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

18th Quarter Monitoring Report

Monitoring Period: August - October 2018

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Abbreviations and Acronyms

AAS	Atomic Absorption Spectrophotometer
AECL	Adroit Environment Consultants Ltd
As, Pb, Hg	Arsenic, Lead and Mercury
BCSIR	Bangladesh Council of Scientific and Industrial Research
BDS	Business Development 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 Environmental and Social Monitoring Report of 18th quarterly monitoring program covers the status of different environmental and social parameters about the Environmental Management Plan and of the construction stage as stated 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 November 2018 covering every monitoring aspects as stated in the EIA study, approved 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 implementation status of Environmental Compliance with the environmental parameters such as ambient air quality, noise level, water quality, land resource condition, traffic management, water resources management, morphology, agricultural resources monitoring, fisheries resources, social environment monitoring, ecosystem monitoring and the Sundarbans Reserve Forest (SRF) health monitoring.

The progress of Project implementation activities includes extension of roads, site development at jetty area, construction of township area, labour colony, civil and infrastructure development works and initiation of mechanical construction etc. In this quarter, the environmental due diligence covers: the Environmental Management System and Action Plan, Occupational Health and Safety, Workers' wellbeing, Biodiversity and Sustainable Management of Natural Resources etc. The monitoring team observed that, the BIFPCL is mostly complying with the EMP as suggested in the EIA report of the Power Plant as well as in coal transportation report. However, 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.

Those include raising awareness among the workers for using appropriate PPEs, recreation and praying facilities for the labours, proper implementation for the grievance redress mechanism for workers or local community, placement of sufficient waste disposal bins in appropriate locations and most important continuous occupational and health safety monitoring by the project proponent.

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

All the preselected parameters i.e. particulate matters ($PM_{2.5}$, PM_{10} and SPM), O_3, CO, SOx and NOx were measured at all the preselected locations during this monitoring. However, the measured values of all parameters for every location were found within the standard limit set by ECR' 2005 (amended). No significant changes were observed among the concentrations of the air pollutants in any locations. It can also be noted that, among all locations, the concentration of major air quality parameters have been found higher at Khan Jahan Ali Bridge area in all seasons and is lower in Sundarbans area. However, according to the measured values it can be easily said that, the present air shed is not a degraded air shed and the observed pollution sources were the movement of numerous types of vehicles on roads (two-stroke human haulers, buses, trucks etc.), land development works, brickworks, refineries, cement works, wood stoves and wind generated dust.

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 nine locations during this (18^{th} quarter) monitoring season (**Table 2.4**). On the other hand, the observed noise levels at North West corner (Koigar Daskati) and South West corner (Moidara) of the Project area were found to exceed the Bangladesh standard limit of their corresponding standard values. In course of the total eighteen monitoring locations , the noise level of eight locations were found to exceed the Bangladesh standard limit of their corresponding standard values in their different monitoring seasons (Table 2.4). The eight locations were NW corner of the Project area (Oct-2016, Nov-2018), Chunkuri-2 (Mar-2014 & Jan-2017), SW corner of the Project area (Jan-2016, July-2016 & Nov-2018), Proposed Township area (July-2016), Khan Jahan Ali Bridge (Mar-2014), Harbaria (July-2014, Oct-2014, Apr-2015, Oct-15, July-2016, Oct-2016, Apr-2017, July-2018), Akram Point of Sundarbans (Apr-2015) and Hiron point of Sundarbans (July-2014). However, any additional anthropogenic noise producing activities within the study area may contribute to enhance the noise level.

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

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In this 18^{th} quarter (Post-monsoon 2018), only salinity was recorded comparatively higher but still under the recommended value of ECR'1997. The main issue was the higher salinity than any other post-monsoon seasons over the whole monitoring scheme. On the other hand, pH, Temperature and DO level was somewhat good at the project site. Huge construction activities and land filling near the bank side slightly reduces DO level sometimes for a while of that portion of the river.

In the 17^{th} quarterly (Monsoon, 2018) monitoring, TD, TH and TSS were not found increased in respect to the same seasons of last four consecutive years. COD was good in all the stations except the project site during the last monsoon. Nitrate (NO_3^-) and sulphate (SO_4^{2-}) reduced a lot due to freshwater availability during monsoon period. Phosphate (PO_4^{3-}) concentration become an issue under the Standard of Inland Surface Water Quality (0.05 mg/L). It was also found that rather than construction activities PO_4^{3-} was coming from the agricultural practices, surface run-off from upstream and plankton decay in the river itself. 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 5 mg/L, which is even less than half of the recommended concentration (10 mg/L) for Inland Surface Water.

On the other hand, in course of groundwater quality monitoring, the concluding remark only represents the status of monsoon season of the monitoring scheme. It has been observed that the physical characteristics of groundwater quality is still in good condition and in acceptable state for drinking purpose. In addition, dissolved and solid quantities of the water are also found very low than the highest recommended limit for Bangladesh. Only, chemical oxygen demand during 2014 and 2015 was higher than ECR, 1997. Other nutrients like nitrate, sulphate and phosphate met the Bangladesh demand completely together with the metals of arsenic, lead and mercury.

Soil salinity and pH govern the increase and decrease of other parameters. The soil salinity increased in all sampling plots except in Kapalirmet. There is no major change in organic matter pole in the sampling sites. In major nutrients N and P follows organic matter's trend while S showed increasing trend. Among the Micronutrients Zn showed increasing trend. Heavy metal concentrations is found in all cases but their concentrations are still well below the concern. Most of the elements showed increasing trend than those of in wet season due to less washout rainfall and less top soil erosion. It is to be noted that, all such changes are for natural reasons*.*

Traffic surveys were carried out at three preselected locations namely Gonabelai, Gachtala and Gonai Bridge around the Project site to understand the nature of traffic flow and traffic load during different phase of the day. The analysis data represents that the Khulna-Mongla Highway receives the 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 results in a limited number of vehicular movements on the surrounding road network.

To assess the riverbank erosion and accretion, time series satellite images were used, processed and analyzed in order to identify the locations of erosion and accretions as well as the shifting of bankline in half-yearly period. For such need the Sentinel-1 Radarsat satellite images having 10m resolution covering the Passur River from Chalna to Hiron Point for the month of January 2018 and June 2018 were collected. For monitoring the half-yearly riverbank erosion and accretion at the project site, Mongla, Harbaria and Akram point areas, banklines of the Passur River were superimposed with each other. It was found that the river is very stable and there is hardly any riverbank erosion or accretion as the river has not shifted from January 2018 to June 2018 as indicating the analyzed images.

Fisheries resources have been monitored at the same locations for seven sampling sites as of earlier quarter monitoring. The following are the key findings of the 18th quarter in the year of 2018-19: Habitat uses are observed to be changed yearly (as compared to the year of 2014-2015, of 2015-2016, of 2017-18 and of 2018-19) caused mainly due to biophysical changes having tidal effect, seasonal variability, food availability and also fisheries resource management practices. Moreover, through analyzing the type of habitat uses by different ages of different fish species (based on the length-based community structure model) such two types of habitats have been found as the i) Ground for Maturation and ii) Omni-Ground comprising major other two habitat types (a) Nursery and Feeding Ground/Migratory Route and (b) Ground for Maturation of fry and juvenile fishes and iv) Omni-ground. Shannon-Weiner index has also been observed to vary between 18th quarter with that of all previous quarter. Highest Shannon-Weiner index was found at Haldikhali Khal (0.92 out of 2 species) indicating most evenly distributed fish species. On the contrary, lowest evenness was found at Sheola Khal in Chandpai (0.34 out of 19 species). However, maximum FSR was obtained in Maidara River (n=9), while very low FSR was recorded at Akram Point (n=1). Fries of fin fish were widely distributed from middle stretches to the upper stretches (Harbaria to Chalna Point) and juveniles and adult age group in Sheola Khal at Chandpai, Maidara and Chalna Point of the Passur River system. Among the fishes Bairagi, Banspata, Bele, Chela, Gagra Tengra, etc. were more between the two sampling sites. Moreover, fries were dominant at the Maidara and Chalna-Passur Confluence. Adults of large-sized fishes were observed at Chalna and Akram Point in this quarter monitoring. Fish species like Bairagi (Amadi Chela) attains the maximum abundance among the migratory fish species observed in the 18th quarter of monitoring year, 2018-19. Moreover, Poma and Golda species were found in maximum sampling sites. Among migratory species, Tular Dandi and Paissa were observed to migrate long distance. In this monitoring year, the highest stocking rate in respect of Bagda was observed in case of gher in Kapashdanga and No stocking was reported in case of Rajnagar and Chunkuri-2. The present study revealed that the highest catch susceptibility was also found in case of Behundi Jal (6 kg/haul). Ber Jals were most frequently used in all upper and middle reaches in the Passur River System, especially for collecting Hilsa, Poma, etc. Hooks were frequently used in the downstream of the Passur River System. The highest catch was observed at Akram Point and lowest at Chalna Point in the Passure in this monitoring phase.

Vegetation composition, plant diversity, vegetation canopy status, plant health, dolphin and zooplanktons occurrence in river systems have been monitored for this monitoring season. A total of 44 tree species were recorded from all the monitoring sites with Shanon-Winner diversity index of 2.74. Canopy status of two studied homestead vegetation has been slightly reduced due to felling of dominated trees and improved in another two sites for expansion of foliage boundary of newly recruited tree from sapling stage. Plant health has improved in most of the locations.

Dolphin occurrence was recorded at Passur and Maidara River and in some connected tributaries of Passur River like Shella Gang, Dhangmari and Bhadra Khal. The occurrence followed high at Bhadra Khal and then Shella Gang. Improve habitat suitability by banning all fishing activities both Shella and Bhadra Khal are the cause of increasing dolphin occurrences of two above mentioned canals. *Copipod* and *Daphnia* are common zooplankton observed most of the places of Passur River.

From last observation, it can be said that in terms of seedling density, pneumatophores, crab hole, canopy cover and leaf area index the forest condition is showing positive changes periodically, although there has some seasonal effect. Based on different indicators it is found that the health condition at Harbaria and Sutarkhali is good. Other sites are almost same condition. Moreover, tree mortality and top dying of Sundari was lower in all monitoring plot. From the last monitoring, it can be said that illicit felling of Karamjol is reduced comparatively over time. In addition, Hiron point is severely affected by different plastic waste. The complex species Sundari have been dying in a part of Akram point and Koromjol plot.

On the other hand, there was no significant change observed during the last visit at Harbaria point. Among the species, the height of Sundari is comparatively more in Harbaria. Goran species are dominant in some part of Hiron point and Akram point. In terms of biomass and carbon stock, Sundari provides the best carbon stock in Sundarban. Among the observed plots, Sutarkhali and Harbaria point have highest biomass and carbon stock. The forest is subjected to bank erosion. It is to be noted here that the potential anchorage point for coal transhipment of the proposed power plant project is situated in the periphery of this area. So, there is a possibility of disturbance into the ecosystem on natural succession. The monitoring should be continued to know the dynamics of mangrove attributes which are very much interlinked with each other as well as with the environment.

The work of construction phase is continued with the engagement of almost all types of construction subcontractors. About 3800 employees and labors were engaged for the ongoing construction activities. 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.

Improved accommodation, drinking water, kitchen, sanitation and recreational facilities have been observed in some of the labor shed but there is a controversy among the labors and representative of proponent over the availability of sufficient drinking water especially during summer and its quality. Already two medical units are working in the project. One is from the proponent side and the other is from EPC contractor side. Although labors are by now familiar and habituated with the use of PPEs during working in the field, but due to carelessness of the labors one death casualties have been documented during field survey.

For reducing dust inside the Plant site, about 68,750 plants/fruit/medicinal trees are already planted in and around the project site. The BIFPCL medical camp (that had been established as CSR) has performed well to provide medical service in the study area. About 3,069 patient received health treatments over last three months (August, 2018 to October, 2018). In addition, medical unit of EPC contractor also performed well by providing necessary emergency support including an 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 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. It is also to be noted that, successful implementation of the EMP depends on regular monitoring of the selective indicators at the specified locations.

An independent environmental monitoring team was suggested as mandatory in the EIA report as mentioned in the Power Plant EIA approval condition no. 32 and Coal Transportation EIA approval condition no. 17 by DOE for monitoring the Project related activities considering the sustainability of the ecosystem of the study area particularly for the Sundarbans Reserve Forest area. It has also been recommended that the environmental monitoring officer/agency should monitor the EMP implementation and submit a quarterly report to the concerned Department.

In this context, BIFPCL initiated the study to monitor the environmental and social indicators and the implementation status of EMP (Environmental Management Plan) during pre-construction as well as construction phase of the Thermal Power Plant. As per approval of the EIA study of Coal Transportation from DOE Condition No. 26, “Additional environmental baseline data to be collected as suggested in the EIA report”. Subsequently, CEGIS was engaged for conducting the monitoring activities to inspect 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 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 is presented in **Figure 1.2.**

According to the contract, the findings of the previously formulated seventeen (17) quarterly monitoring reports have been submitted to BIFPCL. Subsequently the reports were sent to the DoE and Forest Department. In addition, all the monitoring reports were regularly uploaded in BIFPCL website. The current document constitutes the 18th quarterly monitoring aspects covering all the preselected monitoring parameters and locations, which helped in improving and further upgrading the environmental monitoring database until today.

1.2 Objectives

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

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

1.3 Criteria for Selection of Monitoring sites/locations

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

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

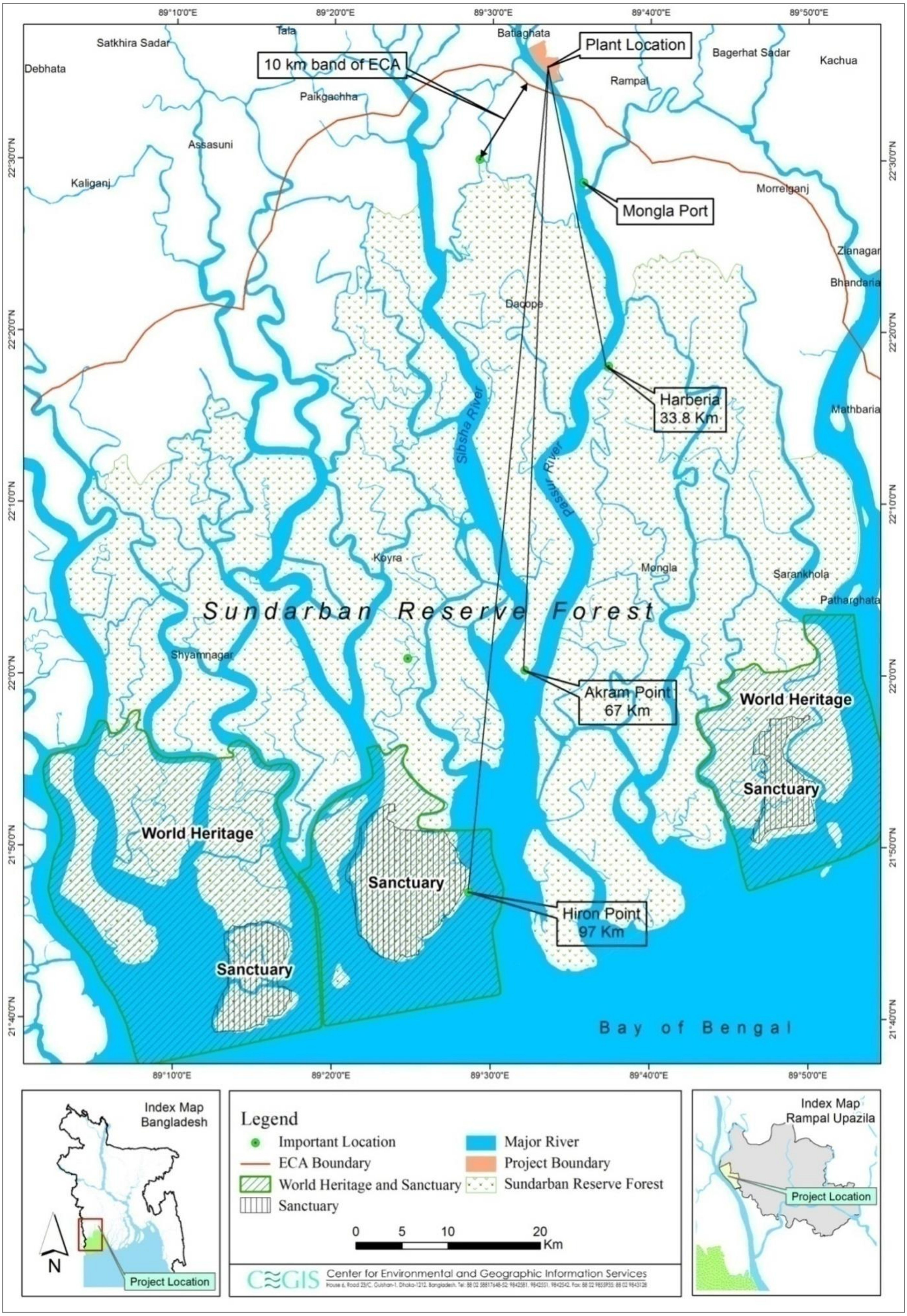


Figure 1.1: Location Map of the Study Area

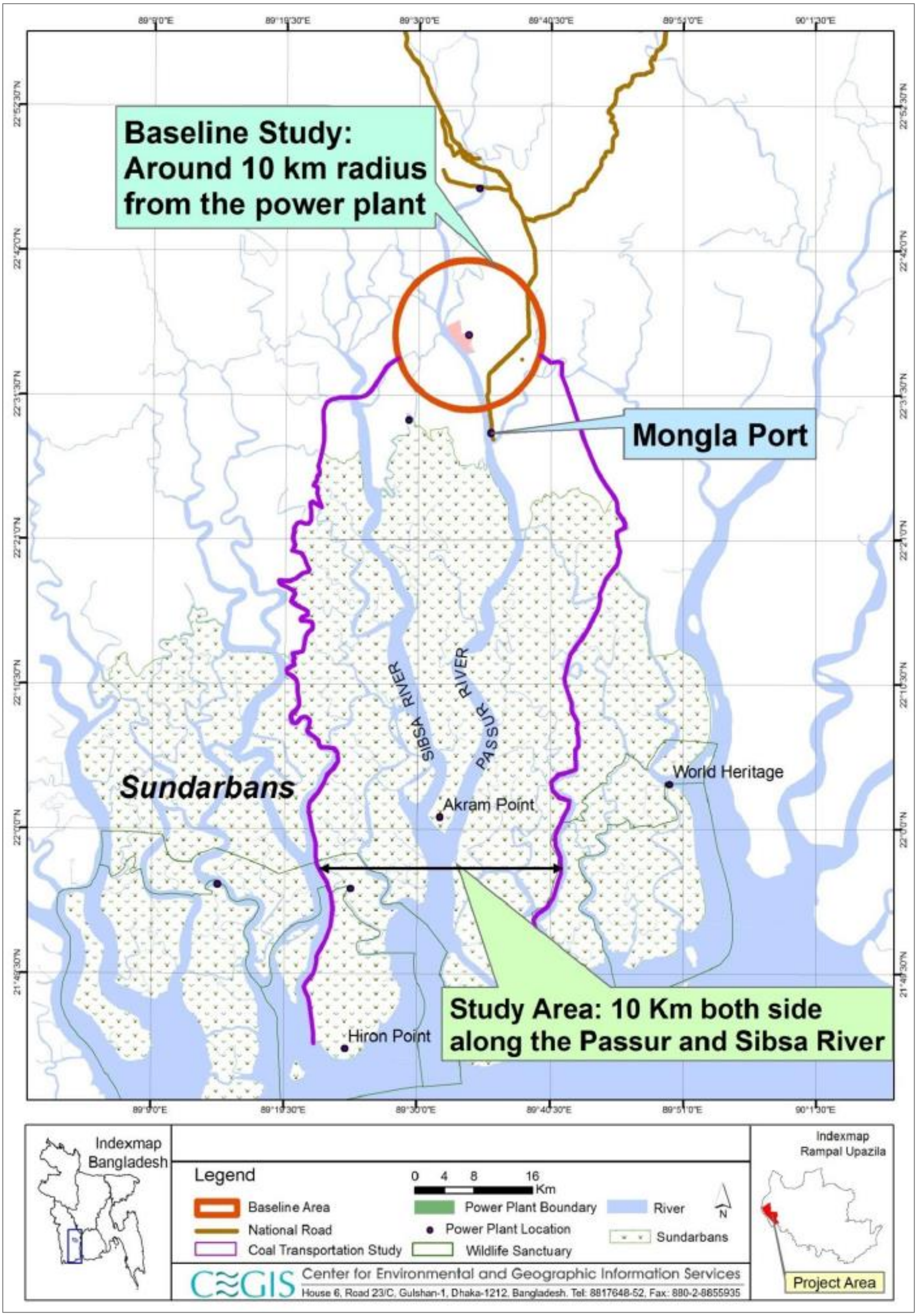


Figure 1.2: AOI of Environmental and Socio-economic Monitoring

1.4 Main stakeholders

1.4.1 Forest Department

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

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

The monitoring team was formed as per requirements of the Forest Department. BIFPCL also forwarded each copy of the earlier quarterly monitoring reports to the Chief Conservator of Forest, Bangladesh Forest Department, Agargaon, Dhaka and Conservator of Forest, Khulna Circle, Boyra, Khulna. Similarly, the report of 18th quarterly monitoring will also be forwarded to the same officials of this Department.

1.4.2 Department of Environment (DoE)

The monitoring plan, including indicators, parameters, location and schedule, have been prepared incorporating the suggestion(s) of the Department of Environment. A discussion meeting was conducted at CEGIS office 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 regularly. 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 included 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 implementing the Environmental Management Plan (EMP) accordingly for ensuring environmental and social safeguarding of the Project.

1.4.4 Bangladesh Power Development Board (BPDB)

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

Thermal Power Plant. Moreover, BPDB i.e. in this season 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

The air quality during this monitoring period in November 2018 was monitored at the preselected sites considering the major effects to be borne by the Project activities during pre-construction, construction and operation stages.

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 Power Plant activities. The monitoring locations as well as the indicators were selected during the EIA study based on a number of criteria e.g., the sensitivity of the receptors, project activities like coal-carrying vessel movement, trans-shipment point; wind speed, wind direction and atmospheric deposition (Wet and Dry) and atmospheric stability class. A comprehensive discussion on the recently assessed air quality has been reported in the following sections. It is also to be noted that, the air quality was monitored for eight (8) hours period at all the monitoring sites.

2.3 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 in this season 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 conditions of air quality during this quarter has also been monitored in the same locations as monitored in earlier quarters. In addition, two more locations were also included in the monitoring program as per recommendation of the DOE approved coal transportation study monitoring frame work. 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 Akram point, 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		

Sl. No.	Monitoring Indicators	Locations	GPS Points	Frequency	Methods/ Tools/ Techniques
10		Hiron Point, Sundarbans	89˚27'53.2"E; 21˚46'27.60"N		
11		Khulna city near Khan Jahan Ali Bridge	89˚35'35.5"E; 22˚46'36.8"N		
12		Project site-1 (Proposed Township area)	89º 33´ 13.7"E 22º35´43"N		
13		Access road bridge area	89°35'16.49"E2 2°34'37.11"N		

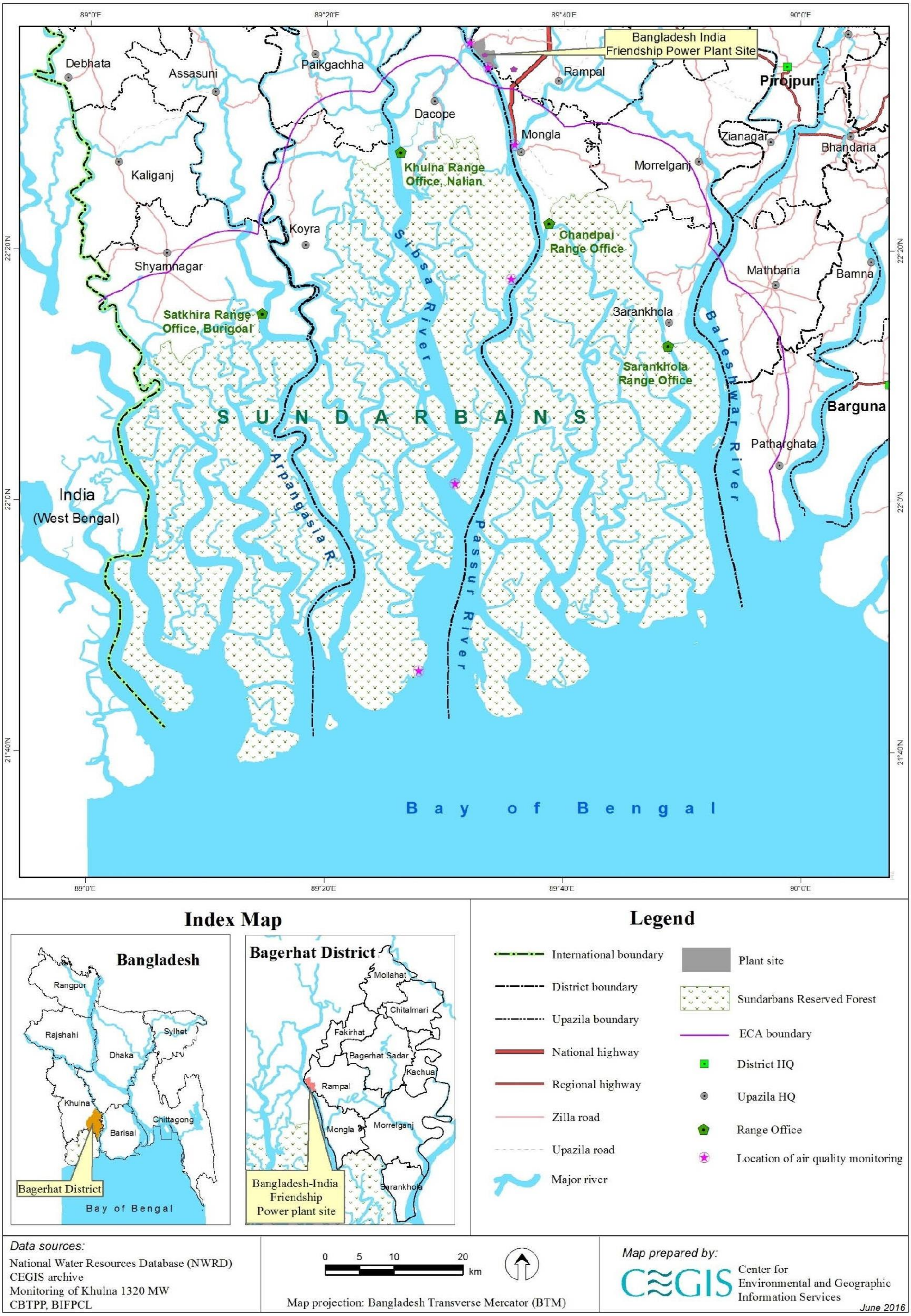


Figure 2.2: Air Quality Monitoring Locations

2.6 Status of air quality

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

Table 2.2: Air Pollutants Emission Standards

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

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

The maximum value (40.9 µg/m^3) of $PM_{2.5}$ was obtained at the access road bridge area whereas the minimum value (15.4 µg/m^3) was recorded at Gaurambha. All the values for the corresponding sites during this season were found within the standard limit (65 µg/m^3) set by ECR, 2005. Similar situation was observed in case of PM_{10} concentrations and was found highest (128.3 µg/m^3) at the access road bridge area while lowest (50.1 µg/m^3) at the Gaurambha area. However, all the results of PM_{10} for every location were found within the standard limit too. In general, the measured values were found lower than the previously monitored results in the same seasons of the previous years. From the measured values it can be mentioned that, seasonal variation is the main reason of increasing and decreasing of the concentration of the particulate matter concentration. However, major sources of particulate matter as observed were the construction works, land development works of block –B, unpaved roads and vehicle movement in and around the project area. Other sources, which may contribute to the existing pollution sources, are the small industries like i.e. brick kilns, refineries, cement works, etc., diffuse sources like wood stoves, fires, and wind generated dust etc.

Similarly, the concentration of SPM was found higher at the at Access road bridge area (177.8 µg/m^3 for 8 hours monitoring period and 130.72 µg/m^3 calculating for 24 hours measuring period) and whereas, the minimum concentration was observed at Harbaria area of Sundarbans Forest (90.3 µg/m^3). All 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 during this monitoring period were found much lower than the Bangladesh standard limit of (365 µg/m^3) at all the sampling locations. Maximum concentration (13.4 µg/m^3) was found at Koigordashkatir Char area while minimum concentration (8.7 µg/m^3) was found at Khan Jahan Ali Bridge area. 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 poset 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 (16.8 µg/m^3) during this monitoring period was found at Koigardshkatir Char area whereas the lowest (9.7 µg/m^3) was recorded at Khan Jahan Ali Bridge area. The monitoring results are shown in **Table A1** in **Appendix IV**. However, emission from local human hauler, car, bus and industries like brickworks, refineries, cement works, iron and steel making, etc. are currently contributing to the concentration of NOx in this area (**Figure 2.3**).

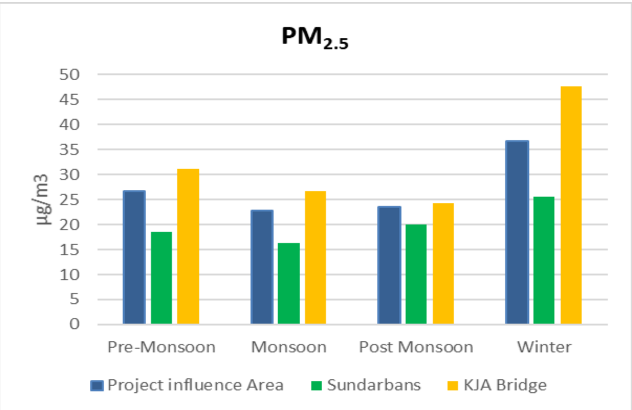
Carbon Monoxide (CO)

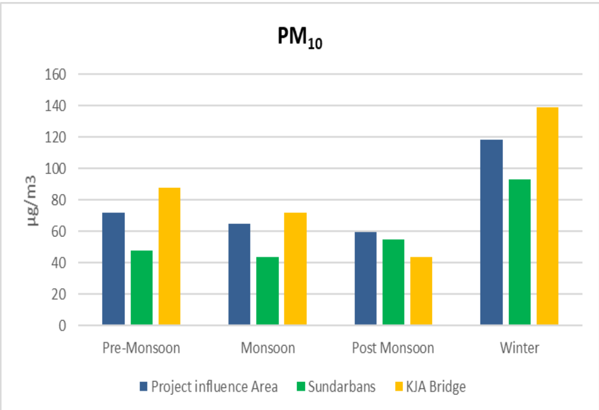
CO is generally produced due to the incomplete combustion of fossil fuel. The concentration of CO in the monitored locations were found much lower than the standard values set in ECR’2005. The maximum value was observed as 33 µg/m^3 at Mongla port area and 20 µg/m^3 at Gaurambha, Harbaria in this season and Akram point of Sundarbans area respectively. The possible reasons for such CO concentration would be due to the movement of various types of vehicles across the Passur River and its adjoining areas (**Figure 2.3**).

Ozone (O_3)

Similarly, results of O_3 in both the Sundarbans Forest Area and Project area were found within the range of 9-2 µg/m^3, which are negligible comparing to the Bangladesh standards limits of 157 µg/m^3. In this 18^{th} quarterly monitoring study, the maximum concentration (9 µg/m^3) was found at Gaurambha area (**Figure 2.3**).

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





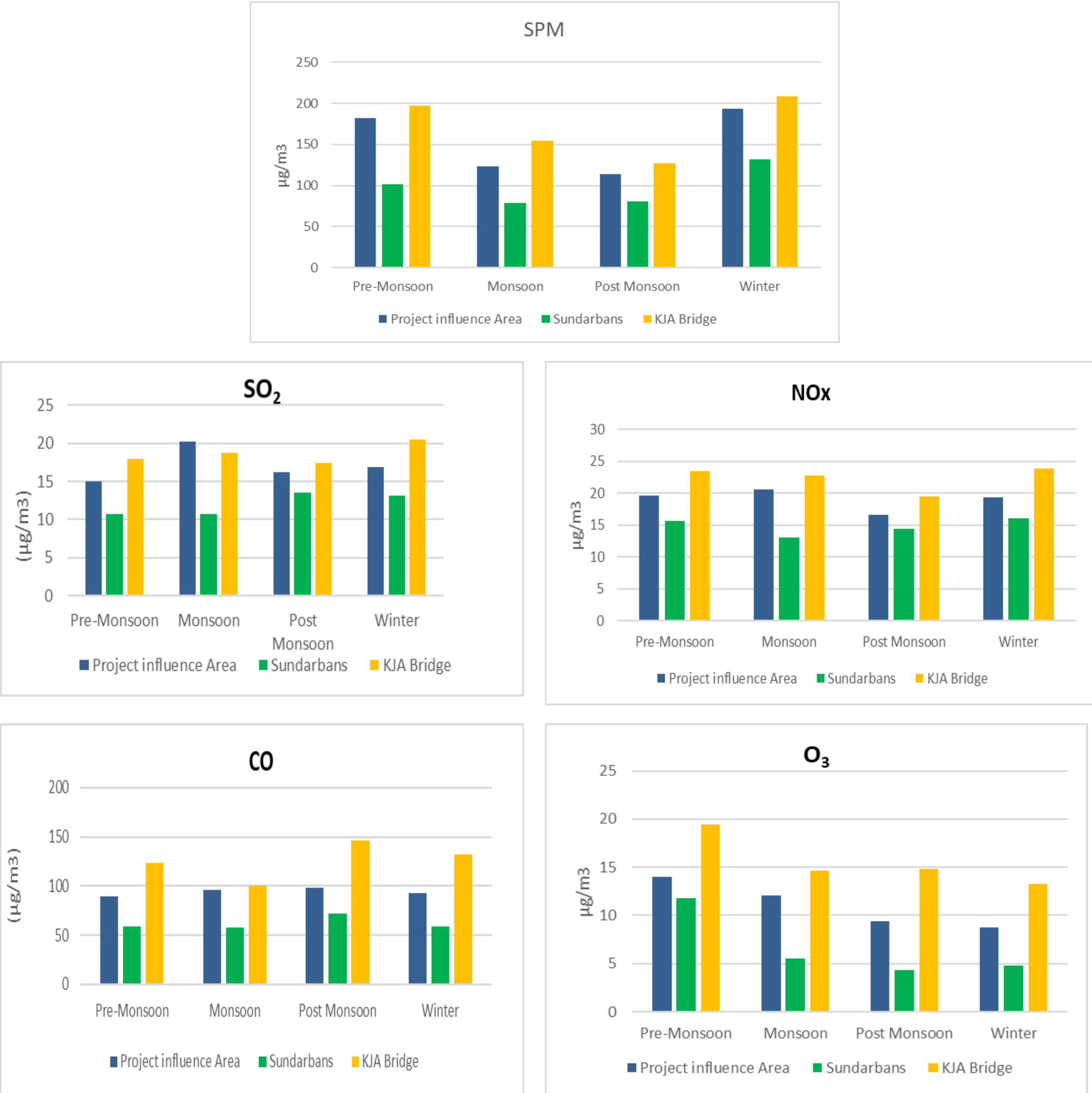


Figure 2.3: Seasonal variation of the Air Quality Parameters

2.6.1 Findings

All the preselected parameters i.e. particulate matters ($PM_{2.5}$, PM_{10} and SPM), O_3, CO, SOx and NOx were measured at all the preselected locations during this monitoring. However, the measured values of all parameters for every location were found within the standard limit set by ECR’ 2005 (amended). No significant changes were observed among the concentrations of the air pollutants in any locations. It can also be noted that, the concentration of major air parameters has been found higher at Khan Jahan Ali Bridge area in all seasons among all 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 air shed and to the observed pollution sources were the movement of numerous types of vehicles on roads (two-stroke human haulers, buses, trucks etc.), land development works, brickworks, refineries, cement works, wood stoves and wind generated dust.

2.7 Noise Quality

Among the sources of noise generation, the urban and rural vehicles i.e. 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 during this monitoring season (**18th** monitoring program). Generally, the level of noise is monitored at eleven locations during every monitoring season. In this season each of the location was monitored too.

2.7.1 Methodology

Noise levels were measured thrice in a day (morning, afternoon and evening) at eleven (11) 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. On the other hand, the monitoring locations were selected considering the sensitivity of the nearest receptors and accordingly, six sites were selected in and around the Project area, 3 (three) sites were designated inside the Sundarbans Reserve Forest Area, one at Mongla Ghat area and the remaining one was selected at the Khan Jahan Ali Bridge toll plaza area (**Figure 2.5**)

Figure 2.4: Ambient Noise Acquisition in 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 (**Table 2.3**).

Table 2.3: Noise Monitoring Plan

SL.No.	Date	Monitoring locations	GPS points	Time of noise monitoring
1	Nov 21, 2018	South West corner of the Project boundary	89°33'34.5"E 22°34'33.8"N	Morning, Noon and evening
2	Nov 22, 2018	Proposed township area near Chimney location, Mauza: Sapmari Katakhali	89°32'3.8"E 22°36'32.5"N	Morning, Noon and evening
3	Nov 23, 2018	North West corner of the Project boundary (Kaigar Daskati)	89°33'51.8"E 22°36'1.06"N	Morning, Noon and evening
4	Nov 24, 2018	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	Nov 25, 2018	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	Nov 26, 2018	Pankhali, Dacope, (4km North West from the Chimney location)	89°31'24.2"E 22°36'6.7"N	Morning, Noon and evening
7	Nov 27, 2018	Mongla Port Area	89°35'50.4"E 22°28'24.8"N	Morning, Noon and evening
8	Nov 12, 2018	Harbaria, Sundarbans	89°35'34.2"E 22°17'43.1"N	Morning and Noon
9	Nov 13, 2018	Akram point, Sundarbans	89°30'54.1"E 22°'23.50"N	Morning and Noon
10	Nov 14, 2018	Hiron Point, Sundarbans	89°27'53.2"E21°46'27.60"N	Morning and Noon
11	Nov 28, 2018	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 set the average values for the respective locations have been appended in **Table 2.4** for ready reference; but the detailed Noise Level Data have been attached in **Table C1, C2**, **C3 and C4** respectively in the **Appendix IV**.

Dacope Upazila Parishad

This monitoring location is a commercial area and located at a distance of 4 km in the North West direction of the 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 58.23 dB (A) in this monitoring season which is 11.77 dB (A) lower than the Bangladesh standard limit (70 dB) (**Table 2.4**). The significant noise sources at this place were found as the road traffics, engine operated van (locally called Nosimon), motor bikes, easy bikes (battery operated tri-cycle), hat/bazar etc.

North West Corner of the Project Area (Kaigar Daskati)

The North West (NW) corner of the Project site is under the Kaigar Daskati mauza of Gaurambha union. The selected monitoring site is situated at the Gucchha gram (a cluster village) and can be characterized as a residential area for the resettled people. However, the standard value for this area is 55 dB (A) at day time (Noise Pollution Control Rules, 2006). The average day time noise level during this monitoring period was recorded as 58.82 dB (A) which was 3.82 dB (A) higher than that of Bangladesh standard limit.

Chunkuri-2, Bajua

This area is located at 4km South West direction from the 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 48.69 dB (A) which was 6.31 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.

Proposed township area of the Project

The proposed township area of the Power Plant is located at the northeast portion of the Project area. The prominent noise sources were the construction activities and some discrete local gathering from the surrounding homesteads. 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 50.68 dB (A) in this site which was 4.32 dB (A) lower than that of standard limit.

Barni, Gaurambha

This area can be characterized as both the residential and commercial interests and the standard noise limit for this kind of mixed zone is 60 dB (A) at day time. The noise level was found as 53.03 dB (A) during this monitoring season which is 6.97 dB (A) lower than the standard value.

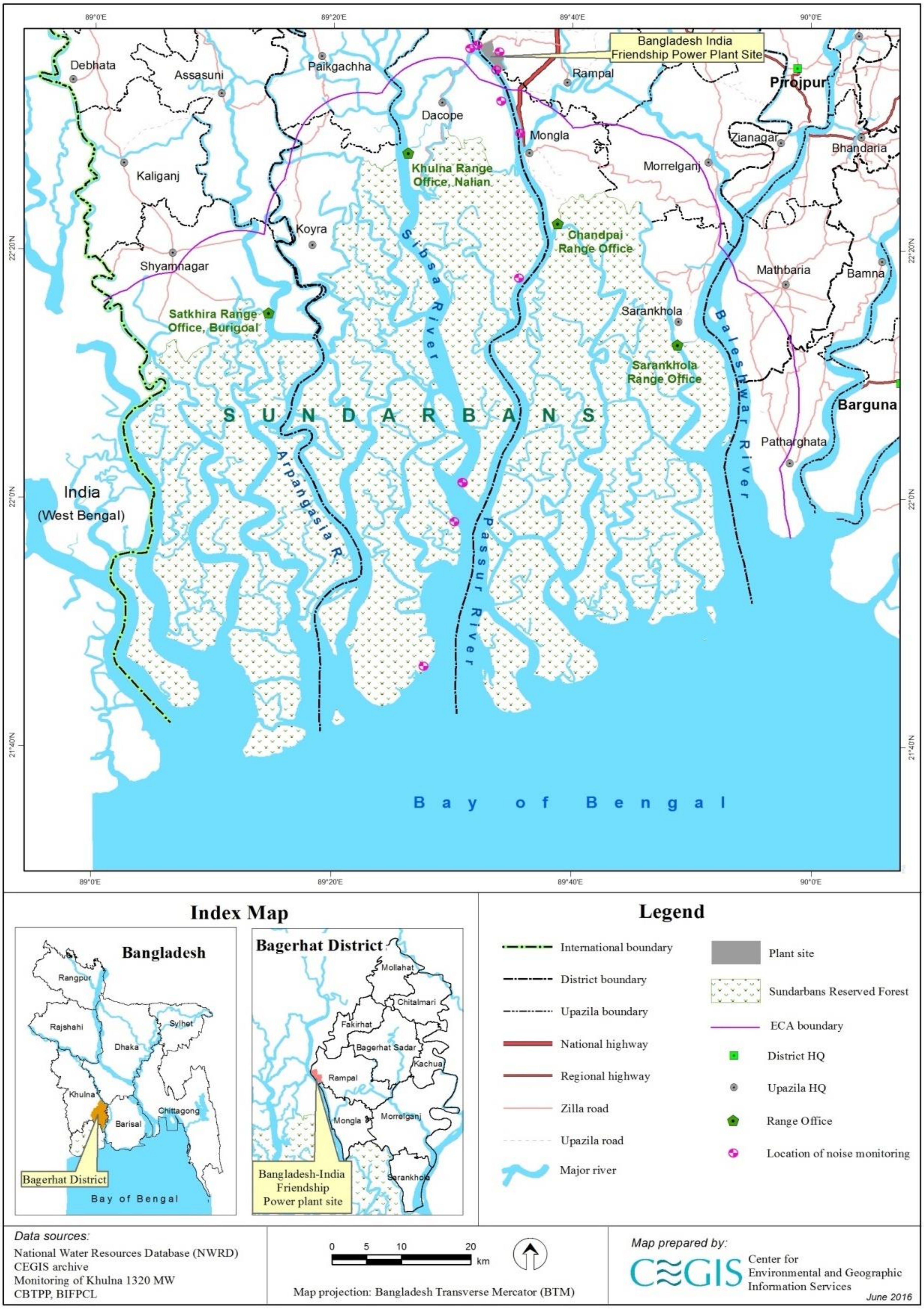


Figure 2.5: Noise Level Monitoring Locations

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 62.15 dB (A) which is considerably lower than the Bangladesh standard limit of day time noise level {(70 dB (A)}. The highway traffic was found to be the main source of noise generation. Besides, the site attracts local visitors for its scenic beauty which also creates a significant source of noise pollution in this area.

Mongla Port area

This area is heavily occupied with the industrial set up and the corresponding standard value for the industrial area is 75 dB (A) for the day time. During this period, the average day time noise level at this location was observed as 55.97 dB (A) which was 15.03 dB (A) lower than that of Bangladesh standard value. The sources of noise were mostly road traffic (heavy vehicles, light vehicles, etc.), noise from Mongla Port activities (crane, ships, etc.) and local mob in the Ghat area.

Harbaria, Sundarbans

Harbaria area of the Sundarbans is considered as a hot spot of biodiversity and an important anchoring site for most of the large ships. Most of the sea going vessels used to anchor at this site for transhipment 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 48.80 dB (A) during this monitoring period which was 1.20 dB (A) lower than that of standard limit. However, movement of ships, sound created by running engines of anchored ships and barges, transhipment 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 41 dB (A) which was much 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 noise sampling location falls under the demarcated area of World Heritage Site. 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, the noise level was found as 39.40 dB (A) during this monitoring season which was 10.60 dB (A) lower than the standard value. This area is also under the silent zone where the ambient day time noise standard is 50 dB (A). Sound of sea shore, wind blow, creeping of birds and small mechanized sea going boat might be responsible for the present noise level.

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

Sl.	Location	Monitoring periods																		
		QM 1	QM 2	QM 3	QM 4	QM 5	QM 6	QM 7	QM 8	QM 9	QM 10	QM 11	QM-12	QM-13	QM-14	QM-15	QM-16	QM-17	QM-18	Std*
1	*Chalna, Dacope*	68.13	52.87	54.63	53.28	57.08	49.77	65.12	66.07	65.08	52.42	65.51	59.29	61.62	58.64	60.1	59.63	57.54	58.23	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	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	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
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	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	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	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	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	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	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	50

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

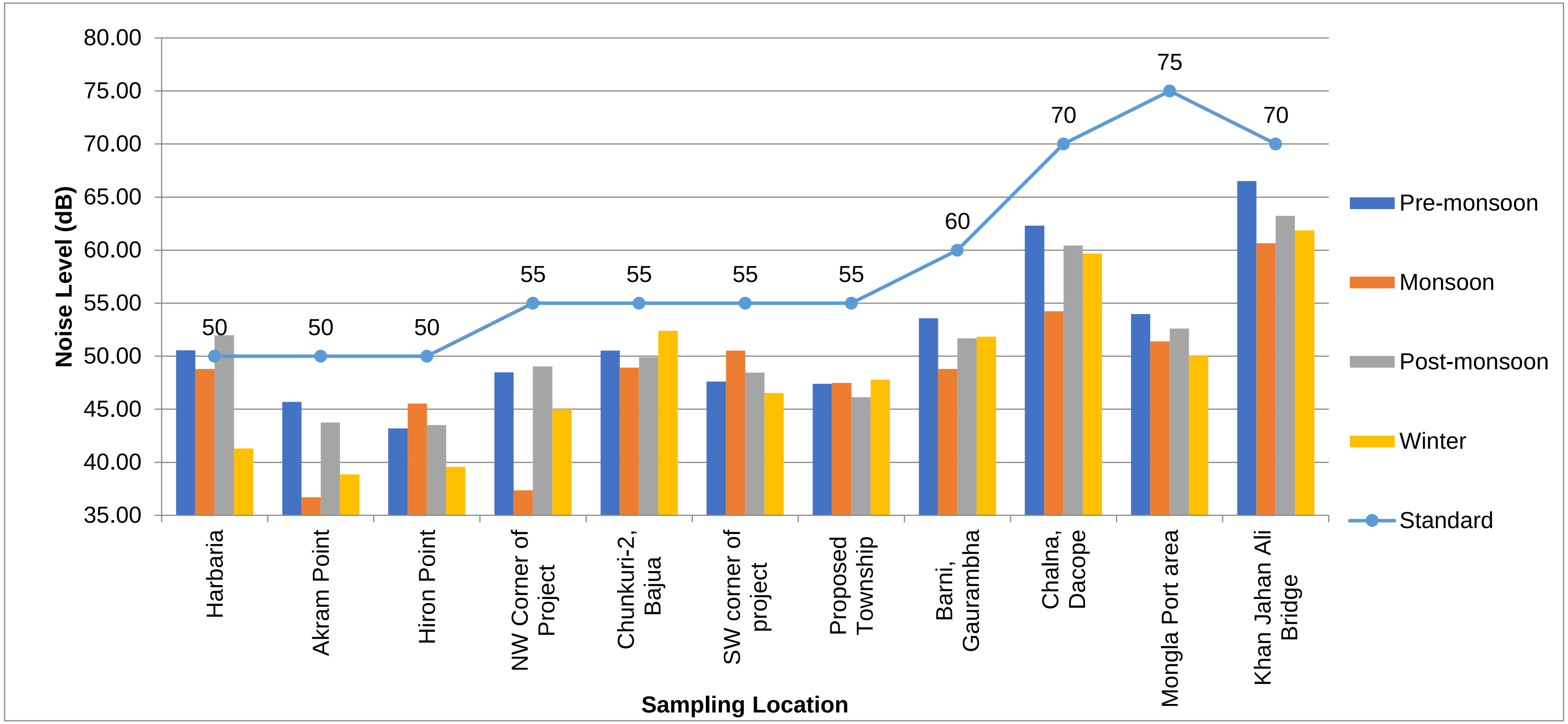


Figure 2.6: Status of Noise level at the monitoring locations

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 nine locations during this (18^{th} quarter) monitoring season (**Table 2.4**). On the other hand, the observed noise levels at North West corner (Koigar Daskati) and South West corner (Moidara) of the Project area were found to exceed the Bangladesh standard limit of their corresponding standard values. In course of the total eighteen monitoring seasons, the noise level of eight locations were found to exceed the Bangladesh standard limit of their corresponding standard values in their different monitoring seasons (Table 2.4). The eight locations were NW corner of the Project area (Oct-2016, Nov-2018), Chunkuri-2 (Mar-2014 & Jan-2017), SW corner of the Project area (Jan-2016, July-2016 & Nov-2018), Proposed Township area (July-2016), Khan Jahan Ali Bridge (Mar-2014), Harbaria (July-2014, Oct-2014, Apr-2015, Oct-15, July-2016, Oct-2016, Apr-2017, July-2018), Akram Point of Sundarbans (Apr-2015) and Hiron point of Sundarbans (July-2014). However, any additional anthropogenic noise producing activities within the study area may contribute to enhance the noise level.

2.8 Water Quality

An updated water quality status of the Passur-Sibsa River system and adjacent waterbodies have been depicted in this section. The methodologies used for the entire monitoring activities, both the national and international guidelines were followed and adopted. This report includes physical water quality parameters collected during 18th quarterly monitoring (October 2018) and the tested results obtained from the laboratory up to July 2018 (17^{th} quarterly monitoring). The surface and groundwater quality were monitored in the respective locations performed during the previous monitoring. A number of identical parameters were selected to understand the quality of the water for community use, aquatic life, and for the Sundarbans Forest ecosystem itself.

2.8.1 Methodology

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

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

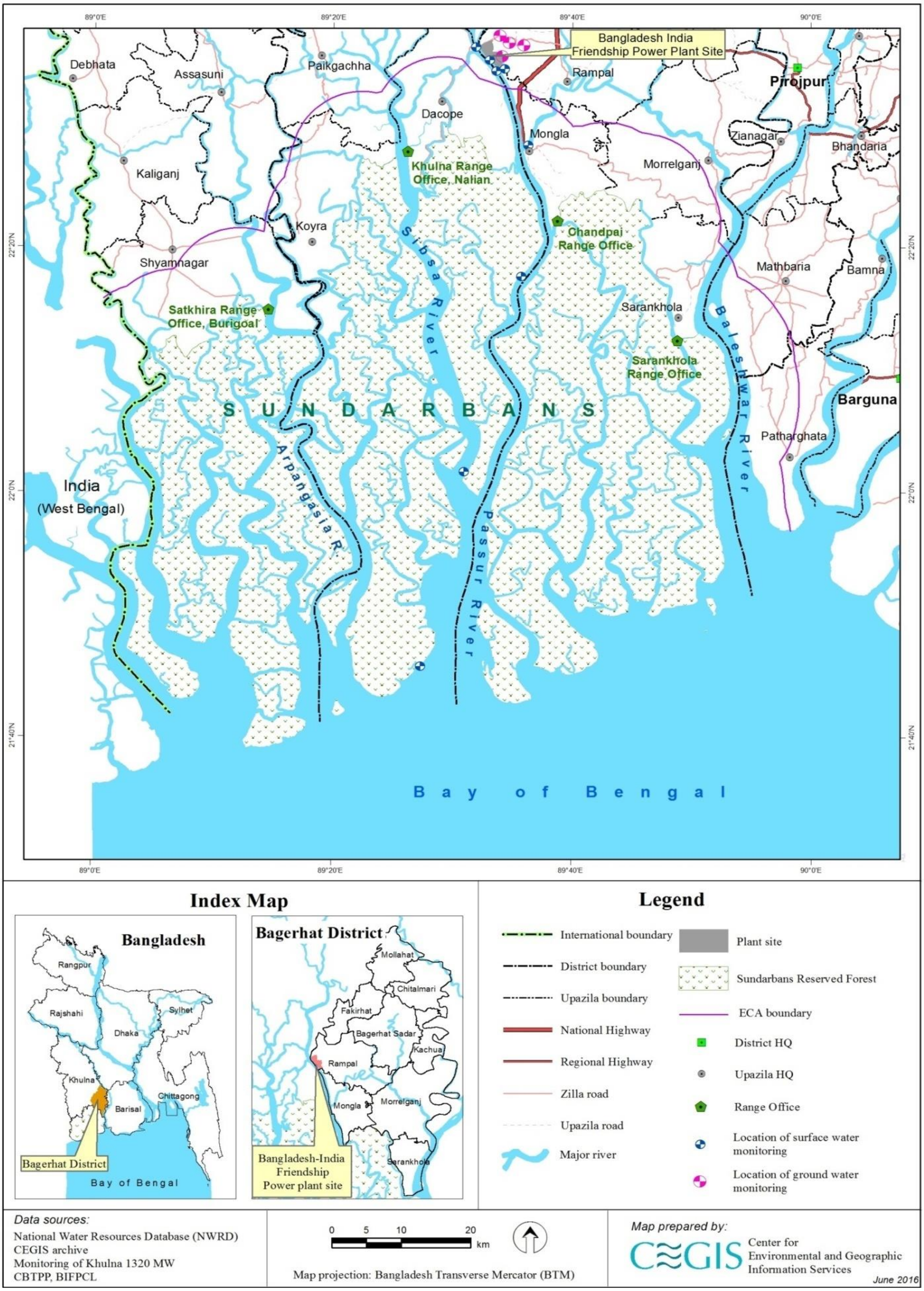


Figure 2.7: Surface water and Groundwater Quality Monitoring Locations

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		

2.8.2 Selection of Parameters

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

2.8.3 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 the following four (04) 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 paramenters 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.

2.8.4 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).

2.8.5 Sampling Procedure

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

2.8.6 Surface Water Sampling Procedure

Figure 2.8: River Water Sample Collection, tagging and in-situ testing

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 30-50 m 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**).

2.8.7 Groundwater Sampling Procedure

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

2.8.8 Water Quality Parameter Analysis Techniques/Methods

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

Table 2.7: Testing Methodology of Water Quality Parameter

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

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 are within the Sundarbans Reserve Forest area from where it requires several days to carry the sample to the nearest laboratory i.e. at Khulna. Hence, water samples were kept in specified bottles (wrinkled paper water bottles) for 5 days for natural incubation. The difference of 5 day's DO and initial DO was considered as BOD_5. Samples of other preselected parameters were preserved and analyzed in the laboratory.

