Bangladesh – India Friendship Power Company (Pvt.) Limited
(A Joint Venture of NTPC Ltd. and BPDB)

Monitoring of Environment Parameter and Implementation of Environmental Management Plan During Construction Period along with Engineering Activities for 2x660 MW Maitree Super Thermal Power Project at Rampal in Bagerhat District of Khulna Division, Bangladesh

16th Quarter Monitoring Report

Monitoring Period: February - April 2018

June 2018

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Abbreviations and Acronyms

AAS	Atomic Absorption Spectrophotometer
AECL	Adroit Environment Consultants Ltd
As, Pb, Hg	Arsenic, Lead and Mercury
BCSIR	Bangladesh Council of Scientific and Industrial Research
BDS	Business Development Activities
BIFPCL	Bangladesh-India Friendship Power Company (Pvt.) Limited
BOD	Biochemical Oxygen Demand
BPDB	Bangladesh Power Development Board
BUET-BRTC	Bangladesh University of Engineering and Technology - Bureau of Research, Testing and Consultation
CDM	Clean Development Mechanism
CEGIS	Center for Environmental and Geographic Information Services
COD	Chemical Oxygen Demand
CPUE	Catch per Unit Effort
CSR	Corporate Social Responsibility
dBH	Diameter at Breast Height
DCR	Duplicate Carbon Receipt
DO	Dissolved Oxygen
DoE	Department of Environment
DPHE	Department of Public Health Engineering
EC	Electrical Conductivity
ECR	Environment Conservation Rules
EHS	Environmental Health Safety
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EPC	Engineering Procurement Construction
FGD	Focus Group Discussion
FGD	Flue Gas Desulfurization
FSR	Fisheries Species Richness
GIS	Geographic Information System
GoB	Government of Bangladesh
GPS	Global Positioning System
GW	Groundwater
HS	Household Survey

IFC	International Finance Corporation
IGA	Income Generation Activities
ISO	International Organization for Standardization
IUCN	International Union for Conservation of Nature
Kg	Kilogram
KII	Key Informants Interview
MoPEMR	Ministry of Power, Energy and Mineral Resources
MW	Mega Watt
MSDS	Materials Safety Data Sheet
NTPC	National Thermal Power Corporation
OHSAS	Occupational Health and Safety Management Systems
PCU	Passenger Car Unit
PGCB	Power Grid Company of Bangladesh Ltd
PMU	Project Management Unit
PRA	Participatory Rural Appraisal
PWD	Public Works Department
QMR	Quarterly Monitoring Report
RRA	Rapid Rural Appraisal
RS	Remote Sensing
SRDI	Soil Resources Development Institute
SRF	Sundarbans Reserve Forest
TDS	Total Dissolved Solid
TH	Total Hardness
ToR	Terms of References
TSS	Total Suspended Solid
USEPA	United States Environmental Protection Agency
VOC	Volatile Organic Compounds

Unit

dB	Decibel
hr	Hour
Kg	Kilogram
Km	Kilometre
KV	Kilo Volt
KW	Killo Watt
m	Meter
mg	Milligram
MW	Mega Watt
Nm	Normal Meter
ppm	parts per million
ppt	parts per trillion
ton/year	Ton Per Year
s	Seconds

Unit Conversion Table

General Units

1°C = 274.15 K=33.8° F

1 hectare = 10^{-2} km^2 = 2.471 acres

1 kilogram = 2.20 pound

1 kilometre = 0.62137 mile

1 liter = 0.001 cubic meter

1 meter = 3.2808 feet

1 metric ton = 1000 kg

1 mg/L ≈1 g/m^3≈1 ppm (w/w)

1 mg/m^3 = 1 µg /L

1 pascal = 1 N/m^2= 0.01 millibar

1 square mile = 640 acre = 2.590 km^2

Energy Unit

1 GWyr = 8.76 x 10^9 kW

1 horsepower = 746 W

1 KWh = 3412 Btu

1 kWh = 859.85 kcal

1 KWh = 3.6 x 10^6 J

1MW=1000KW=10^6W

Glossary

Aman:	Group of rice varieties grown in the monsoon season and harvested in the post-monsoon season. This is generally transplanted at the beginning of monsoon from July-August and harvested in November-Dec. Mostly rain-fed, supplemental irrigation needed in places during dry spell.
Aus:	Group of rice varieties sown in the pre-monsoon season and harvested in the monsoon season. These are broadcasted/transplanted during March-April and harvested during June-July. Generally rain-fed, irrigation needed for HYVT. (High yield variety) Aus.
B Aus:	Broadcast Aus
Bazar:	Market
Beel:	A saucer-shaped natural depression, which generally retains water throughout the year and in some cases seasonally connected to the river system.
Boro:	A group of rice varieties sown and transplanted in winter and harvested at the end of the pre-monsoon season. These are mostly HYV and fully irrigated, planted in December-January and harvested before the onset of monsoon in April- May.
Haat:	Market place where market exchanges are carried out either once, twice or thrice a week, however not every day.
Gear/Jaal:	Different types of fishing net to catch fish from the water bodies.
Kutcha:	A house made of locally available materials with earthen floor, commonly used in the rural areas.
Khal:	A drainage channel usually small, sometimes man-made through which the water flows. These may or may not be perennial.
Kharif:	Pre-monsoon and monsoon growing season. Cropping season linked to monsoon between March-October, often divided into kharif-1 (March-June) and kharif-2 (July-October).
Perennial Khal:	Water available in the khal all the year round.
Pacca:	Well-constructed building using modern masonry materials.
Rabi:	Dry agricultural crop growing season; mainly used for the cool winter season between November and February.
Seasonal Khal:	Water not available in the khal all the year round.
T. *Aman*:	Transplanted Aman
Upazila:	Upazila is an administrative subdivision of a District.

Executive Summary

This quarterly (16th quarterly program) Environmental and Social Monitoring Report covers the status of different environmental and social parameters in regard to the EMP of the construction stage as stated in the EIA (Environmental Impact Assessment) study. This report represents the monitoring period from February, 2018 to April, 2018. Accordingly, the CEGIS team has carried out the monitoring activities in April 2018, comprising the monitoring of implementation of Environmental Management Plan (EMP) and Environmental Compliance with the environmental parameters such as ambient air quality, noise level, water quality, land resource condition, agricultural resources monitoring, fisheries resources monitoring which covers fish habitats, migration and production, social environment monitoring, ecosystem monitoring and the Sundarbans Reserve Forest health monitoring.

The progress of Project construction activities includes extension of roads and embankment, construction equipment aggregation, preparatory of civil and infrastructure development works, labour colony preparation etc. In this quarter, the environmental due diligence covers: the Environmental Management System and Action Plan, Occupational Health and Safety, Workers' wellbeing, Biodiversity and Sustainable Management of Natural Resources etc. The monitoring team observed that, BIFPCL has mostly been complying with the EMP as suggested in the EIA report. However, as per EMP (approved by DoE) and being the Environmental Monitoring Consultant, CEGIS recommend few measures which should be complied for ensuring environmental and social safeguarding for the Project, which include, raising awareness for using appropriate PPEs, recreation facilities for the labours, proper implementation for the grievance redress mechanism for workers or local community, placement of sufficient waste disposal bins in appropriate locations, separate arrangements for praying facilities etc.

Moreover, in the recent monitoring period, the EHS unit of BIFPCL has been found to be strengthened with appointment of a number of professionals. Moreover, the EPC also appointed OHAS expert for daily monitoring, training and regulating the EHS plan during construction stages of this project. All of the documents like Occupational Health and Safety Policies; Establishment of the grievance redress mechanism; Emergency preparedness and has response plan; fire prevention, protection and control plan; stakeholder engagement plan etc. have been finalized and employed professionals for addressing them in the current phase (Construction Phase). However, proper documentation of any accident/incident or any health hazard risk issues preventive measures should be adopted for near by accidental events and any unforeseeable injury, illness, or damages; Proper implementation of waste management plan; Site specific ESMP; Safety training program for the Project personnel and labour force should be continued.

During this monitoring period, all the preselected parameters i.e. particulate matters ($PM_{2.5}$, PM_{10} and SPM), O_3, CO, SOx and NOx were measured following the proper procedures. The measured values of all parameters for every location were found within the standard limit set by ECR' 2005. This time no significant changes in the air pollutant concentration were found among the parameters. However, according to the measured values it can be easily said that the present status of the air shed is not a degraded air shed but the concurrent concentration of the air pollutants were probabaly due to the movement of numerous types of vehicles on roads i.e. two-stroke human haulers, buses, trucks, land development works, brickworks,

refineries, cement works, wood stoves and wind generated dust which are currently contributing to the pollutant's concentration in this area.

However, during this monitoring season (16_{th} quarter); the observed noise level was not found to exceed the Bangladesh standard limit of noise level in any of the ten locations (Table 2.4). In course of the total sixteen monitoring seasons, the noise level of eight locations were found to exceed the Bangladesh standard limit of their corresponding standard values in their different monitoring seasons (Table 2.4) and has been mentioned in the previous reports. However, any additional anthropogenic noise producing activities within the study area may contribute to enhance the noise level.

The water samples were collected in this recent monitoring period of April, 2018, from the preselected 17 locations (14 locations for surface water and 3 locations for ground water analysis). Water samples from Hironpoint of Sundarbans was not collected because the team could not reach to the site due to bad weather condition. However, all the samples were collected and tagged immediately maintaining the internationally recognized procedures. Later on, the samples were submitted to DPHE and BCSIR laboratory for chemical analysis of the selected parameters. This 16th quarterly monitoring report includes the laboratory reports of the 15th quarterly monitoring period (January, 2017) and in-situ monitoring results of the current quarterly monitoring period (16th quarterly monitoring program). The lab test results for the concurrent monitoring period could not be provided in this report as they are yet to be received from the respective organizations. Similar to the earlier results, spatial and seasonal variations were also observed in different parameters analyzed in the later period. However all parameters are well within the standard limit set by ECR' 1997 for both the surface water and groundwater.

Five mauzas (Baranpara, Chunkuri-2, Kapalirmet, Chakgona and Basherhula) within the 10 km radius of the power plant have been selected for monitoring of plot use, soil fertility/ nutrient status, soil contamination with heavy metals and soil salinity. Soil samples have been collected from five locations at three layers (Depth of layer 0-15 cm, 15-30 cm and 30-45 cm) inside the monitoring area in the month of April 2018 to analyze the samples. Samples will be tested from Soil Resource Development Institute (SRDI), Dhaka. Results of soil quality will be collected from the SRDI and appended in the next (2nd phase) monitoring report.

In course of fisheries resources monitoring habitat uses were observed to be changed yearly (as compare to the year of 2014-2015, of 2015-2016 and of 2017-18) and mainly caused due to biophysical changes like tidal effect, seasonal variability, food availability and fisheries resources management practices. Moreover, three types of habitats were found which are: i) Feeding ground, ii) Growing ground, and iii) Nursing ground . Shannon-Weiner index has also been observed to vary between 16th quarter with that of all previous quarters. Highest Shannon-Weiner index was found at Akram Point (0.92) indicating most evenly distributed fish species. On the contrary, lowest evenness was found at Maidara (0.21). However, maximum FSR was obtained in Sheola Khal at Chandpai (n=11), while very low FSR was recorded at Mongla-Passur Confluence (n=2). Fries for fin fish were widely being distributed among the upper stretches (Chalna Point to Mongla-Passur Confluence) and juveniles and adult age group in Sheola Khal at Chandpai and Harbaria Khal of the Passur River system. Among these Banspata, Bele, Daitna, Dogri, Jaba, etc. fishes were more among these two sampling sites. Moreover, large sized adult fishes of Lakkha, Jaba and Vetki were observed at Akram Point in this quarter. Fish species like Chela attains the maximum abundance among the migratory

fish species. Moreover, Golda, Pheksa, Paissa, Kuchia, Chitra, Bele, and Bagda species were found in maximum sampling sites. Among these species, Golda and Chitra were observed to migrate long distance. In this monitoring year, highest stocking was observed in case of gher in Kapasdanga and lowest in Chunkuri-2. The present study revealed that the highest catch susceptibility was found in case of Behundi Jal (4 kg/haul). Net Jal were most frequently used in all the upper and middle reaches of Passur River System, especially for fry collection. Charpata Jal was commonly used in the middle reach of the Passur River. Moreover, the highest total catch was observed in Sheola Khal while the lowest catch was found in in Mongla Point, Maidhara River Confluence, and Chalna Point in this monitoring phase.

Plant health, vegetation canopy status, bird habitat, butterfly occurrences, dolphin occurrence in river systems were monitored for this monitoring season. Plant heath showed usual growth comparing to the previous time. Overall canopy status of the studied homestead vegetation was found changed insignificantly except for Chalkghona than the previously monitoring priod i.e. in January 2018. Eight nests of four bird species were recorded from two monitoring sites. Occurrences of butterflies was observed to be more than the previously monitored seasons for all the monitoring sites. In total there were 16 butterfly species have been recorded and was observed to move around the wild herbs and shrubs which were in blooming forms. Dolphin occurrence was also recorded and was sighted relatively lower in number at Passur and Maidar River but higher at Dhangmari Khal and Bhadra river. This was may be due to ongoing dredging activities at Passur river and fishing activities in the Dhangmari Khal and Bhadra river. Moreover, Dolphins were also sighted at Passur River near Karamjal and Harbaria area.

The forest condition has been showing positive changes periodically in terms of seedling density, pneumatophores, crab hole, canopy cover and leaf area index (m^2 leaf area/m^2 ground area) although there has some seasonal effect. Based on different indicators it was found that the health condition at Sutarkhali is good .But logging is severely affected at Koromjol .On the other hand, no significant changes were observed during the last visit. Among the species, the height of Sundari is comparatively higher in Harbaria and Goran species are moderately higher in Akram point. The Akram point is situated at the confluence of Shibsa and Passur River. Therefore, during tidal inflow the forest floor receives large amount of soil sediment than other locations. But the number of seedling was found almost zero hence it can assumed that, the forest is currently experiencing retrogression process where the climax species are started to decay. Therefore, this area is much sensitive in terms of disturbance than the other monitored locations in th Sundarbans area

Among the five monitoring plots, Baranpara, Chunkuri-2 and Basherhula were found to be cultivated with local Aman like Chapshail and Benapole in the Kharif-II season. During the monitoring period the cropping pattern was found to be Fallow-Local Aman-Fallow in three monitoring plots out of five. The rest two monitoring plots (Kapalirmet and Chakgona) remained fallow due to salinity problem. The highest rice production (2.2 tons) was recorded in monitoring plot-2 (Chunkuri-2) and the lowest (0.9 tons) in monitoring plot-1(Baranpara). No crop damage was observed in any monitoring plot.

From July to November the livestocks face deficit in the feed/fodder. According to the local opinions, Rampal Power Plant area was the major source of grazing land for cattle's, goats, sheep in dry season and for buffaloes and ducks in monsoon season during per-projectsituation. However, after the development of land for the project, there were hardly any land which was able to compensate the pressure on fodder of livestock

in the vicinity of the project area. The severity of the livestock/poultry diseases infestation is more or less same as past situations as it was informed by the local people. However, the mortality rate of the livestock/poultry became negligible, due to extension works at farmers' level by Department of Livestock.

In course of the social monitoing, the compensation for structures, trees and crops officially have been completed while 8% of land compensation has not yet been disbursed due to lack of legal documents/paper and showing denial to receive compensation of their affected land. While starting the major construction works; employment opportunity of local labor has been increased which may create hope to the affected households.

In terms of training on livelihood restoration program, people of Rajnagar union have shown some positive remarks whereas the representative of the studied mauzas of Gaurambha union showed disappointing opinion. They stated that a very few of the representative of these affected households have received sewing and computer literacy trainings or any kind of employment opportunities by the project authority. Now on ward, most of the local labors will be recruited from Rajnagar and Rampal unions.

Improved accommodation, drinking water and sanitation facilities have been prepared separately in a hub at the edge of project area which is nearly finished. These facilities has been developed following international standards. Labors of Dipon Group have already used these facilities as most of their working labors have been migrated from other areas. Consciousness of using personal protective equipments is well developed to the working labors. Almost all the labors are found to use PPEs and it is strictly monitored by the project authority and EPC contractors.

The project authority and the EPC contractor have already recruited environment, health and safety officer for ensuring safe and hygienic health, safety and environment condition in the project as well as in the surrounding areas. The medical camp (that had been established as CSR) has also performed well in providing medical service in the study area. The authority has shifted the medical camp near the entry gate of the Power Plant to create the medical facility available for the local people.

1. Introduction

1.1 Background

The proposed Khulna 2x660MW coal based Maitree Super Thermal Power Project is a joint venture project of Bangladesh Power Development Board (BPDB), Bangladesh and National Thermal Power Corporation (NTPC) Ltd., India as per contract signed in January 2012 and run by the JV (Joint Venture) company as Bangladesh-India Friendship Power Company Pvt. Ltd. (BIFPCL).

As per scope of the EIA study, a detailed Environmental Management Plan (EMP) has been developed suggesting mitigation, enhancement, contingency and compensation measures. The measures should duly be implemented during the pre-construction, construction and operation phases in order to minimize the degree of negative effects expected to be generated by the power plant and its associated activities. It is also to be noted that successful implementation of the EMP depends on regular monitoring of the selective indicators at the specified locations.

An independent environmental monitoring team have been proposed and suggested as mandatory for monitoring the Project activities considering the sustainability of the ecosystem of the study area particularly for the Sundarbans Reserve Forest area. It has also been recommended that the environmental monitoring officer/agency should monitor the EMP implementation and submit a quarterly report to the concerned department.

In this context, BIFPCL initiated the monitoring study to monitor the environmental and social indicators and the implementation status of EMP (Environmental Management Plan) during construction phase of the Thermal Power Plant. Subsequently, CEGIS has been engaged for conducting the monitoring activities to inspect the status of environmental parameters and implementation of the EMP for safeguarding the environment of the Sundarbans Mangrove Forest and the surrounding ecosystem and communities.

This report is aimed at understanding the baseline condition and a plausible description of the recommended environmental and social parameters of the study area. It provides a complete scenario of environmental compliance status of the construction phase along with engineering activities during this 16th quarterly monitoring program.

The location of the proposed project encompasses Sapmari Katakhali and Kaigar Daskati Mauza of Rajnagar Union under Rampal Upazila of Bagerhat district (Figure 1.1). The Power Plant lies in between latitude 22˚ 37’ 0’’ N and 22˚ 34’ 30’’ N and longitude 89˚ 32’ 0’’ E and 89˚ 34’ 5’’ E. The plant site is at about 23 km south from the Khulna City and about 14 km in the north-west direction from the nearest tip of the Sundarbans (considering the proposed chimney location). The relative distance from various World heritage sites are presented in **Figure 1.1**. The study area includes: i) area covering 10 km radius from the Plant location, ii) area within 5 km strip from both bank of the Passur and the Sibsa rivers starting from the Plant site to Hiron point have been presented in **Figure 1.2**.

According to the contract, the findings of the previously formulated fifteen (15) quarterly monitoring reports have been submitted to BIFPCL. Subsequently the reports were sent to the DoE and Forest Department. In addition, all the monitoring reports were regularly uploaded in BIFPCL website. The current document constitutes the **16th quarterly monitoring** report

covering all the preselected monitoring parameters and locations, which helped in improving and further upgrading the environmental monitoring database until today.

1.2 Objectives

The overall objective of the study is to monitor the environment and social parameters and the implementation status of Environmental Management Plan (EMP) during construction phase of the Power Plant.

- To monitor, the environmental compliances regarding EMP implementation during Power Plant's construction works and associated activities.
- To monitor status of compliances regarding the conditions set by DoE.

1.3 Criteria for Selection of Monitoring sites/locations

The monitoring sites have been selected considering the sensitive receptors and the ambience of the surroundings likely to be impacted from the Project related activities. These includes-

- Wind direction, wind speed, sensitive receptors in and around the vicinity of the Project site were considered to monitor the ambient air quality. Considering the sensitive receptors in the vicinity potential locations were identified and selected for noise level monitoring in and around the project influenced area.
- Sites for water quality monitoring were selected by considering the water sources likely to be impacted by the project activities.
- Monitoring sites for fisheries resources consider the fish habitats, biodiversity, migration and production zones likely to be impacted by the said activities.
- Monitoring locations for ecosystem and biodiversity have also been selected considering the induced impacts of the Project.
- Monitoring locations for soil and land resources have been selected considering the induced impacts likely to be generated by the project activities.
- Monitoring of socio-economic conditions of the PAPs (Project Affected Peoples) which are likely to be changed by the project activities.
- Sundarbans Reserve Forest (SRF) health Monitoring locations have been selected considering the potential access routes of coal transportation and associated activities for power plant, which may have effects on Sundarbans Reserve Forest area.
- Monitoring of EMP status in and around the project area for environmental sustainability and social acceptability.

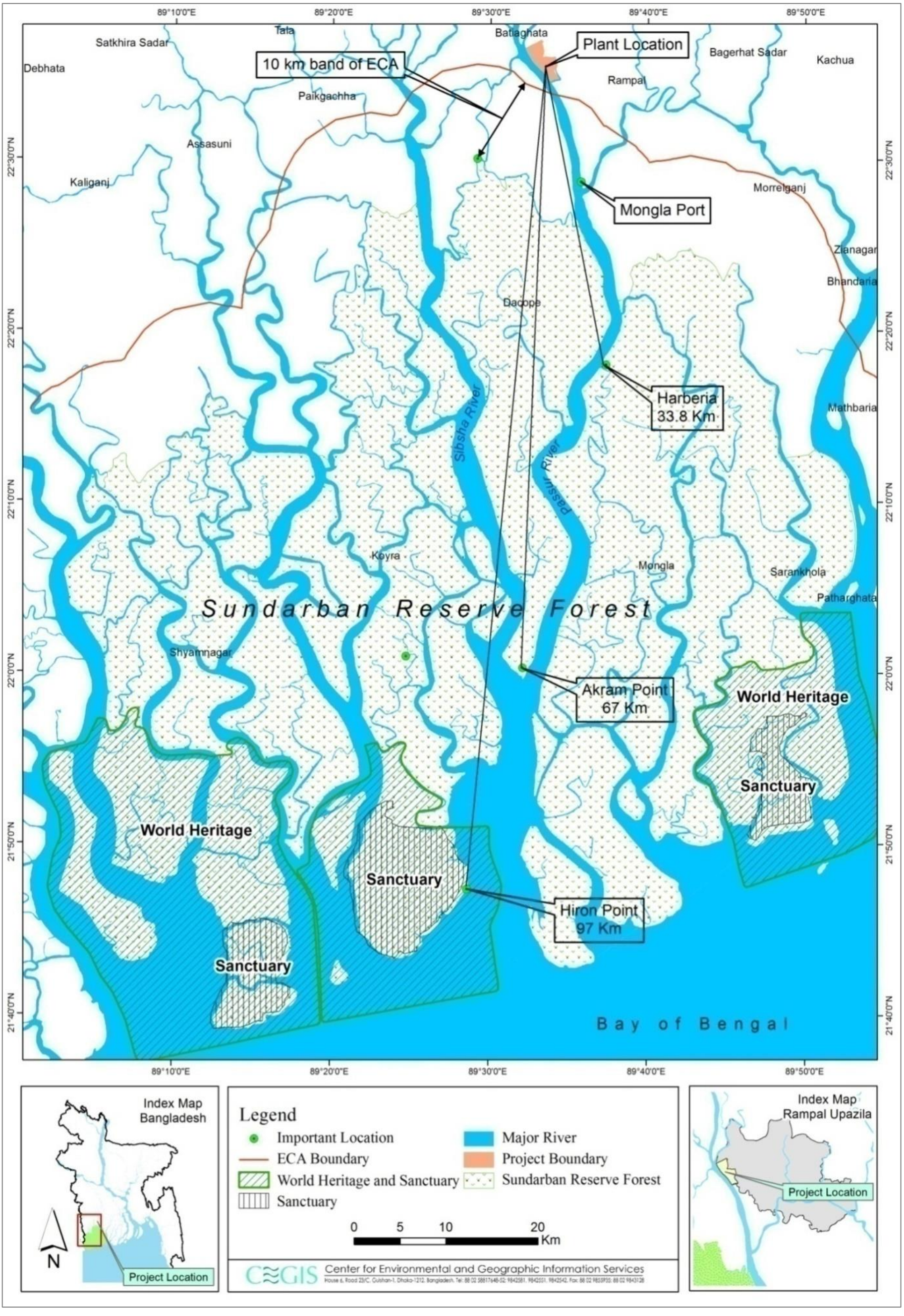


Figure 1.1: Location Map of the Study Area

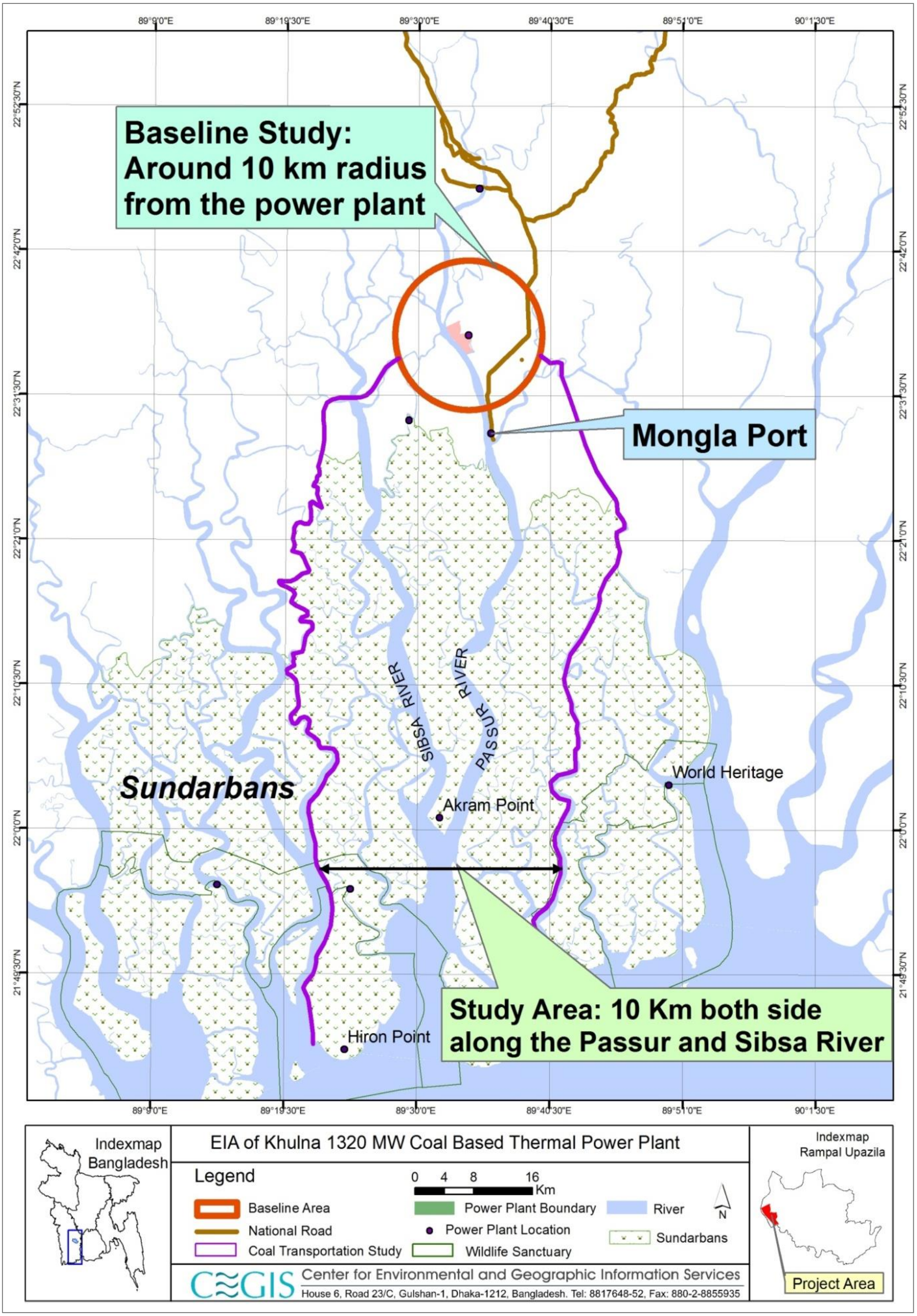


Figure 1.2: Area of Interest of Environmental and Socio-economic Monitoring

1.4 Main stakeholders

1.4.1 Forest Department

Monitoring of the Sundarbans Reserve forest area need to be complied as the conditions set out by the DoE during approval of the EIA report. Hence, permission from the Forest Department is necessary to carry out monitoring activities in the Sundarbans. The Forest Department has provided permission for carrying out monitoring activities in the Sundarbans under certain conditions which maintaining of close communication with Forest Department, submitting of the monitoring report to the Forest Department along with the following activities during conducting the monitoring study:

- Inclusion of a Soil Scientist and a Botanist in the monitoring team,
- Monitoring of regeneration, in growths (seedlings), diseases and pests (if necessary, to carry out laboratory analysis),
- Monitoring of soil nutrients (macro, micro) and heavy metals,
- Monitoring of floral diversity, species richness and dominancy,
- Measurement of carbon content both above and below the ground level,
- Assessment of impact on canopy cover, leaves phenology, flowers behaviour, pneumatophore and crab hole conditions.

The monitoring team was formed as per requirements of the Forest Department. BIFPCL also forwarded each copy of the earlier quarterly monitoring reports to the Chief Conservator of Forest, Bangladesh Forest Department, Agargaon, Dhaka and Conservator of Forest, Khulna Circle, Boyra, Khulna. Similarly, the report of 15th monitoring will also be forwarded to same officials of this Department.

1.4.2 Department of Environment (DoE)

The monitoring plan, including indicators, parameters, location and schedule, has been prepared incorporating the suggestion(s) of the Department of Environment. Before initiating the monitoring study, a discussion meeting was held at CEGIS office with the experts of DoE to finalize the monitoring plan.

The BIFPCL forwards the monitoring reports and data to DoE regularly. The monitoring reports are also presented to the Environmental Clearance Committee of the DoE during renewal of the site clearance. In addition, during each monitoring visit one representative from the local DoE office is included to accompany the monitoring team.

1.4.3 Bangladesh India Friendship Power Company (Pvt.) Limited (BIFPCL)

Bangladesh India Friendship Power Company (Pvt.) Limited (BIFPCL) is the Project proponent of the proposed Power Project. The official(s) of BIFPCL has been assisting the study team from the beginning of the study. In addition, BIFPCL is implementing the Environmental Management Plan (EMP) accordingly for ensuring environmental and social safeguarding of the project.

1.4.4 Bangladesh Power Development Board (BPDB)

BPDB is the main promoter of BIFPCL and is providing lateral support to BIFPCL in every phases of implementation (pre-construction, construction and operation) of the Rampal Power

Plant. Moreover, BPDB is also ensuring the environmental compliance monitoring of different steps of the Power Plant construction.

1.4.5 Local Community

The Project Affected Peoples (PAPs) are included in each of the social environment monitoring program. The changes in important socio-economic indicators are examined through Focus Group Discussions (FGDs, KIIs) and other informal discussions with local people in different locations of the project influenced area.

1.4.6 Major component of monitoring study

The Physical, Biological and Social aspects are monitored on regular basis and this quarterly monitoring report is furnished with the following subsequent chapters,

- **Physical Environment:** This covers the aspects of air quality, noise level, water quality, Soil and land resources and traffic management;
- **Biological environment:** This includes fisheries resources, ecological status, the Sundarbans Reserve Forest (SRF) health conditions and agricultural resources;
- **Social environment:** This covers compensation, resettlement/rehabilitation, project related employment generation, labor and working condition, community health, security and safety and corporate social responsibilities.
- **Environmental compliance monitoring:** This includes Monitoring of Environmental and Social Management System Action Plan Implementation, Monitoring of labor and working conditions, Monitoring of community health, safety and security and Monitoring of biodiversity and sustainable management of living natural resources.

2 Physical Environment

Air quality has been assessed considering the major impacts to be borne by the project activities during pre-construction, construction and operation stages of the power project. The air quality was monitored in the preselected sites except in the Hiron point of the Sundarbans (due to unfavorable weather condition) during this monitoring period in April, 2018.

2.1 Methodology

In general, there are five (5) major air pollutants i.e., Particulate Matters ($PM_{2.5}$, PM_{10}, and SPM), SOx, NOx, CO and O_3 are expected to be generated from the Power Plant activities. The monitoring locations as well as the indicators were selected during the EIA study based on a number of criteria e.g., the sensitivity of the receptors, project activities like coal-carrying vessel movement, trans-shipment point; wind speed, wind direction and atmospheric deposition (Wet and Dry) and atmospheric stability class. A comprehensive discussion on the recently assessed air quality has been reported in the following sections. It is also to be noted that, the air quality was monitored for eight (8) hours period at all the monitoring sites.

2.2 Method of Sampling and Laboratory Testing

Respirable Dust Sampler (Model-Envirotech India APM-460 BL) and Fine Particulate Sampler (Model-Envirotech India APM-550) were used to collect air samples in the selected sites. The $PM_{2.5}$, PM_{10}, and SPM were tested by gravimetric method. The concentration was analyzed by West-Gaeke method. Likewise, the concentration of NO_2 was tested by Jacob and Hochheiser method and concentration of CO and Ozone (O_3) were measured by Metravi CO-10 meter and Tongdy O_3 Monitor respectively.

The major air pollution sources currently contributing to the air pollution along the Passur River in between the Project site and Mongla Port area are the cement, LNG and petroleum industries, commercial areas, and other sources like marine vessels, small boat, and residential sources. These pollution sources are listed in **Table A2 of Appendix IV.**

2.3 Pollution sources in the Sundarbans

Most of the river traffic plying towards and away from Mongla Port area through the Sundarbans Reserve Forest area may be the prominent sources of air pollutants i.e. Particulate matters ($PM_{2.5}$, PM_{10} and SPM), Oxides of Sulphur (SOx), Oxides of Nitrogen (NOx) and Green House Gases (GHGs) in this area. In addition, engine boats and other motorized vehicles for fishing, honey collection, Golpata (Nipa palm) & timber collection, tourism business are also currently contributing in polluting in and around the Sundarbans reserve forest area. An inventory of the existing emission types and sources for the study area has been provided in **Table A2** of **Appendix IV**.

2.4 Monitoring locations

The ambient conditions of air quality during this quarter has also been monitored in the same locations as monitored in earlier quarters. The monitored locations for the air quality monitoring program are shown in **Figure 2.2**. The details of the monitoring plan have been provided in **Table 2.1.**

Figure 2.1: Air Quality monitoring at Harbaria, Sudarbans

Table 2.1: Air Quality Monitoring Plan

Sl. No.	Monitoring Indicators	Locations	GPS Points	Frequency	Methods/ Tools/ Techniques
1	Particulate Matter ($PM_{2.5}$, PM_{10} and SPM) SO_X, NO_X, CO and O_3.	South West corner of the Project boundary	89˚33'34.5"E; 22˚34'33.8"N	Each Quarter of the year	Method of testing $PM_{2.5}$: Gravimetric
2		Proposed township area near Chimney location, Mauza: Sapmari Katakhali.	89˚32'3.8"E; 22˚36'32.5"N		Method of testing PM_{10}: USEPA (1997) Method 201 or 201A (as appropriate)
3		North West corner of the Project boundary (Kaigar Daskati)	89˚33'51.8"E; 22˚36'1.06"N		Method of testing SOX: USEPA (2000) Method 6 or 6A or 6B or ISO (1998)
4		Barni, Gaurambha union (4km North East from the chimney location)	89˚34'37.7"E; 22˚38'51.8"N		Method 11632 (as appropriate)
5		Chunkuri-2, Bajua Union (4km South West from the chimney location)	89˚34'01.1"E; 22˚32'3.3"N		Method of testing NOX: USEPA (2000) Method 7 or 7A or 7B or 7C or 7D or ISO (1993) Method 10396 (as appropriate).
6		Pankhali, Dacope, (4km North West from the Chimney location)	89˚31'24.2"E; 22˚36'6.7"N		
7		Mongla Port Area	89˚35'50.4"E; 22˚28'24.8"N		
8		Harbaria, Sundarbans	89˚35'34.2"E 22˚17'43.1"N		

Sl. No.	Monitoring Indicators	Locations	GPS Points	Frequency	Methods/ Tools/ Techniques
9		Akram point, Sundarbans	89˚30'54.1"E 22˚ '23.50"N		
10		Hiron Point, Sundarbans	89˚27'53.2"E; 21˚46'27.60"N		
11		Khulna city near Khan Jahan Ali Bridge	89˚35'35.5"E; 22˚46'36.8"N		
12		Project site-1 (Proposed Township area)	89º 33´ 13.7"E 22º35´43"N		
13		Project site-2 (BIFPCL-site office)	89º33´51.7"E; 22º05´34.7"N		

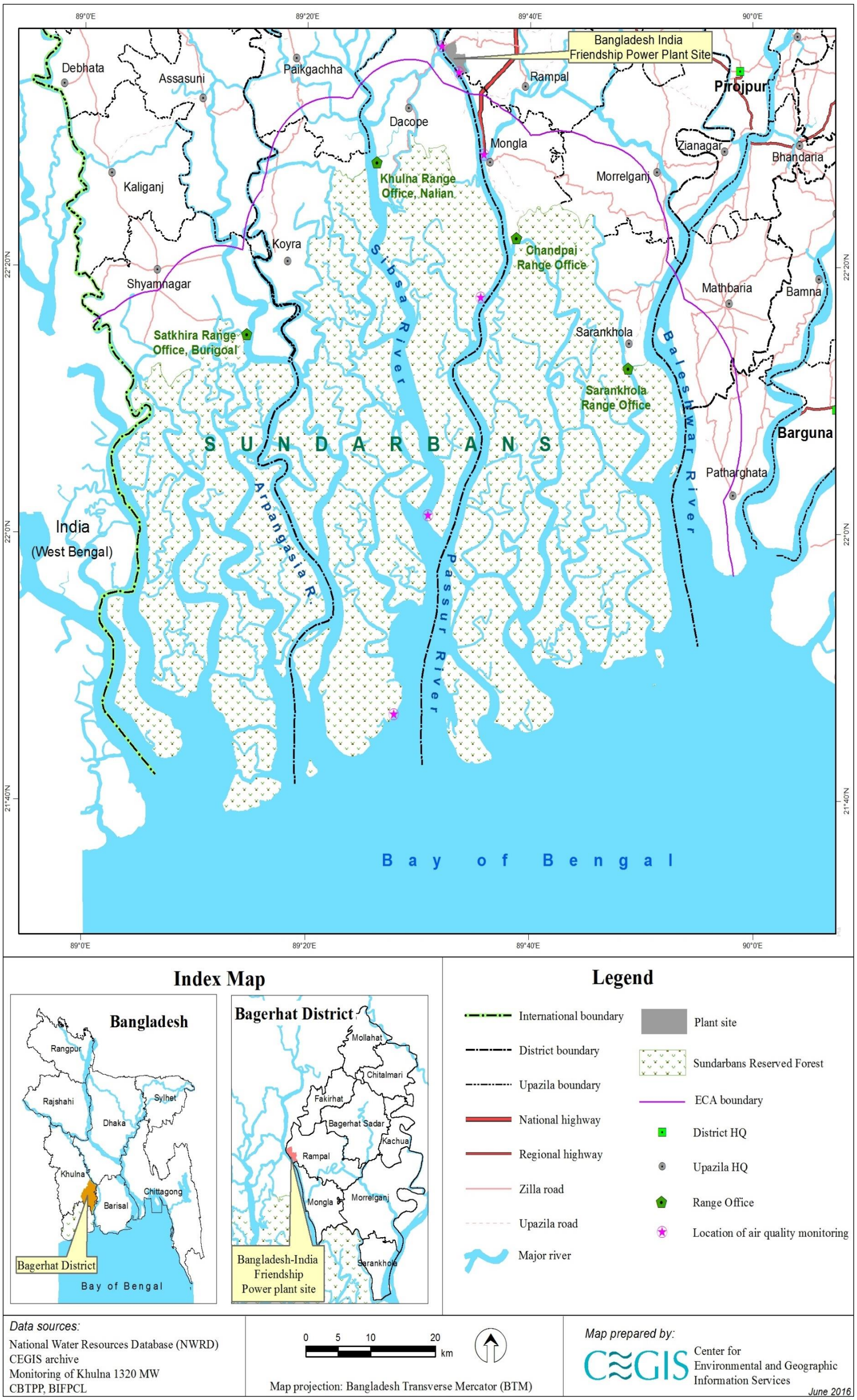


Figure 2.2: Air Quality Monitoring Locations

2.5 Status of air quality

Air quality is expressed in terms of standards set forth for public health and welfare protection (against decreased visibility and damage to Human, animals, crops, vegetation etc.). The standards currently followed are listed below. Units of measurement for the standards are parts per million (ppm) by volume, and micro grams per cubic meter of air (µg/m^3). However, the air pollution emission standards are attached in the following **Table 2.2**.

Table 2.2: Air Pollutants Emission Standards

Pollutant		Average time	Standard (ECR' 2005)
Carbon Monoxide (CO)		1 Hour	40 mg/m^3
		8 hour	10 mg/m^3
Oxides of Nitrogen (NOx)		Annual	100 µgm^3
Ozone (O_3)		8 hour	157 µgm^3
		1 Hour	235 µgm^3
Particulate matters	$PM_{2.5}$	24 Hour	65 µgm^3
	PM_{10}	24 Hour	150 µgm^3
	SPM	8 Hour	200 µgm^3
Oxides of Sulfur (SOx)		24 Hour	365 µgm^3
		Annual	80 µgm^3

Particulate Matter ($PM_{2.5}$, PM_{10} and SPM)

The maximum value (33.1 µg/m^3) of $PM_{2.5}$ was obtained at the Project site office area whereas the minimum value (11.4 µg/m^3) was recorded at Bajua area. All the values for the corresponding sites were found within the standard limit (65 µg/m^3) set by ECR, 2005 in this season. Similar situation was observed in case of PM_{10} concentrations as the concentration was found highest (118.1µg/m^3) at the Project site office area. However, all the results of PM_{10} for every location were found within the standard limit. In general, the measured values were significantly lower than the monitoring results of January, 2018 but little bit higher than the monitoring results of April 2017. Seasonal variation is the main cause of decreasing the particulate matter concentration from Janury, 2018 to April 2018 at the project area as winter is remarked the worst season of air pollution in Bangladesh. At the same time, increasing the massive civil construction works in the study area directly responsible for raise the PM concentration in ambient air than previous year. However, major sources of particulate matter are construction works, land development works of block –B, unpaved roads and vehicular movement in and around the project area. But the other sources may contribute to the existing pollution status i.e. a number of small industries i.e. brick kilns, refineries, cement works, etc., diffuse sources i.e. wood stoves, fires, and wind generated dust etc.

Similarly, the concentration of SPM was found higher at the Chalna bazar area (154.1 µg/ m^3) and whereas, the minimum concentration was observed at Harbaria area of Sundarbans Forest (72.4 µg/m^3). All the observed values were found within the standard limit. In this case, construction activities, land development works, wind erosion, a large number of two-stroke human haulers, buses, trucks, and other anthropogenic activities were observed during the field visit which might be the reason for such higher concentration of particulate matters in this area. All the monitoring data have been attached in **Table A1** in **Appendix IV**. All the observed data of PM_{10}, $PM_{2.5}$ and SPM were found to be within the standard limit set by the ECR' 2005.

Sulfur-Dioxide (SO_2)

During this monitoring period, the concentration of Sulphur dioxide (SO_2) in ambient air were found much lower than the Bangladesh standard limit of (365 µg/m^3) at all the sampling locations. Maximum concentration (13.2 µg/m^3) was found at (North West corner of the project boundary) Koigardashkati area while minimum concentration (6.1 µg/m^3) was found at Barni area. The values of SOx were never found to cross the standard value set in ECR' 2005. Emission from local human hauler, car, bus and industries like brickworks, refineries, cement works, iron and steel making, etc are currently contributing to the concentration of SOx in this area.

Nitrogen Dioxide (NO_2)

The values of NOx in Project site and its adjoining areas were observed below than the Bangladesh standard of 100 µg/m^3. During this monitoring period the maximum concentration (14.8 µg/m^3) was found at the project site office area whereas the lowest (7.3 µg/m^3) was recorded at Gaurambha (Barni) area. The monitoring results are shown in **Table A1** in **Appendix IV**. However, emission from local human hauler, car, bus and industries like brickworks, refineries, cement works, iron and steel making, etc are currently contributing to the concentration of SOx in this area

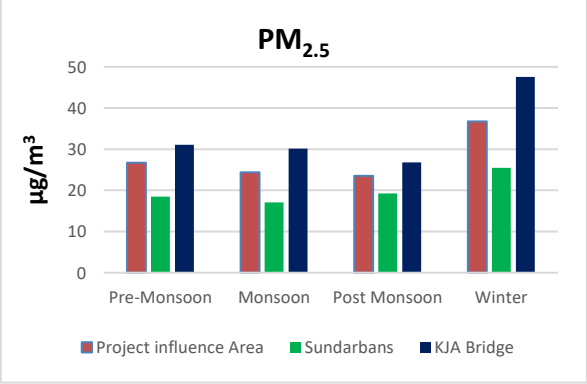
Carbon Monoxide (CO)

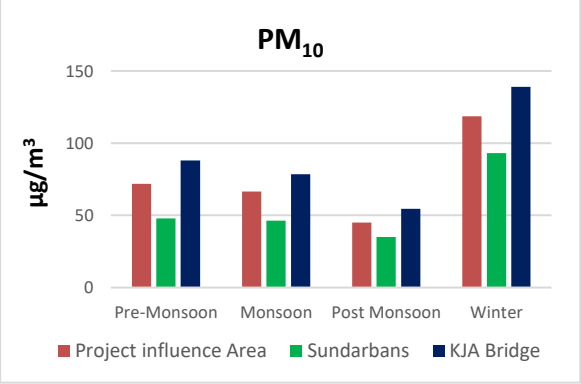
Generally CO is produced by the incomplete combustion of fossil fuel. The concentration of CO in the monitored locations were found much below than the standard values set in ECR'2005. The value was observed as 46 µg/m^3 and 24 µg/m^3 for Proposed Township area and at Barni, Gaurambha area respectively. The possible reasons for such CO concentration would be due to the movement of various types of vehicles across the Passur River and its adjoining areas.

Ozone (O_3)

Similarly, results of O_3 in both the Sundarbans Forest Area and Project area were found within the range of 9-2 ppb, which are negligible comparing to the Bangladesh standards limits of 157 µg/m^3. In this 16th quarterly monitoring study, the maximum concentration (9 µg/m^3) was found at three locations namely the Proposed Township area, Moidara area and Khan Jahan Ali Bridge area. Ozone are formed due to the mixing of volatile organic carbons and oxides of nitrogen.

Findings of the previously monitored data with seasonal variation has been appended in the following section-





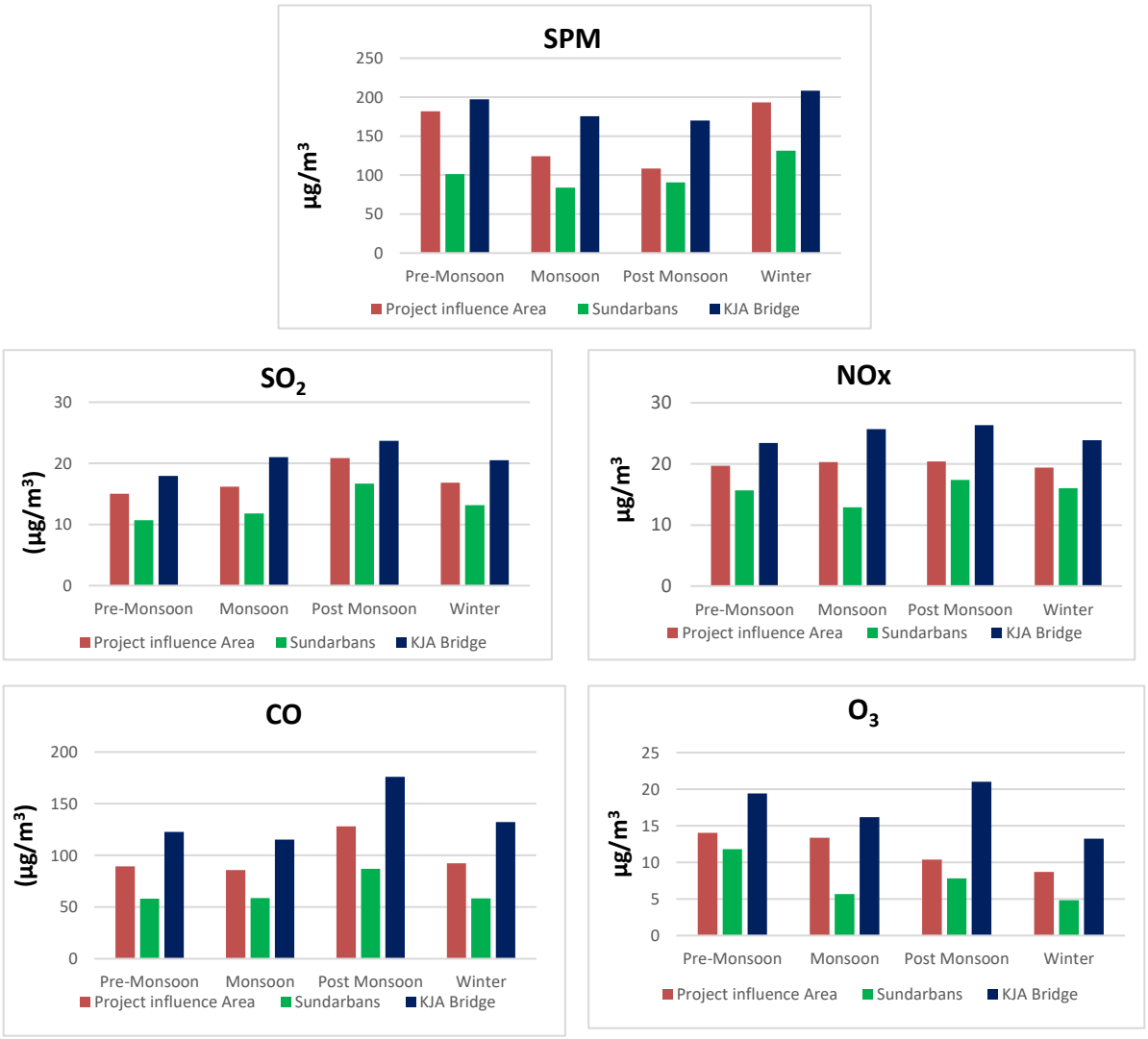


Figure 2.3: Seasonal variation of the Air Quality Parameters

2.5.1 Findings

During this monitoring period, all the preselected parameters i.e. particulate matters ($PM_{2.5}$, PM_{10} and SPM), O_3, CO, SOx and NOx were measured at all the preselected locations except in Hiron Point of Sundarbans. Due to rough weather conditions, it was not possible for the team to reach to Hiron Point of Sundarbans. However, the measured values of all parameters for every location were found within the standard limit set by ECR' 2005 (amended). No significant changes were observed among the concentration. However, according to the measured values it can be easily said that, the air shed is not a degraded air shed and the present concentration of the air pollutants are probably due to the movement of numerous types of vehicles on roads (two-stroke human haulers, buses, trucks etc.), land development works, brickworks, refineries, cement works, wood stoves and wind generated dust.

2.6 Noise Quality

Generally, the level of noise has been being monitored at eleven locations during every monitoring season but due to adverse climatic condition, Hiron Point was not monitored during this monitoring season.

2.6.1 Methodology

Noise levels were measured thrice in a day (morning, afternoon and evening) in and around the project area as well as inside the Sundarbans forest area. Each time noise levels were recorded using ***Kanomax*** *sound level meter* for five minutes' periods with an interval of 30 seconds and the meter was set up and calibrated following the instruction manual.

2.6.2 Locations of Noise Level Monitoring

Out of ten (10) monitored locations, six sites were selected in and around the Project area, two sites were inside the Sundarbans Reserve Forest Area, the other one was at the Khan Jahan Ali Bridge toll plaza area (**Figure 2.5**) and the remaining one was at Mongla Port area (**Figure 2.5.**).

Figure 2.4: Ambient Noise Acquisition in Sundarbans

Table 2.3: Noise Monitoring Plan

SL.No.	Date	Monitoring locations	GPS points	Time of noise monitoring
1	April 17, 2017	South West corner of the Project boundary	89˚33'34.5"E 22˚34'33.8"N	Morning, Noon and evening
2	April 18, 2017	Proposed township area near Chimney location, Mauza: Sapmari Katakhali	89˚32'3.8"E 22˚36'32.5"N	Morning, Noon and evening
3	April 19, 2017	North West corner of the Project boundary (Kaigar Daskati)	89˚33'51.8"E 22˚36'1.06"N	Morning, Noon and evening
4	April 20, 2017	Barni, Gaurambha union (4km North East from the chimney location)	89˚34'37.7"E 22˚38'51.8"N	Morning, Noon and evening
5	April 21, 2017	Chunkuri-2, Bajua Union (4km South West from the chimney location)	89˚34'01.1"E 22˚32'3.3"N	Morning, Noon and evening
6	April 22, 2017	Pankhali, Dacope, (4km North West from the Chimney location)	89˚31'24.2"E 22˚36'6.7"N	Morning, Noon and evening
7	April 23, 2017	Mongla Port Area	89˚35'50.4"E 22˚28'24.8"N	Morning, Noon and evening
8	April 24, 2017	Harbaria, Sundarbans	89˚35'34.2"E 22˚17'43.1"N	Morning, Noon and evening
9	April 25, 2017	Akram point, Sundarbans	89˚30'54.1"E 22˚'23.50"N	Morning, Noon and evening
10	April 26, 2017	Hiron Point, Sundarbans	89˚27'53.2"E21˚46'27.60"N	Not monitored in this season
11	April 27, 2017	Khulna city near Khan Jahan Ali Bridge	89˚35'35.5"E 22˚46'36.8"N	Morning, Noon and evening

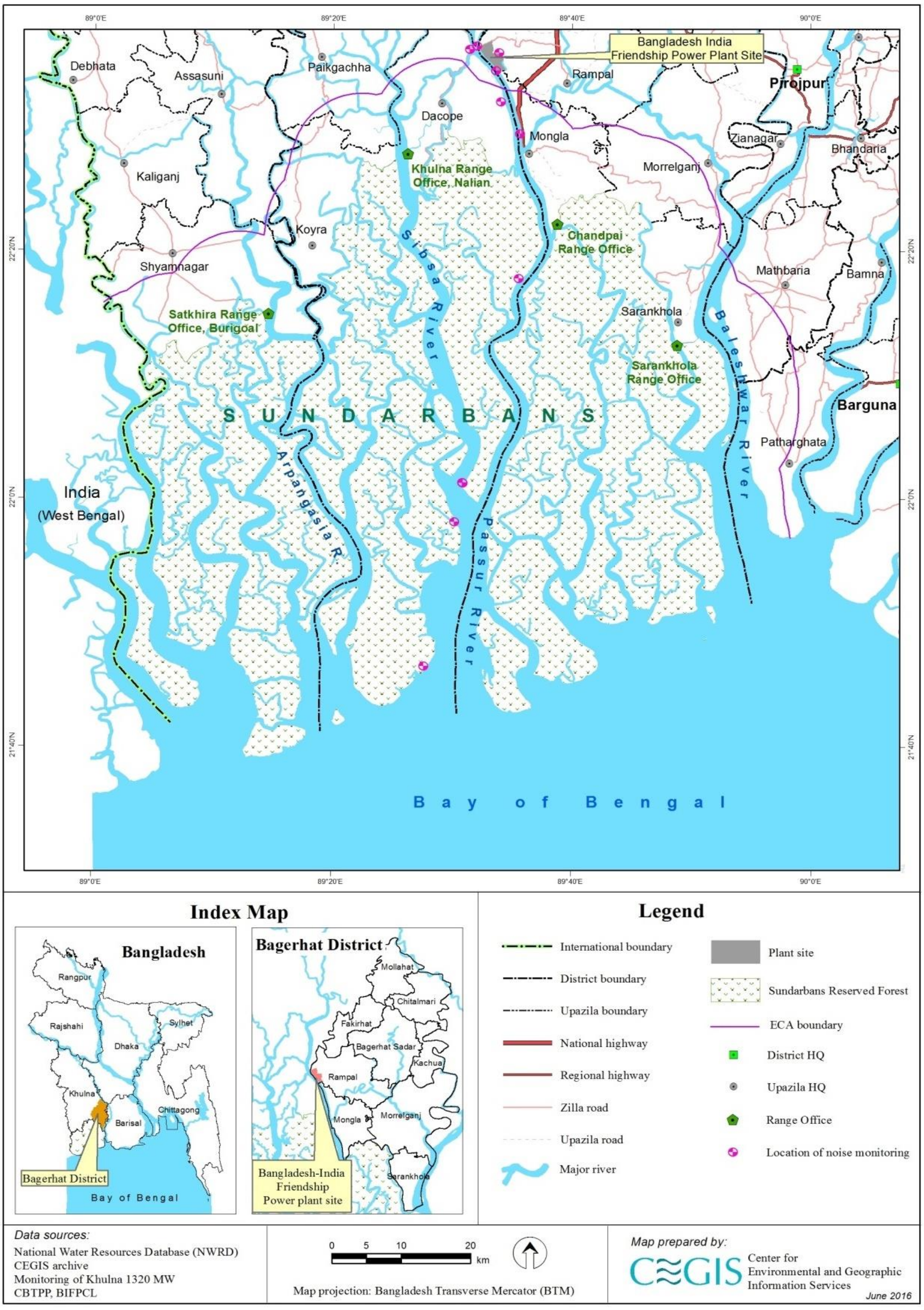


Figure 2.5: Noise Level Monitoring Locations

2.6.3 Status of Noise level monitoring

In order to provide an overview of the observed data set the average values for the respective locations has been appended in **Table 2.4** for ready reference; but the detailed Noise Level Data has been attached in Table C1, C2 and C3 respectively in the Appendix IV.

Dacope Upazila Parishad

This monitoring location is a commercial area and located at a distance of 4 km in the North West direction of the Chimney. According to the Noise Pollution Control Rules (2006), noise level standard for this area at day time is 70 dB and the maximum noise level was recorded as 59.63 dB (A) which is about 10.37 dB (A) lower than the Bangladesh standard limit (70 dB) (**Table 2.4**). The significant noise sources at this place were found as the road traffics, engine operated van (locally called Nosimon), motor bikes, easy bikes (battery-operated tri-cycle), hat/bazar etc.

North West Corner of the Project Area (Kaigar Daskati)

The North West (NW) corner of the Project site is under the Kaigar Daskati mauza of Gaurambha union. The selected monitoring site is situated at the Gucchha gram (a cluster village) and can be characterized as a residential area for the resettled people. However, the standard value for this area is 55 dB (A) at day time (Noise Pollution Control Rules, 2006). This time, the average day time noise level during this monitoring was recorded as 47.90 dB (A) and is lower than the standard value set for noise pollution control.

Chunkuri-2, Bajua

This area is located at 4km South West direction from the chimney location [89.5669°E, 22.5342°N]. This site is a residential area and the standard has been set as 55 dB (A) at day time (Noise control rule, 2006). During the monitoring period (April, 2018), the noise level was found to be 52.93 dB (A) which never crossed the standard. However, the observed noise sources were rural crowd, noise from riverside homesteads etc. in this site.

South West corner of the Project area

The South West corner of the Project area is located at the mouth of Maidara Khal. Here the noise level was found to be 47.55 dB (A) and is much lower than the standard value (55 dB). However, frequent movement of water vessels over the Moidara Khal and adjacent Passur River are the main source of noise generation in this site. However, this time noise from the construction site was felt from this location but was found to be insignificant for the corresponding standard noise limit.

Proposed township area of the Project

This is a residential area and the standard has been set as 55 dB (A) at daytime (Noise control rule, 2006). Sound level during this monitoring period was found as 50.81 dB (A) in this site and was close to that of the Bangladesh standard for the daytime. The proposed township area (Sapmari) of the Power Plant is located at the northeast portion of the Project area. The prominent noise sources were the construction activities and some discrete local gathering from the surrounding homesteads.

Barni, Gaurambha

The area can be characterized as both the residential and commercial interests and the standard noise limit for this kind of mixed zone is 60 dB (A) at day time. The noise level was found as 56.14 dB (A) during this monitoring season which is lower than the standard value. However, the maximum average noise level (58.8 dB) was found at this place during the first quarterly monitoring period which also did not cross the corresponding noise limit.

Khan Jahan Ali Bridge, Khulna

This is a commercial zone. The monitoring site is occupied by the toll office of Khan Jahan Ali Bridge, agricultural farms and local tourism spots. The average noise level was found as 64.87 dB (A) which is considerably lower than the Bangladesh standard of day time {70 dB(A)}. The highway traffic was found to be the main source of noise generation. Besides, the site attracts local visitors for its scenic beauty which also creates a significant source of noise pollution in this area.

Mongla Port area

This area is heavily occupied with the industrial set up and the corresponding standard value for the industrial area is 75 dB (A) for the day time. During this period, the average day time noise level at this location was observed as 62.95 dB (A) which is 12.05 dB (A) lower than the Bangladesh standard value. The sources of noise were mostly road traffic (heavy vehicles, light vehicles, etc.), noise from Mongla Port activities (crane, ships, etc.) and local mob in the Ghat area.

Harbaria, Sundarbans

Harbaria area of the Sundarbans is considered as a hot spot of biodiversity and an important anchoring site for most of the large ships. Most of the sea going vessels used to anchor at this site for transshipment of goods and commodities. The area is under the silent zone and the standard limit of ambient noise at daytime is 50 dB (Noise pollution control rules, 2006). The noise level was measured at a distance of 100 m (Inside the forest area) from the River bank and found as 47.93 dB (A) during this monitoring period. However, movement of ships, running engines of anchored ships and barges, transshipment activities, bird's chirping, wave breaking sound and wind action on tree leaves were observed to be the main sources of noise in this site.

Akram point, Sundarbans

Akram Point of the Sundarbans is another biodiversity hot spot in the Sundarbans. This area is under the silent zone and the ambient daytime noise standard is 50 dB (A). In this monitoring season, noise level was recorded at a distance of 100 m (Inside the forest area) from the River bank. The average daytime ambient noise level during this monitoring season was observed as 45.39 dB (A) which is much lower {4.61 dB (A)} than that of Bangladesh standard value. However, Birds' chirping, stormy wind, wave breaking sound and falling of leaves from the trees were found as the main sources of noise.

Hiron point of Sundarbans

This area is also under the silent zone where the ambient daytime noise standard is 50 dB (A). However, due to adverse weather condition, this point was not monitored in this season.

Table 2.4: Summary of the ambient noise recorded in consecutive monitoring periods of 2014, 2015, 2016, 2017 and 2018

Period	Location										
	Chalna, Dacope	NW Corner of the Project area	Chunkuri-2, Bajua	SW corner of the project area	Proposed Township area	Barni, Gaurambha	Khan Jahan Ali Bridge, Khulna	Mongla Port area	Harbaria, Sundarbans	Akram Point, Sundarbans	Hiron Point, Sundarbans
QM 1	68.13	51.89	57.76	49.2	48.75	58.84	71.7	61.24	40.88	40.94	38.63
QM 2	52.87	NM	52.55	47.6	46.68	49.95	60.8	53.84	56.13	47.9	51.29
QM 3	54.63	41.92	51.39	45.95	41.92	49.78	66.28	60.5	55.3	43.98	47.98
QM 4	53.28	35.25	49.29	36.03	41.47	43.6	61.72	38.69	34.38	34.32	37.37
QM 5	57.08	44.67	47.05	43.58	41.47	54.17	73.45	48.15	65.37	54.86	47.84
QM 6	49.77	41.56	40.66	43.75	46.75	46.18	52.82	39.61	35.03	NM	NM
QM 7	65.12	41.94	47.43	42.7	50.52	55.16	64.25	47.01	50.75	49.6	46.06
QM 8	66.07	50.96	53.62	60.44	53.77	59.16	68.45	52.7	45.2	42.95	NM
QM 9	65.08	50.79	44.49	54.5	53.37	53.97	65.85	49.88	44.55	42.95	43.11
QM 10	52.42	52.65	53.4	65.37	55.79	56.75	63.77	52.86	52.9	47.96	NM
QM 11	65.51	55.48	51.55	48.51	43.69	54.91	60.95	49.86	55.33	41.77	44.38
QM-12	59.29	44.52	55.31	45.19	42.62	49.05	55.57	48.95	41.18	38.08	42.29
QM-13	61.62	47.19	50.44	43.25	42.65	44.83	56.72	47.61	54.1	44.3	NM
QM-14	58.64	46.95	50.44	43.26	43.93	45.52	62.47	49.66	46.48	42.38	39.79
QM-15	60.1	49.3	51.4	44.5	53.3	55.6	61.7	59.8	44.4	40.1	38.8
QM-16	59.63	47.9	52.93	47.55	50.81	56.14	64.87	62.95	47.93	45.39	NM
Std* (ECR'2006)	70	55	55	55	55	60	70	75	50	50	50

*Note: All values are in decibels (dBA), QM- Quarter Monitoring, NM – Not Monitored, *Std- Standard as defined in National Noise Control Rules 2006*

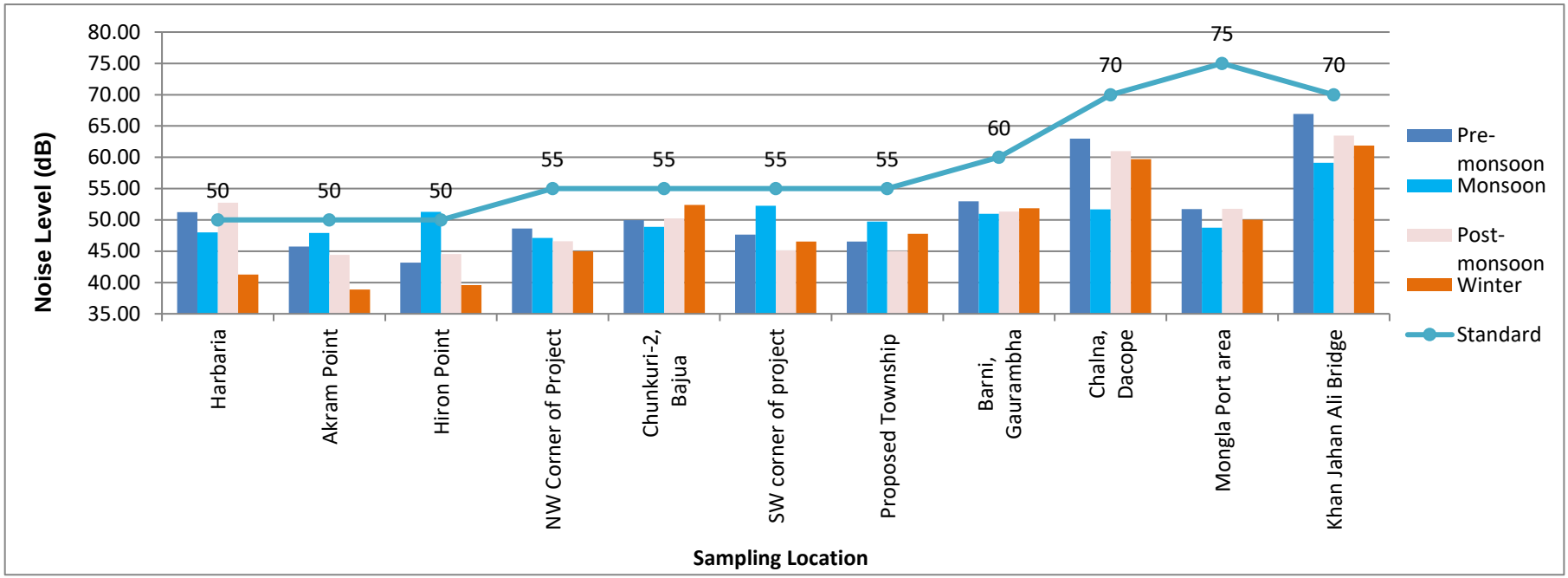


Figure 2.6: Seasonal variation of Noise level at different locations

2.6.4 Findings

The noise generation sources in the study area can mainly be divided into two types; one is natural and the other one is anthropogenic. Natural sources were birds' chirping, stormy wind, wave breaking on the shoreline, howling of leaves and so on. On the other hand, traffic mobilization, industrial activities, vessels movement within the rivers and local vehicles are the generation sources of anthropogenic noise. However, during this monitoring season (16th quarter); the observed noise level was not found to exceed the Bangladesh standard limit of noise level in any of the ten locations (**Table 2.4**). However, any additional anthropogenic noise producing activities within the study area may contribute to enhance the noise level.

2.7 Water Quality

An updated water quality status of the Passur-Sibsa River system and adjacent water-bodies have been depicted in this section. The methodologies used for the entire monitoring activities, both the national and international guidelines were followed and adopted. This report includes physical water quality parameters collected during 16th quarterly monitoring (April 2018) and the tested results obtained from the laboratory up to January 2018 (15th quarterly monitoring). The surface and groundwater quality were monitored in the respective locations performed during the previous monitoring. A number of identical parameters were selected to understand the quality of the water for community use, aquatic life, and for the Sundarbans Forest ecosystem itself.

2.7.1 Methodology

Water quality monitoring covers selection of water quality parameters, identification of sampling locations, determination of sampling frequency and evaluation criteria of the monitoring parameters etc. Standard approaches and methodologies were followed for the above-mentioned events. Both the surface and groundwater quality statuses in and around the Power Plant and the Sundarbans area were examined. The monitoring results have been presented graphically and been compared with the national standards (ECR, 1997 and all available amendments).

The samples were collected from Sixteen (16) pre-selected locations (14 locations for surface water along the Passur River, Sibsa River, Maidhara River, near the proposed township area, and 2 locations for groundwater around the study area). The selected monitoring locations for the current monitoring program are shown in **Figure 2.7**. The sampling locations were selected preliminarily at the inception stage and finalized during the 1st quarterly monitoring study. The details of the monitoring plan covering sampling locations, geographical locations, frequency and analysis techniques of sampling for surface and groundwater are given in **Table 2.5** and **Table 2.6** respectively.

Table 2.5: Surface Water Quality Monitoring Parameters, Locations and Plan

Sl no	Monitoring Indicators	Locations	GPS (Decimal Degree)		Frequency	Methods/Tools/ Techniques
			Easting	Northing		
1	pH, Temperature, Salinity, DO, BOD_5, TDS, TH, TSS, COD, Nitrate, Sulphate, Phosphate, Arsenic, Lead, Mercury, Oil & Grease	Left Bank of Passur River at 100m u/s of North West corner of the Project boundary	22.604167˚N	89.527222˚E	Quarterly	In-situ measurement (pH, Temperature, Salinity, DO) and Laboratory analysis (TDS, TH, TSS, COD, Nitrate, Sulphate, Phosphate, Arsenic, Lead, Mercury, Oil & Grease). BOD_5 were measured for an interval period of 5 days.
2		Middle of Passur River at 100m u/s of North West corner of the Project boundary	22.607222˚N	89.528889˚E		
3		Right Bank of Passur River at 100m u/s of North West corner of the Project boundary	22.609361˚N	89.531417˚E		
4		Left Bank of Passur River at Project site-Jetty	22.584833˚N	89.543583˚E		
5		Middle of Passur River at Project site-Jetty	22.587667˚N	89.546472˚E		
6		Right Bank of Passur River at Project site-Jetty	22.589333˚N	89.548222˚E		
7		Left Bank of Passur River at South West corner of the Project boundary	22.572889˚N	89.552583˚E		
8		Middle of Passur River at South West corner of the Project boundary	22.574611˚N	89.557500˚E		
9		Right Bank of Passur River at South West corner of the Project boundary	22.575667˚N	89.559861˚E		
10		Maidara river at the South East corner of the project boundary at Ichamoti-Maidara confluence	22.600639˚N	89.565611˚E		
11		Maidara river near proposed Township area	22.577472˚N	89.569250˚E		
12		Passur river at Passur – Ghasiakhali confluence	22.473861˚N	89.602361˚E		
13		Passur river at Harbaria of the Sundarbans Reserve Forest area	22.295250˚N	89.593139˚E		
14		Passur river at Akram Point of the Sundarbans Reserve Forest area	-	-		
15		Passur river at Hiron point of the Sundarbans Reserve Forest area	-	-		

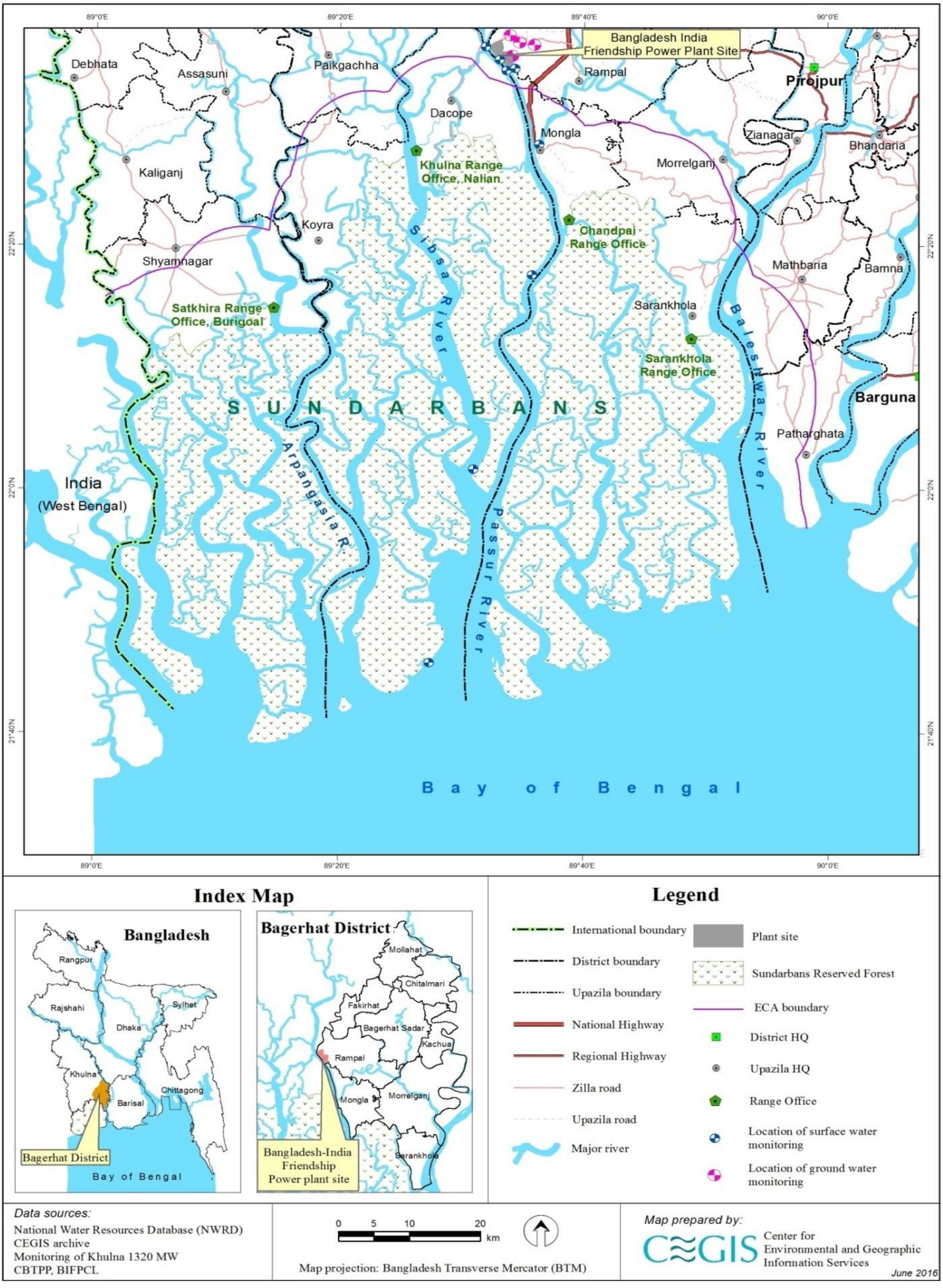


Figure 2.7: Surface water and Groundwater Quality Monitoring Locations

Table 2.6: Groundwater Quality Monitoring Parameters, Locations and Plan

Sl no	Locations	GPS (Decimal Degree)		Frequency	Methods/Monitoring indicators/ Techniques
		Easting	Northing		
1	Near Proposed Township Area	22.594167˚N	89.566139˚E	Quarterly	▪ In-situ testing of physical water quality parameters by Horiba U-50 multimeter ▪ Sample preserving and Laboratory analysis at DPHE Central Laboratory for inorganic non-metallic, aggregate organic and metals quality
2	Rajnagar	22.612528˚N	89.576056˚E		
3	Kalekarber	22.609306˚N	89.596278˚E		
4	Kapasdanga	22.622528˚N	89.563000˚E		

2.7.2 Selection of Parameters

Water quality parameters were selected based on tentative potential impacts to be generated during pre-construction, construction and operation phases of the Power Plant Project.

2.7.3 Surface Water Quality Parameters

The selected parameters for surface water quality include Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Heavy Metals (As, Pb, Hg), pH, Salinity, Nitrate (NO_3^-), Total Dissolve Solids (TDS), Total Suspended Solids (TSS), Total Hardness (TH), Turbidity, Temperature and Oil and Grease. The main parameters were grouped into following four categories:

- Physical and aggregate properties i.e. pH, Temperature, Salinity, Hardness, TDS, TS, Turbidity, Oil & Grease;
- Inorganic non-metallic constituents i.e., DO, NO3-, PO43- and SO42-;
- Aggregate organic constituents i.e. BOD, COD;
- Heavy metals i.e. As, Pb and Hg;

2.7.4 Groundwater Quality Parameters

Ground water quality parameters include Dissolved Oxygen (DO), Chemical Oxygen Demand (COD), Heavy Metals (As, Pb, Hg), pH, Salinity, Hardness, Nitrate (NO_3^-), Phosphate (PO_4^{3-}), Sulphate (SO_4^{2-}), Total Dissolve Solids (TDS), Total Hardness (TH) and Temperature.

