Migratory/Acquatic Birds (Local Name)	Local Status	Distribution
1	Kanibock	NT	W
2	Nolbock	NT	W
3	Choto bock	LR	SB
4	Lelvhodro Bok	VU	SB
5	Machranga	NT	W
6	Pankaouri	NT	W
7	Pantihas	NT	W
8	Dholabok	LR	NE, SB
9	Bale Has	LR	SB
10	Kaem	LR	SB
11	Cherchiri/Cegha	VU	SB
12	Choipokhshi	VU	SB
13	Paikor	VU	SB
14	Gobok	VU	SB
15	Kajla Bock	LR	SB
16	Manikjor	LR	SB
17	Lairal	LR	SB
18	Fepi	VU	SB

List of Floral Resources of Bibiyana (Medicinal Plants)

Sl. No.	Name of the trees (Local Name)	Local Status	Distribution
1	Nim	VU	W
2	Aurjun	VU	S
3	Lazzabati	NT	W
4	Hatir Shoor	LR	W
5	Bon Jamir	LR	NE
6	Ojaru Jarman Lata	NT	W
7	Dumaru	NT	NE
8	Durba Gas	NT	W
9	Palui Shak	NT	W
10	Amloky	VU	W
11	Bohera	VU	NE
12	Hartaki	VU	NE
13	Roktachita	VU	W

Sl. No.	Name of the trees (Local Name)	Local Status	Distribution
14	Harjora	VU	W
15	Kumari Lata	NT	W
16	Cini cham	NT	W
17	Mohalom	VU	S
18	Dhutra	NT	W
19	Nishinda	VU	W
20	Shatamukhi	VU	W
21	Patharkuchi	VU	W
22	Tunithankuni (Thankhuni)	NT	W
23	Bhatipata	NT	S
24	Hiyalmati	NT	E
25	Helencha	NT	W
26	Chaku	NT	E
27	Sharnalata	VU	W
28	Kalomeg	VU	S
29	Isharmul	VU	S
30	Harengashak	NT	S
31	Kheraiya	NT	S
32	Dhal Kolosh	VU	E
33	Akond	VU	S
34	Tulshi	LR	W
35	Kheyaghas	LR	W
36	Bon Begun	NT	S
37	Mankochu	NT	W

Name of the Trees

Sl. No.	Name of the Trees (Local Name)	Local Status	Distribution
1	Raintee	NT	W
2	Kadam	NT	W
3	Shilkorai	NT	W
4	Akashi	LR	NE
5	Mehagini	LR	W
6	Chandan	CR	S
7	Kalahozra	NT	NE
8	Shewla	NT	W
9	Karul	CR	W
10	Hizal	NT	NE
11	Patkhara	LLR	S
12	Banyan Tree	CR	W
13	Pahari Neem	CR	N
14	Shimul	NT	W
15	Eucalictus	NT	NE
16	Latim	NT	N
17	Merua	NT	E
18	Jiga	NT	E
19	Bhatipata	NT	E
20	Beljam	LR	E
21	Chambol	LR	NE
22	Belgium	LR	NE

Sl. No.	Name of the Trees (Local Name)	Local Status	Distribution
23	Doubgach	LR	E
24	Jalmondhir	LR	S
25	Murta	LR	S
26	Shegun	NT	W
27	Taragach	NT	N
28	Chini bot	NT	N
29	Chatni	NT	N
30	Barun	NT	N
31	Jagdumur	NT	N
32	Ratin	VU	Hilly area

Name of the Fruit Trees

Sl. No.	Name of the Fruit Trees (Local Name)	Local Status	Distribution
1	Mango	NT	W
2	Jackfruit	NT	W
3	Coconut	NT	W
4	Payara	NT	W
5	Jam	NT	W
6	Lichee	VU	W
7	Amra	LR	S
8	Nut	NT	W
9	Boroi	NT	W
10	Jambura	NT	W
11	Lemon	NT	W
12	Papwa	NT	W
13	Banana	NT	W
14	Dalim	VU	W
15	Kamranga	VU	W
16	Pineapple	VU	W
17	Gab	NT	W
18	Dewa	NT	W
19	Bel	NT	W
20	Mangstan	LR	W
21	Tal	NT	W
22	Caw	CR	W
23	Kalojam	LR	E
24	Chalte	VU	E
25	Jalpai	LR	W
26	Koichura	NT	S
27	Atafal	VU	W