2.8.9 Water Quality Reporting Arrangement

Water quality status of the adjacent water bodies of power plants and the Sundarbans deep forests are being observed since April 2014. To do so, all sampling points are clustered in five different sampling sites considering homogenous characteristics of the sampling points as well as the type of ecosystem touching the sample points. The clustered sample monitoring sites and the logical explanation of the clusters are presented in the following **Table 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.
(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 18th monitoring period (October 2018: post monsoon season) are described below and the legend identification has been shown in **Figure 2.11** and the legend identification and direction is shown in **Figure 2.9**:

i. pH

Eighteenth (18th) quarterly monitoring was held in the month of October 2018, usually called the Post-monsoon season of Bangladesh. During that visit, pH values in the monitoring sites were found to range between 7.0 and 8.2. The lowest pH value was found in the Passur River at Passur-Mongla confluence whilst highest was at Project jetty site (**Figure 2.10**). The last monitoring season showed consistency to all the other post-monsoon monitoring seasons (**Table B.1: Appendix-IV**).

Altogether, pH value was 7.6 near the power plant areas and 8.0 at Akram point of Sundarbans. However, until now, pH value did not violate the ECR' 1997 Standard yet (6.5-8.5 inland water and 6-9 for project waste disposal).

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). In addition to that, post-monsoon shows a little bit lower pH value than the winter season, as during post-monsoon there was some rains at August while in January it is normally zero.

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).

ii. Temperature

Comparatively low surface water temperature were recorded in the last monitoring season (post-monsoon) than the other monitoring period in all the observed sites (Figure 2.11). Water temperature at Passur River at 100m u/s of North West corner from the Project boundary and Passur-Mongla confluence showed the lowest temperature (270C) while high temperature was observed at the Maidara River near proposed township area (300C). According to the ECR, 1997; 300C water temperature is still be tolerable by the aquatic organisms in tropical environment. All of the monitoring sites showed 1oC temperature variation except the township area of Maidara River. This small river contains very low quantity of water, which may increase up to 30oC even during post-monsoon season without having other influences. It could also be possible that this little variation in water temperature might be the variation in water temperature recording time during the survey day. In addition, deep mangrove forest can assist in reducing water temperate a bit. It can be concluded that, construction works does not influence water temperature until to date.

The surface water temperature largely depends on daily weather condition (Bartram J et al., 1996). According to the seasonal weather pattern of Bangladesh the temperature drops to a minimum level during winter, which is also applicable for the water temperature and thus it differs largely than the other season's temperatures. Recorded temperatures indicated that there was spatial variation among the monitoring sites even in the same season. Water temperature inside the Sundarbans tended to be slightly lower than the water temperatures near the power plant sites in post-monsoon.

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

iii. Salinity

The observed salinity concentration ranged between 0.0ppt and 13.9ppt during the post-monsoon period. However, there was some spatial variations in salinity concentration of Passur-Sibsa River System. The maximum salinity was observed at Hiron point in the Sundarbans while minimum in the Maidara River. The highest salinity at the Akram and Hiron point was because of complete seawater influence. Besides, in all the sampling locations close to the project site the salinity range was found 0.2-1.0 ppt. During this monitoring period, salinity concentration was supposed to be the lowest (0.0ppt) near the project site based on the previous post-monsoon season salinity records. But, at the last post-monsoon due to almost zero rainfall and very low upstream freshwater availability, the salinity increased a bit even near about the project boundary **(Table B.3 of Appendix- IV)** .

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 eighteenth consecutive monitoring periods are presented in **Figure 2.12** and all the observed dataset are attached in **Table B.3** of **Appendix- IV.**

iv. Dissolved Oxygen

During the eighteenth monitoring period, DO concentrations ranged 5.8-8.2 mg/L. The maximum concentration was found in the deep forest (Harbaria) while the minimum value was recorded at the Ichamoti-Maidara confluence (5.8 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.

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

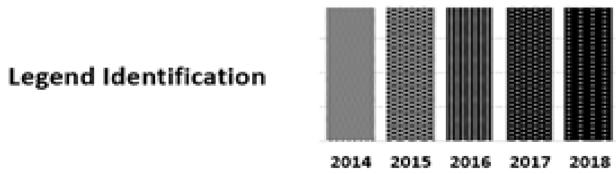


Figure 2.9: Legend direction (left to right: 2014-2018)

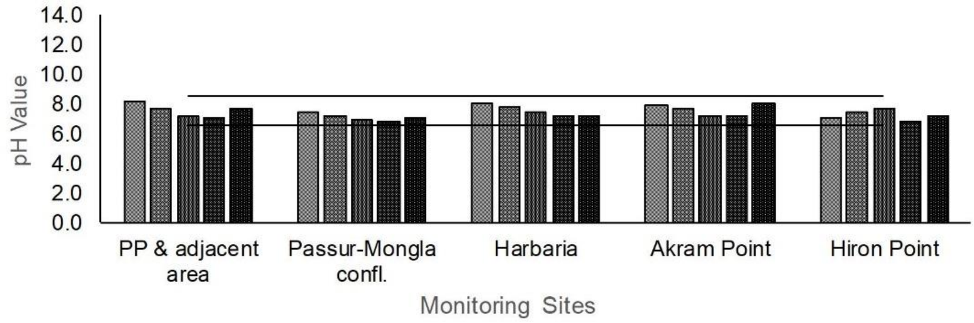


Figure 2.10: Variations in Post-monsoon pH values in different monitoring sites

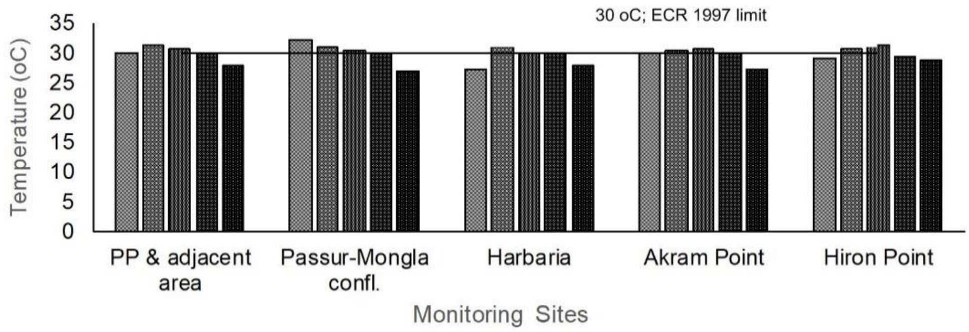


Figure 2.11: Variations in Post-monsoon temperature in different monitoring sites

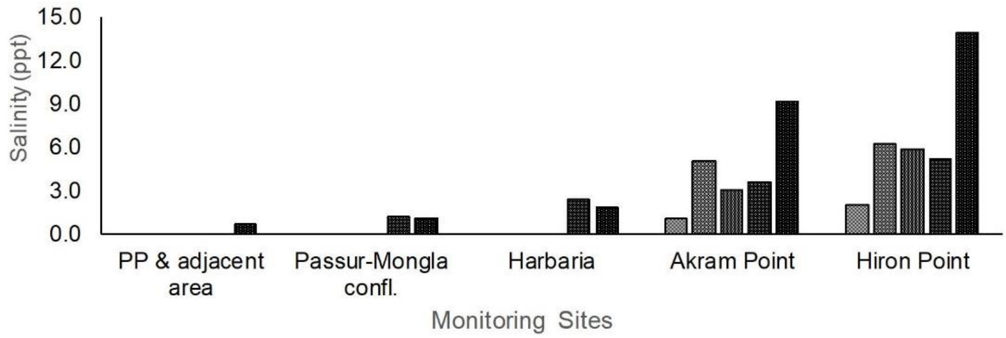


Figure 2.12: Variations in Post-monsoon salinity in different monitoring sites

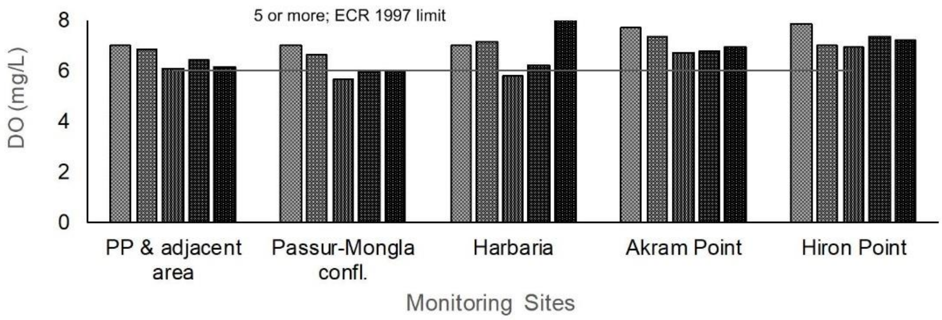


Figure 2.13: Variations in Post-monsoon DO in different monitoring sites

Laboratory tested parameters

The laboratory tested results obtained up to 17th monitoring period (July 2018: monsoon season) are described below:

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

TDS mainly indicates the presence of various kinds of minerals like ammonia, nitrate, phosphate, alkalis, some acids, sulphates and metallic ions etc., which comprise both colloidal and dissolved solids in water (Tareq M S et al., 2013). During the last monsoon period, the TDS values were found to range between 205 mg/L to 7,680 mg/L, which was almost same as all other previous monsoon seasons (**Figure 2.15**). 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. The legend identification for the laboratory tested paramenters are shown in **Figure 2.14**. 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 less than 200 mg/L in most of the cases excluding the deep forests. Regarding spatial variation, the more it is downstream of this RS, the higher the TDS concentrations due to tidal influence of the Bay of Bengal that contains lots of salts and other nutrients.

Total Hardness (TH) follows similar pattern as that of TDS e.g. high TH during pre-monsoon followed by 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 monsoon season, the range was found to be 185-2,030 mg/L. Water body of power plant and its adjacent areas (average 245 mg/L) are less harder than the water body of deep Sundarbans Forests (Around 1,280 mg/L) (**Figure 2.16**). During the rainy season, the water hardness in all the monitoring stations in Passur River were found to be low whereas it was found comparatively higher in pre-monsoon and winter seasons (**Table B.8: Appendix IV**). Generally, water hardness is found to be higher in monsoon season but in Passur River, it is found to be higher in pre monsoon season due to the saline water intrusion toward upstream. (Rahman et al., 2013).

TSS includes solid materials of organic and inorganic in origins, which are normally suspended in water. In Passur-Sibsa RS, the suspended matters generally contain sand, clay, silt and loam. During the 17th quarterly monitoring period, the TSS concentrations among the monitoring sites varied from 12 mg/L to 20 mg/L. The highest value was found at Right Bank of Passur River at South West corner from the Project boundary while the lowest value was found at Maidara River near proposed township area (**Figure 2.17**). TSS values in every spots recorded during the last monsoon period found to be within the Bangladesh standard limit of 150 mg/L (ECR, 1997). Since 2014 oil spillage, TSS was found higher than the standard limit at 2015. After that, the issue was not found any more, and revived naturally.

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 winter 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.**

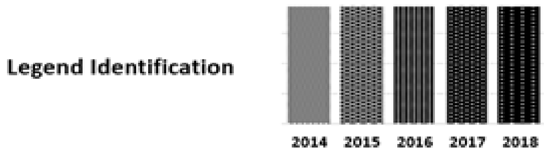


Figure 2.14: Legend identification

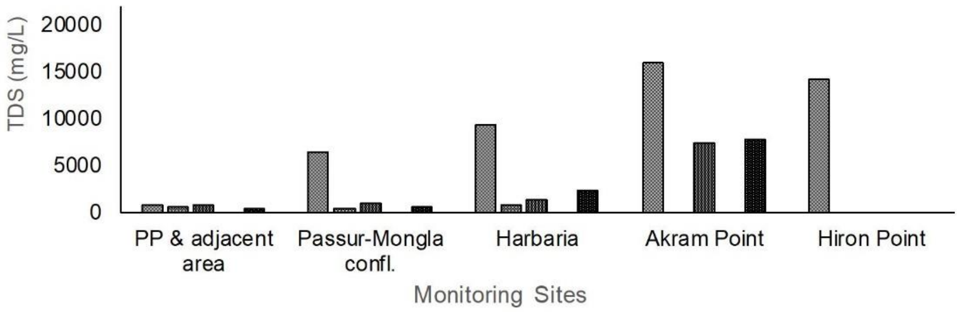


Figure 2.15: Variations in TDS concentrations in different monitoring sites

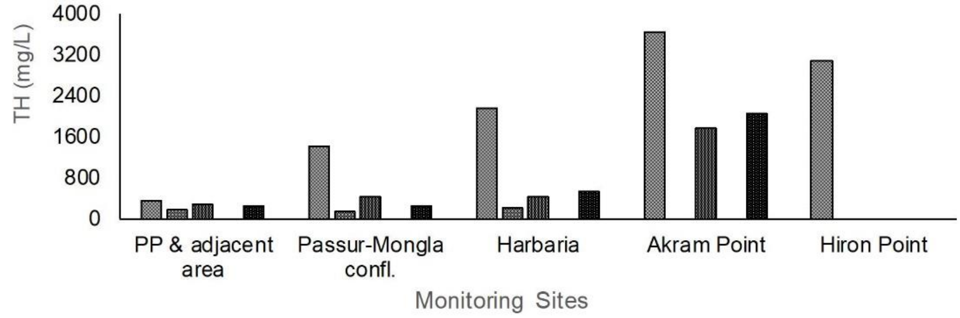


Figure 2.16: Variations in TH status in different monitoring sites

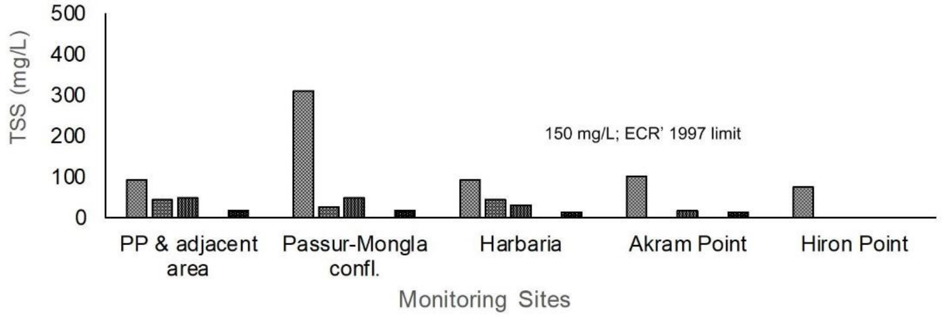


Figure 2.17: Variations in TSS concentrations in different monitoring sites

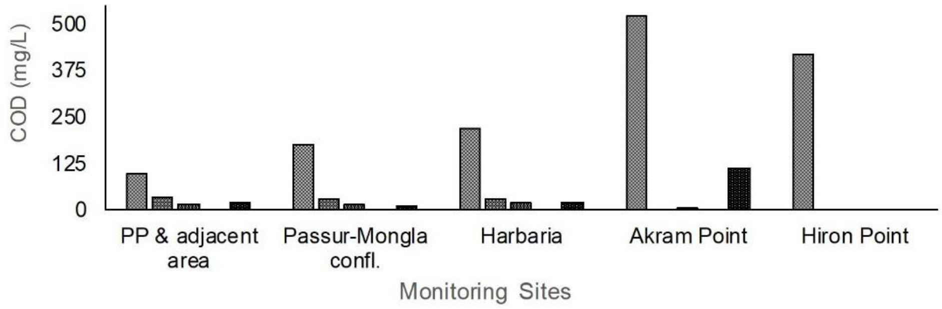


Figure 2.18: Variations in COD concentrations in different monitoring sites

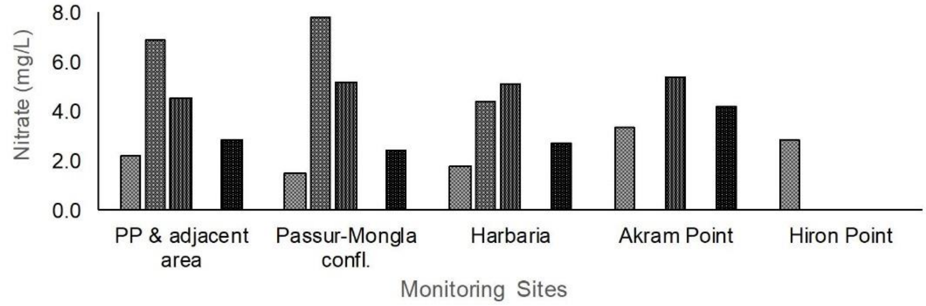


Figure 2.19: Variations in Nitrate concentrations in different monitoring sites

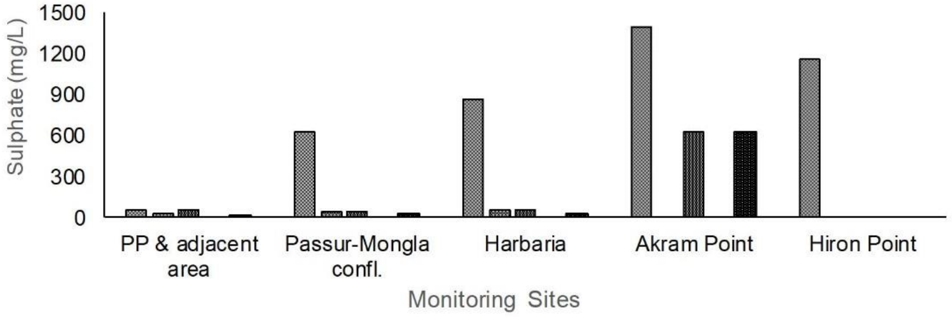


Figure 2.20: Variations in Sulphate concentrations in different monitoring sites

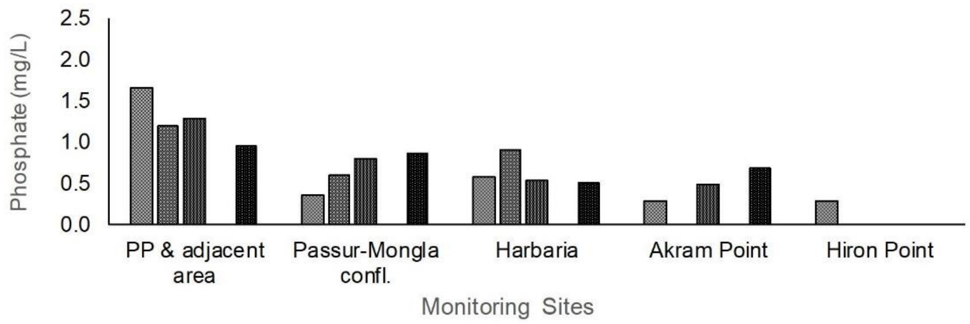


Figure 2.21: Variations in Phosphate concentrations in different monitoring sites

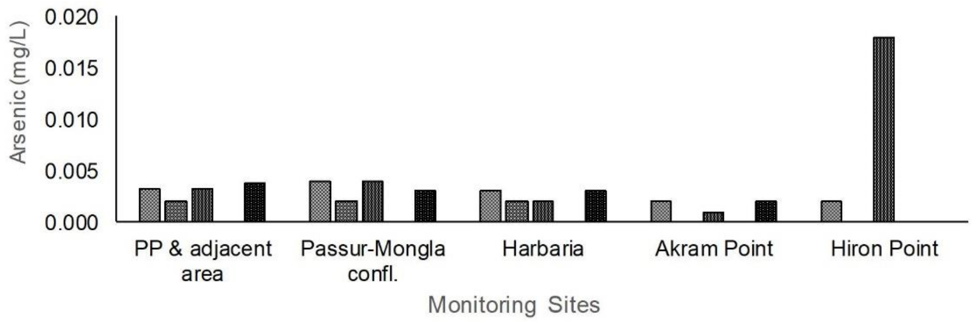


Figure 2.22: Variations in Arsenic concentrations in different monitoring sites

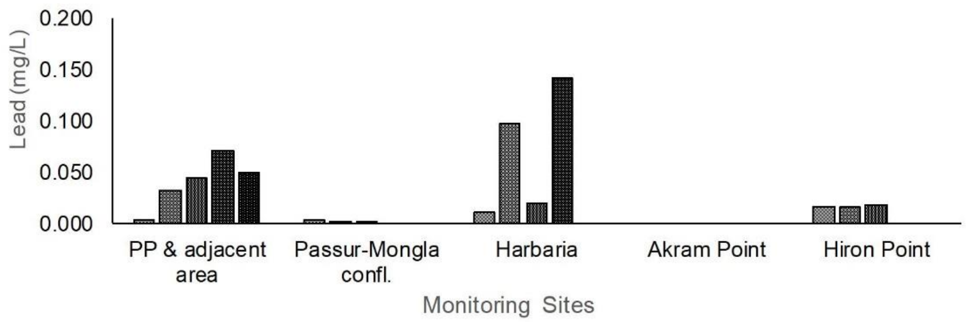


Figure 2.23: Variations in Lead concentrations in different monitoring sites

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 10 mg/L to 110 mg/L during the last monsoon season. The highest value was found at the Akram point. The high values of COD indicate high 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 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. COD concentrations is complied with the ECR' 2017 (25 mg/L) inland surface water standard from any monitoring site during the last monsoon season except Project jetty site (30 mg/L), Maidara-Ichamoti Confluence (40 mg/L) and Akram point (110 mg/L). Various activities at project jetty 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

In the last monitoring, **NO_3^-** concentrations varied from around 0.8 mg/L to 4.4 mg/L. The maximum concentration of 4.4 mg/L, recorded at Ichamoti-Maidara confluence whilst lowest concentration of 0.8 mg/L was found at the Left Bank of Passur River at 100m u/s of North West corner from the Project boundary. The highest concentration at Ichamoti-Maidara confluence was because of the agricultural runoff from adjacent crop fields during the monsoon period.

NO_3^- concentration showed both temporal and spatial variations in the same season among 17th quarterly monitoring. For instance, in the last monsoon season, power plant and its adjacent areas NO_3^- concentration was around 3.0 mg/L and at the same location it was found almost double (5.0 mg/L) in the monsoon season of the year 2016. In case of spatial variation, at the left Bank of Passur River at 100m u/s of North West corner from the Project boundary, NO_3^- concentration was found 4.0 mg/L at 2016 and it reduced to 1.0 mg/L at 2018 (**Figure 2.19)**.

It is noticeable that, the more the upstream of the RS the lower the nitrate concentrations during the last monsoon period. However, the results obtained from all the monitoring sites were found to be within the standard concentration stated in ECR'1997 (5 mg/L for inland surface water).

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 visible clearly in monsoon and pre-monsoon seasons only. Freshwater availability from upstream makes this variation.

The highest value (620 mg/L) of sulphate is found in Akram point while the lowest is found in Left Bank of Passur River at South West corner from the Project boundary (10 mg/L). However, all the observed dataset of Sulphate (SO_4^{2-}) found within the standard limit (400 mg/L) specified in ECR, 1997 except Akram point. 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**).

PO_4^{3-} concentrations were found in between 0.67 mg/L and 1.20 mg/L during the last monitoring period (Monsoon 2018) (**Figure 2.21**). Based on the **Figure 2.21**, it is verified that, PO_4^{3-} concentration decrease in the direction of upstream to downstream of the RS. Upstream anthropogenic activities probably the reason for this kind of trend. Except Akram point, all the monitoring sites violated ECR' 1997 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 15 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 17th monitoring, the results again fitted with the said range. Though there were some seasonal variations in As concentrations, but still As concentration complies with the drinking water quality standard of WHO (0.01 mg/L). The Bangladesh limit is as high as of 0.05mg/L **(Figure 2.22)**.

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 17th monitoring period, the concentration of Pb ranged 0.001-0.06 mg/L (**Figure 2.23**). The standard concentration of 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 0.002 mg/L. In the monsoon, the concentrations persist less than 0.001 mg/L constantly. 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 analysed 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 9 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).

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

In other seasons (Pre-monsoon, post monsoon and winter), 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 sometimes.

Total Carbon and Total Organic Carbon

Total Carbon (TC) represents all the carbon in the sample, including both inorganic and organic carbon. Total Organic Carbon (TOC) is the amount of carbon found in an organic compound and is often used as a non-specific indicator of water quality or cleanliness of pharmaceutical manufacturing equipment. Total Inorganic Carbon (TIC) often referred to as inorganic carbon (IC), carbonate, bicarbonate, and dissolved carbon dioxide (CO_2).

According to the monitoring results, it was found that TOC ranged in between 19-22 mg/L approximately. The normal standard for TOC vary from 7-10 mg/L in the river. The TC, TOC and TIC of the monitored sites are presented in the **Table 2.9.**

Table 2.9: Status of TC, TOC and TIC of the monitored sites

Monitoring sites	Total Carbon (mg/L)	Total Organic Carbon (mg/L)	Total Inorganic Carbon (mg/L)
Project jetty site	26.4	19.5	6.9
Harbaria	25.1	21.9	3.2

PAHs (Polycyclic aromatic hydrocarbons)

Polycyclic aromatic hydrocarbons (**PAHs**, also ***polyaromatic hydrocarbons*** *or* ***polynuclear aromatic hydrocarbons***) are hydrocarbons-organic compounds containing only carbon and hydrogen that are composed of multiple aromatic rings (organic rings in which the electrons are delocalized). PAHs are uncharged, non-polar molecules found in coal and in tar deposits. They are also produced by the thermal decomposition of organic matter (for example, in engines and incinerators or when biomass burns in forest fires).

Most PAHs are insoluble in water, which limits their mobility in the environment, although PAHs sorb to fine-grained organic-rich sediments. Aqueous solubility of PAHs decreases approximately logarithmically as molecular mass increases. Two-ringed PAHs, and to a lesser extent three-ringed PAHs, dissolve in water, making them more available for biological uptake and degradation. Further, two- to four-ringed PAHs volatilize sufficiently to appear in the atmosphere predominantly in gaseous form, although the physical state of four-ring PAHs can depend on temperature. In contrast, compounds with five or more rings have low solubility in water and low volatility; they are therefore predominantly in solid state, bound to particulate air pollution, soils, or sediments. In solid state, these compounds are less accessible for biological uptake or degradation, increasing their persistence in the environment.

PAHs have a strong affinity for organic carbon, and thus highly organic sediments in rivers, lakes, and the ocean can be a substantial sink for PAHs. Algae and some invertebrates such as protozoans, mollusks, and many polychaetes have limited ability to metabolize PAHs and bio-accumulate disproportionate concentrations of PAHs in their tissues; however, PAH metabolism can vary substantially across invertebrate species. Most vertebrates metabolize and excrete PAHs relatively rapidly. Tissue concentrations of PAHs do not increase (bio-magnify) from the lowest to highest levels of food chains.

PAHs transform slowly to a wide range of degradation products. Biological degradation by microbes is a dominant form of PAH transformation in the environment. Soil-consuming invertebrates such as earthworms speed PAH degradation, either through direct metabolism or by improving the conditions for microbial transformations. Abiotic degradation in the atmosphere and the top layers of surface waters can produce nitrogenated, halogenated, hydroxylated, and oxygenated PAHs; some of these compounds can be more toxic, water-soluble, and mobile than their parent PAHs.

During the last monitoring (monsoon), the PAHs was undetectable near the Project jetty site and at the Harbaria. It indicates that there were no PAHs pollution until now in the Passur-Sibsa RS.

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 tidal intrusion in different seasons. In this 18th quarter (Post-monsoon 2018), only salinity was recorded comparatively higher but still under the recommended value of ECR'1997. The main issue was the higher salinity than any other post-monsoon seasons over the whole monitoring scheme. On the other hand, pH, Temperature and DO level was somewhat good at the project site. Huge construction activities and land filling near the bank side slightly reduces DO level sometimes for a while of that portion of the river. In this 17th quarter (Monsoon, 2018) TD, TH and TSS did not increase in respect to the same seasons of last four consecutive years. COD was good in all the stations except the project site during the last monsoon. Nitrate (NO_3^-) and sulphate (SO_4^{2-}) reduced a lot due to freshwater availability during monsoon period. Phosphate (PO_4^{3-}) concentration become an issue under the Standard of Inland Surface Water Quality (0.05 mg/L). It was also found that rather than construction activities PO_4^{3-} was coming from the agricultural practices, surface run-off from upstream and plankton decay in the river itself.

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 5 mg/L, which is even less than half of the recommended concentration (10 mg/L) for Inland Surface Water.

2.8.10 Status of the Groundwater quality

In-situ tested parameters

The in-situ tested results obtained up to 18th monitoring period (October 2018: post-monsoon season) are described below:

pH and Temperature

The values of pH and temperature of groundwater in the monitored sites complied with the drinking water quality standards as specified in ECR, 1997 (6.5-8.5 and 20-30°C respectively). The pH values during 18th monitoring scheme were found to vary from 7.3 to 7.6, while temperature was around 30°C at Rajnagar and Kapasdanga site. During this visit, no groundwater is being withdrawn inside the project site (near township area). No significant differences have been observed against the previous 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 eighteen consecutive monitoring results of pH and temperatures (post-monsoon data) and DO of selected sites are presented in **Figure 2.25.** However the legend identification is shown in **Figure 2.24** for all the observed dataset and are attached in **Table B.16-17** of **Appendix- IV**.

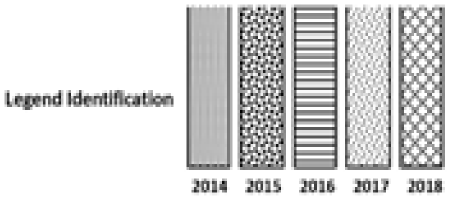


Figure 2.24: Legend direction (left to right: 2014-2018)

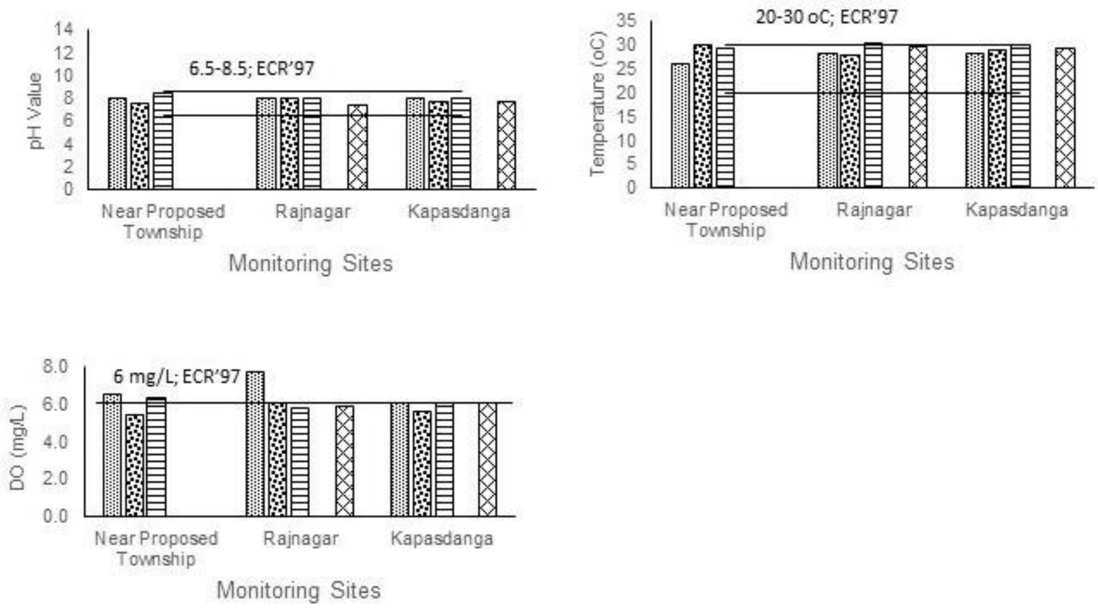


Figure 2.25: Status of pH, Temperature, and DO of post-monsoon seasons of the last four consecutive years

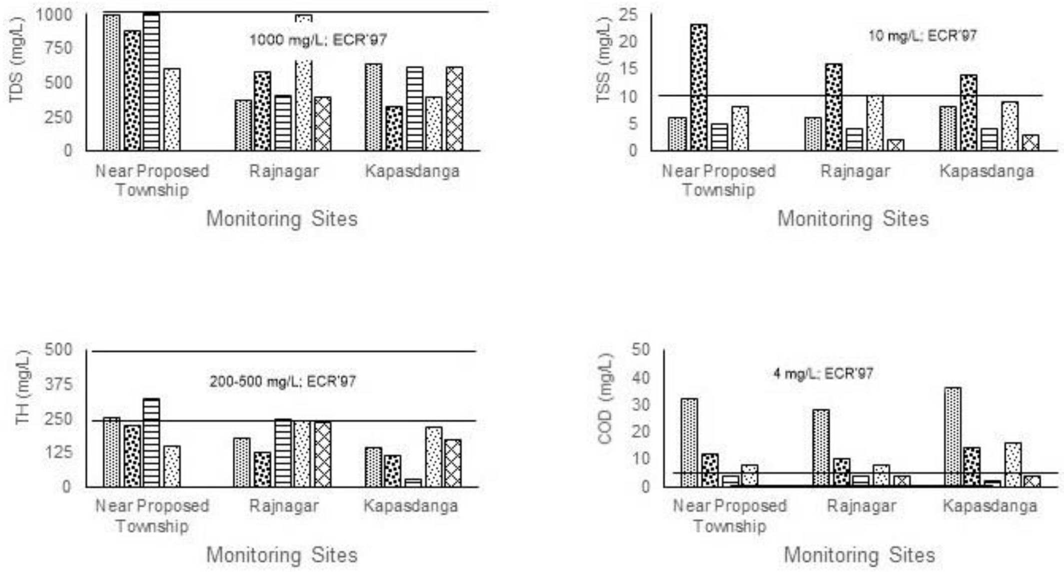


Figure 2.26: Status of TDS, TSS, TH and COD of monsoon seasons of the last four consecutive years

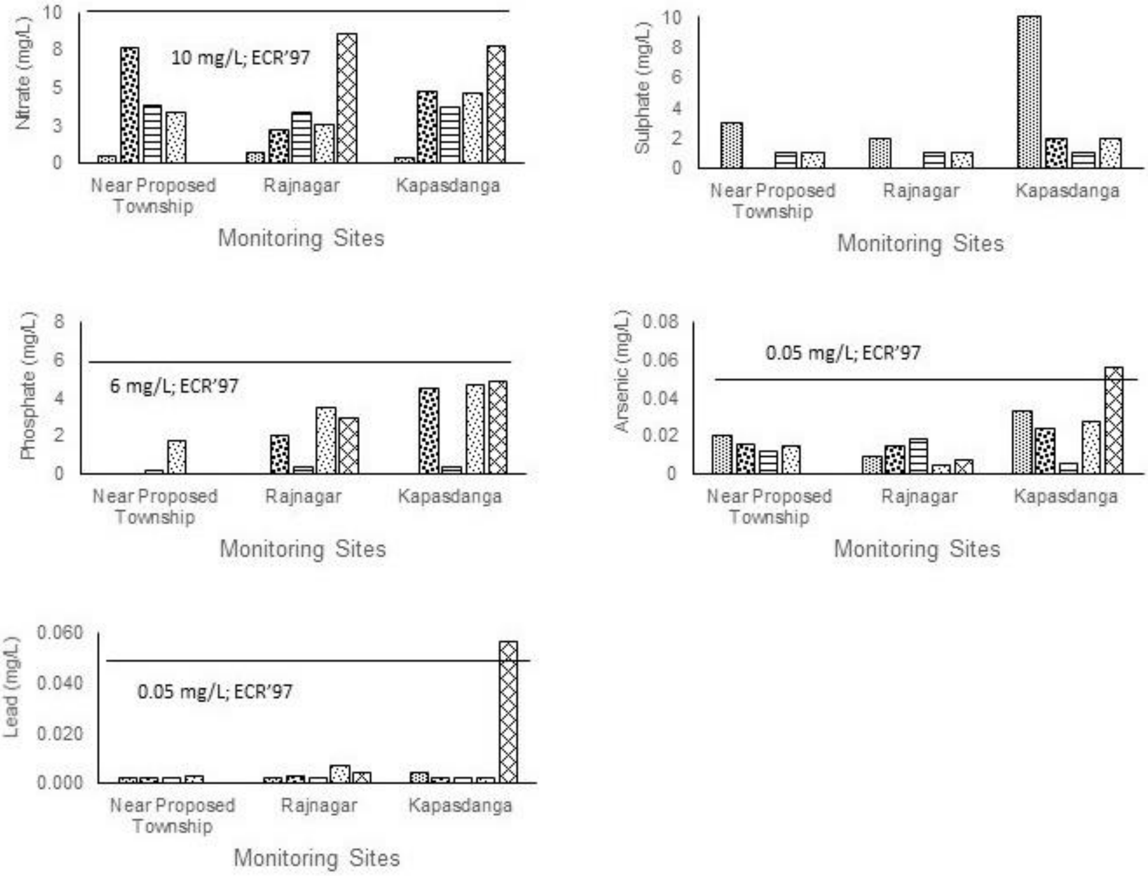


Figure 2.27: Status of Nitrate, Sulphate, Phosphate, Arsenic and Lead of monsoon seasons of the last four consecutive years

Salinity and Dissolved Oxygen (DO)

Groundwater salinity concentration in all the monitoring sites were found to be negligible and in most of the cases below, the minimum detectable limits in all the consecutive monitoring seasons. During this monitoring season, groundwater salinity of Rajnagar and Kapashdanga were found to be 0.0 ppt (**Table B.18: Appendix- IV**).

DO ranged between 5.9 mg/L to 6.1 mg/L during this monitoring season. Though DO concentration were found slightly lower than the recommended ECR, 1997 (6.0mg/L), at Rajnagar, however, it is still drinkable. A slight low DO concentration in drinking water might only reduce the taste of water. Higher DO level makes water tastier but causes corrosion to the supply pipe.

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

Laboratory tested parameters

The laboratory tested results obtained up to 17th monitoring period (July 2018: monsoon season) are described as follows:

TDS, TSS and TH

The highest TDS value of 608 mg/L was recorded in Rajnagar and the lowest was in Kapasdanga (370 mg/L). It is mentionable that, the TDS concentrations in all the monsoon periods were found within the Bangladesh standard limit of 1000 mg/L (ECR, 1997) (**Figure 2.26: TDS**). Until now, TDS did not come out as an issue in the monsoon season. However, in the pre-monsoon season of the year 2014, TDS showed extreme spatial variations. That variation was for the physically damaged Tube wells for a while.

Total Suspended Solids (TSS), also known as non-filterable residue, are the solids (minerals and organic material) which remain trapped on a 1.2μm filter (U.S.EPA, 1998). During this monitoring period, the TSS concentrations ranged in between 2-3 mg/L, which complied with the Standard for Drinking Water Quality, Bangladesh (TSS: 10 mg/L, ECR, 1997) (**Figure 2.26: TSS**). Among all the monitoring seasons, the observed TSS concentrations were much lower in monsoon season than the winter season (**Table B.21**). These variations would be due to lack of freshwater availability for sufficient groundwater recharging. In addition, evaporation have also condensed the water along with its suspended matters.

TH of the two monitored spots varied from 170mg/L to 235mg/L (**Figure 2.26: TH**) in the last monsoon season. Rajnagar showed the highest concentration not only in the last monsoon but also over the whole monitoring scheme so far. Over the last four monsoon 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 4.0mg/L. Monitoring sites completely complied with the Bangladesh Standard as COD concentrations for these sites in the last monsoon period were found only 4.0mg/L. Except first and second quarterly monitoring period, all the other 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 between 7.8 mg/L and 8.6 mg/L in the last monsoon period (**Figure 2.27: Nitrate**). The maximum value was recorded in Rajnagar while the lowest was in Kapasdanga. NO_3^- concentrations were within ECR, 1997 limit (10mg/L) in this 17th monitoring period. NO_3^- in groundwater showed both spatial and temporal variations in monsoon season.

Groundwater sulphate (SO_4^{2-}) concentration have been monitored since 2015. On that time, 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 (**Figure 2.27: Sulphate**) except a trend of comparatively high concentrations in winter than all other monitoring seasons.

On the other hand, the concentrations of PO_4^{3-} were found between 2.9 mg/L and 4.8 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 4.8 mg/L during the last monitoring scheme. PO_4^{3-} concentrations actually have 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, 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 between 0.01 mg/L and 0.05 mg/L which are very much 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 pollution 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 only represent the status of monsoon season of the monitoring scheme. It has been observed that the physical characteristics of groundwater quality is still in good condition and in acceptable state for drinking purpose. In addition, dissolved and solid quantities of the water are also found very low than the highest recommended limit for Bangladesh. Only, chemical oxygen demand during 2014 and 2015 was higher than ECR, 1997. Other nutrients like nitrate, sulphate and phosphate met the Bangladesh demand completely together with the metals of arsenic, lead and mercury.

2.9 Land Resources monitoring

2.9.1 Methodology

Monitoring Indicators

Monitoring of selected indicators are very crucial for better management of land resources. 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 degrade the soil of the study area. But, before that (during pre-construction and construction stage), only natural phenomenon's are responsible to alter soil parameters.

Sampling Frequency

The frequency of monitoring for land resources data collection was considered twice in a year. Accordingly, the plot use data was collected in the 18th monitoring program during November 10th, 2018 to November 21st, 2018 and the analysed results with justification will be provided in the next report(19th quarterly monitoring report)

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). Sodium absorption ratio (SAR), exchangeable sodium percentage (ESP) has been calculated from the analysed data. It can also be mentioned that the structural change of soils in the sampling plots can also be identified from these data.

The formula to calculate SAR is given below, with concentration expressed in mill equivalents per liter (meq/L) analyzed from a saturated paste soil extract.

$$SAR= \frac{[Na^+]}{\sqrt{½ ([Ca^+]+[Mg^+])}}$$

ESP is the sodium adsorbed on soil particles as a percentage of the Cation Exchange Capacity (CEC). It is calculated as:

$$ESP = \frac{[Na^+]}{CEC} X\ 100$$

CEC is often estimated as the major exchangeable cations, including hydrogen. Both cation and CEC are expressed as meq/100g. ESP can also be calculated as:

$$ESP = \frac{[Na^+]}{[Ca^{2+}+Mg^{2+}+Na^+ +K^+]}\ X\ 100$$

ESP is used to characterise the sodicity of soils only, whereas SAR is applicable to both soil solution or irrigation water.

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 2.28**.

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 also considered as potential factor for monitoring purpose. All the selected plots has been classified 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 wet season.

Soil Samples Collection

Standard procedures were maintained during the collection of soil samples. In every plot, minimum three pits were dug through augur to collect the said soil samples **(Figure 2.28)**. Each plot had three composite samples, top soil (0-15 cm), sub soil (15-30 cm) and sub stratum (30-45 cm). And then the soil samples were preserved in an air-tight plastic bag for laboratory analysis.

Figure 2.28: Soil sample collection from Baserhula and kapalirmet

Laboratory Analysis

Collected soil samples were sent to the SRDI, Dhaka for laboratory analysis. Analyzed results will be incorporated in next monitoring report (19th monitoring) report.

Table 2.10: 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″		

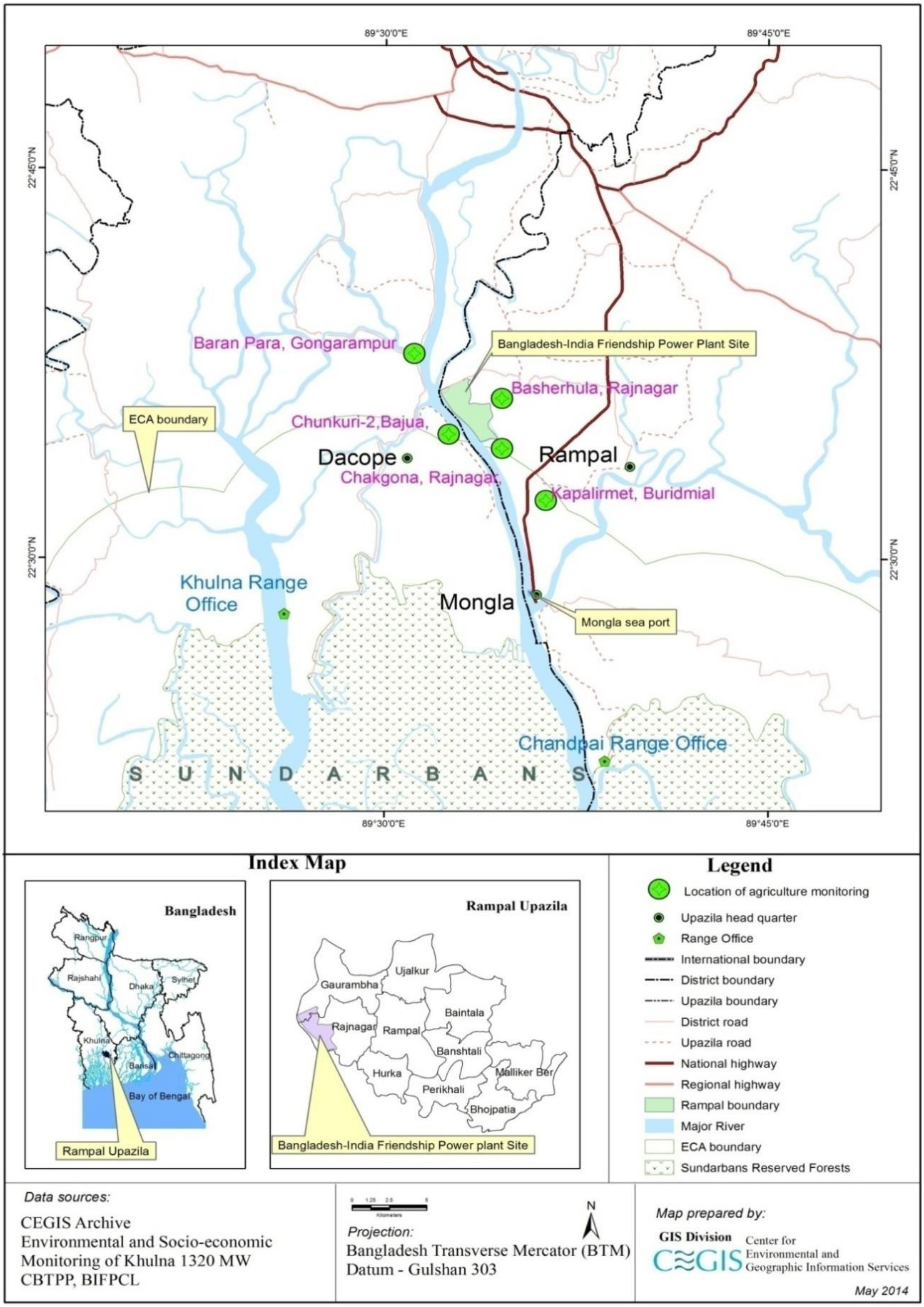


Figure 2.29: Land Resource Monitoring Locations

2.9.3 Status of Agriculture monitoring

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

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 also considered for agricultural resources monitoring too.

During 18th 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.

2.9.4 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 November 2018 and described in the following sections and presented in **Figure 2.30**:

Monitoring Plot-1 (Baranpara)

This plot is located at Baranpara mauza and the area is about 0.4 hectare. During 18th monitoring period, 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 found to be 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 remained same as for the earlier monitoring season. The detailed cropping pattern is shown in **Table E.2** of **Appendix IV**.

Monitoring 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 was observed in this plot. Due to this problem crop production may be decreased. No management practice was found to prevent the diseases.. Detailed cropping pattern has been shown in **Table E.2** of **Appendix IV.**

Monitoring Plot-3 (Kapalirmet)

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

Owners of Shrimp farms of this area used the saline water in these plots for shrimp culture as there was no scope to drain out saline water from this area. The situation is still not in farmers' favor. Farmer of this land decided that they would not cultivate crops in future due to increase in salinity. Rather they would only practice the shrimp culture in future. It was observed during the recent monitoring period that, the plot still remained fallow (18th monitoring). Detailed for this plot is presented in **Table E.2 of Appendix IV**.

Figure 2.30: Present Cropping Pattern and monitoring plots

Monitoring Plot-4 (Chakghona)

This monitoring plot is located at Chakgona and the size of the plot is about 0.14 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.**

Monitoring 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 (17th monitoring). However, detailed cropping pattern is shown in **Table E.2** of **Appendix IV.**

Agriculture Plot-6 (Bidyarbon)

This sampling plot is newly selected for monitoring as per the TOR. The size of the plot is 0.1 ha. 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.

2.9.5 Crop Production in Monitoring Plots

The information on crop production were collected after harvesting in April 2019. For this reason crop production details will be incorporated in April, 2019 report (20th monitoring).

2.9.6 Crop Damage in Monitoring Plots

The information on crop damage were collected after harvesting in April 2019. For this reason, crop damage details will be incorporated in April, 2019 report (20th monitoring).

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 2.11: Monitoring of EMSAP Implementation

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

Sl. No.	Impacts	Mitigation Measures	Remarks on Due Diligence
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 and November; 2018

2.10 Livestock Resources Monitoring

Monitoring Indicators

The frequency of monitoring for livestock resources data collection was considered twice in a year. During the 18th quarterly visit, consultations and group discussions were organized with local people to know the status of feed/fodder and diseases of livestock in the adjacent of the project area (Baranpara, Chunkuri-2) and study area (Mongla bazar, Bhaga bazar, Rampal). The data on livestock status was collected in November 2018 and described in the following sections and present livestock scenario is presented in **Figure 2.31.**

Figure 2.31: Present Livestok Scenerio in the study area

2.10.1 Feed/Fodder condition of Livestock Resources

Feed and fodder condition remain similar to the previous monitoring (16th monitoring). During this monitoring, a claim for shortage of fodder is found in two monitoring spots (Chakgona and Basherhula). According to their voice, they started selling cows as area of grazing land is squeezed. The project area was previously used for grazing land, which is completely confined now. Even the authority (BIFPCL and Forest department), jail (Khoar) cows when it enters in the confined area. On the other side, 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. Under this situation, monthly single cow rearing cost increased up to 1000 BDT which creates an extra burden to the poor farmers and forced them to sell cows.

2.10.2 Diseases of Livestock Resources

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

Soil salinity and pH govern the increase and decrease of other parameters. The soil salinity increasesed in all sampling plots except in Kapalirmet. There is nomajor change in organic matter pole in the sampling sites. In major nutrients N and P follows organic matter’s trend while S showed increasing trend. Among the Micronutrients Zn showed increasing trend. Heavy metal concentrations is found in all cases but their concentrations are still well below the concern. Most of the elements showed increasing trend than those of in wet season due to less washout rainfall and less top soil erosion. It is to be noted that, all such changes are for natural reasons.

2.11 Transportation Monitoring

2.11.1 Location of Traffic Survey

The traffic survey for third quarter monitoring during the construction phase was conducted from November 25 to 28, 2018 on three-week days at three pre-selected locations around the project site (**Figure 2.32**). Weather was Sunny during the surveys conducted.

The selected sites were Khudir Bottola and Gonai Bridge at Khulna Mongla Road and Gonabelai Bridge at Power Plant access road.

2.11.2 Methodology

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

2.11.3 Traffic Volume Calculation

The survey results were used in computing the traffic volume of these roads in Passenger Car Unit (PCU). PCU is a matrix used in Transportation Engineering, to assess traffic-flow rate on roadways. A PCU is essentially the impact that a mode of transport has on traffic variables (such as headway, speed, density) compared to a single car. While calculating the traffic volume in PCU, vehicle conversion factors suggested by the Roads and Highway department of Bangladesh were used as mentioned in **Table 2.12**.

Table 2.12: Factors Used for PCU estimation

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

**Source: Roads and Highway department of Bangladesh*

Results of Monitoring

The summary results of vehicular movements at three different locations are shown in **Table 2.13** below. Results shows that, the Passenger Car Unit (PCU) per hour suggest that the Khulna-Mongla Highway receives the largest number of vehicles, compared to other surveyed roads.

Table 2.13: 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	373	453	293
Khulna Mongla Road at Gonai Bridge	218	430	185
Power Plant access road at Gonabelai Bridge	177	105	179

Source: Field Survey, November, 2018

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

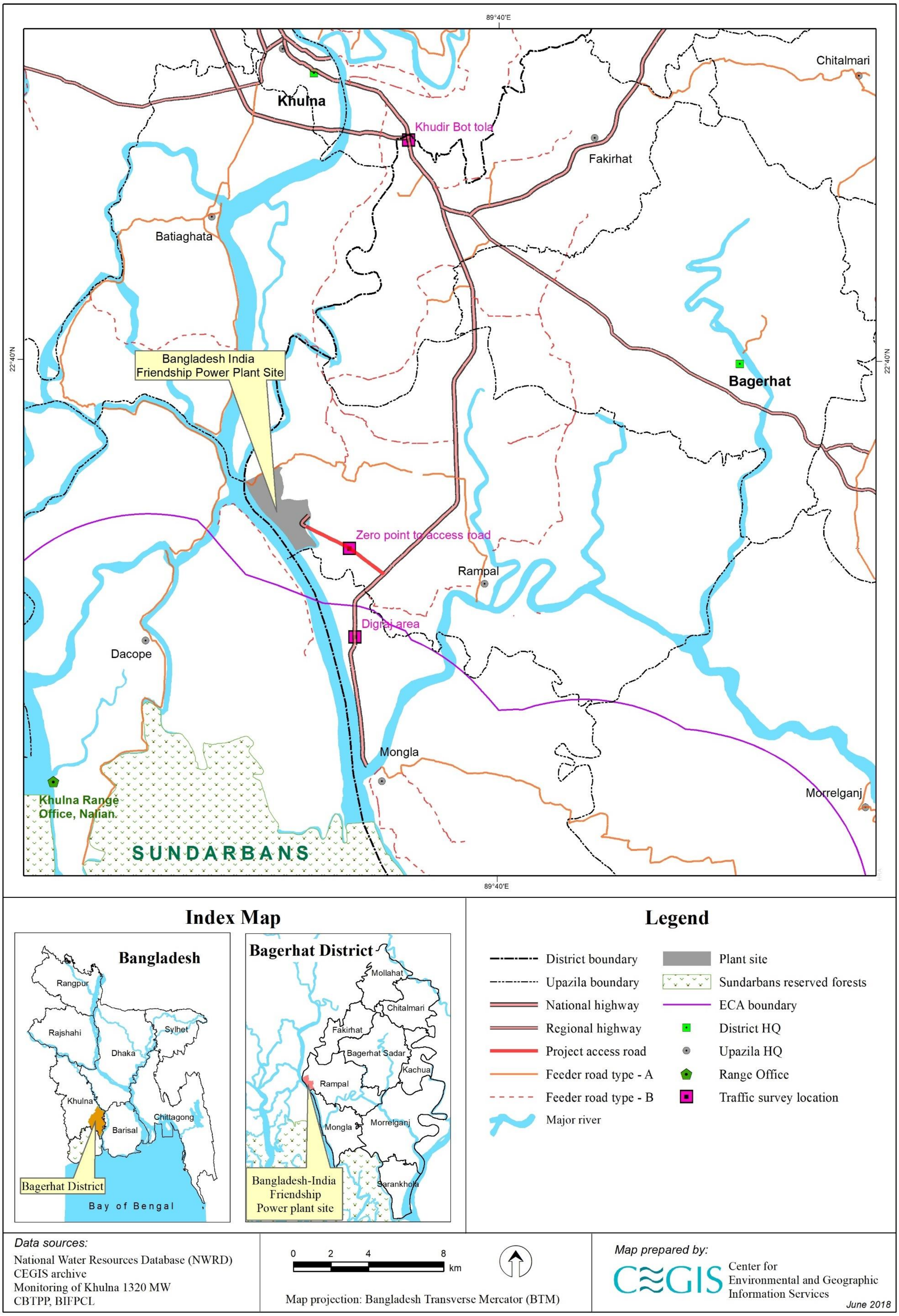


Figure 2.32: Traffic Monitoring Locations

2.12 Water resources Monitoring Plan

2.12.1 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.

2.13 Methods to Assess the Riverbank Erosion and Accretion of the Passur River

For the assessment of the riverbank erosion and accretion, time series satellite images were used. Time series satellite images were processed and analyzed before the assessment and identify the locations of erosion and accretion as well as the shifting of bankline in half yearly period. The steps of images processing and analysis is briefly explained below.

