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

Monitoring of Environment Parameters and Implementation of Environmental Management Plan during pre-construction and construction period along with Engineering Activities for Site Development of Khulna 2X660 MW Maitree Super Thermal Power Plant




Thirteenth Quarter Monitoring Report of Fourth Year (2017)

Monitoring Period: March - May 2017

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Table of Contents

List of Tables

List of Figures

List of Photographs

List of Maps

Abbreviations and Acronyms

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

ISO	International Organization for Standardization
IUCN	International Union for Conservation of Nature
IFC	International Finance Corporation
Kg	Kilogram
KII	Key Informants Interview
MoPEMR	Ministry of Power, Energy and Mineral Resources
MW	Mega Watt
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	Decible
ppm	parts per million
ppt	parts per thousand
hr	Hour
Kg	Kilogram
Km	Kilometer
KW	Killo Watt
m	Meter
mg	Milligram
ton/year	Ton Per Year
MW	Mega Watt
Nm	Normal Meter
s	Seconds
KV	Kilo Volt

Unit Conversion Table

General Units

1 meter = 3.2808 feet

1 kilometer = 0.62137 mile

1 kilogram = 2.20 pound

1 metric ton = 1000 kg

1 square mile = 640 acres = 2.590 km^2

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

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

1 liter = 0.001 cubic meter

1°C = 274.15^0 K=33.8° F

1 mg/m^3 = 1 µg /L

1 mg/L ≈1 g/m^3≈1 ppm (w/w)

Energy Unit

1 KWh = 3412 Btu

1MW=1000KW=10^6 W

1 KWh = 3.6 x 10^6 J

1 kWh = 859.85 kcal

1 horsepower = 746 W

1 GWyr = 8.76 x 10^9 kWh

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 HYV T. Aus.
B:	When preceding a crop means broadcast (B. 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. The channel 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 constructedbuilding 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 (13th quarterly program) Environmental and Social Monitoring Report covers status of different environmental and social parameters including environmental compliance related monitoring in regard to the EMP of the pre-construction stage as stated in the EIA study. This quarterly report represents the period from February 2017 to April 2017 and in this period (in April 2017), CEGIS team has carried out the monitoring activities comprising of 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 status of environmental compliance in regard to the EMP (provided in the EIA) summarizes the assessment of the effectiveness of the recommended mitigation measures and also to identify any further requirement for additional mitigation measures or remedial action associated with Project Phases (Pre-construction/Construction/ or Operation). In regard to the progress of Project activities, it revealed that land development for the BIFPCL's site (Block A) has been completed. Construction of the embankments, slope protection works and the main access road (two lane) from Babur Bari (at Khulna-Mongla road) to the Plant site also has been completed. The project Site office has been shifted to the South-West corner of the project boundary and construction of bridges and culverts of the access road have also been completed. 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. The monitoring team found that, BIFPCL has been mostly complying with the EMP as suggested in the EIA report. However, as per the EMP approved by DoE and being the Environmental Monitoring Consultant of the Project, CEGIS recommends few site specific measure(s) that should be complied for ensuring environmental and social safeguarding of the Project, such as demarcation sign in local language, emphasizing local participants in the training program, labor recruitment plan, stockpiling of construction materials at a safe distance from river bank; placement of sufficient waste disposal bins need to be placed at the labor shed, and working area.

Moreover, in the recent monitoring period, the HR policy was found developed as the management of site specific EHS program have been established; Occupational Health and Safety Policies; Establishment of the grievance redress mechanism; Emergency preparedness and response plan; fire prevention, protection and control plan; stakeholder engagement plan etc. were found finalized and incorporated for the next phase (construction phase) of the Project. According to the Project authority the work order for construction of this Power Plant has been issued to the EPC contractor (BHEL) and it is expected that the construction works will be started soon. Site specific Fire and Safety Officer have also been appointed. However, proper documentation of any accident/ incident or any health hazard risk issues needs to be recorded; preventive measures for near miss accidental events and any unforeseeable injury, illness, or damage shall be adopted; Site specific ESMP have been prepared by the EPC contractors; Safety training program for the Project personnel and labour force shall be arranged.

However, during this monitoring period the local weather condition can be characterized by stormy wind, high air temperature, cloudy sky and most importantly a strong stormy weather prevailed in the study area. Hence it was not possible for the monitoring team to reach to Hiron point site to collect the environmental data. This time the concentration of all the ambient air quality monitoring parameters (**SO_2, NO_x, $PM_{2.5}$, PM_{10}, CO and O_3**) were found within the standard limit set by **ECR'97**. However, newly developed land for industrial activities along the Passur River, loading-unloading activities of ships & barges and cement industries can be noted as the major known sources of **$PM_{2.5}$**, **PM_{10}** and **SPM** in this area. Other pollutants may be generated from the commonly known sources like the local off road vehicles (human hauler/ Nosimon) and engines of trawler, barges, ship etc.

In the study area, noise generation sources can mainly be divided into two types; one is natural and another one is anthropogenic. Natural sources are 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 salient sources of anthropogenic noise sources. In the course of total thirteen monitoring seasons, it was observed that the noise level at Harbaria, has crossed the standard value in seven seasons among the thirteen monitoring seasons which might due to the presence of a number of large ships; loading and unloading activities; horns from boats, ships and barges and natural sources of nose generatrion.

On the other hand, in the recent monitoring period of April 2017, water samples were collected from the preselected 17 locations (14 locations for surface water and 3 locations for ground water analysis). However, all the samples were collected by maintaining the proper procedures and tagged those samples immediately in the corresponding sites. Later on, the samples were submitted to DPHE and BCSIR for laboratory analysis of the preselected parameters. However, this monitoring report contains laboratory reports of the last monitoring study (**January, 2017**) and in-situ monitoring results of recent quarterly monitoring period (**13th quarterly monitoring program**). Similar to the earlier results, spatial and seasonal variations are still present for the analyzed parameters. But the analyzed results indicated that, all parameters were well within the standard limit set by **ECR**' **1997** for surface water.

Regarding the land resources monitoring, five mauzas (Baranpara, Chunkuri-2, Kapalirmet, Chakgona and Basherhula) within the 10 km radius of the Power Plant have been selected for monitoring the plot use, soil fertility/nutrient status, soil contamination with heavy metals and soil salinity. Soil samples have been collected from five locations at three depths (0-15 cm, 15-30 cm and 30-45 cm) inside the monitoring area in the month of **April, 2017** for the dry season for analyzing the samples. According to the analysed data, it has been observed that highest EC (8.44) (ds/m) and pH (8.8) were found in Kapalirmet and Chakgona mauza respectively. Highest organic matter content (2.22%) was found in Kapalirmet mauza whereas highest macro nutrients was found in Chunkuri, Kapalirmet and Chakgona mauzas. Lead (Pb) and Cadmium (Cd) was found within the limit in the monitoring plots.

Fisheries resources have been monitored at the same locations for seven sampling sites as of earlier quarter monitoring. The following are the key findings of the 13th monitoring program in the **year of 2017-18**. Habitat uses are observed to be changed yearly (as compared to the year of **2014-2015**, of **2015-2016** and of **2017-18**) caused mainly due to biophysical changes having tidal effect, seasonal variability, food availability and also fisheries resource

management practices. Moreover, through analyzing the type of habitat uses by different ages of different fish species (based on the length-based community structure model) such two types of habitats have been found as the i) Grazing and feeding ground, ii) Nursing ground.

The fish diversity using Shannon-Weiner index has also been found varried between **13th quarter** with that of 2014-15, 2015-16 and 2016-17. Highest Shannon-Weiner index was calculated at Harbaria Khal (0.79) indicating most evenly distributed fish species. On the contrary, lowest evenness was found at Haldikhali Khal (0.37). Moreover, maximum Fish Species Richness (FSR) was obtained in Harbaria Khal (n=7), while very low FSR was recorded at Haldikhali Khal and Maidara Point (n=1). Fries and juveniles for fin fish were widely distributed among all the stretches of the Passur River system. Paissa, Golda Chingri and Bele fishes were more widely being distributed among the sampling sites. Moreover, fries fish of Chali Chingri was commonly found at Chalna and Mongla Point, of Bele and Golda at Chalna Point and Maidara and of Bagda at Mongla Point and Maidara. Moreover, brood female fishes of Paissa were observed at Harbaria Khal sampling sites in this quarter.

Fish species like Gulsha Tengra was found to be the maximum abundant (about 25%) among the migratory fish species. Moreover, three (3) fish species, Paissa, Golda and Bele were observed indicating long range of distribution. The highest stocking rate was observed in case of gher in Kapasdanga. Highest mortality rate was found in case of ghers at Rajnagar. The highest productivity has been found in Sheola khal at Chandpai. The lowest productivity was found in the Mongla Point, Maidara and Chalna Point, because all the fry fishes are not considered as catch. Net Jal, Box Net and Tana Jal were observed most frequently used in all upper reaches in Passur River System. Charpata Jal was commonly used in middle reach and lower reach of the Passur River. Moreover, the highest total catch was observed in Sheola khal at Chandpai and lowest in the Mongla Point, Maidara and Chalna Point in this monitoring phase. Fish production was found only in the Gher of Rajnagar.

Among the Aquatic Ecosystem Monitoring indicator, Dolphin occurrence in Passur River near Project site, Dhangmari Khal and Bhadra Kal have been monitored for this monitoring season. A total of 8 Ganges dolphin have been recorded from 18 km boat transect survey. Whereas 16 dolphins have been sighted from 13 km survey transect length of Dhangmari Khal and 6 dolphin were recorded from 10 km length of Bhadra Khal.

From the last monitoring, it can be predicted in terms of seedling density, pneumatophore, crab hole, canopy cover and leaf area index (m^2 leaf area/m^2 ground area) that the forest condition is showing positive changes periodically, although there has some seasonal effect. As indicated earliar, based on above indicators it is found that the health condition at Akram point is getting worse. This is due to the physiographic location of this plot, which is facing high environmental stress. 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 which are being monitored under this study. Here, the forest is experiencing retrogation process where the climax species are started decaying. Hence, this area is sensitive in terms of disturbance. So, there is a possibility of disturbance into the ecosystem on natural succession. Therefore, the monitoring should be continued to know the dynamism of mangrove attributes which are very much interlinked with each other as well as with the environment and more monitoring site should be delineated as control site to compare any potential impact due to coal transportation and transshipment along the Passur River.

Data on cropped area, crop production and crop damage have been collected from the pre-selected five mauzas for the year of 2016-17.Among the five sampling plots, the highest

production (0.44 ton) has been recordedin plot-2 (Chunkuri-2) and lowest production (0.15 ton) was recorded in plot-5(Basherhula). HYV Aman was found to be cultivated at Baranpara mauza, while in other plots local Aman was cultivated in the year of 2016-17. The total crop damage area was found 0.06 ha and 0.09 ha at Baranpara and Basherhula mauzas respectively. Total 0.043 ton rice production was damaged by pest infestation (Stem borer and Rat) in Baranpara (0.024 ton) and Basherhula (0.019 ton). It was also found that the farmers of Chakgona and Kapalirmet could not cultivate crops in Kharif-II season and decided non practicing crops cultivation in near future due to increase in salinity level.

In addition, present agricultural practices and status of crop production are incorporated in this report to provide an idea of the present agricultural scenario in the monitoring study area. According to the local DAE (Department of Agriculture Extension) offices, total cropped area was 77,706 ha, of which 38,756 ha, 20,236 ha, 15,400 ha and 3,314 ha are in the Batiaghata, Dacope, Rampal and Mongla upazila respectively. Total crop production was recorded as 309,912 tons, of which 116,289 tons, 105,141 tons, 75,699 tons and 12,784 tons were produced in the Batiaghata, Dacope, Rampal and Mongla upazila respectively. The highest **(62%)** production was recorded for Local Aman crops at Mongla upazila and the lowest **(1%)** production observed for Local Boro crops at Rampal upazila under Bagerhat district respectively.

Officially the compensation process is almost completed though some affected entities who were found still denying to receive compensation and few entities could not yet able to arrange legal documents/paper of their affected land. Also, about 150 non-titled households were informally settled at project site of which eighteen households were primarily shifted to Foyla cluster village. But, eight of those shifted house-holds left the shelter village due to mismatch of their occupation with that area. It is expected that, requirement of local labors will be highly increased in construction phase activity while the project authority adopted a policy to recruit about 70% of unskilled and semi skilled labors in this phase. That may create employment opportunities for local communities as well as people residing in shelter village.

Workers working condition i.e. accommodation, drinking water, sanitation and medical facilities has been improving over time though it is not up to the mark of international standard. Those facilities will be improved in international standard by the EPC contractor who has been recruited for implementing the Project construction activity. Personal safety equipments will be provided for workers safety and security and will also be monitored through a monitoring cell.

Community health and safety issue is largely contributed with dust/sand blow and noise. Somehow it has been mitigated by tree plantation, boundary wall construction and work restriction in quiet time (**8 pm to 7 am**). Until solidify the soil, regular pouring of water should be ensured from March to May in each year to reduce dust/sand blow to the surrounding communities. The project authority (BIFPCL) introduced a medical camp as CSR, from the beginning of per-construction phase in which about 3,823 people received health treatments over last six months **(Nov, 2016** to **Apr, 2017**) which showed a progressive figure from the early stage of its establishment. The medical service will also include emergency response in case of degradation in community health and safety due to the Project.

1. Introduction

1.1 Background

1. The proposed 1320 MW capacity coal based Thermal Power Plant is a joint venture project of Bangladesh Power Development Board (BPDB), Bangladesh and National Thermal Power Corporation (NTPC) Ltd., India as per the contract signed in January, 2012 and run by Bangladesh-India Friendship Power Company pvt. Ltd. (BIFPCL), The JV (Joint Venture) company.

2. The proposed coal based thermal power Plant is a Red category project as per ECA, 1995 and the subsequent rules ECR, 1997, and therefore require conducting of IEE and EIA studies to examine the environmental sustainability and social acceptability. These studies will be the basis for getting Site Clearance Certificate (SCC) and Environmental Clearance Certificate (ECC) from Department of Environment (DoE), Bangladesh. To that end, BPDB engaged Center for Environmental and Geographic Information Services (CEGIS) as independent public trust for conducting Initial Environmental Examination (IEE) and Environmental Impact Assessment (EIA) studies under a Contract signed on **13th July**, **2010** between BPDB and CEGIS.

3. Accordingly, CEGIS has conducted detailed EIA study during 2011-2013 encompassing a rational study area which is also ecologically very important by virtue of the existence of the world's largest single tract of Mangrove Forest, the Sundarbans with remarkable biodiversity in this area. As per the scope of EIA study, a detailed Environmental Management Plan (EMP) has been developed suggesting mitigation, enhancement, contingency, and compensation measures that shall duly be implemented during project pre-construction, construction and operation phase in order to minimize the negative impacts considered to be generated by the power plant associated activities.

4. Successful implementation of the EMP depends on regular monitoring of the selective indicators at specified locations. Therefore, an independent environmental monitoring team has been proposed and moreover, compliance monitoring has been suggested mandatory for this Project considering the sustainability of the ecosystem of the study area particularly of the Sundarbans Reserve Forest. 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.

5. In this context, BIFPCL initiated a study on monitoring environmental and social parameters and implementation of EMP during pre-construction and construction phases of the proposed Thermal Power Plant for safeguarding the environment of the Sundarbans Mangrove Forest and the surrounding ecosystem and communities. Subsequently, CEGIS has been engaged for carrying out the monitoring of environmental parameters and implementation of the EMP under a contract signed between CEGIS and BIFPCL which was further extended on 16/3/2017. As per contract CEGIS has been conducting the monitoringstudy since **early 2014** and still continuing.

6. This report is aimed at understanding the baseline condition and a plausible description of the recommended environmental and social parameters of the study area as described in the EIA study for Power Plant. It has also provided a complete scenario of environmental compliance status during pre-construction phase along with engineering activities for the **13th quarterly monitoribg program** for the proposed ***2×660 MW Moitree Super Thermal Power***

Project being constructed at Rampal, Bagerhat.

7. The location of the proposed project encompasses Sapmari Katakhali and Kaigar Daskati Mauza of Rajnagar Union under Rampal Upazila of Bagerhat district (**Map 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 about 23 km south from the Khulna City and 14 km in the north-west direction from the nearest tip of the Sundarbans. Location of the study area and their relative distance from forest health survey sites are presented in **Map 1.1**. The study area includes: i) area covering 10 km radius from the Plant location, ii) area within 10 km strip from both bank of Passur and Sibsa rivers starting from the Plant site to Hiron point (**Map 1.2**).

8. According to the contract, the results of all the previous 12 quarterly monitoring reports have been submitted to BIFPCL and BIFPCL subsequently submitted all these reports to DoE and Forest Department. All monitoring reports were also regularly uploaded in BIFPCL website. The current document constitutes **13th quarterly monitoring** report covering all the monitoring parameters and at pre-selected monitoring locations which have helped improve and further upgrade the environmental monitoring database till today.

1.2 Objectives

9. The overall objective is to monitor the environmental parameters and implementation of Environmental Management Plan (EMP) during pre-construction and construction phases of the installation of the Power Plant.

10. The aim of the quarterly monitoring is to monitor the ambient state of environment that will be considered as the baseline and will later be compared with the environmental condition in future when the Power Plant will be in operation phase. The monitoring activities also include monitoring of environmental compliance of the Power Plant's pre-construction activities.

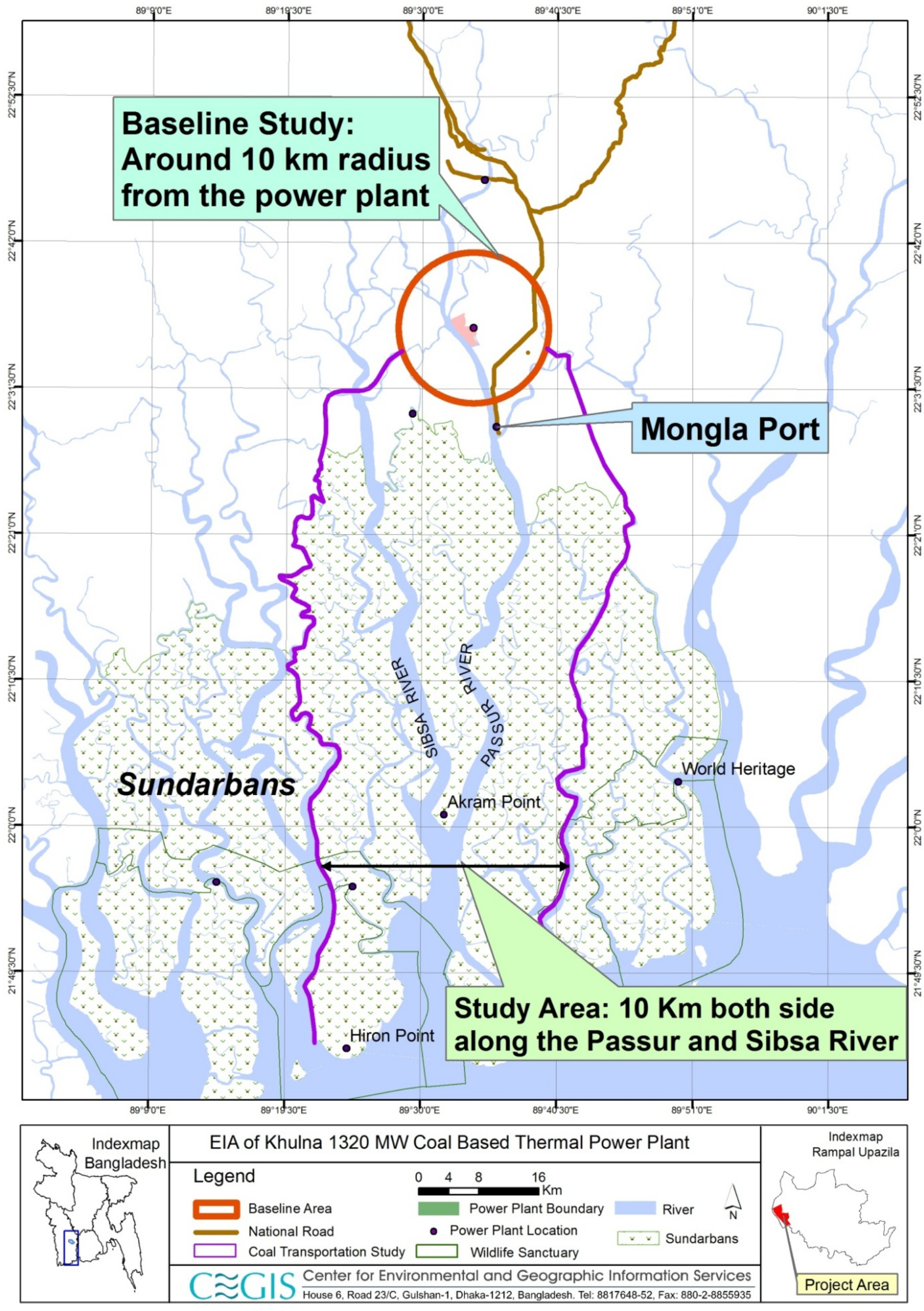
1.3 Criteria for Selection of Monitoring sites/locations

11. The monitoring sites have been selected considering the sensitive receptors and the ambience likely to be impacted from the Project related activities.

- Monitoring locations for ambient air quality were selected considering the wind direction, sensitive receptors in the vicinity of the Project etc. Site selection for monitoring of ambient noise condition also considers the same as that for air quality.
- Sites for ambient water quality were selected by considering the water sources likely to be impacted/ polluted by both the natural and anthropogenic sources.
- Monitoring sites of fisheries resources covers the fish habitats, biodiversity, migration and production zones likely to be impacted.
- Monitoring locations of ecosystem and biodiversity have been selected considering the induced impacts of the Project.
- Monitoring locations of soil and land resources likely to be impacted by the project activities have been selected.
- Monitoring of social environment i.e. the PAPs (project affected peoples) and the changes of socio-economic parameters which are likely to be impacted.

- Sundarbans Reserve Forest (SRF) health Monitoring locations have been selected considering the potential access routes for Power Plant which may have impacts on Sundarbans Reserve Forest.
- Monitoring of EMP status in and around the project area for environmental sustainability and social acceptebility.

Map 1.1: Location Map of the Rampal Coal Based Thermal Power Plant



Map 1.2: Area under the Interest of Environmental and Socio-economic Monitoring

1.4 Main stakeholders

Forest Department

12. The monitoring of the study area includes some locations in Sundarbans that needs to comply with the conditions set out by the DoE in the approval of EIA report. Hence, permission from the Forest Department is necessary to carry out monitoring activities in the Sundarbans.

13. The Forest Department has issued the permission for carrying out monitoring activities in the Sundarbans under certain conditions that include keeping close communication with Forest Department, submitting the monitoring report to Forest Department and including the following activities in the monitoring study:

- Inclusion of 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 at above and below ground level,
- Assessment of impact on canopy cover, leaves phenology, flowers behaviour, pneumatophore and crab hole conditions.

14. The monitoring team has been formed as per the requirements of the Forest Department. BIFPCL also forwarded each copy of the earlier twelve quarterly monitoring report to the Chief Conservator of Forest, Bangladesh Forest Department, Agargaon, Dhaka and Conservator of Forest, Khulna Circle, Boyra, Khulna. Similarly, this 13th monitoring reportwill also be forwarded to the Forest Department.

Department of Environment (DoE)

15. The monitoring plan, including indicators, 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 with experts of DoE to finalize the monitoring plan at CEGIS office.

16. The BIFPCL forwards the monitoring reports and data to the DoE regularly. The monitoring report are also being presented to the Environmental Clearance Committee of the DoE during the renewal of the site clearance. In each monitoring visit a representative from the local DoE has also been accompanied the monitoring team.

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

17. Bangladesh India Friendship Power Company (Pvt.) Limited (BIFPCL) is the Project proponent of the proposed Power Project. The monitoring plan has been prepared based on the conditions set by DoE while approving the EIA report. The official(s) of BIFPCL has been assisting the study team from beginning of the study. In addition, BIFPCL is implementing the environmental management plan (EMP) for ensuring environmental and social safeguarding of the project.

Bangladesh Power Development Board (BPDB)

18. BPDB is the main promoter of BIFPCL and is providing lateral support to BIFPCL in every phase (pre-construction, construction and operation) of the Rampal Power Plant. In addition, BPDB is also ensuring the environmental compliance monitoring of different stages of the Power Plant construction.

Local Community

19. The Project Affected Peoples (PAPs) were included in the monitoring of social environment. The changes in important socio-economic parameters were examined through Focus Group Discussions (FGDs) and informal discussions with local people at different locations surrounding the project area.

1.5 Major component of monitoring study

20. The Physical, Biological and Social aspect have been monitored on regu basis and the quarterly monitoring report is furnished in the subsequent chapters as follows,

- 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 and agricultural resources monitoring;
- Social environment covers compensation, resettlement/rehabilitation, project related employment generation, labor and working condition, community health, security and safety and corporate social responsibilities.
- Environmental compliance monitoring includes Monitoring of Environmental and Social Management System Action Plan Implementation, Monitoring of labour and working conditions, Monitoring of community health, safety and security and Monitoring of biodiversity and sustainable management of living natural resources.

2. Physical Environment

2.1 Air Quality

21. Air quality is considered to be one of the most important environmental component to be affected by the proposed Project activities. Accordingly, in this pre-monsoon season (**April, 2017**) air quality has been monitored at the preselected sites to understand the seasonal and spatial variation among the air quality parameters as well as pollutant concentrations in the study area.

2.1.1 Methodology

22. Five (**5**) major air pollutants i.e., **Particulate Matters ($PM_{2.5}$, PM_{10}, and SPM), SO_X, NO_X, CO** and **O_3** are expected to be generated from the proposed Power Plant. As such, these were considered for the monitoring study. The monitoring locations have been selected during the EIA study. In this context, eleven (11) sites have been selected based on a number of criteria e.g., the sensitivity of the receptors, project activities like coal-carrying vessel movement, transshipment point etc.; wind direction and atmospheric stability class. Moreover, the potential location of air pollution has been projected on the basis of model generated pollutant dispersion scenario to determine the maximum ground level concentration of potential pollutants which may be emitted from the Power Plant activities. A comprehensive discussion on the ambient air quality has been reported in the following sections. All the parameters were monitored for eight (8) hours and the data has been analyzed by taken into consideration the eight (8) hours concentration.

Method of Sampling and Laboratory Testing

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

Monitoring locations

24. Ambient air quality has been monitored in the same locations as monitored in the earlier quarters except at Hiron point of Sundarbans due to the adverse weather condition. However, the earlier locations as well as recently monitored locations of the air quality monitoring points have been shown in **Map 2.1**. The details of the monitoring plan have been provided in **Table 2.1.**

Pollution sources at Project area

25. The major pollution sources currently contributing to the ambient air pollution along the Passur River in between the Project site and Mongla Port area are the existing infrastructures (i.e., cement and petroleum industries) and other pollution sources are marine vessels and residential sources. These pollution sources are listed in **Table A2** of Appendix **IV.**

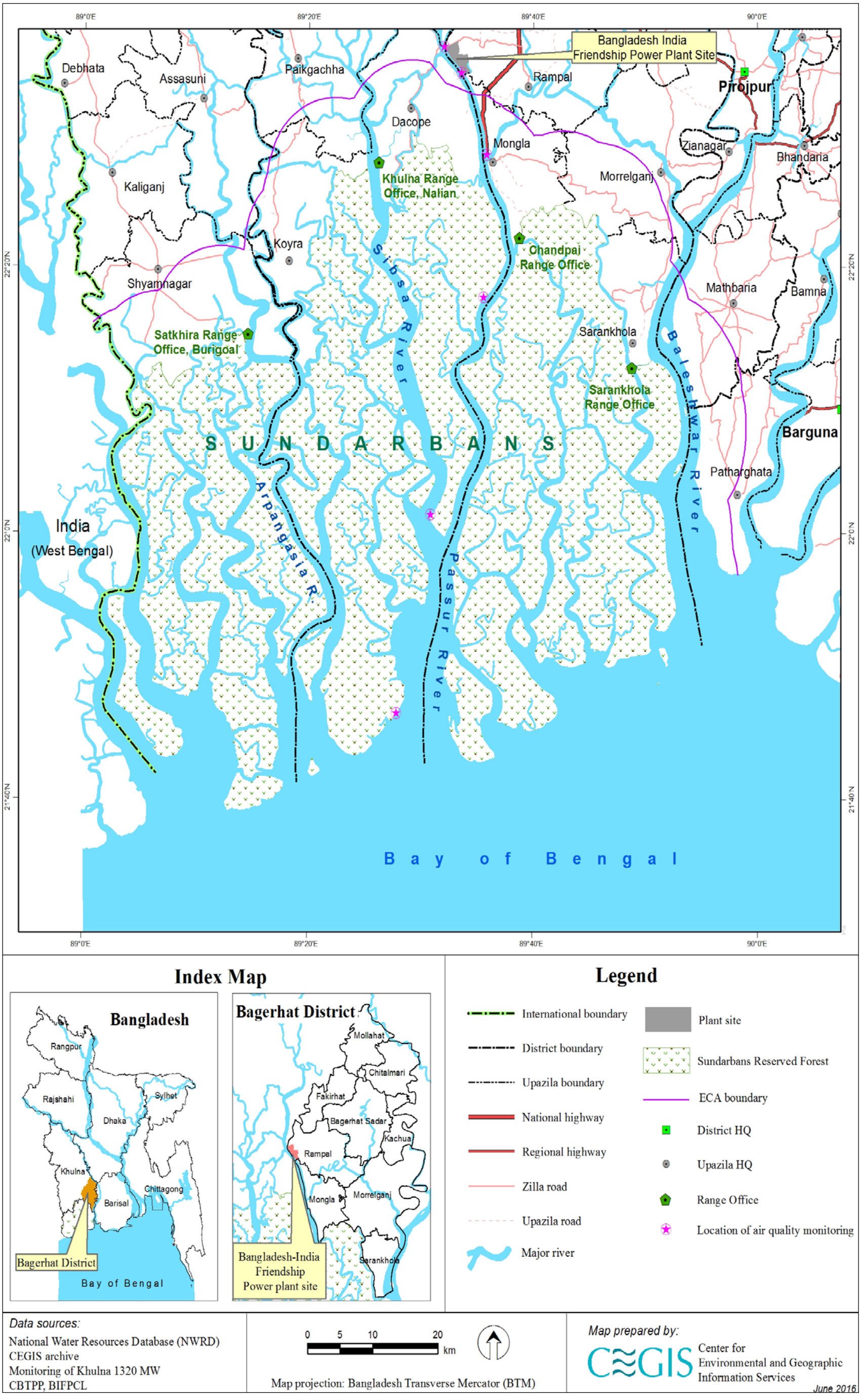
Pollution sources in the Sundarbans

26. Mostly river traffic of Mongla Port travelling across the Sundarbans are the prominent sources of Suspended Particulate Matter (SPM), Oxides of Sulphur (SO_2), Oxides of Nitrogen (NO_x) and Green House Gas (GHGs). Moreover, engine boats and other motorized vehicles for fishing, honey collection, golpata and timber collection activities were also considered as the sources of air pollutant in the Sundarbans area.

27. An inventory of the existing emission types and sources in the study area have been provided in **Table A2** of **Appendix IV**.

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}, 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 year	In situ field measurement conducted with the facilities of outsourced laboratory. **Method of testing $PM_{2.5}$:** Gravimetric **Method of testing PM_{10}:** USEPA (1997) Method 201 or 201A (as appropriate) **Method of testing SO_X:** USEPA (2000) Method 6 or 6A or 6B or ISO (1998) Method 11632 (as appropriate) **Method of testing NO_X:** USEPA (2000) Method 7 or 7A or 7B or 7C or 7D or ISO (1993) Method 10396 (as appropriate).
2		Proposed township area near Chimney location, Mauza: Sapmari Katakhali	89°32'3.8"E 22°36'32.5"N		
3		North West corner of the Project boundary (Kaigar Daskati)	89°33'51.8"E 22°36'1.06"N		
4		Barni, Gaurambha union (4km North East from the chimney location)	89°34'37.7"E 22°38'51.8"N		
5		Chunkuri-2, Bajua Union (4km South West from the chimney location)	89°34'01.1"E 22°32'3.3"N		
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		
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		



Map 2.1: Air Quality Monitoring Locations

2.1.2 Status of air quality

28. 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 current standards are listed below. Units of measurement for the standards are parts per million (ppm) by volume, and micrograms per cubic meter of air (µg/m^3).

Table 2.2: Air Pollutants Emission Standards

Pollutant		Averaging Time	Bangladesh (DoE) Standard for ambient Air (ECR 2005)
Carbon Monoxide (CO)		1 hour	40 mg/m^3
		8 hours	10 mg/m^3
Nitrogen Dioxide (NO_x)		1 hour	-
		Annual	100 µg/m^3
Ozone (O_3)		8 hours	157 µg/m^3
		1 hour	235 µg/m^3
Particulate Matters (PM)	$PM_{2.5}$	24 hours	65 µg/m^3
	PM_{10}	24 hours	150 µg/m^3
	SPM	8 hours	200 µg/m^3
Sulphur Dioxide (SO_2)		24 hours	365 µg/m^3
		Annual	80 µg/m^3

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

29. The values of **$PM_{2.5}$**, **SPM** and **PM_{10}** were found within the standard limit at each location in each of the 12 quarter of the monitoring period. In this 13th monitoring period the concentration of **$PM_{2.5}$** was found maximum (**23.1 µg/m^3**) at Khan Jahan Ali bridge area among all the locations. On the other hand the maximum concentration of **PM_{10}** was found 105 (µg/m^3) at Chalna Bazar area while the lowest concentration (27 µg/m^3) was observed at Vodra khal (Majhar Point). Similarly the concentration of SPM was found maximum at Mongla port area (187 µg/m^3). The concentration of particulate matters were always found higher at Khulna Khan Jahan Ali Bridge. Large number of two-stroke human hauler, small engine boats and the other anthropogenic activities were observed during the time of monitoring which could be the reason for the higher concentration. In addition, cement industries and road traffic might also be considered as the sources of particulate matters around the area. All the monitoring data are given in **Table A1** in **Appendix IV.**

Sulphur Dioxide (SO2)

30. During this monitoring period, the concentrations of Sulphur dioxide (SO_2) in the ambient air were found far below the Bangladesh standard limit of 365 µg/m^3. The maximum concentration (12.9 µg/m^3) was found in Chalna, Dacope area while the minimum concentration (5.5 µg/m^3) was found in Gourambha.

Nitrogen Dioxide (NOx)

31. The values of NOx in Project site and its adjoining areas were found far below the Bangladesh standard limit (100 µg/m^3). The concentration of NO_x was always observed higher at Khan Jahan Bridge in Khulna in all seasons than the other locations. The monitoring results are shown in **Table A1** in **Appendix IV**

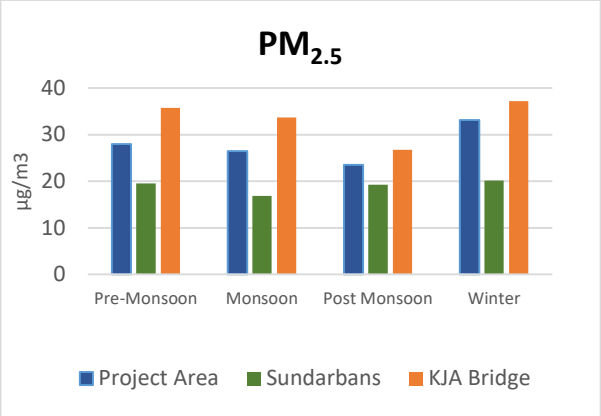
Carbon Monoxide (CO)

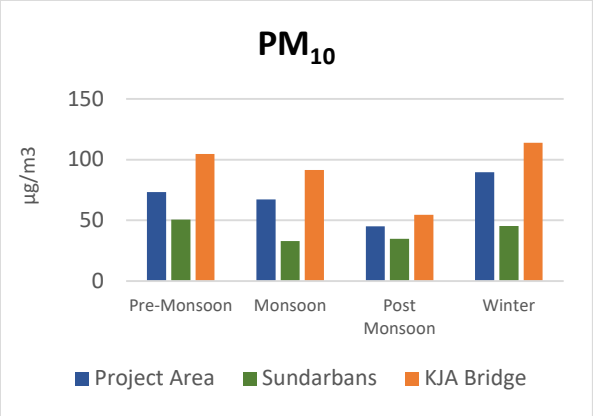
32. The observed concentration of CO at the monitored locations were found lower than the standard values imposed by ECR'97. The value ranged in between 68 µg/m^3 and 94 µg/m^3 in and around Project area and in Sudarbans area against the national standard of 10,000 µg/m^3 for 8 hours. The possible causes for the CO concentration could be the movement of numerous types of vehicles on the roads and boats in the river.

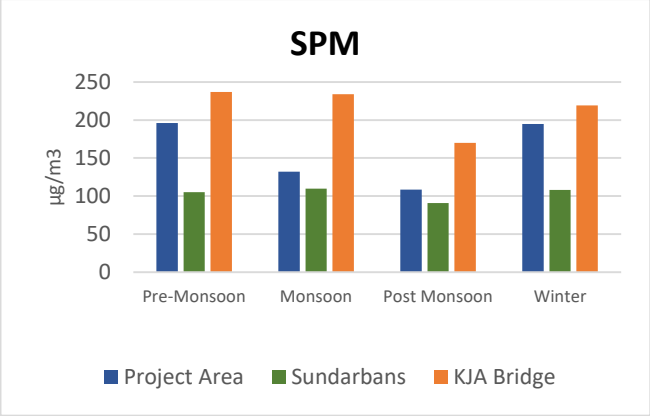
Ozone (O_3)

33. Similarly, results of **O_3** both in the Sundarbans Reserve forest area and Project area were found to be 3 -8 µg/m^3 which were far below than the Bangladesh standards limits of 157 µg/m^3 for 8 hours. In this 13th monitoring study the maximum concentration (8 µg/m^3) was found at township area, Barni and at Harbaria. Mentionable that, the ground-level or "bad" ozone is not emitted directly into the air, but is created by chemical reactions between oxides of nitrogen (NOx) and volatile organic compounds (VOC) in the presence of sunlight.

2.1.3 Findings of the previously monitored data







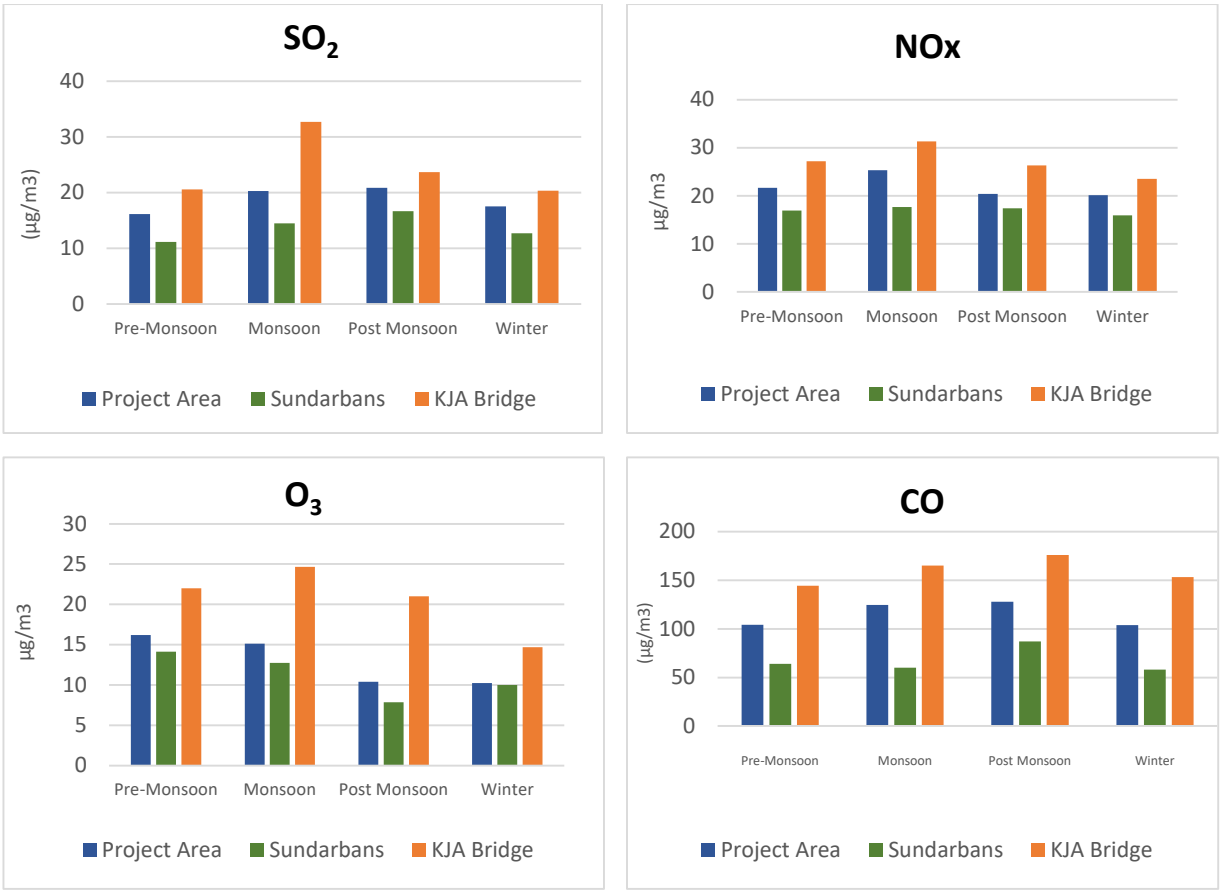


Figure 2.1: Seasonal variation of the Air Quality Parameters

Findings:

34. 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. No anomalies were observed during the monitoring visit as well as in monitoring results. The concentration of all the parameters were found within the limit set by ECR' 97. However, a large number of pollution souces have been observed along the Passur River which are currently contributing in increasing the pollutant's concentration in the surrounding areas.

2.2 Noise

35. Noise is the generated sound that is not desired by the perceiver, because it is unpleasant, loud, or interferes with hearing. By extension, in experimental sciences, "noise" refers to any random fluctuations of sound/noise that makes more difficult the perception of an expected signal. From a physics standpoint, noise is indistinguishable from sound as both are vibrations through a medium, like air or water. In general point of view, noise is the chaotic feeling of sound where many sound waves are mixed and difficult to distinguish a single signal.

36. Noise is described by a weighted sound intensity (or level), which represents sound heard by the human ear and is measured in units called decibels (dBA). Noise is recorded through *Noise Level (Sound Pressure Level) Meter* for determining the ambient noise level in the study area.

37. Noise levels were monitored during 2014 (March, July, October), 2015 (January, April, July, October), 2016 (January, April, July and October) and 2017 (January, April). In this 13th quarterly monitoring, the noise level was recorded at pre-monsoon period. It was evident that the noise was generated from the common sources i.e., the rural vehicles (human hauler/nosimon, auto-rickshaw); whereas in case of the monitoring spot in or around the waterways, the sources were trawler, ship, sometimes waves breaking against the shore, etc. Barges, trawlers and ships were found plying over the waterway during this season.