Name of Flower Trees

Sl. No.	Name of Flower Trees	Local Status	Distribution
1	Ghandaraj	LR	W
2	Rose	LR	W
3	Night Queen	VU	W
4	Raktajaba	NT	W
5	Urpul	NT	S
6	Dumur Flower	NT	NE
7	Pata Bahar	NT	S
8	Dalia	VU	W
9	Kamini	VU	W

Sl. No.	Name of Flower Trees	Local Status	Distribution
10	Bakul	VU	W
11	Gasful	NT	W
12	Krishna Chura	VU	W
13	Murta	NT	W
14	Beliful	VU	W
15	Moragful	VU	N
16	Sunflower	LR	W
17	Polash	VU	W

Name of Floral Resources

Sl. No.	Floral Resources (Local Name)	Local Status	Distribution
1	Water Hyacinth	NT	W
2	Shapla	NT	W
3	Waterlily	NT	W
4	Shingrai	VU	S
5	Chisrai	VU	S
6	Parua	VU	S
7	Tendara	VU	S
8	Aerail	VU	N
9	Nolkhagra	VU	S
10	Kolmi	NT	W
11	Helencha	NT	W
12	Malancha	NT	W
13	Halenga	NT	W
14	Keisir	NT	S
15	Kutipana	NT	S

Name of Cultivated Crops and Vegetables in the Project Area

Sl. No.	Aous Paddy(Local Name)	Planting Season	Harvesting Season
1	Aus paddy	April	July
2	Chini paddy	June (Ashar)	August
3	Biplob		
4	BR-28		
5	BR-29		
6	Paijam		
7	Botta Balam		
8	Nazirshail		
9	Lal Balam		
10	Chinigura		
11	Latial		
12	Chirashail		

Sl. No.	Amon Rice(Local Name)	Planting Season	Harvesting Season
1	Lucky Paddy	March (Chaitra)	November (Agrahayan)
2	Bagdar		
3	Goyal Bitpa		
4	Jalo Beda Biron		
5	Boro Rice	November-December (Augrahayan-Poush)	April (Boishakh)
6	BR 29		
7	BR 28		
8	BR 26		
9	BR 14		
10	Hybrid		
11	Khaiya		
12	Dhali Boro		
Sl. No.	**Jute**	**March(Chaitra)**	**August(Bhandra)**
1	Mustard	October-November (Katric – Agrahayan)	February(Falgun)

Sl. No.	Winter Vegetable	Planting Season	Harvesting Season
1	Cavage, Cauliflower, Radis, Poteto, Data, Chilee, Begun, Dhania, Puishak, Vandi, Olkopy, Tometo, Salgom, Sweet Palmkin, Sweet Poteto, Khira, Watermillon, Chal Palmkin, Lau, Seem, Ginga, Anaj (Cirinta)	October-November (Katric-Agrahayan)	December, January, February, March (Poush, Mag, Falgunand Chaitra)
2	Mukhi	December(Poush)	June, July,August (Srabon, Badra and Asshin)
	Vegetables(Local Name)		
1	Data, Papwa, Puishak, Lady Finger, Karala	Throughout the year	

Annexure- 9: Water Quality of Plant Site

BCSIR LABORATORIES, DHAKA
Dr. Qudrat-i-Khuda Road, Dhanmondi, Dhaka-1205

ANALYSIS REPORT

Ref. No. : 233 of BCSIR Lab. Dhaka dt. 22.10.07
Referred by : BANGLADESH CENTRE FOR ADVANCED STUDIES
House #10, Road # 16A, Guslhan-1, Dhaka-1212.
Vide : Letter No. IFC/BGF/2007/08, dt.22 October, 2007
Site and date of
Sample Collection : Parkul village, Kushiyara river. 05 October, 2007
Subject of the letter : Cooling Water Chemical Analysis
No. of Sample : 1 (One)

