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

Monitoring of Environment Parameter and Implementation of Environmental Management Plan during Construction Period along with Engineering Activities for 2X660 MW Maitree Super Thermal Power Project at Rampal in Bagerhat District

20th Quarter Monitoring Report

Monitoring Period: February 2019 - April 2019

June 2019

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Abbreviations and Acronyms

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

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

Unit

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

Unit Conversion Table

General Units

1°C = 274.15 K=33.8° F

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

1 kilogram = 2.20 pound

1 kilometre = 0.62137 mile

1 liter = 0.001 cubic meter

1 meter = 3.2808 feet

1 metric ton = 1000 kg

1 mg/L ≈1 g/m^3≈1 ppm (w/w)

1 mg/m^3 = 1 µg /L

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

1 square mile = 640 acre = 2.590 km^2

Energy Unit

1 GWyr = 8.76 x 10^9 kW

1 horsepower = 746 W

1 KWh = 3412 Btu

1 kWh = 859.85 kcal

1 KWh = 3.6 x 10^6 J

1MW=1000KW=10^6W

Glossary

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

Executive Summary

This 20th quarterly monitoring report covers the recent status of implementation on EMP (Environmental Management Plan) during construction stage as recommended in the EIA (Environmental Impact Assessment) study vide Memo No: DoE/Clearance/5062/2011 dt. 05/08/2013 and EIA report of Coal Transportation vide Memo No: DoE/ Clearance/5532/2016 dtd.31/01/2018. Accordingly, the CEGIS team has carried out the monitoring activities in April, 2019 covering every monitoring aspects of ToR (Terms of Reference) and approval conditions from DoE and valuable suggestions and comments from different national and international organizations. However, the aspects can briefly be mentioned as monitoring of the Environmental Compliance and monitoring of the selected environmental parameters such as ambient air quality, noise level, water quality, land resource condition, traffic management status, water resources management status, chemical properties of river bed materials, agricultural resources monitoring, fisheries resources, socio-economic monitoring, ecosystem monitoring and the Sundarbans Reserve Forest (SRF) health monitoring.

The progress of Project implementation activities includes extension and development of internal road network, jetty construction activities, construction of township area, labour colony, civil and infrastructure development works and mechanical construction etc. In this quarter, the environmental due diligence covers the Environmental Management System Action Plan, Occupational Health and Safety, Workers' wellbeing, Biodiversity and Sustainable Management of Natural Resources etc. The monitoring team observed that, the BIFPCL is mostly complying with the EMP as suggested in the EIA report of the Power Plant as well as in the EIA Report of Coal Transportation. In addition, CEGIS as an Environmental Monitoring Consultant, has recommended few measures, as per EMP to be complied for ensuring environmental and social safeguarding for the Project adjacent area.

The recommendations include raising awareness among the workers for using appropriate Personal Protective Equipment (PPEs) (to avoid any accidental case), proper implementation for the grievance redress mechanism for workers or local community, placement of sufficient waste disposal bins in appropriate locations and most importantly, the continuous occupational and health safety monitoring by the project proponent.

All of the aspects like Occupational Health and Safety (OHS) Policies; Establishment of the grievance redress mechanism; Emergency preparedness and response plan; Fire prevention, Protection and Control Plan; Stakeholder Engagement Plan etc. are being implemented in the current phase. Most importantly, the EPC contractor has taken some specific measures/initiatives to control the frequent accidental events which occurred during the last couple of months. Among those, strengthening the OHS department, arranging robust training sessions, employing lockout/tagout procedures, use of proper tool for the designated purposes, Inspection of all machineries, equipment and tools to ensure they are in good working order, blocking off areas where heavy machinery or vehicles are being used, ensuring license or proper training for workers/drivers/operators/supervisors to operate machineries, equipment and tools, vehicles etc.However, proper documentation of any accident/incident or any health hazard risk issues preventive measures should be adopted for nearby accidental events and any unforeseeable injury, illness, or damages;

During this monitoring tier, all the preselected air quality parameters were measured at all the preselected locations except at the Hiron point of Sundarbans as because of extreme rough weather condition the team could not reach to the Hiron point location of Sundarbans. However, the measured values of all parameters for all locations were found within the standard limit set by ECR' 2005. No significant changes were observed among the concentrations of air pollutants at the designated locations as well as for the corresponding seasons. However, from the analyzed results It can be noted that, the concentrations of major air pollutants were found higher at Khan Jahan Ali Bridge area in all seasons than other locations whereas the concentration were found lower in Sundarbans area. And no significant exceedances have ever been recorded among the concentrations of criteria pollutants due to the concurrent construction activities of Power Plant as well as Jetty construction.

On the other hand, the noise generation sources in the study area can mainly be divided into two types; one is natural and the other one is anthropogenic. However, the observed noise levels were not found to exceed the Bangladesh standard limit of noise level at seven locations during this monitoring (20th quarter) season. On the contrary, the observed noise levels at North West Corner (Kaigar Daskati), South West corner (Moidara) and at North East corner (Shapmari area) of the Project area were found to exceed the Bangladesh standard limit of their corresponding standard values. However, in course of the total twenty monitoring seasons, the noise level of eight locations were found to exceed the Bangladesh standard limit of their corresponding standard values in different monitoring seasons.

In case of water quality, the physico-chemical properties of Passur River water changes with the tidal intrusion in different seasons. During this 20th quarterly program, only salinity was recorded comparatively higher than the other selected parameters. The reason behind the issue might be due to the higher salinity than any other dry seasons over the completely monitoring program. On the other hand, pH, Temperature and DO level were found good in the surroundings of the project site as well as in the deep mangrove forests.

On the other hand, during the 19th quarterly visit (February, 2019), TDS and TH increased two to three folds in respect to the same seasons of the last five consecutive years. TSS of the rivers remained same comparing to the previous winter seasons. High COD was found at all the monitoring stations. Nitrate (NO_3^-) and Phosphate (PO_4^{3-}) reduced a lot most probably due to freshwater availability and dissolved nitrate and phosphate used by plankton's community of the rivers. In case of metal pollution, no variation was recorded for As, Pb and Hg concentration and even no issues as well. Oil & grease concentration was found less than 2.0 mg/L, which is even less than half of the recommended concentration (10 mg/L) for Inland Surface Water. Likewise, it has been observed that the physical characteristics of groundwater quality is still in good condition and in acceptable state for drinking purpose except slight salinity in the observed water samples. This salinity might be the reason of saline water infiltration due to excessive withdrawn by the surrounding communities during the dry season. In addition, evaporation also responsible for this slight salinity in groundwater. Project activities are not related to this sort of changes. Based on the recommended limit/standard for Bangladesh (Drinking water standards, ECR 1997) it can be said that the Chemical characteristics of the groundwater were found suitable and safe for drinking purpose.

Only, chemical oxygen demand (COD) during 2014 and 2015 was found higher than the limit as set in ECR, 1997. The observed groundwater quality is completely free from the metal pollution of Arsenic, Lead, and Mercury.

According to the ToR, plot use, soil fertility/nutrient status, soil contamination with heavy metals and soil salinity are to be monitored and accordingly, six mauzas (Baranpara, Chunkuri-2, Kapalirmet, Chakgona, Basherhula and Bidyarbon) within the 10 km radius of the Power Plant have been selected to do so. Eighteen soil samples were collected from three layers (Depth of layers are 0-15 cm, 15-30 cm and 30-45 cm) during the month of April 2019 and sent to Soil Resource Development Institute (SRDI), Dhaka to analyze the soil samples. The analyzed data will be incorporated in the next monitoring (21st monitoring) report after getting the results from SRDI. Similarly, the year wise crop production was also monitored during this monitoring tier. The highest production was observed at all locations during 2018-19 followed by 2013-14. On the other hand, lowest crop production was observed in the monitoring plots during 2016-17. Shrimp farming is being practiced instead of crop cultivation in monitoring plot-3- due to intrusion of saline water in this plot. The crop was not cultivated during 2014-15 to 2017-18 year in monitoring plot-4, because a school cum cyclone shelter was constructed in the plot. So, the monitoring plot-4 has been shifted to the opposite bank of the river where cropping practice was found during 2018-19. No crop damage was noticed in any monitoring plot in 2018-19.

The feed and fodder as well as diseases condition of livestock/poultry remains more or less similar to that of the previous monitoring periods. During this monitoring tier, local people claimed for shortage of fodder in two monitoring spots (Chakgona and Basherhula) due to lack of grazing land. So, situation is difficult and hard to collect fodder. Unavailability of fodder in the vicinity and high market price of commercial feedstuffs, the cost of livestock rearing is increasing day by day in the study area. The severity of the disease's infestation was reported more or less alike in this concurrent circumstance as for the past situations.

Traffic surveys were also carried out at three preselected locations namely Khudir Bottola and Gonai Bridge at Khulna Mongla Road and Taltola Bridge at Power Plant access road to understand the nature of traffic flow and traffic load during different phases of the day. The analyzed data represent that the Khulna-Mongla Highway support for largest number of vehicles compared to other surveyed roads. The vehicular movements observed during the survey were mostly for the regular activities and construction activity of the MSTPP increases a limited number of vehicular movements on the surrounding road network. Traffic volume and traffic nature at the Power Plant access road has relatively increased compared to the earlier months due to the construction activity at MSTPP and access road widening activities. However, comparing to the pre-construction stage, traffic volume at the access road of the Power Plant has increased slightly but not significantly.

Sediment quality analysis for dry season was carried out considering potential coal transportation route along the River Passur. According to the observed data, only Hg exceed average shale value and upper crust value of the respective monitoring sites. Other two elements (As and Pb) remains within the standard limit. Maximum concentration of As and Pb were found in project site (Jetty area) while Hg concentration was found high at Moidara river (beside project area).

Similarly, the fisheries resources was monitored at ten sampling sites as of earlier quarter monitoring. However, no fishing activities were observed in Haldikhali Khal (B), Bhodra Khal (D) and Mongla Point (G) during this monitoring tier. Habitat uses were observed to be changed yearly (as compared to the year of 2014-2015, 2015-2016, 2017-18, 2018-19 and 2019-2020) caused mainly due to biophysical changes e.g. tidal effect, seasonal variability, food availability and 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) two types of habitats was found i.e. i) Ground for Feeding and Maturation, ii) Omni-Ground with the capacity of nursery, maturation and feeding. However, Shannon-Weiner Index has also been performed and found to be varied between 20th quarter with that of all previous quarters. Highest Shannon-Weiner Index was found at Harbaria Khal (0.99) indicating most evenly distributed fish species. On the contrary, lowest evenness was found at Passur-Maidara Confluence (0.14). However, maximum FSR was obtained in Charaputia Khal and Sheola Khal (n= 11 and 22 respectively), while very low FSR was recorded at Maidara River and its confluence (n=8). On the other hand, Fries of fin fish were widely distributed from middle stretches to the upper stretches (Chandpai to Chalna Point) and juvenile age group in Akram Point, Charaputia Khal and Harbaria Khal of the Passur River system. The catch revealed that among the fishes Bairagi, Golda Chingri and Bagda were dominant in the seven sampling sites. On the contrary, fries were dominant at the Chalna, Maidara, Jongra and Passur-Sheola Confluence. Adults of large-sized fishes were observed at Akram Point, Charaputia Khal and Harbaria Khal.

Fish species like Sada Bele attains the maximum abundance among the migratory fish species. Moreover, Potka species were found in maximum sampling sites. Among the other species Tular Dandi, Poma and Bairagi were observed to migrate at a long distance. In this monitoring year, the highest stocking rate in respect of Bagda was observed in Kapashdanga and whereas the lowest was observed in Rajnagar. The present study revealed that the highest catch susceptibility was also found in case of Aton Jal (5.5 kg/ haul). Ber Jal was most frequently used in upper and middle reaches in the Passur River System. Hooks were also frequently used in the downstream of the Passur River System. The highest total catch was observed at Charaputia Khal and lowest at Sheola Khal, Passur-Jongra Confluence, Passur-Mongla Confluence, Passur-Maidara Confluence, Passur River and Chalna Point in this monitoring phase.

In course of terrestrial ecological monitoring vegetation composition, plant diversity, vegetation canopy status, plant health, bird habitat status, dolphin occurrence in river systems were monitored during this monitoring season. A total number of 54 tree species were recorded from all the monitoring sites with Shanon-Winner diversity index of 3.30. Canopy status of two studied homestead vegetation was found more or less same. Status of plant health also remain unchanged for most of the locations. In addition, no bird nest was observed at any of these locations.

On the other hand, Dolphin occurrence was recorded at Passur and Maidara River and some connected tributaries of Passur River like Shella Gang, Dhangmari and Bhadra Khal. The occurrence was observed as high at Bhadra Khal and then Shella Gang. Improving habitat suitability by banning all fishing activities both in Shella and Bhadra Khal may be the reason behind the increasing of dolphin occurrences in the two above mentioned canals.

Forest health is a condition of forest ecosystems that sustains their complexity while providing ecosystem services for human needs. Giving priority to maintain the ecosystem of the sundarban reserve forest, the authority took initiative for ecosystem monitoring and the Sundarbans Reserve Forest (SRF) health monitoring periodically. This will help to determine detrimental changes or improvements that occur over time. Forest health monitoring data will also provide baseline to compare forest health condition during power plant's operation phase. Sundarbans Forest Health were monitored using various bio-indicators such as tree growth, species diversity, seedling regeneration capacity, pneumatophore occurrence, crab hole density, Canopy cover changes, Leaf Area Index, leaf phenology, pest and diseases, Biomass and carbon stock. From the periodical field observation, different bio-indicators (i.e. seedling regeneration capacity, pneumatophores occurrence, crab hole density, canopy cover changes, Leaf Area) were found in steady state condition indicating no detrimental changes in the parameters. In addition, some bio-indicators such as tree growth, seedling regeneration, biomass and carbon stock increased significantly which indicates improvements of forest health over time. Soil acidity, salinity and organic matter/ Organic carbon content were identified as the most influential soil variables responsible for species compositional variation. Gewa was the dominant species followed by Sundari and Kakra. No severe pest and disease attack were observed in the monitoring PSPs except top dying symptom of Sundari. Overall, it can be said that forest health is in good condition except top dying of Sundari.

In course of socio-economic monitoring, the ongoing construction works is being continued. Local semi-skilled labors should get opportunity for gaining technical knowledge through 'learning by doing' approach but it is not possible in present time because important technical activities are conducted in this stage.

Apart from some exceptional cases, improved accommodation, drinking water, kitchen, sanitation and recreational facilities have been observed in the labor sheds. However, labors are by now familiar and habituated with the use of PPEs during working in the field.

In addition, for reducing dust inside the Plant site, water spraying work is being continued. The BIFPCL medical camp (that had been established as CSR) has been performing satisfactorily in providing medical service for the project surrounding t area. According to BIFPCL about 3,000 patient received health treatments over the last three months. In addition, medical unit of EPC contractor also performing well by providing necessary emergency support including a well-equipped ambulance as well.

1. Introduction

1.1 Background

A detailed Environmental Management Plan (EMP) suggesting mitigation, enhancement, contingency and compensation measures was developed as per scope of the EIA study for every phases of Power Project. The proposed measures must be implemented during the pre-construction, construction and operation phases in order to minimize the degree of impacts expected to be generated by the power plant and its associated activities and to comply with the national and international standards.

An independent environmental monitoring team was suggested by DoE as mandatory in the EIA report as mentioned in the Power Project EIA approval condition no. 32 and Coal Transportation EIA approval condition no. 17 for monitoring the Project related activities considering the sustainability of the ecosystem of the study area particularly for the Sundarbans Reserve Forest area. In addition, as per approval of the EIA study of Coal Transportation from DOE Condition No. 26, “Additional environmental baseline data to be collected and incorporated in the monitoring report as suggested in the EIA report

In this context, BIFPCL initiated the monitoring study to monitor the environmental components, social indicators and the implementation status of EMP (Environmental Management Plan) during pre-construction and construction phase of 2x660 MW Maitree Super Thermal Power Plant. Subsequently, CEGIS was engaged for conducting the said activities to examine the status of environmental parameters and progress of the implementation of EMP for safeguarding the environment of the Sundarbans Mangrove Forest and the surrounding ecosystem with its communities holistically.

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

According to the contract, the findings of the previously formulated Nineteen (19) quarterly monitoring reports have been submitted to BIFPCL. The current document constitutes the 20th quarterly monitoring aspects covering all the preselected monitoring parameters and locations.

1.2 Objectives

- The overall objective of the study is to monitor the important environment and social parameters and the implementation status of Environmental Management Plan (EMP) during construction phase of the Power Plant. The main objectives are to monitor, the environmental compliances regarding EMP implementation during Power Plant's construction works and associated activities.
- To monitor the status of compliances regarding the conditions set by DoE.

1.3 Criteria for Selection of Monitoring sites/locations

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

- Wind direction, wind speed, sensitive receptors in and around the vicinity of the Project site were considered to monitor the ambient air quality. Potential locations were also identified and selected for noise level monitoring. Similarly, sites for water quality monitoring, were selected considering the water resources likely to be impacted by the project activities.
- Monitoring aspects for fisheries resources consider the fish habitats, biodiversity, migration and production zones likely to be impacted by the said activities.
- Monitoring locations for ecosystem and biodiversity have also been selected considering the induced impacts of the Project.
- Soil and land resources monitoring locations and parameters have been selected considering the induced impacts likely to be impacted by the project activities on the surrounding farming land.
- Monitoring of socio-economic conditions of the PAPs (Project Affected Peoples) and project surrounding communities with their concurrent circumstances which are likely to be transformed and /or altered by the project activities.
- Locations for Sundarbans Reserve Forest (SRF) health Monitoring have been selected considering the potential access routes of coal transportation through Sundarbans Forest area and associated activities for different phases of the power plant which may have effects on Sundarbans Reserve Forest area.
- Monitoring of Environmental compliances regarding EMP implementation status in and around the project area has been set in view of the approval conditions from DoE for ensuring environmental sustainability and social acceptability.

Figure 1.1: Location Map of the Study Area

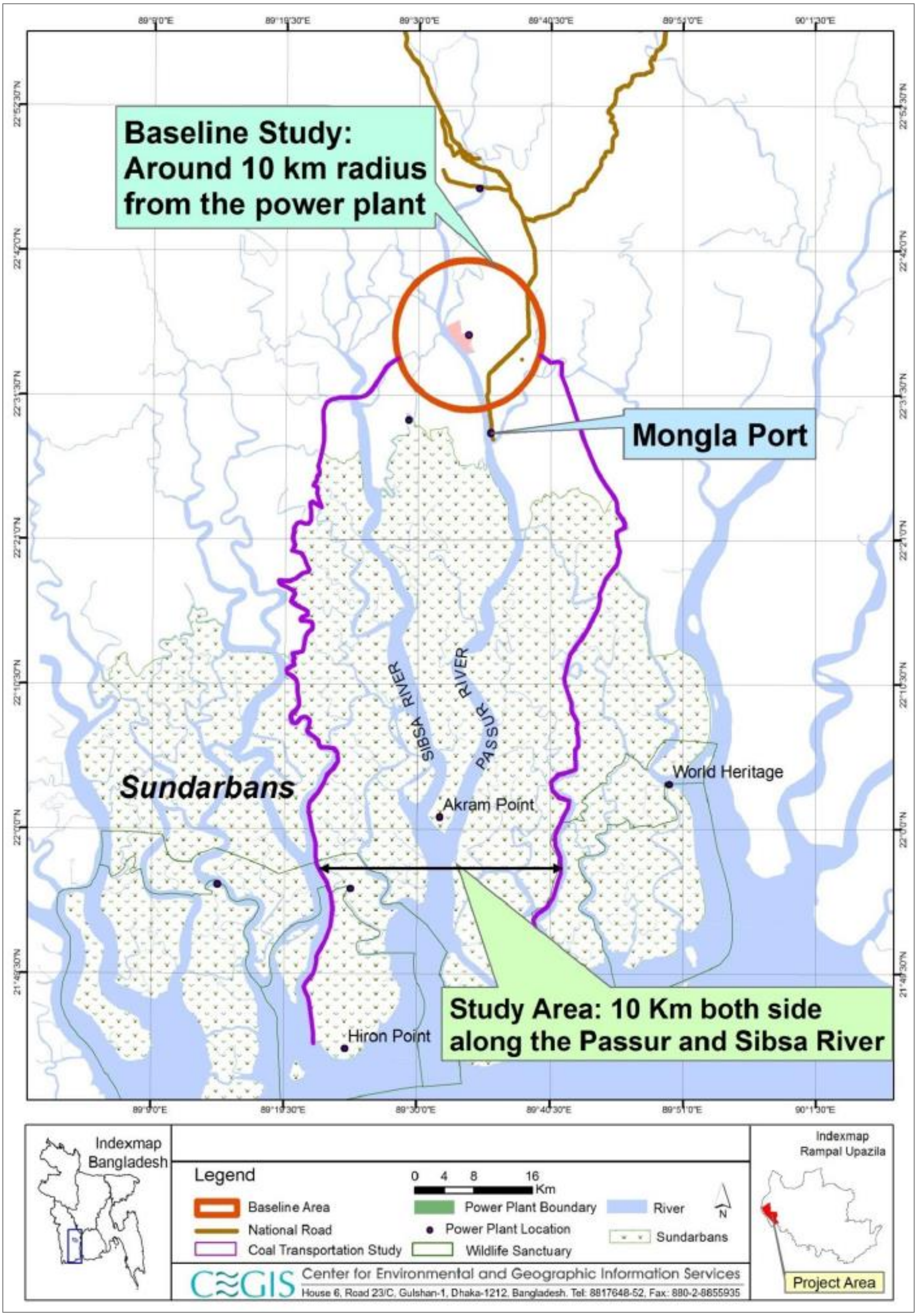


Figure 1.2: AOI of Environmental and Socio-economic Monitoring

1.4 Main stakeholders

1.4.1 Forest Department

Monitoring of the Sundarbans Reserve Forest area need to be addressed as the conditions set out by the DoE during approval of the EIA report. Hence, permission from the Forest Department is essential to carry out monitoring study on Sundarbans Forest health. The Forest Department has been providing the permission under certain conditions i.e. keeping close communication with the Forest Department, submission of the monitoring report to the Forest Department along with the following activities:

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

However, BIFPCL forwards each copy of the earlier quarterly monitoring reports to the Chief Conservator of Forest, Bangladesh Forest Department, Agargaon, Dhaka and Conservator of Forest, Khulna Circle, Boyra, Khulna. Similarly, the report of 20th quarterly monitoring will also be forwarded to the same officials of the corresponding Departments.

1.4.2 Department of Environment (DoE)

The monitoring plan, including indicators, parameters, location and schedule have been prepared and arranged by incorporating the suggestion(s) and approval conditions from both the Power Plant EIA study and Coal Transportation EIA study of the Department of Environment. A number of discussion meeting was conducted with the experts of DoE before initiating the monitoring study for finalizing the monitoring plan. The BIFPCL forwards the monitoring reports and data to DoE on a regular basis (Monthly and Quarterly). The monitoring reports are also presented to the Environmental Clearance Committee of the DoE during renewal of the site clearance. In addition, one representative from the local DoE office is involved in each monitoring visit to accompany the monitoring team.

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

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

1.4.4 Bangladesh Power Development Board (BPDB)

BPDB is the main promoter of BIFPCL and is providing lateral support to BIFPCL in every phases of implementation (pre-construction, construction and operation) of the Maitree Super Thermal Power Plant. Moreover, BPDB i.e. is also ensuring the environmental compliance monitoring of different steps of the Power Plant construction.

1.4.5 Local Community

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

1.4.6 Major component of monitoring study

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

- Physical Environment: This covers the aspects of air quality, noise level, water quality, Soil and land resources, traffic management and the morphological study;
- Biological environment: This includes fisheries resources, ecological status, the Sundarbans Reserve Forest (SRF) health conditions;
- Social environment: This covers compensation, resettlement/rehabilitation, project related employment generation, labour and working condition, community health, security and safety, along with corporate social responsibilities.
- Environmental compliance monitoring: This 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

In February 2019, the air quality parameters were monitored at the preselected sites considering the major effects to be borne by the Project activities during pre-construction, construction and operation stages except at the Hiron point of Sundarbans. Due to the cyclone FANI it was not possible for the team to reach to the furthest location of environmental monitoring.

2.2 Methodology

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

2.3 Method of Sampling and Laboratory Testing

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

2.4 Pollution sources in the Sundarbans

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

2.5 Monitoring locations

The ambient status of air quality during this quarterly visit was monitored at the same locations as monitored in earlier quarterly programs. Moreover, the status of two additional locations were also included in the monitoring program as per the conditions recommended by DOE. The monitored locations for the air quality-monitoring program are shown in **Figure 2.2.** The details of the monitoring plan have been provided in **Table 2.1.**

Figure 2.1: Conducting Air Quality monitoring at Harbaria, Sudarbans

Table 2.1: Air Quality Monitoring Plan

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

Sl. No.	Monitoring Indicators	Locations	GPS Points	Frequency	Methods/ Tools/ Techniques
11		Khulna city near Khan Jahan Ali Bridge	89˚35'35.5"E; 22˚46'36.8"N		
12		Project site-1 (Proposed Township area)	89º 33´ 13.7"E 22º35´43"N		
13		Access road bridge area	89°35'16.49" 22°34'37.11"N		

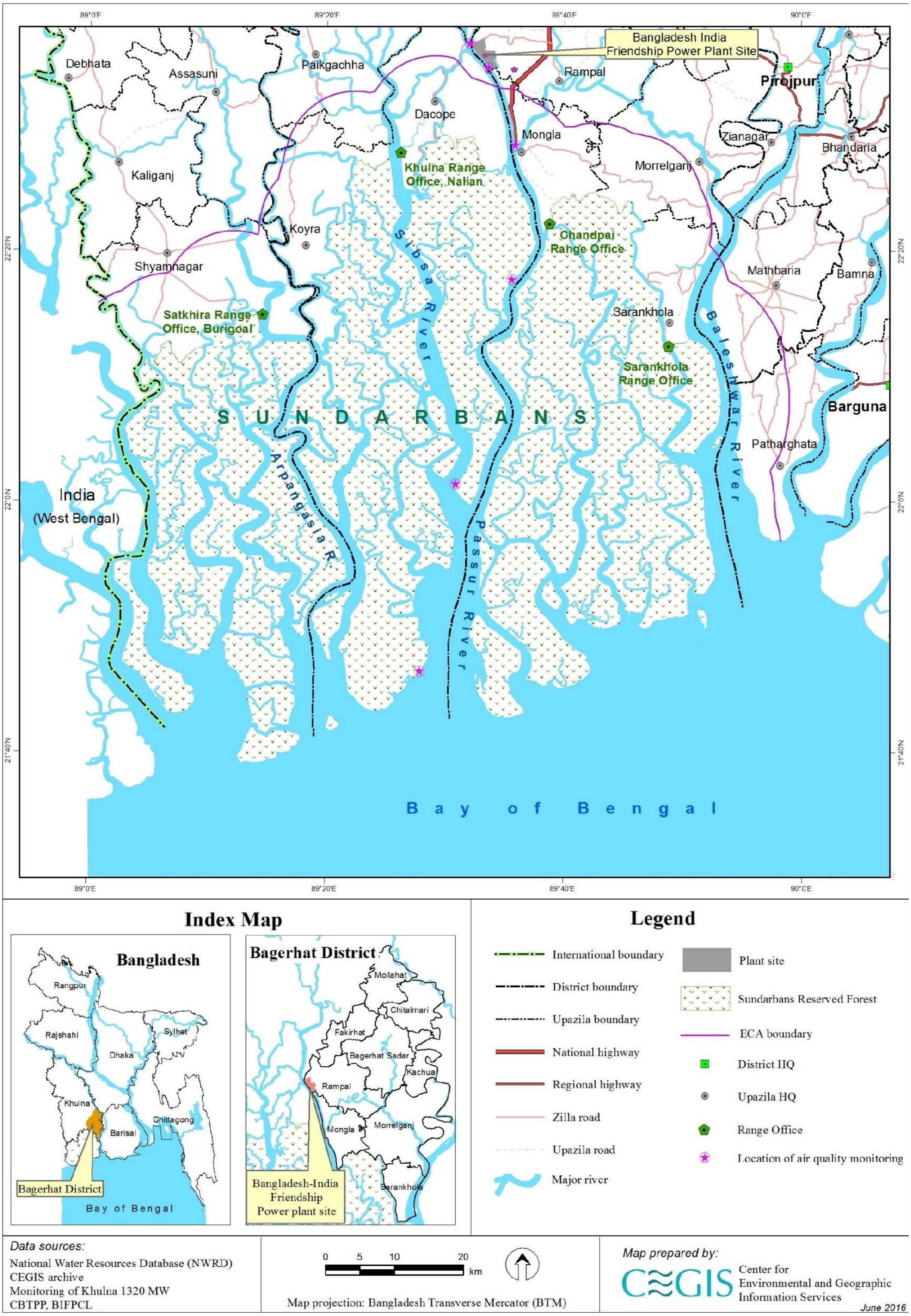


Figure 2.2: Air Quality Monitoring Locations

2.6 Status of air quality

Air quality is expressed in terms of the standards set forth for public health and welfare protection (against decreased visibility and damage to Human, animals, crops, vegetation etc.). The air quality standards currently followed are listed below. However, the air pollution emission standards are listed in the following **Table 2.2**.

Table 2.2: Air Pollutants Emission Standards

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

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

The maximum value (36.1 µg/m^3) of $PM_{2.5}$ was measured at the Access Road Bridge area (Taltola Bridge) whereas the minimum value (13 µg/m^3) was recorded at Akram point of Sundarbans Forest. All the values for the corresponding sites during this season were found well below the standard limit (65 µg/m^3) set by ECR, 2005. On the other hand, PM_{10} concentrations were also found highest (137.0 µg/m^3) at the Taltola Bridge area and lowest (51.9 µg/m^3) at Akram point of Sundarbans. Likewise $PM_{2.5}$, all the results of PM_{10} for every location were found within the staVndard limit (150 µg/m^3) too. However, the measured values were found slightly higher than the previously monitored results in the same seasons. From the measured values it can be mentioned that, effect of seasonal variations on the surrounding environment may be the main reason of increasing and decreasing of the concentration of the particulate matter in this area.

However, major sources of particulate matter generation in and around the project area as observed were the piling activities, soil contraction works, digging, tunneling and burrowing works, jetty erection activities, major construction works, dust from unpaved roads and vehicle movement, Construction materials and goods transportation and so on. Other sources of pollutants which may contribute to the existing pollution sources are the small industries like brick kilns, refineries, cement works, etc., diffuse sources like wood stoves, fires, and wind generated dust etc. On the contrary, the concentration of SPM was found higher at Khan Jahan Ali Bridge area (173.4 µg/m^3) whereas, the minimum concentration was observed at Akram point of Sundarbans Forest (71.1 µg/m^3) and the observed values were found within the standard limit. In this case, construction activities, land development works, wind erosion, large number of two-stroke human haulers, buses, trucks, and other anthropogenic activities were observed during the field visit, which might be the reason for such higher concentration of particulate matters in this area for the corresponding season (**Figure 2.3**). All the monitoring data have been attached in **Table A1** in **Appendix IV**.

Sulfur-Dioxide (SO_2)

The concentration of Sulphur dioxide (SO_2) in ambient air were found much lower than the Bangladesh standard limit of (365 µg/m^3) at all the sampling locations. Among those, the maximum concentration (16.8 µg/m^3) was found at Mongla ghat area while minimum concentration (7.9 µg/m^3) was found at Township area of power plant. The values of SO_x were never found to cross the standard value set in ECR' 2005. On the other hand, the average concentration of SO_2 have been found lower in post monsoon seasons than the Winter seasons. Emission from local human hauler, car, bus and industries like brickworks, refineries, cement works, iron and steel making, etc. are currently contributing to the concentration of SO_2 in this area (**Figure 2.3**).

Nitrogen Dioxide (NO_2)

The values of NOx in the Project site and its adjoining areas were observed below than the Bangladesh standard value of 100 µg/m^3. The maximum concentration (17.8 µg/m^3) during this monitoring period was found at Mongla ghat area whereas the lowest (9.4 µg/m^3) was recorded at Akram point of Sundarbans. The monitoring results are shown in **Table A1** in **Appendix IV**. However, emission from local human hauler, car, bus and industries like brickworks, refineries, cement works, iron and steel making, etc. are currently contributing to the concentration of NOx in this area (**Figure 2.3**).

Carbon Monoxide (CO)

Carbon monoxide (CO) is generally produced due to the incomplete combustion of fossil fuel. The concentration of CO in the monitored locations were found much lower than the standard values set in ECR'2005. During the monitoring tier the maximum value of CO was measured (24 µg/m^3) at Township area and minimum value was obtained (14 µg/m^3) at Chalna and Akram point of Sundarbans respectively. The possible reasons for such CO concentration may be due to the movement of various types of vehicles across the Passur River and its adjoining areas (**Figure 2.3).**

Ozone (O_3)

Similarly, measured O_3 concentrations both in the Sundarbans Forest Area and Project area were found within a range of 8-1 µg/m^3, which are negligible comparing to the Bangladesh standards limits of 157 µg/m^3. In this 20th quarterly monitoring study, the maximum concentration (8 µg/m^3) was found at Bajua bazar area and the minimum value was obtained at Shapmari and Akram point of Sundarbans (**Figure 2.3).**

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

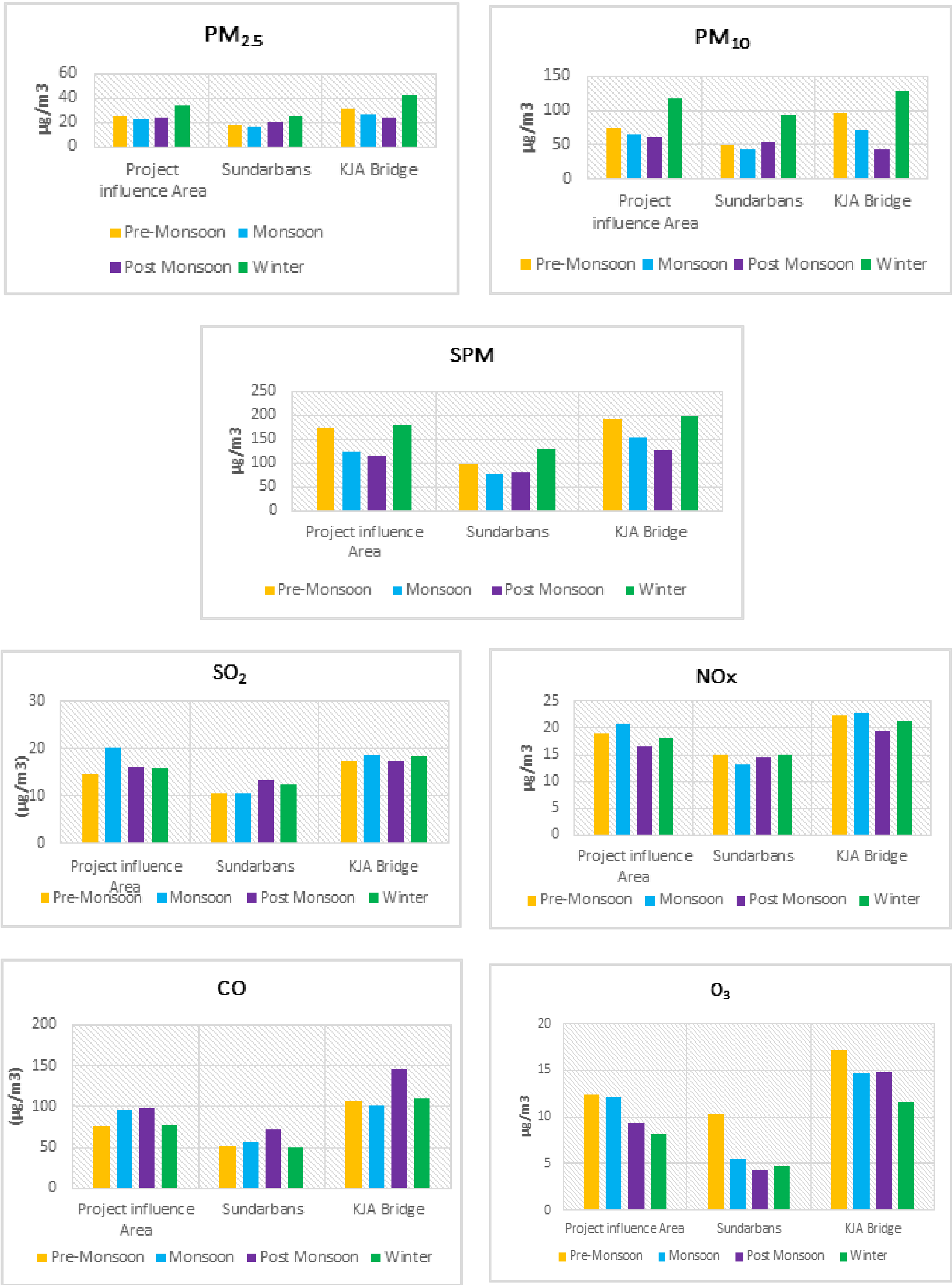


Figure 2.3: Seasonal variation of the Air Quality Parameters

2.6.1 Findings

During this monitoring tier, all the preselected parameters were measured at all the preselected locations except the Hiron point of Sundarbans. Due to extreme weather, the team could not reach to this pre-selected site. However, the measured values of all parameters for all locations were found within the standard limit set by ECR’ 2005. No significant changes were observed among the concentrations of air pollutants for each location. It can also be noted that, the concentrations of major air pollutants were found higher at Khan Jahan Ali Bridge area in all seasons than other locations whereas lower in Sundarbans area. However, according to the measured values it can be easily said that, the present air shed is not a degraded airshed as no significant exceedances has ever been recorded among the concentrations of criteria pollutants.

2.7 Noise Quality

Among the sources of noise generation, buses, trucks, local human haulers, auto-rickshaws, motorized vans, motorbikes etc. were much noticeable in the study area. On the other hand, engine boats, trawlers, small barges, ships plying over the waterways and the wave breaking sound were found to be dominant noise generating sources in the Sundarbans Reserve Forest area.

2.7.1 Methodology

Noise levels were measured thrice in a day (morning, afternoon and evening) at ten (10) locations in and around the project area and inside the Sundarbans forest area. Each time, noise levels were recorded using sound level meter for five minutes of time span with an interval period of 30 second and the meter was properly set up and calibrated following the instruction manual. Moreover, the monitoring locations were selected considering the sensitivity of the nearest receptors.

Figure 2.4: Ambient Noise Acquisition in Harbaria, Sundarbans

2.7.2 *Locations of Noise Level Monitoring*

Out of eleven (11) locations, three locations were inside the Sundarbans, six locations were in and around the Project site, one was at Khan Jahan Ali Bridge on Rupsha River and the remaining one was at Mongla Port area (**Figure 2.5)** Generally, the level of noise is monitored at eleven locations during every monitoring season. In this season each of the location was monitored except Hiron Point. Due to commencement of northwester cyclone time, it was too risky to go the Hiron Point and collect the necessary data. The detail noise level monitoring plan is presented in the following **Table 2.3**

Table 2.3: Noise Monitoring Plan

SL. No.	Monitoring locations	GPS points	Time of noise monitoring
1	South West corner of the Project boundary	89°33'34.5"E 22°34'33.8"N	Morning, Noon and evening
2	Proposed township area near Chimney location, Mauza: Sapmari Katakhali	89°32'3.8"E 22°36'32.5"N	Morning, Noon and evening
3	North West corner of the Project boundary (Kaigar Daskati)	89°33'51.8"E 22°36'1.06"N	Morning, Noon and evening
4	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	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	Pankhali, Dacope, (4km North West from the Chimney location)	89°31'24.2"E 22°36'6.7"N	Morning, Noon and evening
7	Mongla Port Area	89°35'50.4"E 22°28'24.8"N	Morning, Noon and evening
8	Harbaria, Sundarbans	89°35'34.2"E 22°17'43.1"N	Morning and Noon
9	Akram point, Sundarbans	89°30'54.1"E 22°'23.50"N	Morning and Noon
10	Hiron Point, Sundarbans	89°27'53.2"E21°46'27.60"N	Not monitored
11	Khulna city near Khan Jahan Ali Bridge	89°35'35.5"E 22°46'36.8"N	Morning, Noon and evening

2.7.3 Status of Noise

In order to provide an overview of the observed data the average LAeq values for the respective locations have been appended in **Table 2.4** for ready reference; but the average LAeq values of Noise Level have been attached in **Table C1, C2**, **C3 and C4** respectively in the **Appendix IV**.

Dacope Upazila Parishad

This location is a commercial area and located at a distance of 4 km from the North West direction of the proposed Chimney location. According to the Noise Pollution Control Rules (2006), noise level standard for this area at day time is 70 dB and the level of noise was recorded as 61.67 dB (A) during this monitoring season which was 8.33 dB (A) lower than that of Bangladesh standard limit (70 dB) (Table 2.4). The significant noise sources at this place were found as the road traffics, engine operated van (locally called Nosimon), motor bikes, easy bikes (battery operated tri-cycle), hat/bazar etc. North West Corner of the Project Area

(Kaigar Daskati)

The North West (NW) corner of the Project site is under the Kaigar Daskati mauza and can be characterized as a residential area. However, the noise level standard for this area is 55 dB (A) at day time (Noise Pollution Control Rules, 2006). The average day time noise level during this monitoring period was recorded as 56.85 dB (A) which was 1.85 dB (A) higher than that of Bangladesh standard limit.

Chunkuri-2, Bajua

This area is located at 4km South West direction from the proposed chimney location. This site is a residential area and the standard has been set as 55 dB (A) at day time (Noise control rule, 2006). During this monitoring period, the noise level was found to be 51.68 dB (A) which was 3.32 dB (A) lower than that of Bangladesh standard limit. However, the observed noise sources were rural crowd, noise from river side homesteads etc. in this site.

South West corner of the Project area

The South West corner of the Project area is in Maidara Khal of Rajnagar union. This area is a residential area and the standard limit of noise is 55 dB at day time (ECR, 1997). The level of noise at this monitoring location in this season was found to be 56.05 dB (A) which was 1.05 dB (A) higher than that of Bangladesh standard limit. Frequent movement of water vessels over the Moidara Khal was one of the main reasons of noise generation. In addition, site development activities for jetty and construction of jetty currently generating noise in this area.

Shapmari Area (North-east corner of the project boundary)

This area is located at the north-east portion of the Project area. The prominent noise sources were the construction activities and some discrete local gathering from the surrounding homesteads. This is a residential area and the standard has been set as 55 dB (A) at daytime (Noise control rule, 2006). The level of sound during this monitoring period was recorded as 58.83 dB (A) in this site which was 3.83 dB (A) higher than that of standard *limit*

Barni, Gaurambha

This area can be characterized as of both the residential and commercial interests and the standard noise limit for this kind of mixed zone is 60 dB (A) at day time. The noise level was found as 53.18 dB (A) during this monitoring season which is 6.82 dB (A) lower than the standard value

Khan Jahan Ali Bridge, Khulna

This is a commercial zone. The monitoring site is occupied by the toll office of Khan Jahan Ali Bridge, agricultural farms and local tourism spots. The average noise level was found as 66.95 dB (A) which is 3.05 dB (A) lower than the Bangladesh standard limit of day time noise level for the corresponding category. The highway traffic was found to be the main source of noise generation. Besides, the site attracts local visitors for its scenic beauty which also creates a significant source of noise pollution in this area

Mongla ghat area

The corresponding standard value for the commercial area is 70 dB (A) for the day time. During this period, the average day time noise level at this location was observed as 63.99 dB (A). The sources of noise were mostly road traffic (heavy vehicles, light vehicles, etc.), noise from and local mob in the Ghat area.

Harbaria, Sundarbans

Harbaria area of the Sundarbans is considered as a hot spot of biodiversity and an important anchoring site for most of the large ships. Most of the sea going vessels used to anchor at this site for transshipment of goods and commodities. The area is under the silent zone and the standard limit of ambient noise at daytime is 50 dB (Noise pollution control rules, 2006). The noise level was measured at a distance of 100 m (Inside the forest area) from the River bank and found as 48.43 dB (A) during this monitoring period which was 1.57 dB (A) lower than that of standard limit. However, movement of ships, sound created by running engines of anchored ships and barges, transshipment activities, bird's chirping, wave breaking sound and wind action on tree leaves were observed to be the main sources of noise in this site.

Akram point, Sundarbans

Akram Point of the Sundarbans is another biodiversity hot spot in the Sundarbans. This area is under the silent zone and the ambient daytime noise standard is 50 dB (A). In this monitoring season, noise level was recorded at a distance of 100 m (Inside the forest area) from the River bank. The average day time ambient noise level during this monitoring season was observed as 42.33 dB (A) which was 7.67dB (A) lower than that of Bangladesh standard value. However, Birds' chirping, stormy wind, wave breaking sound and falling of leaves from the trees were found as the main sources of noise.

Hiron point of Sundarbans

This location falls under the demarcated area of World Heritage Site. Generally, noise level is measured at the western bank of Passur river mouth and eastern side of the Sundarbans South Sanctuary. This location is highly important as the Mother vessels enter into the Passur river adjacent to this point and the river is roughly 5-6 km wide between two banks at the confluence point. However, due to rough weather the monitoring team could not reach to this site and hence the noise level at Hiron Point was not monitored during this monitoring season.

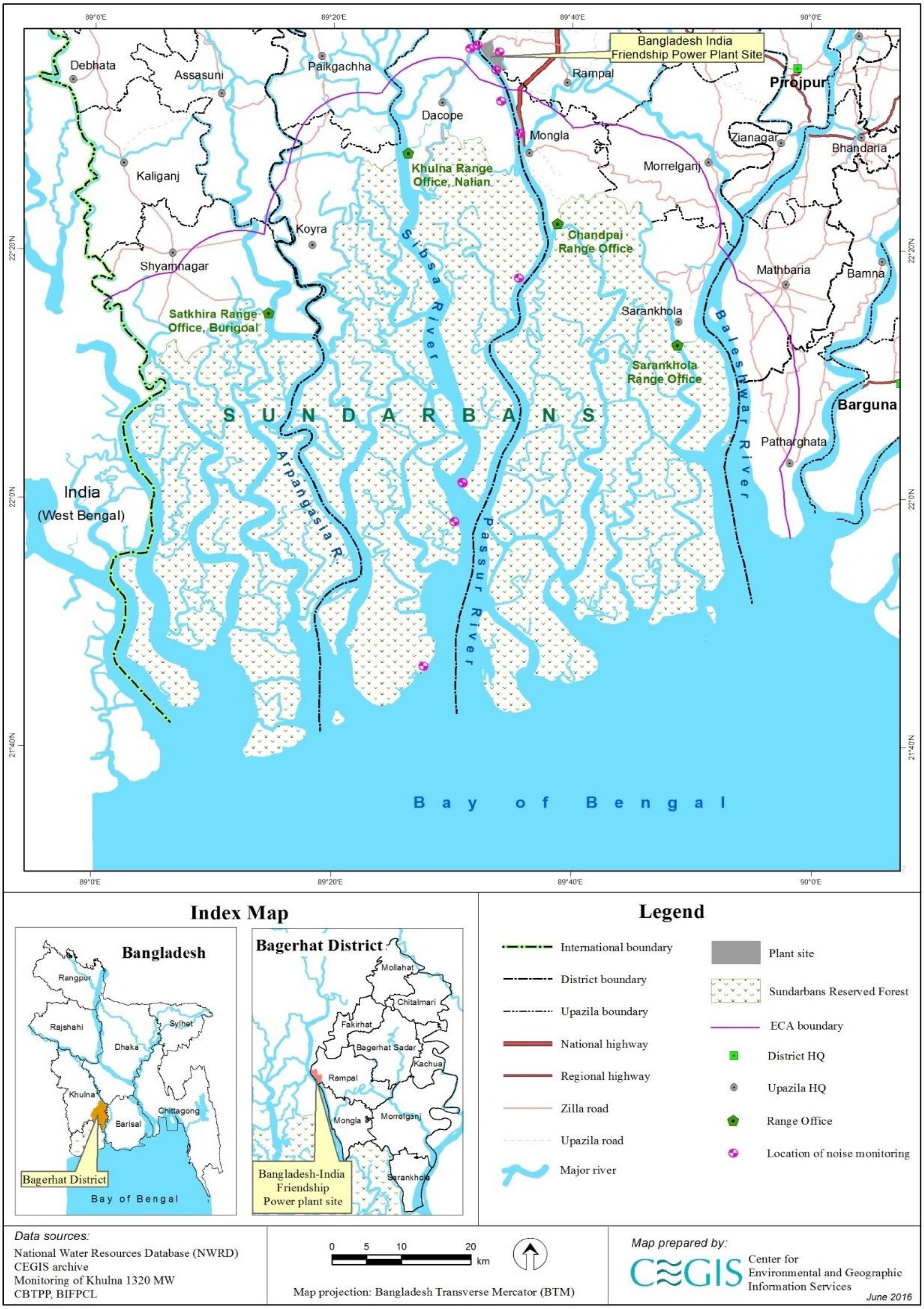


Figure 2.5: Noise Level Monitoring Locations

Table 2.4: Summary of the ambient noise recorded in consecutive monitoring periods of 2014, 2015, 2016, 2017, 2018 and 2019

Sl.	Location	Monitoring periods																				Std*
		QM 1 (Apr-14)	QM 2(Jul-14)	QM 3 (Oct-14)	QM 4 (Jan-15)	QM 5 (Apr-15)	QM 6 (Jul-15)	QM 7 (Oct-15)	QM 8 (Jan-16)	QM 9 (Apr-16)	QM 10 (Jul-16)	QM 11 (Oct-16)	QM-12 (Jan-17)	QM-13 (Apr-17)	*QM-14 (Oct-17)*	QM-15 (Jan-18)	QM-16 (Apr-18)	QM-17 (jul-18)	QM-18 (Nov-18)	QM-19 (Feb-19)	QM-20 (Apr-19)	
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	58.64	60.1	59.63	57.54	58.23	56.45	61.67	70
2	*NW Corner of the Project area (Kaigar Daskati)*	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	46.95	49.3	47.90	45.63	58.82	50.75	56.85	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	50.44	51.4	52.93	47.54	48.69	50.18	51.68	55
4	*SW corner of the project area (Moidara)*	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	43.26	44.5	47.55	52.63	61.78	*55.79*	56.05	55
5	*Proposed Township area (Shapmari)*	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	43.93	53.3	50.81	44.25	50.68	*58.13*	58.83	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	45.52	55.6	56.14	45.52	53.03	52.57	53.18	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	62.47	61.7	64.87	63.36	62.15	66.93	66.95	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	49.66	59.8	62.95	60.97	55.97	66.18	63.99	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	46.48	44.4	47.93	50.28	48.80	49.67	48.43	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	42.38	40.1	45.39	45.20	41.00	46.45	42.33	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	39.79	38.8	NM	NM	39.4	39.21	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*

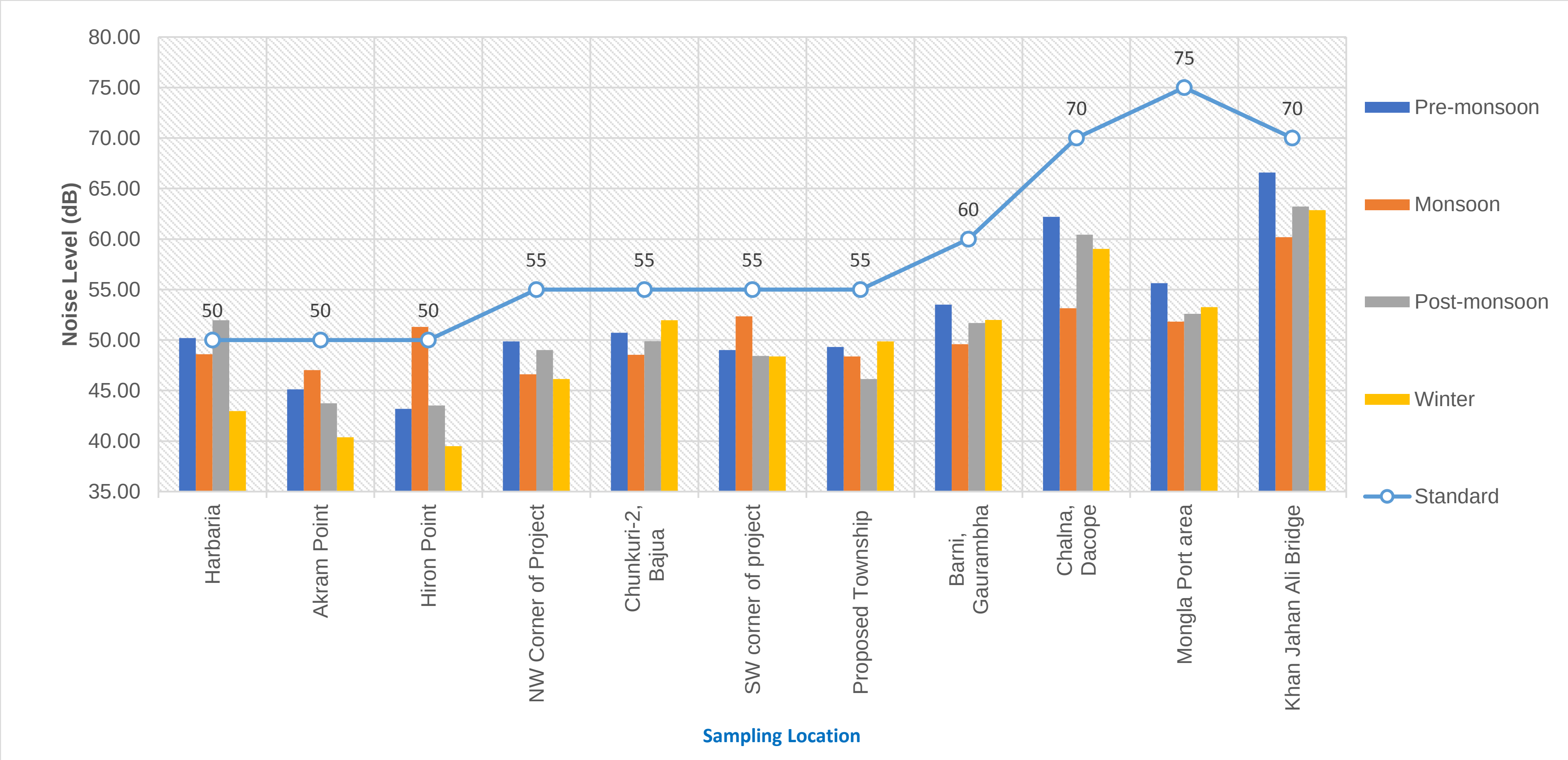


Figure 2.6: Status of Noise level at the monitoring locations

2.7.4 Findings

The noise generation sources in the study area can mainly be divided into two types; one is natural and the other one is anthropogenic. Natural sources of noise generation were birds' chirping, stormy wind, wave breaking on the shoreline, howling of leaves and so on. On the other hand, traffic mobilization, industrial activities, vessels movement within the rivers and local vehicles were the anthropogenic sources of noise. However, the observed noise level was not found to exceed the Bangladesh standard limit of noise level at seven locations during this monitoring (20th quarter) season (**Table 2.4**). On the other hand, the observed noise levels at North West Corner (Kaigar Daskati), South West corner (Moidara) and Proposed Township area (Shapmari) of the Project area were found to exceed the Bangladesh standard limit of their corresponding standard values. In course of the total twenty monitoring seasons, the noise level of eight locations were found to exceed the Bangladesh standard limit of their corresponding standard values in their different monitoring seasons (**Figure 2.6**).

2.8 Water Quality

An updated water quality status of the Passur-Sibsa River system and adjacent water bodies have been depicted in this section. Both national and international guidelines were followed in developing the methodology. This report includes the description of In-situ water quality parameters analyzed during 20th quarterly monitoring (April 2019) and the tested results obtained from the laboratory up to January, 2019 (19th quarterly monitoring). Methodology

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

The samples were collected from Seventeen (17) pre-selected locations (14 locations for surface water along the Passur River, Sibsa River, Maidhara River, near the proposed township area, and 3 locations for groundwater around the study area). However, during this tier, the sample was not collected from the Hiron Point of Sundarbans due to rough weather condition. The selected monitoring locations for the current monitoring program are shown in **Figure 2.7**. The details monitoring plan covering sampling locations, geographical locations, frequency and analysis techniques of parameters for surface and groundwater are given in **Table 2.5** and **Table 2.6** respectively.

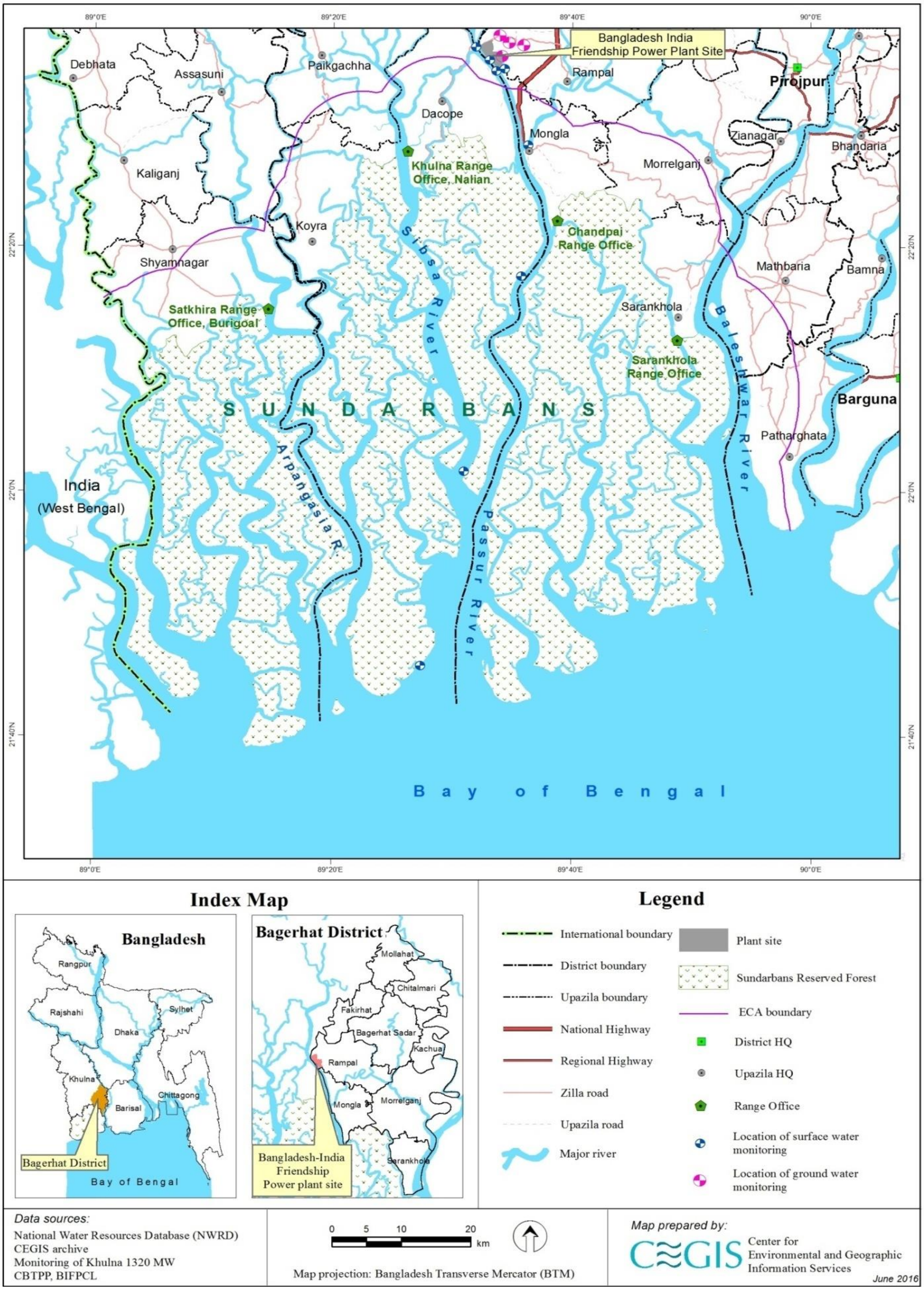


Figure 2.7: Surface water and Groundwater Quality Monitoring Locations

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

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

Table 2.6: Groundwater Quality Monitoring Parameters, Locations and Plan

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

2.8.1 Selection of Parameters

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

2.8.2 Surface Water Quality Parameters

The selected parameters for surface water quality include Temperature, pH, Dissolved Oxygen (DO), Total Dissolve Solids (TDS), Total Suspended Solids (TSS), Total Hardness (TH), Turbidity, Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Salinity, Nitrate (NO_3^-), Phosphate (PO_4^{3-}), Sulphate (SO_4^{2-}), Heavy Metals (As, Pb, Hg), and Oil and Grease.

The parameters were categorized into 4 groups:

- Physical and aggregate properties i.e. pH, Temperature, Salinity, Hardness, TDS, TSS, 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;

However, some additional parameters i.e. PAH (Polynuclear Aromatic Hydrocarbons), TOC (Total Organic Carbon) and TC (Total Carbon) were included in the monitoring study as per recommendation of the DOE approved coal transportation study monitoring framework. The analysed data of the additional parameters will be recorded and submitted to the DoE and other concerned authorities as per the condition no. 26 of the EIA approval of coal transportation study. Nevertheless, all the analysed data will be incorporated and discussed in the next monitoring report after obtaining the analysed results from the respective organizations.

2.8.3 Groundwater Quality Parameters

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

2.8.4 Sampling Procedure

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

2.8.5 Surface Water Sampling Procedure

Figure 2.8: Surface Water Sample Collection

The study area is highly influenced by tidal variation. Hence, temporal and spatial variations of tides were considered in sampling procedure. Surface water samples were collected at a distance of 30-50m away from the riverbank and at a depth of 6 cm below the water surface during low tides or relative slag period after the low tide for all parameters except oil and grease. The non-acidified sampling bottles were rinsed with respective water samples before sampling and storing below 10^{o}C. Acidified sampling bottles were used for heavy metal (As, Pb, Hg) sample collection while wrinkle bottles were used for BOD_5. All samples were preserved as per standard procedure (**Figure 2.8).**

2.8.6 Groundwater Sampling Procedure

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

2.8.7 Water Quality Parameter Analysis Techniques/Methods

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

Table 2.7: Testing Methodology of Water Quality Parameter

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

Parameters	Methods/Measuring Tools	Unit	BD Standard (ECR 1997)
Arsenic (As)	Atomic Absorption Spectrophotometers–Hydride Vapor Generating (AAS-HVG)	ppm or mg/L	0.05
Lead (Pb)	Atomic Absorption Spectrophotometers–Graphite Furnace (AAS-GF)	ppm or mg/L	0.05
Mercury (Hg)	Mercury Analyzer	ppm or mg/L	0.001

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

2.8.8 Water Quality Reporting Arrangement

Water quality status of the adjacent water bodies of power plants and the Sundarbans deep forests are being observed since April, 2014. Yearly variations of winter (January, 2019) for chemical water quality statuses and yearly variations in pre-monsoon (April, 2019) for physical water quality statuses are presented and compared with the ECR' 1997 Standards. To do so, all sampling points were clustered in five different sampling sites considering homogenous characteristics of the sampling points as well as the type of ecosystem touching the sample location. The clustered sampling sites and logical explanation of the clusters are presented in the following **Table 2.8**-

Table 2.8: Monitoring sites and characteristics.

SL	Monitoring sites	Site Characteristics
(a)	**Power plant & adjacent areas**	In this monitoring site, total 11 sampling points have been averaged to represent the water quality status of power plant and its adjacent surface water bodies. These 11 sampling points are situated in the same river system and embedded within 1km radius of power plant. In addition, previous monitoring results indicated same water chemistry. Therefore, this study makes the clusters to represent the water quality status of the areas in a more explainable and understandable way.
(b)	**Mongla-Passur confluence**	This monitoring site comprises with an individual monitoring point situates at least 13km downstream of the power plant. This point is a confluence of Passur river and Mongla-Ghasiakhali channel. The terrestrial ecosystem is mostly dominated by agricultural lands followed by rural settlements.
(c)	**Harbaria**	Harbaria site comprises with an individual monitoring point situates around 15 km downstream of the Mongla-Passur confluence. This site is dominated by Sundarbans Forest. Heavy activities of mother vessels unloading and small cargo movement for carrying of clinker, coal and LPG gas. Influenced by tidal effects of Bay of Bengal.
(d)	**Akram point**	Akram point is an individual point, which is, located around 35 km downstream of the Harbaria point. This site is situated on the bank of Sibsa river before mixing with Passur river at Sibsa point. This site is completely dominated by deep forests ecosystems. Influenced by tidal effects of Bay of Bengal.

SL	Monitoring sites	Site Characteristics
(e)	**Hiron Point**	Hiron point is the furthest point of this surface water-monitoring scheme. This point is at 25 km downstream of the Akram point. Deep forests and marine habitats are the main characteristics of the site. This site is completely exposed to Bay of Bengal. This site is also an individual monitoring point.

Status of Surface Water Quality

In-situ tested parameters

The in-situ tested results obtained up to 20th monitoring period (April, 2019: Pre-monsoon season) are described below:

pH

Twentieth (20th) quarterly monitoring was carried out in April, 2019. During this visit, pH values in the monitoring sites were ranged in between 7.9 and 9.9. The lowest pH value was found in the Passur River at Akram point of the Sundarbans whilst the highest value was recorded at Middle of the Passur River at 100m u/s of North West corner from the Project boundary. Generally, pH value was found to be the highest during this monitoring period (April 2019) than all other previous monitoring periods of the same season. The main reason can be the high salinity intrusion than previous time or no rainfall at all. During the visit, salinity concentration was also found almost double than the previous pre-monsoon season of the years 2014, 2015 and 2016 (**Figure 2.10**) at some of the locations. Altogether, pH value was almost 8.8 near the power plant areas and around 8.1 inside the deep forests area. In the last pre-monsoon season, pH value showed distinct spatial variations and some of the records were found even higher (slightly alkaline in nature) than the ECR, 1997 Standard (6.5-8.5).

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

Seasonal variations in pH concentrations among the selected monitoring sites during the quarterly monitoring programs of first, second, third, fourth, fifth and sixth year of Passur-Sibsa RS are presented in **Figure 2.10** and the observed dataset are attached in **Table B.1 of Appendix- IV**.

Temperature

Surface water temperature indicated close conformity with the previously monitored values for the same pre-monsoon seasons. The values varied from 31^0C to 33^0C among the monitored sites. Maidara-Ichamoti confluence and near the township area got highest temperature (32^0C to 33^oC) except other monitoring sites adjacent to the power plant (**Figure 2.11**). Deep mangrove forests also showed the average temperature of 31^0C. According to the ECR, 1997, 30^0C water temperature is still be tolerable by the aquatic organisms in tropical environment.

However, some sites showed increasing pattern of temperature rather than the ECR limit. These changes could be due to high salinity and hot environment of the last pre-monsoon season. However, the power plant is not discharging any hot water into its surrounding environment as it is still in construction phase.

The surface water temperature largely depends on daily weather condition *(Bartram J et al., 1996*). According to the weather pattern of Bangladesh the temperature drops to minimum level during winter, which is also applicable for the water temperature and thus it differs largely than the other season's temperatures. Recorded temperatures indicated that there was spatial variation among the monitoring sites even in the same season.

In the past, water temperature inside the Sundarbans were found to be slightly higher than the water temperatures near the power plant sites in pre-monsoon. However, this time this trend has been changed due to some climatic factors (hot environment in April, 2019).

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

Salinity

The observed salinity concentration ranged in between 8.0ppt and 22.9ppt during this period. The maximum salinity was observed at Akram point of Sundarbans while the minimum value was recorded at all the sampling sites close to the project site. During this monitoring period, fresh water flow from upstream was comparatively low due to insufficient rainfalls. On the other side, high salinity from seawater increased water salinity in the direction of downstream to upstream. It is very important to mention here that, for the last two pre-monsoon season, the salinity concentration in all the sampling sites were found comparatively higher than all other pre-monsoon seasons.

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

Dissolved Oxygen

DO concentrations were found to be ranged in between 5.9-7.0 mg/L. The maximum concentration was recorded at Akram point while the minimum value was recorded at the Left Bank of Passur River at 100m u/s of North West corner from the Project boundary (5.9 mg/L). In case of surface water standard, DO limit must not be dropped than 5.0mg/L at any cost. Lower DO than the standard limit (ECR' 1997) will first harm the aquatic organisms (plankton) and then the fish community. DO level of the Passur-Sibsa (2019) RS was found relatively same comparing to the last pre-monsoon season of 2018.

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

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

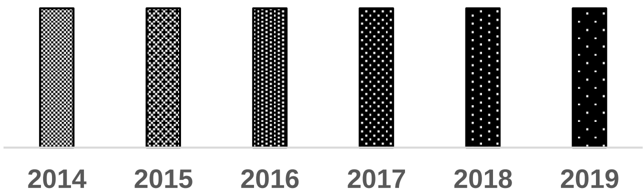


Figure 2.9: Legend direction (left to right: 2014-2019)

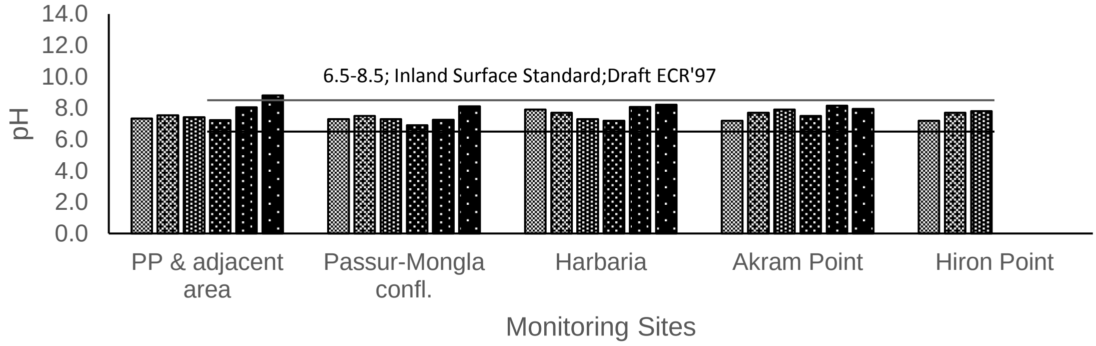


Figure 2.10 Variations in Pre-monsoon pH values in different monitoring sites

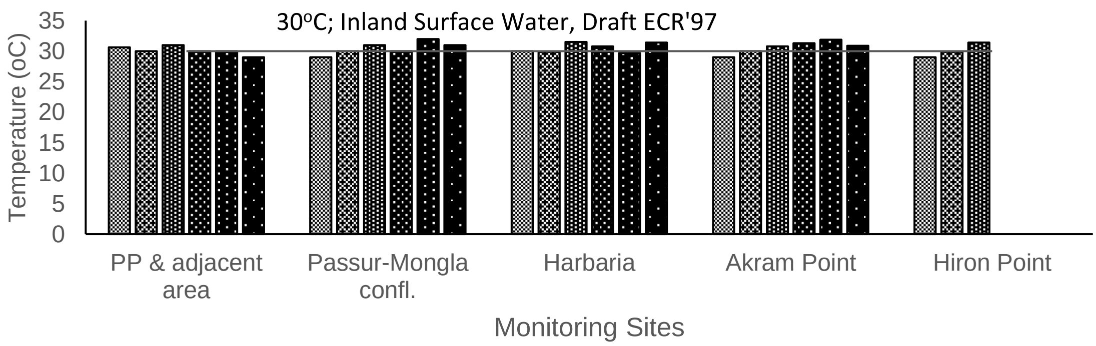


Figure 2.11: Variations in Pre-monsoon temperature in different monitoring sites

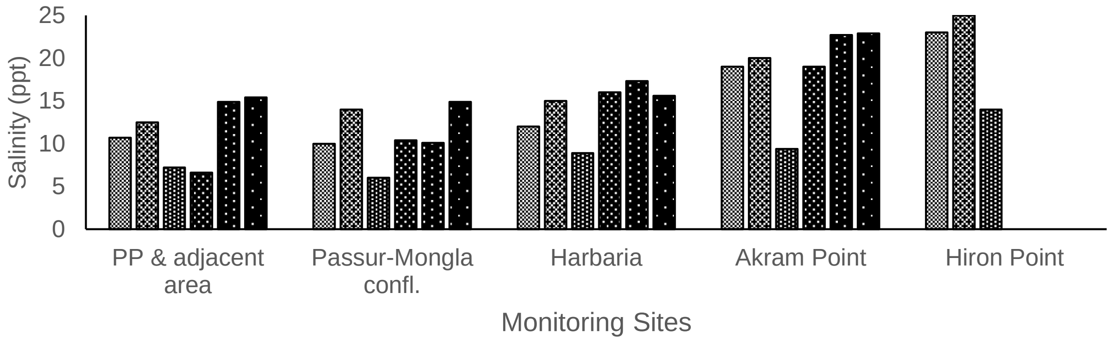


Figure 2.12: Variations in Pre-monsoon salinity in different monitoring sites

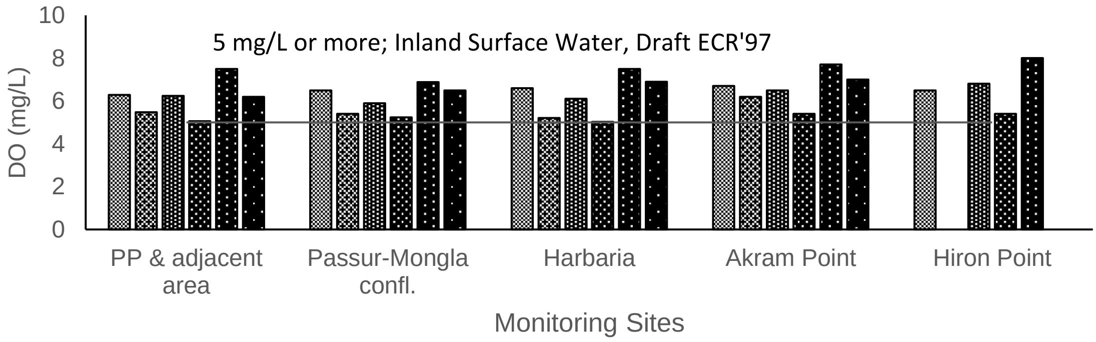


Figure 2.13: Variations in Pre-monsoon DO in different monitoring sites

Laboratory tested parameters

The laboratory tested results obtained up to 19th monitoring period (January 2019: Winter season) are described below:

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

Total Dissolved Solids (TDS) mainly indicates the presence of various kinds of minerals like ammonia, nitrate, phosphate, alkalis, some acids, sulphates and metallic ions etc., which comprise both colloidal and dissolved solids in water (*Tareq M S et al., 2013*). During the last winter period, the TDS values were found to be ranged in between 9,883mg/L to 21,110mg/L, which is comparatively a bit higher than other previous winter seasons (**Figure 2.15**). The main reason of high TDS was the shifting of monitoring time a bit towards February due to some unavoidable reasons (beginning of February 2019 instead of January 2019). In the February of the year, upstream freshwater flow was even lower than the January. Above all these, the average TDS status are always showing the same pattern. For instance, TDS in power plant and adjacent areas are comparatively less than the deep Sundarbans Forests.

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

Total Hardness (TH) follows similar pattern to that of TDS e.g. high TH during pre-monsoon and winter season. The higher the TDS, the higher the nutrients and therefore higher occurrence of TH. Insufficient freshwater supply due to low rainfall during winter and pre-monsoon period increase the TDS concentrations in Passur-Sibsa RS. Seawater contains huge quantity of calcium and magnesium, which make the water hard. In the last winter season, the range was found to be 2,050-6,900 mg/L. Water body of power plant and its adjacent areas (2,050mg/L) are less hard than the water body of deep Sundarbans Forests (Akram point: 5,900 mg/L and Hiron Point: 6,900 mg/L) (**Figure 2.16**). According to the figure 2.9, it is noticeable that water hardness of the monitoring sites of this season are comparatively higher than the other winter seasons. From January to February, the hardness reaches to its highest concentration in this river system. The water hardness is even higher than the ECR limit of 200-500mg/L. During the rainy season, the water hardness in all the monitoring stations in Passur River were found to be lower whereas it was found remarkably higher in pre-monsoon season (**Table B.8: Appendix IV**). Generally, water hardness is found to be higher in pre-monsoon season due to the saline water intrusion toward upstream (*Rahman et al., 2013*).

Total Suspended Solid (TSS) includes solid materials of organic and inorganic in origins, which are normally suspended in water. In Passur and Sibsa RS, the suspended matters generally contain sand, clay, silt and loam. During the 19th quarterly monitoring period, the TSS concentrations among the monitoring sites varied from 8-16 mg/L. The highest value was found at Left Bank of Passur River at South West corner from the Project boundary while the lowest value was found at Maidara River near township area (**Figure 2.17**). TSS values in every spot recorded during the last winter period found to be within the Bangladesh standard limit of 150 mg/L (ECR, 1997). At 2014, TSS reached more than 300mg/L at both Akram and Hiron point due to the oil spillage occurred at 9th December 2014. Above all, in the Passur-Sibsa RS, there was found consistency in the concentrations of suspended matters.

