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

23rd Quarter Monitoring Report

Monitoring Period: November 2019 - January 2020

May 2020

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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

Units

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

Units Conversion Table

General Units

1°C = 274.15 K=33.8° F

1 hectare = 10-2 km2 = 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/m3≈1 ppm (w/w)

1 mg/m3 = 1 µg /L

1 pascal = 1 N/m2= 0.01 millibar

1 square mile = 640 acre = 2.590 km2

Energy Units

1 GWyr = 8.76 x 109 kW

1 horsepower = 746 W

1 KWh = 3412 Btu

1 kWh = 859.85 kcal

1 KWh = 3.6 x 106 J

1MW=1000KW=106W

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 23rd quarterly monitoring report covers the recent status of EMP (Environmental Management Plan) implementation during construction stage as recommended in the EIA (Environmental Impact Assessment) study vide Memo No: DoE/Clearance/5062/2011 dt. 05/08/2013 and EIA report of Coal Transportation vide Memo No: DoE/Clearance/5532/2016 dtd.31/01/2018. Accordingly, CEGIS team carried out the monitoring activities covering every monitoring aspects as assigned in the ToR (Terms of Reference) and approval conditions from DoE along with valuable suggestions and recommendations from different national and international organizations. In other words, the aspects can briefly be addressed as monitoring of the Environmental Compliances and monitoring of the selected environmental parameters such as ambient air quality, noise level, water quality, land resource, traffic management status, water resources management status, chemical properties of river bed materials, agricultural resources monitoring, fisheries resources, Socio-economic monitoring, aquatic & terrestrial ecosystem monitoring and the Sundarbans Reserve Forest (SRF) health monitoring.

The progress of Project implementation includes construction of major components of power plant, development of internal road networks, jetty construction, mechanical development works etc. During this quarter, the environmental due diligence covers the Environmental Management System Action Plan, Occupational Health, Safety & Workers' wellbeing, Biodiversity and Sustainable Management of Natural Resources etc. The monitoring team investigated the environmental and social aspects of construction activities along with the implementation of EMPs as suggested in the EIA reports of both the Power Plant and Coal Transportation followed by the conditions from DOE. In addition, as an Environmental Monitoring agency, CEGIS recommended some measures as per suggested EMPs which were to be complied for ensuring environmental and social safeguarding of the study area.

The recommendations include the mandatory use of dust mask by the laborers, who works under high exposure levels, restriction on discharging of waste water from labor colony to the nearby water bodies and linking with the main drainage canal, limiting groundwater extraction, regular management of the saplings for greenbelt development, raising awareness among the workers for using appropriate PPEs, ensuring the aspects regarding worker's association and insurance, continuous occupational and health safety monitoring by the project proponent.

Moreover, all the aspects on Occupational Health and Safety Policies; Establishment of the grievance redress mechanism; Emergency preparedness and response plan; Fire safety plan; Stakeholder Engagement Plan etc. were found working properly during the monitoring tier. No fatalities or incidents were recorded in this quarter as the EPC contractor put their prime concern over minimizing the accidental events through strengthening the OHS department; arranging robust training sessions for workers/drivers/operators/supervisors; employing lockout/ tag out procedures; regular inspection of all machineries, equipment and tools; blocking off areas for running heavy machinery or vehicles and establishing effective water sprinkling system.

All the measured values of the parameters for all locations were found well below the standard limit set by ECR' 2005. No significant changes were observed among the concentrations of air pollutants for the corresponding locations. It can also be noted that, the concentrations of major air pollutants were found comparatively lower in the Sundarbans area than that of other

monitoring locations. However, according to the measured values, it can be said that the present air shed is not a degraded air shed as no significant exceedances or variation has ever been recorded among the concentrations of criteria pollutants

However, the measured noise levels were not found to be exceeded the Bangladesh standard limit of noise level at eight (08) locations out of eleven noise level monitoring locations during this monitoring period. Of the three locations where noise levels wrere found exceeded the permissible limit are: (i) Chunkuri-2 (Bajua) located 4 km away from the chimney location on the Southwest having commercial activities, which have noise influencing potential; (ii) Moidara and (iii) Shapmari both are located close to the project site and these locations were also found to be exceeded the permissible limit of noise level as the background noise levels of those locations may be influenced by the construction activities.

The physico-chemical properties of Passur River water quality is highly influenced by tidal effects which further depends on seasonality, upstream flow and catchment water discharge. During this 23rd quarterly monitoring period (February, 2020), physical conditions of the Passur-Sibsa RS (River system) were found fairly healthy except some normal fluctuations in the concentrations of parameters at some sites. TDS, TH and TSS were found compatible to national and international standards but COD was found higher in all the monitoring sites except at South west corner of the project site i.e. at Maidara River. Possible reasons could be the effect of sediment loadings and higher nutrients contributed by the Bay of Bengal. Nitrate (NO_3^-) and Phosphate (PO_4^{3-}) were found within a standard range in respect to a natural river course. In case of metal pollution, no variations were recorded for Arsenic (As), Lead (Pb) and Mercury (Hg) concentrations and even no issues as well. Oil and grease concentration was found less than 2.0 mg/L, which is far below the recommended concentration (10.0 mg/L) for Inland Surface Water as per ECR, 1997.

On the other hand, the status of physical properties (February, 2020), chemical and presence of heavy metals (November, 2019) were also observed in the collected groundwater samples. The results showed that the physical properties of groundwater quality was still in good condition and within the acceptable range for drinking purpose. Saline water infiltration due to excessive withdrawal of groundwater by the surrounding communities during the dry season might be considered as one of the major reason of groundwater salinity in this area. In addition, evaporation is also responsible for such slight salinity in groundwater. Chemical characteristics of the groundwater quality were also found suitable as per Drinking water standards, ECR'1997. The observed groundwater was also found completely free from the heavy metal pollution As, Pb and Hg.

In course of agricultural soil quality, the analyzed data showed an increased concentration of Na at all the monitored locations which ultimately affect SAR and ESP. The soil sampling was carried out immediately after the tropical cyclone BULBUL which might be a reason of such increased concentration of Na in soil. Increase in SAR and ESP create favorable conditions for metal mobilization. Similarly, the Lead concentration increased at four locations (Baranpara, Kapaliermet, Biddyarban and Chakgona) which were found higher than that of dry seasons. Less washout during rainy season might play another role behind this fact.

Traffic surveys were carried out at three preselected locations in order to understand the nature of traffic flow and traffic load for enhanced construction activities of Power Plant. Traffic nature at all the three surveyed location were found similar to that of earlier monitoring findings during this monitoring tier. The survey results showed a slightly lower traffic load than the earlier period of monitoring which further reveals that the Khulna-Mongla Highway received

the largest number of vehicles compared to the other surveyed roads. It was also observed that the vehicular movements during the survey were mostly for regular activities of the surveyed region and construction activity of the MSTPP contributed a limited number of vehicles on the surrounding road networks.

Fisheries resources monitoring was carried out at the preselected 13 sampling sites which were set at the inception stage. Out of these sites, effective samplings were done at ten (10) sites as fishing activities for the remaining three (3) sites in the river were not observed. Amongst the effective sites, seven (07) were in the river (captured fisheries) and three (03) were in the country side (shrimp farms i.e. cultured fisheries). The observed changes in habitat uses in every past fiscal year along with the current one (as compared to the fiscal year of 2014-2015, 2015-2016, 2016-2017, 2017-2018 and 2018-2019) might be due to the biophysical changes in water bodies which could be characterized by tidal effect, forest erosion and vegetation coverage, seasonality, food availability and also fisheries management practices.

Moreover, through analyzing the type of habitat uses by different age group of fish species (based on the length-based community structure model) three types of habitats were found i.e. i) nursery ground, ii) spawning ground and iii) ground for maturation and feeding. Shannon-Weiner diversity index was also observed to be varied in this 23rd quarterly period as found for all previous quarters. Highest Shannon-Weiner index was found for Charpunti (0.78 out of 10 species) indicating most evenly distribution of fish species. On the contrary, lowest evenness was found at Mongla Point (0.4). However, maximum FSR was found at Maidara site (n=12), while very low FSR was recorded at Bhodra Khal confluence (n=1). Fries of fin fish and shrimp were found widely distributed from middle stretches to the upper stretches (Chandpai to Chalna Point) as juveniles to adult age group were observed at Mongla, Maidara, Charaputia, Bhodra and Harbaria site of the Passur River system. Fish species like *Amadi* attained the maximum abundance among the migratory fish species as observed during this tier. Moreover, among migratory species *Poa*, *Paissa*, *Baila* and *Datina* were observed to migrate through long distances. On the other hand, the highest stocking rate in respect of Bagda was observed in Kapashdanga Gher followed by Rajnagar Gher and Chunkuri-2. In addition, the highest productivity was found at Mongla Point and the lowest productivity was recorded at Maidar River site. The present study also revealed that catch susceptibility was highest for Bepdi Jal (20 kg/haul).

In course of the ecological monitoring vegetation composition, plant diversity, vegetation canopy status, plant health, bird habitat status, dolphin occurrence in river systems were monitored for this monitoring season. A total of 54 tree species were recorded from all the monitoring sites with a Shanon-Winner diversity index of 3.98. Canopy status of all studied homestead vegetation were found unchanged comparing to the same corresponding seasons of monitoring period except for one site where effects of Cyclone Bulbul are still observable. Plant health also remain unchanged in most of the locations. Population of local Migratory birds reduced due to changes in land use practices.

Dolphin occurrences were recorded at Passur and Maidara River and at some connected tributaries of Passur River like Shella Gang, Dhangmari and Bhadra Khal. The occurrence was found higher at Bhadra Khal and Shella River than the other site. The highest encounter rate was recorded as 1.82 per Individuals/km/hour at Bhadra Khal.

Moreover, Sundarbans Forest Health Monitoring program was intended to understand the changes in status and patterns of forest trees and conditions of associated aspects along the

Passur River. The monitoring indicators included plant growth, tree regeneration, tree crown condition, tree damage, lichen communities, plant diversity, soil chemistry and plant physiology. It can be predicted in terms of seedling density, pneumatophores, crab hole, canopy cover and leaf area index (m^2 leaf area/m^2 ground area) that the forest condition is showing positive changes periodically except for some seasonal effects. Phenological changes were not seen in all Permanent Sampling Plots (PSPs). Om the other hand, sedimentation rate was found comparatively higher in Hiron point plot than the other plots. In addition, logging activities severely affected at the plant health at Koromjol and Hiron point. The complex species Sundari were found died in some of the part of Akram point and Koromjol plot. Height of Sundari species was recorded comparatively higher in Harbaria whereas Goran species were found dominant in Akram point. It can be noted that, the Akram point is situated at the confluence of Shibsa and Passur River and is subjected to excessive erosion. About 45m area from the river side along the plot (2 quadrate of first subplot) were found already eroded. However, during tidal inflow the forest floor carries large amount of sediment than other locations and as a result the number of seedling were recorded almost zero in Akram point as this plot is experiencing retrogression process where the climax species are started decaying. Furthermore, in course of socio-economic monitoring the project authority stated that they required skilled or semi-skilled labor but were not sufficient comparing to the demand. In this aspect, the BIFPCL authority made some plans through which they could get skilled labor from the locality. As a result, they took initiative to sign an MoU with the Bangladesh Industrial and Technical Assistance Center (BITAC) to offer different courses (i.e. electronics, electrics, welding etc.) in order to engage future professionals from the local areas.

Labor sheds were found clean and the workers were found satisfied with the concurrent adequate toilet facilities, kitchen, waste management, drainage, and drinking water and supply water facilities. Dust suppression activities and measures taken for minimizing sound pollution were found adequate as the authority put more emphasize on water spraying systems and decrease the number of working hour during the night shift. For making green belt around the project site, the authority planned to plant about two lacs of trees of local species. It was reported that about 65,000 plants were planted and monitoring was continued to avoid high mortality rate of plants.

The CSR activities have been continuing by the project authority. Till 23rd Quarterly Monitoring, a total of 51,946 people have got free medical treatment services from different campaigns organized by the BIFPCL. In the winter season, they have distributed about 4,500 pieces of blankets to the poor and destitute people as a part of their CSR activities. Besides, about 211 persons have received training on sewing, and about 215 persons have received computer literacy skill development training, which have been supporting the local people in developing their efficiency to the semi-skill level.

1. Introduction

1.1 Background

As per the scope of works, the environmental components, social indicators and the implementation status of EMP (Environmental Management Plan) during the construction phase of 2x660 MW Maitree Super Thermal Power Plant are being broadly monitored. As an independent environmental monitoring team, CEGIS was engaged for conducting the said activities in accordance with the EIA approval condition no. 32 and Coal Transportation EIA approval condition no.17.

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 located at about 23 km south from the Khulna City and near about 14 km from the north-west direction of nearest tip of the Sundarbans (considering the proposed chimney location). Location of the study area along with the distance from 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 (**Figure 1.2**)**.** According to the contract, the findings of the previously formulated quarterly monitoring reports have been submitted to BIFPCL. The current document constitutes the 23rd quarterly monitoring aspects covering all the preselected monitoring parameters and locations.

Monitoring of environmental parameters and associated data collection are being continued considering the spatial as well seasonal variation. The duration of the 23rd Quarterly Monitoring Period is November, 2019 to January, 2020, which signifies a part of the winter season. It was supposed to conduct the monitoring activities within the said months. CEGIS Monitoring Team has carried out the monitoring activities in winter season in early February, 2020 instead of January, 2020 due to the unavailability of the sea going vessel as tourism is vigorous in the season. This is to note that the collected data completely covered for the corresponding winter season.

1.2 Objectives

The prime objectives of the study are:

- to monitor the important environment and social parameters during construction phase of the Power Plant and
- to monitor, the environmental compliances regarding EMP implementation during Power Plant's construction works and associated activities.

1.3 Criteria for Selection of Monitoring Sites/Locations

The monitoring sites have been selected considering the sensitivity and the ambience of the surroundings likely to be impacted from the Project related activities which includes-

- Wind speed and direction, sensitive receptors in and around the vicinity of the Project site (to monitor the ambient air quality). Potential noise generation sources

are also identified and selected for noise level monitoring. Similarly, sites for water quality monitoring were selected considering the water resources (Maidara and other nearer water bodies, Passur River from Chalna to Hiron Point) likely to be impacted by the project activities.

- Potential locations for fisheries resources monitoring are considered considering the fish habitats, biodiversity, migration and production zones likely to be impacted by the project activities.
- Monitoring locations for ecosystem and biodiversity, Soil and land resources were selected considering the induced impacts of the Project related activities on the project surrounding areas.
- Monitoring of socio-economic conditions of the PAPs (Project Affected Peoples) and project surrounding communities are being carried out on the basis of their circumstances likely to be transformed and /or altered by the project activities.
- Locations for Sundarbans Reserve Forest (SRF) Health Monitoring were selected considering the potential access routes of coal transportation through Sundarbans Forest area and associated activities for different phases of the power plant development and operation which might have significant effects on Sundarbans's flora and fauna.
- Monitoring aspects for Environmental compliances regarding EMP implementation status in and around the project area has been set as per suggestions made in the EIA reports and approval conditions from DoE for ensuring environmental sustainability and social acceptability.