2.13.1 Collection and Processing of Images

Sentinel-1 Radarsat satellite images having 10m resolution covering the Passur River from Chalna to Hiron Point for the month January 2018 and June 2018 were collected. After that satellite images were geo-referenced to have the same projection system. Then, it was found that one image differ with other image. In that case, images were co-registered to avoid the distortion with each image.

2.13.2 Delineation of Banklines

After collection and processing of images, banklines have been delineated of the Passur River for the mentioned period using Arc-GIS tool. Then, banklines have been analyzed and superimposed to assess the erosion-accretion and shifting of the river during period from January to June 2018.

2.14 Monitoring of Erosion and Accretion

For monitoring the half yearly riverbank erosion and accretion at the project site, Mongla, Harbaria and Akram point areas, banklines of the Passur River were superimposed with each other. It was found that the river is very stable and there is no riverbank erosion or accretion as the river has not shifted from January 2018 to June 2018 (Figure 1). Hence, there is no bankline shifting of the Passur River along its both banks during its passage from Chalna to Hiron Point (**Figure 2.33**).

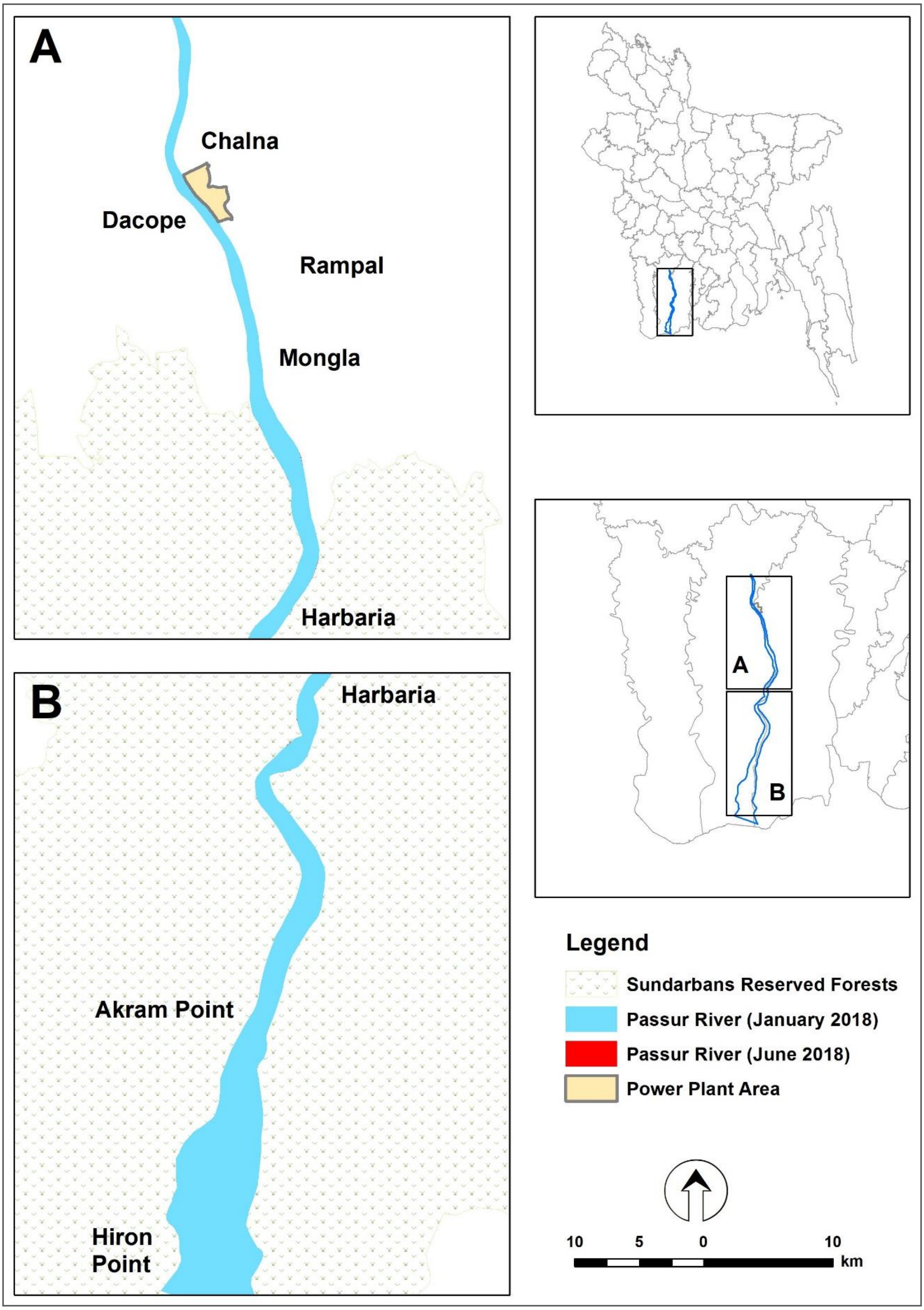


Figure 2.33: Riverbank Erosion and Accretion of the Passur River from January to June 2018

2.14.1 Monitoring changes in tidal penetration and inundation

Tidal Water Level Data Analysis

In connection with the monitoring of the tidal water level of the Hiron Point, Mongla Port and Rampal Jetty area, daily tidal water level data at Hiron Point and Mongla Port were collected from BIWTA for the period of May-July 2018. An exercise has been conducted to establish the relationship between the stations, based on the relationship of the water level between Hiron Point and Mongla Port stations, the lag time and peak attenuation from Mongla Port to Rampal Jetty area were extrapolated.

Relation between Hiron Point and Mongla Port

To assess the lag time and peak attenuation between Hiron Point and Mongla Port, daily peak tidal water level was taken into consideration for the period from May to July 2018. After that, data were plotted in the same graph for Hiron Point and Mongla Port which is presented in **Figure 2.34.**

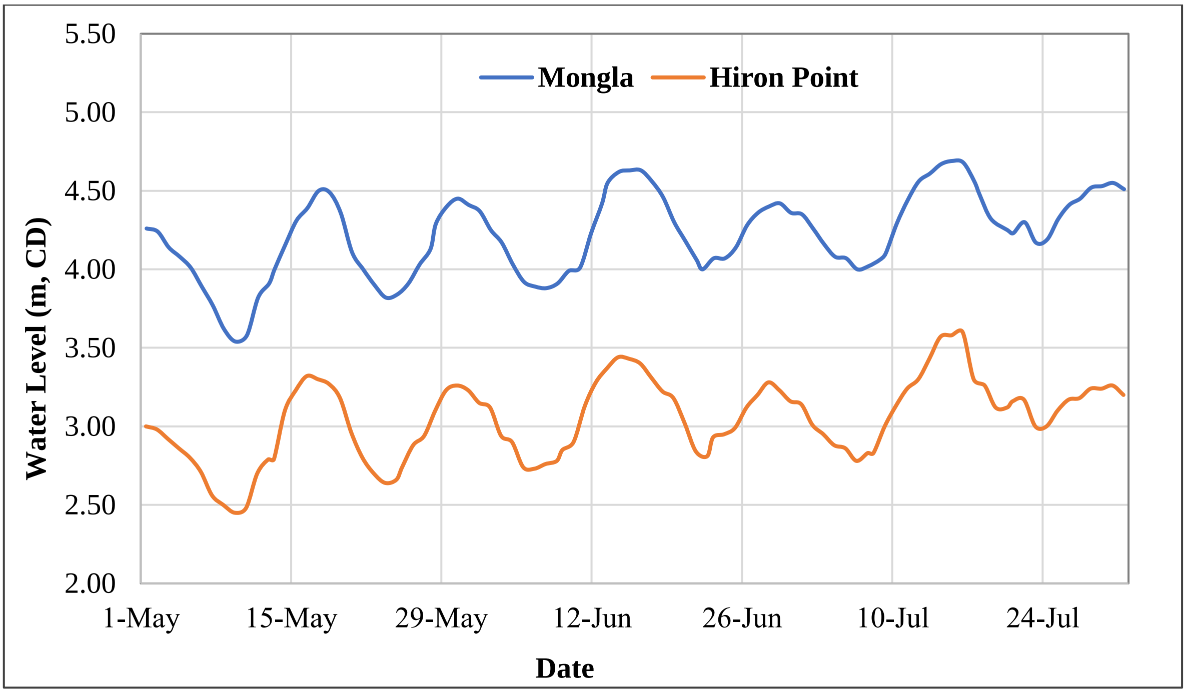


Figure 2.34: Peak water level at Hiron Point and Mongla Port for the period May-July 2018

Moreover, maximum water level and corresponding time during full moon and no-moon were assessed for the above two stations to find out the lag time and peak attenuation between two stations considering the distance between stations.

It is observed that during no-moon period, water level at Hiron Point reaches the peak of +3.27 m that propagates upstream towards Mongla Port where water level reaches the peak of +4.49 m later on the same day. Distance between Hiron Point and Mongla Port is approximately 80 km. The peak attenuation between this two stations is 1.22 m during no-moon period. It was also found that the travelling time or lag time to reach this peak is around 1 hour 25 minutes. The methodology is presented in **Figure 2.35.** Similarly, the peak attenuation and lag time were assessed for full moon period in May 2018 which are 1.19 m and 1 hour 25 minutes respectively.

Additionally, same analysis was done for the month of June 2018 and July 2018. It is observed that the peak attenuation during the month of June is 1.2m while it is 1.10 m in July while the lag time to reach peak water level from Hiron Point to Mongla Port for the month of June and July are 1 hour 20 minutes and 1 hour 15 minutes respectively.

It was found that average travelling time to propagate the peak water level through tide from Hiron Point to Mongla Port is about 1 hour 20 minutes while the peak attenuation is roughly 1.2 m.

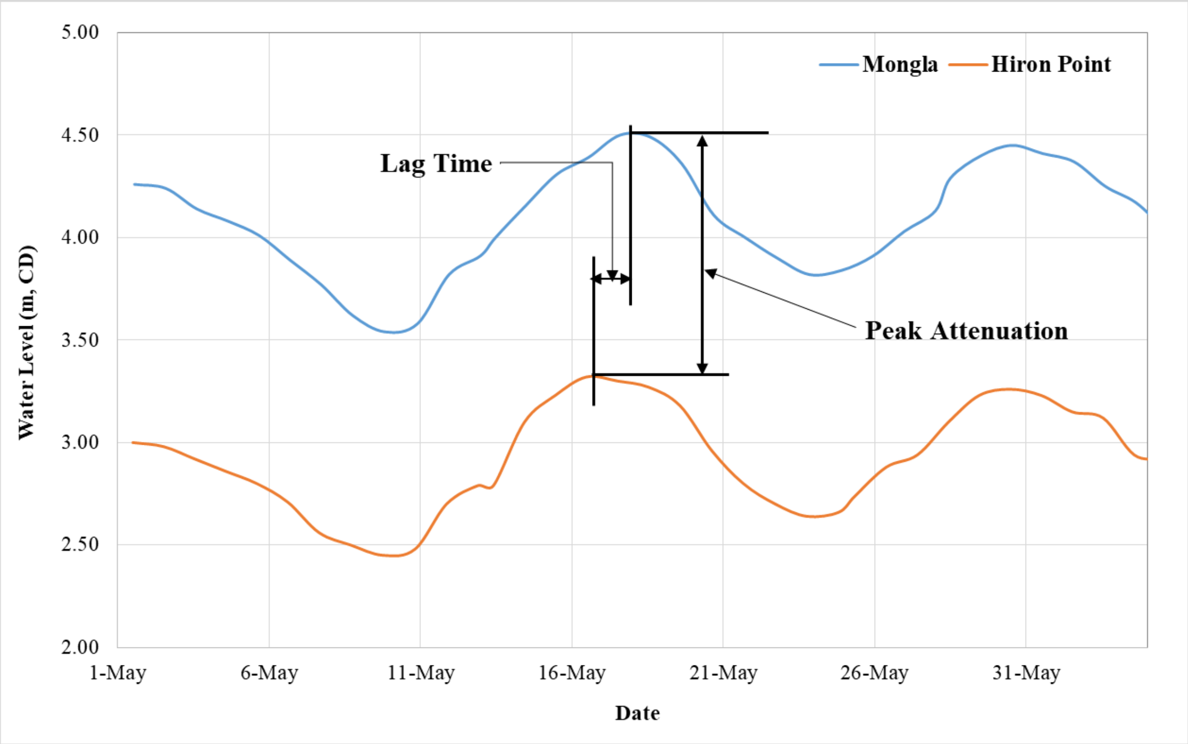


Figure 2.35 : Process of calculation of lag time and peak attenuation

Relation between Hiron Point and Mongla Port has been used to extrapolate the lag time and peak attenuation at Rampal Jetty area. The travelling distance from Mongla Port to Rampal Jetty area is 15 km., based on the relation, it is estimated that water level at certain peak at Hiron Point will need around 1 hour 35 minutes to reach at Rampal Jetty area where corresponding peak attenuation is nearby 1.43 m.

2.15 Monitoring of Chemical properties of bed materials

2.15.1 Methodology

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

Sampling Frequency

The frequency of monitoring for sediment quality is considered twice in a year (January and July). Accordingly, the sediment sampling was done in 17th quarterly monitoring (July, 2018). The sediment quality assessment is incorporated in 18th 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 monitoring is done in different sampling points. The major indicators for monitoring are heavy metals (As, Pb and Hg), pH and Sulfate. The selected heavy metals are mainly found in coal and assumed to pollute the sediment and water system during operation stage of power plant.

Location

The sampling locations are selected in both near places of project area and inside the Sundarbans. The sampling locations are stated in **Table 2.14**. Locations of collected samples are presented in **Figure 2.36**.

Table 2.14: 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″		

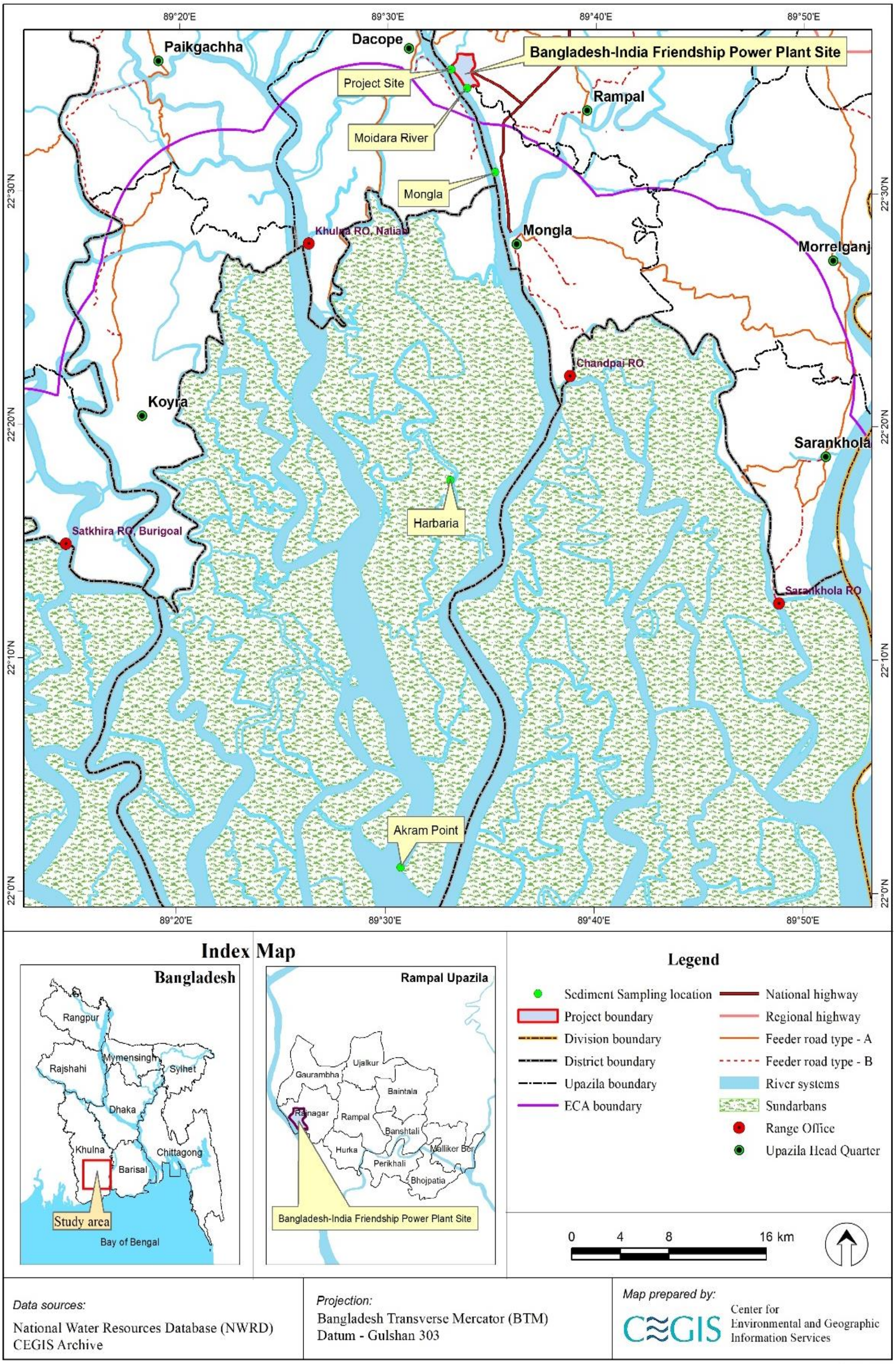


Figure 2.36: Sediment sampling locations

2.15.2 Process of Sediment Samples Collection

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

Sediment 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 have been handed over to the BCSIR, Dhaka for laboratory analysis immediate after 17th monitoring. The data is presented in **Table 2.15**.

Table 2.15: Sediment quality monitoring data at different locations of the Passur River

Site No	Location	Monitoring Parameter				
		pH	SO_4 (mg/kg)	As (mg/kg)	Pb (mg/kg)	Hg (mg/kg)
1	Project Site	8.61	184	5.37	6.03	1.38
2	Moidara River	8.18	297	3.65	6.59	1.5
3	Mongla Port	8.22	103	2.53	6.05	1.36
4	Harbaria	9.06	329	4.04	8.67	2.08
5	Akram Point	8.66	277	6.18	8.13	1.81

2.15.3 Status of sediment quality of the Pasur River

Sediment quality analysis data is incorporating from this monitoring (18th monitoring). So that, this will be used as baseline condition or primary sediment condition of the observed points. The change of sediment quality will be stated in following monitoring reports.

According to the analyzed data none of these metals showed any specific trend, whether it increased or decreased, following upstream or downstream. In general, the maximum concentration of Pb and Hg is observed in Harbaria while As showed its maximum at Akram point. None of these metals exceed reference level stated in different literature **(Table 2.16)**. The average concentration of As, Pb and Hg in 17th monitoring is 4.4 ppm, 7.1 ppm and 1.6 ppm respectively. Only As concentration exceed the average value near project site.

Table 2.16: Reference level of different metals in sediment of the Passur River

Sl No.	Name of Heavy metal	Average Shale Value (ppm)	Average heavy metal content in the Pasur River, M M Ali, et al, 2018. (ppm)	
			Summer	Winter
01.	Arsenic (As)	13	8.87	12.4
02.	Lead (Pb)	20	21.9	33.6
03.	Mercury (Hg)	18	-	-

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 project site were categorized into three major groups and monitored quarterly with the aim to establish baseline conditions to compare with the probable impact of proposed project in place. These groups include fisheries resources, ecological resources and Sundarbans Reserve Forest (SRF).

3.1 Fisheries Resources

The monitoring of seventeen quarters for the session of 2014-15, 2015-16, 2016-17, 2017-18 as well as of 2018-2019 were completed and reported earlier. This chapter contains the findings of 18th quarter and comparison with the earlier seventeen (17) 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). Fish migration status was monitored through assessing migratory fish species diversity, migration pattern, migration purpose, period and extent of migration etc. Species evenness, species richness and community structure were investigated for monitoring fish diversity. Shrimp/fish farm practice was monitored by viewing stocking pattern, growth rate and mortality rate. Fish production monitoring was divided into capture and shrimp/fish farm production.

3.1.1 Methodology

Fish Habitat Status

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 analyzed using the Jaccard Index (JI) for estimating the extent of similarity between pairs of data sets. Basic life requirements for fish community are given in **Table D.1 of Appendix IV.**

Fish Migration

Migratory species were identified 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

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

Fish Production

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

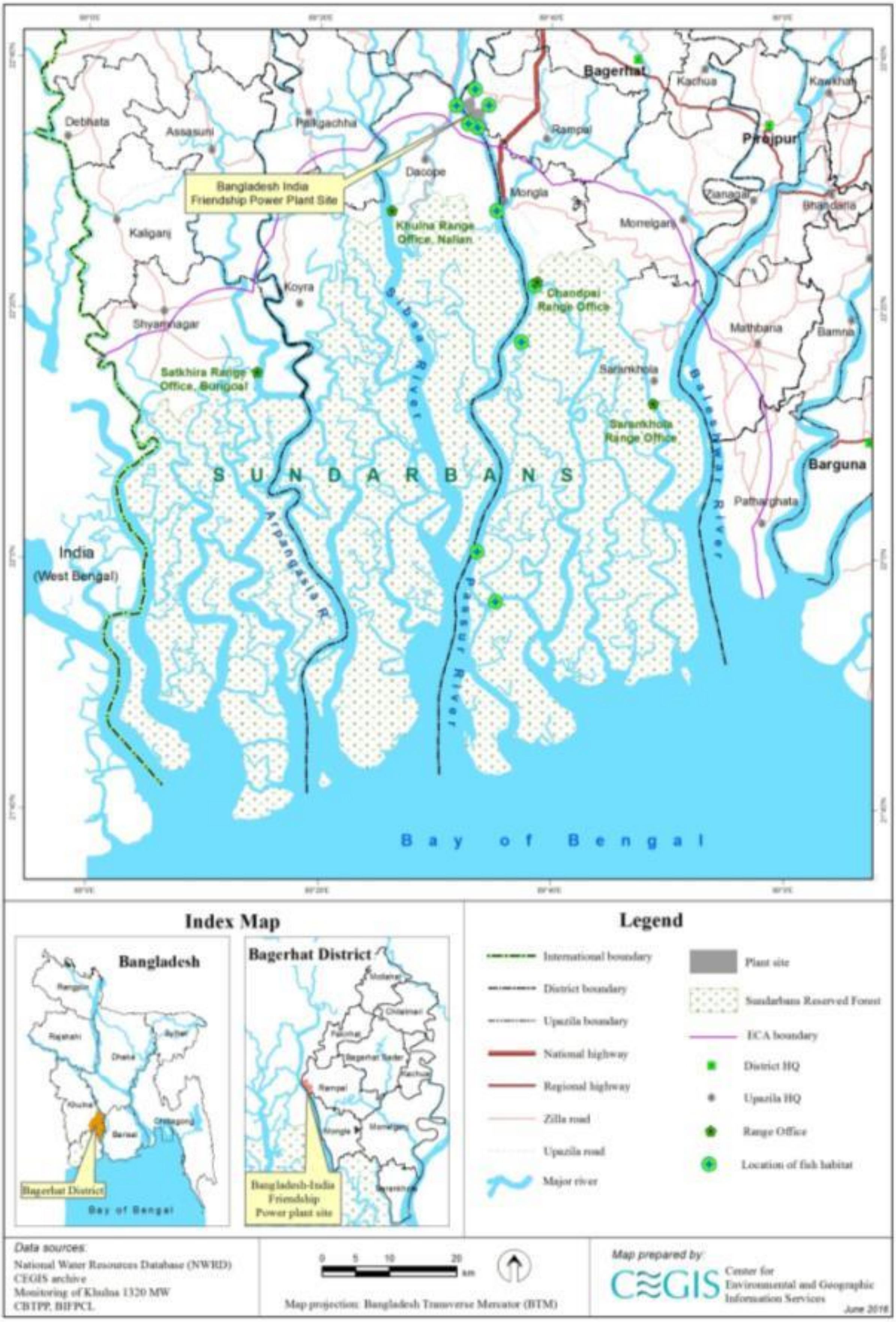


Figure 3.1: Fisheries Resources Monitoring Locations

3.1.1 Status of monitoring

Followed by the quarter monitoring of the 2014-15, 2015-16, 2016-17, 2017-18 and 2018-19 (up to 17th quarter monitoring), 18th quarter monitoring of session 2018-19 was conducted during the period from 11 November to 20 November, 2018. No fishing activities were observed in Charaputia (C), Bhodra Khal (D), the confluence point of Passur-Jongra Khal (F) and the Mongla Point (H) during field visit in this monitoring.

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.

(a) 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 18th quarter monitoring according to the ToR in respect of habitat uses for previous quarters of fisheries monitoring (Table 3.2).

Table 3.2: Classification of habitat use of 10 sampling sites

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

Monitoring Quarter	Type of Habitat Use
	• Feeding and Breeding Ground
11th (October, 2016)	• Breeding and Spawning Ground • Feeding and Grazing Ground
12th (January, 2017)	• Grazing and Spawning Ground • Nursing Ground
13th (April, 2017)	• Grazing and Feeding Ground • Nursing Ground
14th (October, 2017)	• Grazing and Feeding Ground • Nursing Ground
15th (January, 2018)	• Grazing and Feeding Ground • Nursing Ground
16th (April, 2018)	• Feeding ground • Growing ground • Nursing ground
17th(November, 2018)	• Spawning and Nursery Ground • Nursery Ground with Feeding and Growing Capacity • Growing and Feeding Ground • Omni-ground

During the 18th quarterly monitoring of 2017-18, the sampling sites were divided into major two classes which are described in the following sections and are shon in **Figure 3.2.**

1. Ground for Maturation: The confluence of the Passur-Haldikhali Khal (B) was found to support single length group (10-20cm) of Tular Dandi (Maximum Length, L_{max} = 44cm; Length at Maturity, L_{mat} = 12 cm) (McKay, R.J., 1984) and Koidda Poma (L_{max} = 45 cm; L_{mat} = 15cm) (Rahman, 1989 and 2005; Huda et al., 2003). It is indicated that the mentioned confluence was used as the ground for maturation for observed fish species.

2. Omni-Ground: Another classes, found to support multi-length groups (from 1cm to above 25cm length groups) of observed fish species, was considered as the omni-ground for fishes. This class was also bifurcated in to two major habitats - i) Nursery and Feeding Ground and ii) Growing and Feeding Ground.

(a) Nursery and Feeding Ground/Migratory Route

Among the sampling sites, the Chalna Point, confluence of the Passur and Rupsa Rivers (J) was identified as the nursery ground for very high abundance of fry fishes. Besides fry fishes, adult of Hilsa and other fishes were also found in this site. It is, therefore, supposed that the adult fishes may use this habitat for feeding and/or migratory route.

(b) Ground for Maturation

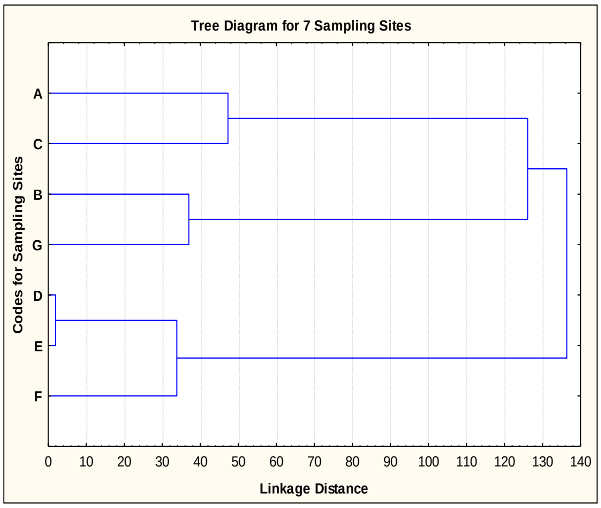
The sampling sites, A, G, E and I, were found to be rich in 3-5cm and 5-10cm length groups, known to as the maturation stage, of different fish species (Rahman, 1989 and 2005; Huda et al., 2003). These sites was, thus, considered as the ground for maturation in respect of the observed fish species. These sites was also classified as follows:

(c) Growing and Maturation Ground

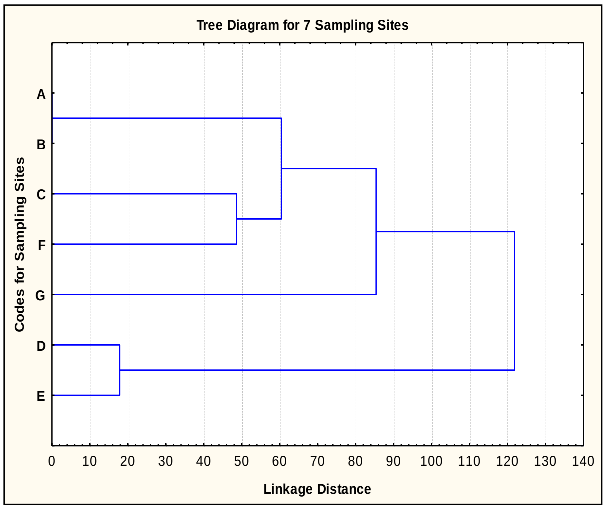
Among the sampling sites, the Akram Point (A) and the Moidara River (I) were found to be moderately rich (about 50%) in both the 3-5cm and 5-10cm length groups. These sites were, thus, considered as the growing ground for 3-5cm length-groups and maturation ground for 5-10cm length-groups for observed fishes. Fry fishes were also found in the Moidara River (I).

(d) Maturation Ground for Juveniles

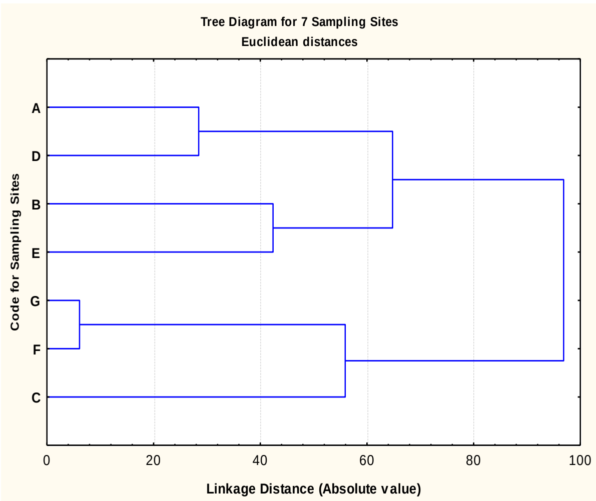
Among the sampling sites, Harbaria Khal (E) and Sheola Khal at Chandpai (G) were found to be highly rich in 3-5cm length-group of particularly small-sized observed fish species, which is known as the length at maturation for these species (Rahman, 1989 and 2005; Huda et al., 2003). These sites was, therefore, considered as the maturation ground for juveniles.



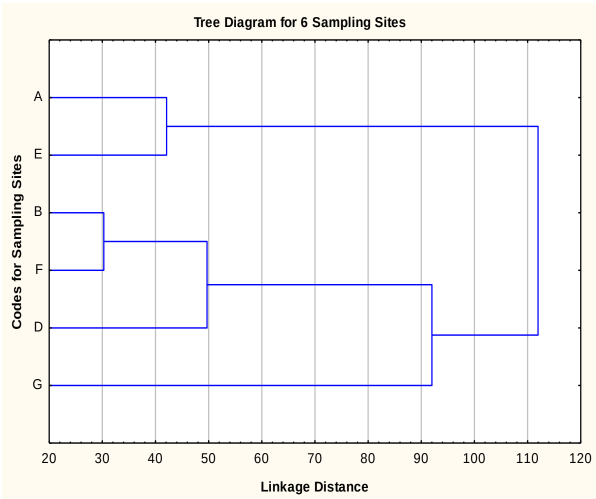
1st Monitoring, April, 2014



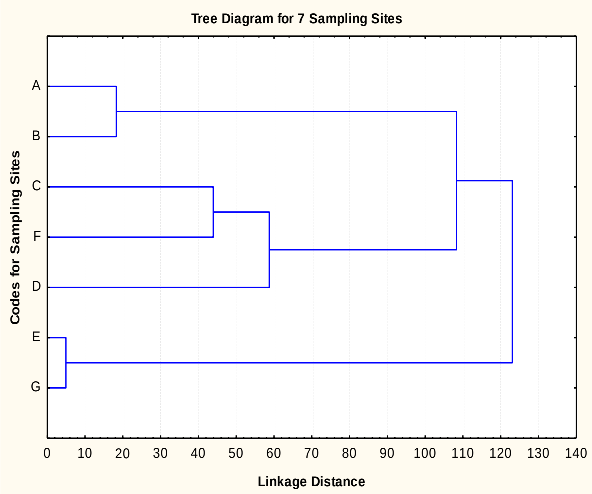
2nd Monitoring, July 2014

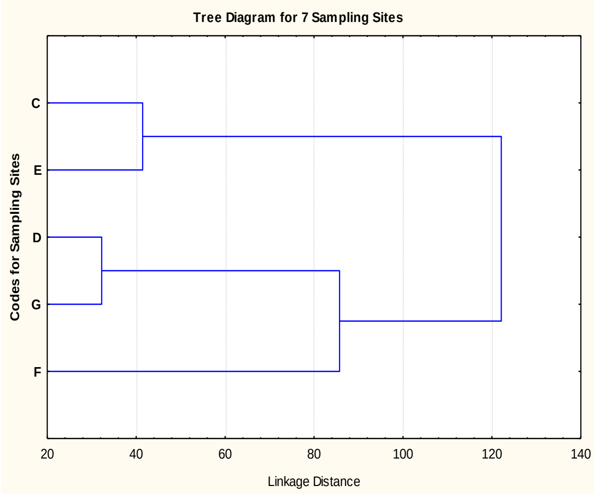


3rd Monitoring, October, 2014



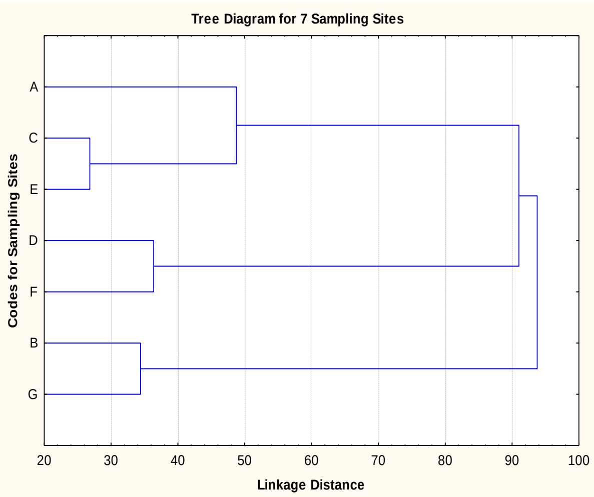
4th Monitoring, January 2015

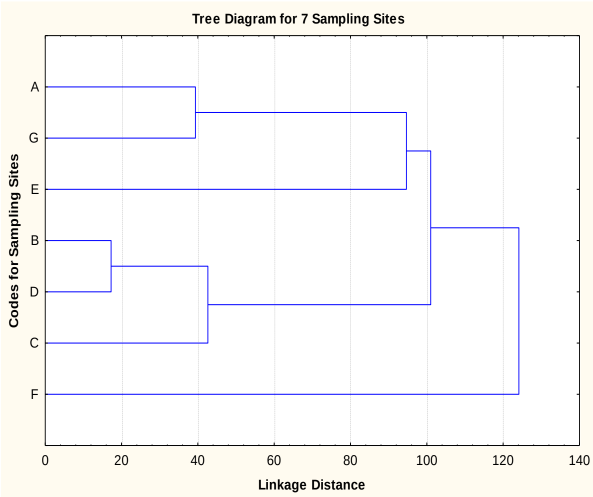




5th Monitoring, April, 2015

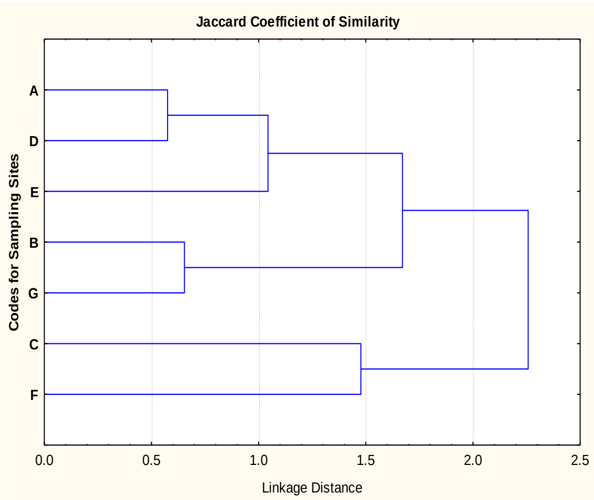
6th Monitoring, August, 2015

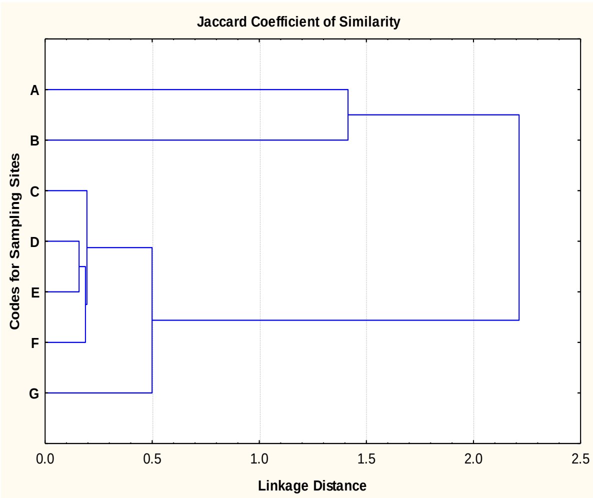


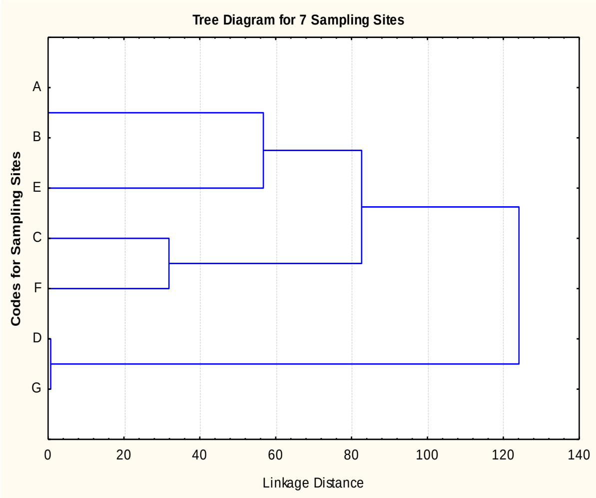


7th Monitoring, October, 2015

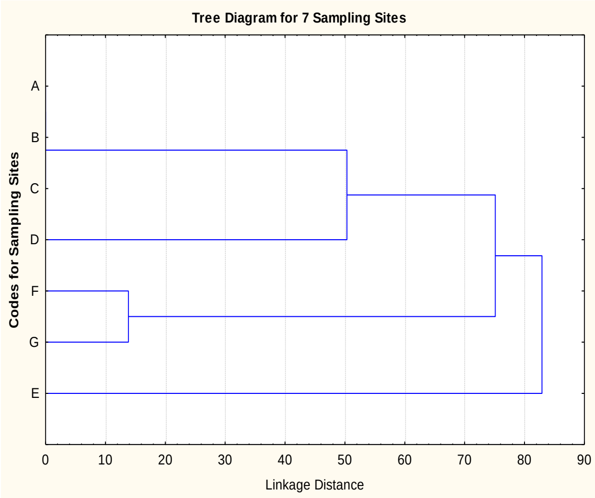
8th Monitoring, January, 2016







9th Monitoring, April, 2016



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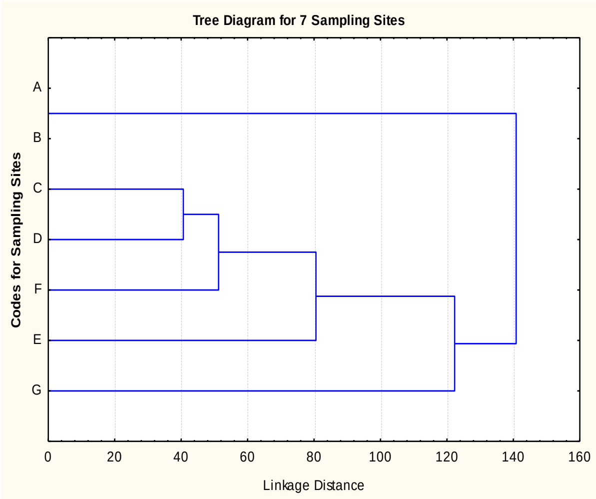
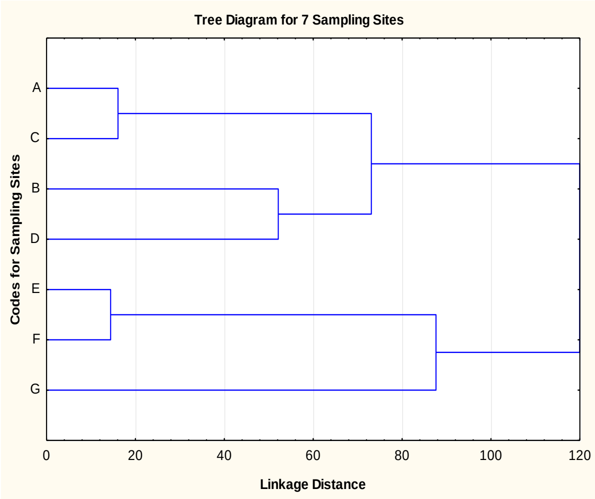
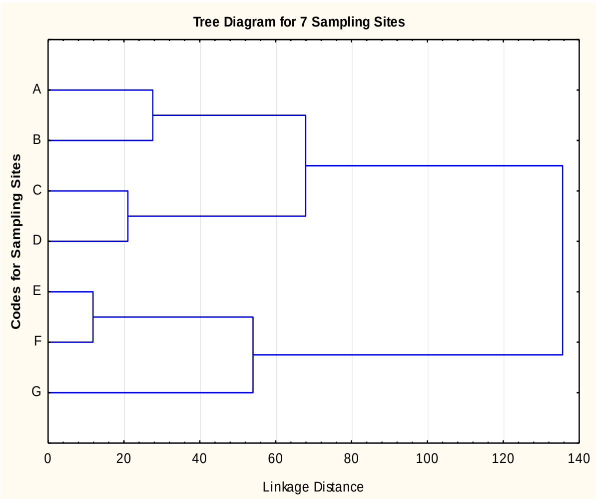


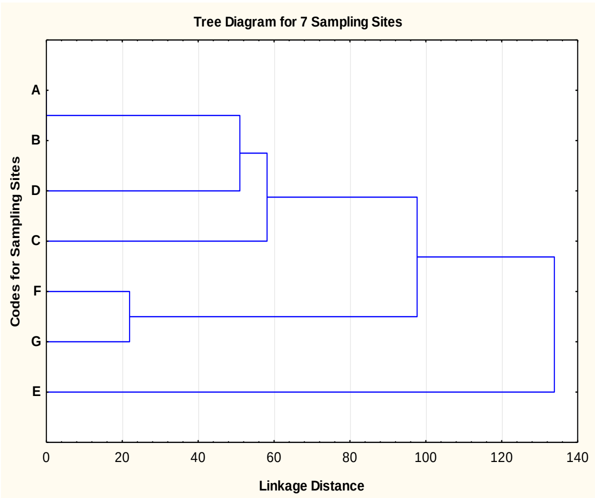
11th Monitoring, October, 2016



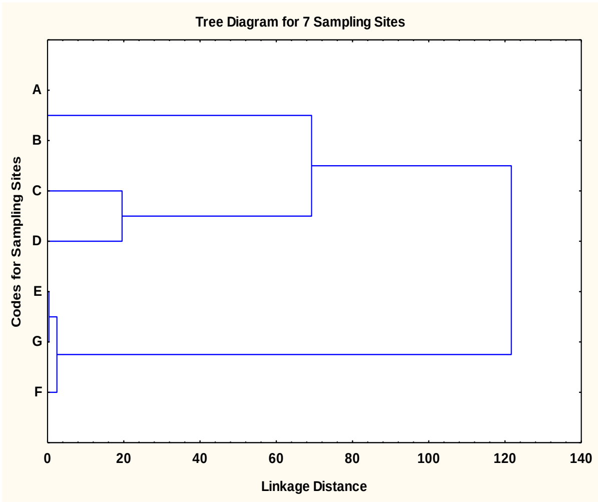
12th Monitoring, January, 2017



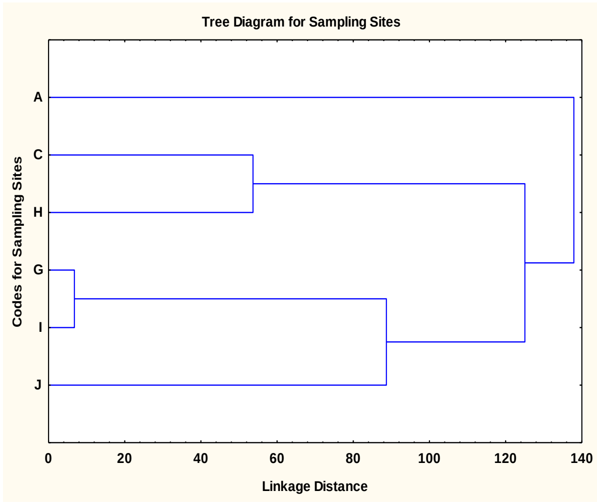
13th Monitoring, April, 2017



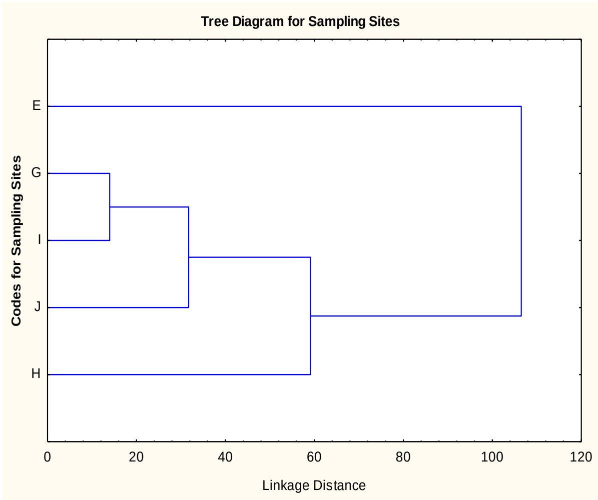
14th Monitoring, October, 2017



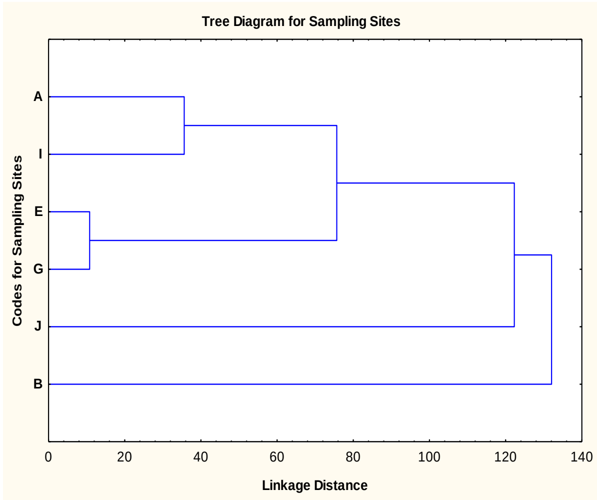
15th Monitoring, January, 2018



16th Monitoring, April, 2018



17th Monitoring, July, 2018

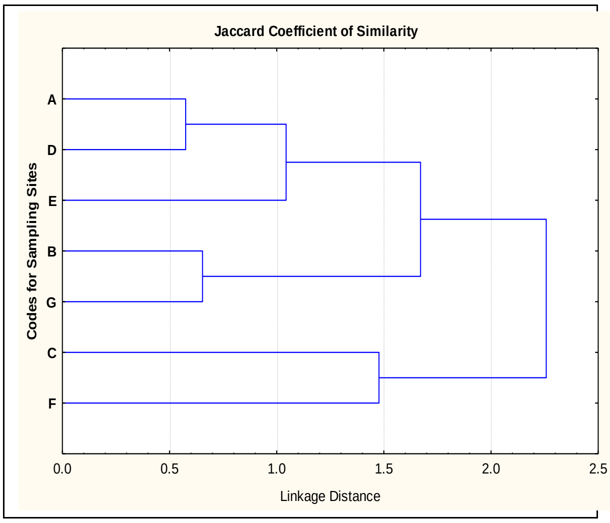


18th Monitoring, November, 2018

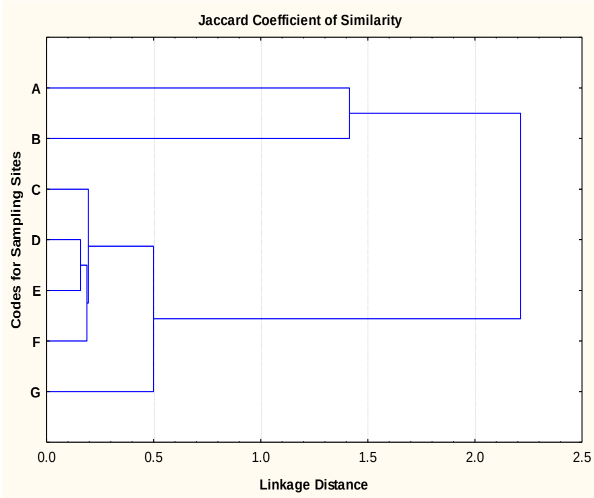
(Note: Life stages are identified through length measurement of the fish individuals)

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

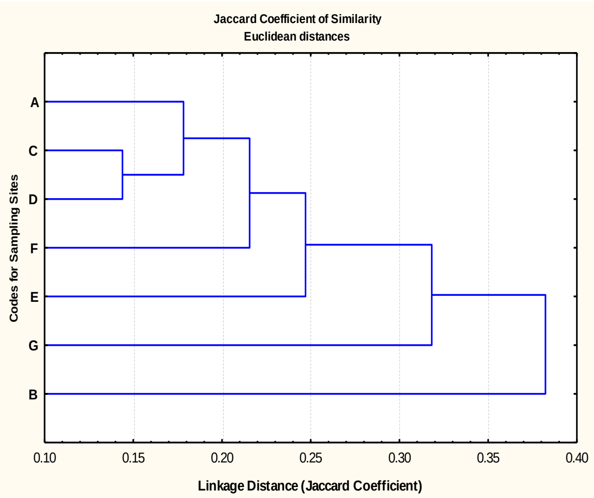
The dendogram indicated the distances among the JI (Jaccard Coefficient Index) indices which are opposite to the JI values. It was found that the length-wise distribution relationship varied not only with the seasons but also with the year to year. In this quarterly monitoring in 2018-19 (18^{th}), the JI value between the Sheola Khal at Chandpai (G) and the Maidara (I) sampling sites were the highest (**Figure 3.3**) which indicates the maximum similarity in species occurrence between these two sites out of 13 sampling sites.