2.7.5 Sampling Procedure

The standard sampling procedure was followed for both surface and groundwater sampling to reduce the possibility of any error. Each sample was labelled at the time of sampling.

2.7.6 Surface Water Sampling Procedure

Figure 2.8: River Water Sample Collection

The study area is highly influenced by tidal variation. Hence, temporal and spatial variations of tides were considered in sampling procedure. Surface water samples were collected at a distance of 30-50m away from the riverbank and at a depth of 6 cm below the water surface during low tides or relative slag period after the low tide for all parameters except oil and grease. The non-acidified sampling bottles were rinsed with respective water samples before sampling and storing below 10^{o}C. Acidified sampling bottles were used for heavy metal (As, Pb, Hg) sample collection while wrinkle bottles were used for BOD_5. All samples were preserved as per standard procedure.

2.7.7 Groundwater Sampling Procedure

The groundwater samples were collected from hand operated tube wells after 5-7 minutes of water extraction. Each sampling bottle was rinsed with respective water samples before sample collection and storing. Acidified sampling bottles were used for heavy metals (As, Pb, Hg) sample collection and were preserved following standard procedure.

2.7.8 Water Quality Parameter Analysis Techniques/Methods

Water quality parameters were analysed as per the procedure of American Public Health Association (APHA) standard. The analysis procedures of different parameters along with the standards are given in **Table 2.7**.

Table 2.7: Testing Methodology of Water Quality Parameter

Parameters	Methods/Measuring Tools	Unit	BD Standard (ECR 1997)
Temperature	Horiba U-50 multimeter	^{0}C	20 - 30
pH	Horiba U-50 multimeter	ppm or mg/L	6.5-8.5
TDS	Horiba U-50 multimeter	ppm or mg/L	2100 (SW), 1000 (GW)
TSS	Horiba U-50 multimeter	ppm or mg/L	150 (SW), 10 (GW)
Salinity	Horiba U-50 multimeter	ppt	-
DO	Horiba U-50 multimeter	ppm or mg/L	6
BOD_5	5-Day BOD Test at 20^{0}C	ppm or mg/L	50 (SW)
COD	Closed Reflux Method	ppm or mg/L	200 (SW), 4.0 (GW)
Total Hardness (as $CaCO_3$)	Titrimetric	ppm or mg/L	200-500
Ortho-Phosphate (PO_4^{3-})	UV-VIS Spectrophotometers	ppm or mg/L	6
Nitrate (NO_3^-)	UV-VIS Spectrophotometers	ppm or mg/L	10
Sulphate (SO_4^{2-})	UV-VIS Spectrophotometers	ppm or mg/L	400
Oil and Grease	Liquid-liquid extraction with hexane, treatment with silica gel and gravimetric determination	ppm or mg/L	10 (SW)
Arsenic (As)	Atomic Absorption Spectrophotometers–Hydride Vapor Generating (AAS-HVG)	ppm or mg/L	0.05
Lead (Pb)	Atomic Absorption Spectrophotometers–Graphite Furnace (AAS-GF)	ppm or mg/L	0.05
Mercury (Hg)	Mercury Analyzer	ppm or mg/L	0.001

BOD_5 could not be tested in the laboratory as transportation time of samples for BOD_5 test is only 6 hrs and the sampling locations are within the Sundarbans Reserve Forest area from where it requires several days to carry the sample to the nearest laboratory i.e. at Khulna. Hence, water samples were kept in specified bottles (wrinkled paper water bottles) for 5 days for natural incubation. The difference of 5 day's DO and initial DO was considered as BOD_5. Samples of other preselected parameters were preserved and analysed in the laboratory.

2.7.9 Water Quality Reporting Arrangement

Water quality status of the adjacent water bodies of power plants and the Sundarbans deep forests are being observed since April 2014. In this 16th quarterly water quality monitoring report, yearly variations of pre-monsoon (April) water quality statuses are presented and compared with the ECR' 1997 Standards. To do so, all sampling points are clustered in five different sampling sites considering homogenous characteristics of the sampling points as well as the type of ecosystem touching the sample points. The clustered sample monitoring sites and the logical explanation of the clusters are presented in the following table.

Table 2.8: Monitoring sites and characteristics

SL	Monitoring sites	Site Characteristics
(a)	Power plant & adjacent areas	In this monitoring site, total 11 sampling points have been averaged to represent the water quality status of power plant and its adjacent surface water bodies. These 11 sampling points are situated in the same river system and embedded 1km radius of power plant. In addition, previous monitoring results indicated same water chemistry. Therefore, this study makes the clusters to represent the water quality status of the areas in a more explainable and understandable way.
(b)	Mongla-Passur confluence	This monitoring site comprises with an individual monitoring point situates at least 13km downstream of the power plant. This point is a

SL	Monitoring sites	Site Characteristics
		confluence of Passur river and Mongla-Ghasiakhali channel. The terrestrial ecosystem is mostly dominated by agricultural lands followed by rural settlements.
(c)	Harbaria	Harbaria site comprises with an individual monitoring point situates around 15 km downstream of the Mongla-Passur confluence. This site is dominated by Sundarbans Forest. Heavy activities of mother vessels unloading and small cargo movement for carrying of clinker, coal and LPG gas. Influenced by tidal effects of Bay of Bengal.
(d)	Akram point	Akram point is an individual point, which is, located around 35 km downstream of the Harbaria point. This site is situated on the bank of Sibsa river before mixing with Passur river at Sibsa point. This site is completely dominated by deep forests ecosystems. Influenced by tidal effects of Bay of Bengal.
(e)	Hiron Point	Hiron point is the furthest point of this surface water-monitoring scheme. This point is at 25 km downstream of the Akram point. Deep forests and marine habitats are the main characteristics of the site. This site is completely exposed to Bay of Bengal. This site is also an individual monitoring point.

2.7.10 Status of Surface Water Quality

In-situ tested parameters

The in-situ tested results obtained up to 16th monitoring period (April 2018: pre-monsoon period) are described below:

pH

Sixteenth (16th) quarterly monitoring has been held in the month of April 2018, usually called the Pre-monsoon season of Bangladesh. During this visit, pH values in the monitoring sites are found to range between 7.3 and 8.2. The lowest pH value was found in the Passur River at Mongla-Passur Confluence whilst highest was at Akram point. Generally, pH value was found to be the highest during this monitoring period (April 2018) than all other previous monitoring periods of the same season. The main reason can be the high salinity intrusion than previous time. During this visit, salinity concentration was also found almost double than the previous pre-monsoon season (**Figure 2.10**). Altogether, pH value was almost 8.0 near the power plant areas, at Harbaira and Akram point. However, until now, pH value did not show any unexpected results as this limit complies with the ECR, 1997 Standard (6.5-8.5).

pH values of pre-monsoon and monsoon seasons were found to be comparatively lower than those of the post-monsoon and winter seasons (**Table B.1: Appendix-IV**). During post monsoon and winter season, river flow and water level normally reduced due to inadequate rainfall and insufficient inflow from U/S (upstream) of Passur-Sibsa RS (River System). As a result, pH values increased than those of the pre-monsoon and monsoon seasons, which has also reported by others (Rahman et al., 2013). Fluctuations in pH values during different season of the year can be attributed to factors like; removal of CO_2 by photosynthesis through bicarbonate degradation, dilution of waste with freshwater, reduction in salinity and temperature, and decomposition of organic matter (Rajasegar, 2003).

No significant differences in pH values were observed among the observed monitoring sites. Only spatial variation in the river water exists with minor changes. Seasonal variations in pH concentrations among the selected monitoring sites during the quarterly monitoring programs of first, second, third, fourth and fifth year of Passur-Sibsa RS are presented in **Figure 2.10** and the observed dataset are attached in **Table B.1 of Appendix- IV**.

Temperature

Surface water temperature indicated close conformity with the previously monitored values for the same pre-monsoon season. The values in this monitoring period, varied from 30-32^{0}C among the monitored sites. Water temperature at Akram point and Passur-Mongla confluence showed the highest temperature (32^{o}C) while low temperature was observed at the power plant site and its adjacent areas (30^{o}C). According to the ECR, 1997, 30^{0}C water temperature is still be tolerable by the aquatic organisms in tropical environment. As the water temperature is still within the standard limit of Bangladesh near the power plant and adjacent areas, meaning that the construction activities is not increasing the water temperature until now.

The surface water temperature largely depends on daily weather condition (Bartram J et al., 1996). According to the seasonal weather pattern of Bangladesh the temperature drops to a minimum level during winter, which is also applicable for the water temperature and thus it differs largely than the other season's temperatures. Recorded temperatures indicated that there was spatial variation among the monitoring sites even in the same season. Water temperature inside the Sundarbans tended to be slightly higher than the water temperatures near the power plant sites in pre-monsoon. The main reason behind this, is the higher electrical conductivity due to high salinity inside the Sundarbans (close to the Bay of Bengal), which increases the water temperatures slightly. For an instance, water temperature was found as 32^{0}C at the Akram point while near the power plant sites, it is found as 30^{0}C.

The measured temperature in the selected sites during the quarterly monitoring programs of first, second, third, fourth and fifth year are presented in **Figure 2.11** and all the observed dataset are attached in **Table B.2 of Appendix- IV.**

Salinity

The observed salinity concentration ranged between 10.1ppt and 22.7ppt during the pre-monsoon monitoring period. The maximum salinity was observed at Akram point in the Sundarbans while minimum in all the sampling locations close to the project site. During this monitoring period, fresh water flow from upstream was comparatively low due to insufficient rainfalls. On the other side, high salinity from sea water increased water salinity in the direction of downstream to upstream. It is very important to mention here that the salinity concentration in all the sampling sites were found comparatively higher than all other other pre-monsoon seasons.

In the monitored river systems, the highest salinity was observed in pre-monsoon season followed by winter season. Freshwater unavailability from upstream and the dominated tidal factors are the main reason of high salinity concentration in pre-monsoon and winter. The water salinity data in the selected sampling stations of Passur-Sibsa RS of the sixteen consecutive monitoring periods are presented in **Figure 2.12** and all the observed dataset are attached in **Table B.3 of Appendix- IV**.

Dissolved Oxygen

During the sixteenth monitoring period, DO concentrations varied 5.8-6.5mg/L. The maximum concentration was found near the power plant sites while the minimum value was recorded at the Mongla Passur confluence. In case of surface water standard, DO limit must not be dropped than 6.0mg/L at any cost. Lower DO than the standard limit (ECR' 1997) will first harm the aquatic organisms (plankton) and then the fish community. DO level near the project sites are still suitable for the aquatic life's. At Mongla-Passur confluence, low DO level might

be the effect of low freshwater availability from Mongla-Ghasikhali channel including heavy activities of markets, transportations of goods and port facility. However, this situation is a temporary one as during high tide and monsoon season, DO level of this site increases more than 6.0mg/L.

In case of seasonal variations, maximum concentrations were observed during monsoon and post monsoon season. Higher DO level was observed in monsoon and post-monsoon season, basically were for heavy rainfall and freshwater availability. During winter, salinity affects the temperature and then water temperature affects the holding capacity of DO in water. However, still the DO concentration of Passur-Sibsa RS (near project site and inside the Sundarbans), are complying with the water usable for irrigation, as irrigation usable DO concentration limit is only 5.0mg /L (ECR, 1997).

Pre-monsoon variations of DO at the monitoring sites of Passur-Sibsa RS are shown in **Figure: 2.13** and all the observed dataset are attached in **Table B.4 of Appendix- IV.**

Biochemical Oxygen Demand (BOD5)

According to the BOD_5 results obtained during April 2018, the biochemical oxygen demand was highest near the power plant sites. Power plant and its adjacent areas surface water need 4mg of O_2 per litre of water to decompose the organic materials naturally. On the other hand, the lowest demand was found at Harbaria. Beside this spatial variation, BOD_5 also showed temporal variations in this river system. As for example, in 2014, decomposition O_2 at Akram point was 5mg/L which is reduced to 3mg/L during this monitoring. However, all the values were found to be within the standard limit as stated in the ECR' 1997 usable by fisheries (6mg/L or less). The pre-monsoon variations in BOD_5 concentration of Passur-Sibsa RS is presented in **Figure 2.14.**

BOD_5 concentrations also showed seasonal variations. Highest concentration usually observed during monsoon and pre-monsoon seasons than post monsoon and winter. The water temperatures normally found low in winter season than that of pre-monsoon and monsoon seasons, which in turn decreases the bacterial and microbial activities (decomposition) and reduces BOD_5.

The BOD_5 values at different monitoring sites of Passur-Sibsa RS during all pre-monsoon monitoring period are presented in **Figure: 2.14** and all the observed dataset are attached in **Table B.5 of Appendix- IV.**

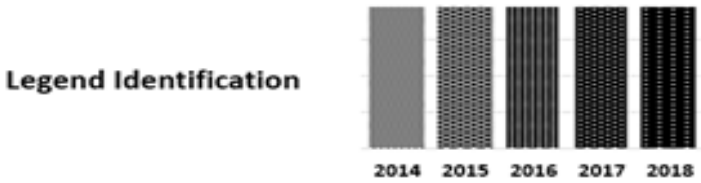


Figure 2.9: Legend direction (left to right: 2014-2018)

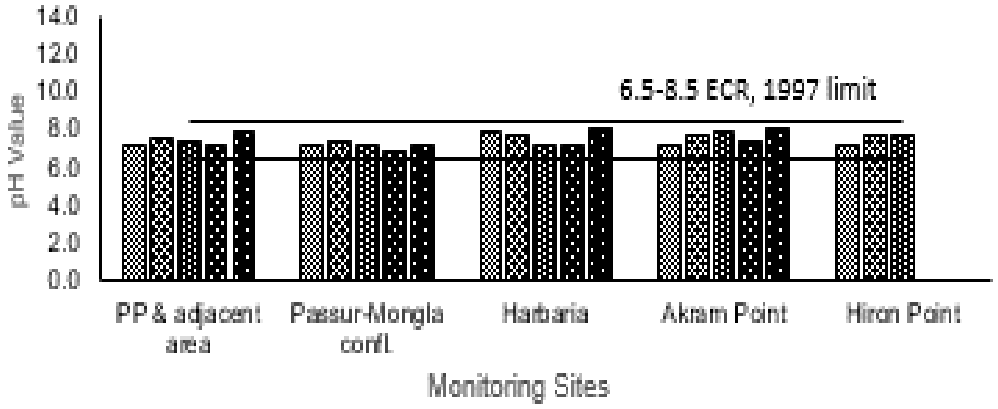


Figure 2.10 Variations in pre-monsoon pH values in different monitoring sites

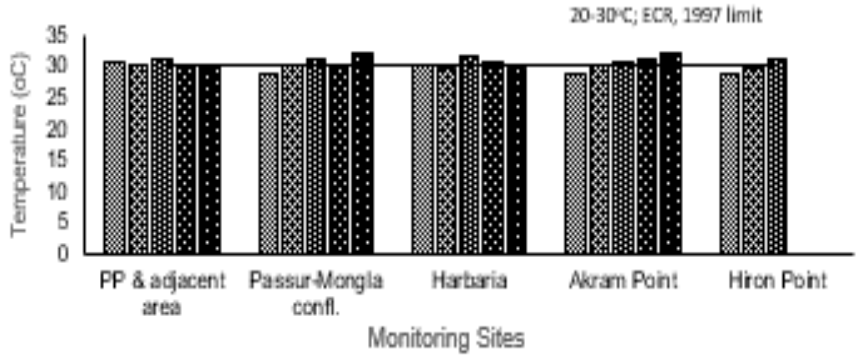


Figure 2.11: Variations in pre-monsoon temperature in different monitoring sites

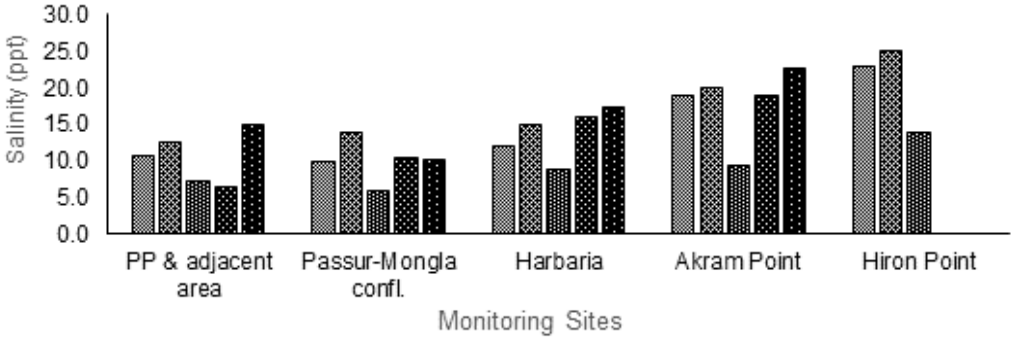


Figure 2.12: Variations in pre-monsoon salinity in different monitoring sites

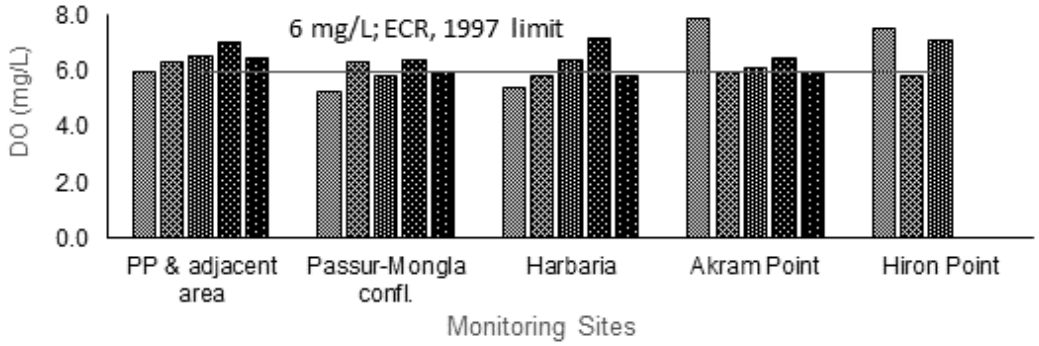


Figure 2.13: Variations in pre-monsoon DO in different monitoring sites

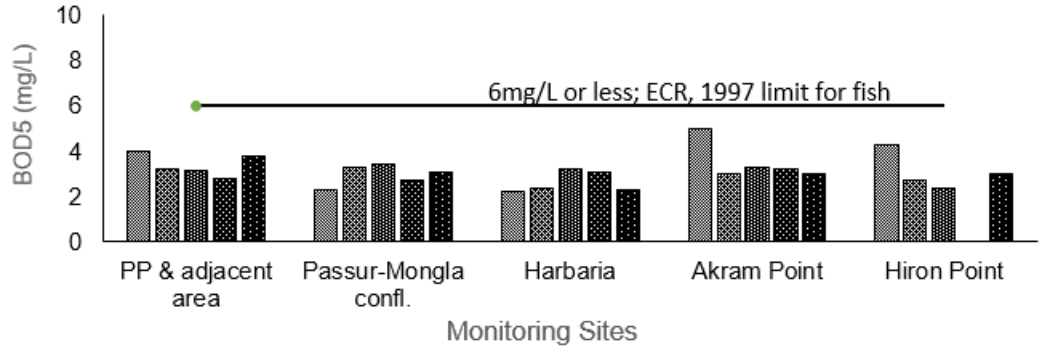


Figure 2.14: Variations in pre-monsoon BOD_5 in different monitoring sites

Laboratory tested parameters

The laboratory tested results obtained up to 15th monitoring period (January 2018: winter period) are described below:

Total Dissolved Solids (TDS), Total Hardness (TH) and Total Suspended Solids (TSS)

TDS mainly indicates the presence of various kinds of minerals like ammonia, nitrate, phosphate, alkalis, some acids, sulphates and metallic ions etc., which comprise both colloidal and dissolved solids in water (Tareq M S et al., 2013). During the last winter period, the TDS values were found to range between 2,455mg/L to 14,190mg/L, which was comparatively a bit low concnetration than other previous winter seasons (**Figure 2.16**). Above all these, the average TDS status are always showing the same pattern. For instance, TDS in power plant and adjacent areas are compratively less than the deep Sundarbans Forests.

In Passur-Sibsa RS, TDS has temporal variations as well. The TDS values during pre-monsoon and winter is high because of low rainfall and at the same time the tidal effects. The Bay of Bengal contains lots of minerals and turn the dominant composition of the said river system during pre-monsoon and winter. Therefore, in monsoon and post monsoon, the TDS concentration falls down to almost zero in some cases. Regarding spatial variation, the more it is downstream of this RS, the higher the TDS concentrations due to tidal influence of the Bay of Bengal that contains lots of salts and other nutrients.

Total Hardness (TH) follows similar pattern as that of TDS e.g. high TH during pre-monsoon

and winter season. The higher the TDS, the higher the nutrients and therefore higher occurrence of TH. Insufficent freshwater supply due to low rainfall during winter and pre-monsoon period increase the TDS concentrations in Passur-Sibsa RS. Sea water contains huge quantity of calcium and magnesium which basically make the water hard. In the last winter season, the range was found to be 510-1740 mg/L. Water body of power plant and its adjacent areas (510 mg/L) are less harder than the water body of deep Sundarbans Forests (Akram point: 1475 mg/L and Hiron Point: 1740 mg/L) (**Figure 2.17**). According to the figure 2.9, it is noticeable that water hardness of the monitoring sites of this season are compratively lower than the other winter seasons. During the rainy season, the water hardness in all the monitoring stations in Passur River were found to be low whereas it was found remarkably higher in pre-monsoon season (**Table B.8: Appendix IV**). Generally, water hardness is found to be higher in monsoon season but in Passur River it is found to be higher in pre monsoon season due to the saline water intrusion toward upstream. (Rahman et al., 2013).

TSS includes solid materials of organic and inorganic in origins which are normally suspended in water. In Passur and Sibsa RS, the suspended matters generally contain sand, clay, silt and loam. During the 15th quarterly monitoring period, the TSS concentrations among the monitoring sites varied from 13mg/L to 17mg/L. The highest value was found at Harbaria while the lowest value was found at Mongla-Passur confluence and Hiron point followed by power plant and adjacent sites (**Figure 2.18**). TSS values in every spots recorded during the last winter period found to be within the Bangladesh standard limit of 150 mg/L (ECR, 1997). At 2014, TSS reached more than 300mg/L at both Akram and Hiron point due to the oil spillage occurred at 9th December 2014.

Generally, in Passur-Sibsa RS, TSS was found to be higher in post-monsoon and winter season than those of pre-monsoon and monsoon. During post-monsoon and winter season, the TSS value increases, probably due to comparatively low amount of rains and less fresh water flow, urban runoff, industrial wastes, bank erosion, bottom feeders (such as carp), algae growth or wastewater discharges.

The status of TDS, TH and TSS of Passur River in the monitored winter seasons at different monitoring sites are presented in **Figure 2.16, 2.17 and 2.18** respectively and all the observed dataset are attached in **Table B.6, Table B.8 and Table B.9 of Appendix- IV.**

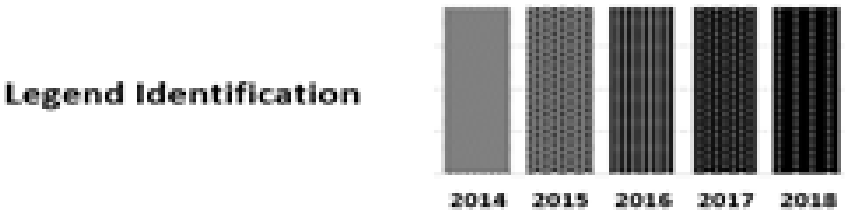


Figure 2.15: Legend identification

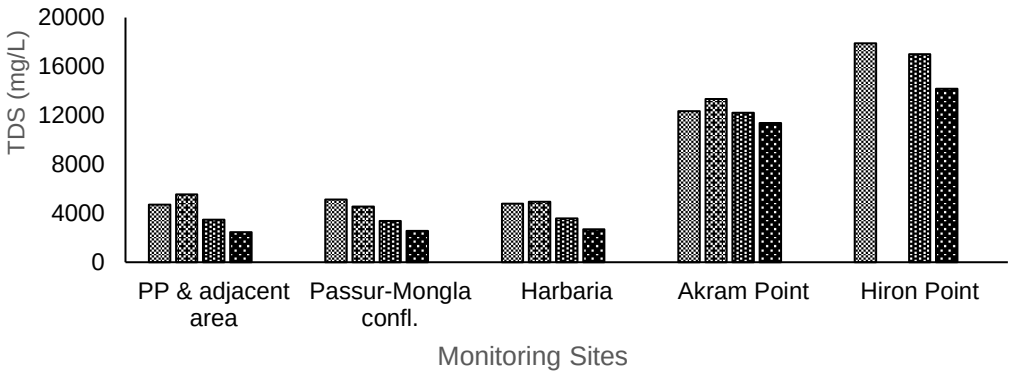


Figure 2.16: Variations in TDS concentrations in different monitoring sites

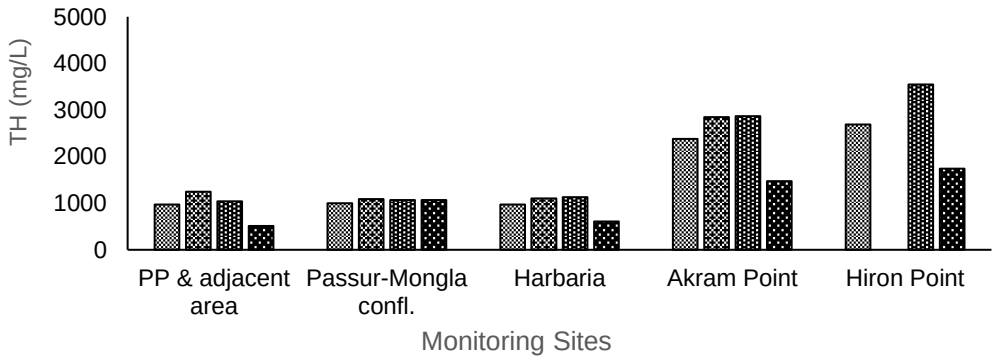


Figure 2.17: Variations in TH status in different monitoring sites

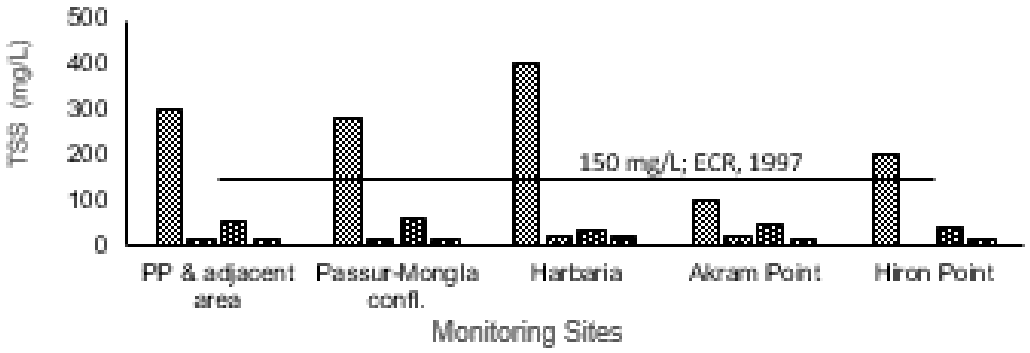


Figure 2.18: Variations in TSS concentrations in different monitoring sites

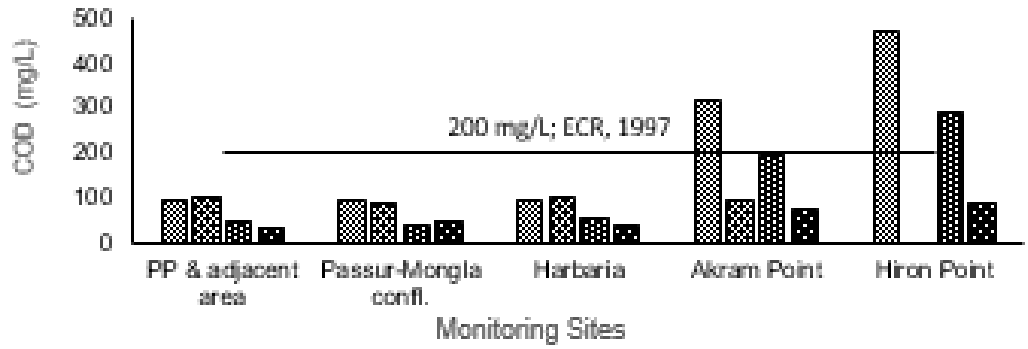


Figure 2.19: Variations in COD concentrations in different monitoring sites

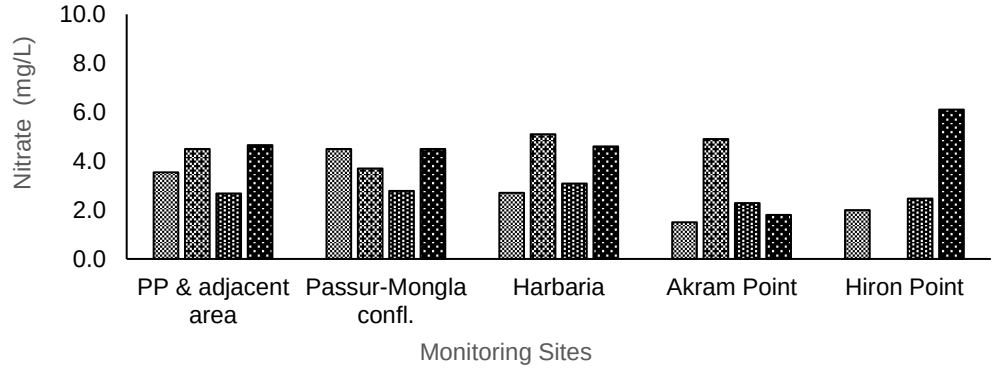


Figure 2.20: Variations in Nitrate concentrations in different monitoring sites

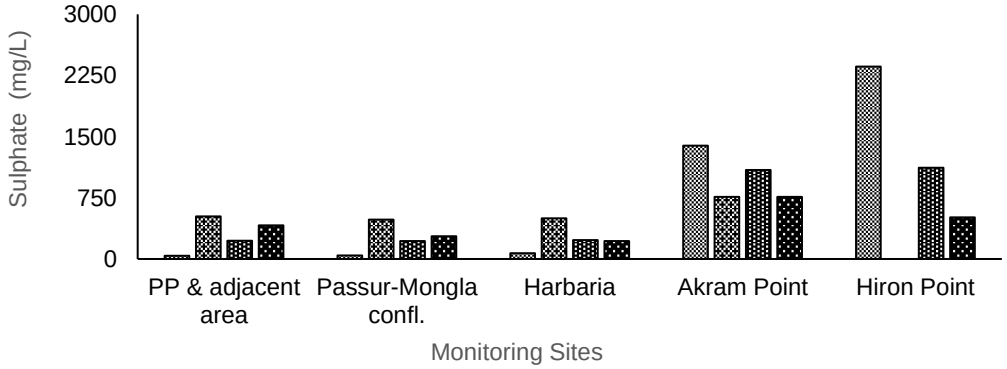


Figure 2.21: Variations in Sulphate concentrations in different monitoring sites

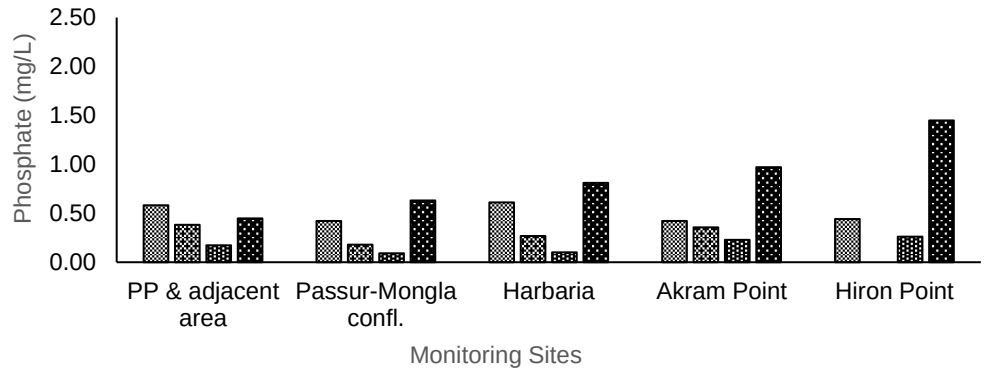


Figure 2.22: Variations in Phosphate concentrations in different monitoring sites

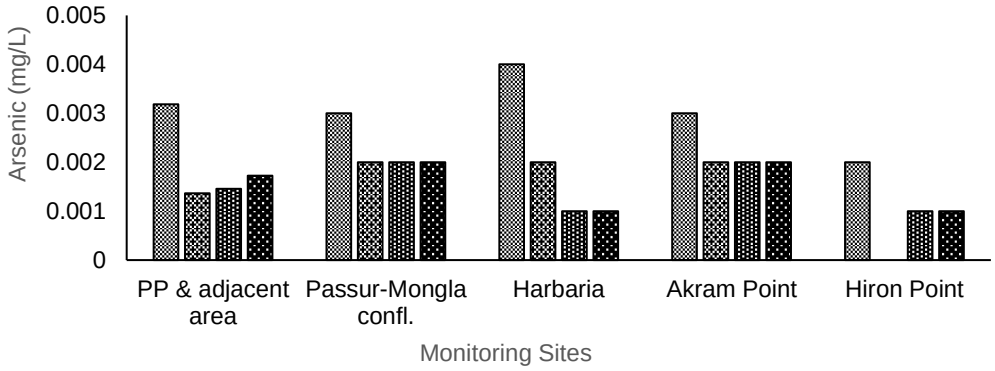


Figure 2.23: Variations in Arsenic concentrations in different monitoring sites

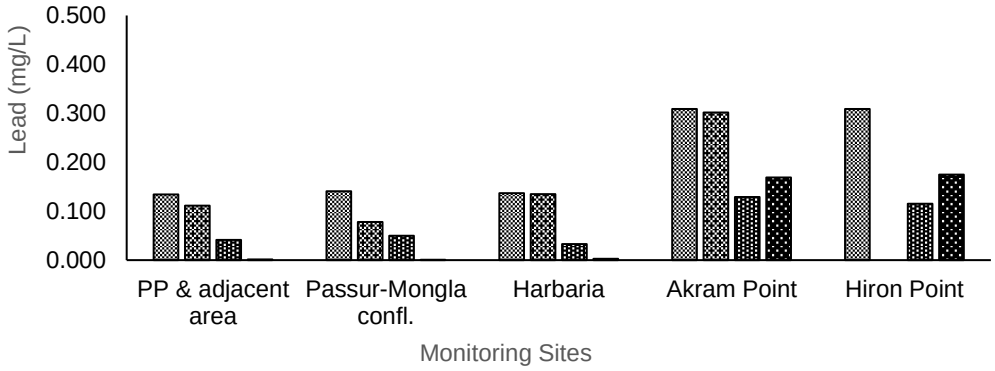


Figure 2.24: Variations in Lead concentrations in different monitoring sites

Chemical Oxygen Demand

COD is an indicator of organic pollution, which is caused by the inflow of natural organic loads, domestic, livestock and industrial wastes, which contain elevated levels of organic pollutants (Ayati, 2003). In fact, the higher the organic matter, the higher will be the decomposition and hence there will be a higher demand of O_2 in the water body.

COD concentrations varied from 37mg/L to 88mg/L during the last winter period. The highest

value was found at the Hiron point. The high values of COD indicate high level of organic pollution in the river water (Sivasubramanium, 1999). **Figure 2.19** indicates that, organic loads are higher in the deep forests of Sundarbans than the upstream areas especially the power plant and its adjacent areas. Deep forests supply lots of organic loads in the river while upstream loads as well increase the organic materials concentrations in huge at the downstream of the RS. However, the COD concentrations complied with the ECR' 1997 waste discharge standard from any project except the deep forests monitoring sites of Akram and Hiron point at 2014. That could be the reason of oil spillage of that year which lead the death of plantkons and other aquatic life forms ultimately increase the organic matter decomposition rate.

Over the year COD concentration was found to be higher in pre-monsoon season followed by winter as these seasons had insignificant rainfall comparing to those of other seasons and which actually increased the density of organic matter. The COD concentrations of pre-monsoon and winter seasons (dry) were found higher than those of monsoon and post-monsoon seasons. In monsoon, higher discharge diluted the COD load of the river water, which in turn reduced COD concentration in post monsoon. All observed values of COD are shown in **Figure 2.19** and the whole monitored dataset are provided in **Table B.10 of Appendix- IV.**

Nitrate, Sulphate and Phosphate

In the last monitoring, NO_3^- concentrations varied from 1.8mg/L to 6.1mg/L. The maximum concentration of 6.1mg/L, recorded at Hiron point whilst lowest concentration of 1.8mg/L was found at Akram point. NO_3^- concentration showed both temporal and seasonal variations in the same season among 15th quarterly monitoring. As for example, in the last winter season, power plant and adjacent areas NO_3^- concentration was around 5mg/L, at Akram point was only 1.8mg/L and at Hiron point was more than 6.0mg/L (**Figure 2.20**). However, the results obtained from all the monitoring sites were found to be within the standard concentration stated in ECR'1997 (10mg/L).

The highest values were found in pre-monsoon season of 1st quarter of 2nd year, which would be due to the higher amount of surface and groundwater runoff, dissolution of nitrogen-rich geological deposits, and biological degradation of organic matter as observed from numerous studies (Spencer, 1975; Kinne, 1984; Gleick, 1993; Wetzel, 2001; Rabalais, 2002) (**Table B.11**). High nitrate concentration was found in monsoon period across the Passur-Sibsa RS which would be the result of surface run-off, agricultural run-off, atmospheric deposition and domestic wastes dumping together with industrial pollution from upstream.

Naturally, sulphate (SO_4^{2-}) concentration is higher in seawater as well as in coastal river due to tidal interactions. The monitored dataset substantiates this fact i.e., SO_4^{2-} concentration of Passur-Sibsa RS increases in the direction of upstream to downstream. In the last winer period, sulphate showed spatial variations indicating altered the direction of higher concentrations towards downstream. However, according to the last monitoring results, most of the observed values of SO_4^{2-} were found within the standard limit of 400mg/L specified in ECR, 1997 except Akram and Hiron Point (**Figure 2.21**). In monsoon and post monsoon seasons, SO_4^{2-} concentrations were comparatively low, which would be due to dilution by upstream fresh water flow (**Table B.12**).

PO_4^{3-} concentrations were found in between 0.4mg/L and 1.5mg/L during the last monitoring period (January 2018) (**Figure 2.22**). Based on the **Figure 2.22**, it is verified that in the last

winter, PO_4^{3-} concentration increased in the direction of upstream to downstream of the RS. But, this trend was not followed by the other previous winter seasons. However, all other monitoring sites confirmed the compliance against standard limit of 6mg/L, specified for surface water. The recorded low phosphates value during dry seasons might be attributed to the limited flow of upstream freshwater, high salinity and utilization of phosphate by phytoplankton, stated by *Senthilkumar et al., 2002; Rajasegar,* 2003 (**Table B.13**).

NO_3^-, SO_4^{2-} and PO_4^{3-} concentrations at different monitoring sites of the 15 consecutive monitoring periods are shown in **Figure 2.20, 2.21 and in 2.22** and all the observed dataset are given in **Table B.11, Table B.12** and **Table B.13** of **Appendix- IV**.

Heavy Metals

It has earlier been revealed that Arsenic (As) concentrations varied between 0.001 to 0.004 mg/L. During this 15th monitoring, the results again fitted with the said range. Though there were some seasonal variations in As concentrations, but still As concentration complies with the drinking water quality standard of WHO (0.01 mg/L). The Bangladesh limit is as high as of 0.05mg/L **(Figure 2.23)**.

Lead (Pb) dissolved in water is very harmful to aquatic organisms; due to bioaccumulation, it increases in body tissue of organisms (Rompas, 2010). It is also evident that organic fertilizer, which comes from lime and compost fertilizers, can contain heavy metal, e.g., NPK fertilizer (phosphate fertilizers containing Pyromorphite- $Pb_5(PO_4)_3$ like the way said by Zhu et. al., 2004), which may result in higher amount of Pb concentration in river water during winter season. During 15th monitoring period, the lowest concentration of Pb (0.001mg/L) was observed near the power plant and Mongla-Passur confluence. In contrary, the highest concentration of 0.175mg/L was found in Passur River at Hiron point (**Figure 2.24**). This would be due to the dumping of bilge water from large ships, which were found to be anchored at the site.

The values of Hg (Mercury) revealed a continuous consistency among all the spots in all the seasons. The values never exceeded 0.002mg/L. All the observed data found to be within the Bangladesh standard limit (0.1mg/L) set by the ECR, 1997 of Bangladesh.

The average value of As and Pb concentrations at different monitoring sites of the consecutive monitoring periods for winter season are presented in **Figure 2.23 and in 2.24** and all the observed dataset are given in **Table B.14, Table B.15** and **Table B.16** of **Appendix- IV**.

Oil and Grease

In order to measure the concentration of oil and grease in Passur-Sibsa River, samples were collected at five locations during low tide from the surface layer and analysed following the standard testing method of APHA. The concentration of oil and grease are presented in **Table-B.7 of Appendix-IV.**

During monsoon and post monsoon periods, the concentration of oil and grease were found lower than that of winter and pre-monsoon season. It appears from the data that Passur and Sibsa river system recorded high concentration of oil and grease in winter period in 2014, which might be due to accidental oil spillage occurred on the 9th December 2014. An amount of 350,000 litres (Philips, 2014) of furnace oil had spilled in the river and spreaded over an area of 350 km^2 (Welle, 2014).

Oil and grease was found to be <5mg/L for all the monitoring sites in the last winter season

except at the left bank of passur river at south west corner of the project boundary (16.6 mg/L). In other seasons (pre monsoon, monsoon and post monsoon), this organic compound has increased in the last three consecutive years. Plying of motorized boats, launches and other tourist boats could be the reasons of high oil and grease including the RASH MELA Festival inside Sundarbans every year. Moreover, for the seasonal fishing at sea, the engine boats and other fishing boats contributes huge amount of oil and grease in the river water. So, due to oil spillage and discharges of other organic residual from large number of marine vessels in the location; oil discharge from the fishing boats and other anthropogenic activities might be the reason of having such higher amount of oil and grease concentration.

Findings

Passur River is highly influenced by tidal effects. Tidal pentration in the Passur River depends on seasonal change, upstream flow and catchment water discharge. However, the physico-chemical properties of Passur River changes with tidal intrusion in different seasons.

In this quarter (April 2018), the pH, Temperature and Salinity values was recored higher than perivous quarter (January 2018). pH and Salinity increase as the Passur river moves toward ocean confluences. Bay of Bengal water contains high salinity and pH, which intrudes upward through Passur River. Therfore, upstream monitoring data shows lower pH and Salinlity with respect to downstream. Pressure from upstream freash water or catchment discharge have reduced the pH and Salinity values at Maidara Passur confluences and Mongla-Passur confluences.

DO values are very much sensitive with the weather condition that changes with sunlight penetration, temperature etc. In general, DO vaues are recored higher in this quarter (April 2018) than the previous winter (January 2018). Increasing BOD values in April 2018 than January 2018 reflect the surface discharge washout by heavy rainfall at the catchment in April 2018 before sampling.

Total suspended solids (TSS) are particles that are *larger than 2 microns* found in the water column. TSS was recorded lower in January 2018 than October 2017. Rainfall runoff is responsible for increasing the TSS at Passur River. It increases at Sundarbans areas due to presence of high litterfall and other living organisms.

During January 2018, the COD values were increased to October 2017 due to increasing the intrusion of ocean water and reducing the upstream flow. COD was increasing toward the downstream of Passur River.

Runoff from agricultural field is one of the key sources increasing NO_3^- in Passur river water. NO_3^- level in January 2018 was recorded higher than October 2017, which was quit unusual. It was significantly higher than the values of January 2017. High rainfall runoff in January was the main reason for increasing the NO_3^- level at Passur River. The concentration of NO_3^- reduce towards downstream of Passur river.

As like previous year, SO_4^{2-} concentration in January 2018 was recorded higher than the October 2017. It was relatively higher than Janury 2017 but not so much significant difference with the average value. Industrial discharge might be the cause for increasing SO_4^{2-} concentration. Moreover, bivalent Sulphate salt in ocean water is the major sources of SO_4^{2-} concentration in Passur River.

Agricultural runoff, sewerage are major sources of PO_4^{3-} in river water. PO_4^{3-} concentration in Passur River was recorded lower in January 2018 than October 2018. Reducing catchment

washout in January 2018 was responsible for reducing Phosphate in Passur River.

No variation was recorded for As and Hg concentration but Pb concentration was recorded lower than just preceding monitoring report. Presence Pb concentration in river water are not depended on seasonal variation but spatial distribution of sources.

Increasing oil& grease concentration at the left bank of Passur River at southwest corner at the project boundary was responsible for oil discharge from unregulated/informal vessels ply at Passur River.

2.7.11 Status of the Groundwater quality

In-situ tested parameters

The in-situ tested results obtained upto 16th monitoring period (April 2018: pre-monsoon period) are described below:

pH and Temperature

The values of pH and temperature of groundwater in the monitored sites complied with the drinking water quality standards as specified in ECR, 1997 (6.5-8.5 and 20-30^{o}C respectively). The pH values during 16th monitoring scheme were found to vary from 6.9 to 7.2, while temperature was exactly 30°C at Rajnagar and Kapasdanga site. During this visit, no groundwater is being withdrawn inside the project site (near township area). No significant differences have been observed against the previous winter season results. Similarly, no significant variation was recorded in groundwater temperature over the monitoring periods.

Both the results of pH and Temperature were found more or less consistent with all those to the previously obtained respective season's data. The sixteen consecutive monitoring results of pH and temperatures (pre-monsoon data) of selected sites are presented in **Figure 2.26** and **2.27** and all the observed dataset are attached in **Table B.17** and **B.18** of **Appendix- IV**.

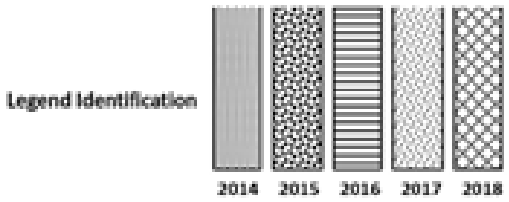


Figure 2.25: Legend direction (left to right: 2014-2018)

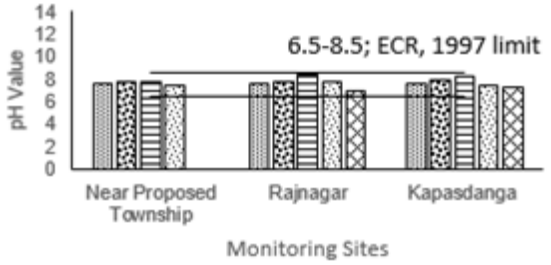


Figure 2.26: Variations in pre-monsoon pH value in different monitoring sites

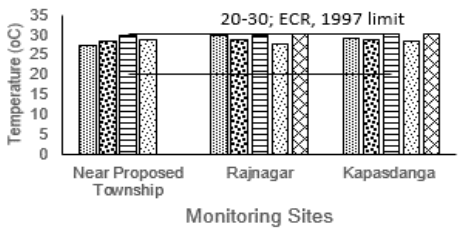


Figure 2.27: Variations in pre-monsoon temperature

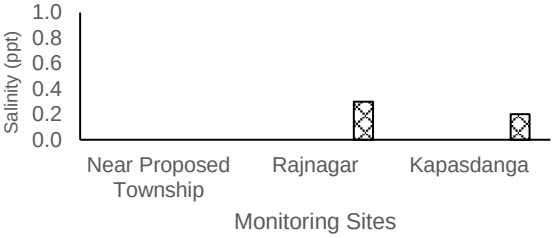


Figure 2.28: Variations in pre-monsoon salinity concentrations

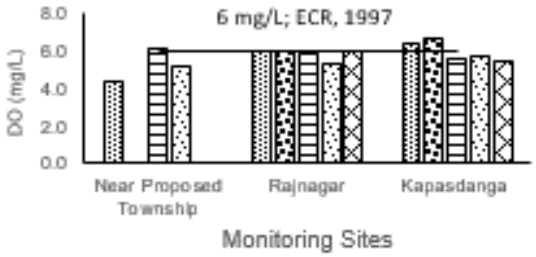


Figure 2.29: Variations in pre-monsoon DO concentrations

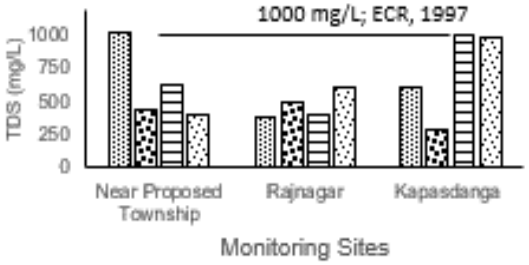


Figure 2.30: Variations in winter period TDS concentrations

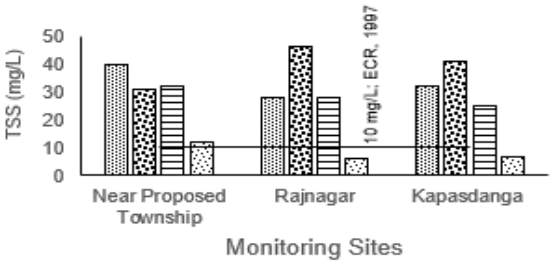


Figure 2.31: Variations in winter period TSS

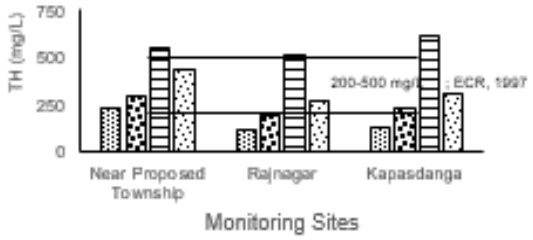


Figure 2.32: Variations in winter period TH

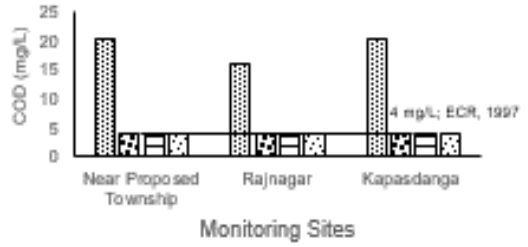


Figure 2.33: Variations in winter period COD concentrations

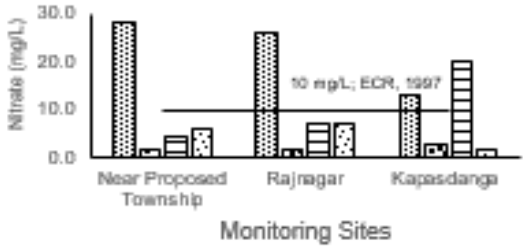


Figure 2.34: Variations in winter period nitrate concentrations

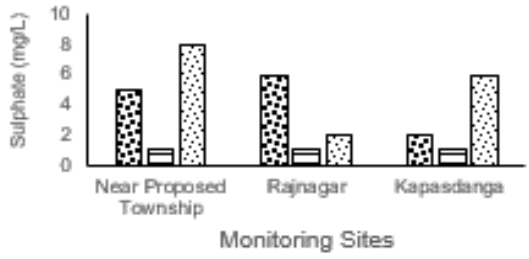


Figure 2.35: Variations in winter period sulphate concentrations

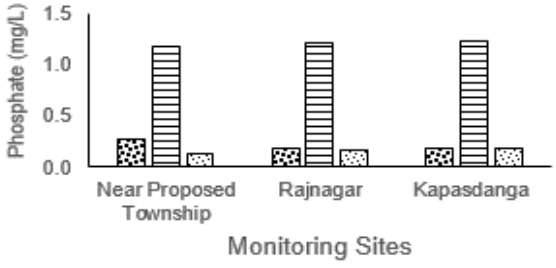


Figure 2.36: Variations in winter period phosphate concentrations

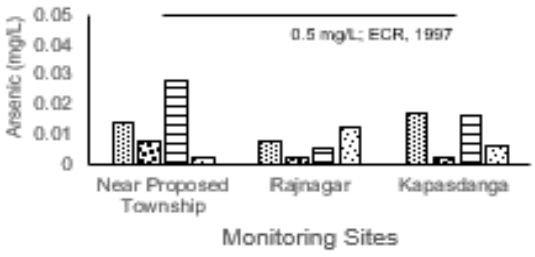


Figure 2.37: Variations in winter period Arsenic concentrations

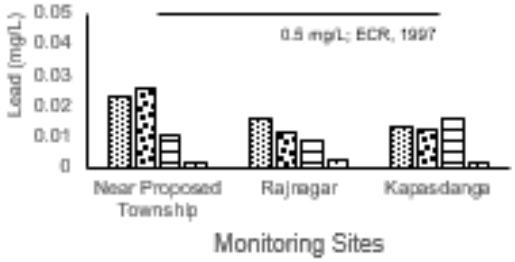


Figure 2.38: Variations in winter period Lead concentrations

Salinity and Dissolved Oxygen (DO)

Groundwater salinity concentration in all the monitoring sites were found to be negligible and in most of the cases below the minimum detectable limits in all the consecutive monitoring seasons. During this monitoring season, groundwater salinity of Rajnagar and Kapashdanga were found to be 0.3ppt and 0.2ppt respectively (**Figure 2.28**). This slight changes of groundwater salinity might be due to the shortage of freshwater availability during winter and pre-monsoon seasons along with increased salinity concentration of river water.

DO ranged between 5.4 mg/L to 6.2 mg/L during this monitoring season. Though DO concertation were found slightly lower than the recommended ECR, 1997 (6.0mg/L), at Kapasdanga, however, it is still drinkable. A slight low DO concentration in drinking water might only reduce the taste of water. Higher DO level makes water tastier but causes corrosion to the supply pipe.

All monitoring results of salinity and DO of the selected monitoring sites are presented in **Figure 2.28 and 2.29** and all the observed dataset of DO are attached in **Table B.18** of **Appendix- IV.**

Laboratory tested parameters

The laboratory tested results obtained upto 15th monitoring period (January 2018: winter period) are described as follows:

TDS, TSS and TH

The highest TDS value of 994mg/L was recorded in Kpasdanga and the lowest in Near Proposed Township area (405mg/L). It is mentionable that, the TDS concentrations in all the winter periods were found within the Bangladesh standard limit of 1000mg/L (ECR, 1997) except first quarterly monitoring period (Winter of 2014). At the first monitoring, the TDS concnetration was found little bit higher (1021mg/L) than the ECR'1997 Standard for Drinking Water Quality (**Figure 2.30**).

Total Suspended Solids (TSS), also known as non-filterable residue, are the solids (minerals and organic material) which remain trapped on a 1.2µm filter (U.S.EPA, 1998). Among all the monitoring seasons, the observed TSS concentrations, were much higher in winter season than other monitoring seasons (pre-monsoon, monsoon and post-monsoon) (**Table B.20**). These variations would be due to lack of freshwater availability for sufficient groundwater recharging. In addition, evaporation have also condensed the water along with its suspended matters. During this monitoring period, the TSS concentrations ranged in between 6 to12mg/L,

which complied with the Standard for Drinking Water, Bangladesh (TSS: 10mg/L, ECR, 1997) except the site of near Township area which showed 12mg/L (**Figure 2.31**).

TH concentrations of the three monitored spots varied from 265mg/L to 430mg/L (**Figure 2.32**) in the last winter season monitoring period. The maximum value was found near proposed Township area of the project site while the lowest was found at Rajnagar. Over the last four winter seasons, drinking water hardness complied with standard limit (200-500 mg/L) set by the ECR 1997. So far, no incidents of weathering of Ca^{2+} bearing minerals or excessive application of lime was found during the monitoring periods which could cause excessive amount of TH in groundwater.

Groundwater TDS, TSS and TH values of the consecutive winter periods are presented in **Figure: 2.30, 2.31** and **2.32** and all the observed dataset are attached in **Table B.19, B.20** and **Table 21** of A**ppendix- IV.**

Chemical Oxygen Demand

The Bangladesh standard for COD in drinking water is 4.0mg/L. All the three monitoring sites completely complied with the Bangladesh Standard as COD concetrations for these three sites in the last winter period were found only 4.0mg/L. Except the first quarterly monitoring period, all the other winter seasons COD concetrations were also within the Bangladesh Standard for Drinking Water.

The COD concentrations of all the winter period monitoring sites are given in Figure 2.33 and all the observed dataset are attached in Table B.22 of Appendix- IV.

Nitrate, Sulphate and Phosphate

Nitrate (NO_3^-) values ranged between 1.7mg/L and 7.2mg/L in the last winter period (**Figure 2.34**). The maximum value was recorded in Rajnagar while the lowest was in Kapasdanga. NO_3^- concentrations found in winter was within ECR, 1997 limit (10mg/L). During winter, most of the sampling locations gets high nitrate concentration. This finding indicates that during winter all the aquifers of the observed locations may face shortage of freshwater availability. In addition, NO_3^- conentrations of ground water monitoring sites have both spatial and temporal variations.

Groundwater sulphate (SO_4^{2-}) concentration have been monitored since 2015. Since that time, SO_4^{2-} concentrations were complying with the Bangladesh Standard for Drinking Water Quality (400mg/L). SO_4^{2-} concentration in groundwater didn't show any pattern yet (**Figure 2.35**) except a trend of comparatively high concnetrations in winter than all other monitoring seasons.

On the other hand, the concentrations of PO_4^{3-} were found between 0.1mg/L and 0.2mg/L, which was within the standard limit of 6 mg/L (ECR'1997) (Figure 2.36). At the winter of 2016, PO_4^{3-} concentration reached to its highest peak at 1.2mg/L. PO_4^{3-} concentrations actually have both spatial and temporal variations but which is very minor in the interest of this monitoring objectives as well as drinking purpose by the community resides there. The observed winter seasons NO_3^-, SO_4^{2-} and PO_4^{3-} concentrations of groundwater are presented in **Figure 2.34, 2.35, 2.36** and all the observed dataset are attached in **Table B.22** of **Appendix- IV.**

Arsenic (As), Lead (Pb) and Mercury (Hg)

According to Bangladesh Standard (ECR, 1997), the maximum acceptable concentration of Arsenic in groundwater is 0.05 mg/L. The As (Arsenic) concentrations among all the

monitoring locations ranged between 0.01 and 0.03mg/L which are very much within the Bangladesh drinking water limit (ECR, 1997) (Figure 2.37). It can therefore, be concluded that, groundwater of the monitoring areas is not contaminated by arsenic pollution yet.

The Pb and Hg concentrations were also measured and the values were found within the permissible limit specified in ECR 1997 (0.05mg/L for Pb and 0.001mg/L for Hg). The concentration of Pb showed only spatial variation to some extent (Figure 2.38). However, the water of the tube-wells was found suitable for drinking purpose in terms of metal pollution status.

The observed values of As and Pb in all the winter period monitored sites are presented in **Figure: 2.37** and **2.38** and all the observed dataset of As, Pb and Hg are presented in **Table B.23, B.24 and B.25 of Appendix-IV**.

2.8 Land Resources monitoring

2.8.1 Methodology

Monitoring Indicators

Monitoring of the selected indicators are very crucial for better management of land resources in the study area. Plot/land use, soil fertility/nutrient status, soil contamination with heavy metals and soil salinity are considered as the major indicators for land resources monitoring. It is also assumed that during the operation phase of the power plant fly ash and other air borne pollutants may deposit on the surrounding agriculture land.

Sampling Frequency

The frequency of monitoring for land resources data collection was considered twice in a year. So, plot use monitoring will be accomplished in April and October in each year. Plot use data were collected in April, 2018 and next plot use monitoring data will be collected in October and furnished in every progress report. For monitoring of soil fertility/nutrient, status of soil contamination with heavy metals, samples will be collected twice in a year (dry and wet season). Accordingly, the plot use data and samples were collected in 16th monitoring program of construction phase during April, 2018.

Location

The selected mauzas were remains same in this phase as pre-construction phase monitoring. They are Baranpara (E-89°30′59.1″, N-22°37′57.0″) of Batiaghata upazila, Chunkuri-2 (E-89°32′20.0″, N-22°34′51.0″) of Dacope upazila, Kapalirmet (E-89°36′8.8″, N-22°32′18.9″) of Mongla upazila, Chakgona (E-89°34′25.3″, N-22°34′18.3″) and Basherhula (E-89°34′25.0″, N-22°36′14.0″) of Rampal upazila under Khulna and Bagerhat districts as stated in **Table 2.9**. Locations of collected soil samples are presented in **Figure 2.39.**

2.8.2 Process of Soil Samples Collection

Plot Selection

Monitoring plots were selected through group discussions, especially with the plot owners and experts such as Upazila Agriculture Officers of Batiaghata and Dacope of Khulna, Rampal and Mongla of Bagerhat District and Senior Scientific Officer of Soil Resource Development Institute (SRDI) of Khulna during construction phase monitoring. Wind speed and wind

direction was also considering the potential locations for the monitoring purpose. All the selected plots were characterized as medium high land (F_1), which are normally flooded in the range of 30-90 cm and remain inundated for more than two weeks to few months during the flood period.

Soil Samples Collection

Soil samples were collected following the standard practices of composite method. The samples in each plot were collected using augur from five dug pit. From each pit, three soil samples were collected from three different depths (0-15cm, 15-30cm and 30-45cm) and then mixed properly to make a composite sample. After that a 500g of soil mass was taken and stored into an air tight poly bag for laboratory analysis. However, continuous monitoring of these plots has given an opportunity to observe the seasonal change among the indicators of each locality. The selected indicators are soil reaction (pH), soil salinity (EC), Organic matter (OM), base Cations-Ca, Mg, K and Na, status of macro nutrients (N, P and S), status of micro nutrients (B, Fe, Mn and Zn) and presence of heavy metals (Pb and Cd).

Laboratory Analysis

Collected soil samples have been handed over to the SRDI, Dhaka for laboratory analysis. Analyzed results are presented in **Table C.2** of **Annex-IV** after obtaining from SRDI

Table 2.9: Land Resources Monitoring Plan

Site No.	Monitoring indicators	Location	GPS(Decimal Degree)		Sampling Frequency	Methods/Tools/Techniques
			Easting	Northing		
01	Plot use, Soil fertility and Nutrient, Chemical Properties of Soil (pH, Pb, Cd), Crop production and damage	Mauza: Baranpara, Union: Gangarampur Upazila: Batiaghata, District: Khulna	E-89°30′59.1″	N-22°37′57.0″	Bi-yearly (April and October)	In situ field sampling and Laboratory Testing in SRDI
02		Mauza: Chunkuri-2, Union:Bajua Upazila: Dacope, District :Khulna	E-89°32′20.0″	N-22°34′51.0″		
03		Mauza: Kapalirmet/Buridmial Union: Burirdanga, Upazila: Mongla District: Bagerhat	E-89°36′8.8″	N-22°32′18.9″		
04		Mauza: Chakgona, Union: Rajnagar Upazila: Rampal, District: Bagerhat	E-89°34′25.3″	N-22°34′18.3″		
05		Mauza: Basherhula, Union: Rajnagar Upazila: Rampal, District: Bagerhat	E-89°34′25.0″	N-22°36′14.0″		

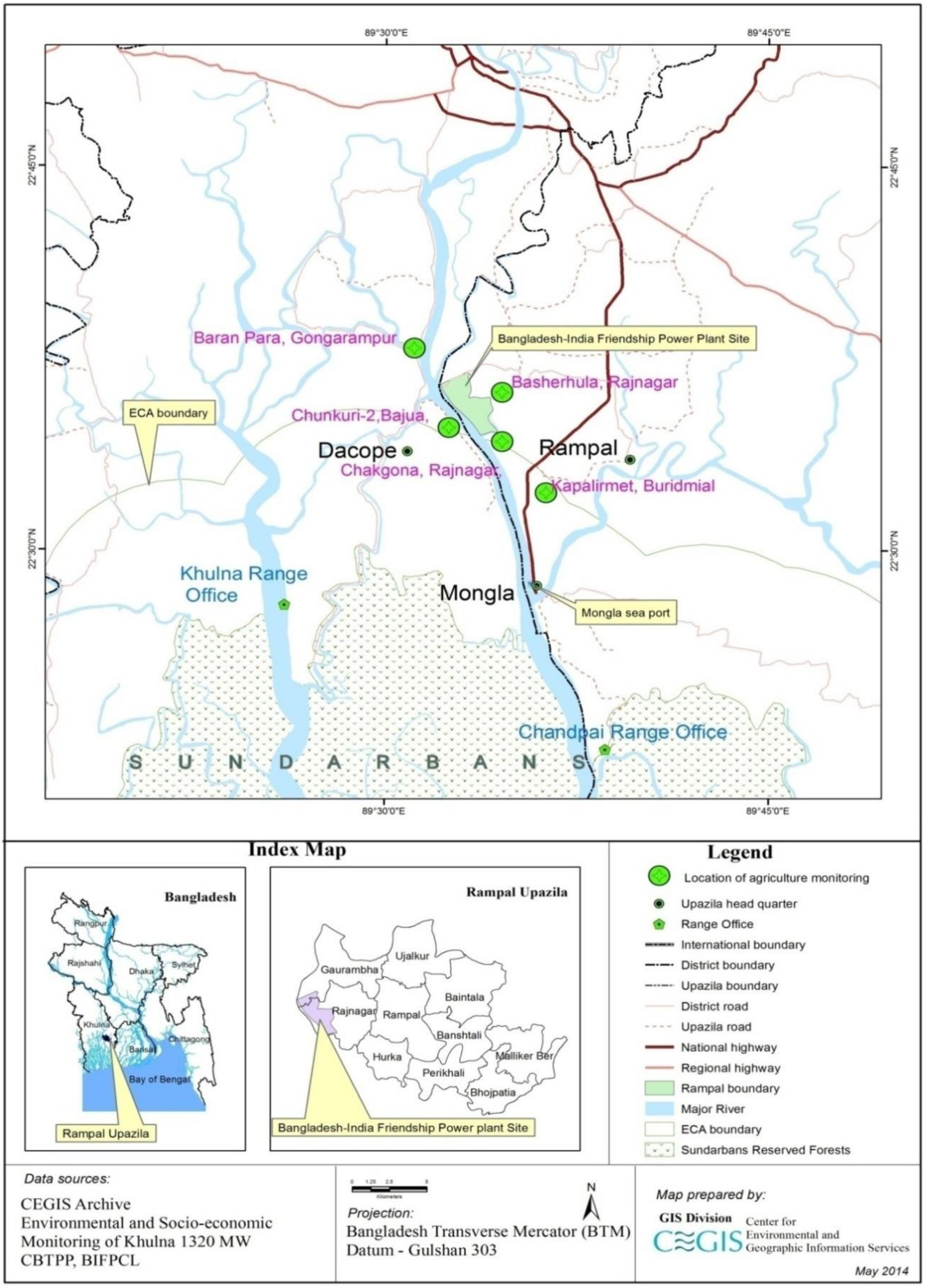


Figure 2.39: Land Resource Monitoring Locations

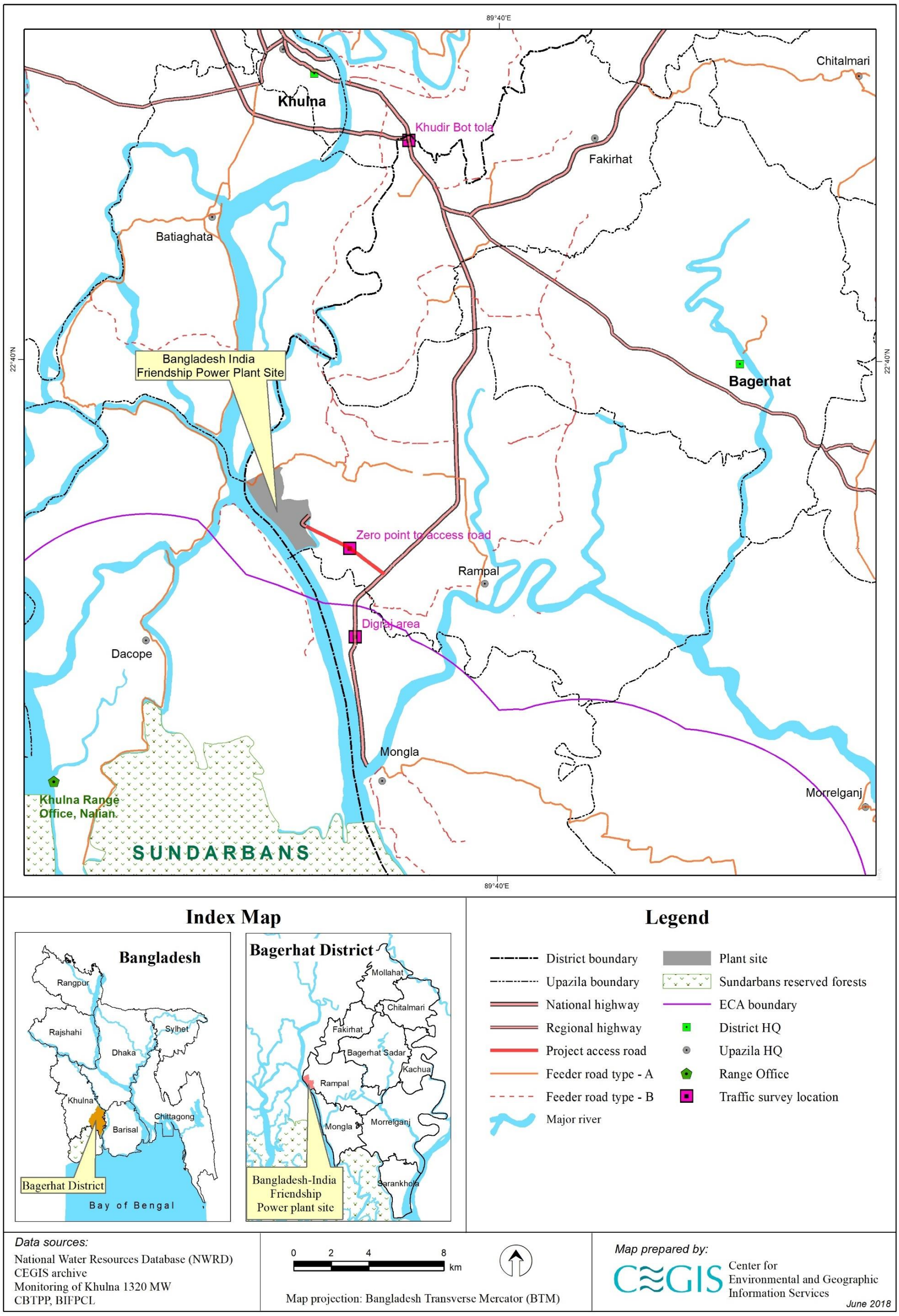


Figure 2.40: Traffic Monitoring Locations

2.8.3 Status of Soil Quality of Monitoring Plots

Results of soil quality will be collected from the SRDI and appended in the next (17th quarterly program) monitoring report and will be presented in **Table E.2 of Appendix IV**.

2.9 Transportation Monitoring

2.9.1 Location of Traffic Survey

The traffic survey during the construction phase was conducted from April 25 to 27, 2018 at the selected locations as stated in the RFP (**Figure 2.40**). Weather was sunny during the survey. The selected sites were Babu Bari (access road), Tilok and Gonabelai near the project site.

2.9.2 Methodology

Traffic surveys were carried out at three distinct periods (7:00 AM to 10:00AM; 12:00 PM to 2:00PM; and 17:00 PM to 19:00 PM) to understand the nature of traffic flow and traffic load on the preselected locations during different phase of the day. Vehicles were categorized based on the available vehicle type around in the project area.

2.9.3 Traffic Volume Calculation

The survey results were used in computing the traffic volume of these roads in Passenger Car Unit (PCU). PCU is a matrix used in Transportation Engineering, to assess traffic-flow rate on roadways. A PCU is essentially the impact that a mode of transport has on traffic variables (such as headway, speed, density) compared to a single car. While calculating the traffic volume in PCU, vehicle conversion factors suggested by the Roads and Highway department of Bangladesh were used as mentioned in **Table 2.10**.

Table 2.10: Factors Used for PCU Calculation

Vehicle type	Factor
Bus	2.5
Minibus/Truck	2
Car/Microbus/Zeep	1
CNG	0.5
Rickshaw	0.8
Tempo/Human hauler	0.6
Motorcycle	0.3
Bicycle	0.2
Push Chart	4

**Source: Roads and Highway department of Bangladesh*

2.9.4 Results of Monitoring

The summary results of vehicular movements at three different locations are shown in **Table 2.11** below. Results shows that, the Passenger Car Unit (PCU) per hour suggest that the Khulna-Mongla Highway receives the largest number of vehicles, compared to other roads.

Table 2.11: Calculated PCU in Five Locations at Three Different Time Period

Location	7:00 AM to 10:00AM	12:00 PM to 2:00PM	17:00 PM to 19:00PM
Baburbari	375	318	315
Tilok	690	776	614
Gonabelai	156	100	208

Source: Field Survey, April, 2018

The vehicular movements observed during the surveys were mostly for the regular activities. Construction activities of the Power Plant has been started and traffic volume at the access road of Babubari has increased compared the number of traffic during preconstruction phase of the power plant. The detail survey findings regarding the traffic volume surveys as well as the detail calculations are attached in **Annex IV (Table F1, F2, and F3).**

3 Biological Environment

Biological resources include all living organism within an ecosystem which interact with one another as well as with the physical environment. The biological resources around the project site were categorized into three major groups and monitored quarterly with the aim to establish baseline conditions to compare with the probable impact of proposed project in place. These groups include fisheries resources, ecological resources and Sundarbans Reserve Forest (SRF).

3.1 Fisheries Resources

The monitoring of all four quarters for the session of 2014-15, of 2015-16 and of 2016-17 as well as 1st 2nd and 3rd (13th 14th and 15th in total) quarter of 2017-18 were completed and reported earlier. This chapter contains the outcome of this 16th quarter in total) along with the comparisons with the earlier fifteen (15) quarters.

3.1.1 Location of Monitoring Sites

In this phase, the monitoring activities were carried out in thirteen (13) pre-selected locations among which ten (10) were capture fish habitat and three (3) were shrimp/fish farms (culture fish). The capture sampling sites were selected based on the available fishing ground of upstream, mid stream and downstream of Passur River system. Shrimp/fish farms were selected based on the project activities on the influence zone. The fisheries resources monitoring locations are provided in **Table 3.1** and also shown in **Figure 3.1**

Table 3.1: The Sampling Locations for monitoring of Fisheries Resources

Site	Capture Habitat Location
A	Akram Point
B	Haldikhali
C	Charaputia
D	Bagha
E	Harbaria
F	Jongra
G	Chandpai
H	Mongla Port
I	Maidara
J	Chalna Point, Batiaghata
Culture Habitat Location	
A	Bhekatkhali Khal, Rajnagar
B	Kapasdanga-Muralia
C	Chunkuri-2

3.1.2 Selection of Parameters

Five major components were selected in fisheries monitoring according to TOR, such as, fish habitat status, fish migration, fish diversity, shrimp/fish farm practices and fish production. Fish habitat status was monitored through investigating habitat suitability index in view of habitat classification based on length frequencies of different fish species, sensitivity of fish diversity and survival success of different life stages of fish to abiotic factors (water quality, bed material, morphological aspects and biotic factors (food cover). Fish migration status was monitored through assessing migratory fish species diversity, migration pattern, migration

purpose, period and extent of migration etc. Species evenness, species richness and community structure were investigated for monitoring fish diversity. Shrimp/fish farm practice was monitored by viewing stocking pattern, growth rate and mortality rate. Fish production monitoring was divided into capture and shrimp/fish farm production.

3.1.3 Methodology

Fish Habitat Status

Fish habitat status was monitored through determination of Habitat Suitability Index (HSI) by applying numerical habitat model based on the habitat classification and sensitivity of fish diversity and survival success of different life stages of fish to abiotic and biotic factors. Fish habitat classification was analyzed by calculating *Ecludean Distance* among sampling sties. Moreover, the similarities in species composition among the sites were analyzed using the *Jaccard Index (JI)* for estimating the extent of similarity between pairs of data sets. Basic life requirements for fish community are given in **Table D.1 of Appendix IV**.

Fish Migration

Migratory species were identified by analyzing the common species found in the catch assessment survey from the sampling sites based on IUCN list.

Fish Diversity

Fish diversity was surveyed by Catch Per Unit Effort (CPUE) method. The fish individuals were counted according to the length of each species from the samples. Diversity was estimated by analyzing *Shannon-Weiner Index* ranges from 0 to 1. Fish species richness (FSR) was analyzed using the *Simpson's Index* that generates two types of values. The first one includes values from 0 to 1 expressing normalization scores for species richness status and the second one includes values from one (01) to values equal to the total number of species found in the sample which suggests that how many species are dominant in this fish community. Fish community structure has also been analyzed through counting the length-wise fish individuals.

Fish-Shrimp Culture Practice

For monitoring shrimp/fish farm, three farms within the direct impact zone of the proposed Power Plant were surveyed. Stocking pattern of the shrimp/fish farm is the major issue for successful production, because of having natural genetic resources from the wild source of the Passur River System. Moreover, mortality rate should be minimized for getting more economical output from the farms. So, stocking pattern and mortality rate and its causes were surveyed intensively.

Fish Production

Fish production for riverine fish was surveyed through CPUE. The information on the species-wise production of shrimp/fish farm was collected from the selected farms for the last catch.