2.2.1 Methodology

38. Each time noise level was recorded using portable noise level meter for a five minutes time span at 30 seconds interval. Depending on the site condition and acoustic environment, the noise meter was set up and calibrated following the instruction manual. All the data were collected in Leq, L10 and L90 dBA values.

Locations of Noise level Monitoring

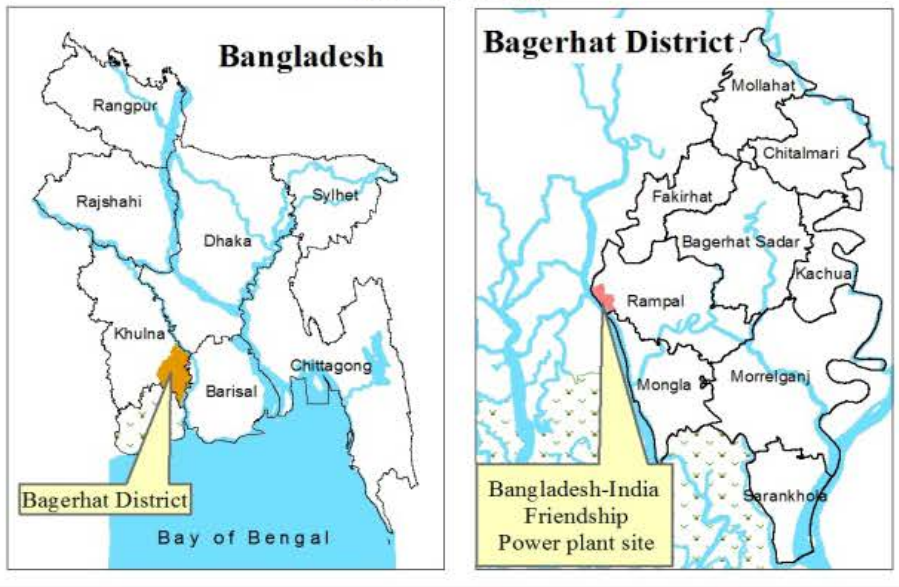
39. Eleven (11) locations were selected for the noise level monitoring of which two locations were inside the Sundarbans Reserve Forest area, six locations are in and around the Project site, one is at Khan Jahan Ali Bridge on Rupsha River and one is at Mongla Port (**Map 2.2**).

Photo 2.1: Professional conducting an ambient noise acquisition survey in Harbaria, 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"E 21°46'27.60"N	Morning, Noon and evening
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

Index Map



Legend

- International boundary
- District boundary
- Upazila boundary
- National highway
- Regional highway
- Zilla road
- Upazila road
- Major river
- Plant site
- Sundarbans Reserved Forest
- ECA boundary
- District HQ
- Upazila HQ
- Range Office
- Location of noise monitoring

Data sources:
National Water Resources Database (NWRD)
CEGIS archive
Monitoring of Khulna 1320 MW
CBTPP, BIFPCL

0 5 10 20 km

Map projection: Bangladesh Transverse Mercator (BTM)

Map prepared by:
CEGIS Center for Environmental and Geographic Information Services
June 2016

Map 2.2: Noise Level Monitoring Locations

2.2.2 Status of Noise

40. The brief summary of Noise level data is appended in **Table 2.3**; but the detailed Noise level data collected from field is provided at Table no. **C1, C2**, **C3** and **C4** in the **Appendix IV**. Ambient noise data were recorded at the following places:

Dacope Upazila Parishad

41. The monitoring location is at Chalna Bazar, Pankhali, Dacope (89.5234°E, 22.6046°N) which is (4km North West from the Chimney location).the place is a commercial area. According to the Environmental Conservation Rules (ECR) 1997, noise level standard for commercial area at day time is 70 dBA. The noise level was recorded as 61.62 dBA which was 08.38 dBA lower than Bangladesh standard limit for corresponding location (**Table 2.3**).

42. The significant noise sources at this place were road traffic and crowd. The road traffics were mostly from locally made engine van (locally called Nosimon), motor bike, easy bike (battery operated tri-cycle), etc.

North West Corner of the Project Area (Kaigar Daskati)

43. The North West (NW) corner of the Project area is under Kaigar Daskati mauza of Gaurambha union. The monitoring location (89.5334°E, 22.6093°N) is near a Gucchha gram (a cluster village built by the Government for the landless and homeless people). This area is residential and the standard noise level for this place is 55 dBA at day time (ECR, 1997). During this monitoring period, the average day time noise level was recorded as 47.19 dBA which was also lower (07.81 dBA) than the standard value like Chalna.

Chunkuri-2, Bajua

44. The monitoring point (89.5669°E, 22.5342°N) in this area lies at 4km South West from the chimney location, is a residential area. The standard value for this area is 55 dB at day time (ECR, 1997). During the time in Apr, 2017, it was found to be 50.44 dBA which was below the standard limit. The noise sources were rural road traffic and crowd. The road traffics were mostly locally made engine van (called as Nosimon), motorcycle, bicycle, van, etc.

South West corner of the Project area

45. The South West corner of the Project area is in Maidara Khal of Rajnagar union. The noise level at the monitoring location in this area (89.5601°E, 22.5761°N) in Apr, 2017 was found to be 43.25 dBA. This area is a residential area and the standard limit of noise is 55 dB at day time (ECR, 1997). The noise level was found much lower (11.75 dB) than the standard value (55 dB). Frequent movement of water vessels over the Moidara Khal was one of the main reasons of noise generation.

Proposed township area of the Project

46. The proposed township site, of the Power Plant at Sapmari is located at the eastern portion of the Project area. This area is residential and the standard is 55 dBA at day time (ECR, 1997). In this monitoring period, noise level at the monitoring point ([89.5644°E, 22.6005°N]) was found to be 42.65 dBA which was almost close (42.62 dBA) to that of the previous monitoring season. The value was far below (12.35 dBA) than the Bangladesh standard.

Barni, Gaurambha

47. Barni, Gaurambha is about 4km North East from the chimney location; which encompasses both residential and commercial area. The standard noise level for a mixed zone is 60 dBA at day time (ECR, 1997). The noise level at this monitoriong point (89.5772°E, 22.6477°N) was found as 44.83 dBA during this monitoring season which was 15.17 dB lower than the Bangladesh standard.

Khan Jahan Ali Bridge, Khulna

48. The monitoring location (89.5935°E, 22.7779°N) is close to the toll booth of Khan Jahan Ali Bridge, Khulna [. This area is a commercial area and the standard for the commercial area is 70dBA at day time (ECR, 1997). The average noise level was found 56.72 dBA which was far below (13.28 dB) than the Bangladesh standard of day time. The highway traffic was the main source of noise grneration.

Mongla Port area

49. The monitoring location (89.5936°E, 22.4916°N) is at Khulna-Mongla highway, 200m north-ward from the main entrance of the Mongla Port area. The area is industrial and the standard for the industrial area is 75 dBA at day time (ECR, 1997). The average day time noise level was 47.61 dBA which was 27.39 dBA lower than the Bangladesh standard value for this location.

50. The sources of noise were mostly road traffic (heavy vehicles, light vehicles, Nosimon, etc) and noise from Mongla Port activities (crane, ships, etc).

Harbaria, Sundarbans

51. Harbaria area of the Sundarbans is very critical considering the richness of biodiversity. This area is within the important navigation route of Mongla Port Area. Most of the sea going vessels was used to anchor at this site for lighterage operation. The area is under silent class of noise standard and standard limit of ambient noise at day time is 50 dBA (ECR, 1997). The noise level was measured to be 54.10 dBA in this monitoring period at 100m inside the forest on the right bank of the Passur River (89.5926°E, 22.2968°N) to avoid the disturbance of noise from wave breaking against the shore. The value was found higher (04.10 dBA) than day time standard value.

52. Distant ship movement, running engines of anchored ships, wind, birds, wave and wind action on tree leaves were the main sources of noise.

Akram point, Sundarbans

53. Akram Point of the Sundarbans is another biodiversity hot spot in the Sundarbans. This area was selected for anchorage point of coal carrying mother vessel for the Power Plant. The area is also under the silent class for which the ambient day time noise standard is 50 dB. The monitoring location (89.5152°E, 22.0219°N) is at the left bank of the Sibsa River. Noise was recorded as 100m inside the forest from the river bank to avoid noise from wave breaking. The average day time ambient noise level during this monitoring season was found to be 44.30 dBA which was lower (05.70 dBA) than that of Bangladesh standard value. Birds' chirping, stormy wind, wave and tree leaves were the main sources of noise here.

Table 2.4: Summary of the ambient noise recorded in consecutive thirteen (13) Quarter monitoring sessions during 2014, 2015, 2016 & 2017

Sl No.	Location	QM1 Mar-14	QM2 Jul-14	QM3 Oct-14	QM4 Jan-15	QM5 Apr-15	QM6 Jul-15	QM7 Oct-15	QM8 Jan-16	QM9 Apr-16	QM10 July-16	QM11 Oct-16	QM12 Jan-17	QM13 Apr-17	Std*
1	Chalna, Dacope	68.13	52.87	54.63	53.28	57.08	49.77	65.12	66.07	65.08	52.42	65.51	59.29	61.62	70
2	NW Corner of the Project area	51.89	NM	41.92	35.25	44.67	41.56	41.94	50.96	50.79	52.65	55.48	44.52	47.19	55
3	Chunkuri-2, Bajua	57.76	52.55	51.39	49.29	47.05	40.66	47.43	53.62	44.49	53.4	51.55	55.31	50.44	55
4	SW corner of the project area	49.2	47.6	45.95	36.03	43.58	43.75	42.7	60.44	54.50	65.37	48.51	45.19	43.25	55
5	Proposed Township area(Sapmari), project site	48.75	46.68	41.92	41.47	41.47	46.75	50.52	53.77	53.37	55.79	43.69	42.62	42.65	55
6	Barni, Gaurambha	58.84	49.95	49.78	43.6	54.17	46.18	55.16	59.16	53.97	56.75	54.91	49.05	44.83	60
7	Khan Jahan Ali Bridge, Khulna	71.7	60.8	66.28	61.72	73.45	52.82	64.25	68.45	65.85	63.77	60.95	55.57	56.72	70
8	Mongla Port area	61.24	53.84	60.5	38.69	48.15	39.61	47.01	52.7	49.88	52.86	49.86	48.95	47.61	75
9	Harbaria, Sundarbans	40.88	56.13	55.3	34.38	65.37	35.03	50.75	45.2	44.55	52.9	55.33	41.18	54.10	50
10	Akram Point, Sundarbans	40.94	47.9	43.98	34.32	54.86	NM	49.6	42.95	42.95	47.96	41.77	38.08	44.30	50
11	Hiron Point, Sundarbans	38.63	51.29	47.98	37.37	47.84	NM	46.06	NM	43.11	NM	44.38	42.29	NM	50

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

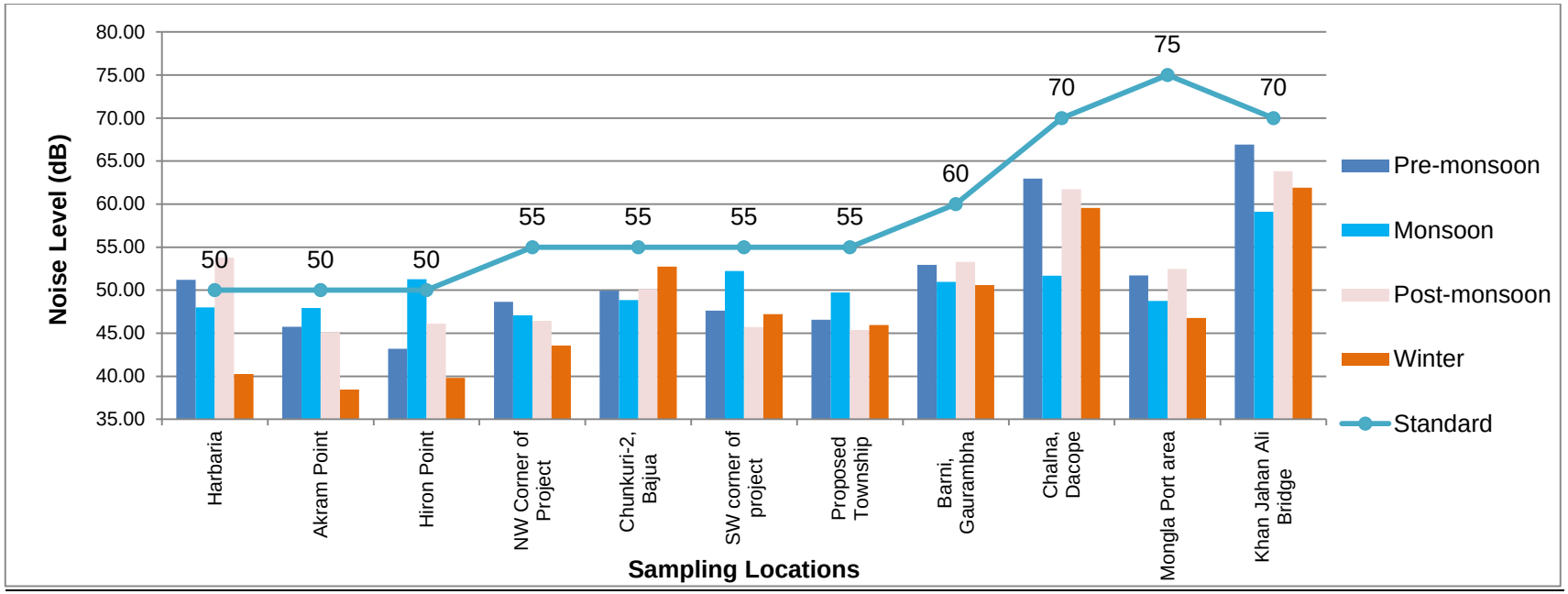


Figure 2.2: Seasonal variation of Noise level at different locations

2.2.3 Findings

54. In the study area, noise generation sources can mainly be divided into two types; one is natural and the other one is anthropogenic. Natural sources are birds' chirping, stormy wind, wave breaking on the shoreline, howling of leaves and so on. On the other hand traffic mobilization, industrial activities, vessel movement within the rivers and local vehicles are the salient sources of anthropogenic noise. However, in this monitoring season (**13th quarter**); the observed noise level was exceeded only at one place i.e. at Harbaria and it was 04.10 dBAhigher than the Bangladesh Standard (**Figure 2.2 and Table 2.3**). It was observed that the noise level at Harbaria point had crossed the standard value in seven seasons among the thirteen monitoring seasons. The reason might be due to distant ship movement, running engines of anchored ships, wind, birds, noise from wave breaking against the shore and wind action on tree leaves. On the other hand, it was found that noise level at three locations namely Chalna under Dacope upazila, Barni (Gaurambha), and Mongla Port area had never crossed the Bangladesh standard limit for their corresponding value.

2.3 Water Quality

55. An updated status of various parameters of water quality status of the Passur Sibsa River system has been incorporated in this section. The entire monitoring activities and analyzing methodologies were adopted following both the national and international guidelines. This report includes in-situ data of some water quality parameters collected during **April, 2017** (**13th quarterly monitoring visit)** and the available laboratory tested data obtained up to January, 2017 **(12th quarterly monitoring visit)**. The quality of both surface water and ground water at the respective locations were monitored. A number of identical parameters are chosen to understand the quality of the water for community use, aquatic life, and the Sundarbans forest ecosystem.

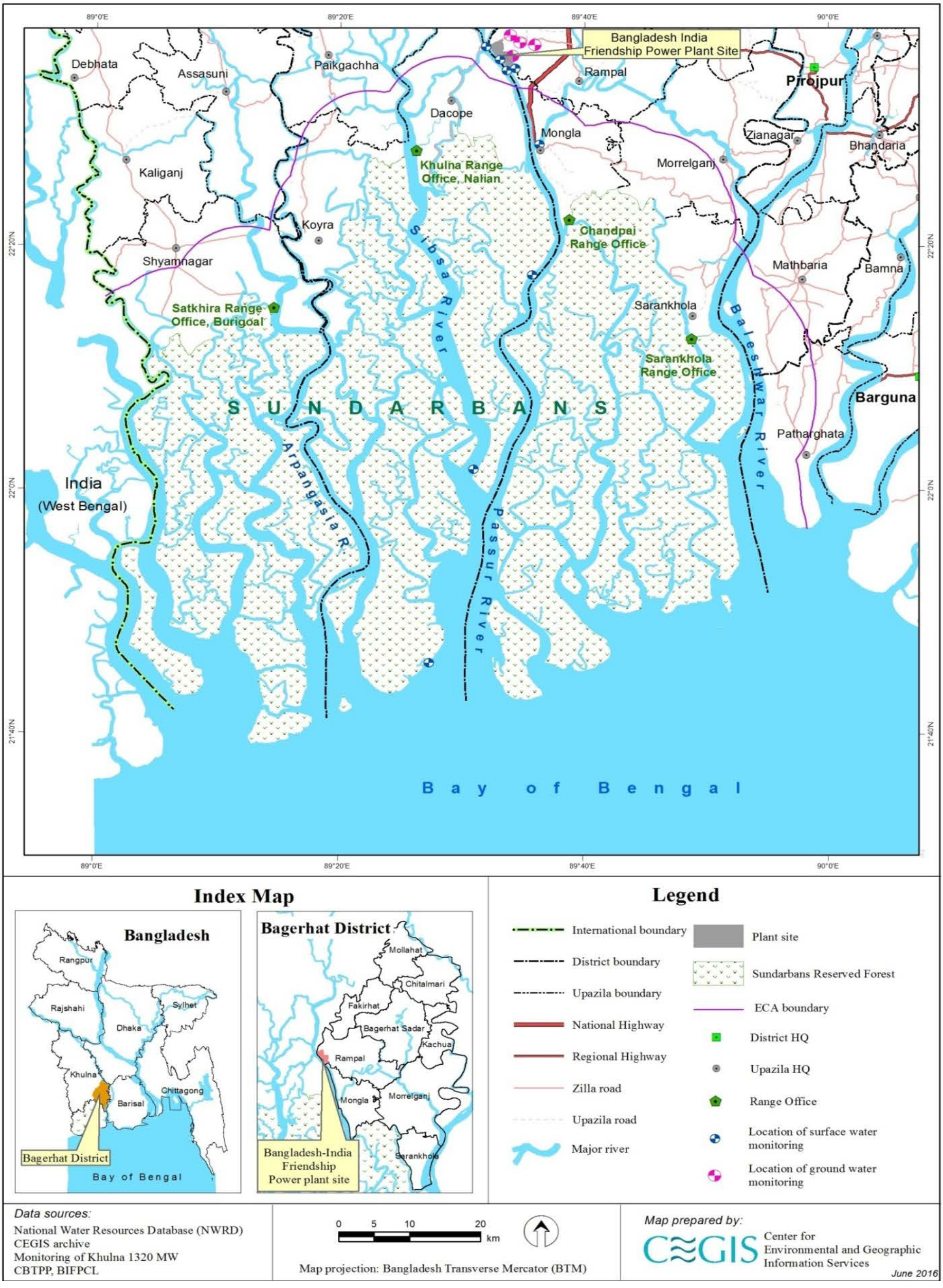
2.3.1 Methodology

56. Monitoring of water qualitycovers the water quality parameters, sampling locations, sampling frequency, evaluation criteria etc. Standard practices were followed for analyzing the water quality parameters. Both the surface and ground water quality status in and around the Power Plant and the Sundarbans area have been examined. The monitoring results have not only been presented but also been compared with the national standards (ECR, 1997 and all amendments).

57. The samples have been collected from Seventeen (17) preselected locations (14 locations for surface water along Passur River, Sibsa River, Maidara River, near the proposed township area, and three locations for groundwater around the study area). The selected monitoring locations for the current monitoring program are shown in **Map 2.3**. The sampling locations are preliminarily selected at inception stage and finalized during the 1st monitoring study. The details of the monitoring plan (selected water quality parameters, sampling locations, and frequency of sampling at each location) for surface water is shown in **Table 2.4** and for groundwater in **Table 2.5.**

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 and Laboratory analysis (TDS, TH, TSS, COD, Nitrate, Sulphate, Phosphate, Arsenic, Lead, Mercury, Oil & Grease). BOD_5 was 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 cornerof 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				



Map 2.3: 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 (April, July, October, January)	In-situ measurement (pH, Temperature, Salinity, DO) and Laboratory analysis (COD, As, Hg, Pb, TH, TDS, TSS, Nitrate, Sulphate, Phosphate)
2	Rajnagar	22.612528° N	89.576056° E		
3	Kalekarber	22.609306° N	89.596278° E		
4	Kapasdanga	22.622528° N	89.563000° E		

Sampling Procedure

58. The standard sampling procedure has been followed for both surface and groundwater sampling to reduce the probability of error. Each sample was tagged at the time of sampling.

Photo 2.2: Professional is collecting water samples at Harbaria of Sundarbans

Surface Water Sampling Procedure

59. Firstly, the study area is highly influenced by tidal variation. Hence, temporal and spatial variations of tides have been considered significantly in sampling procedure. Surface water samples were collected at 50 m away from the riverbank and at a depth of 6 cm below the river surface during the low tides or relative slag period after the low tide.. For oil and grease, samples were collected from the river surface. The individual sampling bottle was rinsed with respective water samples before storing. Acidified sampling bottles were used for heavy metal (As, Pb, Hg) analysis and wrinkle bottles were used for BOD_5. All the samples were preserved as per standard procedure.

Groundwater Sampling Procedure

60. Groundwater availability depends on the infiltration rate and transmissibity of aquifer, seasonal variation in water table, excessive water extraction from nearby agricultural field etc. 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 storing. Acidified sampling bottles were used for heavy metal (As, Pb, Hg) analysis and were preserved following standard procedure.

Photo 2.3: professional is taking reading of water parameter at Mongla-Passur confluence

Parameters tested for water quality

61. Water quality parameters were selected on the basis of tentative potential impacts to be generated during pre-construction, construction and operation phases of the Power Plant Project. Only four parameters namely pH, temperature, salinity, DO and BOD_5 were tested in-situ. BOD_5 could not be tested in the laboratory as transportation time of sample for BOD_5 test is only 6 hrs, which was not possible in this study. The sampling location is within the Sunderbans Reserve Forest area from where it takes almost a day to carry the sample to the nearest laboratory i.e. at Dhaka, since there is no laboratory nearby the sampling locations. Hence water sample was kept in specified bottle for 5 days for natural incubation. The difference of 5 day's DO and in-situ DO was considered as BOD_5.Samples of rest of the preselected parameters were collected and further analyzed in the laboratory.

Surface Water Quality Parameters

62. The selected parameters for surface water quality includes 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, NO^{3-}, PO_4^{3-} and SO_4^{2-}
- Aggregate organic constituents i.e. BOD, COD
- Heavy metals i.e. As, Pb and Hg

Groundwater Quality Parameters

63. The parameters of ground water quality include Dissolved Oxygen (DO), Chemical Oxygen Demand (COD), Heavy Metals (As, Pb, Hg), pH, Salinity, Hardness, Nitrate (NO3), Total Dissolve Solids (TDS), Total Hardness (TH) and Temperature.

Water quality analysis procedure

64. The collected samples of selected water quality parameters were analyzed as per the procedure of American Public Health Association (APHA) standard. The analysis procedures along with the standards have been appended in **Table 2.6**.

Table 2.7: Testing Methodology of Water Quality Parameter

Parameters	Methods/Measuring Tools	Unit	BD Standard (ECR 1997)
Temperature	Horiba U-50 multimeter	^0C	20 - 30
pH	Horiba U-50 multimeter	mg/L	6.5-8.5
TDS	Horiba U-50 multimeter	ppm	1000
TSS	Horiba U-50 multimeter	ppm	10
Salinity	Horiba U-50 multimeter	ppt	
DO	Horiba U-50 multimeter	ppm or mg/l	6
BOD_5	5-Day BOD Test at 20^0C	ppm or mg/l	50 (SW)

Parameters	Methods/Measuring Tools	Unit	BD Standard (ECR 1997)
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	6
Nitrate (NO_3^-)	UV-VIS Spectrophotometers	ppm or mg/l	10
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

2.3.2 Status of the surface water quality

In-situ tested parameters

(a) pH

65. During this monitoring season pH values ranged between 6.8 and 7.8 among the monitoring sites. The highest value was found at Middle of Passur River at Project site-Jetty while the lowest value was observed at at Ichamoti-Maidara confluence at the South East corner of the Project boundary. The results were in close conformity among all the locations and the monitoring results of the same period of previous years.

66. pH values of pre-monsoon and monsoon seasons were found to be comparatively lower than post-monsoon and winter seasons. During post monsoon and winter seasons, river flow and level normally get reduced because of less rainfall and less inflow from u/s (upstream) of Passur-Sibsa RS (River System). As a result, pH values became higher than pre-monsoon and monsoon seasons, which was 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 CO2 by photosynthesis through bicarbonate degradation, dilution of waste with fresh water, reduction in salinity and temperature, and decomposition of organic matter (Rajasegar, 2003).

67. No significant pH differences were observed except spatial variation in the river water. Seasonal variations in pH concentrations among the selected monitoring locations during the quarterly monitoring programs of first, second and third year of Passur-Sibsa RS are presented in **Figure-2.3** and all the observed dataset are attached in **Table B.1** of **Appendix-IV.**

(b) Temperature

68. The monitoring results of temperature of this quarter show close conformity with the previously monitored values in the same season. The latest values varried from 29.8^{0}C to 31.3^{0}C among the monitored locations. During all the monitoring period maximum temperature

was found in July 2014 and might be due to the temperature rise in the month of June & July (Summer Season). But all the observed values were found to be within the BD standard (20^oC-30^oC).

69. 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 data. However, it was foumd from the observed data that the average temperatures were similar to all the other seasons' value. No significant spatial variation was observed during the monitoring periods. The measured temperature values of selected monitoring locations during quarterly monitoring programs The measured temperature values of selected monitoring locations during the quarterly monitoring programs of first, second and third year are presented in **Figure-2.4** and all the observed dataset are attached in **Table B.2** of **Appendix- IV**

(c) Salinity

70. The observed salinity values varried from 5.9 ppt to 19 ppt during this monitoring period and the maximum value was observed at Akram point in the Sunderbans while minimum value (5.9 ppt) was observed at Middle of Passur River at 100m u/s of North West corner from the Project boundary. During his monitoring period fresh water flow from upstream was found minimum and thus the tidal inflow acted as a dominant factor in increasing the salinity level. However, the observed values are found similar in the same seasons of the previous years. The highest average were found in pre-monsoon season of the previous years. Water salinity data at the selected sampling stations of Passur-Sibsa RS of the thirteen consecutive periods are presented in **Figure: 2.5** and all the observed dataset are attached in **Table B.3** of **Appendix- IV.**

(d) Dissolved Oxygen

71. The DO concentrations in the monitored locations were found in between 6.4 mg/L and 7.5 mg/L. The maximum value was found at Right Bank of Passur River at Project site-Jetty while the lowest amount was recorded at Left Bank of Passur River at South West corner of the Project boundary.It may be mentioned that the maximum concentrations were observed during monsoon and post monsoon than the other seasons. These higher values of DO in the upstream stations could be due to availability of DO enriched freshwater.Seasonal variations of DO at the monitoring sites of Passur-Sibsa RS are shown in **Figure: 2.6** and all the observed dataset are attached in **Table B.4** of **Appendix- IV**.

(e) Biochemical Oxygen Demand (BOD5)

72. The BOD_5 values ranged from 2.1 to 3.4 mg/L. Maximum value of BOD_5 was found at Ichamoti-Maidara confluence at the South East corner of the Project boundary while the lowest of 2.1 mg/L was observed at Left Bank of Passur River at 100m u/s of North West corner of the Project boundary. However, all the values were found to be within the standard limit as stated in the ECR' 1997 and in IFC standard.

73.

74. It is also evident from the figure that the highest average value was recorded in Passur-Mongla confluence during monsoon season because the river received huge amount of organic load and agricultural runoff from the adjacent areas. Thus, BOD_5 has been found

higher during summer season than monsoon and the least during winter. The water temperatures normally records low in winter season than those of pre-monsoon, monsoon and post monsoon seasons, which in turn decreases the bacterial and microbial activities and reduces level of BOD_5.

75. The BOD_5 values at different monitoring locations during the monitoring of Passur-Sibsa RS are presented in **Figure: 2.7** and all the observed dataset are attached in **Table B.5 of Appendix- IV.**

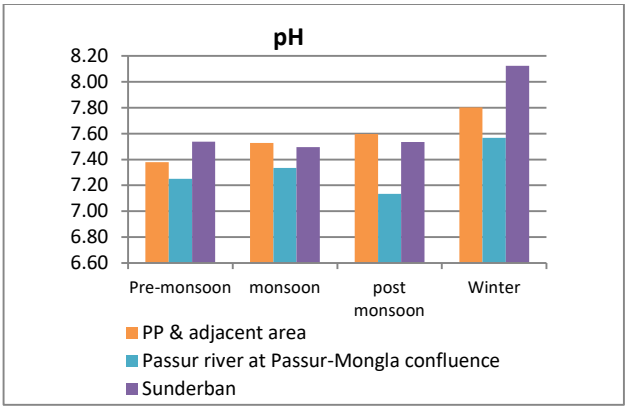


Figure 2.3: Variations in average pH values in sampling spots for the consecutive seasons

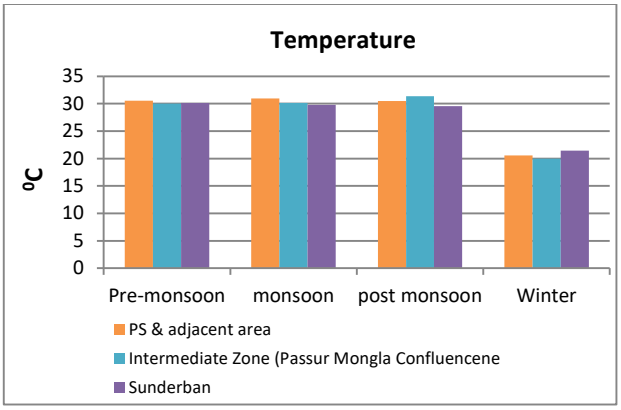


Figure 2.4: Variations in average temperature values in sampling spots for the consecutive seasons

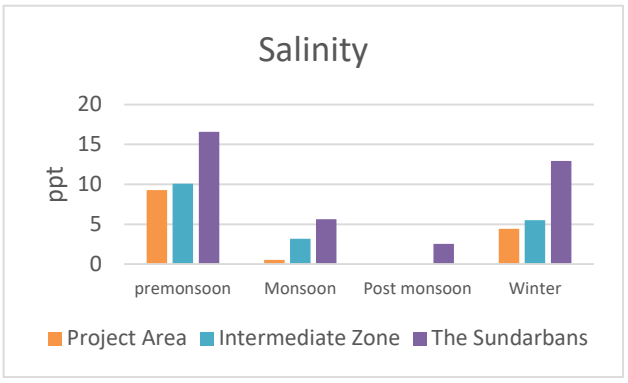


Figure 2.5: Variations in average salinity values in sampling spots for the consecutive seasons

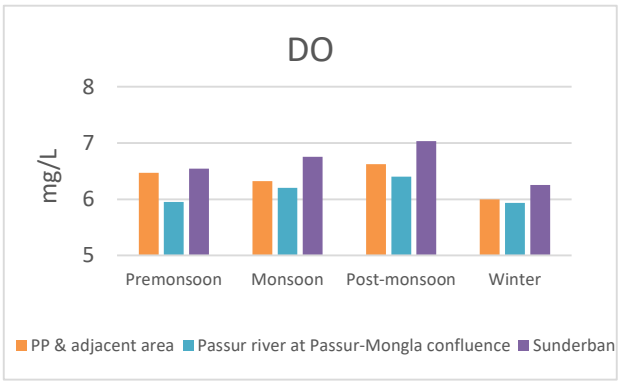
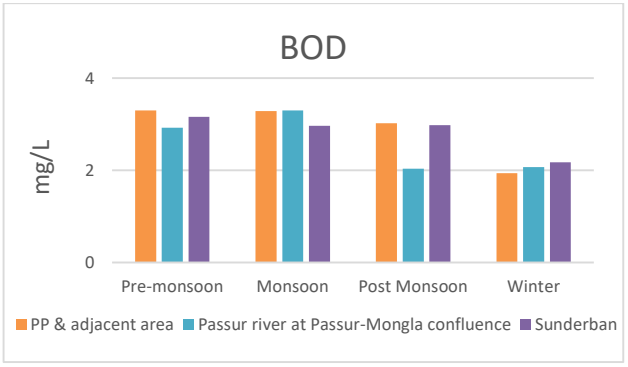


Figure 2.6: Variations in average DO values in sampling spots for the consecutive seasons



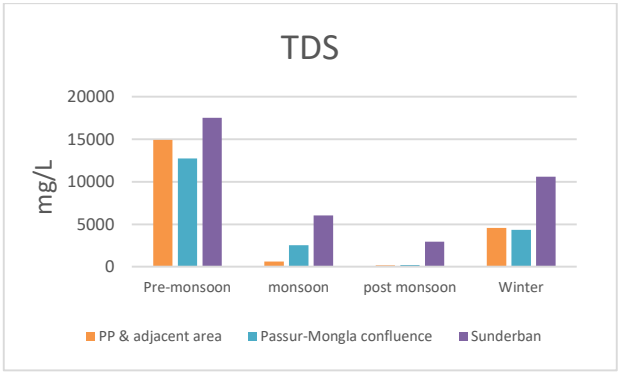


Figure 2.7: Variations in average BOD_5 values in sampling spots for the consecutive seasons

Figure: 2.8: Variations in average TDS values in sampling spots for the consecutive seasons

Laboratory tested parameters

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

76. TDS mainly indicates the presence of various kinds of minerals like ammonia, nitrite, 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***).The observed values of TDS in this monitoring period varied from 3100 mg/L to 17000 mg/L. TDS values were found lower than those observed in the previously obtained data of the same season of 2014 and in 2015. The lowest value was found in Left Bank of Passur River at 100m u/s of North West corner of the Project boundary while the highest value of 17000 mg/L was observed at Akram point in the Sundarbans. This could be due to proximity to the sea water and the erosion-accretion process of the river

77. In most of the observed locations, the TDS concentrations seemed to be lower in monsoon and post monsoon period and higher in pre-monsoon and winter season.

78. The highest and lowest concentration of Total Hardness were found to be 915 mg/L and 3550 mg/L and observed at Middle Passur River at Project site-Jetty and in Passur River at Hiron point in the Sundarbans Reserve forest area respectively. During the rainy season, the hardness in all monitoring stations in Passur River were found to be lower whereas it was found remarkably higher in pre-monsoon season. Because, in general cases the hardness is found to be higher in monsoon season but in Passur River it is found higher in pre monsoon season due to the saline water intrusion to the upstream in this season (***Rahman et al., 2013***).

79. TSS includes solid materials of organic and inorganic in origins which are suspended in water. In Passur and Sibsa Rivers system the suspended matters generally contain sand, clay, silt and loam. During the 12th monitoring period, the TSS concentrations among the monitoring locations varied from 37 mg/L to 61 mg/L. The highest value was found at Middle Passur River at Project site-Jetty while the lowest value was found in Passur River at Hiron point of Sunderbans. TSS values in every spots were found to be within the Bangladesh standard limit of 150 mg/L (ECR, 1997) for inland fresh water. The monitored values were found to be lowest in this pre-monsoon season of 13th monitoring period compared to the other values recorded in the previous seasons of the monitoring years.

80. On the other hand, the values are found to be relatively higher in pre-monsoon season than those of monsoon. During dry season (pre-monsoon and winter season), the TSS value increases, probably due to less fresh water flow, urban runoff, industrial wastes, bank erosion, bottom feeders (such as carp), algae growth or wastewater discharges. In Mongla-Passur confluence the concentration is very high which could be due to the heavy load of marine vehicles, and Mongla Port Authority's development work, and most importantly the domestic and industrial runoff from the adjacent areas.

81. The TDS, TH and TSS of Passur River in pre-monsoon, monsoon, post-monsoon and winter seasons at different monitoring locations are presented in **Figure: 2.8, 2.9** and **2.10** respectively and all the observed dataset are attached in **Table B.8, Table B.9** and **Table B.10** of **Appendix- IV respectively..**

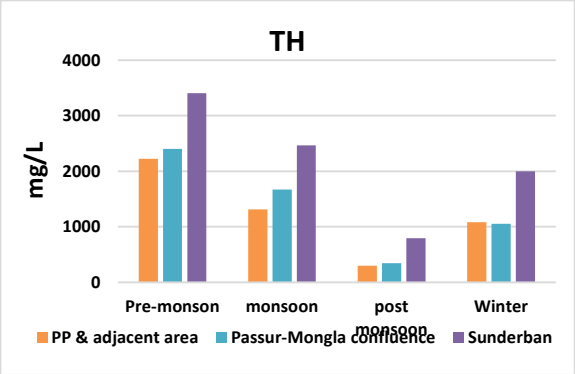


Figure 2.9: Variations in average TH values in sampling spots for the consecutive seasons

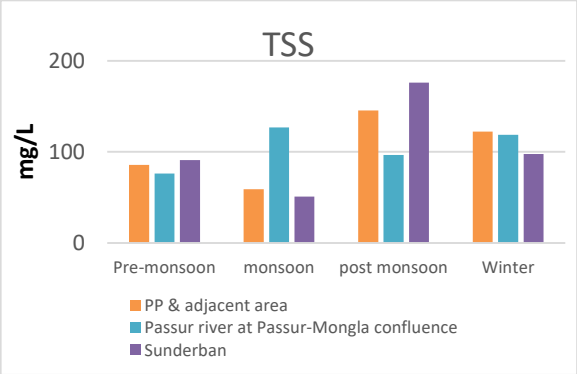


Figure: 2.10: Variations in average TSS values in sampling spots for the consecutive seasons

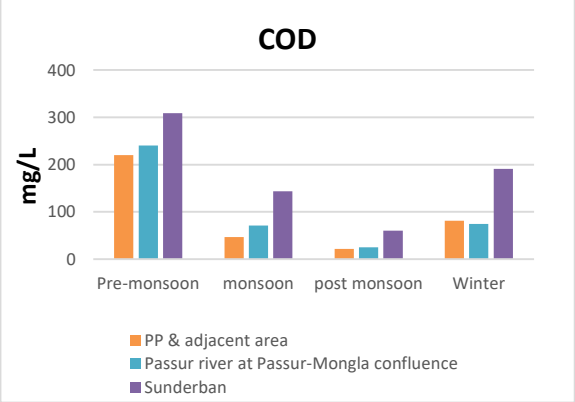


Figure 2.11: Variations in average COD values in sampling spots for the consecutive seasons

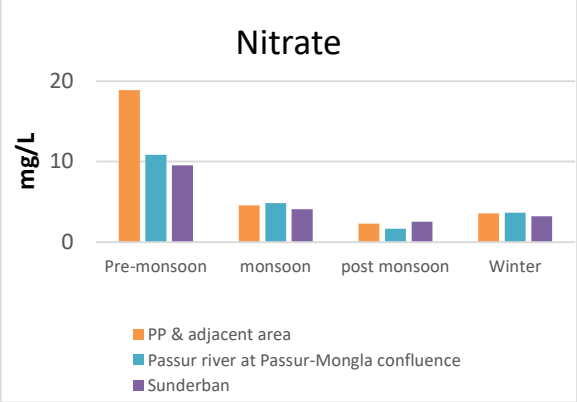


Figure 2.12: Variations in average Nitrate values in sampling spots for the consecutive seasons

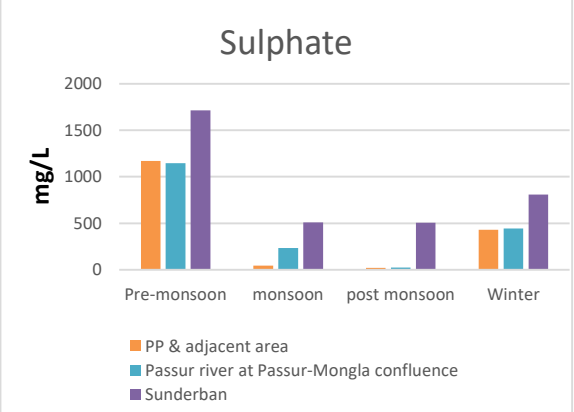


Figure 2.13: Variations in average Sulphate values in sampling spots for the consecutive seasons

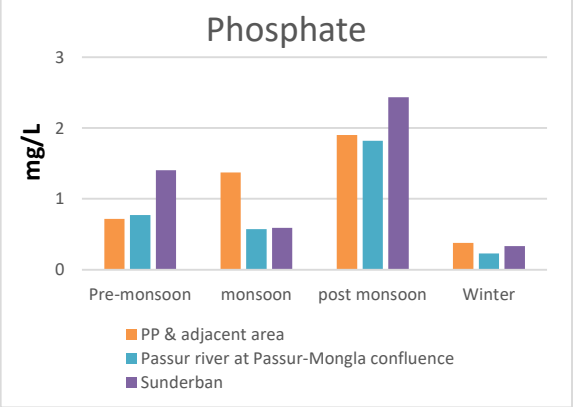


Figure 2.14: Variations in average Phosphate values in sampling spots for the consecutive seasons

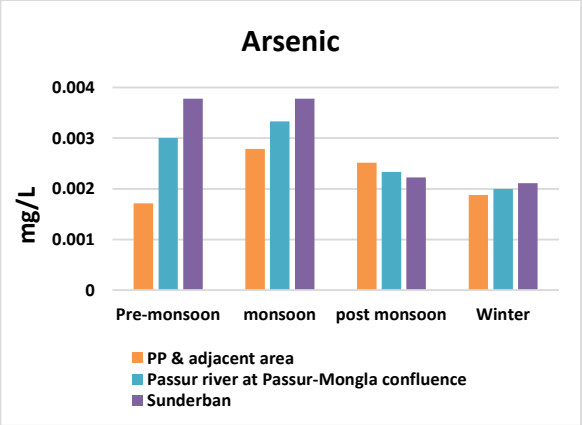


Figure 2.15: Variations in average Arsenic values in sampling spots for the consecutive seasons

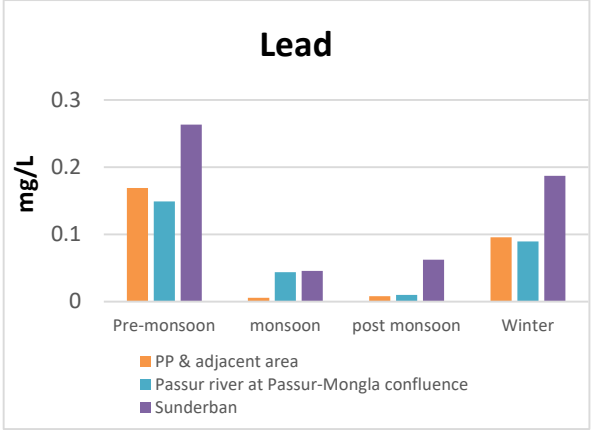


Figure 2.16: Variations in average Pb values in sampling spots for the consecutive seasons