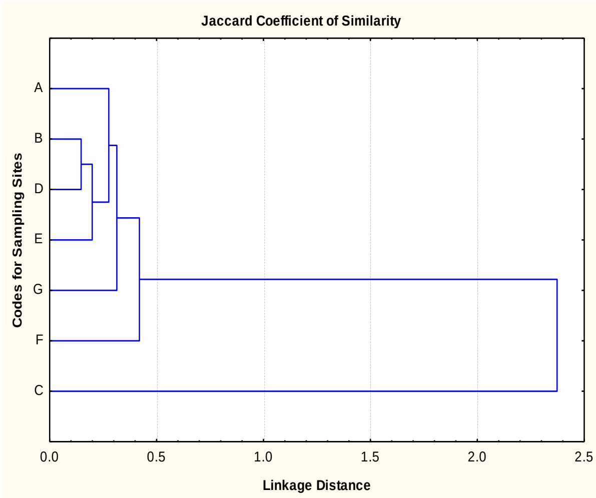
1st Monitoring, April, 2014



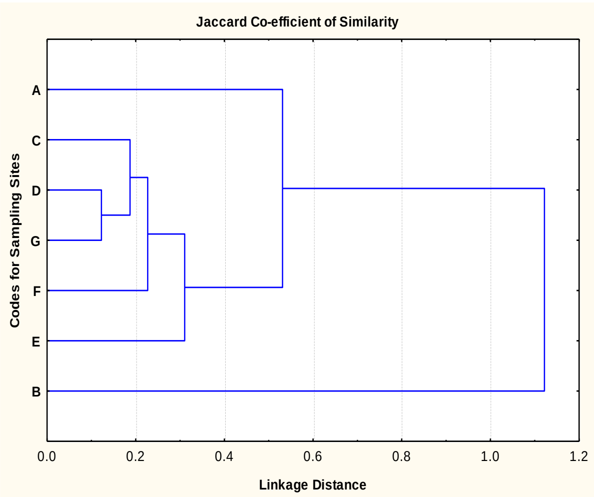
2nd Monitoring, July 2014



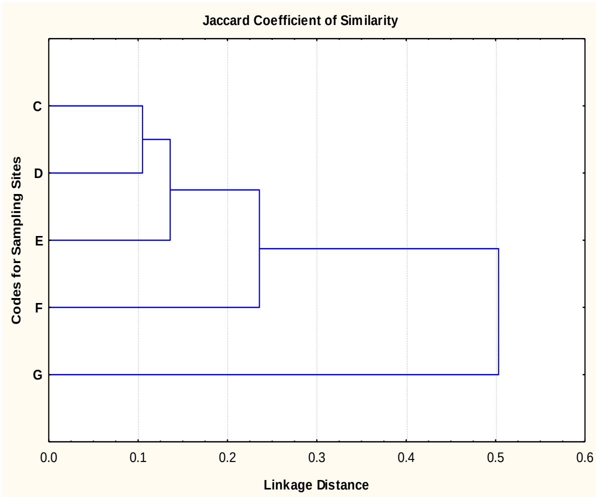
3rd Monitoring, October, 2014



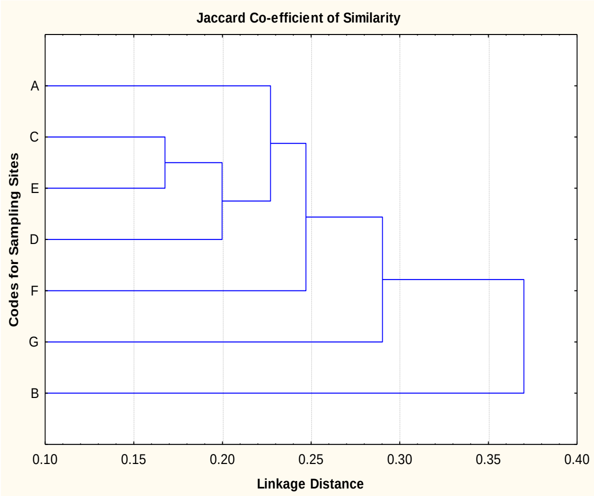
4th Monitoring, January 2015



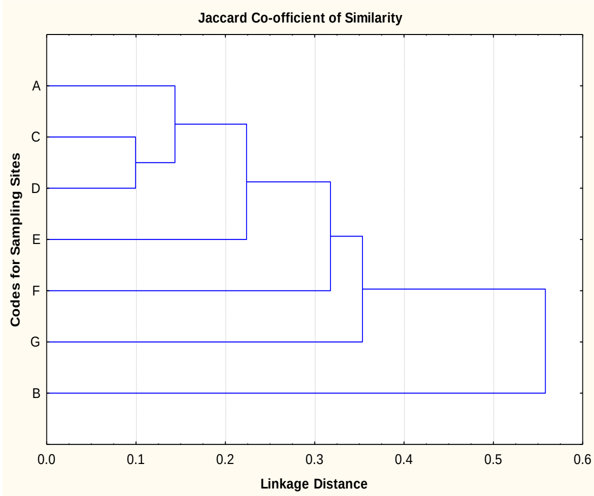
5th Monitoring, April, 2015



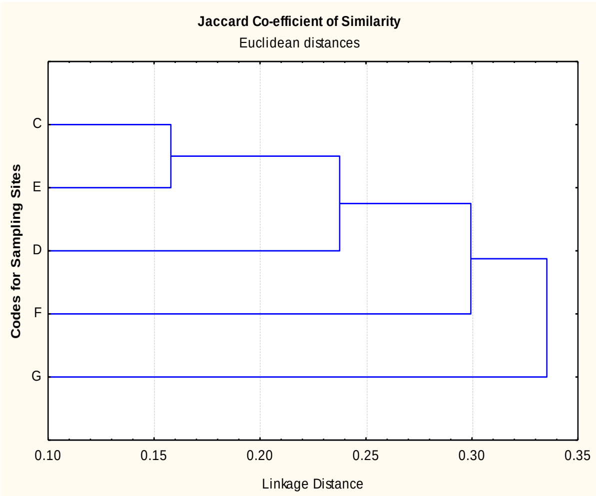
6th Monitoring, August, 2015



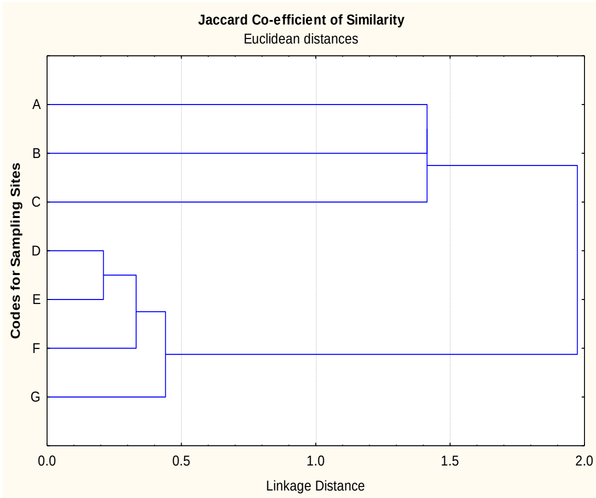
7th Monitoring, October, 2015



8th Monitoring, January, 2016



9th Monitoring, April, 2016



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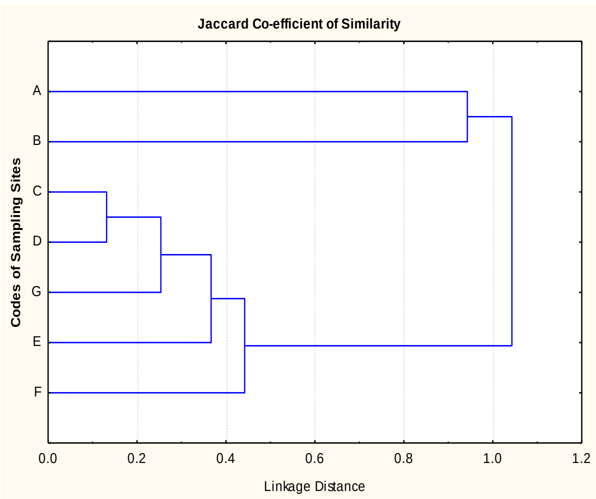
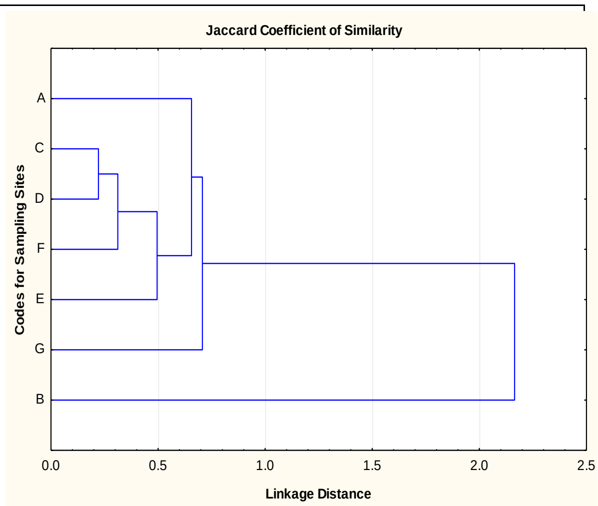
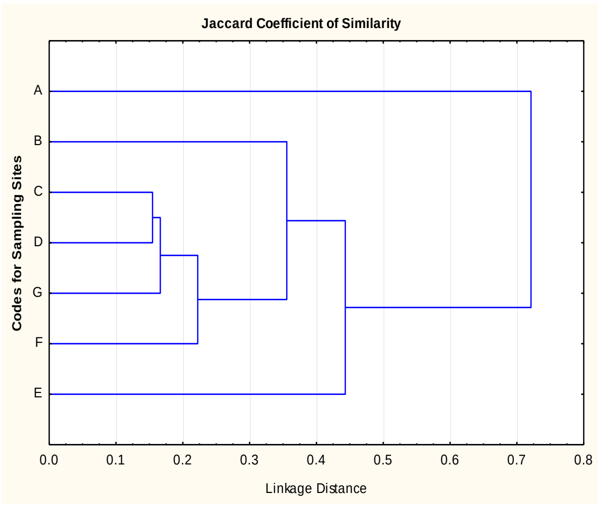


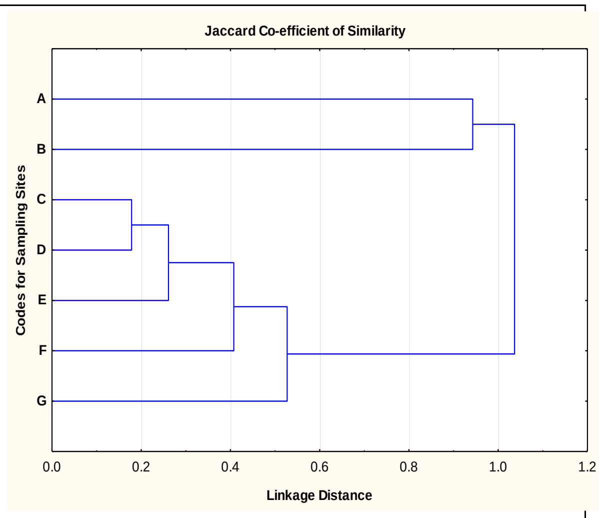
11th Monitoring, October, 2016



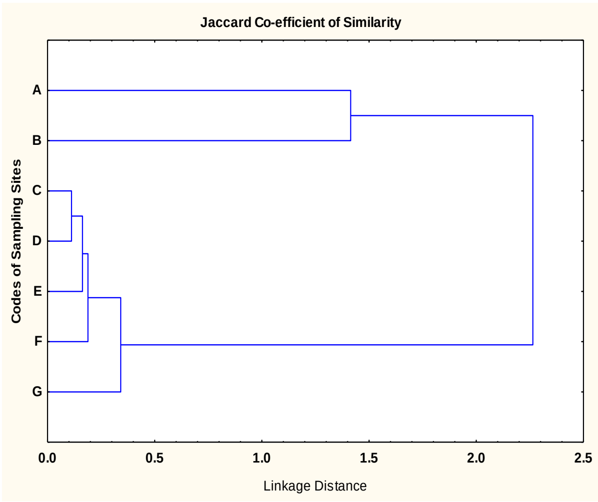
12th Monitoring, January, 2017



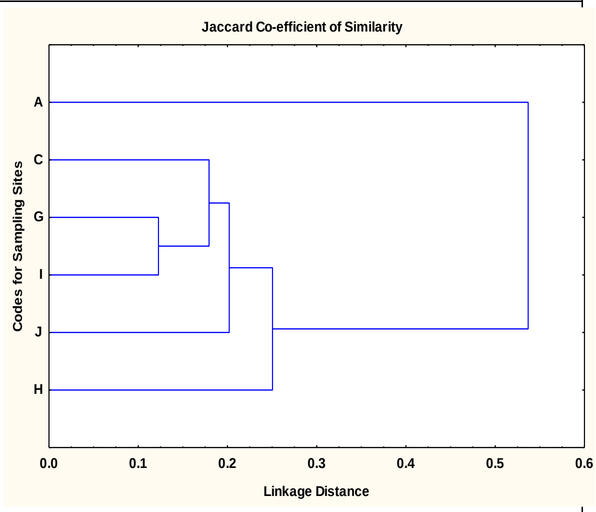
13th Monitoring, April, 2017



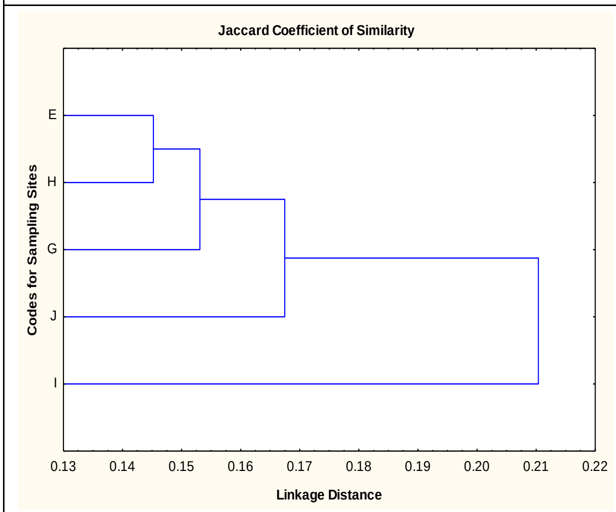
14th Monitoring, October, 2017



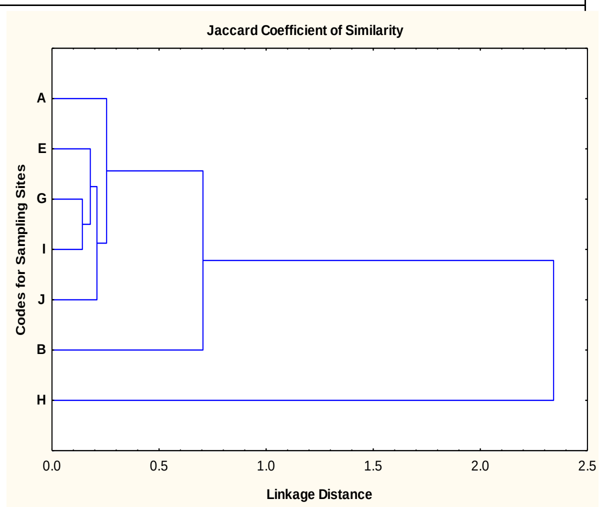
15th Monitoring, January, 2018



16th Monitoring, April, 2018



17th Monitoring, July, 2018



18th Monitoring, November, 2018

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

(e) 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).**

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

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

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

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

Fish Diversity

Shannon-Weiner Index

In this monitoring year of 2018-19, species evenness also varies among the sampling sites. Highest Shannon-Weiner index was found in the confluence of the Passur and the Haldikhali Khal (0.92 out of 2 species) indicating most evenly distributed fish species. On the contrary, lowest evenness was found at the Sheola Khal in Chandpai (0.34 out of 19 species) (shown in the **Table 3.3**). It has also been found that both the number of fish species found in in-situ catch and the evenness of their distribution within the sampling sites show high variation with the changing seasonal and yearly bio-physical conditions.

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 3.5** and **Figure-3.5**).

In this monitoring phase, species richness varies with the sampling sites. Maximum FSR 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.

obtained in the Maidara River (n=9), while very low FSR was recorded at the Akram Point (n=1). Different scenarios of richness were found in this quarter in comparison to the previous monitoring years. Among habitats in upstream portions of the Passur River, Maidara River was home to a rich assemblage of Bairagi, Chali Chingri, Motka, Horina, Chapila, Dogri, Poma, Bele, Tit Punti and Banspata; and Chalna Point was of Bairagi and Chanda. Among the habitats in down stream portions, Chandpai was rich in Bairagi and Motka Chingri; Harbaria was in Motka, Chami Chingri, Gagra Tengra and Horina, Haldikhali was in Koidda Poma and Tular Dandi and Akram Point was in Paissa. No catch was observed in Jongra, Bhodra, Charaputia, and Mongla Point in monitoring of this quarter.

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

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

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

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

Table 3.5: Site wise Rich Species Number

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

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

Rupchanda in 1stQuarter of 1st Year

Chela in 2nd Quarter of 1st Year

	
Phesa, Chela, Hilsa, Gagla Tengra	Harina Chingri

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

	
Amadi Chela	Banspata

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

	
Adult Poma in Chalna Point	Fry of Bagda at Chalna Point

Meth and Gagra Tengra

Gagra Tengra

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

Mutkure and Paissa

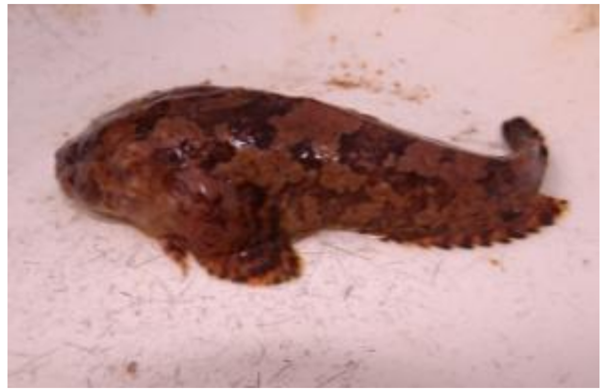
Khorsula

Menu

Vetki

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

Gulsha Tengra, Bele, Aswine Bele and Paissa



Gangania

Telcupa

Golda

Kain Magur

A Mix of Culture and Capture Fishes

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

Tau Paissa

Bele

Horina Chingri

Gulsha and Gagra Tengra

Jaba

Female Gulsha Tengra

Fry Fishes

Chata Bele

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

Kain Magur

Banspata, Vetki, Koidda and Poma

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

Poma and Tapsi

Tapsi

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

Miscellaneous Fish Species

Hilsha

Tapse

Poma and Tapse

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

Catch Sample

Juvenile of Kain Magur

Khayra Chela

Jevenile of Pangas

Brood Paissa

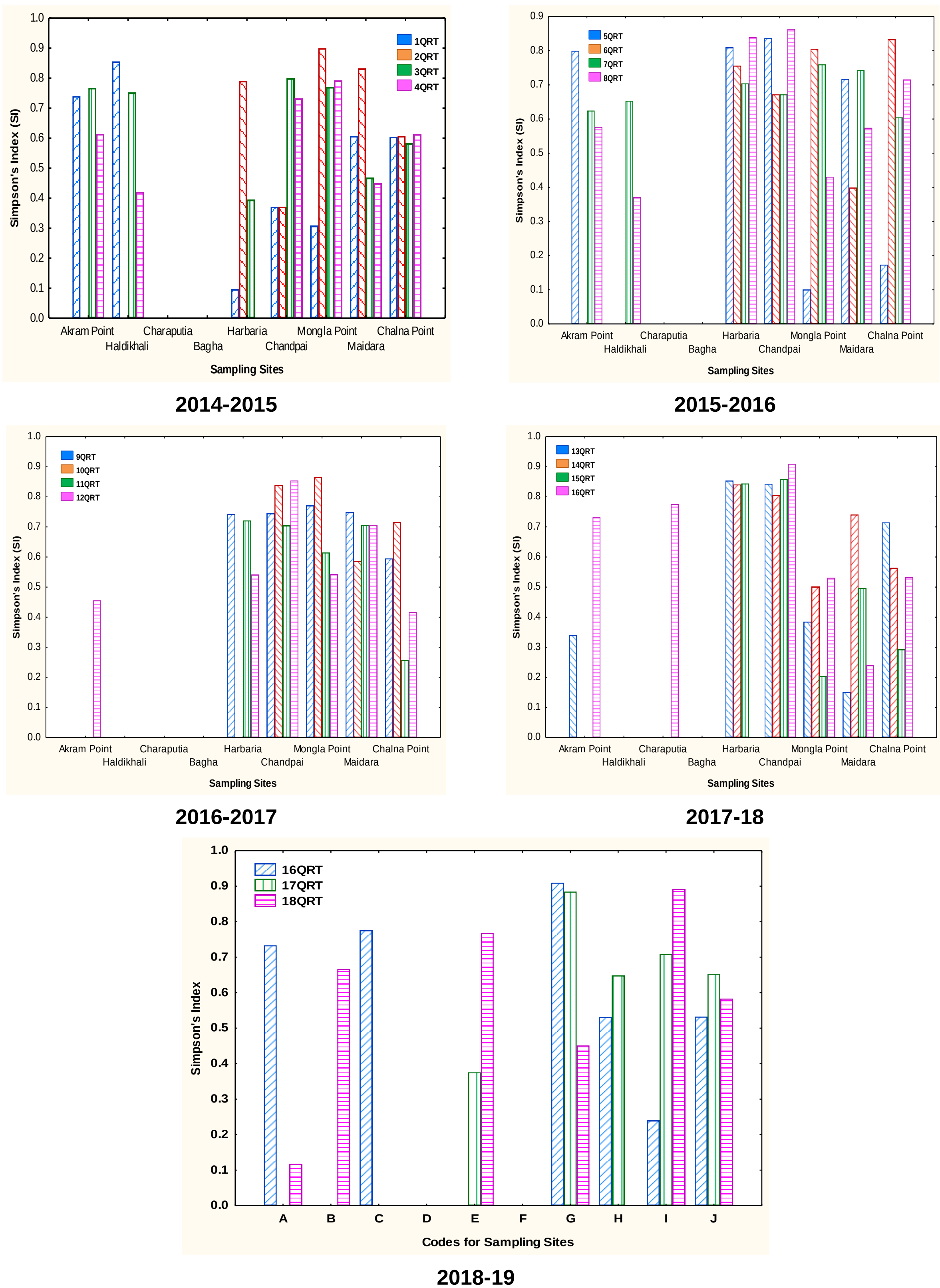
Paissa and Gagra Tengra

Aswene Bele, Daitna, Tapse and Chitra

Dry Fish of Khayra Chela

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

Figure 3.4: Length-wise distribution of fish species

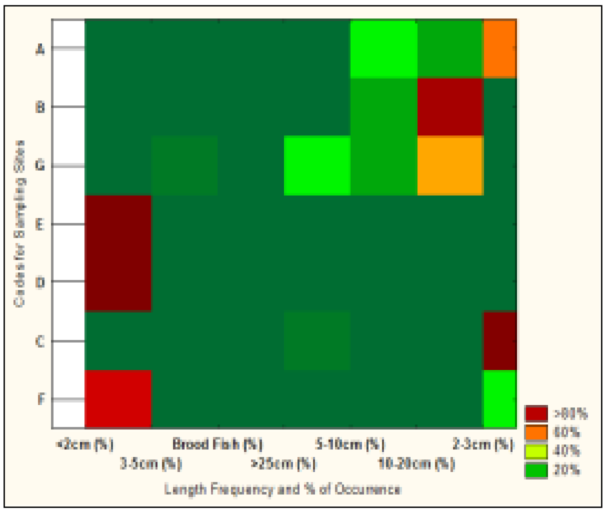


(FSR is identified though Simpson's Index)

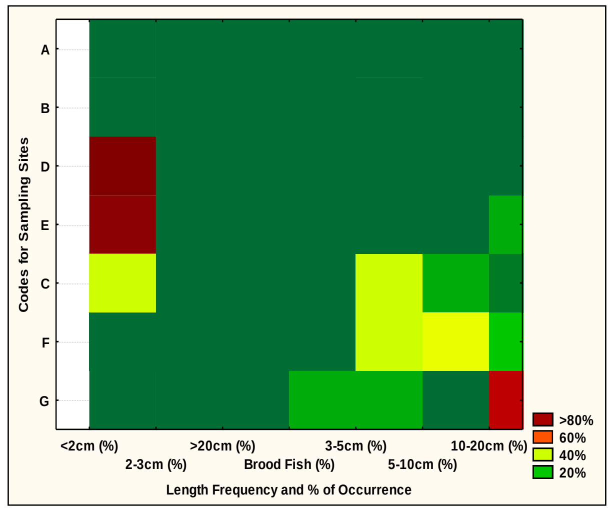
Figure 3.5: Site-wise fish species richness (FSR) in the Passur River System.

Fish Community Structure

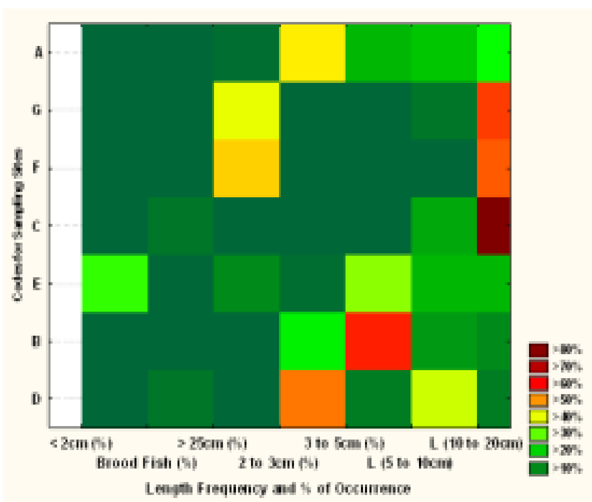
Fish community structure was analyzed through counting the length-wise fish individuals (**Figure 3.6**). The following Table **D.2** and **D.3** of **Appendix IV** and show that fries of fin fish were widely distributed from middle stretches to the upper stretches (Harbaria to Chalna Point) and juveniles and adult age group in Sheola Khal at Chandpai, Maidara and Chalna Point of the Passur River system. Among the fishes Bairagi, Banspata, Bele, Chela, Gagra Tengra, etc. were more between the two sampling sites. Moreover, fries were dominant at the Maidara and Chalna-Passur Confluence. Adults of large-sized fishes were observed at Chalna and Akram Point in this quarter monitoring.



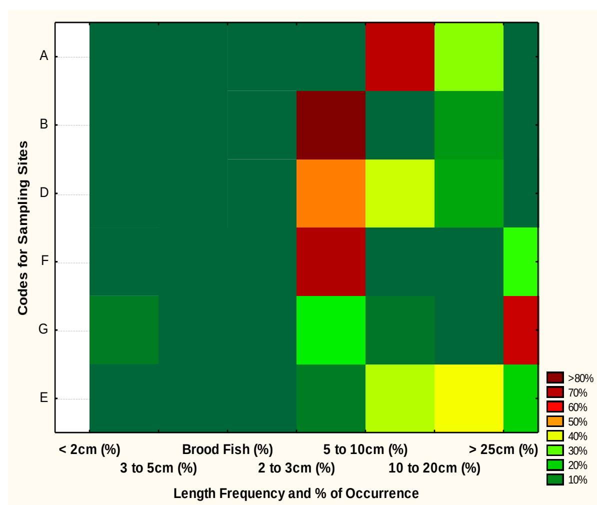
1st Monitoring, April, 2014



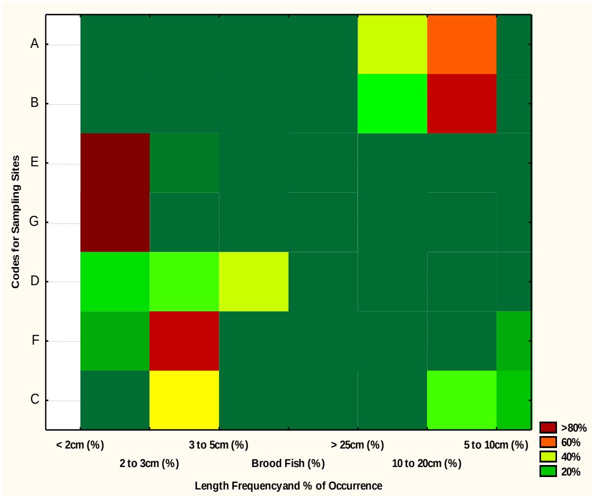
2nd Monitoring, July 2014



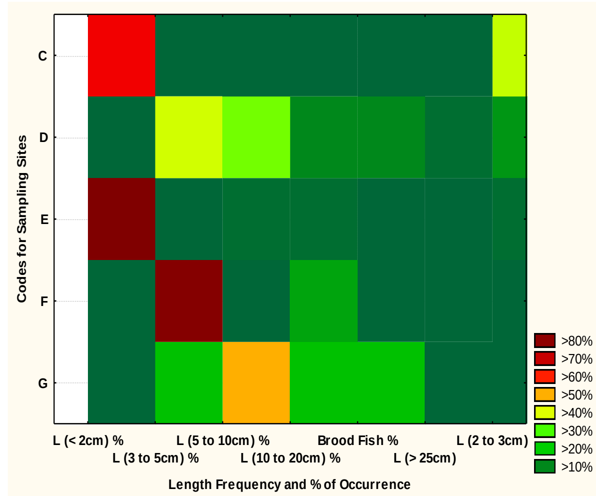
3rd Monitoring, October, 2014



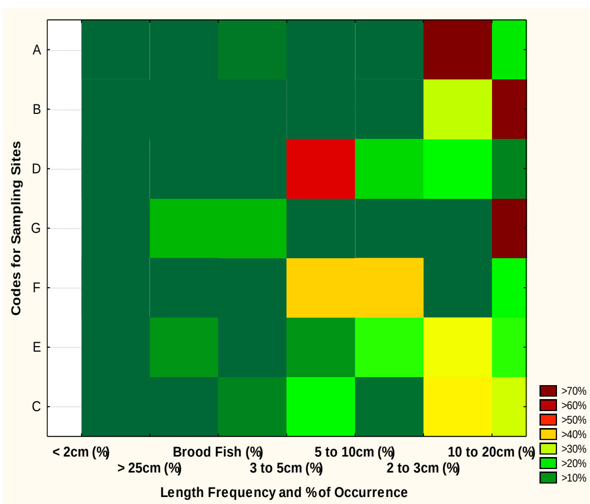
4th Monitoring, January 2015



5th Monitoring, April, 2015



6th Monitoring, August, 2015



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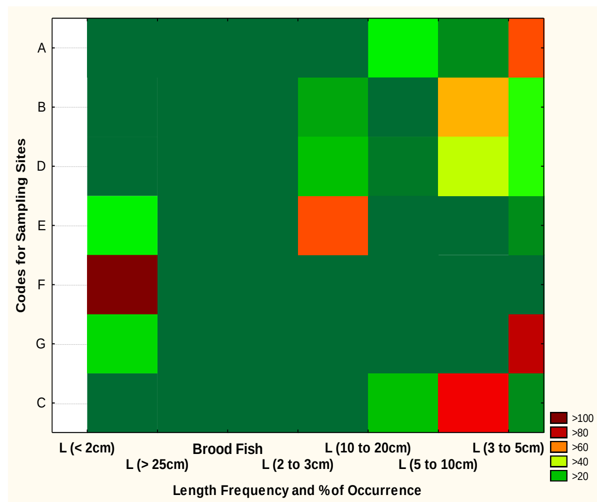
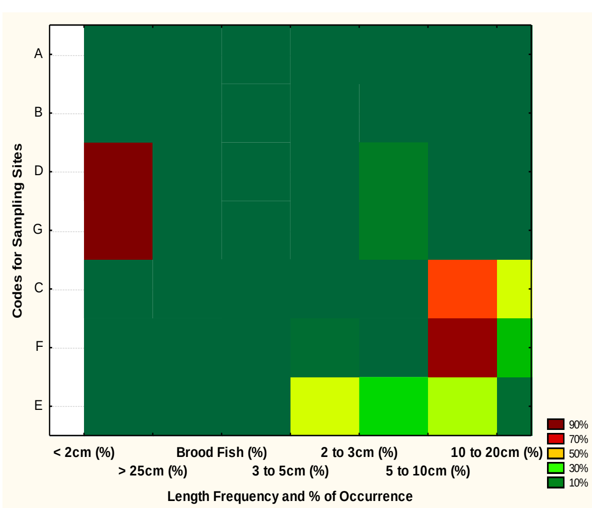
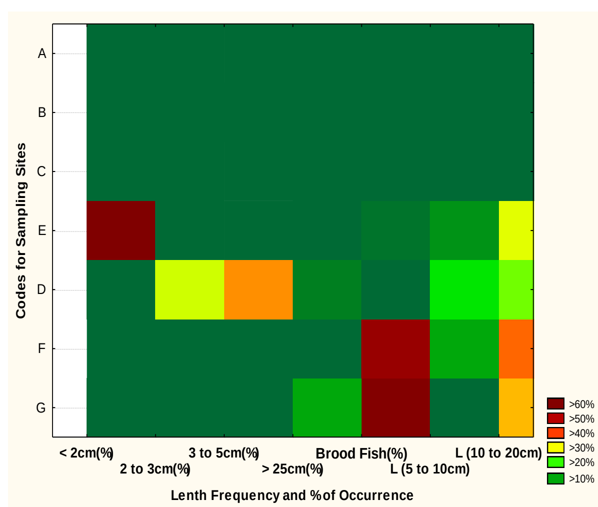


8th Monitoring, January, 2016



9th Monitoring, April, 2016



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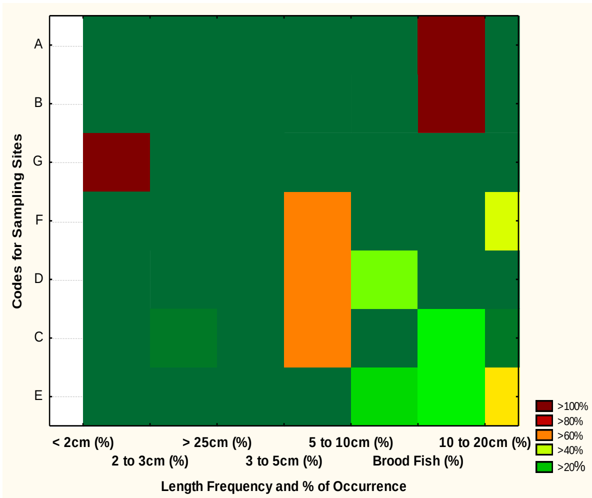

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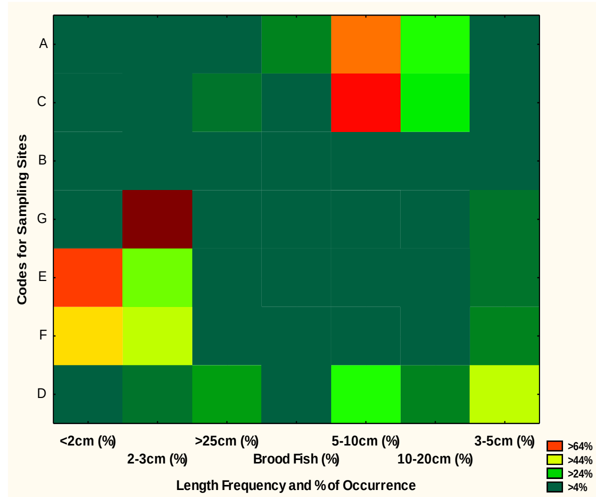
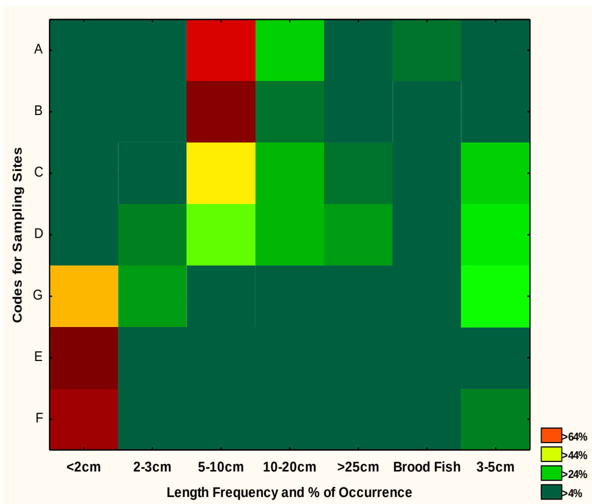
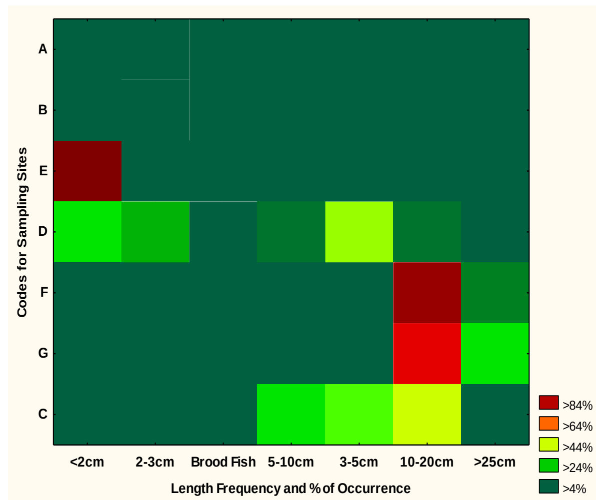


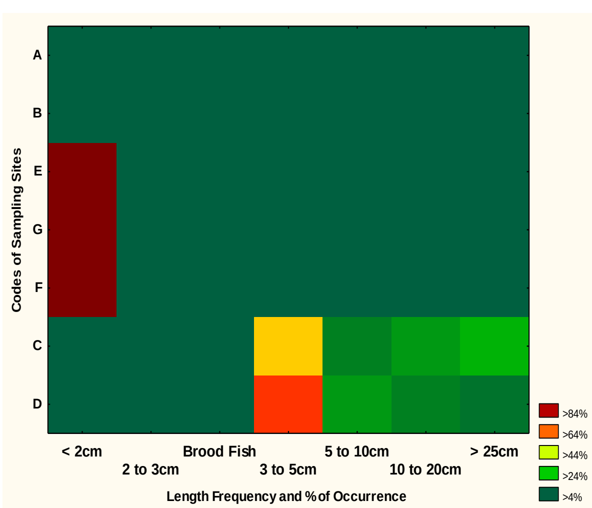
12th Monitoring, January, 2017



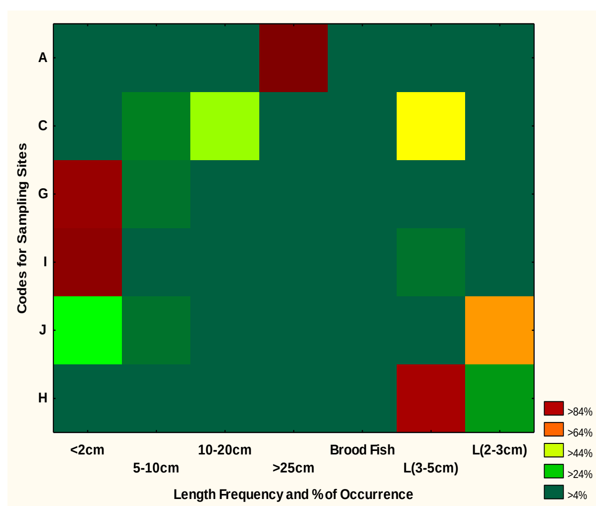
13th Monitoring, April, 2017



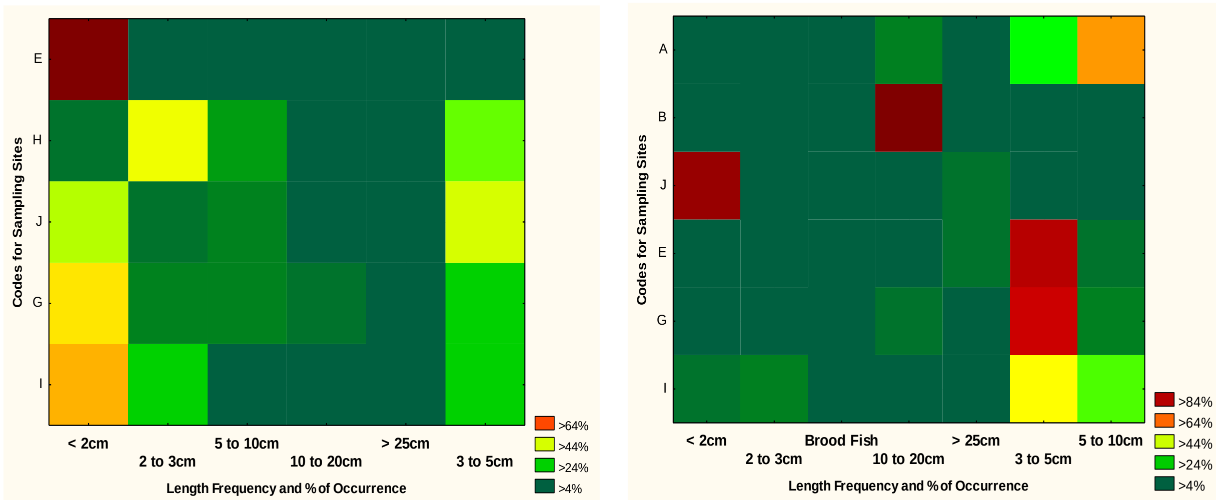
14th Monitoring, October, 2017



15th Monitoring, January, 2018



16th Monitoring, April, 2018



17th Monitoring, July, 2018 **18th Monitoring, November, 2018**

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

Migratory Species Diversity

Migratory species were identified by analyzing the common species available in the regular catch from the sampling sites. Fish species like Bairagi (Amadi Chela) attains the maximum abundance among the migratory fish species observed in the 18th quarter of monitoring year, 2018-19. The relative abundance of the migratory species is given below in the **Figure 3.7**.

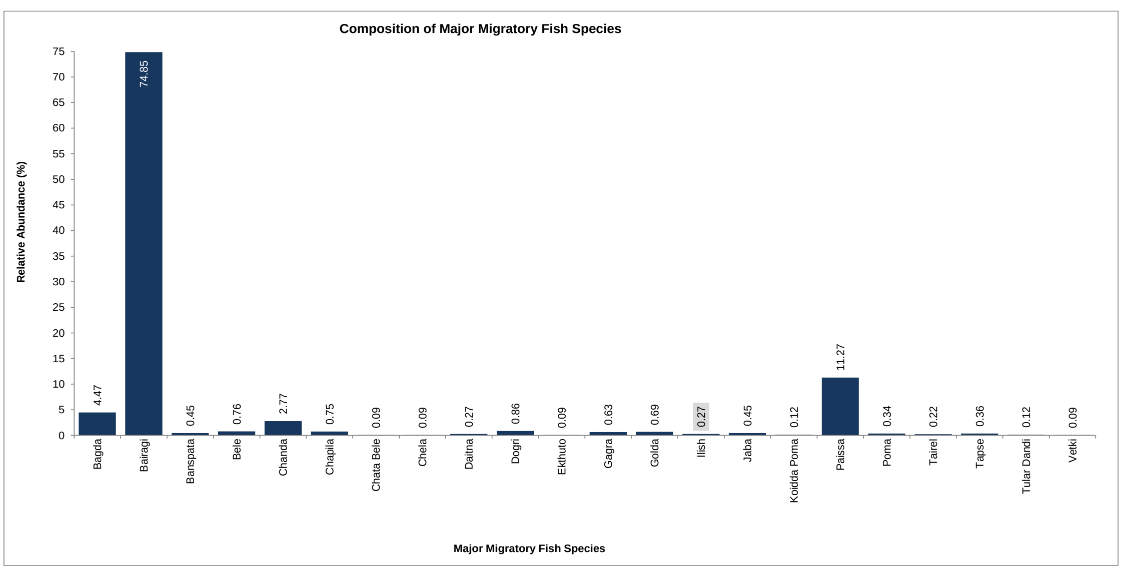


Figure 3.7: Relative abundance of major migratory fish species in sampling sites

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. Poma and Golda species were found in maximum sampling sites. Among migratory species, Tular Dandi and Paissa were observed to migrate long distance (**Figure 3.8** and **Table D.4 of Appendix IV**).

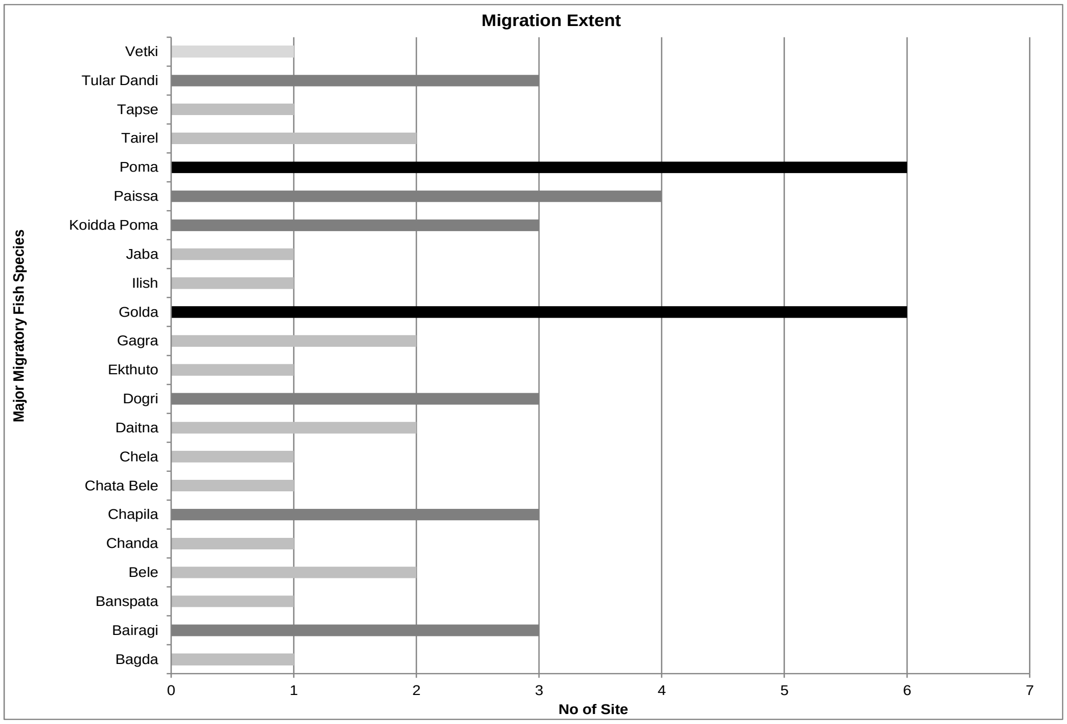


Figure 3.8: Migration extent of major migratory fish species in sampling sites

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) has been declining over the years. For this reason, most of the farmers are compelled to stock hatchery produced seeds along with some wild seeds in their farms. However, most of the stocks are still collected from wild source of the Passur River in this monitoring phase.

In this monitoring year, the highest stocking rate in respect of Bagda was observed in case of gher in Kapashdanga (**Table 3.6**). No stocking was reported in case of Rajnagar and Chunkuri-2. Furthermore, the Gher was temporarily transformed into the paddy field in case of Gher in Chunkuri-2 from the month of August.

Table 3.6: Stocking Pattern of Fish/Shrimp farm

Location	Fish Species	Average of Stocking Density (No/ha)	Stocking Date
Rajnagar *(42.09ha)*	Bagda	0	N/A
	Catla	1,280	July
	Common Carp	320	
	Grass Carp	320	
	Rui	4,480	
Kapashdanga-Muralia *(115.7ha)*	Bagda	1,296	July
	Bhangan	0	
	Catla	0	
	Chali	0	
	Golda	0	
	Horina	0	
	Paissa	0	
	Rui	0	
	Tengra	0	
	Tilapia	0	
	Vetki	0	
Chunkuri-2 *(6.07ha)*	Gher temporarily transformed in to the paddy field		0

Source: CEGIS Field Survey, 2018

Shrimp/Fish Growth Rate and Mortality

During the 18th quarter of monitoring, the highest growth rate has been observed in the case of Gher at Kapasdanga. The highest mortality has been reported in case of Gher in Rajnagar due to viral infection (**Table 3.7)**.

Table 3.7: Growth Rate and Mortality of Fish/Shrimp

Gher No.	1st QM (Apr 2014)		2nd QM (Jul 2014)		3rd QM (Oct 2014)		4th QM (Jan 2015)		5th QM (Apr 2015)		6th QM (Aug2015)		7th QM (Oct 2015)	
	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
2	0.3	30-35	0.3	94	0.25	10	-	-	-	-	0.14	20	0.15	100
3	0.2	25-30	0.2	25	0.20	65	-	-	-	10	0.15	50	0.25	20

Gher No.	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 (%)
1	-	-	-	-	0.2	20	0.20	60	-	-	-	30
2	-	-	0.21	15	0.3	40	0.25	50	-	-	-	10
3	-	-	0.17	30	0.15	30	0.20	30	-	-	-	25

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

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

Fish Production

Capture Fish Production

In 18th quarter monitoring, the highest productivity was found in Sheola Khal of Chandpai. The lowest productivity was found at the Maidara River in the Passur and at the Chalna Point. Note that fries found in the catch were not considered in the productivity assessment.

The present study revealed that the highest catch susceptibility was also found in case of Behundi Jal (6 kg/haul). The following table also expresses that Ber Jals were most frequently used in all upper and middle reaches in the Passur River System, especially for collecting Hilsa, Poma, etc. Hooks were frequently used in the downstream of the Passur River System. The highest catch was observed at Akram Point and lowest at Chalna Point in the Passure in this monitoring phase (**Table 3.8 and Table 3.9**).

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

Sl. No	Site	Habitat	Gear Name/Type	Haul Duration (hr)	No of Haul	Total Catch (kg)	kg/haul
A	Akram Point	Confluence	Khepla Jal	3	12	2.5	0.21
			Spear	13	6	13.02	2.2
B	Haldikhali	Haldekhali-Passure Confluence	Spear	3	3	0.8	0.3
C	Charaputia	Charaputia Khal	Not Found	0	0	0	0
D	Bhadra	Bhadra Khal	Not Found	0	0	0	0
E	Harbaria	Harbaria Khal	Spear	3.4	22	0.31	0.01
			Tana Jal	1.5	3	0.05	0.02
F	Jongra	Jongra Khal	Not Found	0	0	0	0
G	Chandpai	Sheola Khal	Behundi	4	1	6	6
			Box Net	2	1	0.1	0.10
			Charpata Jal	15	1	20	20
			Spear	5	225	0.6	0
H	Mongla Point	Passur River	NA	0	0	0	0
I	Maidara	Maidara River	Behundi	2	6	4.5	0.75
			Jhaki Jal	1	30	0.25	0.01
J	Chalna Point	Passur River	Chhandi Jal	4	1	1	1
			Dora Jal	1	1	0.5	0.50
			Net Jal	4	1	0	0
			Vola Jal	1	1	0.05	0.05

Source: Catch assessment survey, CEGIS (2018-19)

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

Table 3.9: Total Catch in the Sampling Sites

Sampling Site	Total Catch (kg)												
	1st QM	2nd QM	3rd QM	4th QM	5th QM	6th QM	7th QM	8th QM	9th QM	10th QM	11th QM	12th QM	13th QM
A	28	0	3	28.7	6	0	20	276.2	0	0	10	2	2
B	65	0	1	3.3	0	0	10	12.8	0	0	4	0	0.25
C	1,559	0.5	8	8.7	1.05	0.33	19.5	173.6	2.8	0	2.6	10	8.13
D	0	12	3	30	10.5	5.08	10.75	189	0	12	18	56	77.5
E	0	0.6	5	0	0.5	0.4	0.6	7.8	5	7.5	2.6	0	0
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
A	2	0	0	17	0	16
B	0.25	0	0	0	0	1
C	0	0	0	1.50	0	0
D	0	0	0	0	0	0
E	8.13	1.5	2.56	0	0.1	2
F	0	0	0	0	0	0
G	77.5	10.5	37.67	3	4	27
H	0	0	0	0.33	22	0
I	0.3	0.4	0.67	0.13	3	5
J	0.12	0.3	0	1	0.25	1.2

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

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

Culture Fish Production

The present study on shrimp/fish farm in the 18th quarter monitoring phase showed that the highest production was observed in the Gher of Kapasdanga (**Figure 3.9**).

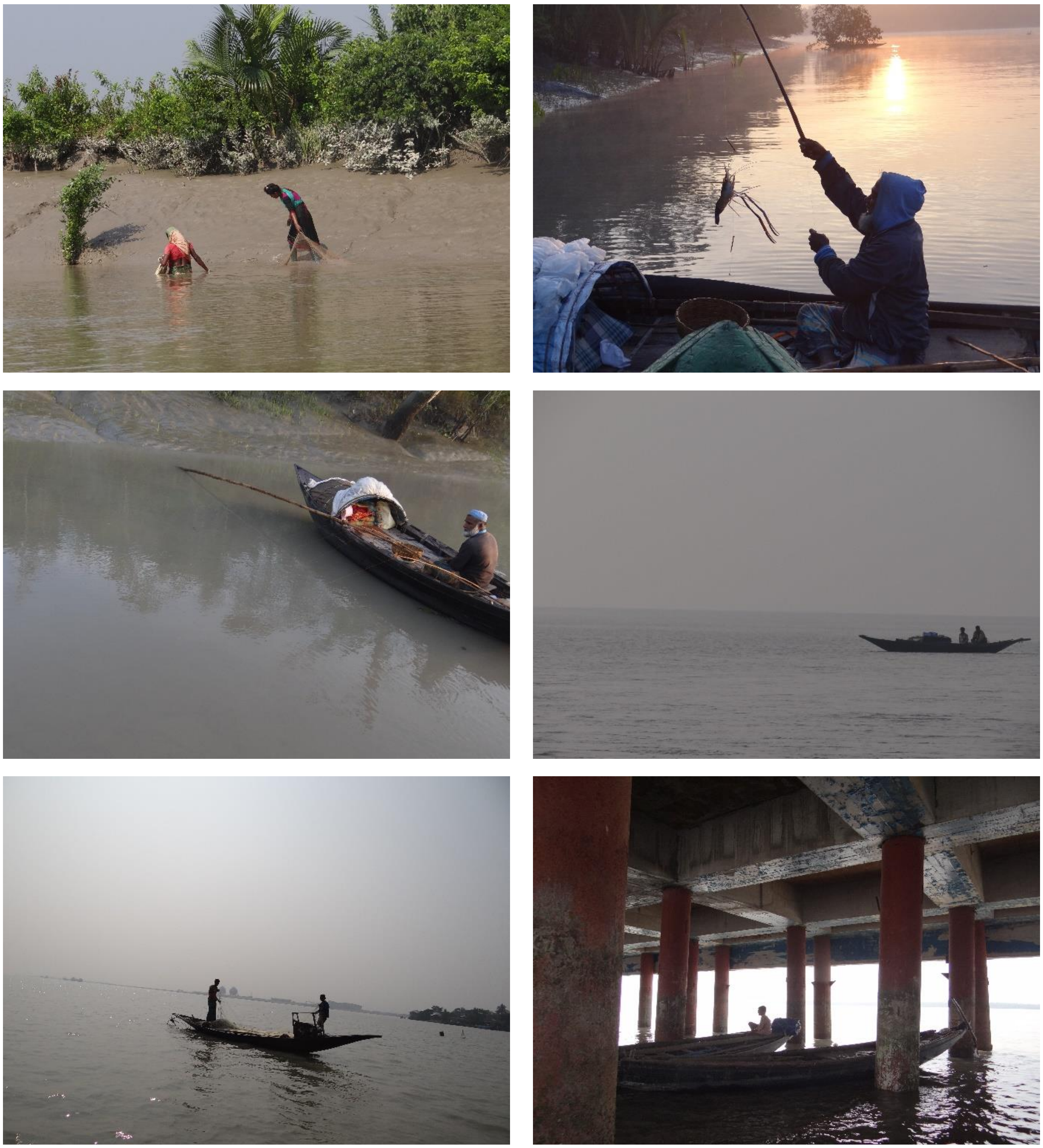


Figure 3.9: Fishing gears and crafts use in fishing at sampling sites

3.2 Monitoring of Ecosystem and Bio-diversity

3.2.1 Indicators Selection

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

Composition and diversity of flora is important for vegetation study which indicates vegetation structure of an area. Plant health is directly related with biomass productivity. Plant health of an area may change for changing of different environmental parameters like temperature, composition of gaseous components, soil salinity, humidity and nutrients, 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, landuse 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, Sundarban 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 it's 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

Gewa *(Excoecaria agallocha)* is dominating among all the trees due to its heist population. Moist and saline soil favors luxurious succession of this mangrove plant in homestead vegetation. Beside this, Safeda *(Manilkara zapota)* and Boroi *(Zizyphus sp)* are the two species of fruit yielding trees. Monocots including Narikel *(Cocos nucifera)* and Khejur *(Phoenix sylvestris)* occupied the top canopy of the vegetation. In addition 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. 30 number of Gewa trees have been felled at south western corner of the homestead.

Homestead at Kalekarber dighi

Narikel *(Cocos nucifera)* and Khejur *(Phoenix sylvestris)* occupies the top canopy. Aam (Mangifera indica), Safeda (Manilkara zapota), Peyara (Psidium guajava) and Boroi (Zizyphus sp) are common trees height about 3-5 m. 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, Bakul (*Mimusops elengii)* and few number of Kola (Musa sp) are found on these homestead platforms. Among the creepers and herbs, Swarnalata *(Cuscuta reflexa)* and Durba *(Cynodon sp)* are found. South-eastern part of the homestead are now filled by sand hence no undergrowths found there.

Homestead at Chalkghona

Similar to the above homesteads, in the selected homestead at Chalkghona, Narikel is the dominating tree species as well as occupying the top canopy. As the homestead is near the peripheries of river and shrimp gher, soil salinity supports luxurious growth of mangrove plant Gewa (Excoecaria agallocha). This homestead has two shallow ditches which contain brackish water throughout the year and 2 Gol *(Nipa fruticans)* bushes are existing there. Most of the medium size trees like Safeda *(Manilkara zapota),* Aam *(Mangifera indica),* Peyara *(Psidium guajava)*, Papay *(Carica papaya)* etc are fruit bearing trees. Beside this, some ornamental plants also exist.

Homestead at Barni

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

Random quadrate vegetation survey has been conducted at selected homesteads during recent monitoring tier. A total of 44 plant species (excluding herbs and shrubs) has been recorded from 15 nos of surveyed sample quadrates. Details of the survey result is presented in **Table 3.10** below.