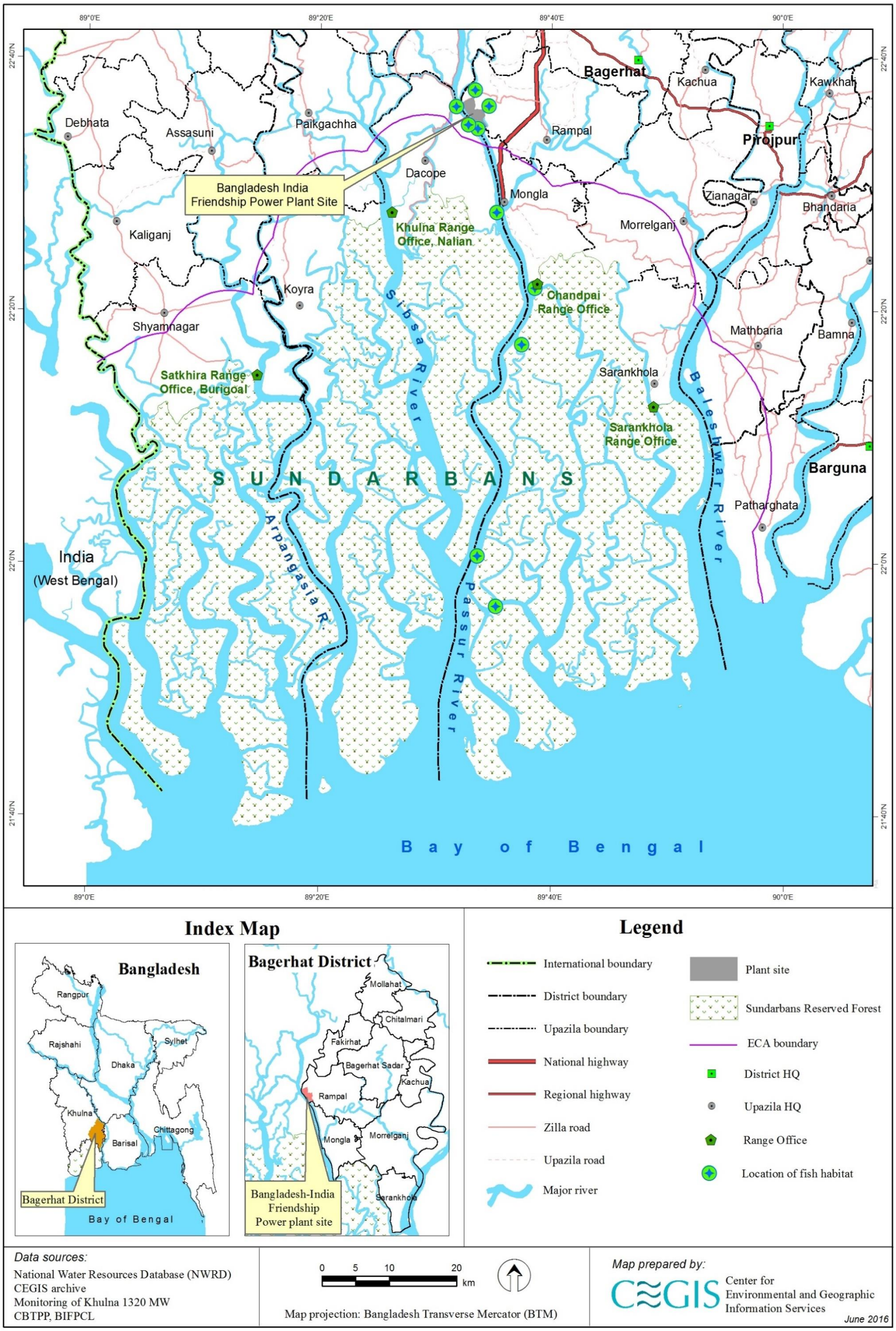


Figure 3.1: Fisheries Resources monitoring locations

3.1.4 Status of monitoring

Followed by the first, second, third and fourth quarter monitoring of the 2014-15, 2015-16 and 2016-17 as well as first and second quarter of 2017-18, third quarter monitoring of 2017-18 (15th quarter in total) was conducted during the period of April, 2018. No fishing activities were observed in Haldikhali Khal (B), Bagha Khal (D), Harbaria Khal (E) and Jongra Khal (F) during field visit in this monitoring.

3.1.5 Fish Habitat Status

Fish habitat status has also varied in the view of habitat classification and habitat use pattern of different life stages of different fish species.

3.1.6 Habitat Classification

Habitat classification was analyzed by using the length-wise distribution of different fish species in the sampling sites. The length of different life stages of fish species was identified and evaluated from literature review. Linkage distance was calculated with the similarity in distribution. The entire stretch of the Passur River System consists of three major behavioral habitats. The sampling sites were classified on the basis of abundance of different life stages of fish species in those habitats. The following tables shows the classification of seven sampling sites in respect of habitat uses for previous quarters of fisheries monitoring (**Table 3.2**).

Table 3.2: Classification of habitat use of seven (07) sampling sites

Monitoring Quarter	Type of Habitat Use
1st QMR (April, 2014)	Grazing Ground; Grazing and Breeding Ground
2nd QMR (July, 2014)	Grazing Ground; Spawning and Nursery Ground
3rd QMR (October, 2014)	Grazing Ground; Grazing and Breeding Ground; Spawning, Nursery and Grazing Ground
4th QMR (January, 2015)	Grazing Ground; Grazing and Breeding Ground; Spawning, Nursery and Grazing Ground
5th QMR (April, 2015)	Grazing Ground; Nursery Ground; Spawning and Nursery
6th QMR (August, 2015)	Grazing, Breeding Ground; Spawning, and Nursery Ground
7th QMR (October, 2015)	Grazing Ground; Nursery Ground and Growing and Feeding
8th QMR (January, 2016)	Nursery and Feeding Ground; Growing and Feeding
9th QMR (April, 2016)	Spawning and Nursery Ground; Feeding and Growing Ground
10th QMR (July, 2016)	Nursery Ground; Feeding and Breeding Ground
11th QMR (October, 2016)	Breeding and Spawning Ground; Feeding and Grazing Ground
12th QMR (January, 2017)	Grazing and Spawning Ground; Nursing Ground
13th QMR (April, 2017)	Grazing and Feeding Ground; Nursing Ground
14th QMR (October, 2017)	Grazing and Feeding Ground; Nursing Ground
15th QMR (January, 2018)	Grazing and Feeding Ground; Nursing Ground
16th QMR (April, 2018)	Grazing and Feeding Ground; Nursing Ground

During the third quarterly monitoring of 2017-18 (16th quarter) three major habitats - i) Feeding ground, ii) Growing ground for juvenile fishes and iii) Nursing ground for fry fishes were also identified as same as found in last two quarter monitoring shown in the **Figure 3.2**

Feeding Ground

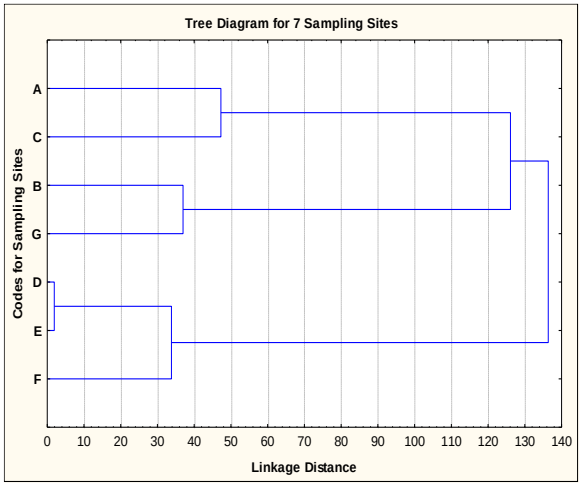
Among the sampling sites, Akram Point (A) was identified as the feeding ground for abundance of large-sized adult fishes.

Growing Ground

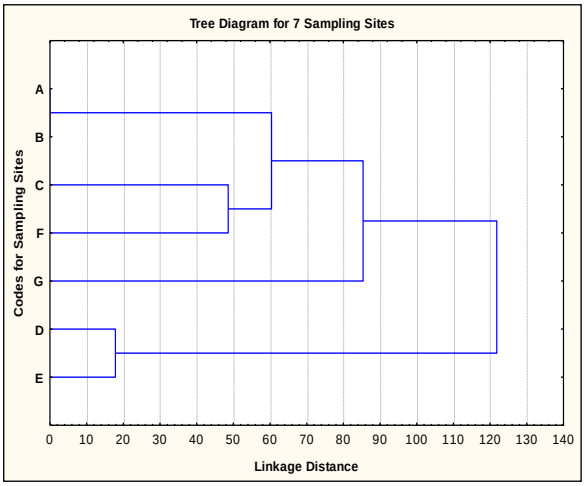
Among the sampling sites, Charaputia Khal (C) and Mongla Point were identified as the feeding ground for abundance of juvenile fishes.

Nursing Ground

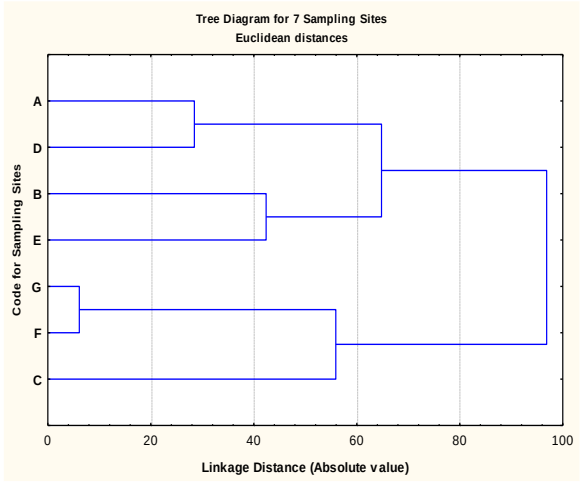
Among the sampling sites, mainly the Sheola Khal at Chandpai (G), Maidara-Passure Confluence (I) and Chalna Point (J) were identified as the nursing ground.



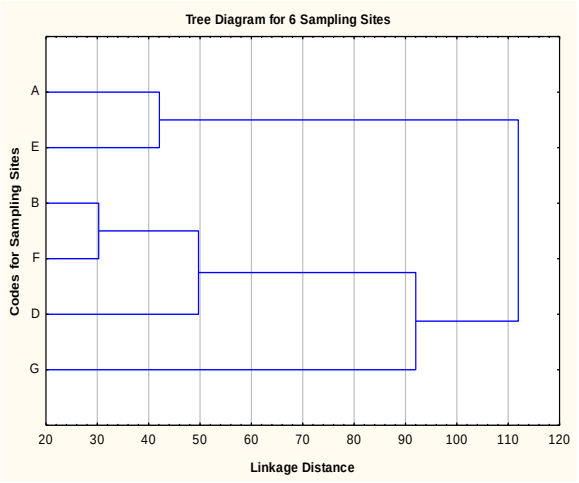
1st Monitoring, April, 2014



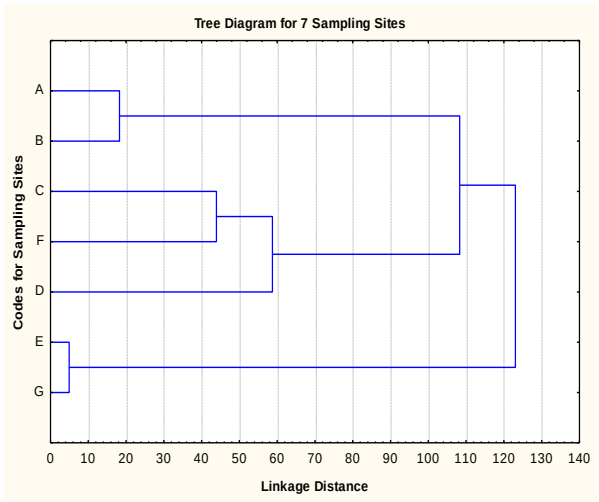
2nd Monitoring, July 2014



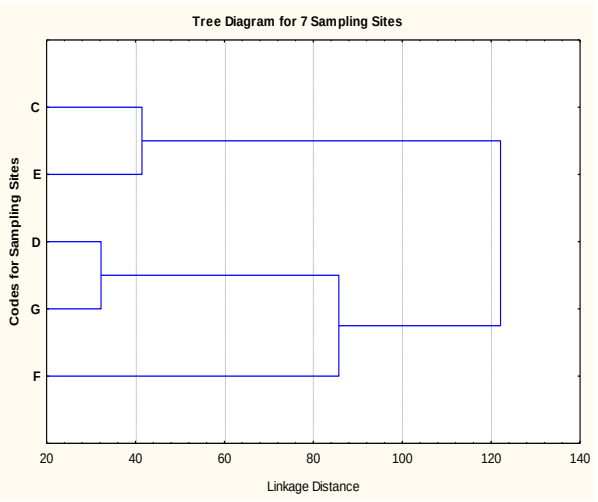
3rd Monitoring, October, 2014



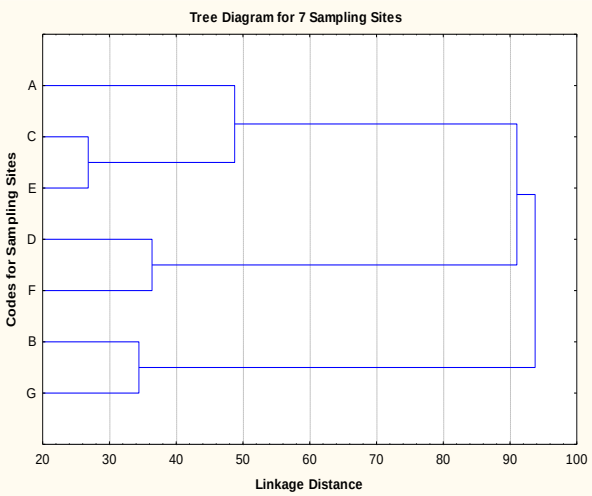
4th Monitoring, January 2015



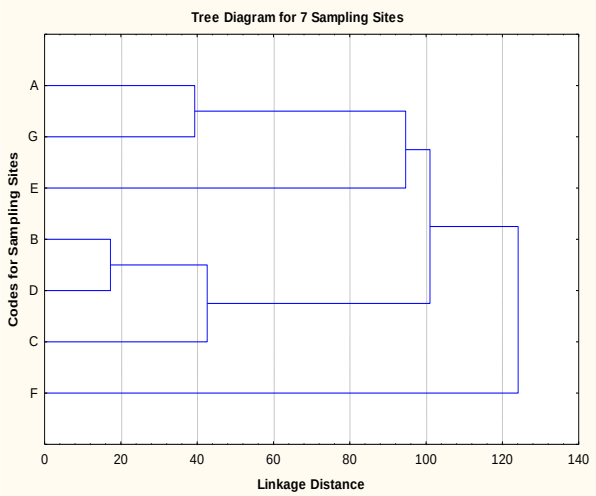
5th Monitoring, April, 2015



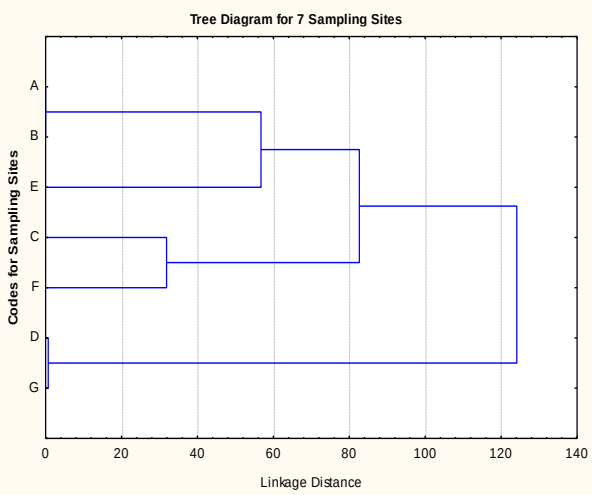
6th Monitoring, August, 2015



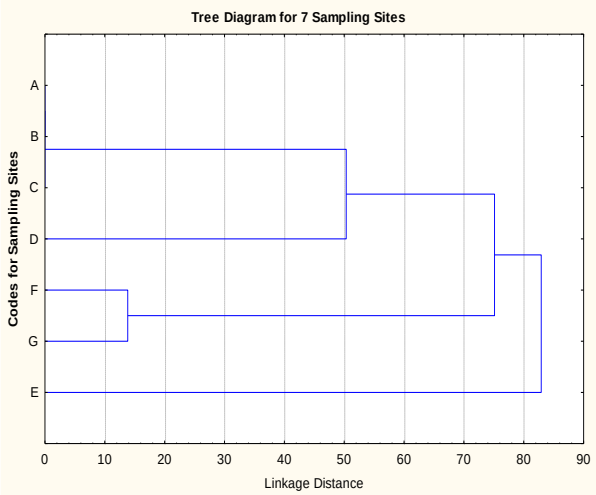
7th Monitoring, October, 2015



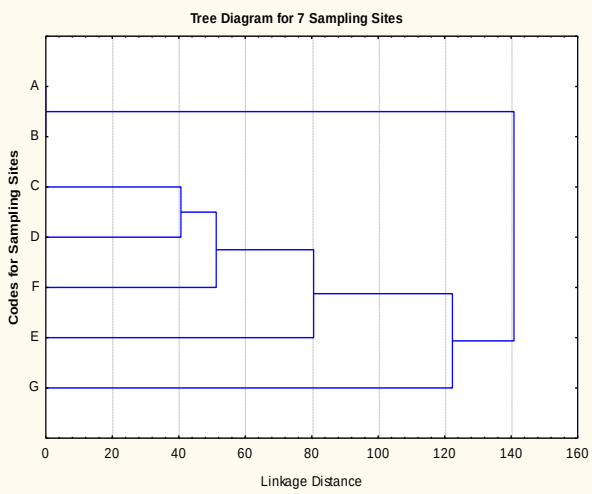
8th Monitoring, January, 2016



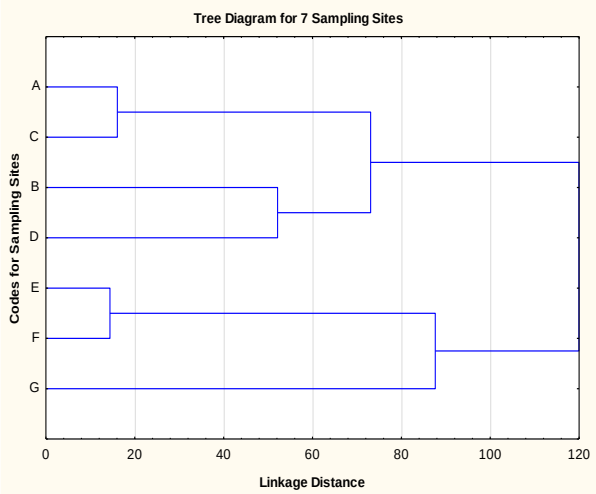
9th Monitoring, April, 2016



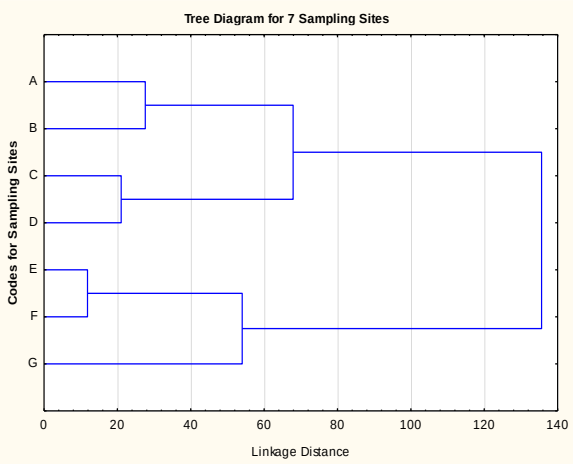
10th Monitoring, July, 2016



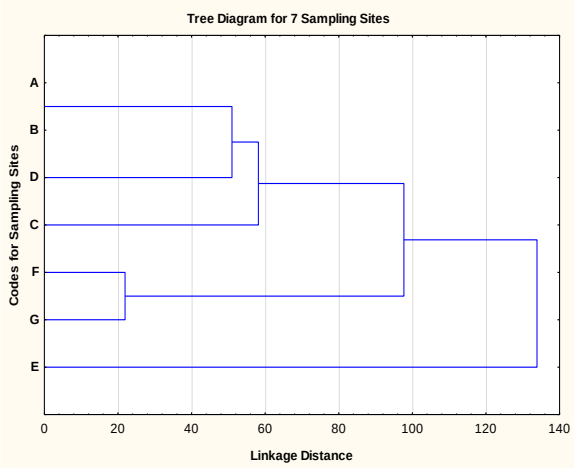
11th Monitoring, October, 2016



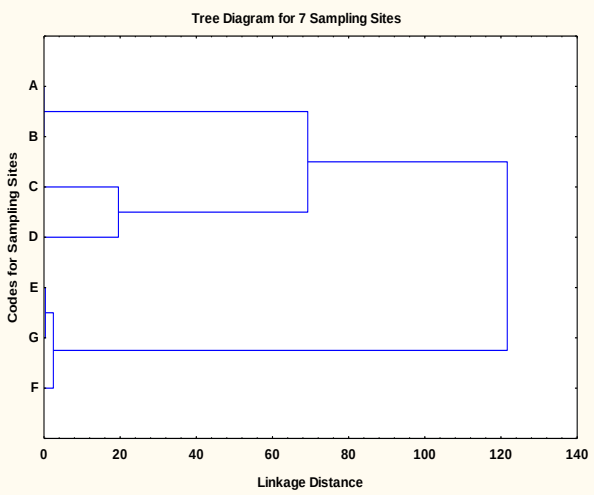
12th Monitoring, January, 2017



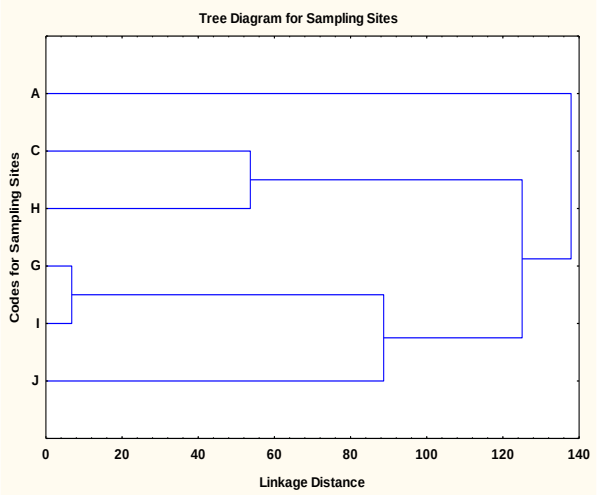
13th Monitoring, April, 2017



14th Monitoring, October, 2017



15th Monitoring, January, 2018

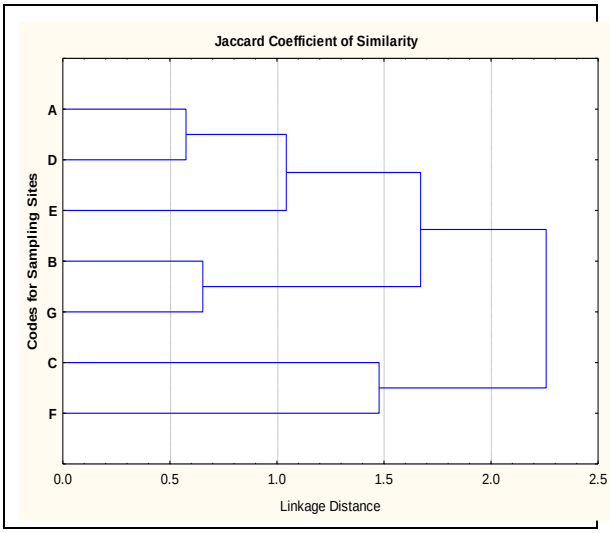


16th Monitoring, April, 2018

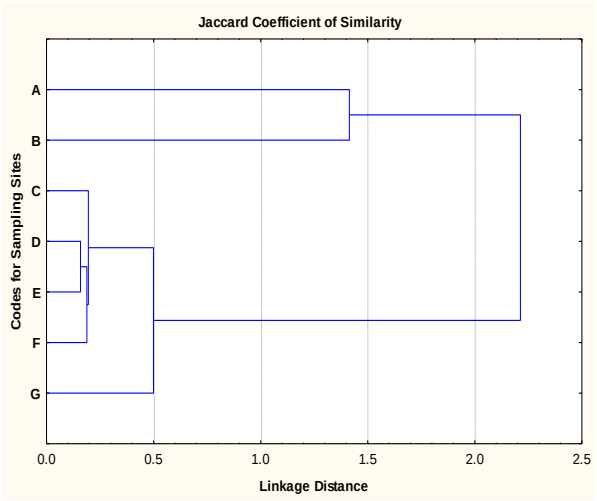
(Note: Life stage is identified through length measurement of the fish individuals)

Figure 3.2: Habitat Classification on the basis of Different Life Stages of Fish Species

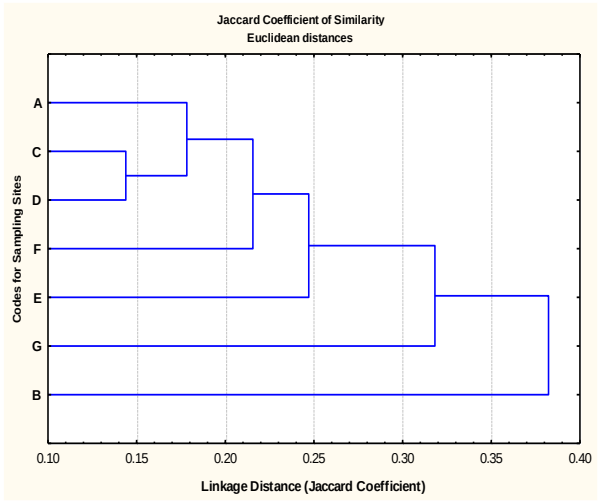
The dendogram is indicated the distances among the JI (Jaccard Coefficient Index) indices which are opposite to the JI values. It was found that the length-wise distribution relationship varied not only with the seasons but also with the year to year. In this third quarterly of the monitoring in 2017-18 (15th), the JI value between Sheola at Chandpai (G) and Maidara (I) sampling sites was also the highest (**Figure 3.3**) which indicates the maximum similarity in species occurrence between these two sites out of ten (10) sampling sites.



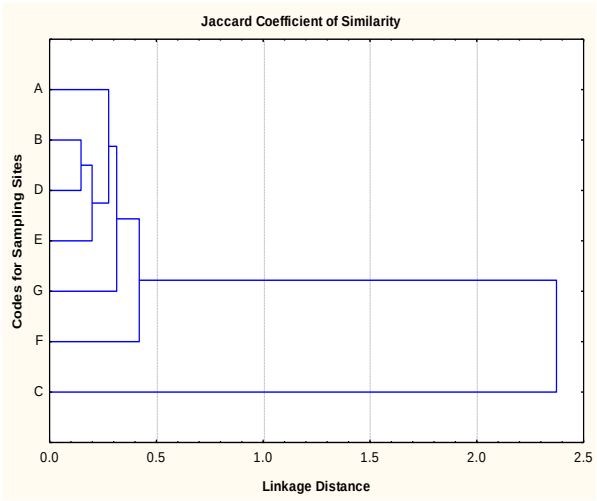
1st Monitoring, April, 2014



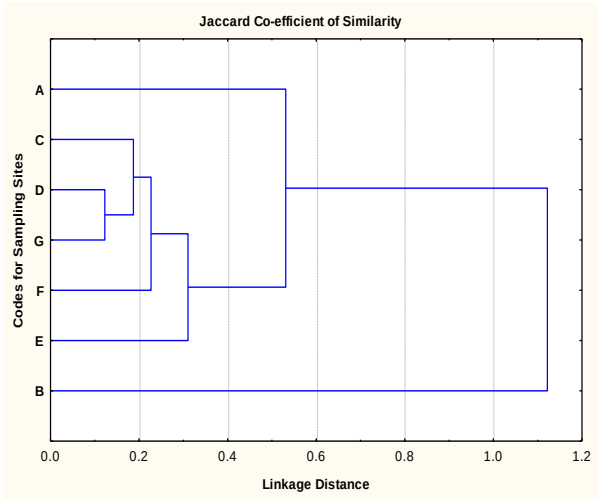
2nd Monitoring, July 2014



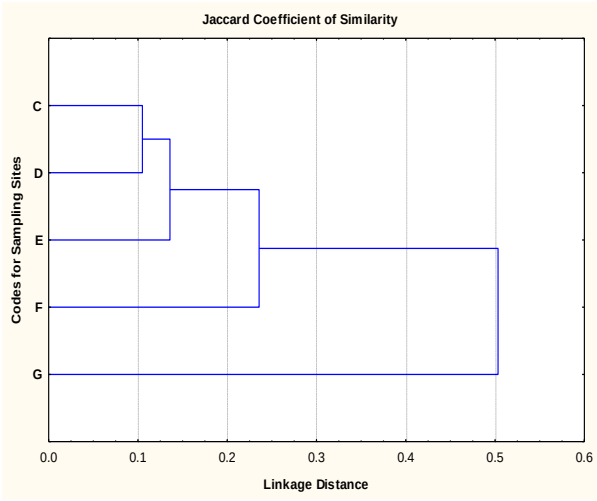
3rd Monitoring, October, 2014



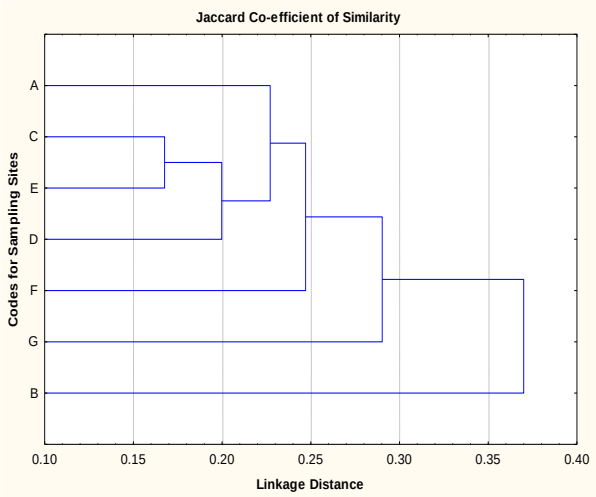
4th Monitoring, January 2015



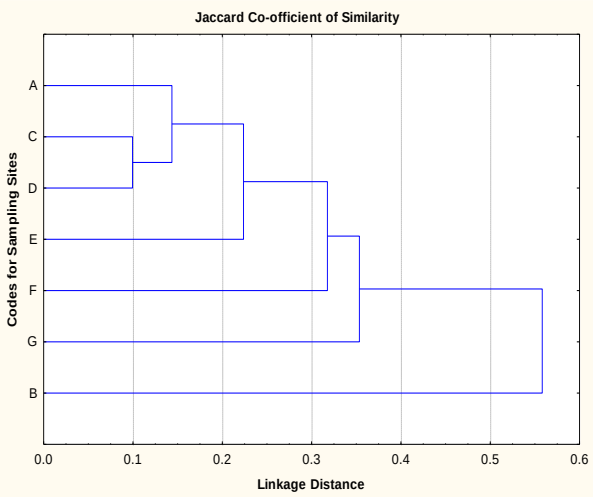
5th Monitoring, April, 2015



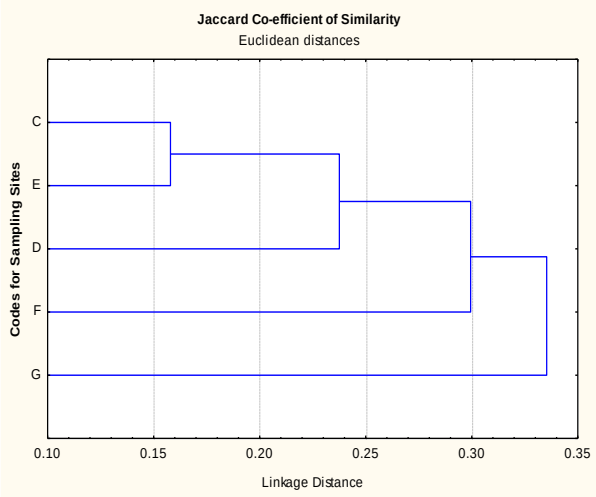
6th Monitoring, August, 2015



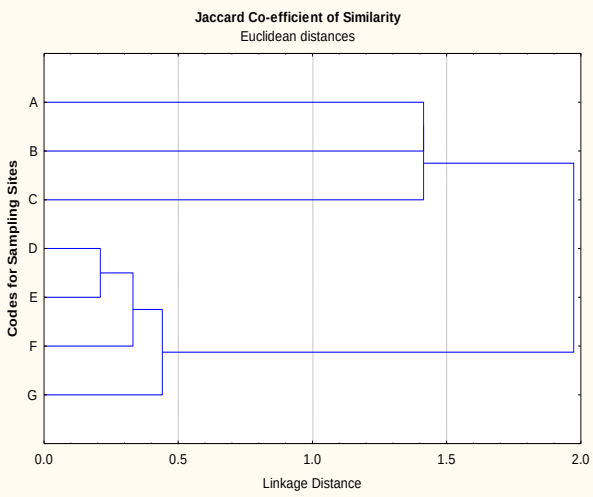
7th Monitoring, October, 2015



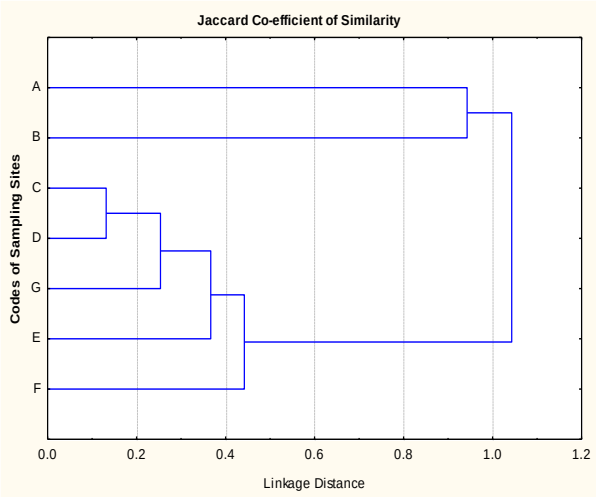
8th Monitoring, January, 2016



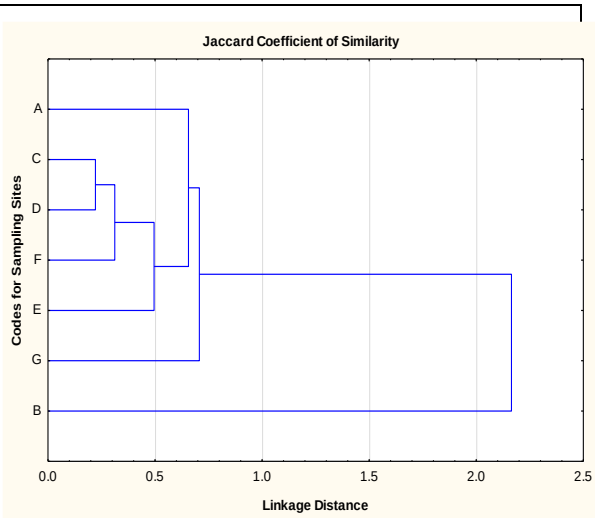
9th Monitoring, April, 2016



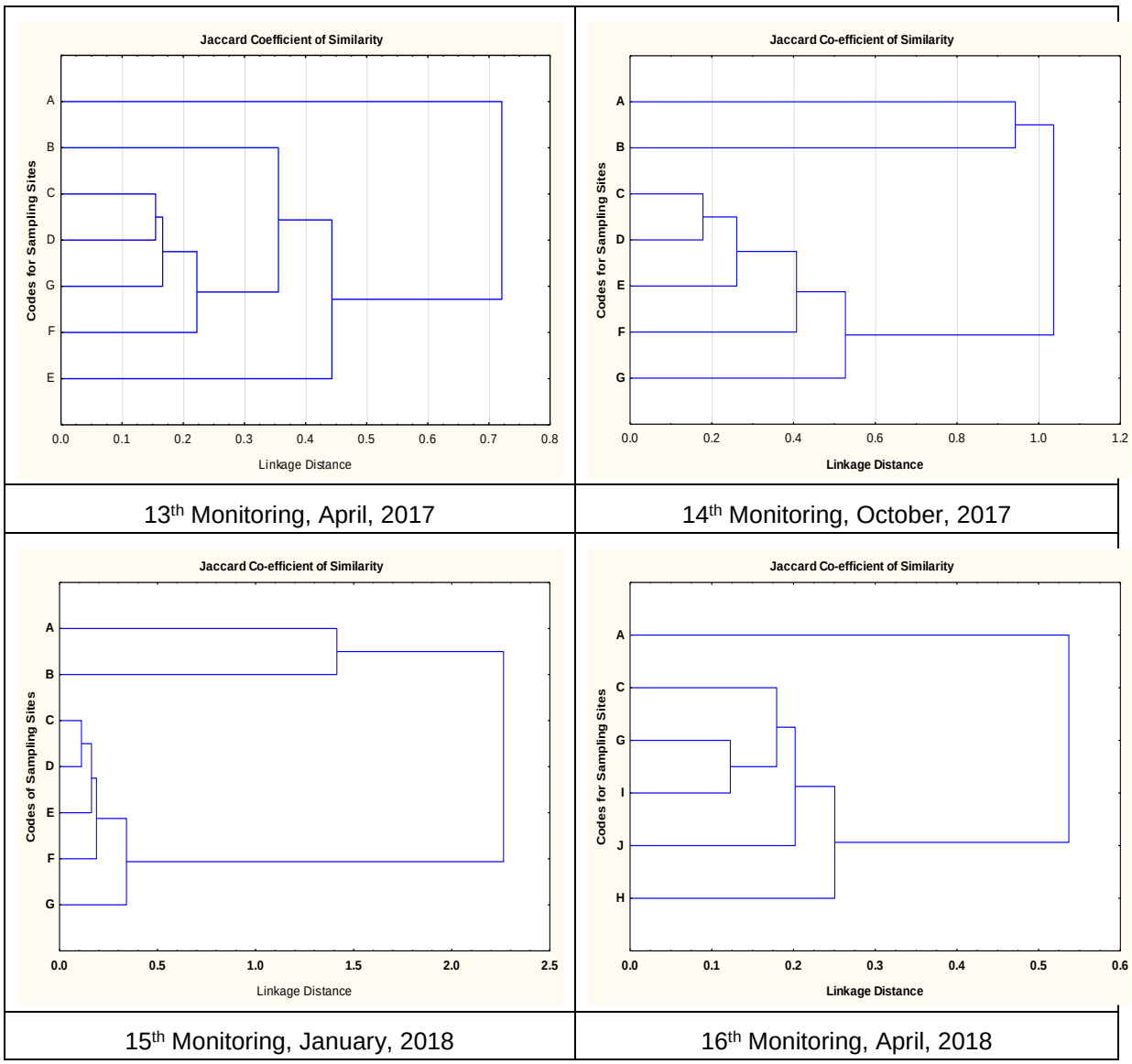
10th Monitoring, July, 2016



11th Monitoring, October, 2016



12th Monitoring, January, 2017



13th Monitoring, April, 2017 | 14th Monitoring, October, 2017

15th Monitoring, January, 2018 | 16th Monitoring, April, 2018

Figure 3.3: Dendogram Showing Similarity in Binary Species Composition in seven sampling sites

Habitat Suitability Index (HSI)

Habitat Suitability Index (HSI) was determined for the year of 2014-15 and 2015-16 considering the exposure to water quality and the production performance of different fish species. Production performance was measured through considering length-structured production assessment model (E. L. Cadima, 2003). Suitability analysis was conducted by applying Iyengar and Sudarshan (1982) developed model. All data was normalized through using UNDP developed normalization equation (UNDP, 2006).

In the first year of monitoring, Sheola khal at Chandpai was found as the most suitable habitat for fish species among Passur River System. Sheola khal has also been identified as the most suitable in second year which is followed by Harbaria, Akram Point, Haldikhali, Mongla Point, Maidara and Chalna Point (**Table 3.3**).

Table 3.3: Habitat Suitability Index (HSI) for selected spot in the study area

Sampling Sites	Location	HSI* (2014-2015)	HSI (2015-2016)	HSI (2016-2017)
A	Akram Point	0.334	0.56	0.45
B	Haldikhali	0.408	0.54	0.51
C	Harbaria	0.226	0.64	0.85
D	Chandpai	0.520	0.72	0.81
E	Mongla Port	0.321	0.43	0.45
F	Maidara	0.224	0.25	0.35
G	Botiaghata, Chalna Point	0.218	0.32	0.33

**HSI value is calculated on the basis of life requirement and length-age structured population dynamics model*

Note: The HSI will be calculated on the basis of one year monitoring data

3.1.7 Fish Diversity

Shannon-Weiner Index

In the monitoring year of 2018-19, species evenness also varies among the sampling sites. Highest Shannon-Weiner index was found at Akram Point (0.92) (although very few species were found) indicating most evenly distributed fish species. On the contrary, lowest evenness was found at Maidara (0.21) (shown in the **Table 3.1.3**). It has also been found that both the number of fish species found in in-situ catch and the evenness of their distribution within the sampling sites show high variation with the changing seasonal and yearly bio-physical conditions. The different fish species caught in different catch are shown in **Figure 3.4**.

Fish Species Richness (FSR)

Fish species richness was identified through Simpson's Index1. Considerable difference is noticed in the fish species richness (FSR) in different habitat classes (**Table 3.4** and **Figure 4.5**).

In this monitoring phase, species richness varies with the sampling sites. Maximum FSR was obtained in Sheola Khal at Chandpai (n=11), while very low FSR was recorded at Mongla-Passur Confluence and Chalna Point (n=2). Different scenarios of richness were found in this quarter in comparison to the previous monitoring years. Among habitats in upstream portions of the Passur River, Mongla Point was home to a rich assemblage of Chela and Golda Chingri; Maidara River was of Chali Chingri; and Chalna Point was of Nona Chingri and Bele. Among the habitats in down stream portions, Chandpai was rich in Chela, Bele, Horina Chingri, Lal Chewa and Motka Chingri; Harbaria was in Motka Chingri, Mutkura, Golda Chingri, Gagra, Chami Chingri and Kain Magur; Charaputia was in Chaka Chingri, Golda Chingri, Poma and Goda Katali Chingri and Akram Point was in Jaba, Lakkha and Vetki.

[1]Simpson's index is a method to calculate the community characteristics of fish in a particular habitat. It is mainly used to know about the species richness of a particular habitat to tell how many species are rich in their abundance. The value of this index ranges from 0 to 1. There is other kind of value which is described in the methodology section. The second value is mainly used tomeasure the species richness in the sampling sites.

Table 3.4: Site Wise Species Diversity using Shannon–Weiner Index

Site	Species No													Shannon-Weiner Index*											
	1st QM	2nd QM	3rd QM	4th QM	5th QM	6th QM	7th QM	8th QM	9th QM	10th QM	11th QM	12th QM	13th QM	1st QM	2nd QM	3rd QM	4th QM	5th QM	6th QM	7th QM	8th QM	9th QM	10th QM	11th QM	12th QM	13th QM
A	33	0	13	7	3	0	10	15	0	0	1	2	2	0.5	0	0.7	0.6	1	-	0.6	0.4	0	0	0	0.9	0.74
B	12	0	24	14	0	0	11	3	0	0	1	0	5	0.9	0	0.6	0.4	0	-	0.6	0.6	0	0	0	0	0.37
C	2	12	9	0	11	26	18	24	17	0	23	10	18	0.3	0.77	0.4	0	0.8	0.6	0.5	0.7	0.6	0	0.6	0.6	0.79
D	12	22	15	26	27	24	20	25	8	19	32	27	15	0.3	0.78	0.7	0.5	0.7	0.7	0.5	0.7	0.6	0.6	0.6	0.8	0.76
E	7	13	10	11	6	16	9	9	15	12	5	4	4	0.4	0.6	0.8	0.8	0.2	0.7	0.9	0.4	0.7	0.5	0.7	0.7	0.51
F	3	13	6	4	10	8	14	6	7	5	7	12	9	0.8	0.77	0.5	0.6	0.7	0.4	0.8	0.7	0.8	0.7	0.9	0.9	0.53
G	6	3	5	7	18	3	8	6	6	4	12	3	15	0.7	0.82	0.7	0.7	0.2	1	0.7	0.8	0.6	0.9	0.2	0.7	0.67

Site	Species Number			Shannon-Weiner Index		
	14th QM	15th QM	16th QM	14th QM	15th QM	16th QM
A	0	0	3	0	0	0.92
B	0	0	0	0	0	0
C	0	0	12	0	0	0.69
D	0	0	0	0	0	0
E	0	0	0	0	0	0
F	6	17	0	0.85	0.81	0
G	81	29	21	0.62	0.74	0.78
H	112	13	3	0.54	0.21	0.55
I	3	13	12	0.88	0.33	0.21
J	4	5	10	0.78	0.32	0.54

**According to Shannon-Weiner Index, 0-0.30: Low diversity/equally distribution (VH); 0.31-0.50: Moderate Diversity (M); 0.51-0.80: High Diversity (HD) and 0.80-1.0: Very High Diversity (VHD)*

Table 3.5: Site wise Rich Species Number

Site	Location	No. of Rich Species											
		2014-2015				2015-2016			2016-2017				
		1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	11th	12th
A	Akram Point	4	0	4	3	3	-	3	2	0	0	1	2
B	Haldikhali	7	0	4	2	0	-	3	2	0	0	1	0
C	Harbaria	1	5	2	0	4	4	3	6	4	0	4	2
D	Chandpai	2	2	5	4	5	8	3	7	4	6	3	7
E	Mongla Point	1	10	4	5	3	6	4	2	4	7	3	2
F	Maidara	3	6	2	2	4	2	4	2	3	2	3	3
G	Chalna Point	3	3	2	3	1	3	3	4	2	4	1	2

Site	Location	No. of Rich Species			
		2017-18			
		13th	14th	15th	16th
A	Akram Point	2	0	0	4
B	Haldikhali	1	0	0	0
C	Charaputia	0	0	0	4
D	Bagha	0	0	0	0
E	Harbaria	7	6	6	0
F	Jongra	0	0	0	0
G	Chandpai	6	5	7	11
H	Mongla Point	2	2	1	2
I	Maidara	1	3	2	1
J	Chalna Point	4	2	1	2

Rupchanda in 1stQuarter of 1st Year

Chela in 2nd Quarter of 1st Year

Phesa, Chela, Hilsa, Gagla Tengra

Harina Chingri

Fish Species at 3rd Quarter Monitoring of 1st Year 2014-15

Amadi Chela

Banspata

Fish Species in Upstream of Passur River at 4th Quarter Monitoring of 1st Year 2014-15

Adult Poma in Chalna Point

Fry of Bagda at Chalna Point

Meth and Gagra Tengra

Gagra Tengra

Fish species found in 1st quarter of the second monitoring year (2015-16)

Mutkure and Paissa

Khorsula

Menu

Vetki

Fish species found in 2nd quarter of the second monitoring year (2015-16)

Gulsha Tengra, Bele, Aswine Bele and Paissa

Gangania

Telcupa

Golda

Kain Magur

A Mix of Culture and Capture Fishes

Fish species found in 3rd quarter of the second monitoring year (2015-16)

Tau Paissa

Bele

Horina Chingri

Gulsha and Gagra Tengra

Jaba

Female Gulsha Tengra

Fry Fishes

Chata Bele

Fish species found in 4th quarter of the second monitoring year (2015-16)

Kain Magur

Banspata, Vetki, Koidda and Poma

Fish species found in 1st quarter of the 3rd monitoring year (2016-17)

Poma and Tapsi

Tapsi

Fish species found in 2nd quarter of the 3rd monitoring year (2016-17)

Miscellaneous Fish Species

Hilsha

Tapse

Poma and Tapse

Fish species found in 3rd quarter of the 3rd monitoring year (2016-17)

Catch Sample

Juvenile of Kain Magur

Khayra Chela

Jevenile of Pangas

Brood Paissa

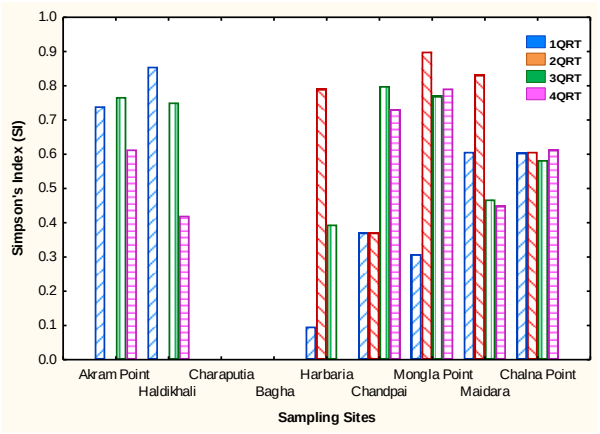
Paissa and Gagra Tengra

Aswene Bele, Daitna, Tapse and Chitra

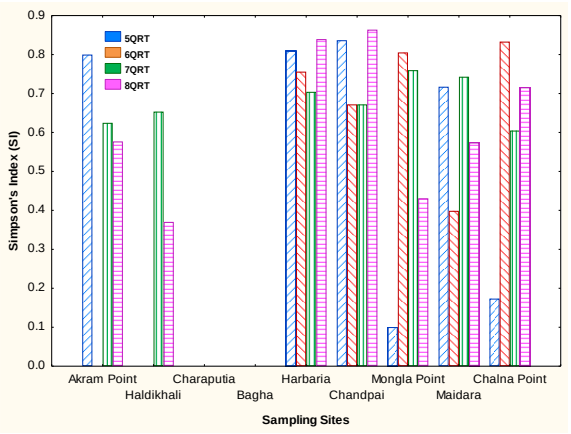
Dry Fish of Khayra Chela

Fish species found in 4th quarter of the 3rd monitoring year (2016-17)

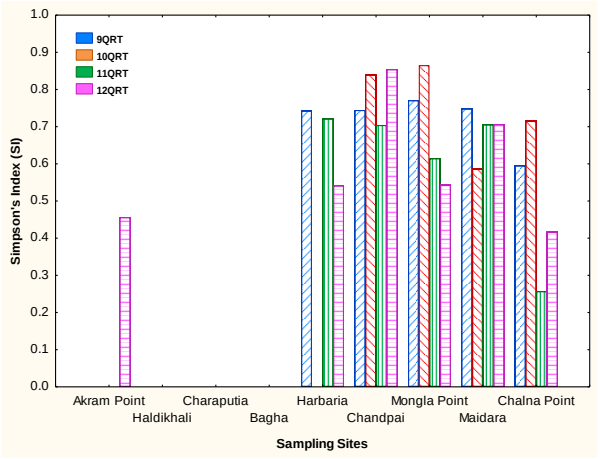
Figure 3.4: Length-Wise Distribution of Fish Species



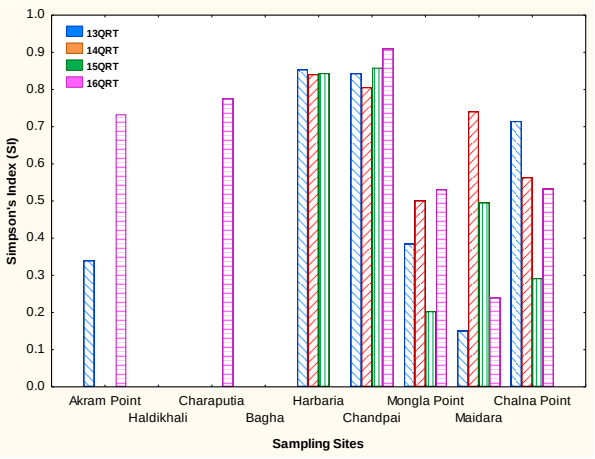
2014-2015



2015-2016



2016-2017



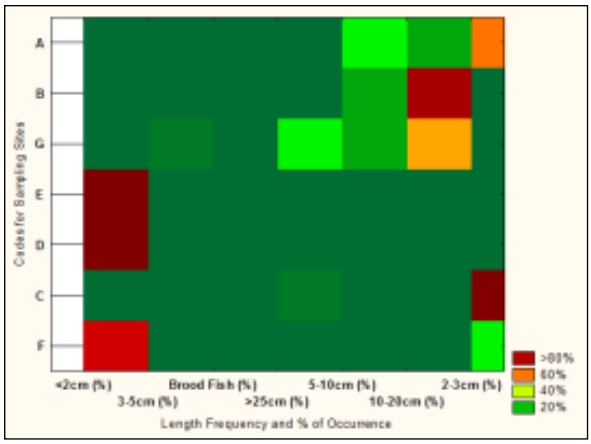
2017-18

(FSR is identified though Simpson's Index)

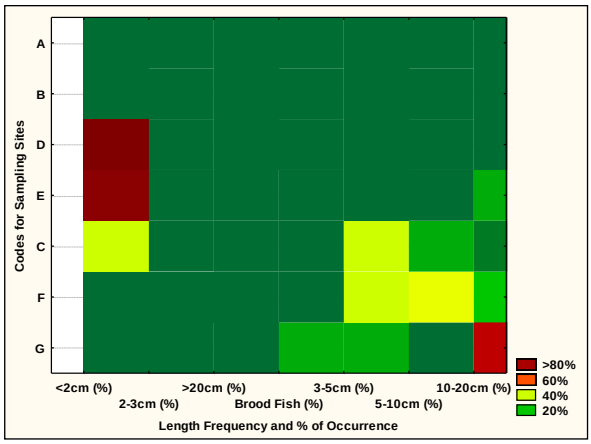
Figure 3.5: Site-wise fish species richness (FSR) in the Passur River System.

3.1.8 Fish Community Structure

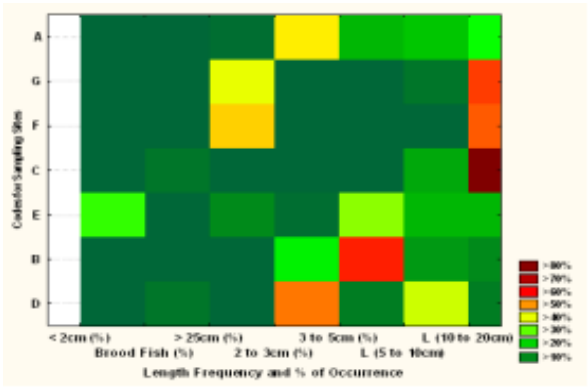
Fish community structure was analyzed through counting the length-wise fish individuals (**Figure 3.4**). The following Table D.2 and D.3 of **Appendix IV** and **Figure 3.5** for 16th quarter of monitoring year of 2018-19 show that fries for fin fish were widely being distributed among the upper stretches (Chalna Point to Mongla-Passur Confluence) and juveniles and adult age group in Sheola Khal at Chandpai and Charaputia Khal) of the Passur River system. Among these Banspata, Bele, Daitna, Dogri, Jaba, etc fishes were more among these two sampling sites. Moreover, fries fishes were dominant at Maidara and Mongla Point. Moreover, large sized adult fishes of Lakkha, Jaba and Vetki were observed at Akram Point in this quarter.



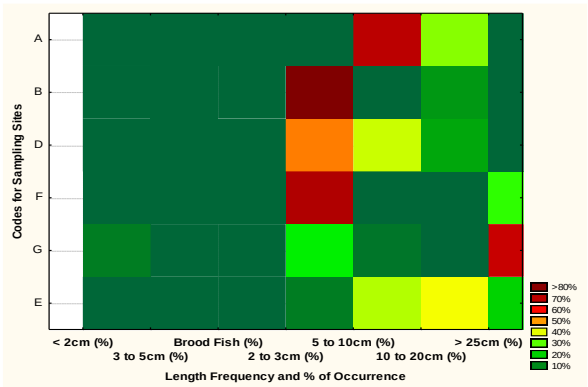
1st Monitoring, April, 2014



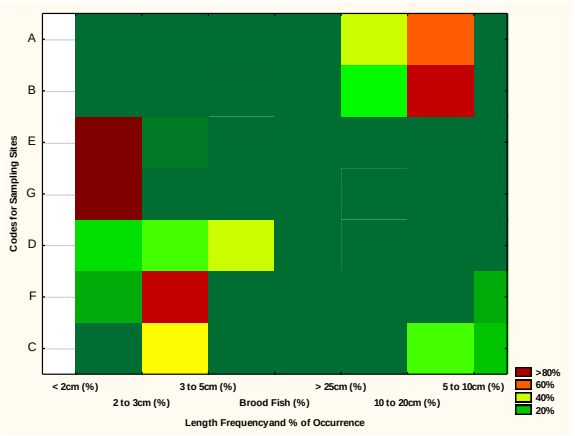
2nd Monitoring, July 2014



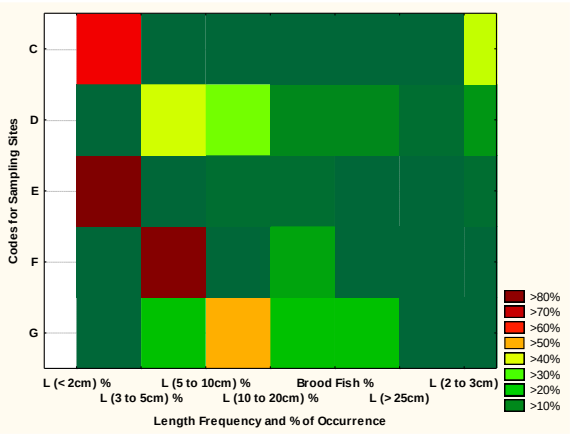
3rd Monitoring, October, 2014



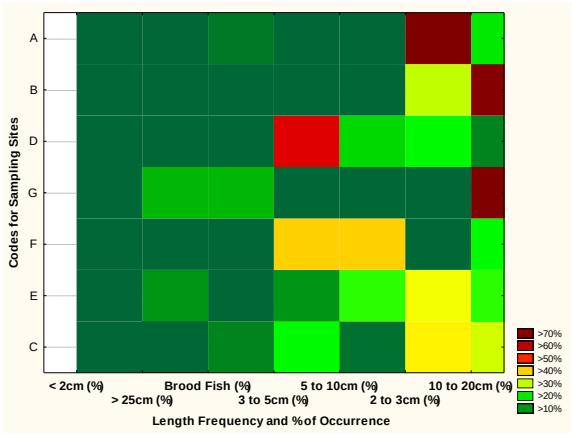
4th Monitoring, January 2015



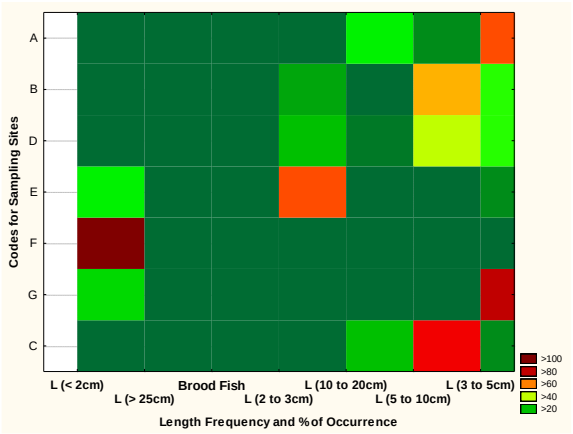
5th Monitoring, April, 2015



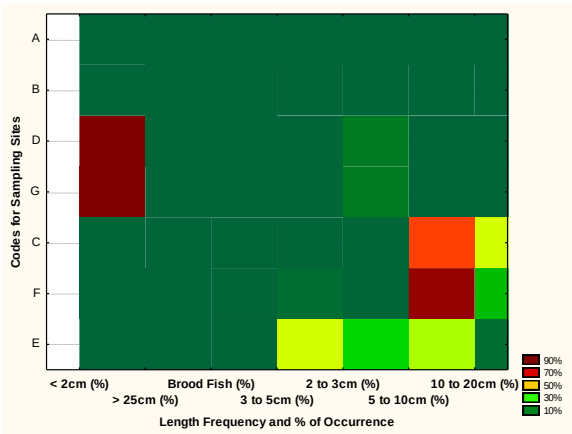
6th Monitoring, August, 2015



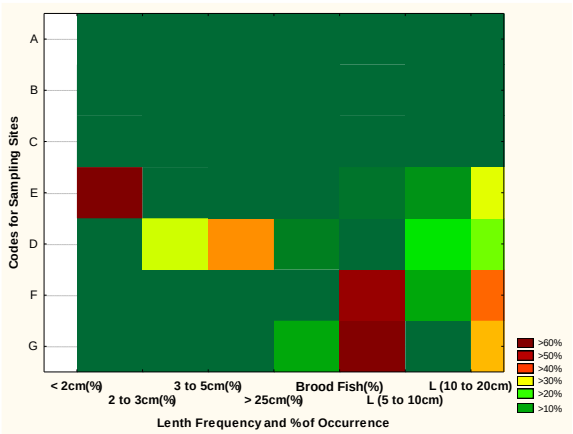
7th Monitoring, October, 2015



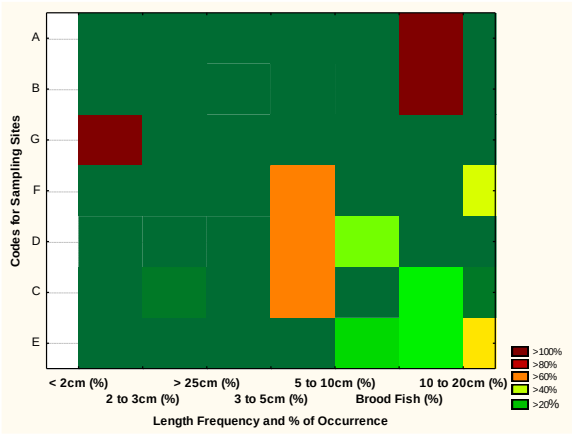
8th Monitoring, January, 2016



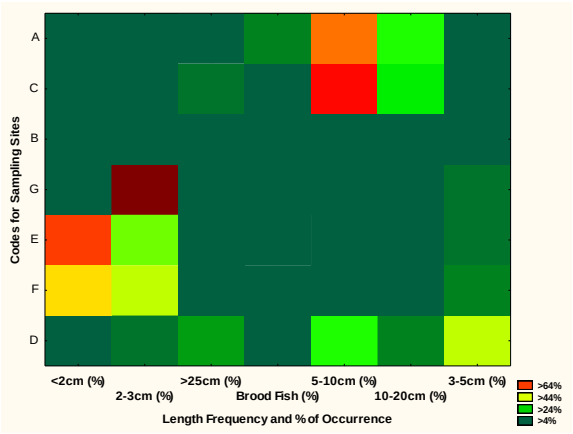
9th Monitoring, April, 2016



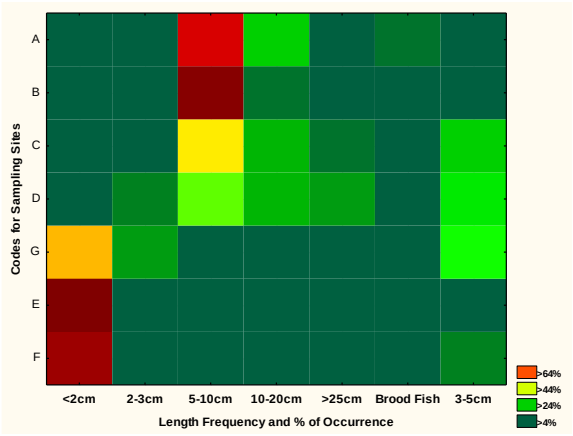
10th Monitoring, July, 2016



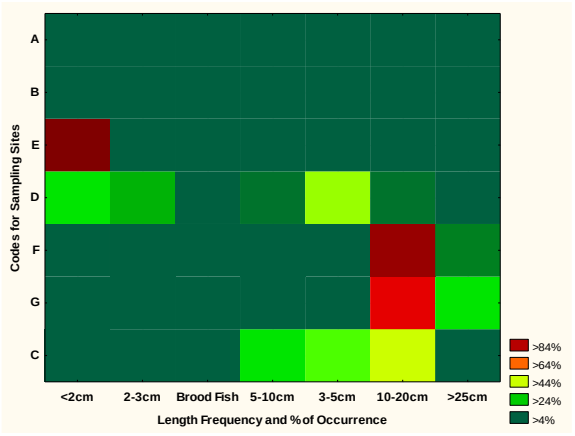
11th Monitoring, October, 2016



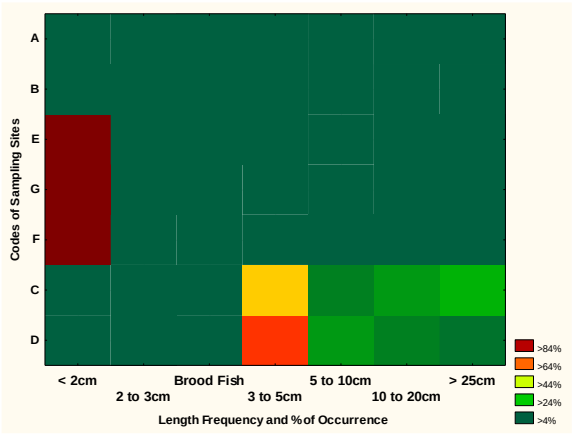
12th Monitoring, January, 2017



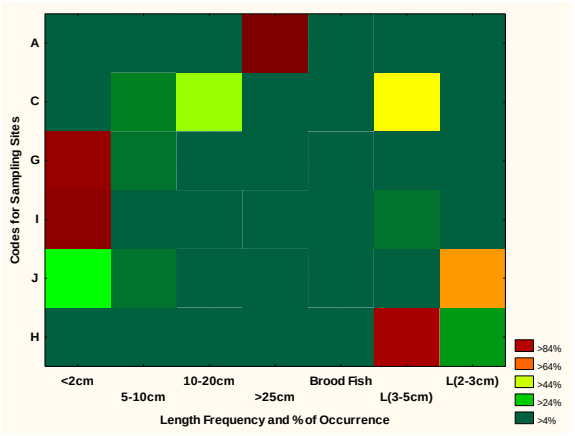
13th Monitoring, April, 2017



14th Monitoring, October, 2017



15th Monitoring, January, 2018



16th Monitoring, April, 2018

Figure 3.6: Habitat Distribution of Different Life Stages of Fish Species

Note: N.B.: Colour ranges from deepest green to deepest red. 0-4.99% Occurrence signifies Deepest Green; 5-9.99%-Shaded Green; 11-14.99%-Normal Green; 15-19.99%-Light Green; 20-24.99%; 25-29.99%-Lightest Green; 30-34.99%; 35-39.99%; 40-44.99; 45-49.99; 50-54.99-Light Magenta; 55-59.99-Deep Magenta; 60-64.99%; 65-69.99%; 70-74.99%; 75-79.99%-Light Red; 80-84.99%-Deep Red; 85-89.99%; 90-94.99%; 95-100%-Deepest Red

3.1.9 Fish Migration

Migratory Species Diversity

Migratory species were identified by analyzing the common species available in the regular catch from the sampling sites. Fish species like Chela attains the maximum abundance among the migratory fish species observed in the 16th quarter of monitoring year of 2018-19. The relative abundance of the migratory species is give below in the **Figure 3.7**.

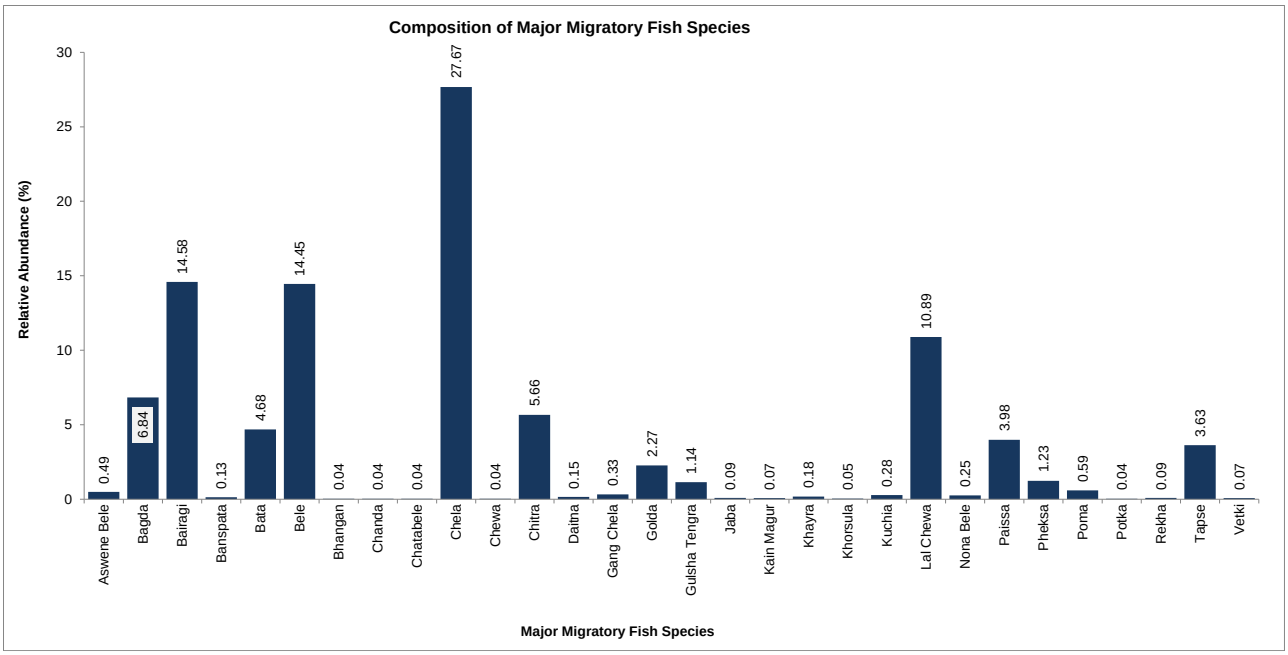


Figure 3.7: Relative abundance of major migratory fish species in sampling sites

Migration Extent, Time and Purpose

Major fish species showed interesting pattern in distribution for exploiting different purposes mentioned in the following table all along the sampling sites. Golda, Pheksa, Paissa, Kuchia, Chitra, Bele, and Bagda species were found in maximum sampling sites. Among these species, Golda and Chitra were observed to migrate long distance (Table D.4 of Appendix IV). Fries in case of Chitra and Rekha fish, however, comes long distance due to drifting migration through tidal water.

3.1.10 Shrimp/Fish Farm

Three farms situated in the direct impact zone of Power Plant were surveyed for monitoring shrimp/fish farm. Stocking pattern of the shrimp/fish farm is one of the major issues for successful production because of having natural genetic resources from the wild source of the Passur River System. Moreover, maximization of growth rate and minimization of mortality rate should be ensured for getting more economical output from the farms. So, stocking pattern, growth rate and mortality rate and its causes were surveyed intensively.

3.1.11 Stocking Pattern

It is reported by the farmers of the shrimp farms that availability of wild seed (PL) has been declining over the years. For this reason, most of the farmers are compelled to stock hatchery produced seeds along with some wild seeds in their farms. However, most of the stocks are still collected from wild source of the Passur River in this monitoring phase.

In this monitoring year, highest stocking was observed in case of gher in Kapasdanga and lowest in Chunkuri-2 (Table 3.6).

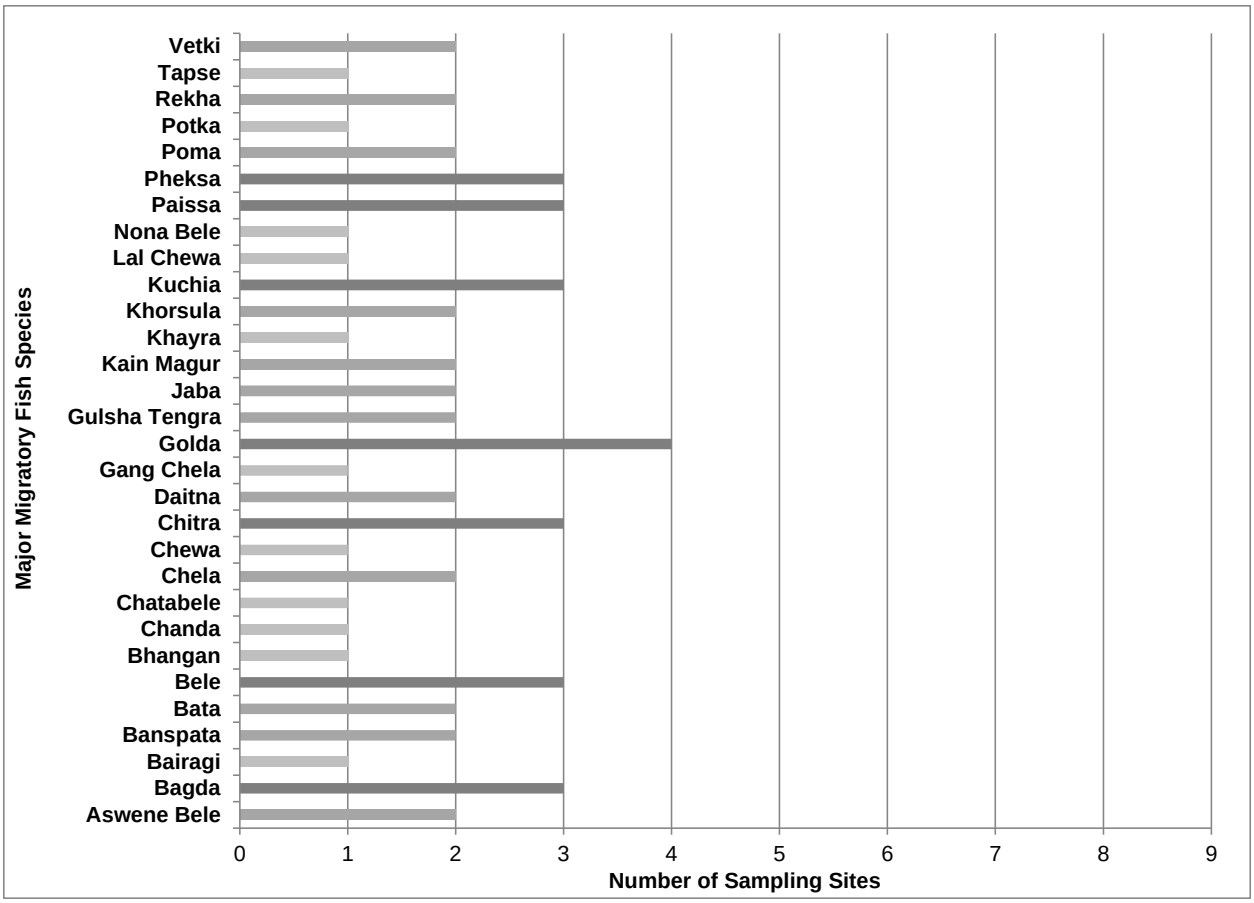


Figure 3.8: Migration extent of major migratory fish species in sampling sites

Table 3.6: Stocking Pattern of Fish/Shrimp farm

Location	Area (ha)	Fish Species	Stocking Density (No/ha)	Stocking Date
Rajnagar	42.09	Bagda	11,879	February
		Golda	238	
		Rui	36	
		Grass Carp	23	
		Catla	261	
		Tilapia	16,631	
		Horina	-	
		Gusha	-	
		Paissa	-	
		Khorulla	-	
		Vetki	-	
		Gulsha	-	
		Bele	-	
Sub-total =			29,068	
Kapashdanga-Muralia	115.7	Bagda	14,524	January and February
		Golda	795	
		Rui	321	
		Tilapia	34	
		Nilotica	88	

Location	Area (ha)	Fish Species	Stocking Density (No/ha)	Stocking Date
		Khorulla	86	
		Mrigel	12	
		Catla	17	
		Grass Carp	5	
		Common Carp	160	
		Sarpunti	156	
		Horina	17,286	
		Chali Chingri	-	
		Bele	-	
		Vetki	-	
		Tengra	-	
		Paissa	-	
		Tairel	-	
		Pheksa	-	
Sub-total =			33,484	
Chunkuri-2	6.07	Bagda	8,237	January
		Tilapia	-	
		Tengra	-	
		Paissa	-	
		Horina Chingri	-	
Sub-total =			8,237	

Source: CEGIS Field Survey, 2018

3.1.12 Shrimp/Fish Growth Rate and Mortality

During the 16th quarter of the monitoring tiers, the highest growth rate has been observed in the Ghers at Kapasdanga and lowest at Chunkuri-2. The highest mortality has been reported in case of gher in Chunkuri-2 due to viral infection (**Table 3.7).**

Table 3.7: Growth Rate and Mortality of Fish/Shrimp

Gher No.	1st QM		2nd QM		3rd QM		4th QM		5th QM		6th QM		7th nQM		8th QM		9th QM		10th QM		11th QM		12th QM		13th QM	
	Growth Rate (cm/day)	Mortality (%)	Growth Rate (cm/day)	Mortality (%)	Growth Rate (cm/day)	Mortality (%)	Growth Rate (cm/day)	Mortality (%)	Growth Rate (cm/day)	Mortality (%)	Growth Rate (cm/day)	Mortality (%)	Growth Rate (cm/day)	Mortality (%)	Growth Rate (cm/day)	Mortality (%)	Growth Rate (cm/day)	Mortality (%)	Growth Rate (cm/day)	Mortality (%)	Growth Rate (cm/day)	Mortality (%)	Growth Rate (cm/day)	Mortality (%)	Growth Rate (cm/day)	Mortality (%)
1	0.3	15-20	0.2	40	0.25	50	-	-	-	30	0.18	25	0.20	60	-	-	-	-	0.2	20	0.20	60	-	-	-	30
2	0.3	30-35	0.3	94	0.25	10	-	-	-	-	0.14	20	0.15	100	-	-	0.21	15	0.3	40	0.25	50	-	-	-	10
3	0.2	25-30	0.2	25	0.20	65	-	-	-	10	0.15	50	0.25	20	-	-	0.17	30	0.15	30	0.20	30	-	-	-	25

Gher No.	14th QM		15th QM		16th QM	
	Growth Rate (cm/day)	Mortality (%)	Growth Rate (cm/day)	Mortality (%)	Growth Rate (cm/day)	Mortality (%)
1	0.03	50	-	-	0.28	20
2	0.38	35	-	-	0.42	30-45
3	0.02	25	-	-	0.4	50

Source: CEGIS Field Survey, 2014, 2015 & 2016

3.1.13 Fish Production

Capture Fish Production

In 16th quarter monitoring, the highest productivity was found in Sheola at Chandpai (Table 3.1.7). The lowest productivity was found in the Mongla Point, Maidara River and Confluence and Chalna Point. Because all the fry fishes are not considered as catch. Moreover, there was no fishing observed in Haldikhali, Bagha, Harbaria and Jongra.