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

The status of TDS, TH and TSS of Passur River in the monitored post-monsoon seasons at different monitoring sites are presented in **Figure 2.15, 2.16 and 2.17** respectively and all the observed dataset are attached in **Table B.5, Table B.6 and Table B.7 of Appendix- IV.**

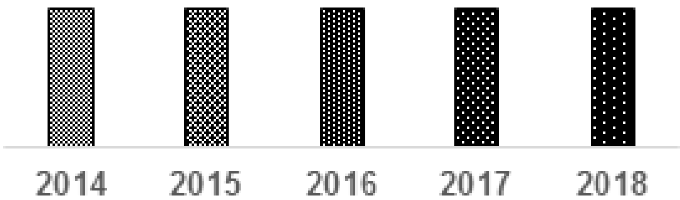


Figure 2.14: Legend direction (left to right: 2014-2019)

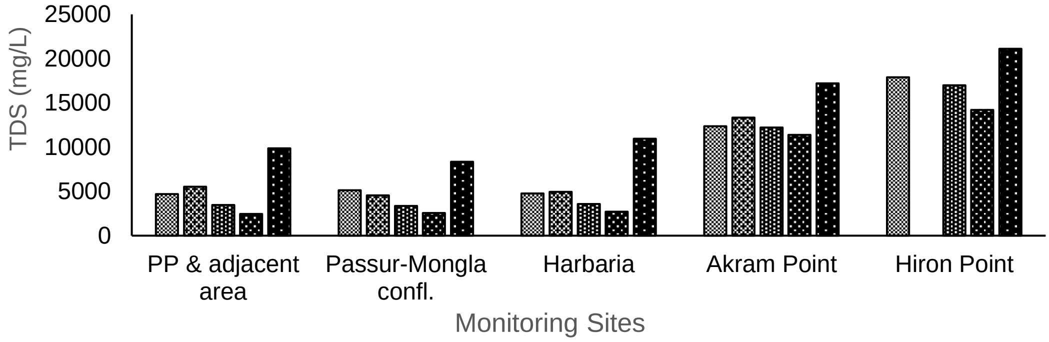


Figure 2.15: Variations in TDS concentrations in different monitoring sites

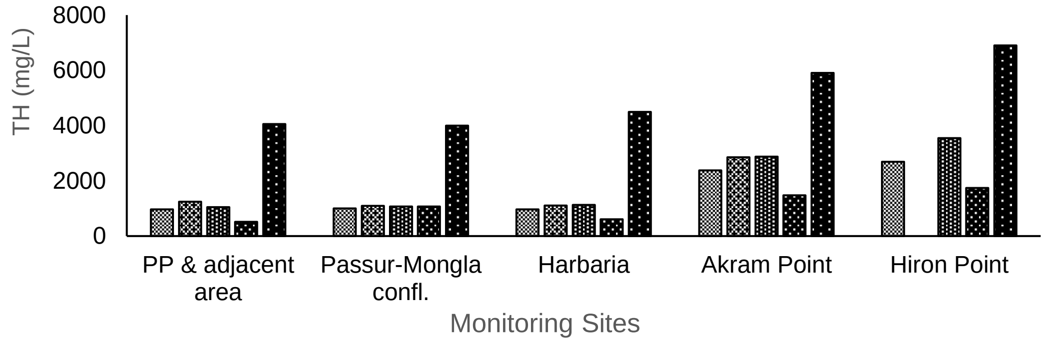


Figure 2.16: Variations in TH status in different monitoring sites

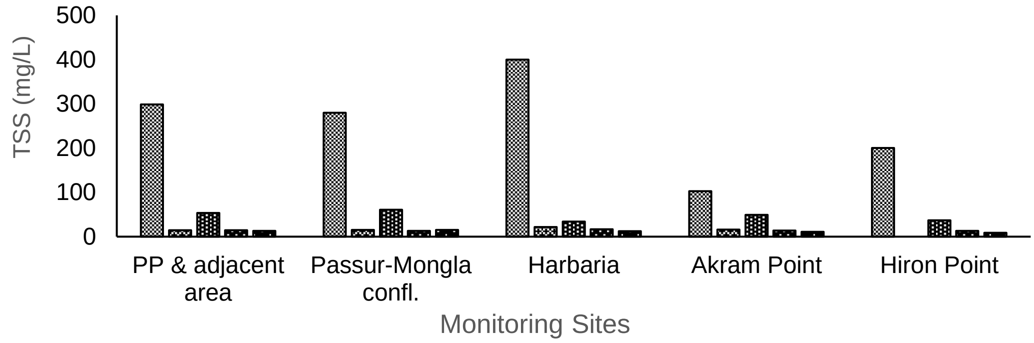


Figure 2.17: Variations in TSS concentrations in different monitoring sites

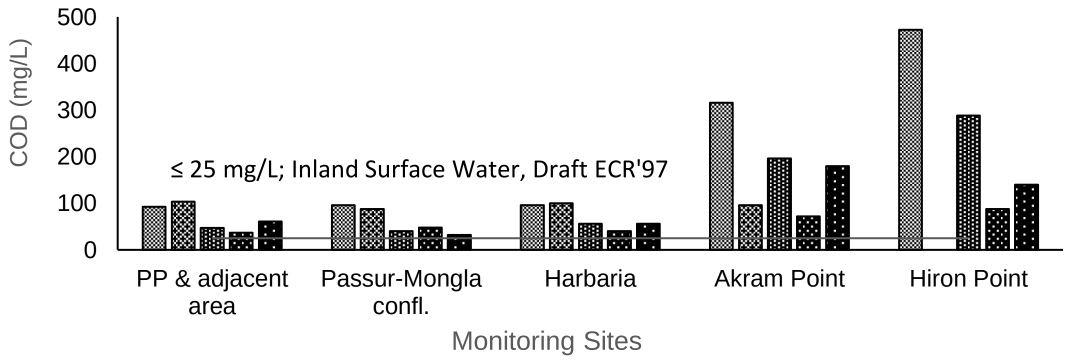


Figure 2.18: Variations in COD concentrations in different monitoring sites

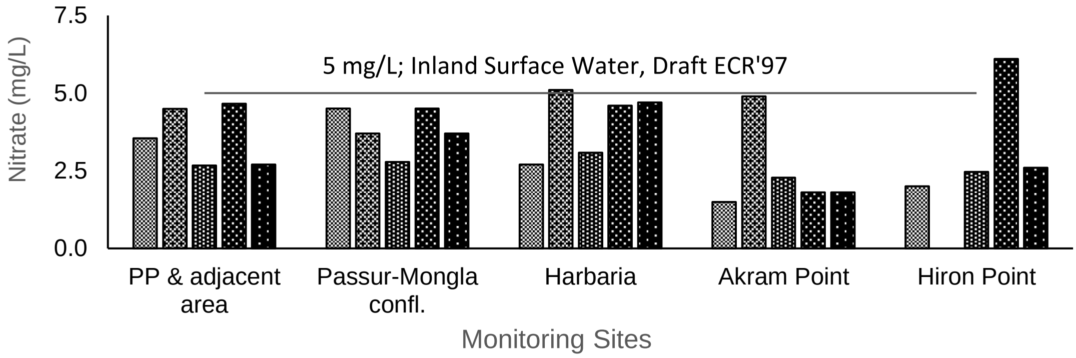


Figure 2.19: Variations in Nitrate concentrations in different monitoring sites

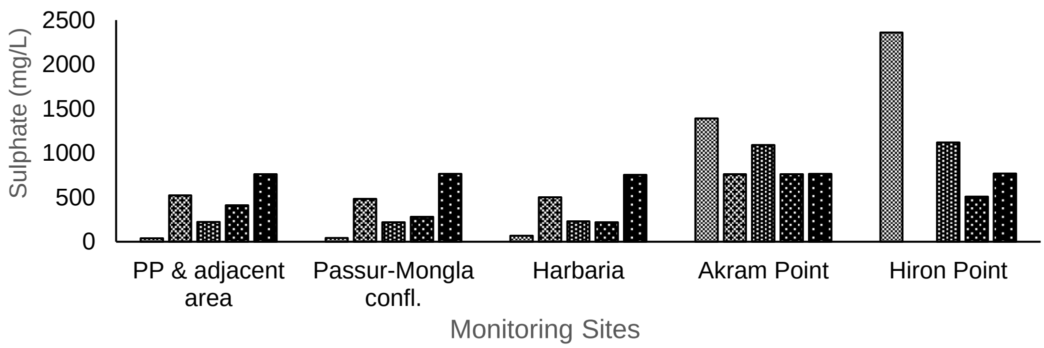


Figure 2.20: Variations in Sulphate concentrations in different monitoring sites

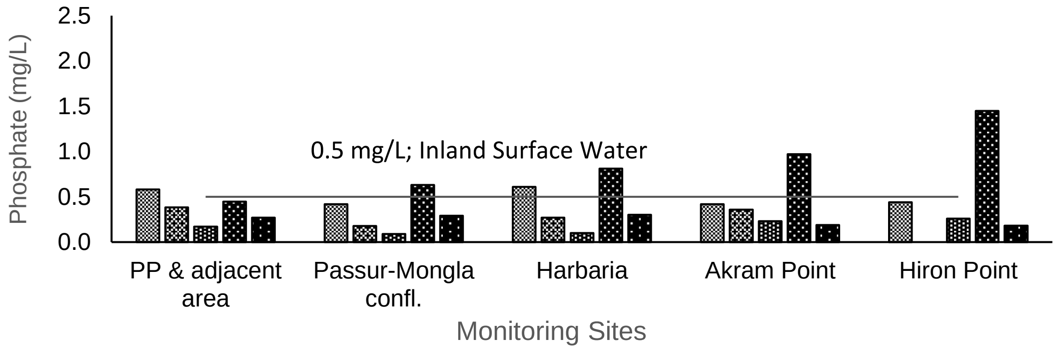


Figure 2.21: Variations in Phosphate concentrations in different monitoring sites

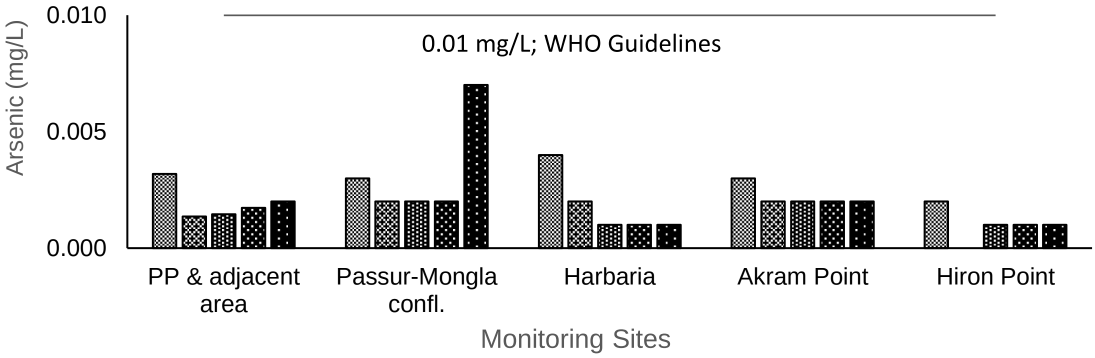


Figure 2.22: Variations in Arsenic concentrations in different monitoring sites

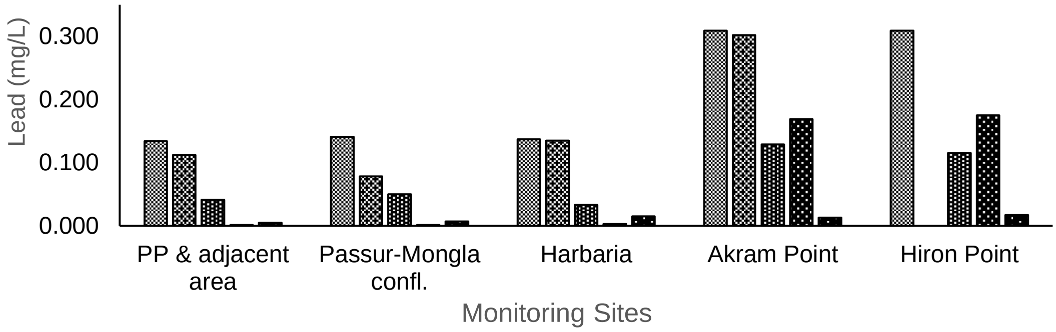


Figure 2.23: Variations in Lead concentrations in different monitoring sites

Chemical Oxygen Demand (COD)

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

COD concentrations varied from 32 mg/L to 180 mg/L during the last winter season. The highest value was found at the Akram point while the lowest was at Mongla Passur confluence. The high values of COD indicated higher level of organic pollution in the river water (*Sivasubramanium, 1999*). **Figure 2.18** indicates that, organic loads are higher in the deep forests of Sundarbans than the upstream areas especially near the power plant and its adjacent areas. Deep forests supply many organic loads in the river while upstream loads as well increase the organic materials concentrations in huge at the downstream of the RS. None of the sites complied with the Draft ECR' 2017 (25 mg/L) inland surface water standard. Various activities near the power plant sites, other industrial and agricultural activities may influence the COD continuously. The extreme high COD at 2014 was the reason of oil spillage of that year which lead the death of planktons and other aquatic life forms ultimately increased the organic matter decomposition rate.

Over the year, COD concentration was found to be higher in pre-monsoon season followed by winter as these seasons had insignificant rainfall comparing to those of other seasons and which actually increased the density of organic matter. The COD concentrations of pre-monsoon and winter seasons (dry) were found higher than those of monsoon and post-monsoon seasons. In monsoon, higher discharge diluted the COD load of the river water, which in turn reduced COD concentration in post monsoon. All observed values of COD are shown in **Figure 2.18** and the completely monitored dataset are provided in **Table B.8 of Appendix- IV.**

Nitrate, Sulphate and Phosphate

Similarly, NO_3^- concentrations varied from 1.3mg/L to 4.7mg/L. The maximum concentration (4.7mg/L) was recorded at Harbaria whilst the lowest concentration (1.3mg/L) was found at Maidara River near township area. NO_3^- concentration showed both temporal and seasonal variations in the same season among the monitoring periods. As for example, in the last winter season NO_3^- concentration was found around 2.7mg/L at Akram point. But it was only 1.8mg/L at Akram point and more than 2.6mg/L at Hiron point (**Figure 2.19**). However, the results obtained from all the monitoring sites were found to be within the standard concentration stated in ECR'1997 (10mg/L).

The highest values were found in pre-monsoon season of 1st quarter of 2nd year, which would be due to the higher amount of surface and groundwater runoff, dissolution of nitrogen-rich geological deposits, and biological degradation of organic matter as observed from numerous studies (*Spencer, 1975; Kinne, 1984; Gleick, 1993; Wetzel, 2001; Rabalais, 2002*) (**Table B.9**). Highest nitrate concentration was found in monsoon period across the Passur-Sibsa RS, which would be the result of surface run-off, agricultural run-off, atmospheric deposition and domestic wastes dumping together with industrial pollution from upstream.

Naturally, **sulphate (SO_4^{2-})** concentration is higher in seawater as well as in coastal river due to tidal interactions. The monitored dataset substantiates this fact i.e., SO_4^{2-} concentration of Passur-Sibsa RS increases in the direction of upstream to downstream. However, this variation is dominant in monsoon and pre-monsoon seasons only. Freshwater availability from upstream makes this variation.

The highest value (770 mg/L) of sulphate was found at the Right Bank of Passur River at South West corner from the Project boundary while the lowest value (756 mg/L) was found at the Harbaria of Sundarbans. Sulphate starts usually to increase from winter season and reaches at its highest peak in pre-monsoon season. Comparatively lower concentration of SO_4^{2-} in monsoon and post monsoon seasons could be due to the dilution effect of upstream freshwater (**Figure 2.20 and Table B.10, Appendix- IV**).

Likewise, **PO_4^{3-}** concentrations were found to be ranged in between 0.17 mg/L and 0.40 mg/L during the last monitoring period (January, 2019) (**Figure 2.21**). Based on the **Figure 2.21**, it is verified that, PO_4^{3-} concentration did not show any spatial variations during last winter but showed temporal variations. Upstream anthropogenic activities probably the reason for this kind of trend along with pattern of rainfalls and bio-geochemical cycles. All the monitoring sites complied with the ECR' 1997/ Draft ECR 2017 rules of 0.5 mg/L of PO_4^{3-} in the inland surface water.

The recorded low phosphates value during dry seasons might be attributed to the limited flow of upstream freshwater, high salinity and utilization of phosphate by phytoplankton, stated by *Senthilkumar et al., 2002; Rajasegar, 2003* (**Table B.11**).

NO_3^-, SO_4^{2-} and PO_4^{3-} concentrations at different monitoring sites of the 18 consecutive monitoring periods are shown in **Figure 2.19, 2.20 and in 2.21** and all the observed dataset are given in **Table B.9, Table B.10** and **Table B.11** of **Appendix- IV**.

Heavy Metals

It has earlier been revealed that Arsenic (As) concentrations varied between 0.001 to 0.006 mg/L. During this 19th monitoring, the results again fitted with the said range. Though there were some seasonal variations in As concentrations, but still As concentration complies with the drinking water quality standard of WHO (0.01 mg/L). The Bangladesh limit is as high as of 0.05 mg/L **(Figure 2.22)**.

Lead (Pb) dissolved in water is very harmful to aquatic organisms; due to bioaccumulation, it increases in body tissue of organisms (*Rompas, 2010*). It is also evident that organic fertilizer, which comes from lime and compost fertilizers, can contain heavy metal, e.g., NPK fertilizer (phosphate fertilizers containing Pyromorphite- $Pb_5(PO_4)_3$ like the way said by Zhu et. al., 2004), which may result in higher amount of Pb concentration in river water. During 19th monitoring period, the concentration of Pb ranged 0.003-0.017mg/L (**Figure 2.23**). The standard concentration for inland surface water is 0.1 mg/L.

The values of Hg (Mercury) revealed a continuous consistency among all the spots in all the seasons. The values never exceeded 0.001 mg/L. In the winter, the concentrations persisted also the same. All the observed data found to be within the Bangladesh standard limit (0.05 mg/L) set by the ECR, 1997 of Bangladesh.

The average value of As and Pb concentrations at different monitoring sites of the consecutive monitoring periods for winter season are presented in **Figure 2.22 and in 2.23** and all the observed dataset are given in **Table B.12, Table B.13** and **Table B.14** of **Appendix- IV**.

Oil and Grease

In order to measure the concentration of oil and grease in Passur-Sibsa River, samples were collected at five locations during low tide from the surface layer and analyzed following the standard testing method of APHA. The concentration of oil and grease are presented in **Table-B.15 of Appendix-IV.**

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

The values of Oil and grease were found to be <2.0 mg/L at all the monitoring sites in the last winter season. Oil and grease showed both spatial and temporal variations. In other seasons (pre-monsoon, monsoon and post monsoon). This organic compound has increased in the last three consecutive years. Plying of motorized boats, launches and other tourist boats could be the reasons of high oil and grease including the RASH MELA Festival inside Sundarbans every year. Moreover, for the seasonal fishing at sea, the engine boats and other fishing boats contributes huge amount of oil and grease in the river water. Therefore, due to oil spillage and discharges of other organic residual from large number of marine vessels in the location; oil discharge from the fishing boats and other anthropogenic activities might be the reason of having such higher amount of oil and grease concentration.

Findings

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

In this 20th quarterly monitoring, only salinity was recorded comparatively higher. The main issue was the higher salinity than any other winter seasons over the completely monitoring scheme. On the other hand, pH, Temperature and DO level was good at the project site and in the deep mangrove forests.

In this 19th quarter (winter, 2019), TDS and TH increased two to three folds in respect to the same seasons of last five consecutive years. TSS of the rivers remained same compare to the previous post-monsoon seasons. High COD was found in all the monitoring stations. Nitrate (NO_3^-) and Phosphate (PO_4^{3-}) reduced a lot most probably due to freshwater availability and dissolved nitrate and phosphate used by plankton's community of the rivers.

In case of metal pollution, no variation was recorded for As, Pb and Hg concentration and even no issues as well.

Oil & grease concentration was found less than 2.0 mg/L, which is even less than half of the recommended concentration (10 mg/L) for Inland Surface Water.

2.8.9 Status of the Groundwater quality

In-situ tested parameters

The in-situ tested results obtained up to 20th monitoring period (April, 2019: Pre-monsoon season) are described below:

pH and Temperature

Groundwater pH and temperature values were found to be complied with the drinking water quality standards as specified in ECR, 1997 (6.5-8.5 and 20-30ºC respectively) except in Kapashdanga for pH. The pH values during the 20th monitoring scheme were found to vary from 8.3 to 8.9, while temperature ranged in between 29-30°C. Slightly higher pH value at Kapasdanga might be for the dry season (temporal variations). No significant differences were observed against the previous monsoon season results. Similarly, no significant variation was recorded in groundwater temperature over the monitoring periods.

Both the results of pH and Temperature were found more or less consistent with all those to the previously obtained respective season's data. The twentieth consecutive monitoring results of pH and temperatures (pre-monsoon) of selected sites are presented in **Figure 2.25: pH, Temperature** and all the observed dataset are attached in **Table B.16-17** of **Appendix-IV**.

Salinity and Dissolved Oxygen (DO)

Groundwater salinity concentration in all the monitoring sites were found to be in between 0.1-0.7ppt. During this monitoring season, groundwater salinity of Township area, Rajnagar and Kapasdanga were found to be 0.1ppt, 0.5ppt and 0.7ppt respectively (**Figure 2.25: Salinity**). This slight change of groundwater salinity might be due to the shortage of freshwater availability during winter and pre-monsoon seasons along with increased salinity concentration of river water.

DO ranged between 6.0mg/L to 6.5mg/L during this monitoring season. Level of DO in groundwater was perfect for human drinking purpose (not less than 6.0mg/L or too high). However, minimum changes in DO level in drinking water may only reduce the taste of water. Higher DO level makes water tastier but causes corrosion to the supply pipe.

All monitoring results of salinity and DO of the selected monitoring sites are presented in **Figure 2.25: DO** and all the observed dataset of DO and Salinity are attached in **Table B.18 and B.19** of **Appendix- IV** respectively**.**

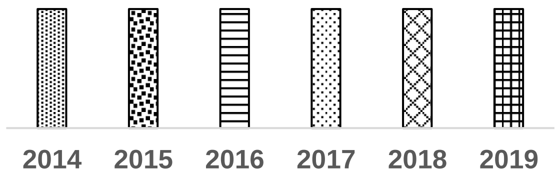


Figure 2.24: Legend direction (left to right: 2014-2019)

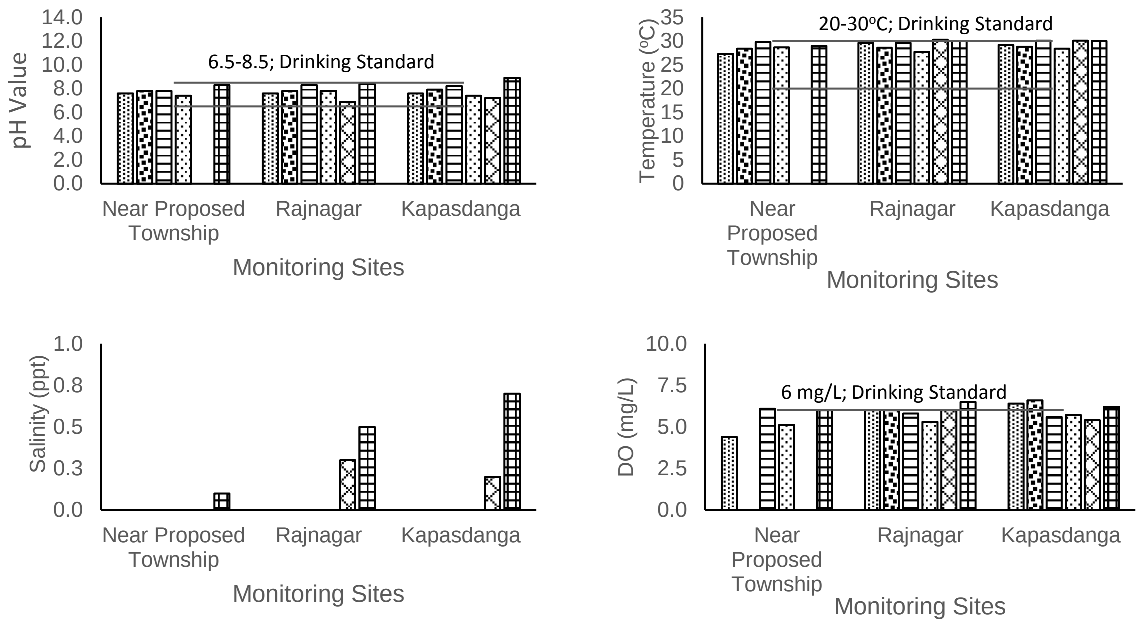
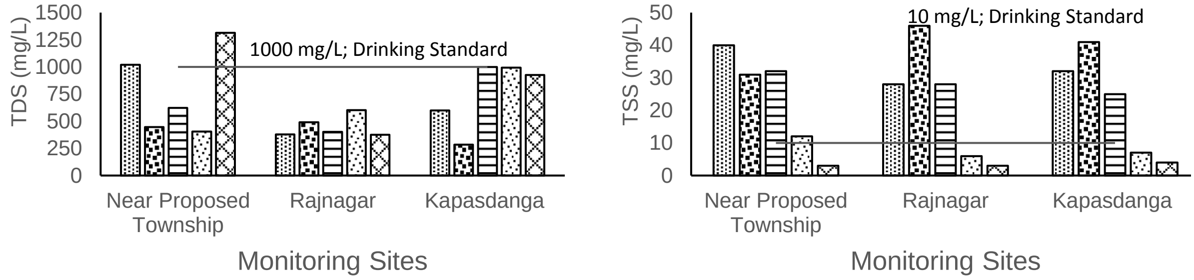


Figure 2.25: Status of pH, Temperature, DO and Salinity of pre-monsoon seasons of the last six consecutive years



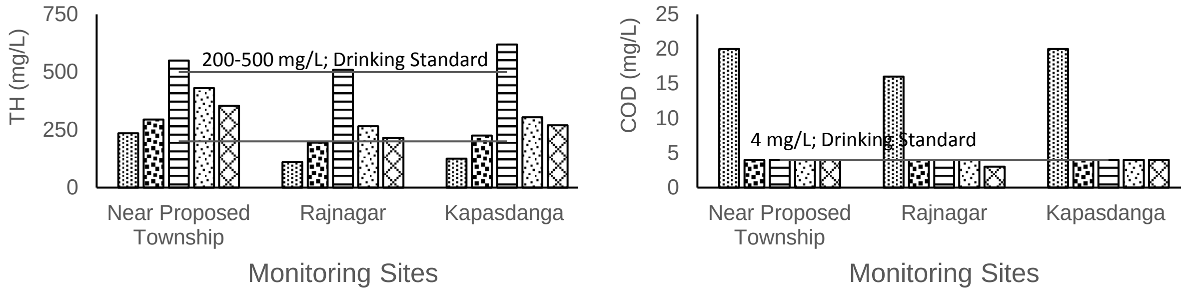


Figure 2.26: Status of TDS, TSS, TH and COD of winter seasons of the last five consecutive years

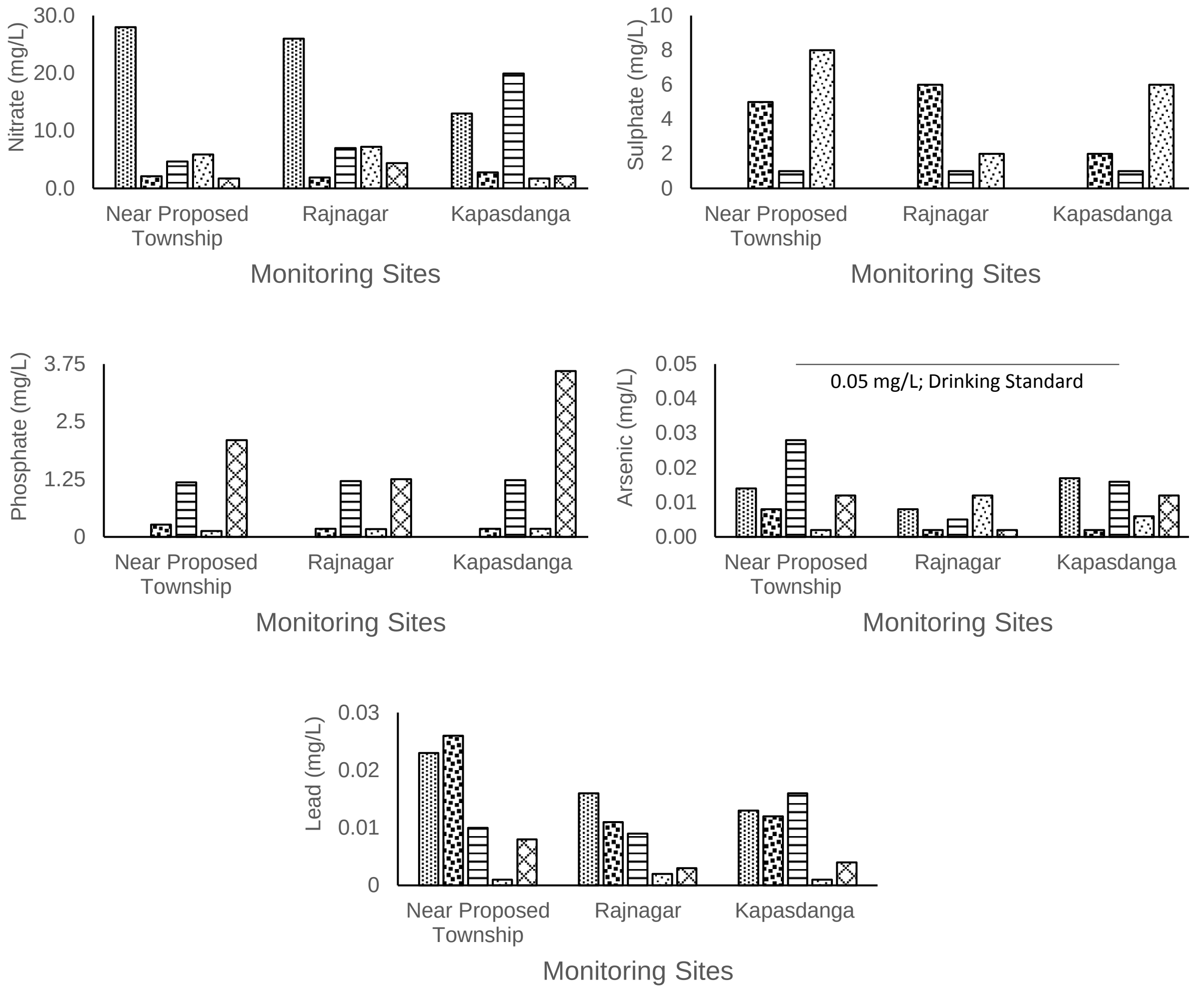


Figure 2.27: Status of Nitrate, Sulphate, Phosphate, Arsenic and Lead of winter seasons of the last five consecutive years

Laboratory tested parameters

The laboratory tested results obtained up to 19th monitoring period (January 2019: winter season) are described as follows:

TDS, TSS and TH

The highest TDS value of 1315 mg/L was recorded Near Township area while at Rajnagar (376 mg/L) and Kapasdanga (927 mg/L), it complied completely with the ECR' 1997 (1000mg/L) (**Figure 2.26: TDS**). High TDS in township area might be the high nutrients in the water during the dry season.

TSS also known as non-filterable residue, are the solids (minerals and organic material) which remain trapped on a 1.2µm filter (*U.S.EPA, 1998*). Among all the monitoring seasons, the observed TSS concentrations were found higher in winter season than the other monitoring seasons (pre-monsoon, monsoon and post-monsoon) (**Table B.21**). This variation would be due to lack of freshwater availability for sufficient groundwater recharging. In addition, evaporation have also condensed the water along with its suspended matters. During this monitoring period, the TSS concentrations ranged in between 3-4 mg/L, which complied with the Standard for Drinking Water, Bangladesh (TSS: 10mg/L, ECR, 1997) (**Figure 2.26: TSS**).

TH concentrations of the three monitored spots varied from 215 mg/L to 355 mg/L (**Figure 2.26: TH**). The maximum value was found at Shapmari area while the lowest was found at Rajnagar. Over the last five winter seasons, drinking water hardness complied with standard limit (200-500 mg/L) set by the ECR 1997. So far, no incidents of weathering of Ca^{2+} bearing minerals or excessive application of lime was found during the monitoring periods which could cause excessive amount of TH in groundwater.

Groundwater TDS, TSS and TH values of the consecutive winter periods are presented in **Figure: 2.26: TDS, TSS and TH** and all the observed dataset are attached in **Table B.20, B.21** and **Table 22** of A**ppendix- IV.**

Chemical Oxygen Demand

The Bangladesh standard for COD in drinking water is 4.0 mg/L. Monitoring sites completely complied with the Bangladesh Standard as COD concentrations for these sites in the last post-monsoon period were found only 4.0 mg/L. Except the year 2014, all the other post-monsoon seasons COD concentrations were also within the recommended limit for Bangladesh.

The COD concentrations of all the pre-monsoon period monitoring sites are given in **Figure 2.26: COD** and all the observed dataset are attached in Table **B.23** of **Appendix- IV**.

Nitrate, Sulphate and Phosphate

Nitrate (NO_3^-) values ranged in between 1.7 mg/L and 4.4 mg/L in the last winter period (**Figure 2.27: Nitrate and Table B.24**). The maximum value was recorded in Rajnagar while the lowest was in Shapmari area. NO_3^- concentrations were within ECR, 1997 limit (10mg/L) during the last winter period. NO_3^- in groundwater showed both spatial and temporal variations in winter seasons.

SO_4^{2-} concentrations were complying with the Bangladesh Standard for Drinking Water Quality (400 mg/L). SO_4^{2-} concentration in groundwater did not show any pattern yet except a trend of comparatively high concentrations in winter than all other monitoring seasons (**Appendix-IV: Table B.25**).

On the other hand, the concentrations of PO_4^{3-} were found between 1.3 mg/L and 3.6 mg/L, which was within the standard limit of 6.0 mg/L (ECR'1997) (**Figure 2.27: Phosphate**). PO_4^{3-} concentration reached to its highest peak at 6.2 mg/L during the post-monsoon of 2014. PO_4^{3-} concentrations actually showed both spatial and temporal variations but which is minor in the interest of this monitoring objectives as well as drinking purpose by the community resides there.

The observed winter seasons NO_3^-, SO_4^{2-} and PO_4^{3-} concentrations of groundwater are presented in **Figure 2.27: Nitrate, Sulphate** and **Phosphate,** and all the observed dataset are attached in **Table B.24, B.25, and B.26** of **Appendix- IV.**

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

According to Bangladesh Standard (ECR, 1997), the maximum acceptable concentration of Arsenic (As) in groundwater is 0.05 mg/L. The As concentrations among all the monitoring locations ranged in between 0.002 mg/L and 0.012 mg/L which were within the Bangladesh standard for drinking water quality (ECR, 1997) (**Figure 2.27: Arsenic).** It can therefore be concluded that, groundwater of the monitoring areas is not contaminated by arsenic yet.

Lead (Pb) and Mercury (Hg) concentrations were also measured and the values were found within the permissible limit specified in ECR 1997 (0.05 mg/L for Pb and 0.001 mg/L for Hg). The concentration of Pb showed only spatial variation to some extent (**Figure 2.27: Lead**). However, the water of the tube-wells was found suitable for drinking purpose in terms of metal pollution status.

The observed values of as and Pb in all the pre-monsoon period monitored sites are presented in **Figure: 2.27: Arsenic, Lead** and all the observed dataset of As, Pb and Hg are presented in **Table B.27, B.28 and B.29** of **Appendix-IV**.

Remarks

This concluding remark represent the status of physical (April 2019), chemicals and metals status (October 2018) characteristics of drinking water. It has been observed that the physical characteristics of groundwater quality is still in good condition and in acceptable state for drinking purpose except slight salinity in the observed water. This salinity might be the reason of saline water infiltration due to excessive withdrawn by the surrounding communities during the dry season. In addition, evaporation also responsible for this slight salinity in groundwater. Project activities are not related to this sort of changes.

Chemical characteristics of the groundwater quality are also found suitable and save to drink based on the recommended limit for Bangladesh (Drinking water standards, ECR 1997). Only, chemical oxygen demand during 2014 and 2015 was higher than ECR, 1997. The observed groundwater is completely free from the metal pollution of Arsenic, Lead, and Mercury.

2.9 Land Resources monitoring

2.9.1 Methodology

Monitoring Indicators

Monitoring of selected indicators is very crucial for better management of land resources in the study area. Plot/land use, soil fertility/nutrient status, soil contamination with heavy metals and soil salinity are considered as the major indicators for land resources monitoring. It is also assumed that during the operation phase of the power plant fly ash and other air borne pollutants may deposit on the surrounding agriculture land, which ultimately pollute the study area soil. Before that (during pre-construction and construction stage), only natural phenomena are responsible to alter soil parameters.

Sampling Frequency

The frequency of monitoring for land resources data collection was considered twice in a year. So, plot use monitoring will be accomplished in April and October in each year. Accordingly, the plot use data was collected in the 20th monitoring program during April 23th, 2019 to April 27th, 2019.

Monitoring Indicators

The continuous monitoring had given an opportunity to observe seasonal change along with spatial change of selected indicators of sampling plots. 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).

Location

The selected mauzas are Baranpara (E-89°30′59.1″, N-22°37′57.0″) of Batiaghata Upazila, Chunkuri-2 (E-89°32′20.0″, N-22°34′51.0″) of Dacope Upazila, Kapalirmet (E-89°36′8.8″, N-22°32′18.9″) of Mongla Upazila, Chakgona (E-89°34′25.3″,N-22°34′18.3″) of Rampal Upazila and Basherhula (E-89°34′25.0″, N-22°36′14.0″) of Rampal Upazila under Khulna and Bagerhat Districts. However, a new sampling location (Bidyarbon- E-89°34′40.0″, N-22°33′42.0″) of Mongla Upazila is included with the previous ones for monitoring as per TOR. The sampling locations are stated in **Table 2.9**. Locations of collected soil samples are presented in **Figure 2.32**

2.9.2 Process of Soil Samples Collection

Plot Selection

Monitoring plots were selected at the very beginning of this study. Expert's judgement along with plot owner's opinion was taken into consideration for this selection. Upazila Agriculture Officers of Batiaghata and Dacope of Khulna, Rampal and Mongla of Bagerhat District and Senior Scientific Officer of Soil Resource Development Institute (SRDI) of Khulna were contacted for collecting expert's judgement. Wind speed and wind direction were considered as potential local factor for the monitoring purpose. All the selected plots were characterized as medium high land (F_1), which are normally flooded in the range of 30-90 cm and remain inundated for more than two weeks to few months during the flood period.

Soil Samples Collection

Standard procedure was maintained during the collection of soil samples. In every plot, minimum three pits were dug through augur to collect composite sample (**Figure 2.29 to 2. 32**). Each plot had three composite samples, top soil (0-15 cm), sub soil (15-30 cm) and sub stratum (30-45 cm). Soil samples were preserved in an air-tight plastic bag for laboratory analysis.

Figure 2.28: Soil sample collection from sampling plot-1 (Baranpara)

Figure 2.29: Soil sample collection form Sampling plot-2 (Chunkuri-2)

Figure 2.30: View of Monitoring plot-6 (Bidyarbon) at April, 2019

Figure 2.31: View of Monitoring plot-3 (Kapalirmet) at April, 2019

Laboratory Analysis

Collected soil samples have been handed over to the SRDI, Dhaka for laboratory analysis. The analysis data and report will be incorporated with next monitoring (21^{st} monitoring) report.

Table 2.9: Land Resources Monitoring Plan

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, Cd), Crop production and damage	Mauza: Baranpara Union: Gangarampur Upazila: Batiaghata, District: Khulna	E-89°30′59.1″	N-22°37′57.0″	Bi-yearly (April and October)	In situ field sampling and Laboratory Testing in SRDI
2		Mauza:Chunkuri-2 Union:Bajua Upazila: Dacope District :Khulna	E-89°32′20.0″	N-22°34′51.0″		
3		Mauza:Kapalirmet/ Buridmial Union: Burirdanga Upazila: Mongla District: Bagerhat	E-89°36′8.8″	N-22°32′18.9″		
4		Mauza: Chakgona Union: Rajnagar 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″		

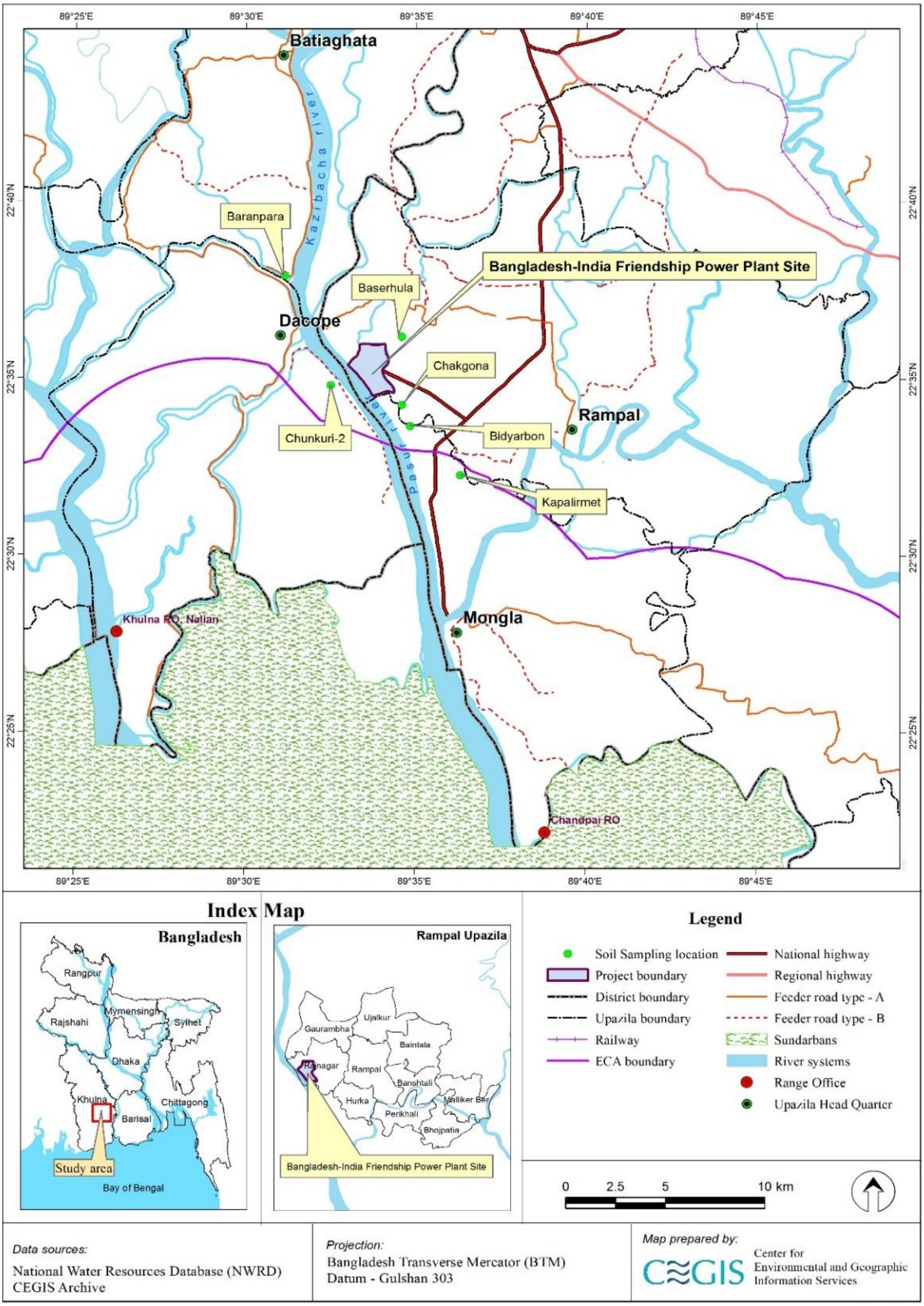


Figure 2.32: Land Resource Monitoring Locations

2.10 Agriculture Resources Monitoring

Monitoring of agriculture resources has been scheduled twice a year as per the monitoring frequency as stated in the ToR and accordingly, the survey was conducted in April, 2019. The data on Local Aman (Production, damage, input use etc.) was collected through informal interview (KII, RRA and FGD) with the local farmers from the monitoring area.

2.10.1 Methodology

2.11 Locations

The agricultural monitoring locations remain same as the soil sampling locations which is presented in **Table 2.9 and Figure 3.32.**

2.12 Monitoring Indicators

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

During 20th quarterly visit, consultations and group discussions were organized with local people to know the use of agricultural inputs, present cropping patterns by land type, crop damages and other conditions like drainage congestion/water logging, salinity intrusion or other natural calamities induced impacts, diseases and pest infestation as well as management practices and crop production in the selected locations of the monitoring area.

2.12.1 Present Cropping Patterns of Monitoring Plots

Detailed data on cropping pattern for this year were obtained through discussions with the plot owners. Based on the discussions, the plot-based cropping patterns was identified and the associated data was collected in April 2019 and described in the following sections and presented in **Figure 2.33 to Figure 2.34.**

2.13 Agriculture Plot-1 (Baranpara)

This plot is located at Baranpara mauza and the area is about 0.4 hectare. During 20th monitoring, the plot was found to be water logged and hence the excess amount of water couldn't be drained out properly from the plot. Therefore, the Local Aman (Chapshail) was cultivated in this plot in Kharif-II season. For this production of Local Aman no chemical fertilizers and pesticides were applied in this plot. The cropping practice and management practice remain same as the previous monitoring (16th monitoring). The detailed cropping pattern is shown in **Table E.2** of **Appendix IV**.

2.14 Agriculture Plot-2 (Chunkuri-2)

This monitoring plot is located at Chunkuri-2 and the size of the plot is about 0.93 hectare. Local Aman (Benapole) was found to be cultivated in this plot in Kharif-II season. No chemical fertilizers were applied in this plot. However, extensive false smut infestation is found in this plot. Due to this problem crop production might be decreased. No management practice was found to prevent the diseases. The cropping practice and management practice remain same as the previous monitoring. Detailed cropping pattern has been shown in **Table E.2** of **Appendix IV.**

2.15 Agriculture Plot-3 (Kapalirmet)

This monitoring plot is located at Kapalirmet and the size of the plot is about 0.14 hectare. During the 1st monitoring period of pre-construction phase, it was found to be cultivated, but later on, this plot became fallow from the 2nd and 3rd monitoring program due to increase in salinity. According to the opinion of the local people (**Figure2.33 and 2.34**), the saline water entered into the settlement areas including their cultivated plots and got inundated by saline water during the year 2014-15 due to the re-excavation of Ghona River and Golbunia khal by Bangladesh Water Development Board (BWDB). As a result, farmers started practicing shrimp culture instead of cultivating traditional crops in these plots. However, a number of farmers tried to cultivate crops in their plot in this adverse condition, but all crops were actually damaged due to the above-mentioned fact.

Owners of Shrimp farms of this area used the saline water in these plots for shrimp culture as there was no scope to drain out saline water from this area. The situation is still not in farmers' favour. Farmer of this land decided that they would not cultivate crops in future due to increase in salinity. Rather they would only practice the shrimp culture in future. It was observed during the recent monitoring period that, the plot still remained fallow (20th monitoring). Detailed for this plot is presented in **Table E.2 of Appendix IV**.

Figure 2.33: FGD on Agriculture aspect (Basherhula) at April, 2019

Picture 2.34: FGD on Agriculture aspect (Kapalirmet) at April, 2019

2.16 Agriculture Plot-4 (Chakgona)

This monitoring plot is located at Chakgona and the size of the plot is about 0.23 hectare. The previous monitoring plot is converted to school cum cyclone shelter instead of agricultural land. So that, monitoring plot is shifted to the opposite bank of the river where cropping practice, water logging condition and other local factors are similar to the previous one. Local Aman (Chapsail) is found in the field during field visit where no chemical fertilizer is used **Table E.2** of **Appendix IV.**

2.17 Agriculture Plot-5 (Basherhula)

This monitoring plot is located in Basherhula and the size of the plot is about 0.47 hectare. Local Aman (Chapshail) was found to be cultivated in this plot in Kharif-II season of 2018-19. Chemical fertilizer (Urea @ 50kg/plot) and granular pesticides (Basudin @1kg/plot) were reported to be used in the plot. Only Leaf folder was observed in this plot as pest infestation. The cropping practice and management practice remain same as the previous monitoring. However, detailed cropping pattern is shown in **Table E.2** of **Appendix IV.**

2.18 Agriculture Plot-6 (Bidyarbon)

This sampling plot is newly selected for monitoring as per the TOR during 18th monitoring in November 2018 and accordingly, the monitoring is continuing in this plot. The size of the plot is 0.22 hectare. Only local Aman (Chapshail) is cultivated in this area during Kharif-II season. Chemical fertilizer and pesticides are not used here. Detailed cropping pattern is shown in **Table E.2** of **Appendix IV**.

2.18.1 Crop Production in Monitoring Plots

The information on crop production were collected after harvesting in April 2019 for the 3rd monitoring of construction period (2018-19). Crop production varies from plot to plot and variety to variety due to fertility status and management practices of the plot. For this reason, the production level of the plots is not same. The highest rice production (2.14 tons/plot) was observed in monitoring agriculture plot-2 (Chunkuri-2) and the lowest (0.44 tons/plot) rice production was observed in monitoring agricultural plot-4 (Chakgona). Local Aman was cultivated in all the monitoring plots in 2018-19 except the monitoring plot of Kapalirmet. The monitoring plot (Kapalirmet) inundated by saline water in 2018-19. Farmers are practicing shrimp culture instead of traditional crops cultivation in this plot due to adverse impact of salinity. Detailed information on crop production in monitoring plots is presented in the **Table E.3 and Figure E1** of **Appendix IV.**

2.18.2 Crop Damage in Monitoring Plots

During the monitoring period the information on crop damage was collected after harvesting in April, 2019. No crop damage was noticed in any monitoring plot in 2018-19. Detailed crop damage information is presented in **Table E.4** of **Appendix IV.**

Monitoring of EMP during construction activities on land and agriculture resources

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

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

Table 2.10: Monitoring of EMSAP Implementation

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

Source: Field Survey, April 2019

2.19 Livestock Resources Monitoring

2.19.1 Methodology

Monitoring Indicators

The frequency of monitoring for livestock resources data collection was considered twice in a year. During the monitoring period, some extensive consultations/group discussions were organized with local people to know the status of feed/fodder and diseases of livestock in the adjacent areas of the project area (Baranpara of Batiaghata, Chunkuri-2 of Dacope) and study area (Digraj bazar of Mongla, Bhaga bazar of Rampal). Livestock related data was collected in April 2019 and is described in the following sections and present livestock scenario is presented in **Figure 2.35 to Figure2.38**.

Figure 2.35: Cattles rearing scenario in the study area at April, 2019

Figure 2.36: Buffalo rearing scenario in the study area at April, 2019

Figure 2.37: Goat rearing scenario in the study area at April, 2019

Figure 2.38: Duck rearing scenario in the study area at April, 2019

2.19.2 Feed/Fodder condition of Livestock Resources

According to the local people, feed and fodder condition remain similar to the previous monitoring periods (16th and 18th monitoring). During this monitoring, a claim for shortage of fodder is found in two monitoring spots (Chakgona and Basherhula) due to restriction in entering into the project area on livestock grazing. So, situation is difficult and hard for fodder collection of farmers in the vicinity. On the other hand, Forest department is using the stated land for forestation which is a mandatory issue for power plant or any other infrastructure construction from environmental point of view. To protect the new forest area, they have a right to jail unwanted cows/animals. Farmers were collecting fodder from the project area manually. For the reason livestock rearing cost have increased in the study area.

2.19.3 Diseases of Livestock Resources

Diseases of livestock/poultry remain similar to the previous monitoring periods (16th and 18th monitoring). According to Veterinary Surgeon (VS) of the Rampal upazila, the unhygienic condition of the courtyard between July to November is spreading diseases to livestock and poultry populations. However, some diseases were also found in year-round. The severity of the infestation was reported more or less alike in this concurrent circumstance as for the past situations. The mortality rate of the livestock/poultry has become negligible, due to immunization and insemination program run by Department of Livestock.

2.20 Transportation Monitoring

2.20.1 Location of Traffic Survey

The traffic survey for this quarterly monitoring was conducted in April, 2019 on two week days and one weekend at three pre-selected locations (**Figure 2.39**). The selected sites were Khudir Bottola, Gonai Bridge at Khulna Mongla Road and Gonabelai Bridge at Power Plant access road.

2.20.2 Methodology

Traffic surveys were carried out at three distinct period of time (07:00 AM to 10:00 AM; 12:00 PM to 2:00 PM; and 05:00 PM to 07:00 PM) to understand the nature of traffic flow and traffic load on selected locations during different segment of the day. Vehicles were categorized based on the available vehicle type in the study area.

2.20.3 Traffic Volume Calculation

The survey results were used to compute the traffic volume of the said road. PCU is a matrix used in Transportation Engineering and is used to assess traffic-flow rate on roadways. A PCU is essentially an impact on traffic variables (such as headway, speed, density) compared to a single car. While calculating the traffic volume in PCU, vehicle conversion factors suggested by the Roads and Highway department of Bangladesh were used as mentioned in **Table 2.11.**

Table 2.11: Factors Used for PCU Calculation

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

Source: Roads and Highway Department, Bangladesh

Results of Monitoring

The summary results of vehicular movements at three different locations are shown in **Table 2.12** below. From the calculated results it can be clearly said that, the Khulna-Mongla Highway receives the largest number of vehicles, compared to other surveyed roads.

Table 2.12: Calculated PCU in Five Locations at Three Different Time Period

Location	7:00 AM to 10:00AM	12:00 PM to 2:00PM	17:00 PM to 19:00PM
Khulna Mongla Road at Khudir Bottola	558	656	413
Khulna Mongla Road at Gonai Bridge	294	369	367
Power Plant access road at Gonabelai Bridge	265	262	281

Source: Field Survey, April, 2019

The vehicular movements observed during the surveys were mostly for the regular activities though the construction activities of Power Plant are progressing heavily. Traffic volume and traffic nature at the access road of Babubari showed similar pattern to that of the earlier monitoring tiers during the construction period. However, the traffic volume at the access road of the Power Plant has increased compared the number of traffic during preconstruction phase of the Power Plant. The detail survey findings regarding the traffic volume surveys as well as the detail calculations are attached in **Table F1, F2, and F3 of Appendix IV.**

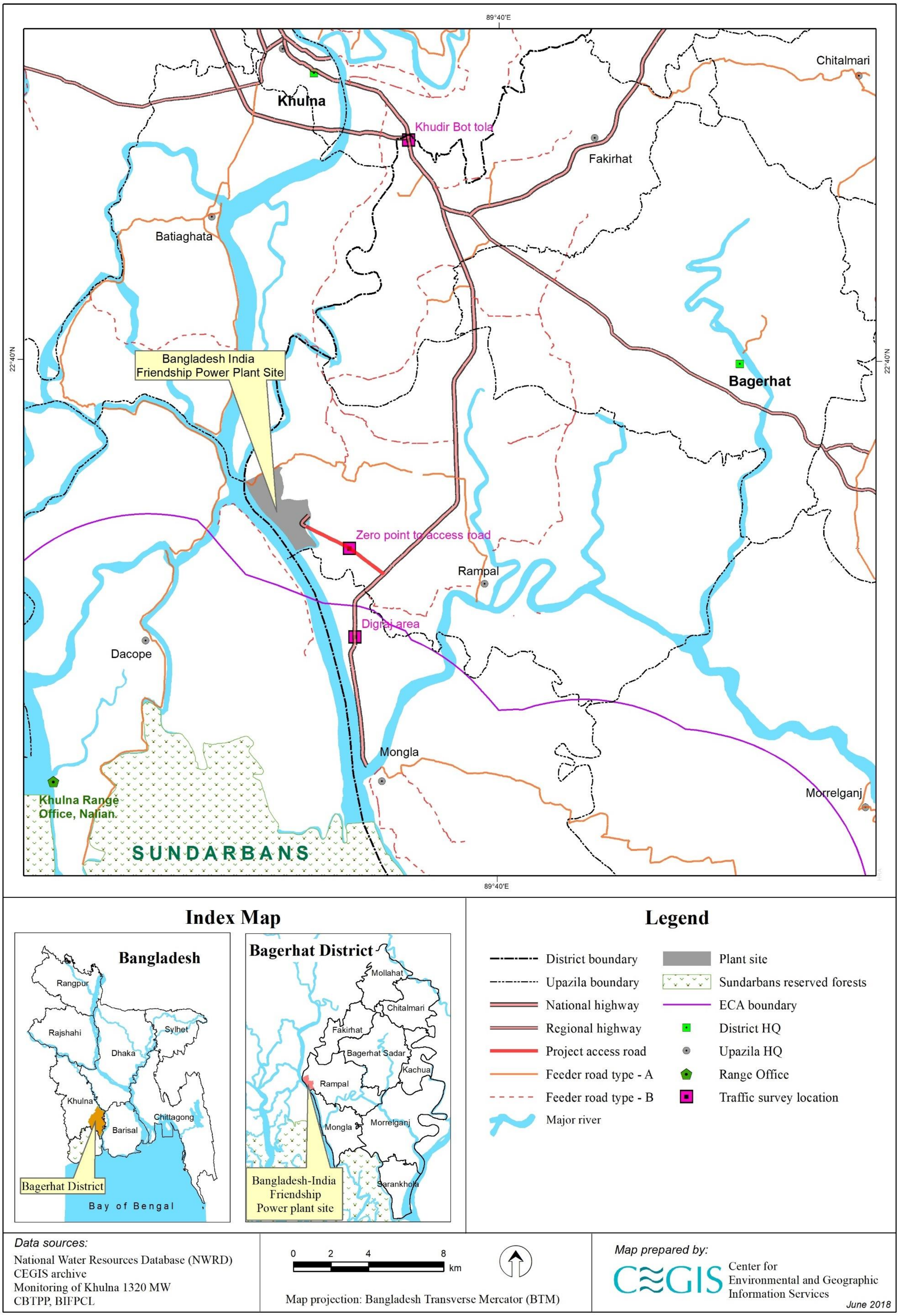


Figure 2.39: Traffic Monitoring Locations

2.21 Water resources Monitoring Plan

2.21.1 Introduction

Bangladesh is a land of rivers. Rivers in different regions have different characteristics. Rivers in the northern parts have fluvial characteristics while it is tidal in the southern parts of Bangladesh. Passur River is one of the dynamic and major rivers in the southern parts of Bangladesh. Rampal power plant is being constructed along the left bank of the Passur River (Figure 1). It is always important to monitor the morphological characteristics of the river at regular interval to assess the dynamics of the river in case of any development works. Monitoring of river dynamics like riverbank erosion & erosion and shifting of the bankline of the Passur River with a half-yearly basis may facilitate the proper management and planning of the power plant.

2.22 Monitoring of Chemical properties of bed materials

2.22.1 Methodology

Sediment quality is considered as an important environmental indicator for heavy metal pollution in any natural flowing ecosystem. The investigation of heavy metals in water and sediments can be used to assess the anthropogenic impacts and risks posed by waste discharges to the riverine ecosystems. Therefore, sediment quality assessment is being carried during environmental issues monitoring of this project.

Sampling Frequency

The frequency of monitoring for sediment quality is considered twice in a year. Accordingly, the sediment sampling was done in 19th monitoring (February, 2019) and the corresponding results has been incorporated in this 20th monitoring report.

Monitoring Indicators

The main objective of sediment quality monitoring is to find out the heavy metal accumulation in sediments due to anthropogenic activities (e.g. power plant activity and coal transportation). To find out the answers a biannual sediment quality monitoring is being done in different sampling points. The major indicators were heavy metals (As, Pb and Hg), pH and Sulphate. The selected heavy metals can mainly be found in coal and assumed to pollute the sediment during operation stage of power plant as huge amount of coal will be transhipped and transported along the Passur River.

Location

The sampling locations were selected at both the project area and inside the Sundarbans Reserve Forest area. The sampling locations are mentioned in **Table 2.13** and the Locations of collected samples are showed in **Figure 2.40**.

Table 2.13: Sediment Monitoring Plan

Site No	Monitoring Indicators	Location	GPS (Decimal Degree)		Sampling Frequency	Methods/ Tools/ Techniques
			Northing	Easting		
1	Heavy metals (Arsenic-As, Mercury-Hg, Lead-Pb); pH and Sulfate (SO_4)	Project Site	N-22°35′21.2″	E-89°32′53.4″	Bi-yearly (January and July)	In situ field sampling and Laboratory Testing at BCSIR
2		Moidara River	N-22°34′33.4″	E-89°33′38.8″		
3		Mongla Port	N-22°30′57.1″	E-89°35′0.3″		
4		Harbaria	N-22°17′44.2″	E-89°32′53.4″		
5		Akram Point	N-22°01′07.6″	E-89°30′34.4″		

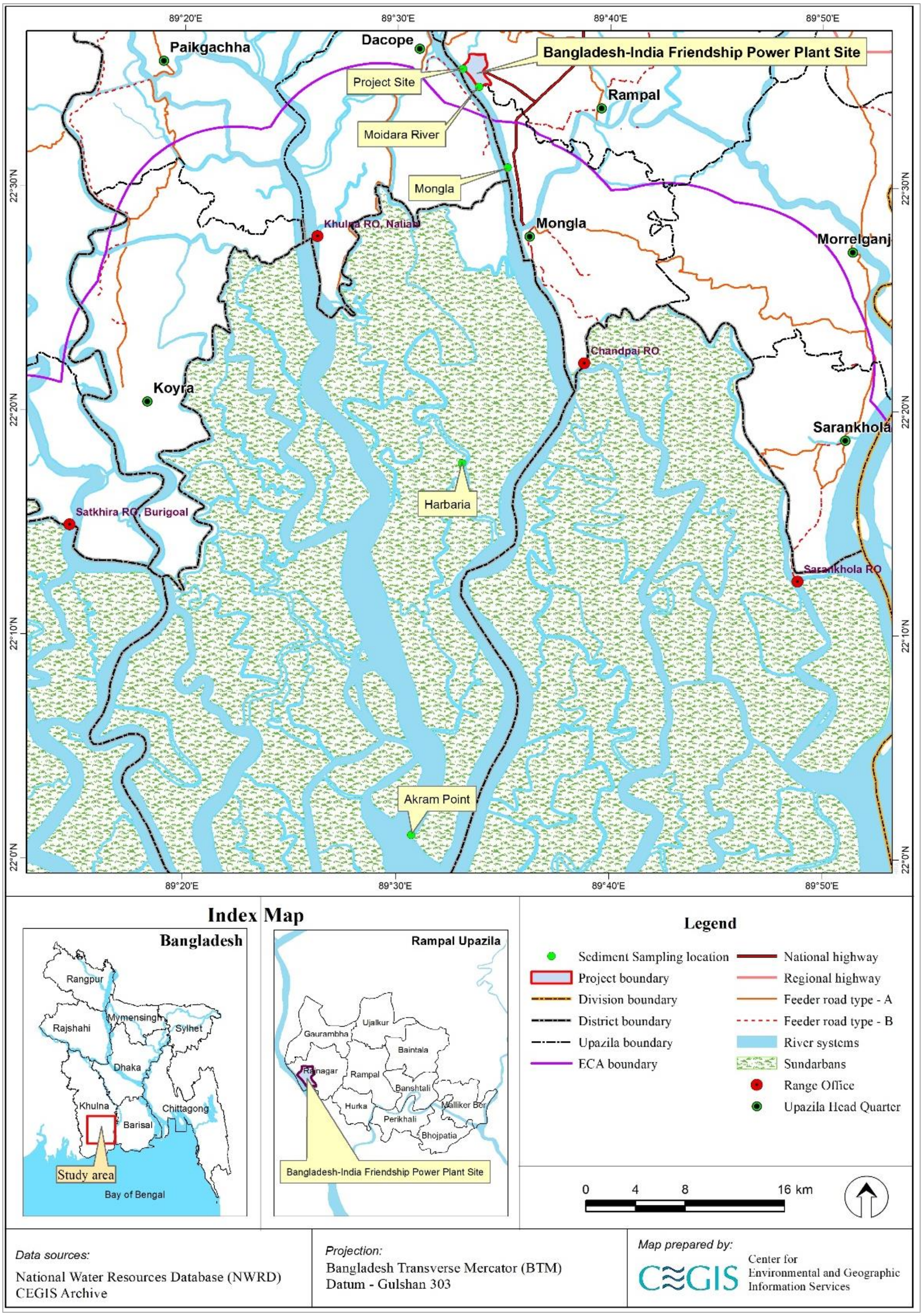


Figure 2.40: Sediment sampling locations

2.22.2 Process of Sediment Samples Collection

Plot Selection

The sampling locations were selected on the basis of potential route of coal transhipment and transportation. Project site jetty and Moidara River are around the power plant, while Harbaria and Akram point are inside the Sundarbans area where the coal transportation and coal transhipment will take place. The sampling points were selected on the basis of TOR. Expert's judgement was also taken to validate the sampling points.

Soil Samples Collection

Standard procedure was maintained during the collection of sediment samples. At least three replications were taken to ensure composite samples. Sediment samples were preserved in air-tight plastic bag for laboratory analysis.

Laboratory Analysis

Collected sediment samples were handed over to BCSIR, Dhaka for laboratory analysis immediate after conducting sediment sampling. The data is presented in **Table 2.14**.

Table 2.14: Sediment quality monitoring data at different locations of the Pasur River

Site No	Location	Monitoring Parameter									
		pH		SO4 (mg/kg)		As (mg/kg)		Pb (mg/kg)		Hg (mg/kg)	
		Wet season, 2018	Dry Season, 2019	Wet season, 2018	Dry Season, 2019	Wet season, 2018	Dry Season, 2019	Wet season, 2018	Dry Season, 2019	Wet season, 2018	Dry Season, 2019
1	Project Site	8.61	8.8	184	489	5.37	7.51	6.03	8.71	1.38	2.04
2	Moidara River	8.18	8.6	297	464	3.65	4.16	6.59	6.52	1.5	3.1
3	Mongla Port	8.22	9.25	103	264	2.53	4.6	6.05	5.19	1.36	1.77
4	Harbaria	9.06	7.9	329	490	4.04	4.1	8.67	5.02	2.08	1.24
5	Akram Point	8.66	8.6	277	708	6.18	4.69	8.13	5.67	1.81	1.37

2.22.3 Status of sediment quality of the Pasur River

Incorporation of sediment quality analysis starts from 18th monitoring which is considered as wet season sediment quality whereas this monitoring data is representing dry season sediment quality. These data (both wet season and dry season) will be used as baseline data for monitoring further sediment quality data analysis.

According to the analyzed data, only Mercury (Hg) exceed average shale value *(Marowsky and Wedepohl, 1971)* and average upper crust value *(Rudnick and Gao, 2014*). Other two trace element (As and Pb) value found within the stated limits. During this monitoring seasonal variation is observed. Elements showed decreasing pattern in near sea sampling points (Harbaria and Akram point) while showed increasing pattern far from open sea and near to the project area. None of these metals showed any specific trend, whether it increased or decreased, following upstream or downstream. In general, the maximum concentration of As and Pb is observed at Project side (Jetty) while Hg showed its maximum at Moidara river. The average concentration of As, Pb and Hg in 20th monitoring is 5 ppm, 6.2 ppm and 1.9 ppm respectively. Pb and Hg concentration in sediment exceed the average value of this monitoring at project site and Moidara River, while As crossed this value only in project site.

Table 2.15: Reference level of different metals in sediment of the Pasur River

Sl No.	Name of Heavy metal	Average upper crust concentration (ppm)	Average Shale Value (ppm)	Average heavy metal content in the Pasur River in ppm (Ali *et al.,* 2018)	
				Summer	Winter
01.	Arsenic (As)	4.8	14	8.87	12.4
02.	Lead (Pb)	17	20	21.9	33.6
03.	Mercury (Hg)	0.05	0.26	-	-

3. Biological Environment

Biological resources include all living organisms within an ecosystem which interact with one another as well as with the concerned physical environment. The biological resources around the study area were categorized into three major groups and monitored quarterly. These groups include fisheries resources, ecological resources and Sundarbans Reserve Forest (SRF).

3.1 Fisheries Resources

Findings of the previously conducted monitoring for nineteen quarters for the session of 2014-15, 2015-16, 2016-17, 2017-18 as well as of 2018-2019 were reported earlier. This chapter contains the findings of 20^{th} quarter comparing with the earlier nineteen (19) quarters.

Location of Monitoring Sites

In this phase, the monitoring activities were carried out in 13 pre-selected locations of which 10 locations were for capture fish habitat and three (03) were for shrimp/fish farms (culture fish habitat). Sampling sites for capture fishery were selected based on the available fishing grounds at upstream, midstream and downstream of the Passur River system. Sampling sites for culture fishery (shrimp/fish farms) were selected considering the project influence area. The fisheries resources monitoring locations are provided in **Table 3.1** and also shown in **Figure 3.1**

Table 3.1: The sampling locations for monitoring of fisheries resources

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

Selection of Parameters

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

In addition, fish migration status was monitored through assessing the migratory fish species diversity, migration pattern, migration purpose, period and extent of migration etc. moreover, Species evenness, species richness and community structure were investigated for monitoring fish diversity. Furthermore, Shrimp/fish farm practice was monitored by viewing stocking pattern, growth rate and mortality rate. Fish production monitoring has been divided into capture and shrimp/fish farm production.

3.1.1 Methodology

Fish Habitat Status

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

Fish Migration

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

Fish Diversity

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

Fish-Shrimp Culture Practice

Three farms within the direct impact zone of the proposed Power Plant were surveyed for monitoring shrimp/fish farm. Stocking pattern of the shrimp/fish farm is the major issue for successful production as 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. Hence, stocking pattern, mortality rate and its causes were surveyed intensively.

Fish Production

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

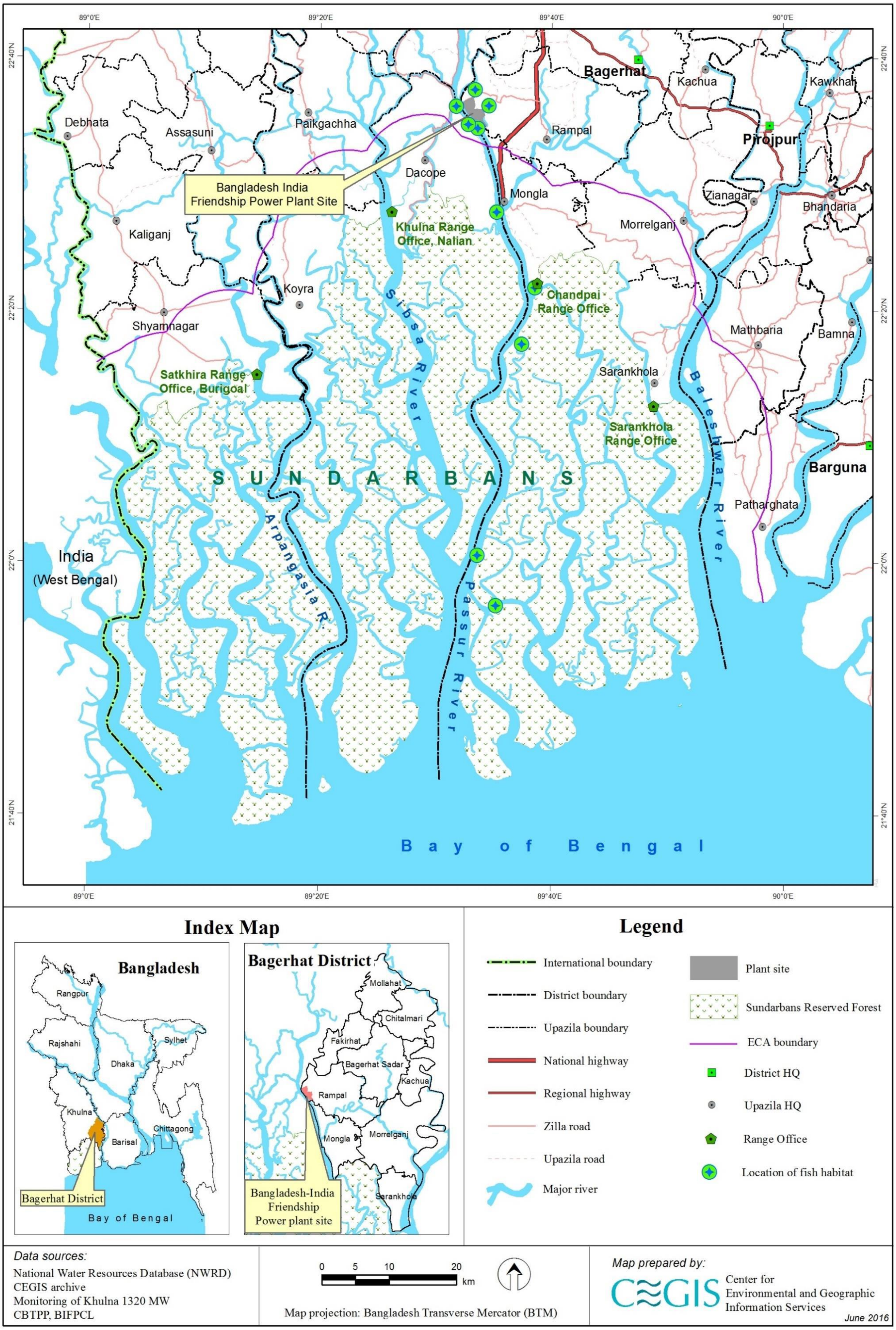


Figure 3.1: Fisheries Resources Monitoring Locations

3.1.2 Status of monitoring

Followed by the quarter monitoring of the 2014-15, 2015-16, 2016-17, 2017-18 and 2018-19 (up to 19th quarter monitoring), 20th quarter monitoring of session 2019-20 was conducted during the period from 23 April to 02 May, 2019. No fishing activities were observed in Haldikhali Khal (B), Bhodra Khal (D) and Mongla Point (G) during field.

Fish Habitat Status

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

Habitat Classification

Habitat classification was analyzed by using the length-wise distribution of different fish species in the sampling sites. The length of different life stages of fish species were identified and evaluated from literature review. Linkage distance was calculated with the similarity in distribution. The entire stretch of the Passur River System consists of three major behavioral habitats. The sampling sites were classified on the basis of abundance of different life stages of fish species in those habitats. The following tables show the classification of seven (07) for 1 to 15th quarter monitoring and ten (10) sampling sites from 16th to 19th quarter monitoring according to the ToR in respect of habitat uses for previous quarters of fisheries monitoring (**Table 3.2 and Figure-D1 of Appendix-IV**).

Table 3.2: Classification of habitat use of 10 sampling sites

Monitoring Quarter	Type of Habitat Use
1st quarter (April, 2014)	• Grazing Ground • Grazing and Breeding Ground
2nd quarter (July, 2014)	• Grazing Ground • Spawning and Nursery Ground
3rd quarter (October, 2014)	• Grazing Ground • Grazing and Breeding Ground • Spawning, Nursery and Grazing Ground
4th quarter (January, 2015)	• Grazing Ground • Grazing and Breeding Ground • Spawning, Nursery and Grazing Ground
5th quarter (April, 2015)	• Grazing Ground • Nursery Ground • Spawning and Nursery
6th quarter (August, 2015)	• Grazing, Breeding Ground • Spawning, and Nursery Ground
7th quarter (October, 2015)	• Grazing Ground, • Nursery Ground and • Growing and Feeding
8th quarter (January, 2016)	• Nursery and Feeding Ground • Growing and Feeding
9th quarter (April, 2016)	• Spawning and Nursery Ground • Feeding and Growing Ground
10th quarter (July, 2016)	• Nursery Ground • Feeding and Breeding Ground

Monitoring Quarter	Type of Habitat Use
11th quarter (October, 2016)	• Breeding and Spawning Ground • Feeding and Grazing Ground
12th quarter (January, 2017)	• Grazing and Spawning Ground • Nursing Ground
13th quarter (April, 2017)	• Grazing and Feeding Ground • Nursing Ground
14th quarter (October, 2017)	• Grazing and Feeding Ground • Nursing Ground
15th quarter (January, 2018)	• Grazing and Feeding Ground • Nursing Ground
16th quarter (April, 2018)	• Feeding ground • Growing ground • Nursing ground
17th quarter (July, 2018)	• Spawning and Nursery Ground • Nursery Ground with Feeding and Growing Capacity • Growing and Feeding Ground • Omni-ground
18th quarter (November, 2018)	• Ground for Maturation • Omni-Ground: Nursery and Feeding Ground/Migratory Route; Ground for Maturation; Growing and Maturation Ground; Maturation Ground for Juveniles
19th quarter (February, 2019)	• Ground for Feeding • Omni-Ground including Nursery Ground and Ground for Maturation

During the 20th quarterly monitoring done in April of 2019-20 fiscal year, the sampling sites were divided into two major classes and shown in the **Figure-3.2** along with the previous ones.

1. Ground for Feeding and Maturation: The Akram Point was found to support mostly one length group (10-20cm). It indicates that the mentioned sampling sites were found to be used as the ground for feeding and maturation of observed fish species. (Ref.: Fish Community Structure).

2. Omni-Ground: Another classes, found to support multi-length groups (<2cm, 2-3cm, 3-5cm, 5-10cm, 10-20cm and >25cm length groups) of observed fish species (Ref.: Fish Community Structure), was considered as the omni-ground for fishes. This class was also divided into two major functional habitats - i) Nursery Ground and ii) Ground for Maturation.

(a) Nursery Ground

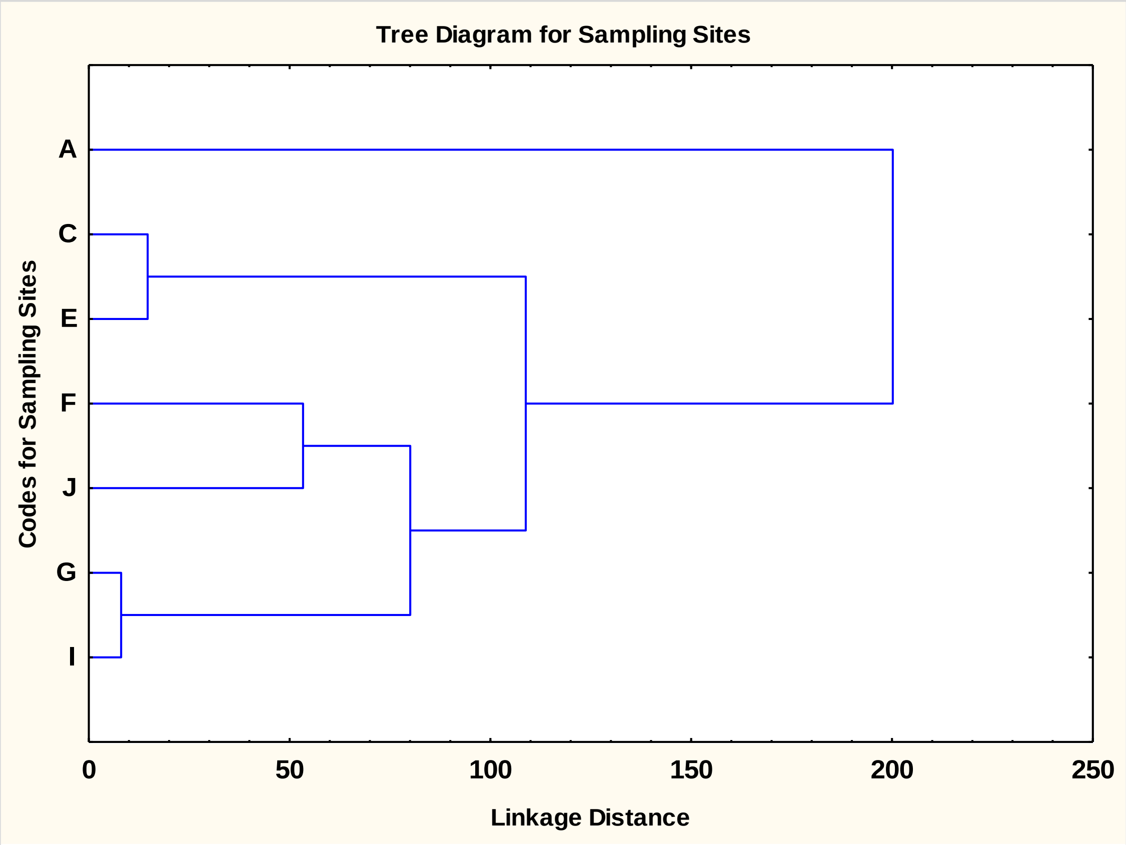
The catch revealed that availability of fry stage (Length group: <2cm as defined in the methodology) of different fish species were dominant than other stages of fishes in all the observed khals except in the Akram Point. It indicates that these habitats functions as nursery ground for various fish species. These habitats can further be divided into two other micro habitats as follows:

Ground for Nursery: The Passur-Jongra Confluence (G) and the Passur-Maidara confluence (I) were observed to have a potentiality for availability of fries of different fish species with a little proportion of Juvenile group.

Ground for Nursery, Maturation and Feeding: The Sheola Khal and the Passur-Sheola confluence (F) and Chalna Point (J) were observed to support fries mostly and fingerlings, juveniles, young and adult fishes to some extent.

(b) Ground for Maturation and Feeding

The sampling sites, Charaputia (C) and Harbaria Khal (C) were found to be rich in juveniles with moderately rich in adult fishes. As the <2cm, 3-5cm and 5-10cm length groups are known to as the maturation stage, of different fish species (Rahman, 1989 and 2005; Huda et al., 2003), these sites were, thus, considered as the ground for maturation in respect of the observed fish species.