Table 3.10: Species composition of the sampled homesteads

Sl. No.	Species Name	Rajnagar			Borni				Kalekarber				Chalkghona				Total Number of individuals	Biodiversity Index	Density	Frequency	Abundance
		Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15					
1	*Acacia arabica*												-	-	-	1	1	2.74	0.07	7	100
2	*Acrostichum aureum*				3	-	10	30	-	-	-	3	-	-	1	4	51		3.40	40	850
3	*Adhatoda vasica*				-	1	-	-									1		0.07	7	100
4	*Albizia richardiana*								3	2	2	2	-	1	-	-	10		0.67	33	200
5	*Albizia saman*				3	1	-	-	1	-	-	-	2	-	-	-	7		0.47	27	175
6	*Apanomyxys*								-	2	-	-					2		0.13	7	200
7	*Areca catechu*				-	12	2	-	-	2	-	-					16		1.07	20	533
8	*Azadirachta indica*				-	2	-	-	1	-	1	2					6		0.40	27	150
9	*Bombax ceiba*												-	2	-	-	2		0.13	7	200
10	*Borassus flabeliffer*				2	-	-	-	4	-	-	5					11		0.73	20	367
11	*Carica papaya*												-	1	-	-	1		0.07	7	100
12	*Citrus medica*												-	2	-	-	2		0.13	7	200
13	*Cocos nucifera*	4	2	3	1	2	-	1	3	3	5	5	1	2	2	-	34		2.27	87	3,400
14	*Colocasia esculenta*				-	5	-	-					-	4	-	-	9		0.60	13	450
15	*Diospyros pregrina*								3	-	-	-	3	-	-	-	6		0.40	13	300
16	*Excoecaria agallocha*	4	28	18	-	-	13	3					-	-	15	8	89		5.93	47	1,271

Sl. No.	Species Name	Rajnagar			Borni				Kalekarber				Chalkghona				Total Number of individuals	Biodiversity Index	Density	Frequency	Abundance
		Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15					
17	*Feronia lemonia*				1	-	-	-									1		0.07	7	33
18	*Ficus benghalensis*				-	1	-	-									1		0.07	7	100
19	*Ficus hispida*												-	1	-	-	1		0.07	7	100
20	*Hibiscus tiliaceus*	-	1	-	1	2	-	2	-	-	-	4					10		0.67	33	200
21	*Ipomoea fistulosa*				-	-	-	2									2		0.13	7	200
22	*Ixora coccinea*												1	-	-	-	1		0.07	7	50
23	*Mangifera indica*												1	3	-	-	4		0.27	13	200
24	*Manilkara zapota*				1	-	-	-	2	-	-	-					3		0.20	13	150
25	*Mimusops elengii*								-	1	-	-					1		0.07	7	50
26	*Moringa oleifera*								-	-	1	-	-	1	-	-	2		0.13	13	100
28	*Musa sp*				3	-	-	1	2	-	-	-	-	13	-	-	19		1.27	27	475
29	*Pandanus sp*	4	-	-													4		0.27	7	400
30	*Phoenix sylvestris*	-	1	4	-	-	-	2	1	2	10	10	-	1	1	3	35		2.33	47	500
31	*Phyllanthus acidus*								1	-	-	-					1		0.07	7	100
32	*Phyllanthus emblica*												2	-	-	-	2		0.13	7	200
33	*Pongamia pinnata*	-	1	-									1	-	-	-	2		0.13	7	50
34	*Psidium guajava*				-	1	-	-									1		0.07	7	100

Sl. No.	Species Name	Rajnagar			Borni				Kalekarber				Chalkghona				Total Number of individuals	Biodiversity Index	Density	Frequency	Abundance
		Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15					
35	*Psidium guajava*												2	7	-	-	9		0.60	13	450
36	*Punica granatum*												-	1	-	-	1		0.07	7	100
37	*Sonneratia apetala*	-	-	1													1		0.07	7	100
38	*Spondius pinnata*				-	1	-	-									1		0.07	7	100
39	*Swietenia mahagoni*				4	4	1	-	24	26	1	5	5	2	-	-	72		4.80	60	800
40	*Tamarindus indica*												-	1	-	-	1		0.07	7	100
41	*Terminalia arjuna*				-	1	-	-									1		0.07	7	33
42	*Terminalia catapa*				-	1	-	-					2	-	-	-	3		0.20	13	150
43	*Zizyphus sp*												-	2	-	-	2		0.13	7	200
44	*Gum Tree*												1	-	-	-	1		0.07	7	100

Q=quadrate

Source: CEGIS field sirvey

Plant health

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

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: Unhealthy plants at monitoring sites (Photo taken Nov, 2018)

Number of disease affected trees

Plant health has improved all the locations than previous monitoring tier as the number of disease affected trees has been reduced. Coconut (*Cocos nucifera)* and Date Palm (*Phoenix sylvestris)* are main affected species observed in this monitoring tier. A total of 6 date palm and 4 coconut plants were affected at Rajnagar site and one Palmyra palm observed unhealthy at Borni. Most of which have been observed trunk narrowing and heart rot. In the case of Date Palm, Lethal Yellowing and Terminal Bud destruction were detected at Rajnagar site. Except these, One Mango and one Guava tree has detected leaf blast and leaf spot respectively. Health condition of the monitoring site has been improved due to improvement of drainage condition of the observed locations. However, following table represents the proportion of healthy and unhealthy plants in studied homesteads till last monitoring period. (**Table 3.11**).

Table 3.11: 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
Rajnagar	*Cocos nucifera*	17*	NS	10	5	5	15	4	5	NS	3	4	6	6	9	4
	Phoenix sylvestris	25	NS	15	4	4	22	9	13	NS	10	2	5	4	7	6
	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	
	Phoenix sylvestris	12	0	5	4	4	3	1	4	NS	4	3	4	2	1	
	Borassus flabellifer	6	3	1	0	0	0	0	0	NS	-	-	-	-	-	1
	Mangifera indica	6	3	3	1	1	4	0	0	NS	-	-	-	-	-	
	Excoecaria agallocha	18	0	0	0	0	0	0	0	NS	-	-	-	-	-	
	Swietenia mehogani	11	0	0	0	0	1	0	0	NS	-	-	-	-	-	
	Areca catechu	10	0	6	2	2	8	2	2	NS	-	1	-	3	-	
	Manilkara zapota	1	0	0	0	0	0	0	0	NS	-	-	-	-	-	
	Psidium guajava	2	2	1	0	0	0	0	0	NS	-	-	-	-	-	
Kalekarber Dighi	*Cocos nucifera*	56	35	5	1	1	2	2	3	NS	1	1	-	6	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	
	Phoenix sylvestris	24	0	10	1	1	6	5	1	NS	1	-	5	2	3	
	Albizia saman	3	0	0	0	0	1	0	0	NS	-	-	-	-	-	
	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
	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 Safeda (*Manilkara zapota),* Mango (*Mangifera indica)* possess upper bole of canopy layer. Lower bole are occupied by small fruit yielding trees like Guava (*Psidium guajava)*, Musa sp. Very few grass species and undergrowth vegetation were followed at studied homesteads.

Estimated Canopy cover in homestead vegetation of sampling sites

Canopy status of homestead vegetation have slightly improved at Kalekarber and Chalkghona sites. In the case of both sites, there observed numerous trees which has been just recruited from saplings to tree and expand their canopy layer in post monsoon. At the Rajnagar site, canopy coverage has been reduced for two reasons; one due to unhealthy condition of Coconut and Date Palm trees and another reason is felling of large amount of Gewa trees at the homestead of Rajnagar.

Canopy coverage of the studied homesteads has been represented in following **Table 3.12**.

Table 3.12: 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
Rajnagar	NS	19	19	17	20	20	20	20	21	23	19	15	18	14	11
Borni	NS	26	18	18	12	14	20	20	25	25	23	21	21	23	20
Kalekarber	NS	20	24	25	23	24	24	22	24	26	25	23	24	24	25
Chalkghona	NS	13	24	22	17	21	21	20	21	27	26	25	16	18	21

Note: NS = Not Surveyed

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

Occurrence of dolphins have been monitored within about 20 km length of Passur and Madara river surround the project area (From Chalna to Mongla including Maidara River) through two boat transact in different tidal condition. No dolphin were recorded during ebb tide in early morning (06:20 AM-07:30 AM). A total of 9 dolphins have been recorded in Passur River during mid tide with an encounter rate of 0.20 individuals/km/hour from Chalna to Mongla Ghat. Out of which, 4 dolphins were concentrated at Passur-Chunkuri River confluence and 5 were observed within Maidara River. All the dolphins were in diving mode.

Dolphin occurrence in Dhangmari Khal and Shella Gang

Dolphin occurrence also surveyed at the Dhangmari Khal, Shella Gang Wildlife Sanctuary and Bhadra Khal. Total transect length was 13.7 km from Dhangmari-Passur confluence to Gagramari Forest Patrol Post of Forest Department. A total of 11 dolphins with different sizes were recorded in Dhangmari Khal with an encounter rate 0.55/km/hour. In the case of Shella Gang, the survey transact was bounded from Chandpai forest Office to Joymonirgol Thota to Jongra Forest Patrol Post. A total of 24 individuals have been sighted during one hour and 18 mins survey. The encounter rate was 1.54/km/hour and most of which centered within the mouth of Jongra khal.

The highest occurrence of dolphins recorded at Bhadra Khal from which recorded 36 occurrences of dolphin within the 3.2 km reach. The encounter rate was 8.06/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 3.15.**

Another short survey was conducted Karomjal, Harbaria and Akram Point while passing the river. No dolphin has been notified from any of the above points. However, the survey result is included in **Table: 3.13**.

Figure 3.11: Dolphin signs recorded from Jhongra Khal and Passur River (Nov 2018)

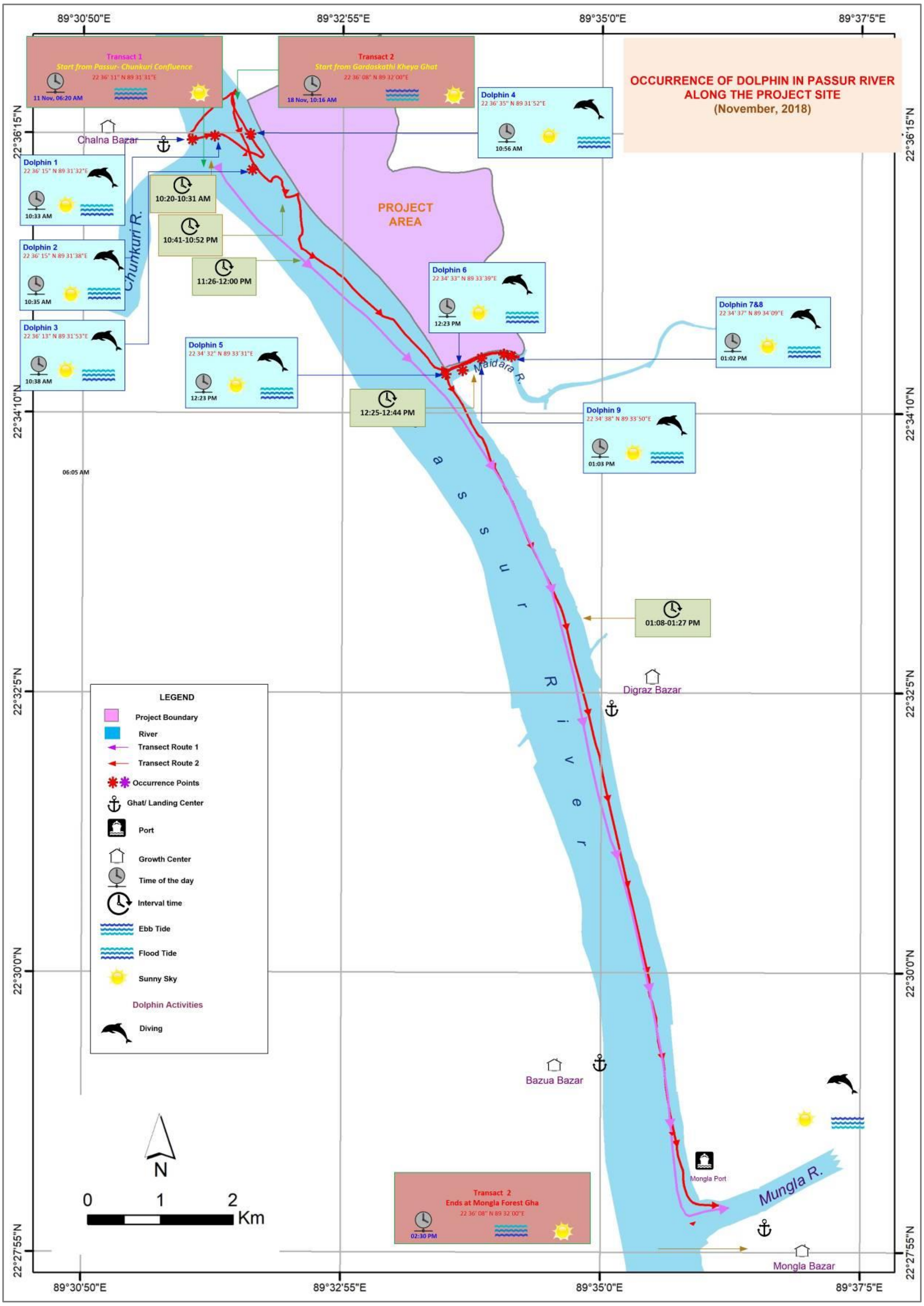


Figure 3.12: Occurrence of dolphins at Passur and Maidara River along the project site

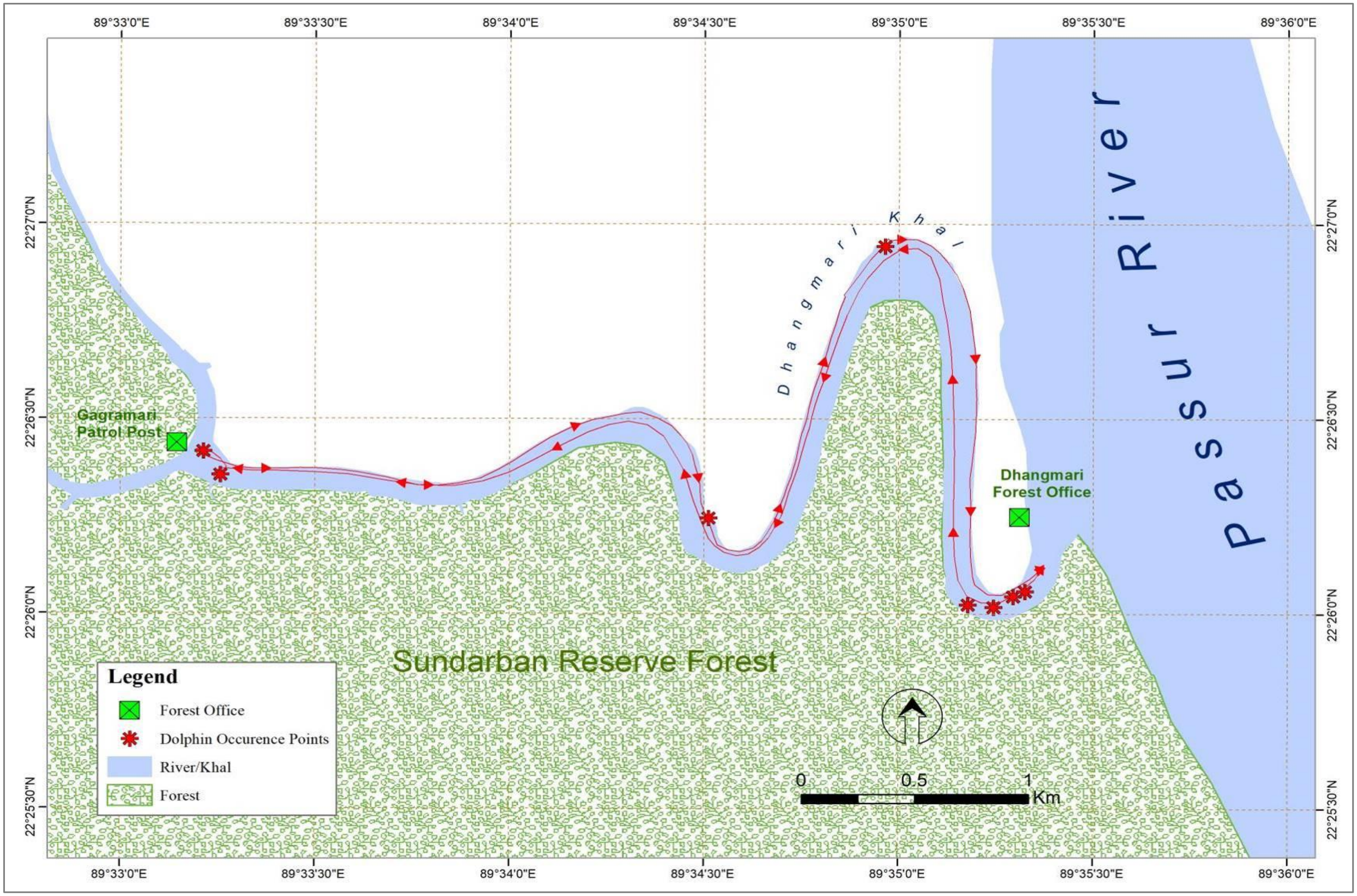


Figure 3.13: Location of dolphin Occurrence at Dhangmari Khal (November, 2018)

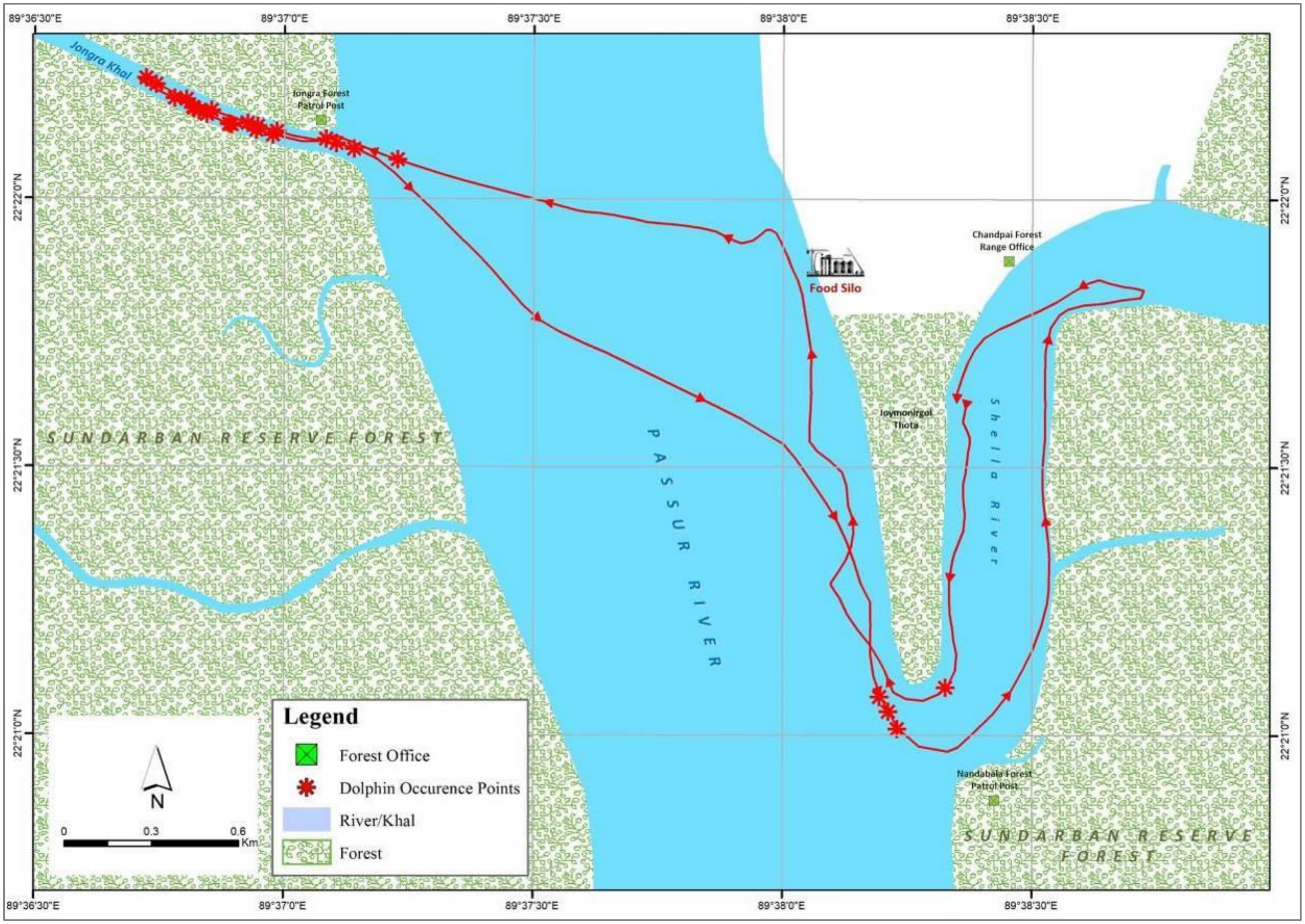


Figure 3.14: Location of dolphin Occurrence at Shella River to Jongra Khal (November, 2018)

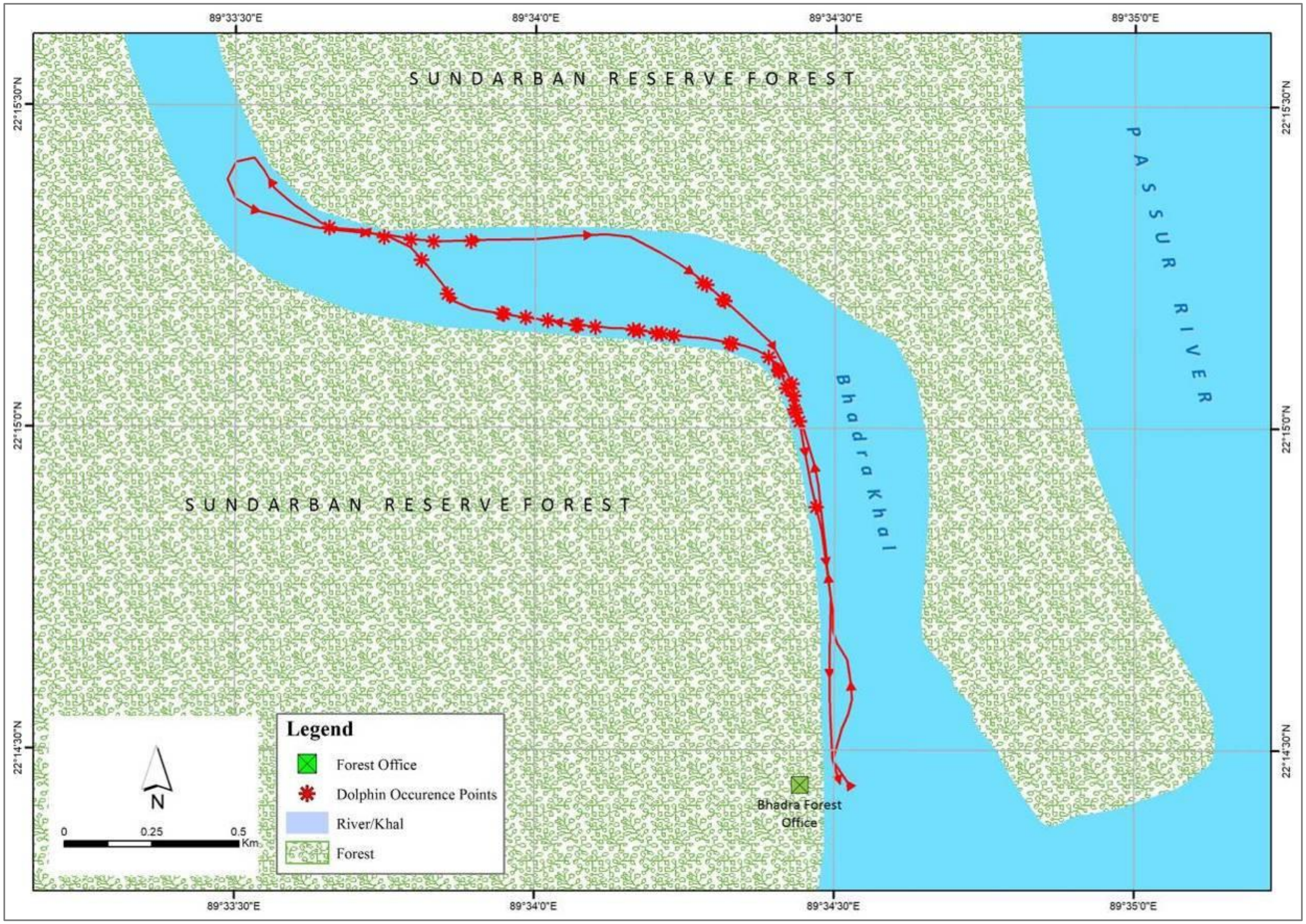


Figure 3.15: Location of Dolphin Occurrence at Bhadra Khal (November, 2018)

Table 3.13: 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	
	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
Passur River Near Project Site	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NS	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	NS	Y
Karamjal	NS	NS	NS	N	NS	Y	Y	Y	N	N	NS	Y	NS	Y	Y	N	Y	NS	Y	Y	Y	Y	NS	Y	N	NS	N	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
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
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
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

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

Occurrence Status: Y = Occurred, N = Not occurred

3.2.5 Plankton occurrences in River system

Zoo-plankton samples have been collected from 4 different locations of Passur river. A total of nine genus have been identified another 4 were unidentified. Of which *Copipod* and *Daphnia* are common of all (**Table 3.14**).

Table 3.14: Composition of Zooplanktones in Passur river system

Sl. No.	Species Name	Class	Order	Abundance in Different Locations			
				KJ	HB	AP	HP
1	*Daphnia* sp	Crustacea	Cladocera	***	*		*
2	*Ditylum* sp	Coscinodiscophyceae	Lithodesmiales				*
3	*Chaetoceros* sp	Coscinodiscophyceae	Biddulphiineae				**
4	*Ceratium* sp.	Dinophyceae	Gonyaulacales				**
5	*Copepod* sp.	Hexanauplia	-	**	***	**	**
6	*Obelia* sp	Hydrozoa	Leptothecata				*
7	*Nauplius* sp	Cirripedia	-			***	
8	*Amphithoe* sp	Malacostraca	Amphipoda		*		
9	*Asterionella* sp	Fragilariophyceae	Araphidineae				**

Note: Location: KJ=Karamjal, HB=Harbaria, AP=Akram Point; HP=Hiron Point;

*Abundance: *=Low, **=Moderate and ***=High.*

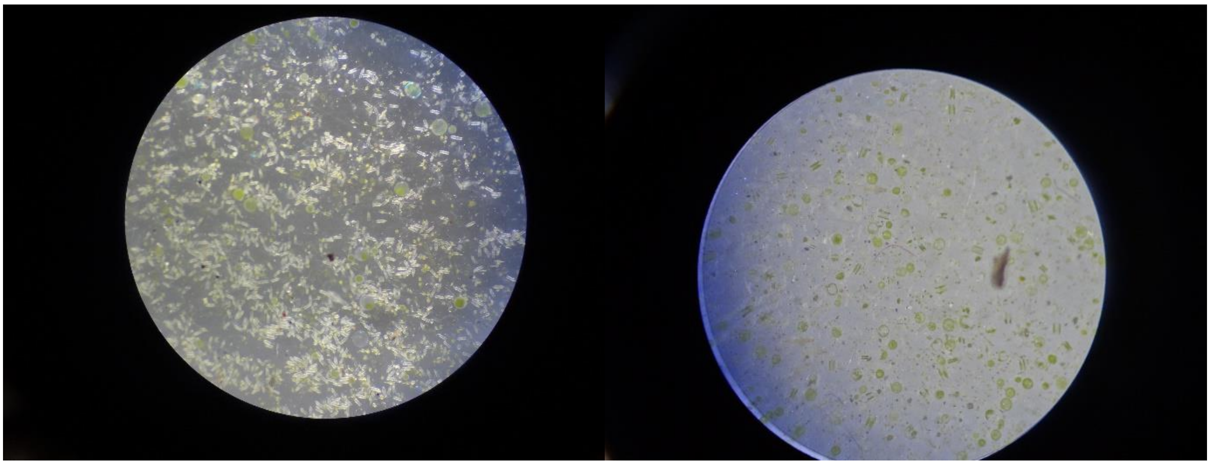


Figure 3.16: View of plankton composition under Microscope (Left: Harbaria and Right: Akram Point)

3.3 Sundarbans Forest Health

CEGIS team has been periodically monitoring the Sundarbans Reserve Forest (SRF) health to monitor the probable impacts of Rampal Thermal Coal Power Plant Project during operational phase. This monitoring program will determine the status, trend and changes of forest health indicators. The Sundarbans forest health is being monitored quarterly as per monitoring schedule and so far, 18th inventories were conducted at five locations, namely Sutarkhali, Karamjal, Harbaria, Akram point and Hiron Point. The parameters that included in this monitoring program are plant growth, tree regeneration, tree crown condition, tree damage, lichen communities, plant diversity, plant physiology, biomass and carbon stock.

3.4 Methodology

To set up permanent sample plots five sites were selected on the basis of the survey conducted from Nov 10 to Nov 16, 2018 (**Figure 3.17)**. Among those, five sites are along the Passur River at Karamjal, Harbaria, Akram point and in Hiron point respectively and the fifth one is near Sutarkhali forest office (**Table 3.15**). The sites were selected considering the distance from the proposed Project site, wind directions, coal transportation route, river systems and vegetation types.

Indicators Selected for this monitoring tier

Frequency of Monitoring for different indicators has been determined considering efficiency. The indicators observed in this tier were as follows:

- Seedling Regeneration
- Pneumatophores
- Crab hole density
- Canopy cover
- Leaf Area Index
- Biomass and carbon stock

Sampling Design of Permanent Sample Plots (PSPs)

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

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

Transect	Plot	Range	Compartment No.	GPS ± (m)		Soil Description	Plot Location Notes
				Latitude (N)	Longitude (E)		
Sutar khali	1	Khulna	32	22.49815	89.48752	Hard Clay	Just opposite from Sutar Khali Forest Station and 40 m SW from Sutar Khali canal
	2	Khulna	32	22.49733	89.48711	Hard Clay	Just opposite from Sutar Khali Forest Station and 140 m SW from Sutar Khali canal
	3	Khulna	32	22.49655	89.48664	Hard Clay	Just opposite from Sutar Khali Forest Station and 240 m SW from Sutar Khali canal
Karamjal	1	Chandpai	31	22.42531	89.59439	Hard Clay	Plot centre 40 m west from Passur river
	2	Chandpai	31	22.42521	89.59341	Hard Clay	Plot centre 140 m west from Passur river
	3	Chandpai	31	22.42261	89.59254	Hard Clay	Plot centre 240 m west from Passur river
Harbaria	1	Chandpai	29	22.2061	89.5924	Hard Clay	40 m west from passure river
	2	Chandpai	29	22.29624	89.59179	Hard Clay	140 m west from passure river
	3	Chandpai	29	22.2962	89.5908	Muddy	240 m west from passure river
Akram Point	1	Khulna	17	22.01953	89.51291	Hard Clay	40 M east from shibsha river
	2	Khulna	17	22.01873	89.51344	Clayee	140 M east from shibsha river
	3	Khulna	17	22.01805	89.51408	Hard Clay	240 M east from shibsha river
Hiron Point	1	Khulna	44	22.77535	89.46104	Sandy	350m east from Gogari canal
	2	Khulna	44	21.91667	89.23333	Sandy	40m north from Bay of Bengal
	3	Khulna	44	22.18333	89.50000	Hard Clay	648m south east from Shibsa river

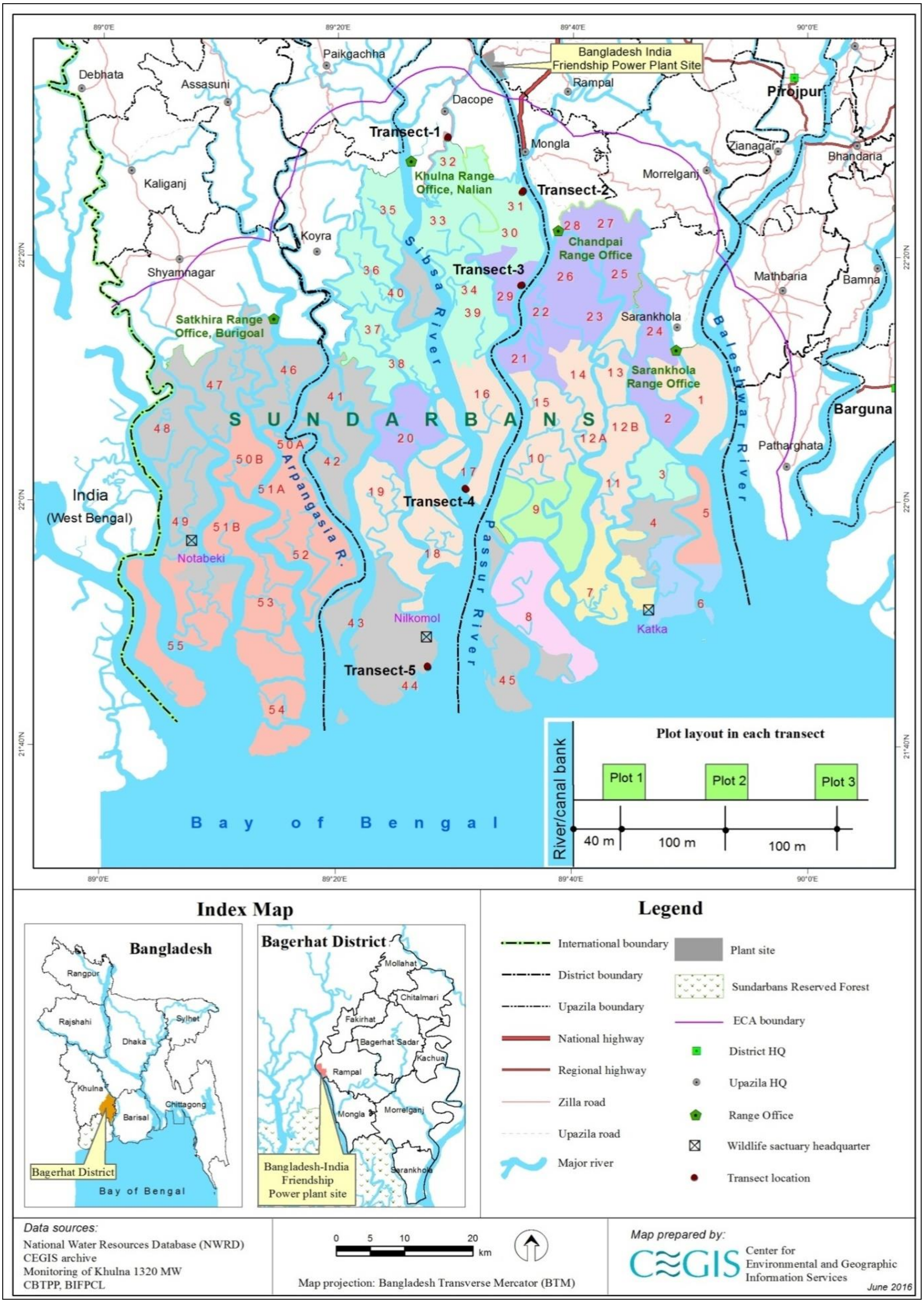


Figure 3.17: Location Map of Sundarbans Forest Health Monitoring Plots (PSPs)

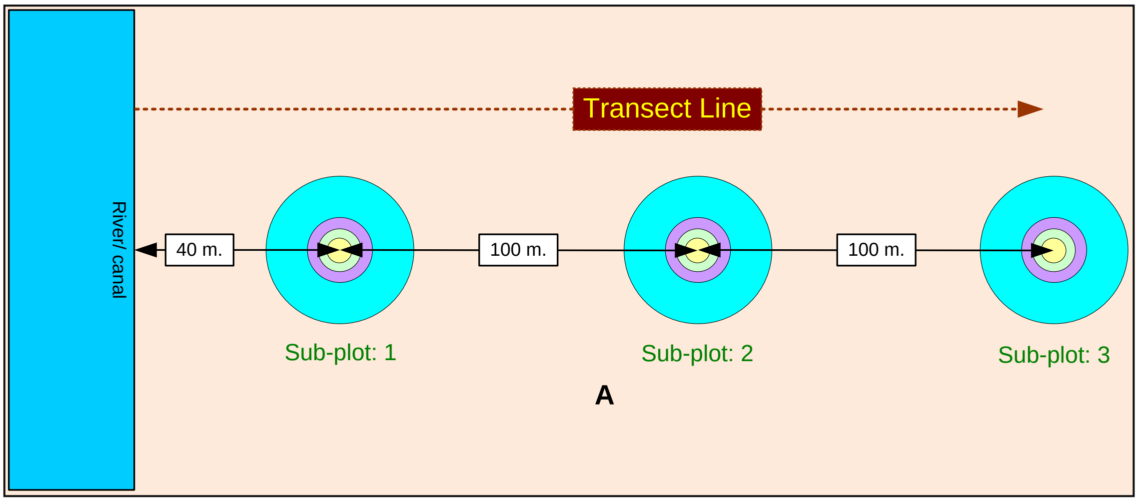


Figure 3.18: Layout of the subplots and transect line perpendicular to the ecotone (river or canal bank)

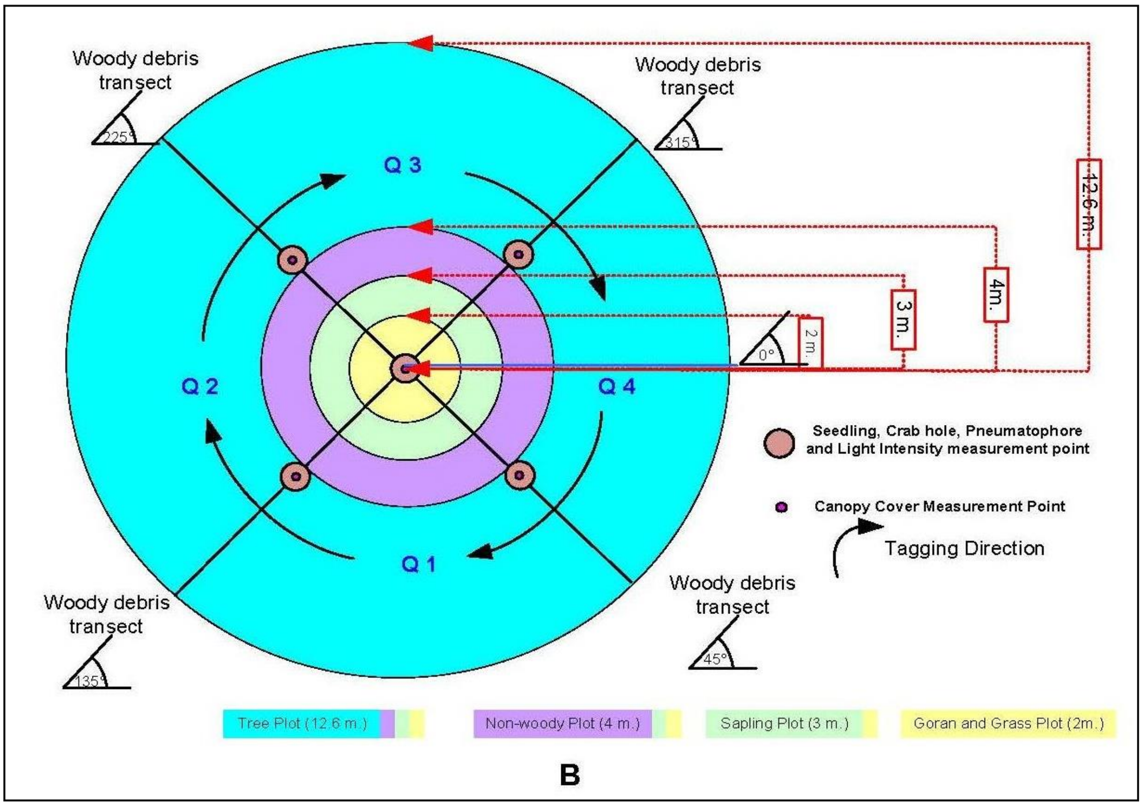


Figure 3.19: Layout of the survey activities in each subplot

3.4.1 Forest Health Survey

Trees

<u>*Forest Health Survey*</u>

(a) Trees

The tag number of trees (DBH ≥ 5cm and lean angle greater than 45º) was monitored. If any new tree was found within 12.62 m radius circle of the Permanent Sample Plot (PSP), they were recorded. Addition to this, tree height was also measure using range finder. A tree stem map was developed for each plot to locate the trees in future surveys.

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

Figure 3.21: Team member measuring height of trees at Sutarkhali

Figure 3.22: Measuring the DBH of trees at Harbaria

(b) Sapling and seedling

Saplings (DBH < 5 cm and height 1.37 m) and seedlings (height < 1.37 m) were assessed within 3 m and 2 m radius circle respectively in each PSP. Seedlings were counted species wise and their status of living were also recorded (**Figure 3.23**). For saplings, species name and DBH were recorded along with the living status.

Figure 3.23: Team member measuring the DBH of saplings at Harbaria

(c) Pneumatophores

The total numbers of living pneumatophores were recorded within a circular area of 1 m radius centring each of the five points of all the subplots. The first point was laid out in the centre of each subplot and other four was in the midpoint of the four woody debris transects that are facing at 45°, 135°, 225° and 315° angles (**Figure 3.2**4).

(d) Crab hole

Crab plays an important role in mangrove ecosystems such as decomposing litter fall thereby increasing 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 1 m radius circle in each subplot's centre and in the midpoint of four transects (**Figure 3.25**).

Figure 3.24: Team member counting pneumatophores on forest floor

Figure 3.25: Counting of crab holes on forest floor

(e) Canopy Cover

Canopy cover percentage was estimated by a spherical densitometer (i.e.Densitometer is 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 (**Figure 3.26**). After levelling the instrument using the level bubble, the dots which had not been occupied by canopy were systematically counted. In each subplot, the meter readings have been taken at five points facing north, south, east, and west direction including the centre point of the subplot. The canopy cover was calculated by taking the average of these five readings.

(f) Leaf Area Index

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)

Figure 3.26: Team member taking canopy cover using Densiometer

(g) Biomass and carbon stock estimation in trees

A total of five 12.62 m 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 (Mac-

Dicken 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.]

3.4.2 Status of monitoring of SRF Health

Seedling

The recruitment of new seedlings depends on regeneration and survival rate. These two indicators also depend on canopy cover, soil chemistry (i.e. pH, salinity, organic matter etc. From the last field observation, it was found that the number of seedlings per hectare didn't change significantly in all the monitoring locations except Karamjal (**Figure 3.27**). Karamjal seedling density has increased over the inventory period from (write the duration). Figure 3.27 shows that higher number of seedlings was found during monsoon period. In contrast, the number decreased during winter to pre-monsoon period. During post monsoon period, seedling density is moderate. This may be due to reduce human interventions at forest floor of the site, which has sustained huge number of seedlings. Seedlings usually die at an early stage of its life span inside natural forest due to competition for nutrients as well as light intensity. The dominant species were Sundari. at sutarkhali and Harbaria and gewa at Hiron point.The seedling at Koromjol subjected to illicit cutting. In the Sundarbans, most of the mangroves' seeds disperse during the rainy season and go up to forest floor. In this relation, seedlings are usually found more just after the rainy season (monsoon to post monsoon) than in other seasons.

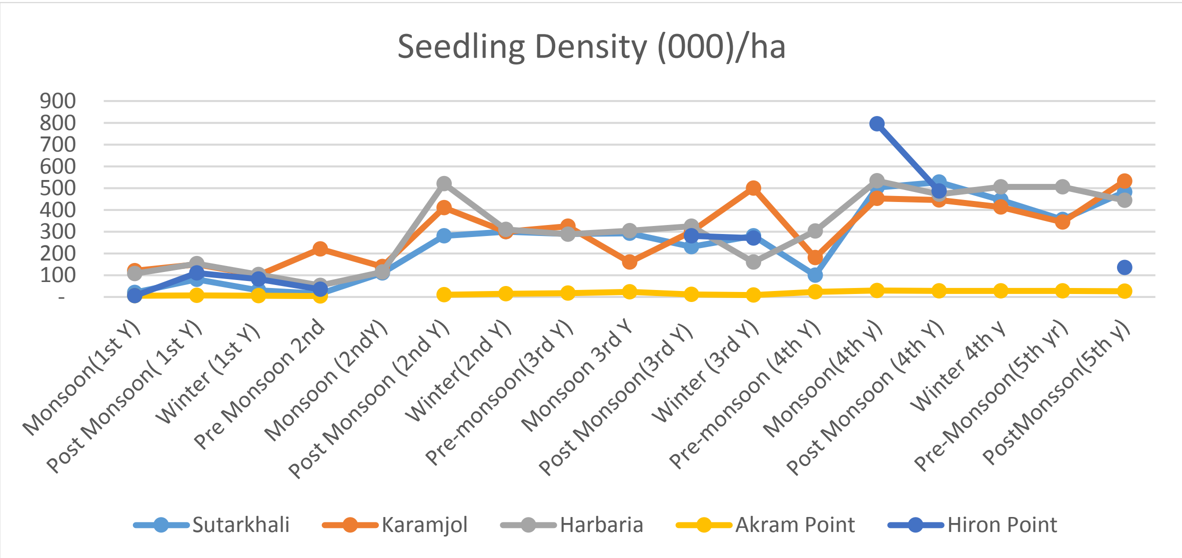
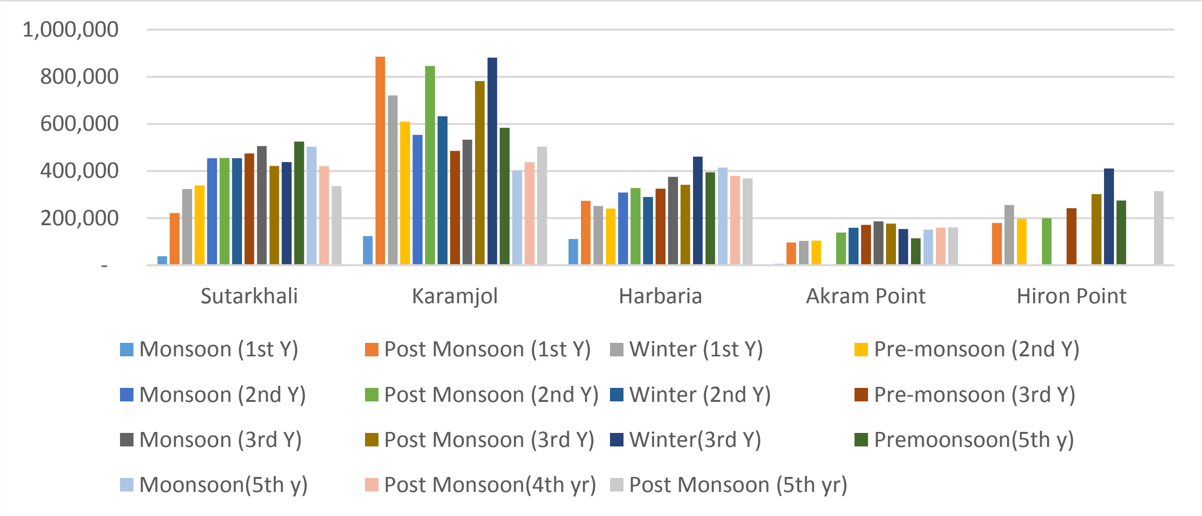


Figure 3.27: Mean (±95%CI) seedlings density among the quarterly surveys in five PSPs

Pneumatophores

The major function of pneumatophores is to exchange gas into the atmosphere during tidal inundation. Hence, the plots that were located in high elevation has less effect of inundation may have lesser number of pneumatophores. Pneumatophores density also changes due to seasonal variability (**Figure 3.28**). Pneumatophores usually die during dry season. The number of pneumatophores per hectare was comparatively very low in Sutarkhali area in post-monsoon period. Among five monitoring sites, the mean pneumatophores density was found good at Hiron point. The number of pneumatophores may also vary due to the elevation of the forest floor from the mean sea level (MSL). From the species composition inventory, it was found that Gewa (*Exoecaria agallocha*) was the dominating species at these monitoring sites. On the contrary, in Karamjol mainly dominated by Baen (*Avicennia officinalis*) and Sundari (*Heritiera fomes*) tree and they have numerous tender pneumatophores compared to others. Floristic composition and over siltation is another fact for pneumatophore density.

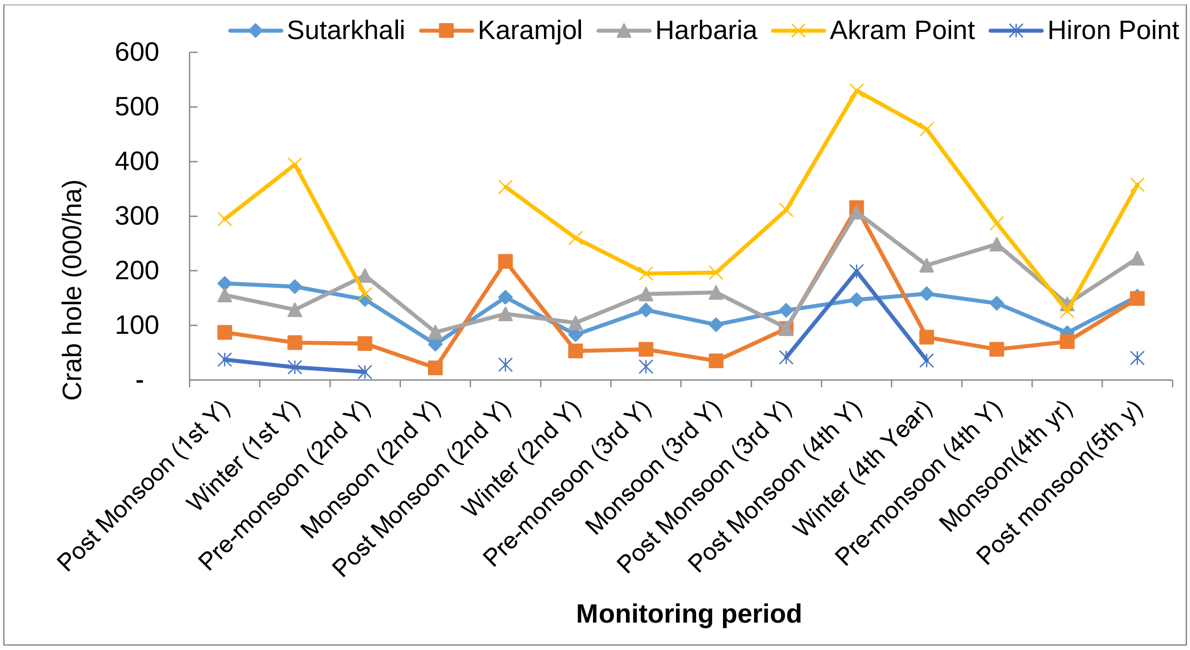


(Pneumatophores density was not monitored at Hiron Point during Monsoon 4th Year)

Figure 3.28: Mean Pneumatophores Density among the quarterly surveys in five PSPs

Crab hole

The crab holes increase oxygen dispersion in anoxic mangrove sediment and promote iron reduction and nitrification process over sulfate reduction in subsurface sediment. Therefore, it is expected to accelerate decomposition rate under oxic and suboxic conditions. The crab hole density was highest at herbaria and Akram Point among the five monitoring sites (Figure 3.29). This could be due to sandy and sediment forest floor at Akram Point. Crab hole has been comparatively same from the last monsoon period at Karamjal and Sutarkhali sites. From **Figure 3.29**, it was not possible to predict the relationship of crab hole with seasonal variability. This might be due to the soil nature of mangrove forest floor. However, there is some differences found in crab hole density during dry and wet period.

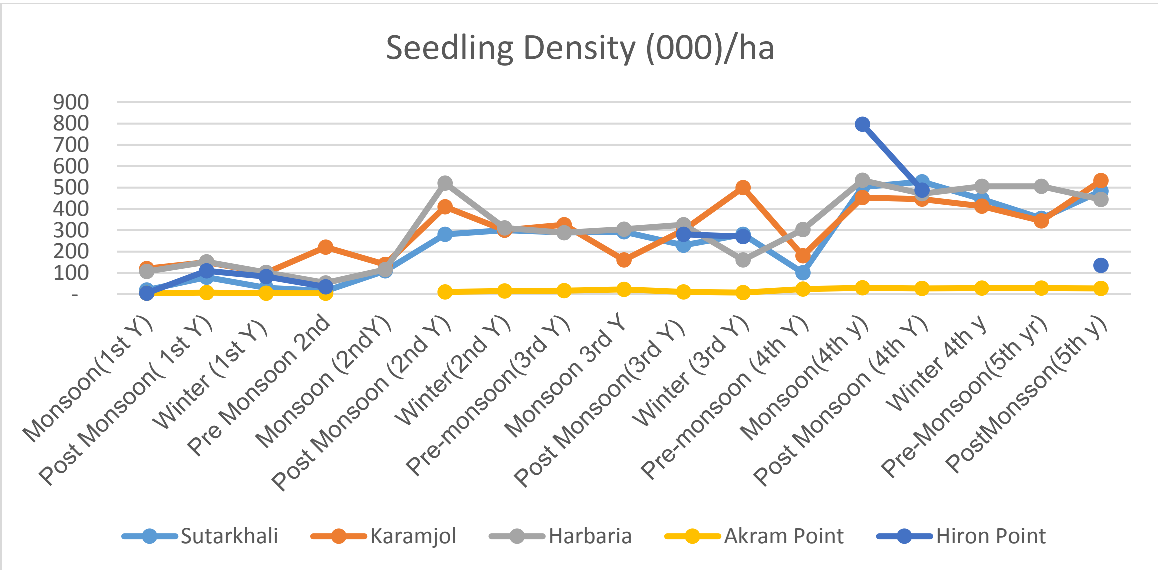


(Crab hole density was not monitored at Hiron Point during Monsoon 4th Year)

Figure 3.29: Mean crab hole density among the quarterly surveys in five PSPs

Canopy cover

In the monitoring plots, the canopy cover percentages were not varied significantly. From the third year to fourth year monsoon, the highest canopy cover percentages were observed during monsoon to post monsoon period which started to decline during winter. Canopy cover was lowest in pre-monsoon period. However, from post monsoon fourth year to post monsoon fifth year, it was found that the canopy cover percentages has decreased in Akram point comparatively with the all monitoring sites (**Figure 3.30**). Since greater than 60% of the canopy coverage in a site is treated as healthy, all the locations of the monitoring sites were in good condition.



(Canopy cover was not monitored at Hiron point during Monsoon 4th Year)

Figure 3.30: Mean canopy cover (%) among the quarterly surveys in five PSPs

Leaf Area Index (LAI)

The LAI (Light Area Index) influences daily rate of net canopy photosynthesis which results in exchange of atmospheric CO_2. The minimum the ratio of under canopy to open canopy light intensity value indicates the maximum LAI. It was found that the LAI has increased in all monitoring locations from previous values except Akram Point. The LAI was much lower due to high under canopy light intensity (**Figure 3.31**).

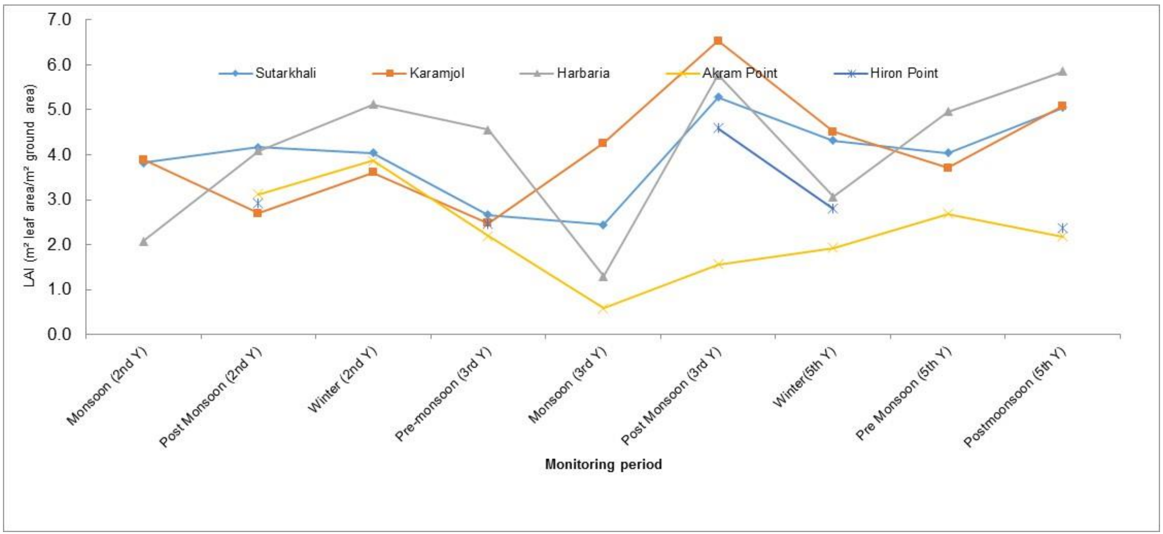


Figure 3.31: Mean L among the quarterly surveys in five PSPs

Tree biomass and organic carbon stock

Table 3.16 shows the total biomass and organic carbon stock. Among the observed tree species Sundari (*Heritieria fomes*) has the highest amount of biomass (3391 t/ha) and carbon (1695.59 t/ha) followed by Gewa (*Excoecaria agallocha*) and Baen (*Avicennia officinalis*). There is no strong variation exists in biomass and carbon stock of the investigated transect (**Table 3.17**). However, transect 1 has the highest amount of biomass (1433 t/ha) and carbon (716 t/ha) among all the observed transect.