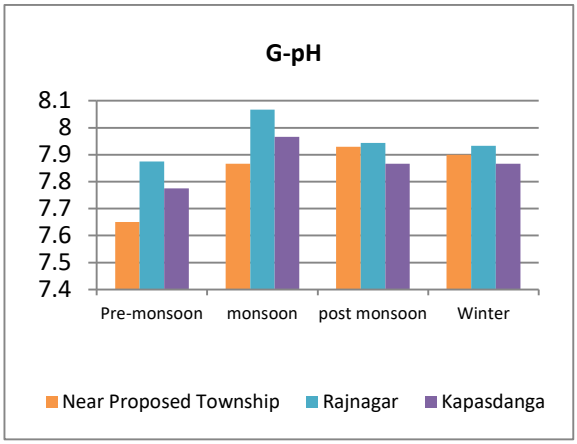


Figure 2.17: Variations in average G-pH values in sampling spots for the consecutive seasons

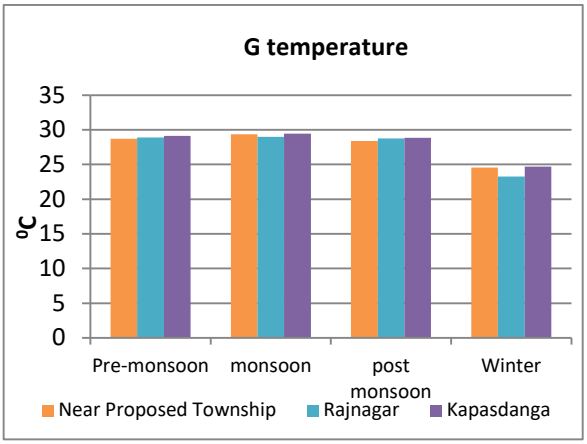


Figure 2.18: Variations in average G-Temperature values in sampling spots for the consecutive seasons

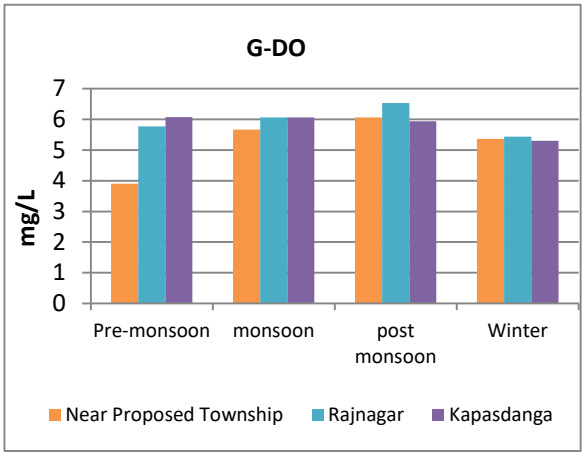


Figure 2.19: Variations in average G-DO values in sampling spots for the consecutive seasons

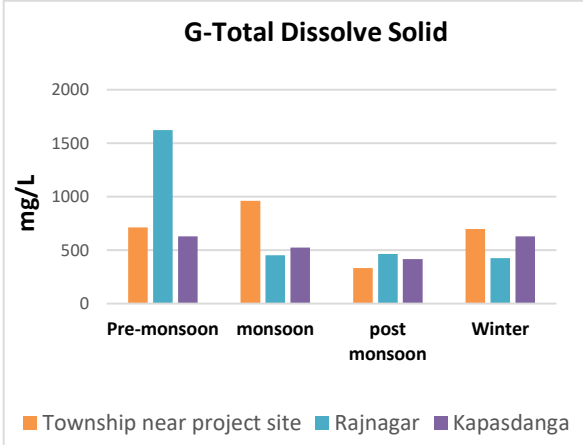


Figure 2.20: Variations in average G-TDS values in sampling spots for the consecutive seasons

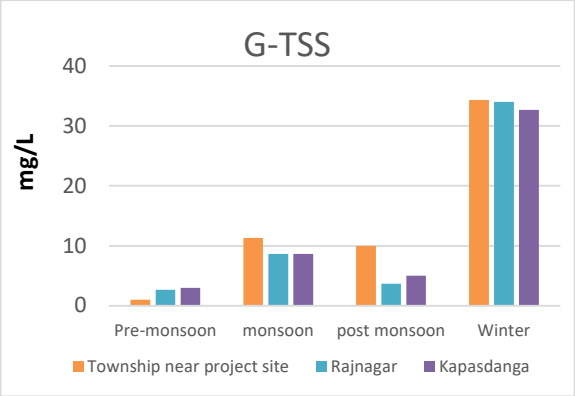


Figure 2.21: Variations in average G-TSS values in sampling spots for the consecutive seasons

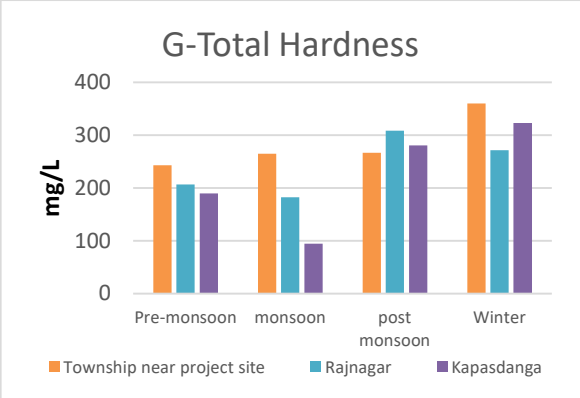


Figure 2.22: Variations in average G-TH values in sampling spots for the consecutive seasons

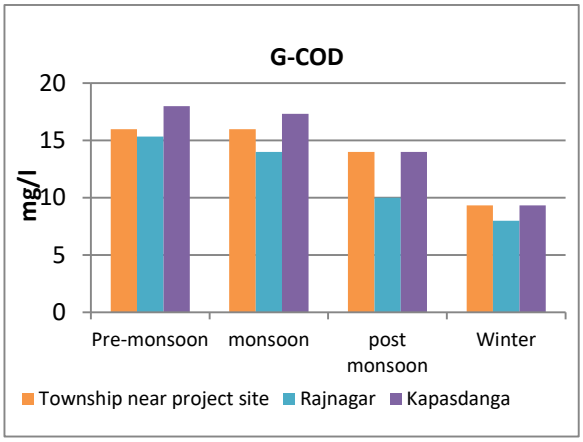


Figure 2.23: Variations in average G-COD values in sampling spots for the consecutive seasons

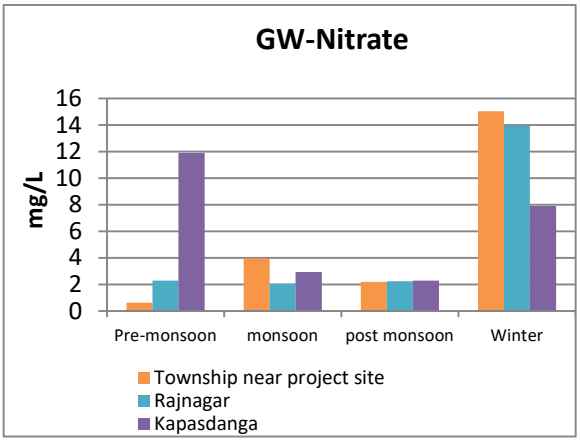


Figure 2.24: Variations in average G-Nitrate values in sampling spots for the consecutive seasons

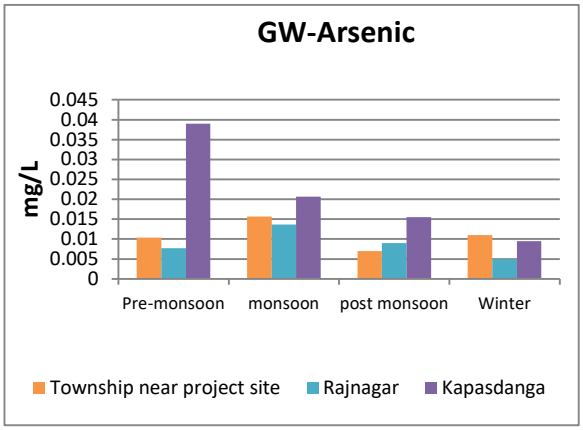


Figure 2.25: Variations in average G-Arsenic values in sampling spots for the consecutive seasons

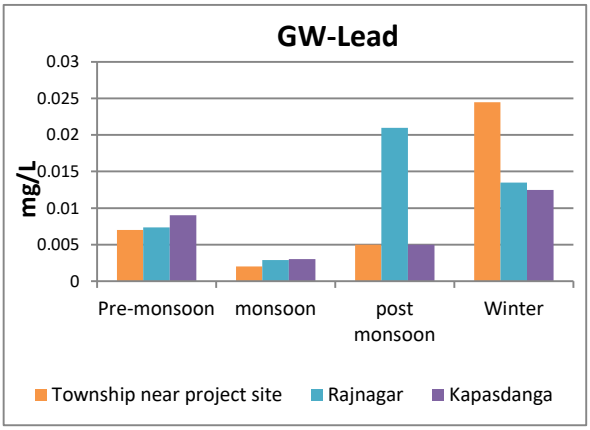


Figure 2.26: Variations in average G-Lead values in sampling spots for the consecutive seasons

(b) Chemical Oxygen Demand

82. COD is an indicator of organic pollution, which is caused by the inflow of domestic, livestock and industrial waste that contains elevated levels of organic pollutants (***Ayati, 2003***). Generally, COD was found higher in Passur-Sibsa RS as it received high amount of organic matter from the Sundarbans forest area and adjacent community.

83. It was observed from data of all the spots that the values of COD varied from 40 mg/L to 288 mg/L in this monitoring period among all the spots. The highest amount was found at Hiron points of the Sundarbans area which could be due to the dumping of household wastes from the nearby places. The lowest were recorded at Middle Passur River at 100m u/s of North West corner of the Project boundary. The high values of COD indicate high levels of organic pollution in the river water (Sivasubramanium, 1999). Moreover, a large scale industrial activity was found taking place along the left bank of Passur River from Chalna to Harbaria, which might also contribute to the high concentration of COD.

84. The COD concentrations of pre-monsoon and winter seasons (dry) were found higher than monsoon and post-monsoon seasons. In monsoon, higher discharge diluted the COD load in the river which in turn reduced COD concentration in post monsoon. all the observed variations among the dataset are shown in **Figure: 2.11** and are provided in **Table B.6 of Appendix- IV.**

(c) Nitrate, Sulphate and Phosphate

85. Among the monitoring locations, the nitrate values varied from 1.87 mg/L to 3.64 mg/L. The maximum value of nitrate (3.64 mg/L) was recorded in Left Bank of Passur River at South West corner of the Project boundary. This may be due to the dumping of bilge water from numerous ships and fishing boats. On the other hand the lowest value of 1.87 mg/L was recorded at Right Bank of Passur River at 100m u/s of North West corner of the Project boundary. The results obtained from all the monitoring locations were found within the standard concentration stated in ECR'1997. The highest values were found in pre-monsoon season of 1st quarter of 2nd year, which could be due to the higher amount of surface and groundwater runoff, dissolution of nitrogen-rich geological deposits, and biological degradation of organic matter (***Spencer, 1975; Kinne, 1984; Gleick, 1993; Wetzel, 2001; Rabalais, 2002***).

86. Naturally, SO_4^{2-} concentration is higher in sea water as well as in river in coastal region due to the tidal interaction with water bodies. The monitored dataset substantiate this fact i.e., SO_4^{2-} concentration of Passur-Sibsa RS increases in the direction of downstream from upstream. The highest value of1120 mg/L of sulphate was found in Hiron point while the lowest value of 160mg/L.was found at Ichamoti-Maidara confluence at the South East corner of the project. However, all the observed value of Sulphate (SO_4^{2-}) were found within the standard limit of 400 mg/ specified in ECR, 1997. The SO_4^{2-} concentrations.

87. In monsoon and post monsoon seasons were found comparatively lower, which could be due to dilution by upstream fresh water flow.

The values of PO_4^{2-} were foundin between 0.0.04 and 0.26 mg/L which were relatively similar to that of the results of pre-monsoon period in the previous years. The highest value was observed in pre-monsoon period of 2014. The reason may be the discharge of bilge water from numerous ships and fishing boats, agricultural and industrial runoff. However, all the observed values are found to be within the standard limit of 6 mg/L, specified for surface water. The recorded low phosphates value during dry seasons could be attributed to the limited flow of freshwater from upstream, high salinity and utilization of phosphate by phytoplankton

(***Senthilkumar et al., 2002; Rajasegar, 2003***). Agricultural fields as fertilizers and phosphates; and detergents used in households coul be other sources of inorganic phosphates during the season (***Tiwari and Nair, 1993***).

88. The varriations in the observed NO_3^{2-}, SO_4^{2-} and PO_4^{2-} concentrations at different monitoring locations of the 13 consecutive monitoring periods are shown in **Figure: 2.12, 2.13** and in **2.14** and all the observed dataset are given in **Table B.11, Table B.12** and **Table B.13 of Appendix- IV**.

(d) Heavy Metals

89. It reveals from the observed data that Arsenic (As) concentrations among all the spots vary from 0.001 mg/L to 0.002 mg/L.. In monsoon, lower concentration of As (Arsenic) was recorded which could be due to dilution by increased river flow. On the other hand, during winter and pre-monson, the Arsenic (As) concentration was recorded higher which could be due to subsurface flow from groundwater to river as groundwater contains Arsenic (As).

90. Heavy metal (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- $Pb_5(PO_4)^3$ (***Zhu et. al., 2004***) which may results in higher amount of Pb concentration in river water in winter season. However, during the 13th monitoring period, the lowest concentration of Pb of 0.024 mg/L was found atLeft Bank of Passur River at 100m u/s of North West corner of the Project boundary and the highest value of 0.129 mg/L was found in Passur River at Akram point of the Sunderbans. This could be due to the dumping of bilge water from large ships which were seen anchored in the site.

91. The values of Hg (Mercury) revealed a continuous consistency among all the spots in all the seasons. The values never exceeded 0.0020 mg/L. All observed data found to be within the Bangladesh standard limit set by the ECR, 1997 of Bangladesh.

92. The observed As and Pb concentrations at different monitoring locations of the consecutive monitoring periods are presented in **Figure: 2.15** and in **2.16** and all the observed dataset are given in **Table B.14, Table B.15 and Table B.16 of Appendix- IV**.

(f) Oil and Grease

93. In order to measure the concentration of oil and grease in Passur River, samples were collected from four locations during low tide from the surface layer. The analysis has been conducted through standard testing method of APHA. The concentration of oil and grease are presented in **Table-B.7** of **Appendix-IV**.

94. 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 spill occurred on the 9th December, 2014. An amount of 350,000 liters (Philips, 2014) of furnace oil had spilled in the river which spread over a 350 km2 area (***Welle, 2014***).

95. During the last (13^{th}) monitoring period, the concentrations of oil and grease varied from <5 mg/L to 138 mg/L. the lowest concentration was recorded at Harbaria of Sundarbans and the maximum concentration was observed at Akram point of Sundarbans. During the visit a lot of motorized boats, launch and other tourist boats were observe at the Passur Sibsa

confluence for the traditional fair (Rash mela). Moreover, for the seasonal fishing at sea during this season, 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 residues from large number of marine vessels in the location; oil discharge from the fishing boats and other anthropogenic activities might contribute to this higher amount of oil and grease concentration in the site.

2.3.3 Status of the Groundwater quality

In-situ tested parameters

a) pH and Temperature

96. The values of pH and temperature of groundwater at observed locations were found fully complied with the drinking water quality standards as specified in ECR, 1997. The pH values during13th monitoring program were fond to vary from 7.4 to 7.8, while temperature was found to vary between 27.7°C and 28.7°C. No significant difference and negative health effect were observed by the monitoring team. Similarly, no significant variation was recorded in groundwater temperature over the monitoring periods.

97. Both the results of pH and Temperature were found more or less consistent with all the previously obtained data. The thirteen consecutive monitoring results of pH and temperatures of selected locations are presented in Figure: **2.17** and **2.18** and all the observed dataset are attached in **Table B.17** of **Appendix- IV**

b) Salinity and Dissolved Oxygen (DO)

98. Salinity is a common parameter in order to determine the ground water quality for drinking and irrigation purpose. However, salinity in the ground water were found very much negligible or were found below the minimum detectable limits in all the consecutive monitoring seasons.

99. The dissolved oxygen observed in township area and Karpashdanga area ranged in between 5.1 mg/L and 5.7 mg/L. The observed DO values were found within the BD standard of 6.0 mg/L set by ECR, 1997. Higher DO values makes water tastier but causes corrosion to the supply pipe.

100. All monitoring results of salinity and DO of selected locations are presented in **Figure: 2.19** and all the observed dataset are attached in **Table B.18** of **Appendix- IV**.

Laboratory tested parameters

(a) TDS, TSS and TH

101. During thismonitoring period, TDS values in all the locations were found within the standard limit of 1000 mg/L. Though the Highest value of 998 mg/L was recorded in Township area but was within the ECR'97 standards. The lowest value of 401 mg/L was recorded in Rajnagar. Mentionable that, the TDS concentrations were found to be within the Bangladesh standard (ECR, 1997) in all the monitoring periods.

102. .

103. Total Suspended Solids (TSS), also known as non-filterable residue, are those solids (minerals and organic material) that remain trapped on a 1.2 µm filter (U.S.EPA, 1998). Among all the monitoring seasons the values were found much higher in monsoon season which could

be due to the runoff from industrial, urban or agricultural areas. During this monitoring period the concentrations among all the locations varied in between 25 mg/L and 32 mg/L which were similar to the values of other monitoring periods of the same season.

104. TH concentrations of the three monitored spots varied from 510 mg/l to 620 mg/l. The maximum value was found in Karpashdanga area near project site while the lowest value was found in Rajnagar area. The values were found little higher than the standard limit (200-500 mg/L) set by the ECR 1997. However, no incidents of weathering of Ca^{2+} bearing minerals or excessive application of lime was found during the monitoring period which could cause excessive amount of TH in ground water. Groundwater TDS, TSS and TH values of theconsecutive monitoring periods in all the monitoring period are presented in **Figure: 2.20, 2.21** and **2.22** and all the observed dataset are attached in **table B.19 and Table 20** of **Appendix- IV**.

(b) Chemical Oxygen Demand

105. The Bangladesh standard for COD in drinking water is 4.0 mg/L. The COD of the tube wells were found within the standard limit and were also similar in all the monitored locations..

106. The COD values of this monitoring period were found to be lower than those of the previously monitored results. The COD concentrations of all the monitoring locations are given in **Figure: 2.23** and all the observed dataset are attached in **Table B.21** of **Appendix- IV**.

(c) Nitrate, Sulphate and Phosphate

107. The Nitrate values varied from 4.65 mg/L to 19.94 mg/L.The maximum value was recorded at Karpashdanga tube well (19.94 mg/L) while the lowest value was found at the township area. However, in this season in 1st monitoring program (i.e. 4th year 1st quarter). The value was found higher in pre-monsoon in Rajnagar which could be due to the excessive fertilizer use in the nearby agricultural field.SO_4^{2-} and PO_4^{2-} concentrations of Passur-Sibsa RS have been included in this study since 2nd monitoring program (i.e. **1st** year **2nd** quarter). Sulphate concentrations were found same (1 mg/L) in all the monitoring locations. On the other hand, the values of PO_4^{2-} were found in between 1.18 mg/L and 1.23 mg/L which was within the standard limit of 6 mg/L . Among all the monitoring period the recorded data were found maximum in the post-monsoon period. The observed ground water NO_3^-, SO_4^{2-} and PO_4^{2-} concentrations are presented in in **Figure 2.24** and all the observed dataset are attached in **Table B.22** of **Appendix- IV.**

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

108. As per Bangladesh Standard (ECR, 1997), the maximum acceptable concentration of Arsenic in groundwater is 0.05 mg/L. The As concentrations among all the monitoring locations ranged between 0.005 and 0.028 mg/L which are very much within the Bangladesh standard limit (ECR, 1997).. It can therefore, be concluded that the ground water sources are suitable for the drinking purpose.

109. The Pb and Hg concentrations were detected and the values remained within the permissible limit specified in ECR 1997. The concentration of Pb was found higher in pre-monsoon and post-monsoon in Rajnagar and Kapasdanga respectively. However, the water of the tube-wells was found suitable for drinking purposes.

110. The observed values of As, Pb and Hg in all the monitored locations are presented in **Figure: 2.25** and **2.26** and all the observed dataset are provided in **Table B.23** of **Appendix-IV**.

2.4 Land Resources

2.4.1 Methodology

Monitoring Indicators

111. Monitoring of the selected indicators is very crucial for land resources monitoring in the study area. Plot use, soil fertility/nutrient status, soil contamination with heavy metals and soil salinity were considederd as the major monitoring indicators for land resources monitoring purpose. Primary data was collected from the field visit and all the secondary data were collected through **FGDs**, **KIIs**, and personal interviews from different Government and NGO's offices. The photographs have been incorporated in **photo 2.4** to **2.11.**

Sampling Frequency

112. As per plan stated in EIA, land resources have been scheduled for monitoring twice in a year.Accordingly, the Plot use data was collected during the **13th monitoring visit** (**April, 2017**).

Location

113. The selected mauzas are Baranpara of Batiaghata upazila, Chunkuri-2 of Dacope Upazila, Kapalirmet of Mongla upazila, Chakgona of Rampal upazila and Basherhula of Rampal upazila under Bagerhat district. Locations of collected soil samples are presented in **Table E.1** of **Appendix IV** and **Map 2.4**.

2.4.2 Process of Soil Samples Collection

Plot Selection

114. Monitoring plots were selected through group discussions, especially with the plot owners and experts such as Upazila Agriculture Officers of Batiaghata, Dacope, Rampal and Mongla of Khulna and Bagerhat Districts respectively and Senior Scientific Officer of Soil Resource Development Institute (SRDI) of Khulna Office. Moreover, wind speed, wind direction and potential locations where fly ash and sulphur could be deposited in the operation phase of the power plant were considered for selection of of the monit. .All the selected areas are medium high land (F1), which are normally flooded within a depth of 30-90 cm and remain inundated continuously for more than two weeks to few months during the floodperiod.

Soil Samples Collection

115. Soil samples were collected following the standard practices of composite method. At each plot, the samples were collected using augur from three dug pit. From each pit, three soil samples were collected from three different depths. The three top soil samples collected from three different pits were then mixed properly to make a composite sample and 500g of soil mass was then taken and stored in an air tight protective poly bag for laboratory analysis. Similar method was followed for collecting for collecting sub soil and sub stratum. However, continuous monitoring of that area has given an opportunity to observe the seasonal change of the indicators of that specific 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

116. Collected soil samples wer e tested from Soil Resource Development Institute (SRDI), Dhaka.

Status of Soil Quality of Monitoring Plots

117. In general monitoring study area is under the Agro-Ecological Zone, AEZ 13: Ganges Tidal Flood Plain (BARC, 2012). So, the analysis report of soil has been compared to the physico-chemical properties of soils of AEZ 13 to understand the variation of the soil fertility status. Generally, organic matter content of the soil is low in the coastal regions of Bangladesh, thus in addition to salinity, plant nutrients in soils affect plant growth (S.A. Haque, 2006). Some basic properties of soil of AEZ 13 can be characterized by PH: (4.5-8.4), OM(%): (1.0-3.4%), N(%): (0.091-0.18%), P: (<5.25-10.5) (µg/gm), K: (0.181-0.36 (meq/100g), S: (15.1-30.0) (µg/gm), Ca: (4.51-7.5) (meq/100g), Mg: (0.751-1.5) (meq/100g), Zn: (0.451-1.35) (µg/gm), B: (0.31-0.6) (µg/gm) and Mo: (0.226-0.30) (µg/gm). The parameter considered for earlier monitoring are same in this quarter as well. The soil qualities for the dry season of 2016-17 year are presented in the following paragraphs.The result of the dry season is presented in **Table E.2** and **E.3** of **Appendix IV**.

Monitoring Plot-1 (Baranpara)

118. It was observed that, overall Ec and pH have increased in the dry season of 2016-17. The Ec varied from 4.52 ds/m to 7.40 ds/m and pH varied from 6.4 to 7.07 It might be an impact of polderization of that locality. The organic matter concentration of the soil decreased pattern was found in the entire layer. Macro nutrients, N, P, K, S and Mg was found significantly higher whereas Ca and Na found lower than dry season of 2013-14, 2014-15 and 2015-16. Micro nutrients, B, Mn and Zn were found significantly higher whereas Fe was found lower than the dry season of 2013-14, 2014-15 and 2015-16. Lead and Cadmium was found in all layer. Highest Pb and Cd were found in top soil. The analytical results of soil were verified with India/Austria Guidelines for agricultural soil [mg kg-1] to know the Maximum Acceptable Concentrations (MAC) level of collected soil samples. This has been done as there is no research conducted on heavy metals in Bangladesh. Limited research work has been conducted on heavy metals. However, concentration of Pb in the leachate did not exceed the permissible limit of soil standard as stated above. By comparing the heavy metals analysis data, Pb and Cd did not appear in polluted category (***Awashthi, 2000***) and (Kabata-Pendias, A. and H.Pendias, 1992) and is presented in **Table E. 2** and **E.3** of **Appendix IV**.

Monitoring Plot-2 (Chunkuri-2)

119. From the analyzed data, it has been observed that Ec and pH significantly reduced in the dry season this year over the dry season of 2013-14, 2014-15 and 2015-16. Organic matter concentration of the soil, decreasing pattern was found. Macro nutrients, N, P, K, S, Ca and Na was found significantly increased while Mg was found decreased over the dry season of 2013-14, 2014-15 and 2015-16. However, Micro nutrients, B, Mn and Zn were found significantly higher whereas Fe was found lower than the dry season of 2013-14, 2014-15 and 2015-16. Lead and Cadmium was found in entire layer. Pb and Cd concentration observed within the limit is presented in **Table E.2** and **E.3** of **Appendix IV**.

Monitoring Plot-3 (Kapalirmet)

120. Overall Ec and pH slightly increased in this dry season over the dry season of 2013-14, 2014-15 and 2015-16. Organic matter concentration of the soil, decreasing pattern was

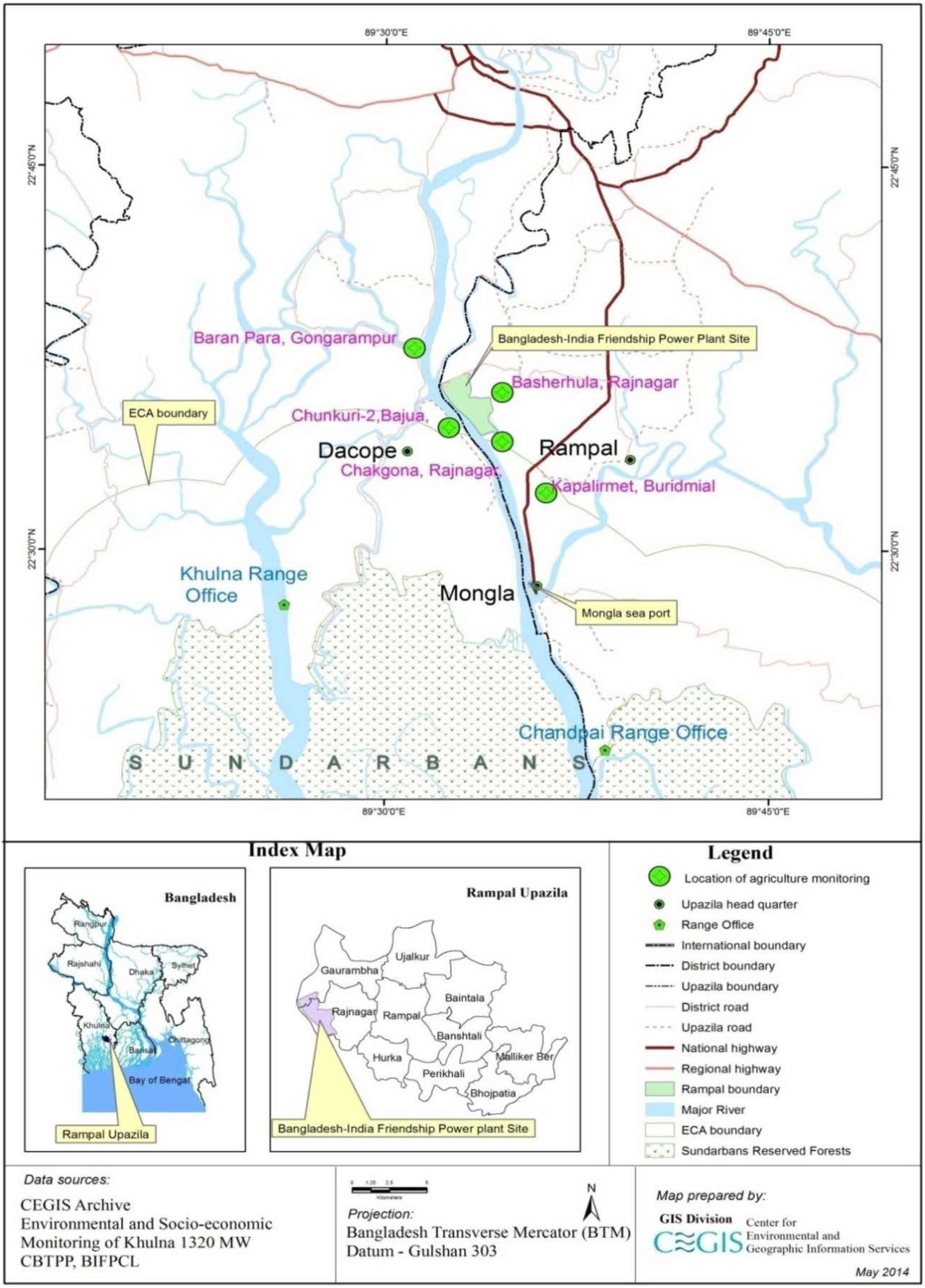
found over all dry season of monitoring period except in the dry season of 2014-15. Macro nutrients, N, K, Ca, Mg and Na was found increased while P and S was found decreasing trend over all the dry season. On the other hand micro nutrients, Fe, B, Mn and Zn of the soil showed the increasing trend over the dry season of 2013-14, 2014-15 and 2015-16. In terms of heavy metal concentration, Highest Pb and Cadmium was found in subsurface layer. Pb and Cd concentration observed within the limit is presented in **Table E.2** and **E.3** of **Appendix IV**.

Monitoring Plot-4(Chakgona)

121. Over all salinity level decreased and pH level significantly increased in the dry season over the dry season of 2013-14, 2014-15 and 2016-17. Organic matter concentration of the soil, increasing pattern was found. Macro nutrients, N, K, Ca, Mg and Na were found significantly reduced while P and S was found increasing trend. Micro nutrients, Fe was found significantly reduced while B, Mn and Zn was found increasing trend. Highest Pb was in substratum layer and Cadmium was found in top soil. Pb and Cd concentration observed within the limit is presented in **Table E.2** and **E.3** of **Appendix IV.**

Monitoring Plot-5(Basherhula)

122. Over all salinity level and pH was found significantly reduced in the dry season than that of the dry season in the monitoring plot. Organic matter level of the soil, decreasing pattern was foundMacro nutrients, N, K, Ca, Mg and Na were found significantly reduced while P and S was found increasing trend. Micro nutrients, Fe was found significantly reduced while B, Mn and Zn was found increasing trend. Micro nutrients, Fe, B and Zn of the soil showed the highest while Mn was found lowest. In terms of heavy metal concentration, Highest Pb was in subsurface layer and Cd was in substratum layer. Pb and cd concentration observed within the limit is presented in **Table E.2** and **E.3** of **Appendix IV**.



Map 2.4: Land Resource Monitoring Locations

Photo 2.4: View of consultation with SAAO of DAE Batiaghata,Khulna

Photo 2.5: View of consultation with UAO of DAE Dacope,Khulna

Photo 2.6: View of consultation with SAAO of DAE Rampal,Bagerhat

Photo 2.7: View of soil sampling at Baranpara,Batiaghata,Khulna

Photo 2.8: View of monitoring plot at Kapalirmet, Mongla, Bagerhat

Photo 2.9: View of monitoring plot at Chakgona,Rampal,Bagerhat

Summary of the soil quality monitoring

Five mauzas (Baranpara, Chunkuri-2, Kapalirmet, Chakgona and Basherhula) within the 10 km radius of the power plant were selected for monitoring of plot use, soil fertility/nutrient status, soil contamination with heavy metals and soil salinity. Soil samples were collected from five locations at three depths (0-15 cm, 15-30 cm and 30-45 cm) inside the monitoring area in the month of April 2017 (for the dry season) and analyzed the samples. It was observed from the analysis that the highest EC of 8.44ds/m and pH of 8.8 occured in Kapalirmet and Chakgona mauza respectively. Highest organic matter content (2.22%) was found in Kapalirmet mauza where as the highest macro nutrients was found in Chunkuri, Kapalirmet and Chakgona mauzas. However, the highest macro nutrients was found in Baranapara, Chunkuri and Chakgona mauzas respectively. Pb and Cd were found within the acceptable limit.

3. Biological Environment

123. 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 four major groups and monitored quarterly and half yearly with the aim to establish baseline conditions to compare with the probable impact of proposed project in place. These group include fisheries resources, ecological resources, Sundarbans Reserve Forest (SRF) and agricultural resources.

3.1 Fisheries Resources Monitoring

Fisheries Resources

Fisheries resources were monitored quarterly in a year. Monitoring of all four quarters of 2014-15 and of 2015-16 and of 2016-17 were completed and reported earlier. This section contains the outcome of this 1st quarter monitoring of 2017-18 along with the comparisons with the earlier twelve (12) quarters.Location of Monitoring Sites

124. The monitoring activities were carried out at ten pre-selected locations of which seven (7) are capture fish habitat and three (3) were shrimp/fish farms. The capture sampling sites were selected based on the fishing availability of upstream, middle stream and downstream of Passur River system. Shrimp/fish farms were selected based on the direct impacted area of Plant site. The sampling sites are detailed in **Table 3.1**

Table 3.1: The Sampling Locations for monitoring of Fisheries Resources

Site	Capture Habitat Location	Sl	Culture Habitat Location
A	Akram Point	1	Bhekatkhali Khal, Rajnagar
B	Haldikhali	2	Kapasdanga-Muralia
C	Harbaria	3	Chunkuri-2
D	Chandpai		
E	Mongla Port		
F	Maidara		
G	Chalna Point, Batiaghata		

Selection of Parameters

125. In the fisheries monitoring, five major components were selected according to TOR, such as, fish habitat status, fish migration, fish diversity, and 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 and sensitivity of fish diversity and survival success of different life stages of fish to abiotic factors (water quality, bed material, hydrological condition, 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.

3.1.1 Methodology

Fish Habitat Status

126. 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

127. 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

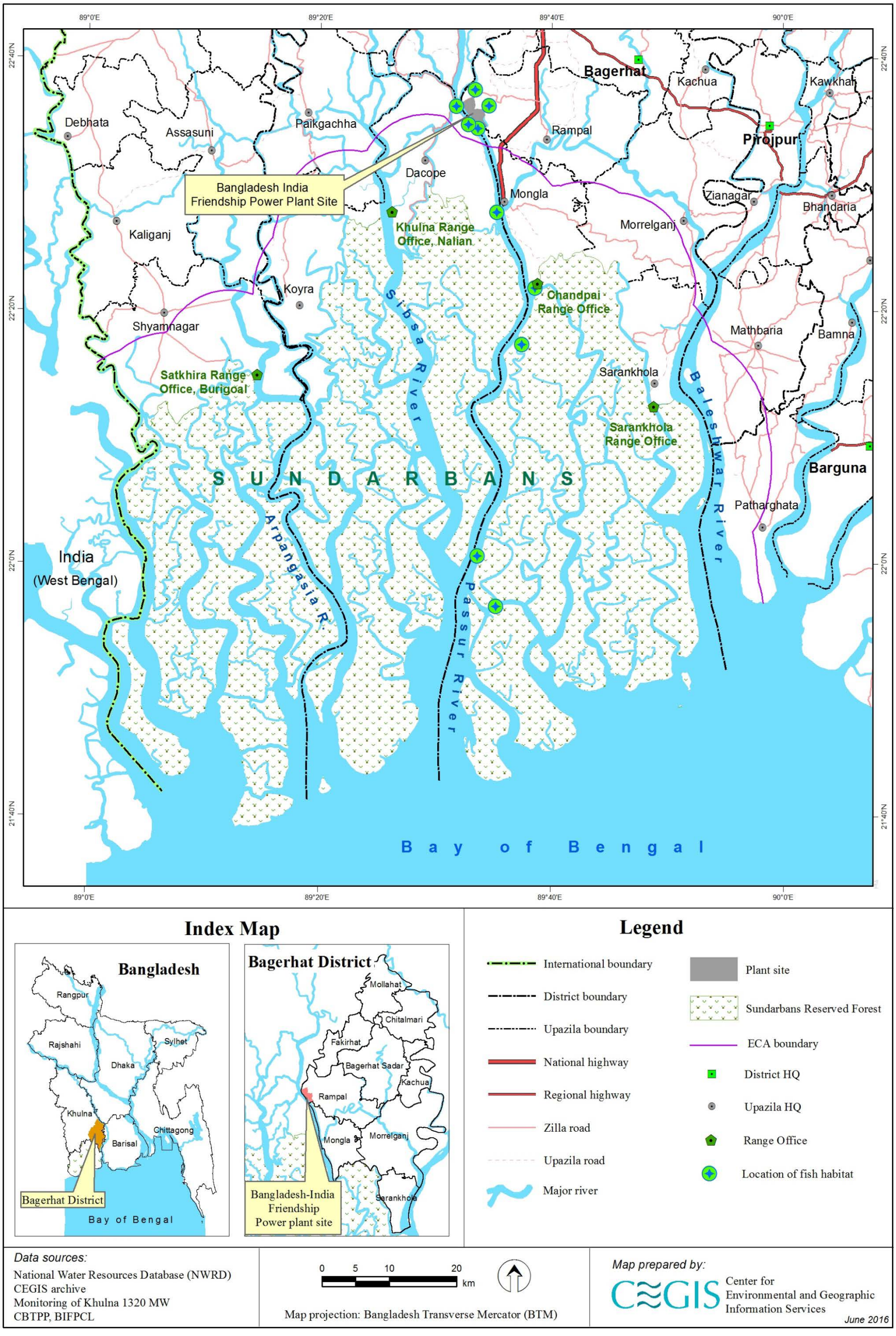
128. Fish diversity was surveyed by Catch/Unit Effort (CPUE) method. The fish individuals were counted according to the length of each species from the samples. Diversity was estimated by analyzing Shannon-Weiner Index that ranges from 0 to 1. Fish species richness (FSR) was analyzed using the Simpson's 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

129. 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

130. 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.



Index Map

Legend

- International boundary
- District boundary
- Upazila boundary
- National highway
- Regional highway
- Zilla road
- Upazila road
- Major river
- Plant site
- Sundarbans Reserved Forest
- ECA boundary
- District HQ
- Upazila HQ
- Range Office
- Location of fish habitat

Data sources:

National Water Resources Database (NWRD)
CEGIS archive
Monitoring of Khulna 1320 MW
CBTPP, BIFPCL

0 5 10 20 km

Map projection: Bangladesh Transverse Mercator (BTM)

Map prepared by:

CEGIS Center for Environmental and Geographic Information Services

June 2016

Map 3.1: Fisheries Resources Monitoring Locations

Period of monitoring

131. Followed by the first, second, third and fourth quarter monitoring of the 2014-15, 2015-16 and 2016-17 year, first quarter monitoring was conducted during the period of 19 to 25 April, 2017.

Fish Habitat Status

132. Fish habitat status has also varied interms of habitat classification and habitat use pattern of different life stages of different fish species.

(a) Habitat Classification

133. 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 were identified and collected from literature. Linkage distance was then 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 (shown in the **Figure 3.1**) on the basis of abundance of different life stages of fish species in those habitats.

134. During **1st quarterly monitoring** (**April, 2014**) fish habitat was classified as the grazing ground (Akram Point and Harbaria), grazing and breeding ground (Haldikhali and confluence of the Passur river at Chalna Point) as well as spawning and nursery ground (Sheola khal at Chandpai, Passur River at Mongla Point and Maidara River). In the second quarter monitoring (**June – July 2014**) two habitats – i) grazing ground and ii) spawning and nursery ground were identified. However, during third quarter monitoring in the month of **October 2014** the similarity of size group distribution of fish species among the habitats were found to be deviated to some extent. In fourth quarterly monitoring phase in **January 2015** three habitats – i) grazing ground, ii) grazing and breeding ground; and iii) spawning, nursery and grazing ground were identified. During the 1st quarter (**April, 2015**) of the second year three habitats – i) grazing ground, ii) nursery ground; and iii) spawning and nursery were identified. During the **2nd quarterly monitoring** of **2nd year** (**October, 2015**) two habitats were identified as: i) grazing and breeding ground and ii) spawning and nursery ground. During the **3rd quarter** monitoring of 2nd year (**October, 2015**) such three habitats as i) grazing ground, ii) nursery ground and iii) growing and feeding were identified. During the 4th quarter monitoring of 2nd year (January, 2015) two major habitats – i) nursery and feeding ground and ii) feeding and growing ground were identified. During the 1st quarter monitoring of 3rd year (**April, 2016**) two major habitats – i) spawning and nursery ground and ii) feeding and growing ground were identified. During the 2nd quarter monitoring of 3rd year (July, 2016) two major habitats – i) nursery ground and ii) feeding and breeding ground were identified. During the 3rd quarter monitoring of 3rd year (**October, 2016**) two major habitats – i) Breeding and spawning ground, mainly for Hilsha and Poma; and ii) feeding and grazing ground were identified. During the 4th quarter monitoring of 3rd year (**January, 2017**) two major habitats – i) Grazing and spawning ground, mainly for Paissa; and ii) Nursing groundwere identified.