The present study revealed that the highest catch susceptibility was also found in case of Behundi Jal (4 kg/haul) (**Table 3.8**). The following table also expresses that Net Jal were most frequently used in all upper and middle reaches in Passur River System, especially for fry collection. Charpata Jal was commonly used in the Charaputia Khal. Moreover, the highest total catch was observed in Sheola Khal and lowest in the Mongla Point, Maidara River and Confluence and Chalna Point in this monitoring phase (**Table 3.9**).

Table 3.8: Total Catch in Different Gears in the Sampling Sites

Sl. No	Site	Habitat	Gear Name/Type	Haul Duration (hr)	No of Haul	Total Catch (kg)	kg/haul
A	Akram Point	Kukilmoni Khal	Ber Jal (Vetki Jal)	12	1	17	1.4
B	Haldikhali	Haldekhali Khal	Not Found	12	1	0	0
C	Charaputia	Charaputia Khal	Charpata	12	1	1.5	0
D	Bagha	Bagha Khal	Not Found	3	5	0	0
E	Jongra	Sheola Khal	Not Found	0	0	0	0
F	Harbaria	Harbaria Khal	Not Found	6	900	0	0
G	Chandpai	Sheola Khal	Behundi	6	5	20	4
			Box Net	1	5.5	0	0
			Net Jal	3.13	4.75	0.53	0.11
H	Mongla Point	Passur River	Jhaki Jal	0.58	20	0.33	0.02
I	Maidara	Maidara River	Net Jal	0.7	8	0.13	0.02
J	Chalna Point	Passur River	Net Jal	4	1	1	1

Source: Catch assessment survey, CEGIS (2016-17)

*** Weight of Fry is not considered for catch assessment*

Table 3.9: Total Catch in the Sampling Sites

Sampling Site	Total Catch (kg)												
	1st QM	2nd QM	3rd QM	4th QM	5th QM	6th QM	7th QM	8th QM	9th QM	10th QM	11th QM	12th QM	13th QM
A	28	0	3	28.7	6	0	20	276.2	0	0	10	2	2
B	65	0	1	3.3	0	0	10	12.8	0	0	4	0	0.25
C	1,559	0.5	8	8.7	1.05	0.33	19.5	173.6	2.8	0	2.6	10	8.13
D	0	12	3	30	10.5	5.08	10.75	189	0	12	18	56	77.5
E	0	0.6	5	0	0.5	0.4	0.6	7.8	5	7.5	2.6	0	0

Sampling Site	Total Catch (kg)												
	1st QM	2nd QM	3rd QM	4th QM	5th QM	6th QM	7th QM	8th QM	9th QM	10th QM	11th QM	12th QM	13th QM
F	0	1.2	13	3.7	1.5	0.7	0.8	0	1.5	0.8	0.5	0	0.3
G	0	1.6	4	0.7	2.9	0.83	0.825	70	1	0.8	0.1	0	0.12

Sampling Site	Total Catch (kg)			
	13th QM	14th QM	15th QM	16th QM
A	2	0	0	17
B	0.25	0	0	0
C	0	0	0	1.50
D	0	0	0	0
E	8.13	1.5	2.56	0
F	0	0	0	0
G	77.5	10.5	37.67	3
H	0	0	0	0.33
I	0.3	0.4	0.67	0.13
J	0.12	0.3	0	1

**Average Weight 0.15kg/mud crab and average weight 0.6 kg/mud eel*

*** Weight of Fry is not considered for catch assessment*

3.1.14 Culture Fish Production

The present study on shrimp/fish farm in the 16th quarter monitoring phase showed that the highest production was in the Gher of Kapasdanga and lowest in Gher of Chunkuri-2.

Figure 3.9: Fishing gears and crafts use in fishing at sampling sites

3.2 Monitoring of Ecosystem and Bio-diversity

3.2.1 Indicators Selection

Indicators for terrestrial and aquatic ecosystems have been selected by prior anticipation of probable impacts on ecological resources in different phases of the proposed project.

Composition and diversity of flora is important for vegetation study which indicates vegetation structure of an area. Plant health is directly related with biomass productivity. Plant health of an area may change for changing of different environmental parameters like temperature, composition of gaseous components, soil salinity, humidity and nutrients, dust particles etc. Plant diseases and proportion of healthy/ unhealthy plant has been studied to observe plant health condition.

Canopy status of terrestrial vegetation indicates plant health and biomass properties of an area. Vegetation canopy structure may change with the changes in plant growth rate. In addition, plant

physiological disorders may occur due to the changes in climatic parameters or even for different human interventions. To monitor vegetation canopy status of the study area, canopy cover has been being studied in different time intervals.

Lichens often grow on trees and shrubs, absorbing nutrients from the atmosphere. Because lichens are very sensitive to air pollution, particularly to sulfur dioxide, fluoride, and ammonia and their presence or absence is an indicator of homestead vegetation health. The acidity of a tree's bark can also affect lichen abundance. Hence, presence of lichen coverage on homestead trees may be a strong bio indicator for understanding air quality of a particular area.

Among the terrestrial faunal community, Bird can be considered as an important *class* that is sensitive to their habitat condition. Changes of environmental parameters, land use and vegetation composition etc. may have direct impact on bird's habitat of a locality. However, two types of bird were found in the study area i.e. *local* and *migratory*. For observing habitat suitability, number of bird nest and bird species can be a good indicator. Numbers of wetlands where migratory birds come in each migration season was also considered to observe migratory bird habitat suitability of the area.

Butterfly and insects are by far the most rich species group of animals, representing major portions of terrestrial biodiversity and very much sensitive to the changes of environmental parameters like air temperature, gaseous components etc.

Moreover, presence of Dolphins in particular wetland is an ecological indicator which indicates the suitability of water quality as well as habitat condition. This aquatic mammal is still present in all river systems of the study area. Any changes in water quality and river bed may have impact on dolphin occurrence in a river system. So, dolphin occurrence is needed to monitor for this study.

3.2.2 Rationales for selection of locations

Four (4) homesteads have been selected for monitoring terrestrial ecosystem to observe the impact of Power project.. Locations of the homesteads have been selected considering wind direction and spatial distribution of pollutants from the project boundary. All the selected homesteads for terrestrial ecosystem monitoring are situated at the northern site of the project area and considering the wind rose diagram it can be assumed that the anticipated impacts may take part according to this area. Beside this, the nearest peak off the Sundarbans Forest area is located at a distance of14 km south from the chimney location.

3.2.3 Terrestrial Ecosystem

Terrestrial ecosystem supports most of the floral and faunal communities which are directly related to the environmental parameters like temperatures, air quality, sunlight, soil nutrients etc. In the study area, homesteads occupy maximum portions of terrestrial ecosystems. As such, observation on different indicators for the selected homestead vegetation and dweller wildlife will be helpful to know the impacts of the power project on local ecological health.

Description of the selected homestead

The homestead in Rajnagar is located at a distance of 2.5 km. in the eastern portion from the

North-east corner of the project boundary. A number of small and medium swamps exist in the study area. Water retention capacity of surface soil of this homestead is very low and for this reason very little number of grass species and other herb species are present in the study area. On the other hand, the selected homestead at Kalekharber is located at about 1.8 km. east from project boundary. In addition, Chalkghona village is located at about 0.5 km south from southeast boundary of the project area. Presence of shallow ditches and peripheral water bodies support growing of saline tolerant plant species (Figure 3.10).

Rajnagar Kalekharber

Figure 3.10: Homesteads vegetation patterns at monitoring sites

Species Composition of selected homestead vegetation

Homestead at Rajnagar

Among the trees, Gewa *(Excoecaria agallocha)* is dominating among all trees. Moist and saline soil favors luxurious succession of this mangrove plant in homestead vegetation. Beside this, Safeda *(Manilkara zapota)* and Boroi *(Zizyphus sp)* are the two species of fruit yielding trees. Monocots including Narikel *(Cocos nucifera)* and Khejur *(Phoenix sylvestris)* occupied the top canopy of the vegetation. In addition, three Bola *(Hibiscus tiliaceus)* and one Sundari (*Heritiera fomes)* also found to exist. The homestead very few grasses or undergrowth vegetation.

Homestead at Kalekarber dighi

Narikel (Cocos nucifera) and Khejur *(Phoenix sylvestris)* occupies the top canopy. Aam (Mangifera indica), Safeda (Manilkara zapota), Peyara (Psidium guajava) and Boroi (Zizyphus sp) are common trees height about 3-5 m. Rendi Koroi *(Albizia saman)* and Raj Koroi *(A. richardiana)* are timber trees those are occupied top canopy height more than 10m. Beside this, Bakul (Mimusops elengii) and few number of Kola (Musa sp) are found on these homestead platforms. Among the creepers and herbs, Swarnalata *(Cuscuta reflexa)* and Durba *(Cynodon sp)* are found.

Homestead at Chalkghona

Similar to the above homesteads, in the selected homestead at Chalkghona, Narikel is the dominating tree species as well as occupying the top canopy. As the homestead is near the

peripheries of river and shrimp gher, soil salinity supports luxurious growth of mangrove plant Gewa (Excoecaria agallocha). This homestead has two shallow ditches, which contain brackish water throughout the year, and two Gol *(Nipa fruticans)* bushes are existing there. Most of the medium size trees like Safeda *(Manilkara zapota),* Aam *(Mangifera indica),* Peyara *(Psidium guajava)*, Papay *(Carica papaya)* etc are fruit bearing trees. Beside this, some ornamental plants also exist.

Homestead at Barni

This homestead contains 21 tree species. Except Narikel *(Cocos nucifera),* Khejur *(Phoenix sylvestris)* and Taal *(Borassus flabellifer)*, most of trees are young in age. The devastating cyclone Aila caused huge damge to the tree species. Then the house owner planted many timber and fruit yielding trees throughout the home yard.

Plant health

Vegetation structure of this area is tree dominant. Random saline water shrimp farming is a big threat to plant health of this area. Hence, Plant health of this area is not satisfactory. Expansion of shrimp farming in this area triggered incretion of salinity of soils. For this reason, overall plant succession, growth and productivity have fallen down day by day (Figure 3.11).

Plant Diseases and symptoms in homestead vegetation

Plant diseases observation of an area is needed to evaluate plant health and productivity. During initial field survey, some tree species were selected for regular observation of plant disease. In this regards, a number of common tree species have been observed in each homesteads.

Leaf spot, leaf blast, nut fall, Mite damage on nut fruit are common diseases of the plants in the study area. A brief discussion was held with homeowners about diseases of selected economic plants, which exist in their homesteads. Most symptoms for plant diseases are descriptive. Although, all plant diseases symptoms are not visible in a same time of the year, but it was tried to observe the existing disease symptoms. Leaf spot and mite damage on fruits is the common symptoms of *Cocos nucifera.* In addition, bud/trunk rot (Heart Rot), lethal yellowing and diameter loss at top portion of this monocot is also common symptom of this plant in all location. Infection of fungal/bacterial is not remarkable all the homesteads. However, Leaf Anthracnose on *Mangifera indica* and Bacteriosis on *Psidium guajava* is commonly found most of the trees. *Phoenix sylvestris* also found unhealthy due to leaf yellowing from manganese deficiency.

Figure 3.11: Unhealthy plants at monitoring sites (Photo taken April, 2018)

Number of disease affected trees

Number of disease affected trees observed more or less same than previous monitoring time in Jan 2018. Coconut (*Cocos nucifera)* and Date Palm (*Phoenix sylvestris)* are main affected species observed in this monitoring tier. A total of 6 coconut plants were affected at Rajnagar site and 6 were at Kalekarber Dighi. Most of which have been observed trunk narrowing and heart rot. In the case of Date Palm, Lethal Yellowing and Terminal Bud destruction were detected at all the 4 monitoring sites. Except these, other monitoring trees followed in healthy condition. However, following table represents the proportion of healthy and unhealthy plants in studied homesteads till last monitoring period. (**Table 3.10**).

Table 3.10: Proportion of healthy and unhealthy plants in studied homesteads

Location	Plant Name	Total No. of Plant	No. of Unhealthy Plant											
			Apr 2014	Jun 2014	Oct 2014	Jan 2015	Apr 2015	Aug 2015	Oct 2015	Jan, 2015	Oct, 2016	Jan, 2017	Jan, 2018	Apr, 2018
Rajnagar	*Cocos nucifera*	17*	NS	10	5	5	15	4	5	NS	3	4	6	6
	Phoenix sylvestris	25	NS	15	4	4	22	9	13	NS	10	2	5	4
	Manilkara zapota	1	NS	0	0	0	0	0	0	NS	-	-	-	-
	Albizia saman	2	NS	0	0	0	0	0	0	NS	-	-	-	-
	Excoecaria agallocha	55*	NS	0	1	1	0	0	0	NS	-	-	-	-
	Mangifera indica	3	NS	1	0	0	2	0	0	NS	-	-	1	-
	Psidium guajava	2	NS	2	0	0	2	0	0	NS	-	-	-	-
Borni	*Cocos nucifera*	10	7	3	0	0	3	1	2	NS	1	2	3	1
	Phoenix sylvestris	12	0	5	4	4	3	1	4	NS	4	3	4	2
	Borassus flabellifer	6	3	1	0	0	0	0	0	NS	-	-	-	-
	Mangifera indica	6	3	3	1	1	4	0	0	NS	-	-	-	-
	Excoecaria agallocha	18	0	0	0	0	0	0	0	NS	-	-	-	-
	Swietenia mehogani	11	0	0	0	0	1	0	0	NS	-	-	-	-
	Areca catechu	10	0	6	2	2	8	2	2	NS	-	1	-	3
	Manilkara zapota	1	0	0	0	0	0	0	0	NS	-	-	-	-
	Psidium guajava	2	2	1	0	0	0	0	0	NS	-	-	-	-
Kalekarber Dighi	*Cocos nucifera*	56	35	5	1	1	2	2	3	NS	1	1	-	6
	Phoenix sylvestris	10	0	3	0	0	1	0	1	NS	3	-	3	-
	Mangifera indica	5	1	1	0	0	0	0	0	NS	-	-	-	-
	Manilkara zapota	2	0	0	0	0	1	0	0	NS	-	-	-	-
	Borassus flabellifer	8	0	0	0	0	0	0	0	NS	-	-	-	-
	Zizyphus sp	1	0	0	0	0	0	0	0	NS	-	-	-	-
	Psidium guajava	8	0	0	0	0	0	0	0	NS	-	-	1	-
	Tamarindus indica	2	0	0	0	0	1	0	0	NS	-	-	-	-
Chalkghona	*Cocos nucifera*	39	25	19	5	5	34	20	0	NS	2	2	4	5
	Phoenix sylvestris	24	0	10	1	1	6	5	1	NS	1	-	5	2
	Albizia saman	3	0	0	0	0	1	0	0	NS	-	-	-	-
	Excoecaria agallocha	36	0	0	1	1	0	0	0	NS	-	-	-	-
	Manilkara zapota	1	0	0	0	0	0	0	0	NS	-	-	-	-
	Psidium guajava	17	1	7	0	0	0	0	0	NS	-	-	-	-
	Mangifera indica	7	2	1	0	0	0	0	0	NS	-	1	-	1
	Borassus flabellifer	2	0	0	0	0	0	0	0	NS	-	-	-	-

*Note: NS = Not Surveyed, *=1 Cocos and 45 Excoecaria have been cut*

Vegetation canopy status

i. Species representation in different canopy layers of homestead vegetation

Coconut/*Cocos nucifera* occupied top canopy of all the studied homestead vegetation. Date Palm/*Phoenix sylvestris* is prevalent as second top layer followed by Gewa/*Excoecharia agallocha*. Most of the fruit yielding trees like Sofeda/*Manilkara zapota,* Mango/*Mangifera indica* possess upper bole of canopy layer. Lower bole are occupied by small fruit yielding trees like Guava/*Psidium guajava*, Musa sp. Very few grass species and undergrowth vegetation were followed at studied homesteads.

ii. Estimated Canopy cover in homestead vegetation of sampling sites

Canopy status of homestead vegetation have insignificantly change from the last monitoring period in 3 monitoring locations. In the case of Chalkghona site, two large Rain trees have been felled by the home owner which hold a large portion of canopy cover. In addition to this, staple canopy of this site occupied by Gewa trees which leaves were in deciduous form. For why the canopy cover dropped down at this site. Canopy cover has slightly improved at Rajnagar site. However there is no cause in favor of this improvement. Canopy coverage of the studied homesteads has been represented in following table.

Table 3.11: Vegetation Canopy Cover in different studied homesteads

Location	% of canopy Coverage												
	Apr 2014	Jun 2014	Oct 2014	Jan 2015	Apr 2015	Aug 2015	Oct 2015	Jan 2016	Jul 2016	Oct 2016	Jan 2017	Jan 2018	Apr 2018
Rajnagar	NS	19	19	17	20	20	20	20	21	23	19	15	18
Borni	NS	26	18	18	12	14	20	20	25	25	23	21	21
Kalekarber	NS	20	24	25	23	24	24	22	24	26	25	23	24
Chalkghona	NS	13	24	22	17	21	21	20	21	27	26	25	16

Note: NS = Not Surveyed

Lichen Cover

Lichen cover has not counted this monitoring tier as most of the lichen are in dead form due to severe dryness of tree trunk.

Bird Habitat

Local Birds and Their Nesting Behavior

Numerous local bird species are observed within the study area. Homestead vegetation are the prime habitat for local birds. Existence of vast shrimp farms as well as canals and rivers also favor good number of water dependent bird species in this area. Most of the birds are nesting on tall trees of homesteads. Cocos nucifera and Excoecharia agallocha followed top priority for nesting. Small bird like Tailor bird, prefer small bushy shrubs. Although, birds do not follow any local boundaries, a clear conception on available bird species have been gathered through discussions with studied homestead owners as well as physical observation.

Bird Species and Number of Bird Nests in Sampling Sites

A total of 8 bird nests of 4 bird species have been observe at two monitoring sites namely Rajnagar and Chalkghona. Nested tree species were *Excoecharia and Pithocellobium sp.* No bird nest have been observed at Borni and Kalekarber site during this monitoring. Following table represent the bird nest monitoring datasheet over the monitoring periods.

Butterfly occurrence

A total of 16 butterflies species have been recorded from studied sites during this monitoring tiers. Out of which, 3 species (Common Sailor, Common Jezebel and Tiny Grass blue) has added this monitoring time. Common Albatross, Haze Blue, Grey Pansy, Rice Swift etc are followed most of the homesteads in this monitoring season. Butterfly occurrence was more common at Borni and Kalekarber sites due to having some wild herbs and shrubs which flowers attract them. Observed butterflies and their occurrences are included in **Table 3.13 and in Figure 3.12**.

Butterfly species observed at the study area (Photo taken April 2018)

Table 3.12: Bird Nest Monitoring Datasheet

Bird Name	No. of Bird Nest observed																																							
	Apr 2014				Jun 2014				Oct 2014				Jan 2015				Apr 2015				Aug 2015				Oct 2015				Jan 2016				Jul 2016				Jan 2017				Jan 2018				Apr 2018			
	R	B	K	C	R	B	K	C	R	B	K	C	R	B	K	C	R	B	K	C	R	B	K	C	R	B	K	C	R	B	K	C	R	B	K	C	R	B	K	C	R	B	K	C	R	B	K	C
Little Cormorant	NS	-	NS	-	12	-	-		-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	NS	NS	NS	NS	10	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
Little Egret	NS	-	NS	1	4	-	-		-	-	-	-	-	-	-	-	-	-	-	-	5	-	-	-	-	-	-	-	NS	NS	NS	NS	5	-	-	1	-	-	-	-	-	-	-	1	2	-	-	2
Asian Pied Starling	NS	1	NS	-	-	-	-	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	NS	NS	NS	NS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
Tailor Bird	NS	-	NS	1		-	-		-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	NS	NS	NS	NS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Spotted Dove	NS	-	NS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	NS	NS	NS	NS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Great Egret	NS	-	NS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		NS	NS	NS	NS	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Magpie Robin	NS	-	NS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		NS	NS	NS	NS	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
House Crow	NS	-	NS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		NS	NS	NS	NS	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	- 1

Note: R = Rajnagar, B = Barni, K = Kalekarber C= Chakgona, NS = Not Surveyed, '-'= Not Found

Table 3.13: Occurrences of Butterflies in the study are

Common Name	Scientific Name	Time and locations for Occurrence of Butterfly species																																							
		Jun 2014				Oct 2014				Jan 2015				Apr 2015				Aug 2015				Oct 2015				Jan 2016				Oct 2016				Jan 2017				Jan 2018				Apr 2018			
		R	B	K	C	R	B	K	C	R	B	K	C	R	B	K	C	R	B	K	C	R	B	K	C	R	B	K	C	R	B	K	C	R	B	K	C	R	B	K	C	R	B	K	C
Common Albatross	*Appias albina*															*						*	*	**	**										*						**		*
Blue Tiger	*Tirumala hamata*						**	*																*						**													
Lime Butterfly	*Papilio demoleus*				*				*		*		*												*		**														**		
Chocolate Argus	*Junonia hedonia*	*		*						*																														*		
Common Cerulean	*Jamides celeno*							*																																*		
Common Crow	*Euploea core*	*		*	*	*	*		*				*		*									*	*	*	*															
Common Emigrant	*Catopsilia pomona*					*	*	**	*		*	*																											*	**	*	*
Common Gull	*Cepora nerissa*						*																																	*		
Common Leopard	*Papilo phalantha*						*	*																																		
Common palmfly	*Elymnias hypermnestra*						*	*			*		*		*									*	*		*					*										
Common Pierrot	*Castalius rosimon*						*		*			*															*					*	*									
Common Rose	*Pachliopta aristolochiae*								*					*				*					*	*			*															
Common Sailor	*Neptis hylas*													*																										**		*
Dainty Grass-blue	*Zizula hylax*						*	*														*	*		*	**			*		*	*									
Danaid Eggfly	*Hypolimnas misippus*											*																														
Evening Brown	*Melanitis leda*				*						*		*			**													*						*	*	*		*						
Foscus Swallowtail	*Papilio fuscus*																																							*	*		*
Grey Pansy	*Junonia atlites*						*												*																					**			
Indian sunbeam	*Curetis thetis*								*							*																								*		
Lemon Pansy	*Junonia lemonius*						*					*																														
Mangrove Jewel	*Hypochrysops epicurus*		*		*																																					
Stripped Tiger	*Danaus genutia*					*		*																**		*																
Orchard Swallowtail	*Papilio aegeus*	*	*													*																									*		

Common Name	Scientific Name	Time and locations for Occurrence of Butterfly species																																										
		Jun 2014				Oct 2014				Jan 2015				Apr 2015				Aug 2015				Oct 2015				Jan 2016				Oct 2016				Jan 2017				Jan 2018				Apr 2018			
		R	B	K	C	R	B	K	C	R	B	K	C	R	B	K	C	R	B	K	C	R	B	K	C	R	B	K	C	R	B	K	C	R	B	K	C	R	B	K	C	R	B	K	C
Pale Grass Blue	*Pseudozizeeria maha*														**	**																													
Three spot Grass Yellow	*Eurema blanda*					*	**		*																																				
Peacock pansy	*Junonia almana*						**								*								** *		*		*				* *				* *				*			**	*	
Rice Swift	*Borbo cinnara*						**	*	**				*																													** *	
Small Grass-yellow	*Eurema smilax*		* *									*			*	**		* *		* *	*					*	* *	*	*		* *	* *	* *							*			*
Swamp Tiger	*Danaus affinis*												*			*																										*	*
Common Red Eye	*Matapa aria*																						*				*																	
Plain Hedge Blue	*Celastrina limbata*																																								** *		*
Common Jazebel	*Delias eucharis*																																								*		

3.2.4 Aquatic Ecosystem Monitoring

Rivers, canals, ponds and saline water shrimp farms are main wetland forms in the study area. Of which, river bear the flowing/ lotic and ponds bear the stagnant/lentic water systems. Canals of this area have merged with shrimp farms. Shrimp farms extend a large proportion of total watershed of the study area those are intervene by human. Therefore, canals are not an actual flowing or stagnant water system.

Monitoring Locations

Passur is the only external river beside the project area which maintains connectivity with all flowing water systems of the study area. On the other hand, Maidara River including two branches (Sailtakhali and Ichamoti) exists as an internal river system. Both of the river systems are support River Dolphin whole of the year. Hence, status of aquatic mammals (Dolphin) in these river systems has been monitored.

Dolphin Occurrence

Dolphin migration route in study area

Two dolphin species (Ganges River Dolphin and Irrawaddi Dolphin) travel throughout the Passur river for whole of the year. The Ganges river dolphin migrates from estuary regions to upstream connected rivers like Rupsha and Madhumoti. Though Irrawardi Dolphin is mostly habituated in estuary regions of Bangladesh, but this aquatic mammal is also occationally sighted in Passur river. Ganges Dolphins also roam through Maidara River mainly during high tide. Siltation and narrowing of upstream branches is limiting the length of migration area of this river day by day.

Dolphin occurrence in Passur and Maidara River

Dolphin occurrences have been monitored within a total of 12 km length of Passur and Madara river surround the project area (From Chalna to Digraz) through boat transact. 2 Ganges River Dolphins were recorded within the Maidara River which were in diving mode (**Figure 3.15**). Occurrence of dolphin-recorded low along the survey transect because dredging activity was conducting within 1 km downstream of Passur-Maidara confluence.

Figure 3.12: Dredging activities at Passur River during the field survey

Dolphin occurrence in Dhangmari Khal and Bhadra River

Dolphin occurrence also surveyed at the Dhangmari Khal Wildlife Sanctuary. Total transect length was 12.25 km from Dhangmari-Passur confluence to Gagramari Patrol Post of Forest Department. A total of 30 dolphins with different sizes were recorded. Of which, 21 individuals have found at river confluence point and within 1 km river reach in front of Gagramari Patrol Post and the average encounter rate of 1.63 individuals/km/hr (**Figure 3.16**). The occurrence has showed increasing trend due to availability of fish species and no fishing activities were shown inside the river during the survey.

A total of 12 dolphin individuals were recorded from Bhadra River within the 4 km reach with an encounter rate 2.05 individuals/km/hr.

Another short survey was conducted Chandpai, Karomjal, Harbaria and Akram Point while passing the river and occurrence of Ganges Dolphin recorded at two of these locations i.e Koramjal and Harbaria. No dolphin was sighted at Sella River mouth near Chandpai Forest Office. Huge fishing activities in this river may disfavor to smooth movement of this aquatic mammals. The Dolphin species may migrate due to the barriers they are facing through dredging activities and fishing activities (**Figure 3.12, 3.13 and 3.14**). However, the survey result is included in **Table: 3.14**.

Figure 3.13: A dead calf of Ganges Dolphin sighted at Shella River near Chandpai which was injured by fishing net

Figure 3.14: Setback fishing net which is a major barrier for dolphin movement at Shella River

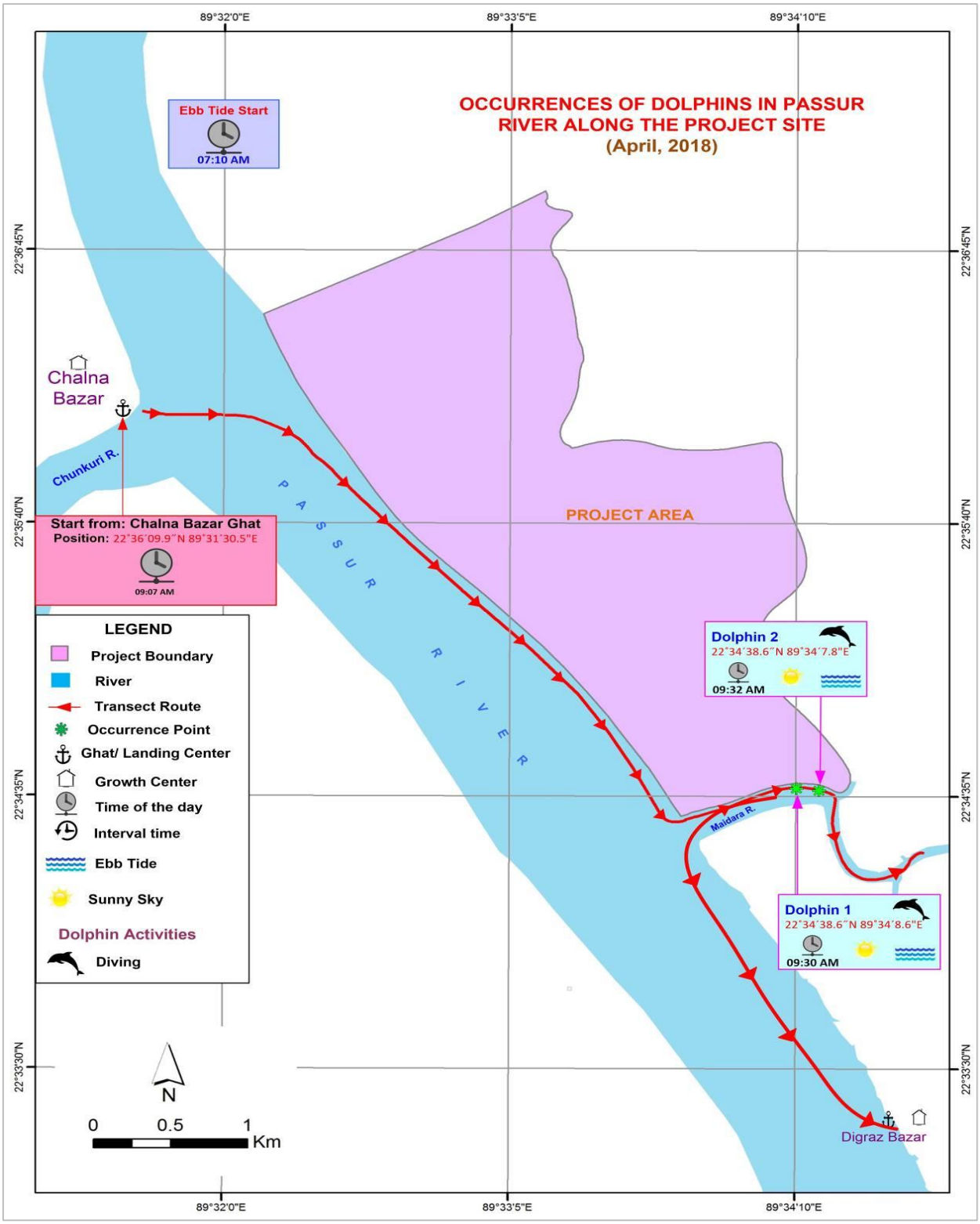


Figure 3.15: Occurrence of dolphins at Passur and Maidara River along the project site (April 2018)

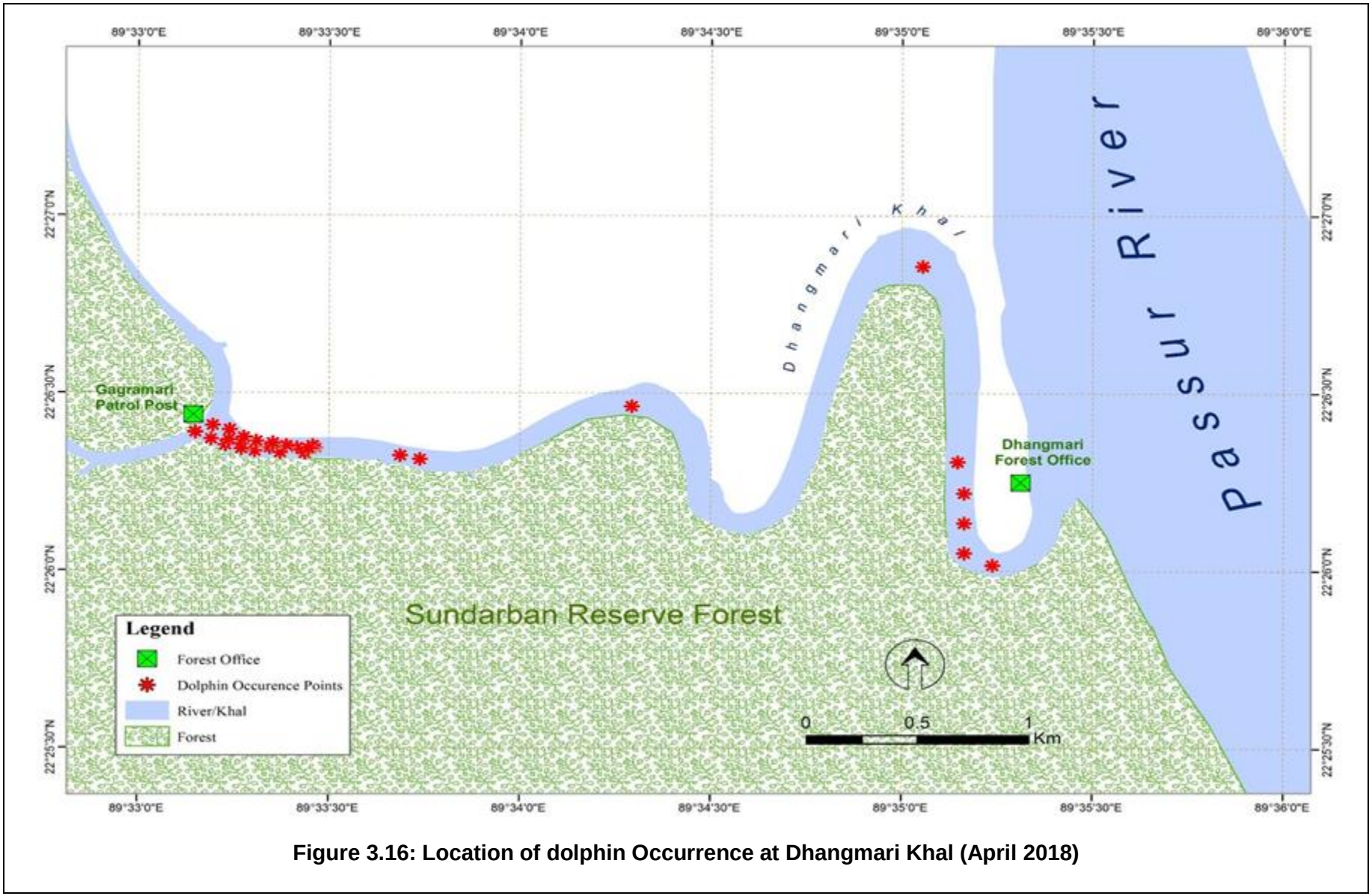


Figure 3.16: Location of dolphin Occurrence at Dhangmari Khal (April 2018)

Table 3.14.: Dolphin observation Datasheet

Location of River systems	Occurrence Status																							
	Apr 2014		Jun 2014		Oct 2014		Jan 2015		Apr 2015		Aug 2015		Oct 2015		Oct 2015		Jul 2016		Oct 2016		Jan 2017		Jan 2018	
	F T	N T	F T	N T	F T	N T	F T	N T	F T	N T	F T	N T	F T	N T	F T	N T	F T	N T	F T	N T	F T	N T	F T	N T
Passur River Near Project Site	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NS	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y
Karamjal	NS	NS	NS	N	NS	Y	Y	Y	N	N	NS	Y	NS	Y	Y	N	Y	NS	Y	Y	Y	Y	NS	Y
Harbaria	NS	NS	NS	N	NS	Y	Y	N	N	N	N	N	Y	NS	Y	N	Y	Y	Y	NS	N	N	Y	N
Akram Point	NS	NS	NS	N	NS	N	NS	Y	Y	Y	NS	NS	N	Y	Y	NS	NS	NS	N	N	NS	NS	N	N
Moidara River	Y	N	N	N	Y	Y	Y	N	Y	N	Y	N	NS	Y	N	Y	Y	NS	NS	Y	N	Y	NS	Y
Shella River at Chandpai	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	N*

Note: FT=Flood Tide, NT=Neap Tide, NS=Not Surveyed, Occurrence Status: Y = Occurred, N = Not occurred

3.3 Sundarbans Forest Health

CEGIS team has been periodically monitoring the Sundarbans Reserve Forest health to oversee the probable impacts of Rampal Thermal Coal Power Plant Project under implementation. This monitoring program will also support in determining the status, trend and changes in the indicators of the forest condition. The Sundarbans forest health is being monitored quarterly as per monitoring schedule and so far, sixteenth (16) surveys were conducted at four locations, namely Sutarkhali, Karamjal, Harbaria, Akram point . The overall monitoring indicators observed in Sixteenth monitoring schedules broadly included plant growth, tree regeneration, tree crown condition, tree damage, lichen communities, plant diversity, soil chemistry, and plant physiology.

3.3.1 Methodology

The indicators observed in this tier were as follows:

- Seedling Regeneration
- Pneumatophores density
- Crab hole density
- Canopy cover
- Leaf Area Index

Forest Health Monitoring Location

To set up permanent sample plots five sites were selected on the basis of the survey conducted from January 6 to January 12 (**Figure 3.17**). Among those, four sites are along the Passur River at Karamjal, Harbaria, Akram point and in Hiron point respectively and the fifth one is near Sutarkhali forest office (**Table 3.10**). The sites were selected considering the distance from the proposed Project site, wind directions, coal transportation route, river systems and vegetation types.

Sampling Design of Permanent Sample Plots (PSPs)

In each site, a transect line was laid out perpendicular to river or canal bank. Along the transect line three circular nested subplots of 12.62 m radius have been laid out at 100 m intervals in order to capture the maximum tree species (**Figure 3.18**). Because of the variation in species composition in SRF, observation plots were laid out from the coast, river or canal side to landward zone (forest proper side). The location of the first subplot was 40 m away from ecotone (riverside) to inner ward of forest in order to save the subplot from river bank erosion. Each subplot was again subdivided into four quadrates for the ease of data detection and recording (**Figure 3.19**). The layout of the survey activities are shown in **Figure 3.19**.

Table 3.15: General Description of Permanent Sampling Plots (PSPs)

Transect	Plot	Range	Compartment No.	GPS ± (m)		Soil Description	Plot Location Notes
				Latitude (N)	Longitude (E)		
Sutar khali	1	Khulna	32	22.49815	89.48752	Hard Clay	Just opposite from Sutar Khali Forest Station and 40 m SW from Sutar Khali canal
	2	Khulna	32	22.49733	89.48711	Hard Clay	Just opposite from Sutar Khali Forest Station and 140 m SW from Sutar Khali canal
	3	Khulna	32	22.49655	89.48664	Hard Clay	Just opposite from Sutar Khali Forest Station and 240 m SW from Sutar Khali canal
Karamjal	1	Chandpai	31	22.42531	89.59439	Hard Clay	Plot Centre 40 m west from Passur River
	2	Chandpai	31	22.42566	89.59340	Hard Clay	Plot Centre 140 m west from Passur River
	3	Chandpai	31	22.42624	89.59240	Hard Clay	Plot Centre 240 m west from Passur River
Harbaria	1	Chandpai	29	22.20610	89.59240	Hard Clay	40 m west from Passur River
	2	Chandpai	29	22.29624	89.59179	Hard Clay	140 m west from Passur River
	3	Chandpai	29	22.29633	89.58993	Muddy	240 m west from Passur River
Akram Point	1	Khulna	17	22.29624	89.59180	Hard Clay	40 M east from Shibsha River
	2	Khulna	17	22.29620	89.59080	Clayee	140 M east from Shibsa River
	3	Khulna	17	22.01805	89.51408	Hard Clay	240 M east from Shibsa River
Hiron Point	1	Khulna	44	22.77533	89.46112	Sandy	350m east from Gogari canal
	2	Khulna	44	21.77624	89.45993	Sandy	40m north from Bay of Bengal
	3	Khulna	44	22.77691	89.45886	Hard Clay	648m South East From Shibsa River

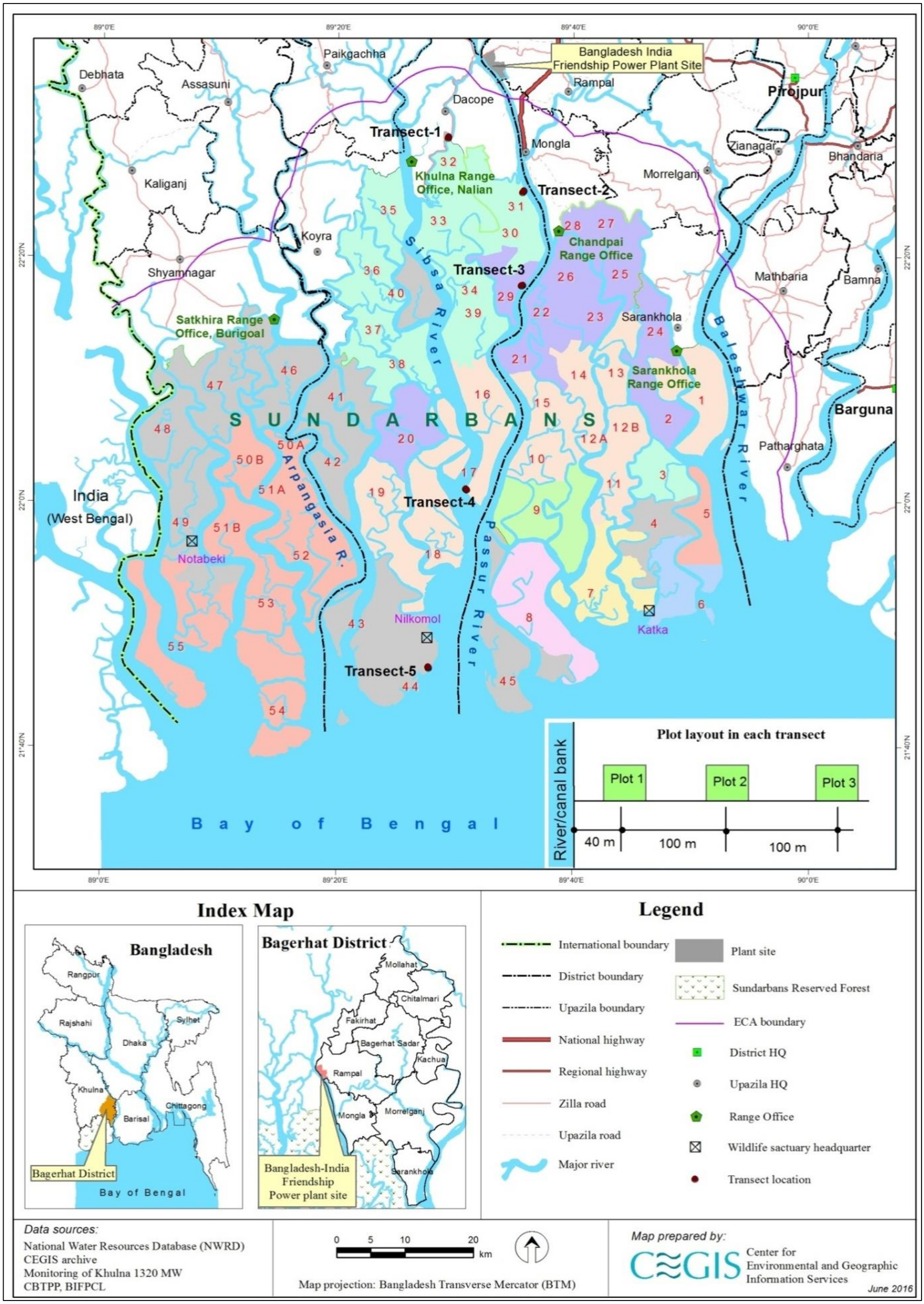


Figure 3.17: Location Map of Sundarbans Forest Health Monitoring Plots (PSPs)

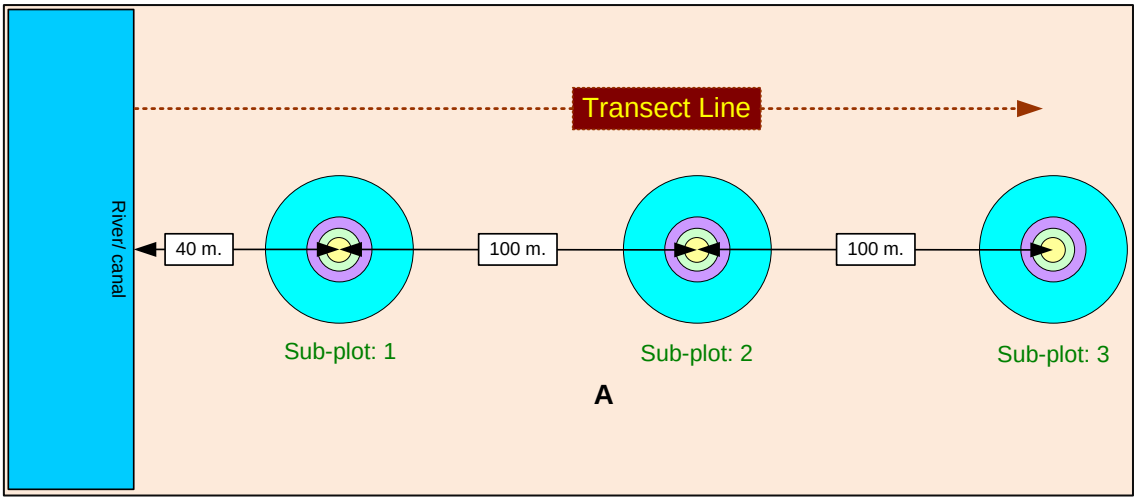


Figure 3.18: Layout of the subplots and transect line perpendicular to the ecotone (river or canal bank)

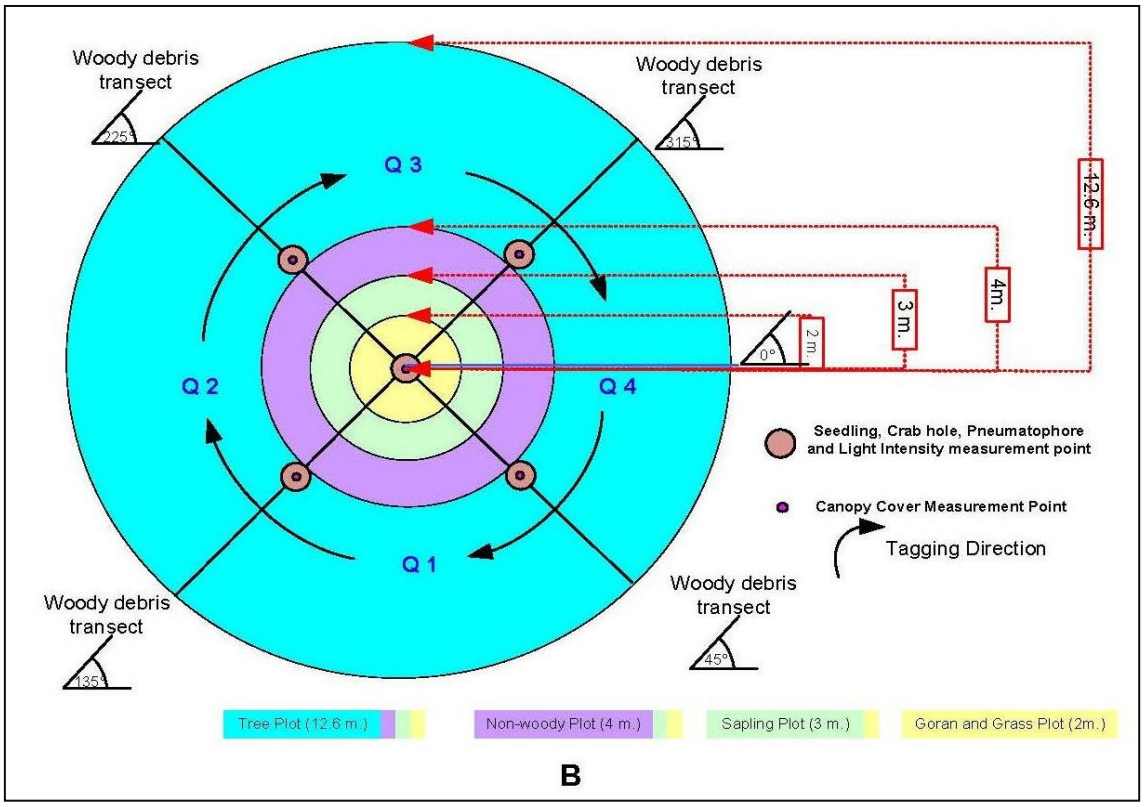


Figure 3.19: Layout of the survey activities in each subplot

3.3.2 Forest Health Survey

Trees

The tag number of trees (DBH ≥ 5cm and lean angle greater than 45º) was monitored and rewritten if any new tree was found within 12.62 m radius circle of the Permanent Sample Plot (PSP). A map showing the location of all trees (tag number) was developed in the same monitoring period to ease the next data collection (**Photo 3.20**). The surveyor (**Photo 3.21 and Photo 3.22**) also took the tree height and diameter.

Figure 3.20: Team Member recording and cross checking data in the field data sheet

Figure 3.21: Team member measuring tree height at Harbaria point

Figure 3.22: Measuring the tree DBH at Sutarkhali

Sapling and seedling

Saplings (DBH < 5 cm and height 1.37 m) and seedlings (height < 1.37 m) were assessed within 3m and 2m radius circle, respectively in each PSP. Seedlings have been counted species wise, and their status of living were also recorded (**Photo 2.23**). For saplings, species name and DBH were recorded along with the living status (**Photo 2.24**)

Pneumatophores

The total numbers of living pneumatophores were recorded within a circular area of 1 m radius centring each of the five points of all the subplots. The first point was laid out in the centre of each subplot and other four was in the midpoint of the four woody debris transects that are facing at 45°, 135°, 225° and 315° angles (**Photo 3.25)**

Figure 3.23: Team member counting the seedlings at Harbaria

Figure 3.24: Team member measuring the saplings DBH at Akrampoint

Crab hole

Crab plays an important role in mangrove ecosystems such as decomposing litter fall thereby increasing fertility. In order to work out the crab density, usually crab hole abundance is monitored. For this purpose, the crab holes were counted within an area of 1 m radius circle in each subplot's centre and in the midpoint of four transects **(Photo 3.26**).

Figure 3.25: Team member counting pneumatophores on forest floor

Figure 3.26: Counting of crab holes on forest floor

Canopy Cover

Percentage (%) of canopy cover was estimated by a spherical densiometer, a gridded convex mirror that provides a simple and inexpensive approach of measuring canopy cover. The densiometer was held at a distance of 30–40 cm from the body and at an elbow height so that head not become visible in the mirror (**Photo 3.27 and Photo 3.28).** After levelling the instrument using the level bubble, the dots, which had not been occupied by canopy, were systematically counted. In each subplot, the meter readings have been taken at five points facing north, south, east, and west direction including the centre point of the subplot. The canopy cover was calculated by taking the average of these five readings

Leaf Area Index

Leaf Area Index (LAI) is a key structural characteristic of forest ecosystems because of the role of green leaves in controlling many biological and physical processes in plant canopies. It influences net canopy photosynthesis. Light absorption by the forest canopy can be used to estimate leaf area index. In this monitoring report, LAI was calculated as follows:

Leaf Area Index (LAI) = loge (I/Io)/-K m2leaf area /m2area of ground (Where, I = Under Canopy Light Intensity, Io = Open Canopy Light Intensity and K is Canopy light extension coefficient i.e., 0.5)

Figure 3.27: Team member taking canopy cover using Lux Meter and Densiometer

Figure 3.28: Team member taking canopy cover using Lux Meter and Densiometer

Soil sampling

The soil samples from the forest floor were collected in post monsoon season of the fourth monitoring year and the data has been incorporated in this tier after colmpleting the analysis (**Table 3.17**). An open face split auger (1m long) was used to pull out one-meter depth soil core. Soil core was then collected from the centre of each plot. From each of the 100 cm soil core, a 5 cm of sub-sample was taken from the middle of 0-15 cm, 15-30 cm, 30-50 cm and 50-100 cm break respectively for bulk density, soil pH, salinity, soil nutrients (Ca, Mg, Al , K, N and P) and organic carbon assessment (Kuaffman, and Donato, 2012).

3.3.3 Status of monitoring of SRF Health

Seedling

From the last field observation, it was found that the number of seedlings per hectare has been increased almost all the monitoring locations except Akram Point (Figure 3.29). The graph has also shown that higher number of seedlings was found during post-monsoon period where as the number decreased during winter to pre-monsoon period. The recruitment of new seedlings depends on regeneration and survival rate. These two indicators also depend on canopy cover, soil chemistry (pH, salinity, organic matter etc.). Seedlings usually die at an early stage of its life span inside natural forest due to competition for nutrients as well as light intensity. The result of this monitoring period showed comparatively higher number of seedling at Harbaria site than that of the other pre-monsoon of the previous years. This may be due to reduce human interventions at forest floor of the site, which has sustained huge number of seedlings. The dominant species were Sundari. The seedling at Koromjol subjected to illicit cutting. Other than the silvicultural competition, the seedlings at Akram point also face natural stresses due to their location being very much closer to the sea. In the Sundarbans, most of the mangroves' seeds disperse during the rainy season and go up to forest floor. In this relation, seedlings are usually found more just after the rainy season (monsoon to post monsoon) than in other seasons.

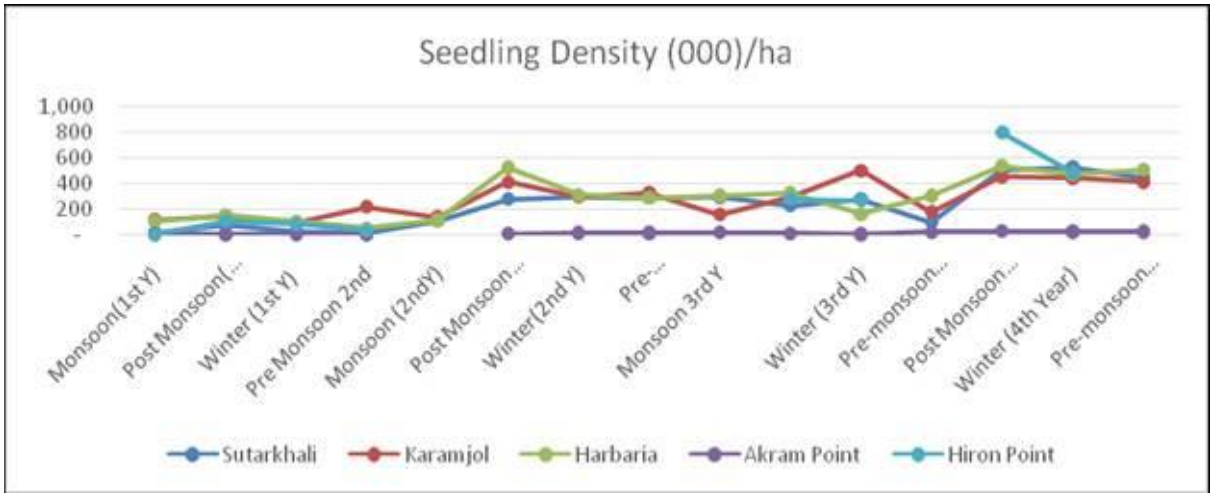
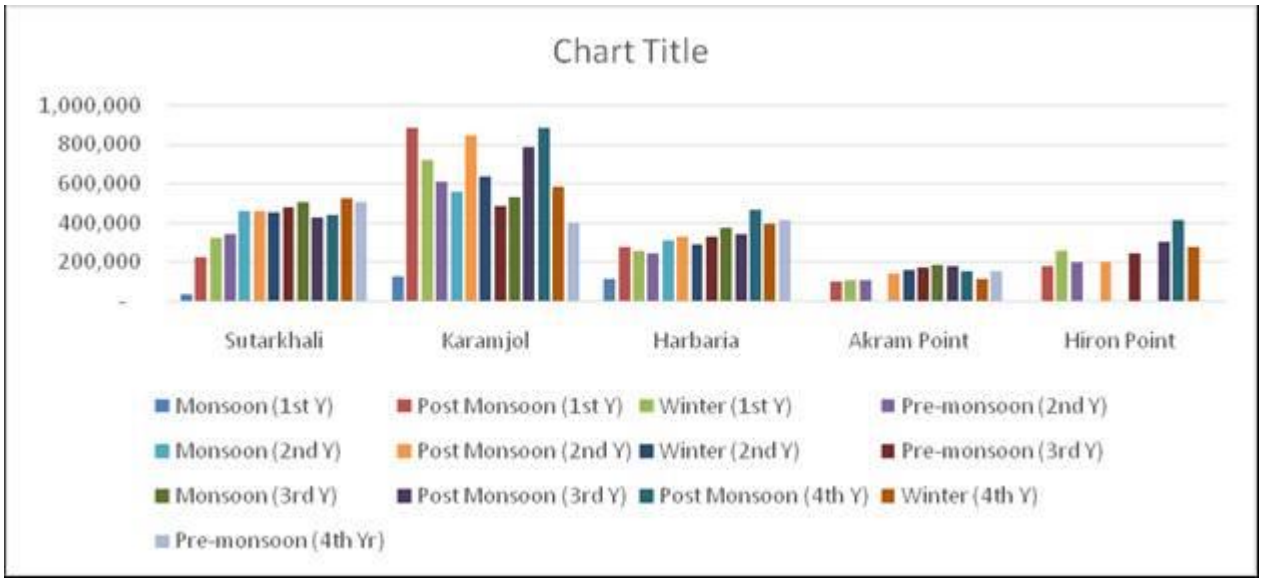


Figure 3.29: Mean (±95%CI) seedlings density among the quarterly surveys in five PSPs

Pneumatophores

Pneumatophores density also changes due to seasonal variability (**Figure 3.30**). Pneumatophores usually dry up and die during dry season. The number of pneumatophores per hectare is found comparatively medium at Karamjol and Sutarkhali area in pre-monsoon period. However, among five monitoring sites, the mean pneumatophores density was found lower at Akram Point due to floristic composition and over siltation. From the species composition inventory, it was found that Gewa (Exoecaria agallocha) was the dominating species at these monitoring sites. On the contrary, Baen (Avicennia officinalis) trees at Karamjol has numerous tender pneumatophores compared to others. The number of pneumatophores may also vary due to the elevation of the forest floor from the mean sea level (MSL). The major function of pneumatophores is to exchange gas into the atmosphere during tidal inundation. Hence, the highly elevated plot with less effect of inundation may have lesser number of pneumatophores.

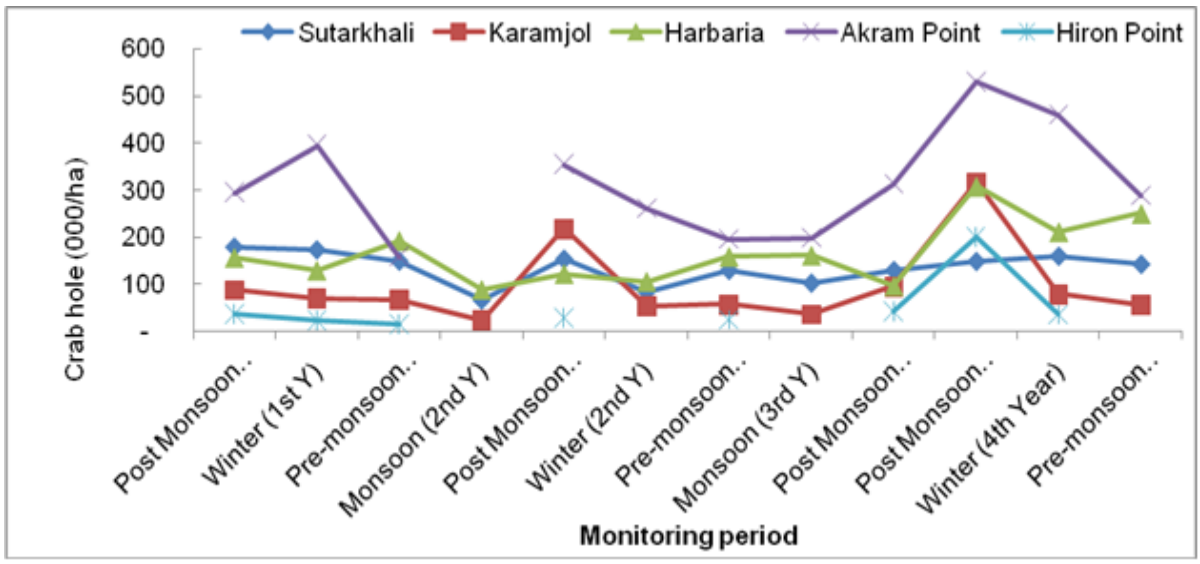


(Pneumatophores density was not monitored at Akram Point during Monsoon 2nd Year)

Figure 3.30: Mean Pneumatophores Density among the quarterly surveys in five PSPs

Crab hole

The crab hole density is the indicator of availability of crab in a site, was found the highest at Akram Point among the five monitoring sites (**Figure 3.31**). This could be due to sandy forest floor at Akram Point because they love to drag hole on that particular habitat. Crab hole also has been notable increased from the last pre-monsoon period at Harbaria site. Crabs are the major macro fauna, ecologically engineering the mangroves through digging burrows. So it is clear that, forest condition is being good overtime at Herbaria and Akram Point. From **Figure 3.31**, it was difficult to predict the relationship of crab hole with seasonal variability. This might be due to the soil nature of mangrove (evergreen forest) forest floor. Although mangroves are hold marshy land, so there are differences in terms of area in dry period (winter) and wet period (monsoon) which shows some influences on crab hole abundance.

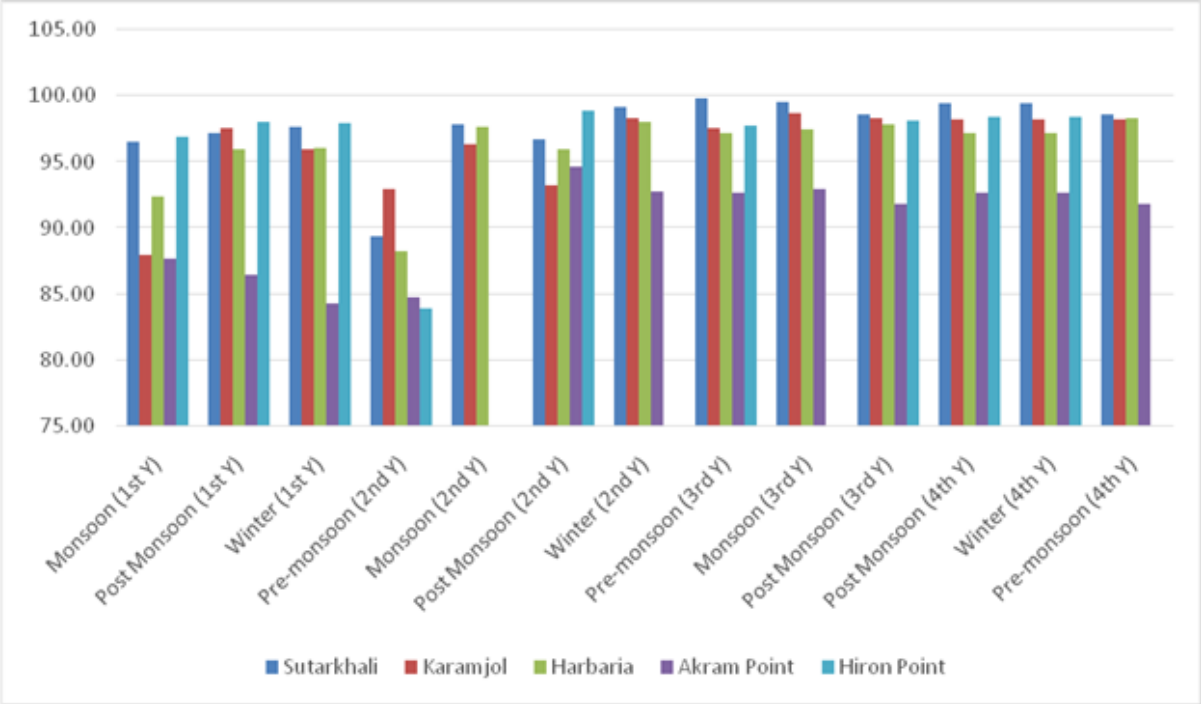


(Crab hole density was not monitored at Akram Point during Monsoon 2nd Year)

Figure 3.31: Mean crab hole density among the quarterly surveys in five PSPs

Canopy Cover

In the monitoring plots, the canopy cover percentages were not varied significantly. From the third year to fourth year pre-monsoon, the highest canopy cover percentages were observed during monsoon to post monsoon which started decreasing during winter and was found the lowest in pre-monsoon period. However, from post monsoon fourth year to winter fourth year, it was found that the canopy cover percentages were similar among the monitoring sites (**Figure 3.32**). Since greater than 60% of the canopy coverage in a site is treated as healthy, all the locations of the monitoring sites were in good condition.



(Canopy cover was not monitored at Akram Point during Monsoon 2nd Year)

Figure 3.32: Mean canopy cover (%) among the quarterly surveys in five PSPs

Leaf Area Index (LAI)

The LAI (Light Area Index) influences daily rate of net canopy photosynthesis which results in exchange of atmospheric CO_2. The minimum the ratio of under canopy to open canopy light intensity value indicates the maximum LAI. It was found that the LAI has almost same in all monitoring locations from previous values except Akram Point. This is a sign of good health of forest. However, at Akram point, like other indicators the LAI was much lower due to high under canopy light intensity.

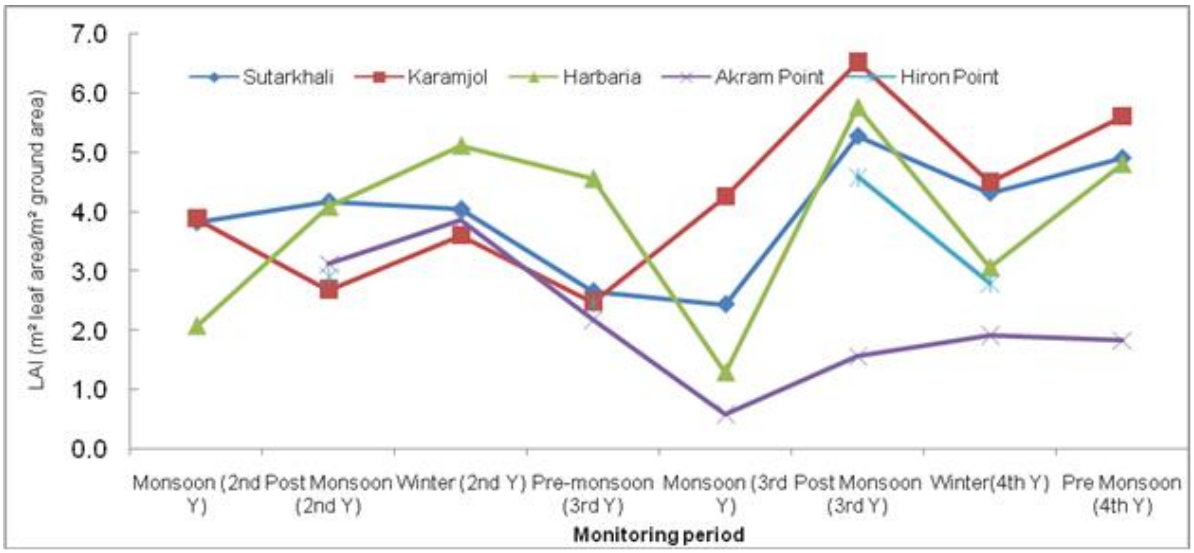


Figure 3.33: Mean L among the quarterly surveys in five PSPs

3.3.4 Findings

In summary of last monitoring activities, it can be predicted in terms of seedling density, pneumatophores, crab hole, canopy cover and leaf area index (m2 leaf area/m2 ground area) that the forest condition is showing positive changes periodically, although there has some seasonal effect. Based on different indicators it is found that the health condition at Sutarkhali is good .But logging is severely affected at Koromjol .On the other hand ,Harbaria point have no significant change observed during the last visit. Among the species, the height of Sundari is comparatively high in Harbaria and Goran species are moderately in Akram point. The Akram point is situated at the confluence of Shibsa and Passur River. Therefore, during tidal inflow the forest floor carry large amount of soil sediment than other locations. But in depth side the number of seedling almost zero so that It can assume that, the forest will experiencing retrogression process where the climax species are started decaying. Hence, this area is sensitive in terms of disturbance. It is to be noted here that the potential anchorage point for coal transhipment of the proposed power plant project is situated in the periphery of this area. So, there is a possibility of disturbance into the ecosystem on natural succession.

3.4 Agriculture Resources Monitoring

Monitoring of agriculture resources has been scheduled twice a year as per the monitoring plan of the ToR and accordingly, the survey was conducted in April, 2018.The data on Local Aman (Production, damage, input use etc.) was collected through informal interview (KII, RRA and FGD) with the local farmers from the monitoring area.

3.4.1 Methodology

Locations

The selected mauzas were remains same in this phase as pre-construction phase monitoring. They are Baranpara (E-89°30′59.1″, N-22°37′57.0″) of Batiaghata upazila, Chunkuri-2 (E-89°32′20.0″, N-22°34′51.0″) of Dacope upazila, Kapalirmet (E-89°36′8.8″, N-22°32′18.9″) of Mongla upazila, Chakgona(E-89°34′25.3″,N-22°34′18.3″) and Basherhula (E-89°34′25.0″, N-22°36′14.0″) of Rampal upazila under Khulna and Bagerhat districts.

Table 3.16: Agricultural Resources Monitoring Plan

Site No.	Monitoring indicators	Location	GPS(Decimal Degree)		Sampling Frequency	Methods/Tools/Techniques
			Easting	Northing		
01	Plot use, Soil fertility and Nutrient, Chemical Properties of Soil (pH, Pb, Cd), Crop production and damage	Mauza: Baranpara, Union: Gangarampur Upazila: Batiaghata, District: Khulna	E-89°30′59.1″	N-22°37′57.0″	Bi-yearly (April and October)	In situ field sampling and Laboratory Testing in SRDI
02		Mauza:Chunkuri-2,Union:Bajua Upazila: Dacope, District :Khulna	E-89°32′20.0″	N-22°34′51.0″		
03		Mauza: Kapalirmet/Buridmial Union: Burirdanga, Upazila: Mongla District: Bagerhat	E-89°36′8.8″	N-22°32′18.9″		
04		Mauza: Chakgona, Union: Rajnagar Upazila: Rampal, District: Bagerhat	E-89°34′25.3″	N-22°34′18.3″		
05		Mauza: Basherhula, Union: Rajnagar Upazila: Rampal, District: Bagerhat	E-89°34′25.0″	N-22°36′14.0″		

Monitoring Indicators

For data collection, five sampling plots have been selected on random basis within the project influence area during construction phase monitoring. The mauzas which were selected for land resources monitoring were considered as well as monitored for agricultural resources monitoring too.

During the 16quarterly visit, some extensive consultations/group discussions were organized with local people to know the use of agricultural inputs, present cropping patterns by land type, crop damages and other conditions like drainage congestion/water logging, salinity intrusion or other natural calamities induced impacts, diseases and pest infestation as well as management practices and crop production in the selected locations of the monitoring area.

3.4.2 Present Cropping Patterns of Monitoring Plots

Detailed data on cropping pattern for this year were obtained through extensive discussions with the plot owners. Based on the discussions, the plot based cropping patterns was identified and the associated data was collected in April 2018 and described in the following sections:

Agriculture Plot-1 (Baranpara)

This plot is located at Baranpara mauza and the area is about 0.4 hectare. During the monitoring periods in 2017-18, the plot was found to be water logged and hence the excess amount of water couldn't be drained out properly from the plot. Therefore, the Local Aman (Chapshail) was cultivated in this plot in Kharif-II season. For this production of Local Aman no chemical fertilizers and pesticides were applied in this plot. The detailed cropping pattern is shown in **Table E.2** of **Appendix IV**.

Agriculture Plot-2 (Chunkuri-2)

This monitoring plot is located at Chunkuri-2 and the size of the plot is about 0.93 hectare. Local Aman (Benapole) was found to be cultivated in this plot in Kharif-II season. No chemical fertilizers were applied in this plot. Occurrence of Pest like Leaf folder cater pillar was reported by the land owner. To protect crop from such pest infestation, Amithin plus as powder pesticides was applied @ 70gm/plot. However, currently no crop are being cultivated in this plot due to the salinity intrusion effects. Detailed cropping pattern has been shown in **Table E.2** of **Appendix IV.**

Agriculture Plot-3 (Kapalirmet)

This monitoring plot is located at Kapalirmet and the size of the plot is about 0.14 hectare. During the 1st monitoring period of pre-construction phase, it was found to be cultivated But later on, this plot remained fallow from the 2nd and 3rd monitoring program due to increase in salinity. According to the opinion of the local people, Bangladesh Water Development Board (BWDB) decided to re-excavate the Ghona River and hence they had to remove all the obstacles to facilitate the re-excavation of the Golbunia khal mouth. Then the saline water was allowed to enter into the settlement areas including their cultivated plots during the year 2014-15 and remained inundated by saline water. As a result farmers started practicing shrimp culture instead of cultivating traditional crops in these plots. However, a number of farmers tried to cultivate crops in their plot in this adverse condition, but all crops were actually damaged due to the above mentioned fact.

Owners of Shrimp farms of this area used the saline water in these plots for shrimp culture as there was no scope to drain out saline water from this area. The situation is still not in farmers' favor. Farmer of this land decided that they would not cultivate crops in future due to increase in salinity. Rather they would only practice the shrimp culture in future. It was observed during the recent monitoring period that, the plot still remained fallow. Detailed for this plot is presented in **Table E.2 of Appendix IV**.

Agriculture Plot-4 (Chakgona)

This monitoring plot is located at Chakgona and the size of the plot is about 0.28 hectare. During the 1st monitoring period of pre-construction phase, it was found that, numerous types of crops were cultivated in this plot. But in later from the 2nd and 3rd monitoring tiers of pre-construction phase, this plot remained fallow due to increase in salinity concentration. Farmer of this land owner has decided not to grow crops in future. It was observed that, shrimp/fish culture are not being practiced in this plot during the Kharif-II season of 2017-18 (16th monitoring program). It may be mentioned that the plot owner has given part of the plot (0.07 ha out of 0.28 ha) voluntarily for construction of the cyclone shelter at Chakgona mauza. Detailed for this plot is presented in **Table E.2** of **Appendix IV.**

Agriculture Plot-5 (Basherhula)

This monitoring plot is located in Basherhula and the size of the plot is about 0.47 hectare. Local Aman (Chapshail) was found to be cultivated in this plot in Kharif-II season of 2017-18. Chemical fertilizer (Urea @ 50kg/plot) and granular pesticides (Basudin @1kg/plot) were reported to be used in the plot. Only Leaf folder was observed in this plot as pest infestation. But currently in this monitoring period no crops were found to be cultivated in this plot due to the excessive amount of salinity. However, detailed cropping pattern is shown in **Table E.2** of **Appendix IV.**

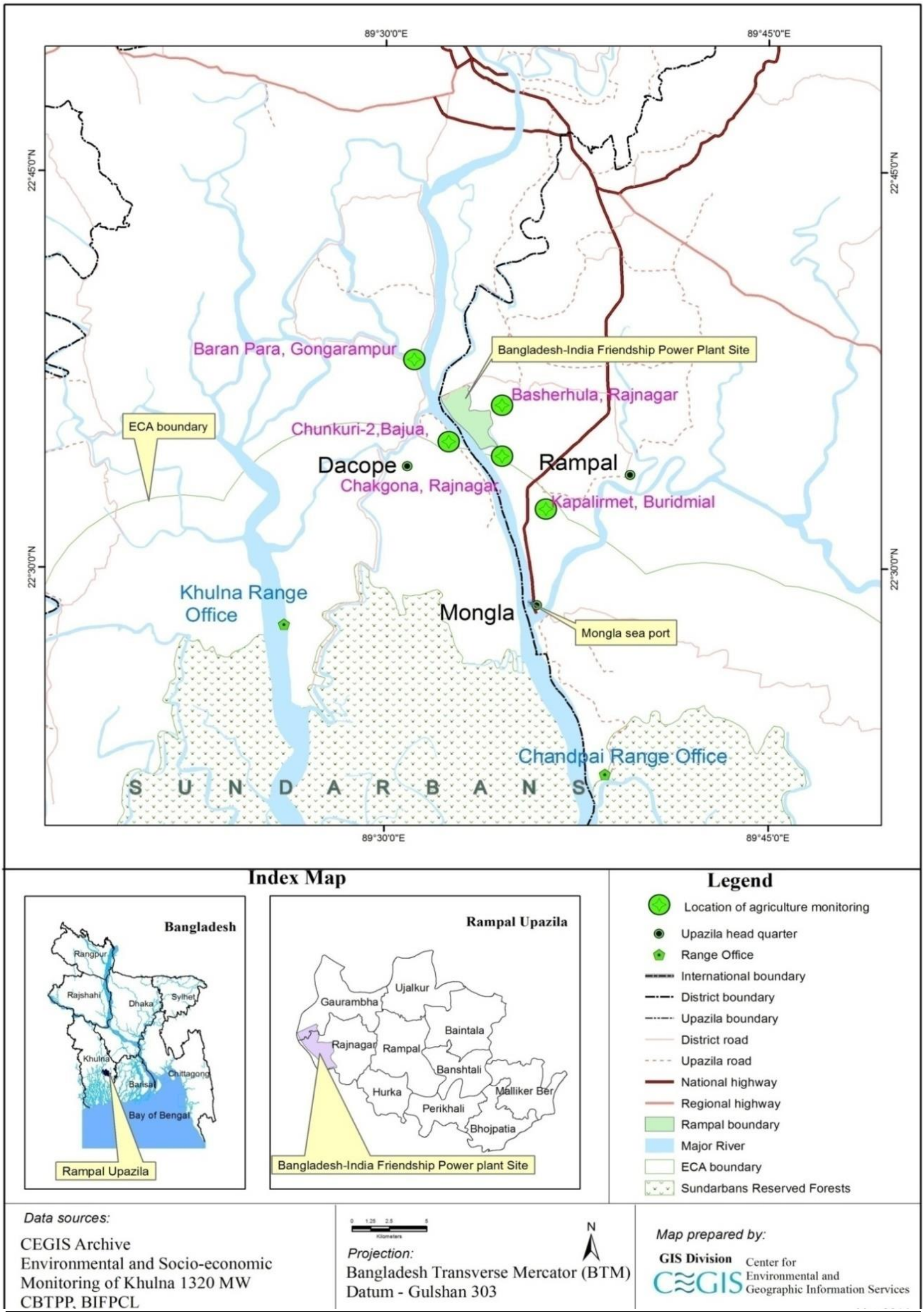


Figure 3.34: Agriculture Resources Monitoring Locations

3.4.3 Crop Production in Monitoring Plots

The information on crop production were collected after harvesting in April 2018. Crop production varies from plot to plot and variety to variety due to fertility status and management practices of the plot. For this reason, the production level of the plots is not same. The highest rice production (2.2 tons) was observed in monitoring plot-2 (Chunkuri-2) and the lowest (0.9 tons) rice production was observed in monitoring plot-1(Baranpara). The monitoring plot (Kapalirmet and Chakgona) remained fallow in 2017-18 due to adverse impact of salinity. Detailed information on crop production in monitoring plots is presented in the **Table E.2 of Appendix IV**.