Table 3.16: Species wise average biomass and carbon stock

Spp	AGB (t/ha)	BGB (t/ha)	Total Biomass (t/ha)	AGB (t/ha)	BGB (t/ha)	Total carbon (t/ha)
Amoor	7.43	1.11	8.54	3.71	0.56	4.27
Baen	397.61	59.64	457.25	198.81	29.82	228.63
Bhutbutta/Dahur	0.78	0.12	0.90	0.39	0.06	0.45
Bola	0.75	0.11	0.86	0.37	0.06	0.43
Gewa	1237.59	185.64	1423.23	618.80	92.82	711.61
Goran	6.06	0.91	6.97	3.03	0.45	3.48
Kakra	294.75	44.21	338.96	147.37	22.11	169.48
Keora	241.05	36.16	277.21	120.52	18.08	138.60
Passur	352.46	52.87	405.33	176.23	26.43	202.66
Sundarii	2948.85	442.33	3391.18	1474.43	221.16	1695.59
Sundori	0.83	0.12	0.96	0.42	0.06	0.48
Urmui	2.40	0.36	2.77	1.20	0.18	1.38
Vaila	4.49	0.67	5.16	2.25	0.34	2.58
		Total	**6319.31**			**3159.66**

Table 3.17: Transect wise average biomass and carbon stock

Transect	AGB (t/ha)	BGB (t/ha)	Total Biomass (t/ha)	AGB (t/ha)	BGB (t/ha)	Total carbon (t/ha)
1	1246.25	186.94	1433.18	623.12	93.47	716.59
2	1061.87	159.28	1221.15	530.94	79.64	610.58
3	1203.61	180.54	1384.15	601.81	90.27	692.08
4	830.23	124.54	954.77	415.12	62.27	477.38
5	1149.46	172.42	1321.87	574.73	86.21	660.94

Summary

From last observation, it can be said that in terms of seedling density, pneumatophores, crab hole, canopy cover and leaf area index the forest condition is showing positive changes periodically, although there has some seasonal effect. Based on different indicators it is found that the health condition at Harbaria and Sutarkhali is good. Other sites are almost same condition. Moreover, tree mortality and top dying of Sundari was lower in all monitoring plot. From the last monitoring, it can be said that illicit felling of Karamjol is reduced comparatively over time. In addition, Hiron point is severely affected by different plastic waste. The complex species Sundari have been died in a part of Akram point and Koromjol plot.

On the other hand, there was no significant change observed during the last visit at Harbaria point. Among the species, the height of Sundari is comparatively high in Harbaria. Goran species are dominant in some part of Hiron point and Akram point. In terms of biomass and carbon stock, Sundari provides the best carbon stock in Sundarban. Among the observed plots, Sutarkhali and Harbaria point has highest biomass and carbon stock. The forest is subjected by bank erosion. It is to be noted here that the potential anchorage point for coal transhipment of the proposed power plant project is situated in the periphery of this area. So, there is a possibility of disturbance into the ecosystem on natural succession. The monitoring should be continued to know the dynamics of mangrove attributes which are very much interlinked with each other as well as with the environment.

4. Social Environment

4.1 Socio-economic Condition and Social Safeguard

The socio-economic monitoring reflects both the positive and negative changes in environmental and social indicators/parameters compared to the findings of previous monitoring results. In this quarter some parameters i.e. employment status, labor and working condition, community health and safety, corporate social responsibilities of project authority etc. were investigated to fulfill the monitoring purposes. Discussions in this chapter were made based on the comparison of previously conducted quarterly monitoring (conducted during 27th July to 30th July, 2018) with the recent survey (from 23rd November to 26th November, 2018).

4.1.1 Methodology

The important parameters/indicators which were expected to be impacted due to construction activities were examined with reference to their previous conditions. The monitoring parameters and locations were changed as per the nature of construction works and process of local labors recruitment.

Earliar, the locally recruited labors stated that they came from Rampal, Rajnagar, Gaurambha and Burirdanga unions. Also, recently conducted Livelihood Restoration Program (LRP) were held mostly in Rajnagar, Gaurambha and Ujalkur (Foyla Shelter Home) unions. Therefore, in this monitoring phase Rajnagar and Gaurambha unions as well as Foyla shelter home were included for social monitoring aspects too.

Informal discussions were held with the local community (Kapasdanga, Barni, Rajnagar, Gaurambha and Baradurgapur) in order to identify the labor recruitment status, health and safety of local community, status of CSR and Livelihood Restoration Program (LRP). Affected households of Foyla Shelter Home were also interviewed for examining the contribution in LRP. In addition, interviews and discussions were also held with the project authority and workers of some Sub-Contractors in the project site, for identifying working condition, accommodation facilities and recruitment process as well.

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

4.1.2 Exploration of Monitoring Parameters

Map presenting surveyed location of social monitoring is shown in **Figure 4.1**

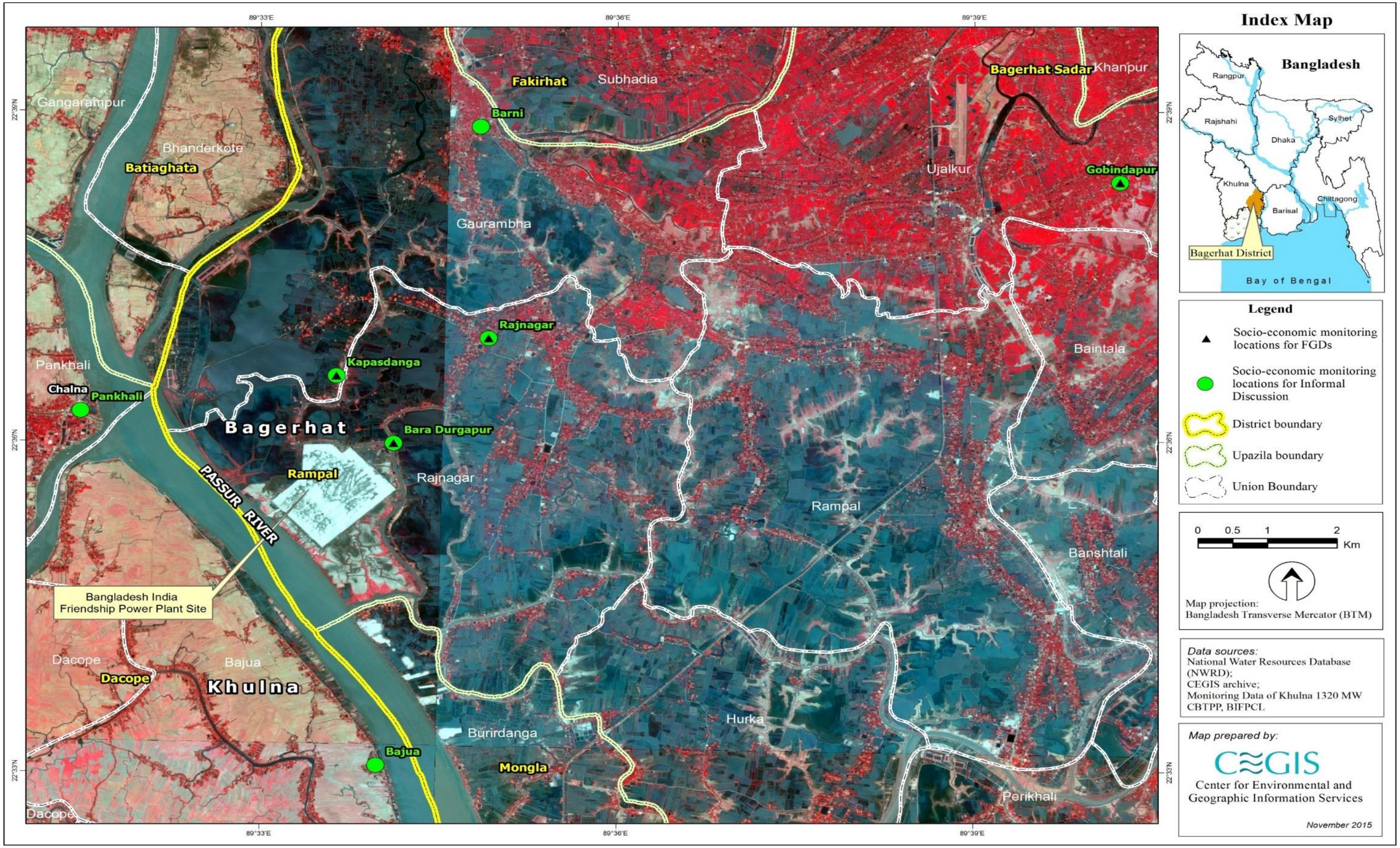


Figure 4.1: Socio-Economic Environment Monitoring Location

Project Related Employment Generation

BIFPCL and BHEL is monitoring the recruitment process of local labors as per the available scope of their engagement in construction works. During the field survey, local labors were considerably found to be involved in non-technical activities i.e. load carrying, laboring in civil works, masonry and so on. The local labors stated that scope of engaging more local labors will be facilitated after starting major and massive construction works. It is noted that, piling and load testing activities are continuing in present days where mostly the technical and experienced labors are recruited.

Though the project authority had plan to train the local unskilled people to elevate them to the level of semi-skilled and skilled labors which seems unnecessary to arrange such training in this early stage. However, the authority opened the opportunity for the local people to achieve technical knowledges through 'learning by doing' approach under the supervision of skilled technical persons. They could be engaged in construction works as work assistant by their own interest and in later they would be able to learn by doing work closely with the experts. In this way, the Project may create scopes for local people to develop their skills in numerous types of positions e.g. masonry, carpenter, electrician, welding, sanitary fittings, tiles fittings and so on. This opportunity has been opened for all the interested workable local people, but with careful supervision to avoid any irregularity in availing of these opportunities.

According to BHEL (EPC Contractor), about 2000 labors were engaged in different project activities at present but most of them are migrant workers. However, local labors were sourced in consultation with local labor suppliers and when local labors are not available at closest unions, then labor from other possible areas were sourced.

In terms of recruiting local labors, the authority prioritized to recruit project affected people as per their availability but it seemed difficult for them to identify actual project affected people. Therefore, they have introduced the provision of grievance redress mechanism which may solve such grievances. A 'Grievance Complaint Box' has already been installed in the project office, but no complaint has yet been dropped. It has also been observed from the field survey that people need to be aware more about the grievance mechanism system and the 'Grievance Complaint Box' should be installed at the entry gate (outside of the plant area).

Labor and working condition

At present, 3800 employees/labors are working in project of which 2000 are Bangladeshi and among them 1600 are residential labors. The labor sheds for the residential labors are separately constructed beside the project boundary. All the sheds are semi pucca structures and Compound of labor sheds is fenced separately. In general, condition of housing, sanitation, bathing and cooking facilities of all the labor sheds were found to be satisfied in contrast with the international and national standards except the shed of Contractor Mr. Qurban Ali which seemed to be very poor in hygiene condition. However, Afcon Group among all the labor sheds of all Contractors, additionally provided some recreational facilities i.e. television in worker's dining room, Volley ball play ground for working labors etc. Separate kitchen and dining room were found in all the sheds. In all the kitchens LPG gas is used for cooking. Sufficient bathrooms and separate latrines (1 latrine for every 12 labors; Source: BIFPCL office) are built for the residential workers of respective contractors. In addition, water is being supplied through water tank in some of those bathroom and latrines. Concrete cisterns in labor sheds are being cleaned weekly or twice in a month usually. Though the water is basically used for bathing by the working labors. In terms of drinking and cooking water facilities, treated water from the water treatment plant is supplied to the shed. In this regard, two drums (200x2=400 liter) of water supplied daily to each shed for drinking and cooking purposes (on average 5 liter/labor/day) (Source: BIFPCL office). A confectionary shop in the labor shed compound functioned well to meet up labors demand.

In terms of worker safety and security issue, approaches made for safety awareness were also observed. Workers were also found to use Personal Protective Equipment (PPEs) and is strictly monitored by the safety officials of BHEL and BIFPCL. 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 Equipments	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

The wage rate of local unskilled/semi-skilled labors determined from the concurrent market rate of those area and the working local labors did not show any unsatisfactory comments regarding wage rate. On the contrary, though there were complains against the limitation of drinking and cooking water from the residential labors, the project authority rejeccted this complain and stated that they managed sufficient amount of water to meet the purpose. Regarding this issue, the authority stated that the motor of water treatment plant generally opened for all to collect necessary amount of water, but it may be mentioned that the working labors face dificulities to match with that time frame. On the other hand, the residential labors also stated that sometimes they got poor quality of water whereas the authority disagreed with the statement and stated that the same water is provided to the project officials and they never faced the problem yet.

Some fatalities occurred during construction works where one death causality was recorded. This might be due to lack of consciousness among the working labors. However, the Project proponent has taken care of this incident as per Project ERP and administrative procedures. and project authority strictly warned to the contractor to strenthen awareness programs and monitoring facilities.

On the other hand, Union Parishad Chairman of Rajnagar, stated that 2 of his union people were injured (one was at the very beginning of the land development activity and another one in present year) during working but the authority took responsibilities for their treatment. though both the persons are now unable to work due to accident, but the authority did not provide any contingency fund/livelihood restoration support for these disabled persons.

Community Health Safety and Security

In order to reduce dust blow attenuation of noise, the project authority has planned for tree plantation inside and around the project area. In this regard, the authority has already planted

68,750 timber/fruit/medicinal trees inside the project area with the collaboration of Bangladesh Forest Department (BFD) (Source: BIFPCL office). The project authority stated that soil of the project site is becoming stable gradually and hence the intensity of sand blowing is decreased over the years. In addition, plantation initiatives may help to reduce sand blowing as well as to ensure environment friendly working space in the project site.

As the construction activities continued for 24 hours a day so heavy construction works should be restricted during quiet time (8 pm to 7 am) which is also specified in the guideline of Department of Environment (DoE).

For ensuring people's safety and security during construction works, access of unauthorized people inside of the project area is prohibited and that is strictly monitored in present days. In this regard, except to the entrance point all other access points are blocked and two tiers of checking system has beeb installed in the entrance point.

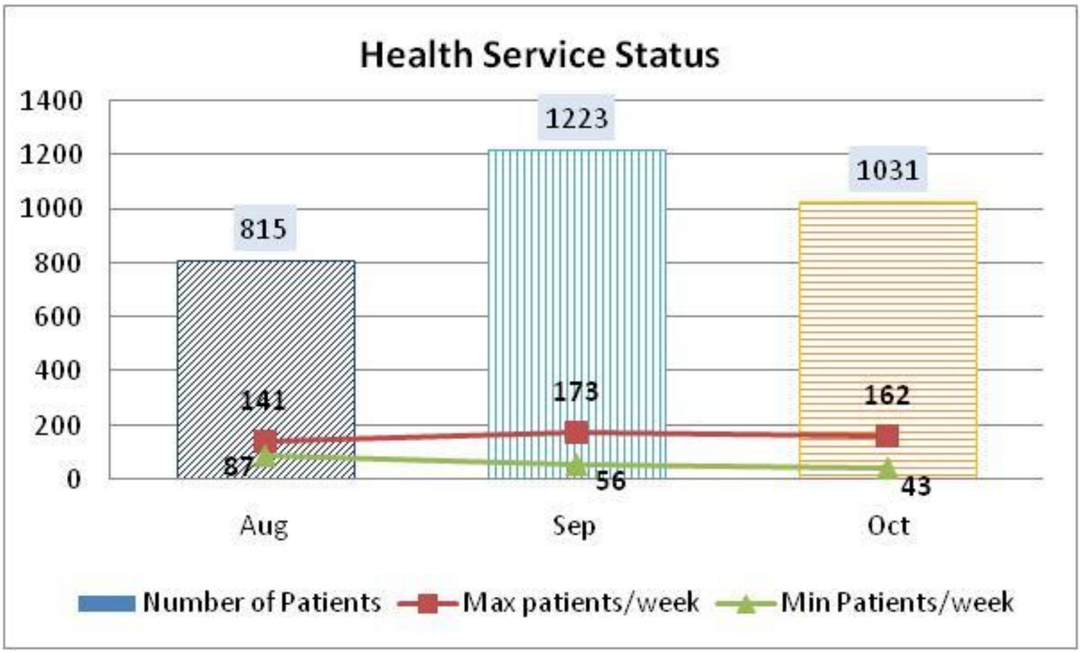
Activities under Corporate Social Responsibilities (CSRs)

Project authority implemented some programs for livelihood restoration and shifting allowance of residential structures of the Project Affected People (PAP) through engaging an NGO (SAMAHAR). In the meantime, the allocated amount for each listed households has already been given and concerned NGO has already left from the field after finishing their contracted assignment.

Project authority has planned to develop sustainable livelihood option for the educated member of the project affected households, according to the scope of their recruitment. In line with this, a person (passed HSC) from the affected household has already been provided a job at BIFPCL Dhaka Office. The authority stated that this process will be continued in future depending upon the requirements.

Sometimes, project authority donated certain amount of money in order to contribute in religious and cultural festivals at the project surrounding unions. They also continuously provided free medical treatment facilities for the local people over last four years, as health treatment facility in these rural areas was quite poor before initiating the proposed power plant project. This treatment facility has been highly appreciated by the local communities and people felt gratitude to the project authority for the services. Popularity of the service is gradually increasing over the years and BHEL (the EPC contractor) has also established their separate medical set up (center) in the plant side to provide treatment support for the working labors.

The medical camp of BIFPCL functioned twice in a week with full set up (including expert physician) for providing free treatment facilities while remaining of the days they provide medicines only (while only paramedic physicians are available not the expert one). The medical center is well equipped with including all necessary tools, paramedics and expert physician. However, BHEL medical center is operated just by 2 medical assistants with some general usual medicines and an ambulance as well (2 ambulance operators).



Source: BIFPCL Office, 2018

Figure 4.2: Record of health service recipients under CSR program

As per the information of BIFPCL treatment facilities, about 3,069 patients got treatment over the last three months from August 2018 to October 2018 (1,023 patients per month). Among the total number of patients, 437 received treatment from the regular medical center of BIFPCL office, remaining 2,632 patients from the weekly medical camp.

5. Environmental Compliance

5.1 Introduction

During the monitoring program, it was observed that almost all of the package item of worksof the proposed power plant has been initiated. The civil construction activities at the Boiler and Turbine installation areas and other heavy equipment installation areas, development of township areas, internal road communications, temporary drainage networks, water treatment system for the construction activities etc. are progressing fast in this stage.

Extension of the two-lane approach road of about 6.0 km. from Babur Bari point at Khulna - Mongla Highway to Project site has been continuing. The bridges and culvert area have already been extended to four lane road requirement. The security system has been highly tightened. Boundary wall around the Project area and the slope protection activities of the developed land is completed. New section wise boundaries within the Project area have been demarcated for safety and harmonizing the works effectively. The newly constructed pre-fabricated building has been used as the main Project Office of BIFPCL and the previous office building has been left over for the use of EPC contractor’s office. The EPC contractor i.e. Bharat Heavy Electricals Limited (BHEL) have already employed different local specialized construction firms for progressing the construction works simultaneously.

In the meantime, one incident happened at the project site. One worker named Sajib Mia, son of Hasan Mia of Jhanjhania village in Rampal Upazilla of Bagerhat district died on Friday (31st August, 2018) due to electrocution during work as he was not wearing any protective equipment. Three others were injured when they tried to save incumbent while they were cutting a rod with a machine at the under-construction Power Plant site. However, the Project proponent has taken care of this incident as per Project ERP and administrative procedure.

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; Labour and Working Condition; Community Health, Safety and Security; Biodiversity and Sustainable Management of Living Natural Resources.

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

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

Sl. No.	Potential Impacts	EMP measures as proposed in the EIA	Actual condition/ Measures already Implemented	Compliance Status	Recommended Action
1	a. 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 both night and day period of time at different potentially sensitive areas by CEGIS. • Noise level is within the limit around the project boundary but exceeds 2/3 areas for operating the captive generator and construction works • Use of PPE 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. • Redress any kind of community or personnel complain regarding noise effect.
2	Dust Generation from construction works	• Limiting activities for producing fugitive dust particle within project area • Vegetation clearance and base stripping should be minimized • Vehicle speed restriction must be enforced to control dust generation • Earthen roads and undeveloped roads should be avoided to minimize dust generation • Construction materials must be covered to protect from wind action	• Frequent air quality monitoring in and around the project sites have been ensured the status of ambient dust particles • Monthly and quarterly monitoring presents the dust generated from the construction sites. • Substantial Water spraying was recorded for reducing dust emission.	• Being Complied	• Implement redresses mechanism for any kind of grievance received from the community affected by the dust;

Sl. No.	Potential Impacts	EMP measures as proposed in the EIA	Actual condition/ Measures already Implemented	Compliance Status	Recommended Action
		• Spray water regularly for suppressing fugitive dust • 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	• Temporary and permanent boundary wall for the main Plant is being completed. • Notification sign has been put into the strategic points. • Medical treatment and medication are provided to the workers related to the project		
3	Water Quality	• Surface water must be saved from any harmful effluent emission and waste dumping from project site • Provide closed system facilities and wastewater treatment plant to minimize emission of effluents from 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	• Harmful disposal was not recorded which is reflected in the monitoring parameters. • Existing drainage system has been rearranged and permanent drainage system being constructed. • Rainfall runoff discharge to nearby river through existing temporary drainage network or fixed pipe and is being cleared occasionally. • EPC contractor is now going to re- check the water quality of outfalls. • Reuse of rainwater stored at temporary drainage areas for sprinkling and curing • Good housekeeping for storing the materials.	Being Complied	• Introduce temporary sewerage treatment system. • 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
		consultation is one hour according to ISO-14001 standard, b) arrange monthly environmental meeting among the mid-level officers through top management when those issues will be discussed under guidance of ECR 1997.	• Labour colony is being prepared with good sanitation facilities. • Onsite sanitation facilities have been developed at the labor sheds as well as the working places. • Training and awareness program are continued to the labors		
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 have to be fenced prior to initiation of construction activities. • Stock piles of construction materials requiring cover up in order to protect them from wind and weathering action. • The existing right of way have to be used for material transportation without creating any block • Keep provision of sanitary toilet, one toilet for 10 persons.	• Heavy equipment and mechanical equipment are kept in the demarcated places. • Demarcation of working places, hazardous and risky materials and equipment are also recorded. • Project area is now highly protected with wall and security • Conventional way of waste collection and disposal system has been initiated both at Plant office and labour shed. • Sanitation facilities are available • Burning of waste materials was not recorded • Install sufficient sanitary toilet at the labour shed	Being Complied	• Sufficient waste disposal bin/s with labelling should be installed at labour shed, and at working area. • Introduce coloured bins to store different types of waste. • Communicate with the local authority for offsite waste transportation and disposal.

Sl. No.	Potential Impacts	EMP measures as proposed in the EIA	Actual condition/ Measures already Implemented	Compliance Status	Recommended Action
		• Location of spoil stock pile ought to be located in safe area and protected from wind and rain action. • No spoil store on River bank/slope • Construction wastes must be reused or recycled as and where possible • Burning of waste material should be restricted • Quality housekeeping practice must be maintained by regular inspection and checking. • 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	• Material transport is being done by regular route • Standard labour colony has been prepared. • Waste management has been included into the induction training of the labour • Local language (Bengali) are being included in the signboards. • Developing a formal procedure for waste collection and disposal		
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 has been given to the rightful owners of the land as per the laws of Bangladesh e.g., ‘Acquisition and Requisition of Immovable Property Ordinance, 1982’. • Compensation made by local DC office • Local DC office facilitates unauthorized occupants of the acquired land to get home in the shelter houses or cluster villages provided by the GoB.	In the process of Compliance	• Initiatives have been taken for the resettled people as per the LRP; • Giving top most priority to the PAPs for getting training and associated jobs as per their skill; • 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
		• Compensation for movable structures • Retention of salvageable materials • Compensation for loss of trading income • one time moving assistance • grant to cover loss of regular wage income • Has a resettlement plan been developed which includes compensation, restoration, livelihood, living standards etc. based on proper socio economic studies? • Human provide/ take extra care/caution for the disadvantaged/ vulnerable group/s (i.e. women, children, ethnic minorities, indigenous people etc.) • Provision of monitoring the compensation and resettlement process	• BIFPCL gives priority to affected people in Project related employment • A significant number of affected people (especially who desires) are working at the construction site. • List of 136 indirectly affected people was given by the DC Office, Bagerhat. • One third of the labour are now recruited from the local which include the PAPs • Livelihood Restoration Plan (LRP) for the PAPs have been prepared by BPDB. • BPDB already appointed an NGO for implementation of LRP. • 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 • Govt./NGOs need to provide support the skill development program and income generation activities to local people	• BIFPCL is maintaining the social liaison especially with the local Government and DC office • They are implementing the HR policies, Labour recruitment Policies, Manpower set up etc.;	In the process of Compliance	• The proponent should recruit a greater number of local labour for the project works according to their skill. • Training and motivational program should be run for the worker of shrimp farm,

Sl. No.	Potential Impacts	EMP measures as proposed in the EIA	Actual condition/ Measures already Implemented	Compliance Status	Recommended Action
		• For the increased movement of people and heavy vehicles, the road networks must be developed	• One third part of the total labour are recruited from the local areas. • Most of the local labours are – directly project affected people, nearest communities or within the Rampal/Mongla areas • The wage of the labour is compatible with the national standard. • Provision of first aid is present; • Medical unit capable of dealing emergency situations like injury, ICU supported ambulance, accident, etc. already set up. • New planned residential areas for the labour are under construction, which includes good sanitation facilities, living condition, medical facilities and recreational facilities. • Prayer room has been constructed. • Available drinking water, sanitation facilities are recorded at site • Recent accidental event has been taken care properly as		local labour, Bauali, Mauali or farmers; • Accidental log sheet or injury log book should be put into display in office premise and entry check post; • The proponent should more control over the contractor or subcontractor on EHS issues

Sl. No.	Potential Impacts	EMP measures as proposed in the EIA	Actual condition/ Measures already Implemented	Compliance Status	Recommended Action
			per procedure of ERP and recommendation		
7	Green House Gas Controlling Measures	• Restriction of any kind of solid wastespecifications. • Approved pollution control devices to be fitted in equipment and machinery. Transport vehicles must not be overloaded. • Avoid queuing of vehicles in areas adjacent to site, particularly near sensitive receptors including housing. Switch off / throttle down all site vehicles, water vessels, generator and machinery when not in use burning. • Regular maintenance of water vessels, vehicles, generator and machinery in accordance with manufacturer's	• Relatively new equipment and machineries are used for construction purposes • The EPC are implemented the project as per IFC guidelines standard, EIA approval of DoE, and EMP of the EIA, etc. mentioned in the bid document. Monitoring program is being run successfully	In the process of Compliance	• Prepare checklist on • equipment and their condition owned by the contractors; GHGs inventory checklist should be prepared immediately at this stage; • Use of energy efficient and CDM technologies and equipment.

Table 5.2: Monitoring of Labor and Working Condition

Sl. no	Potential Impacts	EMP measures as proposed in the EIA	Actual measures already Implemented	Compliance Status	Recommended Action
1	Working Conditions and Management of Worker Relationship	• Preparation of Human Resources Policies and Procedures for Direct workers; • Defined Working condition and Terms of Employment for direct worker; • Sustainably equivalent terms and condition for migrant workers; • Compliance to national law of • forming workers' organization; • No discrimination and equal opportunity for all; • Measures for diminishing past discrimination; • Grievance Redress Mechanism.	• EHS department is working properly • ERP and ESMS has been finalized and they are practicing; • No force and child labour is recorded • The EPC has signed contract with the sub-contractors about labour policies • EPC has also appointed Occupational Health and Safety Officers at site • Ensure minimum wage and working hours as per GoB for the labour. • Induction training and regular training of first aid, toolbox are continued. • No discrimination, equal opportunity and employment terms and conditions for local and migrated labours have to be carefully maintained. • Following the 'Bangladesh Labour Law (Revised) 2013', 'Bangladesh Labour Rule, 2015'.	Being complied	• Appointment of more local workers should be given priority for the jobs according to their skill. • Strictly maintain the security system the unauthorized people cannot enter into theproject area. • Awareness and motivational training should be continued about workers safety, benefits, health and relationships with others and communities

Sl. no	Potential Impacts	EMP measures as proposed in the EIA	Actual measures already Implemented	Compliance Status	Recommended Action
2	Protecting Work Force	• The client will not employ children in any manner that is economically exploitative, or is likely to be hazardous or to interfere with the child's education, or to be harmful to the child health or physical, mental, spiritual, moral, or social development. • No Forced Labour	• Ensured no child labour employment for the EPC or other subcontractor. • Ensured no forced labour • First Aid support to the labours during any accident. • Immediate first aid medical treatment has been given to around 600 numbers of labour by the BIFPCL medical centre from July to November 2018. • ERP has been implemented. • Labours are bound to use PPEs during works at site. • EPC has also appointed Occupational Health and Safety officers at site • First aid, fire and safety, awareness training is conducted every week at project site. • ICU support ambulance and medical support are working. • Contractor has taken insurance policy for engaged labours as per labour policy of Bangladesh.	Being complied	• Proper documentation of contract with the worker is required, which includes working hour, wage and benefit. The Project authority should emphasize for recruitment of the local labours; • The insurance policy should cover the accidental case or injuries of the labours; • Awareness work should be continued regarding the local cultural values, STD and redress of workers grievances • Protect the risky work and site carefully and demarcate it substantially about the dangerous component and services.
3	Safety at site	• Installation/Construction of Safety Fence around the Project area	• Putting safety sign at the strategic places;	Being complied	• All electric lines at project site required to be fixed as safe and tidy;

Sl. no	Potential Impacts	EMP measures as proposed in the EIA	Actual measures already Implemented	Compliance Status	Recommended Action
		• Use of Personnel Protective Equipment's (i.e. safety vest, safety goggles, ear plug, safetyshoes, gloves, dust mask, etc.); • Safety trainings for workers (i.e. fire control, working at height, working in heat, first aid etc.); • Practice of Tool box meeting, safety talks • Safe Storage of Hazardous • Chemicals (e.g. fuel, flammable chemical, toxic chemicals, etc.); • Maintaining Material Safety Data Sheet (MSDS); • Provision of Health care facilities such as doctor, hospital etc. available at/nearby the plant construction site; • Availability of First Aid at work place; • Preparation and Follow of Emergency Response Plan; • Adequate fire precautions in place (e. g., fire extinguishers, escape routes etc.);	• Protecting the specific areas with fence and demarcation sign • A number of designated areas Labour and Project personnel are using appropriate PPEs like reflecting vest, helmet, and safety shoos etc. • Safety training for workers are regularly conducted at project site; • BIFPCL is very much strict to use PPEs by the construction labours and the labours are getting accustomed with the PPEs • Increasing the capacity of temporary hospitals, doctors and 24hr available of ICU support ambulance at the Project site ; • Emergency contact address are found at the site for any kind of sudden incident; • Safety manual has been followed at the construction site; • Available fire extinguisher and Fire safety mock drill is being conducted at some regular intervals.		• Insurance of the labour and employer should be introduced for any accidental case. • 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. • Ensure that the workers are using the appropriate PPEs, no drink or drug at work, personal hygiene and inform immediately to the supervisors for any unsafe condition. • Risky areas or job ensured as per safety guideline

Sl. no	Potential Impacts	EMP measures as proposed in the EIA	Actual measures already Implemented	Compliance Status	Recommended Action
		• Documentation and reporting of occupational accidents, diseases, and incidents; • Policies and procedures for managing and monitoring the performance of third party employers in relation to OHS	• 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	• Medical aid, fire extinguisher, PPEs are provided; • Worker's shed and sanitation facilities are available; • Onsite medical facilities have been continuing. • EHS Department of BIFPCL is now operating in full swing; • Moreover, EPC also appointed one OHS experts at site; Site-specific Environmental Health & Safety checking is continued. • RO Water treatment plant for supplying safe drinking water for the labours.	Being complied.	• Regular training, awareness, motivational and mock drill should continue to be arranged at the construction and operation phase; • Proponent may organize regular meeting with the EPC for grievance related issues and safety issues

Sl. no	Potential Impacts	EMP measures as proposed in the EIA	Actual measures already Implemented	Compliance Status	Recommended Action
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 will look into workers' well- being.	• Consultation with the proponent, EPC, Sub-contractor and labours, no forced labour is recorded. • 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. • Proponent is now pushing to established fare wage of labours and the benefits for every labours • Free first aid medical treatment is being facilitated by BIFPCL to the labour and to the community too. • Grievance register are being initiated for the worker. • The proponent has taken care about the incident though ERP	Being Complied	• Introduce occupational code of practices/best practices compatible with their own culture • Freedom of Association, Rights & scope of bargaining and tripartite consultation should be open for the workers. • Serious care should be taken about the safety issues • The proponent has to look after the following issues – equal benefit among the direct labour, contracted labour, day labour etc, workers work and non-work life balance, emotional supervisory support, organizational support and health surveillance.

Table 5.3: Monitoring of Community Health, Safety and Security

Sl no	Potential Impacts	Proposed EMP	Actual measures already Implemented	Compliance Status	Recommended Action
1	Disturbance to nearby community due to dust from developed land and Noise from construction activities	• Construction of boundary wall around the Project area; • Installation of water spraying system to control dusts; • Conducting dust monitoring and visual inspection around the site boundary; • Adoption of noise management plan.	• They are spraying water to reduce the dust emission especially during the dry days of monsoon. • Temporary and permanent Construction of boundary wall around the project area has been completed. • Block-B is highly responsible for spreading dust to the nearest community. • CEGIS is regularly communicating with the nearby communities for assessing any kind of impacts. • Regular communication and consultation are taken places with the local government and local administration.	Being complied	• BIFPCL may inform BPDB for taking initiative to control dust emission from Block-B area. • Continue the water spraying to the exposed land areas beyond the boundary wall • Local people should be aware about the construction activities relevant to noise and dust. • Water spraying during the evening period must be conducted near the labour colonies
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;. • Grievance register is prepared for the community; • Good communication has been established with the local government and proponent; • BIFPCL has tried to redress the grievance of the local people	Being complied	• Regular local level consultation is necessary for impact monitoring as well as updating the local communities. • Training on behavioral development on the security personnel should be introduced to eliminate the any misunderstanding with the local peoples

Sl no	Potential Impacts	Proposed EMP	Actual measures already Implemented	Compliance Status	Recommended Action
			though offering job, training and other CSR activities;. • Proponent is observing the community grievance or quarries though the monitoring study conducted by CEGIS		
3	Risk of breaching Community Safety	• Construction of boundary wall/safety fence around the Project area; • Practicing Risk Assessment and Evaluation Process; • Practicing safe management for hazardous materials which may pose threat to the community; • Availability and operation of Emergency Response Plan; • Maintaining open communication channel with the local community; • Training and instruction to the security personnel about their behaviour and communication with the local people; • Aware the security personnel about the right of the community people.	• Project site protected as it is nearly isolated from the community through Maidara River • Regular monitoring not only the bio- physical but also the ecological and ultimately the social systems are monitored by third parties (CEGIS) • Implement high security system for the project; • Health check-up is mandatory to every labours during the induction training. • 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 (who are responsible for security).	Being complied	• Continue the training and motivational work for maintaining local norms and values and have a good relation with the local workers and communities; • Make a liaison with the local government for clarifying any kind of indent/ rumor in local communities related with this project; • Safe driving and vehicular movement should be implemented for the approach lane (Babubari to Project site) • Security should be strict for restricting the entrance of unauthorized person.

Sl no	Potential Impacts	Proposed EMP	Actual measures already Implemented	Compliance Status	Recommended Action
			• The project proponent has engaged the local governments for improving their livelihood status		
4	Community Health Risk	• Provision of providing health service facilities to community if the Project poses any health risk like sexually transmitted disease, contract disease, vector-borne diseases; • Implement all pollution mitigation measures to ensure safeguarding to community.	• Increased the medical facilities (consisting medical officer, medical assistant, office assistant) at Plant site; • Arranging twice a weekly health service program (medical consultation and free medicine) for the local community. Around 2000 number of patient has been served through BIFPCL medical camp from June to November 2018 • Protective action are taking to avoid vector borne diseases and HIV positives	Being Complied	• Continued the training activities for migrated labour regarding the local culture and customs; • The proponent may establish business development activities (markets) for the workers and local communities as CSR activities.
5	Youth Employment (Local)	• Providing training/awareness program for the local youth to let them aware about the required qualification to get involved in the Project related activities Emphasis to recruit local labours according to their skills and capacities.	• Informal sitting was arranged with the local government numbers of time and community representatives for labour recruitment; • Significant number of local people(1000-1500) are currently working at the construction site;Regular training/workshop are being organized by the proponents especially on swinging and computer; • The proponents have already taken few initiatives to encourage	Being Complied	• Increasing the number of local labours; • training related to construction work i.e. carpenter, electrician, lineman, elevator mechanic, glazier, iron worker, heavy equipment operator or labourer etc. would be introduced immediately; • Support Income generating activities and business

Sl no	Potential Impacts	Proposed EMP	Actual measures already Implemented	Compliance Status	Recommended Action
			local students through awarding them; • Local labours are working at this project engaged by the sub-contractor companies • Formal training on computer literacy and sewing machine has been initiated in the site and already 3 batches was completed the training program. • 3 days taring was held on Computer for 20 students/ unemployed locals on 17th July2018.		development activities for the local potential youth. • Age limit of the labor should be equal and over 18 years and they should strictly adhere to use appropriate PPE in the site
6	Public Communication, Consultation and Awareness	• Arranging public communication/consultation meeting; • Sharing of Project information with local people; • Organizing environmental and social awareness programs/meetings.	• Informal sitting with the community; • Display Project related information on a display board at Project site; • Regular meetings are carried out at different level; • Advertisement was broadcasted • Publishing Project related discussion/article in different print media. • Project related every information has been uploaded in BIFPCL website	Being Complied	• Continue the dissemination workshop in Dhaka and • Khulna and Bagerhat or Rampal Upazila to aware the community, civil society, environmentalists about the environmental safeguarding measures considered in basic design. • The EPC contractor should follow the social code of conducts / good practices

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

Sl No	Potential Impacts	EMP measures as proposed in the EIA	Actual condition/ Measures already Implemented	Compliance Status	Recommended Action
1	Rainfall runoff from the construction site would cause deterioration of aquatic ecosystem.	• Installation of proper runoff drains; • Use of sediment fences, traps and basins for trapping the sediment, if required.	• Water logged area is not found inside the project boundary • Construction of sediment traps has been mentioned in the Bid documents to instruct the bidders; • Development is initiated for permanent drainage network inside the Project boundary. • Rainfall runoff and other domestic water is drained out though temporary drainage system or formal pipe network • The connectivity of Maidara River is being maintained. • EPC is monitoring the water quality at every outlet from the project site. • RO plant is operating for supplying fresh water supply system both for construction and domestic uses.	Being complied	• Storm water drainage network must be separated from any kind of contamination of chemicals or oily water • Evaporation pond might be used for brine discharge from the RO Plant
2	Disturbance to nearby ecosystem due to different construction activities	• No cutting/ felling of trees along the river bank; • Implementation of onsite waste and air quality management plan; • Limiting soil extraction activities within the defined area;	• Rudimentary processing followed for waste collection and disposal system for this construction stages • Limiting the vegetation clearance and base stripping process within the Project boundary;	Being Complied	• If possible using of light shade (directed downwards) around the outdoor lights; • Regular monitoring of the trees planted around the Project site.

Sl No	Potential Impacts	EMP measures as proposed in the EIA	Actual condition/ Measures already Implemented	Compliance Status	Recommended Action
		• 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 sensitive habitat.	• Boundary wall around the project is completed along with compartmentalization • Provision of cut-off time to switch off unnecessary lights at night; • Selection of local plant species like Goalpata, Sundori, Bian, Kaora for green plantation; • No degradation of the habitat out site the power plant area • EPC contractor is monitoring the air quality, water quality and noise level more intensively in the project area • Working activities are now limited to the project boundary • No lighting and noise effect is noticed significantly outside the project boundary wall • Motivational works are introduced to protect local fauna during training session		• Bird sheds can be developed at the green belt areas or on the bank slope. • Awareness program for ecosystem conservation and development should be introduced as a part of Corporate Environmental Responsibility • Ecosystem monitoring must be continued simultaneously with the power plant construction and operation works.
3	Disturbance to river, inter-tidal areas and wet lands	• No encroachment of inter-tidal flood plain area; • No disturbance to Dolphin community; • Monitoring of Ecosystem Health and Monitoring of Sundarbans Forest Health;	• Monitoring of forest health and ecosystem health in Sundarbans and around the Project site are being carried out by CEGIS; • Completion of slope protection work;	Being Complied	• Care should be taken during navigation, discharging water and construction activities at inter tidal areas. • Take initiative for the continuity of Maidara

Sl No	Potential Impacts	EMP measures as proposed in the EIA	Actual condition/ Measures already Implemented	Compliance Status	Recommended Action
		• 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	• 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 • The natural stream flow of Maidara River near access road has been recorded.		river near the BPDB project site; • Necessary action should be taken if the discharge water quality cross the standard limit (ECR'1997)

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.	Not applicable now	BPDB will comply with the condition prior to initiation of any expansion or extension of the Power Plant.
2	The Coal Specification and Power Plant technology should be maintained as per EIA report. In case any change in design the proponent must obtain consent from DoE.	The Coal Specification and Power Plant technology will be maintained as per EIA report. In case of any change in Plant design and coal specification the proponent shall obtain consent from DoE.	Suggested to comply as and when required.
3	Project Proponent may undertake activities for land development and infrastructural development of the Project.	BIFPCL has already completed land development activities. Infrastructure development activities are being continued.	Being Complied.
4	Project Proponent may open L/C (Letter of Credit) for importing machineries for the Project, which shall also include machineries relating to waste treatment plant and other pollution control devices.	EPC contractor has been appointed 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 for monitoring pre-construction as well as construction activities for examining environmental impacts. No significant impact on the surrounding environment or natural resources impact has been reported yet. All necessary measures have already been incorporated in the technical specification of main Plant EPC package as per DoE stipulations. Pollution control measures have widely been covered in technical specification like Effluent Treatment Plant, ESP, FGD etc. The EPC contractor are constructing the Plant as per the contracted technical specification.	Being Complied.

Sl No	Condition of DoE	Compliance Status	Remarks
6	Proper and adequate mitigation measures shall be ensured throughout preparation, construction and operation period of the proposed Khulna 1320 MW Coal based Thermal Power Plant Project activities.	BIFPCL is monitoring the mitigation measures adopted through the environmental consultant CEGIS. Site development activities have been completed and construction work has already started. Proper and adequate mitigation measures at this stage are being ensured.	Being Complied.
7	Any heritage sight, ecologically critical area, and other environmentally, religious and archaeologically sensitive places shall be kept protected during Project construction phase.	There is no religious, archaeological place in and around the site. The construction activities are being carried out considering and ensuring safeguarding of the Sundarbans Reserve Forest area and ECA (Ecologically Critical Area).	Being Complied.
8	Environment friendly construction and development practices shall be followed that minimize loss of habitats and fish breeding, feeding & nursery sites.	The construction activities are being carried out in and around the project boundary. The equipment and labour/workers are coming to the project through designated/ conventional route. Moreover, regular monitoring activities are also being carried out to compare the impacts. No significant changes are recorded.	Being Complied.
9	Construction works shall be restricted to daytime hours so as to avoid/mitigate the disturbance of local lives as well as implementation schedules of the works shall be notified in advance to nearby residents.	CEGIS is monitoring the community response towards construction works of Power Plant regularly. Moreover, BIFPCL is keeping close communication with local people to receive their grievance related to project activities. The construction activities shall be restricted to daytime only. However, for the timely completion of the Project, if required, works may be continued beyond day time, but that must be done 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.

Sl No	Condition of DoE	Compliance Status	Remarks
10	Proper and adequate sanitation facilities shall be ensured in labour camps throughout the proposed Project period.	At present, the construction activities have been continued in full swing. 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 maintenance. Working during sensitive hours and locating machinery close to sensitive receptor are being avoided.	Being Complied
12	No solid waste can be burnt in the Project area. An environment friendly solid waste management should be in place during the whole period of the Project in the field.	No solid waste is burnt inside the project boundary. Provisions in line with this, condition have been included in Clause No 14.9 of SCC. Solid Waste Management system has been prepared (Section-V, B12, Part-9 of Technical Specification).	Being complied
13	Proper and adequate on-site precautionary measures and safety measures shall be ensured so that no habitat of any flora and fauna would be endangered or destructed.	The construction activity is being carried within the project boundary. Moreover, regular monitoring activities are carried out to compare the impacts. No significant changes are yet recorded.	Being Complied
14	All the required mitigation measures suggested in the EIA report along with the emergency response plan are to be strictly implemented and kept operative / functioning on a continuous basis.	The construction activities have been continued. The project authority has increased the medical facilities for workers. An ICU support ambulance and Doctors are now available for emergency stages. Villagers of surrounding areas also availing the healthcare facilities. The authority is trying to make aware the labours/workers on occupational health and safety through safety signboards, safety training and strong implementation of safety measures. The Emergency response plan is now functioning.	Being Complied

Sl No	Condition of DoE	Compliance Status	Remarks
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 monsoon. Moreover, frequent dust monitoring has been conducted at sensitive points.	Being Complied
16	Storage area for soils and other construction materials shall be carefully selected to avoid disturbance of the natural drainage.	Construction materials have been stock piled far away from river bank and other natural water bodies at selected site to avoid disturbance of the natural drainage. For the time being BIFPCL have constructed temporary drainage network to evacuate drainage water from the Project site. Designed Drainage network will be constructed at the end of Project construction works.	Being Complied
17	Adequate considerations should be given to facilitate drainage system for runoff water from rain/tidal surge.	Permanent drainage system has been developed to facilitate safe drainage of rainfall runoff water accumulated from rain/tidal surge. A setback distance from the river has been tried to maintain during construction stage for this Project.	Being Complied.
18	Adequate facilities should be ensured for silt trap to avoid clogging of drain/canal/water bodies	Run off/ storm water drainage system have silt trap before ultimate discharge of rainfall runoff. Contractor is working to clean the temporary drainage system.	Being Complied.
19	The entire coal handling system should be designed as an enclosed (and not only covered) conveyor system. There should be integrated dust control system with dust extraction and bag filters at unloading areas and at each transfer points on the conveyor system.	Entire coal handling system have been designed as an enclosed conveyor system as per DoE requirement. Integrated dust control system with dust extraction system / bag filter and dust suppression system at crusher house, unloading points, transfer points has been specified in the technical specification of Main Plant EPC contract package. Refer Section V, B4 of Technical Specification.	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,	Compliance action initiated.

Sl No	Condition of DoE	Compliance Status	Remarks
		unloading points, transfer points has been specified in the technical specification of EPC contract package and will be implemented accordingly. Refer Section V, B4 of Technical Specification (Clause no B4.3.1.4).	
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 regards from nearby Cement Industries. Only 25 acres area has been allocated to store residual ash.	Complied at present and will be complied throughout Operation phase.
24	Integrated dry ash handling, loading, unloading and transportation system should be established.	Integrated dry ash handling, loading, unloading and transportation system will be established. Provisions in line with this has been included in Technical Specification of main Plant EPC contract package (Section V, Chapter B4).	Compliance action initiated.
25	There should be adequate and properly sized and designed dry ash silo with appropriate conveyor system.	Adequate and properly sized dry ash silo with appropriate conveying system have been specified in Technical Specification of main Plant EPC contract package (Section V, Chapter B4).	Compliance action initiated
26	Bottom ash should be extracted, crashed and stored in silos for utilization with proper collection and conveyor system.	Bottom ash shall be extracted, crushed and stored in silos for utilization with proper collection and conveying system. The procedures have been included in the technical Specification of EPC contract package. (Section V, Chapter B4).	Compliance action initiated

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

Sl No	Condition of DoE	Compliance Status	Remarks
31	All activities (pre-construction, construction and post-construction stage) should be implemented according to EMP clearly listed in the EIA report.	BIFPCL has adopted all of the EMP applicable at relevant stages. CEGIS, as an environmental consultant of BIFPCL is monitoring implementation of EMP. BIFPCL is taking all possible actions based on EMP monitoring report.	Complied at present.
32	A third party/independent monitoring bodies excluding JVC/BPDB should be engaged immediately for monitoring of all activities during pre-construction, construction and operation phases as per monitoring plan of EIA report and monitoring report must be submitted to Bagerhat District Office, Khulna Divisional Office and Headquarters of the Department of Environment simultaneously.	CEGIS, as an independent monitoring body has been engaged by BIFPCL 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. 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	Compliance action initiated.

Sl No	Condition of DoE	Compliance Status	Remarks
		regularly monitored manually as per recommendation of EMP.	
35	There should be regularly disclosure of the report through workshops and websites and responses should be taken care accordingly.	All the reports are available on website of BIFPCL (www.bifpcl.com). CEGIS is regularly carrying out public consultation.	Being Complied.
36	Online air and water quality monitoring system should be made functional throughout the life of the Plant.	The online monitoring system will be installed when the Plant will be in operation 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.	No ground water has been used so far for Plant purposes. The Plant has been designed considering use of surface water only. Therefore, they have already installed RO water treatment plant for potable water and for construction water sourcing from the river water of	Complied at this stage.

Sl No	Condition of DoE	Compliance Status	Remarks
		Passur. This RO plant is running now.	
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
44	Environmental Monitoring Reports according to specific format specified in the EIA Report shall be made available simultaneously to DoE Bagerhat District Office,	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	Being Complied

Sl No	Condition of DoE	Compliance Status	Remarks
	Khulna Divisional Office and Headquarters on a monthly basis during the construction period of the Project.	Office and Headquarters since October 2017.	
45	The following records must be kept in respect if any samples required to be collected for the purpose of environmental monitoring activities: the date(s) on which the sample was taken; the time(s) at which the sample was collected; the point at which the sample was taken; and the name of the person who collected the sample.	The Monitoring report of CEGIS keeps all the records as suggested.	Being Complied
46	The results of any monitoring required to be conducted under this EIA report must be recorded.	CEGIS is recording all the monitoring data and submitting to BIFPCL through proper documentation. The report is being shared with DoE on regular basis.	Being Complied
47	In case of any emergency, the following information shall be immediately be reported to Bagerhat District Office, Khulna Divisional Office and Headquarters of the Department of Environment (DoE) simultaneously Nature of incident (oil spill, fire, accident. Collision, land slide, etc.) Personnel affected (injured, missing, fatalities, etc.) Emergency support available and its location (standby transport, medical facilities, etc.) Weather conditions Current operations (abandoning the site, firefighting, etc.)	One incident has been occurred in this quarter. One person died on electrocution on Friday (August 31, 2018). The proponent has reported as per their organization policies. They have prepared investigation report about this incident. As per the recommendation of DoE, the proponent has informed to the DC office, Police Station and other relevant authorities. . BIFPCL has established a proper mechanism for recording such incident as suggested during the construction period of the Project.	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	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	Complied at present.

Sl No	Condition of DoE	Compliance Status	Remarks
	practicable after the person becomes aware of the incident.	threatening material harm to the environment as soon as practicable after the person becomes aware of the incident. Health and safety management manual has been 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.	Complied at present.
50	Appropriate permission would require to be obtained from the Forest Department in favour of cutting/felling on any plant/tree/sapling forested by any individual or government before doing such type of activity.	There will be no need of cutting/felling down of any trees. However, in future, if any such case arises, BIFPCL would seek for appropriate permission from the Forest Department.	Being complied
51	Re-vegetation and re-plantation under green belt activities shall be undertaken in consultation with the Forest Department according to those mentioned in the EIA report.	A MoU has been signed with Forest Dept., Bangladesh on 24.02.2015 for implementation of Afforestation Programme. Initial target is to plant 2 lac saplings in 3 years. By this time, Forest Department has already planted about 23000 nos. of saplings of different species. A fresh Agreement with BFD has been signed on 24.01.2018 for plantation of 2 Lakh trees.	Being Complied
52	Climate Change impacts and maximum storm surge height shall have to consider at the design and construction phase.	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
53	A separate EIA/morphological study shall have to be conducted for coal transportation and river dredging to develop sound environmental management plan towards conservation of ecosystem and biodiversity.	Mongla Port Authority (MPA) is the Implementing Agency for dredging. Coal transportation will be done through the existing maritime route, which is Mongla port controlled waterways. M/s IWM has already completed the EIA study for the dredging	Being Complied.

Sl No	Condition of DoE	Compliance Status	Remarks
		activity and submitted the report to MPA. A separate EIA study for Coal Transportation has been conducted by M/s CEGIS as per approved ToR of DoE and already obtained the approval from DoE.	
54	A full-fledged institutional setup for EHS and CSR must be put in place before operation of the Power Plant.	A full-fledged institutional setup for EHS activities shall be in place before operation of the Plant (Project). Meanwhile, a number of CSR activities are ongoing at Project site, like free medical facilities and medicines, free potable water supply to the local people. Infrastructure development of nearby school. BIFPCL has appointed a social worker to collect relevant social data. Health and Safety manual has been prepared.	Being complied
55	The Project authority shall extend active cooperation to DoE officials to facilitate their visit to the site as and when necessary.	BIFPCL is extending its all-out cooperation to DoE	Being Complied
56	Violation of any of the above conditions shall render this approval void.	Noted by BIFPCL	-
57	Any injunction on this Project from the Honourable Supreme Court/High Court Division shall render this approval void.	Noted by BIFPCL	-
58	Without installation of 275 Meter Height Chimney, Effluent Treatment Plant (ETP), Waste Water Treatment Plant (WWTP), Settling Pond, Desalinization Plant, API Oil Water Separator, High Efficiency Electro Static Precipitator (ESP), 'closed-loop' Flue Gas Desulfurization (FGD), Low NOx Burner, online air and water quality monitoring system and other pollution control equipment and 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), Setting Pond, Desalinization Plant, API, Oil Water Separator, High Efficiency Electro Static Precipitator (ESP), 'closed-loop' Flue Gas Desulfurization (FGD), Low NOx Burner, online air and water quality monitoring system for preventing pollution. All these stipulations have been included in the technical specification of	Compliance action initiated

Sl No	Condition of DoE	Compliance Status	Remarks
		Main Plant EPC contract package. Moreover, the area of that equipment position are demarked inside the project boundary.	
59	This EIA Approval has been issued with the approval of the appropriate authority.	BPDB and BIFPCL are thankful to DoE.	-

However, with reference to the approval of EIA study of coal transportation for 2x660MW MSTPP having (Memo no: DoE/clearence/ 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 has been listed as follows-

5.3 Compliance to the conditions of DoE (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 is happened yet. BIFPCL will notify to DOE prior to initiation of any expansion or extension of the Power Plant.	Being complied
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 other pollution control devices.	EPC contractor has been appointed. 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 environmental mpacts. No significant impact on the surrounding environment or natural resources impact has been reported yet.	Being Complied.
5	Proper and adequate mitigation measures shall be ensured throughout the operation period of the Project	The project proponent will include the all mitigation measures in their BID document. However, BIFPCL is monitoring the mitigation easures of the Power Plant CEGIS.	Being Complied
6	Any heritage site, ecologically critical areas, and other environmentally,	There is no religious, Archaeological place in and around the site.	Being Complied

Sl. No.	Conditions	Compliance status	Remarks
	religious and archeologically sensitive places shall be kept protected during project operation.		
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 guide of EIA.	Being Complied
8	Proper and adequate sanitation facilities shall be ensured in labor camps throughout the proposed project period.	At present, the Jetty construction activities are being continued. New residential areas and adequate sanitation facilities are becoming 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 and Jetty Construction works has been continued. The proponent must follow the ERP of the EIA study 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 extraction and bag filters at	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
	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 he construction work is over.	At present, the jetty construction work is going on. The proponent needs to prepare a guideline for disposed off 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	The Monitoring activities	Being Complied.

Sl. No.	Conditions	Compliance status	Remarks
	Sundarbans for protecting ecosystem, biodiversity and forest coverage should be made using latest high resolution image for keeping ambient environment.	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 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 regularly 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.	Being complied
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 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
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

Sl. No.	Conditions	Compliance status	Remarks
30	The following records must be kept in respect of any samples required to be collected for the purposes of environmental monitoring activities : 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.	The Monitoring report of CEGIS keeps all the records as suggested.	Being Complied
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 will be adopted 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	Complied at present.