135. During the **1st quarter** monitoring of 2017-18, two major habitats – i) Grazing and feeding ground, and ii) Nursing ground were identified as shown in e **Figure-3.1**

Grazing and Feeding Ground

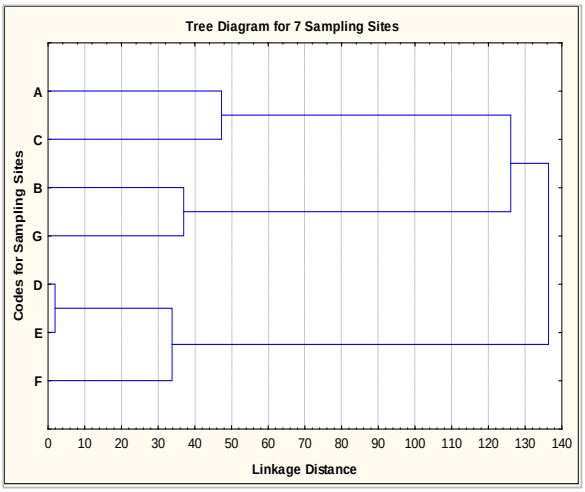
136. Among the sampling sites, Akram Point (A), Haldikhali Khal (B), Harbaria khal (C) and Sheola Khal at Chandpai were identified as the grazing and feeding ground for abundance of both the juvenile and young group of fishesGrazing and Spawning Ground:

137. Among the sampling sites, Akram Point (A) and Harbaria khal(C) were identified as the

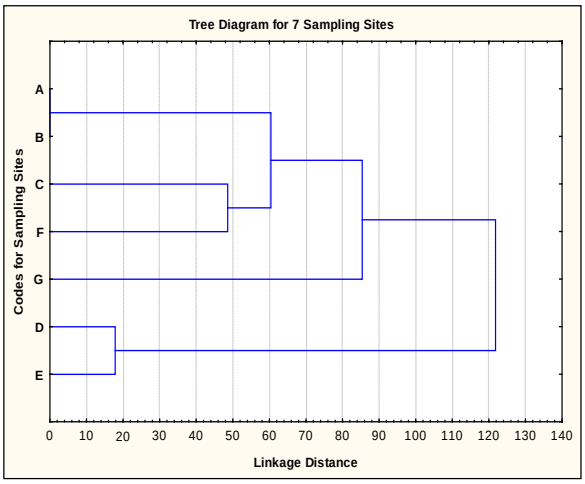
grazing and spawning ground due to abundance of both the juvenile and broodfish.

Nursing Ground

138. Among the sampling sites, mainly the Mongla-Passure Confluence (E), Maidara-Passur Confluence (F) and Chalna Point (G) were identified as the nursing ground.



1st Monitoring, April, 2014



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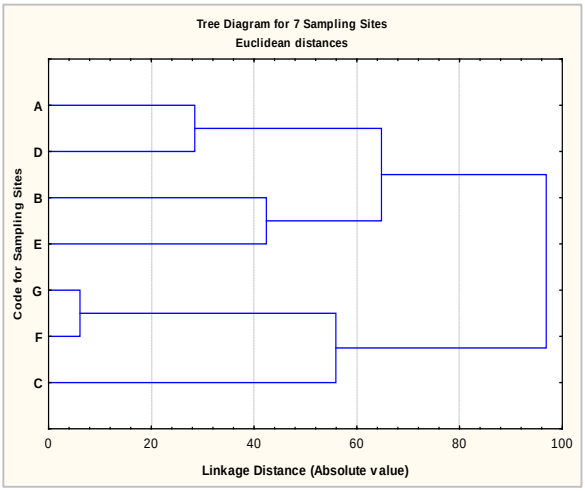

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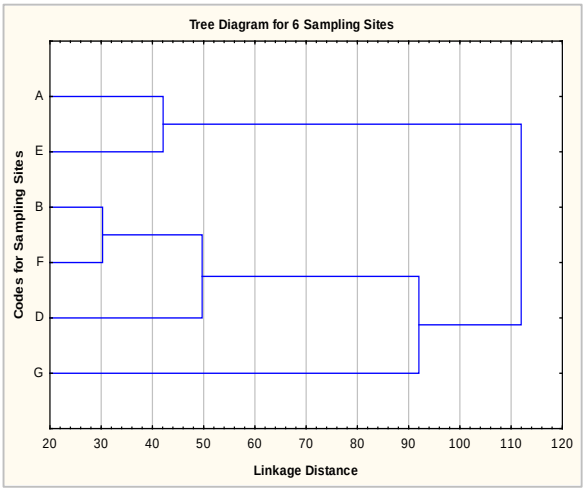
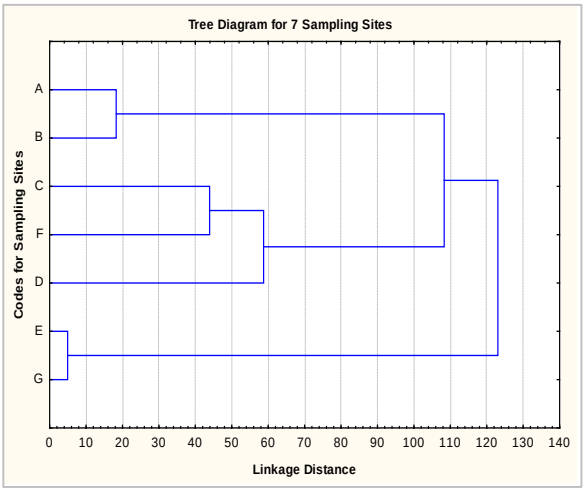


4th Monitoring, January 2015



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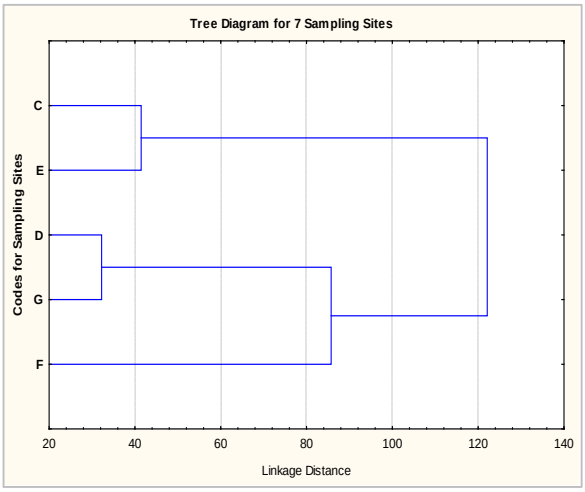

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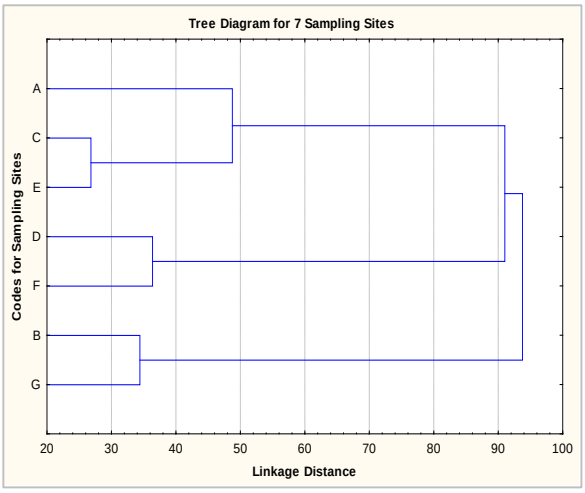

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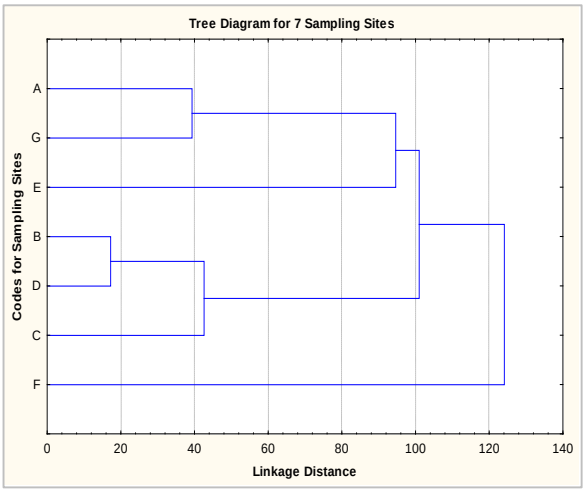
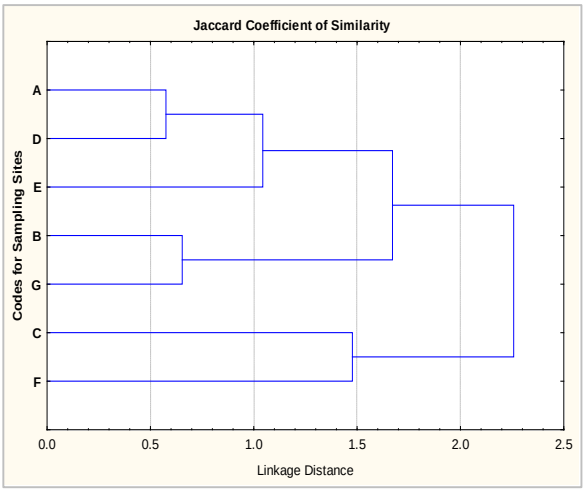
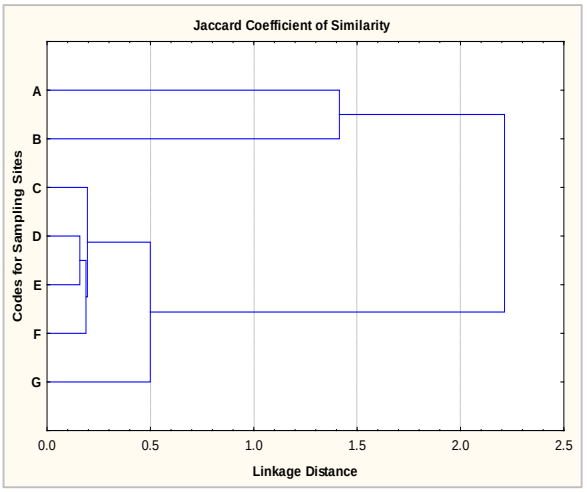
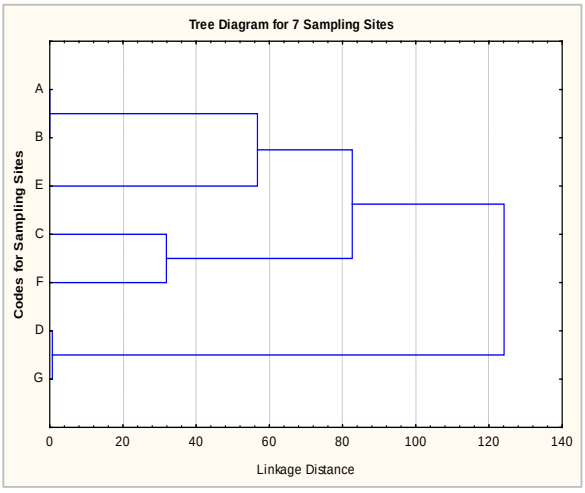


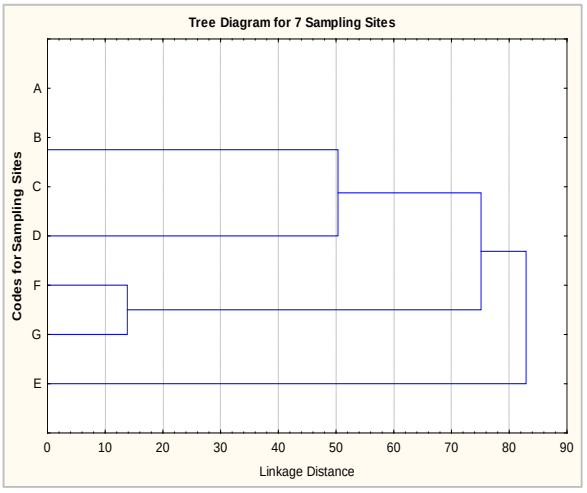
8th Monitoring, January, 2016



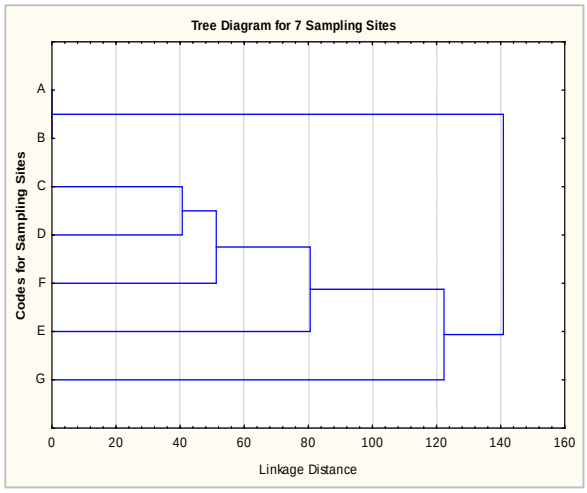




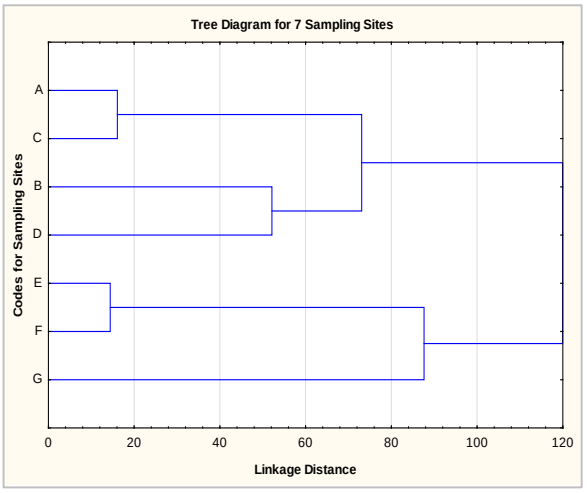
9th Monitoring, April, 2016



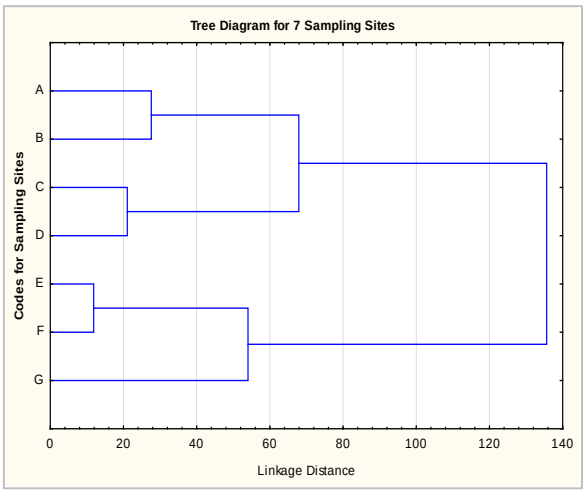
10th Monitoring, July, 2016



11th Monitoring, October, 2016



12th Monitoring, January, 2017

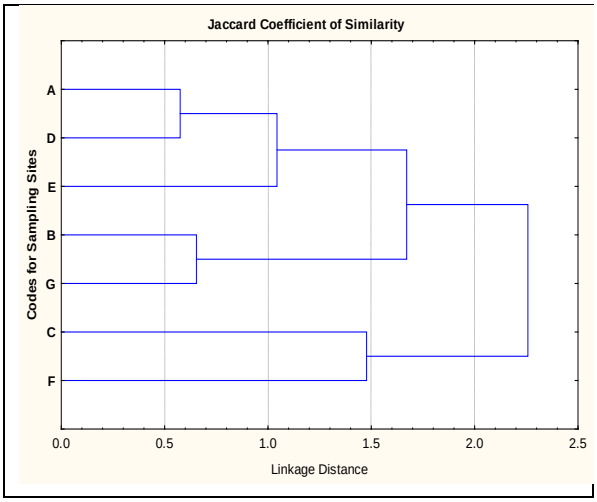


13th Monitoring, April, 2017

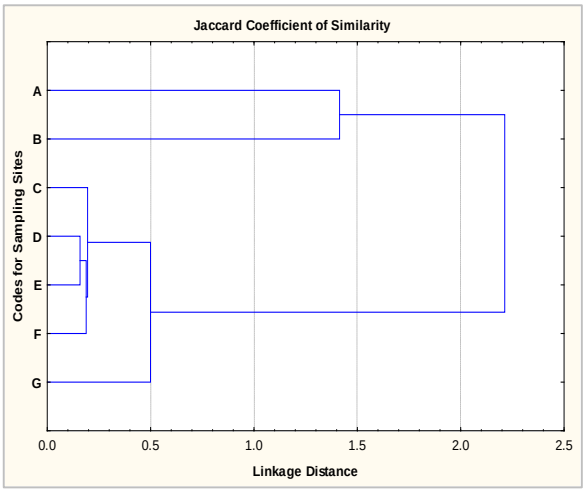
(Note: Life stage is identified through length measurement of the fish individuals)

Figure 3.1: Habitat Classification on the basis of Different Life Stages of Fish Species

139. The dendogram analyses 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 among the four quarters but also among the monitoring years. In this first quarter of the monitoring year of 2017-18, the JI value in C and D sampling sites was also the highest (**Figure 3.2**) which indicates that there was the maximum similarity in species occurrence between these two sites out of seven (7) sampling sites



1st Monitoring, April, 2014



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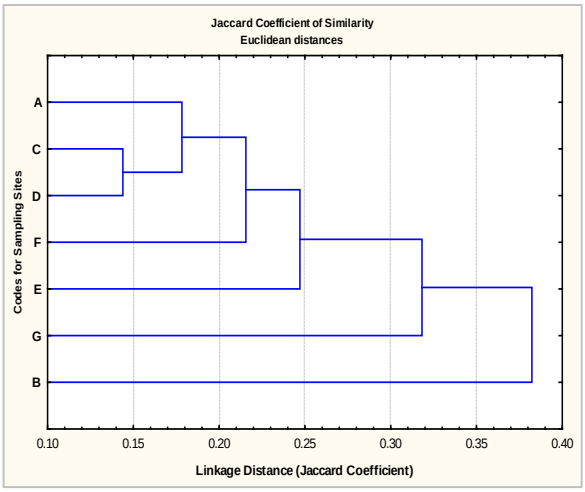
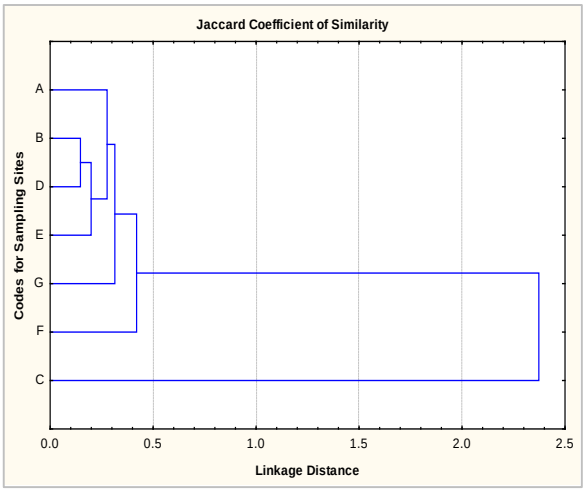
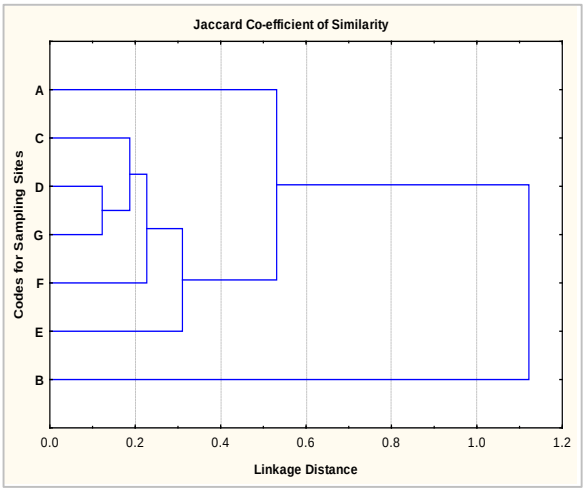


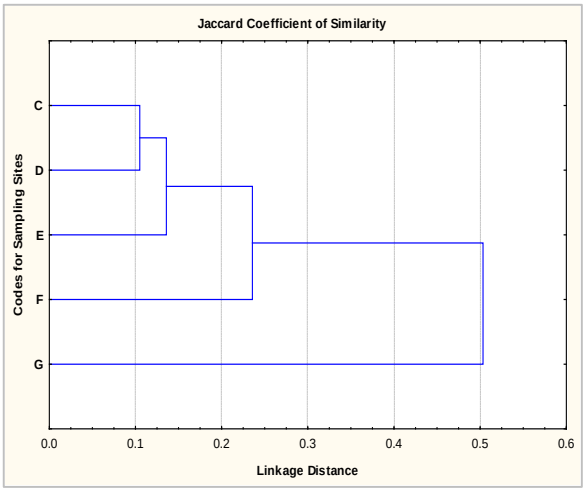
3rd Monitoring, October, 2014



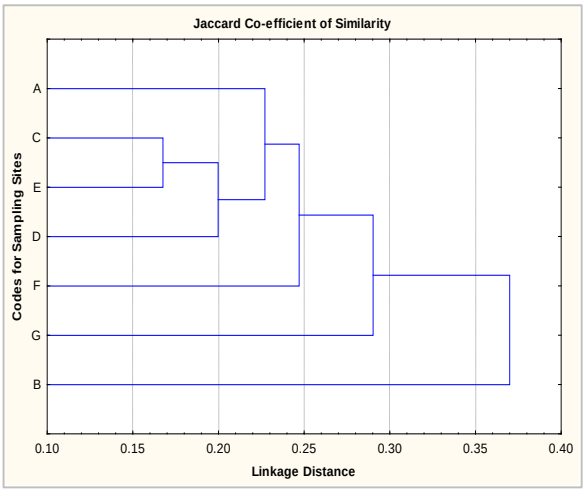
4th Monitoring, January 2015



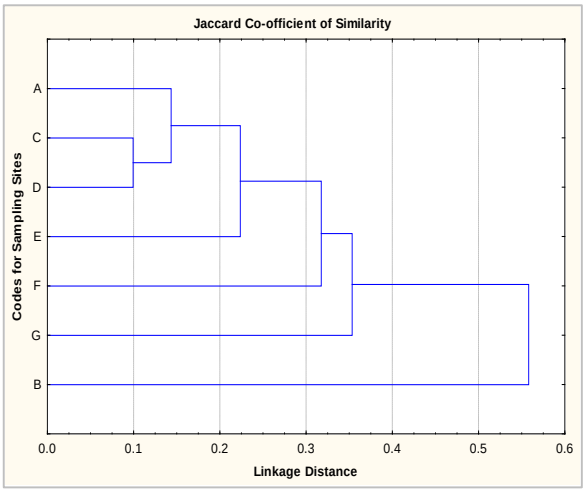
5th Monitoring, April, 2015



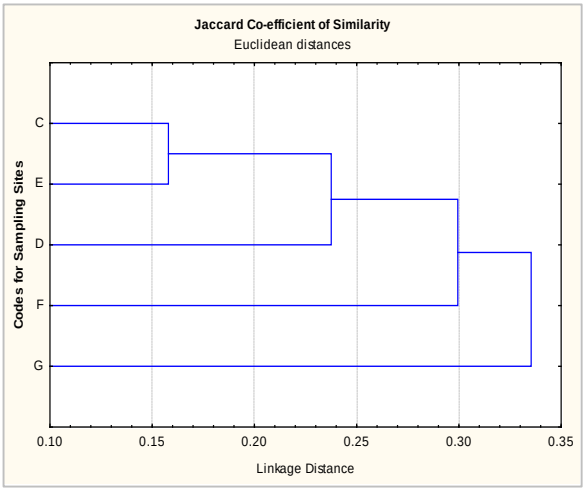
6th Monitoring, August, 2015



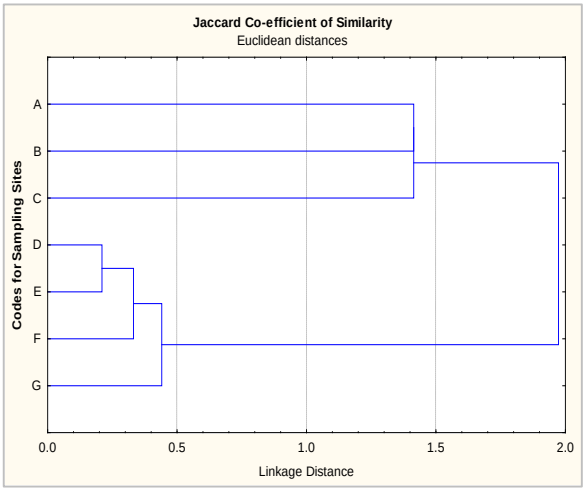
7th Monitoring, October, 2015



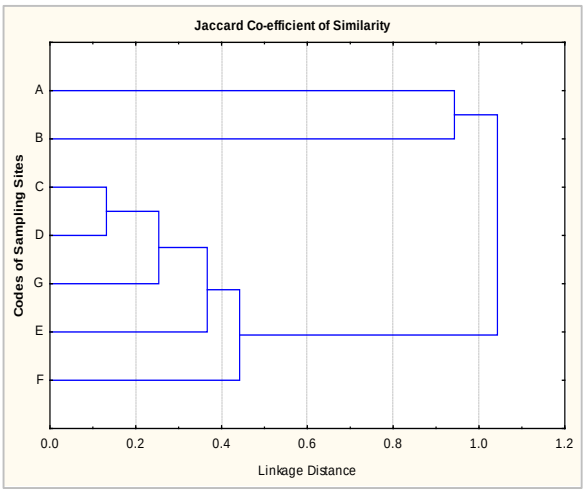
8th Monitoring, January, 2016



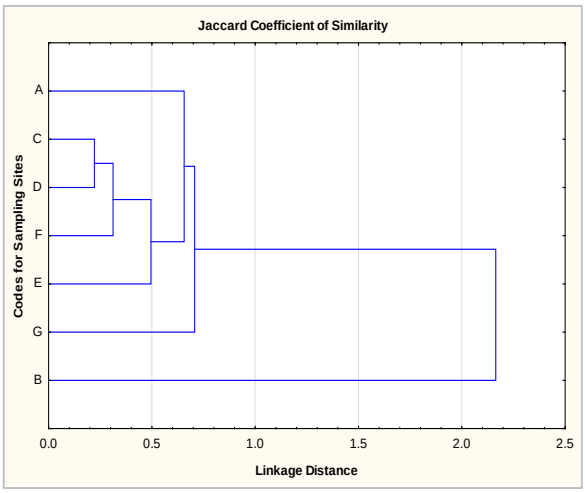
9th Monitoring, April, 2016



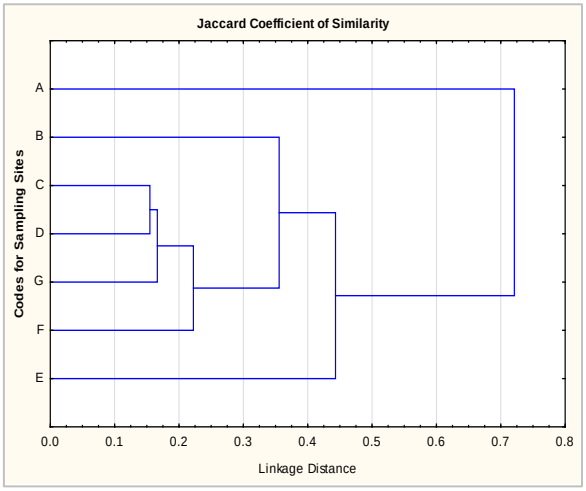
10th Monitoring, July, 2016



11th Monitoring, October, 2016



12th Monitoring, January, 2017



13th Monitoring, April, 2017

Figure 3.2: Dendogram Showing Similarity in Binary Species Composition in seven sampling sites

Habitat Suitability Index (HSI)

140. 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***).

141. In the first year of monitoring, Sheola khal at Chandpai was found as the most suitable habitat for fish species in Passur River System. Sheola khal was also identified as the most suitable habitat in second year which was followed by Harbaria, Akram Point, Haldikhali, Mongla Point, Maidara and Chalna Point (**Table 3.2).**

Table 3.2: 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	
B	Haldikhali	0.408	0.54	
C	Harbaria	0.226	0.64	
D	Chandpai	0.520	0.72	
E	Mongla Port	0.321	0.43	
F	Maidara	0.224	0.25	
G	Botiaghata, Chalna Point	0.218	0.32	

**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

Fish Diversity

Shannon-Weiner Index

142. In the first quarter monitoring during 2017-18, species evenness also varied among the sampling sites (T**able 3.3)**. Highest Shannon-Weiner index was found at Harbaria Khal (0.79) indicating most evenly distributed fish species. On the contrary, lowest evenness was found at Haldikhali Khal (0.37). It was found that both the number of fish species observed in in-situ catch and the evenness of their distribution within the sampling sites showed high variation with the changing seasonal and yearly bio-physical conditions.

143.

Fish Species Richness (FSR)

144. Fish species richness was identified through Simpson's Index[1]. Considerable difference was noticed in the fish species richness (FSR) in different habitat classes (**Table 3.4 and Figure-3.3)**

145. In this monitoring phase, the species richness varied with the sampling sites. Maximum FSR was obtained in Harbaria Khal (n=7), while very low FSR was recorded at Haldikhali Khal and Maidara Point (n=1). 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 Bagda and Chali Chingri; Maidara River at Baro Durgapur was of Bele; and Chalna Point was of Chali Chingri, Horina Chingri, Golda Chingri and Vati Chingri. Among the habitats in downstream portions, Chandpai was rich in Aswene Bele, Chela, Gulsha Tengra, Kain Magur, Poma and Potka; while Harbaria was rich in Paissa, Mutkura, Sada Bele, Chaka Chingri, Golda Chingri, Gulsha and tengra

[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 3.3: 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	3 3	0	1 3	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	1 2	0	2 4	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	1 2	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	1 2	2 2	1 5	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	1 3	1 0	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	1 3	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

**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 3.4: Site wise Rich Species Number

Site	Location	No. of Rich Species												
		2014-2015				2015-2016				2016-2017				2017-18
		1st	2nd	3rd	4th	1st	2nd	3rd	4th	1st	2nd	3rd	4th	1st
A	Akram Point	4	0	4	3	3	-	3	2	0	0	1	2	2
B	Haldikhali	7	0	4	2	0	-	3	2	0	0	1	0	1
C	Harbaria	1	5	2	0	4	4	3	6	4	0	4	2	7
D	Chandpai	2	2	5	4	5	8	3	7	4	6	3	7	6
E	Mongla Point	1	10	4	5	3	6	4	2	4	7	3	2	2
F	Maidara	3	6	2	2	4	2	4	2	3	2	3	3	1
G	Chalna Point	3	3	2	3	1	3	3	4	2	4	1	2	4

Rupchanda in 1st Quarter 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

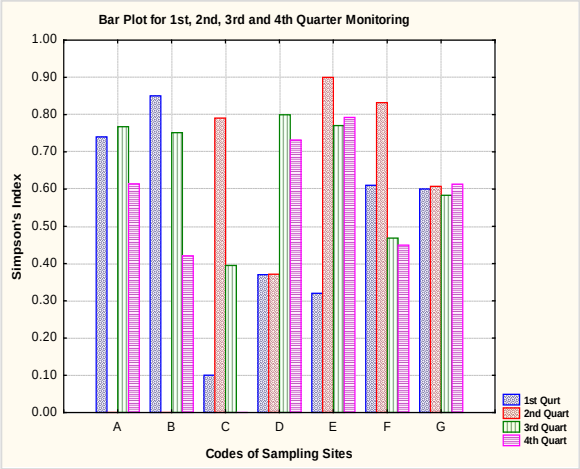
Paissa and Gagra Tengra

Aswene Bele, Daitna, Tapse and Chitra

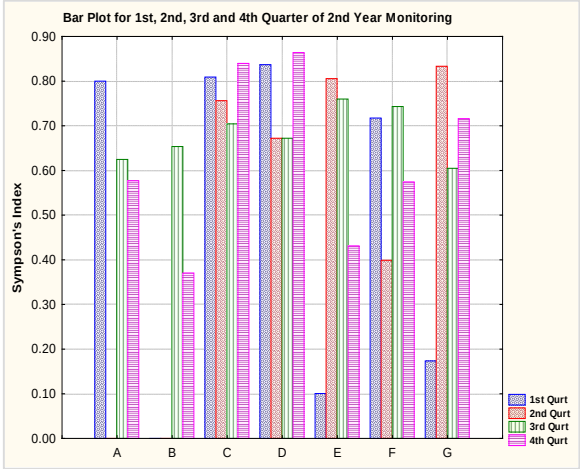
Dry Fish of Khayra Chela

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

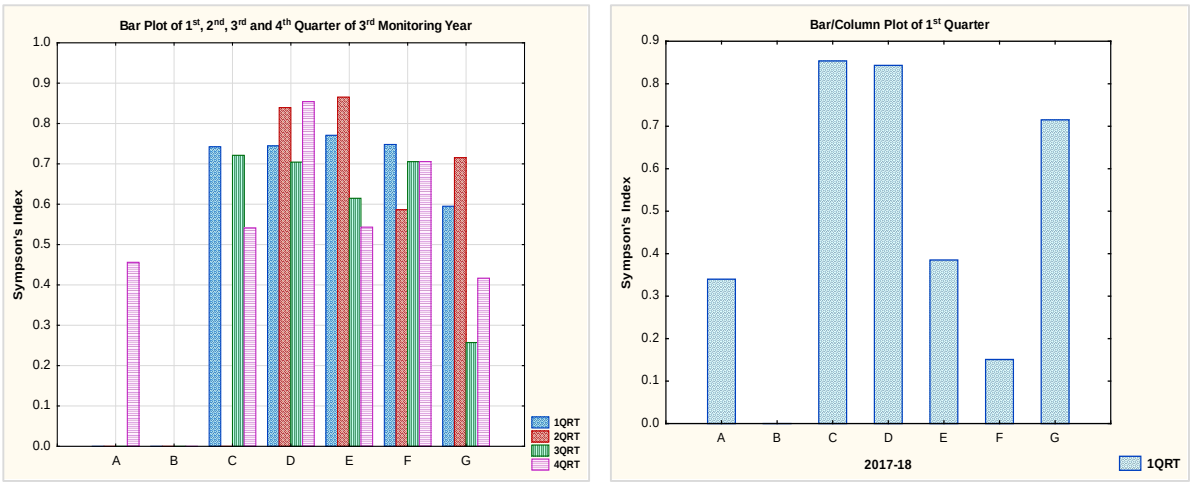
Photo 3.1: ength-wise distribution of fish species



2014-2015



2015-2016



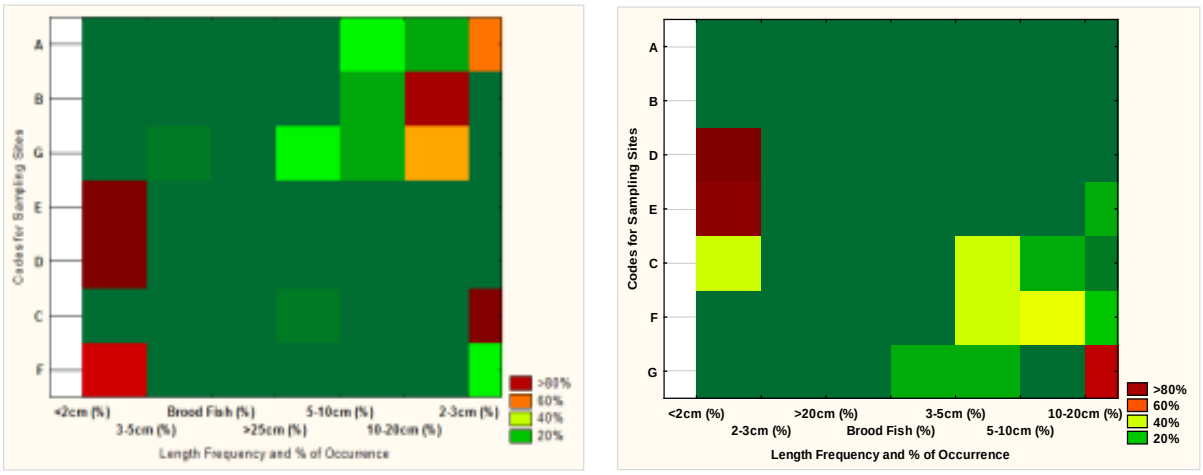
2016-2017 **2017-18**

(FSR is identified though Simpson's Index)

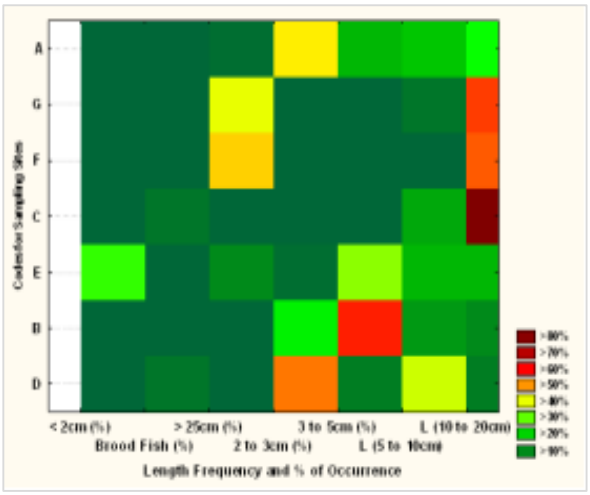
Figure 3.3: Site-wise fish species richness (FSR) in the Passur River System.

Fish Community Structure

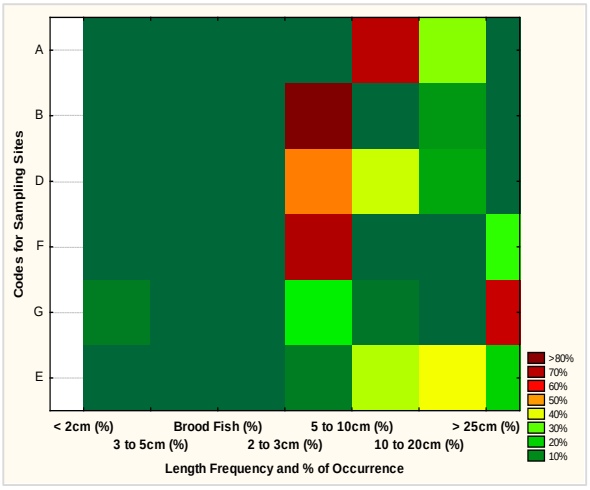
146. Fish community structure was analyzed through counting the length-wise fish individuals (**Photo 3.1.2**). The table **D.2** and **D.3** of **Appendix IV** and **Figure 3.1.4** show that during **1st quarter** of monitoring in 2017-18, fries and juveniles for fin fish were widely distributed along all the stretches of the Passur River system. Among these Paissa, Golda Chingri and Bele fishes were more widely being distributed among the sampling sites. Moreover, fries fish of Chali Chingri was commonly found at Chalna and Mongla Point. On the other hand the fries of Bele and Golda at Chalna Point and Maidara and of Bagda at Mongla Point and Maidara. Moreover, brood female fishes of Paissa were observed at Harbaria Khal sampling sites in this quarter.



1st Monitoring, April, 2014 **2nd Monitoring, July 2014**



3rd Monitoring, October, 2014



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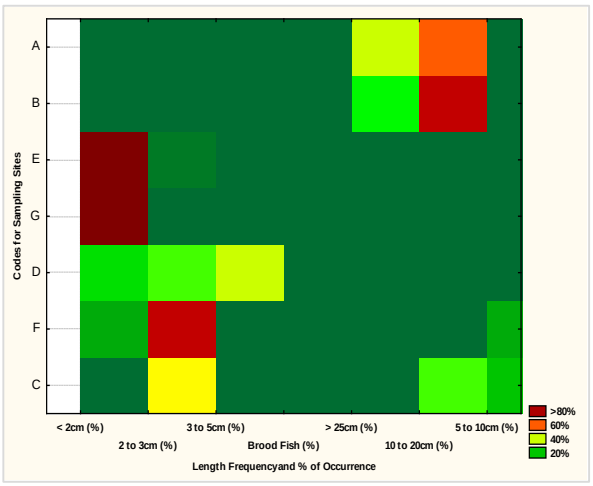
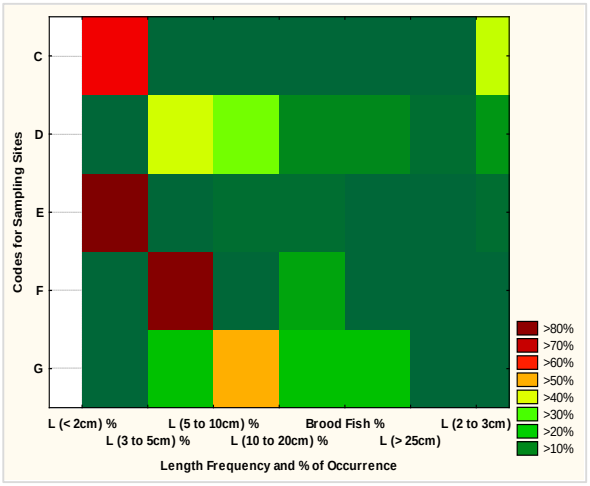
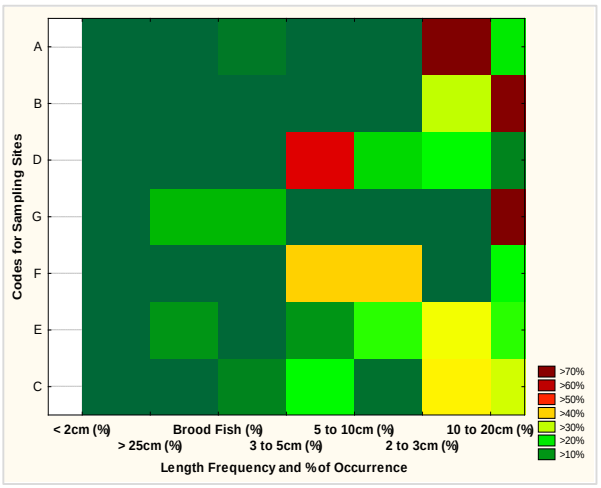


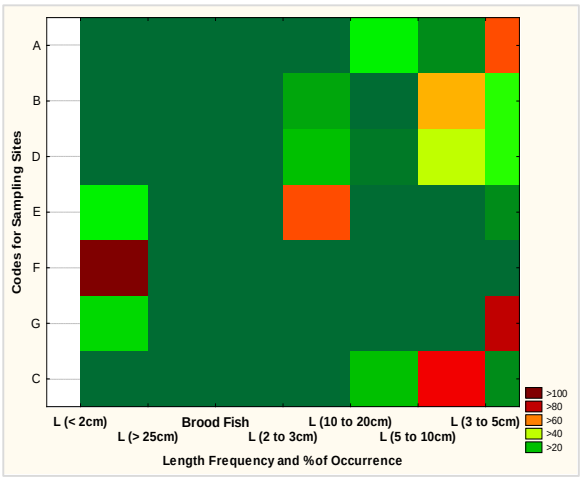
5th Monitoring, April, 2015



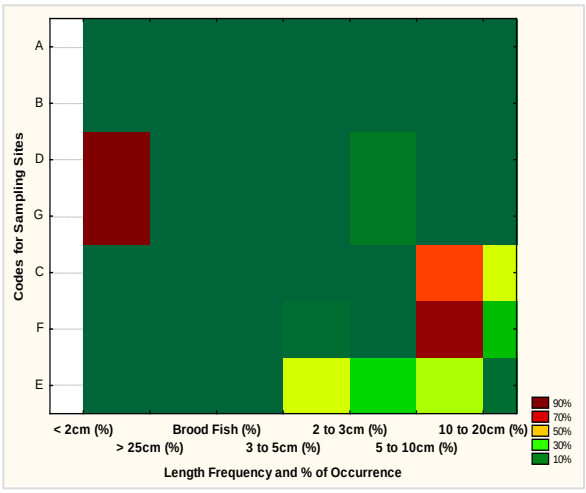
6th Monitoring, August, 2015



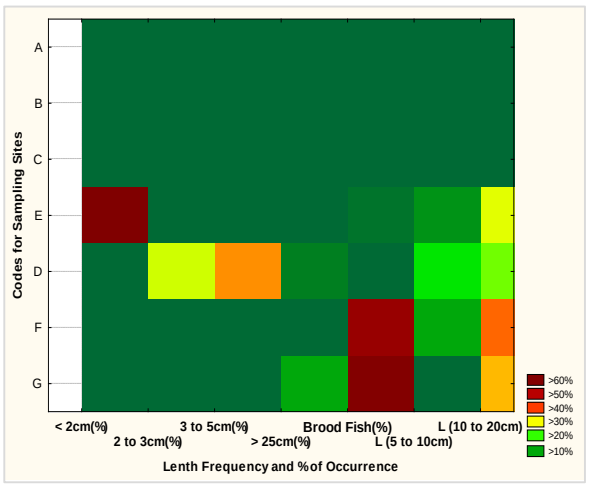
7th Monitoring, October, 2015



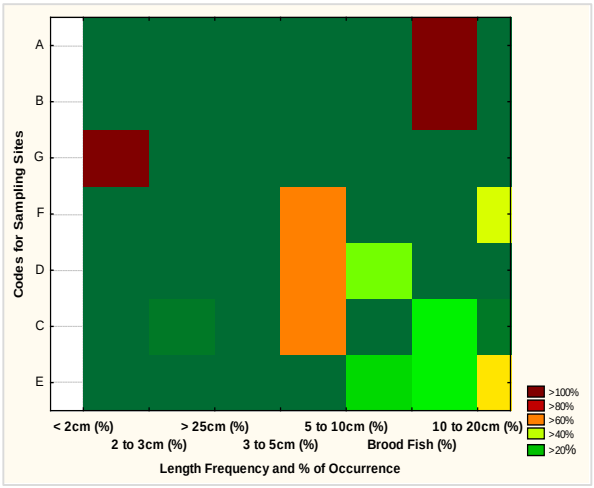
8th Monitoring, January, 2016



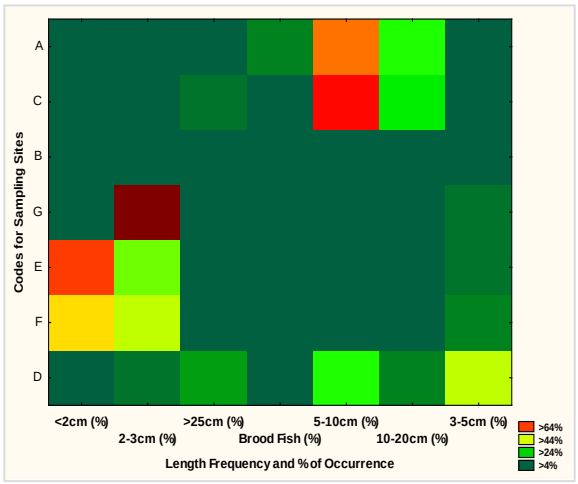
9th Monitoring, April, 2016



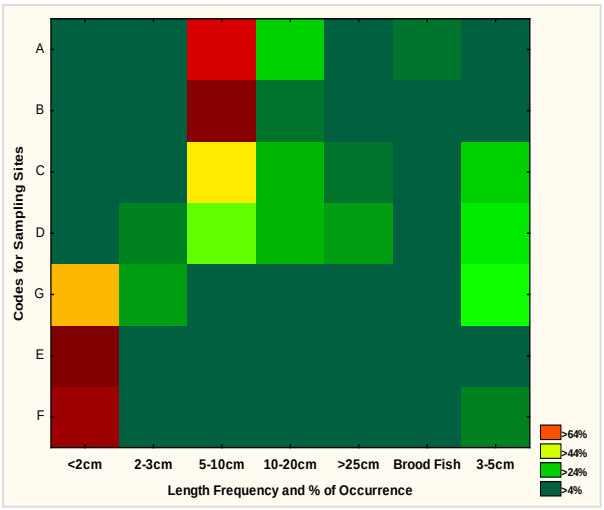
10th Monitoring, July, 2016



11th Monitoring, October, 2016



12th Monitoring, January, 2017



13th Monitoring, April, 2017

Figure 3.4: 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

Fish Migration

Migratory Species Diversity

147. Migratory species were identified by analyzing the common species available in the regular catch from the sampling sites. The maximum abundance (about 25%) of Gulsha Tengra among the migratory fish species were observed in the first quarter of monitoring of 2017-18. The relative abundance of the migratory species is give below in the **Figure 3.1.5**.