Table 3.17: Monitoring of EMSAP Implementation

Sl. No.	Impacts	Mitigation Measures	Remarks on Due Diligence
1	Soil fertility might be impacted due to disposal of waste and waste water.	▪ Construction materials must be collected, stored, and disposed in an appropriate manner. ▪ Recycled waste should be disposed in a suitable landfill.	Complied
2	Soil and ground water quality might be deteriorated by leakage of oil, fuels and hazardous chemicals from tank or storage.	▪ Harmful effluents and waste leakage from oil and chemical tank or storage must be controlled strictly ▪ Wastes or used oil must be stored in a designated area for disposal through authorized vendors. ▪ Measures must be undertaken for fire suppression and the neutralization and collection of any spilled materials ▪ Treatment plant must be installed. ▪ Provide training and awareness building program to the labors and professionals.	Complied
3	Damage to surrounding crops due to project related activities.	▪ Fencing of project area by drum sheet or Tarija. ▪ Limiting the construction activities and stocking within the project boundary.	Complied

Source: Field Survey, April; 2018

3.4.4 Crop Damage in Monitoring Plots

The information on crop damage was collected after harvesting in April, 2018 for the 1st monitoring period of construction phase. No crop damage was noticed in any monitoring plot in 2017-18. Detailed crop damage information is presented in Table E.3 of Appendix IV.

3.5 Livestock Resources Monitoring

3.5.1 Methodology

Monitoring Indicators

The frequency of monitoring for livestock resources data collection was considered twice in a year. During the 16th quarterly visit, some extensive consultations/group discussions were organized with local people to know the status of feed/fodder and diseases of livestock in the adjacent of the project area (Baranpara,Chunkuri-2) and study area (Mongla bazar, Mongla, Bhaga bazar, Rampal). The data on Livestock status was collected in April 2018 and

described in the following sections-

Feed/Fodder of Livestock Resources

According to the opinion of local people, the owners of the livestock population are facing problems in respect of unavailability of fodder and feeds during the months of July to November due to unavailability of grazing land. Rice straw is the main fodder for the Cattle. Oil cake, bran, Grass, etc. are other common feed-stuffs of livestock in this area. Shortage of grazing land throughout the year exaggerates the feed problem to the animal population. The poultry at family level survives by scavenging and generally no feed supplements are provided. However, kitchen waste become feed to the poultry. Currently, some farmers are using bran, paddy and broken rice (Khudh) as feed for chicken and duck.

Diseases of Livestock Resources

Diseases of livestock occurs in every year in the study area. According to the opinion of local people, major bacterial and viral diseases include Peste des Petits Ruminants (PPR), Foot and Mouth Disease (FMD) and Tarka (Anthrax) etc. were observed in the study area. Major poultry diseases were reported as Duck plague, Duck pox, Diarrhoea, Newcastle (Ranikhet), Fowl pox and Fowl cholera etc. The most vulnerable period is considered in between July and November for spreading diseases to livestock and poultry populations. However, some diseases were also reported to be occurred for all the year round. The severity of the infestation was reported more or less alike in this concurrent circumstances as for the past situations. The mortality rate of the livestock/poultry becomes negligible, due to immunization and insemination program run by Department of Livestock.

Monitoring of EMP during construction activities on land and agriculture resources

At present, the following activities on land and agriculture resources are in progress at project site and surrounding areas as follows:

i. Soil fertility
ii. Soil and ground water quality
iii. Damage to surrounding crops.

4 Social Environment

4.1 Socio-economic Condition and Social Safeguard

Socio economic monitoring of this construction phase is intended to investigate the changes in identified socio-economic indicators/parameters i.e. employment status, labor and working condition, community health and safety, corporate social responsibilities(CSR) of project authority and so on in construction activities. Compensation and resettlement information is also been updated and, if any recorded. The monitoring parameters may be changed as per the intensity and volume of construction work. The selected monitoring indicators are methodically surveyed twice in a year (six months' successive interval), but in case of necessity it can be surveyed quarterly in a year (simultaneously with Environmental Monitoring). Discussions in this chapter reflect a comparison or changes of above mentioned indicators, on previous quarterly monitoring surveys and this quarterly monitoring survey (from 3rd May to 7th May, 2018).

4.1.1 Methodology

The important parameters/indicators those may be impacted due to construction activity are examined in this phase with reference to its earlier condition.

Informal discussions were held with local community in the Project surrounding mouzas (Kapasdanga, Barni, Rajnagar and Baradurgapur) - to identify health safety of local community, status of CSR, status of Livelihood Restoration Program (LRP) and employment opportunity in Project related activity. A discussion session was held with the resettled PA people at Foyla Bazaar to identify changes in their socio economic status, adaptation in new location and whether they get any benefit from Project authority or not. Interviews and discussion was also held with the Project authority and working labors in the Project site for identifying working condition and recruitment process as well.

A checklist in compliance with the "Performance Standards on Environmental and Social Sustainability" by International Finance Corporation (IFC) was followed for conducting informal discussion.

4.1.2 Exploration of Monitoring Parameters

Compensation

None of any land compensation cases has been filed over last three months. Therefore, compensation status remained same as it was in previous survey. According to the Bagerhat DC Office, compensation of 85% acquired land (including phase A & phase B) has been paid. Of the remaining, about 7% are owned by Bagerhat DC Office, 5% of land having inconsistency of legal documents or under sue in courts and the owner of about 3% of land are not interested to receive compensation.

Resettlement/Rehabilitation

Ten (10) out of eighteen (18) resettled households resided in the Foyla shelter home whereas eight are already moved out from the shelter home over last four years. Major cause behind their moving out was to unsustainable source of livelihoods and they were not able to adapt with the surrounding livelihoods in Foyla Bazaar area. However, the existing resettled households already managed their source of livelihood in Fayla Bazaar and they are somehow satisfied by residing in the shelter home.

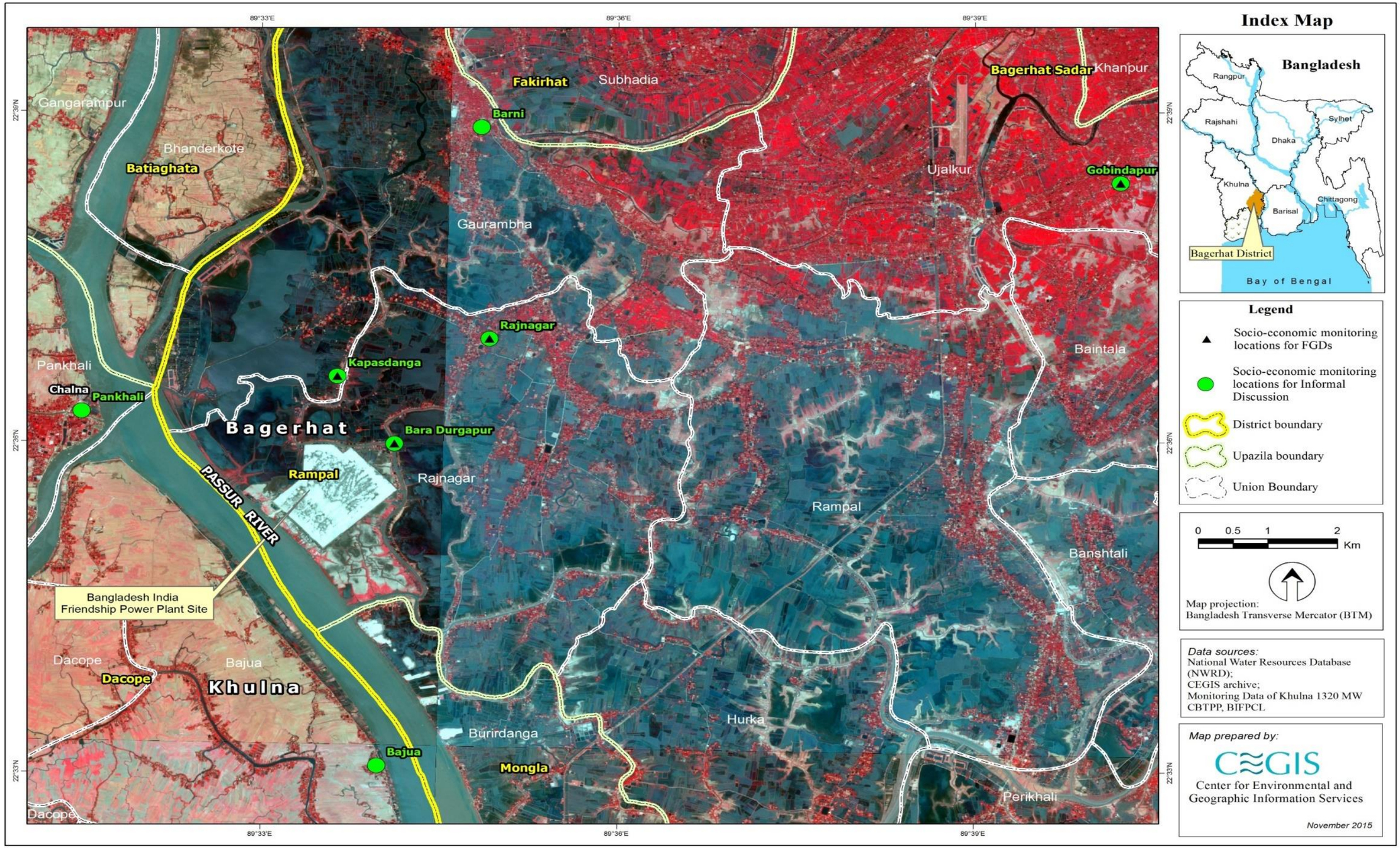


Figure 4.1: Socio-Economic Environment Monitoring Location

Project Related Employment Generation

There are several sub-contractors i.e. Dipon Group, Simplex, Keller, Afcon Group, Energypac, NS Construction etc. are working under the supervision of EPC Contractor named Bharat Heavy Electricals Limited (BHEL). The BIFPCL affirmed the sub-contractors to give priority to local laborers in recruitment according to their area of expertise and they have already monitored it. During field survey it was observed that, local laborers are considerably recruited in non-technical activities i.e. load carrying, laboring in civil works, masons and so on. The local working laborers stated that scope of their engagement depended on the type and volume of construction works. They stated that semi-skilled and non-skilled laborers can be found moderately in the project surrounding mouzas while technically sound laborers are rarely found.

The project authority previously stated that they could train the local people to fit them as semi-skilled and skilled laborers, though it was not possible in recent time due to some technical obligation. However, the authority stated that people can learn themselves by applying learning by doing method. They can be engaged in different interested sectors as work assistant and then learn by working closely with the seniors and experts. The project authority also stated that proposed project may create scope for local people to develop themselves according to their interest in different fields i.e. mason, carpenter, electrician, welding, sanitary fittings, tiles fittings and so on. The representative of the Project authority opined that floor is open for all the interested workers to enhance their expertise. In doing so,if they face any problem then project management should be informed, so that they can take necessary action immediately..

According to the EPC Contractor BHEL, at present about 1500-1800 laborers are working in the site. BNormaly labours are sourced through local labour contractor and it is understood that when local labours are not available sufficiently, then labour from other areas are recruited..

For solving different types of problems in which BIFPCL is directly or indirectly involved, the authority has initiated implementation of the grievance redress mechanism. A grievance box has already been installed in the Project office but till today not a single complaint has been dropped there. People of the project surrounding mouzas said that they knew about the grievance box from the social monitoring team of CEGIS but they are not aware of about the way of dropping complain in the grievance box. In this regard, they sought support and guidance from the project authority..

Labour and working condition

The labor sheds are separately constructed beside the project boundary. Each sub-contractor separately constructed the sheds which are made as semi pucca structure with brick wall and pucca floor; and tin shed roof. In general, condition of housing, sanitation, bathing and cooking facilities of the labor sheds are found to be good while cooking and bathing facilities are seemed to have scope for improvement in few places.. Water of a concrete cistern of Dipan Group, a local sub-contractor is found as not up to the mark. The laborers get itching after using that cistern water for bathing purpose. It is noticed that kitchen of the two semi-pucca sheds of Dipan Groups has been destroyed by the seasonal storm (*Kalboishakhi*). The project authority stated that they have already served notice to the respective sub-contractor to solve this type of problem soon.

LPG Cylinder Gas is used as cooking fuel in the kitchen of those sheds which is really a good initiative. But cooking inside of shed is quite risky which is observed during field survey; though there are existence of a fire extinguisher beside of the cooking stove. So it is essential to restore the kitchen facility as soon as possible and cooking inside the shed is to be restricted to avoid the fire incidents.

In terms of drinking water facilities, treated water from the water treatment plant is distributed to the workers residing at the shed. Labors are satisfied by the quality of water but they requested to increase the quantity of drinking water supply. The project authority stated that quantity of drinking water might be increased but it should be properly used for drinking purpose only. However, rain water harvesting technology may be considered as a solution to the problem of inferior quality of bathing water supply.

Inadequate water supply was found to the toilets in labor sheds while no water supply is provided to the tap and commode flashes in the toilets. Labors took water from outside cistern for meeting up their toilet requirements. The Authority assured that this situation will be improved in the near future.

A confectionary shop is found in the labor shed area which is the only source of refreshment for all the working labors. Labors alleged that the rate of all the food items and other products are high compared to the nearby market price. They requested for an arrangement so that they can get the food items at a reduced price.

It is reported by the laborer that, generally the female workers are locally recruited people, so they do not require residence facilities inside the Project area while they are sharing the sanitation facilities by sharing gent toilets in labor sheds area during working period. They do not face any difficulties for sharing the sanitation and other facilities with their male counterparts yet. However, the project authority stated that they have the provision to develop separate sanitation and other facilities for female workers which will be developed as per it's requirement.

Standard safety awareness approach is being followed by the Project Authority through hanging up a number of safety signboards by the roadside and other areas of the Project site. Workers are found aware about the use of Personal Protective Equipment (PPEs). Use of PPE is strictly monitored by the safety officials of both BHEL and BIFPCL. For ensuring laborers safety and security, following protective equipment are required some of those PPEs are presently found to be used by the laborers in respective working activities. Present practice of using PPEs as well as it's probable requirement in the Project site is specified in separate column in the following Table 4.1.

Table 4.1: Protective equipment of risky limb in human body

Risky limbs of human body	Protective Equipment	Present practice in project site
Eye	Safety spectacles/goggles, Welding shield	✓
Ear	Earplugs	✓
Head and neck	Safety helmets	✓
Hands and arms	Gloves, gauntlets and sleeves that covers part or all of the arm	✓

Risky limbs of human body	Protective Equipment	Present practice in project site
Legs and feet	Safety boots and shoes	✓
Lungs	Dust filtering Half and full masks	✓
Whole body	Boiler suits/aprons/chemical suits	Not applicable at this stage

Source: Personal Protective Equipment at Work Regulations 1992 (as amended)

It is reported that the wage rate of unskilled/semiskilled local laborers varies from BDT 400 to BDT 500 in the project site of which about BDT 30 and BDT 50 is deducted respectively as commission by the labor supplier. In terms of skilled workers wage rate was found up to BDT 700 according to types of work.

As requested, Festival Bonus provision may be considered for the workers as per the law of Bangladesh Government. The labors residing in the shed area requested to construct a prayer room and a recreational room for their use. The project authority assured that they will arrange a suitable place which can be used as a prayer room.

Safety Signboards display in the project site

Labors working in the project site

Cooking inside Labor shed

Using cistern for bathing

Community Health Safety and Security

Local community stated that blowing of dust from the project site is the main cause of deteriorating health condition of the surroundings population. . The Project authority has taken necessary initiatives for solving the dust blowing problem from their end. Boundary walls construction, covering the exposed field with grass, tree plantation, sprinkling water over the dust producing areas in special cases etc. are the initiatives that have already been taken by the Project Authority. All these measures helped to reduce the dust blowing to some extent.. The project authority stated that on completion of all the construction works and practice of suggested measures will help to reduce dust blowing from the project site.

In this regard, the Project authority has signed a contract with Bangladesh Forest Department (BFD), in which 2 lac trees will be planted in the Project site under the supervision of BFD. In line with this, about 45 lacs taka has already given to the BFD for planting 30,000 trees in the Project area. The project authority stated that, this type of initiatives may help to reduce dust blowing as well as ensure environment friendly working condition in the project site. It has been reported that last year about 30000 trees has already been planted at MSTPP site.

At present, piling and other construction activities are on going in the Project area, Problems related to these activities are mitigated by constructing boundary wall, plantation of trees and so on. In addition, it is suggested that heavy construction works should be restricted during night time only. (ECR, 2006).

For ensuring safety and security during construction activity, access of unauthorized people to the project area is prohibited. Guards are posted to the entry points to check/monitor unauthorized people's movement toward the project area. But, a pocket access point is found which connects Durgapur and Sapmari Mouzas where no full time guard is posted.. However, posting of full time guards at that point is recommended to ensure safety and security..

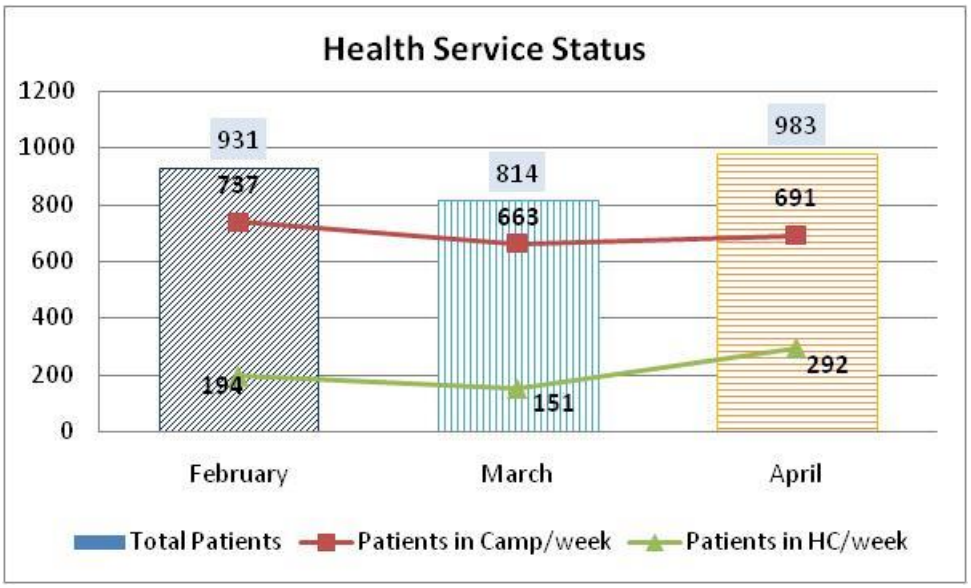
Activities under Corporate Social Responsibilities (CSRs)

Project authority initiated to implement some program for restoring the livelihood of the project affected people. For doing so, a NGO was appointed for preparing LRP for the Project Affected People (PAP). They were mainly responsible for listing out the project affected households, identifying the socio-economic status of those households and seeking opinion for preferable and possible livelihood generating options. The NGO already submitted their finding as a report and the project authority scrutinized the report to take initiatives for playing their role. In the meantime, project authority trained 60 poor people on sewing and computer literacy from Rajnagar Union so that they can restore their livelihoods by using training skills. But, feedback of the training is not satisfactory at all, as most of the trainees have no scope to apply their acquired knowledge for earnings. In this respect, local people stated that trainings on rode welding, wall painting, driving, and skill development as electrical technician, mechanics, and security force could be might better compared to the given two's. A third party agency (NGO namely SAMAHAR) already been appointed for implementation of LRP for PAPs. The contract period is six months.

In addition, project authority played important role for generating employment opportunity for the local people. In this context, a good number of semi skilled and unskilled local labors have been recruited for Project related activities. Project authority had already appointed a local person for official work in Dhaka project office. The Project authority stated that this type of scope/facilities may be further increased.

The Project authority also initiated to provide free medical facilities for the local people as health treatment facility in these rural area is poor. This treatment facility has been highly appreciated and accepted by the local communities and local people like to express their gratitude to the project authority for this type of medical services extended to them.. Popularity of the said service has been gradually increasing over last four years.

Considering the convenience of local people, a medical camp is set up just beside the access road near to the entry point of the Power Plant. The camp provides free medical treatment to the local people twice in a week. The medical camp is well equipped with all necessary equipment and tools. It is suggested that the EPC contractor may also take initiative to set up a medical center/camp for their laborers and workers, where qualified first aider/ paramedical staff may be posted for providing medical treatment to the laborers.



Source: BIFPCL Office at Rampal, 2018

Figure 4.1: Record of health service recipients under CSR program

In figure 4.1, it is observed that 2,728 people received treatment from the BIFPCL health services during February 2018 to April 2018. Health services are provided in two ways - 1) Medical Camp and 2) Health Center (HC). Expert physician provides free service in the medical camp, therefore gathering of patients are quite high on those camping days. During last three months, highest service recipients were in April (983 patients) from both medical camp and health center (Figure: 4.1).

An ambulance service has been provided to expedite emergency response in case of accidental occurrences during construction activities. At present, services are provided only for general ailments.

5 Environmental Compliance

5.1 Introduction

During the recently conducted quarterly monitoring program it was observed that all the civil construction activities are being carried out in a massive manner especially at the Boiler and Turbine installation areas and other heavy equipment areas, development of internal road communications, temporary drainage networks development, water treatment system for the construction activities etc. are progressing fast in this stage.

The two-lane approach road of about 6.0 km. from Babur Bari point at Khulna - Mongla Highway to Project site has been completed. According to the new plan of the GoB, extension works of approach road from existing two lane to six lane is progressing fast. Boundary wall around the Project area and the slope protection activities of the developed land have also been completed. New section wise boundaries within the Project area have been demarcated for safety and harmonising the works effectively. The newly constructed pre-fabricated building has been used as the main Project Office of BIFPCL and the previous office building has been left over for the use of EPC contractor office. The EPC contractor i.e. BHEL have already employed different local specialized construction firms for progressing the construction works simultaneously.

The present environmental compliance monitoring includes the status of EMP implementation based on physical observation and assessment by the study team. A comprehensive diligence checklist has been developed to monitor the environmental compliance of different components e.g., Environmental and Social Management System and Action Plan; Labour and Working Condition; Community Health, Safety and Security; Biodiversity and Sustainable Management of Living Natural Resources.

The aim of the checklists is to check the diligence and effectiveness of the measures. The checklists are produced as Compliance Data Sheet that contains both quantitative and qualitative data. The details of the compliance checklist are attached in Appendix I. The summary of findings of the environmental compliance monitoring are presented in the following Table no. 5.1, 5.2, 5.3 and 5.4 respectively.

Table 5.1: Monitoring of Environmental and Social Management System Action Plan Implementation

Sl. No.	Potential Impacts	EMP measures as proposed in the EIA	Actual condition/ Measures already Implemented	Compliance Status	Recommended Action
1	Generation of Noise within the BIFPCL's Plant premises	• Switch off / throttle down all site machinery, vehicles, water vessels, and generator when not in use • No construction activities at night • Use noise damper within the project boundary, Limit vehicle speed and monitor it at every suitable point.	• CEGIS is carrying out noise survey under environmental monitoring study. • Noise level is within the limit around the project boundary but during the working time noise level for some of the construction site exceeds the standard limit. • Use of PPE by the workers at working period. • Machines/equipment/ generators which are passing idle period are switched off/throttled down. • Developed EHS documents for construction works. • Using sound proof room for the office workers.	Being Complied.	• Limit the noise level (ECR,2006)within the project boundary. • Redress any kind of community complain regarding noise effect.
2	Dust Generation from construction works	• Limiting activities for producing fugitive dust particle within project area • Vegetation clearance and base stripping should be minimized • Vehicle speed restriction must be enforced to control dust generation • Earthen roads and undeveloped roads should be avoided to minimize dust generation • Construction materials must be covered to protect from wind action • Spray water regularly for suppressing fugitive dust	• CEGIS is quarterly monitoring the dust generated at the sensitive receptors like boundary corners, project site, nearby communities and in the Sundarbans Reserve Forest Area. • Water spraying for reducing the dust emission. • Boundary wall for the main Plant is being completed. • Notification sign has been put into the strategic points. • Medical treatment and medication are provided to the workers related to the project	Being Complied	• Implement redresses mechanism for any kind of grievance from the community affected by the dust;

Sl. No.	Potential Impacts	EMP measures as proposed in the EIA	Actual condition/ Measures already Implemented	Compliance Status	Recommended Action
		• Dust particle generated from access roads must be controlled by spraying water during dry season • Stock piles of construction materials must be covered in order to protect from wind action. • An appropriate freeboard must be maintained in trucks hauling construction materials			
3	Water Quality	• Surface water must be saved from any harmful effluent emission and waste dumping from project site • Provide closed system facilities and wastewater treatment plant to minimize emission of effluents from workers colony. • Good housekeeping at workshop and construction site • Appropriate equipment with safety measures should be used for storage and handling of lubricant • Provide training and awareness building program to the workers during construction. The training and awareness programs are: a) arrange weekly consultation session among the workers through plant site managers. The duration of consultation is one hour according to ISO-14001 standard, b) arrange monthly environmental meeting among the mid-level officers through top management when those issues	• Harmful disposal was not recorded which is reflected in the monitoring parameters. • Existing drainage system has been rearranged and temporary drainage system is being developed. • Rainfall runoff discharge to nearby river through existing temporary drainage network and is being cleared occasionally. • EPC contractor is now going to re-check the water quality of outfalls. • Good housekeeping for storing the materials. • Labour colony is being prepared with good sanitation facilities. • Onsite sanitation facilities has been developed at the labour sheds as well as the working places.	Being Complied	• Stockpile of construction material should be placed at a safe distance from drainage network; • ; • Awareness training and good practices should be continued ; • Introduce temporary sewerage treatment system;

Sl. No.	Potential Impacts	EMP measures as proposed in the EIA	Actual condition/ Measures already Implemented	Compliance Status	Recommended Action
		will be discussed under guidance of ECR 1997.			
4	Waste Management System	• Limiting site clearance and base stripping activities within the project boundary**.** • Gathering and stocking of construction materials and machinery must be within a limited area in the project boundary**.** • The project area have to be fenced prior to initiation of construction activities**.** • Stock piles of construction materials requiring cover up in order to protect them from wind and weathering action**.** • The existing right of way have to be used for material transportation without creating any block • Keep provision of sanitary toilet, one toilet for 10 persons. • Location of spoil stock pile ought to be located in safe area and protected from wind and rain action. • No spoil store on River bank/slope • Construction wastes must be reused or recycled as and where possible • Burning of waste material should be restricted • Quality housekeeping practice must be maintained by regular inspection and checking.	• Heavy equipment and mechanical equipment are kept in the demarcated places. • Demarcation of working places, hazardous and risky materials and equipment are also recorded. • Conventional way of waste collection and disposal system has been initiated both at Plant office and labour shed. • Sanitation facilities are available • Burning of waste materials was not recorded • Material transport is being done by regular route • This project is not maintaining significant setback distance from the river especially along the Passur River. • Waste management has been included into the induction training of the labour • Local language(Bengali) are being included in the signboards.	Being complied	• Sufficient waste disposal bin/s with labelling should be installed at labour shed, and at working area. ; • As much as possible the 3R policy may be adopted (reduce, reuse and recovery of the construction waste). • Introduce coloured bins to store different types of waste. • Communicate with the local authority for offsite waste transportation and disposal.

Sl. No.	Potential Impacts	EMP measures as proposed in the EIA	Actual condition/ Measures already Implemented	Compliance Status	Recommended Action
		• Keep onsite waste collection and disposal facilities • Keep provision of different colored waste bin for dumping biodegradable, reusable and recyclable wastes. • Keep provision of awareness building meeting and training for employees			
5	Compensation and Resettlement	• Prepare Proper resettlement action plan and compensation plan if the Project needs any land acquisition addressing compensation, restoration, livelihood, living standards etc. based on proper socio economic studies. • Resettlement of the PAPs • Cash for compensation of land (CCL) before resettlement • formal agreement with the affected people prior to migration/resettlement • Sufficient standing crop compensation • Compensation for movable structures? • Retention of salvageable materials? • Compensation for loss of trading income? • one time moving assistance • grant to cover loss of regular wage income • Has a resettlement plan been developed which includes compensation, restoration, livelihood, living standards etc. based on proper socio economic studies? • Human provide/ take extra care/caution for the disadvantaged/	• Compensation has been given to the rightful owners of the land as per the laws of Bangladesh e.g., '*Acquisition and Requisition of Immovable Property Ordinance, 1982'.* • Compensation made by local DC office • Local DC office facilitates unauthorized occupants of the acquired land to get home in the shelter houses or cluster villages provided by the GoB. • BIFPCL gives priority to affected people in Project related employment • A significant number of affected people (especially who desires) are working at the construction site. • List of 136 indirectly affected people was given by the DC Office, Bagerhat. • Livelihood Restoration Plan (LRP) for the PAPs have been prepared by BPDB. • BPDB already appointed an NGO for implementation of LRP.	In the process of Compliance	• Initiatives should be taken for resettlement of the people as per the LRP; • Introduce training associated with the project activitiesso that the PAPs, could get job according to their skill during construction stages; • The authorities may give directives to the EPC/Sub-contractor/local contractor to recruit more local labours especially from the affected peoples.

Sl. No.	Potential Impacts	EMP measures as proposed in the EIA	Actual condition/ Measures already Implemented	Compliance Status	Recommended Action
		vulnerable group/s (i.e. women, children, ethnic minorities, indigenous people etc.) • Provision of monitoring the compensation and resettlement process			
6	Livelihood and living condition	• The labor recruitment policy must be formulated in such a way that the local laborers can easily get the chance of employment in the project • Govt./NGOs need to provide support the skill development program and income generation activities to local people • For the increased movement of people and heavy vehicles, the road networks must be developed	• BIFPCL is maintaining the social liaison especially with the local Government and DC office • Prepared HR policies, Labour recruitment Policies, Manpower set up etc.; • Local labours are involved in the project construction activities. • Most of the local labours are – directly project affected people, nearest communities or within the Rampal/Mongla areas • The wage of the labour is compatible with the national standard. • Provision of first aid is present; • Medical unit capable of dealing emergency situations like injury, ICU supported ambulance, accident, etc. already set up. • New planned residential areas for the labour are under construction, which includes good sanitation facilities, living condition, medical facilities and recreational facilities. • No praying facilities are available inside the project area. • Prayer room are being constructed.	In the process of Compliance	• The proponent should recruit more number of local labour for the project works according to their skill. • Training program, awareness building program and grievance redress mechanism should be adopted in a formal way; • Accidental log sheet or injury log book should be put into display in office premise and entry check post; • Training may be given to the seasonal fishermen, small boatman, Bouali and Mauali of Sundarbans as future labor force; • Training should be given sequentially to the PAPs, on Local or regional basis; • Separate praying facilities need to be arranged inside the Project area.

Sl. No.	Potential Impacts	EMP measures as proposed in the EIA	Actual condition/ Measures already Implemented	Compliance Status	Recommended Action
7	Green House Gas Controlling Measures	• Restriction of any kind of solid waste burning. • Regular maintenance of water vessels, vehicles, generator and machinery in accordance with manufacturer's specifications. • Approved pollution control devices to be fitted in equipment and machinery. • Transport vehicles must not be overloaded. • Avoid queuing of vehicles in areas adjacent to site, particularly near sensitive receptors including housing. • Switch off / throttle down all site vehicles, water vessels, generator and machinery when not in use	• EPC should adopt energy efficient, CDM (Clean Development Mechanism) measures for selection of technologies; • Making IFC guidelines, EIA approval of DoE, and EMP of the EIA, etc. as a part of the bid document. • Monitoring program is being run successfully • Vehicles and Vessels were not recorded as overloaded during the investigation	To be complied during construction and operation stage.	• Prepare checklist on equipment and their condition owned by the contractors; • GHGs inventory checklist should be prepared immediately at this stage; • Select low GHGs emission machineries and CDM; • Use of energy efficient technologies and equipment.

Table 5.2: Monitoring of Labor and Working Condition

Sl no	Potential Impacts	EMP measures as proposed in the EIA	Actual measures already Implemented	Compliance Status	Recommended Action
1	Working Conditions and Management of Worker Relationship	• Preparation of Human Resources Policies and Procedures for Direct workers; • Defined Working condition and Terms of Employment for direct worker; • Sustainably equivalent terms and condition for migrant workers; • Compliance to national law of forming workers' organization;	• Engaged HR consultant to prepare relevant policies; • Occupation Health and Safety department working ; • ERP and ESMS has been finalized; • No force and child labour is recorded • The EPC has signed contract with the sub-contractors about labour policies	Being complied	• Appointment of Local workers should be given priority for the jobs according to their skill. • No discrimination, equal opportunity and employment terms and conditions for local and migrated labours have to be carefully maintained. • Look after the workers wellbeing, relationships

Sl no	Potential Impacts	EMP measures as proposed in the EIA	Actual measures already Implemented	Compliance Status	Recommended Action
		• No discrimination and equal opportunity for all; • Measures for diminishing past discrimination; • Grievance Redress Mechanism.	• EPC has also appointed Occupational Health and Safety Officers at site • Ensure minimum wage and working hours as per GoB for the labour. • Induction training and regular training of first aid, tool box are continued. • Following the '*Bangladesh Labour Law (Revised) 2013', 'Bangladesh Labour Rule, 2015'.*		with the contractor and other labour groups, health and recreation.
2	Protecting Work Force	• The client will not employ children in any manner that is economically exploitative, or is likely to be hazardous or to interfere with the child's education, or to be harmful to the child health or physical, mental, spiritual, moral, or social development. • No Forced Labour	• Ensured no child labour employment • Ensured no forced labour • First Aid support to the labours during any accident. • Immediate first aid medical treatment has been given to about 100 numbers of labour • ERP has already been developed • Increasing the medical facilities for the labour. • EPC has also appointed Occupational Health and Safety officers at site • First aid, fire and safety, awareness training are conducted every week at project site. • ICU support ambulance and medical support are also improved in this quarter.	Being complied	• Proper documentation of contract with the worker is required which includes working hour, wage and benefit and emphasise recruitment of the local labours; • The insurance policy should cover the accidental case or injuries of the labours; • Awareness work should be continued regarding the local cultural values, STD and redress of workers grievances

Sl no	Potential Impacts	EMP measures as proposed in the EIA	Actual measures already Implemented	Compliance Status	Recommended Action
			• Contractor has taken insurance policy for engaged labours as per labour policy of Bangladesh.		
3	Safety at site	• Installation/Construction of Safety Fence around the Project area; • Use of Personnel Protective Equipment's (i.e. safety vest, safety goggles, ear plug, safety shoes, gloves, dust mask, etc.); • Safety trainings for workers (i.e. fire control, working at height, working in heat, first aid etc.); • Practice of Tool box meeting, safety talks • Safe Storage of Hazardous Chemicals (e.g. fuel, flammable chemical, toxic chemicals, etc.); • Maintaining Material Safety Data Sheet (MSDS); • Provision of Health care facilities such as doctor, hospital etc. available at/nearby the plant construction site; • Availability of First Aid at work place; • Preparation and Follow of Emergency Response Plan; • Adequate fire precautions in place (e. g., fire extinguishers, escape routes etc.);	• Putting safety sign at every strategic places; • Protecting the specific areas with fence; • A number of designated areas were recorded in the project site; • Labour and Project personnel are using appropriate PPEs like reflecting vest, helmet, and safety shoos etc. • Safety training for workers are regularly conducted at project site; • Developed storage area for storing the materials, equipment etc.; • BIFPCL is very much strict to use PPEs by the construction labours and the labours are getting accustomed with the PPEs • Increasing the capacity of temporary hospitals, doctors and 24hr available of ICU support ambulance at the Project site ; • Emergency contact address are found at the site for any kind of sudden incident; • Safety manual has been followed at the construction site; • Available fire extinguisher and Fire safety mock drill is being	Being complied	• Increase the manpower in EHS Department; • All electric distribution lines at project site required to be fixed as safe and tidy; • Insurance of the labour and employer should be introduced for any accidental case. • The worker should use every types of PPEs during construction time at any construction area.

Sl no	Potential Impacts	EMP measures as proposed in the EIA	Actual measures already Implemented	Compliance Status	Recommended Action
		• Documentation and reporting of occupational accidents, diseases, and incidents; • Policies and procedures for managing and monitoring the performance of third party employers in relation to OHS.	conducted at some regular intervals. • Preparing a register for any kind of accidental events and incidents; • Third party OHS check-up is continued; • Project site protection and security system are being maintained by Bangladesh Ansar. They are maintaining the register log and gate pass.		
4	Occupational Health and Safety procedure	• Provision of complete EHS division in the Human Resources Planning/ Organogram • Preparation of Safety Policy to be adopted during Plant operation	• Medical aid, fire extinguisher, PPEs are provided; • Worker's shed and sanitation facilities are available; • Onsite medical facilities have been continuing. • EHS Department of BIFPCL is now operating in full swing; • Moreover, EPC also appointed one OHS expert at site; • Site-specific Environmental Health & Safety checking is continued. • RO Water treatment plant and canteen has been operated for supplying safe drinking water and food.	Being complied.	• Regular training, awareness, motivational and mock drill should continue to be arranged at the construction and operation phase; • OHS procedure should also be followed by all workers including the labours appointed by the sub-contractors. • Place the grievance register in a suitable place where the workers could easily make their comments or develop a more flexible procedure for grievance redress.
5	Workers Well Being	• Provision of Welfare facilities for Worker/Labour such as, timely bonuses, wage, overtime, sick leaves, vacations etc.;	• Consultation with the proponent, EPC, Sub-contractor and labours, no forced labour is recorded. Workers have no complain with	Being Complied	• Introduce occupational code of practices/best practices compatible with their own culture

Sl no	Potential Impacts	EMP measures as proposed in the EIA	Actual measures already Implemented	Compliance Status	Recommended Action
		• Routine medical check-up and emergency medical care for the sick and injured; • Appointment of a leader amongst the labour group, who will look into workers' well-being.	the wage, working condition and the residence facilities. • Numerous provisions have been kept for Health care & information services, canteen facilities, water supply etc. • Proponent is now pushing to established fare wage of labours and the benefits for every labours • Free first aid medical treatment are being facilitated by BIFPCL to the labour and to the community too. • Grievance register are being initiated for the worker.		• Freedom of Association, Rights & scope of bargaining and tripartite consultation should be open for the workers. • Flexible procedure for grievance redress mechanisms • The proponent has to look after the following issues - job satisfaction, worker capacity development , work and non-work life balance, emotional supervisory support, organizational support and health surveillance

Table 5.3: Monitoring of Community Health, Safety and Security

Sl no	Potential Impacts	Proposed EMP	Actual measures already Implemented	Compliance Status	Recommended Action
1	Disturbance to nearby community due to dust from developed land and Noise from construction activities	• Construction of boundary wall around the Project area; • Installation of water spraying system to control dusts; • Conducting dust monitoring and visual inspection around the site boundary; • Adoption of Noise management plan.	• They are spraying water to reduce the dust emission. • Construction of boundary wall around the project area has been completed. • Block-B is highly responsible for spreading dust to the nearest community • CEGIS is regularly communicate with the nearby communities for assessing any kind of impacts • Regular communication and consultation are taken places with the	Being complied	• Spraying water to the exposed land areas especially to the township areas; • 24 hrs. dust monitoring has been initiated on monthly basis inside the project boundary at the sensitive places • More noise monitoring equipment may be installed at the potential sensitive receptors area.

Sl no	Potential Impacts	Proposed EMP	Actual measures already Implemented	Compliance Status	Recommended Action
			local government and local administration.		
2	Grievance of local people	• Availability and operation of Grievance Redress Mechanism; • Maintaining open communication channel with the local community.	• Social liaison officer is working on this issue • Regular monitoring has been conducted to identify the grievance of the nearby communities; • National level stakeholder consultation has been conducted occasionally • Grievance register is prepared for the community • Good communication has been established with the local government and proponent • BIFPCL has tried to redress the grievance of the local people though offering job, training and other CSR activities. • Proponent is observing the community grievance or quarries though the monitoring study conducted by CEGIS	Being complied	• Regular local level consultation is necessary for impact monitoring as well as updating the local communities. • Flexible grievance register procedure and redresses process. • Proponent should develop a framework to eliminate any conflict between migrated labours and local communities.
3	Risk of breaching Community Safety	• Construction of boundary wall/safety fence around the Project area; • Practicing Risk Assessment and Evaluation Process; • Practicing safe management for hazardous materials which may pose threat to the community; • Availability and operation of Emergency Response Plan;	• Project site is now protected as the construction of boundary wall has been completed. • Regular monitoring not only the bio-physical but also the ecological and ultimately the social system are monitored by third parties (CEGIS) • Implement high security system for the project; • Health check-up is mandatory to every labours during the induction training.	Being complied	• Arrange training and motivational work for maintaining local norms and values and have a good relation with the local workers and communities; • Make a liaison with the local government for clarifying any kind of indent/ rumour in local communities related with this project

Sl no	Potential Impacts	Proposed EMP	Actual measures already Implemented	Compliance Status	Recommended Action
		• Maintaining open communication channel with the local community; • Training and instruction to the security personnel about their behaviour and communication with the local people; • Aware the security personnel about the right of the community people.	• Preparing a safety checklist to be followed by EPC and sub-contractors; • Maintaining communication with local community; • Negotiation with local DC office and Bangladesh Ansar and VDP (who are responsible for security). • The project proponent has engaged the local governments and communities for improving their livelihood status		• Aware the security personnel about safeguarding environment and community. • Aware the security personnel about their behavioural intensions towards the local community people.
4	Community Health Risk	• Provision of providing health service facilities to community if the Project poses any health risk like sexually transmitted disease, contract disease, vector-borne diseases; • Implement all pollution mitigation measures to ensure safeguarding to community.	• Increasing medical facilities (consisting medical officer, medical assistant, office assistant) at Plant site; • Arranging twice a weekly health service program (medical consultation and free medicine) for the local community; • Increasing the patient for health services from December 2017 due to development of approach road communication • Protective action are taking to avoid vector borne diseases and HIV positives	Being Complied	• The proponent should train the migrated labour regarding the local culture and customs; • The proponent may establish business development activities (markets) for the workers and local communities as CSR activities. • Awareness program should be introduced to reduce any transmitted disease, HIV and violence toward communities.
5	Youth Employment (Local)	• Providing training/awareness program for the local youth to let them aware about the required qualification to get involved in the Project related activities • Emphasis to recruit local labours according to their skills and capacities.	• Informal sitting was arranged with the local government and community representatives for labour recruitment; • Significant number of local people are currently working at the construction site; • Regular training/workshop are being organized by the proponents;	Being Complied	• Increasing the number of local labours; • training related to construction work i.e. carpenter, electrician, lineman, elevator mechanic, glazier, iron worker, heavy equipment operator or

Sl no	Potential Impacts	Proposed EMP	Actual measures already Implemented	Compliance Status	Recommended Action
			• The proponents have already taken few initiatives to encourage local students through awarding them; • Local labours are working at this project engaged by the sub-contractors companies • Formal training on computer literacy and sewing machine has been initiated in the site and already 3 batches has completed the training program. • BIFPCL has also taken initiatives to send the local youth for industrial training at Khulna divisional area.		labourer etc. would be introduced immediately; • Assign job responsibilities based on skills and training for the locals; • Support Income generating activities and business development activities for the local potential youth.
6	Public Communication, Consultation and Awareness	• Arranging public communication/consultation meeting; • Sharing of Project information with local people; • Organizing environmental and social awareness programs/meetings.	• Informal sitting with the community; • Display Project related information on a display board at Project site; • Regular meetings are being carried out at different level; • Advertisement was broadcasted • Publishing Project related discussion/article in different print media. • Project related every information has been uploaded in BIFPCL website	Being Complied	• Continue the dissemination workshop in Dhaka and Khulna to aware the community, civil society, environmentalists about the environmental safeguarding measures considered in basic design. • The EPC contractor should follow the social code of conducts / good practices

Table 5.4: Monitoring of Biodiversity and Sustainable Management of Living Natural Resources

Sl no	Potential Impacts	EMP measures as proposed in the EIA	Actual condition/ Measures already Implemented	Compliance Status	Recommended Action
1	Rainfall runoff from the construction site would	• Installation of proper runoff drains;	• Water logged area is not found inside the project boundary	Being complied	• The proponent has to maintain the temporary drainage system as huge construction work is going on.

Sl no	Potential Impacts	EMP measures as proposed in the EIA	Actual condition/ Measures already Implemented	Compliance Status	Recommended Action
	cause deterioration of aquatic ecosystem.	• Use of sediment fences, traps and basins for trapping the sediment, if required.	• Construction of sediment traps is mentioned in the Bid documents to instruct the bidders; • Develop temporary drainage network inside the Project boundary. • The connectivity of Maidara River is being maintained. • EPC is monitoring the water quality at every outlet from the project site. • RO plant is operating for supplying fresh water supply system both for construction and domestic uses.		• The proponent needs to monitor the connectivity i.e., the free flow of Maidara River. • Storm water drainage network must be separated from any kind of contamination of chemicals or oily water. • EPC must monitor the waste water generated during the constructions • Evaporation pond might be used for brine discharge from the RO Plant
2	Disturbance to nearby ecosystem due to different construction activities	• No cutting/ felling of trees along the river bank; • Implementation of onsite waste and air quality management plan; • Limiting soil extraction activities within the defined area; • Limiting the vegetation clearance and base stripping process within the Project boundary; • Safety fence around the construction site; • Limiting the use of night light; • Using shade (directed downwards) around the outdoor lights; • Provision of cut-off time to switch off unnecessary lights at night;	• No cutting/ felling of trees occurred along the river bank; • Rudimentary processing followed for waste collection and disposal system • Limiting the vegetation clearance and base stripping process within the Project boundary; • Boundary wall around the project is completed along with compartmentalization • Provision of cut-off time to switch off unnecessary lights at night; • Selection of local plant species for green plantation; • No degradation of the habitat out site the power plant area	Being Complied	• E Build up awareness of the local people and the Project personal regarding. no harm/ no kill of the wild animals and habitats • If possible using of light shade (directed downwards) around the outdoor lights; • Regular monitoring of the trees planted around the Project site. • Bird sheds can be developed at the green belt areas or on the bank slope. • Awareness program for ecosystem conservation and development should be introduced as a part of Corporate Environmental Responsibility

Sl no	Potential Impacts	EMP measures as proposed in the EIA	Actual condition/ Measures already Implemented	Compliance Status	Recommended Action
		• Initiate Green plantation; • No plantation of non-native species; • Retaining top soil for future habitat restoration; • No degradation of sensitive habitat.	• EPC contractor is going to monitor air quality, water quality and noise level more intensively in the project area • Working activities are now limited to the project boundary • No lighting and noise effect is noticed significantly outside the project boundary wall • Training and motivational works are introducing to protect local fauna.		• Limiting the noise level (ECR'97) within the project boundary created by the project activities. • Ecosystem monitoring must be continued simultaneously with the power plant construction and operation works.
3	Disturbance to river, inter-tidal areas and wet lands	• No encroachment of inter-tidal flood plain area; • No disturbance to Dolphin community; • Monitoring of Ecosystem Health and Monitoring of Sundarbans Forest Health; • If required, embankment should be constructed considering a setback distance from river/canal bank; • Slope protection work along the Maidara River should be completed on an urgent basis before rainy season come, and; • BIFPCL may take initiatives of excavating of silted reach of Maidara river near proposed township area to facilitate proper functioning of River for maintaining tidal flow dynamics	• Monitoring of forest health and ecosystem health in Sundarbans and around the Project site are being carried out by CEGIS; • Maintaining significant setback distance from Passur river to the Project site; • Completion of slope protection work; • Protection works along the Maidara River maintained setback distance from Maidara River. • EPC is going to monitor the discharge quality at each of the outlet from this project • The natural stream flow of Maidara River near access road has been recorded.	Being Complied	• BIFPCL/EPC contractor should take necessary actions for maintaining the natural flow of Maidara river • Any disturbance to navigation, degradation of water quality and ecosystem through heavy equipment transportation should not be made. • Necessary action should be taken if the discharge water quality cross the standard limit (ECR'2006)

Sl no	Potential Impacts	EMP measures as proposed in the EIA	Actual condition/ Measures already Implemented	Compliance Status	Recommended Action
1	Rainfall runoff from the construction site would cause deterioration of aquatic ecosystem.	• Installation of proper runoff drains; • Use of sediment fences, traps and basins for trapping the sediment, if required.	• Water logged area is not found inside the project boundary • Construction of sediment traps is mentioned in the Bid documents to instruct the bidders; • Develop temporary drainage network inside the Project boundary. • The connectivity of Maidara River is being maintained. • EPC is monitoring the water quality at every outlet from the project site. • RO plant is operating for supplying fresh water supply system both for construction and domestic uses.	Being complied	• The proponent has to maintain the temporary drainage system as huge construction work is going on. • The proponent needs to monitor the connectivity i.e., the free flow of Maidara River. • Storm water drainage network must be separated from any kind of contamination of chemicals or oily water. • EPC must monitor the waste water generated during the constructions • Evaporation pond might be used for brine discharge from the RO Plant
2	Disturbance to nearby ecosystem due to different construction activities	• No cutting/ felling of trees along the river bank; • Implementation of onsite waste and air quality management plan; • Limiting soil extraction activities within the defined area; • Limiting the vegetation clearance and base stripping process within the Project boundary; • Safety fence around the construction site; • Limiting the use of night light;	• No cutting/ felling of trees occurred along the river bank; • Rudimentary processing followed for waste collection and disposal system • Limiting the vegetation clearance and base stripping process within the Project boundary; • Boundary wall around the project is completed along with compartmentalization	Being Complied	• E Build up awareness of the local people and the Project personal regarding. no harm/ no kill of the wild animals and habitats • If possible using of light shade (directed downwards) around the outdoor lights; • Regular monitoring of the trees planted around the Project site. • Bird sheds can be developed at the green belt areas or on the bank slope. • Awareness program for ecosystem conservation and development

Sl no	Potential Impacts	EMP measures as proposed in the EIA	Actual condition/ Measures already Implemented	Compliance Status	Recommended Action
		• Using shade (directed downwards) around the outdoor lights; • Provision of cut-off time to switch off unnecessary lights at night; • Initiate Green plantation; • No plantation of non-native species; • Retaining top soil for future habitat restoration; • No degradation of sensitive habitat.	• Provision of cut-off time to switch off unnecessary lights at night; • Selection of local plant species for green plantation; • No degradation of the habitat out site the power plant area • EPC contractor is going to monitor air quality, water quality and noise level more intensively in the project area • Working activities are now limited to the project boundary • No lighting and noise effect is noticed significantly outside the project boundary wall • Training and motivational works are introducing to protect local fauna.		should be introduced as a part of Corporate Environmental Responsibility • Limiting the noise level (ECR'97) within the project boundary created by the project activities. • Ecosystem monitoring must be continued simultaneously with the power plant construction and operation works.
3	Disturbance to river, inter-tidal areas and wet lands	• No encroachment of inter-tidal flood plain area; • No disturbance to Dolphin community; • Monitoring of Ecosystem Health and Monitoring of Sundarbans Forest Health; • If required, embankment should be constructed considering a setback distance from river/canal bank; • Slope protection work along the Maidara River should be completed on an urgent basis before rainy season come, and;	• Monitoring of forest health and ecosystem health in Sundarbans and around the Project site are being carried out by CEGIS; • Maintaining significant setback distance from Passur river to the Project site; • Completion of slope protection work; • Protection works along the Maidara River maintained setback distance from Maidara River.	Being Complied	• BIFPCL/EPC contractor should take necessary actions for maintaining the natural flow of Maidara river • Any disturbance to navigation, degradation of water quality and ecosystem through heavy equipment transportation should not be made. • Necessary action should be taken if the discharge water quality cross the standard limit (ECR'2006)

Sl no	Potential Impacts	EMP measures as proposed in the EIA	Actual condition/ Measures already Implemented	Compliance Status	Recommended Action
		• BIFPCL may take initiatives of excavating of silted reach of Maidara river near proposed township area to facilitate proper functioning of River for maintaining tidal flow dynamics	• EPC is going to monitor the discharge quality at each of the outlet from this project • The natural stream flow of Maidara River near access road has been recorded.		

5.2 Compliance to the Conditions of DoE

Sl no	Condition of DoE	Compliance	Remarks
1	This EIA Report is approved only for 1320 MW Khulna Coal Based Power Plant. Any expansion or extension of this Power Plant will require obtaining further Environmental Clearance with additional EIA Study.	Not applicable now	BPDB will comply with the condition prior to initiation of any expansion or extension of the Power Plant.
2	The Coal Specification and Power Plant technology should be maintained as per EIA report. In case any change in design the proponent must obtain consent from DoE.	The Coal Specification and Power Plant technology will be maintained as per EIA report. In case of any change in Plant design and coal specification the proponent shall obtain consent from DoE.	Suggested to comply as and when required.
3	Project Proponent may undertake activities for land development and infrastructural development of the Project.	BIFPCL has already completed land development activities. Infrastructure development activities are being continued.	Being Complied.
4	Project Proponent may open L/C (Letter of Credit) for importing machineries for the Project, which shall also include machineries relating to waste treatment plant and other pollution control devices.	EPC contractor has been appointed. They are in process of importing Power Plant machineries.	Being Complied.
5	The activity under Proposed Khulna 1320 MW Coal based Thermal Power Plant Construction and operation shall not release any pollutant that affect human health or will have damaging impact on the environment or natural resources.	BIFPCL engaged CEGIS for monitoring pre-construction and construction activities for examining environmental impacts. No significant impact on the surrounding environment or natural resources impact has been reported yet. All necessary measures have already been incorporated in the technical specification of main Plant EPC package as per DoE stipulations. Pollution control measures have widely been covered in technical specification like Effluent Treatment Plant, ESP, FGD etc.	Being Complied.
6	Proper and adequate mitigation measures shall be ensured throughout preparation, construction and operation period of the proposed Khulna 1320 MW Coal based Thermal Power Plant Project activities.	BIFPCL is monitoring the mitigation measures adopted through the environmental consultant CEGIS. Site development activities have been completed and construction work has already started. Proper and	Being Complied.

Sl no	Condition of DoE	Compliance	Remarks
		adequate mitigation measures at this stage are being ensured.	
7	Any heritage sight, ecologically critical area, and other environmentally, religious and archaeologically sensitive places shall be kept protected during Project construction phase.	There is no religious, archaeological place in and around the site. The construction activities are being carried out considering and ensuring safeguarding of the *Sundarbans Reserve Forest area* and **ECA** (Ecologically Critical Area).	Being Complied.
8	Environment friendly construction and development practices shall be followed that minimize loss of habitats and fish breeding, feeding & nursery sites.	The construction activities are being carried out in and around the project boundary. The equipment and labour/workers are coming to the project through designated/ conventional route. Moreover, regular monitoring activities are also being carried out to compare the impacts. No significant changes are recorded.	Being Complied.
9	Construction works shall be restricted to daytime hours so as to avoid/mitigate the disturbance of local lives as well as implementation schedules of the works shall be notified in advance to nearby residents.	CEGIS is monitoring the community response towards construction works of Power Plant regularly. Moreover, BIFPCL is keeping close communication with local people to receive their grievance related to project activities. The construction activities shall be restricted to daytime only. However, for the timely completion of the Project, if required, works may be continued beyond day time, but that must be done in such a way that it does not create any disturbance to nearby residents and eco-system.	Being Complied and suggested to continue the same throughout the remaining period of construction works.
10	Proper and adequate sanitation facilities shall be ensured in labour camps throughout the proposed Project period.	At present, the construction activities has been initiated. New residential areas and adequate sanitation facilities are becoming available for the labours. Provisions in line with this, condition have been included in Clause no 2.5 of Special Condition of Contract (SCC) and in Health & safety manual. BIFPCL will ensure the same when massive construction work would start.	Being Complied
11	In order to control noise pollution, vehicles & equipment shall undergo regular maintenance; working during sensitive hours and	All vehicle & equipment used at site are under regular maintenance. Working during sensitive hours and locating	Being Complied

Sl no	Condition of DoE	Compliance	Remarks
	locating machinery close to sensitive receptor shall be avoided.	machinery close to sensitive receptor are being avoided.	
12	No solid waste can be burnt in the Project area. An environment friendly solid waste management should be in place during the whole period of the Project in the field.	No solid waste is burnt inside the project boundary. Provisions in line with this, condition have been included in Clause No 14.9 of SCC. Solid Waste Management system has been prepared (Section-V, B12, Part-9 of Technical Specification).	Being complied and suggested to continue the same throughout the remaining period of construction activities.
13	Proper and adequate on-site precautionary measures and safety measures shall be ensured so that no habitat of any flora and fauna would be endangered or destructed.	The construction activity is being carried within the project boundary. Moreover, regular monitoring activities are carried out to compare the impacts. No significant changes are recorded.	Being Complied
14	All the required mitigation measures suggested in the EIA report along with the emergency response plan are to be strictly implemented and kept operative / functioning on a continuous basis.	At present, the construction activities has been initiated. The project authority has increased the medical facilities for workers. An ICU support ambulance and Doctors are now available for emergency stages. Villagers of surrounding areas also availing the healthcare facilities. The authority is trying to make aware the labours/workers on occupational health and safety through safety signboards, using safety equipment and strong implementation of safety measures. The Emergency response plan must be implemented strictly and kept operative/functioning on a continuous basis.	Being Complied
15	To control dust, spraying of water over the earthen materials should be carried out from time to time.	Water spraying for dust suppression are currently functioning according to the given condition. Moreover, intensive dust monitoring system is going to be implemented around the project site as the massive construction works begin.	Being Complied
16	Storage area for soils and other construction materials shall be carefully selected to avoid disturbance of the natural drainage.	Construction materials have been stock piled far away from river bank and other natural water bodies at selected site to avoid disturbance of the natural drainage. For the time being BIFPCL have constructed temporary drainage network to evacuate drainage water from the	Being Complied

Sl no	Condition of DoE	Compliance	Remarks
		Project site. Designed Drainage network will be constructed at the end of Project construction works.	
17	Adequate considerations should be given to facilitate drainage system for runoff water from rain/tidal surge.	Temporary drainage system has been developed to facilitate safe drainage of runoff water accumulated from rain/tidal surge.. A setback distance from the river has been maintained for this Project.	Being Complied.
18	Adequate facilities should be ensured for silt trap to avoid clogging of drain/canal/water bodies	Run off/ storm water drainage system shall have silt trap constructed before the next monsoon. Contractor is working to complete the construction works of temporary drainage system.	Being Complied.
19	The entire coal handling system should be designed as an enclosed (and not only covered) conveyor system. There should be integrated dust control system with dust extraction and bag filters at unloading areas and at each transfer points on the conveyor system.	Entire coal handling system have been designed as an enclosed conveyor system as per DoE requirement. Integrated dust control system with dust extraction system / bag filter and dust suppression system at crusher house, unloading points, transfer points has been specified in the technical specification of Main Plant EPC contract package. Refer Section V, B4 of Technical Specification.	Being Complied.
20	Coal Plant should have high-efficiency bag filter for arresting dust emissions.	Integrated dust control system with dust extraction system / bag filter and dust suppression system at crusher house, unloading points, transfer points has been specified in the technical specification of EPC contract package and will be implemented accordingly. Refer Section V, B4 of Technical Specification (Clause no B4.3.1.4).	Compliance action initiated.
21	Coal should be stored in a covered storage yard.	All these stipulations have been included in the technical specification of Main Plant EPC contract package, Section V, B4 of Technical Specification (Clause No B4.3.1.6).	Compliance action initiated.
22	The entire coal stockyard should be covered with water sprinkler provided with automated moisture sensor to control self-combustion.	All these stipulations have been included in the technical specification of Main Plant EPC contract package, Section V, B4 of Technical Specification.	Compliance action initiated.
23	100% utilization of fly ash and bottom ash should be planned and implemented throughout	100% utilization of fly ash has been planned and shall be implemented throughout the	Complied at present and will be complied

Sl no	Condition of DoE	Compliance	Remarks
	the operation of the Plant. There should only be a provision of small ash dyke that will not exceed 25 (twenty five) acres of land to store residual ash.	operation of this Plant. EOI has been received in this regards from nearby Cement Industries.. Only 25 acres area has been allocated to store residual ash.	throughout Operation phase.
24	Integrated dry ash handling, loading, unloading and transportation system should be established.	Integrated dry ash handling, loading, unloading and transportation system will be established. Provisions in line with this has been included in Technical Specification of main Plant EPC contract package (Section V, Chapter B4).	Compliance action initiated.
25	There should be adequate and properly sized and designed dry ash silo with appropriate conveyor system.	Adequate and properly sized dry ash silo with appropriate conveying system have been specified in Technical Specification of main Plant EPC contract package (Section V, Chapter B4).	Compliance action initiated
26	Bottom ash should be extracted, crashed and stored in silos for utilization with proper collection and conveyor system.	Bottom ash shall be extracted, crushed and stored in silos for utilization with proper collection and conveying system. The procedures have been included in the technical Specification of EPC contract package. (Section V, Chapter B4).	Compliance action initiated
27	Resettlement and rehabilitation of the displaced population (including those who do not own land) should be done properly.	Land has been acquired by GoB. Resettlement and rehabilitation action was taken as per the law of the Bangladesh. However, BPDB has already written to Ministry for suitable resettlement and rehabilitation as per DoE requirement. In the meantime, BPDB have prepared an assessment (Livelihood Restoration Plan) regarding the rehabilitees (including those who do not own land) for this Power Plant. In this regard BPDB has already invited Tender from local NGO for implementation of the recommendation of the LRP Report.	Compliance action initiated
28	Resettlement plan should be properly implemented and people should be adequately compensated.	Land has been acquired by GoB. Resettlement and rehabilitation action was taken as per the law of the Bangladesh. However, BPDB have prepared an assessment (Livelihood Restoration Plan) regarding the rehabilitees (including those who do not own	Compliance action initiated

Sl no	Condition of DoE	Compliance	Remarks
		land) for this Power Plant. In this regard BPDB has already invited Tender from local NGO for implementation of the recommendation of the LRP Report.	
29	Construction material should be properly disposed-off after construction work is over.	At present, the construction work is going on. Storage room has been prepared for the construction works.. Solid Waste Management system has been prepared keeping the provisions in line with this (**Section-V**, **B12**, and Part 9 of Technical Specification).	Complied at present.
30	As described in the report environmental monitoring should be strictly followed and monitoring report should be shared with DoE to ensure the environmental management properly.	BIFPCL has engaged CEGIS for environmental monitoring in February 2014. Accordingly, each quarterly monitoring report has been submitted and shared with DoE, which are also available at BIFPCL web page.	Being Complied.
31	All activities (pre-construction, construction and post-construction stage) should be implemented according to EMP clearly listed in the EIA report.	BIFPCL has adopted all of the EMP applicable at relevant stages. CEGIS, as an environmental consultant of BIFPCL is monitoring implementation of EMP. BIFPCL is taking all possible actions based on EMP monitoring report.	Complied at present.
32	A third party/independent monitoring bodies excluding JVC/BPDB should be engaged immediately for monitoring of all activities during pre-construction, construction and operation phases as per monitoring plan of EIA report and monitoring report must be submitted to Bagerhat District Office, Khulna Divisional Office and Headquarters of the Department of Environment simultaneously.	CEGIS, as an independent monitoring body has been engaged by BIFPCL as environmental consultant since February 2014 and it is still continued. . From then on, CEGIS has been conducting the monitoring programs quarterly and producing monitoring reports on regular basis which are submitted by CEGIS to BIFPCL for onward submission to the Bagerhat District Office, Khulna Divisional Office and Headquarters of the Department of Environment as directed by DoE.	Being Complied
33	Regular monitoring of the susceptible places of Sundarbans for protecting ecosystem, biodiversity and forest coverage should be made using latest high resolution image for keeping ambient environment.	The Monitoring activities of CEGIS included this part. The monitoring report contains analysis of biodiversity and forest coverage. However, in addition to this, Forest Department has also suggested some survey & analysis which have also been	Being Complied.

Sl no	Condition of DoE	Compliance	Remarks
		monitored and reported by CEGIS through the quarterly compliance monitoring report.	
34	Air, water, soil, biological and social data should be monitored regularly with a network monitoring system with a view to assess the natural quality of the Sundarbans and other fragile ecosystem and report of monitoring results should be submitted to Bagerhat District Office, Khulna Divisional Office and Headquarters of the Department of Environment simultaneously.	The network monitoring system will be installed as a part of the project construction for online monitoring and it will be run at the time in operation. All these stipulations have been included in the technical specification of Main Plant EPC contract package. (Section-V, Clause No B0 6.19.13.2 and Clause No. B0 6.19.13.5). However, air, water, soil and biological components are monitored manually as per recommendation of EMP.	Compliance action initiated.
35	There should be regularly disclosure of the report through workshops and websites and responses should be taken care accordingly.	All the reports are available on website of BIFPCL (www.bifpcl.com). CEGIS is regularly carrying out public consultation.	Being Complied.
36	Online air and water quality monitoring system should be made functional throughout the life of the Plant.	The online monitoring system will be installed when the Plant will be in operation phase and will continue throughout the life time of the Plant. All these stipulations have been included in the technical specification of Main Plant EPC contract package.(Section-V, Clause No B0 6.19.13.2 and Clause No. B0 6.19.13.5).	Compliance action initiated
37	Management Information System (MIS) are to be developed for this coal based Power Plant. The scope of MIS services will obviously include representing the real time monitored data especially environmental parameters displaying at Bagerhat District Office, Khulna Divisional Office and Headquarters of the Department of Environment, BPDB and other concern agencies/Ministries. The MIS should be web based for accessing every individual to show the real time monitored records.	The MIS will be prepared before commissioning of the Plant. The consultant for developing MIS will be engaged at least one year earlier. Specification for elaborate MIS system is already included in EPC contract document. Technical Specification like DDCMIS, DDCS, PADO System, HART system, Plant MMS, Information management security system etc. have been included.	Compliance action initiated

Sl no	Condition of DoE	Compliance	Remarks
38	JVC should provide all sort of logistics support to DoE and other relevant agencies for monitoring environment related items/events.	BIFPCL is ready to provide all sort of logistic support as and when required by DoE and other relevant agencies for monitoring of Plant construction activities and environmental items/events.	Being complied
39	No ground water should be allowed to use for plant purposes.	No ground water has been used so far for Plant purposes. The Plant has been designed considering use of surface water only. Therefore, they have already installed RO water treatment plant for potable water and for construction water sourcing from the river water of Passur.	Complied at this stage.
40	Conduct stakeholder meetings on regular basis for better performance of the Project as a whole.	Pre-construction phase of the Plant has been completed and the construction phase has already started. BIFPCL has appointed a social worker who regularly visits nearby community to consult with the local people. Besides, CEGIS, appointed by the Project authority as environmental monitoring consultant, is also carrying out consultation with the local people on regular basis for better performance of the Project as a whole.	Being Complied
41	Additional Environmental baseline data to be collected as suggested in the EIA report and conveyed to DoE and other concern authorities.	CEGIS has been engaged in February 2014, for preparing Detailed Environmental Baseline. CEGIS has submitted annual monitoring report along with reports of quarterly monitoring containing latest baseline data to BIFPCL for further dissemination to DoE and other concerned authorities.	Being Complied
42	The Environmental Management Plan under the EIA study shall strictly be implemented and kept functioning on a continuous basis.	BIFPCL has been implementing all the EMP measures phase by phase as suggested in EIA report and approval condition of DoE. Those are regularly monitored by CEGIS.	Being Complied
43	The Project authority shall submit a detail work plan with time schedule of development activities at least 7 (seven) days ahead of the work commences in the field to the Bagerhat District Office, Khulna Divisional Office and	The construction works is now going on. . BIFPCL has submitted the detailed work plan seven (7) days before start of the construction activities.	Being complied

Sl no	Condition of DoE	Compliance	Remarks
	Headquarters of the Department of Environment simultaneously.		
44	Environmental Monitoring Reports according to specific format specified in the EIA Report shall be made available simultaneously to DoE Bagerhat District Office, Khulna Divisional Office and Headquarters on a monthly basis during the construction period of the Project.	Environmental Monitoring Reports as per specific format provided in the EIA Report made available by BIFPCL simultaneously to DoE Bagerhat District Office, Khulna Divisional Office and Headquarters starting from October 2017. After getting Notice to proceed from BIFPCL, the EPC Contractor BHEL started mobilising from May-June 2017 and after monsoon significant construction work started from October 2018.	. Being Complied
45	The following records must be kept in respect if any samples required to be collected for the purpose of environmental monitoring activities: the date(s) on which the sample was taken; the time(s) at which the sample was collected; the point at which the sample was taken; and the name of the person who collected the sample.	The Monitoring report of CEGIS keeps all the records as suggested.	Being Complied
46	The results of any monitoring required to be conducted under this EIA report must be recorded.	CEGIS is recording all the monitoring data and submitting to BIFPCL through proper documentation. The report is being shared with DoE on regular basis.	Being Complied
47	In case of any emergency, the following information shall be immediately be reported to Bagerhat District Office, Khulna Divisional Office and Headquarters of the Department of Environment (DoE) simultaneously Nature of incident (oil spill, fire, accident. Collision, land slide, etc.) Personnel affected (injured, missing, fatalities, etc.) Emergency support available and its location (standby	So far no such emergency has occurred. Emergency Reporting/ Emergency response plan have been prepared. Health and safety management manual have been prepared and it is a part of technical specification. BIFPCL has established a proper mechanism for recording such incident as suggested during the construction period of the Project.	Compliance action initiated.

Sl no	Condition of DoE	Compliance	Remarks
	transport, medical facilities, etc.) Weather conditions Current operations (abandoning the site, firefighting, etc.)		
48	The Project authority or its employees must notify the department of Environment of incidents causing or threatening material harm to the environment as soon as practicable after the person becomes aware of the incident.	So far no such incident has occurred. BIFPCL has established a proper mechanism for recording such incident as suggested and notify the department of Environment regarding incidents causing or threatening material harm to the environment as soon as practicable after the person becomes aware of the incident. Health and safety management manual has been prepared and Environment, safety officer has been employed and CEGIS is monitoring EMP.	Complied at present.
49	All pollution incidents shall be reported immediately and simultaneously to the Bagerhat District Office, Khulna Divisional Office and Headquarters of the Department of Environment (DoE) in Dhaka.	So far no such incident has happened. BIFPCL has established a proper mechanism for recording such incident as suggested in the ERP. CEGIS has been engaged to monitor the social and environmental compliance on a regular interval.	Complied at present.
50	Appropriate permission would require to be obtained from the Forest Department in favour of cutting/felling on any plant/tree/sapling forested by any individual or government before doing such type of activity.	There will be no need of cutting/felling down of any trees. However, in future, if any such case arises, BIFPCL would seek for appropriate permission from the Forest Department.	Being complied
51	Re-vegetation and re-plantation under green belt activities shall be undertaken in consultation with the Forest Department according to those mentioned in the EIA report.	A MoU has been signed with Forest Dept., Bangladesh on 24.02.2015 for implementation of Afforestation Programme. Initial target is to plant 2 lac saplings in 3 years. By this time, Forest Department has already planted about 23000 nos. of saplings of different species. A fresh Agreement with BFD has been signed on 24.01.2018 for plantation of 2 Lakh trees.	Being Complied
52	Climate Change impacts and maximum storm surge height shall have to consider at the	The level (elevation) of the land and earthen embankment has been fixed considering the climate	Being Complied

Sl no	Condition of DoE	Compliance	Remarks
	design and construction phase.	change impact and maximum storm surge height.	
53	A separate EIA/morphological study shall have to be conducted for coal transportation and river dredging to develop sound environmental management plan towards conservation of ecosystem and biodiversity.	Mongla Port Authority (MPA) is the Implementing Agency for dredging. Coal transportation will be done through the existing maritime route, which is Mongla port controlled waterways. M/s IWM has already completed the EIA study for the dredging activity and submitted the report to MPA. A separate EIA study for Coal Transportation has been conducted by M/s CEGIS as per approved ToR of DoE and already obtained the approval from DoE.	Being Complied.
54	A full-fledged institutional setup for EHS and CSR must be put in place before operation of the Power Plant.	A full-fledged institutional setup for EHS activities shall be in place before operation of the Plant (Project). Meanwhile, a number of CSR activities are ongoing at Project site, like free medical facilities and medicines, free potable water supply to the local people. BIFPCL has appointed a social worker to collect relevant social data. Health and Safety manual has been prepared.	Being complied
55	The Project authority shall extend active cooperation to DoE officials to facilitate their visit to the site as and when necessary.	BIFPCL is extending its all-out cooperation to DoE	Being Complied
56	Violation of any of the above conditions shall render this approval void.	Noted by BIFPCL	-
57	Any injunction on this Project from the Honourable Supreme Court/High Court Division shall render this approval void.	Noted by BIFPCL	-
58	Without installation of 275 Meter Height Chimney, Effluent Treatment Plant (ETP), Waste Water Treatment Plant (WWTP), Settling Pond, Desalinization Plant, API Oil Water Separator, High Efficiency Electro Static Precipitator (ESP), 'closed-loop' Flue Gas Desulfurization (FGD), Low NOx Burner, online air and water quality monitoring system and other pollution control equipment and	At present, the Plant is in construction phase. The functional and technical specification of the main Plant includes 275 Meter high Chimney, Effluent Treatment Plant (ETP), Waste Water Treatment Plant (WWTP), Setting Pond, Desalinization Plant, API, Oil Water Separator, High Efficiency Electro Static Precipitator (ESP), 'closed-loop' Flue Gas Desulfurization (FGD), Low NOx Burner, online air and water quality monitoring system	Compliance action initiated

Sl no	Condition of DoE	Compliance	Remarks
	obtaining Environmental Clearance Certificate, the proponent shall not start operation of the Project.	for preventing pollution. All these stipulations have been included in the technical specification of Main Plant EPC contract package. Moreover, the area of that equipment position are demarked inside the project boundary.	
59	This EIA Approval has been issued with the approval of the appropriate authority.	BPDB and BIFPCL are thankful to DoE.	-

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Appendices

Appendix I: Checklist of Monitoring Environmental Compliances

Table A: Checklist of Monitoring for ESMP Implementation (During Construction Phase)

Sl No	Potential Impacts	Proposed EMP	Actual Implementation	Recommended Action	Compliance Status
1	Generation of Noise within the BIFPCL's Plant premises	• Conduct noise survey around and inside the site boundary • Reducing Noise and Vibrations to country's ambient standards, and occupational health and safety standards • Introducing vehicle speed limit and speed limit monitoring system • Green Plantation around the Project boundary • Switching off/ throttling down of machines/equipment's/generators which are not in use			
2	Dust Generation from Land development activities and other construction works	• Conducting dust monitoring and visual inspection around the site boundary • No use of earthen and undeveloped roads by vehicles related to the Project use • Installation of water spraying system to control fugitive dusts • Introducing vehicle speed limit and speed limit monitoring system • If yes, do they monitor vehicle speed regularly?			
3	Water Quality	• Fencing the construction site by drum sheet or Tarjja of any other fencing • Arrangement of runoff drainage for reducing any water logging • Location of backfilling stockpile in safe area and protected from wind and rain action • No storing of backfilling materials/spoil stored on river bank/slope • No disposal of waste and wastewater to river or canal.			
4	Waste Management System	• Provision of onsite waste management system			
5	Compensation and Resettlement	• Prepare Proper resettlement action plant and compensation plan if the Project needs any land acquisition addressing compensation, restoration, livelihood, living standards etc. based on proper socio economic studies • Resettlement of the PAPs • cash for compensation of land (CCL) before resettlement			

Sl No	Potential Impacts	Proposed EMP	Actual Implementation	Recommended Action	Compliance Status
		• formal agreement with the affected people prior to migration/resettlement • Sufficient standing crop compensation • Compensation for shift able structures? • Retention of salvageable materials? • Compensation for loss of trading income? • one time moving assistance • grant to cover loss of regular wage income • Has a resettlement plan been developed which includes compensation, restoration, livelihood, living standards etc. based on proper socio economic studies? • Provide/take extra care/caution for the disadvantaged/vulnerable group(s) (i.e. women, children, ethnic minorities, indigenous people etc.) • Provision of monitoring the compensation and resettlement process			
6	Livelihood and living	• Does the Project pose any threat to the livelihood/living standards of the local people? • If yes, are adequate steps taken to reduce the impacts? • Has the company developed any policy which prioritizes the local labourers in employment opportunities? • Is there any possibility that large vehicle related to the Project will cause traffic induced disturbance/s to the local dwellers? • If yes, are there any mitigative steps taken to decrease the disturbance/s? • Has the road network been developed after the Project being proposed and during the construction phase? • Are there separate water and sanitation facilities for the construction workers in the Project area?			
7	Green House Gas Controlling Measures	• Use of efficient generator in the construction activities • Regular maintenance of vehicles, generator and machinery in accordance with manufacturer's specifications • Use of approved pollution control devices fitted in the equipment's and machineries • Switching off and throttling down the machines/equipment's/generators which are not in use			

Table B: Checklist of Monitoring ESMP Implementation (During Construction phase)

(Labor and Working Condition)

Basic Data

Sl No	Description	Values
1	Direct Workers	
2	Contracted Workers	
3	Supply Chain Workers	
	Child labor	
	0 - 12	
	13 - 14	
	14 - 18	

Checklist for Labor and Working Condition

Sl No	Potential Impacts	Proposed EMP	Actual Implementation	Recommended Action	Compliance Status
1	Working Conditions and Management of Worker Relationship	• Preparation of Human Resources Policies and Procedures for Direct workers • Defined Working condition and Terms of Employment for direct worker • Sustainably equivalent terms and condition for migrant workers • Compliance to national law of forming workers' organization • No discrimination and equal opportunity for all • Measures for diminishing past discrimination • Grievance Mechanism			
	Protecting Workforce	• The client will not employ children in any manner that is economically exploitative, or is likely to be hazardous or to interfere with the child education, or to be harmful to the child's health or physical, mental, spiritual, moral, or social development. • No Force Labor			
	Safety at site	• Installation/Construction of Safety Fence around the Project area • Use of Personnel Protective Equipment (i.e. safety suit, safety goggles, ear plug, safety shoes, gloves, dust mask, etc.)			