Sl. No.	Conditions	Compliance status	Remarks
		person becomes aware of the ncident. They will prepare for the coal transportation system before the it 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

References

"Assessing the oil spill's impact on Bangladesh's Sundarbans forest". Deutsche Welle. December 17, 2014.

Awashthi, S.K. 2000. Prevention of Food Adulteration Act No. 37 of 1954. Central and State rules as amended for 1999 (3rded.). New Delhi: Ashoka Law House.

Badran M (2001) Dissolved oxygen, chlorophyll a and nutrient seasonal cycles in waters of the Gulf of Aqaba, Red Sea. Aquat Ecosys Health Manag 4(2):139–150.

BARC (Bangladesh Agricultural Research Council). 2012. Fertilizer Recommendation Guide, Bangladesh Agricultural Research Council, Farmgate, Dhaka.

Bartram J and Balance R (1996), Water Quality Monitoring - A Practical Guide to the Design and Implementation of Freshwater Quality Studies and Monitoring Programmes, UNEP/WHO, Chapter 2.

Brown SAJ, Gillespie JR, Lugo AE. 1989. Biomass estimation methods for tropical forests with application to forest inventory data. For. Sci. 35 (4):881−902

BROWN S. 1997. Estimating biomass and biomass change of tropical forests: a primer. FAO Forestry Paper 134. FAO, Rome, Ital

CHAVE J, RÉJOU-MÉCHAIN, M., A. BÚRQUEZ, E. CHIDUMAYO, M. S. COLGAN, W. B. C. DELITTI, A. DUQUE, T. EID, P. M. FEARNSIDE, R. C. GOODMAN, M. HENRY, A. MARTÍNEZ-YRÍZAR, W. A. MUGASHA, H. C. MULLER-LANDAU, M. MENCUCCINI, B. W. NELSON, A. NGOMANDA, E. M. NOGUEIRA, E. ORTIZ-MALAVASSI, R. PÉLISSIER, P. PLOTON, C. M. RYAN, J. G. SALDARRIAGA, AND G. VIEILLEDENT, et al. 2014. Improved allometric models to estimate the aboveground biomass of tropical trees. Glob. Change Biol. 20: 3177–3190.

CEGIS. (2013). Environmental Impact Assessment of 2X (500-660) MW Coal Based Thermal Plant to be Constructed at the Location of Khulna (p. 456). Bangladesh.

Chave J, Andalo C, Brown S, Cairns M. A., Chambers, J. Q., Eamus D et al (2005) Tree allometry and improved estimation of carbon stocks and balance in tropical forests. Oecologia 145: 87–99

Donato, D.C., Kauffman, J.B., Stidham, M.A. (2009) Protocols for measuring and reporting carbon stocks in mangrove forests. Unpublished report prepared for the workshops on Global Climate Change and Carbon Financing: Opportunities for Bangladesh. Dhaka, Bangladesh, 28, October–9 November 2009.

Eckman, J.E., (1979) Small-scale patterns and processes in a soft-substratum intertidal community. J. Mar. Res.37:437–457.

Eckman, J.E., (1983) Hydrodynamic processes affecting benthic recruitment. Limnol. Oceanogr. 28: 241–257

FAO 1997. Estimating biomass and biomass change of tropical forests: a primer, Rome, Italy: FAO Forestry Paper No. 134

Gleick, P.H. (Ed.), 1993. Water in Crisis: A Guide to the World Fresh Water Resources. Oxford University Press, New York

Goldman, S. 2005. Information theory. Dover, New York.

Harmon, M. E. and J. Sexton (1996). Guidelines for measurements of woody detritus in forest ecosystems. U. S. LTER Publication No. 20.

Heath, R.C., 1989. Basic Ground-Water Hydrology. U.S. Geological Survey Water-Supply Paper 2220, 84p.

Hossain, M., Siddique M. R. H., Bose, A., Limon, S.H., Chowdhury, M.R. K., • Saha, S. (2012) Allometry, above-ground biomass and nutrient distribution in Ceriops decandra (Griffith) Ding Hou dominated forest types of the Sundarbans mangrove forest, Bangladesh. Wetlands Ecol Manage DOI 10.1007/s11273-012-9274-2

Kabata-Pendias, A. and H. Pendias, 1992. Trace Elements in Soils and Plants, 2nd ed. CRC press, Boca Raton, 365pp

Kauffman, J.B. and Donato, D.C. (2012) Protocols for the measurement, monitoring and reporting of structure, biomass and carbon stocks in mangrove forests. Working Paper 86. CIFOR, Bogor, Indonesia.

Kinne, O. (Ed.), 1984. Marine Ecology. John Wiley and Sons, London

Komiyama A, Ong JE, Poungparn S (2008) Allometry, biomass, and productivity of mangrove forests: A review. Aquat Bot 89:128–137

Kabata-Pendias, A. and H.Pendias, 1992. Trace Elements in Soils and Plants, 2nd ed. CRC press, Boca Raton, 365pp

M. H. Rahman and H. Ishiga, “Arsenic pollution in soil and groundwater of Bangladesh,” in Proceedings of the International Conference on Energy and Environment, vol. 2, pp. 1626–1632, 2003.

M. M. Rahman, B. K. Mandal, T. Roy Chowdhury et al., “Arsenic groundwater contamination and sufferings of people in North 24-Parganas, one of the nine arsenic affected districts of West Bengal, India,” Journal of Environmental Science and Health A: Toxic/Hazardous Substances and Environmental Engineering, vol. 38, no. 1, pp. 25–59, 2003. View at Publisher · View at Google Scholar · View at Scopus

MacArthur, R.H. & MacArthur, J.W. (1961) On bird species diversity. Ecology, 42: 594–598.

Margalef, R. (1958) “Information theory in ecology,” General Systems Yearbook, vol. 3, pp. 36–71,

Moore, P.D. & Chapman, S.B. (Ed.) (1986) Methods in Plant Ecology. Blackwell Scientific Publications. 581.5 MET

Nelson D., 2002; Natural Variations in the Composition of Groundwater; Groundwater Foundation Annual Meeting; Oregon Department of Human Services Springfield, Oregon; oages 1-8.

Odum, E. P. (1971) Fundamentals of Ecology, WB Saunders, Philadelphia, Pa, USA, 1971.

Pearson T, Walker S, Brown S (2005) Sourcebook for land use, land-use changes Forestry Projects. Report from BioCF and Winrock International. Available at: http://www.winrock.org/ecosystems/tools.asp?

Phillips, Tom (13 December 2014). "Fears for rare wildlife as oil 'catastrophe' strikes Bangladesh". The Daily Telegraph. Retrieved 15 December 2014.

Pielou, E.C. (1969) an Introduction to Mathematical Ecology. John Wiley & Sons, Inc., New York, 286 pp.

Rabalais, N.N., 2002. Nitrogen in aquatic ecosystems. Ambio 31, 102–112.

Rahman M M., Rahman M T., Rahman M S., Rahman F., Ahmed J U., Shakera B., Halim M A., 2013; Water quality of the largest mangrove forest; Canadian Chemical Transactions; Volume, Issue 2., Page 141-156.

Rahman, M. M. (2012) Relationship between carbon storage, vegetation type and salinity in Sundarbans Reserved Forest. M. Sc. Thesis. Forestry and Wood Technology Discipline, Khulna University, Khulna-9208, Bangladesh.

Rajasegar, M. 2003. Physico-chemical characteristics of the Vellar estuary in relation to shrimp farming. J. Environ. Biol. 24: 95-101.

Rajasegar, M., 2003. Physico-chemical characteristics of the Vellar estuary in relation to shrimp farming. J.Environ. Biol., 24, 95-101.

Raman S M B, Sarder L, Rahaman M S, Ghosh A K, Biswas S K, Siraj S S, Huq K A, Hasanuzzaman A F M and Islam S S (2013), Nutrient dynamics in the Sundarbans mangrove estuarine system of Bangladesh under different weather and tidal cycle, Ecological process, springer, page 5.

Rompas, R. M. (2010). Marine Toxicology. Indonesian Marine Council. Jakarta.

S. A. Haque, 2006. Review article, salinity problems and crop production in coastal regions of Bangladesh. Department of Soil Science, Bangladesh Agricultural University, Mymensingh, Bangladesh. Pak. J. Bot., 38(5): 1359-1365.

Schnitzer SA, DeWalt SJ, Chave J (2006) Censusing and measuring lianas: A quantitative comparison of the common methods. Biotropica 38(5): 581-591

Senthilkumar, S., P. Santhanam and P. Perumal 2002. Diversity of phytoplankton in Vellar estuary, southeast coast of India. In: Proc. 5th Indian Fisheries Forum (Eds. S. Ayyappan, J.K. Jena and M. Mohan Joseph). Published by AFSIB, Mangalore and AeA, Bhubanewar, India. pp. 245-248

Shukla, S.R. and Chandel, S. P. (1980) Plant ecology. 4th Edn. S. Chandel and Co. Ramnagar, New Delhi –110055. 197

Sivasubramanium R (1999). Water quality of river Periyar (River Suruliyar) in Tamil Nadu. In: Mishra SR (Ed.). Limnological Research in India. Daya publishing house, Delhi

Skilleter, G.A., Warren, S. (2000) Effects of habitat modification in mangroves on the structure of mollusc and crab assemblages Journal of Experimental Marine Biology and Ecology, 244: 107–129

Spencer, C., 1975. The micronutrient elements. In: Riley, J.P., Skirrow, G. (Eds.), Chemical Oceanography, vol. II, seconded. Academic Press, London

Sukumar, R., Dattaraja, H. S., Suresh H. S. et al. 1992. “Long-term monitoring of vegetation in a tropical deciduous forest in Mudumalai, southern India,” Current Science, 62:608–616,

Tareq M S., Rahaman S M., Rikta Y S., Islam S M N., Sultana M S 2013; Seasonal Variations in Water Quality of the Ganges and Brahmaputra River, Bangladesh; Jahangirnagar University Environmental Bulletin, Vol.2; pages (71-82)

Warren, J.H., (1990) Role of burrows as refuges from subtidal predators of temperate mangrove crabs. Mar. Ecol. Prog. Ser. 67:295–299

Weiss R (1970) the solubility of nitrogen, oxygen and argon in water and seawater. Deep Sea Res Oceanogr Abstr 17(4):721–735

Wetzel, R.G., 2001. Limnology, 3rd ed. Academic Press

WHO (World Health Organization), Guidelines for drinking water quality, 2nd Edition; 1993.

WHO, the International Network to Promote Household Water Treatment and Safe Storage. 2007

Zhu Y G., Chen, S. B., & Yang, J. C., 2004; Effects of Soil Amendments on Lead Uptake by Two Vegetable Crops from a Lead-Contaminated Soil from Anhui, China. Environ Int., 30(3), 351-356. http://dx.doi.org/10.1016/j.envint.2003.

Macdicken K.G. 1997. A guide to monitoring carbon storage in forestry and agroforestry projects. Specialist, 3: 1– 87.

Appendices

Appendix I: Checklist of Monitoring Environmental Compliances

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

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

Sl No	Potential Impacts	Proposed EMP	Actual Implementation	Recommended Action	Compliance Status
		compensation, restoration, livelihood, living standards etc. based on proper socio economic studies • Resettlement of the PAPs • cash for compensation of land (CCL) before resettlement • formal agreement with the affected people prior to migration/resettlement • Sufficient standing crop compensation • Compensation for shift able structures? • Retention of salvageable materials? • Compensation for loss of trading income? • one time moving assistance • grant to cover loss of regular wage income • Has a resettlement plan been developed which includes compensation, restoration, livelihood, living standards etc. based on proper socio economic studies? • Provide/take extra care/caution for the disadvantaged/vulnerable group(s) (i.e. women, children, ethnic minorities, indigenous people etc.) • Provision of monitoring the compensation and resettlement process			
6	Livelihood and living	• Does the Project pose any threat to the livelihood/living standards of the local people? • If yes, are adequate steps taken to reduce the impacts? • Has the company developed any policy which prioritizes the local labourers in employment opportunities? • Is there any possibility that large vehicle related to the Project will cause traffic induced disturbance/s to the local dwellers? • 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?			

Sl No	Potential Impacts	Proposed EMP	Actual Implementation	Recommended Action	Compliance Status
7	Green House Gas Controlling Measures	• Use of efficient generator in the construction activities • Regular maintenance of vehicles, generator and machinery in accordance with manufacturer's specifications • Use of approved pollution control devices fitted in the equipment's and machineries • Switching off and throttling down the machines/equipment's/generators which are not in use			

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

(Labor and Working Condition)

Basic Data

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

Checklist for Labor and Working Condition

Sl No	Potential Impacts	Proposed EMP	Actual Implementation	Recommended Action	Compliance Status
1	Working Conditions and Management of Worker Relationship	• Preparation of Human Resources Policies and Procedures for Direct workers • Defined Working condition and Terms of Employment for direct worker • Sustainably equivalent terms and condition for migrant workers • Compliance to national law of forming workers' organization • No discrimination and equal opportunity for all • Measures for diminishing past discrimination • Grievance Mechanism			

Sl No	Potential Impacts	Proposed EMP	Actual Implementation	Recommended Action	Compliance Status
	Protecting Workforce	• The client will not employ children in any manner that is economically exploitative, or is likely to be hazardous or to interfere with the child education, or to be harmful to the child's health or physical, mental, spiritual, moral, or social development. • No Force Labor			
	Safety at site	• Installation/Construction of Safety Fence around the Project area • Use of Personnel Protective Equipment (i.e. safety suit, safety goggles, ear plug, safety shoes, gloves, dust mask, etc.) • Safety trainings for workers (i.e. fire control, working at height, working in heat, first aid etc.) • Practice of Tool box meeting, safety talks, • Safe Storage of Hazardous Chemicals (e.g. fuel, flammable chemical, toxic chemicals, etc.) • Maintaining Material Safety Data Sheet (MSDS) • Provision of Health care facilities such as doctor, hospital etc available at/nearby the plant construction site • Availability of First Aid at work place • Preparation and Follow of Emergency Response Plan • Adequate fire precautions in place (for example, fire extinguishers, escape routes etc.) • Documentation and reporting of occupational accidents, diseases, and incidents • Policies and procedures for managing and monitoring the performance of third party employers in relation to OHS			
	Occupational Health and Safety Procedure	• Provision of complete EHS division in the Human Resources Planning/Organogram • Preparation of Safety Policy to be adopted during plant operation			
	Worker's Well Being	• Establishment Grievance Mechanisms • Ensuring fair treatment, non-discrimination and equal opportunity • Compliance of Project's labor policy with the national labor law • No Child Labor • No incident of forced labor • Provision of Welfare facilities for Worker/Labor			

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

(Community Health, Safety and Security)

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

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

(Biodiversity and Sustainable Management of Living Natural Resources)

Sl No	Potential Impacts	Proposed EMP	Actual Implementation	Recommended Action	Compliance Status
1	Runoff (contain mostly sediment load) from newly developed land falls into nearby river and channel.	• Installation of proper run on/runoff drains • Use of sediment fences, traps and basins for trapping the sediment, if required			
2	Disturbance to nearby ecosystem due to different construction activities	• No cutting/ felling of trees along the river bank • Implementation of on-site waste and air quality management plan • Limiting soil extraction activities limited within the defined area • Limiting the vegetation clearance and base stripping process within the Project boundary • Safety fence around the construction site • Limiting the use of night light • Using shade (directed downwards) around the outdoor lights • Provision of cut-off time to switch off unnecessary lights at night • Initiate Green plantation • No plantation of non-native species • Retaining top soil for future habitat restoration • No degradation of critical habitat?			
3	Occupation of river, inter-tidal areas and wetlands	• No encroachment of inter-tidal flood plain area • No disturbance to Dolphin community • Monitoring of Ecosystem Health and Monitoring of Sundarbans Forest Health • If required, embankment should be constructed considering a setback distance from river/canal bank • Slope protection work along the Maidara River should be completed on an urgent basis before rainy season come and • BIFPCL may take initiatives of excavating of silted reach of Maidara river near proposed township area to facilitate proper functioning of River for maintaining tidal dynamics			

Appendix II: Photo Album

Environmental Monitoring of Khulna 2×660 MW Power Plant for 18th monitoring program (November, 2018)

The Monitoring Team

Measuring the Canopy coverage

Collection of DBH data

Measuring the Tree height

Counting seedlings and pneumetaphores

Noise level measurement at Akram point of Sundarbans

Professionals is measuring sapling data

Professionals are collecting plankton samples

Experts are checking the forest health data

collection of benthos samples

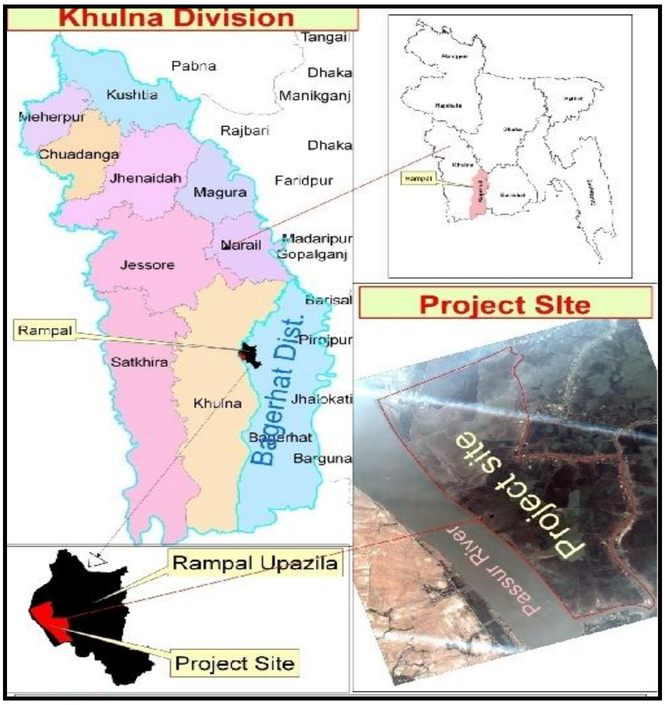
Collection of Capture fisheries data

Appendix III: Terms of References (ToR)

Background

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

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

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

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

Broad Scope of Works

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

The Broad objectives of independent monitoring covers the following activities

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

The main objectives of this works are

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

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

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

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

The Monitoring parameter & associated indicator are given below

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

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

Air quality monitoring progress

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

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

Expected Output

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

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

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

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

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

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

Reporting Requirements

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

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

Appendix IV: Monitoring Data

(A) Air Quality Data

Table A.1: Ambient Air Quality Monitoring Results

Locations of Monitoring	Pollutants	1st QM, Apr 2014	2nd QM, Jul 2014	3rd QM, Oct 2014	4th QM, Jan 2015	5th QM, Apr 2015	6th QM, Jul2015	7th QM, Oct 2015	8th QM, Jan 2016	9th QM, Apr 2016	10th QM, Jul 2016	11th QM, Oct 2016	12th QM, Jan 2017	13th QM, April, 2017	14th QM, Oct, 2017	15th QM Jan, 2018	16th QM April, 2018	17th nQM, Jul 2018	18th QM, Nov, 2018	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	
		Concentrations are in $\mu g/m^3$																		
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	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	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	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	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	100^{Annual}
	CO	120	188	140	190	144	146	88	74	57	35	119	59	91	73	61	32	11.1	28	$(10000)^{8hr}$
	O_3	27	26	19	22	26	12	5	4	1	1	1	5	03	10	03	9	13.2	7	157^{8hr}
	$PM_{2.5}$	39	48	48	39	34	18	17	35	25	3	8	25	14.6	8.5	31.5	26.7	15.8	35.7	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 nQM, Jul 2018	18th QM, Nov, 2018	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	
		Concentrations are in µg/m^3																		
Proposed Township area	**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	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	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	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	100^{Annual}
	CO	165	210	230	164	136	127	102	77	22	31	108	66	78	79	69	27	25	30	$(10000)^{8hr}$
	O$_3$	33	26	26	23	21	16	1	1	1	0	0	1	08	25	04	4	8	6	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	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	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	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	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	100^{Annual}
	CO	110	178	110	210	140	133	87	77	38	47	127	31	74	80	45	43	21	32	$(10000)^{8hr}$
	O$_3$	25	19	17	36	44	11	8	2	0	1	1	3	05	10	05	7	6	8	157^{8hr}
Barni, Gaurambha	**PM$_{2.5}$**	39	47	57	39	41	34	11	29	23	9	10	21.7	7.9	13.8	52.3	18	11.9	15.4	65^{24hr}
	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	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	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	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	100^{Annual}
	CO	175	210	190	150	196	96	96	81	73	41	98	63	85	77	59	24	20	20	$(10000)^{8hr}$
	O$_3$	26	29	22	19	15	9	6	4	0	0	3	5	08	6	04	6	6	2	157^{8hr}
	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	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 nQM, Jul 2018	18th QM, Nov, 2018	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	
			Concentrations are in μg/m³																	
Chunkuri-2, Bajua Dacope	**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	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	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	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	100^{Annual}
	CO	190	205	170	170	33	133	75	70	33	38	79	36	94	69	58	42	23	27	$(10000)^{8hr}$
	O_3	27	24	18	22	41	21	2	1	1	0	2	2	03	5	05	2	4	5	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	65^{24hr}
	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	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	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	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	100^{Annual}
	CO	230	217	250	188	177	125	105	101	55	29	112	48	83	87	49	34	29	30	$(10000)^{8hr}$
	O_3	49	38	36	27	11	13	5	2	2	0	0	3	06	0	06	6	8	8	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	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	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	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	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	100^{Annual}
	CO	230	320	220	211	24	110	84	71	29	31	97	44	72	79	52	29	20	33	$(10000)^{8hr}$
	O_3	57	52	37	26	09	15	8	3	1	2	1	4	04	9	02	3	1	9	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	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 nQM, Jul 2018	18th QM, Nov, 2018	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	
		Concentrations are in μg/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	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	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	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	100^{Annual}
	CO	65	58	70	64	56	112	81	62	47	32	110	67	73	84	57	31	20	20	$(10000)^{8hr}$
	O_3	13	12	13	11	14	12	4	2	2	0	1	4	08	0	02	2	6	4	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	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	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	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	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	100^{Annual}
	CO	49	60	50	46	163	NO	92	64	21	37	101	58	79	69	52	21	25	28	$(10000)^{8hr}$
	O_3	11	14	9	10	27	NO	8	1	0	0	2	3	0	0	03	3	4	5	157^{8hr}
Hiron Point, Sundarbans	$PM_{2.5}$	15	23	19	17	28	NO	27	NO	17	NO	9	21.7	No	17.0	40.5	NO	NO	23.4	65^{24hr}
	PM_{10}	44	38	34	41	60	NO	45	NO	40	NO	14	104.5	NO	92.1	149.8	NO	NO	86.7	150^{24hr}
	SPM	101	119	107	97	110	NO	88	NO	132	NO	26	111.4	NO	102	173.7	NO	NO	107.9	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	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	100^{Annual}
	CO	52	62	65	60	60	NO	93	NO	40	NO	121	43	NO	72	71	NO	NO	22	$(10000)^{8hr}$
	O_3	14	13	11	9	23	NO	2	NO	0	NO	0	4	NO	0	04	NO	NO	6	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	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 nQM, Jul 2018	18th QM, Nov, 2018	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	
			Concentrations are in μg/m³																	
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	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	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	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	100^{Annual}
	CO	330	370	330	296	101	89	94	98	68	36	104	66	79	81	69	36	28	121	$(10000)^{8hr}$
	O_3	59	67	57	39	21	7	4	2	1	0	2	3	07	07	09	9	7	4	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	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	150^{24hr}
	SPM	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	120.6	98.1	144.6	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	365^{24hr}
	NOx	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	14	9	11.6	100^{Annual}
	CO	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	46	32	30	$(10000)^{8hr}$
	O_3	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	9	4	9	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	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	150^{24hr}
	SPM	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	142.5	106.2	177.8	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	365^{24hr}
	NOx	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	14.8	13.4	15	100^{Annual}
	CO	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	38	34	32	$(10000)^{8hr}$
	O_3	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	5	7	9	157^{8hr}

Note(s): Concentrations are in μg/m³.

- 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	√
	PM	√	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
Chunkuri-2, Dacope	SOx	X	X	X	X	√	√	√	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	√
	NOx	X	X	X	X	√	√	√	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	√
	GHGs	X	X	X	X	√	√	√	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	√
Pankhali, Dacope	PM	√	X	X	X	√	√	√	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	√	√
	SOx	X	X	X	X	√	√	√	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	√
	NOx	X	X	X	X	√	√	√	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	√
	GHGs	X	X	X	X	√	√	√	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	√
Mongla Port area	PM	√	√	√	X	√	√	√	√	√	√	√	X	X	X	X	X	X	X	X	√	X	X	X	√
	SOx	X	√	X	X	√	√	√	√	√	√	X	X	X	X	X	X	X	X	X	√	X	X	√	√
	NOx	X	√	X	X	√	√	√	√	√	√	X	X	X	X	X	X	X	X	X	√	X	X	X	√
	GHGs	X	√	X	X	√	√	√	√	√	√	X	X	X	X	X	X	X	X	X	√	X	X	X	√
Harbaria, Sundarbans	PM	X	X	X	X	X	√	√	√	√	√	√	X	X	X	X	X	X	X	X	X	X	X	X	X
	SOx	X	X	X	X	X	√	√	√	√	√	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	NOx	X	X	X	X	X	√	√	√	√	√	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	GHGs	X	X	X	X	X	√	√	√	√	√	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Akram Point Sundarbans	PM	X	X	X	X	X	√	√	X	X	X	√	X	X	X	X	X	X	X	X	X	X	X	X	X
	SOx	X	X	X	X	X	√	√	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	NOx	X	X	X	X	X	√	√	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	GHGs	X	X	X	X	X	√	√	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Hiron Point Sundarbans	PM	X	X	X	X	X	√	√	X	X	X	√	X	X	X	X	X	X	X	X	X	X	X	X	X
	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
	PM	√	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
Khulna City, near Khan Jahan Ali Bridge	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
	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			
		Apr	July	Oct	Jan	Apr	July	Oct	Jan	Apr	July	Oct	Jan	Apr	Oct	Jan	Apr	July	Nov	
		1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	1QM	2QM	3QM	
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	
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	
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	
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	6.5– 8.5
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	
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	
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	
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	
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	

SI	Sampling Locations	pH Values																		BD Standard
		1st year				2nd Year				3rd year				4th year			5th year			
		Apr	July	Oct	Jan	Apr	July	Oct	Jan	Apr	July	Oct	Jan	Apr	Oct	Jan	Apr	July	Nov	
		1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	1QM	2QM	3QM	
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	
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	7.63 1	
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	
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	
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	
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		7.18	

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.2: Surface Water Temperature in Passur River

Sl	Sampling Locations	Temperature (°C)																		BD Standard
		1st Year				2nd Year				3rd year				4th year			5th year			
		Apr	Jul	Oct	Apr	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	Apr	Jul	Nov	
		1QM	2QM	3QM	1QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	1QM	2QM	3QM	
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	
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	
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	
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	
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	20°C – 30°C
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	
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	
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	
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	

Sl	**Sampling Locations**	**Temperature (°C)**																		
		1st Year				**2nd Year**				**3rd year**				**4th year**			**5th year**			**BD Standard**
		Apr	**Jul**	**Oct**	**Apr**	**Apr**	**Jul**	**Oct**	**Jan**	**Apr**	**Jul**	**Oct**	**Jan**	**Apr**	**Oct**	**Jan**	**Apr**	**Jul**	**Nov**	
		1QM	**2QM**	**3QM**	**1QM**	**1QM**	**2QM**	**3QM**	**4QM**	**1QM**	**2QM**	**3QM**	**4QM**	**1QM**	**2QM**	**3QM**	**1QM**	**2QM**	**3QM**	
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	
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	
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	
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	
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	
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	

Source: CEGIS Field Surve

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

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

Sl	Sampling Locations	Salinity (ppt)																	
		1st Year				2nd Year				3rd year				4th year			5th year		
		Apr	Jul	Oct	Apr	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	Apr	Jul	Nov
		1QM	2QM	3QM	1QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	1QM	2QM	3QM
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
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
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
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
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
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
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
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
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
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	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
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
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

SI	Sampling Locations	Salinity (ppt)																	
		1st Year				2nd Year				3rd year				4th year			5th year		
		Apr	Jul	Oct	Apr	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	Apr	Jul	Nov
		1QM	2QM	3QM	1QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	1QM	2QM	3QM
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
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

Source: CEGIS Field Survey

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

Table B.4: Dissolve Oxygen in Passur River

SL	Sampling Locations	Dissolve Oxygen (mg/L)																		
		1st Year				2nd Year				3rd year				4th year			5th year			BD Standard
		Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	Apr	Jul	Nov	
		1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	1QM	2QM	3QM	
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	5 or more (standard for sustaining fisheries)
2	Middle of Passur River at 100m u/s of North West corner from the Project boundary	4.9	6.8	7.7	6.6	6.4	5	6.4	5.1	6.4	5.7	6.1	5.9	7.2	6.4	5.03	6.225	6.2	6.2	
3	Right Bank of Passur River at 100m u/s of North West corner from the Project boundary	5.2	6.7	7.7	6.7	6.2	5	7.1	6.2	6.9	5.6	6	6.1	6.8	6.5	5.06	6.275	6.1	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	
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	
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	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	
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	

SL	Sampling Locations	Dissolve Oxygen (mg/L)																		
		1st Year				2nd Year				3rd year				4th year			5th year			BD Standard
		Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	Apr	Jul	Nov	
		1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	1QM	2QM	3QM	
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	
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	
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	
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	
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	
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	
15	Passur river at Hiron point of Sundarbans	7.5	6.5	7.8	6.5	5.8	NS	7	NS	7.1	6.8	6.9	6.8		7.3	5.4			7.2	

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: BOD5 of Passur River Water

SL	Sampling Location	Biochemical Oxygen Demand (mg/L)																	BD Standard
		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	
		1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	1QM	2QM	
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	6 or less (for sustaining fisheries)
2	Middle of Passur River at 100m u/s of North West corner from the Project boundary	4.9	3.3	4.1	2.3	3.2	2.4	1.9	2.2	3.2	2.8	2.7	1.9	3.4	2.1	1.9	2	2	
3	Right Bank of Passur River at 100m u/s of North West corner from the Project boundary	2.2	2.8	3.4	2.7	3.1	2.9	3.4	1.9	3	2.5	2.8	1.9	2.5	2.7	1.9	3	3	

SL	Sampling Location	Biochemical Oxygen Demand (mg/L)																	BD Standard
		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	
		1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	1QM	2QM	
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	
5	Middle Passur River at Project site-Jetty	3.0	2.5	3.5	1.4	3.5	4.3	3.7	2.4	3.3	2.2	2.5	2.2	2.6	2.4	2.0	4	2	
6	Right Left Bank of Passur River at Project site-Jetty	5.8	3.5	3.6	2.0	3.4	3.7	2.9	1.7	3.1	3.1	2.9	2.1	3.1	2.1	2.3	4	4	
7	Left Bank of Passur River at South West corner from the Project boundary	3.9	2.8	2.6	1.0	3.1	5.3	2.2	1.2	3.1	2.9	2.4	2.1	3.2	2.4	2.0	5	2	
8	Middle of Passur River at South West corner from the Project boundary	3.8	3.3	2.8	2.6	3.2	5.2	2.3	2.3	2.6	2.7	2.7	1.9	2.5	2.7	1.9	5	3	
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	
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	
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	
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	
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	
14	Passur river at Akram point of Sundarbans	5.0	2.9	3.7	2.2	3	NS	2.2	2.4	3.3	2.5	3.4	2.1	3.1	3.2	3.1	3	3	
15	Passur river at Hiron point of Sundarbans	4.3	2.7	3.9	2.3	2.7	NS	2.5	NS	2.4	2.1	3.1	2.2	NS	2.9	2.4		3	

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				3^{rd} year				4^{th} Year			5^{th} year	
		Apr	Jul	Oct	Jan	Apr	July	Oct	Jan	Apr	July	Oct	Jan	Apr	Oct	Jan	Apr	July
		1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	1QM	2QM
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
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
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
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
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
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
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
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
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
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
11	Maidara river near proposed township area	284	96	26	84	94	36	42	108	210	30	8	48	40	32	32	252	20
12	Passur river at Passur - Ghasiakhali confluence	408	172	14	96	92	30	46	88	220	12	16	40	64	**40**	48	260	10
13	Passur river at Harbaria of Sundarbans	372	216	14	96	102	26	36	100	140	16	12	**40**	216	32	40	280	16
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
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

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	
		1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	1QM	2QM	
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	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	
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	
4	Passur river at Hiron point of Sundarbans	<5	<5	<5	>20	<5	NS	10.8	ND	31	NS	10.14	13.8	7.71	<5	<5	<5	NS	
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	

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
		1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	1QM	2QM
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
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
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
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
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

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
		1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	1QM	2QM
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
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
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
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
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
11	Maidara river near proposed Township area	10970	2510	257	4390	13900	355	176	4420	11700	5170	238	3960	13110	1200	2970	14450	340
12	Passur river at Passur - Mongla confluence	12800	6410	209	5130	14050	298	227	4540	11330	893	162	3370	12340	204	2570	14500	580
13	Passur river at Harbaria of Sundarbans	12280	9360	285	4780	13900	683	205	4940	13580	1321	301	3370	13600	245	2690	15350	2190
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
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

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
		1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	1QM	2QM
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
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
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
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
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
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
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
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
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
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
11	Maidara river near proposed township area	2400	725	330	970	3190	130	340	1075	3080	875	240	1170	2300	320	478	1120	220
12	Passur river at Passur - Mongla confluence	3150	1400	377	1000	3210	135	410	1090	3060	405	245	1070	2450	220	1070	1410	245
13	Passur river at Harbaria of Sundarbans	2625	2150	345	970	3080	200	430	1100	3050	415	282	1070	3560	200	610	1330	530

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
		1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	1QM	2QM
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
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

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
		1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	1QM	2QM
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
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
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
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
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
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
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

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
		1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	1QM	2QM
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
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
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	Maidara river near proposed township area	9	24	389	206	160	28	92	10	6	11	30	66	49	30	15	32	12
12	Passur river at Passur - Mongla confluence	50	310	203	280	165	24	60	15	13	47	27	61	38	**25**	13	14	17
13	Passur river at Harbaria of Sundarbans	65	90	869	400	160	42	74	22	18	31	18	**61**	33	27	17	15	13
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	Passur river at Hiron point of Sundarbans	91	72	267	200	180	NS	144	NS	15	NS	33	49	NS	16	13	NS	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.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
		1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	1QM	2QM
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	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
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
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
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
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
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
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
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
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
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
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
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

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
		1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	1QM	2QM
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
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

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
		1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	1QM	2QM
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
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
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
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
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
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

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
		1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	1QM	2QM
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
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
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
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
11	Maidara river near proposed township area	1320	210	63	460	840	27	9	480	1020	480	14	200	1340	76	350	1250	18
12	Passur river at Passur - Mongla confluence	1360	620	44	630	980	39	13	482	1100	42	14	220	1220	**5**	280	1260	28
13	Passur river at Harbaria of Sundarbans	1560	860	69	590	900	51	7	500	1080	60	19	220	1300	13	220	1300	35
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
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

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
		1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	1QM	2QM
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
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
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
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
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
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
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
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
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
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
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
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

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
		1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	1QM	2QM
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
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
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

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
		1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	1QM	2QM
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
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
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
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
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
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

Sl	Sampling Locations	As (mg/L)																
		1st Year				2nd year				3rd year				4^{th} year			5^{th} year	
		Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	Apr	Jul
		1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	1QM	2QM
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
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
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
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
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
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
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
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
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

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
		1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	1QM	2QM
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
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
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
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
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
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
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
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
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
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
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
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

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
		1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	1QM	2QM
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
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
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

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
		1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	1QM	2QM
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
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
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

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
		1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	1QM	2QM
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
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
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
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
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
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

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
		1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	1QM	2QM
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
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
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
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
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
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

Source: CEGIS Field Survey

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

Parameters for ground water quality monitoring

Table B.17: pH and Temperature of Ground Water

Sl	Locations	Tube Well Type	pH value																	
			1st Year				2nd year				3rd year				4th year			5th year		
			Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	Apr	Jul	Nov
			1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	1QM	2QM	3QM
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
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
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
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

Locations	Tube Well Type	Temperature (°C)																	
		1st Year				2nd year				3rd year				4th year			5th year		
		Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	Apr	Jul	Nov
		1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	1QM	2QM	3QM
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
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
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
Kalekharber	Shallow (<250 ft)	27.5	28.7	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.18: Salinity and DO in Groundwater

Sl	Locations	Tube Well Type	Salinity (ppt)																	
			1st Year				2nd year				3rd year				4th year			5th year		
			Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	Apr	Jul	Nov
			1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	1QM	2QM	3QM
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
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
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
4	Kalekharber	Shallow (<250 ft)	0	0	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		
			Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	Apr	Jul	Nov
			1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	1QM	2QM	3QM
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
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**
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**
4	Kalekharber	Shallow (<250 ft)	4.4	6	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
			1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	1QM	2QM
1	Township near project site	Deep (>600 ft)	1113	999	-	1021	NO	881	377	447	1025	1000	617	623	395	602	405	NF	NF
2	Rajnagar	Deep (>600 ft)	4090	371	-	378	390	574	1007	491	384	408	382	401	617	996	602	615	390
3	Kapasdanga	Deep (>600 ft)	643	635	-	600	600	328	611	284	645	607	636	998	558	390	994	370	608
4	Kalekharber	Shallow (<250 ft)	1055	970	-	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
			1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	1QM	2QM
1	Township near project site	Deep (>600 ft)	-	6	19	40	NF**	23	4	31	3	5	7	32	4	8	12	NF	NF
2	Rajnagar	Deep (>600 ft)	-	6	2	28	4	16	5	46	4	4	4	28	10	10	6	12	2
3	Kapasdanga	Deep (>600 ft)	-	8	6	32	6	14	4	41	3	4	5	25	9	9	7	5	3
4	Kalekharber	Shallow (<250 ft)	-	48	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
			1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	1QM	2QM
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
2	Rajnagar	Deep (>600 ft)	220	175	180	110	138	125	450	195	263	248	295	510	420	240	265	195	235
3	Kapasdanga	Deep (>600 ft)	190	140	180	125	216	115	480	225	163	28	183	620	654	215	305	215	170
4	Kalekarber	Shallow (<250 ft)	780	450	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
			1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	1QM	2QM
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
2	Rajnagar	Deep (>600 ft)	28	28	18	16	14	10	8	4	4	4	4	4	4	8	4	4	4
3	Kapasdanga	Deep (>600 ft)	48	32	34	20	18	14	4	4	4	2	4	4	4	16	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
			1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	1	2
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
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

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
			1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	1	2
1	Township near project site	Deep (>600 ft)	-	3	-	-	-	-	1	5	1	1	1	1	5	1	8	NF	NF
2	Rajnagar	Deep (>600 ft)	-	2	-	-	-	-	2	6	2	1	1	1	1	1	2	2	4

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
			1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	1	2
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
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

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
			1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	1	2
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
4	Kalekarber	Shallow (<250 ft)	0.40	0.56	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
			1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	1	2
3	Kapasdanga	Deep (>600 ft)	-	10	-	-	-	-	2	2	8	1	1		3	2	6	4	6
4	Kalekarber	Shallow (<250 ft)	NF	3	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
			1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	1	2
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
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

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)																
		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	Jul	No
		1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	2Q	3Q
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	NF	NF
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
3	Kalekarber	0.376	0.407	NF	NF	D	D	NF	NF	NF	NF	NF	NF	NF	NF	0.006	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		0.004	0.050

Sl	Locations	Pb (mg/L) *BD Standard (0.05 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	Jul	No
		1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	2Q	3Q
1	Township near project site	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	NF	NF
2	Rajnagar	<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	0.004
3	Kalekarber	0.002	0.008	NF	NF	D	D	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF
4	Kapasdanga	<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	0.056

Sl	Locations	Hg (mg/L) *BD Standard (0.001 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	Jul	No
		1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	2Q	3Q
1	Township near project site	<0.00015	<0.00015	<0.0005	<0.0005	NO	0.00015	<0.00015	<0.00015	<0.00015	<0.00015	<0.00015	<0.00015	0.001	<0.0001	<0.001	NF	NF
2	Rajnagar	<0.00015	<0.00015	<0.0005	<0.0005	<0.00015	0.00015	<0.00015	<0.00015	<0.00015	<0.00015	<0.00015	<0.00015	0.001	<0.0001	<0.001	<0.001	<0.001
3	Kalekarber	<0.00015	<0.00015	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	<0.001	NF	NF
4	Kapasdanga	<0.00015	<0.00015	<0.0005	<0.0005	<0.00015	0.00015	<0.00015	<0.00015	<0.00015	<0.00015	<0.00015	<0.00015	0.001	<0.0001	<0.001	<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	Proposed Township area, Project site	41.40	43.09	43.45	42.65	43.05	48.52	45.01	45.53	53.2	54	52.82	53.34	51.95	59.66	56.8	56.13667	55
6	Barni, Gaurambha	43.05	46.45	45.01	44.83	45.60	52.29	53.42	50.44	56.5	54.2	56.1	55.6	55.6	51.80	51.39	52.93	60
7	Khan Jahan Ali Bridge, Khulna	54.01	57.50	58.66	56.72	40.60	42.64	46.55	43.26	60.2	62.1	62.2	61.5	49.4	45.25	47.98	47.54333	70
8	Mongla Port area	47.78	47.45	45.25	47.61	41.40	44.68	45.71	43.93	60.2	60.2	58.4	59.6	50.84	48.33	53.25	50.80667	75
9	Harbaria, Sundarbans	50.79	53.67	57.84	54.10	44.25	46.67	47.31	46.08	45.8	44.7	43.8	44.7	50.23	45.55	65.43	53.73667	50
10	Akram Point, Sundarbans	43.41	45.60	43.89	44.30	58.21	58.59	58.70	58.50	39.4	40.5	41.1	40.3	58.31	60.93	64.87	61.37	50
11	Hiron Point, Sundarbans	NM	NM	NM	NM	39.92	39.79	33.5	37.74	37.2	39	38.4	38.2					50

Sl No	Location	QM2 (Noise Level in dB (A)) July-2018				QM3 (Noise Level in dB (A)) Nov-2018			
		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	58.23
2	NW Corner of the Project area	42.80	47.51	46.57	45.63	56.5	60.1	59.85	58.82
3	Chunkuri-2, Bajua	46.23	49.02	47.34	47.53	45.8	48.9	51.3	48.67
4	SW corner of the Project area	58.84	48.00	51.03	52.63	64.5	60.6	60.2	61.77
5	Proposed Township area, Project site	42.66	45.82	48.78	45.75	45.1	51.2	55.8	50.70
6	Barni, Gaurambha	42.67	47.95	45.90	45.51	58.3	50.6	50.2	53.03
7	Khan Jahan Ali Bridge, Khulna	64.1	64.06	61.90	63.35	64.6	60.9	60.9	62.13
8	Mongla Port area	63.12	59.00	60.77	60.96	55.8	53.1	59.0	55.97
9	Harbaria, Sundarbans	51.98	48.58	50.28	50.28	49.9	47.6	NM	48.75
10	Akram Point, Sundarbans	46.52	43.88	45.2	45.20	41.9	40.1	NM	41.00
11	Hiron Point, Sundarbans	NM	NM	NM	57.54	39.7	39.1	NM	39.40

Source: CEGIS field Survey

Note: NM-Not measured

(D) Fisheries resources monitoring data

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

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

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

Table D.2: Occurrence of Species

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

Local Name	Scientific Name	Local Status*	13th QM	14th QM	15th QM	16th QM	17th QM	18th 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	-	+	-	-	+	-
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
		'-' = 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	Chandpai	100	0	0	0	0	0	0
Bairagi	Chalna Point	100	0	0	0	0	0	0
	Chandpai	0	0	83	17	0	0	0
	Maidara	9	15	55	21	0	0	0
Banspata	Maidara	0	0	20	40	40	0	0
Bele	Maidara	0	6	59	35	0	0	0
Chaka Chingri	Chandpai	0	0	100	0	0	0	0
Chali Chingri	Maidara	0	0	16	84	0	0	0
Chami Chingri	Chandpai	0	0	100	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
	Harbaria	0	0	87	13	0	0	0
Chanda	Chalna Point	100	0	0	0	0	0	0
Chapila	Chalna Point	100	0	0	0	0	0	0
	Maidara	0	8	67	25	0	0	0
Chata Bele	Chandpai	0	0	0	0	0	100	0
Chela	Chandpai	0	0	100	0	0	0	0
Cheng	Maidara	0	100	0	0	0	0	0
Daitna	Akram Point	0	0	0	100	0	0	0
	Chandpai	0	0	0	0	100	0	0
Dogri	Chalna Point	100	0	0	0	0	0	0
	Maidara	0	0	19	81	0	0	0
Ekthuto	Harbaria	0	0	100	0	0	0	0
Gagra Tengra	Chandpai	0	0	0	0	100	0	0
	Harbaria	0	0	0	0	38	62	0
Goda Chingri	Akram Point	0	0	0	100	0	0	0
	Chandpai	0	0	100	0	0	0	0
	Harbaria	0	0	100	0	0	0	0
Golda	Chandpai	0	0	0	0	58	43	0
	Harbaria	0	0	0	50	0	50	0
Horina Chingri	Chandpai	0	0	17	83	0	0	0
	Harbaria	0	0	76	24	0	0	0
	Maidara	0	0	95	5	0	0	0
Ilish	Chalna Point	0	0	0	0	0	100	0
Jaba	Chandpai	0	0	0	0	100	0	0
Jelly Fish	Chandpai	100	0	0	0	0	0	0
Kain Magur	Akram Point	0	0	0	0	0	100	0
	Chandpai	0	0	0	0	0	100	0
Koidda Poma	Akram Point	0	0	0	0	0	100	0
	Haldikhali	0	0	0	0	100	0	0
	Harbaria	0	0	0	0	50	50	0
Kuchia	Chalna Point	100	0	0	0	0	0	0
Kumirer Khil	Chalna Point	100	0	0	0	0	0	0
Moson Tengra	Harbaria	0	0	0	0	0	100	0
Motka	Chandpai	0	0	100	0	0	0	0
	Harbaria	0	0	100	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
	Maidara	0	13	59	28	0	0	0
Mutkura	Harbaria	0	0	100	0	0	0	0
	Maidara	0	0	100	0	0	0	0
Paissa	Akram Point	0	0	30	60	10	0	0
	Chandpai	0	0	0	0	100	0	0
	Harbaria	0	0	0	0	100	0	0
	Maidara	0	0	100	0	0	0	0
Poma	Chalna Point	0	0	0	0	44	56	0
	Chandpai	0	0	0	0	100	0	0
	Harbaria	0	0	0	0	0	100	0
	Maidara	60	40	0	0	0	0	0
Potka	Chalna Point	100	0	0	0	0	0	0
	Maidara	50	0	50	0	0	0	0
Rita	Akram Point	0	0	0	0	0	100	0
Tairel	Chandpai	0	0	0	100	0	0	0
	Maidara	0	0	0	100	0	0	0
Taki	Maidara	0	0	0	0	100	0	0
Tapse	Maidara	0	0	4	0	0	0	0
Tiger Chingri	Chandpai	0	0	1	0	0	0	0
Tit Punti	Chalna Point	5	0	0	0	0	0	0
	Maidara	1.5	2	1.5	0	0	0	0
Tular Dandi	Akram Point	0	0	0	0	0	1	0
	Chalna Point	0	0	0	0	1	0	0
	Haldikhali	0	0	0	0	2	0	0
Vetki	Akram Point	0	0	0	0	0	1	0

Source: CEGIS field survey, 2017 and 2018

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	-	-	-	-	-	-		-	-

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

<table>
<tr><th rowspan="2">Migratory Fish Species</th><th rowspan="2">Sampling Sites</th><th rowspan="2">Year Class*</th><th colspan="12">Migration Purpose</th></tr>
<tr><th>1st QM</th><th>2nd QM</th><th>3rd QM</th><th>4th QM</th><th>5th QM</th><th>6th QM</th><th>7th QM</th><th>8th QM</th><th>9th QM</th><th>10th QM</th><th>11th QM</th><th>12th QM</th></tr>
<tr><td rowspan="7">Loitta</td><td>Haldikhali</td><td>Juvenile and Age-1 adult</td><td>Feeding and Growing</td><td>-</td><td>Feeding and Growing</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td></td><td>-</td><td>-</td></tr>
<tr><td>Akram Point</td><td>Juvenile</td><td>Feeding and Growing</td><td>-</td><td>-</td><td>-</td><td>Feeding and Growing</td><td>-</td><td>-</td><td>-</td><td>-</td><td></td><td>-</td><td>-</td></tr>
<tr><td>Akram Point</td><td>Age-1 adult</td><td>-</td><td>-</td><td>Feeding and Growing</td><td>-</td><td>Feeding and Growing</td><td>-</td><td>-</td><td>-</td><td>-</td><td></td><td>-</td><td>-</td></tr>
<tr><td>Chandpai</td><td>Juvenile</td><td>Feeding and Growing</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td></td><td>-</td><td>-</td></tr>
<tr><td>Harbaria</td><td>Fry, Juvenile and Age-1 adult</td><td>-</td><td>Nursing, Feeding and Growing</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td></td><td>-</td><td>-</td></tr>
<tr><td rowspan="2">Chalna Point</td><td>Age-1 adult</td><td>-</td><td>Feeding and Growing</td><td>-</td><td>-</td><td>Feeding and Growing</td><td>-</td><td>-</td><td>-</td><td>-</td><td></td><td>-</td><td>-</td></tr>
<tr><td>Fry</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>Nursing</td><td></td><td>-</td><td>-</td></tr>
<tr><td rowspan="7">Poma</td><td>Haldikhali</td><td>Juvenile</td><td>Feeding and Growing</td><td>-</td><td>-</td><td>Feeding</td><td>-</td><td>-</td><td>-</td><td></td><td>-</td><td></td><td>-</td><td>-</td></tr>
<tr><td rowspan="3">Akram Point</td><td>Juvenile</td><td>Feeding and Growing</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>Growing and Feeding</td><td>-</td><td></td><td>-</td><td>-</td></tr>
<tr><td>Age-1 adult</td><td>-</td><td>-</td><td>Feeding and Growing</td><td>-</td><td>-</td><td>-</td><td>Feeding</td><td rowspan="2">Feeding</td><td>-</td><td></td><td>-</td><td>-</td></tr>
<tr><td>Adult</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td></td><td>-</td><td></td><td>-</td><td>-</td></tr>
<tr><td rowspan="3">Chandpai</td><td>Fry and Juvenile</td><td>Breeding and Spawning</td><td>Nursing</td><td>-</td><td>-</td><td>-</td><td>Feeding</td><td>-</td><td>-</td><td>-</td><td></td><td>-</td><td>-</td></tr>
<tr><td>Juvenile</td><td>-</td><td>-</td><td>Feeding and Growing</td><td>Feeding</td><td>Feeding and Growing</td><td>-</td><td colspan="2">Feeding and Growing</td><td>-</td><td></td><td colspan="2" rowspan="2">Feeding and Growing</td></tr>
<tr><td>Adult</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td colspan="2">Feeding</td><td>-</td><td></td></tr>
</table>

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
		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	
	Haldikhali	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
Gulsha Tengra	Akram Point	Adult	Feeding and Breeding	-	-	-	-	-	-	-	-		-	-
	Chandpai	Age-1 adult	-	-	-	Feeding	-	Feeding	Feeding and Growing	-	-		-	Feeding
		Juvenile	-	-	-	-	-	-	Feeding and Growing		-		Feeding and Growing	-
	Mongla Point	Age-1 adult	-	Feeding and Growing	-	Feeding and Growing	-	Feeding and Growing		-	Feeding and Growing		-	-
		Juvenile	-	-	-	-	-	-	Feeding and Growing		-		Feeding and Growing	-
	Harbaria	Juvenile	-	-	-	-	-	-	Feeding and Growing		-			-
		Age-1 adult	-	-	-	-	-	-	-	-	Feeding and Growing		-	-
	Maidara	Juvenile and Age-1 Adult	-	-	-	-	-	-	Feeding and Growing	-			-	-
	Chalna Point	Juvenile	-	-	-	-	-	-	-	-	-		Feeding and Growing	-
Potka	Haldikhali	Adult	Feeding and Breeding	-	-	-	-	-	-	-	-		-	-
	Chandpai	Fry	Spawning	Spawning and Nursing	-	-	-	-	-	-	-		-	-
		Juvenile	-	-	-	-	-	-	-	Feeding and Growing	-		-	Feeding
		Adult	-	-	-	Feeding	-	-	-	-	-		Feeding	-
	Mongla Point	Fry	Spawning	-	-	-	-	-	-	-	-		-	-
		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	Fry	-	-	-	-	-	Nursery	-	-	-		-	-
		Juvenile	-	-	-	-	-	-	-	Feeding and Growing	-		-	-
Paira Chanda	Akram Point	Adult	Feeding	-	-	-	-	-	-	-	-		-	-
	Chandpai	Fry	Breeding and Spawning	-	-	-	-	-	-	-	-		-	-
Chewa	Akram Point	Juvenile and Adult	Feeding	-	Feeding and Growing	-	-	-	-	-			-	-
	Chandpai	Fry and Juvenile	Spawning	-	Feeding and Growing	-	Nursing and Grazing	Nursery	Feeding and Growing	-	Nursing		-	-
		Adult	-	-	-	Feeding	-	Feeding	-	Feeding	-		-	-
	Haldikhali	Juvenile and Adult	-	-	Feeding and Growing	-	-	-	-	-	-		-	-
	Harbaria	Juvenile and Adult	-	-	Feeding and Growing	-	-	Feeding and Nursery	-	Feeding	-		-	-
	Mongla Point	Juvenile	-	Feeding and Growing	-	-	-	-	-	-	-		-	-
	South-west of the Project	Juvenile	-	Feeding and Growing	-	-	-	-	-	-	-		-	-
	Chalna Point	Adult	-	-	-	-	Feeding	-	-	-	-		-	-
		Age-1 Juvenile	-	-	-	-	-	-	-	-	Feeding and Growing		-	-
Bele	Akram Point	Adult	Feeding	-	Feeding	Feeding	-	-	-	-	-		-	-
		Juvenile	-	-	-	-	-	-	-	Feeding and Growing	-		-	-

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
	Haldikhali	Juvenile-1, Juvenile and Adult	-	-	Nursing and Growing	Feeding	-	-	-	-	-		-	-
	Harbaria	Juvenile and Adult	-	-	Feeding and Growing	-	Feeding and Growing	Nursery and Feediing	Feeding and Growing	-	-		-	-
	Chandpai	Fry	Breeding and Spawning	Nursing	-	-	Nursing	Nursery	-	-	Nursery		-	-
	Chandpai	Juvenile and Adult	-	-	Feeding and Growing	Feeding	-	Feeding	-	Feeding	-		Feeding and Growing	
	Harbaria	Juvenile and Age-1 Adult	-	-	-	-	-	-	Feeding and Growing				-	-
	Mongla Point	Fry	Breeding and Spawning	-	-	-	-	Nursery	-	-	-		-	-
	Mongla Point	Fry, Juvenile-1 and Juvenile			Nursing and Growing	-	-	-	-	-	-		-	-
	Mongla Point	Juvenile and Adult	-	-	-	Feeding	Feeding and Growing	Feeding	Feeding and Growing	-	-		-	-
	Chalna Point	Fry	Breeding and Spawning	Nursing	-	-	Nursing	-	-	Nursing	-		-	-
	Chalna Point	Adult	-	-	-	Feeding	-	-	-	-	-		-	-
	Maidara	Juvenile and Age-1 adult	-	Feeding and Growing	Feeding and Growing	Feeding	Feeding and Growing	-	-	-	Feeding and Growing		-	-
		Fry	-	-	-	-	-	-	-	Nursing	-		-	Nursing
Tular Dandi	Akram Point	Adult	Feeding	-	-	-	-	-	-	-	-		-	-