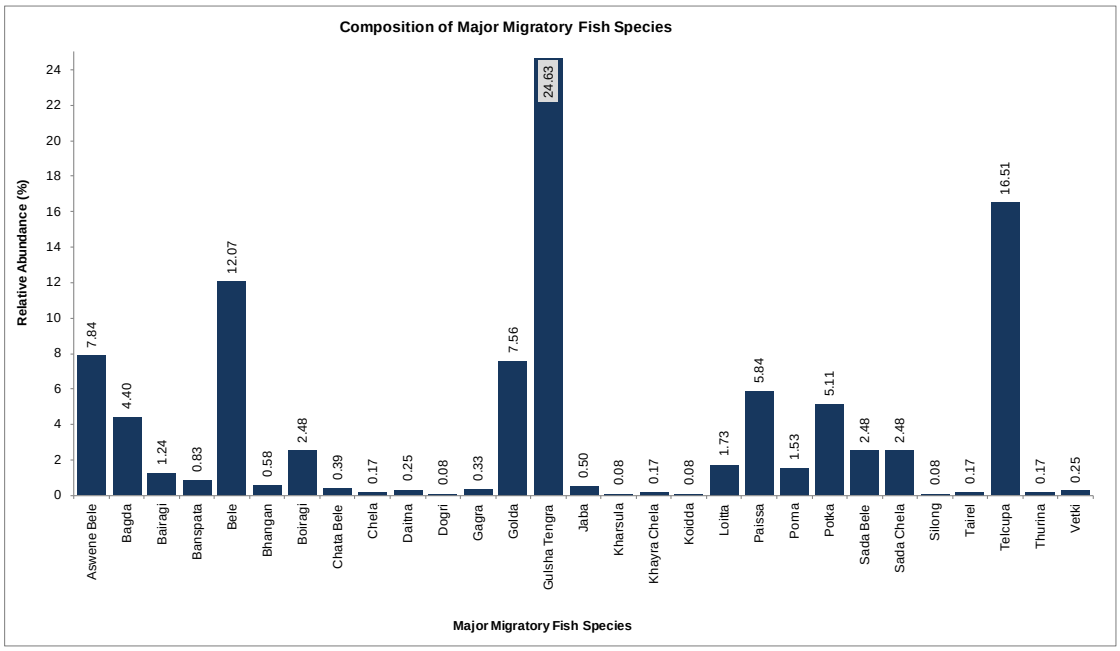


Figure 3.5: Relative abundance of major migratory fish species in sampling sites

Migration Extent, Time and Purpose

148. Major fish species showed interesting pattern in distribution for exploiting different purposes mentioned in the following table all along the sampling sites. Three (3) fish species were found common in most of the sites. These species, also, Paiss, Golda and Bele were observed indicating long range of distribution (**Table D.4 of Appendix IV**).

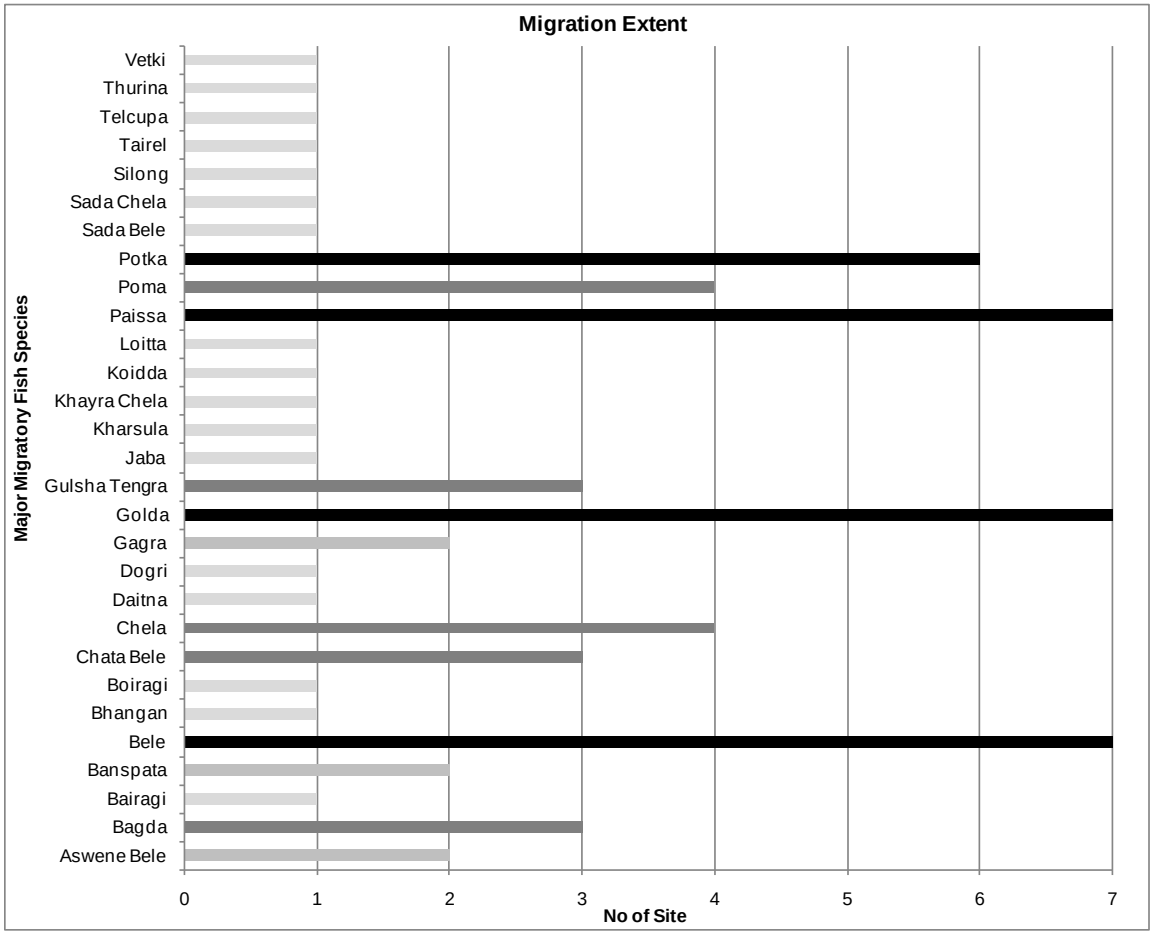


Figure 3.6: Migration extent of major migratory fish species in sampling sites

Shrimp/Fish Farm

149. 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.

Stocking Pattern

150. 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 were collected from wild source of the Passur River in this monitoring phase.

151. In this monitoring year, the seeds for Bagda stock of the entire selected shrimp/fish farm were collected from the wild sources. The stocking density varied with the size of the ghers, socio-economic status of the gher owners and seed availability. The highest stocking rate was observed in case of gher in Kapasdangaseed availability. The highest stocking rate has been observed in case of gher in Kapasdanga (**Table 3.5**).

Shrimp/Fish Growth Rate and Mortality

152. During the fourth quarter of third monitoring year, no growth rate and mortality ratecould be calculated (**Table 3.6**).

Table 3.5: Stocking Pattern of Fish/Shrimp farm

Location	Fish Species	Stocking Density (No/ha)	Stocking Date	Food Item	Total Production (ton)
Rajnagar	Bagda	2,593	Last Week, Feb	Natural	**0**
	Horina Chingri	Natural Stocking			**1**
	Tengra				**0**
	Paissa				**0**
	Chela				**0**
	Vetki				**0**
Kapashdanga	Bagda	3,000	mid-March		**0**
Chunkuri-2	Bagda	2,230	First-Jan		**0**

Source: Field Survey, 2014

Shrimp/Fish Growth Rate and Mortality

153. During the fourth quarter of third monitoring year, no growth rate could be calculated. However, highest mortality rate wasn found in case of ghers at Rajnagar (about 30%) (**Table 3. 6)**.

Table 3.6: Growth Rate and Mortality of Fish/Shrimp

Gher No.	1st QM (Apr 2014)		2nd QM (Jul 2014)		3rd QM (Oct 2014)		4th QM (Jan 2015)		5th QM (Apr 2015)		6th QM (Aug2015)		7th QM (Oct 2015)		8th QM (Jan 2016)		9th QM		10th QM		11th QM		12th QM		12th 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

Source: CEGIS Field Survey, 2014, 2015& 2016

Fish Production

Capture Fish Production

154. In this first quarter monitoring during 2017-2018, the highest productivity was found in Sheola khal at Chandpai **(Table 3.7**). The lowest productivity was found in the Mongla Point, Maidara and Chalna Point. Because all the fry fishes were not considered as catch.

155. The present study revealed that the highest catch susceptibility was found in case of Charpata Jal (77.5 kg/haul) (**Table 3. 7**). The following table also expresses that Net Jal, Box Net and Tana Jal were most frequently used in all upper reaches in Passur River System. Charpata Jal was commonly used in middle reach and lower reach of the Passur River. Moreover, the highest total catch was observed in Sheola khal at Chandpai and lowest in the Mongla Point, Maidara and Chalna Point in this monitoring phase (**Table-3.8**).

Table 3.7: 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	Khepla Jal	1.5	30	2	0.07
B	Haldikhali	Haldekhali Khal	Khepla Jal	1	5	0.25	0.05
C	Harbaria	Harbaria Khal	Charpata Jal	12	8	30	3.75
			Khepla Jal	1	15	0.8	0.05
			Mui Jal	1	3	0.5	0.17
			Spear	3	300	1.2	0.00
D	Chandpai	Sheola Khal	Charpata Jal	12	1	77.5	77.50
E	Mongla Point	Passur River	Net Jal	5	1	0	0.00
F	Maidara	Maidara River	Net Jal	5	12	0.3	0.03
G	Chalna Point	Passur River	Box Net Jal	1	1	0	0.00
			Jhaki Jal	0.5	3	0.25	0.08
			Tana Jal	1	1	0.1	0.10

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

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

Table 3.8 : 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
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

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

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

Culture Fish Production

The fish production in this 1st quarter of 4th year monitoring was found only in the Gher of Rajnagar **(Table D.5 in Appendix IV)**.

Photo 3.2: Fishing gears and crafts use in fishing at sampling sites

3.2 Ecosystem Monitoring

156. Rivers, canals, ponds and shrimp farms are the main types of wetland in the study area. Among which, Rivers are generally termed as the flowing/ lotic and ponds bear the stagnant/lentic water systems. Canals of this area have been merged with shrimp farms and thus the shrimp farms extend a large proportion of total watershed of the study area.

Therefore, canals are no more natural flowing or stagnant water system.

a. Monitoring Location

157. Passur is the only river beside the project area which maintains connectivity with all the flowing water systems of the study area. On the other hand, Maidara River including two branches (Sailtakhali and Ichamoti) exists as internal river system. Hence, status of benthos, planktons and aquatic mammals (Dolphin) were monitored at different locations of the study area.

b. Dolphin Occurrence

Dolphin migration route in study area

158. Ganges River Dolphin and Irrawaddi Dolphin travel through the Passur River throughout 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 sighted in Passur River. Besides, Ganges Dolphins roam through Maidara River mainly during high tide. Siltation and narrowing of upstream branches is limiting the length of migration area of this aquatic mammals day by day.

Dolphin occurrence in Passur River

159. A transect survey was conducted along about 18 km length of Passur River surrounding the project area (From Chalna to Mongla) using mechanized vehicle for observing dolphin occurrence . A total of 8 Ganges River Dolphins were recorded at different locations of the surveyed transect with an occurrence rate of 0.30 individual/km/hour. All of which were diving and occurrence concentrated at the confluence points of the Passur-Chunkuri River and near the industrial area of Mongla Port. (**Figure 3.7**).

160. More short surveys were conducted at Karomjal, Harbaria and Akram Points while passing through the River. Both at Karamjal and Harbaria, evidences of Ganges Dolphin were noticed. In case of Akram Point, dolphin occurrence was not observed due to heavy waves for having rough weather at that time. The survey result is provided in **Table: 3.9**.

Dolphin occurrence in Dhangmari Khal

161. Occurrence of Dolphin were also surveyed at the Dhangmari Khal Wildlife Sanctuary. Total transect length was 13.25 km (6.63 km x 2 transects) from Dhangmari-Passur confluence to Gagramari Patrol Post of Forest Department. 16 dolphin occurrences were recorded from this survey, of which, 6 individuals were found at river confluence point in front of Gagramari Patrol Post and 7 individuals have been recorded from the first meander point near Dhangmari Forest Office. The average encounter rate was calculated as 0.88/km/hr (**Figure 3.8**).

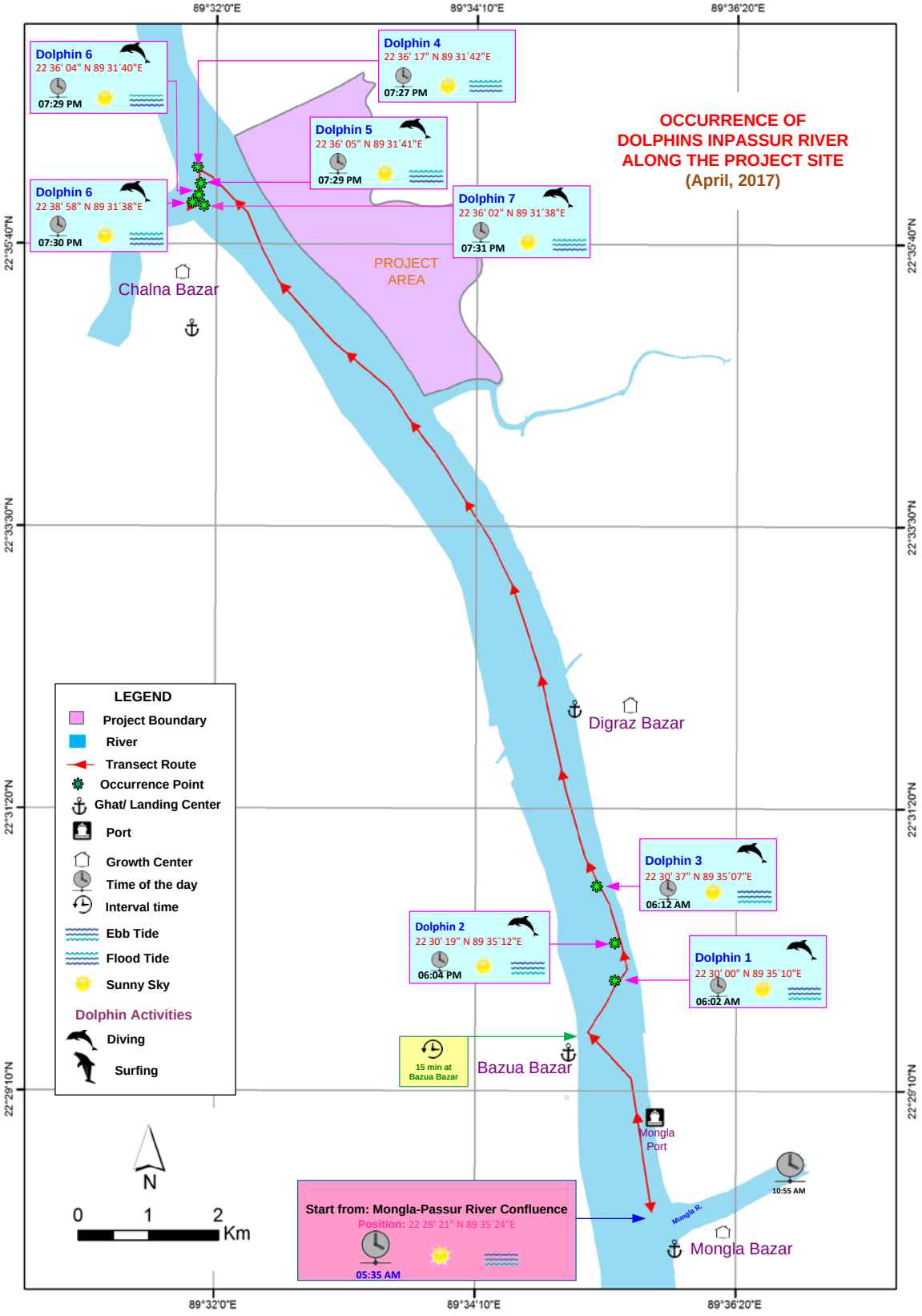


Figure 3.7: Occurrence of Dolphin at Passur and Maidara River along the project site (April 2017)

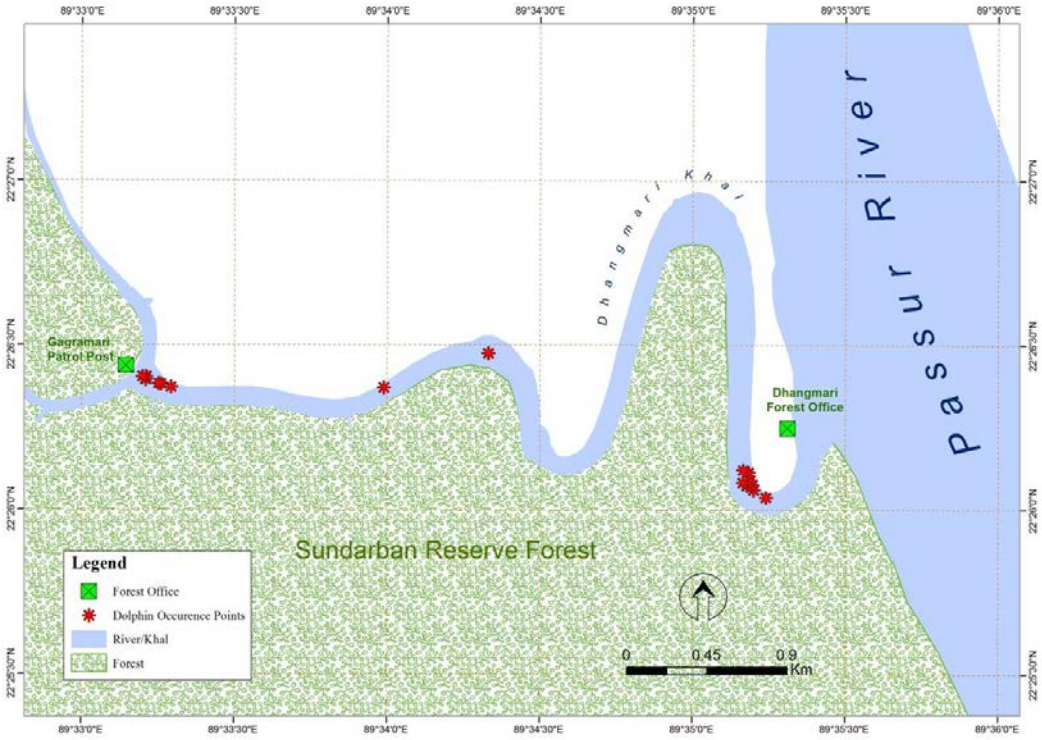


Figure 3.8: Location of dolphin occurrence at Dhangmari Khal (April 2017)

Dolphin occurrence in Bhadra Khal

162. A total of 6 dolphin individuals were recorded from 10.2 km boat transect survey along Bhadra Khal near Mazhar Point. The overall encounter rate was 0.65 individuals/km/hour during ebb tide (**Figure 3.9**).

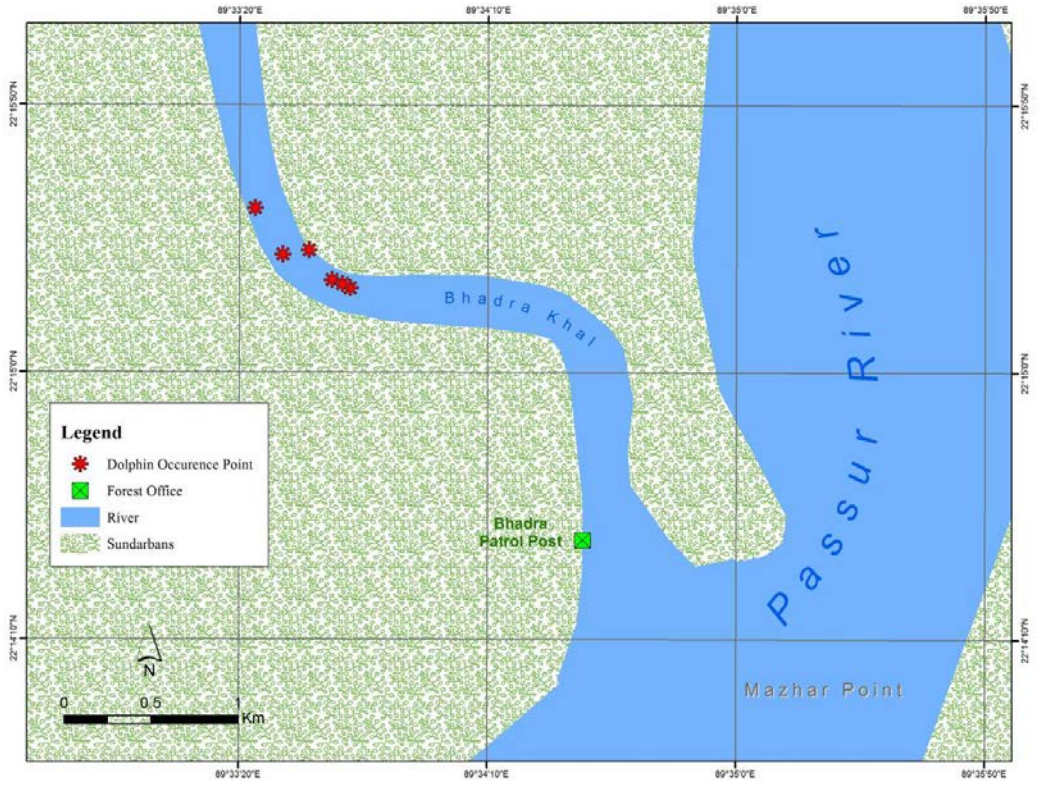


Figure 3.9: Location of dolphin occurrence at Bhadra Khal (April 2017)

Table 3.9: 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		April 2017	
	FT	NT	FT	NT	FT	NT	FT	NT	FT	NT	FT	NT	FT	NT	FT	NT	FT	NT	FT	NT	FT	NT	FT	NT
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	NS	Y
Karamjal	NS	NS	NS	N	NS	Y	Y	Y	N	N	NS	Y	NS	Y	Y	N	Y	NS	Y	Y	Y	Y	Y	Y
Harbaria	NS	NS	NS	N	NS	Y	Y	N	N	N	N	N	Y	NS	Y	N	Y	Y	Y	NS	N	N	N	Y
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	NS

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

3.3 Sundarbans Forest Health

163. 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, twelve (12) surveys were conducted at five locations, namely Sutarkhali, Karamjal, Harbaria, Akram point and Hiron point. In this thirteenth monitoring program a new location (Bhadra) was added considering the potential coal transshipment anchorage location at Mazhar Point. The overall monitoring indicators observed in thirteen 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

Indicators Selected for this monitoring tier

164. Frequency of Monitoring for different indicators has been determined considering efficiency with respect to time, cost and applicability. The indicators observed in this tier were as follows:

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

Forest Health Monitoring Location

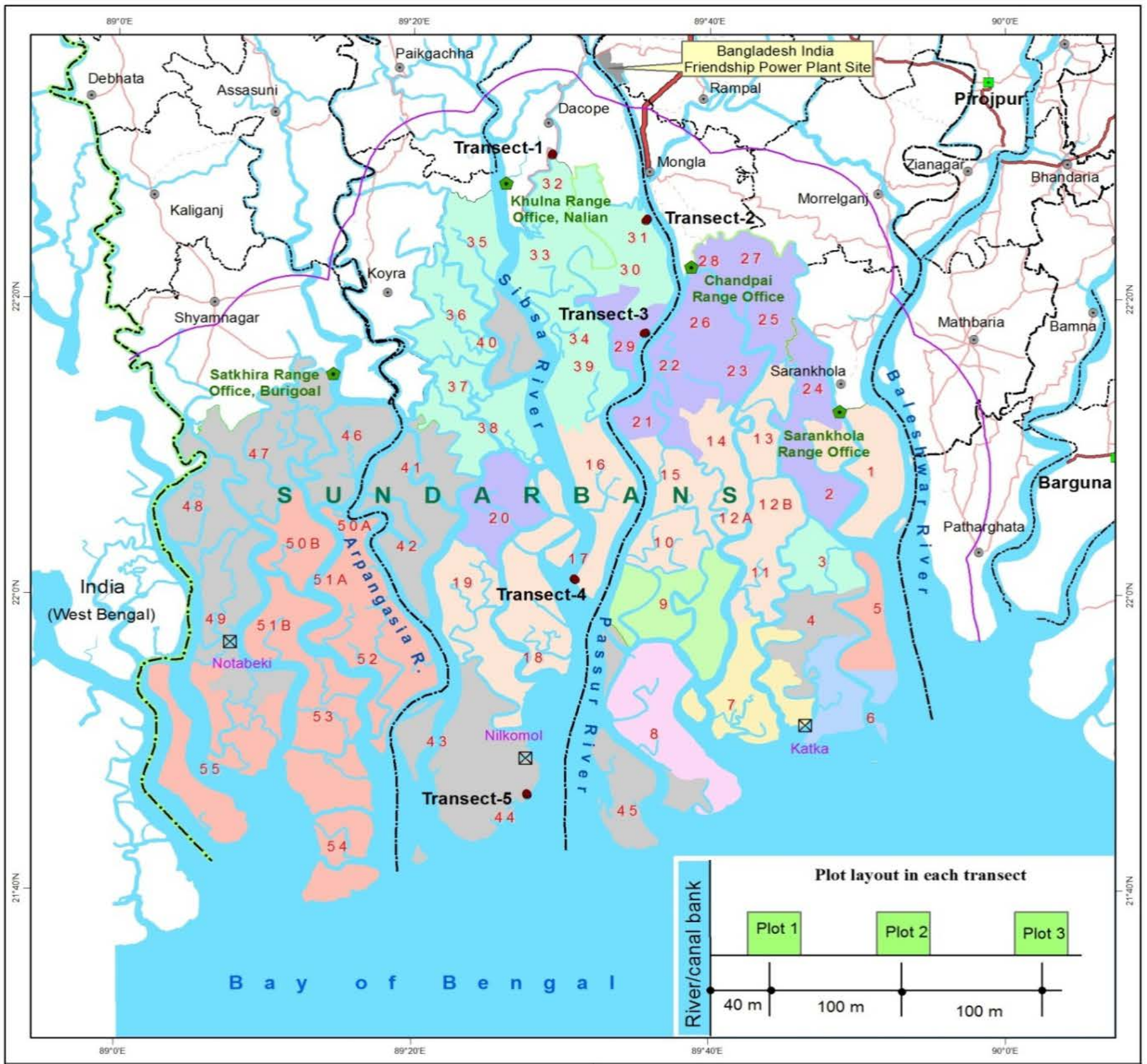
165. To set up permanent sample plots five sites were selected on the basis of the survey conducted from April 3 to April 6, 2014 (**Map 3.2**). Among those, four sites are along the Passur River at Karamjal, Harbaria, Akram point and Hiron point, and the fifth one is near Sutarkhali forest office (**Table 3.10**). The sites were selected considering the distance from the proposed Project site, wind directions, coal transportation route, river systems and vegetation types. In this monitoring tier, Bhadra as an additional site was selected for observing the impact due to future coal transshipment activities at Mazhar Point. Forest health at Hiron Point site wase not monitored in this visit due to unfavorable weather.

Sampling Design of Permanent Sample Plots (PSPs)

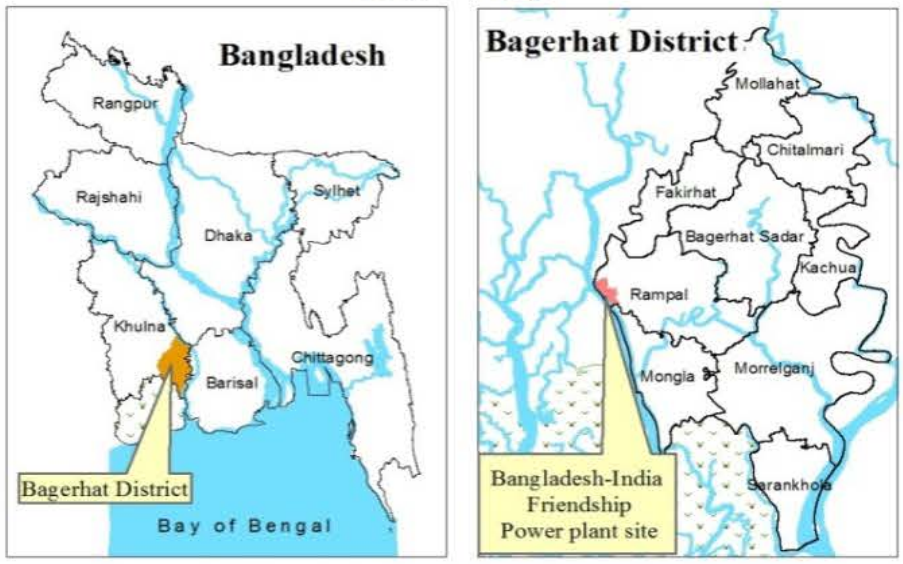
166. In each site, a transect line was laid out perpendicular to river or canal bank. Along the transect line three circular nested subplots of 12.62 m radius have been laid out at 100 m intervals in order to capture the maximum tree species (**Figure 3.7**). Because of the variation in species composition 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 subplotwas again subdivided into four quadrates for the ease of data detection and recording (**Figure 3.10**). the layout of the survey activities are shown in **figure 3.11**

Table 3.10: 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	22.42521	89.59341	Hard Clay	Plot centre 140 m west from Passur river
	3	Chandpai	31	22.42261	89.59254	Hard Clay	Plot centre 240 m west from Passur river
Harbaria	1	Chandpai	29	22.2061	89.5924	Hard Clay	40 m west from passure river
	2	Chandpai	29	22.29624	89.59179	Hard Clay	140 m west from passure river
	3	Chandpai	29	22.2962	89.5908	Muddy	240 m west from passure river
Akram Point	1	Khulna	17	22.01953	89.51291	Hard Clay	40 M east from shibsha river
	2	Khulna	17	22.01873	89.51344	Clayee	140 M east from shibsha river
	3	Khulna	17	22.01805	89.51408	Hard Clay	240 M east from shibsha river
Hiron Point	1	Khulna	44	22.77535	89.46104	Sandy	350m east from Gogari canal
	2	Khulna	44	21.91667	89.23333	Sandy	40m north from Bay of Bengal
	3	Khulna	44	22.18333	89.50000	Hard Clay	648m south east from Shibsa river
Bhadra	1	Khulna	39	22.2351	89.5703	Hard Clay	60m west from Bhadra Khal Bank
	2	Khulna	39	22.2352	89.5694	Hard Clay	150m west from Bhadra Khal Bank
	3	Khulna	39	22.2352	89.5685	Hard Clay	250 m west from Bhadra Khal Bank



Index Map



Legend

- International boundary
- District boundary
- Upazila boundary
- National highway
- Regional highway
- Zilla road
- Upazila road
- Major river
- Plant site
- Sundarbans Reserved Forest
- ECA boundary
- District HQ
- Upazila HQ
- Range Office
- Wildlife sactuary headquarter
- Transect location

Data sources:
National Water Resources Database (NWRD)
CEGIS archive
Monitoring of Khulna 1320 MW
CBTPP, BIFPCL

0 5 10 20 km

Map projection: Bangladesh Transverse Mercator (BTM)

Map prepared by:
CEGIS Center for Environmental and Geographic Information Services
June 2016

Map 3.2: Location Map of Sundarbans Forest Health Monitoring Plots (PSPs)

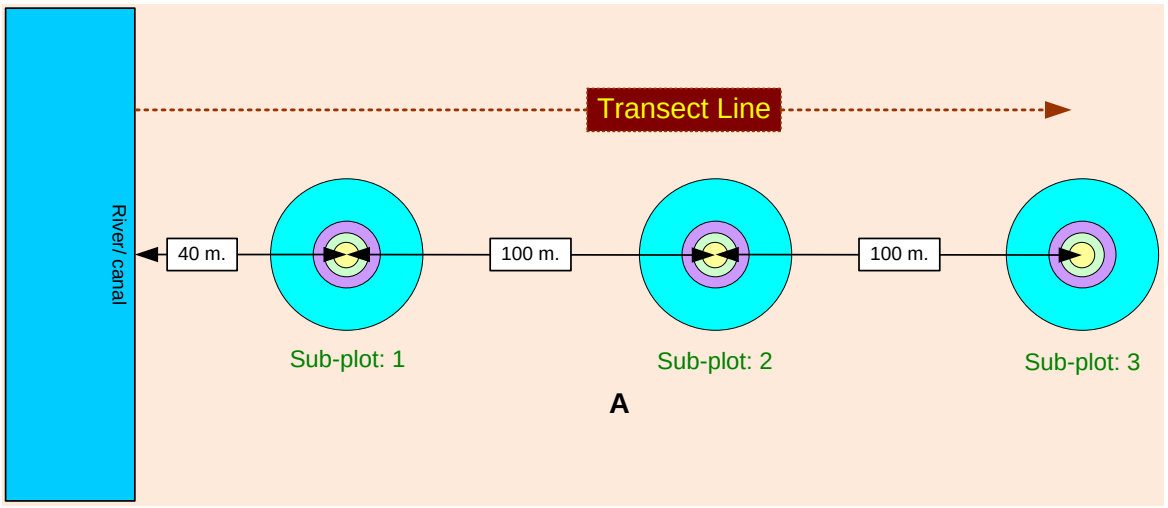


Figure 3.10: Layout of the subplots and transect line perpendicular from ecotone (river or canal bank)

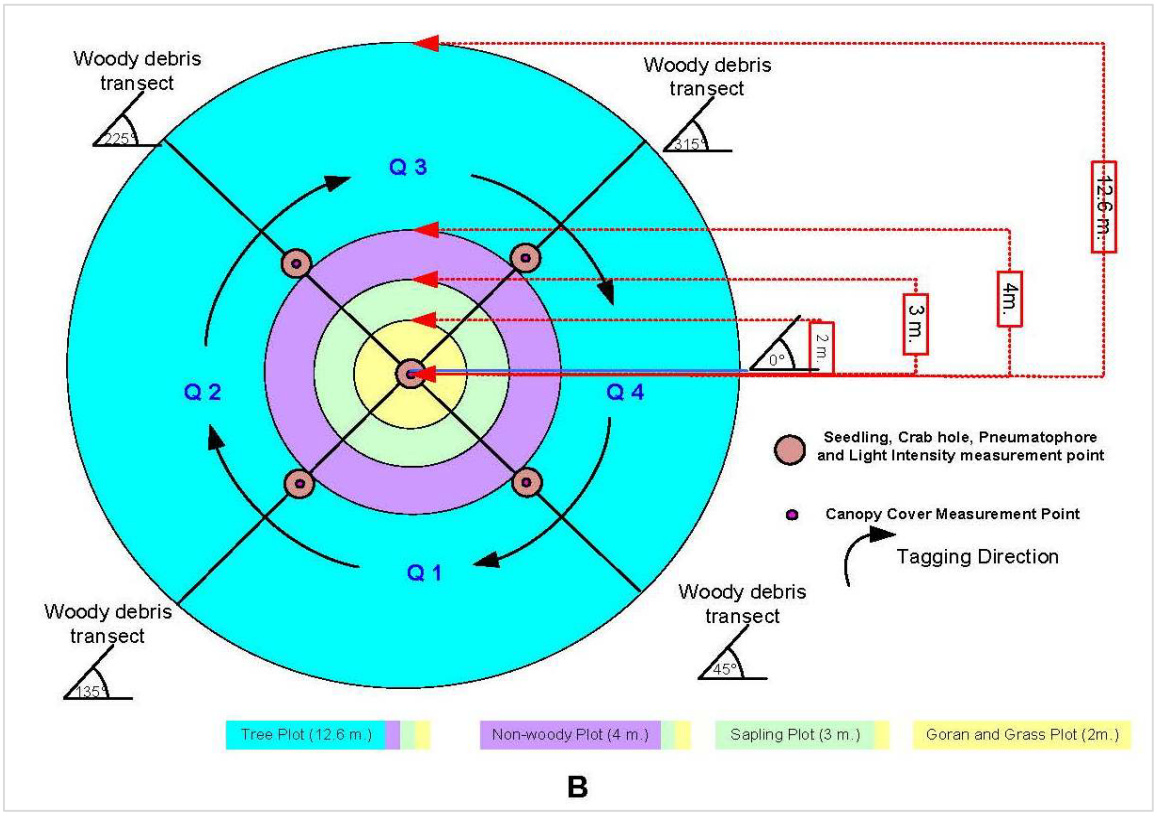


Figure 3.11: Layout of the survey activities in each subplot

Forest Health Survey

(a) Trees

167. The tag number of trees (DBH ≥ 5 cm 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 3.3**). The tree height and diameter were also taken by the surveyor (**Photo 3.4** & **Photo 3.5**).

Photo 3.3: Team Member recording and cross checking data in the field sheet

Photo 3.4: Team member measuring height of trees at Bhadra site

Photo 3.5: Measuring the DBH of trees at Harbaria

(b) Sapling and seedling

168. 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 3.6**). For saplings, species name and DBH were recorded along with the living status (**Photo 3.7**)

Photo 3.6: Team member counting the seedlings at Harbaria

Photo 3.7: Team member measuring the DBH of saplings at Sutarkhali

(c) Pneumatophores

169. The total number 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 3.8**).

(d) Crab hole

170. 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 woody debris transect (**Photo 3.9).**

Photo 3.8: Team member counting pnuematophore on forest floor

Photo 3.9: Counting of crab holes on forest floor

(e) Canopy Cover

171. 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 3.10**). 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.