Figure 1.1: Location Map of the Study Area

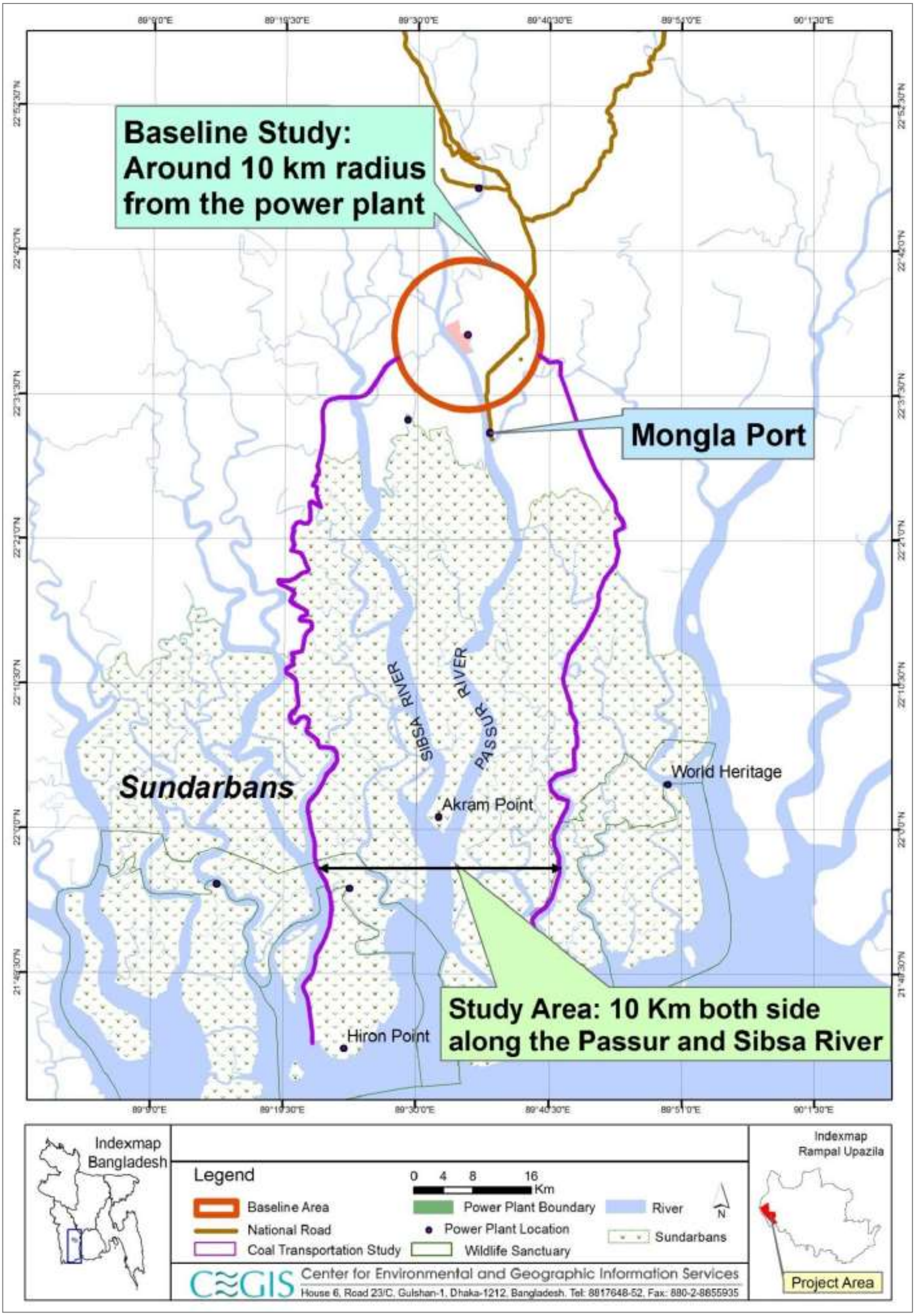


Figure 1.2: AOI of Environmental and Socio-economic Monitoring

1.4 Main Stakeholders

1.4.1 Forest Department

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

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

However, BIFPCL forwards each copy of the earlier quarterly monitoring reports to the Chief Conservator of Forest, Bangladesh Forest Department, Agargaon, Dhaka and Conservator of Forest, Khulna Circle, Boyra, Khulna. Similarly, the report of 23rd quarterly monitoring will also be forwarded to the same officials of the corresponding Departments.

1.4.2 Department of Environment (DoE)

The monitoring plans, indicators, parameters, location have been selected and arranged by incorporating the suggestion(s) and approval condition(s) from both the Power Plant EIA study and Coal Transportation EIA study. The BIFPCL forwards the monitoring reports and data to DoE on a regular basis (Monthly and Quarterly). The monitoring reports are also presented to the Environmental Clearance Committee of the DoE during renewal of the site clearance. In addition, one representative from the local DoE office is involved in each monitoring visit to accompany the monitoring team.

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

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

1.4.4 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), Key informant interview(s) and other informal discussions with the local people in different locations of the project influenced area.

1.4.5 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 covers monitoring of air quality, noise level, water quality, Soil and land resources, traffic management and the morphological study;
- Biological environment covers monitoring of fisheries resources, ecological resources and the Sundarbans Reserve Forest (SRF) health conditions;
- Socio-economic environment covers compensation, resettlement/rehabilitation, project related employment generation, labor and working condition, community health, security and safety, along with corporate social responsibilities.
- Environmental compliances monitoring includes Monitoring of Environmental and Social Management System Action Plan Implementation; Labor and working conditions; Community health, safety & security and Monitoring of biodiversity and sustainable management of living natural resources in and around the project area.

2. Physical Environment

2.1 Air Quality

The air quality parameters and locations were selected considering the major effects to be exerted by the Project activities during pre-construction, construction and operation stages. During the recent visit, all the preselected parameters and locations were monitored to see if any changes occurred due to concurrent construction activities of the project and construction supporting activities

2.2 Methodology

In general, Particulate Matters (i.e., $PM_{2.5}$, PM_{10}, and SPM), SOx, NOx, CO and O_3 are expected to be generated from the coal-based Power Plant activities at its different phases i.e. pre-construction, construction and operation. The monitoring locations as well as the indicators were selected during the EIA study based on a number of selected criteria e.g., the sensitivity of the receptors, project activities like movement of coal-carrying vessels, coal trans-shipment point; wind speed, wind direction, atmospheric deposition (Wet and Dry) and atmospheric stability classes etc. A comprehensive discussion on the recently assessed air quality is reported in the following sections.

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 key sources of air pollution to the Mongla Port Area and project site are: the cement factories, non-regulated mechanized boats, cargo vessels and ships and other commercial activities. The non-regulated ships, mechanized boats, cargo vessels plying through the Sundarbans Reserve Forest (SRF) in connection with the Mongla Port operation, fishing activities, honey, Golpata and timber collection, tourism, etc. may be big 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 the forest area. However, 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

Air quality is generally monitored at the fixed locations for each of the monitoring quarters. As per recommendations of DoE, two additional locations were included in the existing monitoring locations for this quarter. The air quality monitoring activities are shown in **Figure 2.1** and monitoring locations are shown in **Figure 2.2**. Details of the monitoring plan are attributed in **Table 2.1**.

Figure 2.1: Air Quality Monitoring in Shundarbans Forest Area

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 SO_X: 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 NO_X: USEPA (2000) Method 7, 7A, 7B, 7C, 7D, or ISO (1993) Method 10396 (as appropriate).
6		Pankhali, Dacope, (4km North West from the Chimney location)	89˚31'24.2"E; 22˚36'6.7"N		
7		Mongla Port Area	89˚35'50.4"E; 22˚28'24.8"N		
8		Harbaria, Sundarbans	89˚35'34.2"E 22˚17'43.1"N		
9		Akram point, Sundarbans	89˚30'54.1"E 22˚ '23.50"N		
10		Hiron Point, Sundarbans	89˚27'53.2"E; 21˚46'27.60"N		
11		Khulna city near Khan Jahan Ali Bridge	89˚35'35.5"E; 22˚46'36.8"N		
12		Project site-1 (Proposed Township area)	89º 33´ 13.7"E 22º35´43"N		
13		Access road bridge area	89°35'16.49" 22°34'37.11"N		

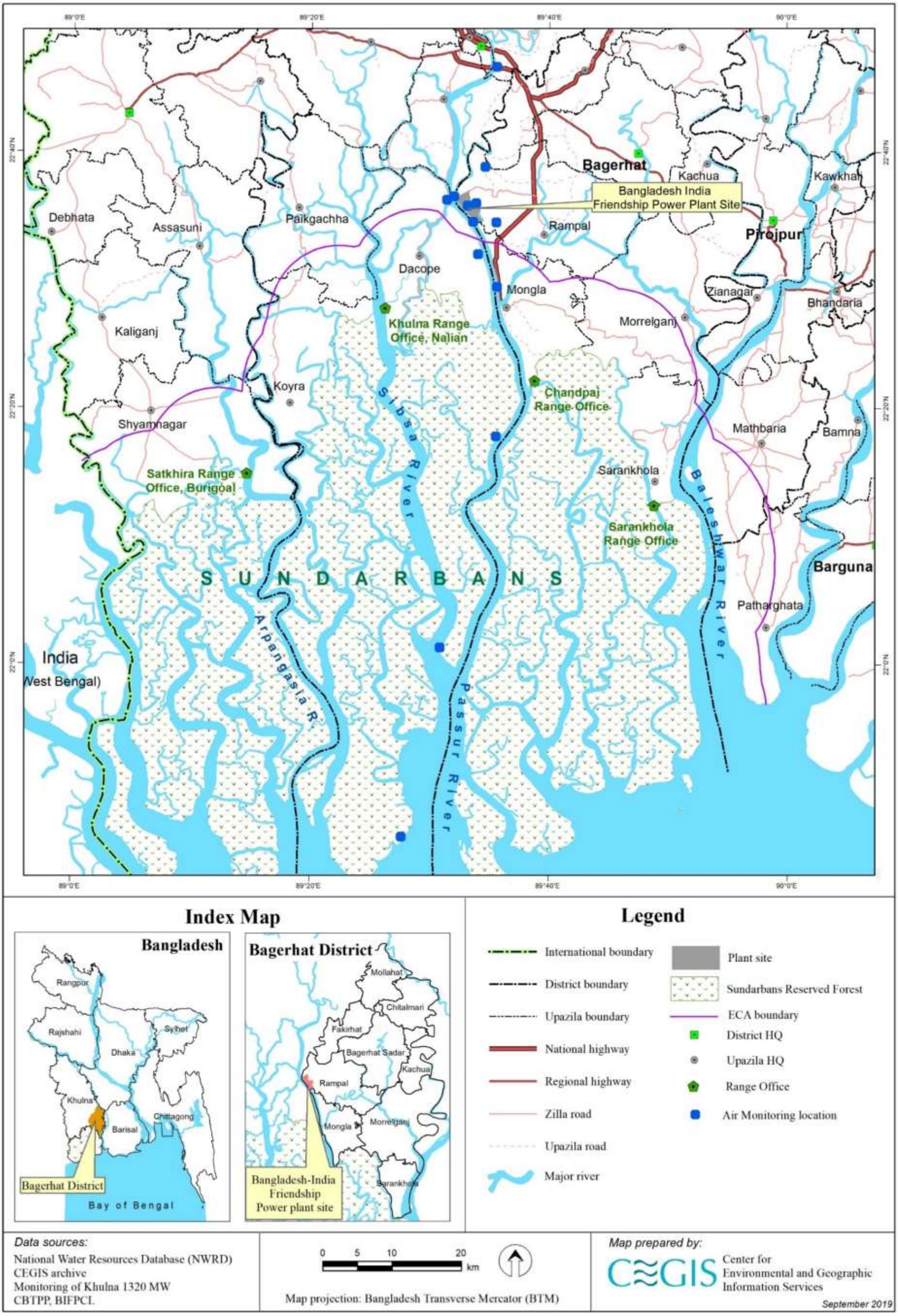


Figure 2.2: Air Quality Monitoring Locations

2.6 Status of Air Quality

In general, air quality is expressed in terms of the standards set forth for public health and welfare protection (against decreased visibility and damage to human being, animals, crops, vegetation etc.). The air quality status was assessed in this 23rd Quarterly Monitoring and the concentrations of the pollutants along with the air pollution emission standards are listed in **Table 2.2**.

The maximum value (44.26 µg/m^3) of $PM_{2.5}$ was found at Township area of project site whereas the minimum value (17.39 µg/m^3) was recorded at Hiron Point of the Sundarbans. All values for the corresponding sites during this season were found well below the standard limit (65 µg/m^3) set by ECR, 2005. On the other hand, PM_{10} concentration was found highest (127.52µg/m^3) at Chalna area and lowest (61.11µg/m^3) at Gaurambha area. Likewise, the $PM_{2.5}$, the concentration of PM_{10} were also found within the standard limit (150 µg/m^3). From the measured values, it can be mentioned that effect of seasonal variations on the surrounding environment may be the main reason for increasing/decreasing of the concentrations of the particulate matter for the corresponding air sheds. On the contrary, the concentration of SPM was found higher at Mongla Ghat area (173.36 µg/m^3) whereas, the minimum concentration (87.51 µg/m^3) was observed at Harbaria of the Sundarbans. The observed values were found within the standard limit (200 µg/m^3). Similarly, the concentration of Sulphur dioxide (SO_2) in ambient air were found much lower than the Bangladesh standard limit of (365 µg/m^3) at all the sampling locations. Among those, the maximum concentration (36.14 µg/m^3) was found at Bajua while the minimum concentration (13.33 µg/m^3) was recorded at Hiron point of the Sundarbans. Also, the values of NOx at Project site and its adjoining areas were observed below than the Bangladesh standard value of 100 µg/m^3. The maximum concentration (24.14 µg/m^3) during this monitoring period was found at Khan Jahan Ali bridge area whereas the lowest concentration (8.65 µg/m^3) was recorded at Hiron Point of the Sundarbans. However, emission from local human hauler, car, bus and industries like brickworks, cement works, iron and steel making, etc. are currently contributing to the concentration of SOx and NOx in the upstream areas.