Sl No	Potential Impacts	Proposed EMP	Actual Implementation	Recommended Action	Compliance Status
		• Safety trainings for workers (i.e. fire control, working at height, working in heat, first aid etc.) • Practice of Tool box meeting, safety talks, • Safe Storage of Hazardous Chemicals (e.g. fuel, flammable chemical, toxic chemicals, etc.) • Maintaining Material Safety Data Sheet (MSDS) • Provision of Health care facilities such as doctor, hospital etc available at/nearby the plant construction site • Availability of First Aid at work place • Preparation and Follow of Emergency Response Plan • Adequate fire precautions in place (for example, fire extinguishers, escape routes etc.) • Documentation and reporting of occupational accidents, diseases, and incidents • Policies and procedures for managing and monitoring the performance of third party employers in relation to OHS			
	Occupational Health and Safety Procedure	• Provision of complete EHS division in the Human Resources Planning/Organogram • Preparation of Safety Policy to be adopted during plant operation			
	Worker's Well Being	• Establishment Grievance Mechanisms • Ensuring fair treatment, non-discrimination and equal opportunity • Compliance of Project's labor policy with the national labor law • No Child Labor • No incident of forced labor • Provision of Welfare facilities for Worker/Labor			

Table C: Checklist of Monitoring ESMP Implementation (During Construction phase)

(Community Health, Safety and Security)

Sl no	Potential Impacts	Proposed EMP	Actual Implementation	Recommended Action	Compliance Status
1	Disturbance to nearby community due to dust from newly developed land and Noise from construction activities	• Construction of boundary wall around the Project are • Installation of water spraying system to control dusts • Conducting dust monitoring and visual inspection around the site boundary • Adoption of Noise management plan			
2	Grievance of local people	• Availability and operation of Grievance Redress Mechanism • Maintaining open communication channel with the local community			
3	Risk of breaching Community Safety	• Construction of boundary wall/safety fence around the Project area • Practicing Risk Assessment and Evaluation Process • Practicing safe management for hazardous materials which may pose threat to the community • Availability and operation of Emergency Response Plan • Maintaining open communication channel with the local community • Training and instruction to the security personnel about their behaviour and communication with the local people • Aware the security personnel about the right of the community people			
	Community Health Risk	• Provision of providing health service facilities to community if the Project possess any health risk like sexually transmitted disease, communicable disease, vector-borne diseases • Implement all pollution mitigation measures to ensure safeguarding to community			***(Continued)***
	Youth Employment	• Providing training/awareness program for the local youth to let them aware about the required			

Sl no	Potential Impacts	Proposed EMP	Actual Implementation	Recommended Action	Compliance Status
		qualification to get involved in the Project related activities			
	Public Communication, Consultation and Awareness	• Arranging public communication/consultation meeting • Sharing of Project information with local people • Organizing environmental and social awareness programs/meetings			

Table D: Checklist of Monitoring ESMP Implementation (During Construction phase)

(Biodiversity and Sustainable Management of Living Natural Resources)

Sl no	Potential Impacts	Proposed EMP	Actual Implementation	Recommended Action	Compliance Status
1	Runoff (contain mostly sediment load) from newly developed land falls into nearby river and channel.	• Installation of proper run on/runoff drains • Use of sediment fences, traps and basins for trapping the sediment, if required			
2	Disturbance to nearby ecosystem due to different construction activities	• No cutting/ felling of trees along the river bank • Implementation of on-site waste and air quality management plan • Limiting soil extraction activities limited within the defined area • Limiting the vegetation clearance and base stripping process within the Project boundary • Safety fence around the construction site • Limiting the use of night light • Using shade (directed downwards) around the outdoor lights • Provision of cut-off time to switch off unnecessary lights at night • Initiate Green plantation • No plantation of non-native species • Retaining top soil for future habitat restoration • No degradation of critical habitat?			

Sl no	Potential Impacts	Proposed EMP	Actual Implementation	Recommended Action	Compliance Status
3	Occupation of river, inter-tidal areas and wetlands	• No encroachment of inter-tidal flood plain area • No disturbance to Dolphin community • Monitoring of Ecosystem Health and Monitoring of Sundarbans Forest Health • If required, embankment should be constructed considering a setback distance from river/canal bank • Slope protection work along the Maidara River should be completed on an urgent basis before rainy season come and • BIFPCL may take initiatives of excavating of silted reach of Maidara river near proposed township area to facilitate proper functioning of River for maintaining tidal dynamics			

Appendix II: Photo Album

Environmental Monitoring of Khulna 2×660 MW Power Plant for 16th monitoring program (July, 2018)

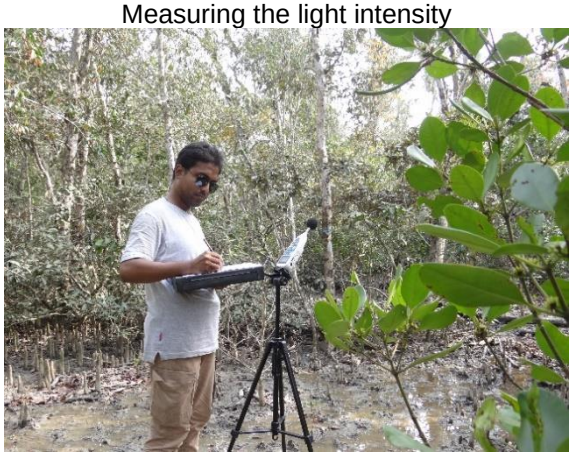
The Monitoring Team

Measuring the Canopy coverage

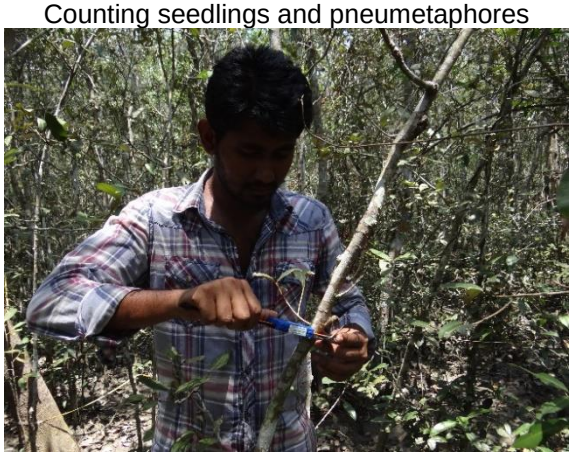
Collection of DBH data

Measuring the light intensity

Counting seedlings and pneumetaphores



Noise level measurement at Akram point of Sundarbans



Professionals is measuring the sapaling DBH

Experts are discussing the with the proponent

Experts are checking the air quality monitoring inside the project boundary

Safety sign at project area

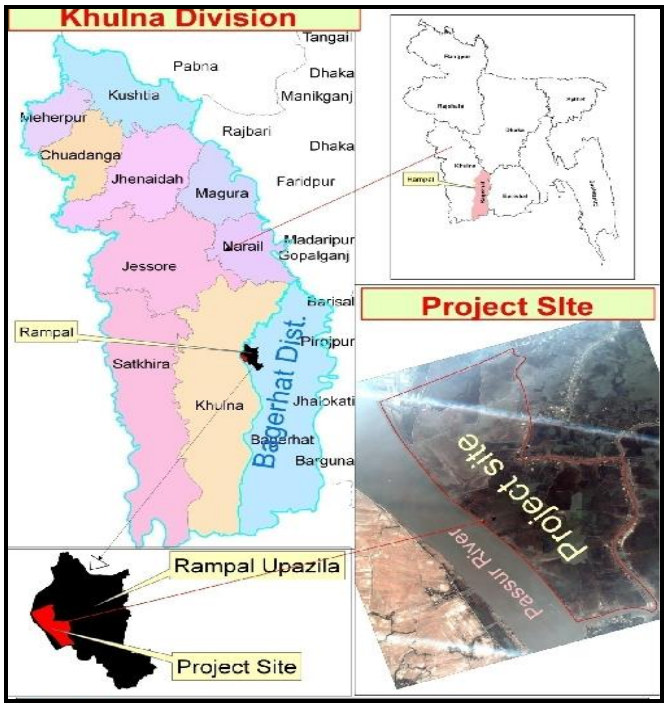
Newly built toilet for labor

Appendix III: Terms of References (ToR)

Background

Bangladesh-India friendship Power Company (Pvt.) Ltd. (BIFPCL), a 50:50 Joint Venture Company of Bangladesh Power Development Board (BPDB) of Bangladesh & NTPC Limited of India is implementing a coal based thermal power plant named 2X660 MW Maitree Super Thermal Power Project at Rampal in Bagerghat district of Khulna division of Bangladesh. The plant is envisaged to be based on super critical technology and is to be operated as Base Load Plant. The fuel envisaged is imported coal.

General Description of 2X660 MW Maitree Super Thermal Power Plant Project

Project Location:	Upazila: Rampal, District: Bagerhat Site is located at 23 kms Southward of Khulna City and 14 kms. North-Eastward from Mongla Port. 
Project Capacity:	1320 MW (2x660 MW), based on Ultra Super-critical Technology
Mode of Operation:	Base Load
Fuel:	Imported Coal
Fuel Transportation:	It is envisaged that imported coal from countries like Indonesia, Australia shall be transported through bigger ships, up to trans-shipment point, from where the coal shall be transported through barges to the coal unloading jetty at the plant end. From jetty to the power plant coal shall be transported through coal conveyor system.

Land& Land Development:	Based on the layout in the FR, it is estimated that approx. 575 acres of land will be required for the project. (375 Acres for Main Plant, 50 Acres for Township, 50 Acres for Jetty).
Evacuation of power:	Provision of line bays in generation switchyard for one no. 400 kV Double Circuit line and one no. 230 kV Double Circuit line have been kept. The Power evacuation (transmission line) system from the Project shall be at 400 kV level and will be outside the scope of the Project. 400 kV is being introduced for the first time in Bangladesh.
Expected Timeline for project implementation	The first unit of capacity 660 MW is scheduled to be synchronised in 41 months from the date of NTP to the EPC contractor for the Power project. Commissioning of the first unit of capacity 660 MW is envisaged at an interval of 5 months thereafter.

Broad Scope of Works

The study covers quarterly monitoring of different environmental and social parameters, and implementation of EMP (Environment Management Plan) during implementation phases as per DoE approval/requirement. The monitoring locations were selected based on physical activities, wind direction, sensitive receptors, etc. and were finalized through the consultation with DoE, Department of Fisheries (DoF), MPA and Forest Department (FD).

The Broad objectives of independent monitoring covers the following activities

- Monitoring implementation of EMP and environmental compliance;
- Monitoring of ambient air quality, noise level and water quality;
- Monitoring of cropping pattern and soil quality;
- Monitoring of fisheries resources covering fish habitats, biodiversity, migration and production;
- Monitoring of ecosystem and biodiversity;
- Monitoring of the Sundarbans Forest Health; and
- Monitoring of socio-economic condition and livelihoods.
- To evaluate the project environmental performance as due to construction activities.

The main objectives of this works are

- Monitoring of Social and Environmental parameters to update the baseline.
- Monitoring of Social and Environmental parameters during Implementation of the Project.
- Assistance to BIFPCL for implementation of Environmental Management Plan (EMP) during construction period.

The scope of work of the Independent Monitoring will include the following specific tasks

- Develop specific monitoring indicators, checklists, and questionnaires to undertake independent monitoring (a preliminary list of monitoring indicators has been given in the EMP) in consultation with BIFPCL, DoE, Forest Department and the Financer;
- Review and verify the implementation progress of various EMP elements, particularly, mitigation plan, compliance monitoring, environmental trainings, documentation, and grievance redress mechanism;
- Physical aspects would cover air quality, noise level, water quality and land resources;
- Biological environment include fisheries resources, ecological resources, Sundarbans Reserve Forest (SRF) health conditions including WHS;
- Environmental compliance monitoring includes Monitoring of Environmental and Social Management System Action Plan Implementation, Monitoring of labor and working conditions, Monitoring of community health, safety and security and monitoring of biodiversity and sustainable management of living natural resources.
- To establish baseline environmental conditions;
- Provide and monitor the environmental parameter during construction activities.
- To detect adverse environmental impacts for river dredging and other activities of site development;
- Provide technical assistance to the client for implementation of the EMP during the power plant construction at different sector of construction activities.
- To demonstrate whether the environmental control measures are operating as per designed;
- To provide data for emission inventories;
- To provide data at regular intervals for dissemination to the stakeholders
- To provide data for improvement and updating of the monitoring program;
- To assist in investigating the event of a trigger level or emission limit value being crossed.
- Update baseline data as per monitoring schedule and location.
- Provide technical assistance to the client for implementation of the EMP during power plant construction.
- Review the EIA document to evaluate the EMP measures incorporated in the contract to mitigate different social and environmental hazards and risks during construction of the Project
- Submit progress reports to the client.
- Physical observation to assess that all mitigation measures mentioned in EMP are carried out in all place.

- Sampling and carrying out necessary analysis of Environmental parameter such as surface & ground water quality, air quality, noise, Biological Environment, Socio-economic environment, Sundarban Forest health etc. according to the monitoring framework in construction phase.
- Morphological changes of the adjacent river of the project will be influenced by the constructional activities. River bank erosion-accretion, drainage system, tidal inundation etc. will be investigate after regular intervals in the study area as per monitoring location of the EIA. The procedure of investigation and methodologies of analysis will be the same as pre-construction phases. River bed pollution will be identified though this study during construction of the power plant.
- Monitoring of floral resources will be performed quarterly. The indicators and procedures of flora monitoring will be relatively same as earlier studies of this projects. Plant composition, canopy coverage , indigenous and exotic species, plant intensities will be the main monitoring indicators during construction phases.
- Monitoring of faunal resources will be performed quarterly at the construction period. Faunal resources survey will coincide with floral resources survey as it will provided more insight about the inter-dependency between flora and fauna in an ecosystem.
- Render any other related services as and when requested.
- Conduct community level consultation in a regular interval and disclose project level information.
- Keep liaison with different organization like Govt department, NGOs, and relevant stakeholders.

The Monitoring parameter & associated indicator are given below

Monitoring Parameter	Indicators
Socio-economy	Livelihood and Occupation
	Income and expenditure
	Displacement and Migration
	Cultural and heritage
	Health and sanitation
	Risks and accidental assessment
	Transportation and communication
	Public and private Infrastructure development
Ecology and Biodiversity	Bio-indicator Assessment
	Movement of indigenous/ native species
	Envision of exotic species and regime dominance
	Species composition (Flora and Fauna)
	Assessment the services of dependent ecosystem
Agriculture	Land use and canopy coverage
	Soil quality (Salinity, pH, OM,)
	Cropping pattern and crop intensities
	Irrigation and crop production
	Farmers survey result
Fisheries	Fish diversity and specification
	Fish production and availability
	Fisher survey result
Noise level	Sound level at the sensitive zone

Monitoring Parameter	Indicators
Water resources	DO, BOD, COD, Salinity , TDS, TS, pH, Hg, Pb
	Total Hardness, Hg, NO_3 and PO_4
	River Morphology,
	Tidal inundation
	Drainage Network
	Erosion and Accretion
	Ground water quality
Air quality	SOx
	NOx
	SPM (PM_{10} and $PM_{2.5}$)
	CO

Air quality monitoring progress

The most commonly used method for automatically monitoring air pollutant such as those above are:

- SOx: measured by Fluorescent signal generated by exiting SO2 with UV light
- NOx: measured by Chemilumiscent reaction between NOx & O3
- O_3: measured by ultra violet absorption analyzer, this determines the Ozone concentration by the attenuation of 254 nm UV light along this signal fixed path cell
- Particulate matter (SPM, PM10, PM 2.5): measured by gravimetric methods including true micro weighing technology for automatic monitoring & instrument named 'Tapered element oscillating micro balance (TOEM)' has been most frequently used. Measurement on filter tape using the principles of beta attenuation for estimating 30 mnt or 1 hr average concentrations of PM10 or PM 2.5 has also been used.
- CO: In urban air pollution studies, a non-disruptive infrared photo meter utilizing a gas filter co relation technology & state of the art optical & electronic technology is used to measure low concentration of CO accurately & reliably.

Expected Output

A breach of a trigger level or emission limit values may indicate a significant increases of a contaminate concentration in an environmental medium.

Baseline Monitoring is monitoring in an around the location of a proposed site so as to establish background environmental conditions prior to any development of the proposed site. In case of existing facilities, baseline-monitoring serves as a reference point to which later monitoring results are compared. The information will be used to evaluate in future compliance monitoring.

Compliance monitoring is periodic monitoring and is to determine whether there is any release of contaminants to the environment and to demonstrate compliance within the project area. It includes measurements of process conditions, process emissions and levels in receiving environments and the reporting of the results of such measurements to demonstrate compliance with limits specified in the legislation.

The information provided by compliance monitoring is also valuable for other environmental and management activities (e.g. for optimizing process, protecting sensitive ecosystems and informing the public of the effectiveness of environmental protection measures).

Assessment monitoring is investigative monitoring which is initiated after detection of the impacts to the environment or on attaining a trigger level. The assessment monitoring will:

- Identify the source of release materials;
- Characterize the nature, extent and rate of releases;
- Evaluate the risk to the environment and to human health;
- Evaluate measures to prevent or minimize future releases;
- Provide information for the design and implementation of corrective measures and
- Express the residual environmental impacts for proper compensation.

Reporting Requirements

As it is proposed to carry out the monitoring program for two quarters and the proposed deliverables are scheduled below

SL	Name	no. of copies
1	Monitoring Report after each monitoring mission (each in one quarter) with complete data, analysis, lab. Results, discussion etc as intended in the scope of work.	10
2	CD-ROM in respect of documents/datasheets	2

Appendix IV: Monitoring Data

(A) Air Quality Data

Table A.1: Ambient Air Quality Monitoring Results

Locations of Monitoring	Pollutants	1st QM, Apr 2014	2nd QM, Jul 2014	3rd QM, Oct 2014	4th QM, Jan 2015	5th QM, Apr 2015	6th QM, Jul2015	7th QM, Oct 2015	8th QM, Jan 2016	9th QM, Apr 2016	10th QM, Jul 2016	11th QM, Oct 2016	12th QM, Jan 2017	13th QM, April, 2017	14th QM, Oct, 2017	15th QM Jan, 2018	16th QM April, 2018	Bangladesh (DoE) Standard (ECR 2005)
Weather		Sunny	Rainy/ Cloudy	Sunny	Sunny	Sunny	Rainy/ Cloudy	Sunny/ Rainy	Sunny	Sunny	Rainy/ Cloudy	Rainy/ Cloudy	Sunny	Suny/ Cloudy	Sunny	Sunny	Suny/ Cloudy	
			Concentrations are in µg/m^3															
SW Corner of the PP area	**$PM_{2.5}$**	33	37	25	33	47	25	22	34	19	5	9	24.8	8.12	28.2	32.9	28.4	65^{24hr}
	PM_{10}	78	77	53	79	83	35	52	135	117	32	22	79	43.8	73.6	133	70	150^{24hr}
	SPM	207	239	190	200	177	42	91	175	332	51	53	115.7	122.4	169.4	145.6	121.5	200^{8hr}
	SO_2	21	24	19	23	15	52	35	14	18	9	8	9.5	9.0	7.2	14.3	11.4	365^{24hr}
	NOx	26	29	27	31	29	35	29	18	18	12	10	11.3	10.7	7.5	17.7	12.8	100^{Annual}
	CO	120	188	140	190	144	146	88	74	57	35	119	59	91	73	61	32	$(10000)^{8hr}$
	O_3	27	26	19	22	26	12	5	4	1	1	1	5	03	10	03	9	157^{8hr}
Proposed Township area	**$PM_{2.5}$**	39	48	48	39	34	18	17	35	25	3	8	25	14.6	8.5	31.5	26.7	65^{24hr}
	PM_{10}	814.69	90	74	102	97	31	48	116	44	11	11	99.5	56.9	40.4	147.8	52	150^{24hr}
	SPM	2156.3	263	217	274	266	47	79	192	187	27	23	154.2	136.7	45.3	181.4	138.7	200^{8hr}
	SO_2	19	28	22	21	22	58	27	13	11	4	6	12.9	10	4.3	15	9.6	365^{24hr}
	NOx	29	39	27	26	24	46	25	16	22	6	8	15.7	11.8	6	18.6	10.2	100^{Annual}
	CO	165	210	230	164	136	127	102	77	22	31	108	66	78	79	69	27	$(10000)^{8hr}$
	O_3	33	26	26	23	21	16	1	1	1	0	0	1	08	25	04	4	157^{8hr}
NW Corner of the PP area	**$PM_{2.5}$**	37	44	19	42	59	28	19	24	11	3	10	29	10.3	15.2	40.7	27.7	65^{24hr}
	PM_{10}	67	78	56	98	91	96	29	125	29	24	14	108.7	31.3	49.9	136.3	100.1	150^{24hr}
	SPM	234	217	157	310	244	321	66	187	115	31	35	168	91.7	63.9	161.7	116.2	200^{8hr}
	SO_2	19	22	18	27	21	56	32	13	17	4	8	12.2	5.8	7.5	9.6	13.2	365^{24hr}
	NOx	23	28	22	32	39	43	21	18	16	5	11	14.7	7.1	9.2	11.7	14.3	100^{Annual}
	CO	110	178	110	210	140	133	87	77	38	47	127	31	74	80	45	43	$(10000)^{8hr}$
	O_3	25	19	17	36	44	11	8	2	0	1	1	3	05	10	05	7	157^{8hr}
Barni, Gaurambha	**$PM_{2.5}$**	39	47	57	39	41	34	11	29	23	9	10	21.7	7.9	13.8	52.3	18	65^{24hr}
	PM_{10}	103	122	67	97	82	65	26	97	82	45	13	105.4	30.5	30.2	140	30.5	150^{24hr}
	SPM	233	244	183	277	236	79	112	176	268	69	30	167.8	95.6	57.2	171.9	90.6	200^{8hr}
	SO_2	21	23	17	22	25	41	31	16	20	10	7	12.2	5.5	4.1	13.8	6.1	365^{24hr}
	NOx	25	28	22	26	27	44	32	21	16	12	9	19.3	9.8	5.0	16.7	7.3	100^{Annual}
	CO	175	210	190	150	196	96	96	81	73	41	98	63	85	77	59	24	$(10000)^{8hr}$
	O_3	26	29	22	19	15	9	6	4	0	0	3	5	08	6	04	6	157^{8hr}
Chunkuri-2, Bajua Dacope	**$PM_{2.5}$**	35	39	46	37	33	35	28	31	25	7	5	25.2	8.7	17.3	33.4	11.4	65^{24hr}
	PM_{10}	77	86	69	68	61	109	49	98	60	23	20	74.4	44.4	100.2	157.1	40.6	150^{24hr}
	SPM	117	113	162	183	188	175	94	167	167	31	48	162	110.6	127.8	200	108	200^{8hr}
	SO_2	19	24	21	18	11	55	33	21	13	7	9	18.9	8.2	7.9	19	10.4	365^{24hr}
	NOx	23	26	27	24	18	49	23	16	25	10	8	18	11.2	8.4	20.7	11.6	100^{Annual}
	CO	190	205	170	170	33	133	75	70	33	38	79	36	94	69	58	42	$(10000)^{8hr}$
	O_3	27	24	18	22	41	21	2	1	1	0	2	2	03	5	05	2	157^{8hr}
Pankhali, Dacope	**$PM_{2.5}$**	47	49	57	41	39	34	25	47	15	8	10	38.7	15.8	17	72.3	15.9	65^{24hr}

Locations of Monitoring	Pollutants	1st QM, Apr 2014	2nd QM, Jul 2014	3rd QM, Oct 2014	4th QM, Jan 2015	5th QM, Apr 2015	6th QM, Jul2015	7th QM, Oct 2015	8th QM, Jan 2016	9th QM, Apr 2016	10th QM, Jul 2016	11th QM, Oct 2016	12th QM, Jan 2017	13th QM, April, 2017	14th QM, Oct, 2017	15th QM Jan, 2018	16th QM April, 2018	Bangladesh (DoE) Standard (ECR 2005)
Weather		Sunny	Rainy/ Cloudy	Sunny	Sunny	Sunny	Rainy/ Cloudy	Sunny/ Rainy	Sunny	Sunny	Rainy/ Cloudy	Rainy/ Cloudy	Sunny	Sun/ Cloudy	Sunny	Sunny	Sun/ Cloudy	
			Concentrations are in µg/m^3															
	PM_{10}	119	127	139	101	105	144	62	128	46	42	18	141.6	105	63.4	208.9	74.3	150^{24hr}
	SPM	297	266	254	208	299	339	183	198	114	78	34	194.6	179	87.5	223.9	154.1	200^{8hr}
	SO_2	28	31	31	24	30	58	36	18	9	8	8	16.1	12.9	8	16.3	12.2	365^{24hr}
	NOx	41	39	36	26	27	47	23	15	19	9	9	19	18.7	10.2	17.7	13.7	100^{Annual}
	CO	230	217	250	188	177	125	105	101	55	29	112	48	83	87	49	34	$(10000)^{8hr}$
	O_3	49	38	36	27	11	13	5	2	2	0	0	3	06	0	06	6	157^{8hr}
Mongla Port area	**$PM_{2.5}$**	47	55	39	41	26	33	19	34	21	9	11	25.7	22.6	33.2	70.1	23.2	65^{24hr}
	PM_{10}	139	174	77	82	35	52	33	132	45	29	15	119.3	93.6	97	209.1	89.9	150^{24hr}
	SPM	288	303	197	217	214	118	65	189	144	50	6	172.3	196	187.2	242	144.7	200^{8hr}
	SO_2	27	28	26	24	14	45	36	16	10	8	7	16.8	10.5	8.2	15.5	11.8	365^{24hr}
	NOx	44	39	33	27	17	40	20	13	14	10	8	15.3	15.1	10.7	18.4	13.2	100^{Annual}
	CO	230	320	220	211	24	110	84	71	29	31	97	44	72	79	52	29	$(10000)^{8hr}$
	O_3	57	52	37	26	09	15	8	3	1	2	1	4	04	9	02	3	157^{8hr}
Harbaria, Sundarbans	**$PM_{2.5}$**	19	22	33	27	24	27	24	26	13	6	10	19.2	10.5	28.3	43.5	11.6	65^{24hr}
	PM_{10}	41	39	59	56	49	42	50	82	42	20	14	85.2	36.7	89.9	152.4	29.1	150^{24hr}
	SPM	111	117	129	139	109	70	73	159	91	43	44	93.5	103.7	107	189.9	72.4	200^{8hr}
	SO_2	9	10	14	12	16	51	34	15	11	6	7	11.9	5.7	7.6	13.2	7.9	365^{24hr}
	NOx	19	22	27	18	22	34	22	14	16	8	10	13	7.7	9.3	15.2	8.3	100^{Annual}
	CO	65	58	70	64	56	112	81	62	47	32	110	67	73	84	57	31	$(10000)^{8hr}$
	O_3	13	12	13	11	14	12	4	2	2	0	1	4	08	0	02	2	157^{8hr}
Akram Point, Sundarbans	**$PM_{2.5}$**	17	19	23	18	49	NO	25	18	9	4	4	14.3	13.2	7.5	35.4	13.7	65^{24hr}
	PM_{10}	39	44	32	39	77	NO	32	77	31	15	14	85.5	96.0	37.8	150.6	36.4	150^{24hr}
	SPM	114	133	97	88	102	NO	51	128	46	23	27	90.9	137.0	41.8	175.1	90.3	200^{8hr}
	SO_2	7	9	12	13	21	NO	27	14	9	4	6	8.4	6	5.8	14	8.3	365^{24hr}
	NOx	17	19	22	17	27	NO	19	15	10	5	6	12.7	10.1	5.9	15.1	9.9	100^{Annual}
	CO	49	60	50	46	163	NO	92	64	21	37	101	58	79	69	52	21	$(10000)^{8hr}$
	O_3	11	14	9	10	27	NO	8	1	0	0	2	3	0	0	03	3	157^{8hr}
Hiron Point, Sundarbans	**$PM_{2.5}$**	15	23	19	17	28	NO	27	NO	17	NO	9	21.7	No	17.0	40.5	NO	65^{24hr}
	PM_{10}	44	38	34	41	60	NO	45	NO	40	NO	14	104.5	NO	92.1	149.8	NO	150^{24hr}
	SPM	101	119	107	97	110	NO	88	NO	132	NO	26	111.4	NO	102	173.7	NO	200^{8hr}
	SO_2	8	7	13	14	15	NO	28	NO	15	NO	9	13.5	NO	6	15.8	NO	365^{24hr}
	NOx	18	18	19	22	20	NO	23	NO	19	NO	9	15.9	NO	7.8	18.1	NO	100^{Annual}
	CO	52	62	65	60	60	NO	93	NO	40	NO	121	43	NO	72	71	NO	$(10000)^{8hr}$
	O_3	14	13	11	9	23	NO	2	NO	0	NO	0	4	NO	0	04	NO	157^{8hr}
Khulna City, near Khan Jahan Ali Bridge	**$PM_{2.5}$**	54	39	52	42	55	46	19	35	11	16	9	34.6	23.1	19.5	78.7	12.4	65^{24hr}
	PM_{10}	139	117	91	84	75	89	49	112	69	68	24	145.9	99.5	39.6	213.9	38.8	150^{24hr}
	SPM	301	287	239	219	222	181	101	181	112	107	64	189.7	187.2	127.9	243.4	78.9	200^{8hr}
	SO_2	33	29	33	28	31	59	28	16	11	10	10	17.1	7.2	7.1	21	7.5	365^{24hr}
	NOx	49	41	39	36	33	38	26	16	15	15	14	18.6	11.7	8.8	25	8.4	100^{Annual}
	CO	330	370	330	296	101	89	94	98	68	36	104	66	79	81	69	36	$(10000)^{8hr}$
	O_3	59	67	57	39	21	7	4	2	1	0	2	3	07	07	09	9	157^{8hr}

Note(s): Concentrations are in µg/m^3.

- *DoE- Department of Environment, NF- Not found; NO-Not observed*
- *Fine Particulate Matter ($PM_{2.5}$), Respirable Dust Content (PM_{10}), Suspended Particulate Matter (SPM), Oxides of Nitrogen (NO_X). Sulfur dioxide (SO_2), Carbone Monoxide (CO) & Ozone (O_3);*
- *Standards for 1hr, 24hr or Annual are indicated using superscript;*
- *This monitoring was carried out by - Respirable Dust Sampler (Model-Envirotech India APM-460BL) and Fine Particulate Sampler (Model-Envirotech India APM-550).*
- *All data presented here are 8 hrs. Monitoring data.*

Table A.2: Baseline conditions of emission of different infrastructures and sources

		Cement Industry	Condensate Fractionating Plant	LPG Bottling Plant	Brick Field	Road Traffic	Small vessels, engine boat	Inland Water Cargo vessel	Sea going Mother Vessel (MV)	Fly ash Carrier	Clinkers Carrier	Clinker, Fly Ash Handling	Coal Carrier (MV)	Coal Ash Carrier (MV)	Coal Carrier (Lighter Vessel)	Coal Ash Carrier (Lighter Vessel)	Coal Loading and Unloading	Coal Handling (Stock Yard, Conveyor belt, etc)	BIF Power Plant (PP)	Other Coal Based PP	Other Fuel Based PP	Dredging and Land Filling	Earth excavation	Other Construction Activities	Residential sources
SW Corner of the PP area	PM	√	X	X	X	√	√	√	X	X	X	X	X	X	X	X	X	X	X	X	X	√	X	√	√
	SOx	X	X	X	X	√	√	√	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	√
	NOx	X	X	X	X	√	√	√	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	√
	GHGs	X	X	X	X	√	√	√	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	√
Proposed Township area of the PP	PM	√	X	X	X	√	√	√	X	X	X	X	X	X	X	X	X	X	X	X	X	√	X	X	√
	SOx	X	X	X	X	√	√	√	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	√
	NOx	X	X	X	X	√	√	√	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	√
	GHGs	X	X	X	X	√	√	√	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	√
NW Corner of the PP area	PM	X	X	X	X	√	√	√	X	X	X	X	X	X	X	X	X	X	X	X	X	√	X	X	√
	SOx	X	X	X	X	√	√	√	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	√
	NOx	X	X	X	X	√	√	√	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	√
	GHGs	X	X	X	X	√	√	√	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	√
Barni, Gaurambha	PM	X	X	X	X	√	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	√	√
	SOx	X	X	X	X	√	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	√
	NOx	X	X	X	X	√	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	√
	GHGs	X	X	X	X	√	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	√
Chunkuri-2, Dacope	PM	√	X	X	X	√	√	√	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	√
	SOx	X	X	X	X	√	√	√	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	√
	NOx	X	X	X	X	√	√	√	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	√
	GHGs	X	X	X	X	√	√	√	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	√
Pankhali, Dacope	PM	√	X	X	X	√	√	√	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	√	√
	SOx	X	X	X	X	√	√	√	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	√
	NOx	X	X	X	X	√	√	√	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	√
	GHGs	X	X	X	X	√	√	√	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	√
Mongla Port area	PM	√	√	√	X	√	√	√	√	√	√	√	X	X	X	X	X	X	X	X	√	X	X	X	√
	SOx	X	√	X	X	√	√	√	√	√	√	X	X	X	X	X	X	X	X	X	√	X	X	√	√
	NOx	X	√	X	X	√	√	√	√	√	√	X	X	X	X	X	X	X	X	X	√	X	X	X	√
	GHGs	X	√	X	X	√	√	√	√	√	√	X	X	X	X	X	X	X	X	X	√	X	X	X	√
Harbaria, Sundarbans	PM	X	X	X	X	X	√	√	√	√	√	√	X	X	X	X	X	X	X	X	X	X	X	X	X
	SOx	X	X	X	X	X	√	√	√	√	√	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	NOx	X	X	X	X	X	√	√	√	√	√	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	GHGs	X	X	X	X	X	√	√	√	√	√	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Akram Point Sundarbans	PM	X	X	X	X	X	√	√	X	X	X	√	X	X	X	X	X	X	X	X	X	X	X	X	X
	SOx	X	X	X	X	X	√	√	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	NOx	X	X	X	X	X	√	√	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	GHGs	X	X	X	X	X	√	√	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Hiron Point Sundarbans	PM	X	X	X	X	X	√	√	X	X	X	√	X	X	X	X	X	X	X	X	X	X	X	X	X

		Cement Industry	Condensate Fractionating Plant	LPG Bottling Plant	Brick Field	Road Traffic	Small vessels, engine boat	Inland Water Cargo vessel	Sea going Mother Vessel (MV)	Fly ash Carrier	Clinkers Carrier	Clinker, Fly Ash Handling	Coal Carrier (MV)	Coal Ash Carrier (MV)	Coal Carrier (Lighter Vessel)	Coal Ash Carrier (Lighter Vessel)	Coal Loading and Unloading	Coal Handling (Stock Yard, Conveyor belt, etc)	BIF Power Plant (PP)	Other Coal Based PP	Other Fuel Based PP	Dredging and Land Filling	Earth excavation	Other Construction Activities	Residential sources
	SOx	X	X	X	X	X	√	√	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	NOx	X	X	X	X	X	√	√	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	GHGs	X	X	X	X	X	√	√	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Khulna City, near Khan Jahan Ali Bridge	PM	√	X	X	√	√	√	√	X	√	√	√	X	X	X	X	X	X	X	X	X	X	X	√	√
	SOx	X	X	X	√	√	√	√	X	√	√	√	X	X	X	X	X	X	X	X	X	X	X	X	√
	NOx	X	X	X	√	√	√	√	X	√	√	√	X	X	X	X	X	X	X	X	X	X	X	X	√
	GHGs	X	X	X	√	√	√	√	X	√	√	√	X	X	X	X	X	X	X	X	X	X	X	X	√

Legend X-Absence of source or no emission,

√-Presence of source, emission of pollutant

(B) Water Quality Data

Surface Water Quality Monitoring Data

Table B.1: pH Values of Passur River Water

Sl	Sampling Locations	pH Values																
		1st year				2nd Year				3rd year				4th year			5th year	BD Standard
		Apr	July	Oct	Jan	Apr	July	Oct	Jan	Apr	July	Oct	Jan	Apr	Oct	Jan	Apr	
		1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	1QM	
1	Left Bank of Passur River at 100m u/s of North West corner from the Project boundary	7.2	7.0	8.1	7.9	7.6	7.8	7.6	7.1	7.5	7.27	6.9	7.6	7.2	7.1	8.28	8.1	6.5– 8.5
2	Middle Passur River at 100m u/s of North West corner from the Project boundary	7.2	7.0	8.2	8.0	7.7	7.9	7.58	7.3	7.8	7.3	7	7.5	7.3	6.9	8.25	8.1	
3	Right Bank of Passur River at 100m u/s of North West corner from the Project boundary	7.2	6.9	8.0	8.1	7.8	7.8	7.64	7.3	7.2	7.93	7.2	7.8	7.3	6.9	8.17	8.1	
4	Left Bank of Passur River at Project site-Jetty	7.9	7.1	8.1	7.9	7.5	7.9	7.6	7.1	7.4	7.56	7.3	8.2	7.2	6.9	8.2	8.1	
5	Middle Passur River at Project site-Jetty	7.1	6.9	8.1	7.9	7.6	8	7.58	7.5	7.8	7.6	7	8.5	7.8	7.2	8.21	8.1	
6	Right Bank of Passur River at Project site-Jetty	7.1	6.9	8.2	7.9	7.7	8	7.62	7.6	7.4	7.9	6.9	8.7	7.4	7.2	8.2	8.1	
7	Left Bank of Passur River at South West corner from the Project boundary	7.4	7.0	8.1	7.6	7.5	8.1	7.78	8.1	7.6	7.94	7.2	8.1	6.9	7.2	8.39	8.0	
8	Middle of Passur River at South West corner from the Project boundary	7.4	6.9	8.0	7.5	7.2	8	7.6	8	7.1	8.04	7.5	8.6	6.8	7.1	8.15	8.1	
9	Right Bank of Passur River at South West corner from the Project boundary	7.3	6.8	8.0	7.8	7.3	8.1	7.64	7.9	7.2	8.2	7.3	8.9	7.1	7	8.16	8.1	
10	Maidara river of the South East corner of the Project at Ichamoti-Maidara confluence	7.4	6.9	8.1	7.7	7.5	8.1	7.3	7.3	7.1	8.1	6.8	8.1	7.2	7.1	8.4	8.1	
11	Maidara river near proposed township area	7.4	6.8	8.1	7.3	7.6	6.9	7.56	7.1	7.4	7.8	7.1	7.6	7.4	7	7.92	7.6	
12	Passur river at Passur-Ghasiakhali confluence	7.3	6.8	7.4	8.2	7.5	7.9	7.1	7.4	7.3	7.3	6.9	7.2	6.9	6.8	7.48	7.3	
13	Passur river at Harbaria of Sundarbans	7.9	6.9	8.0	8.1	7.7	7.9	7.8	8.2	7.3	7.63	7.4	7.8	6.9	7.1	8.19	**8.1**	
14	Passur river at Akram point of Sundarbans	7.2	6.9	7.9	8.1	7.7	NS	7.63	8	7.9	7.67	7.1	8.2	7.2	7.1	8.22	8.2	
15	Passur river at Hiron po.000int of Sundarbans	7.2	7.0	7.0	8.1	7.7	NS	7.39	NS	7.8	NS	7.6	8.5	NS	6.8	8.2	NS	

Source: CEGIS Field Survey

Note: 1QM= First Quarterly Monitoring, 2QM = Second Quarterly Monitoring, 3QM = Third Quarterly Monitoring, 4QM = Fourth Quarterly Monitoring, NS – Not Surveyed

Table B.2: Surface Water Temperature in Passur River

Sl	Sampling Locations	Temperature (°C)																
		1st Year				2nd Year				3rd year				4th year			5th year	BD Standard
		Apr	Jul	Oct	Apr	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	Apr	
		1QM	2QM	3QM	1QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	1QM	
1	Left Bank of Passur River at 100m u/s of North West corner from the Project boundary	31	33	31	19	30	31.8	31.2	22.0	31.2	29.6	30.1	22.8	30	29.8	19.7	30	20°C – 30°C
2	Middle Passur River at 100m u/s of North West corner from the Project boundary	31	33	31	20	30	30.5	31.8	21.0	31.1	29.1	30.8	22.5	30	30.1	19.8	30	
3	Right Bank of Passur River at 100m u/s of North West corner from the Project boundary	31	33	30	20	30	30.5	30.9	21.0	30.8	29.4	30.4	22.1	29.8	30.2	20.2	31	
4	Left Bank of Passur River at Project site-Jetty	31	33	31	19	31	30.8	31.3	22.0	31.4	30.1	30.1	22.8	31.3	30.1	20.3	28	
5	Middle Passur River at Project site-Jetty	30	32	31	19	30	30.6	31.6	22.0	30.9	30.5	31.0	21.8	30.0	29.8	20.3	29	
6	Right Left Bank of Passur River at Project site-Jetty	30	32	31	19	30	30.4	31.1	21.0	31.0	30.5	31.1	21.9	30.0	29.9	20.3	28	
7	Left Bank of Passur River at South West corner from the Project boundary	31	32	30	20	31	30.5	30.3	23.0	30.7	30.7	30.4	22.1	29.9	30.0	20.6	28	
8	Middle of Passur River at South West corner from the Project boundary	31	31	29	19	30	30.8	30.5	22.0	30.4	29.8	30.2	22.0	29.8	30.1	20.2	28	
9	Right Bank of Passur River at South West corner from the Project boundary	31	31	29	19	31	30.6	30.8	21.0	30.1	29.8	31.1	22.1	30.1	30.1	20.3	28	
10	Maidara river of the South East corner of the Project at Ichamoti-Maidara confluence	30	31	28	19	30	30.8	31.8	22.0	31.2	30.4	31.1	21.9	30.3	29.9	19.1	28	
11	Maidara river near proposed township area	30	32	27	20	30	31.6	31.2	23.0	30.6	30.7	31.2	21.8	30.1	30.0	21.1	31	
12	Passur river at Passur-Ghasiakhali confluence	29	30	32	19	30	29.8	30.7	21	31.3	30.7	30.38	22.1	30.2	30	20.8	**30**	
13	Passur river at Harbaria of Sundarbans	30	30	27	22	30	29.0	30.8	22.0	31.5	30.9	29.9	23.1	30.2	29.8	21	30	
14	Passur river at Akram point of Sundarbans	29	29	30	21	30	NS	30.2	21.0	30.8	30.4	30.4	22.5	30.8	29.9	21.2	32	
15	Passur river at Hiron point of Sundarbans	29	30	29	21	30	NS	30.4	NS	31.4	NS	31.3	21.4	NS	29.4	21.2		

Source: CEGIS Field Surve

Note: 1QM= First Quarterly Monitoring, 2QM = Second Quarterly Monitoring, 3QM = Third Quarterly Monitoring, 4QM = Fourth Quarterly Monitoring, NS – Not Surveyed

Table B.3: Salinity (ppt) in Passur River

Sl	Sampling Locations	Salinity (ppt)															
		1st Year				2nd Year				3rd year				4th year			5th year
		Apr	Jul	Oct	Apr	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	Apr
		1QM	2QM	3QM	1QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	1QM
1	Left Bank of Passur River at 100m u/s of North West corner from the Project boundary	11.5	2.5	0.0	4.5	13	0	0	4.1	8	0	0	3.7	6.3	0	2	11.5
2	Middle Passur River at 100m u/s of North West corner from the Project boundary	11.5	0.3	0.0	4.1	15	0	0	4.3	7.4	0	0	3.8	5.9	0	2	11.5
3	Right Bank of Passur River at 100m u/s of North West corner from the Project boundary	11.5	0.2	0.0	4.5	16	0	0	4.3	7	0	0	3.6	6.2	0	2	11.5
4	Left Bank of Passur River at Project site-Jetty	12.0	2.2	0.0	4.7	9	0	0	4.4	6	0	0	4	6.8	0	2.6	12.0
5	Middle Passur River at Project site-Jetty	12.0	0.3	0.0	5.1	13	0	0	5.1	6.2	0	0	3.9	6.9	0	2.6	12.0
6	Right Left Bank of Passur River at Project site-Jetty	12.0	0.5	0.0	5.0	14	0	0	5	9	0	0	4.2	6.1	0	2.7	12.0
7	Left Bank of Passur River at South West corner from the Project boundary	9.5	4.0	0.0	5.2	14	0	0	5.2	8	0	0	4.2	6.5	0	2.8	9.5
8	Middle of Passur River at South West corner from the Project boundary	9.0	0.0	0.0	5.2	13	0	0	4.9	7	0	0	4.1	7.1	0	2.8	9.0
9	Right Bank of Passur River at South West corner from the Project boundary	10.0	2.5	0.0	5.1	12	0	0	5.5	6.8	0	0	4.1	7	0	2.8	10.0
10	Maidara river of the South East corner of the Project at Ichamoti-Maidara confluence	10.0	0.5	0.0	5.2	10	0	0	3.8	7.1	0	0	3.9	7	0	2.6	10.0
11	Maidara river near proposed township area	9.0	4.5	0.0	4.5	9	0	0	2.5	6.3	0	0	3.8	6.9	0	2.52	9.0
12	Passur river at Passur-Ghasiakhali confluence	10.0	9.5	0.0	5.0	14	0	0	4.8	6	0	0	6.7	10.4	1.2	10.8	10.0
13	Passur river at Harbaria of Sundarbans	12.0	10.0	0.0	6.0	15	0	0	5.3	8.9	0	0	8.9	10.4	2.3	2.8	12.0
14	Passur river at Akram point of Sundarbans	19.0	15.0	1.0	16.0	20	NS	5	11.3	9.4	4	3	16.3	16	3.6	13.1	19.0
15	Passur river at Hiron point of Sundarbans	23.0	19.5	2.0	23.0	25	NS	6.2	NS	14	NS	5.8	21.4	NS	5.1	16.45	23.0

Source: CEGIS Field Survey

Note: 1QM= First Quarterly Monitoring, 2QM = Second Quarterly Monitoring, 3QM = Third Quarterly Monitoring, 4QM = Fourth Quarterly Monitoring, NS – Not Surveyed

Table B.4: Dissolve Oxygen in Passur River

SL	Sampling Locations	Dissolve Oxygen (mg/L)																
		1st Year				2nd Year				3rd year				4th year			5th year	BD Standard
		Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	Apr	
		1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	1QM	
1	Left Bank of Passur River at 100m u/s of North West corner from the Project boundary	5.9	6.1	5.6	5.5	6.2	5.3	6.8	5.1	7.1	6.2	6	6.1	7.1	6.3	5.19	6.575	5 or more (standard for sustaining fisheries)
2	Middle of Passur River at 100m u/s of North West corner from the Project boundary	4.9	6.8	7.7	6.6	6.4	5	6.4	5.1	6.4	5.7	6.1	5.9	7.2	6.4	5.03	6.225	
3	Right Bank of Passur River at 100m u/s of North West corner from the Project boundary	5.2	6.7	7.7	6.7	6.2	5	7.1	6.2	6.9	5.6	6	6.1	6.8	6.5	5.06	6.275	
4	Left Bank of Passur River at Project site-Jetty	5.7	6.8	7.6	5.8	6.2	6.7	6.8	5.9	5.8	6.1	6.3	6.2	6.9	6.3	5.1	6.15	
5	Middle of Passur River at Project site-Jetty	5.9	6.9	7.2	5.9	6.6	6.6	7.2	5.3	6.1	6.3	5.9	5.9	7.4	6.3	5.03	6.5	
6	Right Bank of Passur River at Project site-Jetty	5.8	6.6	8.0	6.8	6.4	6	7.6	5.4	6.6	5.8	6.1	5.9	7.5	6.5	4.9	6.575	
7	Left Bank of Passur River at South West corner from the Project boundary	6.6	7.3	5.6	6.1	6.3	7.5	6.4	6	6.9	6.3	5.9	6.3	6.4	6.5	5	6.55	
8	Middle of Passur River at South West corner from the Project boundary	6.5	7.1	5.6	6.9	6.5	7.4	6.1	6.1	7.1	6.4	6	6.4	7.2	7.1	4.98	6.825	
9	Right Bank of Passur River at South West corner from the Project boundary	6.5	7.2	5.8	6.6	6.4	7.3	6.3	5.8	6.8	5.6	6	6.4	6.8	6.5	5.11	6.625	
10	Maidara river of the South East corner of the Project at Ichamoti-Maidara confluence	6.0	6.5	8.0	6.0	6.2	6	7.1	4.1	6.4	5.2	6.1	6.7	6.8	6.3	5.17	6.35	
11	Maidara river near proposed township area	6.7	6.8	8.0	6.2	6.5	6.4	7.1	5.2	5.9	5.4	6.4	6.7	7.1	6.2	5.11	6.7	
12	Passur river at Passur-Ghasiakhali confluence	5.3	6.2	7.0	6.5	6.3	7	6.6	5.4	5.8	5.4	5.6	5.9	6.4	6.4	5.23	5.95	
13	Passur river at Harbaria of Sundarbans	5.4	5.9	7.0	6.6	5.8	7.5	7.1	5.2	6.4	5.4	5.8	6.1	6.4	6.2	5.03	5.8	
14	Passur river at Akram point of Sundarbans	7.9	6.4	7.7	6.7	6	NS	7.3	6.2	6.1	6.2	6.7	6.5	7.2	6.8	5.4	6	
15	Passur river at Hiron point of Sundarbans	7.5	6.5	7.8	6.5	5.8	NS	7	NS	7.1	6.8	6.9	6.8		7.3	5.4		

Source: CEGIS Field Survey-

Note: 1QM= First Quarterly Monitoring (April, 2014), 2QM = Second Quarterly Monitoring (July, 2014), 3QM = Third Quarterly Monitoring (October, 2014), 4QM = Fourth Quarterly Monitoring (January 2015)

Table B.5: BOD_5 of Passur River Water

SL	Sampling Location	Biochemical Oxygen Demand (mg/L)																BD Standard
		1st Year				2nd Year				3rd year				4th year				
		Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	Apr	
		1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	1QM	
1	Left Bank of Passur River at 100m u/s of North West corner from the Project boundary	3.4	2.2	1.9	1.6	3.1	3	2.1	2.1	2.8	2.4	2.8	1.8	2.1	1.9	2.1	3	6 or less (for sustaining fisheries)
2	Middle of Passur River at 100m u/s of North West corner from the Project boundary	4.9	3.3	4.1	2.3	3.2	2.4	1.9	2.2	3.2	2.8	2.7	1.9	3.4	2.1	1.9	2	
3	Right Bank of Passur River at 100m u/s of North West corner from the Project boundary	2.2	2.8	3.4	2.7	3.1	2.9	3.4	1.9	3	2.5	2.8	1.9	2.5	2.7	1.9	3	
4	Left Bank of Passur River at Project site-Jetty	3.2	3.1	4.0	0.8	3	4.4	3.2	1.1	3.6	2.1	3.1	2.1	2.4	2.8	2.0	4	
5	Middle Passur River at Project site-Jetty	3.0	2.5	3.5	1.4	3.5	4.3	3.7	2.4	3.3	2.2	2.5	2.2	2.6	2.4	2.0	4	
6	Right Left Bank of Passur River at Project site-Jetty	5.8	3.5	3.6	2.0	3.4	3.7	2.9	1.7	3.1	3.1	2.9	2.1	3.1	2.1	2.3	4	
7	Left Bank of Passur River at South West corner from the Project boundary	3.9	2.8	2.6	1.0	3.1	5.3	2.2	1.2	3.1	2.9	2.4	2.1	3.2	2.4	2.0	5	
8	Middle of Passur River at South West corner from the Project boundary	3.8	3.3	2.8	2.6	3.2	5.2	2.3	2.3	2.6	2.7	2.7	1.9	2.5	2.7	1.9	5	
9	Right Bank of Passur River at South West corner from the Project boundary	6.5	3.8	2.9	2.1	3.4	5	3.1	2.4	3	3.1	3.1	2.1	2.6	2.3	2.1	5	
10	Maidara river of the South East corner of the Project at Ichamoti-Maidara confluence	3.2	3.3	5.5	1.5	3.2	3.9	4.2	2.7	3.3	3.4	2.8	1.8	3.4	2.4	2.1	4	
11	Maidara river near proposed township area	4.1	3.7	4.0	2.0	3.4	4.2	1.6	1.8	3.5	3.2	2.9	2.1	3.2	2.1	2.0	4	
12	Passur river at Passur-Ghasiakhali confluence	2.3	2.2	1.7	2.0	3.3	4.9	2.1	2.2	3.4	2.8	2.3	2	2.7	3.1	2.4	3.1	
13	Passur river at Harbaria of Sundarbans	2.2	2.5	2.6	1.9	2.4	3.9	2.7	2.1	3.2	2.8	2.7	2.1	2.7	3.1	2.9	2.3	
14	Passur river at Akram point of Sundarbans	5.0	2.9	3.7	2.2	3	NS	2.2	2.4	3.3	2.5	3.4	2.1	3.1	3.2	3.1	3	
15	Passur river at Hiron point of Sundarbans	4.3	2.7	3.9	2.3	2.7	NS	2.5	NS	2.4	2.1	3.1	2.2	NS	2.9	2.4		

Source: CEGIS Field Survey

Note: 1QM= First Quarterly Monitoring, 2QM = Second Quarterly Monitoring, 3QM = Third Quarterly Monitoring, 4QM = Fourth Quarterly Monitoring, NS – Not Surveyed

Table B.6: COD of Passur River System

Sl	Sampling Locations	COD (mg/L)														
		1st Year				2nd year				3rd year				4th Year		
		Apr	Jul	Oct	Jan	Apr	July	Oct	Jan	Apr	July	Oct	Jan	Apr	Oct	Jan
		1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM
1	Left Bank of Passur River at 100m u/s of North West corner from the Project boundary	288	24	6	128	87	42	32	124	220	8	12	56	52	24	48
2	Middle Passur River at 100m u/s of North West corner from the Project boundary	284	20	30	68	58	43	36	100	240	8	8	40	48	8	28
3	Right Bank of Passur River at 100m u/s of North West corner from the Project boundary	328	56	14	92	132	18	28	96	280	8	8	44	56	40	40
4	Left Bank of Passur River at Project site-Jetty	376	28	18	84	102	26	36	100	280	8	12	48	40	32	36
5	Middle Passur River at Project site-Jetty	400	60	14	116	110	21	36	108	240	12	16	52	36	40	32
6	Right Bank of Passur River at Project site-Jetty	364	496	18	108	88	24	40	80	260	8	12	42	48	16	28
7	Left Bank of Passur River at South West corner from the Project boundary	364	108	10	104	96	32	42	100	240	12	8	56	42	48	40
8	Middle of Passur River at South West corner from the Project boundary	400	40	22	16	18	25	28	100	180	8	8	52	36	8	44
9	Right Bank of Passur River at South West corner from the Project boundary	408	120	10	100	106	25	48	124	200	12	12	44	52	4	36
10	Maidara river of the South East corner of the project at Ichamoti-Maidara confluence	276	32	10	116	88	51	40	100	160	8	8	36	44	16	40
11	Maidara river near proposed township area	284	96	26	84	94	36	42	108	210	30	8	48	40	32	32
12	Passur river at Passur - Ghasiakhali confluence	408	172	14	96	92	30	46	88	220	12	16	40	64	**40**	48
13	Passur river at Harbaria of Sundarbans	372	216	14	96	102	26	36	100	140	16	12	**40**	216	32	40
14	Passur river at Akram point of Sundarbans	536	520	54	316	302	NS	84	96	156	4	68	56	240	**16**	72
15	Passur river at Hiron point of Sundarbans	540	416	122	472	470	NS	96	NS	160	NS	56	196	NS	4	88

Source: CEGIS Field Survey

Note: 1QM= First Quarterly Monitoring, 2QM = Second Quarterly Monitoring, 3QM = Third Quarterly Monitoring, 4QM = Fourth Quarterly Monitoring: NS – Not Surveyed.

Table B.7: Oil and grease concentration of Passur River System

Sl	Sampling Locations	Oil and Grease (mg/L)															ECR, 1997 (mg/L)*
		1st Year				2nd year				3rd year				4th year			
		Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	
		1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	
1	Left Bank of Passur River at South West corner from the Project boundary	<5	<5	<5	>15	16.9	9	<5	39	61	5	<5	9.2	*5.73*	<5	16.6	10
2	Passur-Ghasiakhali Confluence	<5	<5	<5	>15	13	7.63	9.87	21	30.3	13.5	<5	15.6	<5	<5	<5	
3	Passur river at Harbaria of Sundarbans	<5	6.3	<5	>20	39.1	10.1	<5	14	26	5.73	<5	<5	<5	<5	<5	
4	Passur river at Hiron point of Sundarbans	<5	<5	<5	>20	<5	NS	10.8	ND	31	NS	10.14	13.8	7.71	<5	<5	
5	Akram Point of Sundarbans	<5	<5	<5	>20	<5	NS	9.73	36	82	5.87	<5	14.2	ND	<5	<5	

Source: CEGIS Field Survey

Note: 1QM= First Quarterly Monitoring, 2QM = Second Quarterly Monitoring, 3QM = Third Quarterly Monitoring, 4QM = Fourth Quarterly Monitoring: NS – Not Surveyed.

Table B.8: TDS of Passur River System

SL	Sampling Locations	TDS (mg/L)														
		1st Year				2nd year				3rd year				4th Year		
		Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan
		1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM
1	Left Bank of Passur River at 100m u/s of North West corner from the Project boundary	13060	251	176	4360	14400	937	158	5570	13400	179	138	3100	13400	496	1913
2	Middle of Passur River at 100m u/s of North West corner from the Project boundary	12630	246	162	3950	14700	941	169	5910	13280	112	106	3140	13480	122	1919
3	Right Bank of Passur River at 100m u/s of North West corner from the Project boundary	12900	383	153	4330	14900	127	152	5490	13560	125	108	3330	13400	123	1915
4	Left Bank of Passur River at Project site-Jetty	13190	445	169	4750	14600	175	172	5720	12830	162	147	3630	13560	172	2500
5	Middle Passur River at Project site-Jetty	13330	353	156	4920	14500	132	162	5850	13100	185	110	3600	13490	125	2520
6	Right Bank of Passur River at Project site-Jetty	13380	402	152	4870	14200	156	160	5480	13460	143	112	3520	13330	125	2500
7	Left Bank of Passur River at South West corner from the Project boundary	13180	655	162	5040	14500	336	192	5650	12820	205	113	3470	13640	160	2840
8	Middle of Passur River at South West corner from the Project boundary	13390	587	153	5050	14600	158	164	5740	12960	195	108	3790	13680	126	2710
9	Right Bank of Passur River at South West corner from the Project boundary	13240	916	154	5130	14250	160	164	5650	13590	140	146	3770	13360	127	2720
10	Maidara river of the South East corner of the project at Ichamoti-Maidara confluence	12400	455	214	5050	14000	2320	183	5450	13340	165	196	2920	13490	1616	2500
11	Maidara river near proposed Township area	10970	2510	257	4390	13900	355	176	4420	11700	5170	238	3960	13110	1200	2970
12	Passur river at Passur - Mongla confluence	12800	6410	209	5130	14050	298	227	4540	11330	893	162	3370	12340	204	2570
13	Passur river at Harbaria of Sundarbans	12280	9360	285	4780	13900	683	205	4940	13580	1321	301	3370	13600	245	2690
14	Passur river at Akram point of Sundarbans	21500	15960	3400	12350	13600	NS	4220	13330	20720	7330	2550	3580	19370	3270	11390
15	Passur river at Hiron point of Sundarbans	21500	14050	5720	17900	25300	NS	5830	NS	25500	NS	4120	12210	NS	4450	14190

Source: CEGIS Field Survey

Note: 1QM= First Quarterly Monitoring, 2QM = Second Quarterly Monitoring, 3QM = Third Quarterly Monitoring, 4QM = Fourth Quarterly Monitoring: NS – Not Surveyed.

Table B.9: TH Passur River System

SL	Sampling Locations	TH (mg/L)														
		1st Year				2nd year				3rd year				4th year		
		Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan
		1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM
1	Left Bank of Passur River at 100m u/s of North West corner from the Project boundary	2900	250	216	930	3000	245	250	1270	3130	240	255	1090	3640	200	430
2	Middle of Passur River at 100m u/s of North West corner from the Project boundary	2500	180	218	870	3050	110	330	1380	3090	205	250	980	3420	150	510
3	Right Bank of Passur River at 100m u/s of North West corner from the Project boundary	2650	170	335	870	3250	105	360	1240	3140	205	190	1030	3300	155	498
4	Left Bank of Passur River at Project site-Jetty	2550	175	390	940	3450	118	365	1220	3010	220	265	1020	3400	160	570
5	Middle Passur River at Project site-Jetty	2600	275	340	990	3250	103	355	1300	3070	232	237	915	3440	145	590
6	Right Bank of Passur River at Project site-Jetty	2625	350	355	970	3200	105	350	1260	3100	218	242	1070	3380	140	480
7	Left Bank of Passur River at South West corner from the Project boundary	2550	325	330	1045	3600	153	345	1370	3060	235	205	935	3540	150	505
8	Middle of Passur River at South West corner from the Project boundary	2800	350	345	1125	3670	105	390	1340	3130	242	217	1100	3480	155	530
9	Right Bank of Passur River at South West corner from the Project boundary	2500	475	325	975	3540	165	445	1270	3110	224	238	1110	3600	175	512
10	Maidara river of the South East corner of the project at Ichamoti-Maidara confluence	2500	450	350	980	3260	470	183	950	3180	220	250	1040	1960	165	505
11	Maidara river near proposed township area	2400	725	330	970	3190	130	340	1075	3080	875	240	1170	2300	320	478
12	Passur river at Passur - Mongla confluence	3150	1400	377	1000	3210	135	410	1090	3060	405	245	1070	2450	220	1070
13	Passur river at Harbaria of Sundarbans	2625	2150	345	970	3080	200	430	1100	3050	415	282	1070	3560	200	610
14	Passur river at Akram point of Sundarbans	4500	3625	980	2380	3420	NS	1090	2850	4520	1750	670	1130	4300	640	1475
15	Passur river at Hiron point of Sundarbans	4850	3050	1440	2690	3640	NS	1460	NS	5050	NS	810	2870	NS	905	1740

Source: CEGIS Field Survey

Note: 1QM= First Quarterly Monitoring, 2QM = Second Quarterly Monitoring, 3QM = Third Quarterly Monitoring, 4QM = Fourth Quarterly Monitoring: NS – Not Surveyed.

Table B.10: TSS Passur River System

SL	Sampling Locations	TSS (mg/L)														
		1st Year				2nd year				3rd year				4th year		
		Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan
		1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM
1	Left Bank of Passur River at 100m u/s of North West corner from the Project boundary	598	126	234	180	160	26	76	14	8	61	20	46	51	18	14
2	Middle of Passur River at 100m u/s of North West corner from the Project boundary	45	92	193	210	167	25	80	12	7	48	18	52	42	15	15
3	Right Bank of Passur River at 100m u/s of North West corner from the Project boundary	53	112	174	230	170	127	65	14	10	56	16	48	48	22	14
4	Left Bank of Passur River at Project site-Jetty	54	99	227	450	160	30	92	17	10	62	20	42	52	16	13
5	Middle Passur River at Project site-Jetty	60	100	232	250	165	27	85	18	8	45	24	54	43	20	13
6	Right Bank of Passur River at Project site-Jetty	55	105	186	200	155	40	97	22	7	49	19	46	38	17	14
7	Left Bank of Passur River at South West corner from the Project boundary	24	116	185	300	150	32	104	20	12	51	20	61	32	15	15
8	Middle of Passur River at South West corner from the Project boundary	27	112	536	530	147	40	90	7	10	43	18	58	44	16	17
9	Right Bank of Passur River at South West corner from the Project boundary	67	37	459	450	155	44	82	18	11	39	16	63	40	14	12
10	Maidara river of the South East corner of the project at Ichamoti-Maidara confluence	7	65	798	280	148	36	96	11	7	42	24	55	37	26	14
11	Maidara river near proposed township area	9	24	389	206	160	28	92	10	6	11	30	66	49	30	15
12	Passur river at Passur - Mongla confluence	50	310	203	280	165	24	60	15	13	47	27	61	38	**25**	13
13	Passur river at Harbaria of Sundarbans	65	90	869	400	160	42	74	22	18	31	18	**61**	33	27	17
14	Passur river at Akram point of Sundarbans	115	99	28	103	150	NS	110	16	23	16	41	34	28	22	14
15	Passur river at Hiron point of Sundarbans	91	72	267	200	180	NS	144	NS	15	NS	33	49	NS	16	13

Source: CEGIS Field Survey

Note: 1QM= First Quarterly Monitoring, 2QM = Second Quarterly Monitoring, 3QM = Third Quarterly Monitoring, 4QM = Fourth Quarterly Monitoring: NS – Not Surveyed.

Table B.11: NO_3^{2-} concentration of Passur River System

Sl	Sampling Locations	NO_3^{2-} (mg/L)														
		1st Year				2nd year				3rd year				4th year		
		Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan
		1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM
1	Left Bank of Passur River at 100m u/s of North West corner from the Project boundary	0.9	2.89	0.32	3	33	9.1	4	6.3	3	3.9	0.25	3.62	4.35	5.8	3
2	Middle of Passur River at 100m u/s of North West corner from the Project boundary	0.7	2.4	1.57	1.5	13	7.5	7.1	4.3	2.9	6.2	0.39	2.89	5.05	6.8	4.2
3	Right Bank of Passur River at 100m u/s of North West corner from the Project boundary	0.1	3.2	1.84	4.3	39	6.2	5	3.9	2.5	4.3	0.42	1.87	4.55	4.5	3.6
4	Left Bank of Passur River at Project site-Jetty	1.3	0.76	1.64	3.1	48	6.6	5.7	3.1	2	5.1	0.76	2.25	6.11	7.1	3
5	Middle Passur River at Project site-Jetty	1.4	2.69	1.42	2.2	69	6.1	3.3	5.2	3.1	2.7	0.52	2.46	3.4	3.1	4.7
6	Right Bank of Passur River at Project site-Jetty	1.1	2.98	1.33	8.5	8	6.6	4.7	4.1	3.6	3.9	0.31	3.01	3.16	5	7.6
7	Left Bank of Passur River at South West corner from the Project boundary	0.75	2.13	1.85	2.7	87	14.9	4.4	4.9	2.6	3.6	0.2	3.64	3.14	4.1	8.8
8	Middle of Passur River at South West corner from the Project boundary	1.1	2.43	2.09	1.8	48	4	6.2	3.7	2.9	5.1	0.41	1.93	3.34	3.4	8.5
9	Right Bank of Passur River at South West corner from the Project boundary	1.2	2.05	2.21	1.9	128	4.9	4.4	4.4	2.6	4.9	0.63	2.17	2.00	3.1	2.8
10	Maidara river of the South East corner of the project at Ichamoti-Maidara confluence	0.3	2.18	2.26	6	62	7	4.9	5.6	2.7	5.2	0.4	2.46	3.61	2.3	1.6
11	Maidara river near proposed township area	0.5	0.88	1.98	4	48	3.1	2.9	3.9	3.1	5.3	0.32	3.1	1.60	3.2	3.4
12	Passur river at Passur - Mongla confluence	0.6	1.52	1.64	4.5	29	7.8	3.1	3.7	3	5.2	0.27	2.78	2.49	3.5	4.5
13	Passur river at Harbaria of Sundarbans	1.4	1.75	1.67	2.7	18	4.4	4.4	5.1	3.4	5.1	0.39	2.78	2.46	4.2	4.6
14	Passur river at Akram point of Sundarbans	2.7	3.32	0.59	1.5	25	NS	3.2	4.9	2.9	5.4	0.25	3.08	3.69	2.2	1.8
15	Passur river at Hiron point of Sundarbans	0.8	2.84	0.4	2	28	NS	11.5	NS	3.5	NS	0.38	2.28	NS	2.6	6.1

Source: CEGIS Field Survey

Note: 1QM= First Quarterly Monitoring, 2QM = Second Quarterly Monitoring, 3QM = Third Quarterly Monitoring, 4QM = Fourth Quarterly Monitoring: NS – Not Surveyed.

Table B.12: SO_4^{2-} concentration of Passur River System

Sl	Sampling Locations	SO_4^{2-} (mg/L)														
		1st Year				2nd year				3rd year				4th year		
		Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan
		1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM
1	Left Bank of Passur River at 100m u/s of North West corner from the Project boundary	1840	20	26	580	1360	67	7	570	1080	18	5	230	422	29	630
2	Middle of Passur River at 100m u/s of North West corner from the Project boundary	1320	23	28	450	1260	11	8	590	1040	10	3	210	460	3	370
3	Right Bank of Passur River at 100m u/s of North West corner from the Project boundary	1280	36	34	480	1240	9	11	560	1020	13	4	200	1340	5	410
4	Left Bank of Passur River at Project site-Jetty	1360	45	33	550	1240	26	10	550	1060	15	4	230	1380	2	310
5	Middle Passur River at Project site-Jetty	1040	32	30	520	1120	6	8	580	980	17	6	280	1280	1	310
6	Right Bank of Passur River at Project site-Jetty	1320	20	27	540	820	8	9	565	1100	14	5	230	1400	2	490
7	Left Bank of Passur River at South West corner from the Project boundary	1640	60	40	630	880	9	12	640	1060	15	6	230	880	2	700
8	Middle of Passur River at South West corner from the Project boundary	1520	40	35	560	1180	19	8	560	1020	18	5	231	1440	1	340
9	Right Bank of Passur River at South West corner from the Project boundary	1280	80	64	620	900	12	6	550	1080	12	8	250	1340	3	340
10	Maidara river of the South East corner of the project at Ichamoti-Maidara confluence	1120	20	63	570	1220	72	11	96	1040	11	14	160	1220	120	270
11	Maidara river near proposed township area	1320	210	63	460	840	27	9	480	1020	480	14	200	1340	76	350
12	Passur river at Passur - Mongla confluence	1360	620	44	630	980	39	13	482	1100	42	14	220	1220	**5**	280
13	Passur river at Harbaria of Sundarbans	1560	860	69	590	900	51	7	500	1080	60	19	220	1300	13	220
14	Passur river at Akram point of Sundarbans	2600	1400	1390	850	1540	NS	84	760	1650	620	190	230	1420	30	760
15	Passur river at Hiron point of Sundarbans	2080	1160	2360	1500	1920	NS	97	NS	2100	NS	320	1090	NS	2	510

Source: CEGIS Field Survey

Note: 1QM= First Quarterly Monitoring, 2QM = Second Quarterly Monitoring, 3QM = Third Quarterly Monitoring, 4QM = Fourth Quarterly Monitoring: NS – Not Surveyed.

Table B.13: PO_4^{2-} concentration of Passur River System

Sl	Sampling Locations	PO_4^{2-} (mg/L)														
		1st Year				2nd year				3rd year				4th year		
		Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan
		1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM
1	Left Bank of Passur River at 100m u/s of North West corner from the Project boundary	0.52	2.23	0.67	0.32	0.86	10	1.27	0.269	0.22	1.14	3.39	0.67	1.31	0.49	0.21
2	Middle Passur River at 100m u/s of North West corner from the Project boundary	0.5	1.99	1.12	0.61	0.53	0.23	1.97	0.269	0.36	1.76	4.11	0.31	1.72	2.5	0.16
3	Right Bank of Passur River at 100m u/s of North West corner from the Project boundary	1.1	2.55	0.95	0.7	0.72	0.67	1.94	0.179	0.27	1.77	4.58	0.09	2.73	2.8	0.3
4	Left Bank of Passur River at Project site-Jetty	2.1	0.45	0.92	0.43	0.49	0.27	2.53	0.357	0.31	2.31	2.76	0.07	2.77	3.3	0.19
5	Middle Passur River at Project site-Jetty	2.2	2.13	1.11	0.41	0.68	0.59	1.3	0.536	0.3	0.98	3.2	0.12	0.66	3.9	0.17
6	Right Bank of Passur River at Project site-Jetty	2	2.42	0.99	0.55	0.61	0.13	1.32	0.269	0.43	1.01	2.48	0.16	0.62	3.9	0.47
7	Left Bank of Passur River at South West corner from the Project boundary	0.57	1.25	1.18	0.76	0.65	0.1	0.99	0.536	0.63	0.87	4.16	0.09	0.65	4.6	1.31
8	Middle of Passur River at South West corner from the Project boundary	1.2	1.51	1.25	0.85	0.53	0.18	1.02	0.625	0.21	0.96	2.76	0.04	0.37	0.41	0.39
9	Right Bank of Passur River at South West corner from the Project boundary	1.5	1.1	1	0.53	0.6	0.1	1.39	0.536	0.33	1.123	2.71	0.07	0.45	0.63	0.62
10	Maidara river of the South East corner of the project at Ichamoti-Maidara confluence	0.55	2.1	1.27	0.59	0.7	0.5	1.27	0.351	0.19	1.06	2.836	0.07	0.61	0.51	0.38
11	Maidara river near proposed township area	1.1	0.53	1.04	0.64	0.55	0.29	1.28	0.269	0.13	1	5.23	0.2	0.47	15.3	0.71
12	Passur river at Passur - Mongla confluence	1.3	0.35	0.86	0.42	0.71	0.59	0.95	0.179	0.31	0.78	4.01	0.09	0.18	1.3	0.63
13	Passur river at Harbaria of Sundarbans	1.1	0.56	1.22	0.61	0.59	0.89	0.35	0.269	0.42	0.53	1.16	**0.09**	0.21	3.15	0.81
14	Passur river at Akram point of Sundarbans	1.3	0.29	0.8	0.42	0.61	NS	0.43	0.357	0.26	0.47	9.08	0.1	0.19	0.36	0.97
15	Passur river at Hiron point of Sundarbans	7.51	0.29	1.09	0.44	0.47	NS	0.45	NS	0.36	NS	5.9	0.23	NS	0.55	1.45

Source: CEGIS Field Survey

Note: 1QM= First Quarterly Monitoring, 2QM = Second Quarterly Monitoring, 3QM = Third Quarterly Monitoring, 4QM = Fourth Quarterly Monitoring: NS – Not Surveyed.