(f) Leaf Area Index

172. 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 (**Photo 3.11**). In this monitoring report, LAI was calculated as follows:

Leaf Area Index (LAI) = $\log_e (I/I_o)/-K$ m^2leaf area /m^2area of ground

(Where, I = Under Canopy Light Intensity, I_o = Open Canopy Light Intensity and K is Canopy light extension coefficient i.e., 0.5)

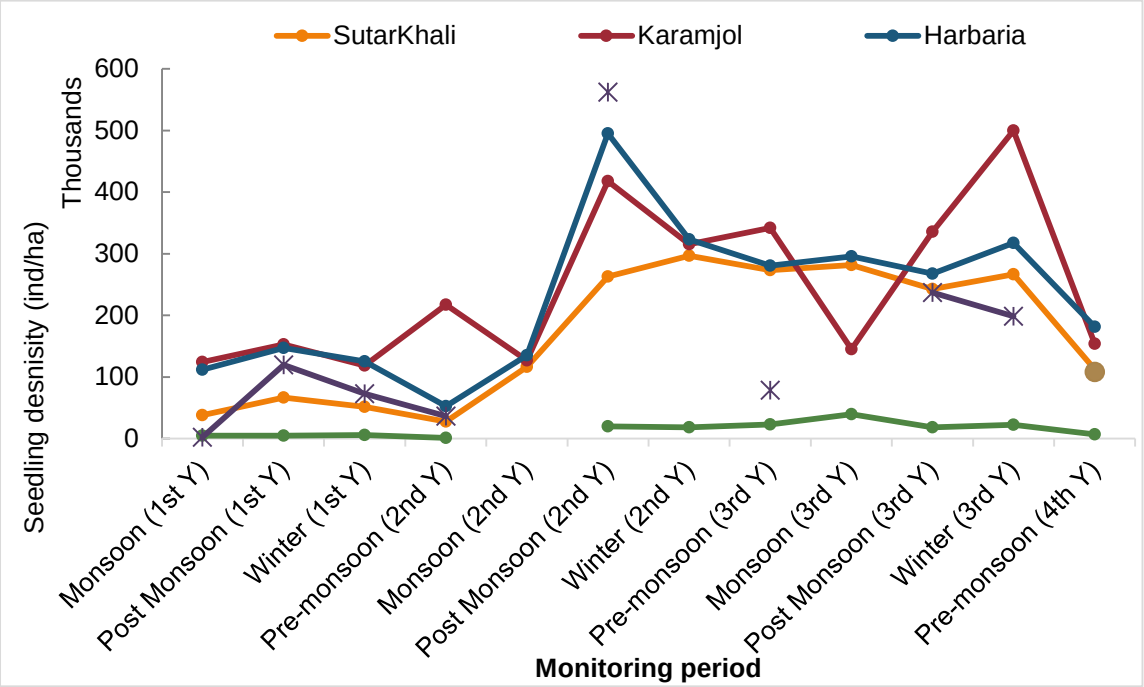
Photo 3.10: Team member taking canopy cover using Densiometer

Photo 3.11: Team member taking light intensity using Lux Meter

3.3.2 Status of monitoring of SRF Health

Seedling

173. It was found from the last monitoring program that number of seedlings per hectare have been increasing almost all the monitoring locations except Akram point (**Figure 3.12**). The graph has also shown that higher number of seedlings was found during monsoon to post-monsoon period whereas 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 in natural forest due to competition for nutrients as well as light intensity. 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 after the rainy season (monsoon to post monsoon) than in other seasons. The result of this 13th monitoring period showed comparatively higher number of seedlings at Hiron point than that of the other pre-monsoon seasons of the previous years. This may be due to higher light intensity as huge illicit feeling of trees was seen, which has created large open space. It is to be noted that seedling density at Hiron point during monsoon of 2nd and 3rd monitoring year, winter of 2nd year and at Akram point during monsoon of 2nd year were not monitored.

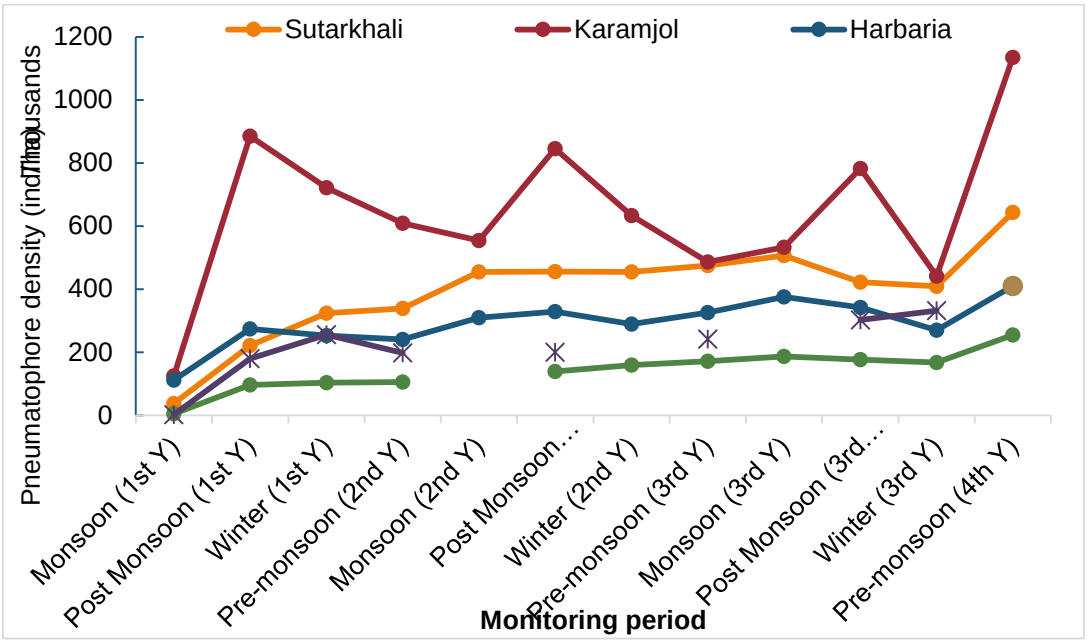


(Seedlings density was not monitored at Akram Point during Monsoon 2nd Year)

Figure 3.12: Mean (±95%CI) seedlings density among the quarterly surveys in five PSPs

Pneumatophores

174. Like seedlings, pneumatophores density also changes due to seasonal variability (**Figure 3.13**). Pneumatophores usually dry up and die during dry season. Hence, the number of pneumatophores per hectare is found comparatively higher in post-monsoon period. However, among five monitoring sites, the mean pneumatophores density wass found lower at Akram point due to floristic composition. From the species composition inventory, it was found that Gewa (Exoecaria agallocha) was the dominating species at this monitoring sites. On the contrary, in Karamjal mainly dominated by Baen (Avicennia officinalis) tree and it 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. It is to be noted that pneumatophore density at Hiron point during monsoon of 2nd and 3rd year, winter of 2nd year and at Akram point during the monsoon of 2nd year was not monitored.

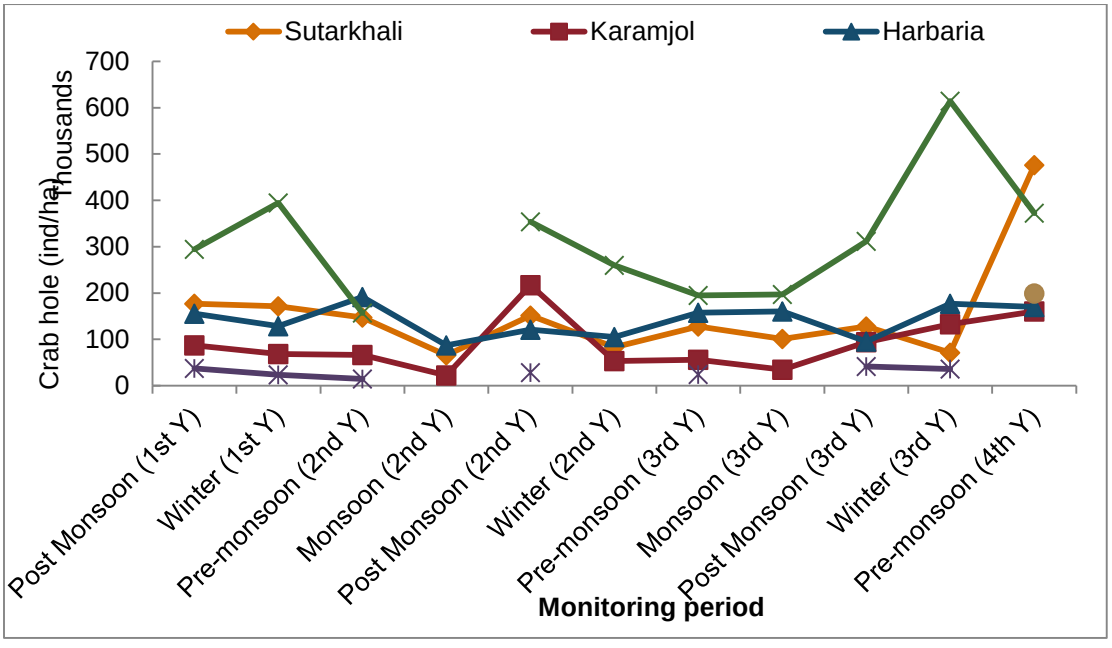


(Pneumatophores density was not monitored at Akram Point during Monsoon 2nd Year)

Figure **3.13: Mean Pneumatophores Density among the quarterly surveys in five PSPs**

Crab hole

175. The crab hole density, the indicator of availability of crab in a site, was found the highest at Akram point among the five monitoring sites **(Figure 3.14**). This could be due tosandy forest floor at Akram point because they love to drag hole on that particular habitat. From figure, it was difficult to predict the relationship of crab hole with seasonal variability. This might be due to the nature of mangrove (evergreen forest) forest floor. Although mangroves are marshy land, there are differences in terms of area in dry period (winter) and wet period (monsoon) which shows some influences on crab hole abundance. It is to be noted that crab hole density at Hiron point during monsoon of 2nd and 3rd year, winter of 2nd year and at Akram point during the monsoon of 2nd year was not monitored.

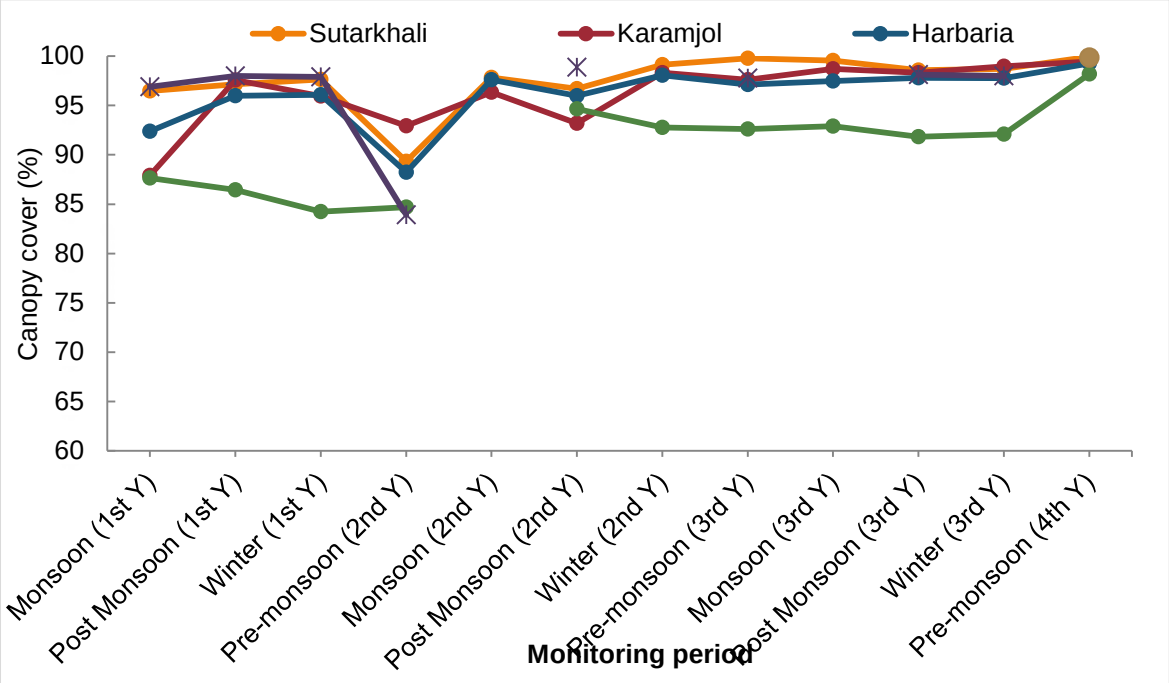


(Crab hole density was not monitored at Akram Point during Monsoon 2nd Year)

Figure 3.14: Mean crab hole density among the quarterly surveys in five PSPs

Canopy cover

176. In the monitoring plots, the canopy cover percentages was not varied significantly. From the first year to second 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 monsoon second year to monsoon third year, it was found that the canopy cover percentages were similar among the monitoring sites (**Figure 3.15**). 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. It is to be noted that canopy cover at Hiron point during the monsoon of 2nd and 3rd year, winter of 2nd year and at Akram point during the monsoon of 2nd year was not monitored.



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

Figure 3.15: Mean canopy cover (%) among the quarterly surveys in five PSPs

Leaf Area Index (LAI)

177. The LAI 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 increased in all monitoring locations from previous values. 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. It is to be noted that LAI at Hiron point during the monsoon of 2nd and 3rd year, winter of 2nd year and at Akram point during the monsoon of 2nd year was not monitored.

Findings

178. From all the last monitoring activities, it can be predicted in terms of seedling density, pneumatophore, crab hole, canopy cover and leaf area index (m^2 leaf area/m^2 ground area) that the forest condition is showing positive changes periodically, although there has some seasonal effect. However, based on above indicators it is found that the health condition at Akram point is worse. This is due to the physiographic location of this plot, which is facing high environmental stress. 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. Here, the forest is experiencing retrogation 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 transshipment 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. Therefore, the monitoring should be continued to know the dynamism of mangrove attributes which are very much interlinked with each other as well as with the environment and more monitoring site should be delineated as control site to compare any potential impact due to coal transportation and transshipment along the Passur River.

3.4 Agriculture Resources

179. Monitoring of agriculture resources has also been scheduled twice a year as per the monitoring plan. Accordingly, the survey was conducted in April, 2017.Upazilla wise secondary data of 2015-16 was collected from the local Department of Agriculture Extension (DAE) offices and data on Local Aman and HYV Aman crops were collected through informal interview (KII, RRA and FGD) with the local farmers.However, the present agriculture practices can be summerized as the plantation of various types of crops like HYV Aus, Local Aman, HYV Aman, HYV Boro, Local Boro, summer and winter vegetables, Pulses, Potato, Sesame and Water melon etc.In this regard, status of crop productionand associated data are incorporated in this report to provide an idea of the present agricultural scenario in the study area.

3.4.1 Methodology

Monitoring Indicators

180. Major cropped area, crop production and crop damages have been considered as major indicators for agriculture resources monitoring.

Frequency and Sampling Method

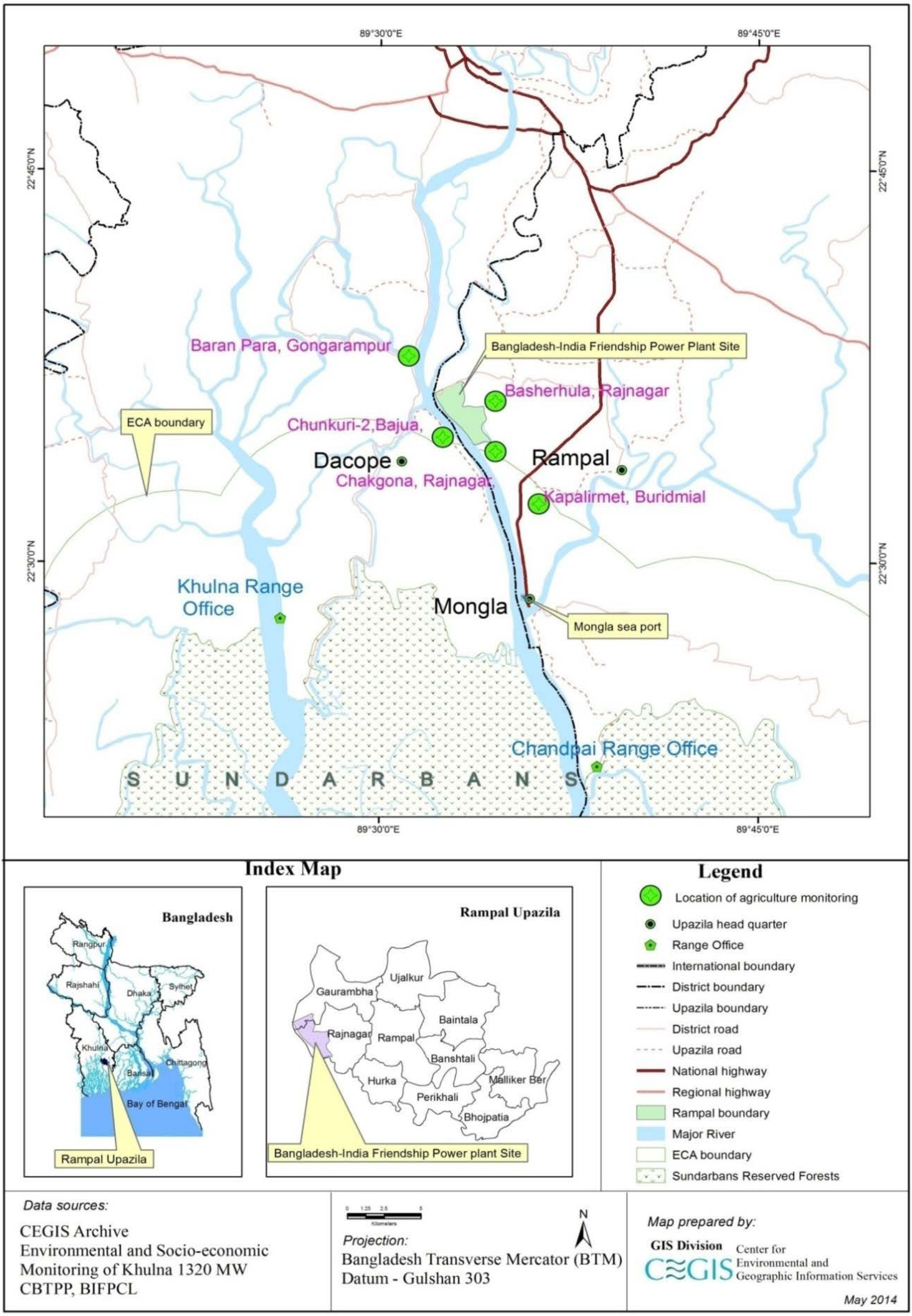
181. Monitoring of agriculture resources was planned to be conductd quarterly in a year. During this field visit, extensive consultations/group discussions were held with local people to know the use of inputs, present cropping patterns by land type, crop damagesand other facts e.g. due to drainage congestion/water 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.

Location

182. For data collection, five sampling plots were selected on random basis within the project influence area. The same mauzas selected for land resources were also considered for agricultural resources onitoring purpose. The locations of agriculture monitoring plots are presented in **Map 3.3**.

Description of the Selected Agriculture Plot for Monitoring

183. Detailed information of the selected plot for agriculture monitoring is presented in Table **E.1 of Appendix IV.**



Map 3.3: Agriculture Resources Monitoring Locations

Present Cropping Patterns of Monitoring Plots

184. Detailed data on the last three years of cropping pattern was obtained through extensive discussion with the plot owners. Based on the discussion, the plot based cropping patterns have been identified for the year 2016. Cropping pattern data has been collected in April 2017 for the year of 2016-17 and described in the following paragraphs.Detailed cropping pattern are presented in **Table E.4** of **Appendix IV**

Agriculture Plot-1 (Baranpara)

185. This plot is located at Baranpara and the areaof the plot is about 0.4 ha. During this monitoring period HYV Aman (BRRI Dhan30)was found to be cultivated in this plot in Kharif-II season.Rice straw and Bajua grass were mixed to improve the soil fertility level. Occurrence of Pest like Stem borer and Rat infestation were reported for damaging the crops. To protect crop from pest infestation, granular pesticides Virtako was applied @ 500gm/plot and Rat flap: 50gm/plot. Due to the application of pesticide, the pest infestation reduced to aminimum level. Crop damage was also recorded in this plot. Detailed cropping pattern is shown in **Table E.4** of **Appendix IV**.

Agriculture Plot-2(Chunkuri-2)

186. This monitoring plot is located at Chunkuri-2 and the size of the plot is about 0.93 ha. During the recent monitoring period it was observed that, farmer of this plot cultivated Local Aman (Benapole) due to the high market price of local variety than HYV variety. Rice straw and Bajua grass were usedto improve the soil fertility level. Stem borer infestation has been observed in this plot. Urea: 130 kg/plot, TSP: 45 kg/plot and MP: 25kg/plot were used in this plot.To protect crop from pest infestation, liquid pesticide Karate 2.5 EC was applied @700ml/plot. Detailed cropping pattern is shown in **Table E.4** of **Appendix IV**.

Agriculture Plot-3 (Kapalirmet)

187. This monitoring plot is located at Kapalirmet and the size of the plot is about 0.14 ha. From the 2nd and 3rdyear monitoring period (2014-15 and 2015-16), this plot remained fallow due to increase in salinity. Farmers of this locality opined that Bangladesh Water Development Board (BWDB) decided to commence the re-excavation of the Ghona River. They removed all the obstacles to facilitate the re-excavation of the Golbunia khal mouth. For this reason, water enters into the settlement areas including their cultivated plots in 2014-15. The whole area was inundated by saline water. As a result farmers of the locality could not cultivate crops and cultured shrimp. Many of the farmers cultivated crops in their plot in this adverse situation, but all crops were damaged by river water and rain water as well in 2015-16. Shrimp gher owners of this area have been practicing to let saline water enter enter in the plots from Ghona River every year for shrimp culture. There has been no scope to drain/wash out saline water from this area. The situation has not been in the farmers' favor as expected yet. However, shrimp/fish has been cultured in this plot in the Kharif-II season of 2016-17. Due to this, farmers have not grown Aman crops in this Kharif-II season (13th quarter monitoring). Farmer of this land decided that they would not practice cropping in future due to increase in salinity. Only shrimp/fish culture will be continued. Detailed cropping pattern for this plot is presented in Table E.4 of Appendix IV.

Agriculture Plot-4 (Chakgona)

188. This monitoring plot is located at Chakgona and the size of the plot is about 0.28 ha. From the 2nd and 3rd year monitoring phase (2014-15 and 2015-16), this plot remained fallow due to increase in salinity concentration. However, shrimp/fish has been cultured in this plot

in the Kharif-II season of 2016-17. Due to this, farmers have not grown Aman crops in this Kharif-II season (13th quartermonitoring of 2016-17). Farmer of this land decided that they would not practice cropping in future. Only shrimp/fish culture will continue. It is mentioned that plot owner has given part of the plot (0.07 ha out of 0.28 ha) voluntarily for the construction of cyclone shelter at Chakgona mouza. Detailed cropping pattern is presented in **Table E.4 of Appendix IV.**

Agriculture Plot-5 (Basherhula)

189. This monitoring plot is located in Basherhula and the size of the plot is about 0.47 ha. Farmer of the plot cultivated Local Aman (Chapsail) in Karif-II season of 2016-17(13th quarter monitoring of 2016-17). Noteworthy that, the Chapsail rice is a salt tolerant variety and has high market value than that of HYV variety. Chemical fertilizer and liquid pesticides are being used in the plot. Pest like Rat infestation has been observed in this plot. Only Urea was applied in his plot @35 kg/plot. To protect crop from pest infestation, liquid pesticide Rat flap applied @50gm/plot. It can be mentioned that the management practices were not ocnducted properly.

Crop Crop Production in Monitoring Plots

190. Crop production is an indicator of the fertility and productivity of a piece of land from the agricultural point of view. Crop production varies from plot to plot and due to different crop variety, fertility status, access to other inputs and management practices of the plot. For this reason, the production levels of the plots were not the same. The highest production (0.44 ton) ewas observed in the monitoring agriculture plot-2 (Chunkuri-2) and lowest production (0.15 ton) was observed in monitoring agriculture plot-5(Basherhula). Among the monitoring plots, Baranpara and Barnimauzas cultivated HYV Aman and HYV Boro while in other plots local Aman was aslo cultivated in 2016-17. Of these monitoring agricultural plots, farmers of Chakgona and Kapalirmet could not cultivate crops in 2016-17. Detailed information on crop production in the monitoring plots is presented in **Table E.5** of **Appendix IV.**

Crop Damage in Monitoring Plots

191. The Kapalirmet and Chakgona plots remained fallow due to the adverse impacts of salinity in 2016-17. Crop damage was observed in monitoring plot-1(Baranpara) and monitoring plot-5(Basherhula) in the year of 2016-17. Crop damage areas were 0.06 ha and 0.09 ha respectively. Total 0.043 ton (Baranpara: 0.024ton and Basherhula: 0.019ton) rice production was damaged by pest infestation (Stem borer and Rat) in these two plots. Detailed crop damage information is presented in **Table E.6** of **Appendix IV.**

Upazila Wise Cropping Pattern of the Monitoring Area for the Period of 2015-16

192. The monitoring area (10km radius) comprises four upazilas namely Batiaghata, Dacope, Rampal and Mongla under Khulna and Bagerhat districts. According to the secondary information of local DAE offices, dominant cropping pattern is Fallow-HYV Aman-Fallow which occupies 85.79% of NCA at Dacope upazlia of Khulna district. Next dominant cropping pattern is Fallow–Local Aman-Fallow which covers 72.90 % of the NCA at Mongla upazila of Bagerhat district. Detailed cropping pattern of the monitoring study area is presented in **Table E.7** of **Appendix IV.**

Upazila Wise Cropped Area, Yield and Crop Production for the Period of 2015-16

193. Net Cropped Area (NCA) is 50,293 ha of which 19,052ha, 18838ha, 12,400ha and 3,292 ha in Batiaghata, Dacope, Rampal and Mongla upazlia respectively. However, total

cropped area was 77,706 ha, of which 38,756 ha, 20,236 ha, 15,400 ha, 3,314 ha were in the Batiaghata, Dacope, Rampal and Mongla upazila respectively for the year of 2015-16. According to the local DAE, total crop production was 309,912 tons, of which 116,289 tons, 105,141 tons, 75,699 tons and 12,784 tons were produced in the Batiaghata, Dacope, Rampal and Mongla upazila respectively. Among the rice crop production, the highest (62%) production of Local Aman crops was observed at Mongla upazila and the lowest (1%) production observed Local Boro crops at Rampal upazila under Bagerhat district respectively. It may be mentioned that, no crop damage was observed in the study area in last three consecutive years. the detailed cropped area, yield and crop production of the monitoring study area are presented in **Table E.8** of **Appendix IV.**

4. Social Environment

4.1 Socio-economic Condition and Social Safeguard

194. Socio economic monitoring of this phase is intended to investigate the change (either improvement or deterioration) in selected socio-economic indicators/parameters with reference to the previous monitoring results. It also intends to recommend for further improvement in pre-construction and construction activities. Methodologically, these indicators are surveyed twice in a year (six months successive interval).Discussions of this chapter reflect a comparative results or changes based on survey done in 1st quarter (from November 2016 to April 2017) and 3rd quarter (from 24th to 28th April, 2017).

4.1.1 Methodology

195. Total 10 informal discussions were conducted both in the Project site and adjacent areas. Of them, one was conducted at Foyla bazaar comprising resettled people and the remaining nine were conducted in Kapasdanga-1, Barni-2, Rajnagar-2, Baradurgapur-1, Pankhali-1 and Bajua-1 mouzas comprising affected land owners and local inhabitants. Besides, informal interviews were conducted in the project site with Additional General Manager, Medial officers and others project related stakeholders (**Map 4.1**).

196. For conducting informal discussion a checklist with the compliance of "Performance Standards on Environmental and Social Sustainability" by International Finance Corporation (IFC) was followed.

4.1.2 Exploration of Monitoring Parameters

Compensation

197. Officially, the compensation process has almost been completed. However, the local people stated that some of the landowners who are indirectly affected did not get the compensation. Besides, a few landowners who lost their land but are still unpaid due to problems in their legal documents regarding land. As per *Acquisition and Requisition of Immovable Property Ordinance, 1982* (Ordinance II of 1982 including amendments up to 1994 - ARIPO 1982), people who do not have legal documents of land will not be considered in the compensation processes. Though the lessees of that land (for shrimp culture) cannot be compensated according to above mentioned act. However according to the co-financier (World Bank, ADB etc.) guideline, this group is also eligible for such assistance.

198. There are shrimp farmers in the study area who used to cultivate shrimp by taking lease (locally called *hari*) of private land for certain contract period. BPDB already prepared a LRP (Livelihood Restoration Plan) through engaging consultant for these indirectly affected people. Meanwhile, the project authority initiated training programs (such as sewing and computer literacy) for the local affected people. In line with, this actor group expects suitable trainings for their livelihood restoration from the project authority.

199. People of Gaurambha union (including Kapasdanga and Barni mauzas) stated that, most of the acquired land were owned by the people of this union and thus, their livelihoods depend on that land. But, they did not get any income restoration or livelihood improvement training from the project authority yet. Contrarily, people of Rajnagar union who were the less affected have received income restoration trainings and other benefits from the project

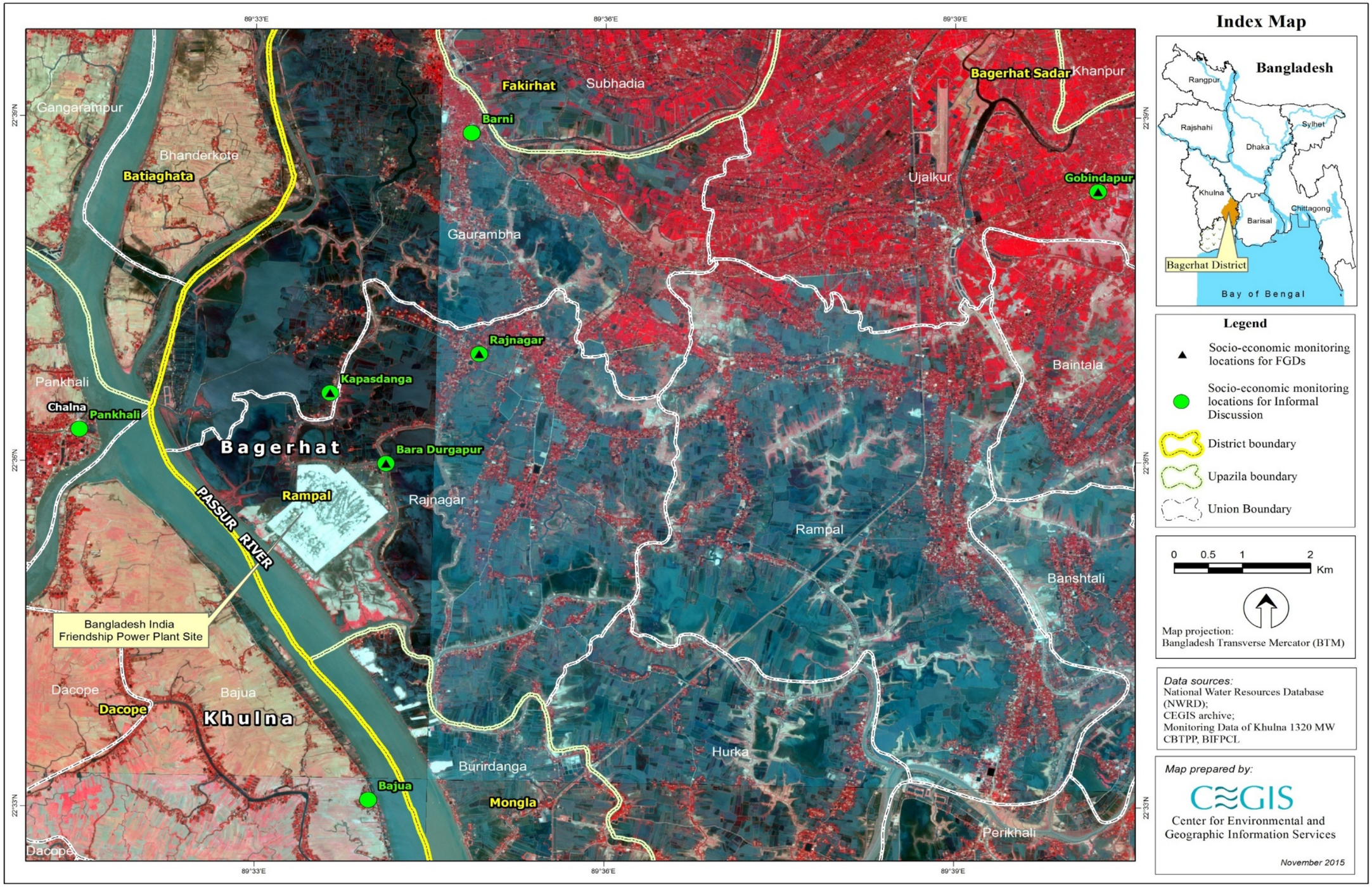
authority". The project authority argued on this issue that the trainings will be continued and might be held in Gaurambha union, if the people of this union arrange logistic support as people of Rajnagar union did.

Resettlement/Rehabilitation

200. About 150 non-titled households (informal settlers) used to live in the project site before commencement of eviction from the acquired land. Of them, 18 households were provided shelter to the *Foyla Shelter Home.* However, eight households are moving out of the shelter home due to the mismatch of their occupation in that area over the last three years. The members of remaining households are somehow trying to cope with the surrounding socio-economic features of that cluster village.

201. After finalizing the LRP (Livelihood Restoration Plan) report, initiatives will be taken to restore the livelihood of the (non-titled) affected persons accordingly. The LRP plan may include some livelihood restoration programs i.e. trainings, one-time cash grant for small entrepreneurship etc.

202. In terms of income restoration and livelihood improvement programs, project authority arranged trainings on sewing and computer literacy to develop skill of project affected people so that they could restore their livelihoods. Two batches of sewing training and two of computer literacy have been completed. The reaction of trainees was found good but they sought possible linkage in job field. They stated that the job sectors related to these trainings have already been saturated. Therefore, people urged that it would be better if the project authority introduces trainings such as rode welding, wall painting, driving, electrician, mechanics, security guards etc.



Map 4.1: Socio-Economic Environment Monitoring Location

Project Related Employment Generation

203. The BIFPCL authority is willing to recruit local labors according to their area of expertise. They also appreciated the proposal for introducing skill development trainings (rod welding, vehicle driving, mechanical, electrical works etc.) to the project affected people and recruit them in the project site in construction and post-construction phase activities according to their capability.

204. The project authority stated that in construction phase activities about 2000-3000 labors can avail employment opportunity of which 70% will be consisted in unskilled and semi-skilled labors. They also stated that they can train the local people to get that opportunity, if possible. The EPC contractor has already recruited some local people who will implement the construction works with the help of sub-contractors. The BIFPCL authority will advise the EPC contractor to recruit local unskilled & semi-skilled labors according to their scope of capbility.

205. A Grievance Redress Committee (GRC) consisting with affected entities, local knowledgeable persons, LGIs and representative of project proponent is essential (which is not formed yet) to solve locally lodged complaints related to the proposed project activities. Project authority has already initiated to establish 'Grievance Cell' but it was not declared among the affected persons or in the study area yet. So, the affected persons were not aware about the function of this cell and way of implementation.

Labor and Working conditions

206. The present accommodation capacity has been madeapproximately two to three hundred workers only. The existing labor sheds are made by locally available thatching materials e.g., *golpata*, bamboo and tin. At present a few labors were using those temporary labor sheds because works of pre-construction phase is almost over. A vast number of labors will be recruited in construction phase while the facilities for labors will be improved by the EPC contractor- ensuring adequate accommodation facilities using standard materials, safe drinking water, hygienic sanitation and proper medical facilities (Source: BIFPCL Authority). The project authority also stated that for preparing those facilities gender issues will be prioritized; even a separate breast feeding room will be arranged for newly mothers.

207. Three toilets were found in the project site those were prepared for the laborers working in pre-construction phase which is not sufficient for the arrangement of construction phase. Water treatment plant and a deep tube well was installed in the Project site for supplying safe drinking and cooking water for the people (labors and employees) staying in the project site during pre-construction phase.

208. A cistern was constructed for meeting up water demand in bathing, cooking and other domestic activities. Additional requirement of water may be managed by preparing separate cisterns for male and female.

209. Initially, there were some resistances from the local labors as they were not used to using Personal Protective Equipment (PPE). But, BIFPCL officials pursued them to use PPE for their own benefit. Over last six months, very little works were conducted at the project site where using PPE was strictly enforced. The project authority stated that workers safety issues will be improved as international standard and a monitoring cell will be formed to monitor workers' health and safety in construction phase. For ensuring labors safety and security, following protective equipment should be provided as per it's requirement, according to the working activity.For ensuring labors safety and security, project authority (BIFPCL) should persuade the labors on using the following personal protective equipments and contractors

should provide the necessary equipment as needed-

Table 4.1: Types of protective equipments provided at sites

Risky limbs of human body	Protective Equipment
Eye	Safety spectacles/goggles
Ear	Earplugs
Head and Neck	Safety helmets
Hands and Arms	Gloves, gauntlets and sleeves that covers part or all of the arm
Legs and Feet	Safety boots and shoes
Lungs	Half and full masks filtering dust
Whole body	Boiler suits/aprons/chemical suits

210. The BIFPCL authority stated that festival allowance will be given to all the temporary and permanent Bangladeshi workers as per the law of Bangladesh government. Recreational arrangements and prayer rooms (a mosque already exists) will also be needed to satisfy the mental, physical and spiritual needs of the labors.

Community Health Safety and Security

211. Local people opined that problem of dust, generated from the Project area is somehow mitigated adopting some measures. The boundary wall around the Project site played an important role to reduce dust flow in the adjacent area. Moreover, The Department of Forest (GoB) already planted 24,000 (fruit, wooden and medicinal) trees and other species of plant in the surrounding of the project site which is also helpful to reduce flow of dust. These trees are also helpful to balance environmental components and to ensure health environment for community people. According to the project authority, plantation process will be continued and they have planned to develop greenery area in open spaces after completing the plant construction activity.

212. In spite of taking these measures people of Kapasdanga and Baradurgapur sometimes faced sand blowing problem in March to May in each year which could be mitigated by regular water pouring system. During construction phase, the environment will be degraded through noise and dust pollution which will affect the community health issues. Though these safety issues can be mitigated by the above mentioned measures, restriction on heavy construction works during quiet time (8 pm to 7 am) should be strictly monitored as well.

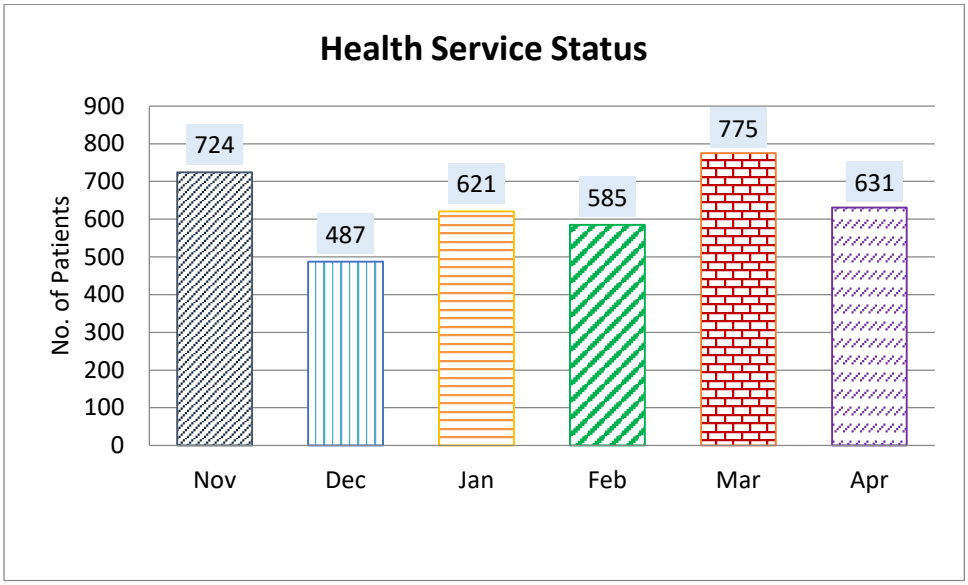
213. For ensuring community safety and security, watch towers have been constructed to monitor the activities outside the project area. During the site visit, damages was observed in a part of boundary wall caused by heavy rain, which need to be repaired as soon as possible. After starting the construction work the permanent drainage, sewerage and water supply network will be constructed as per the final design layout of the proposed project.

Activities under Corporate Social Responsibilities

214. A free medical service was introduced from the very beginning of pre-construction phase activity, targeted to ensure better treatment facilities in project surrounding areas. Popularity of the service expanded the coverage area day by day. At present, the medical camp is carried out twice in a week while patients are treated by an expert physician whereas the medical unit is opened for all the seven days in a week. Patients can get medicine and other general facilities from the medical unit by the guidance of medical assistants.

215. The medical service are being provided from the project authority with an equipped medical arrangements. The team has found 2 shelves were found for keeping medicines and instruments. A separate check-up room, a bed with oxygen support system and 3 supporting staffs were also found regarding this facility. Moreover, some equipments are yet ready to expand the facilities during construction phase activities.

216. The EPC contractor will set up medical center for the labors and workers. For each 50 labor there will be one qualified paramedical stuff which has been noted in the SHE (Site-specific health and Environment) plan.



Source: Field visit to Medical Center at Project area, CEGIS, 2016

Figure 4.1: Record of health service recipients under CSR program

217. From the record it was found that 3,823 people had received health services in the last six months (from November 2016 to April 2017). The highest recipients were in March-2017 and the lowest in December-2016 (**Figure: 4.1**).

218. People showed satisfaction about the service though some showed dissatisfaction on free medicine providing support which was inadequate many times. Most of the patients also stated that after bounding the area patients had to move towards medical camp by existing road only which is time consuming and difficult to get vehicle. They urged vehicle facilities for critical patients. The project authority stated that medicine facilities are available for general ailments however in case of some critical diseases/accidents the patients will be referred to Govt hospital in Bagerhat and Khulna as and when necessary. They also have planned to introduce ambulance facilities during construction phase. It can be mentioned that there was condition to arrange the cost of CSRs as the rate of BDT 0.03 per kW on total profit. However, at present they have run the medical service from their own fund not from the profit at all while the plant did not start its production yet. Therefore, they may not be able to provide all expected facilities in present days which will recover soon as per their available funds.

5. Environmental Compliance

5.1 Introduction

219. Land development work of the Moitre Super Thermal Power Plant Project site has been completed and the EPC contractor would start the construction works very soon.

220. The approach road from Khulna – Mongla Highway to Power Plant Project site has also been completed. Moreover, Boundary wall around the first Phase of Project and the slope protection works have also been completed. The pre-fabricated building has been moved recently to the south-east corner of the project area. Reverse Osmosis (RO) Plant, bridge of the approach road have been completed. Temporary drainage system has been developed to discharge the rainwater accumulated inside the project area. The project area is now being prepared for construction works related to project activities.

221. The environmental compliance monitoring includes monitoring of EMP implementation based on physical observation and assessment by the monitoring 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; Labor and Working Condition; Community Health, Safety and Security; Biodiversity and Sustainable Management of Living Natural Resources.

222. 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 **Table 5.1, 5.2, 5.3** and **5.4** present the summary of findings of the environmental compliance monitoring.