During the monitoring time, the maximum value (44 µg/m^3) of CO was measured at Shapmari (North-East corner of the project boundary) area though the results were found much lower than the standard values set in ECR' 2005. The possible reasons for such CO concentration may be due to the movement of various types of vehicles across the Passur River and its adjoining areas as Carbon Monoxide (CO) is generally produced due to the incomplete combustion of fossil fuel. In addition, the measured values of O_3 both in the Sundarbans Forest Area and Project area were found within a range of 22 ppb to 2 ppb, which are negligible comparing to the Bangladesh standards limits of 157 µg/m^3. Seasonal variations among the concentrations of the parameters are provided in **Figure 2.3** and all the monitoring results are attached in **Table A1 of Appendix IV.**

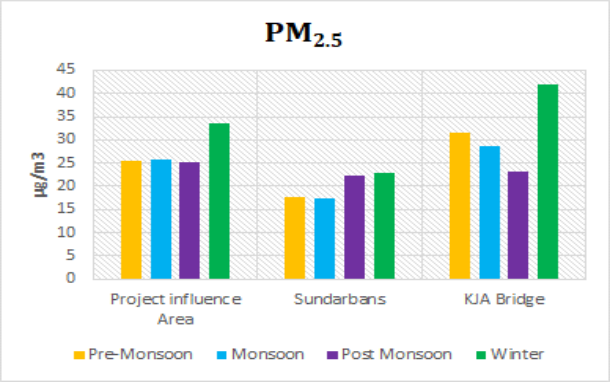
Table 2.2: Air Quality Monitoring Results (February, 2020)

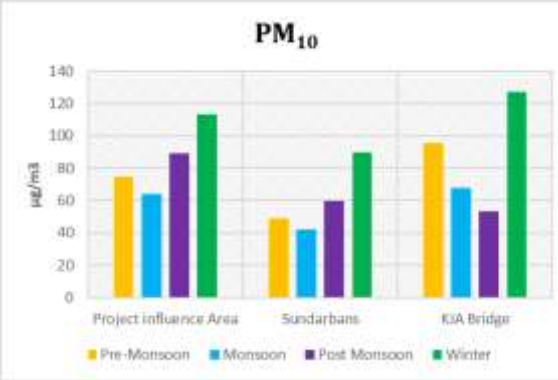
Sl. No.	Location	$PM_{2.5}$ (µg/m^3)		PM_{10} (µg/m^3)		SPM (µg/m^3)		SOx (µg/m^3)		NOx (µg/m^3)		CO (mg/ m^3)		O_3 (ppb)	
		Value	STD*	Value	STD*	Value	STD*	Value	STD*	Value	STD*	Value	STD*	Value	STD*
1	South West corner of the Project boundary (Maidara)	27.12	65	68.12	150	108.48	200	18.35	365	12.12	100	28	10	8	157
2	North-east corner of the project boundary (Sapmari)	19.14	65	83.22	150	106.35	200	27.41	365	18.77	100	44	10	9	157
3	North-west corner of the Project boundary (Kaigardaskati)	21.61	65	77.69	150	100.04	200	19.68	365	17.53	100	30	10	9	157
4	Barni, Gaurambha union (4km North East from the chimney location)	26.66	65	61.11	150	98.74	200	18.88	365	11.58	100	32	10	12	157
5	Chunkuri-2, Bajua Union (4km South West from the chimney location)	39.44	65	100.08	150	146.72	200	36.14	365	20.04	100	18	10	22	157
6	Pankhali (Chalna), Dacope, (4km North West from the Chimney location)	33.26	65	127.52	150	160.02	200	30.89	365	19.02	100	11	10	2	157
7	Mongla Port Area	38.92	65	119.61	150	173.36	200	31.33	365	13.34	100	29	10	4	157
8	Harbaria, Sundarbans	17.81	65	63.27	150	87.51	200	16.47	365	9.9	100	30	10	12	157
9	Akram point, Sundarbans	23.04	65	82.91	150	121.68	200	24.21	365	16.74	100	20	10	2	157
10	Hiron Point, Sundarbans	17.39	65	72.45	150	94.28	200	**13.33**	365	8.65	100	36	10	7	157
11	Khulna city near Khan Jahan Ali Bridge	40.22	65	116.16	150	157.28	200	28.31	365	24.14	100	32	10	10	157
12	Project site-1 (Proposed Township area)	44.26	65	122.73	150	171.29	200	34.12	365	21.72	100	18	10	4	157
13	Access road bridge area	26.26	65	91.39	150	126.13	200	16.16	365	9.04	100	22	10	6	157

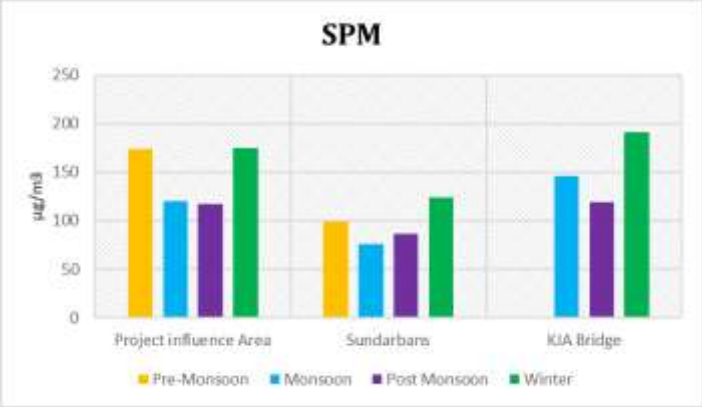
Source: CEGIS field survey

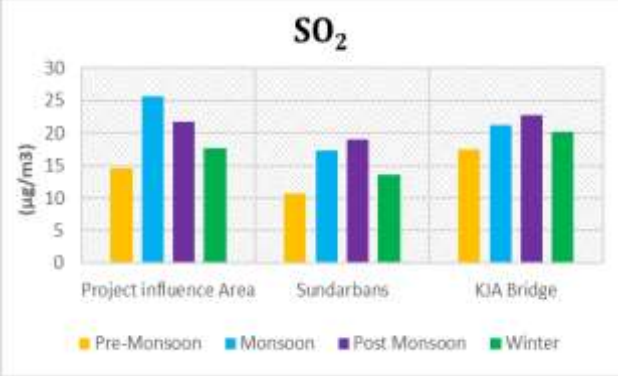
However, major sources of criteria pollutants in and around the project site as observed were the piling activities, digging, tunneling and burrowing works, jetty erection activities, major construction works, dust from unpaved roads and vehicle movement, construction materials, goods transportation, etc. Other sources of pollutants which may contribute to the existing pollution load are the small industries like brick kilns, cement works, etc., diffuse sources like wood stoves, fires, and wind generated dust etc.

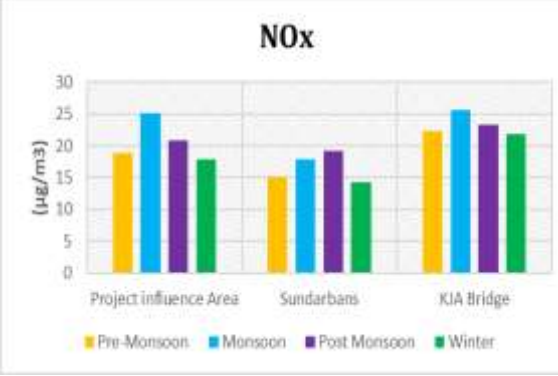
Findings of the previously monitored data with seasonal variation has been appended in the following section-











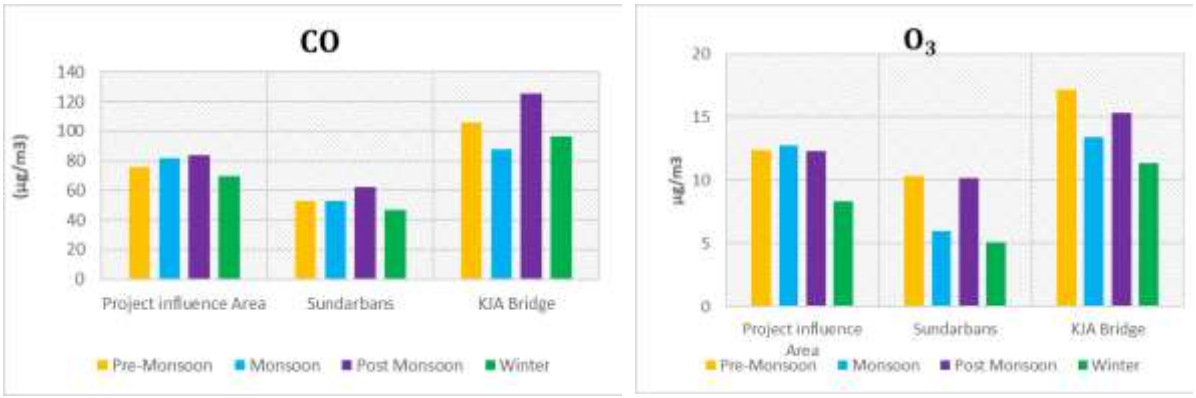


Figure 2.3: Seasonal Variation of the Air Quality Parameters

Cluster analysis was performed to identify the grouping pattern of the criteria pollutants along with their corresponding locations. Euclidean distances were observed to measure the distances among the objects using as variables (annual average concentrations of the seven studied variables for every station). According to the dendogram (Figure 2.) Hiron point (L10), Akram Point (L9) and Harbaria (L7) represents the locations of minimum pollution level situated inside the Sundarbans Forest area and are away from the nuclei of Mongla industrial zone. On the other hand, Chalna (L6), Mongla Ghat (L7) and Khan Jahan Ali Bridge in Khulna (L11) are subjected to higher in population density and increased industrial activities among all sites whereas moidara (L1), shapmari (L2), Gaurambha (L4) and bajua (L5) represent lower in population density and moderate commercial activities **(Figure 2.4).**

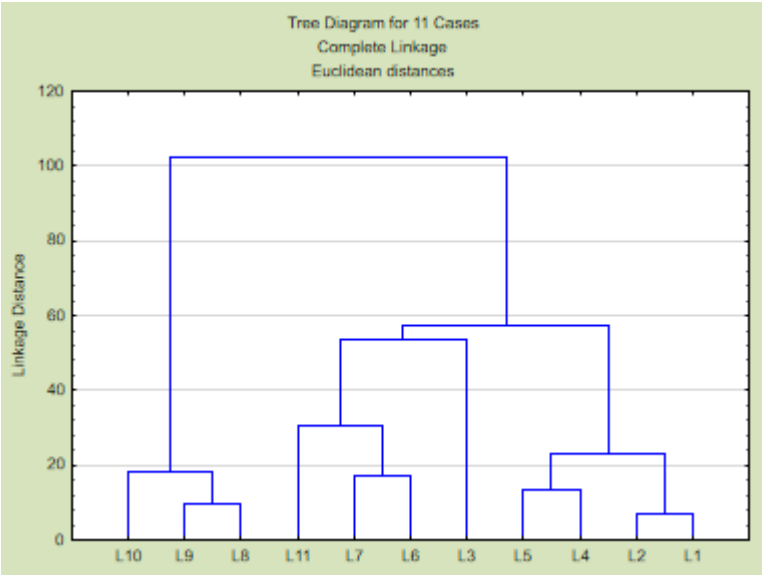


Figure 2.4: Dendogram of the Monitoring Stations using Euclidean Distance

2.6.1 Findings

All the measured values of the parameters for all locations were found well below the standard limit set by ECR' 2005. No significant changes were observed among the concentrations of air pollutants for the corresponding locations. It can also be noted that, the concentrations of major air pollutants were found comparatively lower in the Sundarbans area than that of other monitoring locations. However, according to the measured values, it can be said that the present air shed is not a degraded air shed as no significant exceedances or variation has

ever been recorded among the concentrations of criteria pollutants

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 (23rd monitoring program). Generally, the level of noise is monitored at eleven locations during every monitoring season. In this season, each of the locations was monitored.

2.7.1 Methodology

Noise levels were measured thrice in a day (morning, afternoon and evening) at eight (08) locations, twice at two (02) locations and once at one location 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 noise 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, 6 (six) sites were selected in and around the Project area, 3 (three) sites were designated inside the Sundarbans Reserve Forest Area, 1 (one) at Mongla Ghat area and the remaining 1 (one) was selected at the Khan Jahan Ali Bridge toll plaza area (**Figure 2.5**).

Figure 2.5: Ambient Noise Acquisition

2.7.2 Locations of Noise Level Monitoring

Out of eleven (11) locations, three locations were inside the Sundarbans, six locations were in and around the Project site, one was at Khan Jahan Ali Bridge on Rupsha River and the remaining one was at Mongla Port area (**Figure 2.6)**. A noise monitoring plan including monitoring locations, coordinates and time of monitoring is provided in **Table 2.3**.

Table 2.3: Noise Monitoring Plan

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

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 **TableC1, C2**, **C3, C4, C5 and C6** 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 54.59 dB (A) in this monitoring season which is 15.41 dB (A) lower than that of Bangladesh standard limit (70 dB). 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 as45.42dB (A) which was 9.58 dB (A) lower 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 55.44 dB (A) which was 0.44 dB (A) higher than that of Bangladesh standard limit. However, the observed noise sources were rural crowd, noise from river side homesteads etc. in this site.

South West corner of the Project area

The South West corner of the Project area is in MaidaraKhal of Rajnagar union. This area is a residential area and the standard limit of noise is 55 dB at day time (ECR, 1997). The level of noiseat this monitoring location in this season was found to be 55.60 dB (A) which was 0.60 dB (A) higher than that of Bangladesh standard limit. Frequent movement of water vessels over the Moidara Khal was one of the main reasons of noise generation.

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

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 Pollution (control) Rule, 2006]. The level of sound during this monitoring period was recorded as 48.95 dB (A) in this site which was 6.05dB (A)lower than that of standard limit.

Barni, Gaurambha

In terms of noise level analysis, this area can be characterized as ‘mixed zone’ having both residential and commercial characeristics and as per Noise Pollution (Control) Rules, 2006 the standard noise limit for this kind of mixed zone is 60 dB (A) at day time. The measured average Leq noise level was 61.97 dB (A) during this monitoring period, which is showing little exceedance [1.97 dB (A)] from the standard limit. This is to be noted here that there was no influence of construction site over the exceedance of noise level of the Barni Sampling Site.

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 62.20dB (A) which is 7.80 dB (A) lower than the Bangladesh standard limit of day time noise level for the corresponding category. The highway traffic was found to be the main source of noise generation. Besides, the site attracts local visitors for its scenic beauty which also creates a significant source of noise pollution in this area.

Mongla ghat area

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 as61.06dB (A) which was 13.94 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 transshipment of goods and commodities. The area is under the silent zone and the standard limit of ambient noise at daytime is 50 dB (Noise pollution control rules, 2006). The noise level was measured at a distance of 100 m (Inside the forest area) from the River bank and found as 43.94dB (A) during this monitoring period which was 6.06 dB (A) lower than that of standard limit. However, movement of ships, sound created by running engines of anchored ships and barges, transshipment activities, bird's chirping, wave breaking sound and wind action on tree leaves were observed to be the main sources of noise in this site.