Table B.14: As concentration of Passur River System

Sl	Sampling Locations	As (mg/L)														
		1st Year				2nd year				3rd year				4th year		
		Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan
		1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM
1	Left Bank of Passur River at 100m u/s of North West corner from the Project boundary	0.002	0.003	0.004	0.003	0.002	0.002	0.001	0.001	0.001	0.002	0.002	0.002	0.002	0.002	0.002
2	Middle Passur River at 100m u/s of North West corner from the Project boundary	0.002	0.003	0.004	0.003	0.002	0.002	0.001	0.001	0.003	0.003	0.003	0.001	0.002	0.001	0.002
3	Right Bank of Passur River at 100m u/s of North West corner from the Project boundary	0.001	0.003	0.004	0.003	0.003	0.002	0.001	0.001	0.003	0.005	0.002	0.001	0.001	0.002	0.003
4	Left Bank of Passur River at Project site-Jetty	0.002	0.004	0.004	0.004	0.002	0.002	0.001	0.002	0.002	0.004	0.002	0.002	0.001	0.002	0.002
5	Middle Passur River at Project site-Jetty	0.002	0.004	0.004	0.003	0.002	0.001	0.001	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
6	Right Bank of Passur River at Project site-Jetty	0.002	0.003	0.003	0.003	0.002	0.002	0.001	0.001	0.002	0.002	0.002	0.001	0.002	0.003	0.002
7	Left Bank of Passur River at South West corner from the Project boundary	<0.001	0.003	0.006	0.003	0.002	0.002	0.001	0.002	0.001	0.003	0.002	0.002	0.002	0.003	0.001
8	Middle of Passur River at South West corner from the Project boundary	<0.002	0.004	0.004	0.003	0.002	0.002	0.001	0.001	0.002	0.003	0.003	0.001	0.002	0.002	0.001
9	Right Bank of Passur River at South West corner from the Project boundary	0.002	0.003	0.006	0.003	0.002	0.003	0.001	0.001	0.002	0.004	0.002	0.002	0.003	0.002	0.001
10	Maidara river of the South East corner of the project at Ichamoti-Maidara confluence	<0.001	0.003	0.006	0.004	0.003	0.002	0.001	0.002	0.002	0.005	0.002	0.001	0.003	0.003	0.002
11	Maidara river near proposed township area	0.002	0.002	0.003	0.003	0.003	0.002	0.001	0.001	0.002	0.002	0.002	0.001	0.003	0.001	0.001
12	Passur river at Passur - Mongla confluence	0.002	0.004	0.003	0.003	0.004	0.002	0.001	0.002	0.003	0.004	0.003	0.002	0.002	0.002	0.001
13	Passur river at Harbaria of Sundarbans	0.004	0.003	0.004	0.004	0.004	0.002	0.001	0.002	0.005	0.002	0.003	0.002	0.001	0.003	0.002
14	Passur river at Akram point of Sundarbans	0.004	0.002	0.002	0.003	0.002	NS	0.001	0.002	0.006	0.001	0.003	0.001	0.002	0.002	0.001
15	Passur river at Hiron point of Sundarbans	0.003	0.002	0.003	0.002	0.002	NS	0.001	NS	0.004	NS	0.002	0.002	NS	0.002	0.001

Source: CEGIS Field Survey

Note: 1QM= First Quarterly Monitoring, 2QM = Second Quarterly Monitoring, 3QM = Third Quarterly Monitoring, 4QM = Fourth Quarterly Monitoring: NS – Not Surveyed

Table B.15: Pb concentration of Passur River System

Sl	Sampling Locations	Pb (mg/L)														
		1st Year				2nd year				3rd year				4th year		
		Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan
		1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM
1	Left Bank of Passur River at 100m u/s of North West corner from the Project boundary	0.053	0.004	0.002	0.104	0.098	0.0059	0.007	0.168	0.203	0.01	0.009	0.024	0.002	0.003	0.001
2	Middle Passur River at 100m u/s of North West corner from the Project boundary	0.055	0.002	0.003	0.104	0.102	0.0038	0.006	0.092	0.302	0.009	0.007	0.034	0.001	0.003	0.001
3	Right Bank of Passur River at 100m u/s of North West corner from the Project boundary	0.055	0.005	0.002	0.111	0.138	0.0058	0.008	0.176	0.347	0.017	0.01	0.03	0.003	0.003	0.002
4	Left Bank of Passur River at Project site-Jetty	0.057	0.002	0.003	0.154	0.142	0.011	0.01	0.115	0.336	0.014	0.007	0.036	0.001	0.002	0.002
5	Middle Passur River at Project site-Jetty	0.06	0.002	0.002	0.139	0.135	0.002	0.009	0.148	0.317	0.006	0.006	0.046	0.003	0.002	0.001
6	Right Bank of Passur River at Project site-Jetty	0.058	0.002	0.002	0.138	0.156	0.0021	0.007	0.112	0.298	0.01	0.005	0.041	0.002	0.001	0.001
7	Left Bank of Passur River at South West corner from the Project boundary	0.053	0.002	0.003	0.16	0.142	0.0076	0.01	0.134	0.396	0.007	0.006	0.048	0.003	0.001	0.001
8	Middle of Passur River at South West corner from the Project boundary	0.054	0.003	0.004	0.153	0.148	0.002	0.011	0.099	0.323	0.006	0.007	0.044	0.009	0.002	0.001
9	Right Bank of Passur River at South West corner from the Project boundary	0.056	0.005	0.004	0.139	0.163	0.002	0.009	0.093	0.331	0.012	0.007	0.056	0.003	0.002	0.002
10	Maidara river of the South East corner of the project at Ichamoti-Maidara confluence	0.053	0.004	0.004	0.143	0.135	0.002	0.07	0.023	0.35	0.008	0.008	0.038	<LOQ	0.003	0.002
11	Maidara river near proposed township area	0.048	0.004	<0.002	0.133	0.14	0.002	0.008	0.067	0.275	0.015	0.007	0.056	0.001	0.011	0.001
12	Passur river at Passur - Mongla confluence	0.05	0.032	<0.002	0.141	0.14	0.002	0.009	0.078	0.258	0.098	0.011	0.05	0.0001	0.011	0.001
13	Passur river at Harbaria of Sundarbans	0.043	0.044	0.004	0.137	0.13	0.002	0.012	0.135	0.228	0.02	0.01	0.05	0.001	0.005	0.003
14	Passur river at Akram point of Sundarbans	0.194	0.071	0.032	0.309	0.297	NS	0.084	0.302	0.359	0.142	0.126	0.033	0.009	0.004	0.169
15	Passur river at Hiron point of Sundarbans	0.224	0.05	0.07	0.309	0.291	NS	0.073	NS	0.607	NS	0.151	0.129	NS	0.019	0.175

Source: CEGIS Field Survey

Note: 1QM= First Quarterly Monitoring, 2QM = Second Quarterly Monitoring, 3QM = Third Quarterly Monitoring, 4QM = Fourth Quarterly Monitoring: NS – Not Surveyed.

Table B.16: Hg concentration of Passur River System

Sl	Sampling Locations	Hg (mg/L)														
		1st Year				2nd year				3rd year				4th year		
		Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan
		1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM
1	Left Bank of Passur River at 100m u/s of North West corner from the Project boundary	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.001	< 0.001	< 0.001
2	Middle Passur River at 100m u/s of North West corner from the Project boundary	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.001	< 0.001	< 0.001
3	Right Bank of Passur River at 100m u/s of North West corner from the Project boundary	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.001	< 0.001	< 0.001
4	Left Bank of Passur River at Project site-Jetty	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.001	< 0.001	< 0.001
5	Middle Passur River at Project site-Jetty	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.001	< 0.001	< 0.001
6	Right Bank of Passur River at Project site-Jetty	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.001	< 0.001	< 0.001
7	Left Bank of Passur River at South West corner from the Project boundary	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.001	< 0.001	< 0.001
8	Middle of Passur River at South West corner from the Project boundary	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.001	< 0.001	< 0.001
9	Right Bank of Passur River at South West corner from the Project boundary	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.001	< 0.001	< 0.001
10	Maidara river of the South East corner of the project at Ichamoti-Maidara confluence	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.001	< 0.001	< 0.001
11	Maidara river near proposed township area	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.001	< 0.001	< 0.001
12	Passur river at Passur - Mongla confluence	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.001	< 0.001	< 0.001
13	Passur river at Harbaria of Sundarbans	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.001	< 0.001	< 0.001
14	Passur river at Akram point of Sundarbans	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.001	< 0.001	< 0.001
15	Passur river at Hiron point of Sundarbans	< 0.00015	NS	< 0.00015	< 0.00015	< 0.00015	< 0.00015	NS	NS	< 0.00015	NS	< 0.00015	< 0.00015	< 0.001	< 0.001	< 0.001

Source: CEGIS Field Survey

Note: 1QM= First Quarterly Monitoring, 2QM = Second Quarterly Monitoring, 3QM = Third Quarterly Monitoring, 4QM = Fourth Quarterly Monitoring: NS – Not Surveyed.

Parameters for ground water quality monitoring

Table B.17: pH and Temperature of Ground Water

Sl	Locations	Tube Well Type	pH value															
			1st Year				2nd year				3rd year				4th year			5th year
			Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	Apr
			1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	1QM
1	Near Proposed Township	Deep (>600 ft)	7.6	7.7	7.9	8	TC	8.1	7.49	7.6	7.8	7.8	8.4	8.1	7.4	8.2	6.9	
2	Rajnagar	Deep (>600 ft)	7.6	7.8	8	8.2	7.8	8.3	7.93	8.1	8.3	8.1	7.9	7.5	7.8	8.1	7.4	6.9
3	Kapasdanga	Deep (>600 ft)	7.6	7.7	8	8.1	7.9	8.3	7.7	7.9	8.2	7.9	7.9	7.6	7.4	7.8	7.2	7.2
4	Kalekharber	Shallow (<250 ft)	6.3	6.5	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	

Locations	Tube Well Type	Temperature (°C)															
		1st Year				2nd year				3rd year				4th year			5th year
		Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	Apr
		1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	1QM
Near Proposed Township	Deep (>600 ft)	27.3	28.5	26	24.5	TC	31	30	24	29.8	28.6	29.1	25.1	28.7	27.2	22.9	
Rajnagar	Deep (>600 ft)	29.6	29.9	28	22.5	28.6	28	27.8	23	29.6	29.1	30.4	24.3	27.7	26.5	23.8	30.3
Kapasdanga	Deep (>600 ft)	29.2	28.9	28	25.1	28.8	30	28.7	25	30.1	29.4	29.8	24	28.4	26.4	23.6	30.1
Kalekharber	Shallow (<250 ft)	27.5	28.7	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	

Source: CEGIS Field Survey

Note: 1QM= First Quarterly Monitoring, 2QM = Second Quarterly Monitoring, 3QM = Third Quarterly Monitoring, 4QM = Fourth Quarterly Monitoring:

*NF=Nonfunctional *Drinking water quality standards, The Environment Conservation Rules, 1997*

Table B.18: Salinity and DO in Groundwater

Sl	Locations	Tube Well Type	Salinity (ppt)															
			1st Year				2nd year				3rd year				4th year			5th year
			Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	Apr
			1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	1QM
1	Near Proposed Township	Deep (>600 ft)	0	0	0	1	TC	0	0	0	0	0	0	0	0	0	0	
2	Rajnagar	Deep (>600 ft)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.3	0.3
3	Kapashdanga	Deep (>600 ft)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.4	0.2
4	Kalekharber	Shallow (<250 ft)	0	0	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	

Sl	Locations	Tube Well Type	DO (mg/L)															
			1st Year				2nd year				3rd year				4th year			
			Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	Apr
			1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	1QM
1	Near Proposed Township	Deep (>600 ft)	4.4	5.2	6.5	6.7	TC	6	5.4	4.9	6.1	5.8	6.3	4.5	5.1	6.2	5.2	
2	Rajnagar	Deep (>600 ft)	6	6.2	7.7	6.3	6	5.9	6.1	5.2	5.8	6.1	5.8	4.8	5.3	5.8	4.47	6.0
3	Kapasdanga	Deep (>600 ft)	6.4	6.5	6.1	6.5	6.6	6	5.6	4.8	5.6	5.7	6.1	4.6	5.7	6.2	4.26	5.4
4	Kalekharber	Shallow (<250 ft)	4.4	6	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	

Source: CEGIS Field Survey

Note: 1QM= First Quarterly Monitoring, 2QM = Second Quarterly Monitoring, 3QM = Third Quarterly Monitoring, 4QM = Fourth Quarterly Monitoring:

*NF=Nonfunctional *Drinking water quality standards, The Environment Conservation Rules, 1997*

Table B.19: TDS and TSS concentrations in Groundwater

SL	Locations	Type of tube wells	TDS (mg/L)														
			1st Year				2nd year				3rd year				4th Year		
			Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan
			1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM
1	Township near project site	Deep (>600 ft)	1113	999	-	1021	NO	881	377	447	1025	1000	617	623	395	602	405
2	Rajnagar	Deep (>600 ft)	4090	371	-	378	390	574	1007	491	384	408	382	401	617	996	602
3	Kapasdanga	Deep (>600 ft)	643	635	-	600	600	328	611	284	645	607	636	998	558	390	994
4	Kalekharber	Shallow (<250 ft)	1055	970	-	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	

SL	Locations	Type of tube wells	TSS (mg/L)														
			1st Year				2nd year				3rd year				4th Year		
			Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan
			1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM
1	Township near project site	Deep (>600 ft)	-	6	19	40	NF**	23	4	31	3	5	7	32	4	8	12
2	Rajnagar	Deep (>600 ft)	-	6	2	28	4	16	5	46	4	4	4	28	10	10	6
3	Kapasdanga	Deep (>600 ft)	-	8	6	32	6	14	4	41	3	4	5	25	9	9	7
4	Kalekharber	Shallow (<250 ft)	-	48	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	

Source: CEGIS Field Survey

Note: 1QM= First Quarterly Monitoring, 2QM = Second Quarterly Monitoring, 3QM = Third Quarterly Monitoring, 4QM = Fourth Quarterly Monitoring: NS=Not Surveyed; NF=Non functional;

Table B.20: TH concentrations in Groundwater

Sl No	Locations	Type of tubewell	TH (mg/L)*														
			1st Year				2nd year				3rd year				4th Year		
			Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan
			1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM
1	Township near project site	Deep (>600 ft)	425	250	300	235	NO	225	325	295	305	320	175	550	720	145	430
2	Rajnagar	Deep (>600 ft)	220	175	180	110	138	125	450	195	263	248	295	510	420	240	265
3	Kapasdanga	Deep (>600 ft)	190	140	180	125	216	115	480	225	163	28	183	620	654	215	305
4	Kalekarber	Shallow (<250 ft)	780	450	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	

Source: CEGIS Field Survey

Note: 1QM= First Quarterly Monitoring, 2QM = Second Quarterly Monitoring, 3QM = Third Quarterly Monitoring, 4QM = Fourth Quarterly Monitoring:

*NF=Nonfunctional; *Drinking water quality standards, The Environment Conservation Rules, 1997*

Table B.21: COD concentrations of monitored ground water locations

Sl	Locations	Tube-well Type	COD (mg/L)														
			1st Year				2nd year				3rd year				4th year		
			Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan
			1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM
1	Township near project site	Deep (>600 ft)	32	32	34	20	NO	12	4	4	4	4	4	4	4	8	4
2	Rajnagar	Deep (>600 ft)	28	28	18	16	14	10	8	4	4	4	4	4	4	8	4
3	Kapasdanga	Deep (>600 ft)	48	32	34	20	18	14	4	4	4	2	4	4	4	16	4
4	Kalekarber	Shallow (<250 ft)	32	36	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	

Source: CEGIS Field Survey

*Note: 1QM= First Quarterly Monitoring, 2QM = Second Quarterly Monitoring, 3QM = Third Quarterly Monitoring, 4QM = Fourth Quarterly Monitoring: NS=Not Surveyed; NF=Non functional; N/A=Not Availability; *Drinking water quality standards, The Environment Conservation Rules, 1997*

Table B.22: NO_3^-, SO_4^- and PO_4^- Concentrations in Ground Water

Sl	Locations	Type of tube well	NO_3^{2-} (mg/L) *BD Standard (10 mg/L)																SO_4^{2-} (mg/L) *BD Standard (400 mg/L)																PO_4^{2-} (mg/L) *BD Standard (6.0 mg/L)															
			1st Year				2nd year				3rd year				4th Year				1st Year				2nd year				3rd year				4th Year				1st Year				2nd year				3rd year				4th Year		
			Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan
			1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM
1	Township near project site	Deep (>600 ft)	0.20	0.48	<0.10	28	-	7.6	4.3	2.1	1.7	3.8	6.1	4.65	9.32	3.3	5.9	-	3	-	-	-	-	1	5	1	1	1	1	5	1	8	-	2.2	-	0.74	NO	1.4	0.31	0.267	1.08	0.17	0.167	1.18	2.18	1.68	0.13
2	Rajnagar	Deep (>600 ft)	0.60	0.68	0.31	26	-	2.2	4.2	1.9	2.3	3.3	7.51	7.02	14.7	2.5	7.2	-	2	-	-	-	-	2	6	2	1	1	1	1	1	2	-	2.5	-	0.44	1.98	1.6	0.27	0.179	1.53	0.29	0.67	1.21	1.8	3.5	0.17
3	Kapasdanga	Deep (>600 ft)	0.80	0.40	0.80	13	-	4.7	3.8	2.8	1.9	3.7	10.16	4.65	10.2	4.6	1.7	-	10	-	-	-	-	2	2	8	1	1		3	2	6	-	6.2	-	0.48	4.54	4.1	0.48	0.179	3.26		0.6	1.18	2.1	4.7	0.18
4	Kalekarber	Shallow (<250 ft)	0.40	0.56	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF		NF	3	NF	-	-	-	-	NF	NF	NF	NF	NF	NF	NF		NF	1.2	NF	NF	NF		NF	NF	NF	0.31	NF	1.23	NF	NF	

Source: CEGIS Field Survey

Note: 1QM= First Quarterly Monitoring, 2QM = Second Quarterly Monitoring, 3QM = Third Quarterly Monitoring, 4QM = Fourth Quarterly Monitoring:

*NF=Nonfunctional; *Drinking water quality standards, The Environment Conservation Rules, 1997*

Table B.23: As, Pb and Hg concentrations (mg/L) of monitored ground water locations

Sl	Locations	As (mg/L) *BD Standard (0.05 mg/L)																Pb (mg/L) *BD Standard (0.05 mg/L)																Hg (mg/L) *BD Standard (0.001 mg/L)															
		1st Year				2nd year				3rd year				4th Year				1st Year				2nd year				3rd year				4th Year				1st Year				2nd year				3rd year				4th Year		
		Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan		Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan		Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan
		1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM		1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM		1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM
1	Township near project site	0.013	0.020	0.012	0.014	NO	0.015	0.002	0.008	0.018	0.012	0.033	0.028	0.012	0.014	0.002		0.002	<0.002	0.004	0.023	NO	0.002	0.006	0.026	0.019	0.002	0.001	0.01	0.001	0.003	0.001		<0.00015	<0.00015	<0.0005	<0.0005	NO	0.00015	<0.00015	<0.00015	<0.00015	<0.00015	<0.00015	<0.00015	0.001	<0.0001	<0.001
2	Rajnagar	0.006	0.009	0.006	0.008	0.01	0.014	0.012	0.002	0.007	0.018	0.011	0.005	0.022	0.004	0.012		<0.002	<0.002	<0.002	0.016	0.013	0.0027	0.021	0.011	0.007	0.002	0.001	0.009	0.001	0.007	0.002		<0.00015	<0.00015	<0.0005	<0.0005	<0.00015	0.00015	<0.00015	<0.00015	<0.00015	<0.00015	<0.00015	<0.00015	0.001	<0.0001	<0.001
3	Kalekarber	0.376	0.407	NF	NF	D	D	NF	NF	NF	NF	NF	NF	NF	NF	0.006		0.002	0.008	NF	NF	D	D	NF	NF	NF	NF	NF	NF	NF	NF	0.001		<0.00015	<0.00015	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	<0.001
4	Kapasdanga	0.036	0.033	0.020	0.017	0.034	0.024	0.011	0.002	0.047	0.005	0.016	0.028	0.010	0.027			<0.002	0.004	<0.002	0.013	0.017	0.002	0.005	0.012	0.008	0.002	0.001	0.016	0.001	0.002			<0.00015	<0.00015	<0.0005	<0.0005	<0.00015	0.00015	<0.00015	<0.00015	<0.00015	<0.00015	<0.00015	<0.00015	0.001	<0.0001	

Source: CEGIS Field Survey

Note: 1QM= First Quarterly Monitoring, 2QM = Second Quarterly Monitoring, 3QM = Third Quarterly Monitoring, 4QM = Fourth Quarterly Monitoring: NS=Not Surveyed; NF=Non functional; N/A=Not Availability; TC=temporarily closed, D=Damaged

**Drinking water quality standards, The Environment Conservation Rules, 1997*

(C) Noise Level monitoring data

Table C.1: Summary of the ambient noise monitoring in First Year (2014-15)

Sl No	Location	QM1 (Noise Level in dB (A)) Mar-14				QM2 (Noise Level in dB (A)) Jul-14				QM3 (Noise Level in dB (A)) Oct-14				QM4 (Noise Level in dB (A)) Jan-15				Std*
		Morning (9:00)	A.noon (13:00)	Evening (18:00)	Day time AVG	Morning (9:00)	A.noon (13:00)	Evening (18:00)	Day time AVG	Morning (9:00)	A.noon (13:00)	Evening (18:00)	Day time AVG	Morning (9:00)	A.noon (13:00)	Evening (18:00)	Day time AVG	Day time AVG
1	Chalna, Dacope	80.32	60.86	63.22	68.13	52.71	55.62	50.27	52.87	53.37	53.52	57	54.63	51.92	53.7	54.21	53.28	70
2	NW Corner of the Project area	55.23	53	47.43	51.89	NM	NM	NM	NM	42.67	41.73	41.37	41.92	33.87	36.42	35.46	35.25	50
3	Chunkuri-2, Bajua	62.69	57.19	53.39	57.76	54.61	51.14	51.9	52.55	52.26	51.14	50.76	51.39	55.08	46.29	46.49	49.29	50
4	SW corner of the Project area	49.2	NM	NM	49.2	44.55	48.94	49.33	47.6	45.56	45.1	47.18	45.95	36.57	34.24	37.27	36.03	50
5	Proposed Township area, Project site	47.8	49.7	NM	48.75	46.15	47.21	NM	46.68	42.67	41.73	41.37	41.92	41.49	39.55	43.37	41.47	50
6	Barni, Gaurambha	64.95	50.93	60.65	58.84	48.73	50.37	50.75	49.95	50.18	50.89	48.27	49.78	43.36	38.56	48.86	43.6	50
7	Khan Jahan Ali Bridge, Khulna	76.12	66.72	72.25	71.7	55.97	64.68	61.75	60.8	72.24	58.3	68.3	66.28	61.34	63.4	60.41	61.72	70
8	Mongla Port area	69.38	54.55	59.79	61.24	54.75	54.2	52.58	53.84	66.8	55.2	59.5	60.5	40.26	35.04	40.76	38.69	75
9	Harbaria, Sundarbans	39.24	NM	42.51	40.88	59.25	60.52	48.62	56.13	54.08	56.51	NM	55.3	36.36	32.4	NM	34.38	45
10	Akram Point, Sundarbans	40.95	41.98	39.9	40.94	48.95	46.86	NM	47.9	45.27	42.69	NM	43.98	37.9	30.75	NM	34.32	45
11	Hiron Point, Sundarbans	35.99	40.75	39.16	38.63	51.29	NM	NM	51.29	47.98	39.42	NM	47.98	42.82	31.93	NM	37.37	45

*Note(s): NM – Not Monitored, *Std- Standard as defined in National Noise Control Rules 2006*

Table C.2: Summary of the ambient noise monitoring in Second Year (2015-16)

Sl No	Location	QM1 (Noise Level in dB (A)) Apr-15				QM2 (Noise Level in dB (A)) Jul-15				QM3 (Noise Level in dB (A)) Oct-15				QM4 (Noise Level in dB (A)) Jan-16				Std*
		Morning (9:00)	A.noon (13:00)	Evening (18:00)	Day time AVG	Morning (9:00)	A.noon (13:00)	Evening (18:00)	Day time AVG	Morning (9:00)	A.noon (13:00)	Evening (18:00)	Day time AVG	Morning (9:00)	A.noon (13:00)	Evening (18:00)	Day time AVG	Day time AVG
1	Chalna, Dacope	57.27	54.31	59.65	57.08	43.52	54.23	51.56	49.77	68.32	66.09	60.96	65.12	67.84	61.25	66.31	66.07	70
2	NW Corner of the Project area	45.05	42.15	46.8	44.67	37.58	40.91	46.18	41.56	41.51	39.58	44.74	41.94	53.91	49.02	49.95	50.96	50
3	Chunkuri-2, Bajua	45.9	48.19	NM	47.05	40.57	42.23	39.17	40.66	47.53	45.48	49.28	47.43	56.84	48.12	55.90	53.62	50
4	SW corner of the Project area	40.6	43.25	46.89	43.58	44.57	44.30	42.36	43.75	36.15	48.26	43.68	42.70	60.32	55.30	63.70	60.44	50
5	Proposed Township area, Project site	41.49	39.55	43.37	41.47	43.41	50.86	45.99	46.75	46.89	49.47	55.20	50.52	54.79	52.22	54.29	53.77	50
6	Barni, Gaurambha	58.23	50.11	NM	54.17	46.76	44.83	46.95	46.18	56.40	54.19	54.88	55.16	60.62	60.00	56.86	59.16	50
7	Khan Jahan Ali Bridge, Khulna	75.2	72.75	72.42	73.45	52.95	52.18	53.34	52.82	64.43	61.65	66.65	64.25	69.96	64.81	70.56	68.45	70
8	Mongla Port area	46.02	49.29	49.15	48.15	36.72	38.56	43.54	39.61	45.39	NM	48.63	47.01	54.15	51.82	52.14	52.70	75
9	Harbaria, Sundarbans	67.06	64.05	64.99	65.37	39.33	30.74	NM	35.03	54.97	46.54	NM	50.75	45.72	44.69	*NM*	45.20	45
10	Akram Point, Sundarbans	53.35	56.37	NM	54.86	NM	NM	NM	NM	45.28	53.92	NM	49.60	45.60	40.29	*NM*	42.95	45
11	Hiron Point, Sundarbans	47.48	48.2	NM	47.84	NM	NM	NM	NM	54.44	37.69	NM	46.06	NM	NM	NM	NM	45

*Note(s): NM – Not Monitored, *Std- Standard as defined in National Noise Control Rules 2006*

Table C.3: Summary of the ambient noise monitoring in Third Year (2016-17)

Sl No	Location	QM1 (Noise Level in dB (A)) Apr-16				QM2 (Noise Level in dB (A)) Jul-16				QM3 (Noise Level in dB (A)) Oct-16				QM4 (Noise Level in dB (A)) Jan-17				Std*
		Morning (9:00)	A.noon (13:00)	Evening (18:00)	Day time AVG	Morning (9:00)	A.noon (13:00)	Evening (18:00)	Day time AVG	Morning (9:00)	A.noon (13:00)	Evening (18:00)	Day time AVG	Morning (9:00)	A.noon (13:00)	Evening (18:00)	Day time AVG	Day time AVG
1	Chalna, Dacope	67.71	61.23	66.31	65.08	50.92	50.04	52.3	51.42	60.1	68.6	67.8	65.5	54.4	61	61.46	58.95	70
2	NW Corner of the Project area	53.81	48.66	49.90	50.79	54.40	53.19	50.36	52.65	54.7	54.8	57.0	55.5	44.52	44.52	NM	44.52	50
3	Chunkuri-2, Bajua	43.30	43.35	46.84	44.49	56.29	49.4	54.51	53.4	50.4	47.7	56.6	51.6	55.73	56.2	NM	55.31	50
4	SW corner of the Project area	56.81	54.73	51.97	54.50	67.38	74.12	54.61	65.37	47.8	49.0	50.8	49.2	44.41	45.96	NM	45.19	50
5	Proposed Township area, Project site	55.02	52.41	52.69	53.37	62.71	52.98	51.67	55.79	45.8	41.6	48.7	45.4	NM	43.4	41.85	42.63	50
6	Barni, Gaurambha	50.63	54.19	57.09	53.97	51.2	59.54	59.53	56.75	52.4	57.3	55.0	54.9	49.75	48.35	NM	49.05	50
7	Khan Jahan Ali Bridge, Khulna	66.40	64.82	66.34	65.85	63.52	62.15	65.73	63.80	61.9	59.6	61.3	60.9	51.69	60.05	54.97	55.57	70
8	Mongla Port area	49.89	48.67	51.07	49.88	53.87	52.04	52.7	52.87	49.5	50.0	50.2	49.9	47.82	48.67	50.33	48.94	75
9	Harbaria, Sundarbans	44.40	44.69	NM	44.55	53.87	53.04	52.79	52.9	57.2	53.5	49.3	53.3	41.13	38.4	37.98	39.17	45
10	Akram Point, Sundarbans	45.60	40.29	NM	42.95	47.16	46.48	50.24	47.96	40.5	43.0	42.5	42.0	38.74	38.45	37.06	38.08	45
11	Hiron Point, Sundarbans	48.53	37.69	NM	43.11	NM	NM	NM	NM	46.1	42,08	41.9	44.0	43.62	40.96	42.29	42.29	45

*Note(s): NM – Not Monitored, *Std- Standard as defined in National Noise Control Rules 2006*

Table C.4: Summary of the ambient noise monitoring in Fourth Year (2017-2018)

Sl No	Location	QM1 (Noise Level in dB (A)) Apr-17				QM2 (Noise Level in dB (A)) Oct-17				QM3 (Noise Level in dB (A)) Jan-2018				QM1 (Noise Level in dB (A)) Jan-2018				Std*
		Morning (9:00)	A.noon (13:00)	Evening (18:00)	Day time AVG	Morning (9:00)	A.noon (13:00)	Evening (18:00)	Day time AVG	Morning (9:00)	A.noon (13:00)	Evening (18:00)	Day time AVG	Morning (9:00)	A.noon (13:00)	Evening (18:00)	Day time AVG	Day time AVG
1	Chalna, Dacope	58.21	59.00	66.57	61.62	47.65	51.06	50.27	49.66	60.2	60.2	60.5	60.3	64.09	59.30	65.43	62.94	70
2	NW Corner of the Project area	44.97	49.30	47.31	47.19	47.65	45.12	46.65	46.47	47.8	48.1	49.2	48.37	47.92	54.32	61.14	54.46	55
3	Chunkuri-2, Bajua	45.60	52.29	53.42	50.44	39.82	45.60	41.73	42.38	51.1	51.2	52.1	51.47	44.77	46	63.14	51.30333	55
4	SW corner of the Project area	39.62	42.64	47.48	43.25	60.80	64.08	62.52	62.47	43.5	43.5	45.7	44.23	64.45	63.49	66.63	64.85667	55
5	Proposed Township area, Project site	41.40	43.09	43.45	42.65	43.05	48.52	45.01	45.53	53.2	54	52.82	53.34	51.95	59.66	56.8	56.13667	55
6	Barni, Gaurambha	43.05	46.45	45.01	44.83	45.60	52.29	53.42	50.44	56.5	54.2	56.1	55.6	55.6	51.80	51.39	52.93	60
7	Khan Jahan Ali Bridge, Khulna	54.01	57.50	58.66	56.72	40.60	42.64	46.55	43.26	60.2	62.1	62.2	61.5	49.4	45.25	47.98	47.54333	70
8	Mongla Port area	47.78	47.45	45.25	47.61	41.40	44.68	45.71	43.93	60.2	60.2	58.4	59.6	50.84	48.33	53.25	50.80667	75
9	Harbaria, Sundarbans	50.79	53.67	57.84	54.10	44.25	46.67	47.31	46.08	45.8	44.7	43.8	44.7	50.23	45.55	65.43	53.73667	50
10	Akram Point, Sundarbans	43.41	45.60	43.89	44.30	58.21	58.59	58.70	58.50	39.4	40.5	41.1	40.3	58.31	60.93	64.87	61.37	50
11	Hiron Point, Sundarbans	NM	NM	NM	NM	39.92	39.79	33.5	37.74	37.2	39	38.4	38.2					50

(D) Fisheries resources monitoring data

Table D.1: Data for Basic life Requirements for a Good Fish Community

Life Requirements	Variable Sl.	Habitat Variables
Food (C_F)	V1	Phytoplankton (%)
	V2	Zooplankton (%)
Water Quality (C_{WQ})	V3	Turbidity
	V4	TDS
	V5	Surface water temperature
	V6	Dissolved Oxygen (DO)
	V7	pH
	V8	Salinity
Reproduction (C_R)	V1	Phytoplankton (%)
	V2	Zooplankton (%)
	V3	Turbidity
	V4	TDS
	V5	Surface water temperature
	V6	Dissolved Oxygen (DO)
	V7	pH
	V8	Salinity
Food (C_F)	V1	Phytoplankton (%)
	V2	Zooplankton (%)
Water Quality (C_{WQ})	V3	Turbidity
	V4	TDS
	V5	Surface water temperature
	V6	Dissolved Oxygen (DO)
	V7	pH
	V8	Salinity
Reproduction (C_R)	V1	Phytoplankton (%)

Life Requirements	Variable Sl.	Habitat Variables
	V2	Zooplankton (%)
	V3	Turbidity
	V4	TDS
	V5	Surface water temperature
	V6	Dissolved Oxygen (DO)
	V7	pH
	V8	Salinity
Food (C_F)	V1	Phytoplankton (%)
	V2	Zooplankton (%)
Water Quality (C_{WQ})	V3	Turbidity
	V4	TDS
	V5	Surface water temperature
	V6	Dissolved Oxygen (DO)
	V7	pH
	V8	Salinity
Reproduction (C_R)	V1	Phytoplankton (%)
	V2	Zooplankton (%)
	V3	Turbidity
	V4	TDS
	V5	Surface water temperature
	V6	Dissolved Oxygen (DO)
	V7	pH
	V8	Salinity

Table D.2: Occurrence of Species

Local Name	Scientific Name	Local Status*	1st QM	2nd QM	3rd QM	4th QM	5th QM	6th QM	7th QM	8th QM	9th QM	10th QM	11th QM	12th QM
			'-' = No; '+' = Occurrence											
Amadi Chela	*Chela sp.*	DD	-	-	+	+	+	-	+	+	-	+	-	+
Hilsa	*Tenualosa ilisha*	NO	-	-	+	-	-	+	+	-	-	-	+	-
Sagor Baim	*Anguilla bengalensis*	NT	+	-	-	-	-	+	-	-	-	-	-	-
Bacha	*Eutropiichthys vacha*	CR	+	-	-	-	-	-	-	-	-	+	-	-
Bagda Chingri	*Penaeus monodon*	DD	+	+	+	+	+	+	+	+	+	+	-	+
Banspata	*Brachypleura novae-zeelandiae*	NO	+	+	+	+	-	+	+	+	+	-	+	+
Kukurjib	*Cynoglossus lingua*	NO	+	-	-	-	-	-	-	+	+	+	-	+
Bele	*Glossogobius giuris*	NO	+	+	+	+	+	+	+	+	+	-	+	+
Aswine Bele	*Butis butis*	NO	-	-	-	-	-	-	+	+	+	+	+	+
Bairagi	*Coilia dussumieri*	NO	+	+	+	+	+	+	-	+	-	-	-	+
Boishakhi Chingri	*Macrobrachium* sp.	NO	-	+	-	-	+	+	+	+	+	-	-	-
Chammu Chingri	*Metapenaeus brevicornis*	DD	+	+	+	-	+	+	+	+	+	+	+	-
Chaka Chingri	*Penaeus indicus*	DD	+	+	-	+	+	+	+	+	+	-	+	-
Ghora Chela	*Securicula gora*	-	+	-	-	-	-	-	-	-	-	-	-	-
Chanda Chela	*Securicula* sp.		-	+	+	-	-	-	-	-	+	+	-	-
Sada Chewa	*Trepauchen vagina*	NO	+	-	+	-	-	+	-	-	-	+	-	-
Lal Chewa	*Taenioides cirratus*	NO	+	+	+	+	+	+	+	+	+	-	-	-
Chhuri	*Trichiurus muticus*	NO	+	-	+	-	-	-	-	-	-	-	-	-
Sagor Chela	*Megalops cyprinoids*	NO	+	-	-	-	-	-	-	-	-	-	-	-
Purabi Chela	*Thryssa purava*	NO	+	-	-	-	-	-	-	-	-	-	-	-
Kabashi Tengra	*Mystus cavasius*	DD	+	-	-	-	-	-	-	-	-	-	-	-
Gagra Tengra	*Nemapteryx nenga*	DD	-	+	+	-	+	-	+	-	+	+	+	+
Gulsha Tengra	*Mystus bleekery*	DD	+	+	-	+	-	+	+	+	+	+	+	+
Harina Chingri	*Metapenaeus ensis*	DD	+	+	+	+	+	+	+	+	+	-	+	-
Ekthuto	*Hyporhampus limbatus*	NO	+	-	+	+	-	-	-	+	+	-	+	-
Kakila	*Xenentodon cancila*	NO	+	-	-	-	-	-	-	-	-	-	+	-
Chapila	*Gudusia chapra*	NO	+	+	-	-	-	-	-	-	-	+	-	-
Kuchia	*Monopterus cuchia*	DD	+	+	-	+	+	+	+	+	+	+	+	+
Loitta	*Harpodon nehereus*	NO	+	+	+	-	+	-	-	-	+	+	-	-

Local Name	Scientific Name	Local Status*	1st QM	2nd QM	3rd QM	4th QM	5th QM	6th QM	7th QM	8th QM	9th QM	10th QM	11th QM	12th QM
			'-' = No; '+' = Occurrence											
Motka Chingri	*Macrobrachium villosimanusless*	DD	+	+	+	+	+	+	+	+	+	+	+	-
Mud Crab	*Scylla serrata*	NO	+	-	+	+	+	+	+	+	+	-	+	+
Tular Dandi	*Sillaginopsis panijus*	NO	+	-	+	-	+	-	+	-	-	-	+	-
Paira Chanda	*Scatophagus argus*	DD	+	-	-	-	-	-	-	-	-	+	-	-
Paissa	*Liza parsia*	NO	+	+	+	+	+	+	+	+	+	+	+	+
Pangas	*Pangasius pangasius*	CR	+	-	+	-	-	-	-	+	-	-	-	+
Tak Chanda	*Leiognathus equulus*	NO	+	-	-	-	-	-	+	-	-	+	-	-
Phessa	*Setipinna phasa*	NO	+	+	+	+	+	+	+	+	+	-	+	-
Teli Phessa	*Setipinna phasa*	DD	-	-	+	-	-	-	-	-	-	+	-	-
Poma	*Poma poma*	NO	+	+	+	+	+	+	+	+	+	+	+	+
Potka	*Chelonodon patoca*	NO	+	+	-	+	+	+	-	+	+	-	+	+
Shilong	*Silonia silondia*	EN	+	-	+	-	-	-	-	-	-	-	+	-
Tailla	*Eleutheronema tetradactylum*	DD	+	-	-	-	-	-	-	-	-	+	-	-
Tapse	*Polynemus paradiseus*	DD	+	+	+	-	-	+	+	+	-	-	+	+
Daitna	*Acanthopagrus latus*	DD	-	-	-	+	-	-	-	+	+	-	+	+
Shole	*Channa striatus*	DD	-	-	-	+	-	-	-	+	-	-	-	-
Magur	*Clarias batrachus*	DD	-	-	-	+	-	-	-	+	-	-	-	+
Koi	*Anabas testudineus*	DD	-	-	-	+	-	-	-	+	-	+	-	-
Vetki	*Lates calcarifer*	DD	-	-	-	+	+	+	+	+	+	-	+	+

Local Name	Scientific Name	Local Status*	13th QM	14th QM	15th QM	16th QM
		'-' = No; '+' = Occurrence				
Amadi Chela	*Chela sp.*	DD	+	+	+	+
Hilsa	*Tenualosa ilisha*	NO	-	-	-	-
Sagor Baim	*Anguilla bengalensis*	NT	-	-	-	-
Bacha	*Eutropiichthys vacha*	CR	+	-	-	-
Bagda Chingri	*Penaeus monodon*	DD	+	-	+	+
Banspata	*Brachypleura novae-zeelandiae*	NO	+	+	+	+
Kukurjib	*Cynoglossus lingua*	NO	-	-	+	-
Bele	*Glossogobius giuris*	NO	+	+	+	+

Local Name	Scientific Name	Local Status*	13th QM	14th QM	15th QM	16th QM
		'-' = No; '+' = Occurrence				
Aswine Bele	*Butis butis*	NO	+	+	+	+
Bairagi	*Coilia dussumieri*	NO	+	+	+	+
Boishakhi Chingri	*Macrobrachium* sp.	NO	-	-	-	-
Chammu Chingri	*Metapenaeus brevicornis*	DD	-	+	+	+
Chaka Chingri	*Penaeus indicus*	DD	+	-	+	+
Ghora Chela	*Securicula gora*	-	-	-	-	-
Chanda Chela	*Securicula* sp.	-	-	-	+	+
Sada Chewa	*Trepauchen vagina*	NO	-	-	-	+
Lal Chewa	*Taenioides cirratus*	NO	+	+	-	+
Chhuri	*Trichiurus muticus*	NO	-	-	-	+
Sagor Chela	*Megalops cyprinoids*	NO	-	-	-	-
Purabi Chela	*Thryssa purava*	NO	-	-	-	-
Kabashi Tengra	*Mystus cavasius*	DD	-	-	-	-
Gagra Tengra	*Nemapteryx nenga*	DD	+	+	+	+
Gulsha Tengra	*Mystus bleekery*	DD	+	+	+	+
Harina Chingri	*Metapenaeus ensis*	DD	+	+	+	+
Ekthuto	*Hyporhampus limbatus*	NO	+	+	-	-
Kakila	*Xenentodon cancila*	NO	-	+	-	-
Chapila	*Gudusia chapra*	NO	-	-	-	-
Kuchia	*Monopterus cuchia*	DD	+	+	+	+
Loitta	*Harpodon nehereus*	NO	+	-	+	-
Motka Chingri	*Macrobrachium villosimanusless*	DD	+	+	+	+
Mud Crab	*Scylla serrata*	NO	+	+	+	+
Tular Dandi	*Sillaginopsis panijus*	NO	-	+	-	-
Paira Chanda	*Scatophagus argus*	DD	-	-	-	-
Paissa	*Liza parsia*	NO	+	+	+	+
Pangas	*Pangasius pangasius*	CR	-	-	-	-
Tak Chanda	*Leiognathus equulus*	NO	-	-	-	-
Phessa	*Setipinna phasa*	NO	+	+	-	+
Teli Phessa	*Setipinna phasa*	DD	-	-	-	-
Poma	*Poma poma*	NO	+	+	+	+
Potka	*Chelonodon patoca*	NO	+	+	+	+
Shilong	*Silonia silondia*	EN	+	+	-	-
Tailla	*Eleutheronema tetradactylum*	DD	-	-	-	-

Local Name	Scientific Name	Local Status*	13th QM	14th QM	15th QM	16th QM
		'-' = No; '+' = Occurrence				
Tapse	*Polynemus paradiseus*	DD	-	+	+	+
Daitna	*Acanthopagrus latus*	DD	-	+	+	+
Shole	*Channa striatus*	DD	-	+	+	-
Magur	*Clarias batrachus*	DD	-	+	+	-
Koi	*Anabas testudineus*	DD	-	-	-	-
Vetki	*Lates calcarifer*	DD	+	+	+	+

**Local Status Source: IUCN Red List*

Table D.3: Length-wise species distribution (%) in sampling sites

Fish Species	Site	L (< 2cm)	L (2 to 3cm)	L (3 to 5cm)	L (5 to 10cm)	L (10 to 20cm)	L (> 25cm)	Brood Fish
Aswene Bele	Chandpai	5.66	0.00	0.00	94.34	0.00	0.00	0.00
	Charaputia	0.00	0.00	0.00	0.00	100.00	0.00	0.00
Bagda	Chalna Point	100.00	0.00	0.00	0.00	0.00	0.00	0.00
	Chandpai	99.75	0.00	0.00	0.25	0.00	0.00	0.00
	Maidara	100.00	0.00	0.00	0.00	0.00	0.00	0.00
Bairagi	Chandpai	83.40	0.00	0.00	16.60	0.00	0.00	0.00
Banspata	Chandpai	0.00	0.00	0.00	0.00	100.00	0.00	0.00
	Charaputia	0.00	0.00	0.00	0.00	0.00	100.00	0.00
Bata	Chandpai	100.00	0.00	0.00	0.00	0.00	0.00	0.00
	Mongla Point	0.00	0.00	100.00	0.00	0.00	0.00	0.00
Bele	Chalna Point	100.00	0.00	0.00	0.00	0.00	0.00	0.00
	Chandpai	99.22	0.00	0.00	0.39	0.39	0.00	0.00
	Maidara	100.00	0.00	0.00	0.00	0.00	0.00	0.00
Bhangan	Chalna Point	0.00	0.00	100.00	0.00	0.00	0.00	0.00
Chaka Chingri	Chandpai	97.06	0.00	0.00	2.94	0.00	0.00	0.00
	Charaputia	0.00	0.00	100.00	0.00	0.00	0.00	0.00
Chali Chingri	Chandpai	100.00	0.00	0.00	0.00	0.00	0.00	0.00
	Maidara	100.00	0.00	0.00	0.00	0.00	0.00	0.00
	Mongla Point	0.00	57.14	42.86	0.00	0.00	0.00	0.00
Chami Chingri	Chandpai	87.44	12.56	0.00	0.00	0.00	0.00	0.00
	Maidara	0.00	0.00	100.00	0.00	0.00	0.00	0.00
	Mongla Point	0.00	0.00	100.00	0.00	0.00	0.00	0.00
Chanda	Maidara	100.00	0.00	0.00	0.00	0.00	0.00	0.00

Fish Species	Site	L (< 2cm)	L (2 to 3cm)	L (3 to 5cm)	L (5 to 10cm)	L (10 to 20cm)	L (> 25cm)	Brood Fish
Chatabele	Maidara	0.00	0.00	100.00	0.00	0.00	0.00	0.00
Chela	Chalna Point	41.67	25.00	33.33	0.00	0.00	0.00	0.00
	Chandpai	94.14	0.00	5.86	0.00	0.00	0.00	0.00
Chewa	Maidara	100.00	0.00	0.00	0.00	0.00	0.00	0.00
Chitra	Chandpai	99.35	0.00	0.65	0.00	0.00	0.00	0.00
	Charaputia	0.00	100.00	0.00	0.00	0.00	0.00	0.00
	Maidara	100.00	0.00	0.00	0.00	0.00	0.00	0.00
Daitna	Chandpai	0.00	0.00	35.71	35.71	28.57	0.00	0.00
	Mongla Point	0.00	100.00	0.00	0.00	0.00	0.00	0.00
Dogri	Chandpai	0.00	0.00	0.00	100.00	0.00	0.00	0.00
Gang Chela	Maidara	0.00	77.78	22.22	0.00	0.00	0.00	0.00
Goda Katali	Chandpai	98.77	0.00	0.00	1.23	0.00	0.00	0.00
	Charaputia	0.00	0.00	100.00	0.00	0.00	0.00	0.00
Golda	Chalna Point	100.00	0.00	0.00	0.00	0.00	0.00	0.00
	Chandpai	99.09	0.00	0.00	0.91	0.00	0.00	0.00
	Charaputia	0.00	0.00	0.00	0.00	91.49	8.51	0.00
	Maidara	100.00	0.00	0.00	0.00	0.00	0.00	0.00
Gongonia	Charaputia	0.00	0.00	50.00	50.00	0.00	0.00	0.00
Gulsha Tengra	Chandpai	0.00	0.00	0.00	100.00	0.00	0.00	0.00
	Charaputia	0.00	0.00	66.67	33.33	0.00	0.00	0.00
Horina	Chandpai	87.29	0.52	12.19	0.00	0.00	0.00	0.00
	Mongla Point	0.00	0.00	100.00	0.00	0.00	0.00	0.00
Jaba	Akram Point	0.00	0.00	0.00	0.00	0.00	100.00	0.00
	Chandpai	0.00	0.00	0.00	0.00	100.00	0.00	0.00
Kain Magur	Chandpai	0.00	0.00	0.00	0.00	0.00	100.00	0.00
	Maidara	0.00	100.00	0.00	0.00	0.00	0.00	0.00
Khayra	Chalna Point	0.00	0.00	0.00	100.00	0.00	0.00	0.00
Khorsula	Chalna Point	0.00	50.00	0.00	50.00	0.00	0.00	0.00
	Chandpai	100.00	0.00	0.00	0.00	0.00	0.00	0.00
Kuchia	Chalna Point	0.00	0.00	0.00	100.00	0.00	0.00	0.00
	Chandpai	0.00	0.00	0.00	0.00	33.33	66.67	0.00
	Maidara	0.00	0.00	0.00	100.00	0.00	0.00	0.00
Lakkha	Akram Point	0.00	0.00	0.00	0.00	0.00	100.00	0.00
Lal Chewa	Chandpai	55.56	0.00	0.00	44.44	0.00	0.00	0.00
Motka	Chalna Point	0.00	100.00	0.00	0.00	0.00	0.00	0.00

Fish Species	Site	L (< 2cm)	L (2 to 3cm)	L (3 to 5cm)	L (5 to 10cm)	L (10 to 20cm)	L (> 25cm)	Brood Fish
	Chandpai	59.50	25.77	14.73	0.00	0.00	0.00	0.00
Mud Crab	Chandpai	83.33	16.67	0.00	0.00	0.00	0.00	0.00
	Mongla Point	0.00	100.00	0.00	0.00	0.00	0.00	0.00
Mutkura	Chandpai	25.00	0.00	0.00	75.00	0.00	0.00	0.00
	Maidara	0.00	100.00	0.00	0.00	0.00	0.00	0.00
Nola	Maidara	0.00	0.00	100.00	0.00	0.00	0.00	0.00
Nona Bele	Charaputia	0.00	0.00	28.57	71.43	0.00	0.00	0.00
Nona Chingri	Chalna Point	0.00	100.00	0.00	0.00	0.00	0.00	0.00
Paissa	Chandpai	97.71	0.00	0.00	2.29	0.00	0.00	0.00
	Charaputia	0.00	0.00	0.00	0.00	0.00	0.00	100.00
	Maidara	66.67	33.33	0.00	0.00	0.00	0.00	0.00
Pheksa	Chalna Point	0.00	0.00	0.00	0.00	100.00	0.00	0.00
	Chandpai	0.00	0.00	0.00	100.00	0.00	0.00	0.00
	Mongla Point	0.00	0.00	0.00	100.00	0.00	0.00	0.00
Poma	Chandpai	58.82	0.00	0.00	11.76	29.41	0.00	0.00
	Charaputia	0.00	0.00	0.00	25.81	67.74	0.00	6.45
Potka	Maidara	100.00	0.00	0.00	0.00	0.00	0.00	0.00
Rekha	Chalna Point	100.00	0.00	0.00	0.00	0.00	0.00	0.00
	Charaputia	0.00	0.00	100.00	0.00	0.00	0.00	0.00
Tapse	Chandpai	0.00	0.00	0.00	100.00	0.00	0.00	0.00
Tel Dogri	Chandpai	0.00	0.00	0.00	100.00	0.00	0.00	0.00
Tiger Chingri	Chandpai	80.14	0.00	9.55	10.31	0.00	0.00	0.00
	Maidara	67.31	0.00	32.69	0.00	0.00	0.00	0.00
	Mongla Point	0.00	8.89	91.11	0.00	0.00	0.00	0.00
Vat Dogri	Chandpai	0.50	0.00	0.00	99.50	0.00	0.00	0.00
Vetki	Akram Point	0.00	0.00	0.00	0.00	0.00	100.00	0.00
	Chandpai	0.00	0.00	0.00	0.00	100.00	0.00	0.00

Source: CEGIS field survey, 2017

Table D.4 A: Purpose, timing and extent of migration for different year-class of migratory fish species

Migratory Fish Species	Sampling Sites	Year Class*	Migration Purpose											
			1st QM	2nd QM	3rd QM	4th QM	5th QM	6th QM	7th QM	8th QM	9th QM	10th QM	11th QM	12th QM
Tapsi	Haldikhali	Juvenile and Age-1 adult	Feeding and Growing	-	Feeding and Growing	-	-	-		-	-		-	-
	Akram Point	Juvenile and Age-1 adult	Feeding and Growing	-	-	-	-	-	Feeding	-	-		-	-
		Adult	-	-	-	-	-	-	-	Feeding	-		-	-
	Chalna Point	Age-1 adult and Brood fish	Feeding and Growing	Spawning	-	-	-	Feeding	Feeding and Spawning	-	-		Feeding and Growing	-
		Adult	-	-	Feeding and Growing	-	-	Feeding	Feeding	-	-			-
	Harbaria	Juvenile and Age-1 adult	Feeding and Growing	Feeding and Growing		-	-	-	-	-	-		-	Feeding
		Adult and Brood Fish	-	-	Breeding and Spawning	-	-	-	-	-	-		-	-
	Chandpai	Juvenile	-	-	Feeding and Growing	-	-	-	Feeding	-	-		Feeding	-
	Mongla Point	Adult	-	-	-	-	-	-	-	-	-			-
	South-west of the Project	Age-1 adult	Feeding and Growing	Feeding and Growing	Feeding and Growing	-	-	Feeding	-	-	-		-	-
		Brood Fish	-	-	-	-	-	Breeding and Spawning	-	-	-		-	-
Bairagi	Haldikhali	Juvenile and Age-1 adult	Feeding and Growing	-	Feeding and Growing	-	-	-	-	-	-		-	-
	Akram Point	Juvenile and Age-1 adult	Feeding and Growing	-	-	-	Feeding and Growing	-	-	-	-		-	-
		Juvenile and Adult	-	-	-	-	-	-	-	Growing and Feeding	-		-	-
	Chandpai	Fry	Breeding and Spawning	Breeding and Spawning	Feeding and Growing	Feeding	-	Feeding	-	-	-		-	-
		Juvenile	-	-	-	-	-	-	-	-	-		-	-
	Chalna Point	Juvenile and Age-1 adult	Feeding and Growing	-	-	-	Feeding and Growing	-	-	-	-		-	-
		Fry	-	-	-	-	-	-	-	-	-		-	Nursing
	Harbaria	Juvenile	Feeding and Growing	-	-	-	-	Feeding	-	-	-		-	-
	Mongla Point	Fry	-	Nursing	-	Feeding	-	-	-	-	-		-	Nursing
		Juvenile	-	-	-	-	-	-	-	Feeding	-		-	-
	South-west of the Project	Juvenile	-	Feeding and Growing	-	-	-	-	-	-	-		-	-
		Fry	-	-	-	-	-	-	-	-	-		-	Nursing
Chapila	Haldikhali	Juvenile	Feeding and Growing	-	-	-	-	-	-	-	-		-	-
	Akram Point	Juvenile	Feeding and Growing	-	-	-	-	-	-	-	-		-	-
	Mongla Point	Fry	-	Nursing	-	-	-	-	-	-	-		-	-
	South-west of the Project	Age-1 adult	-	Feeding and Growing	-	-	-	-	-	-	-		-	-
Loitta	Haldikhali	Juvenile and Age-1 adult	Feeding and Growing	-	Feeding and Growing	-	-	-	-	-	-		-	-

Migratory Fish Species	Sampling Sites	Year Class*	Migration Purpose											
			1st QM	2nd QM	3rd QM	4th QM	5th QM	6th QM	7th QM	8th QM	9th QM	10th QM	11th QM	12th QM
	Akram Point	Juvenile	Feeding and Growing	-	-	-	Feeding and Growing	-	-	-	-		-	-
	Akram Point	Age-1 adult	-	-	Feeding and Growing	-	Feeding and Growing	-	-	-	-		-	-
	Chandpai	Juvenile	Feeding and Growing	-	-	-	-	-	-	-	-		-	-
	Harbaria	Fry, Juvenile and Age-1 adult	-	Nursing, Feeding and Growing	-	-	-	-	-	-	-		-	-
	Chalna Point	Age-1 adult	-	Feeding and Growing	-	-	Feeding and Growing	-	-	-	-		-	-
		Fry	-	-	-	-	-	-	-	-	Nursing		-	-
Poma	Haldikhali	Juvenile	Feeding and Growing	-	-	Feeding	-	-	-		-		-	-
	Akram Point	Juvenile	Feeding and Growing	-	-	-	-	-	-	Growing and Feeding	-		-	-
		Age-1 adult	-	-	Feeding and Growing	-	-	-	Feeding	Feeding	-		-	-
		Adult	-	-	-	-	-	-			-		-	-
	Chandpai	Fry and Juvenile	Breeding and Spawning	Nursing	-	-	-	Feeding	-	-	-		-	-
		Juvenile	-	-	Feeding and Growing	Feeding	Feeding and Growing	-	Feeding and Growing		-		Feeding and Growing	
		Adult	-	-	-	-	-	-	Feeding		-			
		Brood Fish	-	-	-	-	-	-	-		-		Spawning	-
	Haldikhali	Fry and Juvenile	-	-	Nursing	-	-	-	-	-	-		-	-
	Harbaria	Adult and Brood Fish	-	-	Breeding and Spawning	-	-	-	-	-	-		Feeding and Spawning	-
		Adult	-	-	-	-	-	-	Feeding		-		-	Feeding
		Fry and Juvenile						Spawning and Nursery	-	-	Feeding and Growing		-	-
	Mongla Point	Fry, Juvenile and Age-1 adult	-	-	Spawning, Feeding and Growing	-	-	-	-	Nursing	-		-	Nursing
		Juvenile	-	-	-	-	-	-	Feeding and Growing		-		-	-
		Age-1 Adult	-	-	-	-	-	-	Feeding	Feeding	-		-	-
		Adult	-	-		Feeding	-	Feeding	-	-	-		Feeding	-
		Brood Fish	-	-	-	-	-	-	-	-	-		Spawning	-
	South-west of the Project	Adult	-	-	Feeding	Feeding	-	Feeding	-	-	-		-	-
	Chalna Point	Juvenile, Adult and Brood Fish	Breeding and Spawning	-	-	-	-	-	-	-	-		Feeding, Growing and Spawning	-
		Juvenile and Adult	-	-	Feeding and Growing	Feeding	Feeding and Growing	-	Feeding and Growing	-	-		-	-
		Fry	-	-	-	-	-	-	-	-	Nursery		-	Nursing
Chhuri	Haldikhali	Adult	Feeding	-	Feeding	-	-	-	-	-	-		-	-
	Akram Point		Feeding	-	Feeding	-	-	-	-	-	-		-	-
Chela	Haldikhali	Adult	Feeding	-	Feeding	-	-	-	-	-	-		-	-

Migratory Fish Species	Sampling Sites	Year Class*	Migration Purpose											
			1st QM	2nd QM	3rd QM	4th QM	5th QM	6th QM	7th QM	8th QM	9th QM	10th QM	11th QM	12th QM
	Akram Point	Juvenile and Adult	Feeding and Growing	-	-	-	-	-	-	-	-		-	-
	Harbaria	Fry and Juvenile	-	Feeding and Growing	-	-	-	Nursery	-	-	-		-	-
	Chandpai		-	-	-	-	-	-	-	Growing and Feeding	Nursery		-	-
Gang Tengra	Haldikhali	Adult	Feeding	-	Feeding	Feeding	-	-	-	-	-		-	-
	Akram Point	Adult	Feeding and Breeding	-	-	Feeding	-	-	-	-	-		-	-
	Harbaria	Adult	-	-	Feeding	-	-	-	-	-	-		-	-
	Chandpai	Adult	-	-	Feeding	Feeding	-	-	-	-	-		-	-
Gagra Tengra	Chandpai	Juvenile and Age-1 adult	-	Feeding and Growing	-	-	Feeding and Growing	-	-	-	-		-	-
	Chalna Point	Age-1 adult	-	-	-	-	Feeding and Growing	-	-	-	-		-	-
	Mongla Point	Age-1 adult	-	Feeding and Growing	-	-	-	-	-	-	-		-	-
	Akram Point	Juvenile and Adult	-	-	Feeding and Growing	-	-	-	-	-	-		-	Feeding
		Adult	-	-	-	-	-	-	Feeding	-	-		-	-
	Haldikhali	Juvenile	-	-	-	-	-	-	Feeding and Growing	-	-		-	-
	Harbaria	Adult	-	-	Feeding	-	Feeding and Growing	-	-	-	Feeding		Feeding	
Gulsha Tengra	Haldikhali	Adult	Feeding and Breeding	-	-	-	-	-	-	-	-		-	-
	Akram Point	Adult		-	-	-	-	-	-	-	-		-	-
	Chandpai	Age-1 adult		-	-	Feeding	-	Feeding	Feeding and Growing	-	-		-	Feeding
		Juvenile		-	-	-	-	-	Feeding and Growing		-		Feeding and Growing	-
	Mongla Point	Age-1 adult		-	Feeding and Growing	-	Feeding and Growing	-	Feeding and Growing		-	Feeding and Growing		-	-
		Juvenile		-	-	-	-	-	-	Feeding and Growing		-		Feeding and Growing	-
	Harbaria	Juvenile		-	-	-	-	-	-	Feeding and Growing		-			-
		Age-1 adult		-	-	-	-	-	-	-	Feeding and Growing		-	-
	Maidara	Juvenile and Age-1 Adult		-	-	-	-	-	Feeding and Growing	-			-	-
	Chalna Point	Juvenile		-	-	-	-	-	-	-	-		Feeding and Growing	-
Potka	Haldikhali	Adult	Feeding and Breeding	-	-	-	-	-	-	-	-		-	-
	Chandpai	Fry	Spawning	Spawning and Nursing	-	-	-	-	-	-	-		-	-
		Juvenile	-	-	-	-	-	-	-	Feeding and Growing	-		-	Feeding
		Adult	-	-	-	Feeding	-	-	-	-	-		Feeding	-

Migratory Fish Species	Sampling Sites	Year Class*	Migration Purpose											
			1st QM	2nd QM	3rd QM	4th QM	5th QM	6th QM	7th QM	8th QM	9th QM	10th QM	11th QM	12th QM
	Mongla Point	Fry	Spawning	-	-	-	-	-	-	-	-		-	-
		Juvenile	-	-	-	-	-	-	-	-	Feeding and Growing		-	-
	Harbaria	Fry	-	-	-	-	-	Nursery	-	-	-		-	-
		Juvenile	-	-	-	-	-	-	-	Feeding and Growing	-		-	-
Paira Chanda	Akram Point	Adult	Feeding	-	-	-	-	-	-	-	-		-	-
	Chandpai	Fry	Breeding and Spawning	-	-	-	-	-	-	-	-		-	-
Chewa	Akram Point	Juvenile and Adult	Feeding	-	Feeding and Growing	-	-	-	-	-			-	-
	Chandpai	Fry and Juvenile	Spawning	-	Feeding and Growing	-	Nursing and Grazing	Nursery	Feeding and Growing	-	Nursing		-	-
		Adult	-	-	-	Feeding	-	Feeding	-	Feeding	-		-	-
	Haldikhali	Juvenile and Adult	-	-	Feeding and Growing	-	-	-	-	-	-		-	-
	Harbaria	Juvenile and Adult	-	-	Feeding and Growing	-	-	Feeding and Nursery	-	Feeding	-		-	-
	Mongla Point	Juvenile	-	Feeding and Growing	-	-	-	-	-	-	-		-	-
	South-west of the Project	Juvenile	-	Feeding and Growing	-	-	-	-	-	-	-		-	-
	Chalna Point	Adult	-	-	-	-	Feeding	-	-	-	-		-	-
		Age-1 Juvenile	-	-	-	-	-	-	-	-	Feeding and Growing		-	-
Bele	Akram Point	Adult	Feeding	-	Feeding	Feeding	-	-	-	-	-		-	-
		Juvenile	-	-	-	-	-	-	-	Feeding and Growing	-		-	-
	Haldikhali	Juvenile-1, Juvenile and Adult	-	-	Nursing and Growing	Feeding	-	-	-	-	-		-	-
	Harbaria	Juvenile and Adult	-	-	Feeding and Growing	-	Feeding and Growing	Nursery and Feediing	Feeding and Growing	-	-		-	-
	Chandpai	Fry	Breeding and Spawning	Nursing	-	-	Nursing	Nursery	-	-	Nursery		-	-
	Chandpai	Juvenile and Adult	-	-	Feeding and Growing	Feeding	-	Feeding	-	Feeding	-		Feeding and Growing	
	Harbaria	Juvenile and Age-1 Adult	-	-	-	-	-	-	Feeding and Growing				-	-
	Mongla Point	Fry	Breeding and Spawning	-	-	-	-	Nursery	-	-	-		-	-
	Mongla Point	Fry, Juvenile-1 and Juvenile			Nursing and Growing	-	-	-	-	-	-		-	-
	Mongla Point	Juvenile and Adult	-	-	-	Feeding	Feeding and Growing	Feeding	Feeding and Growing	-	-		-	-
	Chalna Point	Fry	Breeding and Spawning	Nursing	-	-	Nursing	-	-	Nursing	-		-	-
	Chalna Point	Adult	-	-	-	Feeding	-	-	-	-	-		-	-
	Maidara	Juvenile and Age-1 adult	-	Feeding and Growing	Feeding and Growing	Feeding	Feeding and Growing	-	-	-	Feeding and Growing		-	-

Migratory Fish Species	Sampling Sites	Year Class*	Migration Purpose											
			1st QM	2nd QM	3rd QM	4th QM	5th QM	6th QM	7th QM	8th QM	9th QM	10th QM	11th QM	12th QM
		Fry	-	-	-	-	-	-	-	Nursing	-		-	Nursing
Tular Dandi (Nona bele)	Akram Point	Adult	Feeding	-	-	-	-	-	-	-	-		-	-
	South-west of the Project	Adult	-	-	Feeding	-	-	-	-	-	-		Feeding	-
	Chalna Point	Adult	Feeding	-	Feeding	-	Feeding	-	Feeding	-	-		-	-
Tairel	Akram Point	Adult	Feeding	-	-	-	-	-	-	Feeding	-		-	-
	Harbaria	Age-1 Adult	-	-	-	-	-	-	-	-	Feeding and Growing		-	-
	Mongla Point	Juvenile	Feeding	-	-	-	-	-	-	-	-		-	-
Phekssa	Akram Point	Adult	Feeding	-	-	-	-	-	-	Feeding	-		-	-
		Juvenile	-	-	Feeding and Growing	-	-	-	-	-	-		-	-
	Haldikhali	Juvenile	-	-	Feeding and Growing	-	-	-	-	-	-		-	-
	Haldikhali	Adult	-	-	-	Feeding	-	-	-	-	-		-	-
	Harbaria	Juvenile	-	-	-	-	-	-	-	-	Feeding and Growing		-	-
	Chalna Point	Juvenile and Adult	Feeding	Feeding and Growing	-	-	-	-	Feeding and Growing	-			-	-
		Adult	-	-	Feeding	Feeding	Feeding	-	Feeding	-	-		-	-
	Mongla Point	Adult	-	-	Feeding	Feeding	-	-	Feeding and Growing	-	-		Feeding	-
	Chandpai	Juvenile and Adult	Feeding	Feeding and Growing	-	-	Feeding and Growing	-		-	-		-	-
	Maidara	Juvenile and Adult	Feeding	Feeding and Growing	-	-	-	-	-	-	-		-	-
		Juvenile	-	-	-	-	-	-	Feeding and Growing	-	-		-	-
		Adult	-	-	Feeding	Feeding	-	Feeding	-	-	-		-	-
Paissa	Akram Point	Juvenile and Adult	Feeding	-	Feeding and Growing	Feeding	-	-	-	Feeding and Growing	-		-	Feeding
		Brood	-	-	-	-	-	-	-	-	-		-	Spawning
		Juvenile	-	-	-	-	-	-	Feeding and Growing			-	-	-
	Haldikhali	Juvenile and Adult	Feeding	-	Feeding and Growing	Feeding	-	-	-	-	-		-	-
		Juvenile	-	-	-	-	-	-	Feeding and Growing	-	-		-	-
	Harbaria	Juvenile-1 and Juvenile	-	-	Feeding	-	Feeding and Growing	-	Feeding and Growing	-	-		-	-
		Adult	-	-	-	-	-	-	-	Feeding	-		-	-
	Chandpai	Fry	Breeding and Spawning	-	-	-	Nursing	-	-	-	Nursery		-	-
	Chandpai	Juvenile and Adult	-	-	Feeding and Growing	-	-	Nursery and Feeding	-	-	-		Feeding and Growing	Feeding
	Harbaria	Juvenile	-	-	-	-	-	-	Feeding and Growing	-	-			-
	Mongla Point	Fry	Breeding and Spawning	-	-	-	-	Nursery	-	-	Nursery		-	-
		Age-1 Juvenile	-	-	-	-	-	-	-Nursing, Feeding and Growing	-	Feeding and Growing		-	-

Migratory Fish Species	Sampling Sites	Year Class*	Migration Purpose											
			1st QM	2nd QM	3rd QM	4th QM	5th QM	6th QM	7th QM	8th QM	9th QM	10th QM	11th QM	12th QM
		Age-1 Adult	-	-	-	-	Feeding and Growing	Feeding	-	-			-	-
	Maidara	Fry, Juvenile and Age-1 adult	Breeding and Spawning	Feeding and Growing	-	-	Feeding and Growing	-	-	-			-	-
		Age-1 Juvenile, Juvenile and Age-1 Adult	-	-	-	-	-	-	Nursing, Feeding and Growing	-	-		Feeding and Growing	-
		Adult	-	-	-	-	-	Feeding	-	-	-		-	
Banshpata	Chandpai	Juvenile	Feeding	-	-	-	-	-	-	-	-		-	
		Adult	-	-	-	Feeding	-	Feeding	-	-	-		-	
	Akram Point	Juvenile	-	-	-	-	-	-	Feeding and Growing	-	-		-	
		Adult	-	-	-	-	-	-	-	Feeding	-		-	
	Haldikhali	Juvnile and adult	-	-	Feeding and Growing	Feeding	-	-	Feeding and Growing	-	-		-	
	Harbaria	Adult	-	-	-	-	-	-	-	Feeding	Feeding		Feeding	
	Mongla Point	Fry and Adult	Feeding	Nursing	-	-	-	-	-	-	-		-	
		Adult	-	-	-	Feeding	-	-	-	-	Feeding		-	
	Maidara	Adult	-	-	Feeding	Feeding	-	Breeding and Spawning	-	-	-		-	
	Chalna Point	Adult	-	-	Feeding	Feeding	-	-	-	-	-		-	
Hilsa	Akram Point	Brood Fish	-	-	-	-	-	-	-	-	-		Breeding and Spawning	
	Haldikhali	Brood Fish	-	-	-	-	-	-	-	-	-			
		Juvenile	-	-	Feeding and Growing	-	-	-	-	-	-		-	
	Harbaria	Brood Fish	-	-	-	-	-	-	-	-	-		Breeding and Spawning	
	Chandpai	Adult and Brood Fish	-	-	-	-	-	-	Feeding and Breeding	-	-		-	
	Mongla Point	Adult	-	-	Feeding	-	-	-	-	-	-		-	
		Brood Fish	-	-	-	-	-	-	-	-	-		Breeding and Spawning	
	Maidara	Age-1 Adult	-	-	-	-	-	-	-	-	-		Feeding	
	Chalna Point	Brood fish	-	-	-	-	-	Breeding and Spawning	-	-	-		-	
Pangas	Haldikhali	Juvenile	-	-	Feeding and Growing	-	-	-	-	-	-		-	
	Harbaria	Adult	-	-	-	-	-	-	-	Feeding	-		-	
	Mongla Point	Juvenile and Adult	-	-	Feeding	-	-	-	-	-	-		-	

Table D.4 B: Purpose, timing and extent of migration for different year-class of migratory fish species

Migratory Fish Species	Sampling Sites	Year Class*	Migration Purpose			
			13th QM	14th QM	15th QM	16th QM
Tapsi	Haldikhali	Juvenile and Age-1 adult	-	-	Grazing	-
	Akram Point	Juvenile and Age-1 adult	-	-	-	-
		Adult	-	-	-	-
	Chalna Point	Age-1 adult and Brood fish	-	-	-	-
		Adult	-	Feeding	-	-
	Harbaria	Juvenile and Age-1 adult	Feeding	-	-	-
		Adult and Brood Fish	-	-	-	-
	Chandpai	Juvenile	-	Feeding and Growing	-	Feeding and Growing
	Mongla Point	Adult	-	-	-	-
		Fry	-	-	Nursing	-
	Maidara	Age-1 adult	-	-	-	-
		Brood Fish	-	-	-	-
Bairagi	Haldikhali	Juvenile and Age-1 adult	-	-	-	-
	Akram Point	Juvenile and Age-1 adult	-	-	-	-
		Juvenile and Adult	-	-	-	-
	Chandpai	Fry	-	Nursing	-	Nursing
		Juvenile	-	Feeding and Growing	Feeding and Growing	Feeding and Growing
	Chalna Point	Juvenile and Age-1 adult	-	-	-	-
		Fry	Nursing	-	-	-
	Harbaria	Juvenile	-	-	Feeding and Growing	-
	Mongla Point	Fry	Nursing	-	Nursing	-
		Juvenile	-	-	-	-
	South-west of the Project	Juvenile	-	-	-	-
		Fry	Nursing	-	Nursing	-
Chapila	Haldikhali	Juvenile	-	-	-	-
	Akram Point	Juvenile	-	-	-	-
	Mongla Point	Fry	-	-	-	-
	South-west of the Project	Age-1 adult	-	-	-	-
Loitta	Haldikhali	Juvenile and Age-1 adult	-	-	-	-
	Akram Point	Juvenile	-	-	-	-
	Akram Point	Age-1 adult	-	-	-	-
	Chandpai	Juvenile	-	-	-	-
	Harbaria	Fry, Juvenile and Age-1 adult	-	-	-	-
	Mongla Point	Fry	-	-	Nursing	-
	Chalna Point	Age-1 adult	-	-	-	-
		Fry	-	-	-	-
Poma	Haldikhali	Juvenile	-	-	-	-
	Akram Point	Juvenile	-	-	-	-
		Age-1 adult	-	-	-	-
		Adult	-	-	-	-
	Charaputia	Brood Fish	-	-	-	Spawning
		Juvenile and Adult	-	-	-	Feeding
	Chandpai	Fry and Juvenile	-	-	-	Nursing
		Juvenile	Feeding and Growing	-	-	Feeding and Growing
		Adult		Feeding	Feeding	Feeding
		Brood Fish	-	-	-	-
	Haldikhali	Fry and Juvenile	-	-	-	-
	Harbaria	Adult and Brood Fish	-	-	-	-
		Adult	Feeding	-	-	-
		Fry and Juvenile	-	-	-	-
	Mongla Point	Fry, Juvenile and Age-1 adult	Nursing	-	-	-

Migratory Fish Species	Sampling Sites	Year Class*	Migration Purpose			
			13th QM	14th QM	15th QM	16th QM
		Fry	-	Nursing	-	-
		Juvenile	-	-	-	-
		Age-1 Adult	-	-	-	-
		Adult	-	-	-	-
		Brood Fish	-	-	-	-
	South-west of the Project	Adult	-	Feeding	-	-
	Chalna Point	Juvenile, Adult and Brood Fish	-	-	-	-
		Juvenile and Adult	-	Feeding and Growing	-	-
		Fry	Nursing	-	-	-
Chhuri	Haldikhali	Adult	-	-	-	-
	Akram Point		-	-	-	-
Chela	Haldikhali	Adult	-	-	-	-
	Akram Point	Juvenile and Adult	-	-	-	-
	Harbaria	Fry and Juvenile	-	-	-	-
	Chalna Point		-	-	-	Nursing and Feeding
	Chandpai		-	-	Feeding and Growing	
	Mongla Point		-	Nursing	-	-
Gang Tengra	Haldikhali	Adult	-	-	-	-
	Akram Point	Adult	-	-	-	-
	Harbaria	Adult	-	-	-	-
	Chandpai	Adult	-	-	-	-
Ghagra Tengra	Chandpai	Juvenile and Age-1 adult	-	-	-	-
		Brood Fish	-	-	Breeding	-
	Chalna Point	Age-1 adult	-	-	-	-
	Mongla Point	Age-1 adult	-	-	-	-
	Akram Point	Juvenile and Adult	Feeding	-	-	-
		Adult	-	-	-	-
	Haldikhali	Juvenile	-	-	-	-
	Harbaria	Adult	Feeding		Breeding	-
Gulsha Tengra	Haldikhali	Adult	-	-	-	-
	Akram Point	Adult	-	-	-	-
	Chandpai	Age-1 adult	Feeding	-	Feeding and Growing	-
		Juvenile	-	Feeding and Growing	-	Feeding and Growing
	Charaputia		-	-	-	
	Mongla Point	Age-1 adult	-	-	-	-
		Juvenile	-	-	-	-
	Harbaria	Juvenile	-	-	-	-
		Age-1 adult	-	-	-	-
	Maidara	Juvenile and Age-1 Adult	-	-	-	-
	Chalna Point	Juvenile	-	-	-	-
Potka	Haldikhali	Adult	-	-	-	-
	Chandpai	Fry	-	-	-	-
		Juvenile	Feeding	-	-	-
		Adult	-	Feeding and Growing	Feeding	-
	Mongla Point	Fry	-	-	-	-
		Juvenile	-	-	-	-
	Maidara	Fry	-	-	-	Nursing
	Harbaria	Fry	-	-	-	-
		Juvenile	-	-	-	-
Paira Chanda	Akram Point	Adult	-	-	-	-
	Chandpai	Fry	-	-	-	-
Chewa	Akram Point	Juvenile and Adult	-	-	-	-

Migratory Fish Species	Sampling Sites	Year Class*	Migration Purpose			
			13th QM	14th QM	15th QM	16th QM
	Chandpai	Fry and Juvenile	-	-	-	-
		Juvenile	-	Feeding and Growing	-	-
		Adult	-	-	-	-
	Haldikhali	Juvenile and Adult	-	-	-	-
	Harbaria	Juvenile and Adult	-	-	-	-
	Mongla Point	Juvenile	-	-	-	-
	Maidara	Juvenile	-	-	-	-
		Fry	-	-	Nursing	
	Chalna Point	Adult	-	-	-	-
		Age-1 Juvenile	-	-	-	-
Bele	Akram Point	Adult	-	-	-	-
		Juvenile	-	-	-	-
	Haldikhali	Juvenile-1, Juvenile and Adult	-	-	-	-
	Harbaria	Juvenile and Adult	-	-	-	-
	Chandpai	Fry	-	-	-	Nursing
	Chandpai	Juvenile and Adult	Feeding and Growing	-	Feeding and Growing	
	Harbaria	Juvenile and Age-1 Adult	-	-	-	-
	Mongla Point	Fry	-	Nursing	-	-
	Mongla Point	Fry, Juvenile-1 and Juvenile	-	-	-	-
	Mongla Point	Juvenile and Adult	-	-	-	-
	Chalna Point	Fry	-	-	Nursing	
	Chalna Point	Adult	-	-	-	-
	Maidara	Juvenile and Age-1 adult	-	-	Feeding and Growing	-
		Fry	Nursing	-	Nursing	
Tular Dandi (Nona bele)	Akram Point	Adult	-	-	-	-
	Chandpai	Age-1 Adult	-	-	Feeding	-
	South-west of the Project	Adult	-	Feeding	-	-
	Chalna Point	Adult	-	-	-	-
Tairel	Akram Point	Adult	-	-	-	Feeding
	Harbaria	Age-1 Adult	-	Feeding and Growing	-	-
	Mongla Point	Juvenile	-	-	-	-
Phekssa	Akram Point	Adult	-	-	-	-
		Juvenile	-	-	-	-
	Haldikhali	Juvenile	-	-	-	-
	Haldikhali	Adult	-	-	-	-
	Harbaria	Juvenile	-	-	-	-
	Chalna Point	Juvenile and Adult	-	-	-	Feeding and Growing
		Adult	-	Feeding	-	-
	Mongla Point	Adult	-	-	-	-
		Juvenile	-	-	-	Growing
	Chandpai	Juvenile and Adult	-	-	-	Feeding and Growing
	Maidara	Juvenile and Adult	-	-	-	-
		Juvenile	-	-	-	-
		Adult	-	Feeding	-	-
Paissa	Akram Point	Juvenile and Adult	Feeding	-	-	-
		Brood	Spawning	-	-	-
		Juvenile	-	-	-	-
	Haldikhali	Juvenile and Adult	-	-	-	-
		Juvenile	-	-	-	-
	Charaputia	Brood Fish	-	--	-	Spawning
	Harbaria	Juvenile-1 and Juvenile	-	Feeding and Growing	-	-
		Adult	-	Feeding	-	-
	Chandpai	Fry	-	-	-	Nursing