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	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 the level of country's ambient standards, and also as per 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/ generators which are not in use	• CEGIS is carrying out noise survey in ambient environment under environmental monitoring study. • Forest Department has planted local tree as a depository work of BIFPCL. • Machines/equipment/ generators which are passing idle period are switched off/throttled down. • Developed EHS documents for construction works.	• Use of earplug as PPE should be obligatory for the workers during construction works near the high noise generating sources; • Stop working of the heavy noise generating equipment operators (e.g. stone/brick crusher) during 9:00 pm-7:00 am; • EHS register and Grievance redress register should be properly maintained;	Being Complied.
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 • 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? • Construction of boundary wall	• CEGIS is quarterly monitoring the dust generated from land development activities and other construction works. • Paved road network has been prepared • Boundary wall for the main Plant is completed. • Dust generation is minimal due to heavy pre-monsoon rainfall in this quarter • Boundary wall around the project area is also completed.	• EPC contractor should include vehicular sprinkler for spraying water especially during dry/winter seasons to control fugitive dust; • Vehicular speed should be limited and monitored regularly; • Spray water along the roads, workplace and workers residence area during construction works; • Implement redressal mechanism for any kind of grievance from the community related to dust;	Being Complied and will be complied as and when needed.
3	Water Quality	• Fencing the construction site • Arrangement of runoff drainage for reducing any water logging • Location of backfilling stockpile in safe area and protected from wind and rain • No storing of backfilling materials/spoil stored on river bank/slope	• Boundary wall construction for the main Plant is completed • Rainfall runoff discharge to nearby river through temporary drainage network which is being cleared occasionally.	• Stockpile of construction material should be placed at a safe distance from drainage network; • The solid kitchen waste should be disposed on the designated places; • Signboard, awareness training and good practises should be introduced;	Being Complied

Sl. No.	Potential Impacts	EMP measures as proposed in the EIA	Actual condition/ Measures already Implemented	Recommended Action	Compliance Status
		• No disposal of waste and wastewater to river or canal.	• Onsite sanitation facilities has been developed at the labour sheds as well as the working places.		
4	Waste Management System	• Provision of onsite waste management system	• Conventional way of waste collection and disposal system at Plant office and kitchen has been initiated.	• Sufficient waste disposal bin/s with labelling should be installed at labour shed, and working area before starting of the main construction works; • Proper training/ awareness program should be given/arranged for the labours for waste collection and management;	Being complied
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,	• 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 Government's shelter homes or cluster villages • BIFPCL gives priority to affected people in Project related employment • List of 136 people indirectly affected was given by the DC office, Bagerhat. • Livelihood Restoration plan (LRP). for the PAPs have been prepared by BPDB.	• Initiatives should be taken for resettlement of the people as per the LRP; • Introduce training to the PAPs, so that they could get job according to their skill during construction stages; • Spend fund for the development of the PAPs through income generating activities (IGA) and business development services (BDS);	In the process of Compliance

Sl. No.	Potential Impacts	EMP measures as proposed in the EIA	Actual condition/ Measures already Implemented	Recommended Action	Compliance Status
		living standards etc. based on proper socio economic studies? • Human 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 condition	• 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 mitigation 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?	• Recruited a social officer who is responsible for maintaining social liaison; • Engagement of Human Resources consultant for preparing HR policies, Labour recruitment Policies, Manpower set up etc.; • Land development work has been completed and the EPC contractor is going to start the construction works • Provision of first aid is present; • Medical unit capable of dealing emergency like injury, accident, etc. already set up. • Training plan has been prepared for the next 6 months	• Monitoring of the status should be done regularly; • Training, awareness program and grievance redress mechanism should be adopted in a formal way; • Accidental log sheet or injury log book should be put into display; • Improve the sanitary facilities for the labours who are employed directly or indirectly for this project related activities; • Training should be given to the Bouali, seasonal fishermen, small boatman, Mauali of Sundarbans as future labor force; • Training should be given sequentially to the PAPs, on Local or regional basis; • Site specific EHS plan must be implemented;	In the process of Compliance
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;	• Informing the bidders for EPC of main Plants about energy efficient, CDM measures to be followed; • Making IFC guidelines, EIA approval of DoE, and EMP of the	• Prepare checklist on equipment and their condition owned by the contractors; • GHGs inventory checklist should be prepared during construction stage	To be complied during construction and

Sl. No.	Potential Impacts	EMP measures as proposed in the EIA	Actual condition/ Measures already Implemented	Recommended Action	Compliance Status
		• Use of approved pollution control devices fitted in the equipment and machineries; • Switching off and throttling down the machines/equipment/generators, which are not in use.	EIA, etc. as a part of the bid document. • Monitoring program has been running successfully	and necessary action should be taken accordingly. • Use low GHG emission machineries and CDM during main Plant construction;	operation stage.

Table 5.2: Monitoring of Labor and Working Condition

Sl no	Potential Impacts	EMP measures as proposed in the EIA	Actual measures already Implemented	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 Redress Mechanism.	• Engaged HR consultant to prepare relevant policies; • Recruited Occupation and Health Safety officer; • No discrimination has been recorded. • Women are recorded as worker in this project • ERP and ESMS has been finalized • No force and child labour is recorded	• Follow the Bangladesh Labour Law (Revised) 2013, Bangladesh Labour Rule, 2015 and guidelines of ILO. • Appointment of Local workers should be given priority for non-technical jobs. • Motivational and training works should be introduced regularly. • Ensure minimum wage as per GoB for the labour.	Compliance action initiated and in the process of compliance.
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,	• Ensured no child labour employment • Ensured no forced labour • First Aid support to the labours during any accident	• The HR policy should cover child labour policy and Labour Law (Revised) 2013 and all other amendments; • Proper documentation of contract with the worker is required, which includes working hour, wage, and benefit and	Being complied

Sl no	Potential Impacts	EMP measures as proposed in the EIA	Actual measures already Implemented	Recommended Action	Compliance Status
		spiritual, moral, or social development. • No Forced Labour	• Immediate first aid medical treatment has been given to about 25 numbers of labour • ERP has been developed • Increasing the medical facilities for the labour	emphasise recruitment of the local labours; • The insurence policy should cover the accident or injuries of the labours;	
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.);	• Construction of boundary wall; • Encouraged labour and Project personnel to use appropriate PPEs; • Safety Policy of DoE and IFC, Safety measures proposed in EIA report have been incorporated in the contract with EPC; • EHS plan has been prepared which will be followed by the proponent during construction and operation stages. • ERP has been prepared which will be followed by the proponent during construction and operation stages. • Safety manual has been prepared. • The project area has been prepared for construction works • Fire safety mock drill is being conducted at some regular intervals. • Proponent is going to increase the medical facilities • Project site protecting and security system has been maintained by Bangladesh Answar. They are maintaining the register log.	• Increase the manpower in EHS Department; • Signboard with pictorial view must be kept into proper places and local language; • 5 minute awareness speech should be deliberated to the workers at every morning; • All electric distribution lines at project site required to be fixed as safe and tidy; • Emergency contact number, personnel's, equipment and facilities should be developed before starting of the work of EPC contractor; • The proponent should implement the ERP at their project site and communicate with the other organization for followingthe ERP holistically for coal transportation; • Insurance of the labour and employer should be introduced for any accidental case. .	Being complied

Sl no	Potential Impacts	EMP measures as proposed in the EIA	Actual measures already Implemented	Recommended Action	Compliance Status
		• 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.			
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	• Engagement of HR consultant to develop HR policy and Organogram; • Medical aid, fire extinguisher, PPE are provided; • Worker's shed and sanitation facilities developed for the site development workers • Onsite medical facilities have been continuing. • Site-specific Environmental Health & Safety plan has been finalized. • RO Water treatment plant and canteen has been developed for supplying safe drinking water and food.	• The OHS unit should be functional before starting of the Power Plant construction works • Regular training, awareness, motivational and mock drill should be arranged at the construction and operation phase; • OHS procedure should also be followed by all workers including the labour from sub-contractors. • Appointment of EHS Officer is recommended to expedite the EHS and OHS plan/procedure at project site • Insurance system may be introduced • Introduce formal mechanism of grievance redressal of the labour	Being complied.
5	Workers Well Being	• Provision of Welfare facilities for Worker/Labor such as, timely bonuses, salaries, sick leaves, vacations etc.; • Routine medical check-up and emergency medical care for the sick and injured; • Appointment of a leader amongst the labor group, who will look into workers' well-being.	• Health care & information, canteen, restrooms, accommodation, water supply are facilitated by the proponents. • Proponent is now pushing to established fare wage of labours and the benefits • Grievance register are being initiated for the worker.	• The workers well-being should be protected in the HR policy. • Introduce occupational code of practices/best practices compatible with their own culture • Freedom of Association, Rights & scope of bargaining and tripartite consultation should be open for the workers. • Continue the Implementation of formal procedure for grievance redress mechanisms	Being Complied

Sl no	Potential Impacts	EMP measures as proposed in the EIA	Actual measures already Implemented	Recommended Action	Compliance Status
				• 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	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 area; • Installation of water spraying system to control dusts; • Conducting dust monitoring and visual inspection around the site boundary; • Adoption of Noise management plan.	• Boundary wall around the Project area already completed; • Block-B is highly responsible for spreading dust to the nearest community • Grievance redressal mechanism is under finalization.	• Regular communication with the local community • Low noise generating vehicles and equipment should be used by the EPC contractor	Being complied
2	Grievance of local people	• Availability and operation of Grievance Redress Mechanism; • Maintaining open communication channel with the local community.	• A Social officer has been recruited for maintaining close relation with nearby community; • Regular monitoring has been conducted to identify the grievance of the nearby communities; • National level stakeholder consultation has been conducted occasionally • Proponent is observing the community grievance or quarries though the monitoring study conducted by CEGIS	• Regular local level consultation is necessary for impact monitoring as well as updating the local communities • Proponent should developed a frame work to eliminate any conflict between migrated labors and local communities	Being complied

Sl no	Potential Impacts	Proposed EMP	Actual measures already Implemented	Recommended Action	Compliance Status
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.	• Construction of boundary wall around the Project area; • Incorporating safety policies to be followed in the bid documents for the appointment of EPC contractors; • Preparing a safety checklist to be followed during selection of construction contractors; • Maintaining a good 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	• Assign responsibility of enforcing and monitoring safety procedure to an officer. • Aware labours and all employees about the safety procedure and health check-up. • Arrange a safety training program for Project personnel and labors; • Training and instruction to the security personnel about their behavior and communication with the local people; • Aware the security personnel about safeguarding environment and community.	BIFPCL agrees to comply all the measures during construction stage
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.	• Established a medical unit (consisting medical officer, medical assistant, office assistant) at Plant site; • Arranging weekly health service program (medical consultation and free medicine) for the local community; • Increasing the patient for health services of around 3823 people from November 2016 to April 2017 due to development of approach road communication	• The proponent should train the migrated labor regarding the local culture and customs • Health check-up must be done to the labors • The proponent may arrange consultation meeting with the local communities • The proponent may establish business development activities (markets) for the workers and local communities as CSR activities. • Awareness program should be introduce to reduce any transmitted disease and violence toward communities	Being Complied

Sl no	Potential Impacts	Proposed EMP	Actual measures already Implemented	Recommended Action	Compliance Status
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	• Informal sitting with the local government • Regular training workshop on tailoring and computer has been organized by the proponents • The proponents have already taken few initiatives to encourage local students through awarding them. • Training program for the next six months have been prepared • Proponent has emphasized to EPC for engaging local labours • 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.	• Initiate awareness program for the local youth to get involved in the Project construction activities; • Assign job responsibilities based on skills and training. • Proponent can hire trainer to train on local, regional youths on vocational training. • Support Income generating activities and business development activities for the local potential youth.	Will be complied during construction stage
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 public consultation meetings are taken places at different level; • Advertisement of this power plant was broadcasted • Publishing Project related discussion/article in different print media.	• 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 proponent has to confirme firmly about the technologies, fuel, pollution control measures and emission • The EPC contractor should follow the social code of conducts / good practices	Being Complied

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	Recommended Action	Compliance Status
1	Runoff (contain mostly sediment load) from newly developed land falls into nearby river and channel 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.	• The proponent has to maintained temporary drainage system • The proponent needs to monitor that connectivity of the free flow of Maidara River. • Storm water drainage network must be separated from any kind of contamination of chemicals or oily water.	Will be complied during the construction stage
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; • Initiate Green plantation;	• No cutting/ felling of trees occurred along the river bank; • Limiting soil extraction activities within the defined area; • Limiting the vegetation clearance and base stripping process within the Project boundary; • Boundary wall around the project is completed • Installation of few numbers of night light; • 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 • Working activities are now limited to the project boundary	• Inforce no harm/ no kill of the wild animals and habitats for the project personals and build up awareness for local people • Using of light shade (directed downwards) around the outdoor lights; • Regular monitoring of the trees planted around the Project site. • Awareness program for ecosystem development, dolphin conservation etc should be introduced as a part of Corporate Environmental Responsibility • The pollution prevention technologies and chemicals should be introduced by the EPC contractor • Ecosystem monitoring must be continued simultaneously with the power plant construction and operation	Being Complied

Sl no	Potential Impacts	EMP measures as proposed in the EIA	Actual condition/ Measures already Implemented	Recommended Action	Compliance Status
		• No plantation of non-native species; • Retaining top soil for future habitat restoration; • No degradation of critical habitat.			
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. • The natural stream flow of Maidara River near access road has been opened.	• BIFPCL will pass the information to the EPC contractor for maintaining the natural flow of the Maidara river	Being Complied

5.2 Compliance to 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
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.	To be Complied 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.	BIFPCL will open L/C after finalizing the EPC contractor.	will be Complied as and when required
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 damaging impact on the 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 likeEffluent Treatment Plant, ESP, FGD etc.	Complied at present and will be complied at Construction and Operation phases
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 also monitoring the mitigation measures adopted through an environmental consultant CEGIS. At present preliminary site preparation (pre-construction) activities are being carried out. Mitigation measures appropriate at this stage have been taken. Proper and adequate mitigation measures have widely been covered in Technical Specification. MP prepared & monitoring is being done for pre-construction period.	Complied at present and will be complied at Construction and Operation phase

Sl no	Condition of DoE	Compliance	Remarks
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 pre-construction activities has been carried out ensuring safeguarding of the Sundarbans Reserve Forest area and **ECA** (Ecologically Critical Area).	Complied at present and will be complied at Construction phase
8	Environment friendly construction and development practices shall be followed that minimize loss of habitats and fish breeding, feeding & nursery sites.	The pre-construction activity is being carried out keeping all the mitigation measures in order.	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.	The Project site and the present activities are limited to day time only. BIFPCL is keeping close communication with local people to receive the grievance related to project activities.	Being Complied
10	Proper and adequate sanitation facilities shall be ensured in labour camps throughout the proposed Project period.	At present the Plant is in preliminary site preparation (pre-construction) phase. Adequate sanitation facilities have been provided for this stage. 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 Main Plant construction work would start.	Being Complied
11	In order to control noise pollution, vehicles & equipment shall undergo regular maintenance; working during sensitive hours and locating machinery close to sensitive receptor shall be avoided.	All vehicle & equipment used at site are under regular maintenance. Working during sensitive hours and locating machinery close to sensitive receptor are being avoided. Provisions in line with this condition have been included Clause no 14.11 of SCC and in Health & Safety Manual.	Being Complied
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.	At present the Plant is in preliminary site preparation (pre-construction) phase. No solid waste is burnt. 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
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.	Pre-construction activities are being taken up with adequate on-site precautionary measures and safety measures to safeguard flora and fauna.	Being Complied

Sl no	Condition of DoE	Compliance	Remarks
		Safety manual prepared and it is part of EPC contract document.	
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 Plant is in preliminary site preparation (pre-construction) phase. BIFPCL has appointed a paramedical staff and visiting Doctor is also made available for regular health checkup of the workers. Villagers of surrounding areas also availing the health facilities. Emergency response plan shall be strictly implemented 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 is sprayed in the area around the premises of site office to control dust. Besides, a boundary wall around the Plant has been constructed to control dustwithin the project boundary.	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 stocked and piled far away from river bank and other natural water bodies.	Being Complied
17	Adequate considerations should be given to facilitate drainage system for runoff water from rain/tidal surge.	Drainage facilities have been developed as per requirement at this stage. Adequate drainage system shall be developed during construction and operation phase of the Plant.	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.	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.	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	Compliance action initiated

Sl no	Condition of DoE	Compliance	Remarks
		implemented accordingly. Refer Section V, B4 of Technical Specification (Clause no B4.3.1.4).	
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 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.	100% utilization of fly ash has been planned and shall be implemented throughout the operation of the plant.Only 25 acres area has been allocated to store residual ash. EOI has been received in this regards from nearby Cement Plants.	Complied at present and Will be Complied 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.	Compliance action initiated
28	Resettlement plan should be properly implemented and people should be adequately compensated.	-do-	Compliance action initiated

Sl no	Condition of DoE	Compliance	Remarks
29	Construction material should be properly disposed off after construction work is over.	At present the Plant is in preliminary site preparation (pre-construction) phase. Construction wastes are being reused at this stage.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 and Will be Complied during and after Construction Phase
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 regularly, based on physical observation conducted for that period, 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 this stage. CEGIS, as an environmental consultant of BIFPCL is monitoring implementation of EMP. BIFPCL is taking all possible actions based on EMP monitoring report.	All activities have been performed accoding to the EMP suggestion during the pre-construction stage. Remaining suggestion will be complied during construction and post-construction stage
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 continued till April, 2017. 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	The Monitoring activities of CEGIS included this part. The monitoring report	Being Complied

Sl no	Condition of DoE	Compliance	Remarks
	ecosystem, biodiversity and forest coverage should be made using latest high resolution image for keeping ambient environment.	contains analysis of biodiversity and forest coverage. However, in addition to this, Forest Department has also suggested some survey & analysis which have also been 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 when the Plant will be 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).	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
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

Sl no	Condition of DoE	Compliance	Remarks
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.	Complied at this stage and will be complied during constructionop eration phase
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. During this phase 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 local people.	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 by DoE which has been regularly monitored by CEGIS till April, 2017.	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 Headquarters of the Department of Environment simultaneously.	The detail work plan has been submitted to DoE	Complied
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 shall be made available by BIFPCL simultaneously to DoE Bagerhat District Office, Khulna Divisional Office and Headquarters on a monthly basis during the construction period of the Project.	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 Monitoring report of CEGIS keeps all the records as suggested.	Being Complied

Sl no	Condition of DoE	Compliance	Remarks
	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.		
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 transport, medical facilities, etc.) Weather conditions Current operations (abandoning the site, fire fighting, etc.)	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 would establish a proper mechanism for recording such incident as suggested, when main plant construction activities start.	Compliance action initiated and Will be complied as and when required
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 would establish a proper mechanism for recording such incident as suggestedand 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 CEGIS is monitoring EMP.	Will be complied as and when required
49	All pollution incidents shall be reported immediately and simultaneously to the Bagerhat District Office, Khulna Divisional Office and Headquarters of the	So far no such incident has happened. BIFPCL would establish a proper mechanism for recording such incident as suggested. CEGIS has been engaged to	Will be complied as and when required

Sl no	Condition of DoE	Compliance	Remarks
	Department of Environment (DoE) in Dhaka.	record such incident during pre-construction and construction period	
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 as suggested	Will be Complied as and when necessary
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.	Being Complied
52	Climate Change impacts and maximum storm surge height shall have to consider at the design and construction phase.	The level (elevation) of the land and earthen embankment has been fixed considering the climate change impact and maximum storm surge height.	Being Complied
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 is being conducted by M/s CEGIS as per approved ToR of DoE. Inception Report for the said study has been submitted to BIFPCL.	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

Sl no	Condition of DoE	Compliance	Remarks
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 obtaining Environmental Clearance Certificate, the proponent shall not start operation of the Project.	At present the Plant is in pre-construction phase. The functional 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 systematic for preventing pollution. All these stipulations have been included in the technical specification of Main Plant EPC contract package.	Compliance action initiated and will be complied before starting construction and operation of the Project
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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Appendix I: Checklist of Monitoring Environmental Compliances

Table A: Checklist of Monitoring for ESMP Implementation (During Pre-Construction and Land Development)

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 waste water to river or canal.			

Sl no	Potential Impacts	Proposed EMP	Actual Implementation	Recommended Action	Compliance Status
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 • 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?			

Sl no	Potential Impacts	Proposed EMP	Actual Implementation	Recommended Action	Compliance Status
		• 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 Pre-Construction and Land Development)

(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.) • 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			

Sl no	Potential Impacts	Proposed EMP	Actual Implementation	Recommended Action	Compliance Status
		• 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 Pre-Construction and Land Development)

(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)***

Sl no	Potential Impacts	Proposed EMP	Actual Implementation	Recommended Action	Compliance Status
	Youth Employment	• Providing training/awareness program for the local youth to let them aware about the required 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 Pre-Construction and Land Development)

(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			

Sl no	Potential Impacts	Proposed EMP	Actual Implementation	Recommended Action	Compliance Status
		• 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?			
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 13th monitoring program (April, 2017)

The Monitoring Team

Estimation of tree height

Collection of DBH data

Collection of sapling diameter data

Fisheries catch assessment at sibsha river in Akram point

Conducting air quality monitoring at proposed Township area

Professionals are collecting plankton samples

Awarness sign at project site

Appendix III: Terms of References (ToR)

As per ECA 1995 and ECR 1997, the proposed Project "1320 MW coal based thermal Power Plant at Rampal, Khulna" falls under red category; needs proper monitoring and documenting of environmental and socio-economic parameters.

Accordingly, the EIA study of the proposed plant has already been conducted. The EIA of the proposed Power Plant briefly describes the monitoring plan. The ToR has been prepared for engaging Engineering, environmental and social Contractor for monitoring the environmental and socio-economic parameters during pre-construction and construction phases along with the engineering consideration of the site development and construction of the Project so that the monitoring plan suggested in the EIA is properly followed and satisfies the requirement of ECR 1997 and ECR 2005.

The monitoring works has been divided in to two major components:

Work A: Monitoring of Engineering activities of site development and others.

Work B: Monitoring of Social and Environmental parameters for updating the baseline and Implementation of the Project.

Work A: The main objective of this component is to monitoring the engineering activities of site development and others during pre-construction and construction phase for installation of the Power Plant.

The specific objectives of the monitoring program are:

- To establish baseline environmental conditions;
- To detect adverse environmental impacts for river dredging and land filling activities for site development;
- 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.

Landfill monitoring is an interactive process of incorporating the findings of the site investigation, the environmental impact assessment, environmental monitoring results, risk assessment and the conclusions reached in the investigations.

Work B: The main objective of this component is to monitor the environmental parameters and implementation of environmental management plan during pre-construction and construction phase for installation of the Power Plant. The specific objectives of the monitoring program are:

- Update baseline data as per monitoring schedule and location.
- Monitor and provide the environmental parameters during pre construction activities.
- Provide technical assistance to the client for implementation of the EMP at different sector of construction activities.
- Monitor the environmental aspects during construction of the Project.

- 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.
- Render any other related services as and when requested.

The scope of the services can be specified as bellows:

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
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

Reporting Requirements

As it is proposed to carry out the monitoring program for three (3) years, the schedule of deliverables has to be re-scheduled. The proposed deliverables are scheduled below

- An Inception Report shall be submitted within 30 (thirty) days from the commencement of the assignment
- Submission of 1st quarterly monitoring report at the end of three (3) months from the date of signing contract;

- Submission of 2nd quarterly monitoring report at the end of six (6) months from the date of signing contract;
- Submission of 3rd quarterly monitoring report at the end of nine (9) months from the date of signing contract;
- Submission of Annual (1st) monitoring report at the end of one (1) year from the date of signing contract;
- Submission of 5th quarterly monitoring report at the end of fifteen (15) months from the date of signing contract;
- Submission of 6th quarterly monitoring report at the end of eighteen (18) months from the date of signing contract;
- Submission of 7th quarterly monitoring report at the end of twenty one (21) months from the date of signing contract;
- Submission of Annual (2nd) monitoring report at the end of twenty four (24) months from the date of signing contract;
- Submission of 9th quarterly monitoring report at the end of twenty seven (27) months from the date of signing contract;
- *Submission of 10th quarterly monitoring report at the end of thirty (30) months from the date of signing contract;*
- Submission of 11th quarterly monitoring report at the end of thirty three (33) months from the date of signing contract;
- Submission of Annual (3rd) monitoring report at the end of thirty three months from the date of signing contract;
- All report shall be submitted to BIFPCL in (five) hard copies and soft copy on CD.

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	Bangladesh (DoE) Standard (ECR 2005)	IFC/WB Standard
eather		Sunny	Rainy/ Cloudy	Sunny	Sunny	Sunny	Rainy/ Cloudy	Sunny to Rainy	Sunny	Sunny	Rainy/ Cloudy	Rainy/ Cloudy	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	65^{24hr}	75^{24hr} (IT-1)
	PM_{10}	78	77	53	79	83	35	52	135	117	32	22	79	43.8	150^{24hr}	150^{24hr}(IT-1)
	SPM	207	239	190	200	177	42	91	175	332	51	53	115.7	122.4	200^{8hr}	NF
	SO_2	21	24	19	23	15	52	35	14	18	9	8	9.5	9.0	365^{24hr}	125^{24hr} (IT-1)
	NOx	26	29	27	31	29	35	29	18	18	12	10	11.3	10.7	100^{Annual}	200^{1hr}, 40^{Annual}
	CO	120	188	140	190	144	146	88	74	57	35	119	59	91	$(10000)^{8hr}$	NF
	O_3	27	26	19	22	26	12	5	4	1	1	1	5	03	157^{8hr}	100^{8hr}
Proposed Township area	**$PM_{2.5}$**	39	48	48	39	34	18	17	35	25	3	8	25	14.6	65^{24hr}	75^{24hr} (IT-1)
	PM_{10}	814.69	90	74	102	97	31	48	116	44	11	11	99.5	56.9	150^{24hr}	150^{24hr}(IT-1)
	SPM	2156.3	263	217	274	266	47	79	192	187	27	23	154.2	136.7	200^{8hr}	NF
	SO_2	19	28	22	21	22	58	27	13	11	4	6	12.9	10	365^{24hr}	125^{24hr} (IT-1)
	NOx	29	39	27	26	24	46	25	16	22	6	8	15.7	11.8	100^{Annual}	200^{1hr}, 40^{Annual}
	CO	165	210	230	164	136	127	102	77	22	31	108	66	78	$(10000)^{8hr}$	NF
	O_3	33	26	26	23	21	16	1	1	1	0	0	1	08	157^{8hr}	100^{8hr}
NW Corner of	**$PM_{2.5}$**	37	44	19	42	59	28	19	24	11	3	10	29	10.3	65^{24hr}	75^{24hr} (IT-1)

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	Bangladesh (DoE) Standard (ECR 2005)	IFC/WB Standard
eather		Sunny	Rainy/ Cloudy	Sunny	Sunny	Sunny	Rainy/ Cloudy	Sunny to Rainy	Sunny	Sunny	Rainy/ Cloudy	Rainy/ Cloudy	Sunny	Suny-/cloudy		
			Concentrations are in µg/m³													
the PP area	**PM_{10}**	67	78	56	98	91	96	29	125	29	24	14	108.7	31.3	150^{24hr}	150^{24hr}(IT-1)
	SPM	234	217	157	310	244	321	66	187	115	31	35	168	91.7	200^{8hr}	NF
	SO_2	19	22	18	27	21	56	32	13	17	4	8	12.2	5.8	365^{24hr}	125^{24hr} (IT-1)
	NOx	23	28	22	32	39	43	21	18	16	5	11	14.7	7.1	100^{Annual}	200^{1hr}, 40^{Annual}
	CO	110	178	110	210	140	133	87	77	38	47	127	31	74	$(10000)^{8hr}$	NF
	O_3	25	19	17	36	44	11	8	2	0	1	1	3	05	157^{8hr}	100^{8hr}
Barni, Gaurambha	**$PM_{2.5}$**	39	47	57	39	41	34	11	29	23	9	10	21.7	7.9	65^{24hr}	75^{24hr} (IT-1)
	PM_{10}	103	122	67	97	82	65	26	97	82	45	13	105.4	30.5	150^{24hr}	150^{24hr}(IT-1)
	SPM	233	244	183	277	236	79	112	176	268	69	30	167.8	95.6	200^{8hr}	NF
	SO_2	21	23	17	22	25	41	31	16	20	10	7	12.2	5.5	365^{24hr}	125^{24hr} (IT-1)
	NOx	25	28	22	26	27	44	32	21	16	12	9	19.3	9.8	100^{Annual}	200^{1hr}, 40^{Annual}
	CO	175	210	190	150	196	96	96	81	73	41	98	63	85	$(10000)^{8hr}$	NF
	O_3	26	29	22	19	15	9	6	4	0	0	3	5	08	157^{8hr}	100^{8hr}
Chunkuri-2, Bajua Dacope	**$PM_{2.5}$**	35	39	46	37	33	35	28	31	25	7	5	25.2	8.7	65^{24hr}	75^{24hr} (IT-1)
	PM_{10}	77	86	69	68	61	109	49	98	60	23	20	74.4	44.4	150^{24hr}	150^{24hr}(IT-1)
	SPM	117	113	162	183	188	175	94	167	167	31	48	162	110.6	200^{8hr}	NF
	SO_2	19	24	21	18	11	55	33	21	13	7	9	18.9	8.2	365^{24hr}	125^{24hr} (IT-1)
	NOx	23	26	27	24	18	49	23	16	25	10	8	18	11.2	100^{Annual}	200^{1hr}, 40^{Annual}
	CO	190	205	170	170	33	133	75	70	33	38	79	36	94	$(10000)^{8hr}$	NF
	O_3	27	24	18	22	41	21	2	1	1	0	2	2	03	157^{8hr}	100^{8hr}
Pankhali, Dacope	**$PM_{2.5}$**	47	49	57	41	39	34	25	47	15	8	10	38.7	15.8	65^{24hr}	75^{24hr} (IT-1)

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	Bangladesh (DoE) Standard (ECR 2005)	IFC/WB Standard
eather		Sunny	Rainy/ Cloudy	Sunny	Sunny	Sunny	Rainy/ Cloudy	Sunny to Rainy	Sunny	Sunny	Rainy/ Cloudy	Rainy/ Cloudy	Sunny	Suny- /cloudy		
			Concentrations are in µg/m^3													
	PM_{10}	119	127	139	101	105	144	62	128	46	42	18	141.6	105	150^{24hr}	150^{24hr}(IT-1)
	SPM	297	266	254	208	299	339	183	198	114	78	34	194.6	179	200^{8hr}	NF
	SO_2	28	31	31	24	30	58	36	18	9	8	8	16.1	12.9	365^{24hr}	125^{24hr} (IT-1)
	NOx	41	39	36	26	27	47	23	15	19	9	9	19	18.7	100^{Annual}	200^{1hr}, 40^{Annual}
	CO	230	217	250	188	177	125	105	101	55	29	112	48	83	$(10000)^{8hr}$	NF
	O_3	49	38	36	27	11	13	5	2	2	0	0	3	06	157^{8hr}	100^{8hr}
Mongla Port area	**$PM_{2.5}$**	47	55	39	41	26	33	19	34	21	9	11	25.7	22.6	65^{24hr}	75^{24hr} (IT-1)
	PM_{10}	139	174	77	82	35	52	33	132	45	29	15	119.3	93.6	150^{24hr}	150^{24hr}(IT-1)
	SPM	288	303	197	217	214	118	65	189	144	50	6	172.3	196	200^{8hr}	NF
	SO_2	27	28	26	24	14	45	36	16	10	8	7	16.8	10.5	365^{24hr}	125^{24hr} (IT-1)
	NOx	44	39	33	27	17	40	20	13	14	10	8	15.3	15.1	100^{Annual}	200^{1hr}, 40^{Annual}
	CO	230	320	220	211	24	110	84	71	29	31	97	44	72	$(10000)^{8hr}$	NF
	O_3	57	52	37	26	09	15	8	3	1	2	1	4	04	157^{8hr}	100^{8hr}
Harbaria, Sundarbans	**$PM_{2.5}$**	19	22	33	27	24	27	24	26	13	6	10	19.2	10.5	65^{24hr}	75^{24hr} (IT-1)
	PM_{10}	41	39	59	56	49	42	50	82	42	20	14	85.2	36.7	150^{24hr}	150^{24hr}(IT-1)
	SPM	111	117	129	139	109	70	73	159	91	43	44	93.5	103.7	200^{8hr}	NF
	SO_2	9	10	14	12	16	51	34	15	11	6	7	11.9	5.7	365^{24hr}	125^{24hr} (IT-1)
	NOx	19	22	27	18	22	34	22	14	16	8	10	13	7.7	100^{Annual}	200^{1hr}, 40^{Annual}
	CO	65	58	70	64	56	112	81	62	47	32	110	67	73	$(10000)^{8hr}$	NF
	O_3	13	12	13	11	14	12	4	2	2	0	1	4	08	157^{8hr}	100^{8hr}
Akram Point,	**$PM_{2.5}$**	17	19	23	18	49	NO	25	18	9	4	4	14.3	13.2	65^{24hr}	75^{24hr} (IT-1)

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	Bangladesh (DoE) Standard (ECR 2005)	IFC/WB Standard
eather		Sunny	Rainy/ Cloudy	Sunny	Sunny	Sunny	Rainy/ Cloudy	Sunny to Rainy	Sunny	Sunny	Rainy/ Cloudy	Rainy/ Cloudy	Sunny	Suny- /cloudy		
			Concentrations are in µg/m³													
Sundarbans	**PM_{10}**	39	44	32	39	77	NO	32	77	31	15	14	85.5	96.0	150^{24hr}	150^{24hr}(IT-1)
	SPM	114	133	97	88	102	NO	51	128	46	23	27	90.9	137.0	200^{8hr}	NF
	SO_2	7	9	12	13	21	NO	27	14	9	4	6	8.4	6	365^{24hr}	125^{24hr} (IT-1)
	NOx	17	19	22	17	27	NO	19	15	10	5	6	12.7	10.1	100^{Annual}	200^{1hr}, 40^{Annual}
	CO	49	60	50	46	163	NO	92	64	21	37	101	58	79	$(10000)^{8hr}$	NF
	O_3	11	14	9	10	27	NO	8	1	0	0	2	3	0	157^{8hr}	100^{8hr}
Hiron Point, Sundarbans	**$PM_{2.5}$**	15	23	19	17	28	NO	27	NO	17	NO	9	21.7	No	65^{24hr}	75^{24hr} (IT-1)
	PM_{10}	44	38	34	41	60	NO	45	NO	40	NO	14	104.5	NO	150^{24hr}	150^{24hr}(IT-1)
	SPM	101	119	107	97	110	NO	88	NO	132	NO	26	111.4	NO	200^{8hr}	NF
	SO_2	8	7	13	14	15	NO	28	NO	15	NO	9	13.5	NO	365^{24hr}	125^{24hr} (IT-1)
	NOx	18	18	19	22	20	NO	23	NO	19	NO	9	15.9	NO	100^{Annual}	200^{1hr}, 40^{Annual}
	CO	52	62	65	60	60	NO	93	NO	40	NO	121	43	NO	$(10000)^{8hr}$	NF
	O_3	14	13	11	9	23	NO	2	NO	0	NO	0	4	NO	157^{8hr}	100^{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	65^{24hr}	75^{24hr} (IT-1)
	PM_{10}	139	117	91	84	75	89	49	112	69	68	24	145.9	99.5	150^{24hr}	150^{24hr}(IT-1)
	SPM	301	287	239	219	222	181	101	181	112	107	64	189.7	187.2	200^{8hr}	NF
	SO_2	33	29	33	28	31	59	28	16	11	10	10	17.1	7.2	365^{24hr}	125^{24hr} (IT-1)
	NOx	49	41	39	36	33	38	26	16	15	15	14	18.6	11.7	100^{Annual}	200^{1hr}, 40^{Annual}
	CO	330	370	330	296	101	89	94	98	68	36	104	66	79	$(10000)^{8hr}$	NF
	O_3	59	67	57	39	21	7	4	2	1	0	2	3	07	157^{8hr}	100^{8hr}

Note(s): *Concentrations are in µg/m³.*

- *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	√	×	×	×	√	√	√	×	×	×	×	×	×	×	×	×	×	×	×	×	√	×	√	√
	SOx	×	×	×	×	√	√	√	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	√
	NOx	×	×	×	×	√	√	√	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	√
	GHGs	×	×	×	×	√	√	√	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	√
Proposed Township area of the PP	PM	√	×	×	×	√	√	√	×	×	×	×	×	×	×	×	×	×	×	×	×	√	×	×	√
	SOx	×	×	×	×	√	√	√	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	√
	NOx	×	×	×	×	√	√	√	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	√
	GHGs	×	×	×	×	√	√	√	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	√
NW Corner of the PP area	PM	×	×	×	×	√	√	√	×	×	×	×	×	×	×	×	×	×	×	×	×	√	×	×	√
	SOx	×	×	×	×	√	√	√	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	√
	NOx	×	×	×	×	√	√	√	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	√
	GHGs	×	×	×	×	√	√	√	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	√
Barni, Gaurambha	PM	×	×	×	×	√	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	√	√
	SOx	×	×	×	×	√	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	√
	NOx	×	×	×	×	√	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	√
	GHGs	×	×	×	×	√	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	√
	PM	√	×	×	×	√	√	√	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	√

		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
Chunkuri-2, Dacope	SOx	×	×	×	×	√	√	√	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	√
	NOx	×	×	×	×	√	√	√	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	√
	GHGs	×	×	×	×	√	√	√	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	√
Pankhali, Dacope	PM	√	×	×	×	√	√	√	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	√	√
	SOx	×	×	×	×	√	√	√	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	√
	NOx	×	×	×	×	√	√	√	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	√
	GHGs	×	×	×	×	√	√	√	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	√
Mongla Port area	PM	√	√	√	×	√	√	√	√	√	√	√	×	×	×	×	×	×	×	×	√	×	×	×	√
	SOx	×	√	×	×	√	√	√	√	√	√	×	×	×	×	×	×	×	×	×	√	×	×	√	√
	NOx	×	√	×	×	√	√	√	√	√	√	×	×	×	×	×	×	×	×	×	√	×	×	×	√
	GHGs	×	√	×	×	√	√	√	√	√	√	×	×	×	×	×	×	×	×	×	√	×	×	×	√
Harbaria, Sundarbans	PM	×	×	×	×	×	√	√	√	√	√	√	×	×	×	×	×	×	×	×	×	×	×	×	×
	SOx	×	×	×	×	×	√	√	√	√	√	×	×	×	×	×	×	×	×	×	×	×	×	×	×
	NOx	×	×	×	×	×	√	√	√	√	√	×	×	×	×	×	×	×	×	×	×	×	×	×	×
	GHGs	×	×	×	×	×	√	√	√	√	√	×	×	×	×	×	×	×	×	×	×	×	×	×	×
	PM	×	×	×	×	×	√	√	×	×	×	√	×	×	×	×	×	×	×	×	×	×	×	×	×

		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
Akram Point Sundarbans	SOx	×	×	×	×	×	√	√	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
	NOx	×	×	×	×	×	√	√	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
	GHGs	×	×	×	×	×	√	√	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
Hiron Point Sundarbans	PM	×	×	×	×	×	√	√	×	×	×	√	×	×	×	×	×	×	×	×	×	×	×	×	×
	SOx	×	×	×	×	×	√	√	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
	NOx	×	×	×	×	×	√	√	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
	GHGs	×	×	×	×	×	√	√	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
Khulna City, near Khan Jahan Ali Bridge	PM	√	×	×	√	√	√	√	×	√	√	√	×	×	×	×	×	×	×	×	×	×	×	√	√
	SOx	×	×	×	√	√	√	√	×	√	√	√	×	×	×	×	×	×	×	×	×	×	×	×	√
	NOx	×	×	×	√	√	√	√	×	√	√	√	×	×	×	×	×	×	×	×	×	×	×	×	√
	GHGs	×	×	×	√	√	√	√	×	√	√	√	×	×	×	×	×	×	×	×	×	×	×	×	√

Legend × *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	BD Standard
		Apr	July	Oct	Jan	Apr	July	Oct	Jan	Apr	July	Oct	Jan	Apr	
		1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	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	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	
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	
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	
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	
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	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	
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	
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	
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	
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	
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	
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	
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	
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	

Source: CEGIS Field Survey- April, July and October 2014 and January, April, July and October 2015, January and April 2016

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	BD Standard
		Apr	Jul	Oct	Apr	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	
		1QM	2QM	3QM	1QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	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	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	
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	
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	
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	
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	
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	
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	
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	
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	
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	
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	
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	
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	
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	

Source: CEGIS Field Survey- April, July and October 2014 and January, April, July and October 2015, January and April 2016

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
		Apr	Jul	Oct	Apr	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr
		1st QM	2nd QM	3QM	1QM	1st QM	2nd QM	3QM	4th QM	1st QM	2nd QM	3QM	4th QM	1st QM
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
2	Middle of 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
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
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
5	Middle of 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
6	Right 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
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
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
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
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
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
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
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**
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
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

Source: CEGIS Field Survey- April, July and October 2014 and January, April, July and October 2015, January and April 2016

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	BD Standard
		Apr	Jul	Oct	Apr	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	
		1QM	2QM	3QM	1st QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	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	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	
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	
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	
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	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	
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	
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	
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	
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	
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	
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	
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	
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	
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		

Source: CEGIS Field Survey- April, July and October 2014 and January, April, July and October 2015, January and April 2016

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)													
		1st Year				2nd Year				3rd year				4th year	BD Standard
		Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	
		1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	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	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	
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	
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	
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	
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	
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	
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	
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	
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	
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	
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	
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**	
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	
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	

Source: CEGIS Field Survey- April, July and October 2014 and January, April, July and October 2015, January and April 2016

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			
		Apr	Jul	Oct	Jan	Apr	July	Oct	Jan	Apr	July	Oct	Jan
		1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM
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
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
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
4	Left Bank of Passur River at Project site-Jetty	376	28	18	84	102	26	36	100	280	8	12	48
5	Middle Passur River at Project site-Jetty	400	60	14	116	110	21	36	108	240	12	16	52
6	Right Bank of Passur River at Project site-Jetty	364	496	18	108	88	24	40	80	260	8	12	42
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
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
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
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
11	Maidara river near proposed township area	284	96	26	84	94	36	42	108	210	30	8	48
12	Passur river at Passur - Ghasiakhali confluence	408	172	14	96	92	30	46	88	220	12	16	40
13	Passur river at Harbaria of Sundarbans	372	216	14	96	102	26	36	100	140	16	12	**40**
14	Passur river at Akram point of Sundarbans	536	520	54	316	302	NS	84	96	156	4	68	56
15	Passur river at Hiron point of Sundarbans	540	416	122	472	470	NS	96	NS	160	NS	56	196

Source: CEGIS Field Survey- April, July and October 2014 and January, April, July and October 2015, January2016

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				
		Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	
		1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	
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	10
2	Passur-Ghasiakhali Confluence	<5	<5	<5	>15	13	7.63	9.87	21	30.3	13.5	<5	15.6	
3	Passur river at Harbaria of Sundarbans	<5	6.3	<5	>20	39.1	10.1	<5	14	26	5.73	<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	
5	Akram Point of Sundarbans	<5	<5	<5	>20	<5	NS	9.73	36	82	5.87	<5	14.2	

Source: CEGIS Field Survey- April, July and October 2014 and January, April, July and October 2015, January2016