Akram point, Sundarbans

Akram Point of the Sundarbans is another biodiversity hot spot in the Sundarbans. This area is under the silent zone and the ambient daytime noise standard is 50 dB (A). In this monitoring season, noise level was recorded at a distance of 100 m (Inside the forest area) from the River bank. The average day time ambient noise level during this monitoring season was observed as 36.59dB (A) which was 13.41dB (A) lower than that of Bangladesh standard value. However, Birds' chirping, stormy wind, wave breaking sound and falling of leaves from the trees were found as the main sources of noise.

Hiron point, 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 40.34 dB (A) during this monitoring season which was 9.66 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

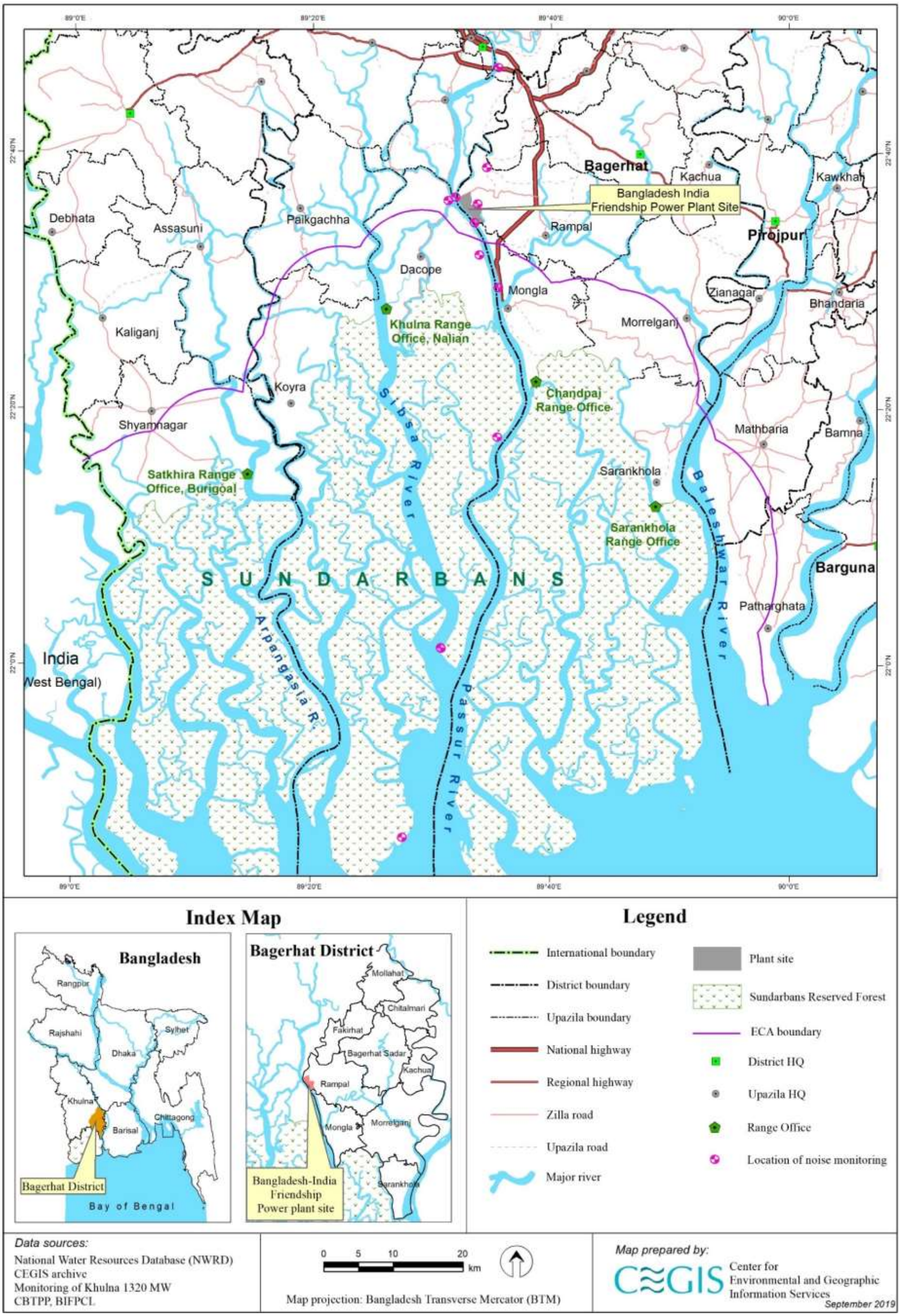


Figure 2.6: Noise Level Monitoring Locations

Table 2.4: Summary of the Ambient Noise Levels Recorded in Consecutive Monitoring Periods

Sl.	Location	Monitoring periods																							
		QM 1 (Apr-14)	QM 2(Jul-14)	QM 3 (Oct-14)	QM 4 (Jan-15)	QM 5 (Apr-15)	QM 6 (Jul-15)	QM 7 (Oct-15)	QM 8 (Jan-16)	QM 9 (Apr-16)	QM 10 (Jul-16)	QM 11 (Oct-16)	QM-12 (Jan-17)	QM-13 (Apr-17)	*QM-14 (Oct-17)*	QM-15 (Jan-18)	QM-16 (Apr-18)	QM-17 (jul-18)	QM-18 (Nov-18)	QM-19 (Feb-19)	QM-20 (Apr-19)	QM-21 (Jul-19)	QM-22 (Nov-19)	QM-23 Feb-20)	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	56.45	61.67	59.34	58.60	54.59	70
2	*NW Corner of the Project area (Kaigar Daskati)*	51.89	NM	41.92	35.25	44.67	41.56	41.94	50.96	50.79	52.65	55.48	44.52	47.19	46.95	49.3	47.90	45.63	58.82	50.75	56.85	55.18	51.11	45.42	55
3	*Chunkuri-2, Bajua*	57.76	52.55	51.39	49.29	47.05	40.66	47.43	53.62	44.49	53.4	51.55	55.31	50.44	50.44	51.4	52.93	47.54	48.69	50.18	51.68	59.36	55.27	55.44	55
4	*SW corner of the project area (Moidara)*	49.2	47.6	45.95	36.03	43.58	43.75	42.7	60.44	54.50	65.37	48.51	45.19	43.25	43.26	44.5	47.55	52.63	61.78	*55.79*	56.05	63.66	46.57	55.60	55
5	*Proposed Township area (Shapmari)*	48.75	46.68	41.92	41.47	41.47	46.75	50.52	53.77	53.37	55.79	43.69	42.62	42.65	43.93	53.3	50.81	44.25	50.68	*58.13*	58.83	54.53	54.88	48.95	55
6	*Barni, Gaurambha*	58.84	49.95	49.78	43.6	54.17	46.18	55.16	59.16	53.97	56.75	54.91	49.05	44.83	45.52	55.6	56.14	45.52	53.03	52.57	53.18	54.67	50.53	61.97	60
7	*Khan Jahan Ali Bridge, Khulna*	71.7	60.8	66.28	61.72	73.45	52.82	64.25	68.45	65.85	63.77	60.95	55.57	56.72	62.47	61.7	64.87	63.36	62.15	66.93	66.95	63.46	66.05	62.20	70
8	*Mongla Port area*	61.24	53.84	60.5	38.69	48.15	39.61	47.01	52.7	49.88	52.86	49.86	48.95	47.61	49.66	59.8	62.95	60.97	55.97	66.18	63.99	62.01	57.25	61.06	75
9	*Harbaria, Sundarbans*	40.88	56.13	55.3	34.38	65.37	35.03	50.75	45.2	44.55	52.9	55.33	41.18	54.10	46.48	44.4	47.93	50.28	48.80	49.67	48.43	44.90	44.10	43.94	50
10	*Akram Point, Sundarbans*	40.94	47.9	43.98	34.32	54.86	NM	49.6	42.95	42.95	47.96	41.77	38.08	44.30	42.38	40.1	45.39	45.20	41.00	46.45	42.33	44.84	44.86	36.59	50
11	*Hiron Point, Sundarbans*	38.63	51.29	47.98	37.37	47.84	NM	46.06	NM	43.11	NM	44.38	42.29	NM	39.79	38.8	NM	NM	39.4	39.21	NM	NM	40.28	40.34	50

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

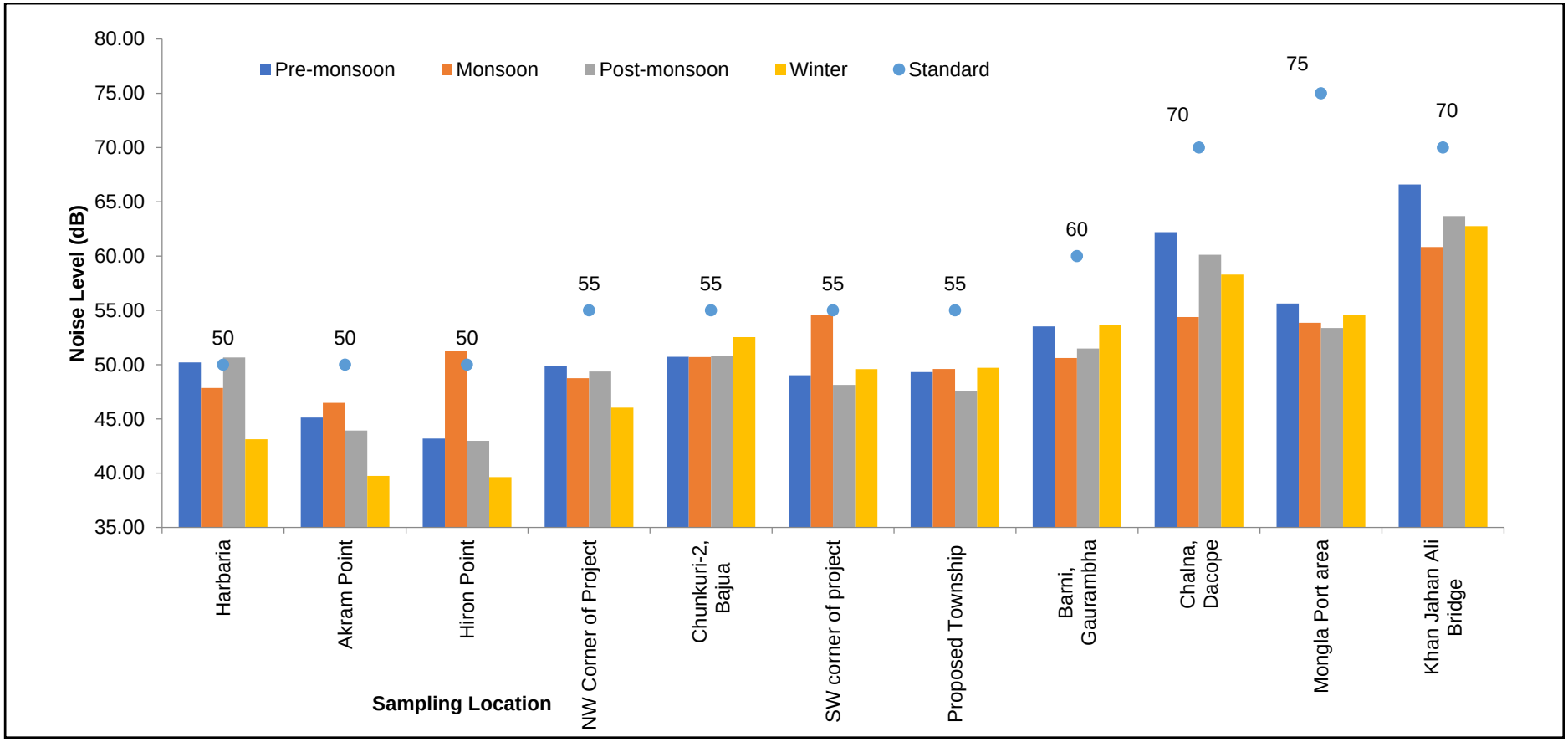


Figure 2.7: Status of Noise Level at the Monitoring Locations

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 eight locations during this monitoring (23rd quarter) season (Table 2.4). On the other hand, the observed noise level at Chunkuri-2 (Bajua) located at 4km South West direction from the chimney location, Moidara located at SW corner of the project area and Shapmari (Proposed Township area) were found to exceed the Bangladesh standard limit of standard values. In course of the total twenty-three monitoring seasons, the noise level of nine locations were found to exceed the Bangladesh standard limit of their corresponding standard values in their different monitoring seasons.

2.8 Water Quality

This section presents an updated water quality status of the Passur-Sibsa River system and adjacent waterbodies. Both national and international guidelines were followed to assess the water quality status during monitoring. This report includes results and corresponding analysis of selected water quality parameters of samples collected during 23rd quarterly monitoring (February, 2020). Several identical sites were selected to observe the quality of water those are potentially used by community, aquatic life, industries and eco-elements of the Sundarbans Reserve Forest ecosystem.

2.8.1 Methodology

The method followed for 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. The statuses of the surface and groundwater quality in and around the project site and the Sundarbans area were examined following standard methods of monitoring. The monitoring results have been presented graphically and checked if there is any exceedance from the national standards (ECR, 1997 and all available amendments).

Samples were collected from 18 pre-selected locations among which Fifteen (15) locations were for surface water along the Passur River (from Chalna to Hiron Pont), Maidara River with surroundings of the Project site and three (03) locations for groundwater across the study area as shown in **Figure 2.8**. The details of the monitoring plan covering sampling locations, geographical locations, frequency and analysis techniques of sampling for surface and groundwater are given in **Table 2.5** and **Table 2.6** respectively.