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

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

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	Brood Fish	-	-	-	-	-	-	-	-	-		Breeding and Spawning	
	Chandpai	Adult and Brood Fish	-	-	-	-	-	-	Feeding and Breeding	-	-		-	
	Mongla Point	Adult	-	-	Feeding	-	-	-	-	-	-		-	
		Brood Fish	-	-	-	-	-	-	-	-	-		Breeding and Spawning	
	Maidara	Age-1 Adult	-	-	-	-	-	-	-	-	-		Feeding	
	Chalna Point	Brood fish	-	-	-	-	-	Breeding and Spawning	-	-	-		-	
Pangas	Haldikhali	Juvenile	-	-	Feeding and Growing	-	-	-	-	-	-		-	
	Harbaria	Adult	-	-	-	-	-	-	-	Feeding	-		-	
	Mongla Point	Juvenile and Adult	-	-	Feeding	-	-	-	-	-	-		-	

Migration Purpose								
Migratory Fish Species	Sampling Sites	Year Class*	13th QM	14th QM	15th QM	16th QM	17th QM	18th 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	-
	Harbaria	Juvenile and Age-1 adult	Feeding	-	-	-	-	-
		Adult and Brood Fish	-	-	-	-	-	-

Migration Purpose								
Migratory Fish Species	**Sampling Sites**	**Year Class***	**13th QM**	**14th QM**	**15th QM**	**16th QM**	**17th QM**	**18th QM**
	Chandpai	Juvenile	-	Feeding and Growing	-	Feeding and Growing	Feeding and Growing	-
	Mongla Point	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	-	-
		Juvenile	-	Feeding and Growing	Feeding and Growing	Feeding and Growing	-	Maturation
	Chalna Point	Juvenile and Age-1 adult	-	-	-	-	-	-
		Fry	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
Chapila	Haldikhali	Juvenile	-	-	-	-	-	-
	Akram Point	Juvenile	-	-	-	-	-	-
	Harbaria	Juvenile	-	-	-	-	Feeding and Growing	-
	Mongla Point	Fry	-	-	-	-	Nursing	-

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

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

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

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

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

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

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

Migration Purpose								
Migratory Fish Species	Sampling Sites	Year Class*	13th QM	14th QM	15th QM	16th QM	17th QM	18th QM
		Brood Fish	-	-	-	-	-	-
	Maidara	Age-1 Adult	-	-	-	-	-	-
	Chalna Point	Adult	-	-	-	-	-	Maturation
		Brood fish	-	-	-	-	-	-
Pangas	Haldikhali	Juvenile	-	-	-	-	-	-
	Harbaria	Adult	-	-	-	-	-	-
	Mongla Point	Juvenile and Adult	-	-	-	-	-	-

Source: Field findings at different times

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

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	-	-

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
	Chali Chingri	0.17	Chali Chingri	0.17	Tengra	10	-	-
	-	-	-	-	Bele	20	-	-
	-	-	-	-	Tilapia	22	-	-
	-	-	-	-	Rui	28	-	-
	-	-	-	-	Vetki	-	-	-
	-	-	-	-	Harina Chingri	-	-	-
	-	-	-	-	Chami Chingri	-	-	-
	-	-	-	-	Catla	56	-	-
	-	-	-	-	Mrigel	50	-	-
Sub-total =		**1.89**		**2.91**		**197.5**	**-**	**-**
Grand-total =		**17.00**		**11.33**		**226.5**	**-**	**-**

Source: CEGIS Field Survey, 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

Sampling Site	Total Catch (kg): 2015-2016							
	5th QM		6th QM		7th QM		8th QM	
	Species	ton	Species	ton	Species	ton	Species	ton
	-	-	Horina Chingri	0.50	Chali Chingri	0	-	0
	-	-	Bele	0.30	Tilapia	0	-	0
	-	-	Paissa	0.25	Vetki	0	-	0
	-	-	-	-	Tengra	0	-	0
	-	-	-	-	Paissa	0	-	0
Sub-total=	**-**	**0**	**-**	**3.02**	**-**	**0**	**-**	**0**
3	Bagda	-	Bagda	3.5	Bagda	0.4	-	0
	-	-	-	-	Paissa	3.2	-	0
	-	-	-	-	Vetki	0.4	-	0
	-	-	-	-	Tilapia	0.06	-	0
	-	-	-	-	Horina Chingri	0.35	-	0
	-	-	-	-	Chali Chingri	0.6	-	0
	-	-	-	-	Chaka Chingri	0.1	-	0
	-	-	-	-	Tengra	0	-	0
	-	-	-	-	Bele	0	-	0
	-	-	-	-	Tairel	0.06	-	0
	-	-	-	-	Bhangan	0	-	0
Sub-total =	**-**	**-**	**-**	**-**	**-**	**5.17**	**-**	**0**
Grand-total =	**-**	**1**		**3.5**		**36.17**	**-**	**9**

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**
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

Sampling Site	Total Catch (kg): 2016-2017							
	9th QM		10th QM		11th QM		12th QM	
	Species	ton	Species	ton	Species	ton	Species	ton
	-	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	
	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
	Horina Chingri	1	Rui (kg)	1.3	-	-	Golda	0.10	Bele	0.20	Catla	1.2
	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				
							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
	-	-	Vetki	0.5	-	-	Golda	**0.13**	Bele	0.06	Bhangan	0.05
	-	-	Paissa	7	-	-	Rui	**8.41**	Bhangan	0.01	Catla	3
	-	-	Phessa	1	-	-	Tilapia	**5.90**	Catla	0.00	Chali	0.4

Sampling Site	Total Catch (kg): 2017-2018 and 2018-19											
	13th QM		14th QM		15th QM		16th QM		17th QM		18th QM	
	Species	ton	Species	ton	Species	ton	Species	ton	Species	ton	Species	ton
	-	-	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
	-	-	Paissa	8	-	-	Tilapia	**1.50**	Horina Chingri	0.00		
	-	-	Tengra	2	-	-	Tengra	**0.12**	Paissa	0.00		
	-	-	Tilapia	5	-	-	Paissa	**0.00**	Tengra	0.00		
	-	-	Rui	3	-	-	Horina Chingri	**0.60**	Tilapia	0.20		
	-	-	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

(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: *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, April 2014, April 2015, April 2016, April and December 2017

Table F.1: Results of Traffic Volume Datasheet

Traffic Volume Survey from Babur Bari to Mongla

Date: November 25, 2018 (Sunday)

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	32	29	0	25	23	0	38	39	0
Rickshaw	0.8	8	7	12	14	6	16	4	10	10
Van	0.6	20	26	27	28	33	36	10	15	14
Cycle	0.2	16	23	8	18	9	5	2	13	3
Human Howler	0.6	11	21	19	14	11	14	9	13	13
CNG	0.5	3	3	3	5	4	4	1	3	2
Private Car	1	13	15	28	17	15	31	8	15	23
Motor Cycle	0.3	27	27	16	61	63	37	6	44	15
Jeep	1	2	2	4	3	4	7	3	4	6
Pick-up	2	11	7	36	15	8	46	9	22	62
Micro	1	15	18	33	7	16	23	10	22	32
Bus	2.5	15	17	78	21	20	100	6	13	48
Light Truck	2	7	11	36	6	10	30	7	5	24
Medium Truck	2	13	10	45	14	18	63	9	4	26
Heavy Truck	2	10	5	30	12	9	42	4	4	15
			Total	**373**			**453**			**293**

Source: CEGIS field survey

Recorder: Gazi A. R. Nahid and Abdur Rahman

Table F.2: Results of Traffic Volume Datasheet

Traffic Volume Survey from Khudir Bottola to Babur Bari

Date: November 27, 2018 (Tuesday)

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	28	25	0	19	14	0
Rickshaw	0.8	4	4	6	5	5	8	2	4	5
Van	0.6	13	16	17	25	28	32	10	12	13
Cycle	0.2	12	10	4	26	14	8	6	10	3
Human Howler	0.6	10	7	10	4	4	5	11	9	12
CNG	0.5	1	1	1	2	2	2	1	1	1
Private Car	1	8	6	15	20	12	32	11	8	18
Motor Cycle	0.3	22	23	13	43	27	21	21	22	13
Jeep	1	1	2	3	7	5	12	1	2	3
Pick-up	2	7	6	26	18	13	61	5	7	23
Micro	1	5	6	11	22	14	36	5	10	14
Bus	2.5	8	7	38	11	11	53	5	7	29
Light Truck	2	6	6	23	18	13	61	3	4	12
Medium Truck	2	7	7	28	16	16	62	7	6	24
Heavy Truck	2	4	7	22	10	10	40	4	5	17
			Total	**218**			**430**			**185**

Source: CEGIS field survey

Recorder: Gazi A. R. Nahid and Abdur Rahman

Table F.3: Results of Traffic Volume Datasheet

Traffic Volume Survey from Babur Bari to Plant site

Date: July 24, 2018 (Tuesday)

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	26	29	0	13	8	0	25	13	0
Rickshaw	0.8	3	5	6	12	9	16	4	3	5
Van	0.6	17	20	22	9	12	13	10	4	8
Cycle	0.2	47	15	12	4	1	1	2	1	1
Human Howler	0.6	12	14	16	11	0	6	9	6	9
CNG	0.5	1	1	1	0	1	0	1	1	1
Private Car	1	5	9	14	4	1	5	8	2	9
Motor Cycle	0.3	17	24	12	15	6	6	6	3	3
Jeep	1	1	0	1	1	0	1	3	1	3
Pick-up	2	3	2	11	4	4	15	9	6	30
Micro	1	6	5	11	5	2	7	10	2	12
Bus	2.5	2	1	8	2	2	9	6	5	28
Light Truck	2	3	3	13	3	2	10	7	5	24
Medium Truck	2	9	10	37	6	0	11	9	7	32
Heavy Truck	2	3	3	12	3	0	6	4	3	14
			Total	**177**			**105**			**179**

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

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	17-Apr	32.6	7.59	25300	8273	36	185.6	12950	12700	250	4.6	0.7	136	15.5
2	17-Apr	32.6	7.59	25300	8273	36	186.2	12950	12700	250	4.6	0.7	138	15.5
3	17-Apr	32.6	7.59	25300	8273	36	184.8	12950	12700	250	4.6	0.7	136	15.5
1	5-May	32.6	7.59	29200	9480	36	198.6	14900	14600	300	4.5	1.2	177	17.6
2	5-May	32.9	7.54	29200	9470	36	198.6	14900	14600	300	4.4	1.2	177	17.6
3	5-May	33.2	7.57	29200	9470	36	199.6	14900	14600	300	4.5	1.2	177	17.6
1	13-Jun	31.6	7.69	18000	5820	36	112.6	9200	9000	200	4.7	1.1	97	10.8
2	13-Jun	31.6	7.69	18000	5800	36	113.2	9200	9000	200	4.7	1.1	97	10.8
3	13-Jun	31.6	7.69	18000	5810	36	112.4	9200	9000	200	4.7	1.1	97	10.8
1	1-Jul	31.6	7.69	440	32.6	36	76.6	285	220	65	5.2	0.8	26	-
2	1-Jul	31.6	7.69	440	32.6	36	76.6	285	220	65	5.2	0.8	26	-
3	1-Jul	31.6	7.69	440	32.6	36	76.6	285	220	65	5.2	0.8	26	-
1	5-Aug	31.6	7.69	275	16.6	36	68.6	192	137	55	5.3	0.7	22	-
2	5-Aug	31.6	7.69	275	16.6	36	68.6	192	137	55	5.3	0.7	22	-
3	5-Aug	31.6	7.69	275	16.6	36	68.6	192	137	55	5.3	0.7	22	-
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

Government of the People's Republic of Bangladesh
Office of the Chief Chemist
Department of Public Health Engineering
Central Lab, 38-39, Mohakhali C/A, Dhaka-1212
Phone: 88-02-9881927, Fax: 88-02-9882003 , Email: wqmsc_central_lab@yahoo.com

Lab Memo: 1252/ CC, DPHE, CL, Dhaka. Date: 10-12-2018

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: CEN2018100001	Sample Receiving date: 19-08-2018
Ref. Memo No: 42.06.2626.119.37.001.18-1306 & Dated: 14-08-2018	Sample Source: Suface Water
Sent by:Engr. Md. Waji Ullah ,Executive Director , CEGIS, Gulshan-1, Dhaka-1212.	Dist:Bagerhat, Upa:Rampal
Care Taker: CEGIS (SW-01)	Union:, Vill.:Chalna, Posur River
Sample Collection date: 31-07-2018	Date of Testing: 19/08/2018-26/09/2018

LABORATORY TEST RESULTS:

Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Arsenic (As)	0.05	0.004	mg/L	AAS	0.001
2	Cadmium (Cd)	0.005	0.0019	mg/L	AAS	0.00015
3	Calcium (Ca)	75	76	mg/L	AAS	0.17
4	Chemical Oxygen Demand (COD)	4.0	20	mg/L	CRM	-
5	Chloride	150-600	135	mg/L	Titrimetic	-
6	Silica (Sio2)	0.0	2.5	mg/L	UVS	-
7	Bi-Carbonate (HCO3-)	0.0	100	mg/L	Titrimetic	-
8	Cr (Total)	0.05	0.026	mg/L	AAS	0.0003
9	Hardness	200-500	210	mg/L	Titrimetic	-
10	Iron (Fe)	0.3-1	9.07	mg/L	AAS	0.05
11	Lead (Pb)	0.05	0.002	mg/L	AAS	0.001
12	Magnesium (Mg)	30-35	14	mg/L	AAS	0.05
13	Nitrogen (Nitrate)	10.0	0.8	mg/L	UVS	0.10
14	Phosphate	6.0	1.03	mg/L	UVS	0.10
15	Potassium (K)	12.0	8	mg/L	AAS	-
16	Sodium (Na)	200	443	mg/L	AAS	0.34
17	Sulphate	400	24	mg/L	UVS	1.0
18	Total Dissolved Solid (TDS)	1000	315	mg/L	Multimeter	-
19	Total Suspended Solid (TSS)	10	17	mg/L	Gravimetric Method	-
20	Turbidity	10	139	NTU	Turbidity Meter	-
21	Carbonate (CO3)	-	0.30	mg/L	Titrimetic	-

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.

Page 1 of 2

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

Test Performed by:	Signature	Countersigned/Approved by:	Signature
1.) Name: Mahabuba Sabina Motin Designation: Sample Analyzer	10-12-18	1.) Name: Md. Biplab Hossain Designation: Chief Chemist	10/12/2018 Md. Biplab Hossain Chief Chemist Department of Public Health Engineering Central Laboratory Mohakhali, Dhaka
2.) Name: Md. Saiful Alam Khosru Designation: Sample Analyzer	10.12.18 Sample Analyzer DPHE, Central Laboratory Mohakhali Dhaka	2.) Name: Designation:	

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Phone: 88-02-9881927, Fax: 88-02-9882003 , Email: wqmsc_central_lab@yahoo.com

Lab Memo: 1252/ CC, DPHE, CL, Dhaka. Date: 10-12-2018

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: CEN2018100002	Sample Receiving date: 19-08-2018
Ref. Memo No: 42.06.2626.119.37.001.18-1306 & Dated: 14-08-2018	Sample Source: Suface Water
Sent by:Engr. Md. Waji Ullah ,Executive Director , CEGIS, Gulshan-1, Dhaka-1212.	Dist:Bagerhat, Upa:Rampal
Care Taker: CEGIS (SW-02)	Union:, Vill.:
Sample Collection date: 31-07-2018	Date of Testing: 19/08/2018-26/09/2018

LABORATORY TEST RESULTS:

Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Arsenic (As)	0.05	0.005	mg/L	AAS	0.001
2	Cadmium (Cd)	0.005	0.0012	mg/L	AAS	0.00015
3	Chemical Oxygen Demand (COD)	4.0	24	mg/L	CRM	-
4	Cr (Total)	0.05	0.027	mg/L	AAS	0.0003
5	Hardness	200-500	205	mg/L	Titrimetic	-
6	Lead (Pb)	0.05	0.001	mg/L	AAS	0.001
7	Nitrogen (Nitrate)	10.0	1.7	mg/L	UVS	0.10
8	Phosphate	6.0	0.83	mg/L	UVS	0.10
9	Sulphate	400	18	mg/L	UVS	1.0
10	Total Dissolved Solid (TDS)	1000	224	mg/L	Multimeter	-
11	Total Suspended Solid (TSS)	10	16	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	10-12-18	1.) Name: Md. Biplab Hossain Designation: Chief Chemist	10/12/2018 Md. Biplab Hossain Chief Chemist Department of Public Health Engineering Central Laboratory Mohakhali, Dhaka.
2.) Name: Md. Saiful Alam Khosru Designation: Sample Analyzer	10.12.18 Sample Analyzer DPHE, Central Laboratory Mohakhali, Dhaka	2.) Name: Designation:	

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Lab Memo: 1252/ CC, DPHE, CL, Dhaka. Date: 10-12-2018

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: CEN2018100003	Sample Receiving date: 19-08-2018
Ref. Memo No: 42.06.2626.119.37.001.18-1306 & Dated: 14-08-2018	Sample Source: Suface Water
Sent by:Engr. Md. Waji Ullah ,Executive Director , CEGIS, Gulshan-1, Dhaka-1212.	Dist:Bagerhat, Upa:Rampal
Care Taker: CEGIS (SW-03)	Union:, Vill.:
Sample Collection date: 31-07-2018	Date of Testing: 19/08/2018-26/09/2018

LABORATORY TEST RESULTS:

Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Arsenic (As)	0.05	0.004	mg/L	AAS	0.001
2	Cadmium (Cd)	0.005	0.0007	mg/L	AAS	0.00015
3	Chemical Oxygen Demand (COD)	4.0	12	mg/L	CRM	-
4	Cr (Total)	0.05	0.024	mg/L	AAS	0.0003
5	Hardness	200-500	185	mg/L	Titrimetic	-
6	Lead (Pb)	0.05	0.020	mg/L	AAS	0.001
7	Nitrogen (Nitrate)	10.0	2.1	mg/L	UVS	0.10
8	Phosphate	6.0	0.76	mg/L	UVS	0.10
9	Sulphate	400	20	mg/L	UVS	1.0
10	Total Dissolved Solid (TDS)	1000	232	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	10-12-18	1.) Name: Md. Biplab Hossain Designation: Chief Chemist	10/12/2018 Md. Biplab Hossain Chief Chemist Department of Public Health Engineering Central Laboratory Mohakhali, Dhaka.
2.) Name: Md. Saiful Alam Khosru Designation: Sample Analyzer	10.12.18 Sample Analyzer DPHE, Central Laboratory Mohakhali, Dhaka	2.) Name: Designation:	

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Lab Memo: 1252/ CC, DPHE, CL, Dhaka.

Date: 10-12-2018

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: CEN2018100004	Sample Receiving date: 19-08-2018
Ref. Memo No: 42.06.2626.119.37.001.18-1306 & Dated: 14-08-2018	Sample Source: Suface Water
Sent by:Engr. Md. Waji Ullah ,Executive Director , CEGIS, Gulshan-1, Dhaka-1212.	Dist:Bagerhat, Upa:Rampal
Care Taker: CEGIS (SW-04)	Union:, Vill.:
Sample Collection date: 31-07-2018	Date of Testing: 19/08/2018-26/09/2018

LABORATORY TEST RESULTS:

Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Arsenic (As)	0.05	0.005	mg/L	AAS	0.001
2	Cadmium (Cd)	0.005	0.0018	mg/L	AAS	0.00015
3	Calcium (Ca)	75	34	mg/L	AAS	0.17
4	Chemical Oxygen Demand (COD)	4.0	30	mg/L	CRM	-
5	Chloride	150-600	128	mg/L	Titrimetic	-
6	Silica (Sio2)	0.0	6.7	mg/L	UVS	-
7	Bi-Carbonate (HCO3-)	0.0	85	mg/L	Titrimetic	-
8	Cr (Total)	0.05	0.034	mg/L	AAS	0.0003
9	Hardness	200-500	200	mg/L	Titrimetic	-
10	Iron (Fe)	0.3-1	8.96	mg/L	AAS	0.05
11	Lead (Pb)	0.05	0.018	mg/L	AAS	0.001
12	Magnesium (Mg)	30-35	15	mg/L	AAS	0.05
13	Nitrogen (Nitrate)	10.0	2.8	mg/L	UVS	0.10
14	Phosphate	6.0	0.88	mg/L	UVS	0.10
15	Potassium (K)	12.0	9	mg/L	AAS	-
16	Sodium (Na)	200	231	mg/L	AAS	0.34
17	Sulphate	400	22	mg/L	UVS	1.0
18	Total Dissolved Solid (TDS)	1000	328	mg/L	Multimeter	-
19	Total Suspended Solid (TSS)	10	18	mg/L	Gravimetric Method	-
20	Turbidity	10	709	NTU	Turbidity Meter	-
21	Carbonate (CO3)	-	0.32	mg/L	Titrimetic	-

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.

Mmotin

BHossain

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

Test Performed by:	Signature	Countersigned/Approved by:	Signature
1.) Name: Mahabuba Sabina Motin Designation: Sample Analyzer	Mmotin 10-12-18	1.) Name: Md. Biplab Hossain Designation: Chief Chemist	BHossain 10/12/2018
2.) Name: Md. Saiful Alam Khosru Designation: Sample Analyzer	10.12.18	2.) Name: Designation:	Md. Biplab Hossain Chief Chemist Department of Public Health Engineering Central Laboratory Mohakhali, Dhaka.

Sample Analyzer
DPHE, Central Laboratory
Mohakhali, Dhaka

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Lab Memo: 1252/ CC, DPHE, CL, Dhaka. Date: 10-12-2018

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: CEN2018100005	Sample Receiving date: 19-08-2018
Ref. Memo No: 42.06.2626.119.37.001.18-1306 & Dated: 14-08-2018	Sample Source: Suface Water
Sent by:Engr. Md. Waji Ullah ,Executive Director , CEGIS, Gulshan-1, Dhaka-1212.	Dist:Bagerhat, Upa:Rampal
Care Taker: CEGIS (SW-05)	Union:, Vill.:
Sample Collection date: 31-07-2018	Date of Testing: 19/08/2018-26/09/2018

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	0.0015	mg/L	AAS	0.00015
3	Chemical Oxygen Demand (COD)	4.0	16	mg/L	CRM	-
4	Cr (Total)	0.05	0.018	mg/L	AAS	0.0003
5	Hardness	200-500	210	mg/L	Titrimetic	-
6	Lead (Pb)	0.05	0.008	mg/L	AAS	0.001
7	Nitrogen (Nitrate)	10.0	1.8	mg/L	UVS	0.10
8	Phosphate	6.0	1.07	mg/L	UVS	0.10
9	Sulphate	400	21	mg/L	UVS	1.0
10	Total Dissolved Solid (TDS)	1000	235	mg/L	Multimeter	-
11	Total Suspended Solid (TSS)	10	16	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 10-12-18	1.) Name: Md. Biplab Hossain Designation: Chief Chemist	BHossain 10/12/2018 Md. Biplab Hossain Chief Chemist Department of Public Health Engineering Central Laboratory Mohakhali, Dhaka.
2.) Name: Md. Saiful Alam Khosru Designation: Sample Analyzer	10.12.18 Sample Analyzer DPHE, Central Laboratory Mohakhali, Dhaka	2.) Name: Designation:	

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Lab Memo: 1252/ CC, DPHE, CL, Dhaka. Date: 10-12-2018

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: CEN2018100006	Sample Receiving date: 19-08-2018
Ref. Memo No: 42.06.2626.119.37.001.18-1306 & Dated: 14-08-2018	Sample Source: Suface Water
Sent by:Engr. Md. Waji Ullah ,Executive Director , CEGIS, Gulshan-1, Dhaka-1212.	Dist:Bagerhat, Upa:Rampal
Care Taker: CEGIS (SW-06)	Union:, Vill.:
Sample Collection date: 31-07-2018	Date of Testing: 19/08/2018-26/09/2018

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	0.0029	mg/L	AAS	0.00015
3	Chemical Oxygen Demand (COD)	4.0	12	mg/L	CRM	-
4	Cr (Total)	0.05	0.026	mg/L	AAS	0.0003
5	Hardness	200-500	215	mg/L	Titrimetic	-
6	Lead (Pb)	0.05	0.041	mg/L	AAS	0.001
7	Nitrogen (Nitrate)	10.0	3.2	mg/L	UVS	0.10
8	Phosphate	6.0	0.67	mg/L	UVS	0.10
9	Sulphate	400	16	mg/L	UVS	1.0
10	Total Dissolved Solid (TDS)	1000	208	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	Mmotin 10-12-18	1.) Name: Md. Biplab Hossain Designation: Chief Chemist	BHossain 10/12/2018 Md. Biplab Hossain Chief Chemist Department of Public Health Engineering Central Laboratory Mohakhali, Dhaka.
2.) Name: Md. Saiful Alam Khosru Designation: Sample Analyzer	10.12.18 Sample Analyzer DPHE, Central Laboratory Mohakhali, Dhaka	2.) Name: Designation:	

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Lab Memo: 1252/ CC, DPHE, CL, Dhaka. Date: 10-12-2018

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: CEN2018100007	Sample Receiving date: 19-08-2018
Ref. Memo No: 42.06.2626.119.37.001.18-1306 & Dated: 14-08-2018	Sample Source: Suface Water
Sent by:Engr. Md. Waji Ullah ,Executive Director , CEGIS, Gulshan-1, Dhaka-1212.	Dist:Bagerhat, Upa:Rampal
Care Taker: CEGIS (SW-07)	Union:, Vill.:
Sample Collection date: 31-07-2018	Date of Testing: 19/08/2018-26/09/2018

LABORATORY TEST RESULTS:

Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Arsenic (As)	0.05	0.005	mg/L	AAS	0.001
2	Cadmium (Cd)	0.005	0.00015	mg/L	AAS	0.00015
3	Calcium (Ca)	75	30	mg/L	AAS	0.17
4	Chemical Oxygen Demand (COD)	4.0	10	mg/L	CRM	-
5	Chloride	150-600	106	mg/L	Titrimetic	-
6	Silica (Sio2)	0.0	1.8	mg/L	UVS	-
7	Bi-Carbonate (HCO3-)	0.0	100	mg/L	Titrimetic	-
8	Cr (Total)	0.05	0.023	mg/L	AAS	0.0003
9	Hardness	200-500	205	mg/L	Titrimetic	-
10	Iron (Fe)	0.3-1	9.31	mg/L	AAS	0.05
11	Lead (Pb)	0.05	0.012	mg/L	AAS	0.001
12	Magnesium (Mg)	30-35	10	mg/L	AAS	0.05
13	Nitrogen (Nitrate)	10.0	4.0	mg/L	UVS	0.10
14	Phosphate	6.0	1.16	mg/L	UVS	0.10
15	Potassium (K)	12.0	12	mg/L	AAS	-
16	Sodium (Na)	200	342	mg/L	AAS	0.34
17	Sulphate	400	10	mg/L	UVS	1.0
18	Total Dissolved Solid (TDS)	1000	205	mg/L	Multimeter	-
19	Total Suspended Solid (TSS)	10	16	mg/L	Gravimetric Method	-
20	Turbidity	10	457	NTU	Turbidity Meter	-
21	Carbonate (CO3)	-	0.29	mg/L	Titrimetic	-

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.

Umotin Page 1 of 2

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

Test Performed by: Signature

1.) Name: Mahabuba Sabina Motin — Umotin 10-12-18
Designation: Sample Analyzer

2.) Name: Md. Saiful Alam Khosru — 10.12.18
Designation: Sample Analyzer

Sample Analyzer
DPHE, Central Laboratory
Mohakhali Dhaka

Countersigned/Approved by: Signature

1.) Name: Md. Biplab Hossain — 10/12/2018
Designation: Chief Chemist

Md. Biplab Hossain
Chief Chemist
Department of Public Health Engineering
Central Laboratory Mohakhali, Dhaka.

2.) Name:
Designation:

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Lab Memo: 1252/ CC, DPHE, CL, Dhaka.

Date: 10-12-2018

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: CEN2018100008	Sample Receiving date: 19-08-2018
Ref. Memo No: 42.06.2626.119.37.001.18-1306 & Dated: 14-08-2018	Sample Source: Suface Water
Sent by:Engr. Md. Waji Ullah ,Executive Director , CEGIS, Gulshan-1, Dhaka-1212.	Dist:Bagerhat, Upa:Rampal
Care Taker: CEGIS (SW-08)	Union:, Vill.:
Sample Collection date: 31-07-2018	Date of Testing: 19/08/2018-26/09/2018

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	0.010	mg/L	AAS	0.00015
3	Chemical Oxygen Demand (COD)	4.0	24	mg/L	CRM	-
4	Cr (Total)	0.05	0.007	mg/L	AAS	0.0003
5	Hardness	200-500	212	mg/L	Titrimetic	-
6	Lead (Pb)	0.05	0.015	mg/L	AAS	0.001
7	Nitrogen (Nitrate)	10.0	3.7	mg/L	UVS	0.10
8	Phosphate	6.0	0.86	mg/L	UVS	0.10
9	Sulphate	400	24	mg/L	UVS	1.0
10	Total Dissolved Solid (TDS)	1000	286	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 10-12-18	1.) Name: Md. Biplab Hossain Designation: Chief Chemist	BHossain 10/12/2018 Md. Biplab Hossain Chief Chemist Department of Public Health Engineering Central Laboratory Mohakhali, Dhaka
2.) Name: Md. Saiful Alam Khosru Designation: Sample Analyzer	10.12.18 Sample Analyzer DPHE, Central Laboratory Mohakhali, Dhaka	2.) Name: Designation:	

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Department of Public Health Engineering
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Phone: 88-02-9881927, Fax: 88-02-9882003 , Email: wqmsc_central_lab@yahoo.com

Lab Memo: 1252/ CC, DPHE, CL, Dhaka.

Date: 10-12-2018

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: CEN2018100009	Sample Receiving date: 19-08-2018
Ref. Memo No: 42.06.2626.119.37.001.18-1306 & Dated: 14-08-2018	Sample Source: Suface Water
Sent by:Engr. Md. Waji Ullah ,Executive Director , CEGIS, Gulshan-1, Dhaka-1212.	Dist:Bagerhat, Upa:Rampal
Care Taker: CEGIS (SW-09)	Union:, Vill.:
Sample Collection date: 31-07-2018	Date of Testing: 19/08/2018-26/09/2018

LABORATORY TEST RESULTS:

Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Arsenic (As)	0.05	0.004	mg/L	AAS	0.001
2	Cadmium (Cd)	0.005	0.0015	mg/L	AAS	0.00015
3	Chemical Oxygen Demand (COD)	4.0	16	mg/L	CRM	-
4	Cr (Total)	0.05	0.012	mg/L	AAS	0.0003
5	Hardness	200-500	205	mg/L	Titrimetic	-
6	Lead (Pb)	0.05	0.030	mg/L	AAS	0.001
7	Nitrogen (Nitrate)	10.0	3.8	mg/L	UVS	0.10
8	Phosphate	6.0	1.03	mg/L	UVS	0.10
9	Sulphate	400	22	mg/L	UVS	1.0
10	Total Dissolved Solid (TDS)	1000	296	mg/L	Multimeter	-
11	Total Suspended Solid (TSS)	10	20	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 10-12-18	1.) Name: Md. Biplab Hossain Designation: Chief Chemist	BHossain 10/12/2018 Md. Biplab Hossain Chief Chemist Department of Public Health Engineering Central Laboratory Mohakhali, Dhaka
2.) Name: Md. Saiful Alam Khosru Designation: Sample Analyzer	10.12.18 Sample Analyzer DPHE, Central Laboratory Mohakhali, Dhaka	2.) Name: Designation:	

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Lab Memo: 1252/ CC, DPHE, CL, Dhaka. Date: 10-12-2018

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: CEN2018100010	Sample Receiving date: 19-08-2018
Ref. Memo No: 42.06.2626.119.37.001.18-1306 & Dated: 14-08-2018	Sample Source: Suface Water
Sent by:Engr. Md. Waji Ullah ,Executive Director , CEGIS, Gulshan-1, Dhaka-1212.	Dist:Bagerhat, Upa:Rampal
Care Taker: CEGIS (SW-10)	Union:, Vill.:
Sample Collection date: 31-07-2018	Date of Testing: 19/08/2018-26/09/2018

LABORATORY TEST RESULTS:

Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Arsenic (As)	0.05	0.004	mg/L	AAS	0.001
2	Cadmium (Cd)	0.005	0.00019	mg/L	AAS	0.00015
3	Chemical Oxygen Demand (COD)	4.0	40	mg/L	CRM	-
4	Cr (Total)	0.05	0.014	mg/L	AAS	0.0003
5	Hardness	200-500	210	mg/L	Titrimetic	-
6	Lead (Pb)	0.05	0.010	mg/L	AAS	0.001
7	Nitrogen (Nitrate)	10.0	4.4	mg/L	UVS	0.10
8	Phosphate	6.0	0.83	mg/L	UVS	0.10
9	Sulphate	400	21	mg/L	UVS	1.0
10	Total Dissolved Solid (TDS)	1000	265	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	UMotin 10-12-18	1.) Name: Md. Biplab Hossain Designation: Chief Chemist	BHossain 10/12/2018 Md. Biplab Hossain Chief Chemist Department of Public Health Engineering Central Laboratory Mohakhali, Dhaka.
2.) Name: Md. Saiful Alam Khosru Designation: Sample Analyzer	10.12.'18 Sample Analyzer DPHE, Central Laboratory Mohakhali, Dhaka	2.) Name: Designation:	

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Lab Memo: 1252/ CC, DPHE, CL, Dhaka. Date: 10-12-2018

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: CEN2018100011	Sample Receiving date: 19-08-2018
Ref. Memo No: 42.06.2626.119.37.001.18-1306 & Dated: 14-08-2018	Sample Source: Suface Water
Sent by:Engr. Md. Waji Ullah ,Executive Director , CEGIS, Gulshan-1, Dhaka-1212.	Dist:Bagerhat, Upa:Rampal
Care Taker: CEGIS (SW-11)	Union:, Vill.:
Sample Collection date: 31-07-2018	Date of Testing: 19/08/2018-26/09/2018

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	0.0005	mg/L	AAS	0.00015
3	Chemical Oxygen Demand (COD)	4.0	20	mg/L	CRM	-
4	Cr (Total)	0.05	0.004	mg/L	AAS	0.0003
5	Hardness	200-500	220	mg/L	Titrimetic	-
6	Lead (Pb)	0.05	0.016	mg/L	AAS	0.001
7	Nitrogen (Nitrate)	10.0	3.1	mg/L	UVS	0.10
8	Phosphate	6.0	1.2	mg/L	UVS	0.10
9	Sulphate	400	18	mg/L	UVS	1.0
10	Total Dissolved Solid (TDS)	1000	340	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	UMotin 10-12-18	1.) Name: Md. Biplab Hossain Designation: Chief Chemist	BHossain 10/12/2018 Md. Biplab Hossain Chief Chemist Department of Public Health Engineering Central Laboratory Mohakhali, Dhaka.
2.) Name: Md. Saiful Alam Khosru Designation: Sample Analyzer	10.12.'18 Sample Analyzer DPHE, Central Laboratory Mohakhali, Dhaka	2.) Name: Designation:	

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Lab Memo: 1252/ CC, DPHE, CL, Dhaka. Date: 10-12-2018

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: CEN2018100012	Sample Receiving date: 19-08-2018
Ref. Memo No: 42.06.2626.119.37.001.18-1306 & Dated: 14-08-2018	Sample Source: Suface Water
Sent by:Engr. Md. Waji Ullah ,Executive Director , CEGIS, Gulshan-1, Dhaka-1212.	Dist:Bagerhat, Upa:Rampal
Care Taker: CEGIS (SW-12)	Union:, Vill.:
Sample Collection date: 31-07-2018	Date of Testing: 19/08/2018-26/09/2018

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	0.0005	mg/L	AAS	0.00015
3	Chemical Oxygen Demand (COD)	4.0	10	mg/L	CRM	-
4	Cr (Total)	0.05	0.017	mg/L	AAS	0.0003
5	Hardness	200-500	245	mg/L	Titrimetic	-
6	Lead (Pb)	0.05	0.015	mg/L	AAS	0.001
7	Nitrogen (Nitrate)	10.0	2.4	mg/L	UVS	0.10
8	Phosphate	6.0	0.86	mg/L	UVS	0.10
9	Sulphate	400	28	mg/L	UVS	1.0
10	Total Dissolved Solid (TDS)	1000	580	mg/L	Multimeter	-
11	Total Suspended Solid (TSS)	10	17	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	10-12-18	1.) Name: Md. Biplab Hossain Designation: Chief Chemist	10/12/2018 Md. Biplab Hossain Chief Chemist Department of Public Health Engineering Laboratory Mohakhali, Dhaka
2.) Name: Md. Saiful Alam Khosru Designation: Sample Analyzer	10.12.18 Sample Analyzer DPHE, Central Laboratory Mohakhali, Dhaka	2.) Name: Designation:	

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Lab Memo: 1252/ CC, DPHE, CL, Dhaka. Date: 10-12-2018

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: CEN2018100013	Sample Receiving date: 19-08-2018
Ref. Memo No: 42.06.2626.119.37.001.18-1306 & Dated: 14-08-2018	Sample Source: Suface Water
Sent by:Engr. Md. Waji Ullah ,Executive Director , CEGIS, Gulshan-1, Dhaka-1212.	Dist:Bagerhat, Upa:Rampal
Care Taker: CEGIS (SW-13)	Union:, Vill.:
Sample Collection date: 31-07-2018	Date of Testing: 19/08/2018-26/09/2018

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	0.0026	mg/L	AAS	0.00015
3	Chemical Oxygen Demand (COD)	4.0	16	mg/L	CRM	-
4	Cr (Total)	0.05	0.005	mg/L	AAS	0.0003
5	Hardness	200-500	530	mg/L	Titrimetic	-
6	Lead (Pb)	0.05	0.017	mg/L	AAS	0.001
7	Nitrogen (Nitrate)	10.0	2.7	mg/L	UVS	0.10
8	Phosphate	6.0	0.50	mg/L	UVS	0.10
9	Sulphate	400	35	mg/L	UVS	1.0
10	Total Dissolved Solid (TDS)	1000	2190	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	10-12-18	1.) Name: Md. Biplab Hossain Designation: Chief Chemist	10/12/2018 Md. Biplab Hossain Chief Chemist Department of Public Health Engineering Central Laboratory Mohakhali, Dhaka.
2.) Name: Md. Saiful Alam Khosru Designation: Sample Analyzer	10.12.18 Sample Analyzer DPHE, Central Laboratory Mohakhali, Dhaka	2.) Name: Designation:	

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Lab Memo: 1252/ CC, DPHE, CL, Dhaka.

Date: 10-12-2018

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: CEN2018100014	Sample Receiving date: 19-08-2018
Ref. Memo No: 42.06.2626.119.37.001.18-1306 & Dated: 14-08-2018	Sample Source: Suface Water
Sent by:Engr. Md. Waji Ullah ,Executive Director , CEGIS, Gulshan-1, Dhaka-1212.	Dist:Bagerhat, Upa:Rampal
Care Taker: CEGIS (SW-14)	Union:, Vill.:
Sample Collection date: 31-07-2018	Date of Testing: 19/08/2018-26/09/2018

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	0.0027	mg/L	AAS	0.00015
3	Chemical Oxygen Demand (COD)	4.0	110	mg/L	CRM	-
4	Cr (Total)	0.05	0.008	mg/L	AAS	0.0003
5	Hardness	200-500	2030	mg/L	Titrimetic	-
6	Lead (Pb)	0.05	0.062	mg/L	AAS	0.001
7	Nitrogen (Nitrate)	10.0	4.2	mg/L	UVS	0.10
8	Phosphate	6.0	0.67	mg/L	UVS	0.10
9	Sulphate	400	620	mg/L	UVS	1.0
10	Total Dissolved Solid (TDS)	1000	7680	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	10-12-18	1.) Name: Md. Biplab Hossain Designation: Chief Chemist	10/12/2018 Md. Biplab Hossain Chief Chemist Department of Public Health Engineering Central Laboratory Mohakhali, Dhaka.
2.) Name: Md. Saiful Alam Khosru Designation: Sample Analyzer	10.12.18 Sample Analyzer DPHE, Central Laboratory Mohakhali, Dhaka	2.) Name: Designation:	

Page 1 of 1

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Lab Memo: 1252/ CC, DPHE, CL, Dhaka.

Date: 10-12-2018

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: CEN2018100015	Sample Receiving date: 19-08-2018
Ref. Memo No: 42.06.2626.119.37.001.18-1306 & Dated: 14-08-2018	Sample Source: Ground Water
Sent by:Engr. Md. Waji Ullah ,Executive Director , CEGIS, Gulshan-1, Dhaka-1212.	Dist:Bagerhat, Upa:Rampal
Care Taker: CEGIS (GW-01)	Union:, Vill.:
Sample Collection date: 02-08-2018	Date of Testing: 19/08/2018-26/09/2018

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	Chemical Oxygen Demand (COD)	4.0	4	mg/L	CRM	-
3	Hardness	200-500	235	mg/L	Titrimetic	-
4	Lead (Pb)	0.05	0.004	mg/L	AAS	0.001
5	Nitrogen (Nitrate)	10.0	8.6	mg/L	UVS	0.10
6	Phosphate	6.0	2.93	mg/L	UVS	0.10
7	Sulphate	400	4	mg/L	UVS	1.0
8	Total Dissolved Solid (TDS)	1000	390	mg/L	Multimeter	-
9	Total Suspended Solid (TSS)	10	2	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	10-12-18	1.) Name: Md. Biplab Hossain Designation: Chief Chemist	10/12/2018 Md. Biplab Hossain Chief Chemist Department of Public Health Engineering Central Laboratory Mohakhali, Dhaka.
2.) Name: Md. Saiful Alam Khosru Designation: Sample Analyzer	10.12.18 Sample Analyzer DPHE, Central Laboratory Mohakhali, Dhaka	2.) Name: Designation:	

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Lab Memo: 1252/ CC, DPHE, CL, Dhaka.

Date: 10-12-2018

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: CEN2018100016	Sample Receiving date: 19-08-2018
Ref. Memo No: 42.06.2626.119.37.001.18-1306 & Dated: 14-08-2018	Sample Source: Ground Water
Sent by:Engr. Md. Waji Ullah ,Executive Director , CEGIS, Gulshan-1, Dhaka-1212.	Dist:Bagerhat, Upa:Rampal
Care Taker: CEGIS (GW-02)	Union:, Vill.:
Sample Collection date: 02-08-2018	Date of Testing: 19/08/2018-26/09/2018

LABORATORY TEST RESULTS:

Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Arsenic (As)	0.05	0.056	mg/L	AAS	0.001
2	Chemical Oxygen Demand (COD)	4.0	4	mg/L	CRM	-
3	Hardness	200-500	170	mg/L	Titrimetic	-
4	Lead (Pb)	0.05	0.056	mg/L	AAS	0.001
5	Nitrogen (Nitrate)	10.0	7.8	mg/L	UVS	0.10
6	Phosphate	6.0	4.83	mg/L	UVS	0.10
7	Sulphate	400	6	mg/L	UVS	1.0
8	Total Dissolved Solid (TDS)	1000	608	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	Motin 10-12-18	1.) Name: Md. Biplab Hossain Designation: Chief Chemist	Hossain 10/12/2018 Md. Biplab Hossain Chief Chemist Department of Public Health Engineering Central Laboratory Mohakhali, Dhaka.
2.) Name: Md. Saiful Alam Khosru Designation: Sample Analyzer	10.12.18 Sample Analyzer DPHE, Central Laboratory Mohakhali, Dhaka	2.) Name: Designation:	

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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

Analytical Service Cell Ref No: Aug2018011774
Unit (Lab/Inst.) Ref No: A-703 to707
Lab ID: INS-703 to 707
Sample Receiving Date: 16/08/2018
Sample ID: A-703 To 707
Submission Date: 16/Aug/2018
Report Delivery Date: 11/09/2018

Sample Description: MOidara river, Akram point, Mongla port site, Project site, Harbaria

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-703	Sediment (Moidara river)	Arsenic (As)	3.65 mg/kg	3114.C
		Lead (Pb)	6.59 mg/kg	3111.B
		Mercury (Hg)	1.50 mg/kg	3112.B
		pH at 25.1°C	8.18	4500-H$^+$.B
		Sulphate (SO_4)	297 mg/kg	4110.B

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.

Analytical Service Cell
Dr. Qudrat-I-Khuda Road, Dhanmondi, Dhaka-1205,Bangladesh
Telephone:9671108,Fax: 88-02-9671108 E-mail:asc@bcsir.gov.bd Website: www.bcsir.gov.bd

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11th of September 2018 11:16

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

বাংলাদেশ বিজ্ঞান ও শিল্প গবেষণা পরিষদ (বিসিএসআইআর)

BANGLADESH COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH(BCSIR)

A-704	Sediment (Akram point)	Arsenic (As)	6.18 mg/kg	3114.C
		Lead (Pb)	8.13 mg/kg	3111.B
		Mercury (Hg)	1.81 mg/kg	3112.B
		pH at 25.2°C	8.66	4500-H^+.B
		Sulphate (SO_4)	277 mg/kg	4110.B
A-705	Sediment (Mongla port site)	Arsenic (As)	2.53 mg/kg	3114.C
		Lead (Pb)	6.05 mg/kg	3111.B
		Mercury (Hg)	1.36 mg/kg	3112.B
		pH at 24.8°C	8.22	4500-H^+.B
		Sulphate (SO_4)	103 mg/kg	4110.B
A-706	Sediment (Project site)	Arsenic (As)	5.37 mg/kg	3114.C
		Lead (Pb)	6.03 mg/kg	3111.B
		Mercury (Hg)	1.38 mg/kg	3112.B
		pH at 24.7°C	8.61	4500-H^+.B
		Sulphate (SO_4)	184 mg/kg	4110.B
A-707	Sediment (Harbaria)	Arsenic (As)	4.04 mg/kg	3114.C
		Lead (Pb)	8.67 mg/kg	3111.B
		Mercury (Hg)	2.08 mg/kg	3112.B
		pH at 25.1°C	9.06	4500-H^+.B
		Sulphate (SO_4)	329 mg/kg	4110.B

11.09.18
Analyst
Md. Abu Bakar Siddique
Scientific Officer
Institute of National Analytical Research & Service (INARS)
BCSIR, Dhaka

11.09.18
Section/Division In-Charge
শামীম আহমেদ
ঊর্ধ্বতন বৈজ্ঞানিক কর্মকর্তা
ইনস্টিটিউট অব ন্যাশনাল এনালাইটিক্যাল রিসার্চ এন্ড সার্ভিস (আইএনএআরএস)
বিসিএসআইআর, ঢাকা

11-09-2018
In-Charge/Director
Md. Aminul Ahsan
Director (Addl. Charge)
Institute of National Analytical Research & Service (INARS)
BCSIR, Dhaka.

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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

Analytical Service Cell Ref No: Aug2018011770
Lab ID: INS -681 to 696
Sample ID: A-681 to 696

Unit (Lab/Inst.) Ref No: A-681 to 696
Sample Receiving Date: 16/08/2018
Submission Date: 16/Aug/2018
Report Delivery Date: 03/09/2018

Sample Description: Test of Mercury 1.Sample No:SW(1-14), 2.Sample No:GW (Gw-1,GW-2))

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: 16

Report Details:

Lab ID	Particulars of supplied Sample	Parameters	Concentration	Test Method (APHA)
A-681	Water (SW-01)	Mercury (Hg)	Less than 0.001 mg/L	3112.B
A-682	Water (GW-01)	Mercury (Hg)	0.001 mg/L	3112.B
A-683	Water (SW-02)	Mercury (Hg)	Less than 0.001 mg/L	3112.B
A-684	Water (GW-02)	Mercury (Hg)	Less than 0.001 mg/L	3112.B
A-685	Water (SW-03)	Mercury (Hg)	Less than 0.001 mg/L	3112.B
A-686	Water (SW-04)	Mercury (Hg)	Less than 0.001 mg/L	3112.B
A-687	Water (SW-05)	Mercury (Hg)	Less than 0.001 mg/L	3112.B
A-688	Water (SW-06)	Mercury (Hg)	Less than 0.001 mg/L	3112.B
A-689	Water (SW-07)	Mercury (Hg)	Less than 0.001 mg/L	3112.B

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

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A-690	Water (SW-08)	Mercury (Hg)	Less than 0.001 mg/L	3112.B
A-691	Water (SW-09)	Mercury (Hg)	Less than 0.001 mg/L	3112.B
A-692	Water (SW-10)	Mercury (Hg)	Less than 0.001 mg/L	3112.B
A-693	Water (SW-11)	Mercury (Hg)	Less than 0.001 mg/L	3112.B
A-694	Water (SW-12)	Mercury (Hg)	Less than 0.001 mg/L	3112.B
A-695	Water (SW-13)	Mercury (Hg)	Less than 0.001 mg/L	3112.B
A-696	Water (SW-14)	Mercury (Hg)	Less than 0.001 mg/L	3112.B

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

03.09.18 — Section/Division In-Charge — শামীম আহমেদ

03-09-2018 — In-Charge/Director — Md. Aminul Ahsan, Director (Addl. Charge), Institute of National Analytical Research & Service (INARS), BCSIR, Dhaka.

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BANGLADESH COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH(BCSIR)

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

Analysis Report

Analytical Service Cell Ref No: Aug2018011772

Lab ID: INS-699 to 700

Sample ID: A-699 to 700

Unit (Lab/Inst.) Ref No: A-699 to 700

Sample Receiving Date: 16/08/2018

Submission Date: 16/Aug/2018

Report Delivery Date: 08/10/2018

Sample Description: sample analysis of Total Carbon (Harbaria, Project Jetty site))

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: 2

Report Details:

Lab ID	Particulars of supplied Sample	Parameters	Concentration	Test Method (APHA)
A-699	Water (Harbaria)	TOC (Total Organic Carbon)	21.9 mg/L	4310.B
A-700	Water (Project Jetty site)	TOC (Total Organic Carbon)	26.4 mg/L	4310.B

08.10.18 — Analyst — A.H.M. Shofiul Islam Molla Jamal, Scientific Officer, Institute of National Analytical Research & Service (INARS), BCSIR, Dhaka

08.10.18 — Section/Division In-Charge — শামীম আহমেদ

08-10-2018 — In-Charge/Director — Md. Aminul Ahsan, Director (Addl. Charge), Institute of National Analytical Research & Service (INARS), BCSIR, Dhaka.

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BANGLADESH COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH(BCSIR)

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

Analysis Report

Analytical Service Cell Ref No: Aug2018011773
Lab ID: INS-701 to 702
Sample ID: A-701 to 702

Unit (Lab/Inst.) Ref No: A-701 to702
Sample Receiving Date: 16/08/2018
Submission Date: 16/Aug/2018
Report Delivery Date: 11/09/2018

Sample Description: Sample (Akram point, Mongla confluence)

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: 2

Report Details:

Lab ID	Particulars of supplied Sample	Parameters	Concentration	Test Method (APHA)
A-701	Water (Akram point)	Oil and Grease	Less than 5 mg/L	5520.B
A-702	Water (Mongla confluence)	Oil and Grease	Less than 5 mg/L	5520.B

11.09.18
Analyst
A.H.M Shofiul Islam Molla Jamal
Scientific Officer
Institute of National Analytical Research & Service (INARS)
BCSIR, Dhaka

11.09.18
Section/Division In-Charge
শামীম আহমেদ

11-09-2018
In-Charge/Director
Md. Aminul Ahsan
Director (Addl. Charge)
Institute of National Analytical Research & Service (INARS)
BCSIR, Dhaka.

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

Analysis Report

Analytical Service Cell Ref No: Aug2018011771
Lab ID: INS-697 to 698
Sample ID: A-697 to 698

Unit (Lab/Inst.) Ref No: A-697 to 698
Sample Receiving Date: 16/08/2018
Submission Date: 16/Aug/2018
Report Delivery Date: 10/10/2018

Sample Description: Sample (1.Project Jetty Site, 2. Harbaria)

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: 2

Report Details:

Lab ID	Particulars of supplied Sample	Parameters	Concentration	Test Method (APHA)
A-697	Water (PAH) Sample: 01, Project jetty site	Oil and Grease	Less than 1.0 mg/L	3114.C
		TOC (Total Organic Carbon)	19.5 mg/L	4310.B
A-698	Water (PAH) Sample: 02, Harbaria	Oil and Grease	Less than 1.0 mg/L	3114.C
		TOC (Total Organic Carbon)	25.1 mg/L	4310.B

10.10.18
Analyst
Md. Abu Bakar Siddique
Scientific Officer
Institute of National Analytical Research & Service (INARS)
BCSIR, Dhaka

10.10.18
Section/Division In-Charge
শামীম আহমেদ

10-10-2018
In-Charge/Director
Md. Aminul Ahsan
Director (Addl. Charge)
Institute of National Analytical Research & Service (INARS)
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Institute Name: Institute of National Analytical Research & Service (INARS)

Analysis Report

Analytical Service Cell Ref No: Aug2018011771

Lab ID: INS-697 to 698

Sample ID: A-697 to 698

Unit (Lab/Inst.) Ref No: A-697 to 698

Sample Receiving Date: 16/08/2018

Submission Date: 16/Aug/2018

Report Delivery Date: 10/10/2018

Sample Description: Sample (1.Project Jetty Site, 2. Harbaria)

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: 2

Report Details:

Lab ID	Particulars of supplied sample	Parameters	Concentration (mg/L)	Test Method (APHA)

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BANGLADESH COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH(BCSIR)

A-697	Water (PAH) Sample: 01, Project jetty site	Acenapthylene	ND	6440.B
		Anthracene	ND	6440.B
		Benzo(A) Anthracene	ND	6440.B
		Benzo(A) Pyrene	ND	6440.B
		Benzo(B) Fluoranthene	ND	6440.B
		Benzo(G,H,I) Perilene	ND	6440.B
		Benzo(K) Fluoranthene	ND	6440.B
		Chrysene	ND	6440.B
		Dibenzo(A,H) Anthracene	ND	6440.B
		Fluorene	ND	6440.B
		Phenanthrene	ND	6440.B
		Pyrene	ND	6440.B
A-698	Water (PAH) Sample: 02, Harbaria	Acenapthylene	ND	6440.B
		Anthracene	ND	6440.B
		Benzo(A) Anthracene	ND	6440.B
		Benzo(A) Pyrene	ND	6440.B
		Benzo(B) Fluoranthene	ND	6440.B
		Benzo(G,H,I) Perilene	ND	6440.B
		Benzo(K) Fluoranthene	ND	6440.B
		Chrysene	ND	6440.B
		Dibenzo(A,H) Anthracene	ND	6440.B
		Fluorene	ND	6440.B
		Phenanthrene	ND	6440.B
		Pyrene	ND	6440.B

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BANGLADESH COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH(BCSIR)

Analyst	Section/Division In-Charge	In-Charge/Director
10.10.18	10.10.18	10-10-2018
Md. Abu Bakar Siddique Senior Scientific Officer Institute of National Analytical Research & Service (INARS) BCSIR, Dhaka	শামীম আহমেদ উর্ধতন বৈজ্ঞানিক কর্মকর্তা ইনস্টিটিউট অব ন্যাশনাল এনালাইটিক্যাল রিসার্চ এন্ড সার্ভিস (আইএনএআরএস) বিসিএসআইআর, ঢাকা	Md. Aminul Ahsan Director (Addl. Charge) Institute of National Analytical Research & Service (INARS) BCSIR, Dhaka.

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