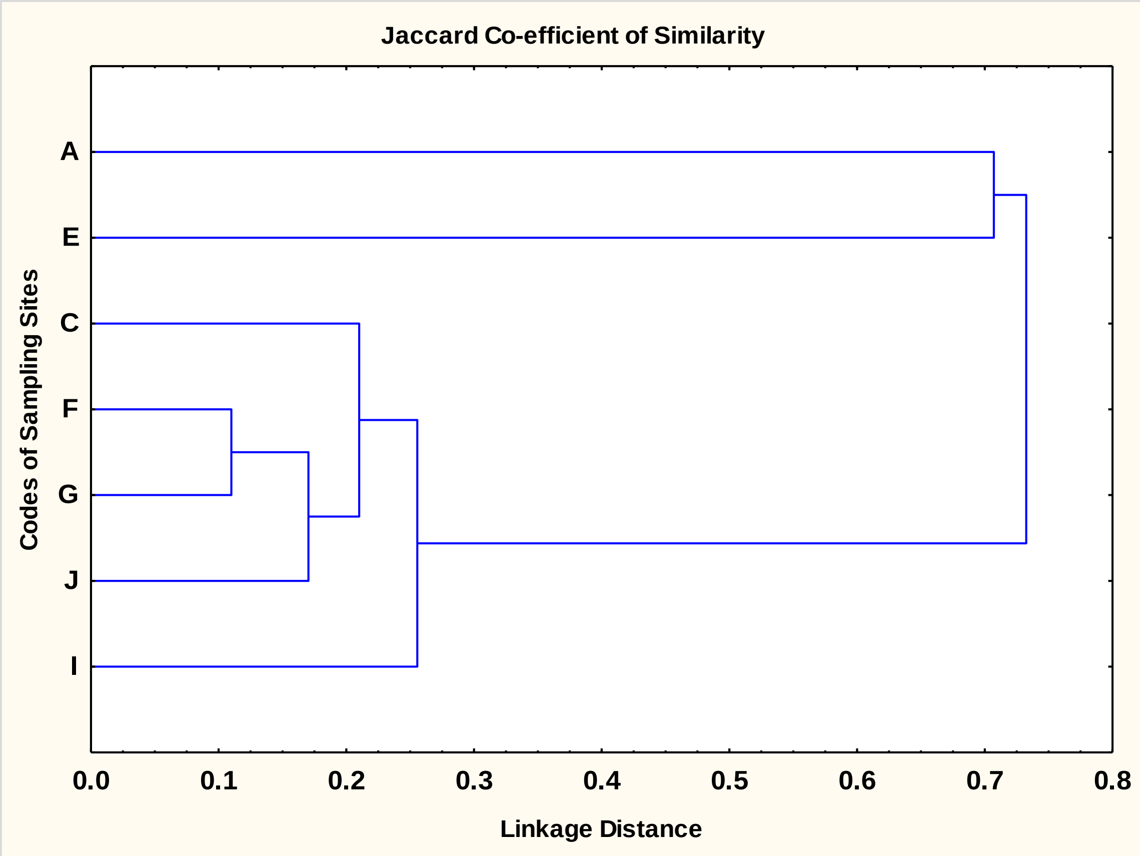


20th Monitoring, April, 2019

(Note: Life stages are identified through length measurement of the fish individuals)

Figure 3.2: Habitat Classification on the basis of different life stages of fish species

The dendogram indicated the distances among the JI (Jaccard Coefficient Index) indices which are opposite to the JI values. It was found that the length-wise distribution relationship varied not only with the seasons but also with the year to year. In this quarterly monitoring in 2019-20 (20th), the JI value between the Sheola Khal at Chandpai (F) and Passur-Jongra Confluence (G) sampling sites were the highest (**Figure 3.3**) which indicates the maximum similarity in species occurrence between these two sites out of 7 sampling sites of available fishing (**Figure D2 of Appendix IV).**



20th Monitoring, April, 2019

Figure 3.3: Dendogram showing similarity in binary species composition in seven sampling sites

Habitat Suitability Index (HSI)

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

In the first year of monitoring, Sheola khal at Chandpai was found as the most suitable habitat for fish species among the Passur River System. Sheola khal has also been identified as the most suitable in second year which is followed by Harbaria, Akram Point, Haldikhali, Mongla Point, Maidara and Chalna Point (**Table 3.3).** In third year (2016-17) of monitoring, Harbaria Khal was found to be mostly suitable habitat for fish. In 2017-18, the Sheola Khal at Chandpai was highly suitable habitat, which was observed to support various length groups of diversified fishes. In the last monitoring year (2018-19), the Sheola Khal at Chandpai attained again highest suitability index, which indicates that this habitat has the potentiality to support various length groups of diversified fishes.

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

Sampling Sites	Location	HSI* (2014-2015)	HIS (2015-2016)	HIS (2016-2017)	HIS (2017-2018)	HIS (2018-2019)
A	Akram Point	0.33	0.56	0.45	0.4	0.35
B	Haldikhali	0.41	0.54	0.51	0.45	0.22
C	Charaputia	-	-	-	0.25	0.31
D	Bhodra	-	-	-	-	-
E	Harbaria	0.23	0.64	0.85	0.6	0.46
F	Chandpai	0.52	0.72	0.81	0.85	0.87
G	Jongra	-	-	-	-	0.18
H	Mongla Point	0.32	0.43	0.45	0.55	0.53
I	Maidara	0.22	0.25	0.35	0.6	0.68
J	Chalna Point	0.22	0.32	0.33	0.42	0.64

**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

<u>*Shannon-Weiner Index*</u>

In this monitoring year of 2019-20, species evenness also varies among the sampling sites. Highest Shannon-Weiner index was found in Harbaria Khal (0.99) indicating most evenly distributed fish species. On the contrary, lowest evenness was found at the Passur-Maidara Confluence (0.14) (shown in the **Table 3.4 and 3.5**). It has also been found that both the number of fish species found in in-situ catch and the evenness of their distribution within the sampling sites show high variation with the changing seasonal and yearly bio-physical conditions. The different fish species caught in different catches are shown in **Figure 3.4 and Figure D3 of Appendix IV**.

Fish Species Richness (FSR)

Fish species richness was identified through Simpson's Index[1]. Considerable difference is noticed in the fish species richness (FSR) in different habitat classes (**Table 3.6 and 3.7** and **Figure-3.5**).

In this monitoring phase, species richness varies with the sampling sites. Maximum FSR was obtained in the Charaputia Khal and Sheola Khal (n= 11 and 22 respectively), while very low FSR was recorded at the Maidara River and its confluence (n=8). 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, Chalna

Point was home to a rich assemblage of Vati Chingri and Golda; Maidara River was of Chaka Chingri. Among habitats in midstream portions, Jongra was rich in Golda, Chamua Chingri and Chaka Chingri, Chandpai was of Tiger Chingri, Sada Bele, Chamua Chingri, Horina Chingri, Chaka Chingri, Potka and Menu. Among the habitats in downstream portions, Harbaria was

[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.

rich in Gagra and Golda, Charaputia was in Bairagi, Tairel, Kain Magur, Pangas, Poma, Jaba and Phessa and Akram Point was of Gagra and Tular Dandi. No catch was observed in Haldikhali, Bhodra, and Mongla sampling sites in the monitoring of this quarter.

Table 3.4: Site Wise Species Diversity using Shannon–Weiner Index(1st to 13th QM)

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

Table 3.5: Site Wise Species Diversity using Shannon–Weiner Index (14th to 20th QM)

Site		Species Number							Shannon-Weiner Index					
	14th QM	15th QM	16th QM	17th QM	18th QM	19th QM	20th QM	14th QM	15th QM	16th QM	17th QM	18th QM	19th QM	20th QM
A	0	0	3	0	8	0	2	0	0	0.92	0	0.16	0	0.65
B	0	0	0	0	2	0	-	0	0	0	0	0.92	0	-
C	0	0	12	0	0	24	11	0	0	0.69	0	0	1.69	0.86
D	0	0	0	0	0	0	-	0	0	0	0	0	0	-
E	0	0	0	17	12	0	2	0	0	0	0.31	0.73	0	0.99
F	6	17	0	0	0	13	22	0.85	0.81	0	0	0	1.44	0.74
G	81	29	21	16	19	0	26	0.62	0.74	0.78	0.85	0.34	0	0.58
H	112	13	3	18	2	13	-	0.54	0.21	0.55	0.49	0	1.44	-
I	3	13	12	10	17	11	8	0.88	0.33	0.21	0.65	0.85	1.46	0.14
J	4	5	10	14	11	21	12	0.78	0.32	0.54	0.52	0.52	0.98	0.50

**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 3.6: Site wise Rich Species Number (1st to 12th QM)

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

Table 3.7: Site wise Rich Species Number (13th to 20th QM)

Site	Location	No. of Rich Species							
		2017-18			2018-19				2019-20
		13th	14th	15th	16th	17th	18th	19th	20th
A	Akram Point	2	0	0	4	0	1	0	2
B	Haldikhali	1	0	0	0	0	3	0	-
C	Charaputia	0	0	0	4	0	0	4	7
D	Bhodra	0	0	0	0	0	0	0	-
E	Harbaria	7	6	6	0	2	4	0	2
F	Chandpai	6	5	7	11	9	2	3	7
G	Jongra	0	0	0	0	0	0	0	3
H	Mongla Point	2	2	1	2	3	0	3	-
I	Maidara	1	3	2	1	3	9	3	1
J	Chalna Point	4	2	1	2	3	2	2	2

Source: CEGIS Field Survey, April 2014-April 2019

Gagra Tengra

Daitna

Chitra

Jaba

Pangas

Kain Magur

Bairagi Chela

Poma

Tairel

Pheksa

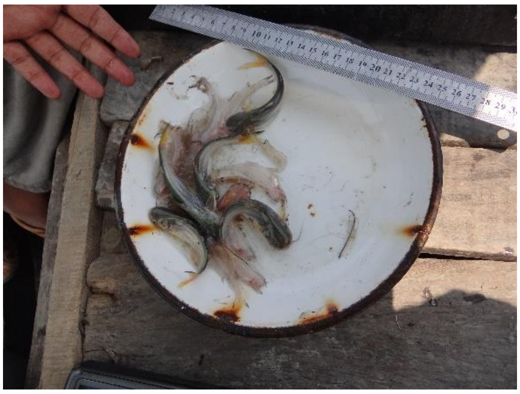
Chokkhu Dhela

Golda

Gulsha Tengra

Tigar Chingri

Juvenile of Loitta and Kuchia



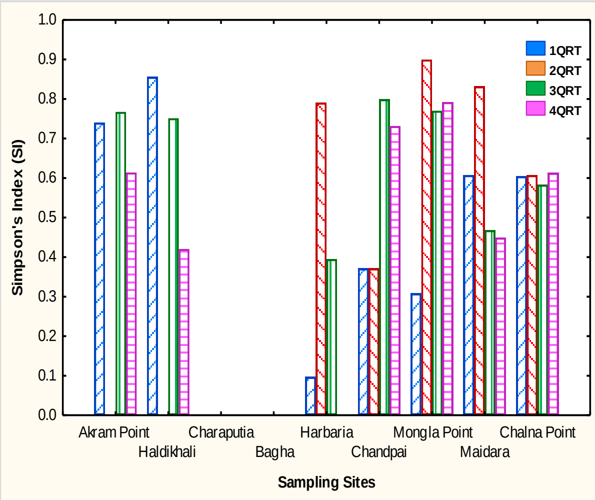
Juvenile Pangas

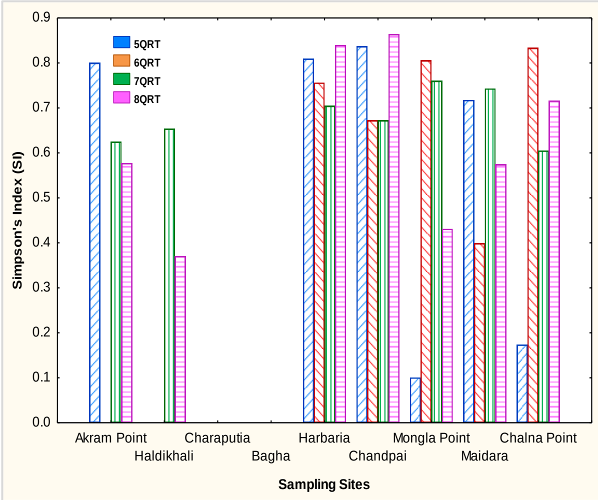
Figure 3.4: Different available observed fish species in 20th quarter monitoring

Source: CEGIS Field Survey, April 2019

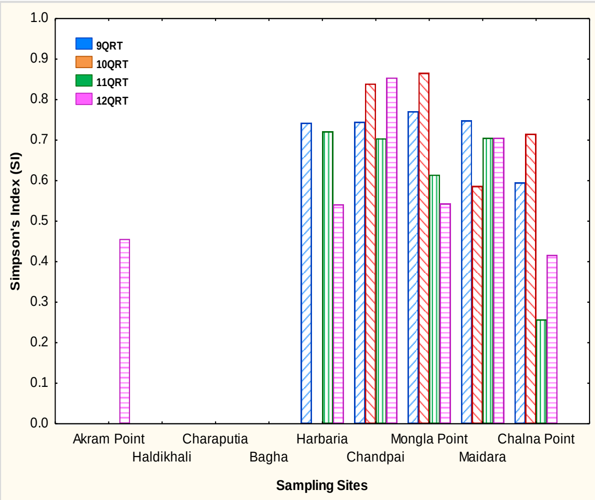
(FSR is identified though Simpson's Index)

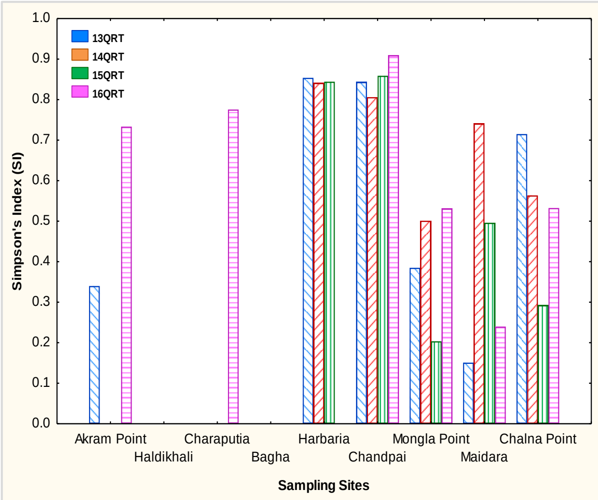
Fish Community Structure



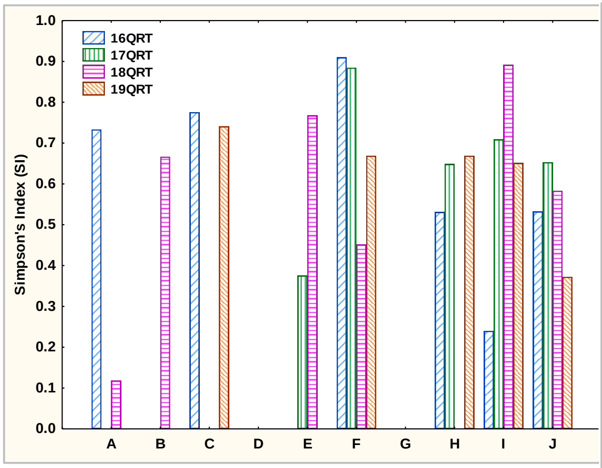


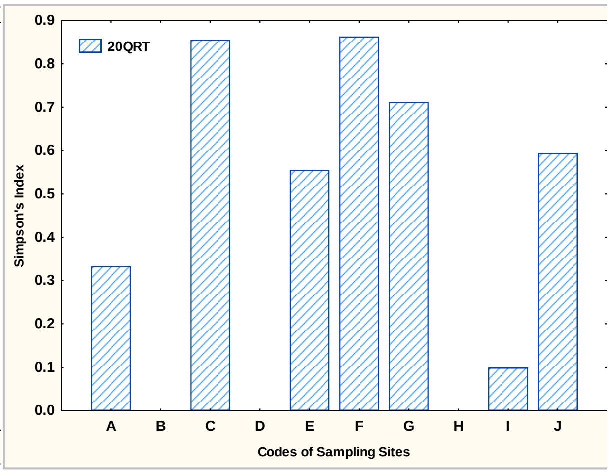
2014-2015 **2015-2016**





2016-2017 **2017-18**

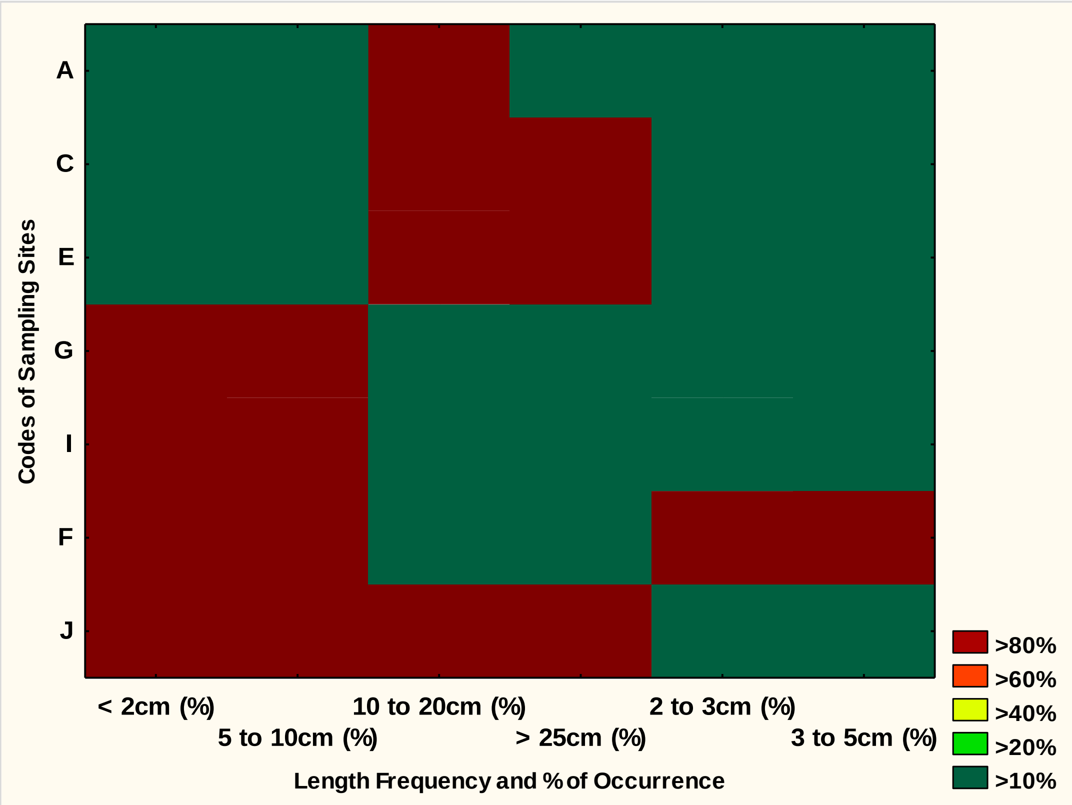




2019-20

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

Fish community structure was analyzed through counting the length-wise fish individuals (**Figure 3.6**). The Table **D.1, D.2 and D3** of **Appendix IV** and **Figure 3.5 and Figure D4 of Appendix IV** for 20th quarter of monitoring year of 2019-20 show that fries of fin fish were widely distributed from middle stretches to the upper stretches (Chandpai to Chalna Point) and juvenile age group in Akram Point, Charaputia Khal and Harbaria Khal of the Passur River system. The catch revealed that among the fishes Bairagi, Golda Chingri and Bagda were dominant in the seven sampling sites. On the contrary, fries were dominant at the Chalna, Maidara, Jongra and Passur-Sheola Confluence. Adults of large-sized fishes were observed at Akram Point, Charaputia Khal and Harbaria Khal.



20th Monitoring, April, 2019

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

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

Fish Migration

<u>Migratory Species Diversity</u>

Migratory species were identified by analyzing the common species available in the regular catch from the sampling sites. Fish species like Sada Bele attain the maximum abundance among the migratory fish species observed in the 20th quarter of monitoring year, 2019-20. The relative abundance of the migratory species is given below in the **Figure 3.7**.

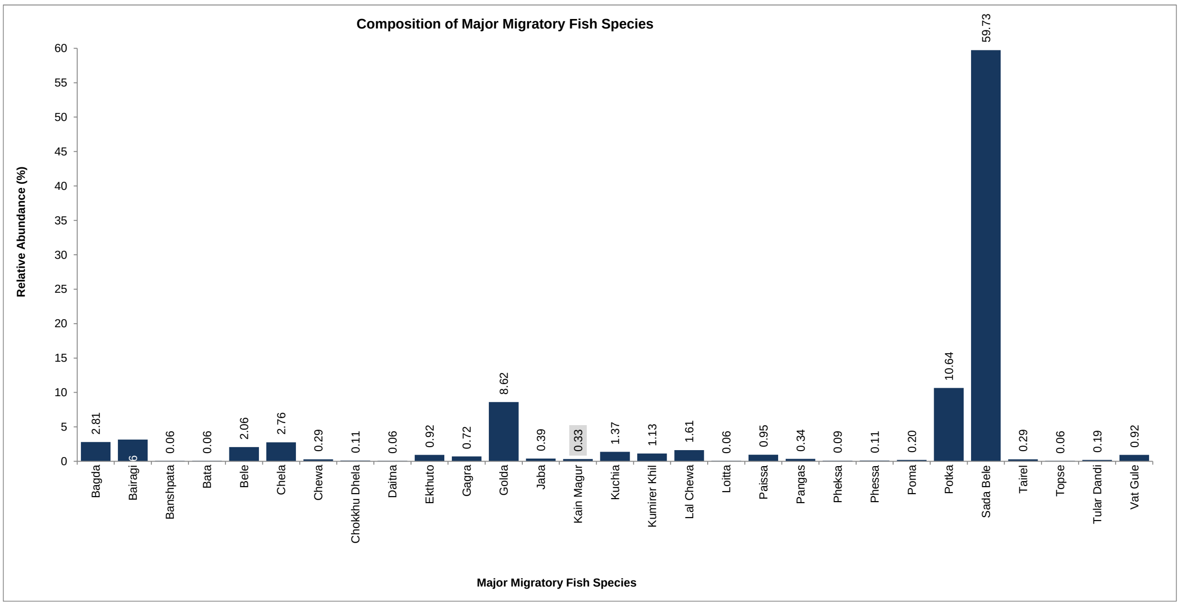


Figure 3.7: Relative abundance of major migratory fish species in sampling sites

Migration Extent, Time and Purpose

Major fish species showed interesting pattern in distribution for exploiting different purposes mentioned in the following table all along the sampling sites. Among migratory species, Tular Dandi, Poma and Bairagi were observed to migrate long distance (**Figure 3.8 and Table D.4 of Appendix IV**).

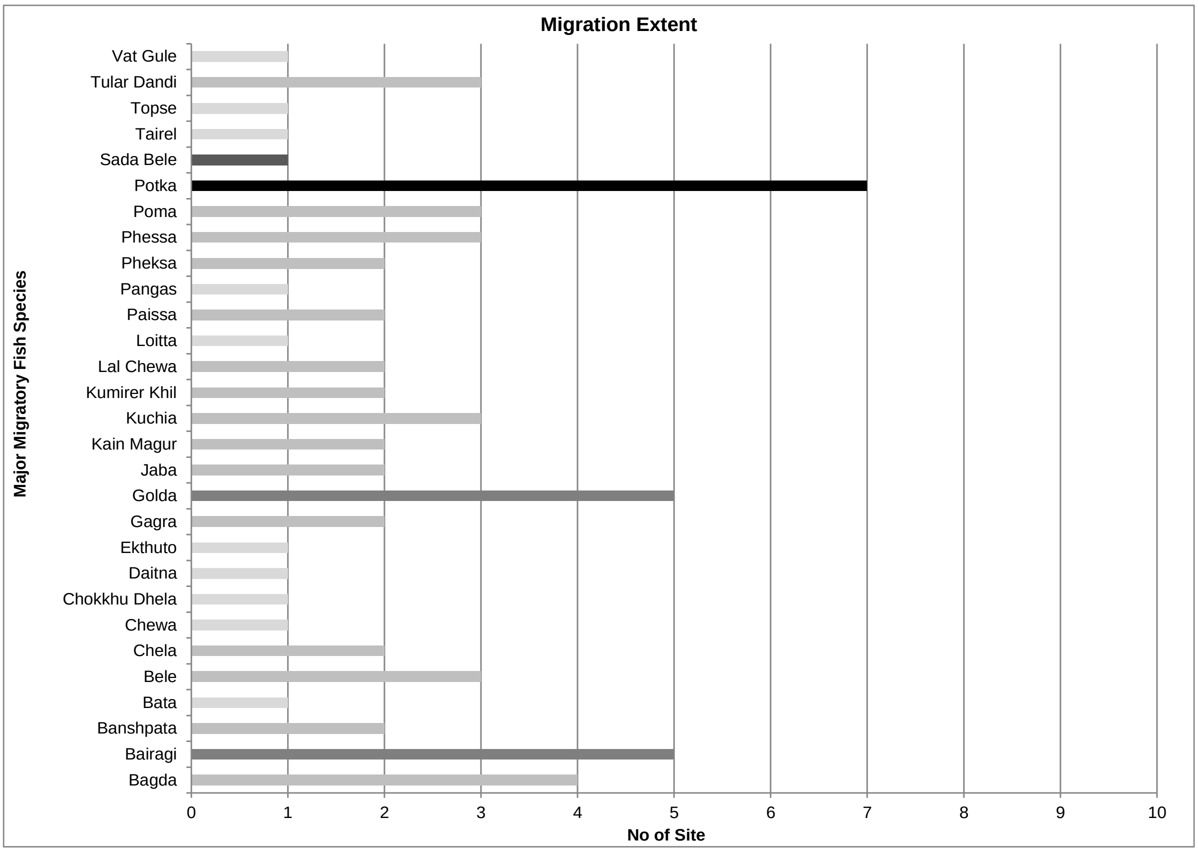


Figure 3.8: Habitat Distribution of Different Life Stages of Fish Species

Shrimp/Fish Farm

Three farms situated in the direct impact zone of Power Plant were surveyed for monitoring shrimp/fish. 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

It is reported by the farmers of the shrimp farms that availability of wild seed (PL) was found to be increased during this monitoring. For this reason, most of the farmers collected wild seeds for their farms. However, a number of stocks are still collected from hatcheries in this monitoring phase. In this monitoring year, the highest stocking rate in respect of Bagda was observed in case of gher in Kapashdanga, Chunkuri-2 and Rajnagar (**Table 3.8**).

Table 3.8: Stocking Pattern of Fish/Shrimp farm

Location	Fish Species	Stocking Density (No/ha)	Stocking Date
Rajnagar *(42.09 ha)*	Bagda	2,376	February
Kapashdanga-Muralia *(115.7ha)*	Bagda	10,350	
	Paissa	942	
	Crab	178	
	Tilapia	3,889	
	Golda	432	
Chunkuri-2 *(6.07ha)*	Bagda	6,260	
	Paissa	2,471	
	Khorsula	613	
	Horina Chingri	25,000	

Source: CEGIS Field Survey, 2019

Shrimp/Fish Growth Rate and Mortality

During the 20th quarter of monitoring, the highest growth rate has been observed in the Kapasdanga Gher and the highest mortality as well due to viral infection (**Table 3.9 and Table 3.10**

Table 3.9: Growth Rate and Mortality of Fish/Shrimp (1st to 13th QM)

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		13th QM	
	Growth Rate (cm/day)	Mortality (%)	Growth Rate (cm/day)	Mortality (%)	Growth Rate (cm/day)	Mortality (%)	Growth Rate (cm/day)	Mortality (%)	Growth Rate (cm/day)	Mortality (%)	Growth Rate (cm/day)	Mortality (%)	Growth Rate (cm/day)	Mortality (%)	Growth Rate (cm/day)	Mortality (%)	Growth Rate (cm/day)	Mortality (%)	Growth Rate (cm/day)	Mortality (%)	Growth Rate (cm/day)	Mortality (%)	Growth Rate (cm/day)	Mortality (%)	Growth Rate (cm/day)	Mortality (%)
1	0.3	15-20	0.2	40	0.25	50	-	-	-	30	0.18	25	0.20	60	-	-	-	-	0.2	20	0.20	60	-	-	-	30
2	0.3	30-35	0.3	94	0.25	10	-	-	-	-	0.14	20	0.15	100	-	-	0.21	15	0.3	40	0.25	50	-	-	-	10
3	0.2	25-30	0.2	25	0.20	65	-	-	-	10	0.15	50	0.25	20	-	-	0.17	30	0.15	30	0.20	30	-	-	-	25

Table 3.10: Growth Rate and Mortality of Fish/Shrimp (14th to 20th QM)

Gher No.	14th QM		15th QM		16th QM		17th QM		18th QM		19th QM		20th 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 (%)
1	0.03	50	-	-	0.28	0.28	0.38	80	-	-	-	-	0.35	50
2	0.38	35	-	-	0.42	0.42	0.30	70	0.30	80	-	-	0.45	80
3	0.02	25	-	-	0.4	0.4	0.20	50	-	-	-	-	0.34	40

Source: CEGIS Field Survey, 2014, 2015, 2016, 2017 & 2018

Fish Production

Capture Fish Production

In 20th quarter monitoring, the highest productivity was found in Charaputia Khal and the lowest productivity at the Sheola Khal at Chandpai, Passur-Jongra Confluence, Passur-Maidara Confluence and Chalna Point **(Table 3.11**). These sampling sites were observed mainly to be used for fry collection and fries found in catch were not considered in the productivity assessment. Fishing is shown in **Figure 3.9**.

The present study revealed that the highest catch susceptibility was also found in case of Aton Jal (5.5 kg/haul) (**Table 3.12**The following table also expresses that Ber Jal was most frequently used in upper and middle reaches in the Passur River System. Hooks were also frequently used in the downstream of the Passur River System.

Table 3.11: Total Catch in Different Gears in the Sampling Sites

Site	Habitat	Gear Name/Type	Haul Duration (hr)	No of Haul	kg/haul
A	Confluence at Akram Point	Hook (Borshi)	2	30	0.013
B	Haldikhali Khal	Not Found	0	0	0.00
C	Charaputia Khal	Aton Jal	9.5	2.5	5.50
		Lining Hook (Borshi)	10	12	2.08
D	Bhodra Confluence	Not Found	0	0	0.00
E	Harbaria Khal	Hook (Borshi)	4	50	0.01
F	Sheola Khal	Net Jal	3.67	3.67	0.00
G	Passur-Jongra Confluence	Net Jal	1.43	1.75	0.00
H	Passur-Mongla Confluence	Not Found	0	0	0.00
I	Passur-Maidara Confluence	Net Jal	2.5	3	0.00
J	Passur River, Chalna Point	Ber Jal	2.58	2.5	0.10
		Net Jal	2	3	0.00

Source: Catch assessment survey, CEGIS, February 2019

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

Table 3.12: 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

Sampling Site	Total Catch (kg)							
	13th QM	14th QM	15th QM	16th QM	17th QM	18th QM	19th QM	20th QM
A	2	0	0	17	0	16	0	0.40
B	0.25	0	0	0	0	1	0	0.00
C	0	0	0	1.50	0	0	93	17.50
D	0	0	0	0	0	0	0	0.00
E	8.13	1.5	2.56	0	0.1	2	0	0.50
F	0	0	0	0	0	0	0	0.00
G	77.5	10.5	37.67	3	4	27	0	0.00
H	0	0	0	0.33	22	0	5	0.00
I	0.3	0.4	0.67	0.13	3	5	1.2	0.00
J	0.12	0.3	0	1	0.25	1.2	0.6	0.17

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

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

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

(a) Culture Fish Production

The present study on shrimp/fish farm in the 20th quarter monitoring phase showed that the highest production was observed in the Gher in Rajnagar **(Table D5, Annex-IV)**.

3.2 Monitoring of Ecosystem and Bio-diversity

3.2.1 Indicators Selection

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

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

Canopy status of terrestrial vegetation indicates plant health and biomass properties of an area. Vegetation canopy structure may be change for change of plant growth rate due to soil properties change, plant physiological disorders due to change of climatic parameters or even for different human interventions. To monitor vegetation canopy status of the study area, canopy cover has been followed in different time intervals.

Among the terrestrial faunal community, Bird is an important class that is sensitive to their habitat condition. Changes of environmental parameters, land use and vegetation composition directly impact on bird's habitat of a locality. Broadly, two types of bird are found in an area; local and migratory. To observe local bird habitat suitability, number of bird nest and nesting bird species can be a good indicator. Numbers of wetlands where migratory birds come in each migration season have also been considered to observing migratory bird habitat suitability of the area.

In the respects of aquatic ecosystems, dolphin is an ecological indicator which indicates water quality as well as aquatic habitat suitability. This aquatic mammal is still present all the river systems of the study area. Any changes of water quality and river bed siltation may change dolphin occurrence in a river system. So, dolphin occurrence is needed to monitor for this study.

3.2.2 Rationales for selection of locations

4 homesteads have been selected for monitoring terrestrial ecosystem's indicators of the study area. Locations of the homesteads have been selected considering wind direction and spatial distribution from the project boundary. All the selected locations for terrestrial ecosystem monitoring is at northern sites as maximum time of the wind rose south to north direction and anticipated impacts will be take part according to this area. Beside this, Sundarbans Reserve Forest is located sum of 14 km south from the project and various indicators of different locations of this forest is also observing for forest health monitoring. So, no site has been selected at south site of the proposed project.

3.2.3 Terrestrial Ecosystem

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

Description of the selected homestead

The homestead in Rajnagar is located at 2.5 km. east from upper North-east boundary of the project site. This is situated inside the damp area as numerous small swamps exist inside and surround the homesteads. Water retention capacity of surface soil of this homestead is very low and for this reason very little number of grasses and other herbs are present. Land elevation of selected homestead at Kalekarber village is comparatively flood free. This is located at about 1.8 km. east from Middle-east boundary of the project. Chalkghona village is located about 0.5 km south from south-east boundary of the project. The selected homestead of this village is close to Maidara River to its north side and saline water shrimp farms to its south periphery. Presence of shallow ditches and peripheral waterbodies support to grow staple coverage of saline tolerant plant species. Borni village is located at about 3.0 km north from north-east boundary. Sampled homestead at Borni is situated at the middle part of the village. This homestead is also dominated by planted tree species and soil condition is similar to Rajnagar site. Vegetation of this homestead have been severely been damaged by past Cyclone Aila.

Species Composition of selected homestead vegetation

Homestead at Rajnagar

This homestead is dominated by Gewa *(Excoecaria agallocha)* among all the trees due to its heist population which get favor from soil's salinity for luxurious succession. Beside this, Safeda *(Manilkara zapota)* and Boroi *(Zizyphus sp)* are the two species of fruit yielding trees. Monocots fruits including Narikel *(Cocos nucifera)* and Khejur *(Phoenix sylvestris)* occupied the top canopy of the vegetation. In addition, a number of Bola *(Hibiscus tiliaceus),* Kewra *(Sonneratia apetala)* and one Sundari (*Heritiera fomes)* also found to exist. The homestead very few grasses or undergrowth vegetation.

Homestead at Kalekarber dighi

Two species like Narikel *(Cocos nucifera)* and Khejur *(Phoenix sylvestris)* occupies the top canopy. The homestead has many Mahagoni *(Swietenia mahagoni*) saplings which population is also high. Aam *(Mangifera indica)*, Safeda *(Manilkara zapota)*, Peyara *(Psidium guajava)* and Boroi (Zizyphus sp) are common trees height not more than 7 m. Mahagoni *(Swietenia mahagoni),* Rendi Koroi *(Albizia saman)* and Raj Koroi *(A. richardiana)* are timber trees those are occupied top canopy height more than 10m. Beside this, Neem *(Azadirachta indica),* Bakul (*Mimusops elengii)* and few number of Kola (Musa sp) are found on these homestead platforms.

Homestead at Chalkghona

Vegetation of this homestead also have rich population of mangrove plant species like Gewa *(Excoecaria agallocha)*, Gol *(Nipa fruticans),* Kewra *(Sonneratia apetala), and* Ora *(Sonneratia caseolaris).* Narikel is the dominating tree species as well as occupying the top canopy. As the homestead is near the peripheries of river and shrimp gher, soil salinity supports luxurious growth of mangrove plant. This homestead has two shallow ditches which contain brackish water throughout the year. A number of ornamental plants also observed on this homestead platform.

Homestead at Barni

A total of 30 tree species have been recorded through quadrate sample survey of this homestead. Of which, Rendi Koroi *(Albizia saman)*, Mahagoni *(Swietenia mahagoni*), Taal *(Borassus flabellifer)*, Narikel *(Cocos nucifera),* Khejur *(Phoenix sylvestris)* are referable. The home owner have planted many fruit yielding trees which is now in sapling form. Among this, Kotbel *(Limonia acidissima)*, Aam *(Mangifera indica)* and Safeda *(Manilkara zapota)* are common. Gewa *(Excoecaria agallocha)* was dominated at western part of this homestead now being less populated due to fell by the house owner. Tiger Fern *(Acrostichum aureum)* is a mangrove herb which presence at here also referable.

Random quadrate vegetation survey has been conducted at selected homesteads during recent monitoring tier. A total of 54 plant species (excluding undergrowths) has been recorded from 16 number of surveyed sample quadrates. Details of the survey result is presented in **Table 3.13** below.

Diversity of plant species followed higher than the previous monitoring as two of the sampled homesteads observed various newly planted saplings.

Table 3.13: Species composition of the sampled homesteads

Species Name	Local Name	Family	Rajnagar				Borni				Kalekarber				Chalkghona				Total No. of individuals	Biodiversity Index
			Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4		
Acacia moniliformis	Akashmoni	Fabaceae						2											2	
Acrostichum aureum	Tiger Fern	Pteridaceae					6	8	8	11			7	1					41	
Albizia richardiana	Chambol	Fabaceae									3		2	4					9	
Albizia saman	Rendi Koroi	Fabaceae				1	2	4	1		1				2	1	1		13	
Aphanamixis polystachya	Rhyna	Meliaceae								4		1							5	
Areca catechu	Supari	Arecaceae						1	1	4		2							8	
Azadirachta indica	Neem	Meliaceae		2							1	2	3	1					9	
Bombax ceiba	Shimul	Bombacaceae														2			2	
Borassus flabeliffer	Taal	Arecaceae					2		1		3		4						10	
Citrus medica	Lebu	Rutaceae														2			2	
Cocos nucifera	Narikel	Arecaceae	3	1			2		2		3	3	5	6	2	5		2	34	
Colocasia esculenta	Mankochu	Araceae						3								2	2		7	
Cordia dichotoma	Bohal	Boraginaceae													2				2	
Dentella repens	Danton	Rubiaceae													1				1	
Diospyros pregrina	Gaab	Ebenaceae									1				1				2	
Emblica officinalis	Amloki	Euphorbiaceae							1										1	**3.30**
Erythrina ovalifolia	Mandar	Fabaceae														1			1	
Excoecaria agallocha	Gewa	Euphorbiaceae	9	1					3	7							10	25	55	
Ficus benjamina	Jogadumur	Moraceae							1										1	
Ficus hispida	Dumur	Moraceae												2					2	
Ficus religiosa	Aswath	Moraceae												1					1	
Heritiera fomes	Sundari	Sterculiaceae	5		6	20													31	
Hibiscus tiliaceus	Bola	Malvaceae					3			2			3	2					10	
Ipomoea fistulosa	Kolmilata	Convolvulaceae							10										10	
Lawsonia inermis	Mehedi	Lythraceae				1			1										2	
Lepisanthes rubiginosa	Amjum	Sapindaceae		2															2	
Limonia acidissima	Kotbel	Rutaceae		1			1												2	
Mangifera indica	Aam	Anacardiaceae					4	5								3			12	
Manilkara zapota	Bakul	Sapotaceae				1	1				1						2		5	
Mimusops elengii	Bokul	Sapotaceae	1									1							2	
Moringa oleifera	Sazna	Moringaceae												1		2			3	

Species Name	Local Name	Family	Rajnagar				Borni				Kalekarber				Chalkghona				Total No. of individuals	Biodiversity Index
			Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4		
Musa sp	Kola	Lythraceae					9	4			11					5			29	
Nipa fruticans	Golpata	Arecaceae															2		2	
Pandanus sp	Keya Kanta	Pandanaceae	10		2	2													14	
Phoenix sylvestris	Khejur	Arecaceae		3	1								14	6		1	3	1	29	
Phyllanthus reticulatus	Sitki	Phyllanthaceae						1					30						31	
Phyllanthus acidus	Orboroi	Phyllanthaceae									1				2				3	
Pongamia pinnata	Koroach	Fabaceae				1				1					2				4	
Psidium guajava	Peyara	Myrtaceae				1	2									6			9	
Punica granatum	Bedana	Lythraceae				1	1									1			3	
Punica granatum	Bedana	Sapotaceae					1									1			2	
Sonneratia apetala	Kewra	Lythraceae				1													1	
Swietenia mahagoni	Mahagoni	Meliaceae					4		1	1	23	26	6		1	2	2		66	
Syzygium cumini	Jaam	Myrtaceae		1				1								3	2		7	
Syzygium samarangense	Jamrul	Myrtaceae				1													1	
Tamarindus indica	Tentul	Fabaceae				1			2							1			4	
Terminalia arjuna	Arjun	Combretaceae														1			1	
Terminalia catapa	Kathbadam	Combretaceae						2	1							1			4	
Unknown 1									2										2	
Unknown 2							1	1	3	8									13	
Unknown 3										5									5	
Zizyphus sp	Kul boroi	Rhamnaceae														1			1	
	Jigar/Jiol														10				10	
	Singara Tree																2		2	

Source: CEGIS field sirvey

Plant health

Structure of vegetation community of this area is tree dominant. Random saline water shrimp farming is a big threat to plant health of this area. Hence, Plant health of this area is not satisfactory. Expansion of shrimp farming in this area triggered incretion of salinity of soils. For this reason, overall plant succession, growth and productivity have changed day by day.

Plant Diseases and symptoms in homestead vegetation

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

Leaf spot, lethal yellowing, leaf blast, nut fall, Mite damage on nut fruit are common diseases of the plants in the study area. A brief discussion was held with home owners about diseases of selected economic plants which exist in their homesteads. Most symptoms for plant diseases are descriptive. Although, all plant diseases symptoms are not visible in a same time of the year, but it was tried to observe the existing disease symptoms. Leaf spot and mite damage on fruits is the common symptoms of *Cocos nucifera.* In addition, bud/trunk rot (Heart Rot), lethal yellowing and diameter loss at top portion of this monocot is also common symptom of this plant in all location. Infection of fungal/bacterial is not remarkable all the homesteads. But Leaf Anthracnose on *Mangifera indica* and Bacteriosis on *Psidium guajava* is commonly found most of the trees. *Phoenix sylvestris* also found unhealthy due to leaf yellowing from manganese deficiency (**Figure 3.10**).

Figure 3.10: Unhealthy monocot plants at monitoring sites (Apri, 2019)

Number of diseases affected trees

There is no change in plant health comparing to same season monitoring in previous monitoring. Most of the cases, monocots like Coconut (*Cocos nucifera)* and Date Palm (*Phoenix sylvestris)* are the main affected species. A total of 9 date palm and 4 coconut plants were affected at Rajnagar site. But the Coconut plant which are not disease affected, followed a little bit of unhealthy due to long time dryness in absence of rainfall. Altogether 8 number of Coconut plants observed unhealthy at Borni, Kalekarber and Chalkghona sites. Most of which are suffered from trunk narrowing and heart rot. Lethal Yellowing and Terminal Bud destruction were detected in date palm. Following table represents the proportion of healthy and unhealthy plants in studied homesteads. (**Table 3.14**).

Table 3.14: Proportion of healthy and unhealthy plants in studied homesteads

Location	Plant Name	Total No. of Plant	No. of Unhealthy Plant															
			Apr 2014	Jun 2014	Oct 2014	Jan 2015	Apr 2015	Aug 2015	Oct 2015	Jan, 2015	Oct, 2016	Jan, 2017	Jan, 2018	Apr, 2018	Jul, 2018	Nov, 2018	Feb 2019	Apr, 2019
Rajnagar	*Cocos nucifera*	17*	NS	10	5	5	15	4	5	NS	3	4	6	6	9	4	4	3
	Phoenix sylvestris	25	NS	15	4	4	22	9	13	NS	10	2	5	4	7	6	8	**9**
	Manilkara zapota	1	NS	0	0	0	0	0	0	NS	-	-	-	-	-		-	-
	Albizia saman	2	NS	0	0	0	0	0	0	NS	-	-	-	-	-		-	-
	Excoecaria agallocha	55*	NS	0	1	1	0	0	0	NS	-	-	-	-	-		-	-
	Mangifera indica	3	NS	1	0	0	2	0	0	NS	-	-	1	-	-	1	-	-
	Psidium guajava	2	NS	2	0	0	2	0	0	NS	-	-	-	-	-		-	-
Borni	*Cocos nucifera*	10	7	3	0	0	3	1	2	NS	1	2	3	1	2		1	**1**
	Phoenix sylvestris	12	0	5	4	4	3	1	4	NS	4	3	4	2	1		-	**1**
	Borassus flabellifer	6	3	1	0	0	0	0	0	NS	-	-	-	-	-	1	1	-
	Mangifera indica	6	3	3	1	1	4	0	0	NS	-	-	-	-	-		-	-
	Excoecaria agallocha	18	0	0	0	0	0	0	0	NS	-	-	-	-	-		1	-
	Swietenia mehogani	11	0	0	0	0	1	0	0	NS	-	-	-	-	-		-	-
	Areca catechu	10	0	6	2	2	8	2	2	NS	-	1	-	3	-		-	-
	Manilkara zapota	1	0	0	0	0	0	0	0	NS	-	-	-	-	-		-	-
	Psidium guajava	2	2	1	0	0	0	0	0	NS	-	-	-	-	-		-	-
Kalekarber Dighi	*Cocos nucifera*	56	35	5	1	1	2	2	3	NS	1	1	-	6	3		1	**3**
	Phoenix sylvestris	10	0	3	0	0	1	0	1	NS	3	-	3	-	-		-	-
	Mangifera indica	5	1	1	0	0	0	0	0	NS	-	-	-	-	-		-	-
	Manilkara zapota	2	0	0	0	0	1	0	0	NS	-	-	-	-	-		-	-
	Borassus flabellifer	8	0	0	0	0	0	0	0	NS	-	-	-	-	-		-	-
	Zizyphus sp	1	0	0	0	0	0	0	0	NS	-	-	-	-	-		-	-
	Psidium guajava	8	0	0	0	0	0	0	0	NS	-	-	1	-	-		-	-
	Tamarindus indica	2	0	0	0	0	1	0	0	NS	-	-	-	-	-		-	-
Chalkghona	*Cocos nucifera*	39	25	19	5	5	34	20	0	NS	2	2	4	5	3		3	**4**
	Phoenix sylvestris	24	0	10	1	1	6	5	1	NS	1	-	5	2	3		-	**1**
	Albizia saman	3	0	0	0	0	1	0	0	NS	-	-	-	-	-		1	-
	Excoecaria agallocha	36	0	0	1	1	0	0	0	NS	-	-	-	-	2		-	-
	Manilkara zapota	1	0	0	0	0	0	0	0	NS	-	-	-	-	-		-	-
	Psidium guajava	17	1	7	0	0	0	0	0	NS	-	-	-	-	-	1	3	-
	Mangifera indica	7	2	1	0	0	0	0	0	NS	-	1	-	1	-		-	-
	Borassus flabellifer	2	0	0	0	0	0	0	0	NS	-	-	-	-	-		-	-

Note: NS = Not Surveyed

**=1 Cocos and 45 Excoecaria have been cut*

Vegetation canopy status

Species representation in different canopy layers of homestead vegetation

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

Estimated Canopy cover in homestead vegetation of sampling sites

Status of vegetation canopy has estimated same except Rajnagar site compared to the status which was in Jan, 2018. In the case of Rajnagar site, canopy coverage has reduced slightly due to effect of sand filling and longtime dryness.

Canopy coverage of the studied homesteads has been represented in following **Table 3.15**.

Table 3.15: Vegetation Canopy Cover in different studied homesteads

Location	% of canopy Coverage																
	Apr 2014	Jun 2014	Oct 2014	Jan 2015	Apr 2015	Aug 2015	Oct 2015	Jan 2016	Jul 2016	Oct 2016	Jan 2017	Jan 2018	Apr 2018	Jul 2018	Nov, 2018	Feb, 2019	Apr, 2019
Rajnagar	NS	19	19	17	20	20	20	20	21	23	19	**15**	18	14	11	22	**19**
Borni	NS	26	18	18	12	14	20	20	25	25	23	**21**	21	23	20	21	**21**
Kalekarber	NS	20	24	25	23	24	24	22	24	26	25	**23**	24	24	25	24	**25**
Chalkghona	NS	13	24	22	17	21	21	20	21	27	26	**25**	16	18	21	22	**22**

Note: NS = Not Surveyed

a. Bird Habitat

Local birds and their nesting behaviour

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

Bird species and number of Bird nests in sampling sites

No bird nest has been observed any one monitoring site. However, **Table 3.16** represent the bird nest monitoring datasheet over the monitoring periods

Table 3.16: Bird Nest Monitoring Datasheet

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

Bird Name	No. of Bird Nest observed																															
	Jan 2016				Jul 2016				Jan 2017				Jan 2018				Apr 2018				Jul 2018				Nov 2018				Apr 2019			
	R	B	K	C	R	B	K	C	R	B	K	C	R	B	K	C	R	B	K	C	R	B	K	C	R	B	K	C	R	B	K	C
Little Cormorant	NS	NS	NS	NS	10	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Little Egret	NS	NS	NS	NS	5	-	-	1	-	-	-	-	-	-	-	1	2	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-
Asian Pied Starling	NS	NS	NS	NS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-
Tailor Bird	NS	NS	NS	NS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Spotted Dove	NS	NS	NS	NS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Great Egret	NS	NS	NS	NS	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Magpie Robin	NS	NS	NS	NS	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-
House Crow	NS	NS	NS	NS	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-

3.2.4 Aquatic Ecosystem Monitoring

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

Monitoring Locations

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

Dolphin Occurrence

Dolphin migration route in study area

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

Dolphin occurrence in Passur and Maidara River

Dolphin occurrence have been monitored within about 5 km length of Passur and Madara river surround the project area (From Chalna to Chalkghona including Maidara River) through boat transact during mid tide. No dolphin was recorded in Passur or Maidara River during the survey. Existing dredging activities in Passur River and placing the gill nets inside the Maidara River may disfavor to dolphin movement. **Figure 3.11** represents the survey transact and location of dolphin occurrence.

Figure 3.11: Present dredging activities in Passur River hamper dolphin migration

Occurrence of Dolphin also surveyed at the Dhangmari Khal, Chandpai Shella Gang Wildlife Sanctuary and Bhadra Khal. In the case of Dhangmari Khal, total transect length was 13.2 km from Dhangmari-Passur confluence to Gagramari Forest Patrol Post up and down (**Figure 3.14**). A total of 21 dolphins with different sizes were recorded in Dhangmari Khal with an encounter rate 1.37/km/hour. In the case of Chandpai Shella Gang, the survey transact was bounded from Chandpai forest Office to Joymonirgol Thota to Jongra Forest Patrol Post which transect length was about 17 km **(Figure 3.15**). A total of 21 individuals have been sighted during one and half hour survey. The encounter rate was .73/km/hour. Most of the dolphins were found at the confluence point of Jongra Khal-Passur River.

During this monitoring, highest occurrence of dolphins observed at Bhadra Khal from which recorded 22 occurrences of dolphin within the 3.5 km reach from Bhadra Patrol Post. The encounter rate was 2.92 individuals/km/hr. Banning fish catch by the Forest department at Bhadra and Shella-Jongra Khal favors the dolphin habitat.

The distribution of dolphin occurrence at Bhadra Khal is presented in **Figure 3.16**.

Another short survey was conducted Karomjal, Harbaria and Akram Point while passing the river. Dolphin has been notified at Karomjal and Harbaria while travelling on boat. However, the survey result is included in **Table: 3.17**.

Figure 3.12: Jhongra-Passur confluence, sighted most of the dolphins (Apr 2019)

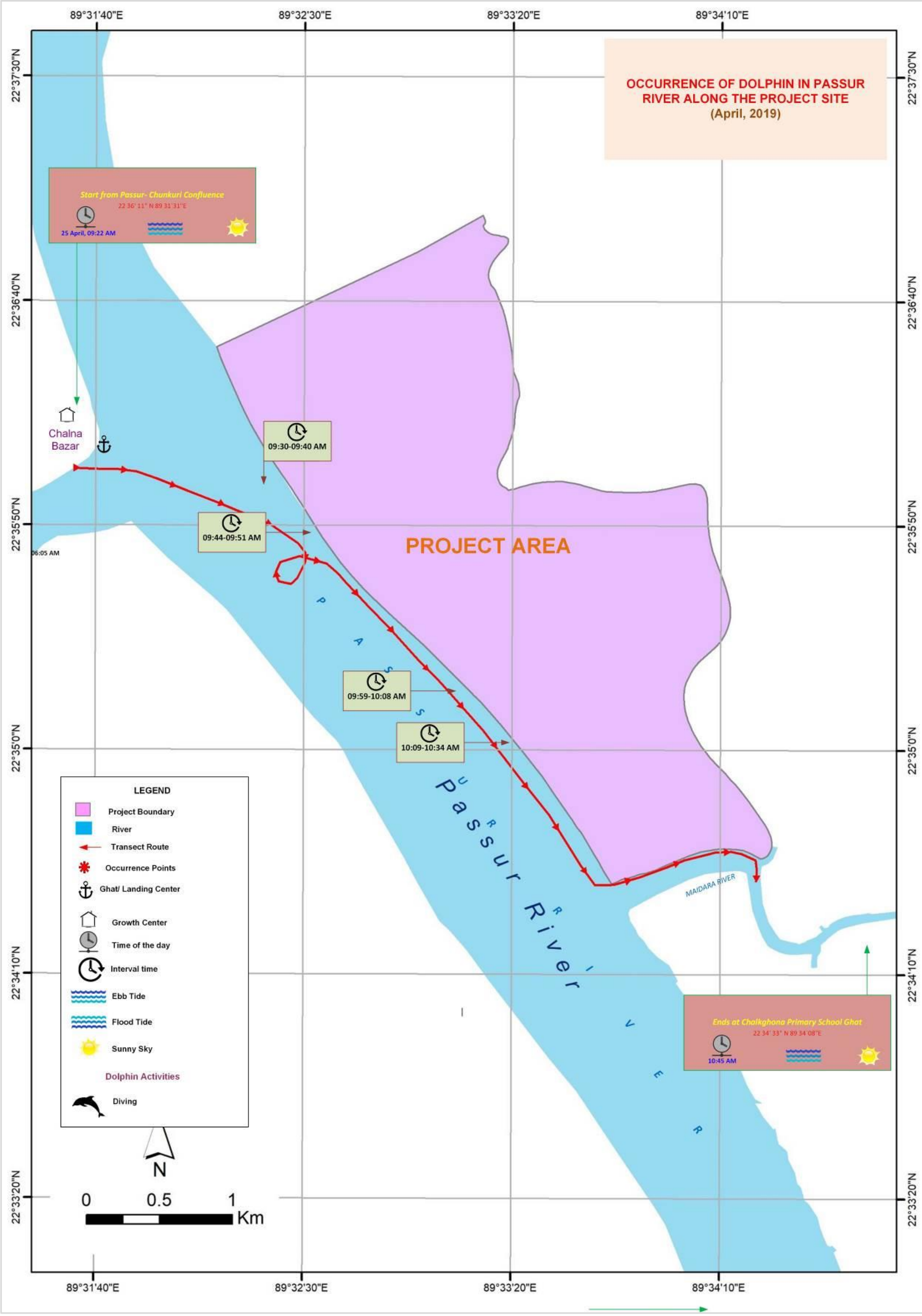


Figure 3.13: Occurrence of dolphins at Passur and Maidara River along the project site

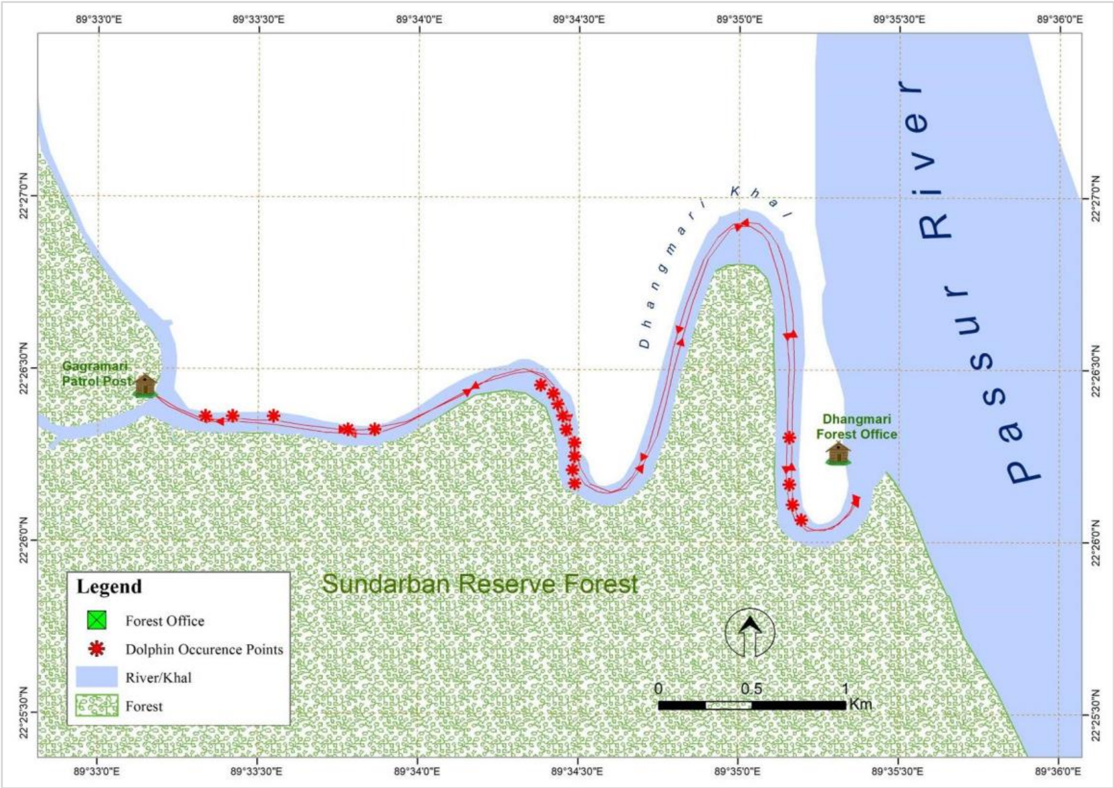


Figure 3.14: Location of dolphin Occurrence at Dhangmari Khal

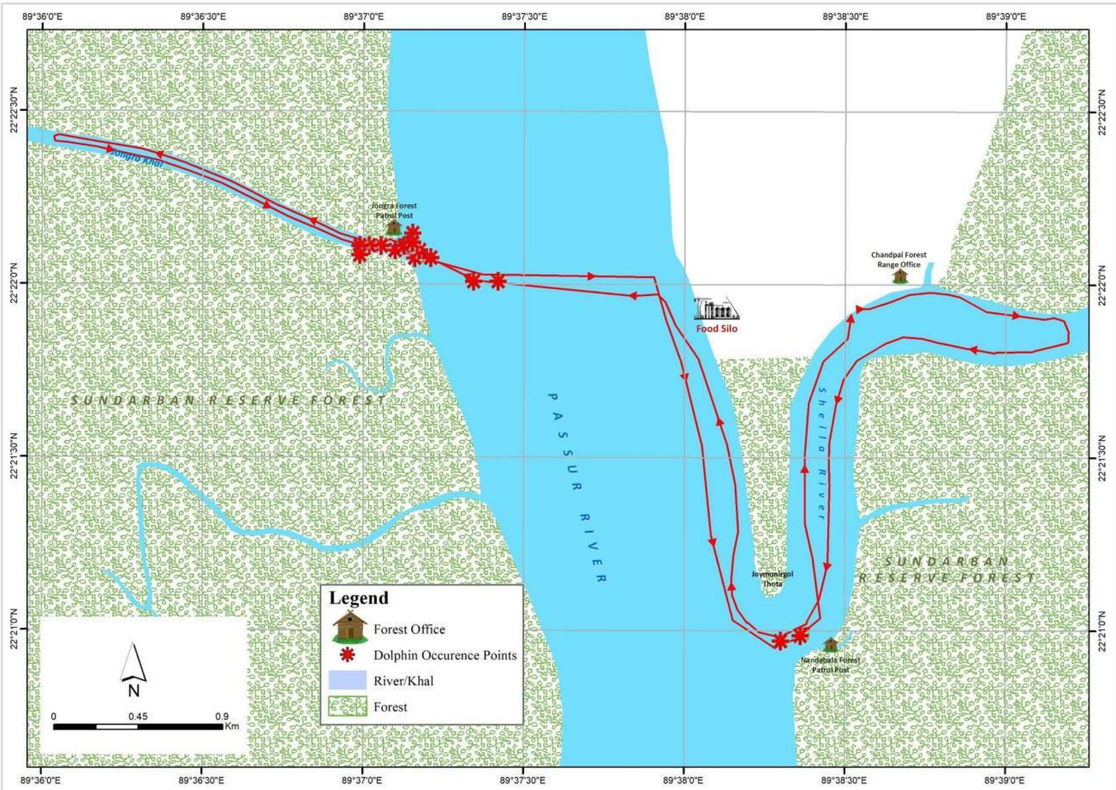


Figure 3.15: Location of dolphin Occurrence at Chandpai (Shella River to Jongra Khal)

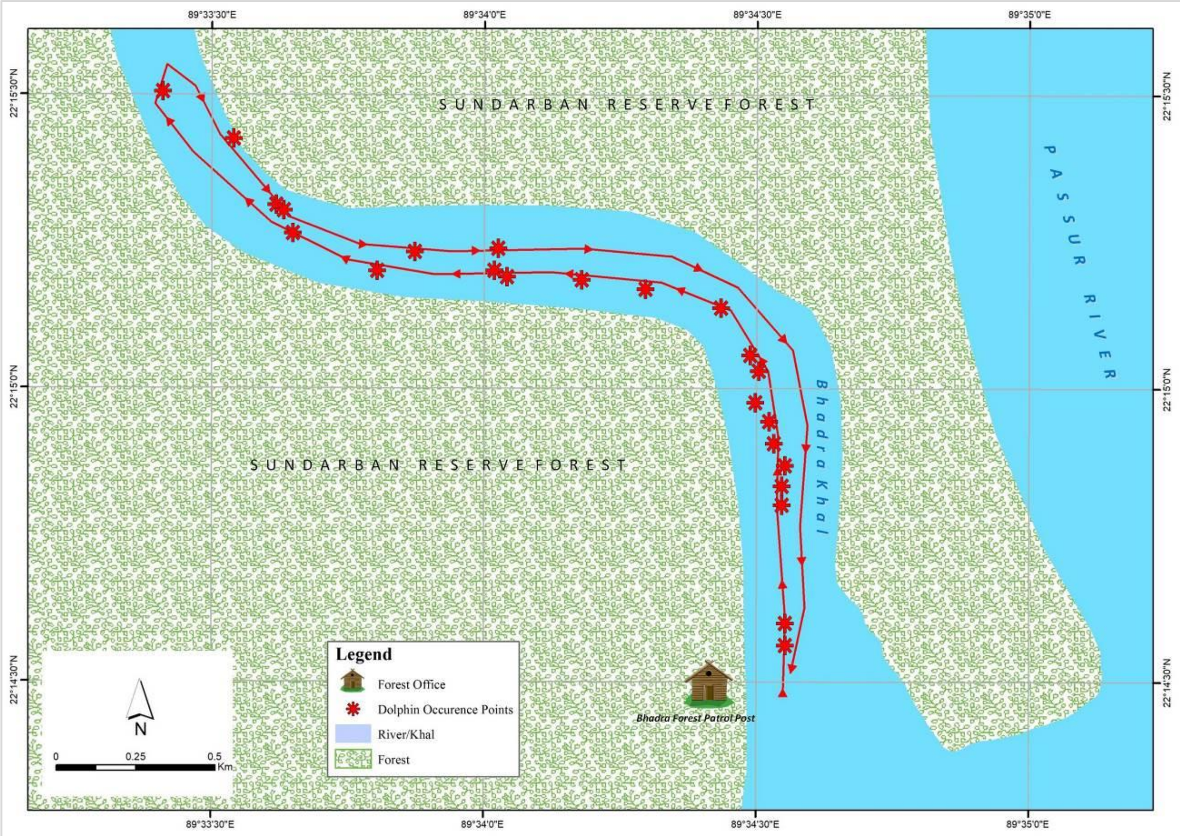


Figure 3.16: Location of Dolphin Occurrence at Bhadra Khal

Table 3.17: Dolphin observation Datasheet

Location of River systems	Occurrence Status																															
	Apr 2014		Jun 2014		Oct 2014		Jan 2015		Apr 2015		Aug 2015		Oct 2015		Oct 2015		Jul 2016		Oct 2016		Jan 2017		Jan 2018		Jun 2018		Nov 2018		Feb 2019		Apr 2019	
	F T	N T	F T	N T	F T	N T	F T	N T	F T	N T	F T	N T	F T	N T	F T	N T	F T	N T	F T	N T	F T	N T	F T	N T	F T	N T	F T	N T	F T	N T	F T	N T
Project Site	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NS	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	NS	Y	NS	Y	NS	N
Karamjal	NS	NS	NS	N	NS	Y	Y	Y	N	N	NS	Y	NS	Y	Y	N	Y	NS	Y	Y	Y	Y	NS	Y	N	NS	N	N	Y	N	Y	N
Harbaria	NS	NS	NS	N	NS	Y	Y	N	N	N	N	N	Y	NS	Y	N	Y	Y	Y	NS	N	N	Y	N	N	N	N	N	Y	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	N	Y	N	N	N	Y	N	N
Moidara River	Y	N	N	N	Y	Y	Y	N	Y	N	Y	N	NS	Y	N	Y	Y	NS	NS	Y	N	Y	NS	Y	Y	Y	NS	Y	NS	N	NS	N
Shella River at Chandpai	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	N*	Y	NS	NS	Y	Y	NS	NS	Y

Note: FT=Flood Tide, NT=Neap Tide, NS=Not Surveyed,

Occurrence Status: Y = Occurred, N = Not occurred

3.3 Sundarbans Forest Health

Forest Health Monitoring program designed to determine the status, changes, and trends in indicators of forest condition on certain time interval basis. The Forest Health Monitoring program uses data from various sources such as ground plots (i.e. long-term monitoring plot) surveys, aerial surveys, and other biotic and abiotic data sources and develops analytical approaches to address forest health issues that affect the sustainability of forest ecosystems. One of the widely used forests healthy monitoring Bio-indicators is growth trend overtime and its relation with leaf are index (*Beets and Whitehead 1996*). Stands with a high leaf area index will accumulate more biomass and total volume per ha than stands with a low leaf area, other things being equal (*Beets et al. 2008*). Lichen abundance is another good indicator of forest health. Lichens often grow on trees and shrubs, absorbing nutrients from the atmosphere. Because lichens are very sensitive to air pollution—particularly to sulfur dioxide, fluoride, and ammonia—their presence or absence is an indicator of forest health. The acidity of a tree's bark can also affect lichen abundance (*Smith et al. 2003*). If air is very badly polluted with sulphur dioxide there may be no lichens present, just green algae may be found. If the air is clean, shrubby, hairy and leafy lichens become abundant (*Bates et al 1996*). The quality of the soil in a forest is another important indicator of forest health (*USDA Forest Service. 2007*). An evaluation of soil quality usually involves measuring the soil's physical, chemical, and biological makeup at different depths. Plant species diversity is another Bio-indicator of healthy forest. One way to assess this diversity is to determine whether there is a mix of plant species of different sizes and ages, thus creating forest "layers" that provide habitat for many species (Greenleaf Forestry and Wood Products Inc. 2010). A healthy forest has good regeneration capacity, which is also a bio-indicator of forest health monitoring. These bio-indicators will be investigated in Sundarbans Reserve Forest (SRF) in light of the Rampal Power Plant Installation.

Forest health Bio-indicators will be applied in Sundarbans Reserve Forest (SRF) to monitor the probable impacts of Rampal Thermal Coal Power Plant Project. To discern the true scenario of Power plant impact on forest health, it is mandatory to create a baseline condition. Taking this into consideration, CEGIS is conducting the forest health monitoring program at five locations namely Sutarkhali, Karamjal, Harbaria, Akram point and Hiron Point at Sundarbans Reserve Forest (SRF) along the Passur River. The parameters that included in this monitoring program were tree growth, regeneration capacity, lichen abundance, plant diversity, biomass and carbon stock.

3.4 Methodology

3.4.1 Permanent Sample Plot (PSP) establishment and layout

To set up permanent sample plots, five plots were established Among those, five sites are along the Passur River at Karamjal, Harbaria, Akram point and in Hiron point respectively and the fifth plot is near Sutarkhali forest office (**Table 3.17**). The sites were selected considering the distance from the proposed Project site, wind directions, coal transportation route, river systems and vegetation types.

3.4.2 Bio-Indicators for Forest Health Monitoring

There are many Bio-indicators for forest health monitoring. As the study forest is a mangrove forest, some of the mangrove traits were also selected as Bio-indicator. The Bio-indicators observed in this forest health monitoring program were seedling regeneration, pneumatophores, species diversity, crab hole density, canopy cover, leaf phonology, Leaf Area Index, Tree growth, phenological behaviour, pest and disease, and biomass and carbon stock.

3.4.3 Sampling Design of Permanent Sample Plots (PSPs)

In each site, a transect line was laid out perpendicular to river or canal bank. Along the transect line, three circular nested subplots of 12.62m radius have been laid out at 100m intervals in order to capture the maximum tree species (**Figure 3.18**). Because of the variation in species composition in SRF, observation plots were laid out from the coast, river or canal side to upper slope zone where forest area is denser. The location of the first subplot was 40m away from ecotone zone in order to save the subplot from river bank erosion. Each subplot was again subdivided into four quadrates. The plot layout is shown in (**Figure 3.19**).

Table 3.18: 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	22.4981	89.4875	Hard Clay	Just opposite from Sutar Khali Forest Station and 40 m SW from Sutar Khali canal
	2	Khulna	32	22.4973	89.4871	Hard Clay	Just opposite from Sutar Khali Forest Station and 140 m SW from Sutar Khali canal
	3	Khulna	32	22.4965	89.4866	Hard Clay	Just opposite from Sutar Khali Forest Station and 240 m SW from Sutar Khali canal
Karamjal	1	Chandpai	31	22.4253	89.5943	Hard Clay	Plot centre 40m west from Passur river
	2	Chandpai	31	22.4252	89.5934	Hard Clay	Plot centre 140m west from Passur river
	3	Chandpai	31	22.4226	89.5925	Hard Clay	Plot centre 240 m west from Passur river
Harbaria	1	Chandpai	29	22.2061	89.5924	Hard Clay	40m west from passure river
	2	Chandpai	29	22.2962	89.5917	Hard Clay	140m west from passure river
	3	Chandpai	29	22.2962	89.5908	Muddy	240m west from passure river
Akram Point	1	Khulna	17	22.0195	89.5129	Hard Clay	40m east from shibsha river
	2	Khulna	17	22.0187	89.5134	Clayee	140m east from shibsha river
	3	Khulna	17	22.0180	89.5140	Hard Clay	240m east from shibsha river
Hiron Point	1	Khulna	44	22.7753	89.4610	Sandy	350m east from Gogari canal
	2	Khulna	44	21.9166	89.2333	Sandy	40m north from Bay of Bengal
	3	Khulna	44	22.1833	89.5000	Hard Clay	648m south east from Shibsa river

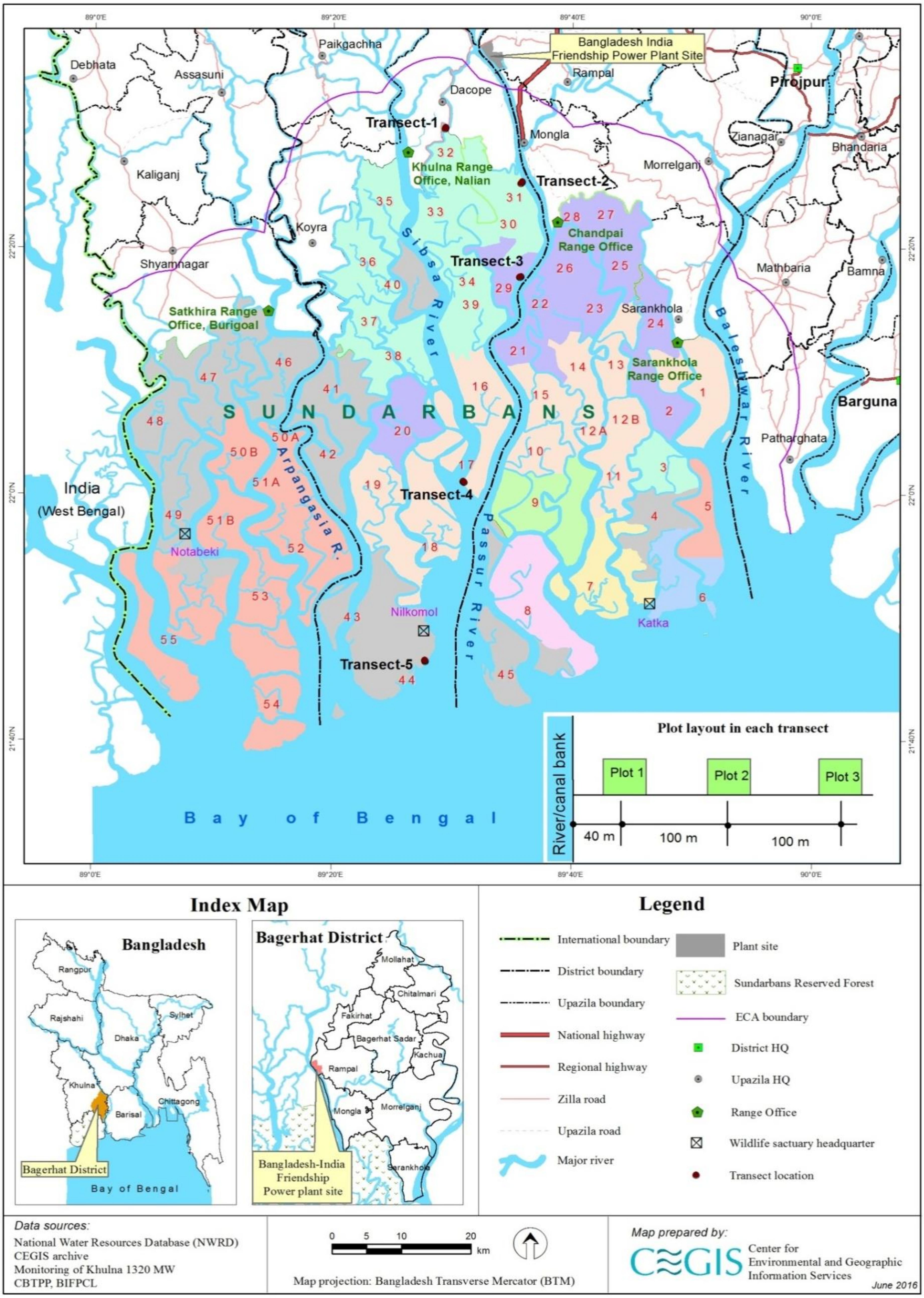


Figure 3.17: Location Map of Sundarbans Forest Health Monitoring Plots (PSP)

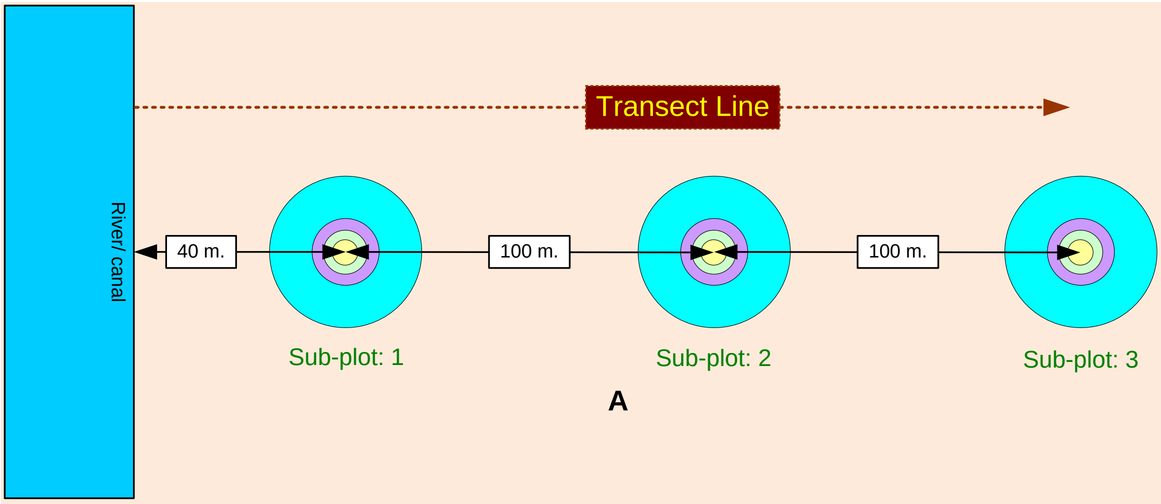


Figure 3.18: Layout of the subplots and transect line perpendicular from ecotone (river or canal bank)

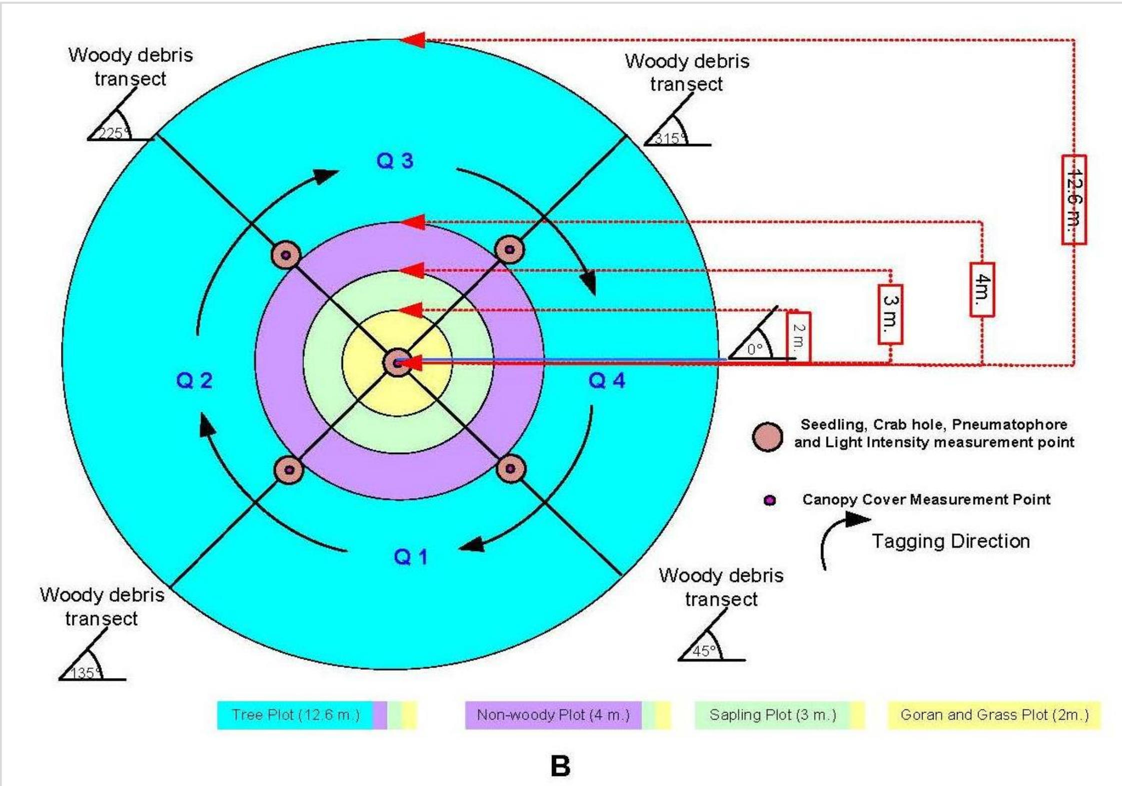


Figure 3.19: Layout of the survey activities in each subplot

3.4.4 Methods

Tree growth

Tree species growth form data were obtained from measured tree DBH. Individual tree DBH ≥5cm was considered for growth trend observation. Basal area increment (BAI) was used as a proxy for the temporal trend of tree growth. Mean annual tree growth rate was calculated as = $[BA_{census2} - BA_{census1}]/[time_2 - time_1]$ where $time_2$ and $time_1$ are the respective census period. Mean basal area increment was than calculated for each sampled species. In addition, if any new tree was found within 12.62m radius circle of the Permanent Sample Plot (PSP), they were also recorded.