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

Sl no	Monitoring Indicators	Locations	GPS (Decimal Degree)		Frequency	Methods/Tools/ Techniques
			Easting	Northing		
1	pH, Temperature, Salinity, DO, BOD_5, TDS, TH, TSS, COD, Nitrate, Sulphate, Phosphate, Arsenic, Lead, Mercury, Oil & Grease	Left Bank of Passur River at 100m u/s of North West corner of the Project boundary	22.604167˚N	89.527222˚E	Quarterly	In-situ measurement (pH, Temperature, Salinity, DO) and Laboratory analysis (TDS, TH, TSS, COD, Nitrate, Sulphate, Phosphate, Arsenic, Lead, Mercury, Oil & Grease). BOD_5 were measured for an interval period of 5 days.
2		Middle of Passur River at 100m u/s of North West corner of the Project boundary	22.607222˚N	89.528889˚E		
3		Right Bank of Passur River at 100m u/s of North West corner of the Project boundary	22.609361˚N	89.531417˚E		
4		Left Bank of Passur River at Project Site-Jetty	22.584833˚N	89.543583˚E		
5		Middle of Passur River at Project Site-Jetty	22.587667˚N	89.546472˚E		
6		Right Bank of Passur River at Project Site-Jetty	22.589333˚N	89.548222˚E		
7		Left Bank of Passur River at South West corner of the Project boundary	22.572889˚N	89.552583˚E		
8		Middle of Passur River at South West corner of the Project boundary	22.574611˚N	89.557500˚E		
9		Right Bank of Passur River at South West corner of the Project boundary	22.575667˚N	89.559861˚E		
10		Maidara river at the South East corner of the project boundary at Ichamoti-Maidara confluence	22.600639˚N	89.565611˚E		
11		Maidara river near proposed Township area	22.577472˚N	89.569250˚E		
12		Passur river at Passur – Ghasiakhali confluence	22.473861˚N	89.602361˚E		
13		Passur river at Harbaria of the Sundarbans Reserve Forest area	22.295250˚N	89.593139˚E		
14		Passur river at Akram Point of the Sundarbans Reserve Forest Area	22.024120° N	89.514220°E		
15		Passur river at Hiron point of the Sundarbans Reserve Forest Area	21.774183°N	89.464778°E		

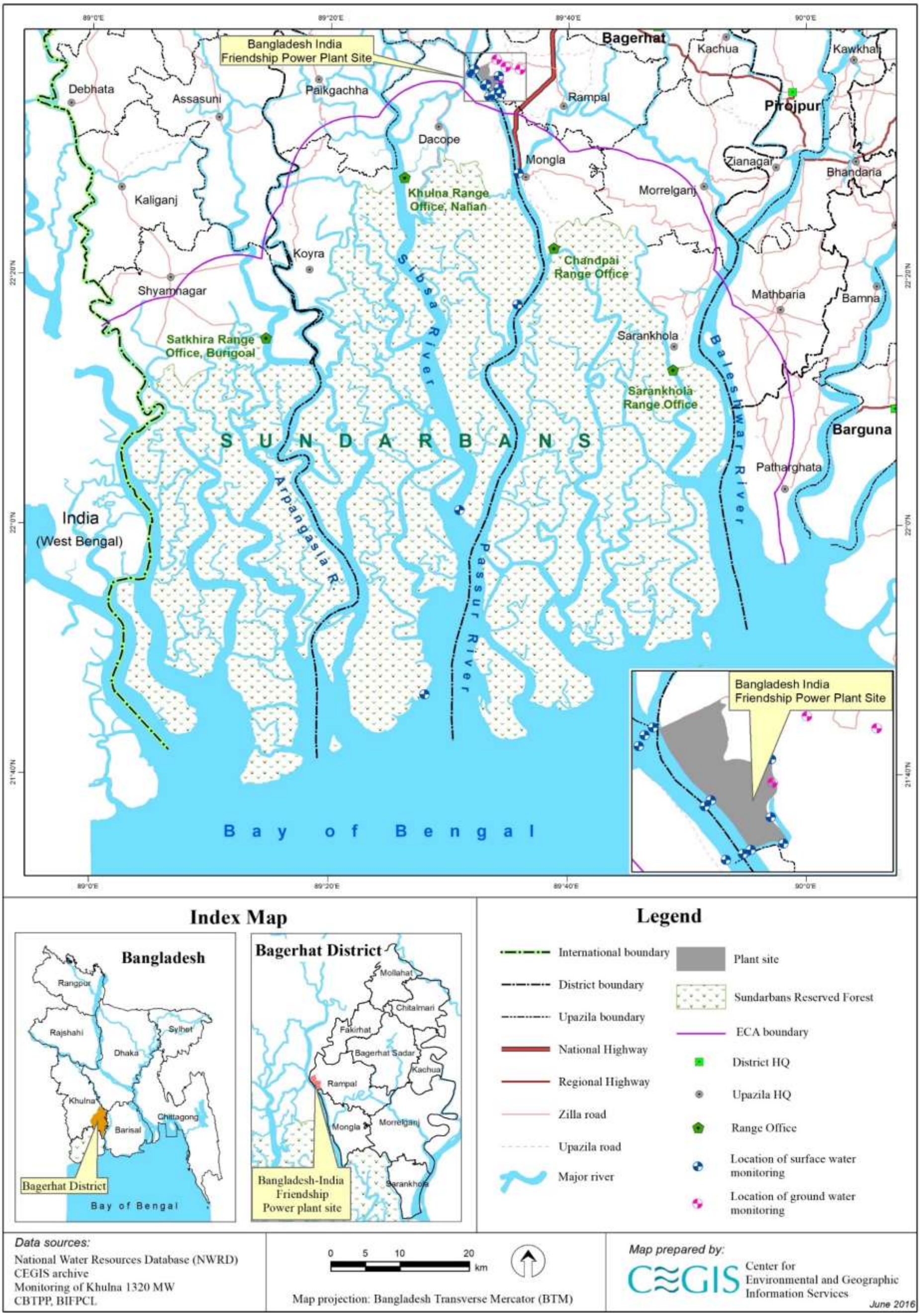


Figure 2.8: Surface Water and Groundwater Quality Monitoring Locations

Table 2.6: Groundwater Quality Monitoring Parameters, Locations and Plan

Sl No	Locations	GPS (Decimal Degree)		Frequency	Methods/Monitoring indicators/ Techniques
		Easting	Northing		
1	Near Proposed Township Area	89.566139˚E	22.594167˚N	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. However, one of the monitoring location (Kalekarber) has been found damaged since 2015. Hence, the corresponding data for this location were not collected.
2	Rajnagar	89.576056˚E	22.612528˚N		
3	Kapasdanga	89.563000˚E	22.622528˚N		

2.8.2 Selection of Parameters

Water quality parameters were selected based on potential impacts to be exerted during pre-construction, construction and operation phases of the 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 4 groups:

- Physical and aggregate properties i.e. pH, Temperature, Salinity, Hardness, TDS, TSS, Turbidity, Oil & Grease;
- Inorganic non-metallic constituents i.e., DO, NO_3^-, PO_4^{3-} and SO_4^{2-};
- Aggregate organic constituents i.e. BOD, COD and
- Heavy metals i.e. As (Arsenic), Pb (lead) and Hg (Mercury);

However, some additional parameters i.e. PAH (Polynuclear/Polycyclic 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 analyzed data of the additional parameters will be recorded and submitted to the DoE and other concerned authorities as per the condition no. 26 of the EIA approval of coal transportation study. Nevertheless, these three (03) additional parameters will be incorporated and discussed in the respective monitoring report (half yearly) after obtaining the analyzed results from the respective organizations (BCSIR and DPHE).

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

Standard sampling procedure was followed for both surface and groundwater monitoring to make the water quality status representative and accurate. From sampling bottle preparation to sample collection, preservation and transportation to the designated laboratory, every task was performed with appropriate procedures.

2.8.6 Surface Water Sampling Procedure

The study area is highly influenced by tidal variation. Hence, temporal and spatial variations of tides were considered in sampling procedure. Surface water samples were collected at a distance of 30-50m away from the riverbank and at a depth of 6 cm below the water surface during low tides or relative slag period after the low tide for all parameters except oil and grease. The non-acidified sampling bottles were rinsed with respective water samples before sampling and storing below 10^{o}C. Acidified sampling bottles were used for heavy metal (As, Pb, Hg) sample collection while wrinkle bottles were used for BOD_5. All samples were preserved as per standard procedure (**Figure 2.9**).

Figure 2.9: Water Sample Collection and insitu Testing of Water Parameters

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

Table 2.7: Testing Methodology of Water Quality Parameter

Parameters	Methods/Measuring Tools	Unit	BD Standard (ECR 1997)
Temperature	Horiba U-50 multimeter	^{0}C	20 - 30
pH	Horiba U-50 multimeter	-	6.5-8.5
TDS	Horiba U-50 multimeter	ppm or mg/L	2100 (SW), 1000 (GW)
TSS	Horiba U-50 multimeter	ppm or mg/L	150 (SW), 10 (GW)
Salinity	Horiba U-50 multimeter	ppt	-
DO	Horiba U-50 multimeter	ppm or mg/L	6
BOD_5	5-Day BOD Test at 20^{0}C	ppm or mg/L	50 (SW)
COD	Closed Reflux Method	ppm or mg/L	200 (SW), 4.0 (GW)
Total Hardness (as $CaCO_3$)	Titrimetric	ppm or mg/L	200-500
Ortho-Phosphate (PO_4^{3-})	UV-VIS Spectrophotometers	ppm or mg/L	6
Nitrate (NO_3^-)	UV-VIS Spectrophotometers	ppm or mg/L	10
Sulphate (SO_4^{2-})	UV-VIS Spectrophotometers	ppm or mg/L	400
Oil and Grease	Liquid-liquid extraction with hexane, treatment with silica gel and gravimetric determination	ppm or mg/L	10 (SW)
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 project area and the Sundarbans forests are being observed since April 2014. In this 23rd quarterly water quality monitoring report, yearly variations of Post-monsoon (October, 2019) for chemical water quality statuses and yearly variations in Winter (January 2020) for physical water quality statuses are presented and compared with the ECR' 1997 Standards. To do so, all sampling points are clustered in five different sampling sites considering homogenous characteristics of the sampling points as well as the type of ecosystem touching the sample points. The clustered sample monitoring sites and the logical explanation of the clusters are presented in the following **Table 2.8**.

Table 2.8: Monitoring Sites and Characteristics

SL	Monitoring sites	Site Characteristics
(a)	Project site & adjacent areas	In this monitoring site, total 11 sampling points have been averaged to represent the water quality status of project site and its adjacent surface water bodies. These 11 sampling points are situated in the same river system and located within 1 km radius of the project area. In addition, previous monitoring results were obtained from characteristically same sites. 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 situated at least 13 km downstream of the project site. This point is a confluence of the Passur river and the 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 situated around 15 km downstream of the Mongla-Passur confluence. This site is surrounded by the Sundarbans Forest. Huge activities of mother vessel unloading and loading of lighterage vessel and their movements for transporting clinker, coal and LPG gas are held in this place. This point has tidal influence.
(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 the Sibsa river before meeting with the Passur river at Sibsa point. This site is completely dominated by deep forest ecosystems. This point has tidal influence.
(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 results of water quality parameters for 23rd monitoring period (February 2020: Winter season) tested in in-situ level are described below**.**

pH

The 23rd Quarterly Monitoring was conducted in Winter in the month of February 2020. The monitoring result revealed that pH values ranges from 7.9 to 8.6. The lowest was found at Maidara River near Township area whilst highest was at South West corner of the project site. The result of this monitoring season showed consistency to that of previous Winter seasons (**Table B.1: Appendix-IV**).

Considering all monitoring quarters it is observed that the average pH value of the project site and inside the Sundarbans was 8.3. However, until now, pH value never exceeded the ECR' 1997 Standard (6.5-8.5 inland water quality standard and 6-9 for the project waste disposal) from an average point of view.

During post monsoon and winter season, overland run-off, river flow and water level normally reduced due to less rainfall and less inflow from upstream (u/s) of the Passur-Sibsa RS (River System). As a result, pH values increased than those of the pre-monsoon and monsoon seasons, which is 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 post-monsoon is

characterized by some rains in August while rainfall in January is normally zero.

Fluctuations in pH values during different seasons of the year can be attributed to factors like; removal of CO_2 by photosynthesis through bicarbonate degradation, dilution of waste with freshwater, reduction in salinity and temperature, and decomposition of organic matter (*Rajasegar, 2003*). Seasonal variations in pH concentrations among the selected monitoring sites during quarterly monitoring programs of first, second, third, fourth, fifth and sixth year of the Passur-Sibsa RS are presented in **Figure 2.10** and the observed dataset are attached in **Table B.1 of Appendix- IV**

Temperature

In winter period, surface water temperature is usually low and averagely it is 24^{o}C in the coastal area. For the last winter monitoring seasons, water temperatures in the observed area reflected the same (**Figure 2.11**). The range of water temperature was 22-25 ^{o}C. Near around the project site, the average water temperature was recorded at 25 ^{o}C while in the further downstream it became 23 ^{o}C. This variation in temperature occurs due to coverage of dense forest inside the reserve forest than the exposed areas of the project site adjacent point.

As per ECR, 1997; 20-30^{0}C water temperature is favorable for the aquatic organisms in tropical environment. It can be concluded that, construction works did not influence winter water temperature 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.

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

Salinity

In a tidal river system, range of salinity fluctuation is usually high. This situation, therefore, also becomes true for the Passur-Sibsa RS in South West Bangladesh. In the last winter, salinity ranges between 0.1 ppt to 11.0 ppt. The average salinity near the project site was found around 3.5 ppt. In the same area, river salinity increased to around 10.0 ppt in the same season of 2019. However, results of river water salinity for other seasons in other quarters were found compatible with the 23rd quarter monitoring result of this point. In contrary, water salinity was found higher in deep reserve forests (6.8 ppt on average). The maximum salinity was observed inside the Sundarbans at Hiron Point as having complete seawater influence.

Salinity concentration is found to be the highest in the Winter and increased the concentration in ascending order from the post-monsoon. Salinity concentrations also showed temporal variations even in the same season. However, it was observed that fluctuations in salinity level were not really related to any of the activities regarding construction of the power plant. It could be the result of the variation of the observation period compare to the other winter season's observations.

In the monitored river systems, the highest salinity was observed in pre-monsoon season followed by winter season. Reduced or unavailability of upstream freshwater flow and

dominant tidal actions are considered as major factors of high salinity concentration in pre-monsoon and winter seasons. The water salinity data in the selected sampling stations of the Passur-Sibsa RS of the six consecutive monitoring years are presented in **Figure 2.12** and all the observed dataset are attached in **Table B.3 of Appendix- IV.**

Dissolved Oxygen

Dissolved oxygen concentrations in river water varies frequently. In tidally influenced river, DO containing capacity depends on its nutrient availability along with its tides. In addition, wind speed in coastal areas also a big factor for DO. In an ideal situation, more than 5.0 mg/L of DO should be available in a river (ECR,1997). In the last monitoring, DO was observed in the range of 6.9-8.6 mg/L. There were spatial variations in DO concentrations in the study area. However, DO levels of the observed sites were not found to be lower than recommended concentrations that are required by the aquatic lifeforms. The average DO level was found 8.0mg/L both in the project site and Sundarbans forest.

Lower concentration of DO than the permissible limit (ECR' 1997) primarily causes harm to the aquatic organisms (plankton) and then to the fish community. DO level of the Passur-Sibsa RS was found comparatively higher than that of any other previous winter season observations. This change of increasing DO level occurred may be due to occurrence of sudden rainfall in conjunction with fullest level high tide.

In case of seasonal variations, maximum concentrations were observed during monsoon and post monsoon season. Presence of higher DO level in monsoon and post-monsoon season basically depends on heavy rainfall and freshwater availability. During winter, high salinity increases the temperature, which in turn reduces the holding capacity of DO in water. However, still the DO concentration of the 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).