Sl. No.	Particulars of supplied sample	Parameters	Concentration
1	Water Collected on 5 October, 2007 from the Kushiyara river at Village: Parkul Union: Auskandi Upazila: Nabigang District: Habiganj	Total hardness as $CaCO_3$	18 mg/L
		Alkalinity as $CaCo_3$	30.3 mg/L
		Total acidity as $CaCo_3$	163 mg/L
		Arsenic, As	Less than 0.01 mg/L
		Calcium, Ca	3.94 mg/L
		Chlorine, CI	Not detectable
		COD	24 mg/L
		Iron, Fe	0.97 mg/L
		Phosphorus, P	3.65 mg/L
		Phosphates, PO_4	11.2 mg/L
		Manganese, Mn	0.22 mg/L
		Mercury, Hg	Less than 0.0 mg/L
		Nitrate, No_3	Not detectable
		Nitrate, No_2	Not detectable
		Ammonia nitrogen, N	3.84 mg/L
		Dissolved oxygen, O_2	2.85 mg/L
		Lead, Pb	Less than 0.1 mg/L
		Potassium, K	1.63 mg/L
		Sodium, Na	3.37 mg/l
		pH at 23.3 ^{0}C	6.95
		TSS	1221 mg/L
		TDS	145 mg/L
		Total solids	1366 mg/L
		Sulfate	2.08 mg/L
		Turbidity	309 NTU
		Conductivity (of filtered sample)	165 us/cm

Sd/- 4-11-2007	Sd/- 4-11-2007	Sd/- 4-11-2007
.....	.....	.....
Sig. of the Scientist	Sig. of Div. 1/C	Counter signature
Senior Scientific Officer	Principal Scientific Officer	Director (Acting)
Analytical Research Division	Analytical Research Division	BCSIR Laboratories, Dhaka
BCSIR Laboratories, Dhaka-1205	BCSIR Laboratories, Dhaka-1205	

Water Quality of Plant Site

জীবনের জন্য বিজ্ঞান

BCSIR LABORATORIES, DHAKA
Dr. Qudrat-i-Khuda Road, Dhanmondi, Dhaka-1205

ANALYSIS REPORT

Ref. No. : 604 of BCSIR Lab. Dhaka dt. 23.03.08

Referred by : Senior fellow, BCAS
BANGLADESH CENTRE FOR ADVANCED STUDIES
House 10, Road 16A, Gulshan -1, Dhaka-1212.

Vide : Letter No. IFC/BGF/2007/12 dt. 23/3/08

Subject of the letter : Cooling Water Chemical Analysis for summer season from Kushiyara river (BIPP Project)

No. of sample : 01 (One)

Sl. No.	Particulars of supplied sample	Parameters	Unit	Concentration
1.	Cooling Water	Total hardness as $CaCO_3$	mg/L	60
		Alkalinity as $CaCO_3$	mg/L	72
		Total acidity as $CaCO_3$	mg/L	45
		Arsenic	mg/L	Less than 0.01
		Ca	mg/L	10.6
		Chlorine	mg/L	Not detectable
		COD	mg/L	13
		Iron	mg/L	0.73
		Phosphorus	mg/L	0.48
		Phosphate	mg/L	0.45
		Manganese	mg/L	Less than 0.05
		Mercury	mg/L	Less than 0.01
		Nitrate	mg/L	2.7
		Nitrites	mg/L	Less than 0.07
		Ammonia Nitrogen	mg/L	Less than 0.5
		Dissolved Oxygen	mg/L	3.98

		Lead	mg/L	Less than 0.1
		Potassium	mg/L	1.96
		Sodium	mg/L	10.7
		pH at 24.5^{0}C		7.64
		TSS	mg/L	13.6
		TDS	mg/L	128
		Total Solid	mg/L	142
		Sulfate	mg/L	6.2
		Turbidity	NTU	16.3
		Conductivity	µS/cm	157