Vegetation Diversity

Tree species data were collected from collected from the PSPs. Individual tree DBH ≥5cm was considered. Saplings (DBH<5cm and height 1.37m) and seedlings (height<1.37m) were assessed within 3m and 2m radius circle respectively in each PSP. Seedlings were counted species wise and their status of living was also recorded. For saplings, species name and DBH were recorded along with the living status.

Diversity analysis was calculated using the species richness, Shannon diversity (H′), and Simpson diversity (D′) and Evenness (E) indices (Magurran & Mcgill 2011). All the calculations were done using R package (Kindt & Coe 2005). Species accumulation curves (SAC; or species-richness curves, collector’s curves, species effort curves) were used to estimate the number of vegetation species in the PSPs. Species accumulation curves show the species richness for combinations of sites. Canonical Correspondence Analysis (CCA) was used to analyze the relationship between distribution of plants and environmental variables. Multidimensional scaling (MDS) was applied to investigate similarities in species composition among sites.

Pneumatophores

The total numbers of living pneumatophores were recorded within a circular area of 1m radius centring each of the five points of all the subplots.

Crab hole

Crab plays an important role in mangrove ecosystems such as decomposing litter fall, which play an important role in increasing soil fertility. In order to record the crab density, crab hole abundance was monitored. For this purpose, the crab holes were counted within an area of 1m radius circle in each subplot’s centre and in the midpoint of four transect.

Canopy Cover

Canopy cover percentage was estimated by a spherical densitometer (i.e. Densitometers a gridded convex mirror that provides a simple and inexpensive approach of measuring canopy cover). The densitometer 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. 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 was taken at five points facing north, south, east, and west direction including the centre point of the subplot. The canopy cover was calculated by taking the average of these five readings.

Leaf Area Index

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

Leaf Area Index (LAI) = $\log_e (I/I_o)/-K$ leaf area / area 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)

Biomass and carbon stock estimation in trees

A total of five 12.62m radius plots were established inside the SRF of Bangladesh. From each plot tree species were identified and each individual was recorded. Diameter at breast height (1.37 m) and height was measured in the field. Total biomass of trees was estimated after adding above and below ground biomass. As the study was conducted in a reserved forest area, it was not possible to cut all the tress and brought them to laboratory for estimating biomass. After reviewing models developed by several authors from across the world (e.g., FAO 1997, Brown et al. 1989), the generic allometric model developed by Chave et al. (2014) was used for measuring biomass as this widely used for tropical region tree standing biomass. Below ground biomass was calculated considering 15% of above ground biomass (MacDicken 1997). After calculating biomass, carbon content was calculated based on the assumption that carbon content is 50 percent of the dry woody biomass (Brown 1997). Aboveground biomass and carbon was calculated on a per-hectare (ha) basis. The model for above ground biomass estimation is as follows:

$AGB=0.0673 \times (\rho D^2H)^{0.976}$

Where, Y = above ground biomass in Kg; H = Height of the trees in meter; D = Diameter at breast height (1.3m) in cm; ρ = Wood density in units of g/cm^3.

Determination of soil organic carbon content

Soil samples were collected from four soil depths: 0-15cm, 15-30cm, 30-50cm and 50-100cm. From each transect, there were four subplots. Soil samples were collected from each subplot. Soil samples were collected in polythene bags with the help of soil core. The samples were weighed before air-dried and there after all the foreign materials were removed by passing through a sieve (2mm). The amount of soil of known volume is weighted. Soil samples were then oven dried at 105˚C for 72 hours. Soil bulk density was calculated following the following formula (Brandy, 1996).

Bulk density (gm/cc) = Oven dry weight of the soil sample/Volume of that soil sample

Loss of ignition (LOI) method was followed to measure organic carbon in soil sample (Allen et al., 1974). One gram of soil was taken in a pre-weighted porcelain cup and oven-dried at 105 °C for 24 hours. The oven-dried sample was then placed in digital Muffle furnace (WiseTherm F, Wisd, Korea) at 450 °C for four hours. After ignition the sample was then placed in desiccators to allow it to room temperature and weight it again to calculate the loss of ignition (LOI%) using the following formula:

%LOI = (W1/W)* 100

Here, W1= loss in weight

W = Weight of oven dry soil

A total of 50% of LOI% or ash free mass was considered as the C content in the sample (Allen, 1989). Finally, the total organic carbon content (t/ha) of each depth was calculated following the following formula:

Organic carbon (%)*Bulk density*Soil depth difference [Final depth – Initial depth]

Leaf Phenology

Leaf phenological trait of major mangrove species such as leaf emergence, leaf shedding, flowering and fruiting and fruit/ propagule dropping time was investigated through secondary information. Leaf phenology has been first introduced in this study for the first time. From next field inventory, leaf phenological behavioral change will be monitored.

Pest and Diseases

Pest and disease type of Sundarban mangrove forest was investigated through literature review, which was then verified in the field through visual observation.

3.5 Results and Discussion

3.5.1 Vegetation diversity, richness and compositional variation

A species accumulation curve shows the species richness for combinations of sites. These curves portray the average pooled species richness when all sites are combined together. The output shows that the average richness for all possible combinations of 5 sites is 21 (**Figure 3.20**). Gewa was the dominant species among all the PSPs which was confirmed by the Rank-abundance curves followed by Sundari and Kakra (**Figure 3.21**). Vegetation species richness has been identified through Shannon, Simpson and evenness Index (**Table 3.19**). Considerable difference was noticed in the species richness in five PSPs. All the three indices shows that transect 2 (Karamjal) has more diversity compare to other PSPs.

Multidimensional scaling (MDS) is a popular approach for graphically representing relationships between objects (e.g. plots or samples) in multidimensional space. The samples are then usually represented graphically in two dimensions such that the distance between points on the plot approximates their multivariate dissimilarity as closely as possible. In the present study, Akram point (T4) and Hiron point (T5) were close to each other indicating similarity in species composition in these two PSPs. In contrast, T1 (Sutarkhali), T2 (Karamjal) and T3 (Harbaria) were far away from T4 and T5 indicating dissimilarity in species composition **(Figure 23**).

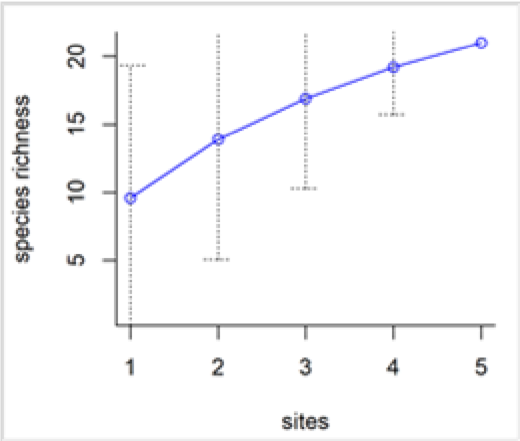


Figure 3.20. Species accumulation curve for the PSPs dataset

The bars indicate +2 and -2 standard Deviations (N.B. 1=Sutarkhali, 2=Karamjal, 3= Harbaria, 4=Akram Point, 5=Hiron Point. Hiron point plot data was taken from last survey)

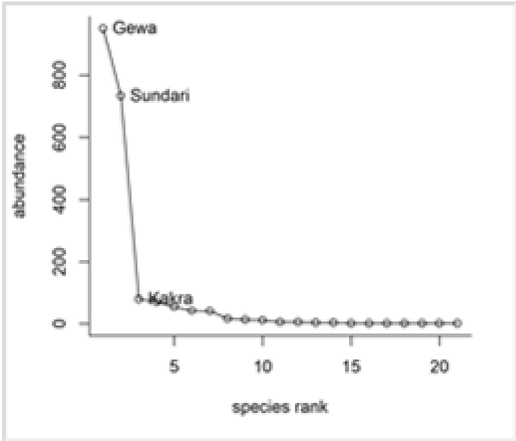


Figure 3.21. Rank-abundance curve for the sampled PSPs

Multidimensional scaling (MDS) is a popular approach for graphically representing relationships between objects (e.g. plots or samples) in multidimensional space. The samples are then usually represented graphically in two dimensions such that the distance between points on the plot approximates their multivariate dissimilarity as closely as possible. In the present study, Akram point (T4) and Hiron point (T5) were close to each other indicating similarity in species composition in these two PSPs. In contrast, T1 (Sutarkhali), T2 (Karamjal) and T3 (Harbaria) were far away from T4 and T5 indicating dissimilarity in species composition (**Figure 3.22**).

Table 3.19: Different diversity indices for vegetation in the Sampled PSPs

Site	Shannon Index	Simpson Index	Evenness Index
T1	1.06	0.46	0.26
T2	2.09	0.83	0.44
T3	1.31	0.64	0.25
T4	0.83	0.47	0.39
T5	0.47	0.22	0.23

3.5.2 Soil quality and vegetation distribution nexus

The first two axes of CCA explained 25.5 % of the cumulative variance in species data. Observed values of the correlation co-efficient (r) between the environmental variables and the axes scores suggest that a combination of factors is responsible for the variability in species composition. For instance, the first CCA axis (eigen value = 0.43, variance explained = 57%) primarily represented a gradient of high-to-low organic carbon (r = 0.42) and low-to-high soil salinity (r = 0.07), and the second CCA axis (eigen value = 0.29, variance explained = 37%) primarily represented a gradient of soil with low-to-high concentration of BD (r = 0.50) and Salinity (r = 0.46) in soil (**Table 3.20** and **Figure 3.22**).

CCA biplot (**Figure 3.23 and Table 3.21)**) indicates that Gewa, Goran and Keora in transect 4 (Akram Point) and transect 5 (Hiron Point) were strongly associated with high soil organic carbon/organic matter content while Bawalilata, Sundari, hargoja, passur, Dahur have opposite associations with OC/OM. Sundari, hargoja, passur, Dahur were associated with high soil salinity (EC) and BD while kalilata, golpata, Amoor were associated with high soil pH.

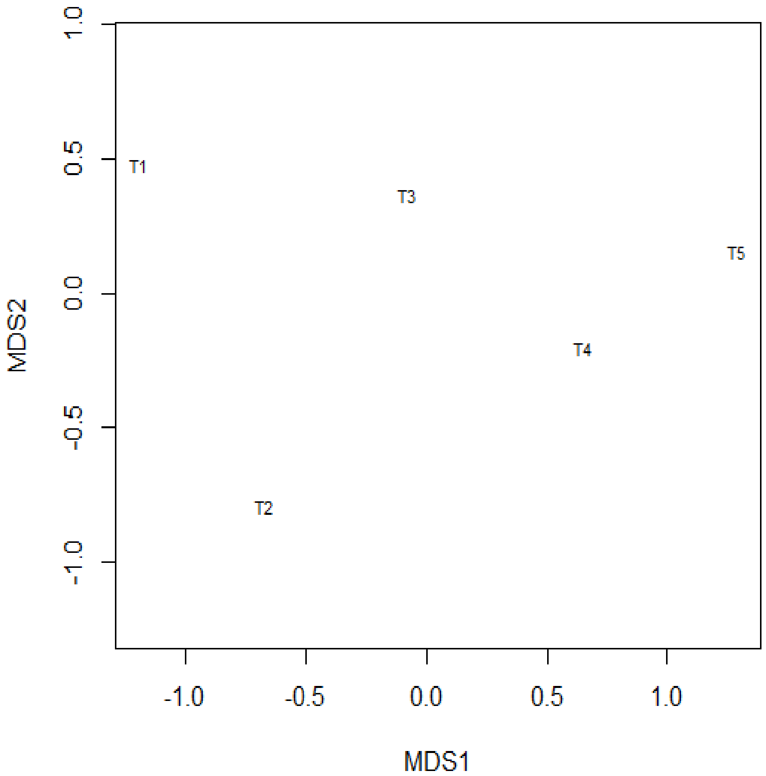


Figure 3.22: Ordination graph for a two-dimensional MDS based on the Bray-Curtis distance

The best configuration out of 500 is shown

N.B .Hiron point plot data was taken from last survey

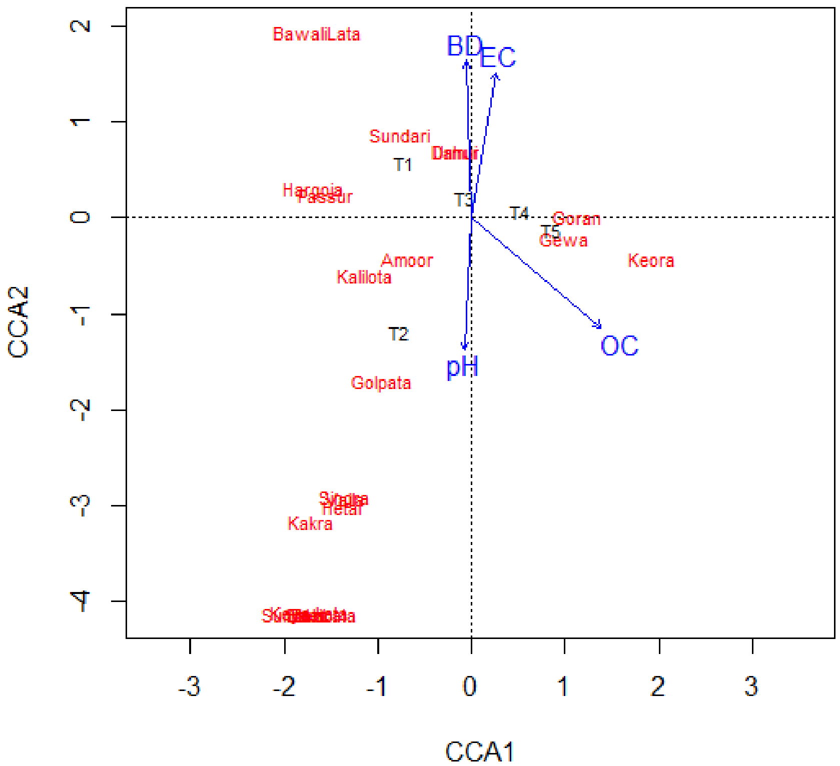


Figure 3.23: CCA ordination. The vectors represent environmental variables

The length of the vector is proportional to its importance and the angle between two vectors reflects the degree of correlation between variables. The angle between a vector and each axis is related to its correlation with the axis.

N.B .Hiron point plot data was taken from last survey

Table 3.20: Results of CCA Ordination

CCA Axes	CCA1	CCA2
Eigen value	0.43	0.29
Proportion Explained	0.57	0.37
Cumulative Proportion	0.57	0.94

Table 3.21: Canonical coefficients correlations of environmental variables

CCA Axes	CCA1	CCA2
BD	0.01	0.50
OC	0.42	-0.34
EC	0.07	0.46
pH	-0.02	-0.42

N.B. N and P were excluded due to multicollinearity problem

3.5.3 Soil quality

The quality of the soil in a forest is an important indicator of forest health. How well the soil functions directly influence the health of the trees and other forest organisms can be explained by soil nutrients.

Soil organic carbon content and bulk density didn't differed significantly (p>0.05) across soil depth (**Table 3.22**). Even though, there is no significant difference, deeper soil depth 50-100cm contained highest amount of soil organic carbon percent (1.93±0.55%) (Table 5). Soil bulk density and length of soil horizon were the determinant of total soil organic carbon content of each soil horizon. Soil bulk density was not significantly different (p>0.05) across soil depth (Table 5).

While comparing soil bulk density and organic carbon percent significant weak correlation (p=0.04) was found of that soil in the study site. We obtained a negative correlation (r = -0.291) between bulk density and organic matter of soil samples. Our studies indicate that as the bulk density increases organic carbon percentage tends to decreases.

All the PSPs have good supply of sediments. In most cases top soil layers (0-30cm) was soft whereas deep soil layer samples were hard. N content of soils varies from 0.04 to 1.07 (mg/g). P varies from 0.314 to 0.63 (mg/g). High value of N and P can hamper plant growth. Soils are neutral to mildly alkaline (6.25 to 7.34 pH). N, P and pH doesn't vary significantly among the sample plot. In addition, N, P and pH doesn't vary within the soil layers as well.

From various studies of tropical mangrove forests worldwide it is observed that mangrove soils may be either acidic or alkaline. Some researchers found soil pH ranging from 2.87-6.40 (Khan t al., 1993; Sukardjo, 1994; Rambok et al., 2010; Ferreira et al., 2010; Moreno and Calderon, 2011). In contrast, other researchers reported soil pH above 7.0 ranging from 7.4-8.22 (Sah et al., 1989; Hossain et al., 2012; Das et al., 2012). In Indian part of Sundarbans soil pH ranges from 7.6-8.0 which is alkaline. Similar phenomenon was also observed in the monitoring plots.

In mangrove soils, N was considered the primary nutrient that affects species composition and structure of forest, although more recent analysis found that N and P influence structure and composition in approximately equal proportions (Elser and Hamilton, 2007). Rambok et al. (2010) reported the highest (25.27%) phosphorus in Sibuti mangrove, Sarawak, Malaysia while Sukardjo (1994) reported 26.34 ppm phosphorus in Apar nature reserve mangrove. However, P concentration is low in the monitoring plots of the study compare to other parts of the mangroves around the world. N concentration is also low in the monitoring plots compare to Indonesian and Malaysian mangroves (Hossain and Nuruddin 2016).

Table 3.22: Soil quality parameters in the PSPs

Depth	N (mg/g)	P (mg/g)	pH	OC (%)	BD (g/cm3)
0-15cm	0.42±0.29a	0.46±0.09a	6.82±0.27a	1.69±0.42a	2.18±0.25a
15-30cm	0.38±0.21 a	0.43 ±0.08a	6.84± 0.15a	1.80±0.52a	2.29±0.39a
30-50cm	0.35±0.24a	0.44±0.05a	6.83±0.20a	1.92±0.48a	2.16±0.27a
50-100cm	0.41± 0.21a	0.46±0.06a	6.87± 0.24a	1.93± 0.55a	2.25±0.36a

3.5.4 Tree Growth

There was no significant variation (p>0.05) in tree growth over the monitoring period for all the PSPs (**Figure 3.24**). However, there was an increasing trend in tree growth was observed in Karamjal and Harbaria monitoring plot.

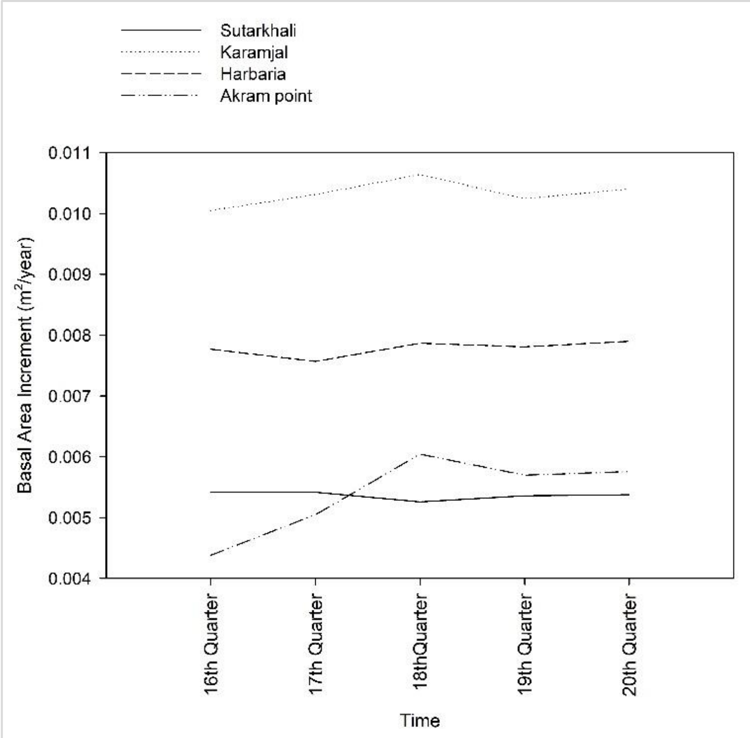


Figure 3.24: Tree growth increment (Basal Area Increment) over subsequent census period

3.5.5 Seedling regeneration

The Seedling density among the four PSP was not significantly different (*P*>0.05) (**Figure 3.25**). An increasing trend of seedling survival was found in all sites. This is because of the time of seed germination and seedling survival in the observed PSPs.

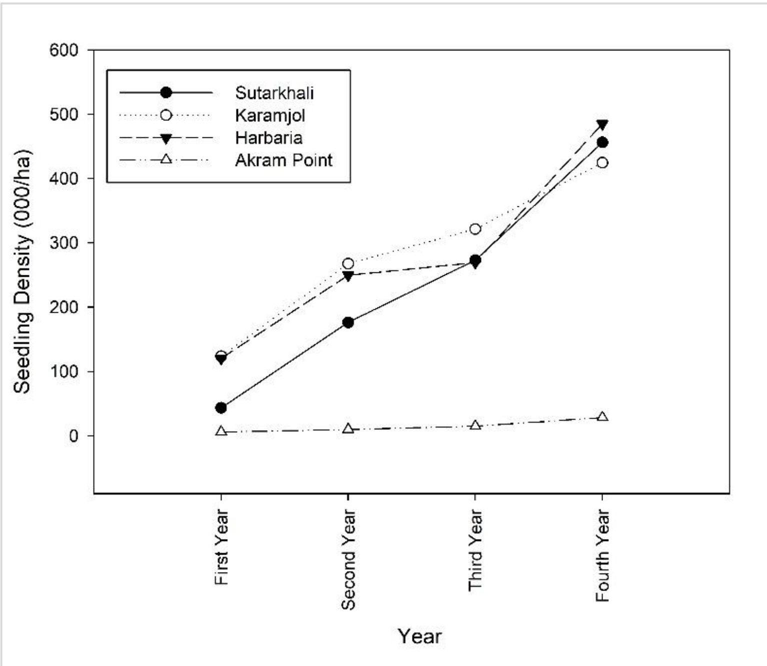
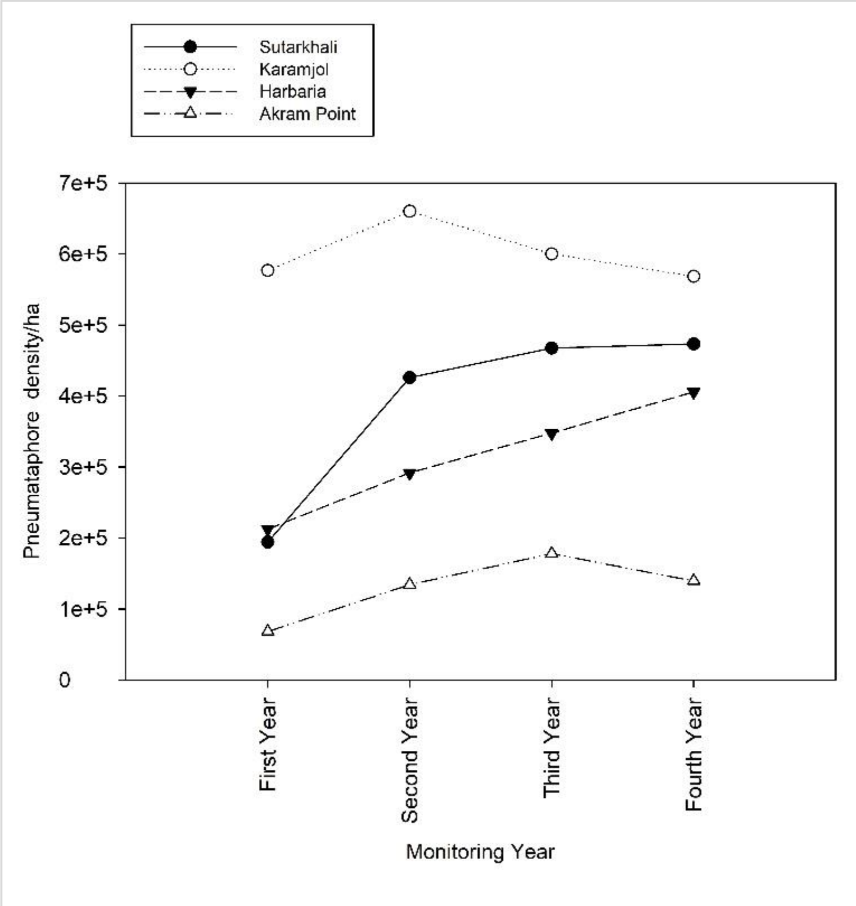


Figure 3.25: Mean (±95%CI) seedlings density among five PSPs over subsequent census period

3.5.6 Pneumatophores

Trees of swamp habitats or those subject to tidal flooding, such as mangroves, often have specialized root systems, called pneumatophores, which often are involved in gas exchange. Average number of pneumatophores per hectare was comparatively very low in Akram point area whereas pneumatophores density was highest in karamjol sample plots. There is no significant variation (p>0.05) in pneumatophores density over the monitoring period for each PSPs (**Figure 3.26**). This indicates that forest health condition is not deteriorating in terms of steady state condition of pneumatophores density over time.

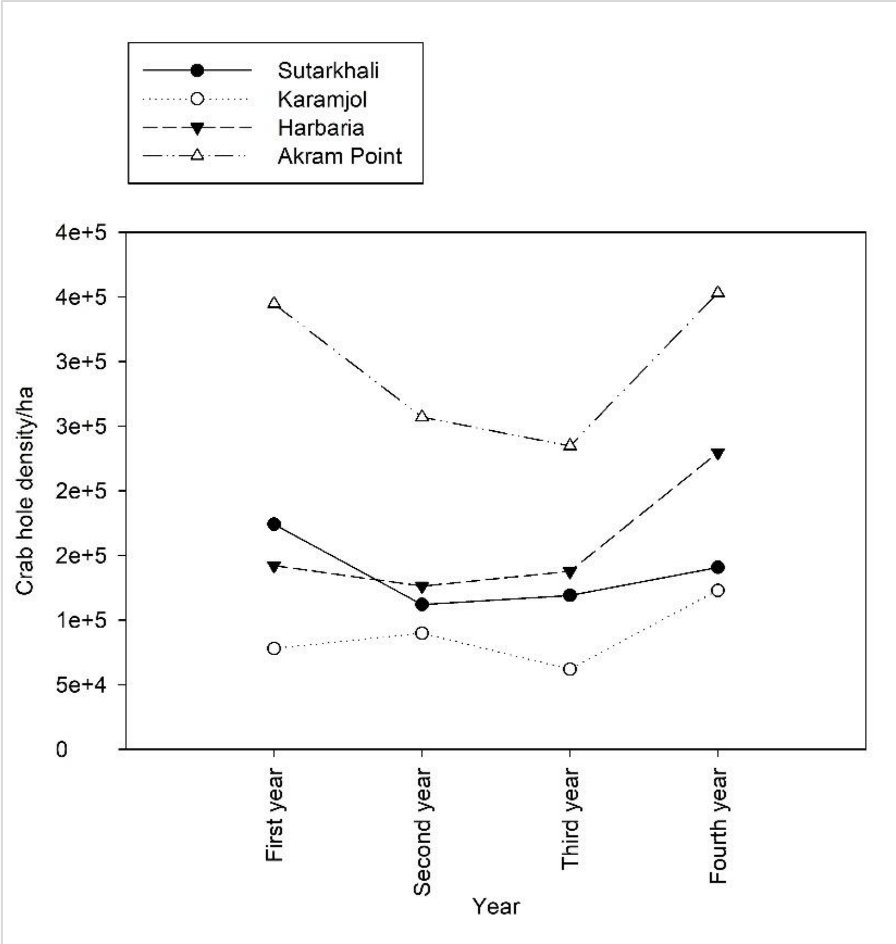


(Pneumatophores density for fifth year was monitored during winter only)

Figure 3.26: Yearly variation of Mean Pneumatophores density among the observed PSPs

3.5.7 Crab hole density

There is no significant variation (p>0.05) in crab density over the monitoring period for Harbaria, Sutarkhali and Karamjol PSPs (**Figure 3.27**). However, Akram point crab density was significantly different then the other three sample plot (p<0.05). Crab hole density was comparatively very low at Karamjol point area whereas density was highest in Akram point.



(Crab hole density was monitored during winter period for 5th year monitoring)

Figure 3.27: Yearly variation of crab hole density among the observed PSPs

3.5.8 Canopy cover

The canopy cover percentage at Akram point monitoring site varied significantly among the four subsequent monitoring ($P<0.05$). The other four PSPs (Sutarkhali, karamjol, herbaria point) canopy cover doesn't vary significantly ($P>0.05$). Akram point PSP's permanent plot canopy cover was lower compare to the rest of PSPs canopy cover percentage (**Figure 3.28**).

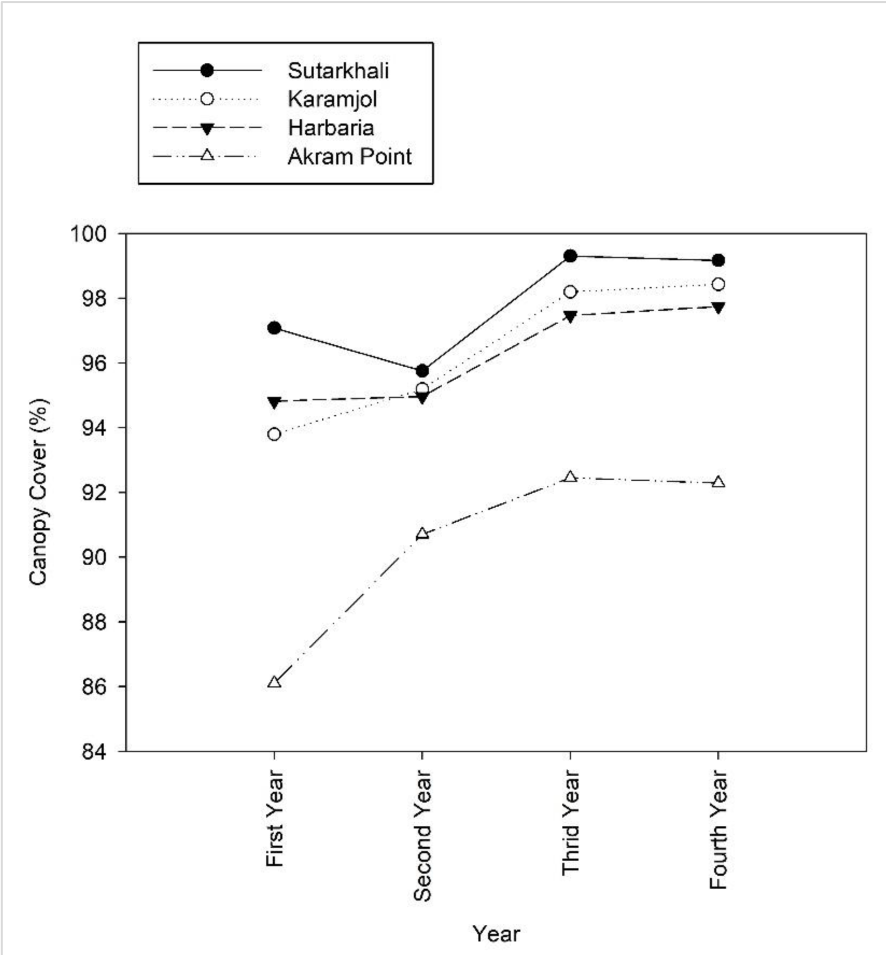


Figure 3.28: Yearly variation of canopy cover (%) among the observed PSPs

3.5.9 Leaf Area Index (LAI)

The LAI (Light Area Index) influences daily rate of net canopy photosynthesis which results in exchange of atmospheric CO_2. The minimum the ratio of under canopy to open canopy light intensity value indicates the maximum LAI. There was significant difference observed at Akram point and Karamjol PSP's compare to Sutarkhali and herbaria LAI (**Figure 3.29**). It was found that the LAI has increased in all monitoring locations from previous census period except Akram Point and Harbaria.

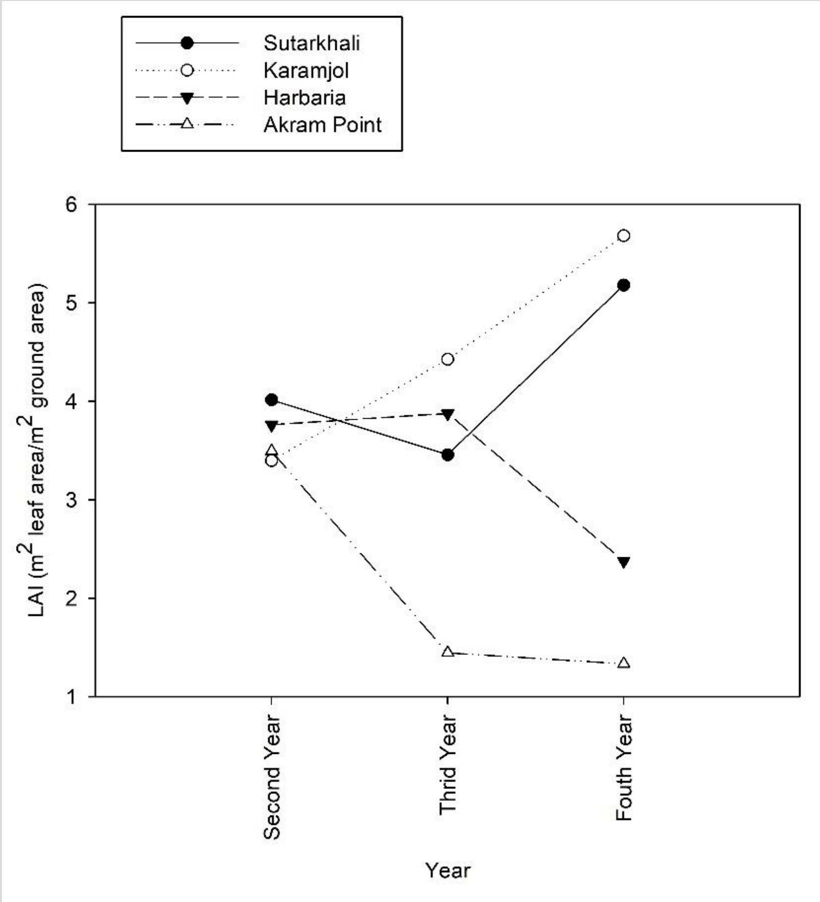


Figure 3.29: Yearly variation of LAI among the observed PSPs

3.5.10 Carbon stock in Trees

Over the census period, there was no significant difference (*P*>0.05) in tree carbon stock for all the PSPs **(Figure 3.30**). However, an increasing trend in carbon stock was observed in all PSPs except Akram point. Species difference in carbon stock was not significant except Sundari and Gewa (**Table 3.23, Table 3.24**). Sundari has the highest amount of carbon stock followed by Gewa.

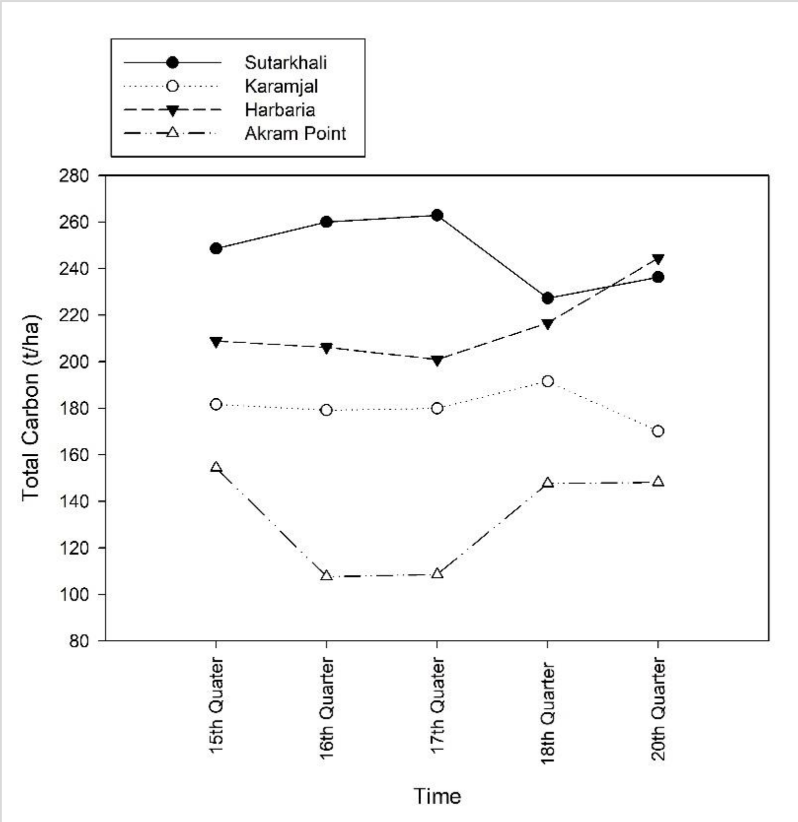


Figure 3.30: Tree carbon stock variation among the observed PSPs

Table 3.23: Species wise Total biomass and carbon stock (t/ha)

Species	TB_16th Quarter	TB_17th Quarter	TB_18th Quarter	TB_20th Quarter	TC_16th Quarter	TC_17th Quarter	TC_18th Quarter	TC_20th Quarter
Amoor	12.86	15.56	2.80	3.29	6.43	7.78	1.40	1.65
Baen	28.77	31.09	143.44	133.01	14.38	15.54	71.72	66.51
Dahur	2.12	2.36	0.28	0.49	1.06	1.18	0.14	0.25
Bola	0.84	0.84	0.27	0.27	0.42	0.42	0.13	0.13
Gewa	307.13	319.95	250.06	250.24	153.57	159.97	125.03	125.12
Goran	-	-	1.32	1.53	0.00	0.00	0.66	0.77
Kakra	105.41	106.20	106.33	104.06	52.70	53.10	53.17	52.03
Lakur	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Passur	85.25	85.87	127.99	151.48	42.62	42.94	63.99	75.74
Sundori	938.77	913.80	932.44	952.77	469.39	456.90	466.22	476.38
Urmui	2.93	4.70	0.87	0.79	1.47	2.35	0.43	0.40
Vaila	23.83	26.16	1.62	1.47	11.92	13.08	0.81	0.74

N.B. Hiron point was excluded from the analysis. TB-Total Biomass, TC-Total Carbon

Table 3.23: Transect wise average Biomass and Carbon stock over different census period

Transect	Sutarkhali	Karamjal	Harbaria	Akram Point
Biomass Stock				
AGB (t/ha)_16th Quarter	452.24	311.48	358.50	187.15
AGB (t/ha)_17th Quarter	457.09	312.91	349.36	188.79
AGB (t/ha)_18th Quarter	395.22	333.10	376.80	256.70
AGB (t/ha)_20th Quarter	411.00	295.88	425.12	257.61
BGB (t/ha)_16th Quarter	67.84	46.72	53.77	28.07
BGB (t/ha)_17th Quarter	68.56	46.94	52.40	28.32
BGB (t/ha)_18th Quarter	59.28	49.97	56.52	38.51
BGB (t/ha)_20th Quarter	61.65	44.38	63.77	38.64
TB (t/ha)_16th Quarter	520.08	358.20	412.27	215.23
TB (t/ha)_17th Quarter	525.65	359.85	401.77	217.11
TB (t/ha)_18th Quarter	454.50	383.07	433.32	295.21
TB (t/ha)_20th Quarter	472.66	340.26	488.89	296.25
Carbon Stock				
AGC (t/ha)_16th Quarter	226.12	155.74	179.25	93.58
AGC (t/ha)_17th Quarter	228.55	156.46	174.68	94.39
AGC (t/ha)_18th Quarter	197.61	166.55	188.40	128.35
AGC (t/ha)_20th Quarter	205.50	147.94	212.56	128.80
BGC (t/ha)_16th Quarter	33.92	23.36	26.89	14.04
BGC (t/ha)_17th Quarter	34.28	23.47	26.20	14.16
BGC (t/ha)_18th Quarter	29.64	24.98	28.26	19.25
BGC (t/ha)_20th Quarter	30.83	22.19	31.88	19.32
TC (t/ha)_16th Quarter	260.04	179.10	206.13	107.61
TC (t/ha)_17th Quarter	262.82	179.92	200.88	108.55
TC (t/ha)_18th Quarter	227.25	191.53	216.65	147.60
TC (t/ha)_20th Quarter	236.33	170.13	244.45	148.12

N.B. Hiron point was excluded from the analysis. TB-Total Biomass, TC-Total Carbon

3.5.11 Phonological behavior

The phenological events such as leaf emergence, leaf shedding, flowering and fruiting and fruit/ propagule dropping time may affected by Air pollution. Hence, Phenological behavior can be used as bio-indicator of forest health. This indicator was introduced for the first time at 19th Monitoring (Jan 2019) for Sundarban Reserve forest monitoring. Phenological behavior of major mangrove species was summarized in **Table 3.25**. There were no changes observed in phenological behavior of the dominant tree species**.**

Table 3.25: Phenological behavior of major mangrove species in the PSPs

Species	Months											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	Leafing											
Sundari												
Gewa												
Goran												
Kakra												
Passur												
	Leaf Shedding											
Sundari												
Gewa												
Goran												
Kakra												
Passur												
	Flowering											
Sundari												
Gewa												
Goran												
Kakra												
Passur												
	Fruiting											
Sundari												
Gewa												
Goran												
Kakra												
Passur												
	Seed/Popagule dropping time											
Sundari												
Gewa												
Goran												
Kakra												
Passur												

Source: Rahman and Islam. 2015.

3.5.12 Pest and Disease

Diseases in trees can also be used as forest health bio-indicator. A number of diseases has been identified by reserachers as chief causes of population decline of the tree species Avicennia *spp*., Rhizophora *spp*., Heritiera *spp.*, Pandanus *spp.*, Phoenix *spp*. and Acanthus spp (Rahman et al. 2010). Certain important diseases of Sundarban mangroves are leaf blight, Dieback, stump and collar rot, trunk gall, root rot, leaf blight, leaf necrosis, powdery mildew (Rahman et al. 2010). However, in the present study, ‘top dying’ of Sundari was observed in all the PSPs. Almost 30-40% Sundari trees were suffering from ‘top dying’ disease.

Summary

Forest health is a condition of forest ecosystems that sustains their complexity while providing ecosystem services for human needs. Giving priority to maintain the ecosystem of the sundarban reserve forest, the authority took initiative for ecosystem monitoring and the Sundarbans Reserve Forest (SRF) health monitoring periodically. This will help to determine detrimental changes or improvements that occur over time. Forest health monitoring data will also provide baseline to compare forest health condition during power plant operational phase. Sundarbans Forest Health were monitored using various bi-indicators such as tree growth, species diversity, seedling regeneration capacity, phenumetophore occurrence, crab hole density, Canopy cover changes, Leaf Area Index, leaf phenology, pest and diseases, Biomass and carbon stock. From the periodical field observation, different bio-indicators (i.e. seedling regeneration capacity, pneumatophores occurrence, crab hole density, canopy cover changes, Leaf Area) were found in steady state condition indicating no detrimental changes occurred. In addition, some boo-indicators such as tree growth, seedling regeneration, biomass and carbon stock increased significantly which indicates improvements of forest health over time. Soil acidity, salinity and organic matter/Organic carbon content were identified as the most influential soil variables responsible for species compositional variation. Gewa was the dominant species followed by Sundari and Kakra. No severe pest and disease attack were observed in the monitoring PSPs except top dying symptom of Sundari. Overall, it can be said that forest health is in good condition except top dying of Sundari.

Canopy Cover measurement

Pneumatophores and crabhole counting

Tree Diameter measurement

Noise measurement inside the PSPs

Data recording by team member **Tree height measurement**

Figure: 3.31 Forest Health monitoring photos

4. Social Environment

4.1 Socio-economic Condition and Social Safeguard

Following the 19th monitoring, the 20th quarterly social safeguard monitoring was conducted and monitored the social safeguard status at the construction phase of the project. This monitoring was conducted following the conditions of DoE and the “Performance Standards on Environmental and Social Sustainability” of International Finance Corporation (IFC). The selected indicators of social safeguard issues like working condition, employment and livelihoods, community health, and corporate social responsibility was monitored, and status of each indicators was identified in this phase of social safeguard monitoring. The status of mentioned indicators monitored in getting feedbacks from the project site and affected area (i.e. Kapasdanga, Rajnagar, Gaurambha and Bara Durgapur mauza). Finally, the present status (February 2019 – April 2019) on social safeguard indicators have been analyzed and presented in the following section.

4.2 Methodology

4.2.1 Physical Observation

For understanding working condition at the project site, physical observation was used as a method for data collection. Applying this method, occupational health and safety, condition of labor shed, toilet facilities, kitchen and food condition, use of PPE was monitored and realized the present phase of monitoring (**Figure 4.1**)

4.2.2 Consultation

A meeting was held at the project site in presence of Environmental Consultant of BIFPCL, Health and Safety Manager of BHEL and Representatives from CEGIS. During this meeting, general conversation held to identify the CSR initiatives and their present status, use of PPE and overall working condition.

Regarding the future plan on CSR activities, the authority identified and suggested some plans and programs. Another consultation was held in Adaghat High School where students and teachers participated and shared their experiences on previous CSR activities and their outcome.

4.2.3 Informal Interview

Informal interview was held with Chairman of Rajnagar Union Parishad, Head Master of Khan Jahan Ali High School, Adaghat High School, Barni High School and Failarhat Primary School. The teachers were explained about the CSR activities held in those schools and their concern about the construction activities and future need of those schools (that would come from the CSR activities).

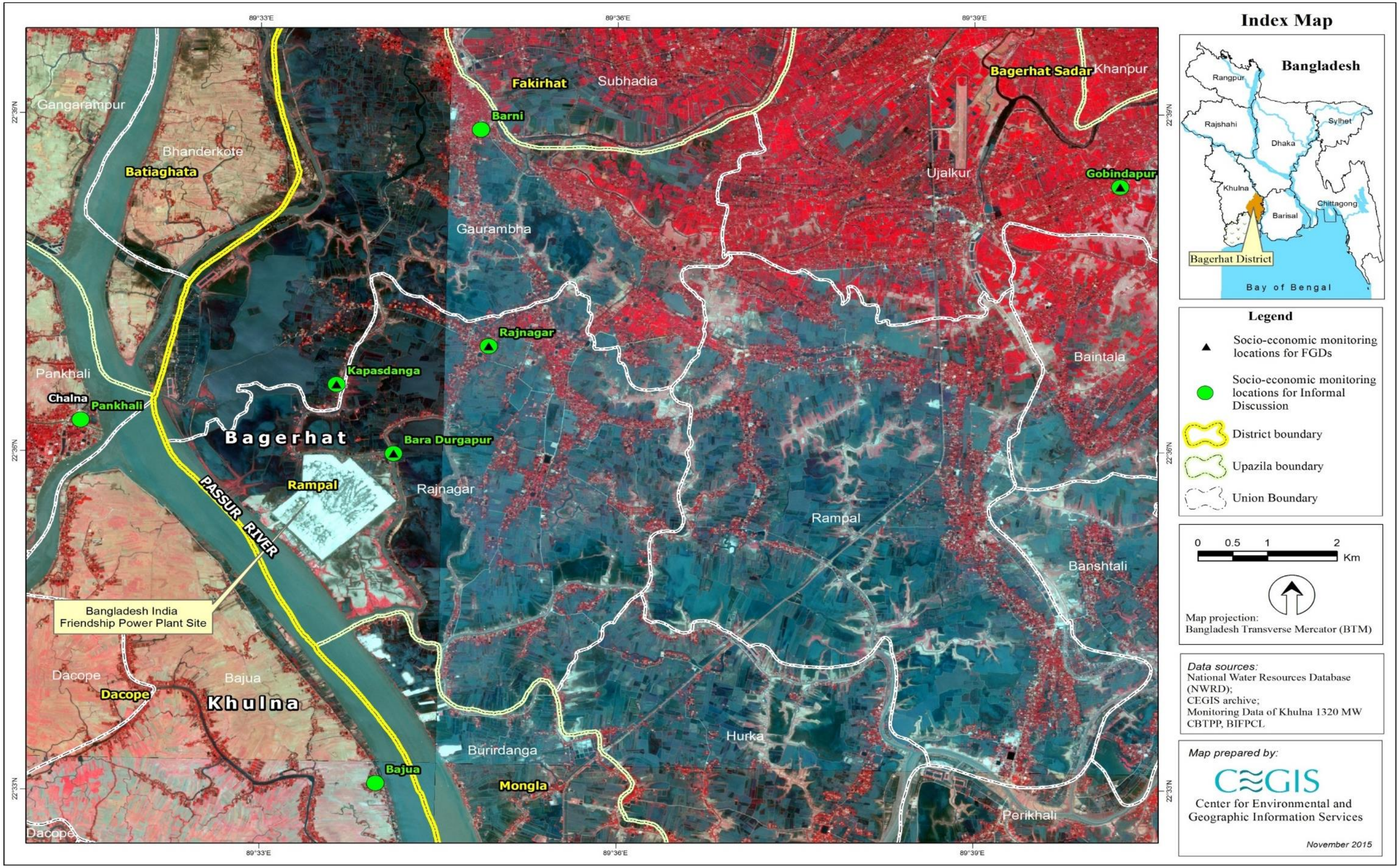


Figure 4.1: Socio-Economic Environment Monitoring Location

Project Related Employment Generation

Most of the labors were recruited by the subcontractors following the terms and conditions of BIFPCL and BHEL. The subcontractors hired skilled and semi-skilled labors those who have related working experiences. The demands based on the workload vary time to time that is linked with the recruitments of labors. The BIFPCL and BHEL monitored the whole recruitment process as they can maintain terms and conditions for successful recruitments. As per the findings, most of the labors, technicians, supervisors and other professionals come from outsides (areas those are not closer to the project sites).

Though there is a condition of DoE in recruiting the local labors, but lack of skills and experiences, a small portion of local people were engaged during the construction phase. Local people found more prompt to work in this project site and stated that scope of more engagements of more local labors should have to be created by providing training to the local people in different trades like electronics, driving, health and hazard safety, fittings, welding etc. Considering this aspect, the BIFPCL took initiatives, and started computer training for generating ICT skill among the local people. Besides, they have the plan to initiate skill development trainings on electronics, driving, health and hazard safety, fittings, welding. The target of this training is to create semi-skilled manpower who would be engaged during the construction and operation phase of this project.

Labour and working condition

Presently, about 4,000 technical and non-technical workers (the number can be varied because of work load) were working for implementing different project related activities. The BHEL instructed all subcontractors to follow all safety and security related requirements (mentioned in the contract documents) for avoiding any accidental risks. A third party was appointed to monitor the safety status. Every day, each subcontractor were arranging tool box training that was compulsory for all workers. The safety engineers from BHEL monitored the status of this training as their routine activities. Most of the labor shed was designed with proper infrastructures and facilities (i.e. kitchen, toilets, beds, water, and electricity). According to labors, the toilet facilities are not enough in comparison with the number of labors. A labor shed found with lack of proper infrastructures that is creating problem for labors to live with good environment. Lack of electric fans and not enough scope to pass winds to the labor sheds made suffocating situation that is creating problems for the labors.

During this phase (20th quarterly monitoring), accidents occurred during the night shift work at the project site. About 5 people were died which was reported in the newspapers (BIFPCL, April 2019). Considering this incident, the safety engineers were playing roles to avoid further risks of such death incidents. The subcontractors were penalized, and compensation for dead workers would be provided to their families which was under processing (till April 2019).

The BIFPCL and BHEL guided all subcontractors to use all safety equipment, and maintain all rules and regulations in which this kind of accidents would be avoided. All machineries are being used by the contractors was monitored by the concerned safety engineers and all workers are trained up to be accustomed with the use of required safety equipment for avoiding the risks of accidental cases.

Present practice of using PPEs in development activities as well as it’s probable requirement in the project site is specified in separate column in the following **Table 4.1**.

Table 4.1: Protective equipments of risky limb in human body

Risky limbs of human body	Protective Equipment	Present practice in project site
Eye	Safety spectacles/goggles, Welding shield	✓
Ear	Earplugs	✓
Head and neck	Safety helmets	✓
Hands and arms	Gloves, gauntlets and sleeves that covers part or all of the arm	✓
Legs and feet	Safety boots and shoes	✓
Lungs	Half and full masks filtering dust	✓

Source: Personal Protective Equipment at Work Regulations 1992 (as amended) and field survey, CEGIS

Community Health Safety and Security

Most of the people are well known about the construction of power plant. Up to this monitoring survey about 63,670 trees have been planted in which 17,328 mangrove trees, 45,550 goal pata, 660 fruit trees and 130 coconut trees planted for reducing dust blow and making the environment more ecofriendly. As per the findings of this phase of monitoring, only 20-25 percent trees (planted before) were surviving within the project boundary. However, this plantation was implemented according to the contract between BIFPCL and Bangladesh Forest Department (DoF), but lack of proper monitoring, manpower and supervision, the survival rate of those planted trees were very low which should be resolved as soon as possible.

Based on the findings of physical observation, water sprayed three (3) – four (4) times because of heavy wind and to avoid dust pollution. People of Boro Durgapur and Kapasdanga informed that construction work is continuing both in day and night shift, neglecting the restriction on construction work from 8 am to 7 pm as per DoE guideline. Use of heavy machinery may be restricted at the night stated by the local people.

The approach road to enter at the Rampal Power Plant is straight and smooth, which is friendly among the drivers to increase the vehicle speed. Because of no direction about the speed limits, there is a chance to occur road accident where community people become vulnerable for being injured. Besides, there is another construction related risks in which community people would be affected during the road crossing.

Local people stated to put speed limit sign in which the vehicles would maintain the speed limits during their movement. In addition, water need to spray for avoiding dust pollution because of construction alongside the approach road.

Activities under Corporate Social Responsibilities (CSRs)

<u>*School Campaigns*</u>

According to BIFCL and BHEL, school bags, water filters and umbrella distributed to thirty (31) schools and eight (08) colleges in which a total of 948 students of those schools and colleges were benefitted which was still continuing. Besides, umbrella distributed among the teachers of those schools and colleges.

In addition, the authority supported different programs like drawing and school athletics competition of nearby schools.

During this field visit, above mentioned school campaigns validated based on the findings of local people, students and teachers. Those local stakeholders positively responded about the school campaigns (as the part of CSR activities under the Rampal Power Plant Project).

Medical Campaigns

With the presence of a MBBS Physician, medical campaign was arranging in both project site as well as at the affected Unions. More than 37,000 local people received treatment under the campaigns. Following the other medical camp, another medical campaign was held in Burirdanga Union on March 03, 2019. In this campaign, local people participated and received treatment. People have a positive opinion on this program but they want to get such services in which serious patients would be able to get the admission to the nearby hospitals from the reference of this medical campaign. In addition, people urge to get diagnosis support under this medical campaign.

Capacity Building Programs

The project management unit stated that they have the plan to initiate skill development training for the local people as they can be capable to be engaged in the project related activities in both construction and operation phases. According to the BIFPCL, Bangladesh Industrial Technical Assistance Centre (BITAC) will be the partner to arrange trainings on electronics, mechanical, wielding, electrical and other trades. Students from localities located near to the project site will get the chance to enhance their capacity to be evolved as semi-skilled professional in the future. A MoU will be signed between BITAC and BIFPCL to start the training program. Under the capacity building program, till now, about 121 persons received training on sewing, and about 140 persons got the ICT skill development training. Local people from Gaurambha, Rajnagar, and Burirdanga unions participated in this skill development training program.

Recommendations

a. For assessing the needs of local communities, it is required to sit together where LGI representatives, local people, civil society members, journalist can participate to identify and share their needs.

b. Publicity on environmental issues regarding this project should be displayed publicly in which community people would be known about the project and its activities.

c. Vocational training on carpeting, electrician & electronics, welding, driving, safety, rock binding, and machineries should be initiated as local labors would be engaged in construction activities as semi-skilled labor force.

d. All machineries should be checked properly before using to avoid the risk of accidents.

e. Mortality rate of trees is very high. For reducing the mortality of tree it is required to recruit a forest plantation expert to monitor the planted trees properly and to take necessary action for plant survival.

f. The conditions of labor sheds should be cleaned for creating a good environment.

g. Toilet facilities for labors should be ensured.

h. Night shift work should be limited to avoid the risks of accidental case and sound pollution.

i. The compensation for death (workers died due to accident) should be provided to their family members as per the existing rules.

j. It is recommended to organize vocational training program for the local people (capable) in different trades so that they can be easily absorbed in the project as semi-skilled worker.

k. Equitable distribution of CSR activities should be followed by engaging all affected people living different unions.

l. Spraying of water should be continued on the approach road, construction sites, and other places where necessary at least three times during dry season to suppress dust.

m. For avoiding the risks of accident, speed limit signs, crossing signs etc. should be provided on the roads.

n. A separate walk way may be considered along the approach road to avoid risk of accident

5. Environmental Compliance

5.1 Introduction

Maitree Super Thermal Power Plant Project is being constructed within a specified time schedule. The Engineering, Procurement and Construction (EPC) contractor has deployed a number of sub-contractors sequentially or simultaneously though good practices.

During the environmental compliance monitoring of Power Plant Construction program, it was observed that almost all of the construction package has been initiated. The civil construction activities at the Boiler, Turbine installation areas and other heavy equipment installation areas, stack point, Jetty, township, internal road communications, permanent drainage networks, water treatment system for the construction activities etc. have been progressing tremendously. Even the mechanical construction works are initiated to install the boiler, ESP, Turbine etc. Equipment are transported to the project site by road. However, the permanent jetty construction works are advancing to import the heavy machineries by Passur River.

Extension of the two-lane approach road of about 6.0 km. from Babur Bari point at Khulna - Mongla Highway to the Project site has been continuing. The bridges and culvert area have already been extended to six lane road requirement. The security system has been highly tightened. Boundary wall around the Project area, slope protection, office building, roads and drainage system are always changing for betterment of the works toward final layouts of the project.

The main Project Office of BIFPCL and EPC contractor's office are going to be shifted to the newly constructed building. The EPC contractor i.e. Bharat Heavy Electricals Limited (BHEL) has already employed different local specialized sub-contractor construction firms for progressing the construction works simultaneously such as DIPON, KELLER, AFCON, POWER MAC etc.

The present environmental compliance monitoring includes the status of EMP implementation based on physical observation, investigation and interviews by the study team. A comprehensive due 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.

In the meantime, two incidents has been happed during the March, 2019. After the electrocution accident in September 2018, these two accidents were taken place again during the project construction works. Two labors died and one injured due to a heavy container tumbled down during their temporary resting period. Both of the victims named Mr. Nayeb Ali (45), Mr. Firoz (49) were from Bheramara Upazila of Kushtia District. The accident had been happed at the evening on 2nd March, 2019.

The second accident was happened on at night nearly 8:00 pm when a crane collapsed and fallen on the labours. Mr. Asadur Rahman (32) from Bagerhat District and Mr. Nasir Uddin (27) form Chapai nawabganj District died during this incident. However, those accidental event has coerced to re-think about the occupational safety status of this project construction works. A detail investigation about the incidents were running at the time of this compliance monitoring visit.

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

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

Sl. No.	Potential Impacts	EMP measures as proposed in the EIA	Actual condition/ Measures already Implemented	Compliance Status	Recommended Action
1	Generation of Noise within the BIFPCL's Plant premises	• Switch off / throttle down all site machinery, vehicles, water vessels, and generator when not in use • No construction activities at night • Use noise damper within the project boundary, Limit vehicle speed and monitor it at every suitable point.	• Noise level has been monitored continuously in every month for both night and day period of time at different potentially sensitive areas and compared with the ECR Standard. • Noise level is within the limit around the project boundary but exceeds at some places during heavy construction works during construction works • Use of PPE (Cap, BootEar plug etc.) by the workers at working period. • Machines/equipment/ generators which are passing idle period are switched off/throttled down. • Using sound proof room for the office workers.	Being Complied.	• Limit the noise level (ECR, 2006) within the project boundary. • Give emphasis to use earplug during the construction site
2	Dust generation from construction works	• Limiting activities for producing fugitive dust particle within project area • Vegetation clearance and base stripping should be minimized • Vehicle speed restriction must be enforced to control dust generation • Earthen roads and undeveloped roads should be avoided to minimize dust generation • Construction materials must be covered to protect from wind action • Spray water regularly for suppressing fugitive dust	• Frequent air quality monitoring in and around the project sites have been conducted and checked it with ECR 2005 standard. • Monthly and quarterly monitoring results revealed that the dust was generated from the construction sites. • Water spraying frequently was recorded for reducing dust emission. • Permanent concrete roads, drainage and building have been constructed	Being Complied	• Spraying water to the stockpiles of construction materials substantially • May use cover or wind breaker for stocking finer construction materials • Use musk by the worker at construction site

Sl. No.	Potential Impacts	EMP measures as proposed in the EIA	Actual condition/ Measures already Implemented	Compliance Status	Recommended Action
		• Dust particle generated from access roads must be controlled by spraying water during dry season • Stock piles of construction materials must be covered in order to protect from wind action. • An appropriate freeboard must be maintained in trucks hauling construction materials.	• Substantial warning sign and notification were not observed at the strategic locations. • Water spraying is limited at the stockpiles construction materials • Significant setback distance was recorded between stock piles and river bodies. • Covering of stock piles were limited due to day to day high construction works		during dust dispersion though wind.
3	Water Quality	• Surface water must be saved from any harmful effluent emission and waste dumping from project site • Provide closed system facilities and wastewater treatment plant to minimize discharge of effluents from worker's colony. • Good housekeeping at workshop and construction site • Appropriate equipment with safety measures should be used for storage and handling of lubricant • Provide training and awareness building program to the workers during construction. The training and awareness programs are: a) Arrange weekly consultation session among the workers through plant site managers. The duration of consultation is one	• Harmful disposal was not recorded which is reflected in the monitoring parameters. • Existing drainage system has been rearranged and permanent drainage system at the North-east corner already been established. Waste water are mixed with the surface runoff both from the project site and labor colony finally discharged though this drainage system. • Rainfall runoff discharge to nearby river through existing temporary drainage network or fixed pipe is being cleared occasionally. • EPC contractor is checking the water quality of outfalls regularly. • Sizeable sanitary toilet has been established at the labour shed. • Reuse of rainwater stored at temporary drainage areas for water sprinkling and curing activities.	Being Complied	• Restrict the solid waste disposal into the drainage system

Sl. No.	Potential Impacts	EMP measures as proposed in the EIA	Actual condition/ Measures already Implemented	Compliance Status	Recommended Action
		hour according to ISO-14001 standard, b) Arrange monthly environmental meeting among the mid-level officers through top management when those issues will be discussed under guidance of ECR 1997.	• Good housekeeping for storing the materials. • Onsite sanitation facilities have been developed at the labor sheds as well as the working places. • Training and awareness program are being continued.		
4	Waste Generation	• Limiting site clearance and base stripping activities within the project boundary. • Gathering and stocking of construction materials and machinery must be within a limited area in the project boundary. • The project area has to be fenced prior to initiation of construction activities. • Stock piles of construction materials requiring cover up in order to protect them from wind and weathering action. • The existing right of way have to be used for material transportation without creating any block • Location of spoil stock pile ought to be located in safe area and protected from wind and rain action. • No spoil store on River bank/slope • Construction wastes must be reused or recycled as and where possible	• Heavy equipment and mechanical equipment are kept in the demarcated places. • Conventional way of waste collection and disposal system has been conducted both at Plant office and labor shed. • Burning of waste materials was not recorded • Material transportation is being done by regular route without as per safety procedure. • Waste management has been included into the induction training of the labor • Local language (Bengali) are being included in the signboards. • Developing a formal procedure for waste collection and disposal • Construction materials and excavated soil were found stored near the river bank. • Scattered solid waste was found in many places of the project site.	Being Complied.	• The number of Waste Disposal Bin/s with labelling should be increased at labor shed, and at working area. • Communication with the local authority for offsite waste transportation and disposal. • Adopting of 3R strategy for waste management.

Sl. No.	Potential Impacts	EMP measures as proposed in the EIA	Actual condition/ Measures already Implemented	Compliance Status	Recommended Action
		• Burning of waste material should be restricted • Quality housekeeping practice must be maintained by regular inspection and checking. • Keep onsite waste collection and disposal facilities • Keep provision of different colored waste bin for dumping biodegradable, reusable and recyclable wastes. • Keep provision of awareness building meeting and training for employees	• Colored waste bins for disposal of different types of waste were not observed during the field visit. • Conventional waste collection system has been observed at the labor colony as the villagers were collecting the waste plastic materials from the labor colonies.		
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	• 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 was paid by the local DC office • Local DC office facilitates unauthorized occupants of the acquired land to get home in the shelter houses or cluster villages provided by the GoB. • BIFPCL gives priority to affected people in Project related employment. • A significant number of affected people (especially who desires) are working at the construction site. • 136 indirectly affected people was given compensation by the DC Office, Bagerhat.	In the process of Compliance	• The CSR activities should be oriented towards the affected people or household

Sl. No.	Potential Impacts	EMP measures as proposed in the EIA	Actual condition/ Measures already Implemented	Compliance Status	Recommended Action
		• Has a resettlement plan been developed which includes compensation, restoration, livelihood, living standards etc. based on proper socio-economic studies? • Human provide/ take extra care/caution for the disadvantaged/ vulnerable group/s (i.e. women, children, ethnic minorities, indigenous people etc.) • Provision of monitoring the compensation and resettlement process	• One third of the labor has been recruited from the local which include the PAPs • Livelihood Restoration Plan (LRP) for the PAPs have been prepared by BPDB. • Local NGOs are working with the PAPs as per the recommendation of LRAP and DoE approval conditions. •		
6	Livelihood and living condition	• The labor recruitment policy must be formulated in such a way that the local laborers can easily get the chance of employment in the project work force. • Govt./NGOs need to provide support the skill development program and income generation activities to local people • For the increased movement of people and heavy vehicles, the road networks must be developed. • Keep provision of sanitary toilet, one toilet for 10 persons.	• BIFPCL is maintaining the social liaison especially with the local Government and DC office • Implementing the HR policies, Labor recruitment Policies, Manpower set up etc. • The EPC contractors are also deployed Environment and Safety officer for better management of construction works • Only specialized mechanic and fitter are being employed in this project as locals are not available for specialized job. • Accidental log sheet or injury log book are being maintained and report is being sent to DOE. • One third of the total labor are recruited from the local areas.	In the process of Compliance	• Training and motivational program should be run for the worker of shrimp farm, local labour, Bauali, Mauali or farmers; • Occupational safety should be prioritized first.

Sl. No.	Potential Impacts	EMP measures as proposed in the EIA	Actual condition/ Measures already Implemented	Compliance Status	Recommended Action
			• Most of the local labors are directly project affected people, nearest communities or within the Rampal/Mongla of Bagerhat District. • The wage of the labor is compatible with the national standard. • Standard labor colony has been prepared except one. • Provision of first aid is present; • Medical unit capable of dealing emergency situations like injury, ICU supported ambulance, accident, etc. are already in place. • Prayer room has been constructed. • Available drinking water, sanitation facilities are recorded at site • The existing occupational safety system has been revised due to repeated accidental events. • BIFPCL has reported those incident as per direction of EIA approval conditions and ERP		
7	Green House Gas Controlling Measures	• Restriction of any kind of solid waste disposal • Approved pollution control devices to be fitted in equipment and machinery. • Transport vehicles must not be overloaded. • Avoid queuing of vehicles in areas adjacent to site, particularly near sensitive receptors including housing.	• The EPC is taking few measures to control the Green House Gas emission. • Used equipment and vehicles are relatively new. • Equipment, generators and vehicles were switched off during not in operation period.	In the process of Compliance	• GHGs inventory checklist should be prepared immediately at this stage;

Sl. No.	Potential Impacts	EMP measures as proposed in the EIA	Actual condition/ Measures already Implemented	Compliance Status	Recommended Action
		• Switch off / throttle down all site vehicles, water vessels, generator and machinery when not in use. • Regular maintenance of water vessels, vehicles, generator and machinery in accordance with manufacturer's			

Table 5.2: Monitoring of Labor and Working Condition Sl. No

Sl. No.	Potential Impacts	EMP measures as proposed in the EIA	Actual measures already Implemented	Compliance Status	Recommended Action
1	Working Conditions and Management of Worker Relationship	• Preparation of Human Resources Policies and Procedures for Direct workers; • Defined Working condition and Terms of Employment for direct worker; • Sustainably equivalent terms and condition for migrant workers; • Compliance to national law of forming workers' organization; • No discrimination and equal opportunity for all; • Grievance Redress Mechanism.	• EHS department has been reshaped and rearranged after two consecutive accidental incidents; • No forced and child labor was recorded; • The EPC has signed contract with the sub-contractors ensuring the labor policies; • BIFPCL has instructed the EPC contractor to ensure safer workplace; • Ensured minimum wage and working hours for the labor as per GoB rules and regulation. • Induction training and regular training of first aid, toolbox is continued strictly.	In the process of Compliance	• Primary and secondary safety system should be implemented at construction site. • Ensure OSHA during construction works to protect from- • Falls (from heights); • Trench collapse; • Scaffold collapse; • Electric shock and arc flash/arc blast; • Failure to use proper personal protective equipment; and • Repetitive motion injuries.

Sl. No.	Potential Impacts	EMP measures as proposed in the EIA	Actual measures already Implemented	Compliance Status	Recommended Action
			• BHEL has deployed more human resources for ensuring occupational safety. • Maintaining the security system so that the unauthorized people cannot enter into the project area. • No discrimination and equal opportunity of employment for local and migrated labors have been ensured following the 'Bangladesh Labor Law (Revised) 2013', 'Bangladesh Labor Rule, 2015'.		
2	Protecting Work Force	• The client will not employ children in any manner that is economically exploitative, or is likely to be hazardous or to interfere with the child's education, or to be harmful to the child health or physical, mental, spiritual, moral, or social development. • No Forced Labor	• Ensured no child labor employment by the EPC or other subcontractor as per GoB laws and regulations. • Ensured no forced labor • Proper documentation of contract with the worker is being maintained which includes working hour, wage and benefit. • First Aid support is provided to the labors as required. • ERP has been more functional and they have taken methodical initiatives during the incident • Now labors are bound to use PPEs during works at site. • Significant numbers of safety officers has been appointed for insuring the safety	Being complied	• The insurance policy should cover the accidental case or injuries of the labors; • Awareness work should be continued regarding the local cultural values, STD, redressing of workers grievances, insurance policy related facilities and also contract clauses of the job to get maximum benefit. • Use the methodical procedure for safety at site.

Sl. No.	Potential Impacts	EMP measures as proposed in the EIA	Actual measures already Implemented	Compliance Status	Recommended Action
			• In association with the induction training, regular safety training were taken places. • New, ICU supporting ambulance, medical unit of BHEL, Medical unit of BIFPCL and contract with Gazi Medical have been arranged at this stage. • Contractor has taken insurance policy for engaging labors as per labor policy of Bangladesh.		
3	Safety at site	• Installation/Construction of Safety Fence around the Project area • Use of Personnel Protective Equipment's (i.e. safety vest, safety goggles, ear plug, safety shoes, gloves, dust mask, etc.); • Safety trainings for workers (i.e. fire control, working at height, working in heat, first aid etc.); • Practice of Tool box meeting, safety talks • Safe Storage of Hazardous • Chemicals (e.g. fuel, flammable chemical, toxic chemicals, etc.); • Maintaining Material Safety Data Sheet (MSDS); • Provision of Health care facilities such as doctor, hospital	• Insufficient safety sign especially the speed limit of the vehicles at the strategic places; • Protecting the specific areas with fence and demarcation sign; • Most of the Labor and Project personnel are using appropriate PPEs like reflecting vest, helmet, and safety shoes etc. • Safety training for workers are strictly conducted at project site; • Road traffic management including traffic movement are ensured at all access roads of the project area. • BIFPCL is strict to use the PPEs by the construction labors • increased the capacity of temporary hospitals, doctors and 24hr available of ICU supporting ambulance at the Project site;	In the process of Compliance	• Training should be repeated on personal safety of the worker like protecting the dangerous part of machine, vigilant for moving cranes, hooks or other lifting equipment, fall protection, extra-attention on electrical works etc. • No drink or drug at work, and system to be adopted to inform the supervisors immediately for any noted occurrence. • All hazardous and risky areas to be protected, fenced and signed accordingly.

Sl. No.	Potential Impacts	EMP measures as proposed in the EIA	Actual measures already Implemented	Compliance Status	Recommended Action
		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.); • 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	• Emergency contact address was found on the board at the site for any kind of sudden incident; • EPC has made a contract with the Gazi Medical of Khulna city for emergency case. • Construction work at site has been performed in presence of safety officer. • Available fire extinguisher was found at some regular intervals. • Preparing a register for any kind of accidental events and incidents; • Third party OHS check-up is continued; • Project site protection and security system are being strictly maintained by Bangladesh Ansar. They are maintaining the register log and gate pass.		
4	Occupational Health and Safety procedure	• Provision of complete EHS division in the Human Resources Planning/ Organogram • Preparation of Safety Policy to be adopted during Plant operation	• Employ significant number of safety officers in proponents' part, EPC contractor part and Sub-contractor also. • Reshaped and re-arranged the total occupational safety procedure. • Medical aid, fire extinguisher, PPEs are provided substantially. • Worker's shed and sanitation facilities are available;	In the process of Compliance	• Awareness build-up, strict to the safety issues, empower and responsible the safety officers at site.

Sl. No.	Potential Impacts	EMP measures as proposed in the EIA	Actual measures already Implemented	Compliance Status	Recommended Action
			• Onsite medical facilities are increased and EPC contractor has made a contract with the government or Private hospital for severe injuries. • BIFPCL has already establish a Health unit and BHEL has established a full-fledged EHS unit. • Mandatory of induction training, tool kit training, awareness, motivational and mock drill are being continued at all project phases • Empowered the EHS officers at site • Introducing primary and secondary safety at site during operation • Site-specific Environmental Health & Safety checking is in progress. • RO Water treatment plant for supplying safe drinking water for the labors is in place.		
5	Workers Well Being	• Provision of Welfare facilities for Worker/Labour such as, timely bonuses, wage, overtime, sick leaves, vacations etc.; • Routine medical check-up and emergency medical care for the sick and injured; • Appointment of a leader amongst the labour group, who	• Workers have no complain with the wage, working condition and the residence facilities. • Numerous provisions have been kept for Health care & information services, canteen facilities, water supply etc.	Being Complied	• BIFPCL has already penalized to BHEL for the intendent. They might have used the financial penalty as accidental benevolent fund. • Freedom of Association, Rights & scope of bargaining and tripartite

Sl. No.	Potential Impacts	EMP measures as proposed in the EIA	Actual measures already Implemented	Compliance Status	Recommended Action
		will look into workers' well-being.	• BIFPCL has developed apps https://bifpcl.com/safety.aspx for stepping up the safety issues well. • Proponent has ensured the establishment of fare wage of labors and the benefits for every labors. • BIFPCL has ensured the benevolent grant to the victim's family by the contractor as per Government' rule. • Free first aid medical treatment is being facilitated by BIFPCL and BHEL for the labor. • Community People are also taking medications from the BIFPCL medical camp running voluntarily. • Grievance of the worker have been redress urgently especially for safety issues • The proponent has taken care about two accident as per the legal procedure.		consultation should be open for the workers. • The proponent has to look after the following issues – equal benefit for the direct labor, contracted labor, day labor etc., workers work and non-work life balance, emotional support and health surveillance.

Table 5.3: Monitoring of Community Health, Safety and Security

Sl no	Potential Impacts	Proposed EMP	Actual measures already Implemented	Compliance Status	Recommended Action
1	Disturbance to nearby community due to dust from developed land and Noise from construction activities	• Construction of boundary wall around the Project area; • Installation of water spraying system to control dusts; • Conducting dust monitoring and visual inspection around the site boundary; • Adoption of noise management plan.	• Regular water spraying reduces the dust emission. • A number of community has been established around the project site especially near the project entrance bridge. • Unmanaged Block-B is highly responsible for spreading dust to the nearest community. • CEGIS is regularly communicating with the nearby communities for assessing any kind of impacts and related complains. • Regular communication and consultation are taken places with the local government and local administration. Dust impacts are recorded at the communities residing at the north-east corner of the Project.	Being complied	• BIFPCL shall inform to BPDB for taking initiative to control dust emission from Block-B area. • Any complain regarding noise and dust from local people to be addressed immediately and recorded accordingly in the register.
2	Grievance of local people	• Availability and operation of Grievance Redress Mechanism; • Maintaining open communication channel with the local community.	• Social liaison officer is working on development the relation with local communities; • National level stakeholder consultation was conducted. • Regional consultation are regularly taken places between	Being complied	• Resolve any kind of grievance to the local communities in association with the local government and local administration. • Training on behavioral development on the security personnel and other foreign officer should

Sl no	Potential Impacts	Proposed EMP	Actual measures already Implemented	Compliance Status	Recommended Action
			local government and project authorities. • Grievance register has been prepared for the community; • Good communication has been established with the local government and proponent; • Proponent is observing the community grievance or quarries though the monitoring study conducted by CEGIS.		be introduced to eliminate any misunderstanding with the local peoples.
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 behavior and	• Implement high security system for the project; • Health check-up is mandatory to every labors during the induction training. • Maintaining communication with local community; • Community people is now getting regular (twice in every week) medical checkup with essential drug facilities from the proponent medical campaign. • Negotiation with local DC office and Bangladesh Ansar and VDP to ensure community safety (who are responsible for security). • They have conducted medical campaign with regular interval for the nearby communities. Last	Being complied	• Continue the training and motivational work for maintaining local norms and values. • Make a liaison with the local government for clarifying any kind of indent/ rumor in local communities related with this project; • Introduce warmness social program for benevolent social development

Sl no	Potential Impacts	Proposed EMP	Actual measures already Implemented	Compliance Status	Recommended Action
		communication with the local people; • Aware the security personnel about the right of the community people.	time the campaign was for the gynecological patient at Rajnagar union (Leaflet and picture has been shown in annex). • The proponent is also contributing fund from CSR for training, school lab development, RO drinking water supply and arranging football tournament in order to make a peaceful relation among the communities.		
4	Community Health and 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.	• Developed the medical facilities (consisting medical officer, medical assistant, office assistant) at Plant site for screening of communicable diseases of the workers and staffs; • Arranging twice a weekly health service program (medical consultation and free medicine) for the local community. Around 2750 number of patient has been served through BIFPCL medical camp from December 2018 to February 2019. • Protective action are taking to avoid vector borne diseases and HIV positives.	Being Complied	• BIFPCL shall communicate regularly with the community to aware them about the health related issues as well as environmental safety and nutritional guidance.