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

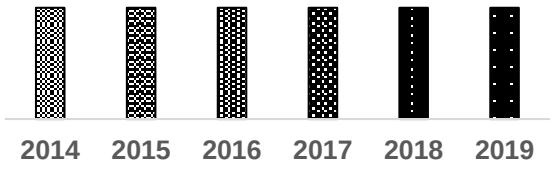


Figure 2.9: Legend Direction (left to right: 2014-2019)

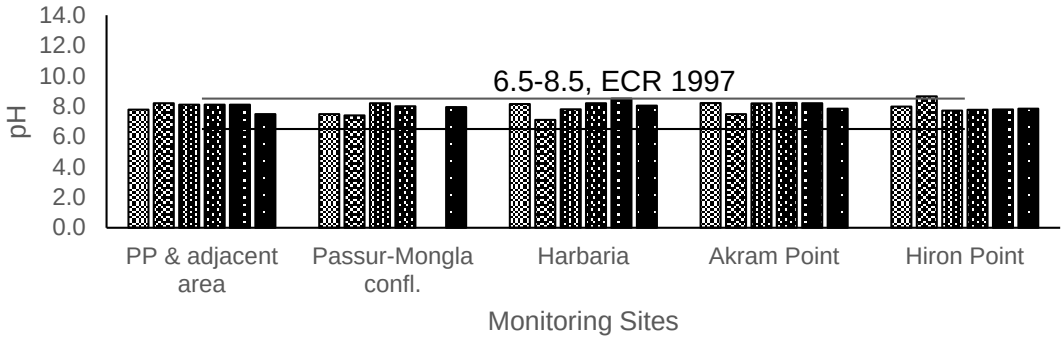


Figure 2.10: Variations in Winter pH Values in Different Monitoring Sites

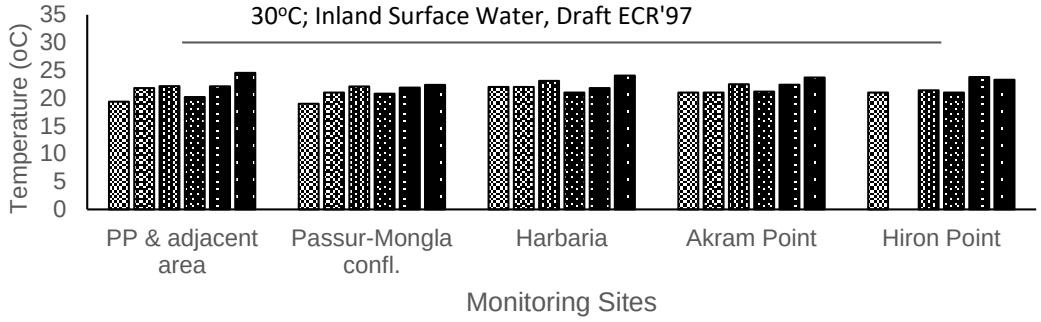


Figure 2.11: Variations in Winter Temperature in Different Monitoring Sites

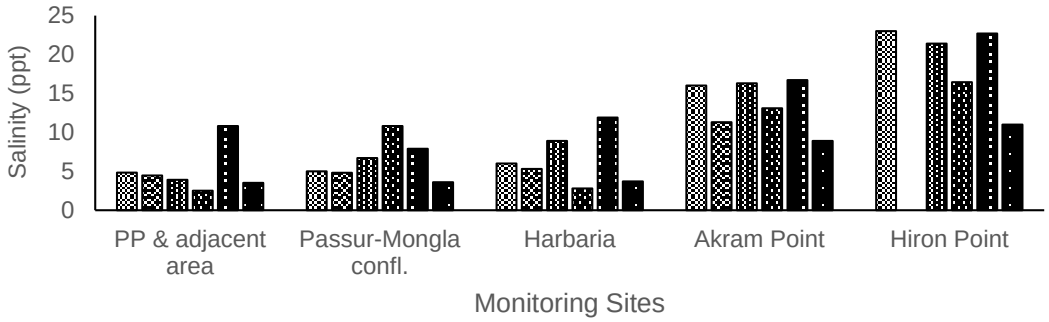


Figure 2.12: Variations in Winter Salinity in Different Monitoring Sites

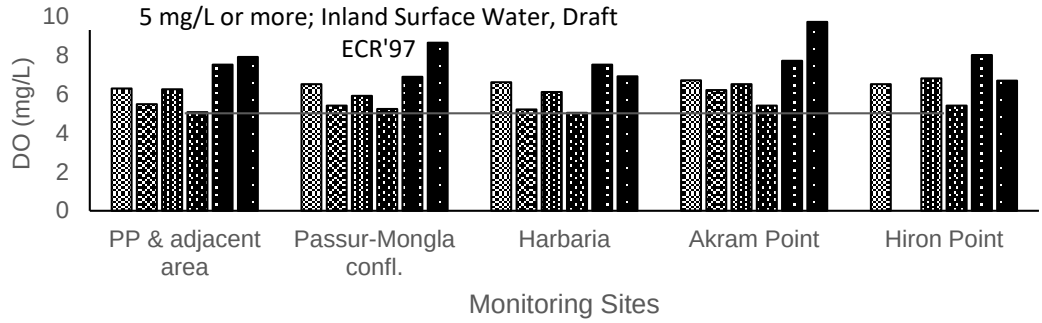


Figure 2.13: Variations in Winter DO in Different Monitoring Sites

Laboratory tested parameters

The laboratory tested results obtained up to November 2019 i.e., Post-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 compounds like ammonia, nitrate, phosphate, alkalis, some acids, sulphates and metallic ions etc., which comprise both colloidal and dissolved solid states in water (*Tareq M S et al., 2013*). During the last post-monsoon period, the TDS concentrations were in the range of 172-1405 mg/L near the project site and 4000-6000 mg/L in the Sundarbans Reserve Forest areas (**Figure 2.15**) respectively. The average results of TDS were always showing the same pattern except the post monsoon season of 2018. TDS of Hiron Point was found around 12,500 mg/L in the previous post monsoon in 2018 which was almost 2/3 times higher than that of other seasons' observed data (4,120-5,830 mg/L).

In the Passur-Sibsa RS, TDS has both spatial and temporal variations. In pre-monsoon and winter, TDS is usually high because of low rainfall and tidal effects. The Bay of Bengal contains many minerals, which in turn contribute in TDS concentration to be high in 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 SRF. Regarding spatial variation, TDS concentration was observed in increasing level as progressing towards downstream of this RS. This is happened 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 nutrients, the higher the TDS and therefore higher occurrence of TH. Insufficient freshwater supply from upstream and low rainfall during winter and pre-monsoon period increase the nutrients concentration in the Passur-Sibsa RS. Seawater contains huge quantity of minerals including calcium and magnesium, which make the water hard.

In the last post-monsoon season, the TH was found to be in the range of 115-350 mg/L with an average concentration of 192 mg/L in the project site and 200-1225 mg/L with an average concentration of 610 mg/L in the SRF (**Figure 2.16**). Due to low rainfall water hardness at the Harbaria, Akram Point and the Hiron Points, became the highest in the post-monsoon. Generally, water hardness is found to be higher in monsoon season but in the Passur River, it is found to be higher in pre-monsoon season due to the saline water intrusion toward upstream (Rahman *et al*., 2013).

Total Suspended Solids (TSSs) include solid materials of organic and inorganic in origins, which are normally suspended in water. In the Passur-Sibsa RS, the suspended matters generally contain sand, clay, silt and loam. TSS concentrations among the monitoring sites varied from 5 mg/L to 15 mg/L observed in the last monitoring results.

The highest (15 mg/L) value was found at the Passur-Mongla Confluence Point (**Figure 2.17**). TSS values in every spot recorded during the last post-monsoon period found to be within the permissible limit of 150 mg/L (ECR, 1997). Since 2014 oil spillage incident, TSS was found higher than the standard limit at 2014 and 2015. After that, the issue was not found any more, and the water bodies reinstated its properties naturally.

Generally, in the Passur-Sibsa RS, TSS was found to be higher in post-monsoon and winter

seasons than those of pre-monsoon and monsoon. During post-monsoon and winter season, the TSS value increases, probably due to relatively low precipitation and less upstream 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 the Passur-Sibsa River in the post-monsoon seasons at different monitoring sites are presented in **Figure 2.15, 2.16 and 2.17** respectively and all the observed datasets are attached in **Table B.8, Table B.9 and Table B.10 of Appendix- IV.**

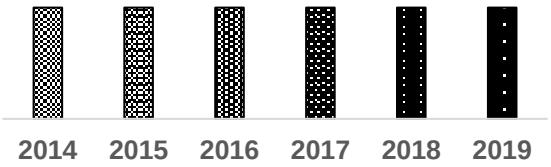


Table 2.14: Legend Direction (left to right: 2014-2019)