29.4.08

Sig. of the Scientist

Dr. Mozaffar Husain
Senior Scientific Officer
Analytical Research Division
BCSIR Laboratories,
Dhaka-1205

29.4.08

Sig. of Div. I/C

M. AZIZUL ISLAM KAZI
Chief Scientific Officer
Analytical Research Division
BCSIR Laboratories, Dhaka

২৯/০৪/০৮

Counter signature

পরিচালক (ভারপ্রাপ্ত)
বিসিএসআইআর গবেষণাগার, ঢাকা
ধানমন্ডি, ঢাকা-১২০৫

Annexure -10: National Ambient Air Quality Standards

Table: National Ambient Air Quality Standards (NAAQS) for Bangladesh

Pollutant	Objectives	Average
CO	10 mg/m^3 (9 ppm)	8 hours(a)
	40 mg/m^3 (35 ppm)	1 hour(a)
Pb	0.5 μg/m^3	Annual
NO_2	100 μg/m^3 (0.053 ppm)	Annual
Pm10	50 μg/m^3	Annual (b)
	150 μg/m^3	24 hours (c)
PM2.5	15 μg/m^3	Annual
	65 μg/m^3	24 hours
O_3	235 μg/m^3 (0.12 ppm)	1 hour (d)
	157 μg/m^3 (0.08 ppm)	8 hours
SO_2	80 μg/m^3 (0.03 ppm)	Annual
	365 μg/m^3 (0.14 ppm)	24 hours (a)

Notes:

(a) Not to be exceeded more than once per year

(b) The objective is attained when the annual arithmetic mean is less than or equal to 50 μg/m^3

(c) The objective is attained when the expected number of days per calendar year with a 24-hour average of 150 μg/m^3 is equal to or less than 1

(d) The objective is attained when the expected number of days per calendar year with the maximum hourly average of 0.12 ppm is equal to or less than 1 (Source: AQMP, DOE).

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

Zone Class	Limits in dBa	
	Daytime (6 a.m. – 9 p.m.)	Nighttime (9 p.m. – 6 a.m.)
Silent zone	45	35
Residential zone	50	40
Mixed (residential/commercial/industrial) zone	60	50
Commercial zone	70	60
Industrial zone	75	70

Source : AQMP, DOE)

Annexure -11: Composition of Bibiyana Gas

Bibiyana Field Gas Composition

(Test Methods: ASTM D-1945-96, GPA Standard 2286-95) Test Date: 20 May, 2011

COMPONENTS (MOLE %)		Mole %	Vol %
Oxygen	(O_2)	0.00000	0.000
Nitrogen	(N_2)	0.20370	0.204
Methane	(CH_4)	95.45877	95.458
Carbon Dioxide	(CO_2)	0.14891	0.149
Ethane	(C_2H_6)	2.39689	2.397
Propane	(C_3H_8)	1.07558	1.076
Isobutane	(iC_4H_{10})	0.21602	0.216
n-Butane	(nC_4H_{10})	0.18561	0.186
Isopentane	(iC_5H_{12})	0.09623	0.196
n-Pentane	(nC_5H_{12})	0.05051	0.051
Hexanes	(C_6H_{14})	0.05195	0.052
Heptanes	(C_7H_{16})	0.06816	0.068
Octanes	(C_8H_{16})	0.04284	0.043
Nonanes	(C_9H_{20})	0.00483	0.005
Nonanes +	(C_9H_{20})+	0.00000	0.000
Total		100.00	100.00

Figure 2.1 b
Bibiyana Field Gas Physical Properties:
(Methods: ASTM 3599-98, GPA 2172-96)

Parameter	Value
Real Relative Density/Specific Gravity	0.592903
Gross (Higher) Heating Value	1061.8052 Btu/scft
Liquefiable Hydrocarbon Content	0.131 GPM (gallons per throusand cubic feet)
Viscosity	0.025cp
Temperature	81^o F
Pressure	977 psi