Sl no	Potential Impacts	Proposed EMP	Actual measures already Implemented	Compliance Status	Recommended Action
5	Youth Employment (Local)	• Providing training/awareness program for the local youth to let them aware about the required qualification to get involved in the Project related activities Emphasis to recruit local labors according to their skills and capacities.	• Informal and formal sitting were arranged with the local government and community representatives for labor recruitment; • Significant number of local people (one third) are currently working at the construction site; • The proponent has already taken a number of initiatives to encourage local students through awarding them; The proponent has given water bottle and bag to the school going students for inspiring them. • Formal training on computer literacy and sewing machine has been initiated in the site and already 3 (three) batches was completed the training program. They are now planning to train on other sectors with the assistance of Khulna polytechnic college. • Age limit of the labor is strictly maintained with the use of appropriate PPE in the site	Being Complied	• Training related to construction work i.e. carpenter, electrician, lineman, elevator mechanic, glazier, iron worker, heavy equipment operator or laborer etc. should be introduced immediately; • The proponent may establish business development activities (markets) for the workers and local communities as CSR activities. • Local administration or NGOs may give small scale loan to the trainees for youth entrepreneurship development.
6	Public Communication, Consultation and Awareness	• Arranging public communication/consultatio n meeting;	• Display Project related information on a display board at Project site;	Being Complied	• Continue the dissemination workshop in Dhaka and Khulna and Bagerhat or Rampal Upazila to aware

Sl no	Potential Impacts	Proposed EMP	Actual measures already Implemented	Compliance Status	Recommended Action
		• Sharing of Project information with local people; • Organizing environmental and social awareness programs/meetings.	• Regular meetings are being carried out at different level; • Publishing Project related discussion/article in different print media. • Project related every information has been uploaded in BIFPCL website. • The local people are well aware regarding the project		the community, civil society, environmentalists about the environmental safeguarding and safety measures taken places in this project. • The EPC contractor should follow the social code of conducts / good practices as applicable.

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

Sl No	Potential Impacts	EMP measures as proposed in the EIA	Actual condition/ Measures already Implemented	Compliance Status	Recommended Action
1	Rainfall runoff from the construction site would cause deterioration of aquatic ecosystem.	• Installation of proper runoff drains; • Use of sediment fences, traps and basins for trapping the sediment, if required.	• Constructing permanent drainage system to discharge water inside the project area. • Maximum area has been developed including the jetty areas and drainage system is also performing well. • Rainfall runoff and other Construction water is drained out though temporary and permanent drainage system or formal pipe network • The connectivity of Maidara River is being maintained even the newly developed construction bridge.	Being complied	• Storm water drainage network must be separated from any kind of polluted (including sewage and domestic effluents) of the labor colonies and construction site.

Sl No	Potential Impacts	EMP measures as proposed in the EIA	Actual condition/ Measures already Implemented	Compliance Status	Recommended Action
			• EPC is monitoring the water quality on monthly basis at every outlet of the project site. • Fences, traps and basins for trapping the sediment were not found inside the project area.		
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 plantation of non-native species; • Retaining top soil for future habitat restoration;	• Limiting the vegetation clearance and base stripping process within the Project boundary; • Plantation program has been running with the help of forest department • They will plant gradually 65000 local species for green belt development. • Selection of local plant species like Goalpata, Sundori, Bain, Kaora for green plantation; • EPC contractor is monitoring the air quality, water quality and noise level more on monthly basis inside the project area • Working activities are now limited during night period of time in the project • No complaints registered from the community regarding lighting and noise effect from the project site. • Motivational works are introduced to protect local fauna during training session.	Being Complied	• Regular monitoring of the planted trees should be continued around the Project site. • Reduce the rate of plant dying at the sapling stages. • Bird sheds shall be created at the green belt areas. • Awareness program for ecosystem conservation and development should be introduced as a part of Corporate Environmental Responsibility and should be notified to the community for participation.

Sl No	Potential Impacts	EMP measures as proposed in the EIA	Actual condition/ Measures already Implemented	Compliance Status	Recommended Action
		• No degradation of sensitive 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 of Sundarbans and around the Project site is being continued; • Maintaining the of slope protection work; • Protection works along the Maidara River maintained setback distance from Maidara River. • EPC is monitoring the discharge quality at each of the outlet from this project on a monthly basis. • The natural stream flow of Maidara River near access road has been recorded. • They are constructing the permanent jetty as per layout	Being Complied	• Monitoring for not to through or dump construction materials or scrap materials to the nearby river

5.2 Compliance to the Conditions of DoE

Sl No	Condition of DoE	Compliance Status	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.	BIFPCL has not taken any extension plan of the proposed 1320 MW Khulna Coal Based Power Plant.	BIFPCL will comply with the condition prior to initiation of any expansion or extension of the Power Plant.
2	The Coal Specification and Power Plant technology should be maintained as per EIA report. In case any change in design the proponent must obtain consent from DoE.	The Coal Specification and Power Plant technology will be maintained as per EIA report. In case of any change in Plant design and coal specification the proponent shall obtain consent from DoE.	Suggested to comply as and when required.
3	Project Proponent may undertake activities for land development and infrastructural development of the Project.	BIFPCL has already completed land development activities. Infrastructure development activities are being continued.	Complied.
4	Project Proponent may open L/C (Letter of Credit) for importing machineries for the Project, which shall also include machineries relating to waste treatment plant and other pollution control devices.	EPC contractor has been appointed and construction activities are in progress. The EPC contractor is importing Power Plant machineries.	Being Complied.
5	The activity under Proposed Khulna 1320 MW Coal based Thermal Power Plant Construction and operation shall not release any pollutant that affect human health or will have damaging impact on the environment or natural resources.	BIFPCL engaged CEGIS as an independent entity for monitoring the construction activities for examining environmental impacts on quarterly basis. No significant impact on the surrounding environment or on the natural resources has been reported yet. All necessary pollution control measures and technologies have already been incorporated in the technical specification of main Plant of EPC package as per DoE stipulations. Pollution control measures have widely been covered in technical specification like Effluent Treatment Plant, ESP, and FGD etc. The EPC contractor are constructing the Plant as per the contracted technical specification. Moreover, monthly environmental compliance monitoring is also continued in the project site in order to record emission or discharge pollution form project.	Being Complied.
6	Proper and adequate mitigation measures shall be ensured throughout preparation, construction and	BIFPCL has monitored the EMP regularly. As a third party monitor, CEGIS has been appointed to monitoring the mitigation	Being Complied.

Sl No	Condition of DoE	Compliance Status	Remarks
	operation period of the proposed Khulna 1320 MW Coal based Thermal Power Plant Project activities.	measures adopted by the proponent during construction stage. Site development activities was completed and construction work has already been continued massively. Proper and adequate mitigation measures at this stage are being ensured However, two accidents have been happened in this quarter.	
7	Any heritage sight, ecologically critical area, and other environmentally, religious and archaeologically sensitive places shall be kept protected during Project construction phase.	There is no religious, archaeological place in and around the site. The construction activities are being carried out and a quarterly monitoring program is continuing to measure the impacts on the surrounding Ecologically Critical Area.	Being Complied.
8	Environment friendly construction and development practices shall be followed that minimize loss of habitats and fish breeding, feeding & nursery sites.	The construction activities are being carried out in and around the project boundary. The quarterly monitoring results reveal no significant impacts on fish habitats and fish breeding, feeding & nursery sites.	Being Complied.
9	Construction works shall be restricted to daytime hours so as to avoid/mitigate the disturbance of local lives as well as implementation schedules of the works shall be notified in advance to nearby residents.	CEGIS is monitoring the community response towards construction works of Power Plant regularly. Moreover, BIFPCL is keeping close communication with local people to receive their grievance related to project activities. The construction activities shall be restricted to daytime only. However, for the timely completion of the Project, if required, works may be continued beyond day time, but that must be done within the project boundary in such a way that it does not create any disturbance to nearby residents and eco-system.	Being Complied and suggested to continue the same throughout the remaining period of construction works.
10	Proper and adequate sanitation facilities shall be ensured in labour camps throughout the proposed Project period.	New residential areas and adequate sanitation facilities are becoming available for the labours. Provisions in line with this, condition have been included in Clause no 2.5 of Special Condition of Contract (SCC) and in Health & safety manual.	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 monitoring. Working during sensitive hours and locating machinery close to sensitive receptor are being avoided.	Being Complied

Sl No	Condition of DoE	Compliance Status	Remarks
12	No solid waste can be burnt in the Project area. An environment friendly solid waste management should be in place during the whole period of the Project in the field.	No solid waste is burnt inside the project boundary. Provisions in line with this, condition have been included in Clause No 14.9 of SCC. Solid Waste Management system has been prepared (Section-V, B12, Part-9 of Technical Specification). However, solid waste has been managed conventional process at this stage.	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.	Quarterly monitoring activities are being carried out to examine the impacts. No significant changes are yet recorded. Moreover, monthly environmental monitoring has been performed for noting any harmful emission or discharge pollution form project.	Being Complied
14	All the required mitigation measures suggested in the EIA report along with the emergency response plan are to be strictly implemented and kept operative / functioning on a continuous basis.	The project authority has increased the medical facilities for workers. An ICU support ambulance and Doctor are now available for emergency stages for both BIFPCL and EPC contractor. They have made a contract with government or private hospital for emergency medical services. The proponent has reshaped and rearranged the safety measures after the two fatal incidents. Villagers of surrounding areas also availing the healthcare facilities. The authority is trying to make aware the labours/workers on occupational health and safety through safety signboards, safety training and strong implementation of safety measures. The Emergency response plan is now functioning.	Being Complied
15	To control dust, spraying of water over the earthen materials should be carried out from time to time.	Water spraying for dust suppression are currently functioning especially for the dry days of this pre-monsoon. Moreover, regular dust monitoring is being conducted at the sensitive points.	Being Complied
16	Storage area for soils and other construction materials shall be carefully selected to avoid disturbance of the natural drainage.	BIFPCL is now constructing permanent drainage system to discharge water from the Project site. They are not interfering any natural drainage system beside the project boundary even construction of bridges on the Maidhara river.	Being Complied
17	Adequate considerations should be given to facilitate drainage system for runoff water from rain/tidal surge.	BIFPCL is now constructing the permanent drainage network to evacuate drainage water from the Project site. A setback distance	Being Complied.

Sl No	Condition of DoE	Compliance Status	Remarks
		from the river has been maintained during construction stage of this Project.	
18	Adequate facilities should be ensured for silt trap to avoid clogging of drain/canal/water bodies	Permanent drainage system is being constructed for discharging surface runoff. Regular monitoring has been conducted for avoiding the water clogging in the canal/drainage network.	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 is being 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.	Compliance action initiated.
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. Refer Section V, B4 of Technical Specification (Clause no B4.3.1.4).	Compliance action initiated.
21	Coal should be stored in a covered storage yard.	All these stipulations have been included in the technical specification of Main Plant EPC contract package, Section V, B4 of Technical Specification (Clause No B4.3.1.6).	Compliance action initiated.
22	The entire coal stockyard should be covered with water sprinkler provided with automated moisture sensor to control self-combustion.	All these stipulations have been included in the technical specification of Main Plant EPC contract package, Section V, B4 of Technical Specification.	Compliance action initiated.
23	100% utilization of fly ash and bottom ash should be planned and implemented throughout 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 this Plant. EOI has been received in this regard from nearby Cement Industries. Only 25 acres area has been allocated to store residual ash.	Compliance action initiated.
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.

Sl No	Condition of DoE	Compliance Status	Remarks
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 as per the legal procedure of GoB. However, BPDB has already written to Ministry for suitable resettlement and rehabilitation as per DoE requirement. In the meantime, BPDB have prepared an assessment (Livelihood Restoration Plan) regarding the rehabilitees (including those who do not own land) for this Power Plant. In this regard BPDB has selected NGO “Samahar” for implementation of the recommendation of the LRP. This NGO is working for last five months.	Compliance action initiated
28	Resettlement plan should be properly implemented and people should be adequately compensated.	Land was acquired by GoB. Resettlement and rehabilitation action had been taken as per the law of the Bangladesh. However, BPDB has prepared an assessment (Livelihood Restoration Plan) regarding the rehabilitees (including those who do not own land) for this Power Plant. In this regard BPDB has engaged a local NGO for implementation of the recommendation of the LRP Report.	Compliance action initiated
29	Construction material should be properly disposed-off after construction work is over.	At present, the construction work is going on. Storage room has been prepared for the construction works which is shifting regularly for the necessity of work. Solid Waste Management plan has been prepared keeping the provisions in line with this (Section-V, B12, and Part 9 of Technical Specification). However, solid waste management has been done following mostly conventional procedure.	Compliance action initiated
30	As described in the report environmental monitoring should be strictly followed and	BIFPCL has engaged CEGIS for environmental monitoring in February 2014. Accordingly, each quarterly monitoring report has	Being Complied.

Sl No	Condition of DoE	Compliance Status	Remarks
	monitoring report should be shared with DoE to ensure the environmental management properly.	been prepared, submitted and shared with DoE, which are also available at BIFPCL web site.	
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 suggestions applicable at relevant stages. CEGIS, as an environmental consultant of BIFPCL is monitoring implementation of EMP. BIFPCL is taking all possible actions based on EMP monitoring report. They have rearranged the safety system after two accidental incidents.	Complied at present.
32	A third party/independent monitoring bodies excluding JVC/BPDB should be engaged immediately for monitoring of all activities during pre-construction, construction and operation phases as per monitoring plan of EIA report and monitoring report must be submitted to Bagerhat District Office, Khulna Divisional Office and Headquarters of the Department of Environment simultaneously.	CEGIS, as an independent monitoring body has been engaged by BIFPCL since February 2014 and it is still continued. From then on, CEGIS has been conducting the monitoring programs quarterly and producing monitoring reports on regular basis which are submitted by CEGIS to BIFPCL for onward submission to the Bagerhat District Office, Khulna Divisional Office and Headquarters of the Department of Environment as directed by DoE.	Being Complied
33	Regular monitoring of the susceptible places of Sundarbans for protecting ecosystem, biodiversity and forest coverage should be made using latest high-resolution image for keeping ambient environment.	The Monitoring activities of CEGIS included this part vastly. The monitoring report contains analysis of biodiversity and forest coverage. However, in addition to this, Forest Department has also suggested some survey & analysis which have also been monitored and reported by CEGIS through the quarterly compliance monitoring report.	Being Complied.
34	Air, water, soil, biological and social data should be monitored regularly with a network monitoring system with a view to assess the natural quality of the Sundarbans and other fragile ecosystem and report of monitoring results should be submitted to Bagerhat District Office, Khulna Divisional Office and Headquarters of the Department of Environment simultaneously.	The network monitoring system will be installed as a part of the project construction for online monitoring and it will be run at the time in operation of the Power 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). However, air, water, soil and biological components are regularly monitored manually as per recommendation of EMP.	Compliance action initiated.

Sl No	Condition of DoE	Compliance Status	Remarks
35	There should be regularly disclosure of the report through workshops and websites and responses should be taken care accordingly.	All the reports are being kept 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
39	No ground water should be allowed to use for plant purposes.	In compliance of the DoE approval condition no. 39 of EIA Report, *“No ground water should be allowed to use for plant purposes”.* The Power Plant has been designed considering use of surface water only during all stages of project development and operation. As such, the authority has already installed a Reverse Osmosis (RO) Water Treatment Plant for use of surface water for potable and also for construction water sourcing from the River Passur. But during the last compliance monitoring visit on 24/4/2019 it was observed that ground water is being withdrawn by installing Deep	Necessary measures should be taken for regular maintenance and continuous functioning of the RO Water Treatment Plant and strong monitoring of it’s functioning in order to meet the necessary water

Sl No	Condition of DoE	Compliance Status	Remarks
		Tube Well. In this regard the representative of the Proponent informed the Team that due to sudden malfunctioning and maintenance of the RO Water Treatment Plant, ground water was used temporarily for necessary water for drinking and construction purpose. They further informed, at present the RO Water Treatment Plant is fully operational and the intake water is sourced from the river water of the Passur. In this context, it is requested to follow the DoE condition no. 39 as strictly as possible at present and also in future.	requirement during all stages.
40	Conduct stakeholder meetings on regular basis for better performance of the Project as a whole.	Pre-construction phase of the Plant has been completed and the construction phase is continued. BIFPCL has appointed a social worker who regularly visits nearby community to consult with the local people. Besides, CEGIS, appointed by the Project authority as environmental monitoring consultant, is also carrying out consultation with the local people on regular basis for better performance of the Project as a whole.	Being Complied
41	Additional Environmental baseline data to be collected as suggested in the EIA report and conveyed to DoE and other concern authorities.	CEGIS has been engaged in February 2014, for preparing Detailed Environmental Baseline. CEGIS has submitted annual monitoring report along with reports of quarterly monitoring containing latest baseline data to BIFPCL for further dissemination to DoE and other concerned authorities.	Being Complied
42	The Environmental Management Plan under the EIA study shall strictly be implemented and kept functioning on a continuous basis.	BIFPCL has been implementing all the EMP measures phase by phase as suggested in EIA report and approval condition of DoE. The status of EMP implementation are also regularly monitored by CEGIS.	Being Complied
43	The Project authority shall submit a detail work plan with time schedule of development activities at least 7 (seven) days ahead of the work commences in the field to the Bagerhat District Office, Khulna Divisional Office and Headquarters of the Department of Environment simultaneously.	The construction works is now going on. BIFPCL has submitted the detailed work plan seven (7) days before start of the construction activities.	Being complied

Sl No	Condition of DoE	Compliance Status	Remarks
44	Environmental Monitoring Reports according to specific format specified in the EIA Report shall be made available simultaneously to DoE Bagerhat District Office, Khulna Divisional Office and Headquarters on a monthly basis during the construction period of the Project.	Environmental Monitoring Reports as per specific format provided in the EIA Report made available by BIFPCL and submitted to DoE Bagerhat District Office, Khulna Divisional Office and Headquarters since October 2017.	Being Complied
45	The following records must be kept in respect if any samples required to be collected for the purpose of environmental monitoring activities: The date(s) on which the sample was taken; The time(s) at which the sample was collected; The point at which the sample was taken; and The name of the person who collected the sample.	The Monitoring report keeps all the records as suggested.	Being Complied
46	The results of any monitoring required to be conducted under this EIA report must be recorded.	CEGIS is recording all the monitoring data and submitting to BIFPCL through proper documentation. The report is being shared with DoE on regular basis.	Being Complied
47	In case of any emergency, the following information shall be immediately be reported to Bagerhat District Office, Khulna Divisional Office and Headquarters of the Department of Environment (DoE) simultaneously. Nature of incident (oil spill, fire, accident. Collision, land slide, etc.). Personnel affected (injured, missing, fatalities, etc.). Emergency support available and its location (standby transport, medical facilities, etc.). Weather conditions Current operations (abandoning the site, firefighting, etc.)	Two accidents have been occurred in this quarter. After the electrocution accident in September 2018, these two accidents was taken place again in this quarter where 4 worked died. The proponent has reported as per their organization policies. They have prepared investigation reports about the incidents. As per the recommendation of DoE, the proponent has informed to the DC office, Police Station and other relevant authorities. BIFPCL has established strong monitoring activities on safety issues, made penalty on EPC contractor tray to established best practices and keep all records for avoiding such an incident again.	Complied at present
48	The Project authority or its employees must notify the department of Environment of incidents causing or threatening material harm to the environment as soon as practicable after the person becomes aware of the incident.	So far, no such incident has occurred. BIFPCL has established a proper mechanism for recording such incident as suggested and notify the department of Environment regarding incidents causing or threatening material harm to the environment as soon as practicable after the person becomes aware of the incident.	Complied at present.

Sl No	Condition of DoE	Compliance Status	Remarks
		Health and safety management manual has been practised and Environment, safety officer has been employed and CEGIS is monitoring EMP.	
49	All pollution incidents shall be reported immediately and simultaneously to the Bagerhat District Office, Khulna Divisional Office and Headquarters of the Department of Environment (DoE) in Dhaka.	So far no such incident has happened. BIFPCL has established a proper mechanism for recording such incident as suggested in the ERP. CEGIS has been engaged to monitor the social and environmental compliance on a regular interval.	Being complied
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 outside the project boundary. However, in future, if any such case arises, BIFPCL would seek for appropriate permission from the Forest Department.	Being complied
51	Re-vegetation and re-plantation under green belt activities shall be undertaken in consultation with the Forest Department according to those mentioned in the EIA report.	A MoU has been signed with Forest Dept., Bangladesh on 24.02.2015 for implementation of Afforestation Programme. Initial target is to plant 2 lac saplings in 3 years. By this time, Forest Department has targeted initially to plant about 65000 nos. of saplings of different species. A fresh Agreement with BFD was signed on 24.01.2018 for plantation of 2 Lakh trees.	Being Complied
52	Climate Change impacts and maximum storm surge height shall have to consider at the design and construction phase.	The design level (elevation) of the land and earthen embankment has been designed and constructed 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.	Coal transportation will be done through the existing maritime route, which is Mongla Port Authority (_MPA) controlled waterways. M/s. Institute of Water Modelling (IWM) has already completed the EIA study for the dredging activity and submitted the report to MPA. A separate EIA study for Coal Transportation was conducted by M/s. Center for Environment and Geographic Information Services (CEGIS) which has been approved by DoE.	Being Complied.
54	A full-fledged institutional setup for EHS and CSR must be put in place before operation of the Power Plant.	A full-fledged institutional setup for EHS activities shall be in place before operation of the Plant (Project). After the two consecutive accidents, the EHS process has been drastically re-arranged and reshaped. Meanwhile, a number of CSR activities are ongoing at	Being complied

Sl No	Condition of DoE	Compliance Status	Remarks
		Project site, like free medical facilities and medicines, free potable water supply to the local people, medical campaign, training etc. infrastructure development of nearby school.	
55	The Project authority shall extend active cooperation to DoE officials to facilitate their visit to the site as and when necessary.	BIFPCL is extending its all-out cooperation to DoE	Being Complied
56	Violation of any of the above conditions shall render this approval void.	Noted by BIFPCL	-
57	Any injunction on this Project from the Honourable Supreme Court/High Court Division shall render this approval void.	Noted by BIFPCL	-
58	Without installation of 275 Meter Height Chimney, Effluent Treatment Plant (ETP), Waste Water Treatment Plant (WWTP), Settling Pond, Desalinization Plant, API Oil Water Separator, High Efficiency Electro Static Precipitator (ESP), 'closed-loop' Flue Gas Desulfurization (FGD), Low NOx Burner, online air and water quality monitoring system and other pollution control equipment and obtaining Environmental Clearance Certificate, the proponent shall not start operation of the Project.	At present, the Plant is in construction phase. The functional and technical specification of the main Plant includes 275 Meter high Chimney, Effluent Treatment Plant (ETP), Waste Water Treatment Plant (WWTP), 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 for preventing pollution. All these stipulations have been included in the technical specification of Main Plant EPC contract package. Moreover, the area of that equipment position is demarked inside the project boundary.	Compliance action initiated
59	This EIA Approval has been issued with the approval of the appropriate authority.	BPDB and BIFPCL are thankful to DoE.	-

However, with reference to the approval of EIA study of coal transportation for 2x660MW MSTPP having (Memo no: DoE/clearance/ 5532/2016/50, dated 31/01/2018), Department of Environment has set some specific conditions to be followed as a fulfillment of the condition no. 53 of the EIA approval letter of 2x660 MW MSTPP. The conditions and compliance status have been listed as follows-

5.3 Compliance to the conditions of DoE (EIA study of Coal Transportation)

Sl. No.	Conditions	Compliance status	Remarks
1	This EIA Report is approved only for Coal Transportation for the Proposed 2x660 MW Maitree Super Thermal Power Plant Project. Any modification of this project as well as Coal Transportation will require further EIA approval with additional EIA Study.	No. modification of this Project as well as Coal Transportation has happened yet. BIFPCL will notify to DOE prior to initiation of any expansion or extension of the Power Plant.	Will be complied as and when required.
3	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 plant and other pollution control devices.	EPC contractor has been appointed for this Project. They are in the process of importing Power Plant machineries.	Being Complied.
4	The activity under Coal Transportation for the Proposed 2x660 MW Maitree Super Thermal Power Plant Project 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 and examining damaging impact on the environment or natural resources. So far, no activity under Coal Transportation for the Proposed 2x660 MW Maitree Super Thermal Power Plant Project has been started. So, no impact on the surrounding environment or natural resources from the coal transportation activities have been reported yet.	Will be complied as when required.
5	Proper and adequate mitigation measures shall be ensured throughout the operation period of the Project	The project proponent has included all the mitigation measures in their BID document. However, BIFPCL is monitoring the implementation of mitigation measures through CEGIS.	Being Complied
6	Any heritage site, ecologically critical areas, and other environmentally, religious and archeologically sensitive places shall be kept protected during project operation.	There is no Religious and Archaeological place in and around the Project site.	Will be complied during Project operation.

Sl. No.	Conditions	Compliance status	Remarks
7	Environment friendly construction and development practices shall be followed that minimize loss of habitats and fish breeding, feeding and nursery sites.	Development of coal transportation system will be followed though best practices and EMP of EIA. Labor/workers will work with more environment friendly way and as per the guidance of EIA.	Being Complied
8	Proper and adequate sanitation facilities shall be ensured in labor camps throughout the proposed project period.	At present, the civil construction of the Project including Jetty construction activities are progressing fast. New residential areas and adequate sanitation facilities are available for the labors. 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.	Being Complied
9	Proper and adequate on-site precautionary Measures and safety measures shall be ensured so that no habitat of any flora and fauna would be endangered or destructed.	The construction of Jetty is being carried as per EMP guideline. Moreover, regular monitoring activities are carried out to assess the significant changes due to jetty construction activities.	Being Complied
10	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.	The proponent has already prepared site-specific ERP. Following this ERP, the MSTPP works and Jetty construction works has been continued. They are now more watchful on safety issues after the two consecutive incidents. The proponent must follow the pragmatic site-specific ERP of along with NOSCOP 2017.	Compliance action initiated
11	To control dust, spraying of water over the earthen materials should be carried out from time to time	Water spraying for dust suppression are currently functioning especially for the dry days at Jetty construction areas. Moreover, frequent dust monitoring has been conducted at Jetty areas and other sensitive points.	Being Complied
12	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	In the BID document, the coal handling system has been mentioned as closed system with the integration of dust control measures. Moreover, continuous monitoring system will be	Compliance action initiated

Sl. No.	Conditions	Compliance status	Remarks
	extraction and bag filters at unloading areas and at each transfer points on the conveyor system.	instructed in the EIA monitoring section.	
13	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.
14	The entire coal stockyard should be Covered with water sprinkler provided with automated moisture sensor to Control self-combustion.	EIA study of the Power Plant suggested to install water sprinkler in coal stockyard which has been repeated in EIA study of Coal transportation. However, all these stipulations have been included in the technical specification of Main Plant EPC contract package.	Compliance Action initiated.
15	Construction material should be properly disposed off after the construction work is over.	At present, the jetty construction work is going on. The proponent needs to prepare a guideline for disposed of the construction materials.	Compliance Action initiated.
16	As described in the report environmental monitoring should be strictly followed and monitoring report should be shared with DOE to ensure the environmental management properly.	BIFPCL has engaged CEGIS for environmental monitoring in February 2014. Accordingly, each quarterly monitoring report has been submitted and shared with DoE, which are also available at BIFPCL web site.	Being Complied.
17	A third party/independent monitoring bodies excluding BIFPCL should be engaged immediately for monitoring of all the 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 since February 2014 and it is still continued. From then on, CEGIS has been conducting the monitoring programs quarterly and producing monitoring reports on regular basis which are submitted by CEGIS to BIFPCL for onward submission to the Bagerhat District Office, Khulna Divisional Office and Headquarters of the Department of Environment as directed by DoE.	Being Complied
18	Regular monitoring of the susceptible places of the Sundarbans for protecting	The Monitoring activities carried out by	Being Complied.

Sl. No.	Conditions	Compliance status	Remarks
	ecosystem, biodiversity and forest coverage should be made using latest high resolution image for keeping ambient environment.	CEGIS included this part vastly. The monitoring report contains analysis of biodiversity and forest coverage. However, in addition to this, Forest Department has also Suggested some survey & analysis which have also have been monitored and reported by CEGIS through the quarterly compliance monitoring report.	
19	Air, water, soil, biological and social data should be monitored regularly with a network monitoring system with a view to assess the natural quality of the Sundarbans and other fragile ecosystem and report of monitoring results should be submitted to Bagerhat District Office, Khulna Divisional Office and Headquarters of the Department of Environment simultaneously.	The network monitoring system will be installed as a part of the project construction for online monitoring and it will run at the time in operation phase. 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).	Being Complied.
20	There should be regular disclosure of the report through workshops and websites and responses should be taken care accordingly.	All of the environmental monitoring reports and other relevant reports are available on website of BIFPCL (www.bifpcl.com). CEGIS is regularly carrying out public consultation.	Being Complied.
21	BIFPCL 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.	Suggested to Comply as and when required.
22	In order to control noise pollution, vessels and equipment shall undergo regular maintenance; working during sensitive hours and locating machinery close to sensitive receptor shall be avoided.	Not applicable in this stage	Suggested to Comply as and when required.
23	Vessels of this project should follow the MPA guidelines and protocol to ensure no hindrance to other vessels.	Not applicable in this stage	Suggested to Comply as and when required.

Sl. No.	Conditions	Compliance status	Remarks
24	The vessels used for this project should maintain IMO criteria to enable identification of substances harmful to the marine environment.	Not applicable in this stage	Suggested to Comply as and when required.
25	All the vessels should follow applicable MARPOL Convention, Annex V on the prevention of pollution by garbage from ships.	Not applicable in this stage	Suggested to Comply as and when required.
26	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 reports of quarterly monitoring containing latest baseline data to BIFPCL for further dissemination to DoE and other concerned authorities.	Being Complied
27	The Environmental Management Plan under the EIA study shall· strictly be implemented and kept functioning on a continuous basis.	BIFPCL has been implementing the EMP measures phase by phase as suggested in EIA report and approval condition of DoE. The status of EMP implementation are also regularly monitored by CEGIS.	Being Complied
28	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 jetty construction works is now going on. BIFPCL has submitted the detailed work plan seven (7) days before starting of the construction activities to the Bagerhat District Office, Khulna Divisional Office and Headquarters of the Department of Environment simultaneously.	Being complied
29	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 quarterly basis during the project period.	Environmental Monitoring Reports of the Power Plant project including Jetty construction as per specific format provided in the EIA Report made available by BIFPCL and submitted to DoE Bagerhat District Office, Khulna Divisional Office and Headquarters since April, 2018.	Being Complied
30	The following records must be kept in respect of any samples required to be collected for the purposes of environmental monitoring activities:	The Monitoring report of CEGIS keeps all the records as suggested.	Being Complied

Sl. No.	Conditions	Compliance status	Remarks
	a) the date(s) on which the sample was taken; b) the time(s) at which the sample was collected; c) the point at which the sample was taken; and d) The name of the person who collected the sample.		
31	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
32	In case of any emergency, the following information shall immediately be reported to Bagerhat District Office, Khulna Divisional office and Headquarters of the Department of Environment (DOE) simultaneously: a. Nature of incident (oil spill, fire, accident, collision, land slide etc.) b. Personnel affected (injured, missing, fatalities, etc.) c. Emergency support available and its location (standby transport, medical facilities, etc.) d. Weather conditions e. Current operations (abandoning the site, firefighting, etc.)	Emergency Reporting/ Emergency response Plan have been prepared for the Power Plant which includes the Jetty. Health and safety management manual have been prepared and it is a part of technical specification. BIFPCL has respond immediately after two accidents as per direction of DOE. BIFPCL will adopt the ERP suggested on the EIA study of coal transportation in associated with the NOSCOP and NPDM for the incident as suggested.	Compliance Action initiated.
33	National Oil Spill Contingency Plan (NOSCOP) should be followed to establish an organizational structure to combat marine pollution	Not applicable in this stage	Suggested to comply as and when required.
34	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.	BIFPCL has established a proper mechanism for the project to record such incident as suggested and notify the department of Environment regarding incidents causing or threatening material harm to the environment as soon as practicable after the person	Complied at Present.

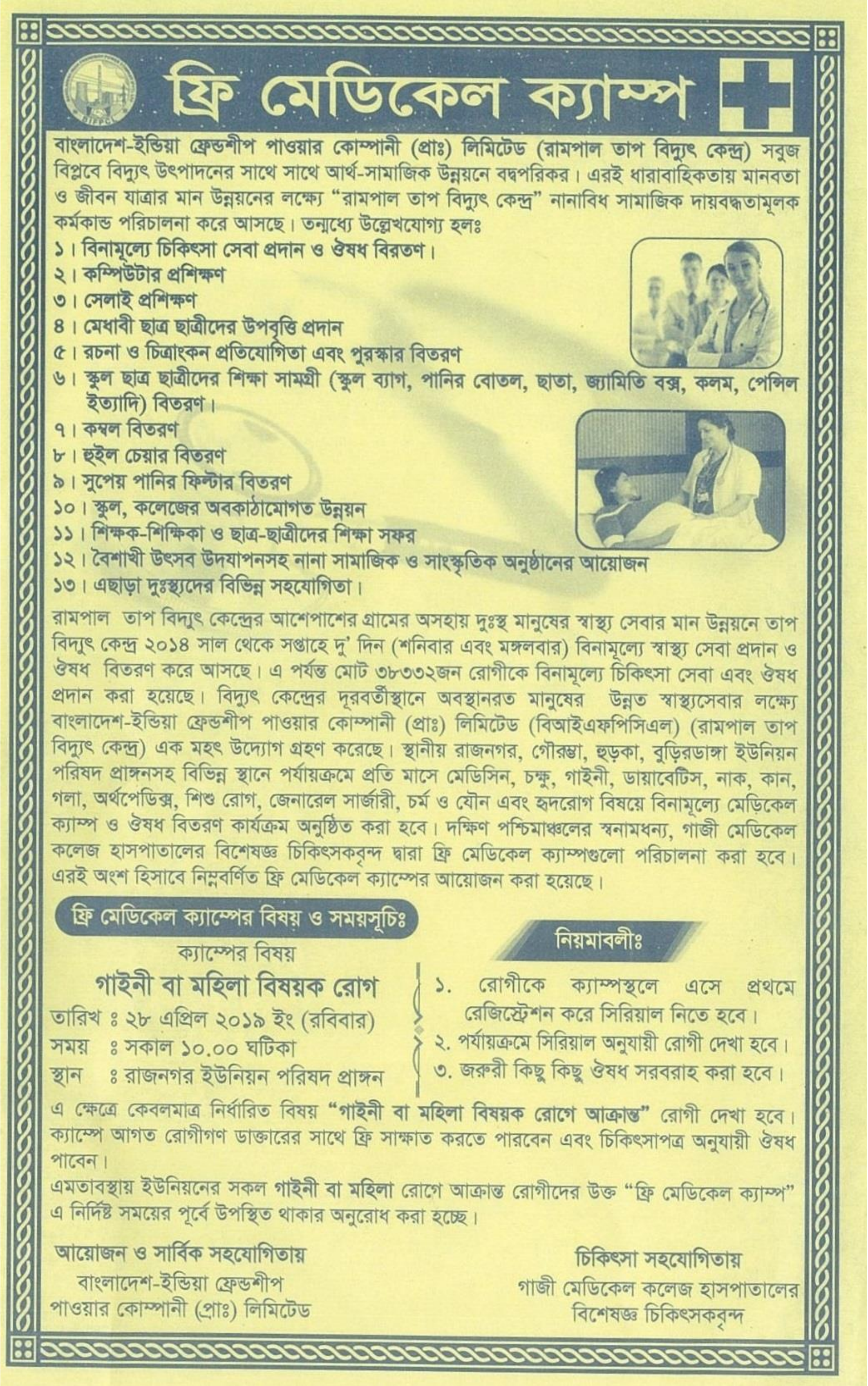
Sl. No.	Conditions	Compliance status	Remarks
		becomes aware of the incident. They will prepare for the coal transportation system before the operation. Moreover, monitoring activities is continuing for any significant changes on natural system.	
35	All pollution incidents shall be reported immediately and simultaneously to the Bagerhat District Office, Khulna Divisional Office and Headquarters of the Department of Environment (DOE) in Dhaka.	BIFPCL has established a proper mechanism for recording such incident as suggested in the ERP. CEGIS has been engaged to monitor the social and environmental compliance on a regular interval.	Complied at Present.
36	Climate Change impacts and maximum storm surge height shall have to consider at the design and construction phase of the jetty.	The design level (elevation) of the land and earthen embankment has been fixed considering the climate change impact and maximum storm surge height.	Being Complied
37	The transshipment point Faraway Buoy at the Bay should be used from November to March, and Mazhar point should be used from April to October every year for transporting coal which has been mentioned in the EIA Report.	Not applicable in this stage	Suggested to comply as and when required.
38	Violation of any of the above conditions shall render this approval void.	Noted by BIFPCL	-
39	Any injunction on this project from the Honorable Supreme Court/High Court Division shall render this approval void.	Noted by BIFPCL	-
40	This EIA approval is valid for one year from the date of issuance and the project authority shall apply for renewal to the Bagerhat District Office of DoE at Bagerhat with a copy to Head Office of DOE in Dhaka.	The authority is maintaining the renewal process as suggested.	Being complied

CSR Activities by BIFPCL

Blood Donation Program

Medical Campaign at nearby village

Regular Weekly Medical Treatment at Project Site



ফ্রি মেডিকেল ক্যাম্প

বাংলাদেশ-ইন্ডিয়া ফ্রেন্ডশীপ পাওয়ার কোম্পানী (প্রাঃ) লিমিটেড (রামপাল তাপ বিদ্যুৎ কেন্দ্র) সবুজ বিপ্লবে বিদ্যুৎ উৎপাদনের সাথে সাথে আর্থ-সামাজিক উন্নয়নে বদ্বপরিকর। এরই ধারাবাহিকতায় মানবতা ও জীবন যাত্রার মান উন্নয়নের লক্ষ্যে "রামপাল তাপ বিদ্যুৎ কেন্দ্র" নানাবিধ সামাজিক দায়বদ্ধতামূলক কর্মকান্ড পরিচালনা করে আসছে। তন্মধ্যে উল্লেখযোগ্য হলঃ

১। বিনামূল্যে চিকিৎসা সেবা প্রদান ও ঔষধ বিরতণ।
২। কম্পিউটার প্রশিক্ষণ
৩। সেলাই প্রশিক্ষণ
৪। মেধাবী ছাত্র ছাত্রীদের উপবৃত্তি প্রদান
৫। রচনা ও চিত্রাংকন প্রতিযোগিতা এবং পুরস্কার বিতরণ
৬। স্কুল ছাত্র ছাত্রীদের শিক্ষা সামগ্রী (স্কুল ব্যাগ, পানির বোতল, ছাতা, জ্যামিতি বক্স, কলম, পেন্সিল ইত্যাদি) বিতরণ।
৭। কম্বল বিতরণ
৮। হুইল চেয়ার বিতরণ
৯। সুপেয় পানির ফিল্টার বিতরণ
১০। স্কুল, কলেজের অবকাঠামোগত উন্নয়ন
১১। শিক্ষক-শিক্ষিকা ও ছাত্র-ছাত্রীদের শিক্ষা সফর
১২। বৈশাখী উৎসব উদযাপনসহ নানা সামাজিক ও সাংস্কৃতিক অনুষ্ঠানের আয়োজন
১৩। এছাড়া দুঃস্থ্যদের বিভিন্ন সহযোগিতা।

রামপাল তাপ বিদ্যুৎ কেন্দ্রের আশেপাশের গ্রামের অসহায় দুঃস্থ মানুষের স্বাস্থ্য সেবার মান উন্নয়নে তাপ বিদ্যুৎ কেন্দ্র ২০১৪ সাল থেকে সপ্তাহে দু' দিন (শনিবার এবং মঙ্গলবার) বিনামূল্যে স্বাস্থ্য সেবা প্রদান ও ঔষধ বিতরণ করে আসছে। এ পর্যন্ত মোট ৩৮৩৩২জন রোগীকে বিনামূল্যে চিকিৎসা সেবা এবং ঔষধ প্রদান করা হয়েছে। বিদ্যুৎ কেন্দ্রের দূরবর্তীস্থানে অবস্থানরত মানুষের উন্নত স্বাস্থ্যসেবার লক্ষ্যে বাংলাদেশ-ইন্ডিয়া ফ্রেন্ডশীপ পাওয়ার কোম্পানী (প্রাঃ) লিমিটেড (বিআইএফপিসিএল) (রামপাল তাপ বিদ্যুৎ কেন্দ্র) এক মহৎ উদ্যোগ গ্রহণ করেছে। স্থানীয় রাজনগর, গৌরম্ভা, হুড়কা, বুড়িরডাঙ্গা ইউনিয়ন পরিষদ প্রাঙ্গনসহ বিভিন্ন স্থানে পর্যায়ক্রমে প্রতি মাসে মেডিসিন, চক্ষু, গাইনী, ডায়াবেটিস, নাক, কান, গলা, অর্থপেডিক্স, শিশু রোগ, জেনারেল সার্জারী, চর্ম ও যৌন এবং হৃদরোগ বিষয়ে বিনামূল্যে মেড়িকেল ক্যাম্প ও ঔষধ বিতরণ কার্যক্রম অনুষ্ঠিত করা হবে। দক্ষিণ পশ্চিমাঞ্চলের স্বনামধন্য, গাজী মেডিকেল কলেজ হাসপাতালের বিশেষজ্ঞ চিকিৎসকবৃন্দ দ্বারা ফ্রি মেডিকেল ক্যাম্পগুলো পরিচালনা করা হবে। এরই অংশ হিসাবে নিম্নবর্ণিত ফ্রি মেডিকেল ক্যাম্পের আয়োজন করা হয়েছে।

ফ্রি মেডিকেল ক্যাম্পের বিষয় ও সময়সূচিঃ

ক্যাম্পের বিষয়

গাইনী বা মহিলা বিষয়ক রোগ

তারিখ ঃ ২৮ এপ্রিল ২০১৯ ইং (রবিবার)
সময় ঃ সকাল ১০.০০ ঘটিকা
স্থান ঃ রাজনগর ইউনিয়ন পরিষদ প্রাঙ্গন

নিয়মাবলীঃ

১. রোগীকে ক্যাম্পস্থলে এসে প্রথমে রেজিস্ট্রেশন করে সিরিয়াল নিতে হবে।
২. পর্যায়ক্রমে সিরিয়াল অনুযায়ী রোগী দেখা হবে।
৩. জরুরী কিছু কিছু ঔষধ সরবরাহ করা হবে।

এ ক্ষেত্রে কেবলমাত্র নির্ধারিত বিষয় **"গাইনী বা মহিলা বিষয়ক রোগে আক্রান্ত"** রোগী দেখা হবে। ক্যাম্পে আগত রোগীগণ ডাক্তারের সাথে ফ্রি সাক্ষাত করতে পারবেন এবং চিকিৎসাপত্র অনুযায়ী ঔষধ পাবেন।

এমতাবস্থায় ইউনিয়নের সকল **গাইনী বা মহিলা** রোগে আক্রান্ত রোগীদের উক্ত "ফ্রি মেডিকেল ক্যাম্প" এ নির্দিষ্ট সময়ের পূর্বে উপস্থিত থাকার অনুরোধ করা হচ্ছে।

আয়োজন ও সার্বিক সহযোগিতায়
বাংলাদেশ-ইন্ডিয়া ফ্রেন্ডশীপ
পাওয়ার কোম্পানী (প্রাঃ) লিমিটেড

চিকিৎসা সহযোগিতায়
গাজী মেডিকেল কলেজ হাসপাতালের
বিশেষজ্ঞ চিকিৎসকবৃন্দ

Leaflet for the Free Medical Camp

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Appendices

Appendix I: Checklist of Monitoring Environmental Compliances

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

Sl No	Potential Impacts	Proposed EMP	Actual Implementation	Recommended Action	Compliance Status
1	Generation of Noise within the BIFPCL's Plant premises	• Conduct noise survey around and inside the site boundary • Reducing Noise and Vibrations to country's ambient standards, and occupational health and safety standards • Introducing vehicle speed limit and speed limit monitoring system • Green Plantation around the Project boundary • Switching off/ throttling down of machines/equipment's/generators which are not in use			
2	Dust Generation from Land development activities and other construction works	• Conducting dust monitoring and visual inspection around the site boundary • No use of earthen and undeveloped roads by vehicles related to the Project use • Installation of water spraying system to control fugitive dusts • Introducing vehicle speed limit and speed limit monitoring system • If yes, do they monitor vehicle speed regularly?			
3	Water Quality	• Fencing the construction site by drum sheet or Tarjja of any other fencing • Arrangement of runoff drainage for reducing any water logging • Location of backfilling stockpile in safe area and protected from wind and rain action • No storing of backfilling materials/spoil stored on river bank/slope			

Sl No	Potential Impacts	Proposed EMP	Actual Implementation	Recommended Action	Compliance Status
		• No disposal of waste and wastewater to river or canal.			
4	Waste Management System	• Provision of onsite waste management system			
5	Compensation and Resettlement	• Prepare Proper resettlement action plant and compensation plan if the Project needs any land acquisition addressing compensation, restoration, livelihood, living standards etc. based on proper socio economic studies • Resettlement of the PAPs • cash for compensation of land (CCL) before resettlement • 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?			

Sl No	Potential Impacts	Proposed EMP	Actual Implementation	Recommended Action	Compliance Status
		• Is there any possibility that large vehicle related to the Project will cause traffic induced disturbance/s to the local dwellers? • If yes, are there any mitigative steps taken to decrease the disturbance/s? • Has the road network been developed after the Project being proposed and during the construction phase? • Are there separate water and sanitation facilities for the construction workers in the Project area?			
7	Green House Gas Controlling Measures	• Use of efficient generator in the construction activities • Regular maintenance of vehicles, generator and machinery in accordance with manufacturer's specifications • Use of approved pollution control devices fitted in the equipment's and machineries • Switching off and throttling down the machines/equipment's/generators which are not in use			

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

(Labor and Working Condition)

Basic Data

Sl No	Description	Values
1	Direct Workers	
2	Contracted Workers	
3	Supply Chain Workers	
4	Child labor	
5	0 - 12	
6	13 - 14	
7	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			
2	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 • 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.)			

Sl No	Potential Impacts	Proposed EMP	Actual Implementation	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			
3	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			
4	Worker's Well Being	• Establishment Grievance Mechanisms • Ensuring fair treatment, non-discrimination and equal opportunity • Compliance of Project's labor policy with the national labor law • No Child Labor • No incident of forced labor • Provision of Welfare facilities for Worker/Labor			

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

(Community Health, Safety and Security)

Sl No	Potential Impacts	Proposed EMP	Actual Implementation	Recommended Action	Compliance Status
1	Disturbance to nearby community due to dust from newly developed land and Noise from construction activities	• Construction of boundary wall around the Project are • Installation of water spraying system to control dusts • Conducting dust monitoring and visual inspection around the site boundary • Adoption of Noise management plan			
2	Grievance of local people	• Availability and operation of Grievance Redress Mechanism • Maintaining open communication channel with the local community			
3	Risk of breaching Community Safety	• Construction of boundary wall/safety fence around the Project area • Practicing Risk Assessment and Evaluation Process			

Sl No	Potential Impacts	Proposed EMP	Actual Implementation	Recommended Action	Compliance Status
		• 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			
4	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)***
5	Youth Employment	• Providing training/awareness program for the local youth to let them aware about the required ualification to get involved in the Project related activities			
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			

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

(Biodiversity and Sustainable Management of Living Natural Resources)

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

Sl No	Potential Impacts	Proposed EMP	Actual Implementation	Recommended Action	Compliance Status
		• 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 and Socio-economic Monitoring of Khulna 2×660 MW Power Plant for 19th monitoring program (February, 2019)

The Monitoring Team

Measuring the Canopy coverage

Collection of DBH data

Measuring the Tree height

Counting seedlings and pneumatophores

Noise level measurement at Akram point of Sundarbans

Professionals is measuring open light intensity

Collection of Capture fisheries data

Collection of field data

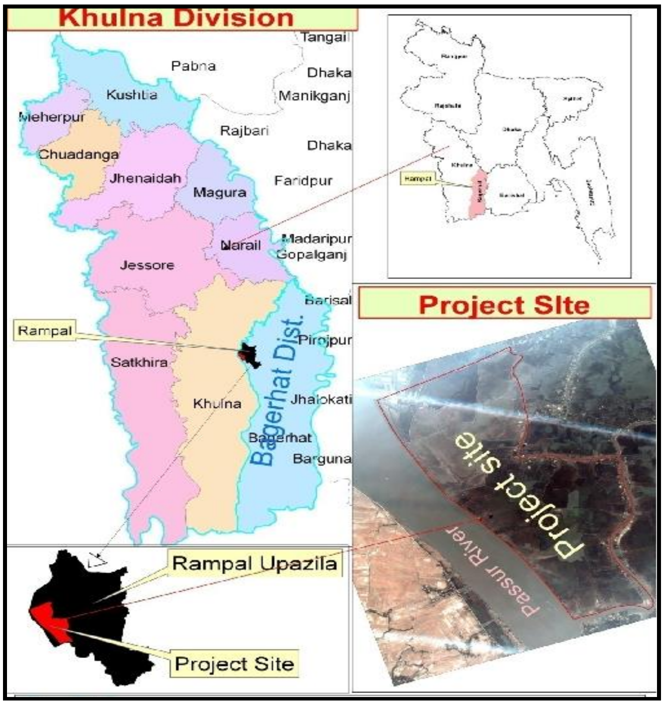
Length wise distribution of fish species

Appendix III: Terms of References (ToR)

Background

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

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

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

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

Broad Scope of Works

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

The Broad objectives of independent monitoring covers the following activities

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

The main objectives of this works are

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

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

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

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

The Monitoring parameter & associated indicator are given below

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

Monitoring Parameter	Indicators
	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

Air quality monitoring progress

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

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

Expected Output

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

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

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

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

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

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

Reporting Requirements

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

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

Appendix IV: Monitoring Data

(A) Air Quality Data

Table A1: Ambient Air Quality Monitoring Results

Locations of Monitoring	Pollutants	1st QM, Apr 2014	2nd QM, Jul 2014	3rd QM, Oct 2014	4th QM, Jan 2015	5th QM, Apr 2015	6th QM, Jul2015	7th QM, Oct 2015	8th QM, Jan 2016	9th QM, Apr 2016	10th QM, Jul 2016	11th QM, Oct 2016	12th QM, Jan 2017	13th QM, April, 2017	14th QM, Oct, 2017	15th QM Jan, 2018	16th QM April, 2018	17th QM, Jul 2018	18th QM, Nov, 2018	19th QM, Feb, 2019	20th QM, Feb, 2019	Bangladesh (DoE) Standard (ECR 2005)
Weather		Sunny	Rainy/ Cloudy	Sunny	Sunny	Sunny	Rainy/ Cloudy	Sunny/ Rainy	Sunny	Sunny	Rainy/ Cloudy	Rainy/ Cloudy	Sunny	Sunny/ Cloudy	Sunny	Sunny	Sunny/ Cloudy	Rainy/ Cloudy	Sunny/ Cloudy	Sunny	Sunny	
			Concentrations are in µg/m^3																			
SW Corner of the PP area	**$PM_{2.5}$**	33	37	25	33	47	25	22	34	19	5	9	24.8	8.12	28.2	32.9	28.4	15.2	31.1	27.3	21.7	65^{24hr}
	PM_{10}	78	77	53	79	83	35	52	135	117	32	22	79	43.8	73.6	133	70	15.8	106	105.4	98.2	150^{24hr}
	SPM	207	239	190	200	177	42	91	175	332	51	53	115.7	122.4	169.4	145.6	121.5	12.9	137.4	151.6	128.6	200^{8hr}
	SO_2	21	24	19	23	15	52	35	14	18	9	8	9.5	9.0	7.2	14.3	11.4	11.9	12.7	11.6	13.9	365^{24hr}
	NOx	26	29	27	31	29	35	29	18	18	12	10	11.3	10.7	7.5	17.7	12.8	10.2	14.8	12.4	16	100^{Annual}
	CO	120	188	140	190	144	146	88	74	57	35	119	59	91	73	61	32	11.1	28	15	18	$(10000)^{8hr}$
	O_3	27	26	19	22	26	12	5	4	1	1	1	5	03	10	03	9	13.2	7	9	6	157^{8hr}
Shapmari area	**$PM_{2.5}$**	39	48	48	39	34	18	17	35	25	3	8	25	14.6	8.5	31.5	26.7	15.8	35.7	30.6	18.9	65^{24hr}

Locations of Monitoring	Pollutants	1st QM, Apr 2014	2nd QM, Jul 2014	3rd QM, Oct 2014	4th QM, Jan 2015	5th QM, Apr 2015	6th QM, Jul2015	7th QM, Oct 2015	8th QM, Jan 2016	9th QM, Apr 2016	10th QM, Jul 2016	11th QM, Oct 2016	12th QM, Jan 2017	13th QM, April, 2017	14th QM, Oct, 2017	15th QM Jan, 2018	16th QM April, 2018	17th QM, Jul 2018	18th QM, Nov, 2018	19th QM, Feb, 2019	20th QM, Feb, 2019	Bangladesh (DoE) Standard (ECR 2005)
Weather		Sunny	Rainy/ Cloudy	Sunny	Sunny	Sunny	Rainy/ Cloudy	Sunny/ Rainy	Sunny	Sunny	Rainy/ Cloudy	Rainy/ Cloudy	Sunny	Sunny/ Cloudy	Sunny	Sunny	Sunny/ Cloudy	Rainy/ Cloudy	Sunny/ Cloudy	Sunny	Sunny	
			Concentrations are in $\mu g/m^3$																			
	PM_{10}	814.69	90	74	102	97	31	48	116	44	11	11	99.5	56.9	40.4	147.8	52	64.4	109.9	126.3	106.1	150^{24hr}
	SPM	2156.3	263	217	274	266	47	79	192	187	27	23	154.2	136.7	45.3	181.4	138.7	113.4	143.9	168	150.8	200^{8hr}
	SO_2	19	28	22	21	22	58	27	13	11	4	6	12.9	10	4.3	15	9.6	10.8	12.2	12.3	12.1	365^{24hr}
	NOx	29	39	27	26	24	46	25	16	22	6	8	15.7	11.8	6	18.6	10.2	13.1	13.6	13.8	13.9	100^{Annual}
	CO	165	210	230	164	136	127	102	77	22	31	108	66	78	79	69	27	25	30	21	20	$(10000)^{8hr}$
	O_3	33	26	26	23	21	16	1	1	1	0	0	1	08	25	04	4	8	6	4	1	157^{8hr}
NW Corner of the PP area	**$PM_{2.5}$**	37	44	19	42	59	28	19	24	11	3	10	29	10.3	15.2	40.7	27.7	12.9	32.3	20.3	14.2	65^{24hr}
	PM_{10}	67	78	56	98	91	96	29	125	29	24	14	108.7	31.3	49.9	136.3	100.1	44.3	117.4	93.6	58.7	150^{24hr}
	SPM	234	217	157	310	244	321	66	187	115	31	35	168	91.7	63.9	161.7	116.2	76.3	156.2	125.5	119.2	200^{8hr}
	SO_2	19	22	18	27	21	56	32	13	17	4	8	12.2	5.8	7.5	9.6	13.2	5.8	13.4	10.7	11.6	365^{24hr}
	NOx	23	28	22	32	39	43	21	18	16	5	11	14.7	7.1	9.2	11.7	14.3	5.9	15	11.3	13.5	100^{Annual}
	CO	110	178	110	210	140	133	87	77	38	47	127	31	74	80	45	43	21	32	20	16	$(10000)^{8hr}$
	O_3	25	19	17	36	44	11	8	2	0	1	1	3	05	10	05	7	6	8	1	5	157^{8hr}
	$PM_{2.5}$	39	47	57	39	41	34	11	29	23	9	10	21.7	7.9	13.8	52.3	18	11.9	15.4	19.3	19.7	65^{24hr}

Locations of Monitoring	Pollutants	1^{st} QM, Apr 2014	2^{nd} QM, Jul 2014	3^{rd} QM, Oct 2014	4^{th} QM, Jan 2015	5^{th} QM, Apr 2015	6^{th} QM, Jul2015	7^{th} QM, Oct 2015	8^{th} QM, Jan 2016	9^{th} QM, Apr 2016	10^{th} QM, Jul 2016	11^{th} QM, Oct 2016	12^{th} QM, Jan 2017	13^{th} QM, April, 2017	14^{th} QM, Oct, 2017	15^{th} QM Jan, 2018	16^{th} QM April, 2018	17^{th} QM, Jul 2018	18^{th} QM, Nov, 2018	19^{th} QM, Feb, 2019	20th QM, Feb, 2019	Bangladesh (DoE) Standard (ECR 2005)
Weather		Sunny	Rainy/ Cloudy	Sunny	Sunny	Sunny	Rainy/ Cloudy	Sunny/ Rainy	Sunny	Sunny	Rainy/ Cloudy	Rainy/ Cloudy	Sunny	Sunny/ Cloudy	Sunny	Sunny	Sunny/ Cloudy	Rainy/ Cloudy	Sunny/ Cloudy	Sunny	Sunny	
			Concentrations are in µg/m³																			
Barni, Gaurambha	**PM_{10}**	103	122	67	97	82	65	26	97	82	45	13	105.4	30.5	30.2	140	30.5	20.5	50.1	102	69.9	150^{24hr}
	SPM	233	244	183	277	236	79	112	176	268	69	30	167.8	95.6	57.2	171.9	90.6	5.2	113.5	127.5	92.2	200^{8hr}
	SO_2	21	23	17	22	25	41	31	16	20	10	7	12.2	5.5	4.1	13.8	6.1	6.1	9.5	11.5	12.6	365^{24hr}
	NOx	25	28	22	26	27	44	32	21	16	12	9	19.3	9.8	5.0	16.7	7.3	7.4	10.7	13.8	13.8	100^{Annual}
	CO	175	210	190	150	196	96	96	81	73	41	98	63	85	77	59	24	20	20	17	18	$(10000)^{8hr}$
	O_3	26	29	22	19	15	9	6	4	0	0	3	5	08	6	04	6	6	2	3	4	157^{8hr}
Chunkuri-2, Bajua Dacope	**$PM_{2.5}$**	35	39	46	37	33	35	28	31	25	7	5	25.2	8.7	17.3	33.4	11.4	10.2	26.8	22.8	15	65^{24hr}
	PM_{10}	77	86	69	68	61	109	49	98	60	23	20	74.4	44.4	100.2	157.1	40.6	30.6	105.9	126.7	72.7	150^{24hr}
	SPM	117	113	162	183	188	175	94	167	167	31	48	162	110.6	127.8	200	108	78.6	128.5	146.6	117.6	200^{8hr}
	SO_2	19	24	21	18	11	55	33	21	13	7	9	18.9	8.2	7.9	19	10.4	7.5	12.1	12.4	11.2	365^{24hr}
	NOx	23	26	27	24	18	49	23	16	25	10	8	18	11.2	8.4	20.7	11.6	8.4	14	13.8	13.7	100^{Annual}
	CO	190	205	170	170	33	133	75	70	33	38	79	36	94	69	58	42	23	27	25	20	$(10000)^{8hr}$
	O_3	27	24	18	22	41	21	2	1	1	0	2	2	03	5	05	2	4	5	9	8	157^{8hr}
Pankhali, Dacope	**$PM_{2.5}$**	47	49	57	41	39	34	25	47	15	8	10	38.7	15.8	17	72.3	15.9	11.1	24.8	28.6	15.8	65^{24hr}

Locations of Monitoring	Pollutants	1^{st} QM, Apr 2014	2^{nd} QM, Jul 2014	3^{rd} QM, Oct 2014	4^{th} QM, Jan 2015	5^{th} QM, Apr 2015	6^{th} QM, Jul2015	7^{th} QM, Oct 2015	8^{th} QM, Jan 2016	9^{th} QM, Apr 2016	10^{th} QM, Jul 2016	11^{th} QM, Oct 2016	12^{th} QM, Jan 2017	13^{th} QM, April, 2017	14^{th} QM, Oct, 2017	15^{th} QM Jan, 2018	16^{th} QM April, 2018	17^{th} QM, Jul 2018	18^{th} QM, Nov, 2018	19^{th} QM, Feb, 2019	20th QM, Feb, 2019	Bangladesh (DoE) Standard (ECR 2005)
Weather		Sunny	Rainy/ Cloudy	Sunny	Sunny	Sunny	Rainy/ Cloudy	Sunny/ Rainy	Sunny	Sunny	Rainy/ Cloudy	Rainy/ Cloudy	Sunny	Sunny/ Cloudy	Sunny	Sunny	Sunny/ Cloudy	Rainy/ Cloudy	Sunny/ Cloudy	Sunny	Sunny	
			Concentrations are in µg/m³																			
	PM_{10}	119	127	139	101	105	144	62	128	46	42	18	141.6	105	63.4	208.9	74.3	58.4	92	125.8	92.7	150^{24hr}
	SPM	297	266	254	208	299	339	183	198	114	78	34	194.6	179	87.5	223.9	154.1	98.4	139	178.2	141.1	200^{8hr}
	SO_2	28	31	31	24	30	58	36	18	9	8	8	16.1	12.9	8	16.3	12.2	9.4	10.4	13.3	10.4	365^{24hr}
	NOx	41	39	36	26	27	47	23	15	19	9	9	19	18.7	10.2	17.7	13.7	12.1	13.4	14.9	11.7	100^{Annual}
	CO	230	217	250	188	177	125	105	101	55	29	112	48	83	87	49	34	29	30	14	14	$(10000)^{8hr}$
	O_3	49	38	36	27	11	13	5	2	2	0	0	3	06	0	06	6	8	8	8	3	157^{8hr}
Mongla Port area	$PM_{2.5}$	47	55	39	41	26	33	19	34	21	9	11	25.7	22.6	33.2	70.1	23.2	13.2	30.3	26.6	35	65^{24hr}
	PM_{10}	139	174	77	82	35	52	33	132	45	29	15	119.3	93.6	97	209.1	89.9	47.5	103.7	109.3	131	150^{24hr}
	SPM	288	303	197	217	214	118	65	189	144	50	6	172.3	196	187.2	242	144.7	73.7	161.9	157.1	183.1	200^{8hr}
	SO_2	27	28	26	24	14	45	36	16	10	8	7	16.8	10.5	8.2	15.5	11.8	6.5	12	10.8	16.8	365^{24hr}
	NOx	44	39	33	27	17	40	20	13	14	10	8	15.3	15.1	10.7	18.4	13.2	7.2	16.8	12.6	17.8	100^{Annual}
	CO	230	320	220	211	24	110	84	71	29	31	97	44	72	79	52	29	20	33	28	17	$(10000)^{8hr}$
	O_3	57	52	37	26	09	15	8	3	1	2	1	4	04	9	02	3	1	9	7	3	157^{8hr}
	$PM_{2.5}$	19	22	33	27	24	27	24	26	13	6	10	19.2	10.5	28.3	43.5	11.6	11.4	20.6	15.4	14.2	65^{24hr}

Locations of Monitoring	Pollutants	1^{st} QM, Apr 2014	2^{nd} QM, Jul 2014	3^{rd} QM, Oct 2014	4^{th} QM, Jan 2015	5^{th} QM, Apr 2015	6^{th} QM, Jul2015	7^{th} QM, Oct 2015	8^{th} QM, Jan 2016	9^{th} QM, Apr 2016	10^{th} QM, Jul 2016	11^{th} QM, Oct 2016	12^{th} QM, Jan 2017	13^{th} QM, April, 2017	14^{th} QM, Oct, 2017	15^{th} QM Jan, 2018	16^{th} QM April, 2018	17^{th} QM, Jul 2018	18^{th} QM, Nov, 2018	19^{th} QM, Feb, 2019	20th QM, Feb, 2019	Bangladesh (DoE) Standard (ECR 2005)
Weather		Sunny	Rainy/ Cloudy	Sunny	Sunny	Sunny	Rainy/ Cloudy	Sunny/ Rainy	Sunny	Sunny	Rainy/ Cloudy	Rainy/ Cloudy	Sunny	Sunny/ Cloudy	Sunny	Sunny	Sunny/ Cloudy	Rainy/ Cloudy	Sunny/ Cloudy	Sunny	Sunny	
			Concentrations are in $\mu g/m^3$																			
Harbaria, Sundarbans	**PM_{10}**	41	39	59	56	49	42	50	82	42	20	14	85.2	36.7	89.9	152.4	29.1	24.3	80.5	92.6	63.9	150^{24hr}
	SPM	111	117	129	139	109	70	73	159	91	43	44	93.5	103.7	107	189.9	72.4	47.6	90.3	118.3	90.9	200^{8hr}
	SO_2	9	10	14	12	16	51	34	15	11	6	7	11.9	5.7	7.6	13.2	7.9	4.9	11.6	9.5	11.6	365^{24hr}
	NOx	19	22	27	18	22	34	22	14	16	8	10	13	7.7	9.3	15.2	8.3	5.4	13	10.1	13	100^{Annual}
	CO	65	58	70	64	56	112	81	62	47	32	110	67	73	84	57	31	20	20	25	16	$(10000)^{8hr}$
	O_3	13	12	13	11	14	12	4	2	2	0	1	4	08	0	02	2	6	4	3	5	157^{8hr}
Akram Point, Sundarbans	**$PM_{2.5}$**	17	19	23	18	49	NO	25	18	9	4	4	14.3	13.2	7.5	35.4	13.7	14	29.1	16.2	13	65^{24hr}
	PM_{10}	39	44	32	39	77	NO	32	77	31	15	14	85.5	96.0	37.8	150.6	36.4	41.6	100.2	93.2	51.9	150^{24hr}
	SPM	114	133	97	88	102	NO	51	128	46	23	27	90.9	137.0	41.8	175.1	90.3	58	121.4	117.8	71.1	200^{8hr}
	SO_2	7	9	12	13	21	NO	27	14	9	4	6	8.4	6	5.8	14	8.3	6.3	10.8	10.1	8.9	365^{24hr}
	NOx	17	19	22	17	27	NO	19	15	10	5	6	12.7	10.1	5.9	15.1	9.9	9.3	11.7	11.3	9.4	100^{Annual}
	CO	49	60	50	46	163	NO	92	64	21	37	101	58	79	69	52	21	25	28	17	14	$(10000)^{8hr}$
	O_3	11	14	9	10	27	NO	8	1	0	0	2	3	0	0	03	3	4	5	3	1	157^{8hr}
Hiron Point,	**$PM_{2.5}$**	15	23	19	17	28	NO	27	NO	17	NO	9	21.7	No	17.0	40.5	NO	NO	23.4	18.2	NO	65^{24hr}

Locations of Monitoring	Pollutants	1st QM, Apr 2014	2nd QM, Jul 2014	3rd QM, Oct 2014	4th QM, Jan 2015	5th QM, Apr 2015	6th QM, Jul2015	7th QM, Oct 2015	8th QM, Jan 2016	9th QM, Apr 2016	10th QM, Jul 2016	11th QM, Oct 2016	12th QM, Jan 2017	13th QM, April, 2017	14th QM, Oct, 2017	15th QM Jan, 2018	16th QM April, 2018	17th QM, Jul 2018	18th QM, Nov, 2018	19th QM, Feb, 2019	20th QM, Feb, 2019	Bangladesh (DoE) Standard (ECR 2005)
Weather		Sunny	Rainy/ Cloudy	Sunny	Sunny	Sunny	Rainy/ Cloudy	Sunny/ Rainy	Sunny	Sunny	Rainy/ Cloudy	Rainy/ Cloudy	Sunny	Sunny/ Cloudy	Sunny	Sunny	Sunny/ Cloudy	Rainy/ Cloudy	Sunny/ Cloudy	Sunny	Sunny	
			Concentrations are in μg/m^3																			
Sundarbans	**PM$_{10}$**	44	38	34	41	60	NO	45	NO	40	NO	14	104.5	NO	92.1	149.8	NO	NO	86.7	96.1	NO	150^{24hr}
	SPM	101	119	107	97	110	NO	88	NO	132	NO	26	111.4	NO	102	173.7	NO	NO	107.9	127.8	NO	200^{8hr}
	SO$_2$	8	7	13	14	15	NO	28	NO	15	NO	9	13.5	NO	6	15.8	NO	NO	10.6	10.7	NO	365^{24hr}
	NOx	18	18	19	22	20	NO	23	NO	19	NO	9	15.9	NO	7.8	18.1	NO	NO	12.5	10.9	NO	100^{Annual}
	CO	52	62	65	60	60	NO	93	NO	40	NO	121	43	NO	72	71	NO	NO	22	21	NO	$(10000)^{8hr}$
	O$_3$	14	13	11	9	23	NO	2	NO	0	NO	0	4	NO	0	04	NO	NO	6	6	NO	157^{8hr}
Khulna	**PM$_{2.5}$**	54	39	52	42	55	46	19	35	11	16	9	34.6	23.1	19.5	78.7	12.4	12.5	21.3	20.8	33	65^{24hr}

Locations of Monitoring	Pollutants	1st QM, Apr 2014	2nd QM, Jul 2014	3rd QM, Oct 2014	4th QM, Jan 2015	5th QM, Apr 2015	6th QM, Jul2015	7th QM, Oct 2015	8th QM, Jan 2016	9th QM, Apr 2016	10th QM, Jul 2016	11th QM, Oct 2016	12th QM, Jan 2017	13th QM, April, 2017	14th QM, Oct, 2017	15th QM Jan, 2018	16th QM April, 2018	17th QM, Jul 2018	18th QM, Nov, 2018	19th QM, Feb, 2019	20th QM, Feb, 2019	Bangladesh (DoE) Standard (ECR 2005)
Weather		Sunny	Rainy/ Cloudy	Sunny	Sunny	Sunny	Rainy/ Cloudy	Sunny/ Rainy	Sunny	Sunny	Rainy/ Cloudy	Rainy/ Cloudy	Sunny	Sunny/ Cloudy	Sunny	Sunny	Sunny/ Cloudy	Rainy/ Cloudy	Sunny/ Cloudy	Sunny	Sunny	
			Concentrations are in μg/m^3																			
City, near Khan Jahan Ali Bridge	PM_{10}	139	117	91	84	75	89	49	112	69	68	24	145.9	99.5	39.6	213.9	38.8	45.4	57.9	91.3	125.9	150^{24hr}
	SPM	301	287	239	219	222	181	101	181	112	107	64	189.7	187.2	127.9	243.4	78.9	69.9	102.9	158	173.4	200^{8hr}
	SO_2	33	29	33	28	31	59	28	16	11	10	10	17.1	7.2	7.1	21	7.5	7.5	8.7	10.4	15.3	365^{24hr}
	NOx	49	41	39	36	33	38	26	16	15	15	14	18.6	11.7	8.8	25	8.4	11.1	9.7	11.1	17.1	100^{Annual}
	CO	330	370	330	296	101	89	94	98	68	36	104	66	79	81	69	36	28	121	19	23	$(10000)^{8hr}$
	O_3	59	67	57	39	21	7	4	2	1	0	2	3	07	07	09	9	7	4	5	6	157^{8hr}
Township area	$PM_{2.5}$	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	29.1	13.7	28.6	21.2	17.2	65^{24hr}
	PM_{10}	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	70.3	60.8	111.7	88.7	61.6	150^{24hr}
	SPM	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	120.6	98.1	144.6	129.4	102.5	200^{8hr}
	SO_2	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	13.1	8.4	10.2	11.3	7.9	365^{24hr}
	NOx	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	14	9	11.6	12.1	11.9	100^{Annual}
	CO	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	46	32	30	18	243	$(10000)^{8hr}$
	O_3	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	9	4	9	1	5	157^{8hr}
access road bridge	$PM_{2.5}$	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	33.1	20.9	40.9	26.9	36.1	65^{24hr}
	PM_{10}	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	118.1	83.7	128.3	112.9	137	150^{24hr}
	SPM	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	142.5	106.2	177.8	168.2	163.2	200^{8hr}
	SO_2	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	12.2	10.9	13.4	12.5	15.7	365^{24hr}
	NOx	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	14.8	13.4	15	13	17.6	100^{Annual}
	CO	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	38	34	32	23	21	$(10000)^{8hr}$

Locations of Monitoring	Pollutants	1st QM, Apr 2014	2nd QM, Jul 2014	3rd QM, Oct 2014	4th QM, Jan 2015	5th QM, Apr 2015	6th QM, Jul2015	7th QM, Oct 2015	8th QM, Jan 2016	9th QM, Apr 2016	10th QM, Jul 2016	11th QM, Oct 2016	12th QM, Jan 2017	13th QM, April, 2017	14th QM, Oct, 2017	15th QM Jan, 2018	16th QM April, 2018	17th QM, Jul 2018	18th QM, Nov, 2018	19th QM, Feb, 2019	20th QM, Feb, 2019	Bangladesh (DoE) Standard (ECR 2005)
Weather		Sunny	Rainy/ Cloudy	Sunny	Sunny	Sunny	Rainy/ Cloudy	Sunny/ Rainy	Sunny	Sunny	Rainy/ Cloudy	Rainy/ Cloudy	Sunny	Sunny/ Cloudy	Sunny	Sunny	Sunny/ Cloudy	Rainy/ Cloudy	Sunny/ Cloudy	Sunny	Sunny	
			Concentrations are in µg/m^3																			
	O_3	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	5	7	9	6	7	157^{8hr}

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

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

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

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

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

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

Legend X-Absence of source or no emission,

√-Presence of source, emission of pollutant

(B) Water Quality Data

Surface Water Quality Monitoring Data

Table B.1: pH Values of Passur River Water

Sl	Sampling Locations	pH Values																				BD Standard
		1st year				2nd Year				3rd year				4th year			5th year				6th Year	
		Apr 1QM	July 2QM	Oct 3QM	Jan 4QM	Apr 1QM	July 2QM	Oct 3QM	Jan 4QM	Apr 1QM	July 2QM	Oct 3QM	Jan 4QM	Apr 1QM	Oct 2QM	Jan 3QM	Apr 1QM	July 2QM	Nov 3QM	Feb 4QM	Apr 1QM	
1	Left Bank of Passur River at 100m u/s of North West corner from the Project boundary	7.2	7.0	8.1	7.9	7.6	7.8	7.6	7.1	7.5	7.27	6.9	7.6	7.2	7.1	8.28	8.1	8.4	7.9	8.18	9.0	6.5– 8.5
2	Middle Passur River at 100m u/s of North West corner from the Project boundary	7.2	7.0	8.2	8.0	7.7	7.9	7.58	7.3	7.8	7.3	7	7.5	7.3	6.9	8.25	8.1	8.4	6.04	8.03	9.9	
3	Right Bank of Passur River at 100m u/s of North West corner from the Project boundary	7.2	6.9	8.0	8.1	7.8	7.8	7.64	7.3	7.2	7.93	7.2	7.8	7.3	6.9	8.17	8.1	8.4	8.09	8.06	8.7	
4	Left Bank of Passur River at Project site-Jetty	7.9	7.1	8.1	7.9	7.5	7.9	7.6	7.1	7.4	7.56	7.3	8.2	7.2	6.9	8.2	8.1	8.3	7.65	7.78	8.9	
5	Middle Passur River at Project site-Jetty	7.1	6.9	8.1	7.9	7.6	8	7.58	7.5	7.8	7.6	7	8.5	7.8	7.2	8.21	8.1	8.3	8.20	7.97	8.4	
6	Right Bank of Passur River at Project site-Jetty	7.1	6.9	8.2	7.9	7.7	8	7.62	7.6	7.4	7.9	6.9	8.7	7.4	7.2	8.2	8.1	8.2	7.87	8.04	8.5	
7	Left Bank of Passur River at South West corner from the Project boundary	7.4	7.0	8.1	7.6	7.5	8.1	7.78	8.1	7.6	7.94	7.2	8.1	6.9	7.2	8.39	8.0	8.4	8.11	7.89	9.3	
8	Middle of Passur River at South West corner from the Project boundary	7.4	6.9	8.0	7.5	7.2	8	7.6	8	7.1	8.04	7.5	8.6	6.8	7.1	8.15	8.1	8.5	7.44	7.85	8.7	
9	Right Bank of Passur River at South West corner from the Project boundary	7.3	6.8	8.0	7.8	7.3	8.1	7.64	7.9	7.2	8.2	7.3	8.9	7.1	7	8.16	8.1	8.5	7.07	8.06	8.4	
10	Maidara river of the South East corner of the Project at Ichamoti-Maidara confluence	7.4	6.9	8.1	7.7	7.5	8.1	7.3	7.3	7.1	8.1	6.8	8.1	7.2	7.1	8.4	8.1	8.6	7.94	8.05	9.3	
11	Maidara river near proposed township area	7.4	6.8	8.1	7.3	7.6	6.9	7.56	7.1	7.4	7.8	7.1	7.6	7.4	7	7.92	7.6	7.3	7.631	7.8	8.2	
12	Passur river at Passur-Ghasiakhali confluence	7.3	6.8	7.4	8.2	7.5	7.9	7.1	7.4	7.3	7.3	6.9	7.2	6.9	6.8	7.48	7.3	8.3	7.02	8.65	8.1	
13	Passur river at Harbaria of Sundarbans	7.9	6.9	8.0	8.1	7.7	7.9	7.8	8.2	7.3	7.63	7.4	7.8	6.9	7.1	8.19	8.1	8.4	7.19	7.71	8.2	
14	Passur river at Akram point of Sundarbans	7.2	6.9	7.9	8.1	7.7	NS	7.63	8	7.9	7.67	7.1	8.2	7.2	7.1	8.22	8.2	8.2	8	7.77	7.9	
15	Passur river at Hiron po.000int of Sundarbans	7.2	7.0	7.0	8.1	7.7	NS	7.39	NS	7.8	NS	7.6	8.5	NS	6.8	8.2	NS	NS	7.18	7.79	NS	