Migratory Fish Species	Sampling Sites	Year Class*	Migration Purpose			
			13th QM	14th QM	15th QM	16th QM
	Chandpai	Juvenile and Adult	Feeding	Feeding and Growing	-	Feeding and Growing
	Harbaria	Juvenile	-	-	Feeding and Growing	-
	Mongla Point	Fry	-	-	Nursing	-
		Age-1 Juvenile	-	-	-	-
		Age-1 Adult	-	-	-	-
	Maidara	Fry, Juvenile and Age-1 adult	-	-	-	-
		Age-1 Juvenile, Juvenile and Age-1 Adult	-	-	-	-
		Adult	-	-	-	-
Banshpata	Chandpai	Juvenile	-	-	-	Growing
		Adult	-	Feeding	Feeding	-
	Charaputia	-	-	-	-	Feeding
	Akram Point	Juvenile	-	-	-	-
		Adult	-	-	-	-
	Haldikhali	Juvnile and adult	-	-	-	-
	Harbaria	Adult	-	-	-	-
	Mongla Point	Fry and Adult	-	-	-	-
		Adult	-	-	-	-
	Maidara	Adult	-	Feeding	-	-
	Chalna Point	Adult	-	-	-	-
Hilsa	Akram Point	Brood Fish	-	-	-	-
	Haldikhali	Brood Fish	-	-	-	-
		Juvenile	-	-	-	-
	Harbaria	Brood Fish	-	-	-	-
	Chandpai	Adult and Brood Fish	-	-	-	-
	Mongla Point	Adult	-	-	-	-
		Brood Fish	-	-	-	-
	Maidara	Age-1 Adult	-	-	-	-
	Chalna Point	Brood fish	-	-	-	-
Pangas	Haldikhali	Juvenile	-	-	-	-
	Harbaria	Adult	-	-	-	-
	Mongla Point	Juvenile and Adult	-	-	-	-

Source: Field findings at different times

**Only Age-1 to Brood fish was allowed to interpret the migration purpose; F = Feeding; Sp = Spawning; (-) = Not Found*

Table D.5: The Present Catch in Three Sampling Ghers

Sampling Site	Total Catch (kg): 2014-2015							
	1st QM (April, 2014)		2nd QM (July, 2014)		3rd QM		4th QM	
	Species	ton	Species	ton	Species	ton	Species	ton
1	Bagda	5	Bagda	6.42	Bagda	4.8	-	-
	Vetki	1.57	Bele	0	Gusha Chingri	-	-	-
	Bele	0.98	Cheng	0	Harina Chingri	-	-	-
	Harina Chingri	0.78	Bhangan	0	Rui (kg)	-	-	-
	Chali Chingri	0.11	Chali Chingri	0	Catla (kg)	-	-	-
	Chaka Chingri	0.08	-	-	-	-	-	-
Sub-total =		**8.52**		**6.42**		**4.8**	**-**	**-**
2	Bagda	4	Bagda	1	Bagda	7	-	-
	Harina Chingri	2	Harina Chingri	0.33	Vetki	1	-	-
	Chali Chingri	0.18	Chali Chingri	0.08	Paissa	10	-	-
	-	-	Golda Chingri	0.01	Phessa	2.4	-	-
	-	-	Bele	0.08	Bhangan	1.7	-	-
	-	-	Tengra&Paissa	0.04	Golda Chingri	0.9	-	-
	-	-	-		Gulsha Tengra	0.2	-	-
Sub-total =		**6.00**		**2.00**		**23**		**-**
3	Bagda	1.38	Bagda	2.4	Bagda	1.5	-	-
	Harina Chingri	0.34	Harina Chingri	0.34	Paissa	10	-	-
	Chali Chingri	0.17	Chali Chingri	0.17	Tengra	10	-	-
	-	-	-	-	Bele	20	-	-
	-	-	-	-	Tilapia	22	-	-
	-	-	-	-	Rui	28	-	-
	-	-	-	-	Vetki	-	-	-
	-	-	-	-	Harina Chingri	-	-	-
	-	-	-	-	Chami Chingri	-	-	-
	-	-	-	-	Catla	56	-	-
	-	-	-	-	Mrigel	50	-	-
Sub-total =		**1.89**		**2.91**		**197.5**	**-**	**-**
Grand-total =		**17.00**		**11.33**		**226.5**	**-**	**-**

Sampling Site	Total Catch (kg): 2015-2016							
	5th QM		6th QM		7th QM		8th QM	
	Species	ton	Species	ton	Species	ton	Species	ton
1	Bagda	-	Bagda	1.6	Bagda	2	Catla	2
	Horina Chingri	1	Horina Chingri	1	Horina Chingri	3.2	Glass Carp	0.1
	Tengra	-	Chali Chingri	0.5	Gusha Chingri	0.8	Horina Chingri	0.8
	Paissa	-	Paissa	0.25	Paissa	24	Minar Carp	0.1
	Chela	-	Bele	0.25	Vetki	0.2	Nilotica	1.6
	Vetki	-	-	-	Kailla	0.4	Paissa	0.6
	-	-	-	-	Bele	0	Rui	3
	-	-	-	-	Tilapia	0	Vetki	0.8
	-	-	-	-	Catla	0	-	0
	-	-	-	-	Minar Carp	0	-	0
	-	-	-	-	Glass Carp	0	-	0
	-	-	-	-	Kakra	0.4	-	0
Sub-total=	**-**	**1**	**-**	**3.06**	**-**	**31**	**-**	**9**
2	Bagda	-	Bagda	1.67	Bagda	0	-	0
	-	-	Chali Chingri	0.30	Horina Chingri	0	-	0
	-	-	Horina Chingri	0.50	Chali Chingri	0	-	0
	-	-	Bele	0.30	Tilapia	0	-	0
	-	-	Paissa	0.25	Vetki	0	-	0
	-	-	-	-	Tengra	0	-	0
	-	-	-	-	Paissa	0	-	0
Sub-total=	**-**	**0**	**-**	**3.02**	**-**	**0**	**-**	**0**
3	Bagda	-	Bagda	3.5	Bagda	0.4	-	0
	-	-	-	-	Paissa	3.2	-	0
	-	-	-	-	Vetki	0.4	-	0
	-	-	-	-	Tilapia	0.06	-	0
	-	-	-	-	Horina Chingri	0.35	-	0
	-	-	-	-	Chali Chingri	0.6	-	0
	-	-	-	-	Chaka Chingri	0.1	-	0
	-	-	-	-	Tengra	0	-	0
	-	-	-	-	Bele	0	-	0
	-	-	-	-	Tairel	0.06	-	0
	-	-	-	-	Bhangan	0	-	0
Sub-total =	**-**	**-**	**-**	**-**	**-**	**5.17**	**-**	**0**
Grand-total =	**-**	**1**		**3.5**		**36.17**	**-**	**9**

Sampling Site	Total Catch (kg): 2016-2017							
	9th QM		10th QM		11th QM		12th QM	
	Species	ton	Species	ton	Species	ton	Species	ton
1	-	0	-	-	Bagda	3	-	0
	-	0	-	-	Tengra	0.1	-	0
	-	0	-	-	Horina Chingri	0.8	-	0
	-	0	-	-	Paissa	0.1	-	0
	-	0	-	-	Vetki	2	-	0
	-	0	-	-	-	0	-	0
	-	0	-	-	-	0	-	0
	-	0	-	-	-	0	-	0
	-	0	-	-	-	0	-	0
	-	0	-	-	-	0	-	0
	-	0	-	-	-	0	-	0
	-	0	-	-	-	0	-	0
Sub-total =	**-**	**0**	-	-	**-**	**6**	**-**	**0**
2	Bagda	1	-	-	Bagda	2	Bagda	0.0035
	Horina	0.14	-	-	Bele	1.6	Horina Chingri	0.288
	-	0	-	-	Chali Chingri	4	Paissa	0.22
	-	0	-	-	Horina Chingri	8	Tengra	0.305
	-	0	-	-	Paissa	0.28	Chela	0.45
	-	0	-	-	Tengra	0.8	Tilapia	0.53
	-	0	-	-	Tilapia	8	Vetki	0.06
	-	-	-	-	Vetki	2.4	Bele	0.15
Sub-total =		**1.14**	-	-	**-**	**9**	**-**	**0**
3	Bagda	2	-	-	Bagda	0.4	-	0
	-	0	-	-	Horina Chingri	0.35	-	0
	-	0	-	-	Paissa	0.06	-	0
	-	0	-	-	Tengra	0.4	-	0
	-	0	-	-	Tilapia	3.2	-	0
Sub-total =	**-**	**2**	**-**		**-**	**4**	**-**	**2.01**
Grand-total =	**-**	**3.14**	**-**		**-**	**19**	**-**	**2.01**

Sampling Site	Total Catch (kg): 2017-2018 and 2018-19							
	13th QM		14th QM		15th QM		16th QM	
	Species	ton	Species	ton	Species	ton	Species	ton
1	Bagda	0	Bagda	3	-	-	Bagda	2.00
	Horina Chingri	1	Rui (kg)	1.3	-	-	Golda	0.10
	Tengra	0	Catla (kg)	1	-	-	Rui	0.12
	Paissa	0	-	-	-	-	Grass Carp	0.20
	Chela	0	-	-	-	-	Catla	0.30
	Vetki	0	-	-	-	-	Tilapia	0.45
							Horina	0.10
							Gusha	0.00
							Paissa	0.00
							Khorulla	0.00
							Vetki	0.00
							Gulsha	0.00
							Bele	0.00
Sub-total =	**-**	**1**	**-**	**3.6**	-	-	=	**3.27**
2	Bagda	0	Bagda	5	-	-	Bagda	**3.93**
	-	-	Vetki	0.5	-	-	Golda	**0.13**
	-	-	Paissa	7	-	-	Rui	**8.41**
	-	-	Phessa	1	-	-	Tilapia	**5.90**
	-	-	Bhangan	0.7	-	-	Nilotica	**0.00**
							Khorulla	**0.00**
							Mrigel	**0.00**
							Catla	**0.00**
							Grass Carp	**0.11**
							Common Carp	**5.55**
							Sarpunti	**0.53**
							Horina	**1.91**
							Chali Chingri	**1.16**
							Bele	**0.43**
							Vetki	**1.96**

Sampling Site	Total Catch (kg): 2017-2018 and 2018-19							
	13th QM		14th QM		15th QM		16th QM	
	Species	ton	Species	ton	Species	ton	Species	ton
							Tengra	**4.20**
							Paissa	**0.14**
							Tairel	**0.003**
							Pheksa	**0.001**
Sub-total =		**0**		**14.2**	-	-	=	**34.38**
3	Bagda	0	Bagda	2	-	-	Bagda	**0.50**
	-	-	Paissa	8	-	-	Tilapia	**1.50**
	-	-	Tengra	2	-	-	Tengra	**0.12**
	-	-	Tilapia	5	-	-	Paissa	**0.00**
	-	-	Rui	3	-	-	Horina Chingri	**0.60**
	-	-	Vetki	2	-	-		
	-	-	Catla	10	-	-		
Sub-total =	**-**	**0**	**-**	**32**	-	-		
Grand-total =	**-**	**1**	**-**	**49.8**	-	-	**=**	**2.72**

Source: CEGIS Field Survey, 2014-2015; (-) = Not Found

(E) Land Resource Monitoring Data

Table E.0: Detailed Information of the Selected Monitoring Plot

Site No.	Monitoring indicators	Location	GPS(Decimal Degree)		Sampling Frequency	Methods/Tools/Techniques
			Easting	Northing		
1	Plot use, Soil fertility and Nutrient, Chemical Properties of Soil (pH, Pb, CdCrop production, and damage	Mauza: Baranpara, Union: Gangarampur Upazila: Batiaghata, District: Khulna	E-89°30′59.1″	N-22°37′57.0″	Bi-yearly (April and October)	In situ field sampling and Laboratory Testing in SRDI
2		Mauza:Chunkuri-2,Union:Bajua Upazila: Dacope, District :Khulna	E-89°32′20.0″	N-22°34′51.0″		
3		Mauza: Kapalirmet/Buridmial Union: Burirdanga, Upazila: Mongla District: Bagerhat	E-89°36′8.8″	N-22°32′18.9″		
4		Mauza: Chakgona, Union: Rajnagar	E-89°34′25.3″	N-22°34′18.3″		

Site No.	Monitoring indicators	Location	GPS(Decimal Degree)		Sampling Frequency	Methods/Tools/Techniques
			Easting	Northing		
		Upazila: Rampal, District: Bagerhat				
5		Mauza: Basherhula, Union: Rajnagar Upazila: Rampal, District: Bagerhat	E-89°34′25.0″	N-22°36′14.0″		
6		Mauza: Barni, Union: Gauramba, Upazila:Rampal,District: Bagerhat	E-89°34′40.0″	N-22°38′53.44″		

Source: Field survey; 2017

Table E.1: Chemical Properties of Soil on Monitoring Plots

Sl. No.	Location	Parameter	2013-2014				2014-2015				2015-2016				2016-17			
			Dry season (April)	Remarks	Wet season (October)	Remarks	Dry season (April)	Remarks	Wet season (October)	Remarks	Dry season (March)	Remarks	Wet season (October)	Remarks	Dry season	Remarks	Wet season (October)	Remarks
1	Baranpara	**Top soil (0-15cm)**																
		EC(ds/m)	9.1	Moderately saline	1.8	Non saline	10.01	Moderately saline	2.54	Very slightly saline	2.46	Very slightly saline	3.25	Very slightly saline	5.09	Slightly saline	1.00	Non saline
		pH	4.2	Very strongly acid	6.7	Neutral	7.6	Slightly alkaline	6.9	Neutral	7.0	Neutral	7.4	Slightly alkaline	6.4	Slightly acid	6.74	Neutral
		OM (%)	3.1	Medium	2.5	Medium	0.93	Very low	1.27	Low	1.35	Low	1.28	Low	1.30	Low	1.64	Low
		N (%)	0.16	Low	0.12	Low	0.05	Very low	0.06	Very low	0.08	Very low	0.06	Very low	0.07	Very low	0.08	Very low
		K (meq/100g)	1.00	Very high	0.59	Very high	1.61	Very high	0.57	Very high	0.69	Very high	0.61	Very high	0.65	Very high	0.64	Very high
		Ca (meq/100g)	11.3	Very high	14.3	Very high	31.50	Very high	14.75	Very high	15.12	Very high	14.68	Very high	15.29	Very high	14.56	Very high
		Mg (meq/100g)	10.7	Very high	8.6	Very high	6.00	Very high	2.06	Very high	2.58	Very high	1.92	Very high	2.24	Very high	1.95	Very high
		Na(meq/100g)	5.50	*	2.7	*	10.01	*	4.76	*	4.43	*	5.07	*	5.76	*	5.15	*
		P(µg/gm)	2.7	Very low	14.3	Medium	8.19	Low	4.60	Very low	5.33	Low	4.82	Very low	5.25	Very low	5.22	Very low
		S(µg/gm)	523.2	Very high	41.4	Very high	354.40	Very high	210.0	Very high	212.18	Very high	226.43	Very high	216.42	Very high	238.12	Very high
		B(µg/gm)	0.45	Medium	0.55	Very high	2.37	Very high	2.11	Very high	2.05	Very high	1.98	Very high	1.92	Very high	1.23	Very high
		Fe(µg/gm)	150.3	Very high	258.6	Very high	49.72	Very high	78.25	Very high	42.96	Very high	79.39	Very high	44.31	Very high	76.48	Very high
		Mn(µg/gm)	7.2	Very high	11.3	Very high	24.72	Very high	6.89	Very high	11.90	Very high	6.87	Very high	10.87	Very high	6.66	Very high
		Zn(µg/gm)	1.4	Medium	1.2	Medium	1.88	High	2.47	Very high	1.82	High	2.33	Very high	2.45	Very high	2.30	Very high
		Lead(Pb) (µg/gm)	31.8	Safe limit	33.7	Safe limit	32.21	Safe limit	25.95	Safe limit	24.23	Safe limit	23.75	Safe limit	22.80	Safe limit	22.55	Safe limit
		Cadmium (Cd)(µg/gm)	0	Safe limit	0	Safe limit	2.39	Safe limit	00	Safe limit	00	Safe limit	00	Safe limit	0.42	Safe limit	0.00	Safe limit
		Subsurface soil (15-30cm)																
		EC(ds/m)	8.4	Moderately saline	2.0	Non saline	7.90	Slightly saline	4.65	Slightly saline	2.23	Very slightly saline	4.88	Slightly saline	4.52	Slightly saline	0.88	Non saline
		pH	4.3	Very strongly acid	6.9	Neutral	7.8	Slightly alkaline	7.4	Slightly alkaline	7.1	Neutral	7.6	Slightly saline	7.0	Neutral	6.82	Neutral
		OM (%)	2.9	Medium	2.2	Medium	1.46	Low	1.53	Low	1.67	Low	1.49	Low	1.50	Low	1.25	Low
		N (%)	0.15	Low	0.2	Medium	0.08	Very low	0.08	Very low	0.09	Very low	0.08	Very low	0.08	Very low	0.06	Very low
		K (meq/100g)	1.0	Very high	0.61	Very high	1.46	Very high	0.59	Very high	0.58	Very high	0.60	Very high	0.62	Very low	0.56	Very low
		Ca (meq/100g)	10.48	Very high	14.3	Very high	26.84	Very high	12.31	Very high	12.67	Very high	11.96	Very high	12.70	Very high	12.13	Very high
		Mg (meq/100g)	8.8	Very high	8.2	Very high	5.30	Very high	2.15	Very high	2.10	Very high	2.17	Very high	2.15	Very high	2.20	Very high
		Na(meq/100g)	5.00	*	2.7	*	8.95	*	6.32	*	4.22	*	6.48	*	5.24	*	5.77	*
		P(µg/gm)	2.9	Very low	22.8	High	9,23	Low	4.65	Very low	4.74	Very low	5.03	Very low	4.96	Very low	4.76	Very low
		S(µg/gm)	513.7	Very high	31.4	High	307.65	Very high	221.0	Very high	210.06	Very high	222.75	Very high	220.36	Very high	220.46	Very high
		B(µg/gm)	0.36	Medium	0.49	Optimum	1.86	Very high	0.90	Very high	1.02	Very high	1.02	Very high	1.05	Very high	0.95	Very high
		Fe(µg/gm)	39.1	Very high	60.9	Very high	26.60	Very high	29.27	Very high	22.53	Very high	28.65	Very high	23.63	Very high	32.15	Very high
		Mn(µg/gm)	3.3	High	10.9	Very high	41.87	Very high	5.75	Very high	7.11	Very high	6.04	Very high	6.95	Very high	6.12	Very high
		Zn(µg/gm)	1.5	Optimum	0.87	Low	1.56	Optimum	1.69	Optimum	1.31	Medium	1.62	Medium	1.64	Optimum	1.56	Optimum

Sl. No.	Location	Parameter	2013-2014				2014-2015				2015-2016				2016-17			
			Dry season (April)	Remarks	Wet season (October)	Remarks	Dry season (April)	Remarks	Wet season (October)	Remarks	Dry season (March)	Remarks	Wet season (October)	Remarks	Dry season	Remarks	Wet season (October)	Remarks
		Lead(Pb) (µg/gm)	31.8	Safe limit	32.1	Safe limit	31.54	Safe limit	22.56	Safe limit	22.35	Safe limit	21.32	Safe limit	21.97	Safe limit	20.77	Safe limit
		Cadmium (Cd)(µg/gm)	0	Safe limit	0	Safe limit	2.42	Safe limit	00	Safe limit	00	Safe limit	00	Safe limit	0.39	Safe limit	0.00	Safe limit
		Substratum (30-45cm)																
		EC(ds/m)	9.6	Moderately saline	5.8	Slightly saline	9.26	Moderately saline	5.56	Slightly saline	4.32	Slightly saline	6.48	Slightly saline	7.40	Slightly saline	1.67	Non saline
		pH	5.7	Slightly acid	6.9	Neutral	7.7	Slightly alkaline	7.0	Neutral	7.0	Neutral	7.5	Slightly alkaline	7.0	Neutral	6.94	Neutral
		OM (%)	1.6	Low	1.1	Low	1.62	Low	1.48	Low	1.69	Low	1.46	Low	1.45	Low	2.03	Medium
		N (%)	0.08	Very low	0.06	Very low	0.09	Very low	0.07	Very low	0.09	Very low	0.07	Very low	0.08	Very low	0.10	Low
		K (meq/100g)	1.0	Very high	0.6	Very high	2.00	Very high	0.60	Very high	0.51	Very high	0.58	Very high	0.55	Very high	0.60	Very high
		Ca (meq/100g)	12.6	Very high	16.3	Very high	28.69	Very high	14.06	Very high	13.78	Very high	13.87	Very high	13.83	Very high	13.87	Very high
		Mg (meq/100g)	15.9	Very high	8.8	Very high	5.57	Very high	2.71	Very high	3.03	Very high	2.66	Very high	2.85	Very high	2.62	Very high
		Na(meq/100g)	6.00	*	3.7	*	9.91	*	6.83	*	5.51	*	6.71	*	7.41	*	6.89	*
		P(µg/gm)	2.00	Very low	13.3	Medium	8.24	Low	2.99	Very low	3.13	Very low	3.24	Very low	3.34	Very high	3.29	Very high
		S(µg/gm)	490.9	Very high	31.9	High	307.29	Very high	262.0	Very high	279.37	Very high	259.66	Very high	267.70	Very high	245.33	Very high
		B(µg/gm)	0.73	High	0.77	Very high	1.67	Very high	1.16	Very high	1.34	Very high	1.22	Very high	1.19	Very high	1.06	Very high
		Fe(µg/gm)	51.3	Very high	113.9	Very high	33.91	Very high	73.87	Very high	52.21	Very high	73.56	Very high	50.38	Very high	68.55	Very high
		Mn(µg/gm)	3.9	Very high	5.2	Very high	88.75	Very high	6.21	Very high	6.34	Very high	5.90	Very high	6.04	Very high	6.19	Very high
		Zn(µg/gm)	1.6	Optimum	0.49	Low	1.74	Optimum	3.19	Very high	2.94	Very high	3.25	High	3.07	Very high	2.87	Very high
		Lead(Pb) (µg/gm)	37.8	Safe limit	31.5	Safe limit	32.29	Safe limit	18.89	Safe limit	19.18	Safe limit	19.68	Safe limit	19.19	Safe limit	18.64	Safe limit
		Cadmium (Cd)(µg/gm)	0	Safe limit	0	Safe limit	2.17	Safe limit	00	Safe limit	00	Safe limit	00	Safe limit	0.37	Safe limit	0.00	Safe limit
2	Chunkuri-2	**Top soil (0-15cm)**																
		EC(ds/m)	11.2	Moderately saline	5.6	Slightly saline	13.05	Strongly saline	8.20	Moderately saline	6.92	Slightly saline	6.15	Slightly saline	6.57	Slightly saline	4.63	Slightly saline
		pH	6.1	Slightly acid	6.4	Slightly acid	5.9	Slightly acid	6.0	Slightly acid	6.3	Slightly acid	5.6	Slightly acid	5.8	Slightly acid	6.67	Neutral
		OM (%)	2.1	Medium	1.2	Low	3.22	Medium	1.75	Low	1.98	Medium	1.70	Low	2.01	Medium	1.72	Low
		N (%)	0.11	Low	0.06	Very low	0.18	Low	0.09	Very low	0.11	Low	0.09	Very low	0.11	Low	0.09	Very low
		K (meq/100g)	1.5	Very high	1.14	Very high	2.97	Very high	0.79	Very high	0.86	Very high	0.77	Very high	0.75	Very high	0.75	Very high
		Ca (meq/100g)	12.3	Very high	12.9	Very high	27.15	Very high	11.88	Very high	11.89	Very high	12.15	Very high	12.27	Very high	11.55	Very high
		Mg (meq/100g)	9.8	Very high	8.9	Very high	6.33	Very high	2.50	Very high	2.47	Very high	2.52	Very high	2.50	Very high	2.50	Very high
		Na(meq/100g)	8.5	*	9.4	*	12.51	*	8.16	*	7.11	*	7.19	*	6.59	*	6.27	*
		P(µg/gm)	2.7	Very low	12.8	Medium	8.34	Low	6.89	Low	8.05	Low	6.90	Low	7.76	Low	7.20	Low
		S(µg/gm)	401.9	Very high	16.9	Medium	673.58	Very high	500.0	Very high	574.26	Very high	476.51	Very high	542.38	Very high	423.74	Very high
		B(µg/gm)	0.57	Optimum	0.74	High	0.75	High	1.52	Very high	1.88	Very high	1.50	Very high	1.59	Very high	1.48	Very high

Sl. No.	Location	Parameter	2013-2014				2014-2015				2015-2016				2016-17			
			Dry season (April)	Remarks	Wet season (October)	Remarks	Dry season (April)	Remarks	Wet season (October)	Remarks	Dry season (March)	Remarks	Wet season (October)	Remarks	Dry season	Remarks	Wet season (October)	Remarks
		Fe(µg/gm)	60.2	Very high	223.6	Very high	52.46	Very high	89.23	Very high	48.75	Very high	88.47	Very high	50.15	Very high	89.12	Very high
		Mn(µg/gm)	5.3	Very high	12.8	Very high	74.59	Very high	7.05	Very high	7.44	Very high	7.00	Very high	7.21	Very high	6.78	Very high
		Zn(µg/gm)	1.7	Medium	2.5	Very high	2.66	Very high	5.32	Very high	4.36	Very high	4.91	Very high	5.03	Very high	4.38	Very high
		Lead(Pb) (µg/gm)	0.00	Safe limit	29.2	Safe limit	31.34	Safe limit	14.09	Safe limit	15.12	Safe limit	15.91	Safe limit	16.09	Safe limit	15.90	Safe limit
		Cadmium (Cd)(µg/gm)	0	Safe limit	0	Safe limit	2.31	Safe limit	00	Safe limit	00	Safe limit	00	Safe limit	0.56	Safe limit	0.00	Safe limit
		Subsurface soil (15-30cm)																
		EC(ds/m)	9.1	Moderately saline	5.6	Slightly saline	10.48	Moderately saline	6.97	Slightly saline	5.74	Slightly saline	5.44	Slightly saline	7.48	Slightly saline	2.30	Very slightly saline
		pH	6.7	Neutral	6.4	Slightly acid	6.4	Slightly acid	6.7	Neutral	7.00	Neutral	6.3	Slightly acid	6.5	Slightly acid	6.86	Neutral
		OM (%)	1.8	Low	0.95	Very low	3.08	High	1.64	Low	1.66	Low	1.68	Low	1.67	Low	1.88	Medium
		N (%)	0.09	Very low	0.06	Very low	0.17	Low	0.08	Very low	0.10	Low	0.08	Very low	0.09	Very low	0.09	Very low
		K (meq/100g)	1.6	Very high	1.1	Very high	2.68	Very high	0.75	Very high	0.77	Very high	0.77	Very high	0.76	Very high	0.78	Very high
		Ca (meq/100g)	12.6	Very high	13.8	Very high	26.29	Very high	15.65	Very high	16.44	Very high	16.07	Very high	16.13	Very high	14.38	Very high
		Mg (meq/100g)	9.5	Very high	8.9	Very high	6.29	Very high	3.13	Medium	3.16	Very high	2.95	Very high	2.97	Very high	3.03	Very high
		Na(meq/100g)	8.5	*	9.9	Very high	10.61	*	7.89	*	6.88	*	6.03	*	6.67	*	6.46	*
		P(µg/gm)	2.7	Very low	18.4	Optimum	7.32	Low	6.67	Low	5.77	Low	6.59	Low	6.65	Low	6.48	Low
		S(µg/gm)	280.5	Very high	23.8	Optimum	487.29	Very high	298.0	Very high	311.15	Very high	312.20	Very high	311.90	Very high	298.11	Very high
		B(µg/gm)	1.1	Very high	1.7	Very high	0.92	Very high	1.44	Very high	1.37	Very high	1.39	Very high	1.33	Very high	1.26	Very high
		Fe(µg/gm)	133.9	Very high	193.3	Very high	52.20	Very high	75.51	Very high	35.34	Very high	76.44	Very high	66.73	Very high	74.05	Very high
		Mn(µg/gm)	2.8	Optimum	11.6	Very high	17.75	Very high	8.29	Very high	11.21	Very high	7.98	Very high	10.47	Very high	7.82	Very high
		Zn(µg/gm)	0.99	Medium	1.4	Optimum	2.00	High	1.71	Optimum	1.28	Medium	1.73	Optimum	1.98	High	1.55	Optimum
		Lead(Pb) (µg/gm)	0.00	Safe limit	29.9	Safe limit	31.52	Safe limit	16.63	Safe limit	17.07	Safe limit	15.34	Safe limit	16.28	Safe limit	14.88	Safe limit
		Cadmium (Cd)(µg/gm)	0	Safe limit	0	Safe limit	2.35	Safe limit	00	Safe limit	00	Safe limit	00	Safe limit	0.51	Safe limit	0.00	Safe limit
		Substratum (30-45cm)																
		EC(ds/m)	10.1	Moderately saline	5.3	Slightly saline	10.00	Moderately saline	6.91	Slightly saline	6.59	Slightly saline	5.64	Slightly saline	7.65	Slightly saline	1.86	Non saline
		pH	6.6	Neutral	6.2	Slightly acid	6.6	Neutral	6.4	Slightly acid	6.2	Slightly acid	6.4	Slightly acid	6.5	Slightly acid	7.14	Neutral
		OM (%)	1.9	Medium	1.4	Low	3.36	High	1.53	Low	1.68	Low	1.55	Low	1.60	Low	2.05	Medium
		N (%)	0.09	Low	0.08	Low	0.19	Medium	0.08	Low	0.10	Low	0.08	Very low	0.09	Very low	0.10	Low
		K (meq/100g)	1.5	Very high	1.2	Very high	2.60	Very high	0.72	Very high	0.67	Very high	0.69	Very high	0.69	Very high	0.70	Very high
		Ca (meq/100g)	13.7	Very high	34.4	Very high	18.87	Very high	13.16	Very high	11.99	Very high	13.11	Very high	12.34	Very high	12.77	Very high
		Mg (meq/100g)	11.8	Very high	6.4	Very high	6.34	Very high	3.08	Very high	3.12	Very high	3.11	Very high	3.14	Very high	3.09	Very high
		Na(meq/100g)	8.5	*	9.3	*	10.92	*	7.69	*	6.98	*	6.25	*	6.82	*	6.75	*
		P(µg/gm)	1.3	Very low	19.5	Optimum	6.11	Low	5.71	Low	7.70	Low	5.70	Low	6.51	Low	6.14	Low
		S(µg/gm)	320.4	Very high	32.8	High	428.10	Very high	262.0	Very high	265.61	Very high	273.38	Very high	270.62	Very high	278.15	Very high
		B(µg/gm)	1.14	Very high	1.5	Very high	1.12	Very high	1.36	Very high	1.28	Very high	1.42	Very high	1.23	Very high	1.40	Very high
		Fe(µg/gm)	125.3	Very high	175.5	Very high	117.70	Very high	91.20	Very high	71.63	Very high	89.71	Very high	72.44	Very high	85.64	Very high
		Mn(µg/gm)	2.7	Optimum	12.2	High	46.08	Very high	6.09	Very high	8.79	Very high	6.55	Very high	8.82	Very high	6.60	Very high
		Zn(µg/gm)	1.8	Optimum	0.5	Low	2.15	High	2.83	Very high	2.09	High	2.80	Very high	2.37	Very high	2.76	Very high
		Lead(Pb) (µg/gm)	31.3	Safe limit	29.7	Safe limit	32.46	Safe limit	14.10	Safe limit	13.58	Safe limit	13.59	Safe limit	14.94	Safe limit	13.56	Safe limit

Sl. No.	Location	Parameter	2013-2014				2014-2015				2015-2016				2016-17			
			Dry season (April)	Remarks	Wet season (October)	Remarks	Dry season (April)	Remarks	Wet season (October)	Remarks	Dry season (March)	Remarks	Wet season (October)	Remarks	Dry season	Remarks	Wet season (October)	Remarks
		Cadmium (Cd)(µg/gm)	0	Safe limit	0	Safe limit	2.12	Safe limit	00	Safe limit	00	Safe limit	00	Safe limit	0.48	Safe limit	0.00	Safe limit
3	Kapalirmet	**Top soil (0-15cm)**																
		EC(ds/m)	4.8	Slightly saline	8.5	Moderately saline	3.89	Very slightly saline	8.29	Moderately saline	8.22	Moderately saline	7.53	Slightly saline	8.05	Slightly saline	7.31	Slightly saline
		pH	7.0	Neutral	7.6	Slightly alkaline	6.2	Slightly acid	8.0	Slightly alkaline	8.1	Slightly alkaline	7.8	Slightly alkaline	8.1	Slightly alkaline	7.84	Slightly alkaline
		OM (%)	3.0	Medium	1.5	Low	2.01	Medium	1.75	Low	2.03	Medium	1.77	Low	2.22	Medium	2.35	Medium
		N (%)	0.2	Low	0.07	Very low	0.11	Low	0.09	Very low	0.11	Low	0.09	Very low	0.11	Low	0.12	Low
		K (meq/100g)	1.5	Very high	1.7	Very high	1.32	Very high	0.92	Very high	0.89	Very high	0.87	Very high	0.85	Very high	0.80	Very high
		Ca (meq/100g)	18.2	Very high	19.9	Very high	27.04	Very high	10.77	Very high	11.09	Very high	12.47	Very high	11.56	Very high	13.10	Very high
		Mg (meq/100g)	15.3	Very high	10.0	Very high	6.21	Very high	2.67	Very high	3.48	Very high	2.49	Very high	2.54	Very high	2.56	Very high
		Na(meq/100g)	12.0	*	11.9	*	5.22	*	7.77	*	7.87	*	7.28	*	7.88	*	7.20	*
		P(µg/gm)	3.2	Very low	7.3	Low	6.76	Very high	5.01	Very low	6.26	Low	4.98	Very low	5.86	Very high	5.18	Very high
		S(µg/gm)	545.2	Very high	20.8	Medium	216.69	Very high	700.0	Very high	710.4	Very high	741.10	Very high	734.80	Very high	647.53	Very high
		B(µg/gm)	1.2	Very high	1.3	Very high	0.95	Very high	1.69	Very high	2.03	Very high	1.70	Very high	1.48	Very high	1.64	Very high
		Fe(µg/gm)	37.3	Very high	230.2	Very high	34.56	Very high	94.22	Very high	45.52	Very high	94.20	Very high	48.29	Very high	92.36	Very high
		Mn(µg/gm)	3.8	Very high	6.6	Very high	10.26	Very high	7.28	Very high	6.05	Very high	7.47	Very high	6.27	Very high	7.45	Very high
		Zn(µg/gm)	2.0	High	1.0	Low	1.64	Optimum	3.58	Very high	2.68	Very high	3.66	Very high	3.16	Very high	3.68	Very high
		Lead(Pb) (µg/gm)	12.5	Safe limit	28.9	Safe limit	47.12	Safe limit	8.17	Safe limit	6.89	Safe limit	7.53	Safe limit	8.25	Safe limit	7.46	Safe limit
		Cadmium (Cd)(µg/gm)	0	Safe limit	0	Safe limit	2.86	Safe limit	00	Safe limit	00	Safe limit	00	Safe limit	0.61	Safe limit	0.00	Safe limit
		Subsurface soil (15-30cm)																
		EC(ds/m)	11.1	Moderately saline	6.3	Slightly saline	4.26	Slightly saline	7.43	Slightly saline	8.60	Moderately saline	7.55	Slightly saline	8.44	Moderately saline	7.39	Slightly saline
		pH	7.2	Neutral	7.9	Slightly alkaline	6.3	Slightly acid	8.0	Slightly alkaline	8.1	Slightly alkaline	8.2	Slightly alkaline	8.0	Slightly alkaline	8.32	Slightly alkaline
		OM (%)	2.6	Medium	1.3	Low	3.36	High	1.69	Low	1.95	Medium	1.72	Low	2.00	Medium	1.41	Low
		N (%)	0.2	Low	0.06	Very low	0.19	Medium	0.08	Very low	0.10	Low	0.09	Very low	0.10	Low	0.07	Very low
		K (meq/100g)	1.5	Very high	1.6	Very high	1.13	Very high	0.98	Low	0.98	Very high	0.96	Very high	0.94	Very high	0.92	Very high
		Ca (meq/100g)	11.7	Very high	14.4	Very high	25.16	Very high	16.89	Very high	16.12	Very high	16.00	Very high	16.07	Very high	17.25	Very high
		Mg (meq/100g)	7.1	Very high	9.9	Very high	6.22	Very high	3.94	Very high	3.88	Very high	4.03	Very high	4.17	Very high	3.88	Very high
		Na(meq/100g)	8.5	*	9.8	*	5.45	*	7.86	*	7.89	*	7.66	*	8.04	*	7.72	*
		P(µg/gm)	3.8	Very low	5.6	Low	5.29	Low	5.52	Low	6.21	Low	5.55	Low	6.00	Low	5.50	Low
		S(µg/gm)	341.4	Very high	52.1	Very high	236.58	Very high	655.0	Very high	666.23	Very high	707.00	Very high	672.09	Very high	701.68	Very high
		B(µg/gm)	0.86	Very high	1.6	Very high	0.21	Low	1.93	Very high	2.11	Very high	1.95	Very high	2.02	Very high	1.70	Very high
		Fe(µg/gm)	140.2	Very high	249.0	Very high	30.03	Very high	93.15	Very high	73.04	Very high	93.69	Very high	56.83	Very high	90.42	Very high
		Mn(µg/gm)	3.7	High	5.9	Very high	11.23	Very high	6.95	Very high	8.16	Very high	7.30	Very high	7.85	Very high	7.32	Very high
		Zn(µg/gm)	0.94	Medium	0.5	Low	1.04	Medium	2.39	Very high	1.96	High	2.34	Very high	2.11	High	2.45	Very high
		Lead(Pb) (µg/gm)	0.00	Safe limit	29.3	Safe limit	33.66	Safe limit	9.58	Not polluted	10.03	Safe limit	10.14	Safe limit	10.18	Safe limit	9.71	Safe limit
		Cadmium (Cd)(µg/gm)	0	Safe limit	0	Safe limit	2.18	Safe limit	00	Not polluted	00	Safe limit	00	Safe limit	0.64	Safe limit	0.00	Safe limit
		Substratum (30-45cm)																
		EC(ds/m)	10.8	Moderately saline	7.5	Slightly saline	3.99	Very slightly saline	7.06	Slightly saline	6.77	Slightly saline	8.44	Moderately saline	7.10	Slightly saline	6.54	Slightly saline
		pH	7.3	Neutral	7.8	Slightly alkaline	6.3	Slightly acid	7.9	Slightly alkaline	7.9	Slightly alkaline	8.1	Slightly alkaline	8.0	Slightly alkaline	8.57	Slightly alkaline

Sl. No.	Location	Parameter	2013-2014				2014-2015				2015-2016				2016-17			
			Dry season (April)	Remarks	Wet season (October)	Remarks	Dry season (April)	Remarks	Wet season (October)	Remarks	Dry season (March)	Remarks	Wet season (October)	Remarks	Dry season	Remarks	Wet season (October)	Remarks
		OM (%)	2.8	Medium	1.3	Low	4.03	High	2.38	Medium	2.42	Medium	2.21	Medium	1.98	Medium	2.03	Medium
		N (%)	0.15	Low	0.06	Very low	0.23	Medium	0.12	Low	0.13	Low	0.11	Low	0.10	Low	0.10	Low
		K (meq/100g)	1.5	Very high	1.6	Very high	1.16	Very high	0.87	Very high	0.88	Very high	0.88	Very high	0.86	Very high	0.86	Very high
		Ca (meq/100g)	12.9	Very high	15.4	Very high	27.13	Very high	17.20	Very high	16.88	Very high	16.78	Very high	16.68	Very high	14.64	Very high
		Mg (meq/100g)	10.4	Very high	9.7	Very high	6.25	Very high	3.90	Very high	4.12	Very high	4.00	Very high	4.15	Very high	4.05	Very high
		Na(meq/100g)	8.5	*	9.6	*	5.76	*	7.27	*	7.03	*	8.05	*	6.93	*	8.00	*
		P(µg/gm)	3.4	Very low	5.8	Low	9.24	Optimum	3.65	Very low	3.81	Very low	4.12	Very low	4.05	Very low	3.92	Very low
		S(µg/gm)	345.1	Very high	5.6	Very low	231.67	Very high	732.0	Very high	764.07	Very high	664.37	Very high	749.36	Very high	620.39	Very high
		B(µg/gm)	1.4	Very high	1.1	Very high	1.55	Very high	1.83	Very high	1.56	Very high	1.85	Very high	1.66	Very high	1.59	Very high
		Fe(µg/gm)	120.3	Very high	247.8	Very high	33.82	Very high	87.26	Very high	38.64	Very high	88.40	Very high	40.51	Very high	84.18	Very high
		Mn(µg/gm)	2.9	Optimum	7.2	Very high	53.90	Very high	7.31	Very high	9.43	Very high	7.50	Very high	8.97	Very high	7.50	Very high
		Zn(µg/gm)	0.88	Low	0.79	Low	1.00	Medium	2.09	High	2.35	High	2.21	High	2.12	High	2.33	Very high
		Lead(Pb) (µg/gm)	0.00	Safe limit	27.6	Safe limit	34.37	Safe limit	7.88	Safe limit	7.57	Safe limit	8.05	Safe limit	7.69	Safe limit	7.80	Safe limit
		Cadmium (Cd)(µg/gm)	0	Safe limit	0	Safe limit	2.20	Safe limit	00	Safe limit	00	Safe limit	00	Safe limit	0.52	Safe limit	0.00	Safe limit
4	Chalkghona	**Top soil (0-15cm)**																
		EC(ds/m)	11.5	Moderately saline	7.2	Slightly saline	7.36	Slightly saline	7.31	Slightly saline	7.67	Slightly saline	8.56	Moderately saline	7.78	Slightly saline	6.82	Slightly saline
		pH	7.7	Slightly alkaline	8.0	Slightly alkaline	5.7	Slightly acid	8.5	Strongly alkaline	8.6	Strongly alkaline	8.3	Slightly alkaline	8.7	Strongly alkaline	8.73	Strongly alkaline
		OM (%)	1.5	Low	1.5	Low	2.13	Medium	2.17	Medium	2.15	Medium	2.20	Medium	2.20	Medium	1.88	Medium
		N (%)	0.08	Low	0.08	Low	0.12	Low	0.11	Low	0.11	Low	0.11	Low	0.11	Low	0.99	Low
		K (meq/100g)	1.5	Very high	1.4	Very high	1.72	Very high	0.86	Very high	0.88	Very high	0.88	Very high	0.87	Very high	0.85	Very high
		Ca (meq/100g)	22.2	Very high	14.3	Very high	18.79	Very high	14.58	Very high	15.31	Very high	14.44	Very high	15.22	Very high	14.18	Very high
		Mg (meq/100g)	11.7	Very high	9.4	Very high	6.29	Very high	3.87	Very high	3.89	Very high	3.85	Very high	3.85	Very high	3.84	Very high
		Na(meq/100g)	8.5	*	8.4	*	9.81	*	6.56	*	6.33	*	6.52	*	6.50	*	5.79	*
		P(µg/gm)	5.6	Very low	9.2	Low	4.11	Very low	10.88	Medium	11.26	Medium	11.13	Medium	10.79	Medium	10.43	Medium
		S(µg/gm)	444.2	Very high	4.1	Very low	440.19	Very high	975.0	Very high	982.55	Very high	978.43	Very high	975.48	Very high	862.34	Very high
		B(µg/gm)	0.98	Very high	1.2	Very high	0.85	Very high	1.65	Very low	1.88	Very high	1.69	Very high	1.75	Very high	1.70	Very high
		Fe(µg/gm)	55.3	Very high	189.0	Very high	41.14	Very high	68.05	Very high	43.62	Very high	70.23	Very high	42.89	Very high	68.09	Very high
		Mn(µg/gm)	4.3	High	16.4	Very high	32.04	Very high	7.23	Very high	8.34	Very high	7.42	Very high	7.68	Very high	7.38	Very high
		Zn(µg/gm)	0.76	Low	4.8	Very high	4.33	Very high	3.28	Very high	2.14	High	3.33	Very high	2.45	Very high	3.12	Very high
		Lead(Pb) (µg/gm)	0.00	Safe limit	27.2	Safe limit	30.99	Safe limit	14.94	Safe limit	14.88	Safe limit	15.26	Safe limit	14.82	Safe limit	13.09	Safe limit
		Cadmium (Cd)(µg/gm)	0	Safe limit	0	Safe limit	2.38	Safe limit	00	Safe limit	00	Safe limit	00	Safe limit	0.55	Safe limit	0.00	Safe limit
		Subsurface soil (15-30cm)																
		EC(ds/m)	11.3	Moderately saline	6.2	Slightly saline	7.81	Slightly saline	7.38	Slightly saline	7.02	Slightly saline	7.99	Slightly saline	6.92	Slightly saline	6.58	Slightly saline
		pH	7.7	Slightly alkaline	8.2	Slightly alkaline	5.9	Slightly acid	8.6	Strongly alkaline	8.5	Strongly alkaline	8.4	Slightly alkaline	8.5	Strongly alkaline	8.77	Strongly alkaline
		OM (%)	2.6	Medium	1.3	Low	1.88	Medium	1.90	Medium	1.88	Medium	1.84	Medium	1.91	Medium	1.49	Medium
		N (%)	0.13	Low	0.07	Very low	0.10	Low	0.10	Low	0.10	Low	0.09	Very low	0.10	Low	0.07	Very low
		K (meq/100g)	1.5	Very high	1.1	Very high	1.54	Very high	0.81	Very high	0.84	Very high	0.79	Very high	0.80	Very high	0.79	Very high
		Ca (meq/100g)	22.6	Very high	17.8	Very high	18.96	Very high	16.05	Very high	16.00	Very high	17.10	Very high	16.19	Very high	16.74	Very high
		Mg (meq/100g)	16.3	Very high	8.3	Very high	6.30	Very high	4.25	Very high	4.33	Very high	4.33	Very high	4.26	Very high	4.30	Very high
		Na(meq/100g)	8.5	*	8.6	*	9.23	*	6.93	*	6.56	*	7.10	*	5.97	*	6.48	*
		P(µg/gm)	13.6	Medium	9.4	Low	3.23	Very low	9.23	Low	8.27	Low	8.79	Low	8.41	Low	10.22	Low
		S(µg/gm)	415.6	Very high	47.7	Very high	393.37	Very high	886.0	Very high	990.48	Very high	903.11	Very high	825.13	Very high	865.48	Very high
		B(µg/gm)	0.66	High	0.97	Very high	0.79	Very high	1.46	Very high	1.17	Very high	1.45	Very high	1.27	Very high	1.38	Very high

Sl. No.	Location	Parameter	2013-2014				2014-2015				2015-2016				2016-17			
			Dry season (April)	Remarks	Wet season (October)	Remarks	Dry season (April)	Remarks	Wet season (October)	Remarks	Dry season (March)	Remarks	Wet season (October)	Remarks	Dry season	Remarks	Wet season (October)	Remarks
		Fe(µg/gm)	124.1	Very high	172.7	Very high	25.52	Very high	77.47	Very high	55.06	Very high	76.67	Very high	48.68	Very high	76.12	Very high
		Mn(µg/gm)	6.1	Very high	13.8	Very high	26.59	Very high	6.78	Very high	7.05	Very high	7.53	Very high	7.18	Very high	6.79	Very high
		Zn(µg/gm)	1.1	Medium	3.2	Very high	1.09	Medium	3.37	Very high	2.73	Very high	3.12	Very high	2.56	Very high	2.63	Very high
		Lead(Pb) (µg/gm)	6.3	Safe limit	28.4	Safe limit	30.81	Safe limit	11.83	Safe limit	12.43	Safe limit	11.72	Safe limit	11.78	Safe limit	11.43	Safe limit
		Cadmium (Cd)(µg/gm)	0	Safe limit	0	Safe limit	2.35	Safe limit	00	Safe limit	00	Safe limit	00	Safe limit	0.52	Safe limit	0.00	Safe limit
		Substratum (30-45cm)																
		EC(ds/m)	10.9	Moderately saline	5.1	Slightly saline	7.14	Slightly saline	7.12	Slightly saline	7.45	Slightly saline	7.87	Slightly saline	8.23	Moderately saline	6.83	Slightly saline
		pH	7.5	Slightly alkaline	8.2	Slightly alkaline	6.0	Slightly acid	8.9	Strongly alkaline	8.7	Strongly alkaline	8.4	Slightly alkaline	8.8	Strongly alkaline	8.82	Strongly alkaline
		OM (%)	1.7	Low	1.0	Very low	2.94	Medium	1.53	Low	1.57	Low	1.55	Low	1.55	Low	1.88	Medium
		N (%)	0.09	Very low	0.06	Very low	0.17	Low	0.08	Very low	0.09	Very low	0.08	Very low	0.08	Very low	0.09	Very low
		K (meq/100g)	1.5	Very high	0.95	Very high	1.57	Very high	0.89	Very high	0.90	Very high	0.95	Very high	0.92	Very high	0.88	Very high
		Ca (meq/100g)	13.9	Very high	14.4	Very high	19.10	Very high	15.95	Very high	16.25	Very high	16.72	Very high	16.85	Very high	17.03	Very high
		Mg (meq/100g)	11.1	Very high	7.2	Very high	6.26	Very high	4.15	Very high	4.06	Very high	3.97	Very high	4.00	Very high	4.06	Very high
		Na(meq/100g)	8.5	*	6.7	*	9.33	*	7.20	Very high	7.39	*	6.77	*	6.69	*	6.95	*
		P(µg/gm)	4.1	Very low	9.5	Low	5.67	Low	11.26	Medium	12.33	Medium	10.46	Low	11.48	Optimum	9.47	Low
		S(µg/gm)	334.6	Very high	8.3	Low	343.00	Very high	465.0	Very high	543.04	Very high	562.60	Very high	550.09	Very high	612.47	Very high
		B(µg/gm)	0.67	High	0.63	High	1.05	Very high	1.14	Very high	1.11	Very high	1.22	Very high	1.05	Very high	1.31	Very high
		Fe(µg/gm)	75.3	Very high	160.0	Very high	29.70	Very high	90.55	Very high	67.84	Very high	90.64	Very high	83.17	Very high	90.15	Very high
		Mn(µg/gm)	3.6	Very high	14.1	Very high	25.22	Very high	6.03	Very high	7.03	Very high	6.61	Very high	6.59	Very high	6.90	Very high
		Zn(µg/gm)	1.7	Optimum	2.9	Very high	1.78		2.94	Very high	2.00	High	3.05	Very high	1.82	Very high	3.47	Very high
		Lead(Pb) (µg/gm)	6.3	Safe limit	26.5	Safe limit	32.23	Safe limit	15.50	Safe limit	14.71	Safe limit	14.64	Safe limit	15.03	Safe limit	13.74	Safe limit
		Cadmium (Cd)(µg/gm)	0	Safe limit	0	Safe limit	2.55	Safe limit	00	Safe limit	00	Safe limit	00	Safe limit	0.48	Safe limit	0.00	Safe limit
5	Basherhula	**Top soil (0-15cm)**																
		EC(ds/m)	11.7	Moderately saline	6.0	Slightly saline	7.14	Slightly saline	5.58	Slightly saline	9.10	Moderaely saline	6.41	Slightly saline	6.60	Slightly saline	6.15	Slightly saline
		pH	7.7	Slightly alkaline	8.3	Slightly alkaline	7.3	Neutral	8.7	Strongly alkaline	8.8	Strongly alkaline	8.3	Slightly alkaline	6.5	Slightly alkaline	8.77	Strongly alkaline
		OM (%)	1.7	Low	1.2	Low	1.74	Low	1.59	Low	1.79	Medium	1.48	Low	1.45	Low	1.56	Low
		N (%)	0.09	Low	0.06	Very low	0.10	Low	0.08	Very low	0.09	Very low	0.07	Very low	0.07	Very low	0.08	Very low
		K (meq/100g)	1.5	Very high	1.2	Very high	1.67	Very high	0.75	Very high	0.81	Very high	0.77	Very high	0.80	Very high	0.72	Very high
		Ca (meq/100g)	23.6	Very high	31.4	Very high	25.26	Very high	15.11	Very high	16.53	Very high	15.08	Very high	15.78	Very high	13.45	Very high
		Mg (meq/100g)	11.9	Very high	7.9	Very high	5.50	Very high	4.05	Very high	4.42	Very high	3.90	Very high	3.55	Very high	3.79	Very high
		Na(meq/100g)	8.5	*	8.1	*	7.06	*	6.32	*	8.24	*	6.61	*	5.69	*	6.56	*
		P(µg/gm)	4.5	Very low	7.4	Low	7.12	Low	5.92	Low	5.47	Low	5.87	Low	6.37	Very high	5.26	Low
		S(µg/gm)	272.3	Very high	21.8	Medium	454.19	Very high	607.0	Very high	623.73	Very high	579.39	Very high	610.52	Very high	556.10	Very high
		B(µg/gm)	0.94	Very high	1.1	Very high	1.00	Very high	1.19	Very high	1.32	Very high	1.15	Very high	1.12	Very high	1.05	Very high
		Fe(µg/gm)	50.3	Very high	205.6	Very high	53.37	Very high	85.08	Very high	48.00	Very high	87.22	Very high	51.78	Very high	88.11	Very high
		Mn(µg/gm)	3.4	High	5.9	Very high	49.22	Very high	6.50	Very high	5.22	Very high	6.55	Very high	5.25	Very high	6.58	Very high
		Zn(µg/gm)	1.4	Medium	1.1	Medium	2.27	Very high	1.86	High	1.04	Medium	1.89	High	2.01	High	1.84	High
		Lead(Pb) (µg/gm)	18.8	Safe limit	25.1	Safe limit	30.55	Safe limit	6.19	Safe limit	5.77	Safe limit	5.77	Safe limit	6.06	Safe limit	6.29	Safe limit
		Cadmium (Cd)(µg/gm)	0	Safe limit	0	Safe limit	2.21	Safe limit	00	Safe limit	00	Safe limit	00	Safe limit	0.32	Safe limit	0.00	Safe limit

Sl. No.	Location	Parameter	2013-2014				2014-2015				2015-2016				2016-17			
			Dry season (April)	Remarks	Wet season (October)	Remarks	Dry season (April)	Remarks	Wet season (October)	Remarks	Dry season (March)	Remarks	Wet season (October)	Remarks	Dry season	Remarks	Wet season (October)	Remarks
		Subsurface soil (15-30cm)																
		EC(ds/m)	10.7	Moderately saline	7.0	Slightly saline	7.44	Slightly saline	7.16	Slightly saline	6.29	Slightly saline	7.30	Slightly saline	7.22	Slightly saline	7.21	Slightly saline
		pH	7.7	Slightly alkaline	8.2	Slightly alkaline	7.7	Slightly alkaline	8.7	Strongly alkaline	8.6	Strongly alkaline	8.4	Slightly alkaline	7.9	Slightly alkaline	8.72	Strongly alkaline
		OM (%)	1.5	Low	0.9	Low	2.01	Medium	1.43	Low	1.31	Low	1.42	Low	1.50	Low	1.49	Low
		N (%)	0.08	Very low	0.05	Very low	0.11	Low	0.07	Very low	0.07	Very low	0.07	Very low	0.08	Very low	0.07	Very low
		K (meq/100g)	1.0	Very high	1.2	Very high	2.20	Very high	0.76	Very high	0.77	Very high	0.71	Very high	0.75	Very high	0.78	Very high
		Ca (meq/100g)	24.0	Very high	32.6	Very high	33.28	Very high	14.75	Very high	13.87	Very high	13.77	Very high	13.53	Very high	14.33	Very high
		Mg (meq/100g)	11.7	Very high	8.4	Very high	6.10	Very high	3.76	Very high	3.69	Very high	3.52	Very high	3.75	Very high	3.55	Very high
		Na(meq/100g)	7.0	*	10.1	*	8.66	*	7.06	*	6.93	*	6.74	*	6.70	*	6.70	*
		P(µg/gm)	3.9	Very low	5.3	Low	8.19	Low	6.82	Low	7.03	Low	7.14	Low	7.05	Low	6.77	Low
		S(µg/gm)	317.2	Very high	2.8	Very low	379.38	Very high	627.0	Very high	652.28	Very high	568.50	Very high	649.47	Very high	496.55	Very high
		B(µg/gm)	0.71	High	1.0	Very high	1.38	Very high	1.31	Very high	1.08	Very high	1.38	Very high	1.25	Very high	1.35	Very high
		Fe(µg/gm)	121.4	Very high	307.0	Very high	53.18	Very high	83.13	Very high	50.12	Very high	84.36	Very high	49.26	Very high	83.64	Very high
		Mn(µg/gm)	3.9	Very high	15.5	Very high	45.34	Very high	5.98	Very high	5.62	Very high	6.26	Very high	6.08	Very high	6.10	Very high
		Zn(µg/gm)	1.8	Optimum	0.8	Low	1.99	High	2.27	Optimum	2.34	Very high	2.23	Very high	1.95	Very high	2.15	Very high
		Lead(Pb) (µg/gm)	18.8	Safe limit	23.7	Safe limit	31.49	Safe limit	16.35	Safe limit	17.15	Safe limit	15.69	Safe limit	16.73	Safe limit	13.34	Safe limit
		Cadmium (Cd)(µg/gm)	0	Safe limit	0	Safe limit	2.32	Safe limit	00	Safe limit	00	Safe limit	00	Safe limit	0.37	Safe limit	0.00	Safe limit
		Substratum (30-45cm)																
		EC(ds/m)	10.9	Moderately saline	6.3	Slightly saline	6.68	Slightly saline	6.96	Slightly saline	6.38	Slightly saline	7.39	Slightly saline	7.39	Slightly saline	7.73	Slightly saline
		pH	7.7	Slightly alkaline	8.2	Slightly alkaline	7.8	Slightly alkaline	8.8	Strongly alkaline	8.7	Strongly alkaline	8.7	Strongly alkaline	8.1	Slightly alkaline	8.60	Strongly alkaline
		OM (%)	1.5	Low	1.0	Low	2.81	Medium	2.17	Medium	2.18	Medium	2.09	Medium	2.08	Medium	1.64	Low
		N (%)	0.08	Very low	0.06	Very low	0.16	Low	0.11	Low	0.11	Low	0.11	Low	0.11	Low	0.08	Very low
		K (meq/100g)	1.5	Very high	1.2	Very high	2.20	Very high	0.86	Very high	0.85	Very high	0.90	Very high	0.91	Very high	0.89	Very high
		Ca (meq/100g)	24.4	Very high	32.1	Very high	30.68	Very high	13.95	Very high	12.92	Very high	14.05	Very high	13.97	Very high	14.49	Very high
		Mg (meq/100g)	12.9	Very high	8.3	Very high	6.11	Very high	3.80	Very high	4.01	Very high	3.78	Very high	3.78	Very high	3.95	Very high
		Na(meq/100g)	7.5	*	9.8	*	8.76	*	7.68	*	7.01	*	7.48	*	6.77	*	7.50	*
		P(µg/gm)	6.1	Low	5.9	Low	11.14	Medium	9.12	Low	8.77	Low	8.90	Low	9.18	Low	7.83	Low
		S(µg/gm)	321.1	Very high	3.1	Very low	305.69	Very high	182.0	Very high	230.62	Very high	264.81	Very high	198.85	Very high	22.16	Optimum
		B(µg/gm)	0.63	High	0.85	Very high	2.95	Very high	1.40	Very high	1.54	Very high	1.44	Very high	1.48	Very high	1.47	Very high
		Fe(µg/gm)	77.3	Very high	162.4	Very high	42.36	Very high	66.29	Very high	39.40	Very high	68.25	Very high	40.51	Very high	65.89	Very high
		Mn(µg/gm)	3.2	High	16.9	Very high	31.74	Very high	5.69	Very high	7.16	Very high	5.74	Very high	6.87	Very high	5.85	Very high
		Zn(µg/gm)	2.1	High	2.7	Very high	1.62	Optimum	2.04	High	1.46	Optimum	1.97	High	1.57	Very high	1.95	Very high
		Lead(Pb) (µg/gm)	25.00	Safe limit	22.2	Safe limit	31.54	Safe limit	14.96	Safe limit	16.02	Safe limit	15.20	Safe limit	15.79	Safe limit	14.06	Safe limit
		Cadmium (Cd)(µg/gm)	0	Safe limit	0	Safe limit	2.44	Safe limit	00	Safe limit	00	Safe limit	00	Safe limit	0.39	Safe limit	0.00	Safe limit

Source: SRDI laboratory analysis, May 2017

Table E.2: Existing Cropping Pattern of Monitoring Agriculture Plot

Monitoring agriculture plot	Cropping pattern														
	2013-14			2014-15			2015-16			(2016-17)			(2017-18)		
	Kharif-I (March-June)	Kharif-II (July-October)	Rabi (Nov-February)	Kharif-I (March-June)	Kharif-II (July-October)	Rabi (Nov-February)	Kharif-I (March-June)	Kharif-II (July-October)	Rabi (Nov-February)	Kharif-I (March-June)	Kharif-II (July-October)	Rabi (Nov-February)	Kharif-I (March-June)	Kharif-II (July-October)	Rabi (Nov-February)
Monitoring agriculture plot-1(Baranpara)	Fallow	Local Aman	Fallow	Fallow	HYV Aman	Fallow	Fallow	HYV Aman	Fallow	Fallow	HYV Aman	Fallow	Fallow	Local Aman	Fallow
Monitoring agriculture plot-2(Chunkuri-2)	Fallow	HYV Aman	Fallow	Fallow	Local Aman	Fallow	Fallow	HYV Aman	Fallow	Fallow	Local Aman	Fallow	Fallow	Local Aman	Fallow
Monitoring agriculture plot-3(Kapalirmet)	Fallow	Local Aman	Fallow	Fallow*	Fallow*	Fallow*	Fallow*	Fallow*	Fallow*	*Fallow	*Fallow	*Fallow	*Fallow	*Fallow	*Fallow
Monitoring agriculture plot-4(Chakgona)	Fallow	Local Aman	Fallow	Fallow*	Fallow*	Fallow*	Fallow*	Fallow*	Fallow*	*Fallow	*Fallow	*Fallow	*Fallow	*Fallow	*Fallow
Monitoring agriculture plot-5(Basherhula)	Fallow	Local Aman	Fallow	Fallow	Local Aman	Fallow	Fallow	Local Aman	Fallow	Fallow	Local Aman	Fallow	Fallow	Local Aman	Fallow

Source: Based on field information and farmers interviewed, April 2014, April 2015, April 2016, April and December 2017

Table E.3: Results of Crop production in Monitoring Plots

Monitoring Plots	Crop Production														
	2013-14			2014-15			2015-2016			2016-17			2017-18		
	Kharif I (Mar-Jun)	Kharif II (Jul-Oct)	Rabi (Nov-Feb)	Kharif I (Mar-Jun)	Kharif II (Jul-Oct)	Rabi (Nov-Feb)	Kharif I (Mar-Jun)	Kharif II (Jul-Oct)	Rabi (Nov-Feb)	Kharif I (Mar-Jun)	Kharif II (Jul-Oct)	Rabi (Nov-Feb)	Kharif I (Mar-Jun)	Kharif II (Jul-Oct)	Rabi (Nov-Feb)
Monitoring agriculture land -1															
Production (ton/Plot)	-	0.8*	-	-	1.4*	-	-	1.5*	-	-	0.27*	-	-	0.92*	-
Yield (ton/Ha)	-	1.9*	-	-	3.5*	-	-	3.8*	-	-	2.5*	-	-	2.3*	-
Monitoring agriculture land- 2															
Production (ton/Plot)	-	2.4*	-	-	1.1	-	-	1.9*	-	-	0.44*	-	-	2.2*	-
Yield (ton/Ha)	-	2.6*	-	-	1.7*	-	-	2.0*	-	-	2.4*	-	-	2.4*	-
Monitoring agriculture land- 3															
Production (ton/Plot)	-	0.2*	-	-	-	-	-	-	-	-	-	-	-	-	-
Yield (ton/Ha)	-	1.6*	-	-	-	-	-	-	-	-	-	-	-	-	-
Monitoring agriculture land- 4															
Production (ton/Plot)	-	0.6*	-	-	-	-	-	-	-	-	-	-	-	-	-
Yield (ton/Ha)	-	1.9*	-	-	-	-	-	-	-	-	-	-	-	-	-
Monitoring agriculture land-5															
Production (ton/Plot)	-	0.8*	-	-	0.57*	-	-	0.99*	-	-	0.15*	-	-	1.0*	-
Yield (ton/Ha)	-	1.8*	-	-	1.9*	-	-	2.1*	-	-	1.9*	-	-	2.2*	-

*Source: Based on field information and farmers interviewed, April 2014, April 2015, April 2016, April2017 and December 2017 * indicates cleaned rice*

Table E.4: Results of Crop Damage in Monitoring Plots

Monitoring site	2013-14			2014-15			2015-16			2016-17			2017-18		
	Area (ha)	Prod. (tons)	Causes	Area (ha)	Prod (tons)	Causes	Area (ha)	Prod (tons)	Causes	Area (ha)	Prod (tons)	Causes	Area (ha)	Prod (tons)	Causes
Monitoring agriculture land-1	-	**Not found	-	-	-	-	-	**Not found	-	0.06	0.024*	E	-	**Not found	-
Monitoring agriculture land-2	-	**Not found	-	0.33*	0.4*	E	-	**Not found	-	-	-	-	-	**Not found	-
Monitoring agriculture land-3	-	**Not found	-	-	-	-	-	**Not found	-	-	-	-	-	**Not found	-
Monitoring agriculture land-4	-	**Not found	-	-	-	-	-	**Not found	-	-	-	-	-	**Not found	-
Monitoring agriculture land-5	-	**Not found	**-**	0.17*	0.12*	E	-	**Not found	-	0.09	0.019*	E	-	**Not found	-
Total	-	-	**-**	**0.50***	**0.52***		-	-	-	**0.15**	**0.043***	**-**	-	-	-

*Source: Based on field information and farmers interviewed, April 2014, April 2015, April 2016, April and December 2017 * indicates cleaned rice, **Not found*

Note: A: water logging due to heavy rainfall, B: water logging due to internal river water, C: water logging, D: Salinity, E: Other (Pest infestation)

Table F.1: Results of Traffic Volume Datasheet

Traffic Volume Survey at Babubari

Date: April 27, 2018 (Friday)

Vehicles		7:00 AM to 10:00AM			12:00 PM to 2:00PM			17:00 PM to 19:00PM		
Direction	**Factor**	**Khulna to Mongla**	**Mongla to Khulna**	**PCU**	**Khulna to Mongla**	**Mongla to Khulna**	**PCU**	**Khulna to Mongla**	**Mongla to Khulna**	**PCU**
Rickshaw	0.8	17	9	21	19	27	36	27	36	50
Van	0.6	32	19	30	16	11	16	19	25	26
Cycle	0.2	17	11	5	7	2	2	5	4	2
Human Howler	6	3	4	38	0	2	9	0	1	6
CNG	0.5	8	3	6	3	4	3	10	7	8
Private Car	1	17	5	22	8	6	13	4	6	10
Motor Cycle	0.3	63	27	27	52	45	29	68	60	38
Jeep	1	5	1	6	3	1	4	3	3	5
Pick-up	2	8	9	34	4	6	19	2	4	11
Micro	1	16	10	26	9	8	16	2	8	10
Bus	2.5	16	10	63	11	11	54	11	11	54
Light Truck	2	19	2	42	20	5	50	13	13	52
Medium Truck	2	8	6	27	15	8	45	11	7	35
Heavy Truck	2	5	8	26	4	8	23	3	2	8
			Total	**375**			**318**			**315**

Source: CEGIS field survey

Recorder: Gazi A. R. Nahid
Abdur Rahman

Table F.2: Results of Traffic Volume Datasheet

Date: April 25, 2018 (Wednesday)

Vehicles		7:00 AM to 10:00AM			12:00 PM to 2:00PM			17:00 PM to 19:00PM		
Direction	**Factor**	**Khulna to Mongla**	**Mongla to Khulna**	**PCU**	**Khulna to Mongla**	**Mongla to Khulna**	**PCU**	**Khulna to Mongla**	**Mongla to Khulna**	**PCU**
Rickshaw	0.8	1	0	1	0	0	0	9	0	7
Van	0.6	51	59	66	51	47	59	10	54	38
Cycle	0.2	18	24	8	13	14	5	1	17	4
Human Howler	6	9	8	102	10	4	78	6	13	111
CNG	0.5	7	0	3	5	2	3	0	3	2
Private Car	1	25	11	36	24	16	40	3	26	29
Motor Cycle	0.3	110	86	59	85	108	58	5	135	42
Jeep	1	7	3	10	3	3	6	2	14	15
Pick-up	2	16	14	59	32	23	109	2	35	73
Micro	1	27	11	37	16	11	27	3	27	30
Bus	2.5	40	28	169	34	42	189	3	45	118
Light Truck	2	10	11	42	21	10	61	5	18	46
Medium Truck	2	14	7	41	17	16	64	1	22	45
Heavy Truck	2	9	21	59	10	30	79	2	26	56
			Total	**690**			**776**			**614**

Source: CEGIS field survey

Recorder: Gazi A. R. Nahid
Abdur Rahman

Table F.3: Results of Traffic Volume Datasheet

Date: April 25, 2018 (Wednesday)

Vehicles		7:00 AM to 10:00AM			12:00 PM to 2:00PM			17:00 PM to 19:00PM		
Direction	**Factor**	**Khulna to Mongla**	**Mongla to Khulna**	**PCU**	**Khulna to Mongla**	**Mongla to Khulna**	**PCU**	**Khulna to Mongla**	**Mongla to Khulna**	**PCU**
Rickshaw	0.8	1	0	1	0	0	0	9	0	7
Van	0.6	51	59	66	51	47	59	10	54	38
Cycle	0.2	18	24	8	13	14	5	1	17	4
Human Howler	6	9	8	102	10	4	78	6	13	111
CNG	0.5	7	0	3	5	2	3	0	3	2
Private Car	1	25	11	36	24	16	40	3	26	29
Motor Cycle	0.3	110	86	59	85	108	58	5	135	42
Jeep	1	7	3	10	3	3	6	2	14	15
Pick-up	2	16	14	59	32	23	109	2	35	73
Micro	1	27	11	37	16	11	27	3	27	30
Bus	2.5	40	28	169	34	42	189	3	45	118
Light Truck	2	10	11	42	21	10	61	5	18	46
Medium Truck	2	14	7	41	17	16	64	1	22	45
Heavy Truck	2	9	21	59	10	30	79	2	26	56
			Total	**690**			**776**			**614**

Source: CEGIS field survey

Recorder: Gazi A. R. Nahid
Abdur Rahman

Appendix V: Monitoring Data observed During EIA Study

Table F.1: Air Quality Monitoring Results of Different Location

Date	Sample location	SPM (µg/m^3)	SO_x (µg/m^3)	NO_x (µg/m^3)
01/05/2012	Shibbari More, Khulna	410.0	<25	46.0
	College More, Khulna	320.0	<25	36.0
	Natunrasta More, Khulna	350.0	<25	33.0
	Sonadanga Bus stand	335.0	<25	41.0
Bangladesh Standard (ECR 1997) for residential and rural area		200	80	80
02/05/2012	Bus stand more, Sharankhola Sadar	155.0	10.0	21.0
	In front of Upazila Palli Unnoyon Board Office, Sharankhola Sadar	140.0	11.0	20.
	Thana More, Sharankhola Sadar	150.0	09.0	18.0
	In front of Upazila Health Complex Office, Sharankhola Sadar	148.0	08.0	16.0
Bangladesh Standard (ECR 1997) for sensitive area as the location is within the ECA of Sundarbans		100	30	30
ECR Amendment, 2005		150 (24-hr)	365 (24-hr)	100 (Annual)

Source: CEGIS investigation, 2012

Note: Experts from DoE, Khulna collected samples and all the parameters were tested in the labs of DoE, Khulna. During sample collection, the day was sunny and gentle wind was flowing northwestwards.

Table F.2: Water Quality Monitoring Results

location	Date	Temp.	pH	EC	Cl^-	T.Alkalinity	Turbidity	T S	TDS	SS	DO	BOD	COD	Salinity
		^oC		µS/cm	mg/l	mg/l	NTU	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
1	7-Jan	27.4	7.74	3010	879	36	68.7	1565	1510	55	5.1	0.8	55	1.6
2	7-Jan	27.1	7.72	3020	878.8	36	68.5	1570	1510	60	5.1	0.8	55	1.6
3	7-Jan	27.8	7.71	3030	879	36	68.8	1565	1510	55	5.1	0.8	55	1.6
1	11-Feb	29.8	7.66	4380	1262	36	182	2390	2180	210	4.7	1	76	2.3
2	11-Feb	29.2	7.63	4380	1268	36	178	2390	2190	200	4.7	1	76	2.3
3	11-Feb	29.1	7.65	4380	1263	36	179	2380	2180	200	4.7	1	76	2.3
1	9-Mar	32.6	7.56	11780	2944.4	38	176	6080	5890	190	4.7	1.2	76	6.7
2	9-Mar	32.6	7.57	11780	2945.2	38	178	6080	5890	190	4.7	1.2	76	6.7
3	9-Mar	32.1	7.55	11780	2946.4	38	177	6090	5890	200	4.7	1.2	76	6.7
1	17-Apr	32.6	7.59	25300	8273	36	185.6	12950	12700	250	4.6	0.7	136	15.5

location	Date	Temp.	pH	EC	Cl^-	T.Alkalinity	Turbidity	T S	TDS	SS	DO	BOD	COD	Salinity
		°C		µS/cm	mg/l	mg/l	NTU	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
2	17-Apr	32.6	7.59	25300	8273	36	186.2	12950	12700	250	4.6	0.7	138	15.5
3	17-Apr	32.6	7.59	25300	8273	36	184.8	12950	12700	250	4.6	0.7	136	15.5
1	5-May	32.6	7.59	29200	9480	36	198.6	14900	14600	300	4.5	1.2	177	17.6
2	5-May	32.9	7.54	29200	9470	36	198.6	14900	14600	300	4.4	1.2	177	17.6
3	5-May	33.2	7.57	29200	9470	36	199.6	14900	14600	300	4.5	1.2	177	17.6
1	13-Jun	31.6	7.69	18000	5820	36	112.6	9200	9000	200	4.7	1.1	97	10.8
2	13-Jun	31.6	7.69	18000	5800	36	113.2	9200	9000	200	4.7	1.1	97	10.8
3	13-Jun	31.6	7.69	18000	5810	36	112.4	9200	9000	200	4.7	1.1	97	10.8
1	1-Jul	31.6	7.69	440	32.6	36	76.6	285	220	65	5.2	0.8	26	-
2	1-Jul	31.6	7.69	440	32.6	36	76.6	285	220	65	5.2	0.8	26	-
3	1-Jul	31.6	7.69	440	32.6	36	76.6	285	220	65	5.2	0.8	26	-
1	5-Aug	31.6	7.69	275	16.6	36	68.6	192	137	55	5.3	0.7	22	-
2	5-Aug	31.6	7.69	275	16.6	36	68.6	192	137	55	5.3	0.7	22	-
3	5-Aug	31.6	7.69	275	16.6	36	68.6	192	137	55	5.3	0.7	22	-
1	8-Sep	31.6	7.74	270	15.6	36	65.6	180	135	45	5.5	0.7	22	-
2	8-Sep	31.6	7.76	270	15.6	36	65.6	180	135	45	5.5	0.7	22	-
3	8-Sep	31.6	7.74	270	15.6	36	65.6	180	135	45	5.5	0.7	22	-
1	12-Oct	30.6	7.79	290	26.6	36	62.6	192	145	47	5.6	0.7	22	-
2	12-Oct	30.6	7.78	290	26.6	36	62.6	192	145	47	5.6	0.7	22	-
3	12-Oct	30.6	7.78	290	25.6	36	62.6	192	145	47	5.6	0.7	22	-
1	5-Nov	24.6	7.79	340	38.6	36	56.6	210	170	40	5.6	0.7	22	-
2	5-Nov	26.6	7.79	340	38.6	36	56.6	210	170	40	5.6	0.7	22	-
3	5-Nov	25.6	7.79	340	38.6	36	56.6	210	170	40	5.6	0.7	22	-
1	12-Dec	21.5	772	520	62.6	36	72.6	320	260	60	5.1	0.9	25	0.4
2	12-Dec	20.9	7.71	520	62.6	36	73.6	320	260	60	5.1	0.9	25	0.4
3	12-Dec	21.1	7.72	520	62.6	36	71.6	320	260	60	5.1	0.9	25	0.4

Source: DOE, 2010; All the data were collected in 2010 from the following points-

Note: All samples collected from Mongla port (location 1 - Port side river sample, location 2 – middle of the river and location 3 - Opposite of Mongla port) during high tide period in 2010.