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			
		Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan
		1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM
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
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
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
4	Left Bank of Passur River at Project site-Jetty	13190	445	169	4750	14600	175	172	5720	12830	162	147	3630
5	Middle Passur River at Project site-Jetty	13330	353	156	4920	14500	132	162	5850	13100	185	110	3600
6	Right Bank of Passur River at Project site-Jetty	13380	402	152	4870	14200	156	160	5480	13460	143	112	3520
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

SL	Sampling Locations	TDS (mg/L)											
		1st Year				2nd year				3rd year			
		Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan
		1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM
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
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
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
11	Maidara river near proposed Township area	10970	2510	257	4390	13900	355	176	4420	11700	5170	238	3960
12	Passur river at Passur - Mongla confluence	12800	6410	209	5130	14050	298	227	4540	11330	893	162	3370
13	Passur river at Harbaria of Sundarbans	12280	9360	285	4780	13900	683	205	4940	13580	1321	301	**3370**
14	Passur river at Akram point of Sundarbans	21500	15960	3400	12350	13600	NS	4220	13330	20720	7330	2550	3580
15	Passur river at Hiron point of Sundarbans	21500	14050	5720	17900	25300	NS	5830	NS	25500	NS	4120	12210

Source: CEGIS Field Survey- April, July and October 2014 and January, April, July and October 2015, January 2016

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			
		Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan
		1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM
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
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
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
4	Left Bank of Passur River at Project site-Jetty	2550	175	390	940	3450	118	365	1220	3010	220	265	1020
5	Middle Passur River at Project site-Jetty	2600	275	340	990	3250	103	355	1300	3070	232	237	915
6	Right Bank of Passur River at Project site-Jetty	2625	350	355	970	3200	105	350	1260	3100	218	242	1070
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
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
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
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
11	Maidara river near proposed township area	2400	725	330	970	3190	130	340	1075	3080	875	240	1170
12	Passur river at Passur - Mongla confluence	3150	1400	377	1000	3210	135	410	1090	3060	405	245	1070
13	Passur river at Harbaria of Sundarbans	2625	2150	345	970	3080	200	430	1100	3050	415	282	1070
14	Passur river at Akram point of Sundarbans	4500	3625	980	2380	3420	NS	1090	2850	4520	1750	670	1130
15	Passur river at Hiron point of Sundarbans	4850	3050	1440	2690	3640	NS	1460	NS	5050	NS	810	2870

Source: CEGIS Field Survey- April, July and October 2014 and January, April, July and October 2015, January 2016

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			
		Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan
		1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM
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
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
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
4	Left Bank of Passur River at Project site-Jetty	54	99	227	450	160	30	92	17	10	62	20	42
5	Middle Passur River at Project site-Jetty	60	100	232	250	165	27	85	18	8	45	24	54
6	Right Bank of Passur River at Project site-Jetty	55	105	186	200	155	40	97	22	7	49	19	46
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
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
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
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
11	Maidara river near proposed township area	9	24	389	206	160	28	92	10	6	11	30	66
12	Passur river at Passur - Mongla confluence	50	310	203	280	165	24	60	15	13	47	27	61
13	Passur river at Harbaria of Sundarbans	65	90	869	400	160	42	74	22	18	31	18	**61**
14	Passur river at Akram point of Sundarbans	115	99	28	103	150	NS	110	16	23	16	41	34
15	Passur river at Hiron point of Sundarbans	91	72	267	200	180	NS	144	NS	15	NS	33	49

Source: CEGIS Field Survey- April, July and October 2014 and January, April, July and October 2015, January 2016

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			
		Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan
		1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM
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
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
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	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
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
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
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
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
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
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
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
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
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**
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
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

Source: CEGIS Field Survey- April, July and October 2014 and January, April, July and October 2015, January 2016

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			
		Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan
		1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM
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
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
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
4	Left Bank of Passur River at Project site-Jetty	1360	45	33	550	1240	26	10	550	1060	15	4	230
5	Middle Passur River at Project site-Jetty	1040	32	30	520	1120	6	8	580	980	17	6	280
6	Right Bank of Passur River at Project site-Jetty	1320	20	27	540	820	8	9	565	1100	14	5	230
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
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
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
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
11	Maidara river near proposed township area	1320	210	63	460	840	27	9	480	1020	480	14	200
12	Passur river at Passur - Mongla confluence	1360	620	44	630	980	39	13	482	1100	42	14	220
13	Passur river at Harbaria of Sundarbans	1560	860	69	590	900	51	7	500	1080	60	19	220
14	Passur river at Akram point of Sundarbans	2600	1400	1390	850	1540	NS	84	760	1650	620	190	230
15	Passur river at Hiron point of Sundarbans	2080	1160	2360	1500	1920	NS	97	NS	2100	NS	320	1090

Source: CEGIS Field Survey- April, July and October 2014 and January, April, July and October 2015, January 2016

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

Table B.13: PO42- concentration of Passur River System

Sl	Sampling Locations	PO_4^{2-} (mg/L)											
		1st Year				2nd year				3rd year			
		Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan
		1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM
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
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
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
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
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
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
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
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
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
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
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
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
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**
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
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

Source: CEGIS Field Survey- April, July and October 2014 and January, April, July and October 2015, January 2016

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			
		Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan
		1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM
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
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
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
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
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
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
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
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
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
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
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
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
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**
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
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

Source: CEGIS Field Survey- April, July and October 2014 and January, April, July and October 2015, January 2016

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			
		Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan
		1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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

Source: CEGIS Field Survey- April, July and October 2014 and January, April, July and October 2015, January 2016

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

SI	Sampling Locations	Hg (mg/L)											
		1st Year				2nd year				3rd year			
		Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan
		1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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

Source: CEGIS Field Survey- April, July and October 2014 and January, April, July and October 2015, January 2016

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
			Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr
			1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	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
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
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
4	Kalekharber	Shallow (<250 ft)	6.3	6.5	NF	NF	NF	NF	NF	NF	ND				

Locations	Tube Well Type	Temperature (°C)												
		1st Year				2nd year				3rd year				4th year
		Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr
		1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	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
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
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
Kalekharber	Shallow (<250 ft)	**27.5**	**28.7**	**NF**	**NF**	**NF**	**NF**	**NF**	**NF**	**ND**	**NF**	**NF**	**NF**	**NF**

Source: CEGIS Field Survey- April, July and October 2014 and January, April, July and October 2015, January and April 2016

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

*NF=Non functional *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
			Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr
			1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM
1	Near Proposed Township	Deep (>600 ft)	0	0	0	1	TC	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
3	Kalekharber	Shallow (<250 ft)	0	0	NF**	NF**	NF**	NF**	NF**	NF**	NF**	NF**	NF**	NF**	NF**
4	Kapasdanga	Deep (>600 ft)	0	0	0	0	0	0	0	0	0	0	0	0	0

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
			1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	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
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
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
4	Kalekharber	Shallow (<250 ft)	4.4	6	NF**	NF**	NF	NF**	NF**	NF**	NF**	NF**	NF**	NF**	NF**

Source: CEGIS Field Survey- April, July and October 2014 and January, April, July and October 2015, January and April 2016

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

*NF=Non functional *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			
			Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan
			1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM
1	Township near project site	Deep (>600 ft)	1113	999	-	1021	NO	881	377	447	1025	1000	617	623
2	Rajnagar	Deep (>600 ft)	4090	371	-	378	390	574	1007	491	384	408	382	401
3	Kapasdanga	Deep (>600 ft)	643	635	-	600	600	328	611	284	645	607	636	998
4	Kalekharber	Shallow (<250 ft)	1055	970	-	NF	D	D	NF	NF	NF	NF	NF	NF

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

Source: CEGIS Field Survey- April, July and October 2014 and January, April, July and October 2015, January 2016

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			
			Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan
			1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM
1	Township near project site	Deep (>600 ft)	425	250	300	235	NO	225	325	295	305	320	175	550
2	Rajnagar	Deep (>600 ft)	220	175	180	110	138	125	450	195	263	248	295	510
3	Kalekarber	Shallow (<250 ft)	780	450	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF
4	Kapasdanga	Deep (>600 ft)	190	140	180	125	216	115	480	225	163	28	183	620

Source: CEGIS Field Survey- April, July and October 2014 and January, April, July and October 2015, January 2016

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

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

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

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

Source: CEGIS Field Survey- April, July and October 2014 and January, April, July and October 2015, January 2016

*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				1st Year				2nd year				3rd year				1st Year				2nd year				3rd year			
			Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan
			1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM
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	-	3	-	-	-	-	1	5	1	1	1	1	-	2.2	-	0.74	NO	1.4	0.31	0.267	1.08	0.17	0.167	1.18
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	-	2	-	-	-	-	2	6	2	1	1	1	-	2.5	-	0.44	1.98	1.6	0.27	0.179	1.53	0.29	0.67	1.21
3	Kalekarber	Shallow (<250 ft)	0.40	0.56	NF	NF	-	NF	NF	NF	NF	NF	NF	19.94	NF	3	NF	-	-	-	-	NF					-	1.2	NF	NF	NF		NF	NF		0.31		1.23
4	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	2	8	1	1		-	6.2	-	0.48	4.54	4.1	0.48	0.179	3.26		0.6	1.18

Source: CEGIS Field Survey- April, July and October 2014 and January, April, July and October 2015, January 2016

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

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

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

S – I	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				1st Year				2nd year				3rd year				1st Year				2nd year				3rd year			
		Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan
		1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM
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	0.002	<0.002	0.004	0.023	NO	0.002	0.006	0.026	0.019	0.002	0.001	0.01	<0.00015	<0.00015	<0.0005	<0.0005	NO	0.00015	<0.00015	<0.00015	<0.00015	<0.00015	<0.00015	<0.00015
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	<0.002	<0.002	<0.002	0.016	0.013	0.0027	0.021	0.011	0.007	0.002	0.001	0.009	<0.00015	<0.00015	<0.0005	<0.0005	<0.00015	0.00015	<0.00015	<0.00015	<0.00015	<0.00015	<0.00015	<0.00015
3	Kalekarber	0.376	0.407	NF	NF	D	D	NF	NF	NF	NF	NF	0.016	0.002	0.008	NF	NF	D	D	NF	NF	NF	NF	NF	0.016	<0.0001	<0.0001	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF
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	<0.002	0.004	<0.002	0.013	0.017	0.002	0.005	0.012	0.008	0.002	0.001	0.01	<0.00015	<0.00015	<0.0005	<0.0005	<0.00015	0.00015	<0.00015	<0.00015	<0.00015	<0.00015	<0.00015	<0.00015

Source: CEGIS Field Survey- April, July and October 2014 and January, April, July and October 2015, January 2016

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																Std*
		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													70
2	NW Corner of the Project area	44.97	49.30	47.31	47.19													55
3	Chunkuri-2, Bajua	45.60	52.29	53.42	50.44													55
4	SW corner of the Project area	39.62	42.64	47.48	43.25													55
5	Proposed Township area, Project site	41.40	43.09	43.45	42.65													55
6	Barni, Gaurambha	43.05	46.45	45.01	44.83													60
7	Khan Jahan Ali Bridge, Khulna	54.01	57.50	58.66	56.72													70
8	Mongla Port area	47.78	47.45	45.25	47.61													75
9	Harbaria, Sundarbans	50.79	53.67	57.84	54.10													50
10	Akram Point, Sundarbans	43.41	45.60	43.89	44.30													50
11	Hiron Point, Sundarbans	NM	NM	NM	NM													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	13th 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	+	-	+	+	-	-	-	+	+	-	+	-	+

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	13th QM
			'-' = No; '+' = Occurrence												
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	+	-	-	-	-	-	-	-	-	+	-	-	-
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	0	0	58	42	0	0	0
Bagda	Harbaria	0	0	0	0	100	0	0
	Maidara	100	0	0	0	0	0	0
	Mongla Point	100	0	0	0	0	0	0
Bairagi	Mongla Point	0	67	33	0	0	0	0
Banspata	Chandpai	0	0	0	0	0	100	0
Bele	Chalna Point	50	17	0	33	0	0	0
	Chandpai	0	0	0	0	100	0	0
	Harbaria	0	0	0	75	25	0	0
	Maidara	100	0	0	0	0	0	0
Bhangan	Maidara	0	100	0	0	0	0	0
Boiragi	Maidara	0	0	67	33	0	0	0
Chaka	Haldikhali	0	0	0	100	0	0	0
	Harbaria	0	0	67	28	5	0	0
Chali Chingri	Chalna Point	100	0	0	0	0	0	0
	Mongla Point	100	0	0	0	0	0	0
Chata Bele	Chandpai	0	0	0	0	80	20	0
	Harbaria	0	0	0	0	0	100	0
Chela	Chalna Point	17	50	33	0	0	0	0
	Chandpai	0	0	100	0	0	0	0
Daitna	Harbaria	0	0	0	0	100	0	0
Dogri	Chalna Point	0	0	0	0	0	100	0
Gagra	Haldikhali	0	0	0	50	50	0	0
Gagra Tengra	Akram Point	0	0	0	0	100	0	0
Goda Chingri	Chalna Point	0	100	0	0	0	0	0
Golda	Chalna Point	100	0	0	0	0	0	0

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	0	0	35	52	5	8	0
0	Harbaria	0	0	0	0	24	73	2
0	Maidara	100	0	0	0	0	0	0
Gulsha Tengra	Chandpai	0	0	34	32	34	0	0
0	Harbaria	0	0	0	0	100	0	0
Horina	Chalna Point	5	8	86	0	0	0	0
0	Harbaria	0	0	0	100	0	0	0
Jaba	Harbaria	0	0	0	0	100	0	0
Kain Magur	Chandpai	0	0	0	0	0	100	0
0	Harbaria	0	0	0	0	67	33	0
Kharsula	Chalna Point	0	0	100	0	0	0	0
Khayra Chela	Harbaria	0	0	50	50	0	0	0
Koidda	Haldikhali	0	0	0	100	0	0	0
Kuchia	Chalna Point	0	0	50	50	0	0	0
0	Chandpai	0	0	0	0	0	100	0
Loitta	Maidara	0	0	19	57	24	0	0
Meni	Chalna Point	0	100	0	0	0	0	0
Motka	Maidara	0	0	100	0	0	0	0
Mud Crab	Chalna Point	0	0	100	0	0	0	0
0	Chandpai	0	0	0	100	0	0	0
Mutkura	Chandpai	0	100	0	0	0	0	0
0	Harbaria	0	0	91	9	0	0	0
Paissa	Akram Point	0	0	0	91	0	0	9
0	Chandpai	0	0	0	100	0	0	0
0	Haldikhali	0	0	0	100	0	0	0
0	Harbaria	0	0	1	90	9	0	0
Poma	Chandpai	0	0	0	0	100	0	0

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
0	Harbaria	0	0	0	0	100	0	0
0	Mongla Point	100	0	0	0	0	0	0
Potka	Chalna Point	100	0	0	0	0	0	0
0	Chandpai	0	0	35	65	0	0	0
0	Harbaria	0	0	100	0	0	0	0
Sada Bele	Harbaria	0	0	0	0	100	0	0
Sada Chela	Maidara	0	100	0	0	0	0	0
Silong	Haldikhali	0	0	0	0	100	0	0
Tairel	Harbaria	0	0	0	0	100	0	0
Telcupa	Chandpai	0	0	0	0	0	100	0
Thurina	Chalna Point	0	100	0	0	0	0	0
Tigar Chingri	Chalna Point	0	0	100	0	0	0	0
0	Maidara	0	0	100	0	0	0	0
Vati Chingri	Chalna Point	0	100	0	0	0	0	0
Vetki	Harbaria	0	0	0	0	0	100	0

Source: CEGIS field survey, 2015

Table D.4: 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	13th QRM
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	-	-	-	-	-	-	-	-	-	-		-	-

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	13th QRM
	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	-	-	-	-	-

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	13th QRM
	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	-	-	-	-	-	-	-	-	-	-
	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	-	Nursing, 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	13th QRM
		and Age-1 adult		and Growing											
	Chalna Point	Age-1 adult	-	Feeding and Growing	-	-	Feeding and Growing	-	-	-	-	-	-	-	-
		Fry	-	-	-	-	-	-	-	-	Nursing	-	-	-	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		-			-	
		Adult	-	-	-	-	-	-	Feeding		-				
		Brood Fish	-	-	-	-	-	-	-		-		-	-	
	Haldikhali	Fry and Juvenile	-	-	Nursing	-	-	-	-	-	-	-	-	-	-

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	13th QRM
	Harbaria	Adult and Brood Fish	-	-	Breeding and Spawning	-	-	-	-	-	-	-	Feeding and Spawning	-	-
		Adult	-	-	-	-	-	-	Feeding		-		-	Feeding	
		Fry and Juvenile						Spawning and Nursery	-	-	Feeding and Growing	-	-	-	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	-	-	-	-	-	-

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	13th QRM
		Fry	-	-	-	-	-	-	-	-	Nursery	-	-	Nursing	Nursery
Chhuri	Haldikhali	Adult	Feeding	-	Feeding	-	-	-	-	-	-	-	-	-	-
	Akram Point		Feeding	-	Feeding	-	-	-	-	-	-	-	-	-	-
Chela	Haldikhali	Adult	Feeding	-	Feeding	-	-	-	-	-	-	-	-	-	-
	Akram Point	Juvenile and Adult	Feeding and Growing	-	-	-	-	-	-	-	-	-	-	-	-
	Harbaria	Fry and Juvenile	-	Feeding and Growing	-	-	-	Nursery	-	-	-	-	-	-	-
	Chandpai		-	-	-	-	-	-	-	Growing and Feeding	Nursery	-	-	-	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	-	-	-	-	-	-	-	-

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	13th QRM
	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		-		-	-	
	Mongla Point	Age-1 adult	-	Feeding and Growing	-	Feeding and Growing	-	Feeding and Growing		-	Feeding and Growing		-	-	
		Juvenile	-	-	-	-	-	-	Feeding and Growing		-		-	-	
	Harbaria	Juvenile	-	-	-	-	-	-	Feeding and Growing		-		-	-	
		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	13th QRM
	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	-	-
	Mongla Point	Fry	Spawning	-	-	-	-	-	-	-	-	-	-	-	-
		Juvenile	-	-	-	-	-	-	-	-	Feeding and Growing	-	-	-	Feeding and Growing
	Harbaria	Fry	-	-	-	-	-	Nursery	-	-	-	-	-	-	-
		Juvenile	-	-	-	-	-	-	-	Feeding and Growing	-	-	-	-	-
Paira Chanda	Akram Point	Adult	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	13th QRM
	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	-	-	-	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	-	-	-	Feeding and Growing
Bele		Adult	Feeding	-	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	13th QRM
	Akram Point	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	-	-	-	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	-	-	-	-	-	-

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	13th QRM
	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	-	-	-	Feeding and Growing
		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	-	-	-	Feeding and Growing
	Mongla Point	Juvenile	Feeding	-	-	-	-	-	-	-	-	-	-	-	-
Phekssa	Akram Point	Adult	Feeding	-	-	-	-	-	-	Feeding	-	-	-	-	-
		Juvenile	-	-	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	13th QRM
	Haldikhali	Juvenile	-	-	Feeding and Growing	-	-	-	-	-	-	-	-	-	-
	Haldikhali	Adult	-	-	-	Feeding	-	-	-	-	-	-	-	-	-
	Harbaria	Juvenile	-	-	-	-	-	-	-	-	Feeding and Growing	-	-	-	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	-

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	13th QRM
		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	-	-	-	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	-	-	-	Nursery
		Age-1 Juvenile	-	-	-	-	-	-	-Nursing, Feeding and Growing	-	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	13th QRM
		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		Feeding
	Mongla Point	Fry and Adult	Feeding	Nursing	-	-	-	-	-	-	-	-	-		-
		Adult	-	-	-	Feeding	-	-	-	-	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	13th QRM
	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	-	-	-	-	-		-

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	13th QRM
Pangas	Haldikhali	Juvenile	-	-	Feeding and Growing	-	-	-	-	-	-	-	-		-
	Harbaria	Adult	-	-	-	-	-	-	-	Feeding	-	-	-		-
	Mongla Point	Juvenile and Adult	-	-	Feeding	-	-	-	-	-	-	-	-		-

Source: CEGIS Field Survey- April, July and October 2014 and January, April, July and October 2015, January and April 2016

**Only Age-1 to Brood fish has been allowed to interpret the migration purpose; F = Feeding; Sp = Spawning*

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**	**-**	**-**

Source: CEGIS Field Survey- April, July and October 2014 and January, April, July and October 2015, January and April 2016

(E) Land Resource Monitoring Data

Table E.1: 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		Mouza: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 Upazila: Rampal, District: Bagerhat	E-89°34′25.3″	N-22°34′18.3″		
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; 2014

Table E.2: Chemical Properties of Soil on Monitoring Land

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 (April)	Remarks	Wet season (October)	Remarks	Dry season (March)	Remarks
1.	Baran para	**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
		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
		OM (%)	3.1	Medium	2.5	Medium	0.93	Very low	1.27	Low	1.35	Low	1.28	Low	1.30	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
		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
		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
		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
		Na(meq/100g)	5.50	*	2.7	*	10.01	*	4.76	*	4.43	*	5.07	*	5.76	*
		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	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
		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
		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
		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
		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
		Lead(Pb) (µg/gm)	31.8	Not polluted	33.7	Not polluted	32.21	Not polluted	25.95	Not polluted	24.23	Not polluted	23.75	Not polluted	22.80	Safe limit
		Cadmium (Cd)(µg/gm)	0	0	0	Not polluted	2.39	Not polluted	00	Not polluted	00	Not polluted	00	Not polluted	0.42	Safe limit
		Chloride	762.2	*	0	0	0	0	00		00	0	0	0	0	0

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 (April)	Remarks	Wet season (October)	Remarks	Dry season (March)	Remarks
		(Cl-) (µg/gm)														
		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
		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
		OM (%)	2.9	Medium	2.2	Medium	1.46	Low	1.53	Low	1.67	Low	1.49	Low	1.50	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
		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 high
		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
		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
		Na(meq/100g)	5.00	*	2.7	*	8.95	*	6.32	*	4.22	*	6.48	*	5.24	*
		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	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
		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
		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
		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
		Zn(µg/gm)	1.5	Optimum	0.87	Low	1.56	Optimum	1.69	Optimum	1.31	Medium	1.62	Medium	1.64	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 (April)	Remarks	Wet season (October)	Remarks	Dry season (March)	Remarks
		Lead(Pb) (µg/gm)	31.8	Not polluted	32.1	Not polluted	31.54	Not polluted	22.56	Not polluted	22.35	Not polluted	21.32	Not polluted	21.97	Safe limit
		Cadmium (Cd)(µg/gm)	0	Not polluted	0	Not polluted	2.42	Not polluted	00	Not polluted	00	Not polluted	00	Not polluted	0.39	Safe limit
		Chloride (Cl-) (µg/gm)	398.4	*	0	0	0	0	0	0	0	0	00	0	4.52	Slightly saline
		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
		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
		OM (%)	1.6	Low	1.1	Low	1.62	Low	1.48	Low	1.69	Low	1.46	Low	1.45	Low
		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
		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
		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
		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
		Na(meq/100g)	6.00	*	3.7	*	9.91	*	6.83	*	5.51	*	6.71	*	7.41	*
		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
		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
		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
		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

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 (April)	Remarks	Wet season (October)	Remarks	Dry season (March)	Remarks
		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
		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
		Lead(Pb) (µg/gm)	37.8	Not polluted	31.5	Not polluted	32.29	Not polluted	18.89	Not polluted	19.18	Not polluted	19.68	Not polluted	19.19	Safe limit
		Cadmium (Cd)(µg/gm)	0	Not polluted	0	0	2.17	Not polluted	00	Not polluted	00	Not polluted	00	Not polluted	0.37	Safe limit
		Chloride (Cl-) (µg/gm)	692.9	*	0	0	0	0	0	0	0	0	00	0	0	0
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
		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
		OM (%)	2.1	Medium	1.2	Low	3.22	Medium	1.75	Low	1.98	Medium	1.70	Low	2.01	Medium
		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
		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
		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
		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
		Na(meq/100g)	8.5	*	9.4	*	12.51	*	8.16	*	7.11	*	7.19	*	6.59	*
		P(µg/gm)	2.7	Very low	12.8	Medium	8.34	Low	6.89	Low	8.05	Low	6.90	Low	7.76	Medium
		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

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 (April)	Remarks	Wet season (October)	Remarks	Dry season (March)	Remarks
		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
		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
		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
		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
		Lead(Pb) (µg/gm)	0.00	Not polluted	29.2	Not polluted	31.34	Not polluted	14.09	Not polluted	15.12	Not polluted	15.91	Not polluted	16.09	Safe limit
		Cadmium (Cd)(µg/gm)	0	Not polluted	0	Not polluted	2.31	Not polluted	00	Not polluted	00	Not polluted	00	Not polluted	0.56	Safe limit
		Chloride (Cl-) (µg/gm)	1957.6	*	0	0	0	0	0		0	0	00	0	0	0
		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
		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
		OM (%)	1.8	Low	0.95	Very low	3.08	High	1.64	Low	1.66	Low	1.68	Low	1.67	Low
		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
		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
		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
		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
		Na(meq/100g)	8.5	*	9.9	Very high	10.61	*	7.89	*	6.88	*	6.03	*	6.67	*

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 (April)	Remarks	Wet season (October)	Remarks	Dry season (March)	Remarks
		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
		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
		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
		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
		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
		Zn(µg/gm)	0.99	Medium	1.4	Optimum	2.00	High	1.71	Optimum	1.28	Medium	1.73	Optimum	1.98	High
		Lead(Pb) (µg/gm)	0.00	Not polluted	29.9	Not polluted	31.52	Not polluted	16.63	Not polluted	17.07	Not polluted	15.34	Not polluted	16.28	Safe limit
		Cadmium (Cd)(µg/gm)	0	Not polluted	0	Not polluted	2.35	Not polluted	00	Not polluted	00	Not polluted	00	Not polluted	0.51	Safe limit
		Chloride (Cl-) (µg/gm)	1,472.5	*	0	0	0	0	0		0	0	00	00	0	0
		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
		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
		OM (%)	1.9	Medium	1.4	Low	3.36	High	1.53	Low	1.68	Low	1.55	Low	1.60	Low
		N (%)	0.09	Low	0.08	Low	0.19	Medium	0.08	Low	0.10	Low	0.08	Very low	0.09	Very 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
		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
		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
		Na(meq/100g)	8.5	*	9.3	*	10.92	*	7.69	*	6.98	*	6.25	*	6.82	*

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 (April)	Remarks	Wet season (October)	Remarks	Dry season (March)	Remarks
		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
		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
		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
		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
		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
		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
		Lead(Pb) (µg/gm)	31.3	Not polluted	29.7	Not polluted	32.46	Not polluted	14.10	Not polluted	13.58	Not polluted	13.59	Not polluted	14.94	Safe limit
		Cadmium (Cd)(µg/gm)	0	Not polluted	0	Not polluted	2.12	Not polluted	00	Not polluted	00	Not polluted	00	Not polluted	0.48	Safe limit
		Chloride (Cl-) (µg/gm)	1715.0	*	0	0	0	0	0	0	0	0	0	0	0	0
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
		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 alakaline
		OM (%)	3.0	Medium	1.5	Low	2.01	Medium	1.75	Low	2.03	Medium	1.77	Low	2.22	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
		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
		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
		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
		Na(meq/100g)	12.0	*	11.9	*	5.22	*	7.77	*	7.87	*	7.28	*	7.88	*

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 (April)	Remarks	Wet season (October)	Remarks	Dry season (March)	Remarks
		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	Medium
		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
		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
		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
		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
		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
		Lead(Pb) (µg/gm)	12.5	Not polluted	28.9	Not polluted	47.12	Not polluted	8.17	Not polluted	6.89	Not polluted	7.53	Not polluted	8.25	Safe limit
		Cadmium (Cd)(µg/gm)	0	Not polluted	0	Not polluted	2.86	Not polluted	00	Not polluted	00	Not polluted	00	Not polluted	0.61	Safe limit
		Chloride (Cl-) (µg/gm)	3741.9	*	0	0	0	0	0		0	0	00	00	0	0
		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
		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
		OM (%)	2.6	Medium	1.3	Low	3.36	High	1.69	Low	1.95	Medium	1.72	Low	2.00	Medium
		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
		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
		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
		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
		Na(meq/100g)	8.5	*	9.8	*	5.45	*	7.86	*	7.89	*	7.66	*	8.04	*
		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

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 (April)	Remarks	Wet season (October)	Remarks	Dry season (March)	Remarks
		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
		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
		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
		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
		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
		Lead(Pb) (µg/gm)	0.00	Not polluted	29.3	Not polluted	33.66	Not polluted	9.58	Not polluted	10.03	Not polluted	10.14	Not polluted	10.18	Safe limit
		Cadmium (Cd)(µg/gm)	0	Not polluted	0	Not polluted	2.18	Not polluted	00	Not polluted	00	Not polluted	00	Not polluted	0.64	Safe limit
		Chloride (Cl-) (µg/gm)	2217.4	*	0	0	0	0	0		0	0	0	0	0	0
		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
		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
		OM (%)	2.8	Medium	1.3	Low	4.03	High	2.38	Medium	2.42	Medium	2.21	Medium	1.98	Medium
		N (%)	0.15	Low	0.06	Very low	0.23	Medium	0.12	Low	0.13	Low	0.11	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
		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
		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
		Na(meq/100g)	8.5	*	9.6	*	5.76	*	7.27	*	7.03	*	8.05	*	6.93	*
		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	Low

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 (April)	Remarks	Wet season (October)	Remarks	Dry season (March)	Remarks
		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
		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
		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
		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
		Zn(µg/gm)	0.88	Low	0.79	Low	1.00	Medium	2.09	High	2.35	High	2.21	High	2.12	High
		Lead(Pb) (µg/gm)	0.00	Not polluted	27.6	Not polluted	34.37	Not polluted	7.88	Not polluted	7.57	Not polluted	8.05	Not polluted	7.69	Safe limit
		Cadmium (Cd)(µg/gm)	0	Not polluted	0	Not polluted	2.20	Not polluted	00	Not polluted	00	Not polluted	00	Not polluted	0.52	Safe limit
		Chloride (Cl-) (µg/gm)	1801.6	*	0	0	0	0	0	0	0	0	00	0	0	0
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
		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
		OM (%)	1.5	Low	1.5	Low	2.13	Medium	2.17	Medium	2.15	Medium	2.20	Medium	2.20	Medium
		N (%)	0.08	Low	0.08	Low	0.12	Low	0.11	Low	0.11	Low	0.11	Low	0.11	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
		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
		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
		Na(meq/100g)	8.5	*	8.4	*	9.81	*	6.56	*	6.33	*	6.52	*	6.50	*
		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
		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

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 (April)	Remarks	Wet season (October)	Remarks	Dry season (March)	Remarks
		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
		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
		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
		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
		Lead(Pb) (µg/gm)	0.00	Not polluted	27.2	Not polluted	30.99	Not polluted	14.94	Not polluted	14.88	Not polluted	15.26	Not polluted	14.82	Safe limit
		Cadmium (Cd)(µg/gm)	0	Not polluted	0	Not polluted	2.38	Not polluted	00	Not polluted	00	Not polluted	00	Not polluted	0.55	Safe limit
		Chloride (Cl-) (µg/gm)	1576.4	*	0	0	0	0	0		0	0	00	0	0	0
		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
		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
		OM (%)	2.6	Medium	1.3	Low	1.88	Medium	1.90	Medium	1.88	Medium	1.84	Medium	1.91	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
		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
		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
		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
		Na(meq/100g)	8.5	*	8.6	*	9.23	*	6.93	*	6.56	*	7.10	*	5.97	*
		P(µg/gm)	13.6	Medium	9.4	Low	3.23	Very low	9.23	Low	8.27	Low	8.79	Low	8.41	Medium
		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
		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

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 (April)	Remarks	Wet season (October)	Remarks	Dry season (March)	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
		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
		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
		Lead(Pb) (µg/gm)	6.3	Not polluted	28.4	Not polluted	30.81	Not polluted	11.83	Not polluted	12.43	Not polluted	11.72	*	11.78	Safe limit
		Cadmium (Cd)(µg/gm)	0	Not polluted	0	Not polluted	2.35	Not polluted	00	Not polluted	00	Not polluted	00	*	0.52	Safe limit
		Chloride (Cl-) (µg/gm)	2113.5	*	0	0	0	0	0	*	0	0	00	0	0	0
		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
		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
		OM (%)	1.7	Low	1.0	Very low	2.94	Medium	1.53	Low	1.57	Low	1.55	Low	1.55	Low
		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
		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
		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
		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
		Na(meq/100g)	8.5	*	6.7	*	9.33	*	7.20	Very high	7.39	*	6.77	*	6.69	*
		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
		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
		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

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 (April)	Remarks	Wet season (October)	Remarks	Dry season (March)	Remarks
		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
		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
		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
		Lead(Pb) (µg/gm)	6.3	Not polluted	26.5	Not polluted	32.23	Not polluted	15.50	Not polluted	14.71	Not polluted	14.64	Not polluted	15.03	Safe limit
		Cadmium (Cd)(µg/gm)	0	Not polluted	0	Not polluted	2.55	Not polluted	00	Not polluted	00	Not polluted	00	Not polluted	0.48	Safe limit
		Chloride (Cl-) (µg/gm)	1715.0	*	0	0	0	0			0	0	00	0	0	0
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
		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 saline
		OM (%)	1.7	Low	1.2	Low	1.74	Low	1.59	Low	1.79	Medium	1.48	Low	1.45	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
		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
		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
		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
		Na(meq/100g)	8.5	*	8.1	*	7.06	*	6.32	*	8.24	*	6.61	*	5.69	*
		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
		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
		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

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 (April)	Remarks	Wet season (October)	Remarks	Dry season (March)	Remarks
		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
		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
		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
		Lead(Pb) (µg/gm)	18.8	Not polluted	25.1	Not polluted	30.55	Not polluted	6.19	Not polluted	5.77	Not polluted	5.77	Not polluted	6.06	Safe limit
		Cadmium (Cd)(µg/gm)	0	Not polluted	0	Not polluted	2.21	Not polluted	00	Not polluted	00	Not polluted	00	Not polluted	0.32	Safe limit
		Chloride (Cl-) (µg/gm)	2442.6	*	0	0	0	0	0	0	0	0	00	0	0	0
		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
		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
		OM (%)	1.5	Low	0.9	Low	2.01	Medium	1.43	Low	1.31	Low	1.42	Low	1.50	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
		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
		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
		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
		Na(meq/100g)	7.0	*	10.1	*	8.66	*	7.06	*	6.93	*	6.74	*	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	Very high
		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
		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

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 (April)	Remarks	Wet season (October)	Remarks	Dry season (March)	Remarks
		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
		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
		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
		Lead(Pb) (µg/gm)	18.8	Not polluted	23.7	Not polluted	31.49	Not polluted	16.35	Not polluted	17.15	Not polluted	15.69	Not polluted	16.73	Safe limit
		Cadmium (Cd)(µg/gm)	0	Not polluted	0	Not polluted	2.32	Not polluted	00	Not polluted	00	Not polluted	00	Not polluted	0.37	Safe limit
		Chloride (Cl-) (µg/gm)	1611.1	*	0	0	0	0	0		0	0	00	0	0	0
		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
		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
		OM (%)	1.5	Low	1.0	Low	2.81	Medium	2.17	Medium	2.18	Medium	2.09	Medium	2.08	Medium
		N (%)	0.08	Very low	0.06	Very low	0.16	Low	0.11	Low	0.11	Low	0.11	Low	0.11	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
		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
		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
		Na(meq/100g)	7.5	*	9.8	*	8.76	*	7.68	*	7.01	*	7.48	*	6.77	*
		P(µg/gm)	6.1	Low	5.9	Low	11.14	Medium	9.12	Low	8.77	Low	8.90	Low	9.18	Very high
		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
		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

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 (April)	Remarks	Wet season (October)	Remarks	Dry season (March)	Remarks
		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
		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
		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
		Lead(Pb) (µg/gm)	25.00	Not polluted	22.2	Not polluted	31.54	Not polluted	14.96	Not polluted	16.02	Not polluted	15.20	Not polluted	15.79	Safe limit
		Cadmium (Cd)(µg/gm)	0	Not polluted	0	Not polluted	2.44	Not polluted	00	Not polluted	00	Not polluted	00	Not polluted	0.39	Safe limit
		Chloride (Cl-) (µg/gm)	1489.8	*	0	0	0	0	0		0	0	00	0	0	0

*Source: SRDI Laboratory analysis, 2014, 2015 and July 2016, May 2017 * Not specified*

Table E.3: Different Concentrations of metals in the agricultural soil of the study area over three seasons in 2013-14, 2014-15 and 2015-16(dry season)

Parameter	Safe limit of India (mg/kg/ µg/gm/ ppm)	Range in uncontaminated soil in India	Maximum Acceptable Concentration of Agricultural soil in Austria (mg/kg/µg/gm/ppm)	13th Monitoring(2016-17)			
				Dry season(April)			
				Mean (mg/kg/ µg/gm/ ppm)	SD	Min (mg/kg /µg/gm/ ppm)	Max (mg/kg /µg/gm /ppm)
Fe	75-150	*	*	51.3	42.1	23.63	83.17
Mn	*	100-4000	*	7.5	4.0	5.25	10.87
Zn	300-600	10-300	300	2.4	2.4	1.57	5.03
Pb	250-500	2-200	100	14.4	11.8	6.06	22.8
Cd	3.0-6.0	0.01-0.7	5.0	0.5	0.2	0.32	0.64

*Source: SRDI laboratory analysis (2016), Awashthi (2000) and Kabata-Pendias, A. and H.Pendias, (1992) *Not specified*

Table E.4: Existing Cropping Pattern of Monitoring Agriculture Plot

Monitoring agriculture plot	2013-14			2014-15			2015-16			2016-17		
	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
Monitoring agriculture plot-2(Chunkuri-2)	Fallow	HYV Aman	Fallow	Fallow	Local 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
Monitoring agriculture plot-4(Chakgona)	Fallow	Local Aman	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

*Source: Based on information collected during field visit in 2014, 2015, 2016 and 2017 *Fallow-Shrimp/Fish culture*

Table E.5: Results of Crop production in Monitoring Plots

Monitoring Plots	Crop Production(tons)											
	2013-14			2014-15			2015-2016			2016-17		
	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)
Agriculture plot -1(Baranpara)												
Production (Ton/Plot)	-	0.8*	-	-	1.4*	-	-	1.5*	-	-	0.27*	-
Yield (ton/Ha)	-	1.9*	-	-	3.5*	-	-	3.8*	-	-	2.5*	-
Agriculture plot- 2(Chunkuri-2)												
Production (Ton/Plot)	-	2.4*	-	-	1.1	-	-	1.9*	-	-	0.44*	-
Yield (ton/Ha)	-	2.6*	-	-	1.7*	-	-	2.0*	-	-	2.4*	-
Agriculture plot- 3(Kapalirmet)												
Production (Ton/Plot)	-	0.2*	-	-	-	-	-	-	-	-	-	-
Yield (ton/Ha)	-	1.6*	-	-	-	-	-	-	-	-	-	-
Agriculture plot- 4(Chakgona)												
Production (Ton/Plot)	-	0.6*	-	-	-	-	-	-	-	-	-	-
Yield (ton/Ha)	-	1.9*	-	-	-	-	-	-	-	-	-	-
Agriculture plot-5(Basherhula)												
Production (Ton/Plot)	-	0.8*	-	-	0.57*	-	-	0.99*	-	-	0.15*	-
Yield (ton/Ha)	-	1.8*	-	-	1.9*	-	-	2.1*	-	-	1.9*	-

Source: Based on information collected during field visit in 2014, 2015, 2016 and 2017; here (*) is indicating cleaned rice.

Table E.6: Results of Crop Damage in Monitoring Plots

Monitoring plot	Crop damage(tons)											
	2013-14			2014-15			2015-16			2016-17		
	Area (ha)	Prod. (tons)	Causes	Area (ha)	Prod (tons)	Causes	Area (ha)	Prod (tons)	Causes	Area (ha)	Prod (tons)	Causes
Agriculture plot-1(Baranpara)	-	*Not found	-	-	-	-	-	*Not found	-	0.06	0.024*	E
Agriculture plot-2(Chunkuri-2)	-	*Not found	-	0.33*	0.4*	E	-	*Not found	-	-	-	-
Agriculture plot-3(Kapalirmet)	-	*Not found	-	-	-	-	-	*Not found	-	-	-	-
Agriculture plot-4(Chakgona)	-	*Not found	-	-	-	-	-	*Not found	-	-	-	-
Agriculture plot-5(Basherhula)	-	*Not found	-	0.17*	0.12*	E	-	*Not found	-	0.09	0.019*	E
Total	-	-	**-**	**0.50***	**0.52***	**-**	**-**	**-**	**-**	**0.15**	**0.043***	

Source: Based on information collected during field visit in 2014, 2015, 2016 and 2017; here (*) is indicating cleaned rice.

Table E.7: Upazila wise Cropped Area, Yield and Production of the Monitoring Area for the Period of 2014-15

Name of Upazila	2015-16				
	Kharif-I (March-June)	**Kharif-II (July-October)**	**Rabi (Nov-February)**	**Area(ha)**	**% of NCA**
Batiaghata	Fish	HYV Aman	HYV Boro	250	1.31
	Fallow	HYV Aman	HYV Boro	2,950	15.48
	Fish	Fish	HYV Boro	200	1.05
	HYV Aus	HYV Aman	HYV Boro	200	1.05
	Sesame	Local Aman	Fallow	8,500	44.61
	Pulses	HYV Aman	Fallow	1,200	6.30
	Vegetables	HYV Aman	Fallow	100	0.52
	Fallow	Local Aman	Fallow	5,075	26.64
	Fallow	HYV Aman	Pulses	75	0.39
	Vegetables	Vegetables	Vegetables	450	2.36
	Vegetables	Vegetables	Potato	127	0.67
			Sub-total	**19,052**	**100**
Dacope	Fallow	HYV Aman	Fallow	16,161	85.79
	Fallow	Local Aman	HYV Boro	25	0.13
	Fallow	Local Aman	Water melon	2,025	10.75
	HYV Aus	Local Aman	Water melon	600	3.19
	Sunflower	Local Aman	Fallow	100	0.53
			Sub-total	**18,838**	**100**
Rampal	Fallow	HYV Aman	Fallow	1,300	10.48
	Fallow	Local Aman	Fallow	4,700	37.90
	Fallow	Local Aman	Local Boro	310	2.50
	Fallow	Local Aman	HYV Boro	690	5.56
	Fallow	Fallow	HYV Boro	4,000	32.26
	Vegetables	Fallow	Vegetables	800	6.45
	Vegetables	Vegetables	Vegetables	600	4.84
			Sub-total	**12,400**	**100**
Mongla	Fallow	HYV Aman	Fallow	600	18.20
	Fallow	Local Aman	Fallow	2,400	72.90
	Vegetables	Fallow	Vegetables	20	0.60
	Fallow	Fallow	Vegetables	270	8.20
	Fallow	Vegetables	Vegetables	2	0.06
			Sub-total	**3,292**	**100**
Total				**50,293**	**0**

Source: Local DAE Offices, April; 2016 indicates cleaned rice*

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
		°C		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
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	-

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	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

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