Source: CEGIS Field Survey

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

Table B.2: Surface Water Temperature in Passur River

Sl	Sampling Locations	Temperature (°C)																				BD Standard
		1st Year				2nd Year				3rd year				4th year			5th year				6th year	
		Apr 1QM	Jul 2QM	Oct 3QM	Apr 1QM	Apr 1QM	Jul 2QM	Oct 3QM	Jan 4QM	Apr 1QM	Jul 2QM	Oct 3QM	Jan 4QM	Apr 1QM	Oct 2QM	Jan 3QM	Apr 1QM	Jul 2QM	Nov 3QM	Feb 4QM	Apr 1QM	
1	Left Bank of Passur River at 100m u/s of North West corner from the Project boundary	31	33	31	19	30	31.8	31.2	22.0	31.2	29.6	30.1	22.8	30	29.8	19.7	30	30	28	22.02	**31**	20°C – 30°C
2	Middle Passur River at 100m u/s of North West corner from the Project boundary	31	33	31	20	30	30.5	31.8	21.0	31.1	29.1	30.8	22.5	30	30.1	19.8	30	30	26.85	21.96	**31**	
3	Right Bank of Passur River at 100m u/s of North West corner from the Project boundary	31	33	30	20	30	30.5	30.9	21.0	30.8	29.4	30.4	22.1	29.8	30.2	20.2	31	30	27.49	21.82	**31**	
4	Left Bank of Passur River at Project site-Jetty	31	33	31	19	31	30.8	31.3	22.0	31.4	30.1	30.1	22.8	31.3	30.1	20.3	28	30	28.38	22.62	**31**	
5	Middle Passur River at Project Site-Jetty	30	32	31	19	30	30.6	31.6	22.0	30.9	30.5	31.0	21.8	30.0	29.8	20.3	29	30	27.97	22.55	**31**	
6	Right Left Bank of Passur River at Project site-Jetty	30	32	31	19	30	30.4	31.1	21.0	31.0	30.5	31.1	21.9	30.0	29.9	20.3	28	31	28.05	22.35	**31**	
7	Left Bank of Passur River at South West corner from the Project boundary	31	32	30	20	31	30.5	30.3	23.0	30.7	30.7	30.4	22.1	29.9	30.0	20.6	28	31	27.85	22.17	**33**	
8	Middle of Passur River at South West corner from the Project boundary	31	31	29	19	30	30.8	30.5	22.0	30.4	29.8	30.2	22.0	29.8	30.1	20.2	28	31	28	22.27	**31**	
9	Right Bank of Passur River at South West corner from the Project boundary	31	31	29	19	31	30.6	30.8	21.0	30.1	29.8	31.1	22.1	30.1	30.1	20.3	28	31	28	22.54	**32**	
10	Maidara river of the South East corner of the Project at Ichamoti-Maidara confluence	30	31	28	19	30	30.8	31.8	22.0	31.2	30.4	31.1	21.9	30.3	29.9	19.1	28	31	27.62	22.06	**33**	
11	Maidara river near proposed township area	30	32	27	20	30	31.6	31.2	23.0	30.6	30.7	31.2	21.8	30.1	30.0	21.1	31	31	30.2	21	**32**	
12	Passur river at Passur-Ghasiakhali confluence	29	30	32	19	30	29.8	30.7	21	31.3	30.7	30.38	22.1	30.2	30	20.8	**30**	29	26.82	21.89	**31**	
13	Passur river at Harbaria of Sundarbans	30	30	27	22	30	29.0	30.8	22.0	31.5	30.9	29.9	23.1	30.2	29.8	21	30	29	27.62	21.81	**31**	
14	Passur river at Akram point of Sundarbans	29	29	30	21	30	NS	30.2	21.0	30.8	30.4	30.4	22.5	30.8	29.9	21.2	32	30	27.21	22.42	**31**	
15	Passur river at Hiron point of Sundarbans	29	30	29	21	30	NS	30.4	NS	31.4	NS	31.3	21.4	NS	29.4	21.2			28.66	23.78		

Source: CEGIS Field Survey

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

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

Sl	Sampling Locations	Salinity (ppt)																			
		1st Year				2nd Year				3rd year				4th year			5th year				6th year
		Apr	Jul	Oct	jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	Apr	Jul	Nov	Feb	Apr
		1QM	2QM	3QM	1QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	1QM	2QM	3QM	4QM	1QM
1	Left Bank of Passur River at 100m u/s of North West corner from the Project boundary	11.5	2.5	0.0	4.5	13	0	0	4.1	8	0	0	3.7	6.3	0	2	11.5	0.2	0.9	11.1	**16.6**
2	Middle Passur River at 100m u/s of North West corner from the Project boundary	11.5	0.3	0.0	4.1	15	0	0	4.3	7.4	0	0	3.8	5.9	0	2	11.5	0.2	0.1	11.1	**16.2**
3	Right Bank of Passur River at 100m u/s of North West corner from the Project boundary	11.5	0.2	0.0	4.5	16	0	0	4.3	7	0	0	3.6	6.2	0	2	11.5	0.4	0.8	10.6	**16.5**
4	Left Bank of Passur River at Project site-Jetty	12.0	2.2	0.0	4.7	9	0	0	4.4	6	0	0	4	6.8	0	2.6	12.0	0.3	0.9	10.8	**16.6**
5	Middle Passur River at Project site-Jetty	12.0	0.3	0.0	5.1	13	0	0	5.1	6.2	0	0	3.9	6.9	0	2.6	12.0	0.2	0.8	10.8	**16.9**
6	Right Left Bank of Passur River at Project site-Jetty	12.0	0.5	0.0	5.0	14	0	0	5	9	0	0	4.2	6.1	0	2.7	12.0	0.2	0.8	11	**16.9**
7	Left Bank of Passur River at South West corner from the Project boundary	9.5	4.0	0.0	5.2	14	0	0	5.2	8	0	0	4.2	6.5	0	2.8	9.5	0.2	1	9.9	**12.0**
8	Middle of Passur River at South West corner from the Project boundary	9.0	0.0	0.0	5.2	13	0	0	4.9	7	0	0	4.1	7.1	0	2.8	9.0	0.3	0.2	11.5	**16.7**
9	Right Bank of Passur River at South West corner from the Project boundary	10.0	2.5	0.0	5.1	12	0	0	5.5	6.8	0	0	4.1	7	0	2.8	10.0	0.3	0.3	11.1	**16.9**
10	Maidara river of the South East corner of the Project at Ichamoti-Maidara confluence	10.0	0.5	0.0	5.2	10	0	0	3.8	7.1	0	0	3.9	7	0	2.6	10.0	0.3	0.9	11.3	**16.5**
11	Maidara river near proposed township area	9.0	4.5	0.0	4.5	9	0	0	2.5	6.3	0	0	3.8	6.9	0	2.52	9.0	0.2	0.02	9.9	**8.0**
12	Passur river at Passur-Ghasiakhali confluence	10.0	9.5	0.0	5.0	14	0	0	4.8	6	0	0	6.7	10.4	1.2	10.8	10.0	0.6	1	7.9	**14.9**
13	Passur river at Harbaria of Sundarbans	12.0	10.0	0.0	6.0	15	0	0	5.3	8.9	0	0	8.9	10.4	2.3	2.8	12.0	2.2	1.8	11.9	**15.6**
14	Passur river at Akram point of Sundarbans	19.0	15.0	1.0	16.0	20	NS	5	11.3	9.4	4	3	16.3	16	3.6	13.1	19.0	2.8	9.1	16.7	**22.9**
15	Passur river at Hiron point of Sundarbans	23.0	19.5	2.0	23.0	25	NS	6.2	NS	14	NS	5.8	21.4	NS	5.1	16.45	23.0		13.9	22.7	

Source: CEGIS Field Survey

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

Table B.4: Dissolve Oxygen in Passur River

SL	Sampling Locations	Dissolve Oxygen (mg/L)																				
		1st Year				2nd Year				3rd year				4th year			5th year				6th year	BD Standard
		Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	Apr	Jul	Nov	Feb	Apr	
		1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	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	6.3	5.19	6.575	6.0	6.4	8.7	**5.9**	
2	Middle of Passur River at 100m u/s of North West corner from the Project boundary	4.9	6.8	7.7	6.6	6.4	5	6.4	5.1	6.4	5.7	6.1	5.9	7.2	6.4	5.03	6.225	6.2	6.2	7.9	**6.5**	
3	Right Bank of Passur River at 100m u/s of North West corner from the Project boundary	5.2	6.7	7.7	6.7	6.2	5	7.1	6.2	6.9	5.6	6	6.1	6.8	6.5	5.06	6.275	6.1	6.3	7.3	**6.3**	
4	Left Bank of Passur River at Project site-Jetty	5.7	6.8	7.6	5.8	6.2	6.7	6.8	5.9	5.8	6.1	6.3	6.2	6.9	6.3	5.1	6.15	5.5	6	8.7	**6.1**	
5	Middle of Passur River at Project site-Jetty	5.9	6.9	7.2	5.9	6.6	6.6	7.2	5.3	6.1	6.3	5.9	5.9	7.4	6.3	5.03	6.5	6.0	6.2	7.3	**6.5**	
6	Right Bank of Passur River at Project site-Jetty	5.8	6.6	8.0	6.8	6.4	6	7.6	5.4	6.6	5.8	6.1	5.9	7.5	6.5	4.9	6.575	6.5	6	7.4	**6.0**	
7	Left Bank of Passur River at South West corner from the Project boundary	6.6	7.3	5.6	6.1	6.3	7.5	6.4	6	6.9	6.3	5.9	6.3	6.4	6.5	5	6.55	6.8	6.1	7.8	**6.1**	5 or more (standard for sustaining fisheries)
8	Middle of Passur River at South West corner from the Project boundary	6.5	7.1	5.6	6.9	6.5	7.4	6.1	6.1	7.1	6.4	6	6.4	7.2	7.1	4.98	6.825	6.2	6.3	7.1	**6.5**	
9	Right Bank of Passur River at South West corner from the Project boundary	6.5	7.2	5.8	6.6	6.4	7.3	6.3	5.8	6.8	5.6	6	6.4	6.8	6.5	5.11	6.625	6.0	6.2	6.9	**6.1**	
10	Maidara river of the South East corner of the Project at Ichamoti-Maidara confluence	6.0	6.5	8.0	6.0	6.2	6	7.1	4.1	6.4	5.2	6.1	6.7	6.8	6.3	5.17	6.35	6.7	5.8	7.5	**6.3**	
11	Maidara river near proposed township area	6.7	6.8	8.0	6.2	6.5	6.4	7.1	5.2	5.9	5.4	6.4	6.7	7.1	6.2	5.11	6.7	6.3	6	6.0	**6.2**	
12	Passur river at Passur-Ghasiakhali confluence	5.3	6.2	7.0	6.5	6.3	7	6.6	5.4	5.8	5.4	5.6	5.9	6.4	6.4	5.23	5.95	5.8	6	6.9	**6.5**	
13	Passur river at Harbaria of Sundarbans	5.4	5.9	7.0	6.6	5.8	7.5	7.1	5.2	6.4	5.4	5.8	6.1	6.4	6.2	5.03	5.8	6.9	8.21	7.5	**6.9**	
14	Passur river at Akram point of Sundarbans	7.9	6.4	7.7	6.7	6	NS	7.3	6.2	6.1	6.2	6.7	6.5	7.2	6.8	5.4	6	6.8	6.9	7.7	**7.0**	
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	NS	7.3	5.4	NS	NS	7.2	8.0	NS	

Source: CEGIS Field Survey-

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

Table B.5: BOD_5 of Passur River Water

SL	Sampling Locations	BOD_5 (mg/L)																				
		1st Year				2nd Year				3rd year				4th year			5th year				6th year	BD Standard
		Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	Apr	Jul	Nov	Feb	Apr	
		1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	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	1.9	2.1	3	2	2	4	3.2	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	3.3	4.1	2.3	3.2	2.4	1.9	2.2	3.2	2.8	2.7	1.9	3.4	2.1	1.9	2	2	3	3	3.1	
3	Right Bank of Passur River at 100m u/s of North West corner from the Project boundary	2.2	2.8	3.4	2.7	3.1	2.9	3.4	1.9	3	2.5	2.8	1.9	2.5	2.7	1.9	3	3	2	4	3	
4	Left Bank of Passur River at Project site-Jetty	3.2	3.1	4.0	0.8	3	4.4	3.2	1.1	3.6	2.1	3.1	2.1	2.4	2.8	2.0	4	2	2	4	3.5	
5	Middle of Passur River at Project site-Jetty	3.0	2.5	3.5	1.4	3.5	4.3	3.7	2.4	3.3	2.2	2.5	2.2	2.6	2.4	2.0	4	2	4	4	3.4	
6	Right Bank of Passur River at Project site-Jetty	5.8	3.5	3.6	2.0	3.4	3.7	2.9	1.7	3.1	3.1	2.9	2.1	3.1	2.1	2.3	4	4	3	3	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	2.4	2.0	5	2	3	4	1.8	
8	Middle of Passur River at South West corner from the Project boundary	3.8	3.3	2.8	2.6	3.2	5.2	2.3	2.3	2.6	2.7	2.7	1.9	2.5	2.7	1.9	5	3	4	3	2.2	
9	Right Bank of Passur River at South West corner from the Project boundary	6.5	3.8	2.9	2.1	3.4	5	3.1	2.4	3	3.1	3.1	2.1	2.6	2.3	2.1	5	3	4	4	2.1	
10	Maidara river of the South East corner of the Project at Ichamoti-Maidara confluence	3.2	3.3	5.5	1.5	3.2	3.9	4.2	2.7	3.3	3.4	2.8	1.8	3.4	2.4	2.1	4	2	4	5	2.1	
11	Maidara river near proposed township area	4.1	3.7	4.0	2.0	3.4	4.2	1.6	1.8	3.5	3.2	2.9	2.1	3.2	2.1	2.0	4	2.5	3	4	2.2	
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	3.1	2.4	3.1	3	3	5	1.8	
13	Passur river at Harbaria of Sundarbans	2.2	2.5	2.6	1.9	2.4	3.9	2.7	2.1	3.2	2.8	2.7	2.1	2.7	3.1	2.9	2.3	3	4	6	2.2	
14	Passur river at Akram point of Sundarbans	3.4	2.2	1.9	1.6	3.1	3	2.1	2.1	2.8	2.4	2.8	1.8	2.1	1.9	2.1	3	2	2	4	2.1	
15	Passur river at Hiron point of Sundarbans	4.9	3.3	4.1	2.3	3.2	2.4	1.9	2.2	3.2	2.8	2.7	1.9	3.4	2.1	1.9	2	2	3	3	2.1	

Source: CEGIS Field Survey

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

Table B.6: COD of Passur River System

Sl	Sampling Locations	COD (mg/L)																		
		1st Year				2nd year				3rd year				4th Year			5th year			
		Apr	Jul	Oct	Jan	Apr	July	Oct	Jan	Apr	July	Oct	Jan	Apr	Oct	Jan	Apr	July	Nov	Feb
		1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	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	52	24	48	276	20	56	72
2	Middle Passur River at 100m u/s of North West corner from the Project boundary	284	20	30	68	58	43	36	100	240	8	8	40	48	8	28	240	24	44	60
3	Right Bank of Passur River at 100m u/s of North West corner from the Project boundary	328	56	14	92	132	18	28	96	280	8	8	44	56	40	40	230	12	48	48
4	Left Bank of Passur River at Project site-Jetty	376	28	18	84	102	26	36	100	280	8	12	48	40	32	36	232	30	60	44
5	Middle Passur River at Project site-Jetty	400	60	14	116	110	21	36	108	240	12	16	52	36	40	32	254	16	36	56
6	Right Bank of Passur River at Project site-Jetty	364	496	18	108	88	24	40	80	260	8	12	42	48	16	28	252	12	42	64
7	Left Bank of Passur River at South West corner from the Project boundary	364	108	10	104	96	32	42	100	240	12	8	56	42	48	40	212	10	48	88
8	Middle of Passur River at South West corner from the Project boundary	400	40	22	16	18	25	28	100	180	8	8	52	36	8	44	218	24	32	36
9	Right Bank of Passur River at South West corner from the Project boundary	408	120	10	100	106	25	48	124	200	12	12	44	52	4	36	230	16	28	68
10	Maidara river of the South East corner of the project at Ichamoti-Maidara confluence	276	32	10	116	88	51	40	100	160	8	8	36	44	16	40	180	40	36	72
11	Maidara river near proposed township area	284	96	26	84	94	36	42	108	210	30	8	48	40	32	32	252	20	42	68
12	Passur river at Passur - Ghasiakhali confluence	408	172	14	96	92	30	46	88	220	12	16	40	64	**40**	48	260	10	20	32
13	Passur river at Harbaria of Sundarbans	372	216	14	96	102	26	36	100	140	16	12	**40**	216	32	40	280	16	58	56
14	Passur river at Akram point of Sundarbans	536	520	54	316	302	NS	84	96	156	4	68	56	240	**16**	72	296	110	44	**180**
15	Passur river at Hiron point of Sundarbans	540	416	122	472	470	NS	96	NS	160	NS	56	196	NS	4	88	NS	NS	76	140

Source: CEGIS Field Survey

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

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

Sl	Sampling Locations	Oil and Grease (mg/L)																			ECR, 1997 (mg/L)*
		1st Year				2nd year				3rd year				4th year			5th year				
		Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	Apr	Jul	Nov	Feb	
		1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	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	*5.73*	<5	16.6	<5	<1	<2.0	<2.0	10
2	Passur-Ghasiakhali Confluence	<5	<5	<5	>15	13	7.63	9.87	21	30.3	13.5	<5	15.6	<5	<5	<5	<5	<5	<2.0	<2.0	
3	Passur river at Harbaria of Sundarbans	<5	6.3	<5	>20	39.1	10.1	<5	14	26	5.73	<5	<5	<5	<5	<5	<5	<1	<2.0	<2.0	
4	Passur river at Hiron point of Sundarbans	<5	<5	<5	>20	<5	NS	10.8	ND	31	NS	10.1	13.8	7.71	<5	<5	<5	NS	<2.0	<2.0	
5	Akram Point of Sundarbans	<5	<5	<5	>20	<5	NS	9.73	36	82	5.87	<5	14.2	ND	<5	<5	<5	<1	<2.0	<2.0	

Source: CEGIS Field Survey

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

Table B.8: TDS of Passur River System

SL	Sampling Locations	TDS (mg/L)																		
		1st Year				2nd year				3rd year				4th Year			5th year			
		Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	Apr	Jul	Nov	Feb
		1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	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	13400	496	1913	14500	315	855	9940
2	Middle of Passur River at 100m u/s of North West corner from the Project boundary	12630	246	162	3950	14700	941	169	5910	13280	112	106	3140	13480	122	1919	14420	224	733	9950
3	Right Bank of Passur River at 100m u/s of North West corner from the Project boundary	12900	383	153	4330	14900	127	152	5490	13560	125	108	3330	13400	123	1915	14650	232	722	9730
4	Left Bank of Passur River at Project site-Jetty	13190	445	169	4750	14600	175	172	5720	12830	162	147	3630	13560	172	2500	14300	328	824	9860
5	Middle Passur River at Project site-Jetty	13330	353	156	4920	14500	132	162	5850	13100	185	110	3600	13490	125	2520	14450	235	716	9980
6	Right Bank of Passur River at Project site-Jetty	13380	402	152	4870	14200	156	160	5480	13460	143	112	3520	13330	125	2500	14540	208	732	9800
7	Left Bank of Passur River at South West corner from the Project boundary	13180	655	162	5040	14500	336	192	5650	12820	205	113	3470	13640	160	2840	14400	205	945	10190
8	Middle of Passur River at South West corner from the Project boundary	13390	587	153	5050	14600	158	164	5740	12960	195	108	3790	13680	126	2710	14500	286	784	10280
9	Right Bank of Passur River at South West corner from the Project boundary	13240	916	154	5130	14250	160	164	5650	13590	140	146	3770	13360	127	2720	14610	296	786	10080
10	Maidara river of the South East corner of the project at Ichamoti-Maidara confluence	12400	455	214	5050	14000	2320	183	5450	13340	165	196	2920	13490	1616	2500	14160	265	992	10040
11	Maidara river near proposed Township area	10970	2510	257	4390	13900	355	176	4420	11700	5170	238	3960	13110	1200	2970	14450	340	827	8860
12	Passur river at Passur - Mongla confluence	12800	6410	209	5130	14050	298	227	4540	11330	893	162	3370	12340	204	2570	14500	580	940	8350
13	Passur river at Harbaria of Sundarbans	12280	9360	285	4780	13900	683	205	4940	13580	1321	301	3370	13600	245	2690	15350	2190	1715	10950
14	Passur river at Akram point of Sundarbans	21500	15960	3400	12350	13600	NS	4220	13330	20720	7330	2550	3580	19370	3270	11390	20600	7680	8100	17200
15	Passur river at Hiron point of Sundarbans	21500	14050	5720	17900	25300	NS	5830	NS	25500	NS	4120	12210	NS	4450	14190	NS	NS	12500	21110

Source: CEGIS Field Survey

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

Table B.9: TH Passur River System

SL	Sampling Locations	TH (mg/L)																		
		1st Year				2nd year				3rd year				4th year			5th year			
		Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	Apr	Jul	Nov	Feb
		1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	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	3640	200	430	3100	210	335	2050
2	Middle of Passur River at 100m u/s of North West corner from the Project boundary	2500	180	218	870	3050	110	330	1380	3090	205	250	980	3420	150	510	1040	205	310	3900
3	Right Bank of Passur River at 100m u/s of North West corner from the Project boundary	2650	170	335	870	3250	105	360	1240	3140	205	190	1030	3300	155	498	1030	185	313	4100
4	Left Bank of Passur River at Project site-Jetty	2550	175	390	940	3450	118	365	1220	3010	220	265	1020	3400	160	570	1060	200	285	4600
5	Middle Passur River at Project site-Jetty	2600	275	340	990	3250	103	355	1300	3070	232	237	915	3440	145	590	1040	210	255	4200
6	Right Bank of Passur River at Project site-Jetty	2625	350	355	970	3200	105	350	1260	3100	218	242	1070	3380	140	480	1085	215	275	4400
7	Left Bank of Passur River at South West corner from the Project boundary	2550	325	330	1045	3600	153	345	1370	3060	235	205	935	3540	150	505	1080	205	295	4400
8	Middle of Passur River at South West corner from the Project boundary	2800	350	345	1125	3670	105	390	1340	3130	242	217	1100	3480	155	530	1110	212	265	4300
9	Right Bank of Passur River at South West corner from the Project boundary	2500	475	325	975	3540	165	445	1270	3110	224	238	1110	3600	175	512	1100	205	325	4600
10	Maidara river of the South East corner of the project at Ichamoti-Maidara confluence	2500	450	350	980	3260	470	183	950	3180	220	250	1040	1960	165	505	1300	210	295	4000
11	Maidara river near proposed township area	2400	725	330	970	3190	130	340	1075	3080	875	240	1170	2300	320	478	1120	220	315	4100
12	Passur river at Passur - Mongla confluence	3150	1400	377	1000	3210	135	410	1090	3060	405	245	1070	2450	220	1070	1410	245	325	4000
13	Passur river at Harbaria of Sundarbans	2625	2150	345	970	3080	200	430	1100	3050	415	282	1070	3560	200	610	1330	530	2550	4500
14	Passur river at Akram point of Sundarbans	4500	3625	980	2380	3420	NS	1090	2850	4520	1750	670	1130	4300	640	1475	1440	2030	2750	5900
15	Passur river at Hiron point of Sundarbans	4850	3050	1440	2690	3640	NS	1460	NS	5050	NS	810	2870	NS	905	1740	NS	NS	4200	6900

Source: CEGIS Field Survey

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

Table B.10: TSS Passur River System

SL	Sampling Locations	TSS (mg/L)																		
		1st Year				2nd year				3rd year				4th year			5th year			
		Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	Apr	Jul	Nov	Feb
		1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	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	51	18	14	18	17	14	15
2	Middle of Passur River at 100m u/s of North West corner from the Project boundary	45	92	193	210	167	25	80	12	7	48	18	52	42	15	15	17	16	11	12
3	Right Bank of Passur River at 100m u/s of North West corner from the Project boundary	53	112	174	230	170	127	65	14	10	56	16	48	48	22	14	22	15	15	14
4	Left Bank of Passur River at Project site-Jetty	54	99	227	450	160	30	92	17	10	62	20	42	52	16	13	20	18	11	12
5	Middle Passur River at Project site-Jetty	60	100	232	250	165	27	85	18	8	45	24	54	43	20	13	19	16	13	13
6	Right Bank of Passur River at Project site-Jetty	55	105	186	200	155	40	97	22	7	49	19	46	38	17	14	21	15	12	15
7	Left Bank of Passur River at South West corner from the Project boundary	24	116	185	300	150	32	104	20	12	51	20	61	32	15	15	17	16	14	16
8	Middle of Passur River at South West corner from the Project boundary	27	112	536	530	147	40	90	7	10	43	18	58	44	16	17	19	14	13	13
9	Right Bank of Passur River at South West corner from the Project boundary	67	37	459	450	155	44	82	18	11	39	16	63	40	14	12	18	20	15	14
10	Maidara river of the South East corner of the project at Ichamoti-Maidara confluence	7	65	798	280	148	36	96	11	7	42	24	55	37	26	14	23	13	11	14
11	Maidara river near proposed township area	9	24	389	206	160	28	92	10	6	11	30	66	49	30	15	32	12	42	8
12	Passur river at Passur - Mongla confluence	50	310	203	280	165	24	60	15	13	47	27	61	38	**25**	13	14	17	27	15
13	Passur river at Harbaria of Sundarbans	65	90	869	400	160	42	74	22	18	31	18	**61**	33	27	17	15	13	22	12
14	Passur river at Akram point of Sundarbans	115	99	28	103	150	NS	110	16	23	16	41	34	28	22	14	18	14	15	11
15	Passur river at Hiron point of Sundarbans	91	72	267	200	180	NS	144	NS	15	NS	33	49	NS	16	13	NS	NS	6	9

Source: CEGIS Field Survey

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

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

Sl	Sampling Locations	NO_3^{2-} (mg/L)																		
		1st Year				2nd year				3rd year				4th year			5th year			
		Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	Apr	Jul	Nov	Feb
		1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	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	4.35	5.8	3	6.8	0.8	2.8	3.5
2	Middle of Passur River at 100m u/s of North West corner from the Project boundary	0.7	2.4	1.57	1.5	13	7.5	7.1	4.3	2.9	6.2	0.39	2.89	5.05	6.8	4.2	4.9	1.7	0.1	2.6
3	Right Bank of Passur River at 100m u/s of North West corner from the Project boundary	0.1	3.2	1.84	4.3	39	6.2	5	3.9	2.5	4.3	0.42	1.87	4.55	4.5	3.6	5.1	2.1	0.11	1.9
4	Left Bank of Passur River at Project site-Jetty	1.3	0.76	1.64	3.1	48	6.6	5.7	3.1	2	5.1	0.76	2.25	6.11	7.1	3	2.8	2.8	1.7	2.1
5	Middle Passur River at Project site-Jetty	1.4	2.69	1.42	2.2	69	6.1	3.3	5.2	3.1	2.7	0.52	2.46	3.4	3.1	4.7	5.2	1.8	0.9	2.2
6	Right Bank of Passur River at Project site-Jetty	1.1	2.98	1.33	8.5	8	6.6	4.7	4.1	3.6	3.9	0.31	3.01	3.16	5	7.6	5.5	3.2	0.1	3.5
7	Left Bank of Passur River at South West corner from the Project boundary	0.75	2.13	1.85	2.7	87	14.9	4.4	4.9	2.6	3.6	0.2	3.64	3.14	4.1	8.8	2.6	4	0.1	4.2
8	Middle of Passur River at South West corner from the Project boundary	1.1	2.43	2.09	1.8	48	4	6.2	3.7	2.9	5.1	0.41	1.93	3.34	3.4	8.5	4.5	3.7	3.4	3.0
9	Right Bank of Passur River at South West corner from the Project boundary	1.2	2.05	2.21	1.9	128	4.9	4.4	4.4	2.6	4.9	0.63	2.17	2.00	3.1	2.8	5.3	3.8	0.7	3.1
10	Maidara river of the South East corner of the project at Ichamoti-Maidara confluence	0.3	2.18	2.26	6	62	7	4.9	5.6	2.7	5.2	0.4	2.46	3.61	2.3	1.6	5.9	4.4	2.3	2.1
11	Maidara river near proposed township area	0.5	0.88	1.98	4	48	3.1	2.9	3.9	3.1	5.3	0.32	3.1	1.60	3.2	3.4	3.9	3.1	0.12	1.3
12	Passur river at Passur - Mongla confluence	0.6	1.52	1.64	4.5	29	7.8	3.1	3.7	3	5.2	0.27	2.78	2.49	3.5	4.5	4.7	2.4	1.6	3.7
13	Passur river at Harbaria of Sundarbans	1.4	1.75	1.67	2.7	18	4.4	4.4	5.1	3.4	5.1	0.39	2.78	2.46	4.2	4.6	5.2	2.7	0.1	4.7
14	Passur river at Akram point of Sundarbans	2.7	3.32	0.59	1.5	25	NS	3.2	4.9	2.9	5.4	0.25	3.08	3.69	2.2	1.8	5.5	4.2	0.1	1.8
15	Passur river at Hiron point of Sundarbans	0.8	2.84	0.4	2	28	NS	11.5	NS	3.5	NS	0.38	2.28	NS	2.6	6.1	NS	NS	0.9	2.6

Source: CEGIS Field Survey

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

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

Sl	Sampling Locations	SO_4^{2-} (mg/L)																		
		1st Year				2nd year				3rd year				4th year			5th year			
		Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	Apr	Jul	Nov	Feb
		1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	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	422	29	630	1400	24	51	760
2	Middle of Passur River at 100m u/s of North West corner from the Project boundary	1320	23	28	450	1260	11	8	590	1040	10	3	210	460	3	370	1320	18	49	756
3	Right Bank of Passur River at 100m u/s of North West corner from the Project boundary	1280	36	34	480	1240	9	11	560	1020	13	4	200	1340	5	410	1440	20	46	764
4	Left Bank of Passur River at Project site-Jetty	1360	45	33	550	1240	26	10	550	1060	15	4	230	1380	2	310	1260	22	52	748
5	Middle Passur River at Project site-Jetty	1040	32	30	520	1120	6	8	580	980	17	6	280	1280	1	310	1200	21	38	760
6	Right Bank of Passur River at Project site-Jetty	1320	20	27	540	820	8	9	565	1100	14	5	230	1400	2	490	1400	16	42	762
7	Left Bank of Passur River at South West corner from the Project boundary	1640	60	40	630	880	9	12	640	1060	15	6	230	880	2	700	1300	10	56	768
8	Middle of Passur River at South West corner from the Project boundary	1520	40	35	560	1180	19	8	560	1020	18	5	231	1440	1	340	1380	24	52	760
9	Right Bank of Passur River at South West corner from the Project boundary	1280	80	64	620	900	12	6	550	1080	12	8	250	1340	3	340	1240	22	39	770
10	Maidara river of the South East corner of the project at Ichamoti-Maidara confluence	1120	20	63	570	1220	72	11	96	1040	11	14	160	1220	120	270	1200	21	65	758
11	Maidara river near proposed township area	1320	210	63	460	840	27	9	480	1020	480	14	200	1340	76	350	1250	18	46	760
12	Passur river at Passur - Mongla confluence	1360	620	44	630	980	39	13	482	1100	42	14	220	1220	**5**	280	1260	28	30	765
13	Passur river at Harbaria of Sundarbans	1560	860	69	590	900	51	7	500	1080	60	19	220	1300	13	220	1300	35	20	756
14	Passur river at Akram point of Sundarbans	2600	1400	1390	850	1540	NS	84	760	1650	620	190	230	1420	30	760	1460	620	250	764
15	Passur river at Hiron point of Sundarbans	2080	1160	2360	1500	1920	NS	97	NS	2100	NS	320	1090	NS	2	510	NS	NS	780	769

Source: CEGIS Field Survey

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

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

Sl	Sampling Locations	PO_4^{2-} (mg/L)																		
		1st Year				2nd year				3rd year				4th year			5th year			
		Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	Apr	Jul	Nov	Feb
		1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	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	1.31	0.49	0.21	0.38	1.03	0.25	0.25
2	Middle Passur River at 100m u/s of North West corner from the Project boundary	0.5	1.99	1.12	0.61	0.53	0.23	1.97	0.269	0.36	1.76	4.11	0.31	1.72	2.5	0.16	0.25	0.83	0.3	0.30
3	Right Bank of Passur River at 100m u/s of North West corner from the Project boundary	1.1	2.55	0.95	0.7	0.72	0.67	1.94	0.179	0.27	1.77	4.58	0.09	2.73	2.8	0.3	0.29	0.76	0.22	0.17
4	Left Bank of Passur River at Project site-Jetty	2.1	0.45	0.92	0.43	0.49	0.27	2.53	0.357	0.31	2.31	2.76	0.07	2.77	3.3	0.19	0.38	0.88	0.24	0.20
5	Middle Passur River at Project site-Jetty	2.2	2.13	1.11	0.41	0.68	0.59	1.3	0.536	0.3	0.98	3.2	0.12	0.66	3.9	0.17	0.34	1.07	0.4	0.35
6	Right Bank of Passur River at Project site-Jetty	2	2.42	0.99	0.55	0.61	0.13	1.32	0.269	0.43	1.01	2.48	0.16	0.62	3.9	0.47	0.27	0.67	0.53	0.27
7	Left Bank of Passur River at South West corner from the Project boundary	0.57	1.25	1.18	0.76	0.65	0.1	0.99	0.536	0.63	0.87	4.16	0.09	0.65	4.6	1.31	0.29	1.16	0.32	0.20
8	Middle of Passur River at South West corner from the Project boundary	1.2	1.51	1.25	0.85	0.53	0.18	1.02	0.625	0.21	0.96	2.76	0.04	0.37	0.41	0.39	0.29	0.86	0.43	0.20
9	Right Bank of Passur River at South West corner from the Project boundary	1.5	1.1	1	0.53	0.6	0.1	1.39	0.536	0.33	1.123	2.71	0.07	0.45	0.63	0.62	0.42	1.03	0.57	0.37
10	Maidara river of the South East corner of the project at Ichamoti-Maidara confluence	0.55	2.1	1.27	0.59	0.7	0.5	1.27	0.351	0.19	1.06	2.836	0.07	0.61	0.51	0.38	0.24	0.83	0.27	0.40
11	Maidara river near proposed township area	1.1	0.53	1.04	0.64	0.55	0.29	1.28	0.269	0.13	1	5.23	0.2	0.47	15.3	0.71	0.28	1.2	0.22	0.28
12	Passur river at Passur - Mongla confluence	1.3	0.35	0.86	0.42	0.71	0.59	0.95	0.179	0.31	0.78	4.01	0.09	0.18	1.3	0.63	0.37	0.86	0.33	0.29
13	Passur river at Harbaria of Sundarbans	1.1	0.56	1.22	0.61	0.59	0.89	0.35	0.269	0.42	0.53	1.16	**0.09**	0.21	3.15	0.81	0.26	0.5	0.25	0.30
14	Passur river at Akram point of Sundarbans	1.3	0.29	0.8	0.42	0.61	NS	0.43	0.357	0.26	0.47	9.08	0.1	0.19	0.36	0.97	0.20	0.67	0.5	0.19
15	Passur river at Hiron point of Sundarbans	7.51	0.29	1.09	0.44	0.47	NS	0.45	NS	0.36	NS	5.9	0.23	NS	0.55	1.45	NS	NS	0.61	0.18

Source: CEGIS Field Survey

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

Table B.14: As concentration of Passur River System

Sl	Sampling Locations	As (mg/L)																		
		1st Year				2nd year				3rd year				4th year			5th year			
		Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	Apr	Jul	Nov	Feb
		1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	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	0.002	0.002	0.002	0.001	0.004	0.003	0.002
2	Middle Passur River at 100m u/s of North West corner from the Project boundary	0.002	0.003	0.004	0.003	0.002	0.002	0.001	0.001	0.003	0.003	0.003	0.001	0.002	0.001	0.002	0.001	0.005	0.002	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	0.001	0.002	0.003	0.001	0.004	0.002	0.003
4	Left Bank of Passur River at Project site-Jetty	0.002	0.004	0.004	0.004	0.002	0.002	0.001	0.002	0.002	0.004	0.002	0.002	0.001	0.002	0.002	0.002	0.005	0.002	0.001
5	Middle Passur River at Project site-Jetty	0.002	0.004	0.004	0.003	0.002	0.001	0.001	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.001	0.003	0.002	0.001
6	Right Bank of Passur River at Project site-Jetty	0.002	0.003	0.003	0.003	0.002	0.002	0.001	0.001	0.002	0.002	0.002	0.001	0.002	0.003	0.002	0.002	0.002	0.001	0.002
7	Left Bank of Passur River at South West corner from the Project boundary	<0.001	0.003	0.006	0.003	0.002	0.002	0.001	0.002	0.001	0.003	0.002	0.002	0.002	0.003	0.001	0.002	0.005	0.002	0.003
8	Middle of Passur River at South West corner from the Project boundary	<0.002	0.004	0.004	0.003	0.002	0.002	0.001	0.001	0.002	0.003	0.003	0.001	0.002	0.002	0.001	0.001	0.003	0.002	0.001
9	Right Bank of Passur River at South West corner from the Project boundary	0.002	0.003	0.006	0.003	0.002	0.003	0.001	0.001	0.002	0.004	0.002	0.002	0.003	0.002	0.001	0.001	0.004	0.002	0.001
10	Maidara river of the South East corner of the project at Ichamoti-Maidara confluence	<0.001	0.003	0.006	0.004	0.003	0.002	0.001	0.002	0.002	0.005	0.002	0.001	0.003	0.003	0.002	0.002	0.004	0.001	0.002
11	Maidara river near proposed township area	0.002	0.002	0.003	0.003	0.003	0.002	0.001	0.001	0.002	0.002	0.002	0.001	0.003	0.001	0.001	0.001	0.003	0.001	0.005
12	Passur river at Passur - Mongla confluence	0.002	0.004	0.003	0.003	0.004	0.002	0.001	0.002	0.003	0.004	0.003	0.002	0.002	0.002	0.001	0.002	0.003	0.001	0.007
13	Passur river at Harbaria of Sundarbans	0.004	0.003	0.004	0.004	0.004	0.002	0.001	0.002	0.005	0.002	0.003	0.002	0.001	0.003	0.002	0.001	0.003	0.002	0.001
14	Passur river at Akram point of Sundarbans	0.004	0.002	0.002	0.003	0.002	NS	0.001	0.002	0.006	0.001	0.003	0.001	0.002	0.002	0.001	0.002	0.002	0.001	0.002
15	Passur river at Hiron point of Sundarbans	0.003	0.002	0.003	0.002	0.002	NS	0.001	NS	0.004	NS	0.002	0.002	NS	0.002	0.001	NS	NS	0.001	0.001

Source: CEGIS Field Survey

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

Table B.15: Pb concentration of Passur River System

Sl	Sampling Locations	Pb (mg/L)																		
		1st Year				2nd year				3rd year				4th year			5th year			
		Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	Apr	Jul	Nov	Feb
		1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	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	0.002	0.003	0.001	0.002	0.002	0.003	0.004
2	Middle Passur River at 100m u/s of North West corner from the Project boundary	0.055	0.002	0.003	0.104	0.102	0.0038	0.006	0.092	0.302	0.009	0.007	0.034	0.001	0.003	0.001	0.001	0.001	0.007	0.005
3	Right Bank of Passur River at 100m u/s of North West corner from the Project boundary	0.055	0.005	0.002	0.111	0.138	0.0058	0.008	0.176	0.347	0.017	0.01	0.03	0.003	0.003	0.002	0.004	0.02	0.017	0.007
4	Left Bank of Passur River at Project site-Jetty	0.057	0.002	0.003	0.154	0.142	0.011	0.01	0.115	0.336	0.014	0.007	0.036	0.001	0.002	0.002	0.001	0.018	0.013	0.005
5	Middle Passur River at Project site-Jetty	0.06	0.002	0.002	0.139	0.135	0.002	0.009	0.148	0.317	0.006	0.006	0.046	0.003	0.002	0.001	0.003	0.008	0.01	0.003
6	Right Bank of Passur River at Project site-Jetty	0.058	0.002	0.002	0.138	0.156	0.0021	0.007	0.112	0.298	0.01	0.005	0.041	0.002	0.001	0.001	0.001	0.041	0.012	0.007
7	Left Bank of Passur River at South West corner from the Project boundary	0.053	0.002	0.003	0.16	0.142	0.0076	0.01	0.134	0.396	0.007	0.006	0.048	0.003	0.001	0.001	0.007	0.012	0.011	0.003
8	Middle of Passur River at South West corner from the Project boundary	0.054	0.003	0.004	0.153	0.148	0.002	0.011	0.099	0.323	0.006	0.007	0.044	0.009	0.002	0.001	0.003	0.015	0.014	0.004
9	Right Bank of Passur River at South West corner from the Project boundary	0.056	0.005	0.004	0.139	0.163	0.002	0.009	0.093	0.331	0.012	0.007	0.056	0.003	0.002	0.002	0.005	0.03	0.019	0.006
10	Maidara river of the South East corner of the project at Ichamoti-Maidara confluence	0.053	0.004	0.004	0.143	0.135	0.002	0.07	0.023	0.35	0.008	0.008	0.038	<LOQ	0.003	0.002	0.002	0.01	0.008	0.004
11	Maidara river near proposed township area	0.048	0.004	<0.002	0.133	0.14	0.002	0.008	0.067	0.275	0.015	0.007	0.056	0.001	0.011	0.001	0.003	0.016	0.017	0.005
12	Passur river at Passur - Mongla confluence	0.05	0.032	<0.002	0.141	0.14	0.002	0.009	0.078	0.258	0.098	0.011	0.05	0.0001	0.011	0.001	0.002	0.015	0.009	0.007
13	Passur river at Harbaria of Sundarbans	0.043	0.044	0.004	0.137	0.13	0.002	0.012	0.135	0.228	0.02	0.01	0.05	0.001	0.005	0.003	0.003	0.017	0.009	0.015
14	Passur river at Akram point of Sundarbans	0.194	0.071	0.032	0.309	0.297	NS	0.084	0.302	0.359	0.142	0.126	0.033	0.009	0.004	0.169	0.001	0..062	0.018	0.013
15	Passur river at Hiron point of Sundarbans	0.224	0.05	0.07	0.309	0.291	NS	0.073	NS	0.607	NS	0.151	0.129	NS	0.019	0.175	NS	NS	0.014	0.017

Source: CEGIS Field Survey

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

Table B.16: Hg concentration of Passur River System

Sl	Sampling Locations	Hg (mg/L)																		
		1st Year				2nd year				3rd year				4th year			5th year			
		Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	Apr	Jul	Nov	Feb
		1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	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	< 0.001	< 0.001	< 0.001	0.004	< 0.001	< 0.001	< 0.001
2	Middle Passur River at 100m u/s of North West corner from the Project boundary	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.001	< 0.001	< 0.001	0.002	< 0.001	< 0.001	< 0.001
3	Right Bank of Passur River at 100m u/s of North West corner from the Project boundary	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.001	< 0.001	< 0.001	0.001	< 0.001	< 0.001	< 0.001
4	Left Bank of Passur River at Project site-Jetty	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.001	< 0.001	< 0.001	0.001	< 0.001	< 0.001	< 0.001
5	Middle Passur River at Project site-Jetty	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.001	< 0.001	< 0.001	0.001	< 0.001	< 0.001	< 0.001
6	Right Bank of Passur River at Project site-Jetty	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.001	< 0.001	< 0.001	0.001	< 0.001	< 0.001	< 0.001

Sl	Sampling Locations	Hg (mg/L)																		
		1st Year				2nd year				3rd year				4th year			5th year			
		Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	Apr	Jul	Nov	Feb
		1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	1QM	2QM	3QM	4QM
7	Left Bank of Passur River at South West corner from the Project boundary	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.001	< 0.001	< 0.001	0.001	< 0.001	< 0.001	< 0.001
8	Middle of Passur River at South West corner from the Project boundary	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.001	< 0.001	< 0.001	0.001	< 0.001	< 0.001	< 0.001
9	Right Bank of Passur River at South West corner from the Project boundary	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.001	< 0.001	< 0.001	0.001	< 0.001	< 0.001	< 0.001
10	Maidara river of the South East corner of the project at Ichamoti-Maidara confluence	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.001	< 0.001	< 0.001	0.001	< 0.001	< 0.001	< 0.001
11	Maidara river near proposed township area	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.001	< 0.001	< 0.001	0.001	< 0.001	< 0.001	< 0.001
12	Passur river at Passur - Mongla confluence	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.001	< 0.001	< 0.001	0.001	< 0.001	< 0.001	< 0.001

Sl	Sampling Locations	Hg (mg/L)																		
		1st Year				2nd year				3rd year				4th year			5th year			
		Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	Apr	Jul	Nov	Feb
		1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	1QM	2QM	3QM	4QM
13	Passur river at Harbaria of Sundarbans	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.001	< 0.001	< 0.001	0.001	< 0.001	< 0.001	< 0.001
14	Passur river at Akram point of Sundarbans	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.001	< 0.001	< 0.001	0.001	< 0.001	< 0.001	< 0.001
15	Passur river at Hiron point of Sundarbans	< 0.00015	NS	< 0.00015	< 0.00015	< 0.00015	< 0.00015	NS	NS	< 0.00015	NS	< 0.00015	< 0.00015	< 0.001	< 0.001	< 0.001	NS	NS	< 0.001	< 0.001

Source: CEGIS Field Survey

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

Parameters for ground water quality monitoring

Table B.17: pH and Temperature of Ground Water

Sl	Locations	Tube Well Type	pH value																			
			1st Year				2nd year				3rd year				4th year			5th year				6th year
			Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	Apr	Jul	Nov	Feb	Apr
			1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	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	8.2	6.9	NF	NF	MF	7.1	8.3
2	Rajnagar	Deep (>600 ft)	7.6	7.8	8	8.2	7.8	8.3	7.93	8.1	8.3	8.1	7.9	7.5	7.8	8.1	7.4	6.9	7.9	7.3	6.9	8.4
3	Kapasdanga	Deep (>600 ft)	7.6	7.7	8	8.1	7.9	8.3	7.7	7.9	8.2	7.9	7.9	7.6	7.4	7.8	7.2	7.2	7.6	7.6	6.5	8.9
4	Kalekharber	Shallow (<250 ft)	6.3	6.5	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF

Locations	Tube Well Type	Temperature (ºC)																			
		1st Year				2nd year				3rd year				4th year			5th year				6th year
		Apr	Jul	Oct	Jan	Apr	Apr	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	Apr	Jul	Nov	Feb	Apr
		1QM	2QM	3QM	4QM	1QM	1QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	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	27.2	22.9	NF	NF	NF	23.8	29
Rajnagar	Deep (>600 ft)	29.6	29.9	28	22.5	28.6	28	27.8	23	29.6	29.1	30.4	24.3	27.7	26.5	23.8	30.3	29.3	30	23.7	30
Kapasdanga	Deep (>600 ft)	29.2	28.9	28	25.1	28.8	30	28.7	25	30.1	29.4	29.8	24	28.4	26.4	23.6	30.1	29.7	29	23.2	30
Kalekharber	Shallow (<250 ft)	27.5	28.7	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF

Source: CEGIS Field Survey

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

*NF=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			5th year				6th Year
			Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	Apr	Jul	Nov	Feb	Apr
			1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	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	0	0	NF	NF	NF	0.1	0.1
2	Rajnagar	Deep (>600 ft)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.3	0.3	0.1	0.1	0.1	0.5
3	Kapashdanga	Deep (>600 ft)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.4	0.2	0.1	0.1	0.1	0.7
4	Kalekharber	Shallow (<250 ft)	0	0	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	

Sl	Locations	Tube Well Type	DO (mg/L)																			
			1st Year				2nd year				3rd year				4th year			5th year				6th Year
			Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	Apr	Jul	Nov	Feb	Apr
			1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	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**	**6.2**	**5.2**	**NF**	**NF**	NF	6.0	6.0
2	Rajnagar	Deep (>600 ft)	6	6.2	7.7	6.3	6	5.9	6.1	5.2	**5.8**	**6.1**	**5.8**	**4.8**	**5.3**	**5.8**	**4.47**	**6.0**	**6**	**5.9**	6.1	6.5
3	Kapasdanga	Deep (>600 ft)	6.4	6.5	6.1	6.5	6.6	6	5.6	4.8	**5.6**	**5.7**	**6.1**	**4.6**	**5.7**	**6.2**	**4.26**	**5.4**	**5.9**	**6.1**	6.2	6.2
4	Kalekharber	Shallow (<250 ft)	4.4	6	NF	NF	NF	NF	NF	NF	**NF**	**NF**	**NF**	**NF**	**NF**	**NF**	**NF**	**NF**	**NF**	NF	NF	

Source: CEGIS Field Survey

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

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

Table B.19: TDS and TSS concentrations in Groundwater

SL	Locations	Type of tube wells	TDS (mg/L)																		
			1st Year				2nd year				3rd year				4th Year			5th year			
			Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	Apr	Jul	Nov	Feb
			1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	1QM	2QM	3QM	4QM
1	Township near project site	Deep (>600 ft)	1113	999	-	1021	NO	881	377	447	1025	1000	617	623	395	602	405	NF	NF	NF	1315
2	Rajnagar	Deep (>600 ft)	4090	371	-	378	390	574	1007	491	384	408	382	401	617	996	602	615	390	365	376
3	Kapasdanga	Deep (>600 ft)	643	635	-	600	600	328	611	284	645	607	636	998	558	390	994	370	608	610	927
4	Kalekharber	Shallow (<250 ft)	1055	970	-	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	

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

Source: CEGIS Field Survey

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

Table B.20: TH concentrations in Groundwater

Sl No	Locations	Type of tubewell	TH (mg/L)*																		
			1st Year				2nd year				3rd year				4th Year			5th year			
			Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	Apr	Jul	Nov	Feb
			1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	1QM	2QM	3QM	4QM
1	Township near project site	Deep (>600 ft)	425	250	300	235	NO	225	325	295	305	320	175	550	720	145	NF	NF	NF	NF	355
2	Rajnagar	Deep (>600 ft)	220	175	180	110	138	125	450	195	263	248	295	510	420	240	265	195	235	178	215
3	Kapasdanga	Deep (>600 ft)	190	140	180	125	216	115	480	225	163	28	183	620	654	215	305	215	170	138	270
4	Kalekarber	Shallow (<250 ft)	780	450	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	

Source: CEGIS Field Survey

*Note: 1QM= First Quarterly Monitoring, 2QM = Second Quarterly Monitoring, 3QM = Third Quarterly Monitoring, 4QM = Fourth Quarterly Monitoring: NF=Nonfunctional; *Drinking water quality standards, The Environment Conservation Rules, 1997*

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

Sl	Locations	Tube-well Type	COD (mg/L)																		
			1st Year				2nd year				3rd year				4th year			5th year			
			Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	Apr	Jul	Nov	Feb
			1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	1QM	2QM	3QM	4QM
1	Township near project site	Deep (>600 ft)	32	32	34	20	NO	12	4	4	4	4	4	4	4	8	NF	NF	NF	NF	4
2	Rajnagar	Deep (>600 ft)	28	28	18	16	14	10	8	4	4	4	4	4	4	8	4	4	4	4	3
3	Kapasdanga	Deep (>600 ft)	48	32	34	20	18	14	4	4	4	2	4	4	4	16	4	4	4	4	4
4	Kalekarber	Shallow (<250 ft)	32	36	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF		

Source: CEGIS Field Survey

*Note: 1QM= First Quarterly Monitoring, 2QM = Second Quarterly Monitoring, 3QM = Third Quarterly Monitoring, 4QM = Fourth Quarterly Monitoring: 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^{2-} and PO_4^{3-} Concentrations in Ground Water

Sl	Locations	Type of tube well	NO_3^{2-} (mg/L) *BD Standard (10 mg/L)																		
			1st Year				2nd year				3rd year				4th Year			5th year			
			Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	Apr	Jul	Nov	Feb
			1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	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	9.32	3.3	5.9	NF	NF	NF	1.7
2	Rajnagar	Deep (>600 ft)	0.60	0.68	0.31	26	-	2.2	4.2	1.9	2.3	3.3	7.51	7.02	14.7	2.5	7.2	5.3	8.6	0.9	4.4
3	Kapasdanga	Deep (>600 ft)	0.80	0.40	0.80	13	-	4.7	3.8	2.8	1.9	3.7	10.16	4.65	10.2	4.6	1.7	5.7	7.8	1.4	2.1
4	Kalekarber	Shallow (<250 ft)	0.40	0.56	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	

Sl	Locations	Type of tube well	SO_4^{2-} (mg/L) *BD Standard (400 mg/L)																		
			1st Year				2nd year				3rd year				4th Year			5th year			
			Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	Apr	Jul	Nov	Feb
			1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	1QM	2QM	3QM	4QM
1	Township near project site	Deep (>600 ft)	-	3	-	-	-	-	1	5	1	1	1	1	5	1	8	NF	NF	NF	1
2	Rajnagar	Deep (>600 ft)	-	2	-	-	-	-	2	6	2	1	1	1	1	1	2	2	4	1	2
3	Kapasdanga	Deep (>600 ft)	-	10	-	-	-	-	2	2	8	1	1		3	2	6	4	6	1	1
4	Kalekarber	Shallow (<250 ft)	NF	3	NF	-	-	-	-	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	

Sl	Locations	Type of tube well	PO_4^{2-} (mg/L) *BD Standard (6.0 mg/L)																		
			1st Year				2nd year				3rd year				4th Year			5th year			
			Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	Apr	Jul	Nov	Feb
			1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	1QM	2QM	3QM	4QM
1	Township near project site	Deep (>600 ft)	NF	2.2	-	0.74	NO	1.4	0.31	0.267	1.08	0.17	0.167	1.18	2.18	1.68	0.13	NF	NF	NF	2.1
2	Rajnagar	Deep (>600 ft)	-	2.5	-	0.44	1.98	1.6	0.27	0.179	1.53	0.29	0.67	1.21	1.8	3.5	0.17	4..5	2.9	0.15	1.3
3	Kapasdanga	Deep (>600 ft)	-	6.2	-	0.48	4.54	4.1	0.48	0.179	3.26		0.6	1.18	2.1	4.7	0.18	0.27	4.8	0.26	3.6
4	Kalekarber	Shallow (<250 ft)	NF	1.2	NF	NF	NF	NF	NF	NF	NF	0.31	NF	1.23	NF	NF	NF	NF	NF	NF	

Source: CEGIS Field Survey

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

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

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

Sl	Locations	As (mg/L) *BD Standard (0.05 mg/L)																				Pb (mg/L) *BD Standard (0.05 mg/L)																				Hg (mg/L) *BD Standard (0.001 mg/L)																			
		1st Year				2nd year				3rd year				4th Year				5th year				1st Year				2nd year				3rd year				4th Year				5th year				1st Year				2nd year				3rd year				4th Year				5th year			
		Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Nov	Feb	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Nov	Feb	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Nov	Feb
		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	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	0.012	0.014	0.002	0.001	NF	NF		0.012	0.002	<0.002	0.004	0.023	NO	0.002	0.006	0.026	0.019	0.002	0.001	0.01	0.001	0.003	0.001	0.001	0.001	NF	NF	0.008	<0.000	<0.000	<0.000	<0.000	NO	0.0001	<0.000	<0.000	<0.000	<0.000	<0.000	<0.000	0.001	<0.000	<0.001	<0.0	<0.0	<0.0	<0.0	<0.0
2	Rajnagar	0.006	0.009	0.006	0.008	0.01	0.014	0.012	0.002	0.007	0.018	0.011	0.005	0.022	0.004	0.012		0.012	0.007	0.003	0.012	<0.002	<0.002	<0.002	0.016	0.013	0.0027	0.021	0.011	0.007	0.002	0.001	0.009	0.001	0.007	0.002	0.001	0.001	0.001	0.004	0.003	<0.000	<0.000	<0.000	<0.000	<0.000	0.0001	<0.000	<0.000	<0.000	<0.000	<0.000	<0.000	0.001	<0.000	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
3	Kalekarber	0.376	0.407	NF	NF	D	D	NF	NF	NF	NF	NF	NF	NF	NF	0.006	NF	NF	NF	0.026		0.002	0.008	NF	NF	D	D	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	<0.00	<0.00	NF	NF	NF	NF	NF	NF	NF	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	0.010	0.027	0.002	0.001	0.004	0.050		0.012	<0.002	0.004	<0.002	0.013	0.017	0.002	0.005	0.012	0.008	0.002	0.001	0.016	0.001	0.002	0.001	0.001	0.001	0.001	0.056	0.004	<0.000	<0.000	<0.000	<0.000	<0.000	0.0001	<0.000	<0.000	<0.000	<0.000	<0.000	<0.000	0.001	<0.000	<0.001		<0.001	<0.001	<0.001	<0.001

Source: CEGIS Field Survey

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

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

(C) Noise Level monitoring data

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

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

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

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

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

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

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

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

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

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

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

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

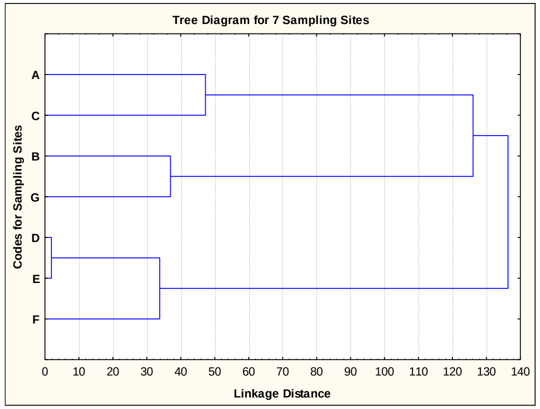
Sl No	Location	QM2 (Noise Level in dB (A)) July-2018				QM3 (Noise Level in dB (A)) Nov-2018				QM4 (Noise Level in dB (A)) Feb-2019				QM4 (Noise Level in dB (A)) Apr-2019				Std*
		Morning (9:00)	A. noon (13:00)	Evening (18:00)	Day time AVG	Morning (9:00)	A.noon (13:00)	Evening (18:00)	Day time AVG	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	
1	Chalna, Dacope	57.64	56.94	58.03	57.54	61.3	56.3	57.1	70	56.14	59.28	53.95	56.45	62.02	61.91	61.08	61.67	62.02
2	NW Corner of the Project area	42.80	47.51	46.57	45.63	56.5	60.1	59.85	55	45.15	54.11	53	50.75	53.70	58.92	57.92	56.85	53.70
3	Chunkuri-2, Bajua	46.23	49.02	47.34	47.53	45.8	48.9	51.3	55	50.19	49.35	51	50.18	49.66	54.02	51.35	51.68	49.66
4	SW corner of the Project area	58.84	48.00	51.03	52.63	64.5	60.6	60.2	55	53.50	58.01	55.88	55.79	58.08	54.79	55.27	56.05	58.08
5	Project site near Shapmari area	42.66	45.82	48.78	45.75	45.1	51.2	55.8	55	58.48	61.21	54.70	58.13	61.35	58.97	56.16	58.83	61.35
6	Barni, Gaurambha	42.67	47.95	45.90	45.51	58.3	50.6	50.2	60	54.32	57.65	45.75	52.57	58.58	51.05	49.92	53.18	58.58
7	Khan Jahan Ali Bridge, Khulna	64.1	64.06	61.90	63.35	64.6	60.9	60.9	70	65.72	69.04	66.03	66.93	67.95	63.09	69.82	66.95	67.95
8	Mongla Port area	63.12	59.00	60.77	60.96	55.8	53.1	59.0	75	64.33	63.37	70.85	66.18	64.12	62.41	65.45	63.99	64.12
9	Harbaria, Sundarbans	51.98	48.58	50.28	50.28	49.9	47.6	NM	50	51.43	47.90	NM	49.67	49.42	47.45	NM	48.43	49.42
10	Akram Point, Sundarbans	46.52	43.88	45.2	45.20	41.9	40.1	NM	50	47.35	45.55	NM	46.45	46.16	38.49	NM	42.33	46.16
11	Hiron Point, Sundarbans	NM	NM	NM	57.54	39.7	39.1	NM	50	33.8	44.62	NM	39.21	NM	NM	NM	-	NM

Source: CEGIS field Survey

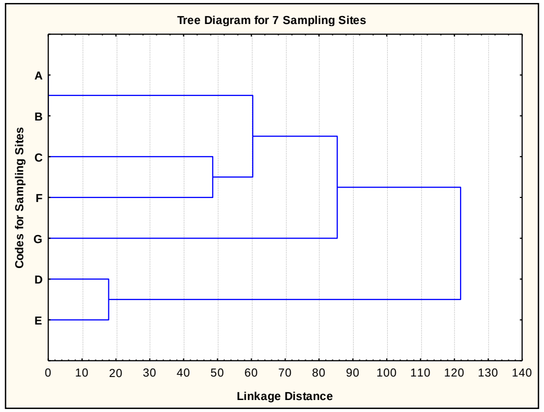
Note: NM-Not measured

(D) Fisheries resources monitoring data

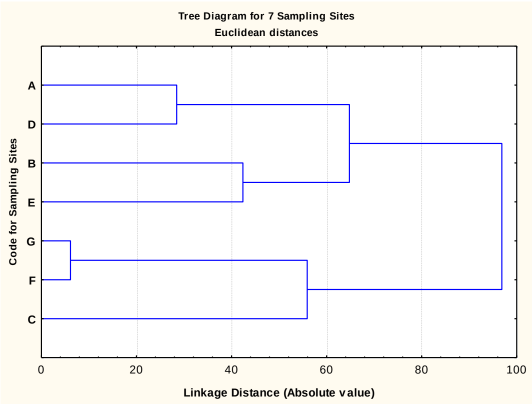
D1: Dendrograms for functional habitat



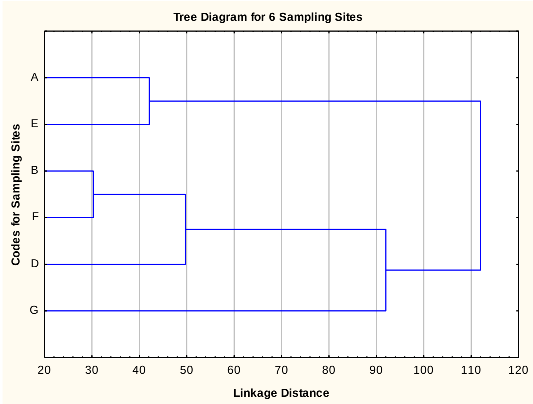
1st Monitoring, April, 2014



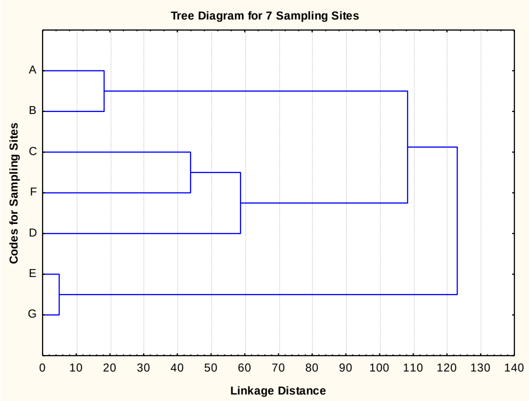
2nd Monitoring, July 2014



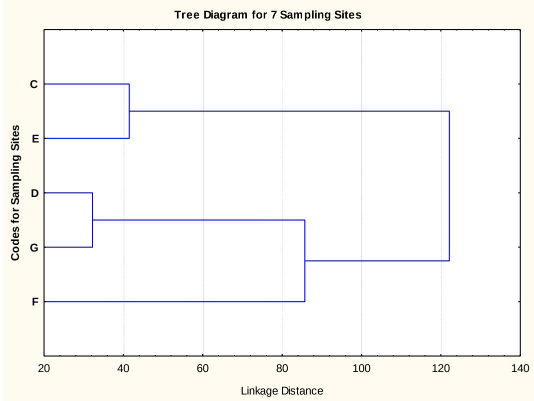
3rd Monitoring, October, 2014



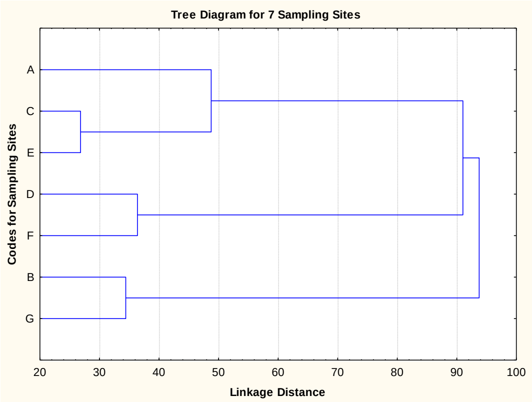
4th Monitoring, January 2015



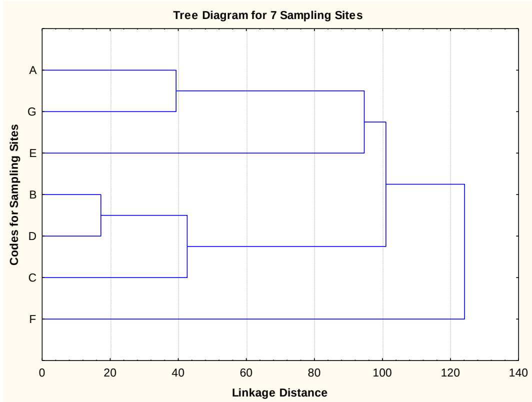
5th Monitoring, April, 2015



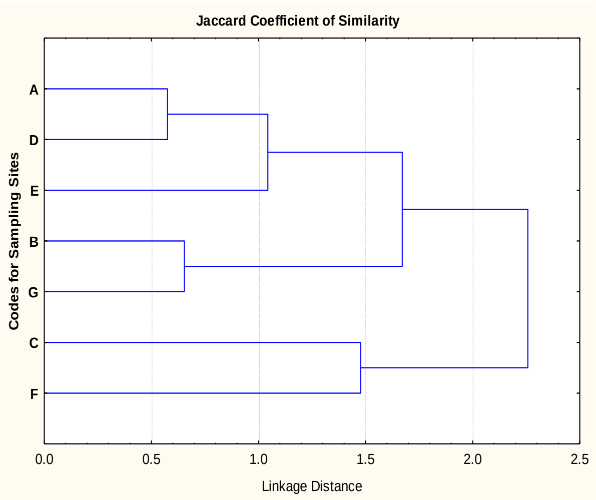
6th Monitoring, August, 2015

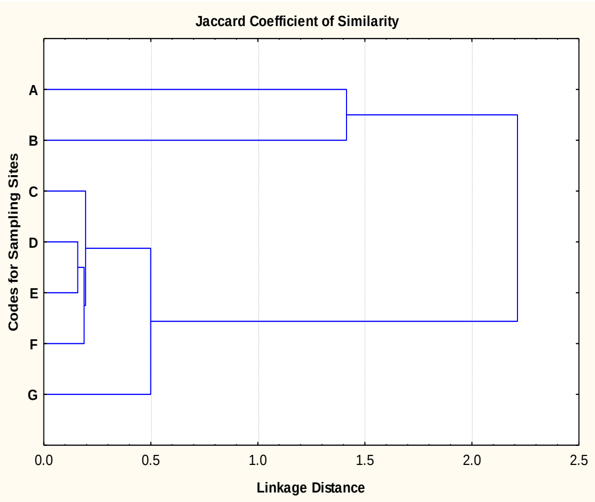


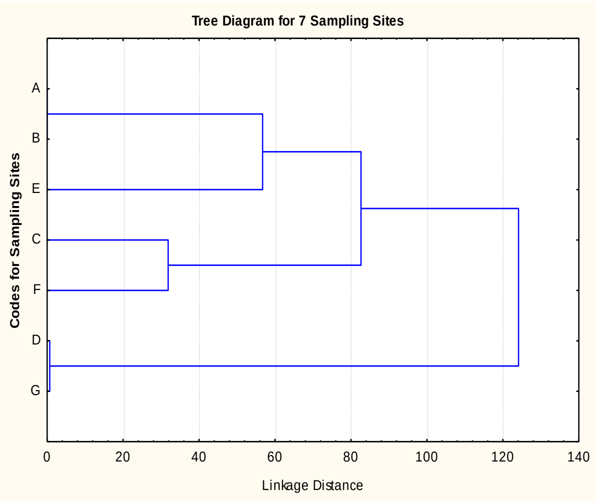
7th Monitoring, October, 2015



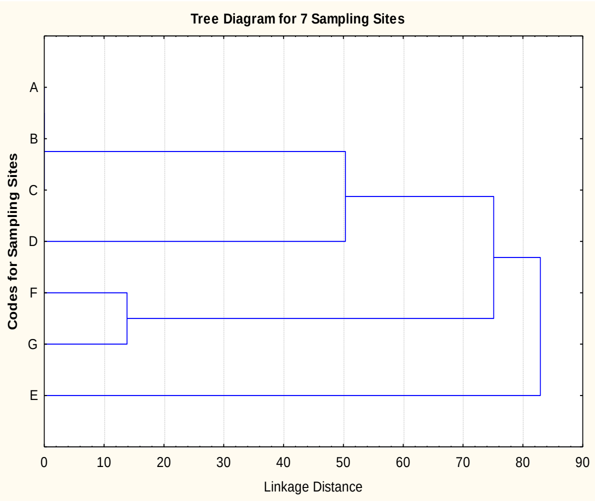
8th Monitoring, January, 2016



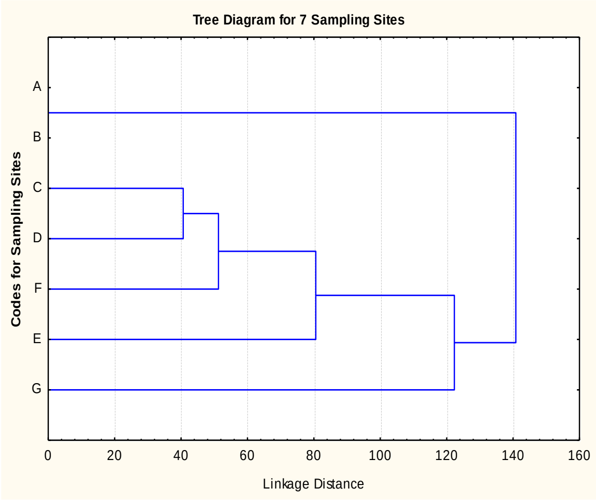




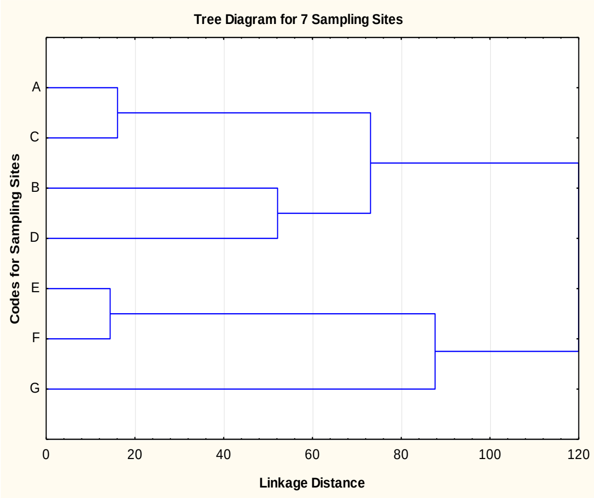
9th Monitoring, April, 2016



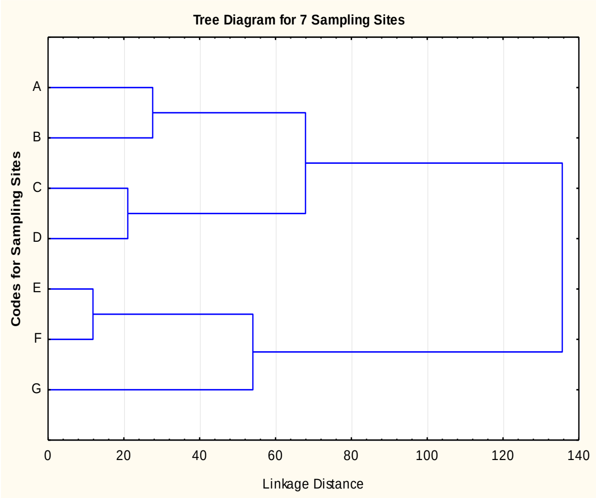
10th Monitoring, July, 2016



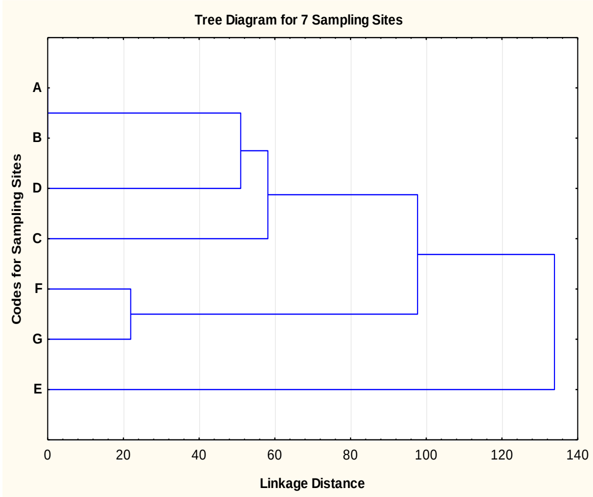
11th Monitoring, October, 2016



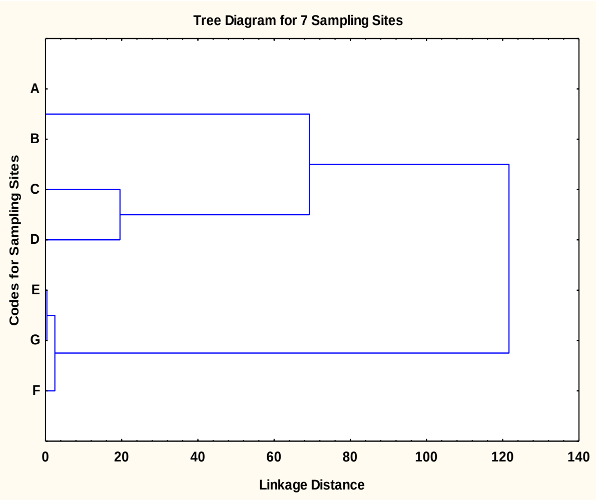
12th Monitoring, January, 2017



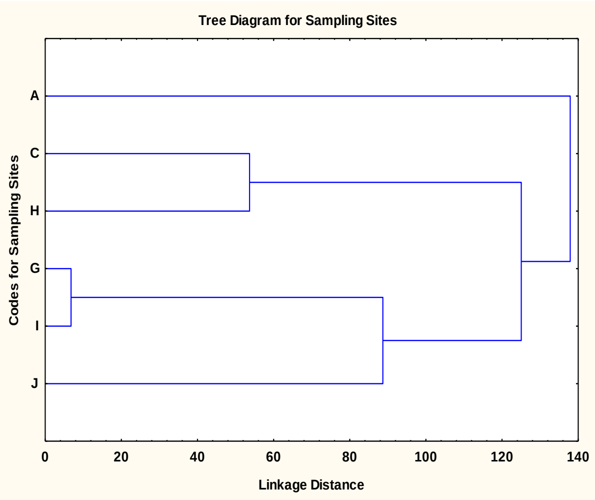
13th Monitoring, April, 2017



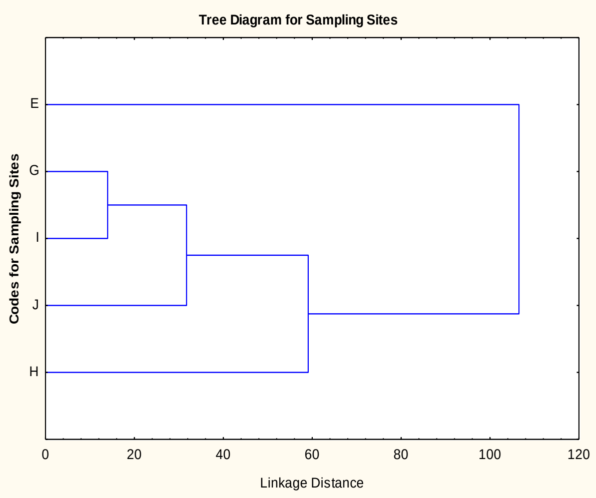
14th Monitoring, October, 2017



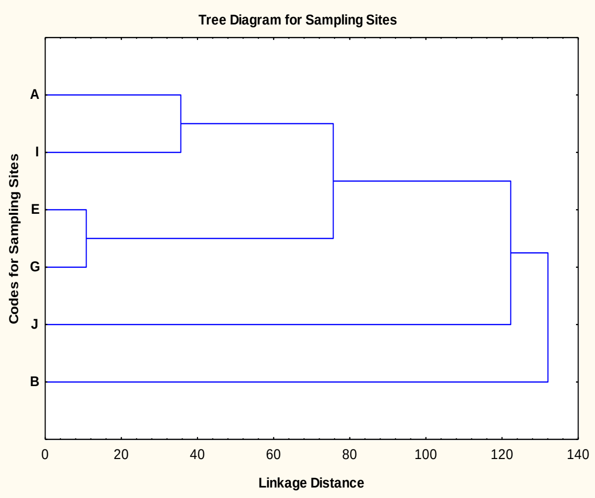
15th Monitoring, January, 2018



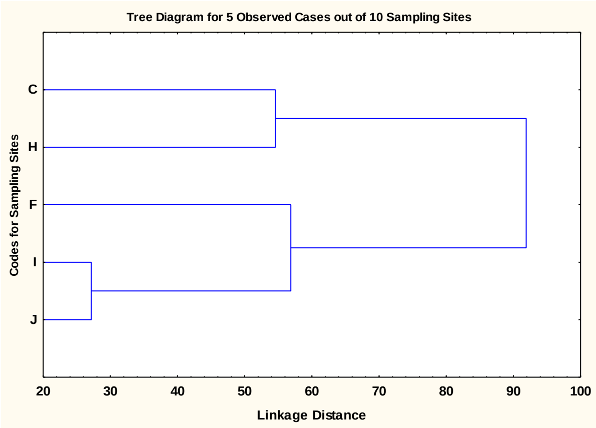
16th Monitoring, April, 2018



17th Monitoring, July, 2018

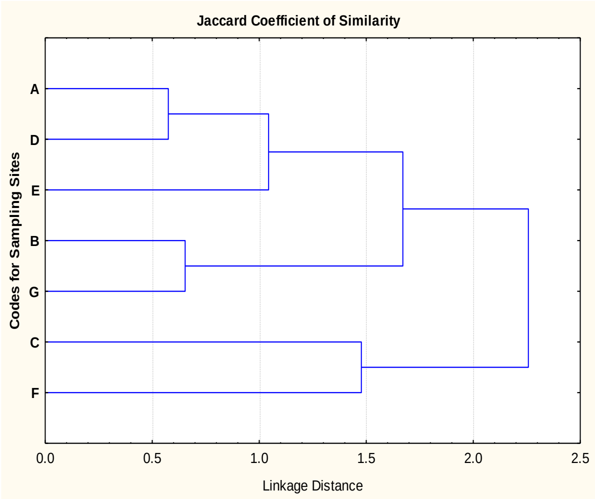


18th Monitoring, November, 2018

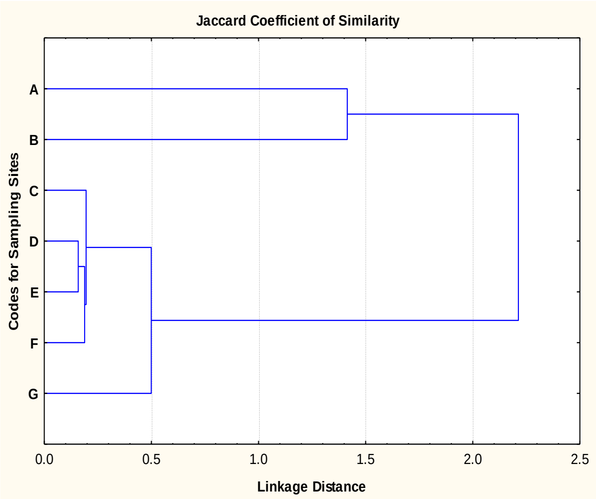


19th Monitoring, February, 2019

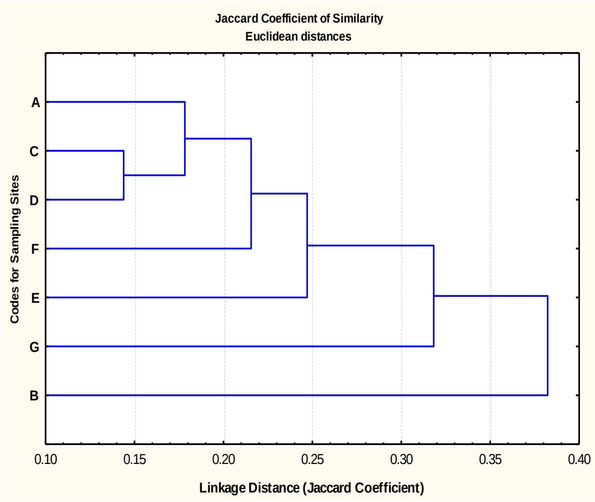
Figure D2: Jaccard Co-efficient of Similarity of Habitats respecting fish species occurrence