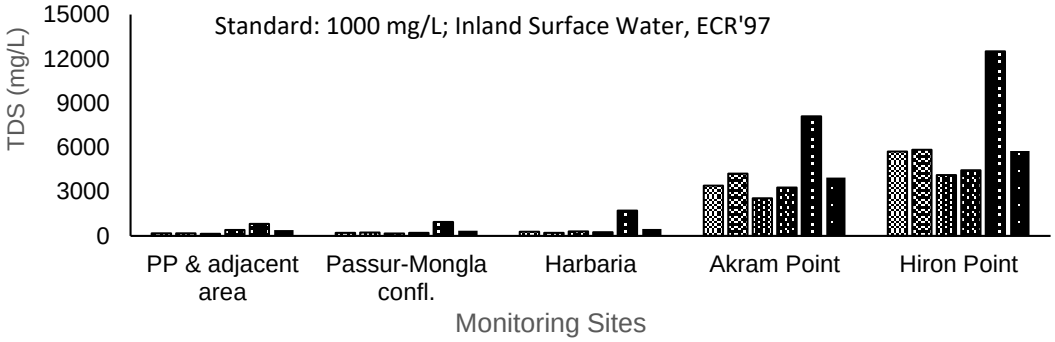


Figure 2.15: Variations in TDS Concentrations in Different Monitoring Sites

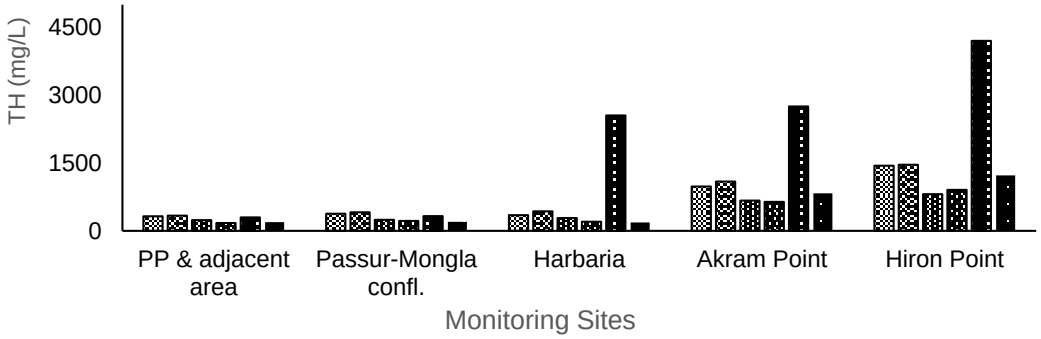


Figure 2.16: Variations in TH Status in Different Monitoring Sites

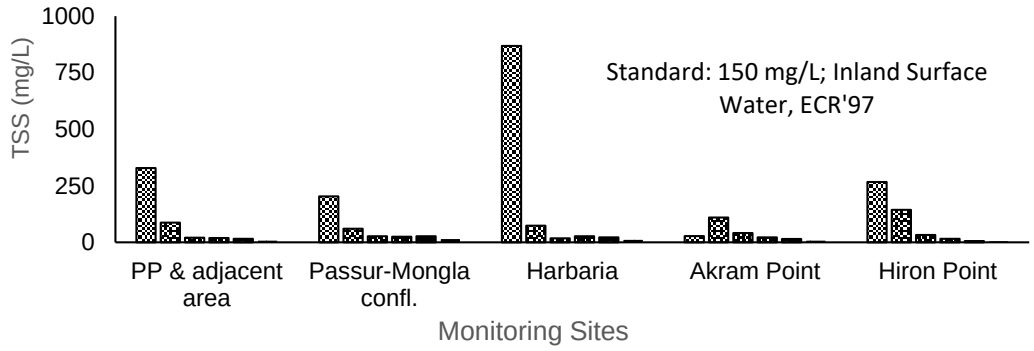


Figure 2.17: Variations in TSS Concentrations in Different Monitoring Sites

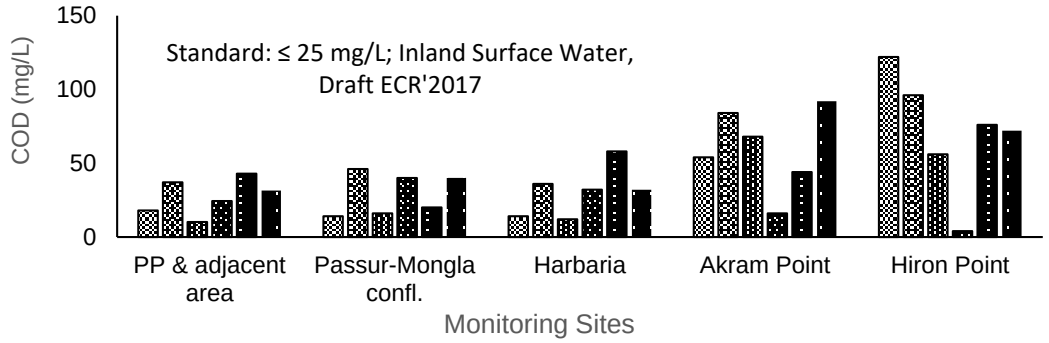


Figure 2.18: Variations in COD concentrations in Different monitoring Sites

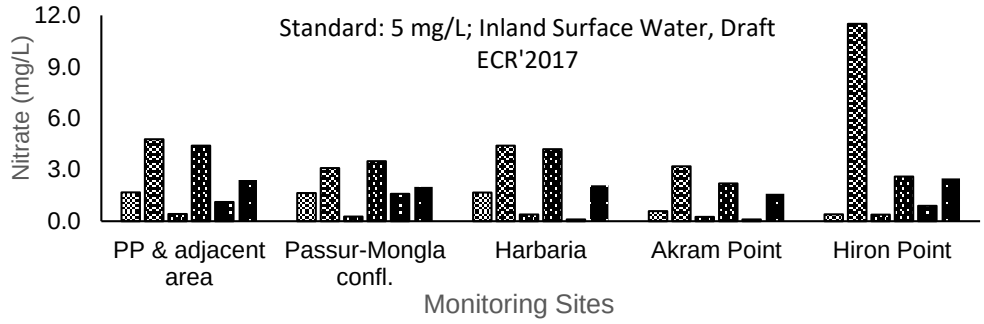


Figure 2.19: Variations in Nitrate concentrations in Different monitoring Sites

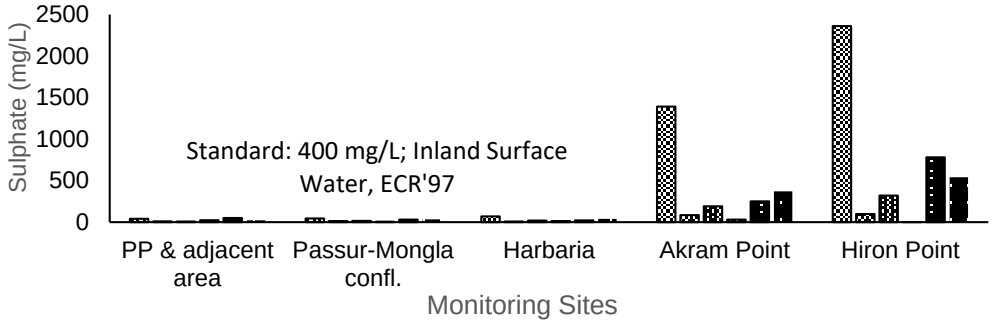


Figure 2.20: Variations in Sulphate Concentrations in Different Monitoring Sites

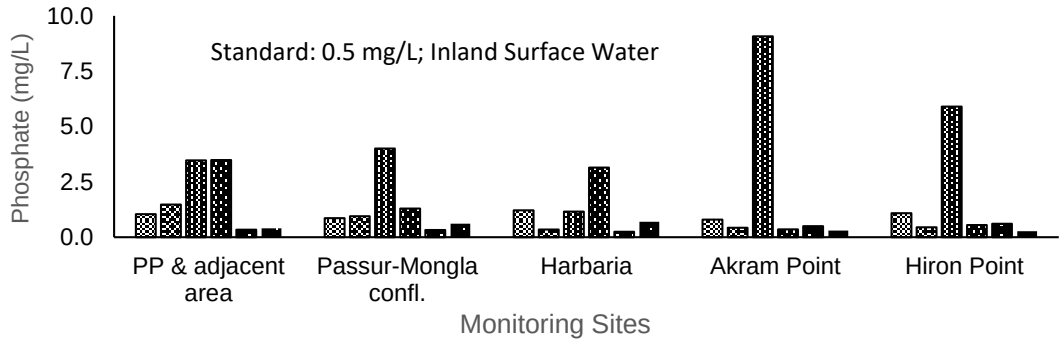


Figure 2.21: Variations in Phosphate Concentrations in Different Monitoring Sites

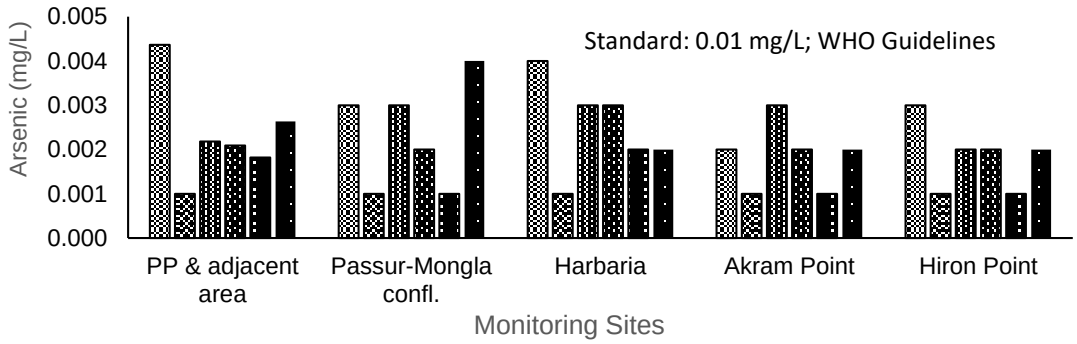


Figure 2.22: Variations in Arsenic concentrations in Different Monitoring Sites

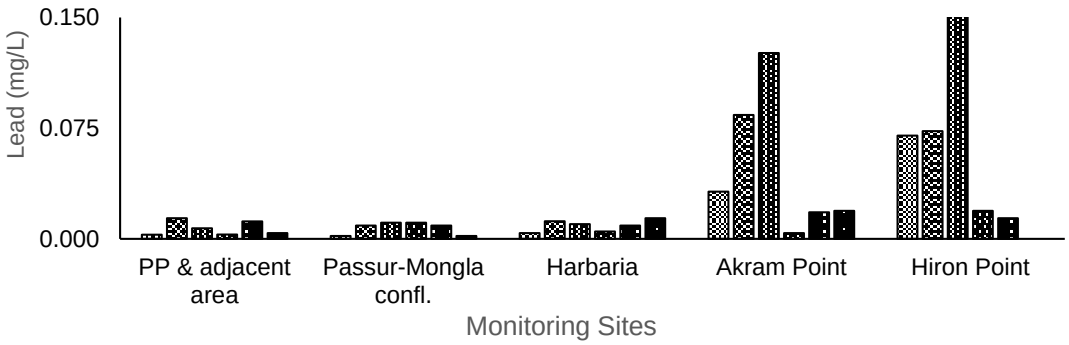


Figure 2.23: Variations in Lead Concentrations in Different Monitoring Sites

Chemical Oxygen Demand (COD)

COD is an indicator of organic pollution, which is caused by the inflow of natural organic loads, domestic, livestock and industrial wastes, which contain increased 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 20 mg/L to 56 mg/L with an average of 31 mg/L in the project site while it increased a bit in the SRF with an average of 60 mg/L. The highest value was found at the Hiron Point while the lowest was at the south-west corner of the project site. 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 SRF than that of the upstream areas especially near the project site and its adjacent areas. SRF itself contributes large quantity of organic loads in the river system while contribution of upstream organic loads increases the concentration of organic matter hugely at the downstream of the RS. The concentrations of COD are for all of the monitoring sites complied with the permissible limit as per Draft ECR' 2017 (25 mg/L) for inland surface water. For example, the concentration of COD at the monitoring point of south west corner of the project site is 20 mg/L. Various activities in the project site, other industrial and agricultural activities may influence the COD continuously. The occurrence of extremely high COD in 2014 was the reason of oil spillage of that year which led the death of planktons and other aquatic life forms ultimately increased the decomposition rate of organic matters.

Over the year, COD concentration was found to be higher in pre-monsoon season followed by winter as these seasons have insignificant rainfall comparing to those of other seasons and which actually increased the density of organic matters. 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 datasets are provided in **Table B.6 of Appendix- IV.**

Nitrate, Sulphate and Phosphate

Usually, Nitrogen is the limiting factor in the marine environment. Therefore, nitrate plays very active role in primary production including the dynamism of aquatic organisms. In the last monitoring, $\mathbf{NO_3^-}$ concentrations varied from 1.3 mg/L to 3.5 mg/L. The maximum concentration of 3.5 mg/L, recorded at the left of the Passur River at North West Corner of the project site. Average NO_3^- concentration near the project site was little bit higher (2.4 mg/L) than that of the ERF (2.1 mg/L).

NO_3^- concentration showed both temporal and spatial variations among different seasons as well as in the same season. For instance, in the last post- monsoon season, project site and its adjacent areas NO_3^- concentration was around 2.4 mg/L which was found around 0.4 mg/L in the same season of 2016. In case of spatial variation, at the left Bank of the Passur River at 100 m u/s of North West Corner of the project site, NO_3^- concentration was found 3.5 mg/L while it reduced to 1.3 mg/L at the South West Corner of the project site on the Passur river.

The results obtained from all the monitoring sites were found to be within the standard stated in ECR'1997 (5 mg/L for inland surface water).

Naturally, $\mathbf{SO_4^{2-}}$ 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 the 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 (540 mg/L) of sulphate was found at the Hiron Point while the lowest value of 4-10 mg/L was at the most of the project site. However, all the observed dataset of SO_4^{2-} found within the standard limit (400 mg/L) specified in ECR, 1997 except Hiron 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**).

High **PO_4^{3-}** concentration is harmful for all kinds of natural water bodies. PO_4^{3-} concentrations were found in the range of 0.2mg/L and 0.7mg/L during the last post-monsoon (**Figure 2.21**). Based on the **Figure 2.21**, it is investigated that, PO_4^{3-} concentration did not show any spatial variation during last post-monsoon but showed temporal variation. Upstream anthropogenic activities probably the reason for this kind of trend along with pattern of rainfalls and bio-geochemical cycles of nitrogen. Most of the sites complied with the permissible limit as per ECR' 1997/ Draft ECR 2017 rules of 0.5 mg/L of PO_4^{3-} in the inland surface water.

The recorded low phosphate value during dry season 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.

NO_3^-, SO_4^{2-} and PO_4^{3-} concentration at different monitoring sites of the 23 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.11, Table B.12** and **Table B.13** of **Appendix- IV**.

Heavy Metals

It has earlier been revealed that Arsenic (As) concentration varied between 0.001 to 0.006 mg/L. During this 23rd monitoring, the results again fitted with the said range. Though there were some seasonal variations in As concentrations, but still As concentration complied with the drinking water quality standard of WHO (0.01 mg/L). The Bangladesh limit is as high as of 0.05 mg/L **(Figure 2.22)**.

Lead (Pb) dissolved in water is very harmful to aquatic organisms; due to bioaccumulation, it increases in body tissue of organisms (Rompas, 2010). It is also evident that organic fertilizer, which comes from lime and compost fertilizers, can contain heavy metal, e.g., NPK fertilizer (phosphate fertilizers containing Pyromorphite- $Pb_5(PO_4)_3$ like the way said by Zhu et. al., 2004), which may result in higher amount of Pb concentration in river water. During 23rd monitoring period, the concentration of Pb ranges from 0.001 to 0.019 mg/L (**Figure 2.23**). The standard concentration for Pb for inland surface water is 0.1 mg/L.

The values of Mercury (Hg) revealed consistency among all the monitoring points in all the seasons in all monitoring quarters. The values never exceeded 0.001 mg/L. In the post-monsoon, the concentrations also remain same. All the observed data are found to be within the permissible limit (0.05 mg/L) as per ECR, 1997.

The average value of As and Pb concentrations at different monitoring sites of the consecutive monitoring quarters for post-monsoon season are presented in **Figure 2.22 and in Figure 2.23** and all the observed dataset are given in **Table B.14, Table B.15** and **Table B.16** of **Appendix- IV**.

Oil and Grease

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

During monsoon and post monsoon periods, the concentration of oil and grease were found lower than that of winter and pre-monsoon season. It appears from the data that Passur and Sibsa river system recorded high concentrations of oil and grease in winter period in 2014, which might be due to occurrence of accidental oil spillage on 9 December 2014. An amount

of 350,000 liters (Philips, 2014) of furnace oil spilled in the river and spread over an area of 350 km^2 (Welle, 2014).

Oil and grease were found to be <2.0 mg/L for all the monitoring sites in the last post-monsoon season. In other seasons (Pre-monsoon, post monsoon and winter), this organic compound has increased in the last three consecutive years. Increasing number of regulated and non-regulated mechanized vessels used for different purposes like cargo transport, human transport including tourist could be the reasons of high oil and grease including the RASH MELA Festival inside the Sundarbans every year. Moreover, indiscriminate discharge of bilge water (oil and grease mixed water) by the non-regulated mechanized boats particularly during seasonal fishing at sea, contributes contamination to river water. Generally, International Maritime Organization (IMO) certified vessels maintain all kinds of regulations applicable for them.

Findings

The Passur 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 the Passur River changes with the tide conditions in different seasons.

In this 23rd quarterly monitoring (Winter, 2020), physical conditions of the Passur-Sibsa RS were found fairly healthy. There were some fluctuations in the concentrations of parameters among different sites only. In addition, pH, Temperature and DO level was found quite good at the project site and in the SRF.

In this 23rd quarter (Post-monsoon, 2019), TDS, TH and TSS concentration in the observed RS found compatible to national and international standards. High COD was found in all the monitoring sites except only South west corner of the project site. As it is high the SRF, this may be the effect of sediment loads and high nutrients contributed by the Bay of Bengal. Nitrate (NO_3^-) and Phosphate (PO_4^{3-}) found in a very standard range in respect to a natural river. In case of metal pollution, no variation was recorded for As, Pb and Hg concentration and even no issues as well. Oil and grease concentration was found less than 2.0 mg/L, which is far below the recommended concentration (10.0 mg/L) for Inland Surface Water as per ECR, 1997.

2.8.10 Status of the Groundwater Quality

In-situ tested parameters

The in-situ tested results obtained up to 23rd monitoring period (February 2020: Winter season) are described below.

pH and Temperature

The values of pH and temperature of groundwater in the monitoring 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 23rd monitoring scheme were found to vary from 7.3 to 7.8, while temperature ranges from 23 to 24°C. No significant differences have been observed against the previous winter season monitoring data. 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 twenty-three consecutive monitoring results of pH and temperatures (winter) of selected sites are presented in **Figure 2.25: pH, Temperature** and all the observed dataset are attached in **Table B. 17** of **Appendix- IV**.

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, average groundwater salinity of Rajnagar, Kapashdanga and Township area was 0.1 ppt (**Table B.18: Appendix- IV**).

DO results ranges from 6.0 to 6.1mg/L during this monitoring season. DO concentrations were found within the recommended limit of ECR, 1997 (6.0 mg/L), at all the three sites. 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. A**ll the observed dataset of DO and Salinity are attached in **Table B.18 and B.18** of **Appendix- IV** respectively.