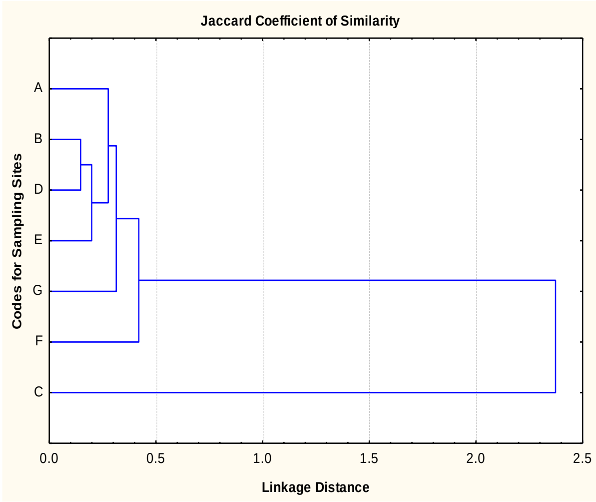
1st Monitoring, April, 2014



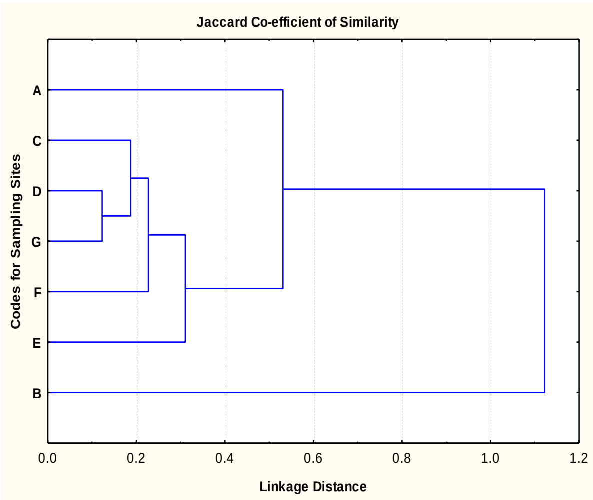
2nd Monitoring, July 2014



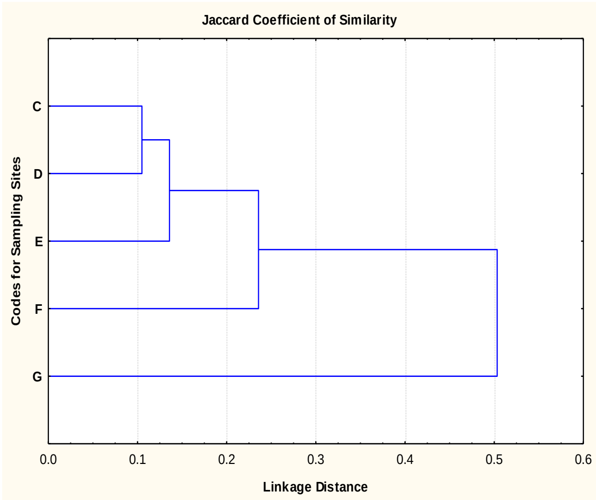
3rd Monitoring, October, 2014



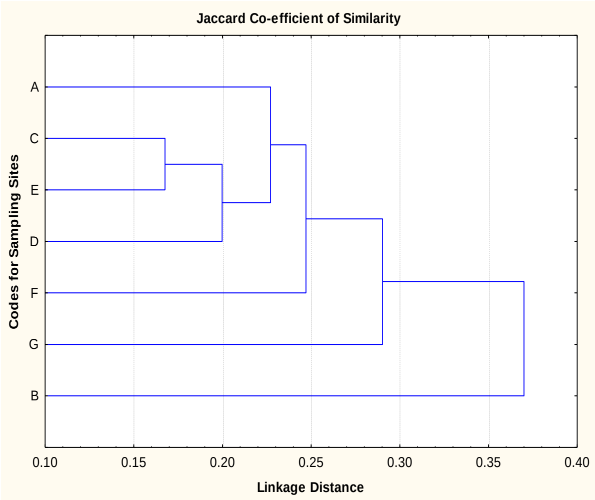
4th Monitoring, January 2015



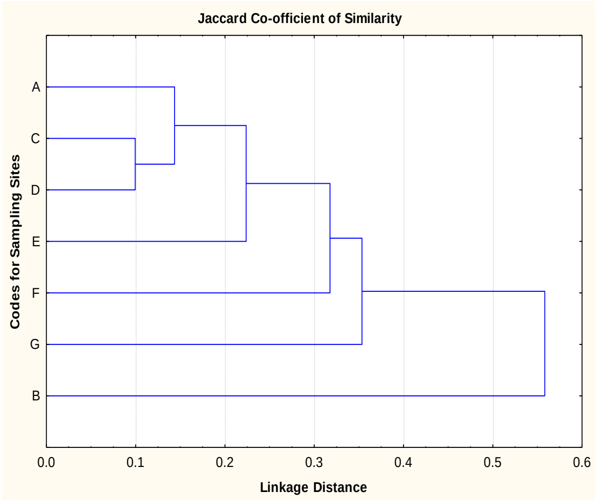
5th Monitoring, April, 2015



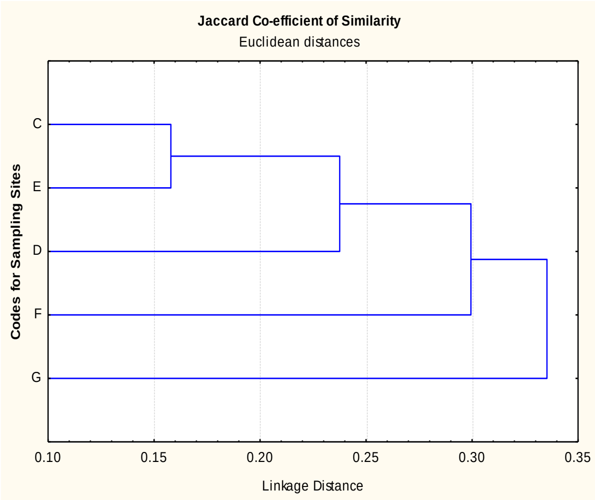
6th Monitoring, August, 2015



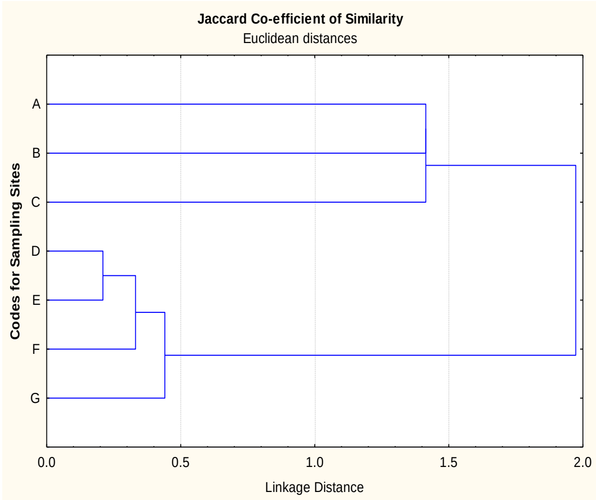
7th Monitoring, October, 2015



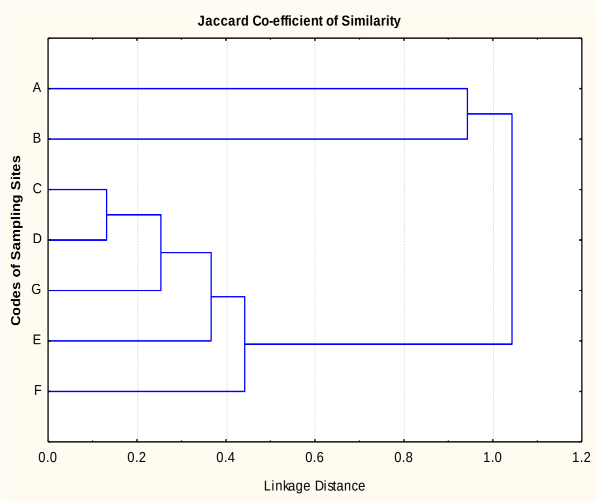
8th Monitoring, January, 2016



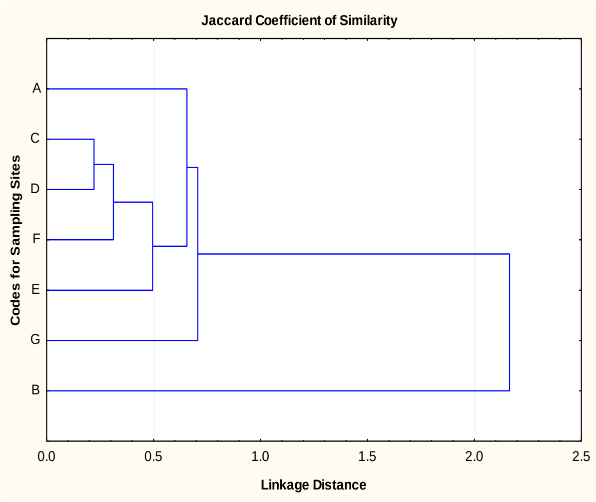
9th Monitoring, April, 2016



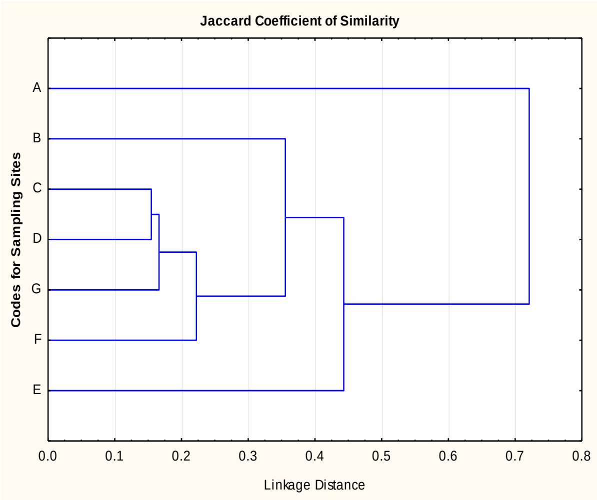
10th Monitoring, July, 2016



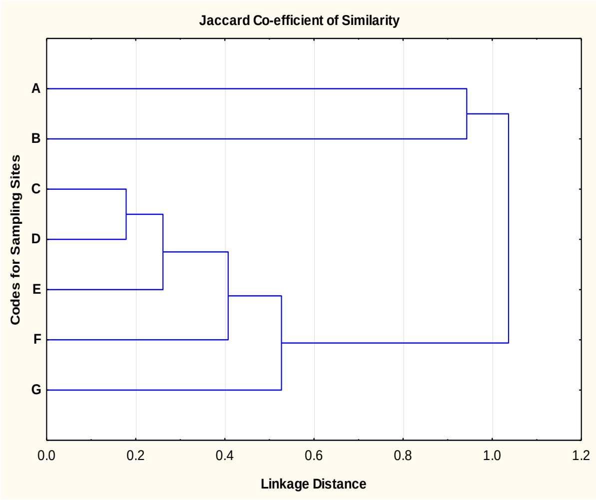
11th Monitoring, October, 2016



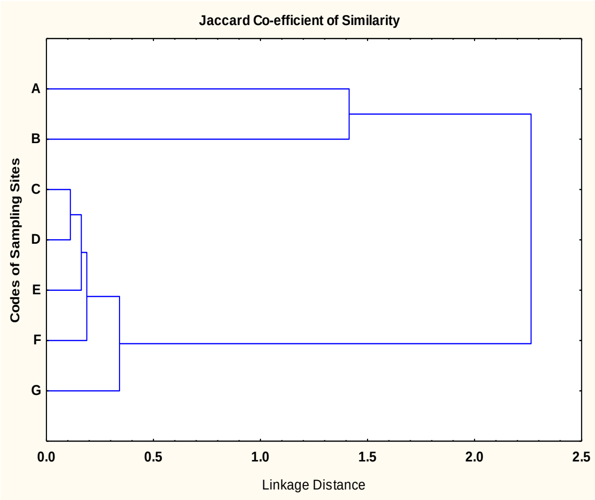
12th Monitoring, January, 2017



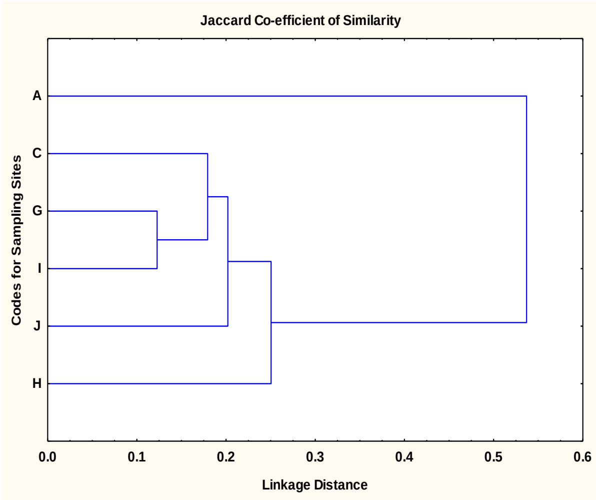
13th Monitoring, April, 2017



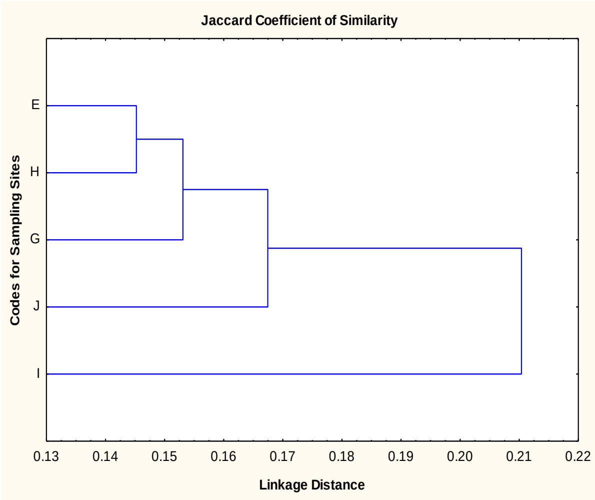
14th Monitoring, October, 2017



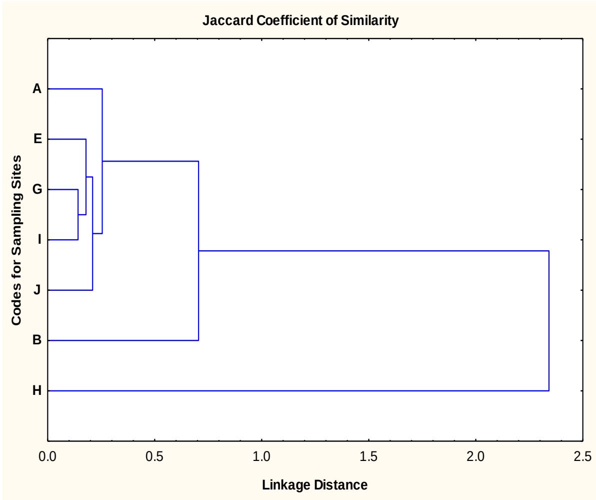
15th Monitoring, January, 2018



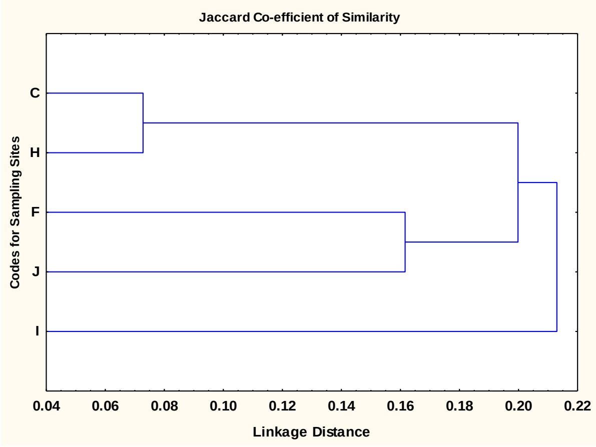
16th Monitoring, April, 2018



17th Monitoring, July, 2018



18th Monitoring, November, 2018



19th Monitoring, February, 2019

Figure D3: Different Fish Species in different quarter monitoring

Rupchanda in 1stQuarter of 1st Year

Chela in 2nd Quarter of 1st Year

Phesa, Chela, Hilsa, Gagla Tengra

Harina Chingri

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

Amadi Chela

Banspata

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

Adult Poma in Chalna Point

Fry of Bagda at Chalna Point

Meth and Gagra Tengra

Gagra Tengra

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

Mutkure and Paissa

Khorsula

Menu

Vetki

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

Gulsha Tengra, Bele, Aswine Bele and Paissa

Gangania

Telcupa

Golda

Kain Magur

A Mix of Culture and Capture Fishes

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

Tau Paissa

Bele

Horina Chingri

Gulsha and Gagra Tengra

Jaba

Female Gulsha Tengra

Fry Fishes

Chata Bele

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

Kain Magur

Banspata, Vetki, Koidda and Poma

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

Poma and Tapsi

Tapsi

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

Miscellaneous Fish Species

Hilsha

Tapse

Poma and Tapse

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

Catch Sample

Juvenile of Kain Magur

Khayra Chela

Jevenile of Pangas

Brood Paissa

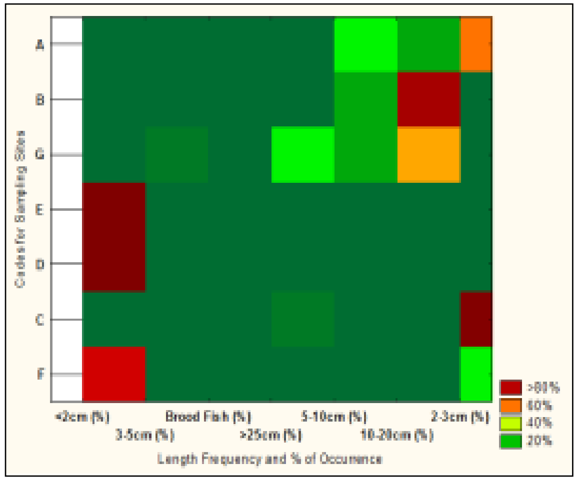
Paissa and Gagra Tengra

Aswene Bele, Daitna, Tapse and Chitra

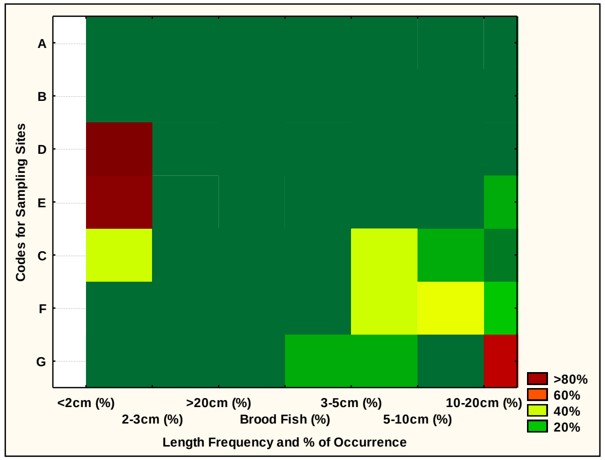
Dry Fish of Khayra Chela

Fish species found in 12th quarter of the monitoring year 2016-17

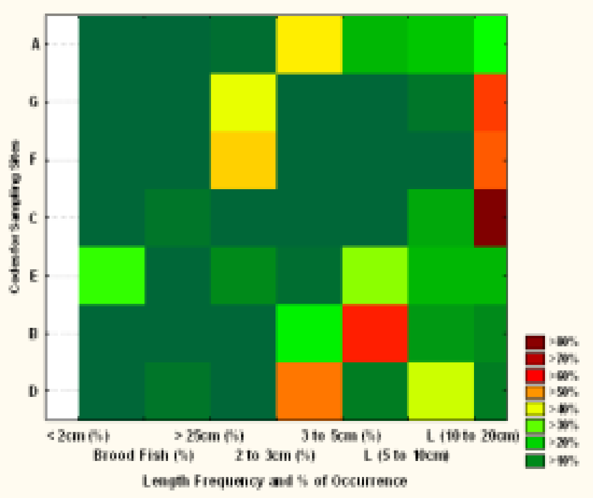
Figure D4: Fish Community Structure



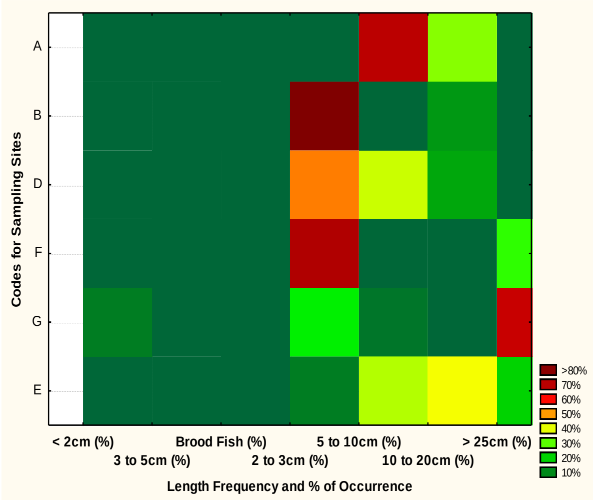
1st Monitoring, April, 2014



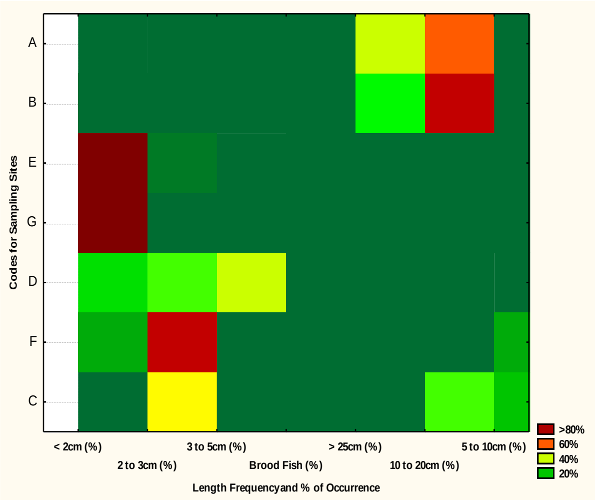
2nd Monitoring, July 2014



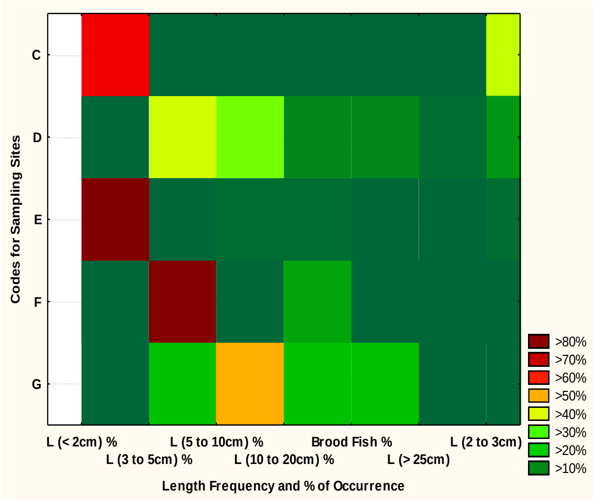
3rd Monitoring, October, 2014



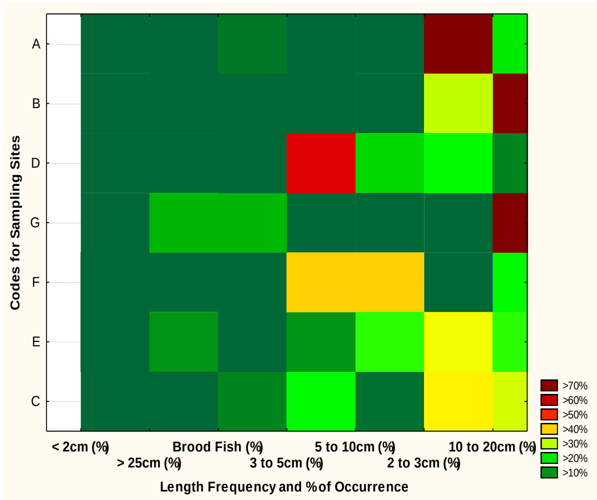
4th Monitoring, January 2015



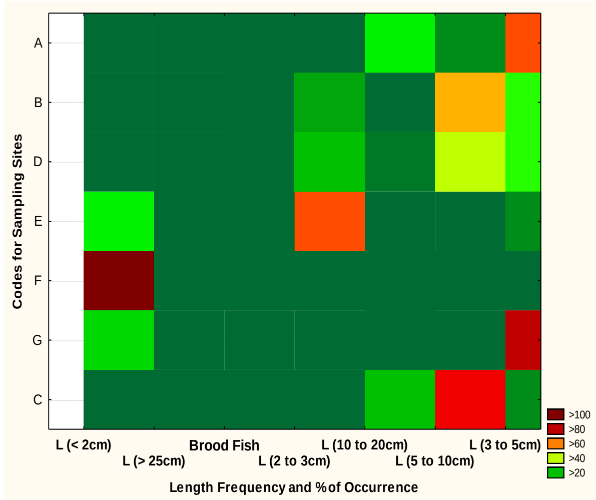
5th Monitoring, April, 2015



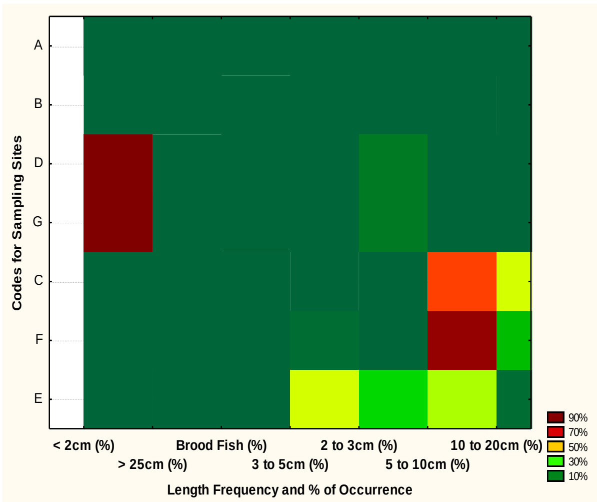
6th Monitoring, August, 2015



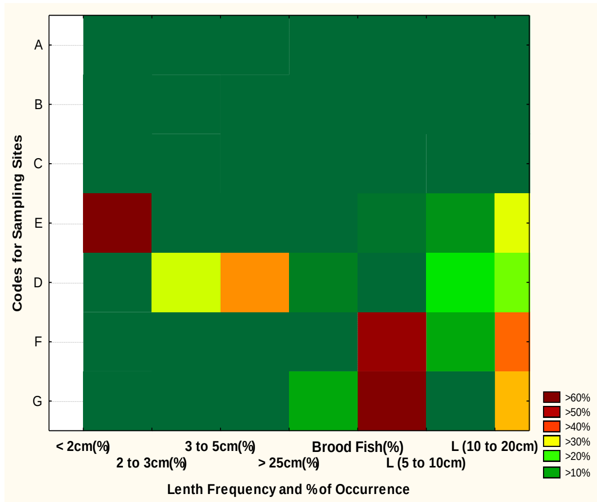
7th Monitoring, October, 2015



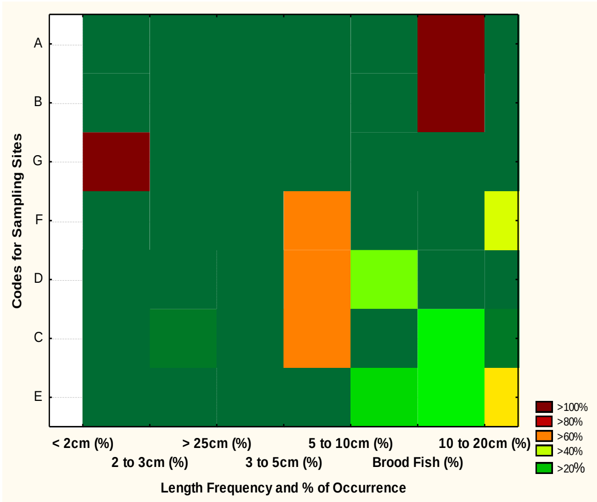
8th Monitoring, January, 2016



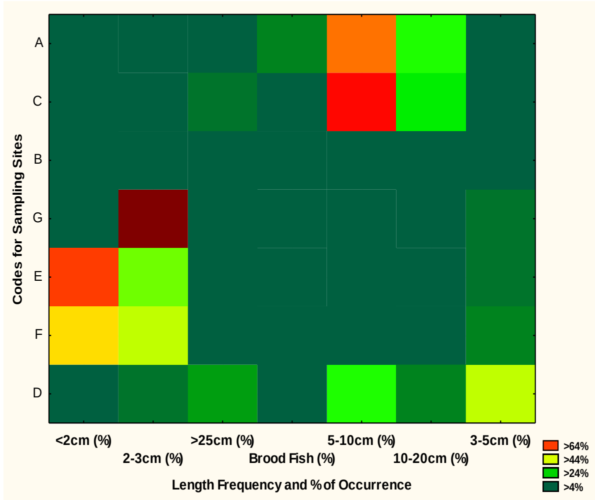
9th Monitoring, April, 2016



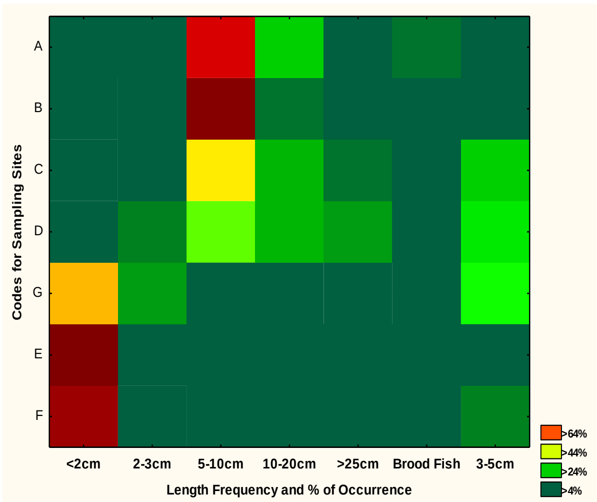
10th Monitoring, July, 2016



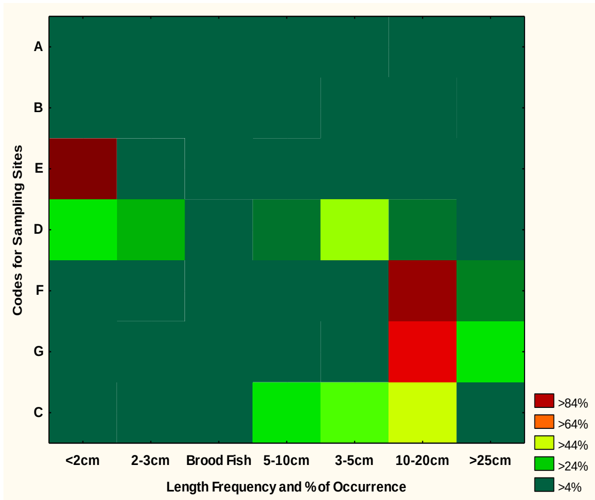
11th Monitoring, October, 2016



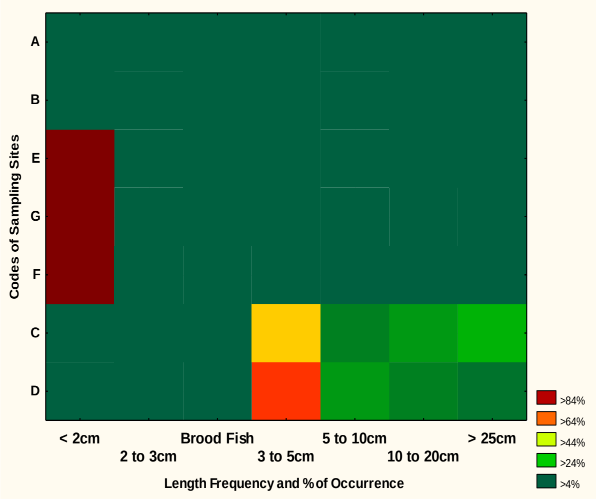
12th Monitoring, January, 2017



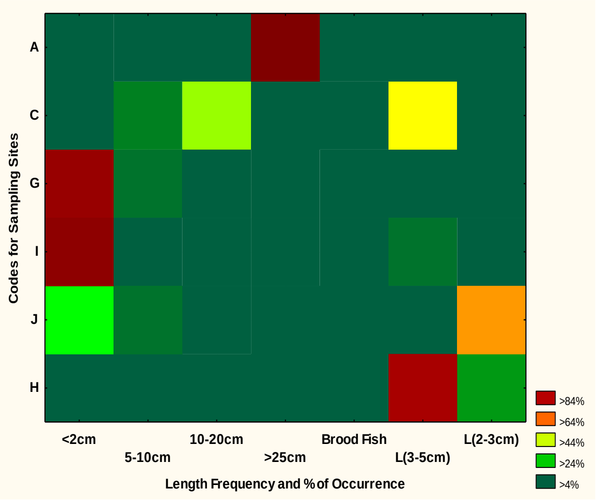
13th Monitoring, April, 2017



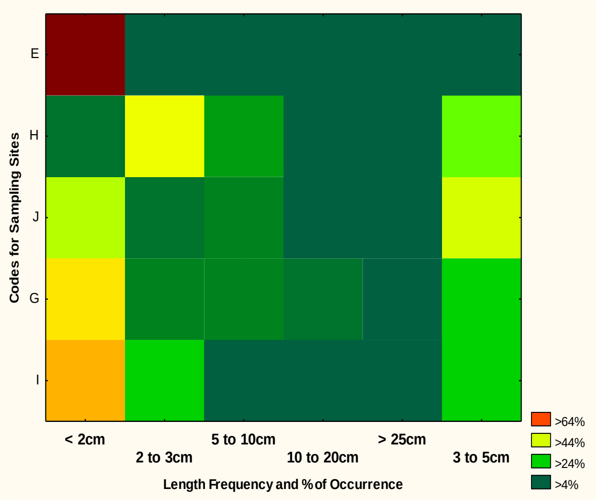
14th Monitoring, October, 2017



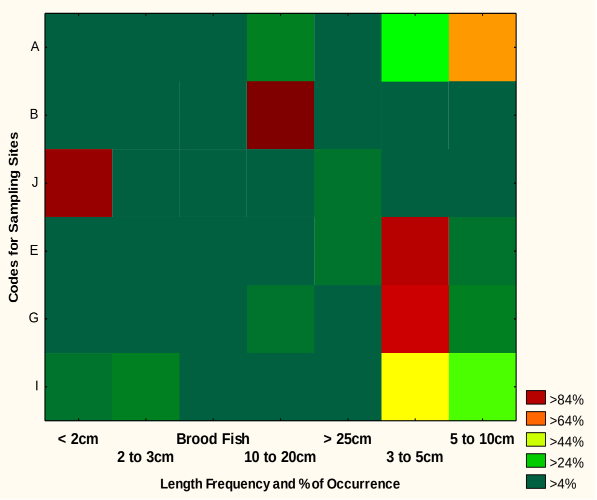
15th Monitoring, January, 2018



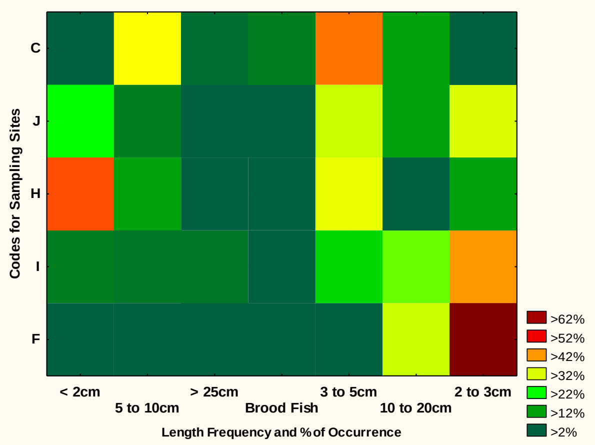
16th Monitoring, April, 2018



17th Monitoring, July, 2018



18th Monitoring, November, 2018



19th Monitoring, February, 2019

Table D.1: Occurrence of Species (1st to 12th QM)

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

Local Name	Scientific Name	Local Status*	1st QM	2nd QM	3rd QM	4th QM	5th QM	6th QM	7th QM	8th QM	9th QM	10th QM	11th QM	12th QM
			'-' = No; '+' = Occurrence											
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	-	-	-	+	+	+	+	+	+	-	+	+

Table D.2: Occurrence of Species (13th to 20th QM)

Local Name	Scientific Name	Local Status*	13th QM	14th QM	15th QM	16th QM	17th QM	18th QM	19thQM	20thQM
		'-' = No; '+' = Occurrence								
Hilsa	*Tenualosa ilisha*	NO	-	-	-	-	-	+	-	-
Sagor Baim	*Anguilla bengalensis*	NT	-	-	-	-	-	-	-	-
Bacha	*Eutropiichthys vacha*	CR	+	-	-	-	-	-	-	-
Bagda Chingri	*Penaeus monodon*	DD	+	-	+	+	+	+	+	+
Banspata	*Brachypleura novae-zeelandiae*	NO	+	+	+	+	+	+	+	+
Kukurjib	*Cynoglossus lingua*	NO	-	-	+	-	-	-	+	-
Bele	*Glossogobius giuris*	NO	+	+	+	+	+	+	+	+
Aswine Bele	*Butis butis*	NO	+	+	+	+	+	-	+	+
Bairagi	*Coilia dussumieri*	NO	+	+	+	+	+	+	+	+
Boishakhi Chingri	*Macrobrachium* sp.	NO	-	-	-	-	+	-	-	-
Chammu Chingri	*Metapenaeus brevicornis*	DD	-	+	+	+	+	+	+	+
Chaka Chingri	*Penaeus indicus*	DD	+	-	+	+	+	+	+	+
Ghora Chela	*Securicula gora*	-	-	-	-	-	-	-	-	-
Chanda Chela	*Securicula* sp.		-	-	+	+	+	+	-	-
Sada Chewa	*Trepauchen vagina*	NO	-	-	-	+	-	-	-	+
Lal Chewa	*Taenioides cirratus*	NO	+	+	-	+	+	-	+	+
Chhuri	*Trichiurus muticus*	NO	-	-	-	+	-	-	-	-
Sagor Chela	*Megalops cyprinoids*	NO	-	-	-	-	-	-	-	-
Purabi Chela	*Thryssa purava*	NO	-	-	-	-	-	-	-	-
Kabashi Tengra	*Mystus cavasius*	DD	-	-	-	-	+	-	-	-
Gagra Tengra	*Nemapteryx nenga*	DD	+	+	+	+	+	+	+	+
Gulsha Tengra	*Mystus bleekery*	DD	+	+	+	+	+	-	+	+
Harina Chingri	*Metapenaeus ensis*	DD	+	+	+	+	+	+	+	+
Ekthuto	*Hyporhampus limbatus*	NO	+	+	-	-	+	+	+	+
Kakila	*Xenentodon cancila*	NO	-	+	-	-	+	-	-	-
Chapila	*Gudusia chapra*	NO	-	-	-	-	+	+	+	-
Kuchia	*Monopterus cuchia*	DD	+	+	+	+	+	+	-	+
Loitta	*Harpodon nehereus*	NO	+	-	+	-	-	-	-	+
Motka Chingri	*Macrobrachium villosimanusless*	DD	+	+	+	+	+	+	+	+
Mud Crab	*Scylla serrata*	NO	+	+	+	+	-	+	+	+

Local Name	Scientific Name	Local Status*	13th QM	14th QM	15th QM	16th QM	17th QM	18th QM	19thQM	20thQM
		‘-‘ = No; ‘+’ = Occurrence								
Tular Dandi	*Sillaginopsis panijus*	NO	-	+	-	-	-	+	+	+
Paira Chanda	*Scatophagus argus*	DD	-	-	-	-	-	-	+	-
Paissa	*Liza parsia*	NO	+	+	+	+	-	+	+	+
Pangas	*Pangasius pangasius*	CR	-	-	-	-	-	+	+	+
Tak Chanda	*Leiognathus equulus*	NO	-	-	-	-	-	-	-	-
Pheksa	*Setipinna phasa*	NO	+	+	-	+	-	-	+	+
Teli Pheksa	*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
Bagda	Chalna Point	100	0	0	0	0	0	0
	Chandpai	100	0	0	0	0	0	0
	Jongra	100	0	0	0	0	0	0
	Maidara	100	0	0	0	0	0	0
Bairagi	Chalna Point	94	0	0	0	6	0	0
	Chandpai	100	0	0	0	0	0	0
	Charaputia	0	0	0	0	100	0	0
	Jongra	100	0	0	0	0	0	0
	Maidara	100	0	0	0	0	0	0
Banshpata	Chalna Point	0	0	0	0	0	100	0
	Jongra	0	0	0	100	0	0	0
Bata	Jongra	100	0	0	0	0	0	0
Bele	Chalna Point	100	0	0	0	0	0	0
	Chandpai	100	0	0	0	0	0	0
	Jongra	100	0	0	0	0	0	0
Chaka Chingri	Chalna Point	100	0	0	0	0	0	0
	Chandpai	100	0	0	0	0	0	0
	Jongra	100	0	0	0	0	0	0
	Maidara	100	0	0	0	0	0	0
Chamua Chingri	Chandpai	100	0	0	0	0	0	0
	Jongra	100	0	0	0	0	0	0
Chata Bele	Jongra	100	0	0	0	0	0	0
Chela	Chandpai	100	0	0	0	0	0	0
	Jongra	100	0	0	0	0	0	0
Chewa	Jongra	100	0	0	0	0	0	0
Chitra	Charaputia	0	0	0	0	0	100	0
	Jongra	100	0	0	0	0	0	0
Chokkhu Dhela	Charaputia	0	0	0	0	100	0	0
Daitna	Charaputia	0	0	0	0	0	100	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
Ekthuto	Chandpai	100	0	0	0	0	0	0
Gagra	Akram Point	0	0	0	0	100	0	0
	Harbaria	0	0	0	0	80	20	0
Golda	Chalna Point	100	0	0	0	0	0	0
	Chandpai	100	0	0	0	0	0	0
	Harbaria	0	0	0	0	100	0	0
	Jongra	100	0	0	0	0	0	0
	Maidara	100	0	0	0	0	0	0
Horina	Chandpai	100	0	0	0	0	0	0
	Jongra	100	0	0	0	0	0	0
Jaba	Charaputia	0	0	0	0	0	100	0
	Maidara	100	0	0	0	0	0	0
Kain Magur	Charaputia	0	0	0	0	61	39	0
	Jongra	100	0	0	0	0	0	0
Kalo Bele	Chandpai	100	0	0	0	0	0	0
Kuchia	Chandpai	0	0	0	100	0	0	0
	Charaputia	0	0	0	0	0	100	0
	Jongra	25	0	0	75	0	0	0
Kumirer Khil	Chandpai	100	0	0	0	0	0	0
	Maidara	0	0	0	100	0	0	0
Lal Chewa	Chandpai	46	0	54	0	0	0	0
	Jongra	100	0	0	0	0	0	0
Loitta	Jongra	100	0	0	0	0	0	0
Menu	Chandpai	100	0	0	0	0	0	0
	Jongra	100	0	0	0	0	0	0
Motka Chigri	Chandpai	100	0	0	0	0	0	0
	Jongra	100	0	0	0	0	0	0
	Maidara	100	0	0	0	0	0	0
Mutkura	Chandpai	100	0	0	0	0	0	0
	Jongra	100	0	0	0	0	0	0
Paissa	Chandpai	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
	Jongra	100	0	0	0	0	0	0
Pangas	Charaputia	0	0	0	0	0	100	0
Pheksa	Chalna Point	0	0	0	0	100	0	0
	Charaputia	0	0	0	0	50	50	0
Poma	Chalna Point	0	0	0	0	50	50	0
	Charaputia	0	0	0	0	100	0	0
	Jongra	100	0	0	0	0	0	0
Potka	Chandpai	100	0	0	0	0	0	0
	Jongra	100	0	0	0	0	0	0
	Maidara	100	0	0	0	0	0	0
Sada Bele	Chandpai	100	0	0	0	0	0	0
Tairel	Charaputia	0	0	0	0	100	0	0
Telcupa	Chandpai	2	0	0	98	0	0	0
	Jongra	100	0	0	0	0	0	0
Tiger Chingri	Chalna Point	57	0	0	29	14	0	0
	Chandpai	100	0	0	0	0	0	0
	Jongra	100	0	0	0	0	0	0
Topse	Chalna Point	0	0	0	0	100	0	0
Tular Dandi	Akram Point	0	0	0	0	100	0	0
	Chalna Point	0	0	0	0	100	0	0
	Jongra	100	0	0	0	0	0	0
Vat Gule	Chandpai	0	100	0	0	0	0	0
Vati Chingri	Chalna Point	100	0	0	0	0	0	0

Source: CEGIS field survey, 2019

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
Tapsi	Haldikhali	Juvenile and Age-1 adult	Feeding and Growing	-	Feeding and Growing	-	-	-		-	-		-	-
	Akram Point	Juvenile and Age-1 adult	Feeding and Growing	-	-	-	-	-	Feeding	-	-		-	-
		Adult	-	-	-	-	-	-	-	Feeding	-		-	-
	Chalna Point	Age-1 adult and Brood fish	Feeding and Growing	Spawning	-	-	-	Feeding	Feeding and Spawning	-	-		Feeding and Growing	-
		Adult	-	-	Feeding and Growing	-	-	Feeding	Feeding	-	-			-
	Harbaria	Juvenile and Age-1 adult	Feeding and Growing	Feeding and Growing		-	-	-	-	-	-		-	Feeding
		Adult and Brood Fish	-	-	Breeding and Spawning	-	-	-	-	-	-		-	-
	Chandpai	Juvenile	-	-	Feeding and Growing	-	-	-	Feeding	-	-		Feeding	-
	Mongla Point	Adult	-	-	-	-	-	-	-	-	-			-
	South-west of the Project	Age-1 adult	Feeding and Growing	Feeding and Growing	Feeding and Growing	-	-	Feeding	-	-	-		-	-
		Brood Fish	-	-	-	-	-	Breeding and Spawning	-	-	-		-	-
Bairagi	Haldikhali	Juvenile and Age-1 adult	Feeding and Growing	-	Feeding and Growing	-	-	-	-	-	-		-	-
	Akram Point	Juvenile and Age-1 adult	Feeding and Growing	-	-	-	Feeding and Growing	-	-	-	-		-	-
		Juvenile and Adult	-	-	-	-	-	-	-	Growing and Feeding	-		-	-
	Chandpai	Fry	Breeding and Spawning	Breeding and Spawning	Feeding and Growing	Feeding	-	Feeding	-	-	-		-	-
		Juvenile	-	-	-	-	-	-	-	-	-		-	-
	Chalna Point	Juvenile and Age-1 adult	Feeding and Growing	-	-	-	Feeding and Growing	-	-	-	-		-	-
		Fry	-	-	-	-	-	-	-	-	-		-	Nursing

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
	Harbaria	Juvenile	Feeding and Growing	-	-	-	-	Feeding	-	-	-		-	-
	Mongla Point	Fry	-	Nursing	-	Feeding	-	-	-	-	-		-	Nursing
		Juvenile	-	-	-	-	-	-	-	Feeding	-		-	-
	South-west of the Project	Juvenile	-	Feeding and Growing	-	-	-	-	-	-	-		-	-
		Fry	-	-	-	-	-	-	-	-	-		-	Nursing
Chapila	Haldikhali	Juvenile	Feeding and Growing	-	-	-	-	-	-	-	-		-	-
	Akram Point	Juvenile	Feeding and Growing	-	-	-	-	-	-	-	-		-	-
	Mongla Point	Fry	-	Nursing	-	-	-	-	-	-	-		-	-
	South-west of the Project	Age-1 adult	-	Feeding and Growing	-	-	-	-	-	-	-		-	-
Loitta	Haldikhali	Juvenile and Age-1 adult	Feeding and Growing	-	Feeding and Growing	-	-	-	-	-	-		-	-
	Akram Point	Juvenile	Feeding and Growing	-	-	-	Feeding and Growing	-	-	-	-		-	-
	Akram Point	Age-1 adult	-	-	Feeding and Growing	-	Feeding and Growing	-	-	-	-		-	-
	Chandpai	Juvenile	Feeding and Growing	-	-	-	-	-	-	-	-		-	-
	Harbaria	Fry, Juvenile and Age-1 adult	-	Nursing, Feeding and Growing	-	-	-	-	-	-	-		-	-
	Chalna Point	Age-1 adult	-	Feeding and Growing	-	-	Feeding and Growing	-	-	-	-		-	-
		Fry	-	-	-	-	-	-	-	-	Nursing		-	-
Poma	Haldikhali	Juvenile	Feeding and Growing	-	-	Feeding	-	-	-		-		-	-
	Akram Point	Juvenile	Feeding and Growing	-	-	-	-	-	-	Growing and Feeding	-		-	-
		Age-1 adult	-	-	Feeding and Growing	-	-	-	Feeding	Feeding	-		-	-
		Adult	-	-	-	-	-	-			-		-	-

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
	Chandpai	Fry and Juvenile	Breeding and Spawning	Nursing	-	-	-	Feeding	-	-	-		-	-
		Juvenile	-	-	Feeding and Growing	Feeding	Feeding and Growing	-	Feeding and Growing		-		Feeding and Growing	
		Adult	-	-	-	-	-	-	Feeding		-			
		Brood Fish	-	-	-	-	-	-	-		-		Spawning	-
	Haldikhali	Fry and Juvenile	-	-	Nursing	-	-	-	-	-	-		-	-
	Harbaria	Adult and Brood Fish	-	-	Breeding and Spawning	-	-	-	-	-	-		Feeding and Spawning	-
		Adult	-	-	-	-	-	-	Feeding		-		-	Feeding
		Fry and Juvenile						Spawning and Nursery	-	-	Feeding and Growing		-	-
	Mongla Point	Fry, Juvenile and Age-1 adult	-	-	Spawning, Feeding and Growing	-	-	-	-	Nursing	-		-	Nursing
		Juvenile	-	-	-	-	-	-	Feeding and Growing		-		-	-
		Age-1 Adult	-	-	-	-	-	-	Feeding	Feeding	-		-	-
		Adult	-	-		Feeding	-	Feeding	-	-	-		Feeding	-
		Brood Fish	-	-	-	-	-	-	-	-	-		Spawning	-
	South-west of the Project	Adult	-	-	Feeding	Feeding	-	Feeding	-	-	-		-	-
	Chalna Point	Juvenile, Adult and Brood Fish	Breeding and Spawning	-	-	-	-	-	-	-	-		Feeding, Growing and Spawning	-
		Juvenile and Adult	-	-	Feeding and Growing	Feeding	Feeding and Growing	-	Feeding and Growing	-	-		-	-
		Fry	-	-	-	-	-	-	-	-	Nursery		-	Nursing
Chhuri	Haldikhali	Adult	Feeding	-	Feeding	-	-	-	-	-	-		-	-
	Akram Point		Feeding	-	Feeding	-	-	-	-	-	-		-	-
Chela	Haldikhali	Adult	Feeding	-	Feeding	-	-	-	-	-	-		-	-

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

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
	Harbaria	Juvenile	-	-	-	-	-	-	Feeding and Growing		-		Feeding and Growing	-
		Age-1 adult	-	-	-	-	-	-	-	-	Feeding and Growing		-	-
	Maidara	Juvenile and Age-1 Adult	-	-	-	-	-	-	Feeding and Growing	-			-	-
	Chalna Point	Juvenile	-	-	-	-	-	-	-	-	-		Feeding and Growing	-
Potka	Haldikhali	Adult	Feeding and Breeding	-	-	-	-	-	-	-	-		-	-
	Chandpai	Fry	Spawning	Spawning and Nursing	-	-	-	-	-	-	-		-	-
		Juvenile	-	-	-	-	-	-	-	Feeding and Growing	-		-	Feeding
		Adult	-	-	-	Feeding	-	-	-	-	-		Feeding	-
	Mongla Point	Fry	Spawning	-	-	-	-	-	-	-	-		-	-
		Juvenile	-	-	-	-	-	-	-	-	Feeding and Growing		-	-
	Harbaria	Fry	-	-	-	-	-	Nursery	-	-	-		-	-
		Juvenile	-	-	-	-	-	-	-	Feeding and Growing	-		-	-
Paira Chanda	Akram Point	Adult	Feeding	-	-	-	-	-	-	-	-		-	-
	Chandpai	Fry	Breeding and Spawning	-	-	-	-	-	-	-	-		-	-
Chewa	Akram Point	Juvenile and Adult	Feeding	-	Feeding and Growing	-	-	-	-	-			-	-
	Chandpai	Fry and Juvenile	Spawning	-	Feeding and Growing	-	Nursing and Grazing	Nursery	Feeding and Growing	-	Nursing		-	-
		Adult	-	-	-	Feeding	-	Feeding	-	Feeding	-		-	-
	Haldikhali	Juvenile and Adult	-	-	Feeding and Growing	-	-	-	-	-	-		-	-

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
	Harbaria	Juvenile and Adult	-	-	Feeding and Growing	-	-	Feeding and Nursery	-	Feeding	-		-	-
	Mongla Point	Juvenile	-	Feeding and Growing	-	-	-	-	-	-	-		-	-
	South-west of the Project	Juvenile	-	Feeding and Growing	-	-	-	-	-	-	-		-	-
	Chalna Point	Adult	-	-	-	-	Feeding	-	-	-	-		-	-
		Age-1 Juvenile	-	-	-	-	-	-	-	-	Feeding and Growing		-	-
Bele	Akram Point	Adult	Feeding	-	Feeding	Feeding	-	-	-	-	-		-	-
		Juvenile	-	-	-	-	-	-	-	Feeding and Growing	-		-	-
	Haldikhali	Juvenile-1, Juvenile and Adult	-	-	Nursing and Growing	Feeding	-	-	-	-	-		-	-
	Harbaria	Juvenile and Adult	-	-	Feeding and Growing	-	Feeding and Growing	Nursery and Feediing	Feeding and Growing	-	-		-	-
	Chandpai	Fry	Breeding and Spawning	Nursing	-	-	Nursing	Nursery	-	-	Nursery		-	-
	Chandpai	Juvenile and Adult	-	-	Feeding and Growing	Feeding	-	Feeding	-	Feeding	-		Feeding and Growing	
	Harbaria	Juvenile and Age-1 Adult	-	-	-	-	-	-	Feeding and Growing				-	-
	Mongla Point	Fry	Breeding and Spawning	-	-	-	-	Nursery	-	-	-		-	-
	Mongla Point	Fry, Juvenile-1 and Juvenile			Nursing and Growing	-	-	-	-	-	-		-	-
	Mongla Point	Juvenile and Adult	-	-	-	Feeding	Feeding and Growing	Feeding	Feeding and Growing	-	-		-	-
	Chalna Point	Fry	Breeding and Spawning	Nursing	-	-	Nursing	-	-	Nursing	-		-	-

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
	Chalna Point	Adult	-	-	-	Feeding	-	-	-	-	-		-	-
	Maidara	Juvenile and Age-1 adult	-	Feeding and Growing	Feeding and Growing	Feeding	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		-	-
	Mongla Point	Juvenile	Feeding	-	-	-	-	-	-	-	-		-	-
Pekssa	Akram Point	Adult	Feeding	-	-	-	-	-	-	Feeding	-		-	-
		Juvenile	-	-	Feeding and Growing	-	-	-	-	-	-		-	-
	Haldikhali	Juvenile	-	-	Feeding and Growing	-	-	-	-	-	-		-	-
	Haldikhali	Adult	-	-	-	Feeding	-	-	-	-	-		-	-
	Harbaria	Juvenile	-	-	-	-	-	-	-	-	Feeding and Growing		-	-
	Chalna Point	Juvenile and Adult	Feeding	Feeding and Growing	-	-	-	-	Feeding and Growing	-			-	-
		Adult	-	-	Feeding	Feeding	Feeding	-	Feeding	-	-		-	-
	Mongla Point	Adult	-	-	Feeding	Feeding	-	-	Feeding and Growing	-	-		Feeding	-
	Chandpai	Juvenile and Adult	Feeding	Feeding and Growing	-	-	Feeding and Growing	-		-	-		-	-
	Maidara	Juvenile and Adult	Feeding	Feeding and Growing	-	-	-	-	-	-	-		-	-
		Juvenile	-	-	-	-	-	-	Feeding and Growing	-	-		-	-
		Adult	-	-	Feeding	Feeding	-	Feeding	-	-	-		-	-

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
Paissa	Akram Point	Juvenile and Adult	Feeding	-	Feeding and Growing	Feeding	-	-	-	Feeding and Growing	-		-	Feeding
		Brood	-	-	-	-	-	-	-	-	-		-	Spawning
		Juvenile	-	-	-	-	-	-	Feeding and Growing			-	-	-
	Haldikhali	Juvenile and Adult	Feeding	-	Feeding and Growing	Feeding	-	-	-	-	-		-	-
		Juvenile	-	-	-	-	-	-	Feeding and Growing	-	-		-	-
	Harbaria	Juvenile-1 and Juvenile	-	-	Feeding	-	Feeding and Growing	-	Feeding and Growing	-	-		-	-
		Adult	-	-	-	-	-	-	-	Feeding	-		-	-
	Chandpai	Fry	Breeding and Spawning	-	-	-	Nursing	-	-	-	Nursery		-	-
	Chandpai	Juvenile and Adult	-	-	Feeding and Growing	-	-	Nursery and Feeding	-	-	-		Feeding and Growing	Feeding
	Harbaria	Juvenile	-	-	-	-	-	-	Feeding and Growing	-	-			-
	Mongla Point	Fry	Breeding and Spawning	-	-	-	-	Nursery	-	-	Nursery		-	-
		Age-1 Juvenile	-	-	-	-	-	-	-Nursing, Feeding and Growing	-	Feeding and Growing		-	-
		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	-	-		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
									and Growing					
		Adult	-	-	-	-	-	Feeding	-	-	-		-	
Banshpata	Chandpai	Juvenile	Feeding	-	-	-	-	-	-	-	-		-	
		Adult	-	-	-	Feeding	-	Feeding	-	-	-		-	
	Akram Point	Juvenile	-	-	-	-	-	-	Feeding and Growing	-	-		-	
		Adult	-	-	-	-	-	-	-	Feeding	-		-	
	Haldikhali	Juvnile and adult	-	-	Feeding and Growing	Feeding	-	-	Feeding and Growing	-	-		-	
	Harbaria	Adult	-	-	-	-	-	-	-	Feeding	Feeding		Feeding	
	Mongla Point	Fry and Adult	Feeding	Nursing	-	-	-	-	-	-	-		-	
		Adult	-	-	-	Feeding	-	-	-	-	Feeding		-	
	Maidara	Adult	-	-	Feeding	Feeding	-	Breeding and Spawning	-	-	-		-	
	Chalna Point	Adult	-	-	Feeding	Feeding	-	-	-	-	-		-	
Hilsa	Akram Point	Brood Fish	-	-	-	-	-	-	-	-	-		Breeding and Spawning	
	Haldikhali	Brood Fish	-	-	-	-	-	-	-	-	-			
		Juvenile	-	-	Feeding and Growing	-	-	-	-	-	-		-	
	Harbaria	Brood Fish	-	-	-	-	-	-	-	-	-		Breeding and Spawning	
	Chandpai	Adult and Brood Fish	-	-	-	-	-	-	Feeding and Breeding	-	-		-	
	Mongla Point	Adult	-	-	Feeding	-	-	-	-	-	-		-	
		Brood Fish	-	-	-	-	-	-	-	-	-		Breeding and Spawning	
	Maidara	Age-1 Adult	-	-	-	-	-	-	-	-	-		Feeding	

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
Pangas	Chalna Point	Brood fish	-	-	-	-	-	Breeding and Spawning	-	-	-		-	
	Haldikhali	Juvenile	-	-	Feeding and Growing	-	-	-	-	-	-		-	
	Harbaria	Adult	-	-	-	-	-	-	-	Feeding	-		-	
	Mongla Point	Juvenile and Adult	-	-	Feeding	-	-	-	-	-	-		-	

Migratory Fish Species	Sampling Sites	Year Class*	Migration Purpose							
			13th QM	14th QM	15th QM	16th QM	17th QM	18th QM	19^{th} QM	20^{th} QM
Tapsi	Haldikhali	Juvenile and Age-1 adult	-	-	Grazing	-	-	-	-	-
	Akram Point	Juvenile and Age-1 adult	-	-	-	-	-	-	-	-
		Adult	-	-	-	-	-	-	-	-
	Chalna Point	Age-1 adult and Brood fish	-	-	-	-	-	-	-	-
		Adult	-	Feeding	-	-	Feeding	-	-	Feeding
	Harbaria	Juvenile and Age-1 adult	Feeding	-	-	-	-	-	-	-
		Adult and Brood Fish	-	-	-	-	-	-	-	-
	Chandpai	Juvenile	-	Feeding and Growing	-	Feeding and Growing	Feeding and Growing	-	-	-
	Mongla Point	Juvenile	-	-	-	-	-	-	Feeding and Growing	-
		Adult	-	-	-	-		-	-	-
		Age-1 adult	-	-	-	-	Feeding and Growing	-	-	-
		Fry	-	-	Nursing	-	-	-	-	-
	Maidara	Age-1 adult	-	-	-	-	-	-	-	-
		Juvenile	-	-	-	-	-	Maturation	-	-
		Adult	-	-	-	-	Feeding	-	-	-
		Brood Fish	-	-	-	-	-	-	-	-
Bairagi	Haldikhali	Juvenile and Age-1 adult	-	-	-	-	-	-	-	-
	Akram Point	Juvenile and Age-1 adult	-	-	-	-	-	-	-	-
		Juvenile and Adult	-	-	-	-	-	-	-	-
	Chandpai	Fry	-	Nursing	-	Nursing	-	-		Nursing
		Juvenile	-	Feeding and Growing	Feeding and Growing	Feeding and Growing	-	Maturation	Feeding and Growing	-

			Migration Purpose							
Migratory Fish Species	**Sampling Sites**	**Year Class***	**13th QM**	**14th QM**	**15th QM**	**16th QM**	**17th QM**	**18th QM**	**19th QM**	**20th QM**
	Chalna Point	Juvenile and Age-1 adult	-	-	-	-	-	-	-	Feeding
		Fry	Nursing	-	-	-	-	Nursing	-	Nursing
	Harbaria	Juvenile	-	-	Feeding and Growing	-	Feeding and Growing	-	-	-
	Mongla Point	Fry	Nursing	-	Nursing	-	-	-	-	-
		Juvenile	-	-	-	-	Feeding and Growing	-	-	-
	Maidara	Juvenile	-	-	-	-	-	Maturation	-	-
		Fry	Nursing	-	Nursing	-	-	Nursing	-	Nursing
	Charaputia	Adult	-	-	-	-	-	-	-	Feeding
	Jongra	Fry	-	-	-	-	-	-	-	Nursing
Chapila	Haldikhali	Juvenile	-	-	-	-	-	-	-	-
	Akram Point	Juvenile	-	-	-	-	-	-	-	-
	Harbaria	Juvenile	-	-	-	-	Feeding and Growing	-	-	-
	Mongla Point	Fry	-	-	-	-	Nursing	-	-	-
		Juvenile	-	-	-	-	Feeding and Growing	-	-	-
		Adult	-	-	-	-	Feeding	-	Maturation	-
	Chalna Point	Adult	-	-	-	-	Feeding	-	Maturation	-
		Fry	-	-	-	-	-	Nursing	-	-
	Maidara	Juvenile to Age-1 adult	-	-	-	-	-	Growing and Maturation	-	-
Loitta	Haldikhali	Juvenile and Age-1 adult	-	-	-	-	-	-	-	-
	Akram Point	Juvenile	-	-	-	-	-	-	-	-
	Akram Point	Age-1 adult	-	-	-	-	-	-	-	-
	Chandpai	Juvenile	-	-	-	-	-	-	-	-
	Jongra	Fry	-	-	-	-	-	-	-	Nursing
	Harbaria	Fry, Juvenile and Age-1 adult	-	-	-	-	-	-	-	-
	Mongla Point	Fry	-	-	Nursing	-	-	-	-	-
	Chalna Point	Age-1 adult	-	-	-	-	-	-	-	-
		Fry	-	-	-	-	-	-	-	-
Poma	Haldikhali	Juvenile	-	-	-	-	-	-	-	-
	Akram Point	Juvenile	-	-	-	-	-	-	-	-
		Age-1 adult	-	-	-	-	-	-	-	-
		Adult	-	-	-	-	-	-	-	-
	Charaputia	Brood Fish	-	-	-	Spawning	-	-	-	-

			Migration Purpose							
Migratory Fish Species	**Sampling Sites**	**Year Class***	**13th QM**	**14th QM**	**15th QM**	**16th QM**	**17th QM**	**18th QM**	**19th QM**	**20th QM**
		Juvenile and Adult	-	-	-	Feeding	-	-	Growing and Maturation	Feeding
	Chandpai	Fry and Juvenile	-	-	-	Nursing	-	-	-	-
		Fry	-	-	-	-	Nursing	-	-	-
		Juvenile	Feeding and Growing	-	-	Feeding and Growing	-	-	-	-
		Adult		Feeding	Feeding	Feeding	-	-	-	-
		Brood Fish	-	-	-	-	-	-	-	-
	Jongra	Fry	-	-	-	-	-	-	-	Nursing
	Haldikhali	Fry and Juvenile	-	-	-	-	-	-	-	-
	Harbaria	Adult and Brood Fish	-	-	-	-	-	-	-	-
		Adult	Feeding	-	-	-	-	Feeding	-	-
		Fry and Juvenile	-	-	-	-	-	-	-	-
	Mongla Point	Fry, Juvenile and Age-1 adult	Nursing	-	-	-	Nursing	-	Feeding and Growing	-
		Fry	-	Nursing	-	-	-	-	-	-
		Juvenile	-	-	-	-	-	-	-	-
		Age-1 Adult	-	-	-	-	-	-	-	-
		Adult	-	-	-	-	-	-	-	-
		Brood Fish	-	-	-	-	-	-	-	-
	Maidara	Adult	-	Feeding	-	-	-	-	Maturation and Feeding	-
		Fry	-	-	-	-	-	Nursing	-	-
	Chalna Point	Juvenile, Adult and Brood Fish	-	-	-	-	-	-	-	-
		Juvenile and Adult	-	Feeding and Growing	-	-	-	Maturation and Feeding	Maturation and Feeding	-
		Fry	Nursing	-	-	-	-	-	-	-
Chhuri	Haldikhali	Adult	-	-	-	-	-	-	-	-
	Akram Point		-	-	-	-	-	-	-	-
Chela	Haldikhali	Adult	-	-	-	-	-	-	-	-
	Akram Point	Juvenile and Adult	-	-	-	-	-	-	-	-
	Harbaria	Fry and Juvenile	-	-	-	-	-	-	-	-
	Chalna Point		-	-	-	Nursing and Feeding	-	-	-	-
	Chandpai		-	-	Feeding and Growing		-	-	-	Nursing
	Mongla Point		-	Nursing	-	-	-	-	-	-

			Migration Purpose							
Migratory Fish Species	**Sampling Sites**	**Year Class***	**13th QM**	**14th QM**	**15th QM**	**16th QM**	**17th QM**	**18th QM**	**19th QM**	**20th QM**
	Jongra	Fry	-	-	-	-	-	-	-	Nursing
Gang Tengra	Haldikhali	Adult	-	-	-	-	-	-	-	-
	Akram Point	Adult	-	-	-	-	-	-	-	-
	Harbaria	Adult	-	-	-	-	-	-	-	-
	Chandpai	Adult	-	-	-	-	Feeding	-	-	-
	Maidara	Fingerling	-	-	-	-	Nursing	-	-	-
	Mongla Point	Fingerling					Nursing	-	-	-
		Age-1 Adult					Feeding and Growing	-	-	-
Ghagra Tengra	Chandpai	Juvenile and Age-1 adult	-	-	-	-	-	Maturation		-
		Brood Fish	-	-	Breeding	-	-	-	-	-
		Fry	-	-	-	-	Nursing	-	-	-
	Chalna Point	Age-1 adult	-	-	-	-	-	-	-	-
	Mongla Point	Age-1 adult	-	-	-	-	-	-	Maturation and Feeding	-
	Akram Point	Juvenile and Adult	Feeding	-	-	-	-	-	-	Feeding and Growing
		Adult	-	-	-	-	-	-	-	-
	Haldikhali	Juvenile	-	-	-	-	-	-	-	-
	Harbaria	Adult	Feeding		Breeding	-	-	-	-	Feeding
		Juvenile	-		-	-	-	Maturation	-	Maturation
	Charaputia	Juvenile and Age-1 adult	-						Maturation	-
Gulsha Tengra	Haldikhali	Adult	-	-	-	-	-	-	-	-
	Akram Point	Adult	-	-	-	-	-	-	-	-
	Chandpai	Age-1 adult	Feeding	-	Feeding and Growing	-	-	-	-	-
		Juvenile	-	Feeding and Growing	-	Feeding and Growing	-	-	-	-
	Charaputia		-	-	-		-	-	Feeding and Growing	-
	Mongla Point	Age-1 adult	-	-	-	-	Feeding and Growing	-	-	-
		Juvenile	-	-	-	-	Feeding and Growing	-	-	-
	Harbaria	Juvenile	-	-	-	-	Feeding and Growing	-	-	-

			Migration Purpose							
Migratory Fish Species	**Sampling Sites**	**Year Class***	**13th QM**	**14th QM**	**15th QM**	**16th QM**	**17th QM**	**18th QM**	**19th QM**	**20th QM**
		Age-1 adult	-	-	-	-	Feeding and Growing	-	-	-
	Maidara	Juvenile and Age-1 Adult	-	-	-	-	-	-	-	-
	Chalna Point	Juvenile	-	-	-	-	-	-	-	-
Potka	Haldikhali	Adult	-	-	-	-	-	-	-	-
	Chalna Point	Fry	-	-	-	-	-	Nursing	-	
	Chandpai	Fry	-	-	-	-	-	-	-	Nursing
		Juvenile	Feeding	-	-	-	-	-	Feeding and Growing	-
		Adult	-	Feeding and Growing	Feeding	-	-	-	-	-
	Jongra	Fry	-	-	-	-	-	-	-	Nursing
	Mongla Point	Fry	-	-	-	-	-	-	-	-
		Juvenile	-	-	-	-	-	-	-	-
	Maidara	Fry	-	-	-	Nursing	-	Nursing	-	Nursing
		Juvenile	-	-	-	-	-	Maturation	-	-
	Harbaria	Fry	-	-	-	-	-	-	-	-
		Juvenile	-	-	-	-	-	-	-	-
	Charaputia	Juvenile	-	-	-	-	-	-	Feeding and Growing	-
Paira Chanda	Akram Point	Adult	-	-	-	-	-	-	-	-
	Chandpai	Fry	-	-	-	-	-	-	-	-
Chewa	Akram Point	Juvenile and Adult	-	-	-	-	-	-	-	-
	Chandpai	Fry and Juvenile	-	-	-	-	-	-	-	Nursing
		Juvenile	-	Feeding and Growing	-	-	-	-	-	-
		Adult	-	-	-	-	-	-	-	-
	Jongra	Fry	-	-	-	-	-	-	-	Nursing
	Haldikhali	Juvenile and Adult	-	-	-	-	-	-	-	-
	Harbaria	Juvenile and Adult	-	-	-	-	-	-	-	-
	Chandpai	Juvenile-1	-	-	-	-	Feeding and Growing	-	-	-
	Mongla Point	Juvenile	-	-	-	-	-	-	-	-
		Fry	-	-	-	-	Nursing	-	-	-
	Maidara	Juvenile	-	-	-	-	-	-	-	-
		Fry	-	-	Nursing		-	-	-	-
	Chalna Point	Adult	-	-	-	-	Feeding	-	-	-

			Migration Purpose							
Migratory Fish Species	**Sampling Sites**	**Year Class***	**13th QM**	**14th QM**	**15th QM**	**16th QM**	**17th QM**	**18th QM**	**19th QM**	**20th QM**
		Age-1 Juvenile	-	-	-	-	-	-	-	-
Bele	Akram Point	Adult	-	-	-	-	-	-	-	-
		Juvenile	-	-	-	-	-	-	-	
	Haldikhali	Juvenile-1, Juvenile and Adult	-	-	-	-	-	-	-	
	Harbaria	Juvenile and Adult	-	-	-	-	-	-	-	
	Chandpai	Fry	-	-	-	Nursing	Nursing	-	-	Nursing
		Juvenile and Adult	Feeding and Growing	-	Feeding and Growing		-	-	-	-
	Jongra	Fry	-	-	-		-	-	-	Nursing
	Harbaria	Juvenile and Age-1 Adult	-	-	-	-	-	-	-	-
	Mongla Point	Fry	-	Nursing	-	-	Nursing	-	-	-
		Fry, Juvenile-1 and Juvenile	-	-	-	-	-	-	-	-
		Juvenile and Adult	-	-	-	-	-	-	-	-
	Chalna Point	Fry	-	-	Nursing		Nursing	-	-	-
		Fingerling	-	-	-	-	Nursing	-	-	-
		Adult	-	-	-	-	-	-	-	-
	Maidara	Juvenile and Age-1 adult	-	-	Feeding and Growing	-	Feeding and Growing	Feeding and Growing	-	-
		Fry	Nursing	-	Nursing		-	-	-	-
	Charaputia	Juvenile and Age-1 adult	-	-	-		-	-	Maturation	-
Tular Dandi (Nona bele)	Akram Point	Adult	-	-	-	-	-	-	-	Feeding and Maturation
	Chandpai	Age-1 Adult	-	-	Feeding	-	-	-	-	-
		Juvenile	-	-	-	-	-	Growing	-	-
		Fry	-	-	-	-	-	-	-	Nursing
	Jongra	Fry	-	-	-	-	-	-	-	Nursing
	Maidara	Adult	-	Feeding	-	-	-	-	Maturation	-
	Chalna Point	Adult	-	-	-	-	-	-	Maturation	Maturation
Tairel	Akram Point	Adult	-	-	-	Feeding	-	-	-	-
	Charaputia	Juvenile	-	-	-	-	-	-	-	Maturation
	Harbaria	Age-1 Adult	-	Feeding and Growing	-	-	-	-	-	-
	Chandpai	Juvenile	-	-	-	-	-	Growing	-	-
	Maidara	Juvenile	-	-	-	-	-	Growing	-	-
	Mongla Point	Juvenile	-	-	-	-	-	-	-	-
Pekssa	Akram Point	Adult	-	-	-	-	-	-	-	-

Migratory Fish Species	Sampling Sites	Year Class*	Migration Purpose							
			13th QM	14th QM	15th QM	16th QM	17th QM	18th QM	19th QM	20th QM
		Juvenile	-	-	-	-	-	-	-	-
	Haldikhali	Juvenile	-	-	-	-	-	-	-	-
	Haldikhali	Adult	-	-	-	-	-	-	-	-
	Charaputia	Juvenile and Adult	-	-	-	-	-	-	-	Feeding and Maturation
	Harbaria	Juvenile	-	-	-	-	-	-	-	-
	Chalna Point	Juvenile and Adult	-	-	-	Feeding and Growing	-	-	-	Maturation
		Adult	-	Feeding	-	-	-	-	Maturation	-
	Mongla Point	Adult	-	-	-	-	-	-	Maturation	-
		Juvenile	-	-	-	Growing	-	-		-
	Chandpai	Juvenile and Adult	-	-	-	Feeding and Growing	-	-	Maturation	--
	Maidara	Juvenile and Adult	-	-	-	-	-	-	-	-
		Juvenile	-	-	-	-	-	-	-	-
		Adult	-	Feeding	-	-	-	-	-	-
Paissa	Akram Point	Juvenile and Adult	Feeding	-	-	-	-	Growing and Maturation	-	-
		Brood	Spawning	-	-	-	-	-	-	-
		Juvenile	-	-	-	-	-	-	-	-
	Haldikhali	Juvenile and Adult	-	-	-	-	-	-	-	-
		Juvenile	-	-	-	-	-	-	-	-
	Charaputia	Brood Fish	-	--	-	Spawning	-	-	-	-
	Harbaria	Juvenile-1 and Juvenile	-	Feeding and Growing	-	-	-	-	-	-
		Adult	-	Feeding	-	-	-	-	-	-
	Chalna	Fry	-	-	-	-	-	-	Feeding and Growing	-
	Chandpai	Fry	-	-	-	Nursing	-	-	Feeding and Growing	Nursing
		Juvenile and Adult	Feeding	Feeding and Growing	-	Feeding and Growing	-	Maturation	-	-
	Jongra	Fry	-	-	-	-	-	-	-	Nursing
	Harbaria	Juvenile	-	-	Feeding and Growing	-	-	Maturation	-	-
	Mongla Point	Fry	-	-	Nursing	-	-	-	-	-
		Age-1 Juvenile	-	-	-	-	-	-	-	-

			Migration Purpose							
Migratory Fish Species	Sampling Sites	Year Class*	13th QM	14th QM	15th QM	16th QM	17th QM	18th QM	19th QM	20th QM
		Age-1 Adult	-	-	-	-	-	-	-	-
	Maidara	Fry, Juvenile and Age-1 adult	-	-	-	-	-	-	Feeding and Growing	-
		Age-1 Juvenile, Juvenile and Age-1 Adult	-	-	-	-	-	-	-	-
		Juvenile	-	-	-	-	-	Growing	-	-
		Adult	-	-	-	-	-	-	-	-
Banshpata	Chandpai	Juvenile	-	-	-	Growing	Feeding and Growing	-	-	-
		Adult	-	Feeding	Feeding	-	-	-	-	-
	Jongra	Juvenile	-	-	-	-	-	-	-	Maturation
	Charaputia	-	-	-	-	Feeding	-	-	Growing and Maturation	-
	Akram Point	Juvenile	-	-	-	-	-	-	-	-
		Adult	-	-	-	-	-	-	-	-
	Haldikhali	Juvnile and adult	-	-	-	-	-	-	-	-
	Harbaria	Adult	-	-	-	-	-	-	-	-
	Mongla Point	Fry and Adult	-	-	-	-	-	-	-	-
		Adult	-	-	-	-	-	-	-	-
		Juvenile	-	-	-	-	Feeding and Growing	-	-	-
	Maidara	Juvenile and Age-1 Adult	-	-	-	-	-	Growing and Maturation	Growing and Maturation	-
		Adult	-	Feeding	-	-	-	Feeding	-	-
	Chalna Point	Juvenile and Age-1 Adult	-	-	-	-	-	-	Growing and Maturation	Feeding
Hilsa	Akram Point	Brood Fish	-	-	-	-	-	-	-	-
	Haldikhali	Brood Fish	-	-	-	-	-	-	-	-
		Juvenile	-	-	-	-	-	-	-	-
	Harbaria	Brood Fish	-	-	-	-	-	-	-	-
	Chandpai	Adult and Brood Fish	-	-	-	-	-	-	-	-
	Mongla Point	Adult	-	-	-	-	-	-	-	-
		Brood Fish	-	-	-	-	-	-	-	-
	Maidara	Age-1 Adult	-	-	-	-	-	-	-	-
	Chalna Point	Adult	-	-	-	-	-	Maturation	-	-
		Brood fish	-	-	-	-	-	-	-	-
Pangas	Haldikhali	Juvenile	-	-	-	-	-	-	-	-

			Migration Purpose							
Migratory Fish Species	**Sampling Sites**	**Year Class***	**13th QM**	**14th QM**	**15th QM**	**16th QM**	**17th QM**	**18th QM**	**19th QM**	**20th QM**
	Charaputia	Adult	-	-	-	-	-	-	-	Feeding
	Harbaria	Adult	-	-	-	-	-	-	-	-
	Mongla Point	Juvenile	-	-	-	-	-	-	Feeding and Growing	-

Source: Field findings at different times

**Only Age-1 to Brood fish was 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	-	-

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
	-	-	-	-	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, 2014-2015

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

Sampling Site	Total Catch (kg): 2015-2016							
	5th QM		6th QM		7th QM		8th QM	
	Species	ton	Species	ton	Species	ton	Species	ton
Sub-total=	**-**	**0**	**-**	**3.02**	**-**	**0**	**-**	**0**
3	Bagda	-	Bagda	3.5	Bagda	0.4	-	0
	-	-	-	-	Paissa	3.2	-	0
	-	-	-	-	Vetki	0.4	-	0
	-	-	-	-	Tilapia	0.06	-	0
	-	-	-	-	Horina Chingri	0.35	-	0
	-	-	-	-	Chali Chingri	0.6	-	0
	-	-	-	-	Chaka Chingri	0.1	-	0
	-	-	-	-	Tengra	0	-	0
	-	-	-	-	Bele	0	-	0
	-	-	-	-	Tairel	0.06	-	0
	-	-	-	-	Bhangan	0	-	0
Sub-total =	**-**	**-**	**-**	**-**	**-**	**5.17**	**-**	**0**
Grand-total =	**-**	**1**		**3.5**		**36.17**	**-**	**9**

Source: CEGIS Field Survey, 2015-2016

Sampling Site	Total Catch (kg): 2016-2017							
	9th QM		10th QM		11th QM		12th QM	
	Species	ton	Species	ton	Species	ton	Species	ton
1	-	0	-	-	Bagda	3	-	0
	-	0	-	-	Tengra	0.1	-	0
	-	0	-	-	Horina Chingri	0.8	-	0
	-	0	-	-	Paissa	0.1	-	0
	-	0	-	-	Vetki	2	-	0
	-	0	-	-	-	0	-	0
	-	0	-	-	-	0	-	0
	-	0	-	-	-	0	-	0
	-	0	-	-	-	0	-	0
	-	0	-	-	-	0	-	0
	-	0	-	-	-	0	-	0
	-	0	-	-	-	0	-	0
Sub-total =	**-**	**0**	**-**	-	**-**	**6**	**-**	**0**

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

Source: CEGIS Field Survey, 2016-2017

Sampling Site	Total Catch (kg): 2017-2018 and 2018-19													
	13th QM		14th QM		15th QM		16th QM		17th QM		18th QM		19th QM	
	Species	ton	Species	ton	Species	ton	Species	ton	Species	ton	Species	ton	Species	ton
1	Bagda	0	Bagda	3	-	-	Bagda	2.00	Bagda	0.76	Bagda	0	Bagda	-
	Horina Chingri	1	Rui (kg)	1.3	-	-	Golda	0.10	Bele	0.20	Catla	1.2	Paissa	-
	Tengra	0	Catla (kg)	1	-	-	Rui	0.12	Chali	1.20	Common Carp	0.3		
	Paissa	0	-	-	-	-	Grass Carp	0.20	Golda	0.00	Grass Carp	0.3		
	Chela	0	-	-	-	-	Catla	0.30	Horina	1.60	Rui	4.2		
	Vetki	0	-	-	-	-	Tilapia	0.45	Paissa	0.00				
							Horina	0.10	Tilapia	12.80				
							Gusha	0.00						

Sampling Site	Total Catch (kg): 2017-2018 and 2018-19													
	13th QM		14th QM		15th QM		16th QM		17th QM		18th QM		19th QM	
	Species	ton	Species	ton	Species	ton	Species	ton	Species	ton	Species	ton	Species	ton
							Paissa	0.00						
							Khorulla	0.00						
							Vetki	0.00						
							Gulsha	0.00						
							Bele	0.00						
Sub-total =	**-**	**1**	**-**	**3.6**	-	-	=	**3.27**	=	**16.56**	=	**6**		
2	Bagda	0	Bagda	5	-	-	Bagda	**3.93**	Bagda	1.48	Bagda	5	Bagda	-
	-	-	Vetki	0.5	-	-	Golda	**0.13**	Bele	0.06	Bhangan	0.05	Paissa	-
	-	-	Paissa	7	-	-	Rui	**8.41**	Bhangan	0.01	Catla	3	Datina	-
	-	-	Phessa	1	-	-	Tilapia	**5.90**	Catla	0.00	Chali	0.4		
	-	-	Bhangan	0.7	-	-	Nilotica	**0.00**	Chali	0.04	Golda	0.08		
							Khorulla	**0.00**	Chel	0.01	Horina	1.8		
							Mrigel	**0.00**	Golda	0.00	Paissa	0.8		
							Catla	**0.00**	Horina	0.50	Rui	3		
							Grass Carp	**0.11**	Motka	0.05	Tengra	0.8		
							Common Carp	**5.55**	Paissa	0.03	Tilapia	8		
							Sarpunti	**0.53**	Rui	0.00	Vetki	2		
							Horina	**1.91**	Tengra	0.13				
							Chali Chingri	**1.16**	Tilapia	0.41				
							Bele	**0.43**	Vetki	0.01				
							Vetki	**1.96**						
							Tengra	**4.20**						
							Paissa	**0.14**						
							Tairel	**0.003**						
							Pheksa	**0.001**						
Sub-total =		**0**		**14.2**	-	-	=	**34.38**	=	**2.75**	=	**25**		
3	Bagda	0	Bagda	2	-	-	Bagda	**0.50**	Bagda	0.10	-	0	Bagda	-

Sampling Site	Total Catch (kg): 2017-2018 and 2018-19													
	13th QM		14th QM		15th QM		16th QM		17th QM		18th QM		19th QM	
	Species	ton	Species	ton	Species	ton	Species	ton	Species	ton	Species	ton	Species	ton
	-	-	Paissa	8	-	-	Tilapia	**1.50**	Horina Chingri	0.00			Golda	-
	-	-	Tengra	2	-	-	Tengra	**0.12**	Paissa	0.00			Paissa	-
	-	-	Tilapia	5	-	-	Paissa	**0.00**	Tengra	0.00			Nilotica	-
	-	-	Rui	3	-	-	Horina Chingri	**0.60**	Tilapia	0.20			Khorsul	-
	-	-	Vetki	2	-	-								
	-	-	Catla	10	-	-								
Sub-total =	**-**	**0**	**-**	**32**	-	-								
Grand-total =	**-**	**1**	**-**	**49.8**	-	-	**=**	**2.72**	**=**	**0.30**	**=**	**0**		

Source: CEGIS Field Survey, 2017-18 and 2018-19

Total Catch (kg): 2019-2020

Location	20th QM	
	Fish Species	Total Production (ton)
Bhekatkhali Khal, Rajnagar	Bagda	32
	Horina	48
	Sub-total =	**80**
Kapashdanga-Muralia	Bagda	1.41
	Paissa	0.60
	Crab	0.00
	Tilapia	0.30
	Golda	0.10
	Horina Chingri	2.92
	Chali Chingri	1.52
	Bele	1.35
	Tengra	0.27
	Major Carp	0.55
	Sub-total =	**9**
Chunkuri-2	Bagda	0.04
	Paissa	0.00
	Khorsula	0.00

Location	20th QM	
	Fish Species	Total Production (ton)
	Horina Chingri	0.10
	Motka	0.04
	Chali Chingri	0.03
	Chaka Chingri	0.01
	Bele	0.01
	Crab	0.03
	Sub-total =	**0.24**

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		Mauza:Chunkuri-2,Union:Bajua Upazila: Dacope, District :Khulna	E-89°32′20.0″	N-22°34′51.0″		
3		Mauza: Kapalirmet/Buridmial Union: Burirdanga, Upazila: Mongla District: Bagerhat	E-89°36′8.8″	N-22°32′18.9″		
4		Mauza: Chakgona, Union: Rajnagar 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; 2017

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

Monitoring agriculture plot	Cropping pattern																	
	2013-14			2014-15			2015-16			(2016-17)			(2017-18)			(2018-19)		
	K-I	K-II	Rabi	K-I	K-II	Rabi	K-I	K-II	Rabi	K-I	K-II	Rabi	K-I	K-II	Rabi	K-I	K-II	Rabi
Monitoring Spot-1 (Baranpara)	Fallow	Local Aman	Fallow	Fallow	HYV Aman	Fallow	Fallow	HYV Aman	Fallow	Fallow	HYV Aman	Fallow	Fallow	Local Aman	Fallow	Fallow	Local Aman	Fallow
Monitoring Spot-2 (Chunkuri-2)	Fallow	HYV Aman	Fallow	Fallow	Local Aman	Fallow	Fallow	HYV Aman	Fallow	Fallow	Local Aman	Fallow	Fallow	Local Aman	Fallow	Fallow	Local Aman	Fallow
Monitoring Spot-3 (Kapalirmet)	Fallow	Local Aman	Fallow	Fallow	Fallow*	Fallow	Fallow	Fallow*	Fallow	Fallow	Fallow*	Fallow	Fallow*	Fallow	Fallow	Fallow	Fallow*	Fallow
Monitoring Spot-4 (Chakgona)	Fallow	Local Aman	Fallow	Fallow	Fallow*	Fallow	Fallow	Fallow*	Fallow	Fallow	Fallow*	Fallow	Fallow*	Fallow	Fallow	Fallow	Local Aman	Fallow
Monitoring Spot-5 (Basherhula)	Fallow	Local Aman	Fallow	Fallow	Local Aman	Fallow	Fallow	Local Aman	Fallow	Fallow	Local Aman	Fallow	Fallow	Local Aman	Fallow	Fallow	Local Aman	Fallow
Monitoring Spot-6 (Bidyarbon_	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Fallow	Local Aman	Fallow

*Source: Based on field information and farmers interviewed. *previously cultivated.* ***K-I:*** *Kharif-I (March-June),* ***K-II:*** *Kharif-II (July-October) and Rabi (November-February)*

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

Monitoring Plots	Crop Production																	
	2013-14			2014-15			2015-2016			2016-17			2017-18			2018-19		
	K-I	K- II	Rabi	K-I	K- II	Rabi	K-I	K- II	Rabi	K-I	K- II	Rabi	K-I	K- II	Rabi	K-I	K- II	Rabi
Monitoring agriculture land -1																		
Production (ton/Plot)	-	0.8*	-	-	1.4*	-	-	1.5*	-	-	0.27*	-	-	0.92*	-	-	1.04*	-
Yield (ton/Ha)	-	1.9*	-	-	3.5*	-	-	3.8*	-	-	2.5*	-	-	2.3*	-	-	2.60*	-
Monitoring agriculture land- 2																		
Production (ton/Plot)	-	2.4*	-	-	1.1	-	-	1.9*	-	-	0.44*	-	-	2.2*	-	-	2.14*	-
Yield (ton/Ha)	-	2.6*	-	-	1.7*	-	-	2.0*	-	-	2.4*	-	-	2.4*	-	-	2.30*	-
Monitoring agriculture land- 3																		
Production (ton/Plot)	-	0.2*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Yield (ton/Ha)	-	1.6*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Monitoring agriculture land- 4																		
Production (ton/Plot)	-	0.6*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.44*	-
Yield (ton/Ha)	-	1.9*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.92*	-
Monitoring agriculture land-5																		

Monitoring Plots	Crop Production																	
	2013-14			2014-15			2015-2016			2016-17			2017-18			2018-19		
	K-I	K- II	Rabi	K-I	K- II	Rabi	K-I	K- II	Rabi	K-I	K- II	Rabi	K-I	K- II	Rabi	K-I	K- II	Rabi
Production (ton/Plot)	-	0.8*	-	-	0.57*	-	-	0.99*	-	-	0.15*	-	-	1.0*	-	-	0.47*	-
Yield (ton/Ha)	-	1.8*	-	-	1.9*	-	-	2.1*	-	-	1.9*	-	-	2.2*	-	-	1.57*	-
Monitoring agriculture land-6																		
Production (ton/Plot)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.98*	-
Yield (ton/Ha)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.10*	-

*Source: Based on field information and farmers interviewed, April 2019, * indicates cleaned rice*

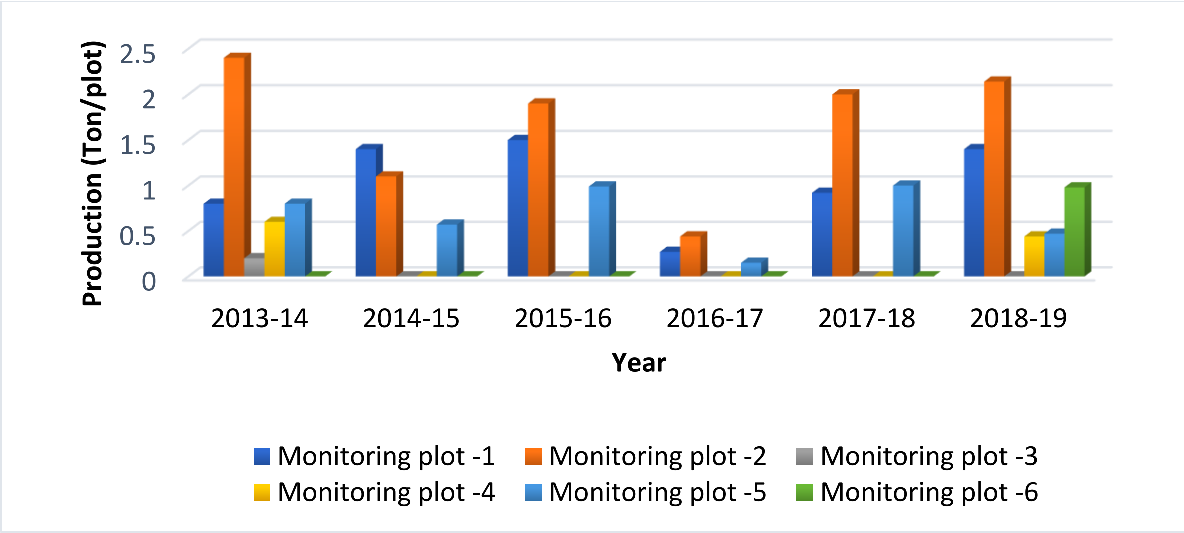


Figure E1: Year wise production scenario of the monitoring plots

The year wise crop production in the monitoring plots is highest during 2018-19 year and followed by 2013-14 year. Crop production is lowest in the monitoring plots during 2016-17 year. It is seemed that in the monitoring plot-3, shrimp culture was found from 2014-15 till to date instead of crop cultivation due to intrusion of saline water in the plot. The monitoring plot-4 crop was not cultivated during 2014-15 to 2017-18 year because a school cum cyclone shelter is constructed in the plot. So, the monitoring plot-4 is shifted to the opposite bank of the river where cropping practice is found during 2018-19. The monitoring plot-6 is newly selected for monitoring as per the TOR during 18th monitoring period and accordingly, the monitoring is continuing. Crop cultivation is found in the plot during 2018-19 year.

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

Monitoring site	2013-14			2014-15			2015-16			2016-17			2017-18			2018-19		
	Area (ha)	Prod. (tons)	Causes	Area (ha)	Prod. (tons)	Causes	Area (ha)	Prod. (tons)	Causes	Area (ha)	Prod. (tons)	Causes	Area (ha)	Prod. (tons)	Causes	Area (ha)	Prod. (tons)	Causes
Monitoring agriculture land-1	-	**Not found	-	-	-	-	-	**Not found	-	0.06	0.024*	E	-	**Not found	-	-	**Not found	-
Monitoring agriculture land-2	-	**Not found	-	0.33*	0.4*	E	-	**Not found	-	-	-	-	-	**Not found	-	-	**Not found	-
Monitoring agriculture land-3	-	**Not found	-	-	-	-	-	**Not found	-	-	-	-	-	**Not found	-	-	**Not found	-
Monitoring agriculture land-4	-	**Not found	-	-	-	-	-	**Not found	-	-	-	-	-	**Not found	-	-	**Not found	-
Monitoring agriculture land-5	-	**Not found	-	0.17*	0.12*	E	-	**Not found	-	0.09	0.019*	E	-	**Not found	-	-	**Not found	-
Monitoring agriculture land-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**Not found	-
Total	-	-	-	**0.50***	**0.52***		-	-	-	**0.15**	**0.043***	-	-	-	-			

*Source: Based on field information and farmers interviewed, April 2019 * Crop damage, **Not found*

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

Table F.1: Results of Traffic Volume Datasheet

Traffic Volume Survey at Khulna Mongla Road (Khudir Bottola)

Date: April 26, 2019 (Friday)

Vehicles		7:00 AM to 10:00AM			12:00 PM to 2:00PM			17:00 PM to 19:00PM		
Direction	Factor	Khulna to Mongla	Mongla to Khulna	PCU	Khulna to Mongla	Mongla to Khulna	PCU	Khulna to Mongla	Mongla to Khulna	PCU
Pedestrian	0	37	25	0	25	25	0	36	40	0
Auto Rickshaw	0.8	23	8	24	21	5	20	7	14	17
Van	0.6	40	17	34	60	21	48	8	23	19
Cycle	0.2	19	11	6	18	7	5	3	15	4
Human Howler	0.6	9	14	14	4	8	7	11	17	17
CNG	0.5	21	4	12	10	2	6	1	6	3
Private Car	1	19	16	35	35	10	45	5	14	18
Motor Cycle	0.3	62	36	29	80	96	53	6	67	22
Jeep	1	3	2	4	3	2	5	1	5	6
Pick-up	2	22	5	53	13	9	43	11	21	64
Micro	1	31	12	43	34	12	45	7	28	35
Bus	2.5	44	16	148	63	26	220	10	20	74
Light Truck	2	16	5	40	4	8	23	12	5	34
Medium Truck	2	23	16	77	30	8	75	11	21	63
Heavy Truck	2	12	8	40	22	10	62	3	17	40
			Total	**558**			**656**			**413**

*-*Source: CEGIS field survey*

Recorder: Gazi A. R. Nahid and Abdur Rahman

Table F.2: Results of Traffic Volume Datasheet

Traffic Volume Survey at Khulna Mongla Road (Gonai Bridge)

Date: April 24, 2019 (Wednesday)

Vehicles		7:00 AM to 10:00AM			12:00 PM to 2:00PM			17:00 PM to 19:00PM		
Direction	Factor	Khulna to Mongla	Mongla to Khulna	PCU	Khulna to Mongla	Mongla to Khulna	PCU	Khulna to Mongla	Mongla to Khulna	PCU
Pedestrian	0	19	17	0	34	15	0	9	18	0
Auto Rickshaw	0.8	9	5	11	14	3	13	9	2	9
Van	0.6	20	14	20	17	10	16	10	16	15
Cycle	0.2	6	7	3	2	18	4	7	16	5
Human Howler	0.6	13	13	16	7	21	17	13	19	19
CNG	0.5	4	6	5	6	2	4	5	21	13
Private Car	1	8	6	13	13	2	15	8	15	23
Motor Cycle	0.3	32	21	16	41	30	21	30	34	19
Jeep	1	2	3	5	1	2	3	1	3	4
Pick-up	2	5	4	19	7	4	22	6	7	26
Micro	1	9	3	12	9	4	13	3	28	31
Bus	2.5	16	9	63	10	7	41	9	19	70
Light Truck	2	6	3	19	10	4	26	4	9	26
Medium Truck	2	15	7	43	34	20	106	9	23	64
Heavy Truck	2	19	5	49	30	5	69	8	15	44

Source: CEGIS field survey

Recorder: Gazi A. R. Nahid and Abdur Rahman

Table F.3: Results of Traffic Volume Datasheet

Traffic Volume Survey at Power Plant access road (Gonabelai Bridge)

Date: April 25, 2019 (Thursday)

Vehicles		7:00 AM to 10:00AM			12:00 PM to 2:00PM			17:00 PM to 19:00PM		
Direction	**Factor**	**Babubari to Plant site**	**Plant site to Babubari**	**PCU**	**Babubari to Plant site**	**Plant site to Babubari**	**PCU**	**Babubari to Plant site**	**Plant site to Babubari**	**PCU**
Pedestrian	0	31	21	0	21	20	0	13	6	0
Auto Rickshaw	0.8	3	6	7	5	10	12	7	5	10
Van	0.6	21	5	16	11	14	15	8	10	11
Cycle	0.2	19	3	5	9	5	3	3	1	1
Human Howler	0.6	17	13	18	11	13	14	11	12	14
CNG	0.5	1	3	2	1	6	3	1	1	1
Private Car	1	10	9	19	6	12	18	5	9	13
Motor Cycle	0.3	32	18	15	17	20	11	6	6	4
Jeep	1	1	10	11	1	18	19	1	2	3
Pick-up	2	6	10	31	8	12	39	11	10	42
Micro	1	6	10	16	7	13	20	7	12	18
Bus	2.5	2	10	29	3	10	30	10	8	44
Light Truck	2	7	6	25	6	11	33	12	8	40
Medium Truck	2	11	13	47	9	8	32	11	17	56
Heavy Truck	2	5	8	25	4	3	14	3	10	26
			Total	**265**			**262**			**281**

Source: CEGIS field survey

Recorder: Gazi A. R. Nahid and Abdur Rahman

Appendix V: Monitoring Data observed During EIA Study

Table G.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 csollected 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 G.2: Water Quality Monitoring Results

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

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

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

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

Appendix VI: Monitoring Results

Air quality data

Adroit Environment Consultants Ltd.

A House of Complete Environmental Management Solutions

Description of analysis:

Experiment Date	Sample Location ID	Concentration present of different parameter in ambient air (µg/m³)							Remarks
		$PM_{2.5}$	PM_{10}	SPM	SO_2	NO_x	CO	O_3	
19/04/2019	SL1	17.2	61.6	102.5	7.9	11.9	24	05	Good.
20/04/2019	SL2	36.1	137.0	163.2	15.7	17.6	21	07	Good
21/04/2019	SL3	21.7	98.2	128.6	13.9	16.0	18	06	Good
22/04/2019	SL4	18.9	106.1	150.8	12.1	13.9	20	01	Good
23/04/2019	SL5	14.2	58.7	119.2	11.6	13.5	16	05	Good
24/04/2019	SL6	15.0	72.7	117.6	11.2	13.7	20	08	Good
25/04/2019	SL7	19.7	69.9	92.2	12.6	13.8	18	04	Good.
26/04/2019	SL 8	33.0	125.9	173.4	15.3	17.1	23	06	Good.
27/04/2019	SL-9	35.0	131.0	183.1	16.8	17.8	17	03	Good.
28/04/2019	SL10	14.2	63.9	90.9	11.6	13.0	16	05	Good.
30/04/2019	SL11	13.0	51.9	71.1	8.9	9.4	14	01	Good.
01/05/2019	SL12	15.8	92.7	141.1	10.4	11.7	14	03	Good.
Units		µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	ppb	
Test Duration (Hours)		8	8	8	8	8	8	8	
Method of Analysis		Gravimetric	Gravimetric	Gravimetric	West-Gaeke	Jacob and Hochheiser	CO Meter	O_3 Meter	
Bangladesh (DoE) Standard for ambient Air		65	150	200	365	100	10,000	157	
IFC/WB Standard		75	150	NF	125	200	NF	160	

Note: This monitoring was accomplished by –
Respirable Dust Sampler (Model-Envirotech India AAS-217BL) and Fine Particulate Sampler (Model-Envirotech India AAS-127mini)

Terminology:

1. Fine Particulate Matter ($PM_{2.5}$), 2. Respirable Dust Content (PM_{10}), 3.Suspended Particulate Matter (SPM), 4 Oxides of Nitrogen (NO_X). 5. Sulphur Di-Oxide (SO_2), 6. Carbone Mono-Oxide (CO), 7. Ozone (O_3) & 8. DoE- Department of Environment, NF – Not found.

Weather Condition: The weather was sunny.

08.05.19
Nigar Sultana
Sr. Chemist

Md. Saiful Islam
Sr. Manager (Engineering)

Muhammad Zulfiker Noman
Chief Operating Officer.

Page 2 of 2

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Mob: 01733376609-10, Fax: +88-02-9116714, Email: nukhan05@gmail.com, aecldhaka@gmail.com
www.aecl-bd.org

Adroit Environment Consultants Ltd.
A House of Complete Environmental Management Solutions

Adroit Environment Consultants Ltd. Mohammadpur Dhaka-1207 Bangladesh 2/12, Block-B, Humayun Road

AECL LABORATORY ANALYSIS REPORT
AMBIENT AIR QUALITY TEST REPORT

Memo # AECL : 699

Subject : Ambient air Quality analysis for Environmental Monitoring of Khulna 1320 MW CBTPP

Project Location : Rampal, Bagherhat.

= =

Description of sample : Ambient air quality analysis report at different locations.

Sample collector : Adroit Environment Consultants Ltd. (Monitoring Team).

Sampling date : 19th April to 1st May, 2019

Reporting date : 8th May, 2019

= =

Sampling locations ID and Name with Longitude-Latitude:

Sampling Location ID	Longitude & Latitude	Position of Sampler
Ambient Air Sample-1 (SL1)	N- 22° 35´43.2´´ E- 89° 33´ 13.7´´	Township area
Ambient Air Sample-2 (SL2)	N- 22° 05´ 34.7´´ E- 89° 33´ 51.7´´	BIFPCL(Project)
Ambient Air Sample-3 (SL3)	N- 22° 34´33.7´´ E- 89° 33´34.2´´	South-West corner of the project Boundary, Moidara
Ambient Air Sample-4(SL4)	N- 22° 36´01.2´´ E- 89° 33´ 48.7´´	Propose Township area near Chimney location, Mouza-Sapmari Katakhali
Ambient Air Sample-5(SL5)	N- 22° 36´31.8´´ E- 89°32´ 03.7´´	North-West corner of the project Boundary (Koigoddas Kathir Char)
Ambient Air Sample-6(SL6)	N- 22°32´03.5´´ E- 89° 34´01.1´´	Bauja Union 4 KM South-West from the Chimney location
Ambient Air Sample-7(SL7)	N- 22° 38´51.5´´ E- 89° 34´ 37.9´´	Barni, Gaurambha Union 4 KM North-West from the Chimney location
Ambient Air Sample-8(SL8)	N- 22° 46´34.9´´ E- 89° 35´30.3´´	Khulna Khan Jahan Ali Bridge near toll plaza area
Ambient Air Sample-9(SL9)	N- 22° 28´31.5´´ E- 89° 35´ 53.0´´	Mongla Port area (nearby Hotel Posur)
Ambient Air Sample-10(SL10)	N- 22° 17´43.1´´ E- 89° 35´ 34.2´´	Harbaria, Sundarbans
Ambient Air Sample-11(SL11)	N- 22° 01´23.5´´ E- 89°30´ 54.1´´	Akram Point (Sibsa River), Sundarban
Ambient Air Sample-12(SL12)	N- 22° 36´06.5´´ E- 89° 31´ 24.2´´	Chalna Bazar area, Dacope

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Mob: 01733376609-10, Fax: +88-02-9116714, Email: nukhan05@gmail.com, aecldhaka@gmail.com
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জীবনের জন্য বিজ্ঞান

"শেখ হাসিনার দর্শন,সব মানুষের উন্নয়ন"

বাংলাদেশ বিজ্ঞান ও শিল্প গবেষণা পরিষদ (বিসিএসআইআর)

BANGLADESH COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH(BCSIR)

Institute Name: Institute of National Analytical Research & Service (INARS)

Analysis Report

CERT. NO. 61.047.18 BAB BANGLADESH ACCREDITATION Accredited for ISO/IEC 17025:2005

Analytical Service Cell Ref No: Mar2019015377	Unit (Lab/Inst.) Ref No: A-357 to 361
Lab ID: INS-357 to 361	Sample Receiving Date: 03/03/2019
Sample ID: A-357 to 361	Submission Date: 03 Mar 2019
	Report Delivery Date: 10/03/2019

Sample Description: Jetty site, Mongla confluence, Harbaria, Akram point, HIron point

Client's Details: Mahadi Hassan
Center For Environmental And Geographic Information Services
House#House No. 06, , Road No. 23/C, Dhaka-1216

Number of Sample: 5

Report Details:

Lab ID	Particulars of supplied sample	Parameter	Concentration	Test Method (APHA)
A-357	Jetty site (Sample-01)	Oil and Grease	Less than 2.0 mg/L	5520.B
A-358	Mongla confluence (Sample-02)	Oil and Grease	Less than 2.0 mg/L	5520.B
A-359	Harbaria (Sample-03)	Oil and Grease	Less than 2.0 mg/L	5520.B
A-360	Akram point (Sample-04)	Oil and Grease	Less than 2.0 mg/L	5520.B
A-361	Hiron point (Sample-05)	Oil and Grease	Less than 2.0 mg/L	5520.B

12.03.19
Analyst
ড. সাবিনা ইয়াসমিন
বৈজ্ঞানিক কর্মকর্তা
ইনস্টিটিউট অব ন্যাশনাল এনালাইটিক্যাল রিসার্চ এন্ড সার্ভিস (আইএনএআরএস)
বিসিএসআইআর, ঢাকা-১২০৫।

12.3.19
Section/Division In-Charge
শামীম আহমেদ
ঊর্ধ্বতন বৈজ্ঞানিক কর্মকর্তা
ইনস্টিটিউট অব ন্যাশনাল এনালাইটিক্যাল রিসার্চ এন্ড সার্ভিস (আইএনএআরএস)
বিসিএসআইআর, ঢাকা

12.03.2019
In-Charge/Director
Md. Aminul Ahsan
Director (Addl. Charge)
Institute of National Analytical Research & Service (INARS)
BCSIR, Dhaka.

Note:
a. The results reported here pertained to the sample received in this laboratory only.
b. Complain and/or query regarding delivered test report should be lodged within one month of report delivery date.
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10th of March 2019 10:58 AM

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বাংলাদেশ বিজ্ঞান ও শিল্প গবেষণা পরিষদ (বিসিএসআইআর)

BANGLADESH COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH(BCSIR)

Institute Name: Institute of National Analytical Research & Service (INARS)

Analysis Report

Analytical Service Cell Ref No: Mar2019015376	Unit (Lab/Inst.) Ref No: A-339 to 356
Lab ID: INS-339 to 356	Sample Receiving Date: 03/03/2019
Sample ID: A-339 to 356	Submission Date: 03 Mar 2019
	Report Delivery Date: 12/03/2019

Sample Description: 1. Sample no: Surface water (1-15) and 2. Sample no: Groundwater (Gw-1, GW-2 and GW-3)

Client's Details: Mahadi Hassan
Center For Environmental And Geographic Information Services
House#House No. 06, , Road No. 23/C, Dhaka-1216

Number of Sample: 18

Report Details:

Lab ID	Particulars of supplied sample	Parameter	Concentration	Test Method (APHA)
A-339	Surface water (Sample-01)	Mercury (Hg)	Less than 0.001 mg/L	3112.B
A-340	Surface water (Sample-02)	Mercury (Hg)	Less than 0.001 mg/L	3112.B
A-341	Surface water (Sample-03)	Mercury (Hg)	Less than 0.001 mg/L	3112.B
A-342	Surface water (Sample-04)	Mercury (Hg)	Less than 0.001 mg/L	3112.B
A-343	Surface water (Sample-05)	Mercury (Hg)	Less than 0.001 mg/L	3112.B
A-344	Surface water (Sample-06)	Mercury (Hg)	Less than 0.001 mg/L	3112.B
A-345	Surface water (Sample-07)	Mercury (Hg)	Less than 0.001 mg/L	3112.B
A-346	Surface water (Sample-08)	Mercury (Hg)	Less than 0.001 mg/L	3112.B
A-347	Surface water (Sample-09)	Mercury (Hg)	Less than 0.001 mg/L	3112.B
A-348	Surface water (Sample-10)	Mercury (Hg)	Less than 0.001 mg/L	3112.B

Note:
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বাংলাদেশ বিজ্ঞান ও শিল্প গবেষণা পরিষদ (বিসিএসআইআর)

BANGLADESH COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH(BCSIR)

Institute Name: Institute of National Analytical Research & Service (INARS)

Analysis Report

CERT. NO.01.047.18 BAB BANGLADESH ACCREDITATION Accredited for ISO/IEC 17025:2005

Analytical Service Cell Ref No: Mar2019015376	Unit (Lab/Inst.) Ref No: A-339 to 356
Lab ID: INS-339 to 356	Sample Receiving Date: 03/03/2019
Sample ID: A-339 to 356	Submission Date: 03 Mar 2019
	Report Delivery Date: 12/03/2019

Sample Description: 1. Sample no: Surface water (1-15) and 2. Sample no: Groundwater (Gw-1, GW-2 and GW-3)

Client's Details: Mahadi Hassan
Center For Environmental And Geographic Information Services
House#House No. 06, , Road No. 23/C, Dhaka-1216

Number of Sample: 18

Report Details:

Lab ID	Particulars of supplied sample	Parameter	Concentration	Test Method (APHA)
A-339	Surface water (Sample-01)	Mercury (Hg)	Less than 0.001 mg/L	3112.B
A-340	Surface water (Sample-02)	Mercury (Hg)	Less than 0.001 mg/L	3112.B
A-341	Surface water (Sample-03)	Mercury (Hg)	Less than 0.001 mg/L	3112.B
A-342	Surface water (Sample-04)	Mercury (Hg)	Less than 0.001 mg/L	3112.B
A-343	Surface water (Sample-05)	Mercury (Hg)	Less than 0.001 mg/L	3112.B
A-344	Surface water (Sample-06)	Mercury (Hg)	Less than 0.001 mg/L	3112.B
A-345	Surface water (Sample-07)	Mercury (Hg)	Less than 0.001 mg/L	3112.B
A-346	Surface water (Sample-08)	Mercury (Hg)	Less than 0.001 mg/L	3112.B
A-347	Surface water (Sample-09)	Mercury (Hg)	Less than 0.001 mg/L	3112.B
A-348	Surface water (Sample-10)	Mercury (Hg)	Less than 0.001 mg/L	3112.B

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বাংলাদেশ বিজ্ঞান ও শিল্প গবেষণা পরিষদ (বিসিএসআইআর)

BANGLADESH COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH(BCSIR)

Institute Name: Institute of National Analytical Research & Service (INARS)

Analysis Report

Analytical Service Cell Ref No: Mar2019015381	Unit (Lab/Inst.) Ref No: A-365 to 369
Lab ID: INS-365 to 369	Sample Receiving Date: 03/03/2019
Sample ID: A-365 to 369	Submission Date: 03 Mar 2019
	Report Delivery Date: 03/04/2019
Sample Description: Project site, Mongla port, Moidara Rivar, Harbaria, Akram point (Analysis of River bed sediment sample)	
Client's Details: Mahadi Hassan Center For Environmental And Geographic Information Services House#House No. 06, , Road No. 23/C, Dhaka-1216	
Number of Sample: 5	

Report Details:

Lab ID	Particulars of supplied sample	Parameters	Concentration	Test Method (APHA)
A-365	Project site	Arsenic (As)	7.51 mg/kg	3114.C
		Lead (Pb)	8.71 mg/kg	3111.B
		Mercury (Hg)	2.04 mg/kg	3112.B
A-366	Mongla port	Arsenic (As)	4.60 mg/kg	3114.C
		Lead (Pb)	5.19 mg/kg	3111.B
		Mercury (Hg)	1.77 mg/kg	3112.B
A-367	Moidara River	Arsenic (As)	4.16 mg/kg	3114.C
		Lead (Pb)	6.52 mg/kg	3111.B
		Mercury (Hg)	3.10 mg/kg	3112.B

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3rd of April 2019 12:09 PM

জীবনের জন্য বিজ্ঞান "শেখ হাসিনার দর্শন,সব মানুষের উন্নয়ন"

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BANGLADESH COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH(BCSIR)

A-368	Harbaria	Arsenic (As)	4.10 mg/kg	3114.C
		Lead (Pb)	5.02 mg/kg	3111.B
		Mercury (Hg)	1.24 mg/kg	3112.B
A-369	Akram point	Arsenic (As)	4.69 mg/kg	3114.C
		Lead (Pb)	5.67 mg/kg	3111.B
		Mercury (Hg)	1.37 mg/kg	3112.B

03.04.19
Analyst
Md. Abu Bakar Siddique
Scientific Officer
Institute of National Analytical Research & Service (INARS)
BCSIR, Dhaka

03.04.19
Section/Division In-Charge
Muhammad Abdullah Al-Mansur
Senior Scientific Officer
Institute of National Analytical Research & Service (INARS)
BCSIR, Dhaka

03.04.19
In-Charge/Director
Md. Aminul Ahsan
Director (Addl. Charge)
Institute of National Analytical Research & Service (INARS)
BCSIR, Dhaka.

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3rd of April 2019 12:09 PM

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BANGLADESH COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH(BCSIR)

A-368	Harbaria	Arsenic (As)	4.10 mg/kg	3114.C
		Lead (Pb)	5.02 mg/kg	3111.B
		Mercury (Hg)	1.24 mg/kg	3112.B
A-369	Akram point	Arsenic (As)	4.69 mg/kg	3114.C
		Lead (Pb)	5.67 mg/kg	3111.B
		Mercury (Hg)	1.37 mg/kg	3112.B

03.04.19
Analyst
Md Abu Bakar Siddique
Scientific Officer
Institute of National Analytical
Research & Service (INARS)
BCSIR Dhaka

03.04.19
Section/Division In-Charge
Muhammad Abdullah Al Mansur
Senior Scientific Officer
Institute of National Analytical
Research & Service (INARS)
BCSIR, Dhaka

03.04.19
In-Charge/Director
Md. Aminul Ahsan
Director (Addl. Charge)
Institute of National Analytical
Research & Service (INARS)
BCSIR, Dhaka.

Note:

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3rd of April 2019 12:09 PM

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বাংলাদেশ বিজ্ঞান ও শিল্প গবেষণা পরিষদ (বিসিএসআইআর)

BANGLADESH COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH(BCSIR)

A-368	Harbaria	Arsenic (As)	4.10 mg/kg	3114.C
		Lead (Pb)	5.02 mg/kg	3111.B
		Mercury (Hg)	1.24 mg/kg	3112.B
A-369	Akram point	Arsenic (As)	4.69 mg/kg	3114.C
		Lead (Pb)	5.67 mg/kg	3111.B
		Mercury (Hg)	1.37 mg/kg	3112.B

03.04.19
Analyst
Md. Abu Bakar Siddique
Scientific Officer
Institute of National Analytical
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03.04.19
Section/Division In-Charge
Muhammad Abdullah Al-Mansur
Senior Scientific Officer
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BCSIR, Dhaka

03.04.19
In-Charge/Director
Md. Aminul Ahsan
Director (Addl. Charge)
Institute of National Analytical
Research & Service (INARS)
BCSIR, Dhaka.

Note:
a. The results reported here pertained to the sample received in this laboratory only.
b. Complain and/or query regarding delivered test report should be lodged within one month of report delivery date.
c. The laboratory is not responsible for the data quality affected due to sampling, transporting and storage conditions of the sample(s) maintained before received in the laboratory.
d. The report shall not be reproduced/published partly or fully without prior approval of the authority.

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3rd of April 2019 12:09 PM

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Lab Memo: 1691/ CC, DPHE, CL, Dhaka.

Date: 20-05-2019

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: CEN2019040102	Sample Receiving date: 26-02-2019
Ref. Memo No: 42.06.2626.119.37.001.19-0385 & Dated: 26-02-2019	Sample Source: Suface Water
Sent by:Md. Mustasim Billah ,Project Leader , CEGIS, Gulshan-1, Dhaka-1212.	Dist:Bagerhat, Upa:Rampal
Care Taker: CEGIS (SW-02)	Union:, Vill.:
Sample Collection date:	Date of Testing: 26/02/2019-25/03/2019

LABORATORY TEST RESULTS:

Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Arsenic (As)	0.05	0.001	mg/L	AAS	0.001
2	Cadmium (Cd)	0.005	0.0009	mg/L	AAS	0.00015
3	Chemical Oxygen Demand (COD)	4.0	60	mg/L	CRM	-
4	Cr (Total)	0.05	0.020	mg/L	AAS	0.0003
5	Hardness	200-500	3900	mg/L	Titrimetic	-
6	Lead (Pb)	0.05	0.005	mg/L	AAS	0.001
7	Nitrogen (Nitrate)	10.0	2.6	mg/L	UVS	0.10
8	Phosphate	6.0	0.30	mg/L	UVS	0.10
9	Sulphate	400	756	mg/L	UVS	1.0
10	Total Dissolved Solid (TDS)	1000	9950	mg/L	Multimeter	-
11	Total Suspended Solid (TSS)	10	12	mg/L	Gravimetric Method	-

Comments: Sample was collected & Supplied by client.
N.B: AAS- Atomic Absorption Spectrophotometer, UVS- UV-Visible Spectrophotometer, CRM-Closed Reflex Methods, LOQ - Limit of Quantitation.

Test Performed by:	Signature	Countersigned/Approved by:	Signature
1.) Name: Mahabuba Sabina Motin Designation: Sample Analyzer	Motin 20-05-19	1.) Name: Mita Sarker Designation: Senior Chemist	20/05/19
2.) Name: Md. Saiful Alam Khosru Designation: Sample Analyzer	20.05.19	2.) Name: Md. Biplab Hossain Designation: Chief Chemist	B Hossain 20/05/19 Md. Biplab Hossain Chief Chemist Department of Public Health Engineering Central Laboratory Mohakhali, Dhaka.

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Lab Memo: 1691/ CC, DPHE, CL, Dhaka.

Date: 20-05-2019

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: CEN2019040103	Sample Receiving date: 26-02-2019
Ref. Memo No: 42.06.2626.119.37.001.19-0385 & Dated: 26-02-2019	Sample Source: Suface Water
Sent by:Md. Mustasim Billah ,Project Leader , CEGIS, Gulshan-1, Dhaka-1212.	Dist:Bagerhat, Upa:Rampal
Care Taker: CEGIS (SW-03)	Union:, Vill.:
Sample Collection date:	Date of Testing: 26/02/2019-25/03/2019

LABORATORY TEST RESULTS:

Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Arsenic (As)	0.05	0.003	mg/L	AAS	0.001
2	Cadmium (Cd)	0.005	0.0013	mg/L	AAS	0.00015
3	Chemical Oxygen Demand (COD)	4.0	48	mg/L	CRM	-
4	Cr (Total)	0.05	0.044	mg/L	AAS	0.0003
5	Hardness	200-500	4100	mg/L	Titrimetic	-
6	Lead (Pb)	0.05	0.007	mg/L	AAS	0.001
7	Nitrogen (Nitrate)	10.0	1.9	mg/L	UVS	0.10
8	Phosphate	6.0	0.17	mg/L	UVS	0.10
9	Sulphate	400	764	mg/L	UVS	1.0
10	Total Dissolved Solid (TDS)	1000	9730	mg/L	Multimeter	-
11	Total Suspended Solid (TSS)	10	14	mg/L	Gravimetric Method	-

Comments: Sample was collected & Supplied by client.
N.B: AAS- Atomic Absorption Spectrophotometer, UVS- UV-Visible Spectrophotometer, CRM-Closed Reflex Methods, LOQ - Limit of Quantitation.

Test Performed by:	Signature	Countersigned/Approved by:	Signature
1.) Name: Mahabuba Sabina Motin Designation: Sample Analyzer	MMotin 20-05-19	1.) Name: Mita Sarker Designation: Senior Chemist	20/05/19
2.) Name: Md. Saiful Alam Khosru Designation: Sample Analyzer	20.05.19	2.) Name: Md. Biplab Hossain Designation: Chief Chemist	BHossain 20/05/19

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Lab Memo: 1691/ CC, DPHE, CL, Dhaka.

Date: 20-05-2019

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: CEN2019040104	Sample Receiving date: 26-02-2019
Ref. Memo No: 42.06.2626.119.37.001.19-0385 & Dated: 26-02-2019	Sample Source: Suface Water
Sent by:Md. Mustasim Billah ,Project Leader , CEGIS, Gulshan-1, Dhaka-1212.	Dist:Bagerhat, Upa:Rampal
Care Taker: CEGIS (SW-04)	Union:, Vill.:
Sample Collection date:	Date of Testing: 26/02/2019-25/03/2019

LABORATORY TEST RESULTS:

Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Arsenic (As)	0.05	0.001	mg/L	AAS	0.001
2	Cadmium (Cd)	0.005	0.0014	mg/L	AAS	0.00015
3	Calcium (Ca)	75	562	mg/L	AAS	0.17
4	Chemical Oxygen Demand (COD)	4.0	44	mg/L	CRM	-
5	Chloride	150-600	5810	mg/L	Titrimetic	-
6	Silica (Sio2)	0.0	16.8	mg/L	UVS	-
7	Bi-Carbonate (HCO3-)	0.0	125	mg/L	Titrimetic	-
8	Cr (Total)	0.05	0.020	mg/L	AAS	0.0003
9	Hardness	200-500	4600	mg/L	Titrimetic	-
10	Iron (Fe)	0.3-1	2.47	mg/L	AAS	0.05
11	Lead (Pb)	0.05	0.005	mg/L	AAS	0.001
12	Magnesium (Mg)	30-35	105	mg/L	AAS	0.05
13	Nitrogen (Nitrate)	10.0	2.1	mg/L	UVS	0.10
14	Phosphate	6.0	0.20	mg/L	UVS	0.10
15	Potassium (K)	12.0	56	mg/L	AAS	-
16	Sodium (Na)	200	3724	mg/L	AAS	0.34
17	Sulphate	400	748	mg/L	UVS	1.0
18	Total Dissolved Solid (TDS)	1000	9860	mg/L	Multimeter	-
19	Total Suspended Solid (TSS)	10	12	mg/L	Gravimetric Method	-
20	Turbidity	10	47.8	NTU	Turbidity Meter	-
21	Carbonate (CO3)	-	0.46	mg/L	Titrimetic	-

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Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ

Comments: Sample was collected & Supplied by client.
N.B: AAS- Atomic Absorption Spectrophotometer, UVS- UV-Visible Spectrophotometer, CRM-Closed Reflex Methods, LOQ - Limit of Quantitation.

Test Performed by:	Signature	Countersigned/Approved by:	Signature
1.) Name: Mahabuba Sabina Motin Designation: Sample Analyzer	20-05-19	1.) Name: Mita Sarker Designation: Senior Chemist	20/05/19
2.) Name: Md. Saiful Alam Khosru Designation: Sample Analyzer	20.05.19	2.) Name: Md. Biplab Hossain Designation: Chief Chemist	20/05/19

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Lab Memo: 1691/ CC, DPHE, CL, Dhaka. Date: 20-05-2019

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: CEN2019040105	Sample Receiving date: 26-02-2019
Ref. Memo No: 42.06.2626.119.37.001.19-0385 & Dated: 26-02-2019	Sample Source: Suface Water
Sent by:Md. Mustasim Billah ,Project Leader , CEGIS, Gulshan-1, Dhaka-1212.	Dist:Bagerhat, Upa:Rampal
Care Taker: CEGIS (SW-05)	Union:, Vill.:
Sample Collection date:	Date of Testing: 26/02/2019-25/03/2019

LABORATORY TEST RESULTS:

Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Arsenic (As)	0.05	0.001	mg/L	AAS	0.001
2	Cadmium (Cd)	0.005	0.0008	mg/L	AAS	0.00015
3	Chemical Oxygen Demand (COD)	4.0	56	mg/L	CRM	-
4	Cr (Total)	0.05	0.022	mg/L	AAS	0.0003
5	Hardness	200-500	4200	mg/L	Titrimetic	-
6	Lead (Pb)	0.05	0.003	mg/L	AAS	0.001
7	Nitrogen (Nitrate)	10.0	2.2	mg/L	UVS	0.10
8	Phosphate	6.0	0.35	mg/L	UVS	0.10
9	Sulphate	400	760	mg/L	UVS	1.0
10	Total Dissolved Solid (TDS)	1000	9980	mg/L	Multimeter	-
11	Total Suspended Solid (TSS)	10	13	mg/L	Gravimetric Method	-

Comments: Sample was collected & Supplied by client.
N.B: AAS- Atomic Absorption Spectrophotometer, UVS- UV-Visible Spectrophotometer, CRM-Closed Reflex Methods, LOQ - Limit of Quantitation.

Test Performed by:	Signature	Countersigned/Approved by:	Signature
1.) Name: Mahabuba Sabina Motin Designation: Sample Analyzer	Motin 20-05-19	1.) Name: Mita Sarker Designation: Senior Chemist	20/05/19
2.) Name: Md. Saiful Alam Khosru Designation: Sample Analyzer	20.05.19	2.) Name: Md. Biplab Hossain Designation: Chief Chemist	B Hossain 20/05/19

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Lab Memo: 1691/ CC, DPHE, CL, Dhaka.

Date: 20-05-2019

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: CEN2019040106	Sample Receiving date: 26-02-2019
Ref. Memo No: 42.06.2626.119.37.001.19-0385 & Dated: 26-02-2019	Sample Source: Suface Water
Sent by:Md. Mustasim Billah ,Project Leader , CEGIS, Gulshan-1, Dhaka-1212.	Dist:Bagerhat, Upa:Rampal
Care Taker: CEGIS (SW-06)	Union:, Vill.:
Sample Collection date:	Date of Testing: 26/02/2019-25/03/2019

LABORATORY TEST RESULTS:

Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Arsenic (As)	0.05	0.002	mg/L	AAS	0.001
2	Cadmium (Cd)	0.005	0.0017	mg/L	AAS	0.00015
3	Chemical Oxygen Demand (COD)	4.0	64	mg/L	CRM	-
4	Cr (Total)	0.05	0.011	mg/L	AAS	0.0003
5	Hardness	200-500	4400	mg/L	Titrimetic	-
6	Lead (Pb)	0.05	0.007	mg/L	AAS	0.001
7	Nitrogen (Nitrate)	10.0	3.5	mg/L	UVS	0.10
8	Phosphate	6.0	0.27	mg/L	UVS	0.10
9	Sulphate	400	762	mg/L	UVS	1.0
10	Total Dissolved Solid (TDS)	1000	9800	mg/L	Multimeter	-
11	Total Suspended Solid (TSS)	10	15	mg/L	Gravimetric Method	-

Comments: Sample was collected & Supplied by client.
N.B: AAS- Atomic Absorption Spectrophotometer, UVS- UV-Visible Spectrophotometer, CRM-Closed Reflex Methods, LOQ - Limit of Quantitation.

Test Performed by:	Signature	Countersigned/Approved by:	Signature
1.) Name: Mahabuba Sabina Motin Designation: Sample Analyzer	Motin 20-05-19	1.) Name: Mita Sarker Designation: Senior Chemist	20/05/19
2.) Name: Md. Saiful Alam Khosru Designation: Sample Analyzer	20.05.19	2.) Name: Md. Biplab Hossain Designation: Chief Chemist	BHossain 20/05/19

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Lab Memo: 1691/ CC, DPHE, CL, Dhaka.

Date: 20-05-2019

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: CEN2019040107	Sample Receiving date: 26-02-2019
Ref. Memo No: 42.06.2626.119.37.001.19-0385 & Dated: 26-02-2019	Sample Source: Suface Water
Sent by:Md. Mustasim Billah ,Project Leader , CEGIS, Gulshan-1, Dhaka-1212.	Dist:Bagerhat, Upa:Rampal
Care Taker: CEGIS (SW-07)	Union:, Vill.:
Sample Collection date:	Date of Testing: 26/02/2019-25/03/2019

LABORATORY TEST RESULTS:

Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Arsenic (As)	0.05	0.003	mg/L	AAS	0.001
2	Cadmium (Cd)	0.005	0.0011	mg/L	AAS	0.00015
3	Calcium (Ca)	75	590	mg/L	AAS	0.17
4	Chemical Oxygen Demand (COD)	4.0	88	mg/L	CRM	-
5	Chloride	150-600	6080	mg/L	Titrimetic	-
6	Silica (Sio2)	0.0	39.7	mg/L	UVS	-
7	Bi-Carbonate (HCO3-)	0.0	135	mg/L	Titrimetic	-
8	Cr (Total)	0.05	0.043	mg/L	AAS	0.0003
9	Hardness	200-500	4400	mg/L	Titrimetic	-
10	Iron (Fe)	0.3-1	8.80	mg/L	AAS	0.05
11	Lead (Pb)	0.05	0.003	mg/L	AAS	0.001
12	Magnesium (Mg)	30-35	210	mg/L	AAS	0.05
13	Nitrogen (Nitrate)	10.0	4.2	mg/L	UVS	0.10
14	Phosphate	6.0	0.20	mg/L	UVS	0.10
15	Potassium (K)	12.0	60	mg/L	AAS	-
16	Sodium (Na)	200	3836	mg/L	AAS	0.34
17	Sulphate	400	768	mg/L	UVS	1.0
18	Total Dissolved Solid (TDS)	1000	10190	mg/L	Multimeter	-
19	Total Suspended Solid (TSS)	10	16	mg/L	Gravimetric Method	-
20	Turbidity	10	228	NTU	Turbidity Meter	-
21	Carbonate (CO3)	-	1.57	mg/L	Titrimetic	-

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Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ

Comments: Sample was collected & Supplied by client.
N.B: AAS- Atomic Absorption Spectrophotometer, UVS- UV-Visible Spectrophotometer, CRM-Closed Reflex Methods, LOQ - Limit of Quantitation.

Test Performed by:	Signature	Countersigned/Approved by:	Signature
1.) Name: Mahabuba Sabina Motin Designation: Sample Analyzer	Wamotin 20-05-19	1.) Name: Mita Sarker Designation: Senior Chemist	20/05/19
2.) Name: Md. Saiful Alam Khosru Designation: Sample Analyzer	20.05.19	2.) Name: Md. Biplab Hossain Designation: Chief Chemist	BHossain 20/05/19

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Lab Memo: 1691/ CC, DPHE, CL, Dhaka.

Date: 20-05-2019

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: CEN2019040108	Sample Receiving date: 26-02-2019
Ref. Memo No: 42.06.2626.119.37.001.19-0385 & Dated: 26-02-2019	Sample Source: Suface Water
Sent by:Md. Mustasim Billah ,Project Leader , CEGIS, Gulshan-1, Dhaka-1212.	Dist:Bagerhat, Upa:Rampal
Care Taker: CEGIS (SW-08)	Union:, Vill.:
Sample Collection date:	Date of Testing: 26/02/2019-25/03/2019

LABORATORY TEST RESULTS:

Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Arsenic (As)	0.05	0.001	mg/L	AAS	0.001
2	Cadmium (Cd)	0.005	0.0017	mg/L	AAS	0.00015
3	Chemical Oxygen Demand (COD)	4.0	36	mg/L	CRM	-
4	Cr (Total)	0.05	0.023	mg/L	AAS	0.0003
5	Hardness	200-500	4300	mg/L	Titrimetic	-
6	Lead (Pb)	0.05	0.004	mg/L	AAS	0.001
7	Nitrogen (Nitrate)	10.0	3.0	mg/L	UVS	0.10
8	Phosphate	6.0	0.20	mg/L	UVS	0.10
9	Sulphate	400	760	mg/L	UVS	1.0
10	Total Dissolved Solid (TDS)	1000	10280	mg/L	Multimeter	-
11	Total Suspended Solid (TSS)	10	13	mg/L	Gravimetric Method	-

Comments: Sample was collected & Supplied by client.
N.B: AAS- Atomic Absorption Spectrophotometer, UVS- UV-Visible Spectrophotometer, CRM-Closed Reflex Methods, LOQ - Limit of Quantitation.

Test Performed by:	Signature	Countersigned/Approved by:	Signature
1.) Name: Mahabuba Sabina Motin Designation: Sample Analyzer	Motin 20-05-19	1.) Name: Mita Sarker Designation: Senior Chemist	20/05/19
2.) Name: Md. Saiful Alam Khosru Designation: Sample Analyzer	20.05.19	2.) Name: Md. Biplab Hossain Designation: Chief Chemist	B Hossain 20/05/19 Md. Biplab Hossain Chief Chemist Department of Public Health Engineer Central Laboratory Mohakhali, Dhak

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Lab Memo: 1691/ CC, DPHE, CL, Dhaka. Date: 20-05-2019

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: CEN2019040109	Sample Receiving date: 26-02-2019
Ref. Memo No: 42.06.2626.119.37.001.19-0385 & Dated: 26-02-2019	Sample Source: Suface Water
Sent by:Md. Mustasim Billah ,Project Leader , CEGIS, Gulshan-1, Dhaka-1212.	Dist:Bagerhat, Upa:Rampal
Care Taker: CEGIS (SW-09)	Union:, Vill.:
Sample Collection date:	Date of Testing: 26/02/2019-25/03/2019

LABORATORY TEST RESULTS:

Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Arsenic (As)	0.05	0.001	mg/L	AAS	0.001
2	Cadmium (Cd)	0.005	0.0010	mg/L	AAS	0.00015
3	Chemical Oxygen Demand (COD)	4.0	68	mg/L	CRM	-
4	Cr (Total)	0.05	0.034	mg/L	AAS	0.0003
5	Hardness	200-500	4600	mg/L	Titrimetic	-
6	Lead (Pb)	0.05	0.006	mg/L	AAS	0.001
7	Nitrogen (Nitrate)	10.0	3.1	mg/L	UVS	0.10
8	Phosphate	6.0	0.37	mg/L	UVS	0.10
9	Sulphate	400	770	mg/L	UVS	1.0
10	Total Dissolved Solid (TDS)	1000	10080	mg/L	Multimeter	-
11	Total Suspended Solid (TSS)	10	14	mg/L	Gravimetric Method	-

Comments: Sample was collected & Supplied by client.
N.B: AAS- Atomic Absorption Spectrophotometer, UVS- UV-Visible Spectrophotometer, CRM-Closed Reflex Methods, LOQ - Limit of Quantitation.

Test Performed by:	Signature	Countersigned/Approved by:	Signature
1.) Name: Mahabuba Sabina Motin Designation: Sample Analyzer	Motin 20-05-19	1.) Name: Mita Sarker Designation: Senior Chemist	20/05/19
2.) Name: Md. Saiful Alam Khosru Designation: Sample Analyzer	20.05.19	2.) Name: Md. Biplab Hossain Designation: Chief Chemist	20/05/19 Md. Biplab Hossain Chief Chemist Department of Public Health Engineering Central Laboratory Mohakhali, Dhaka.

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Lab Memo: 1691/ CC, DPHE, CL, Dhaka. Date: 20-05-2019

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: CEN2019040110	Sample Receiving date: 26-02-2019
Ref. Memo No: 42.06.2626.119.37.001.19-0385 & Dated: 26-02-2019	Sample Source: Suface Water
Sent by:Md. Mustasim Billah ,Project Leader , CEGIS, Gulshan-1, Dhaka-1212.	Dist:Bagerhat, Upa:Rampal
Care Taker: CEGIS (SW-10)	Union:, Vill.:
Sample Collection date:	Date of Testing: 26/02/2019-25/03/2019

LABORATORY TEST RESULTS:

Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Arsenic (As)	0.05	0.002	mg/L	AAS	0.001
2	Cadmium (Cd)	0.005	0.0007	mg/L	AAS	0.00015
3	Chemical Oxygen Demand (COD)	4.0	72	mg/L	CRM	-
4	Cr (Total)	0.05	0.014	mg/L	AAS	0.0003
5	Hardness	200-500	4000	mg/L	Titrimetic	-
6	Lead (Pb)	0.05	0.004	mg/L	AAS	0.001
7	Nitrogen (Nitrate)	10.0	2.1	mg/L	UVS	0.10
8	Phosphate	6.0	0.40	mg/L	UVS	0.10
9	Sulphate	400	758	mg/L	UVS	1.0
10	Total Dissolved Solid (TDS)	1000	10040	mg/L	Multimeter	-
11	Total Suspended Solid (TSS)	10	14	mg/L	Gravimetric Method	-

Comments: Sample was collected & Supplied by client.
N.B: AAS- Atomic Absorption Spectrophotometer, UVS- UV-Visible Spectrophotometer, CRM-Closed Reflex Methods, LOQ - Limit of Quantitation.

Test Performed by:	Signature	Countersigned/Approved by:	Signature
1.) Name: Mahabuba Sabina Motin Designation: Sample Analyzer	Mmotin 20-05-19	1.) Name: Mita Sarker Designation: Senior Chemist	20/05/19
2.) Name: Md. Saiful Alam Khosru Designation: Sample Analyzer	20.05.19	2.) Name: Md. Biplab Hossain Designation: Chief Chemist	20/05/19 Md. Biplab Hossain Chief Chemist Department of Public Health Engineering Central Laboratory Mohakhali, Dhaka.

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Lab Memo: 1691/ CC, DPHE, CL, Dhaka.

Date: 20-05-2019

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: CEN2019040110	Sample Receiving date: 26-02-2019
Ref. Memo No: 42.06.2626.119.37.001.19-0385 & Dated: 26-02-2019	Sample Source: Suface Water
Sent by:Md. Mustasim Billah ,Project Leader , CEGIS, Gulshan-1, Dhaka-1212.	Dist:Bagerhat, Upa:Rampal
Care Taker: CEGIS (SW-10)	Union:, Vill.:
Sample Collection date:	Date of Testing: 26/02/2019-25/03/2019

LABORATORY TEST RESULTS:

Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Arsenic (As)	0.05	0.002	mg/L	AAS	0.001
2	Cadmium (Cd)	0.005	0.0007	mg/L	AAS	0.00015
3	Chemical Oxygen Demand (COD)	4.0	72	mg/L	CRM	-
4	Cr (Total)	0.05	0.014	mg/L	AAS	0.0003
5	Hardness	200-500	4000	mg/L	Titrimetic	-
6	Lead (Pb)	0.05	0.004	mg/L	AAS	0.001
7	Nitrogen (Nitrate)	10.0	2.1	mg/L	UVS	0.10
8	Phosphate	6.0	0.40	mg/L	UVS	0.10
9	Sulphate	400	758	mg/L	UVS	1.0
10	Total Dissolved Solid (TDS)	1000	10040	mg/L	Multimeter	-
11	Total Suspended Solid (TSS)	10	14	mg/L	Gravimetric Method	-

Comments: Sample was collected & Supplied by client.
N.B: AAS- Atomic Absorption Spectrophotometer, UVS- UV-Visible Spectrophotometer, CRM-Closed Reflex Methods, LOQ - Limit of Quantitation.

Test Performed by:	Signature	Countersigned/Approved by:	Signature
1.) Name: Mahabuba Sabina Motin Designation: Sample Analyzer	Mamotin 20-05-19	1.) Name: Mita Sarker Designation: Senior Chemist	20/05/19
2.) Name: Md. Saiful Alam Khosru Designation: Sample Analyzer	20.05.19	2.) Name: Md. Biplab Hossain Designation: Chief Chemist	20/05/19 Md. Biplab Hossain Chief Chemist Department of Public Health Engineering Central Laboratory Mohakhali, Dhaka.

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Lab Memo: 1691/ CC, DPHE, CL, Dhaka.

Date: 20-05-2019

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: CEN2019040112	Sample Receiving date: 26-02-2019
Ref. Memo No: 42.06.2626.119.37.001.19-0385 & Dated: 26-02-2019	Sample Source: Suface Water
Sent by:Md. Mustasim Billah ,Project Leader , CEGIS, Gulshan-1, Dhaka-1212.	Dist:Bagerhat, Upa:Rampal
Care Taker: CEGIS (SW-12)	Union:, Vill.:
Sample Collection date:	Date of Testing: 26/02/2019-25/03/2019

LABORATORY TEST RESULTS:

Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Arsenic (As)	0.05	0.007	mg/L	AAS	0.001
2	Cadmium (Cd)	0.005	0.0012	mg/L	AAS	0.00015
3	Chemical Oxygen Demand (COD)	4.0	32	mg/L	CRM	-
4	Cr (Total)	0.05	0.027	mg/L	AAS	0.0003
5	Hardness	200-500	4000	mg/L	Titrimetic	-
6	Lead (Pb)	0.05	0.007	mg/L	AAS	0.001
7	Nitrogen (Nitrate)	10.0	3.7	mg/L	UVS	0.10
8	Phosphate	6.0	0.29	mg/L	UVS	0.10
9	Sulphate	400	8350	mg/L	UVS	1.0
10	Total Dissolved Solid (TDS)	1000	8350	mg/L	Multimeter	-
11	Total Suspended Solid (TSS)	10	15	mg/L	Gravimetric Method	-

Comments: Sample was collected & Supplied by client.
N.B: AAS- Atomic Absorption Spectrophotometer, UVS- UV-Visible Spectrophotometer, CRM-Closed Reflex Methods, LOQ - Limit of Quantitation.

Test Performed by:	Signature	Countersigned/Approved by:	Signature
1.) Name: Mahabuba Sabina Motin Designation: Sample Analyzer	Motin 20-05-19	1.) Name: Mita Sarker Designation: Senior Chemist	20/05/19
2.) Name: Md. Saiful Alam Khosru Designation: Sample Analyzer	20.05.19	2.) Name: Md. Biplab Hossain Designation: Chief Chemist	B Hossain 20/05/19 Md. Biplab Hossain Chief Chemist Department of Public Health Engineering Central Laboratory Mohakhali, Dhaka.

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Lab Memo: 1691/ CC, DPHE, CL, Dhaka.

Date: 20-05-2019

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: CEN2019040113	Sample Receiving date: 26-02-2019
Ref. Memo No: 42.06.2626.119.37.001.19-0385 & Dated: 26-02-2019	Sample Source: Suface Water
Sent by:Md. Mustasim Billah ,Project Leader , CEGIS, Gulshan-1, Dhaka-1212.	Dist:Bagerhat, Upa:Rampal
Care Taker: CEGIS (SW-13)	Union:, Vill.:
Sample Collection date:	Date of Testing: 26/02/2019-25/03/2019

LABORATORY TEST RESULTS:

Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Arsenic (As)	0.05	0.001	mg/L	AAS	0.001
2	Cadmium (Cd)	0.005	0.0008	mg/L	AAS	0.00015
3	Chemical Oxygen Demand (COD)	4.0	56	mg/L	CRM	-
4	Cr (Total)	0.05	0.022	mg/L	AAS	0.0003
5	Hardness	200-500	4500	mg/L	Titrimetic	-
6	Lead (Pb)	0.05	0.015	mg/L	AAS	0.001
7	Nitrogen (Nitrate)	10.0	4.7	mg/L	UVS	0.10
8	Phosphate	6.0	0.30	mg/L	UVS	0.10
9	Sulphate	400	756	mg/L	UVS	1.0
10	Total Dissolved Solid (TDS)	1000	10950	mg/L	Multimeter	-
11	Total Suspended Solid (TSS)	10	12	mg/L	Gravimetric Method	-

Comments: Sample was collected & Supplied by client.
N.B: AAS- Atomic Absorption Spectrophotometer, UVS- UV-Visible Spectrophotometer, CRM-Closed Reflex Methods, LOQ - Limit of Quantitation.

Test Performed by:	Signature	Countersigned/Approved by:	Signature
1.) Name: Mahabuba Sabina Motin Designation: Sample Analyzer	Motin 20-05-19	1.) Name: Mita Sarker Designation: Senior Chemist	20/05/19
2.) Name: Md. Saiful Alam Khosru Designation: Sample Analyzer	20.05.19	2.) Name: Md. Biplab Hossain Designation: Chief Chemist	B Hossain 20/05/19 Md. Biplab Hossain Chief Chemist Department of Public Health Engineering Central Laboratory Mohakhali, Dhaka.

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Lab Memo: 1691/ CC, DPHE, CL, Dhaka.

Date: 20-05-2019

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: CEN2019040114	Sample Receiving date: 26-02-2019
Ref. Memo No: 42.06.2626.119.37.001.19-0385 & Dated: 26-02-2019	Sample Source: Suface Water
Sent by:Md. Mustasim Billah ,Project Leader , CEGIS, Gulshan-1, Dhaka-1212.	Dist:Bagerhat, Upa:Rampal
Care Taker: CEGIS (SW-14)	Union:, Vill.:
Sample Collection date:	Date of Testing: 26/02/2019-25/03/2019

LABORATORY TEST RESULTS:

Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Arsenic (As)	0.05	0.002	mg/L	AAS	0.001
2	Cadmium (Cd)	0.005	0.0004	mg/L	AAS	0.00015
3	Chemical Oxygen Demand (COD)	4.0	180	mg/L	CRM	-
4	Cr (Total)	0.05	0.039	mg/L	AAS	0.0003
5	Hardness	200-500	5900	mg/L	Titrimetic	-
6	Lead (Pb)	0.05	0.013	mg/L	AAS	0.001
7	Nitrogen (Nitrate)	10.0	1.8	mg/L	UVS	0.10
8	Phosphate	6.0	0.19	mg/L	UVS	0.10
9	Sulphate	400	764	mg/L	UVS	1.0
10	Total Dissolved Solid (TDS)	1000	17200	mg/L	Multimeter	-
11	Total Suspended Solid (TSS)	10	11	mg/L	Gravimetric Method	-

Comments: Sample was collected & Supplied by client.
N.B: AAS- Atomic Absorption Spectrophotometer, UVS- UV-Visible Spectrophotometer, CRM-Closed Reflex Methods, LOQ - Limit of Quantitation.

Test Performed by:	Signature	Countersigned/Approved by:	Signature
1.) Name: Mahabuba Sabina Motin Designation: Sample Analyzer	Umotin 20-05-19	1.) Name: Mita Sarker Designation: Senior Chemist	20/05/19
2.) Name: Md. Saiful Alam Khosru Designation: Sample Analyzer	20.05.19	2.) Name: Md. Biplab Hossain Designation: Chief Chemist	BHossain 20/05/19

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Lab Memo: 1691/ CC, DPHE, CL, Dhaka.

Date: 20-05-2019

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: CEN2019040115	Sample Receiving date: 26-02-2019
Ref. Memo No: 42.06.2626.119.37.001.19-0385 & Dated: 26-02-2019	Sample Source: Suface Water
Sent by:Md. Mustasim Billah ,Project Leader , CEGIS, Gulshan-1, Dhaka-1212.	Dist:Bagerhat, Upa:Rampal
Care Taker: CEGIS (SW-15)	Union:, Vill.:
Sample Collection date:	Date of Testing: 26/02/2019-25/03/2019

LABORATORY TEST RESULTS:

Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Arsenic (As)	0.05	0.001	mg/L	AAS	0.001
2	Cadmium (Cd)	0.005	0.0008	mg/L	AAS	0.00015
3	Chemical Oxygen Demand (COD)	4.0	140	mg/L	CRM	-
4	Cr (Total)	0.05	0.024	mg/L	AAS	0.0003
5	Hardness	200-500	6900	mg/L	Titrimetic	-
6	Lead (Pb)	0.05	0.017	mg/L	AAS	0.001
7	Nitrogen (Nitrate)	10.0	2.6	mg/L	UVS	0.10
8	Phosphate	6.0	0.18	mg/L	UVS	0.10
9	Sulphate	400	769	mg/L	UVS	1.0
10	Total Dissolved Solid (TDS)	1000	21110	mg/L	Multimeter	-
11	Total Suspended Solid (TSS)	10	9	mg/L	Gravimetric Method	-

Comments: Sample was collected & Supplied by client.
N.B: AAS- Atomic Absorption Spectrophotometer, UVS- UV-Visible Spectrophotometer, CRM-Closed Reflex Methods, LOQ - Limit of Quantitation.

Test Performed by:	Signature	Countersigned/Approved by:	Signature
1.) Name: Mahabuba Sabina Motin Designation: Sample Analyzer	Mmotin 20-05-19	1.) Name: Mita Sarker Designation: Senior Chemist	20/05/19
2.) Name: Md. Saiful Alam Khosru Designation: Sample Analyzer	20.05.19	2.) Name: Md. Biplab Hossain Designation: Chief Chemist	BHossain 20/05/19 Md. Biplab Hossain Chief Chemist Department of Public Health Engineering Central Laboratory Mohakhali, Dhaka.

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Lab Memo: 1691/ CC, DPHE, CL, Dhaka.

Date: 20-05-2019

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: CEN2019040116	Sample Receiving date: 26-02-2019
Ref. Memo No: 42.06.2626.119.37.001.19-0385 & Dated: 26-02-2019	Sample Source: Tube Well
Sent by:Md. Mustasim Billah ,Project Leader , CEGIS, Gulshan-1, Dhaka-1212.	Dist:Bagerhat, Upa:Rampal
Care Taker: CEGIS (GW-01)	Union:, Vill.:Township area
Sample Collection date:	Date of Testing: 26/02/2019-25/03/2019

LABORATORY TEST RESULTS:

Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Arsenic (As)	0.05	0.012	mg/L	AAS	0.001
2	Chemical Oxygen Demand (COD)	4.0	4	mg/L	CRM	-
3	Hardness	200-500	355	mg/L	Titrimetic	-
4	Lead (Pb)	0.05	0.008	mg/L	AAS	0.001
5	Nitrogen (Nitrate)	10.0	1.7	mg/L	UVS	0.10
6	Phosphate	6.0	2.1	mg/L	UVS	0.10
7	Sulphate	400	1	mg/L	UVS	1.0
8	Total Dissolved Solid (TDS)	1000	1315	mg/L	Multimeter	-
9	Total Suspended Solid (TSS)	10	3	mg/L	Gravimetric Method	-

Comments: Sample was collected & Supplied by client.
N.B: AAS- Atomic Absorption Spectrophotometer, UVS- UV-Visible Spectrophotometer, CRM-Closed Reflex Methods, LOQ - Limit of Quantitation.

Test Performed by:	Signature	Countersigned/Approved by:	Signature
1.) Name: Mahabuba Sabina Motin Designation: Sample Analyzer	Mmotin 20-05-19	1.) Name: Mita Sarker Designation: Senior Chemist	20/05/19
2.) Name: Md. Saiful Alam Khosru Designation: Sample Analyzer	20.05.19	2.) Name: Md. Biplab Hossain Designation: Chief Chemist	B Hossain 20/05/19 Md. Biplab Hossain Chief Chemist Department of Public Health Engineering Central Laboratory Mohakhali, Dhaka

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Lab Memo: 1691/ CC, DPHE, CL, Dhaka.

Date: 20-05-2019

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: CEN2019040117	Sample Receiving date: 26-02-2019
Ref. Memo No: 42.06.2626.119.37.001.19-0385 & Dated: 26-02-2019	Sample Source: Tube Well
Sent by:Md. Mustasim Billah ,Project Leader , CEGIS, Gulshan-1, Dhaka-1212.	Dist:Bagerhat, Upa:Rampal
Care Taker: CEGIS (GW-02)	Union:, Vill.:Karpasdanga
Sample Collection date:	Date of Testing: 26/02/2019-25/03/2019

LABORATORY TEST RESULTS:

Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Arsenic (As)	0.05	0.034	mg/L	AAS	0.001
2	Chemical Oxygen Demand (COD)	4.0	4	mg/L	CRM	-
3	Hardness	200-500	270	mg/L	Titrimetic	-
4	Lead (Pb)	0.05	0.004	mg/L	AAS	0.001
5	Nitrogen (Nitrate)	10.0	2.1	mg/L	UVS	0.10
6	Phosphate	6.0	3.6	mg/L	UVS	0.10
7	Sulphate	400	1	mg/L	UVS	1.0
8	Total Dissolved Solid (TDS)	1000	927	mg/L	Multimeter	-
9	Total Suspended Solid (TSS)	10	4	mg/L	Gravimetric Method	-

Comments: Sample was collected & Supplied by client.
N.B: AAS- Atomic Absorption Spectrophotometer, UVS- UV-Visible Spectrophotometer, CRM-Closed Reflex Methods, LOQ - Limit of Quantitation.

Test Performed by:	Signature	Countersigned/Approved by:	Signature
1.) Name: Mahabuba Sabina Motin Designation: Sample Analyzer	MMotin 20-05-19	1.) Name: Mita Sarker Designation: Senior Chemist	20/05/19
2.) Name: Md. Saiful Alam Khosru Designation: Sample Analyzer	20.05.19	2.) Name: Md. Biplab Hossain Designation: Chief Chemist	B Hossain 20/05/19 Md. Biplab Hossain Chief Chemist Department of Public Health Engineering Central Laboratory Mohakhali, Dhaka.

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Lab Memo: 1691/ CC, DPHE, CL, Dhaka.

Date: 20-05-2019

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: CEN2019040118	Sample Receiving date: 26-02-2019
Ref. Memo No: 42.06.2626.119.37.001.19-0385 & Dated: 26-02-2019	Sample Source: Tube Well
Sent by:Md. Mustasim Billah ,Project Leader , CEGIS, Gulshan-1, Dhaka-1212.	Dist:Bagerhat, Upa:Rampal
Care Taker: CEGIS (GW-03)	Union:, Vill.:Rajnagar
Sample Collection date:	Date of Testing: 26/02/2019-25/03/2019

LABORATORY TEST RESULTS:

Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Arsenic (As)	0.05	0.002	mg/L	AAS	0.001
2	Chemical Oxygen Demand (COD)	4.0	4	mg/L	CRM	-
3	Hardness	200-500	215	mg/L	Titrimetic	-
4	Lead (Pb)	0.05	0.003	mg/L	AAS	0.001
5	Nitrogen (Nitrate)	10.0	4.4	mg/L	UVS	0.10
6	Phosphate	6.0	1.25	mg/L	UVS	0.10
7	Sulphate	400	2	mg/L	UVS	1.0
8	Total Dissolved Solid (TDS)	1000	376	mg/L	Multimeter	-
9	Total Suspended Solid (TSS)	10	3	mg/L	Gravimetric Method	-

Comments: Sample was collected & Supplied by client.
N.B: AAS- Atomic Absorption Spectrophotometer, UVS- UV-Visible Spectrophotometer, CRM-Closed Reflex Methods, LOQ - Limit of Quantitation.

Test Performed by:	Signature	Countersigned/Approved by:	Signature
1.) Name: Mahabuba Sabina Motin Designation: Sample Analyzer	Mmotin 20-05-19	1.) Name: Mita Sarker Designation: Senior Chemist	20/05/19
2.) Name: Md. Saiful Alam Khosru Designation: Sample Analyzer	20.05.19	2.) Name: Md. Biplab Hossain Designation: Chief Chemist	20/05/19 Md. Biplab Hossain Chief Chemist Department of Public Health Engineering Central Laboratory Mohakhali, Dhaka.

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