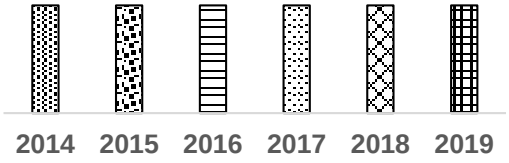


Figure 2.24: Legend Direction (left to right: 2014-2019)

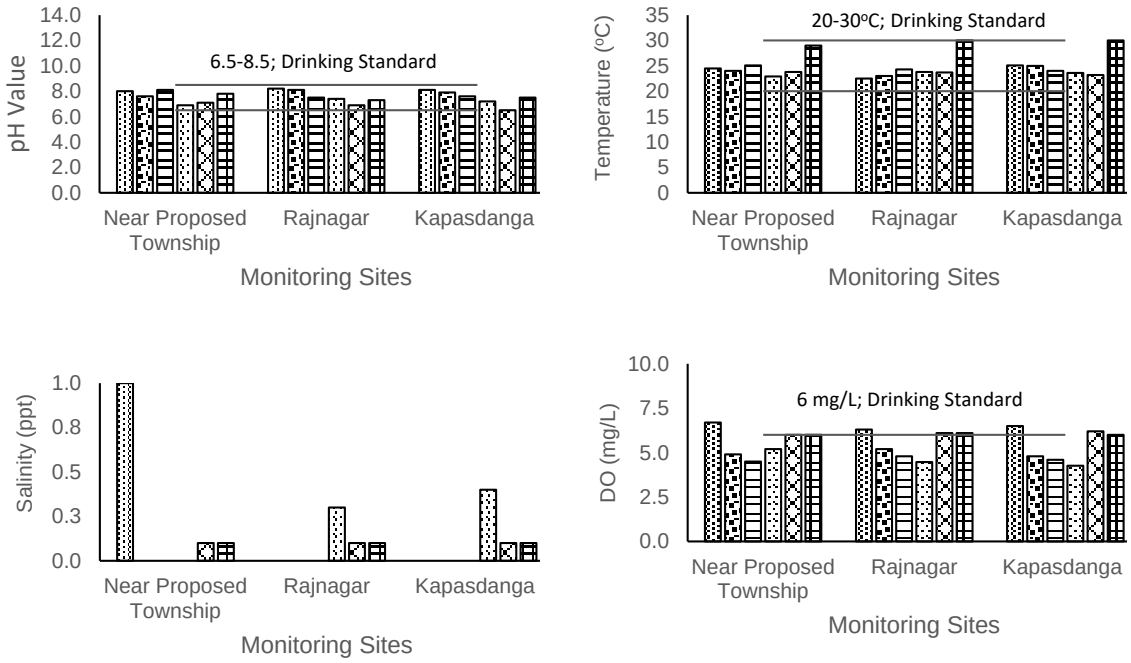


Figure 2.25: Status of pH, Temperature, Salinity and DO of Winter Season of the Last Six Consecutive Years

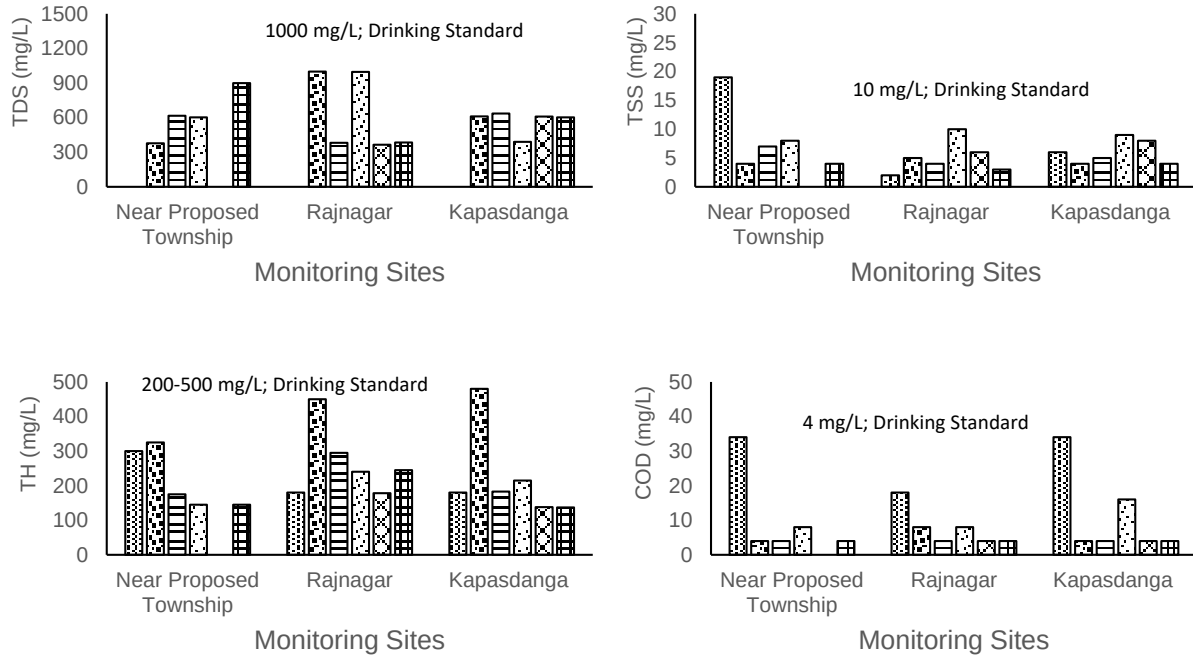
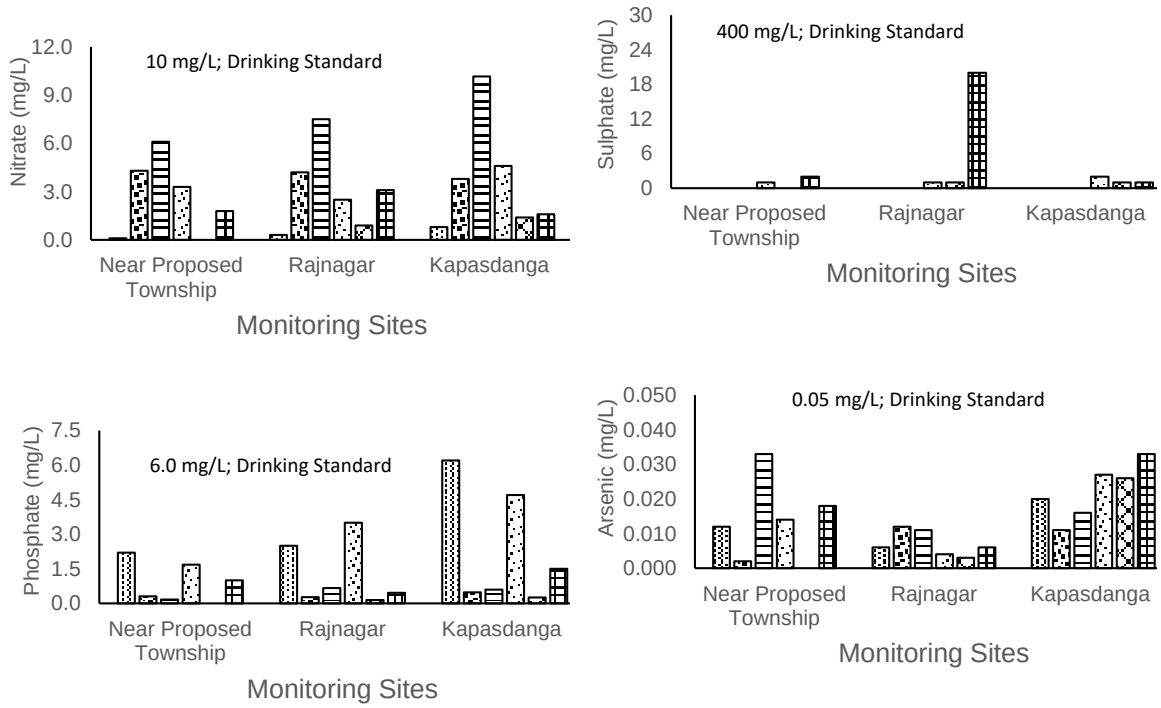


Figure 2.26: Status of TDS, TSS, TH and COD of Post-monsoon Season of the Last Six Consecutive Years



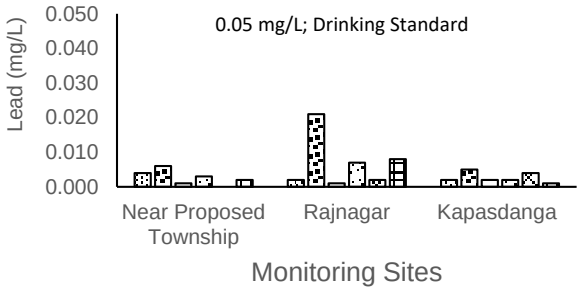


Figure 2.27: Status of NItrate, Sulphate, Phosphate, Arsenic and Lead of Winter Season of the Last Six Consecutive Years

Laboratory tested parameters

The laboratory tested results obtained up to 22nd monitoring period (October 2019: Post-monsoon) are described as follows:

TDS, TSS and TH

The highest TDS value of 900 mg/L was recorded in Township area and the lowest was in Rajnagar (385 mg/L). It is mentionable that, TDS concentrations in all the post-monsoon periods were found within the permissible limit of 1000 mg/L as per ECR, 1997 (**Figure 2.26: TDS**). Until now, TDS did not come out as an issue in the post-monsoon season. However, in the pre-monsoon season of the year 2014, TDS showed extreme spatial variations. That variation was observed due to physical damage held in the pipe of Tube well for some days.

Total Suspended Solids (TSS), also known as non-filterable residue, are the solids (minerals and organic material) which remain trapped on a 1.2 µm filter (U.S.EPA, 1998). During this monitoring period, the TSS concentration ranges in between 3-4 mg/L, which complied with the permissible limit 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 post-monsoon season than the winter season. 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.

Total Hardness (TH) of the three groundwater monitoring sites varied from 137 mg/L to 245 mg/L (**Figure 2.26: TH**). Rajnagar showed the highest concentration not only in the last post-monsoon but also over the whole monitoring scheme so far. Over the last six 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 post-monsoon periods are presented in **Figure: 2.26: TDS, TSS and TH** and all the observed dataset are attached in **Table B.19, B.20** of **Appendix- IV.**

Chemical Oxygen Demand

The Bangladesh standard for COD in drinking water is 4.0 mg/L. Monitoring sites completely complied with the Bangladesh Standard as COD concentrations for these sites in the last post-

monsoon period were found within 4.0 mg/L. Except the year 2014, all the other COD concentrations of the said season were also within the recommended limit for Bangladesh.

The COD concentrations of all the post-monsoon period monitoring sites are given in **Figure 2.26: COD** and all the observed dataset are attached in Table **B.21** of **Appendix- IV**.

Nitrate, Sulphate and Phosphate

Nitrate (NO_3^-) values range between 1.6 mg/L and 3.1 mg/L in the last post-monsoon period (**Figure 2.27: Nitrate**). The maximum value was recorded in Rajnagar while the lowest was in Kapasdanga. NO_3^- concentrations were ranges within ECR, 1997 limit (10mg/L) in this 23rd monitoring period. NO_3^- in groundwater showed both spatial and temporal variations in post-monsoon season.

Groundwater sulphate (SO_4^{2-}) concentrations have been monitored since 2014 Since then, SO_4^{2-} concentrations never exceeded the Bangladesh Standard for Drinking Water Quality (400 mg/L). SO_4^{2-} concentration in groundwater did not show any pattern yet except a trend of comparatively high concentrations in winter than all other monitoring seasons (**Figure 27: Sulphate**).

On the other hand, concentrations of PO_4^{3-} were found between 0.5 mg/L and 1.5 mg/L, which was within the standard limit of 6.0 mg/L (ECR'1997) (**Figure 2.27: Phosphate**). PO_4^{3-} concentration reached to its highest peak at 6.2 mg/L during the post-monsoon of 2014. PO_4^{3-} concentrations actually 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** and **Phosphate,** and all the observed dataset are attached in **Table B.22, B.23 and B.24** 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 ranges between 0.006 mg/L and 0.05 mg/L which are very much within the permissible limit of drinking water quality as per ECR'1997 (**Figure 2.27: Arsenic**). It can therefore, be concluded that, groundwater of the monitoring sites is not yet contaminated by arsenic.

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) except for Mercury at Kapasdanga in the last monitoring. Mercury level (0.002 mg/L) marginally exceeds the standard limit. 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 heavy metal pollution status.

The observed values of As and Pb in all the post-monsoon period monitoring sites are presented in **Figure: 2.27: Arsenic, Lead** and all the observed dataset of As, Pb and Hg are presented in **Table B.25, B.26and B.27** of **Appendix-IV**.

Remarks

This concluding remark represent the status of physical (January 2020), chemicals and presence or concentration of heavy metals (October 2019) characteristics of drinking water. It has been observed that the physical characteristics of groundwater quality is still in good condition and in acceptable state for drinking purpose except slight salinity in the observed water. Saline water infiltration due to excessive withdrawal of groundwater by the surrounding communities during the dry season is considered as the major reason of groundwater salinity. In addition, evaporation is also responsible for this slight salinity in groundwater. Project activities are not related to this sort of changes.

Chemical characteristics of the groundwater quality are also found suitable and safe to drink based on the permissible limit as per Drinking water standards, ECR'1997. In respect to COD, Nitrate and Phosphate, the status is also the same. The observed groundwater is completely free from the heavy metal pollution of Arsenic, Lead, and Mercury.

2.9 Land Resources Monitoring

2.9.1 Methodology

Selection of 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 were considered as major indicators for land resources monitoring. It was also assumed that during the operation phase of the power plant fly ash and other air borne pollutants might deposit on the surrounding agriculture land which ultimately could pollute the soil of surrounding areas. Before that (during pre-construction and construction stage) only natural phenomena may be responsible to alter soil parameters.

Sampling Frequency

As per the ToR, the frequency of data collection was considered twice in a year. Accordingly, the soil samples were collected during 22nd quarterly monitoring period (November, 2020) and sent immediately to the laboratory for analysis purpose.

Monitoring Indicators

The continuous monitoring provides an opportunity to observe seasonal changes of selected indicators along with spatial change of sampling plots. The selected indicators were 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) were calculated from the analyzed data. It can also be mentioned that the structural change of soil in the sampling plots may also be identified from the analyzed data. The formula to calculate SAR is given below, with concentration expressed in milli equivalents per liter (meq/L) analyzed from a saturated paste soil extract.

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

ESP is the sodium absorbed by soil particles as a percentage of the Cation Exchange Capacity (CEC) and 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 characterize the sodicity of soils only, whereas SAR is applicable to both soil and soil solution or irrigation water.

Location

The selected mauzas for monitoring 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 was included with the previous ones for monitoring as per TOR. The sampling locations with their corresponding coordinates are stated in **Table 2.9**. Locations of collected soil samples are presented in **Figure 2.30**.

2.9.2 Process of Soil Samples Collection

Plot Selection

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

Soil Samples Collection

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

Figure 2.28: Soil Sample Collection from Sampling Plot-5 (Baserhula)

Figure 2.29: Soil Sample Collection form Sampling Plot-2 (Chunkuri-2)

Table 2.9: Land Resources Monitoring Plan

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

2.9.3 Status of Soil Quality of Monitoring Plots

Agriculture Plot-1 (Baranpara)

Soil salinity governs most of the chemical properties of agricultural soil of southern area of Bangladesh. Top soil salinity of this monitoring site is increased for second consecutive year (wet season). This year top soil salinity falls under salinity class -3 (slightly saline) which was very slightly saline in the previous wet season monitoring. From the cation analysis it is found that, during this wet season monitoring all cation concentration is increasing except calcium. Among these sodium concentration increases most (around four times than same time of previous year). SAR and ESP results reflects the same. Most importantly, EC found to be higher in wet season than immediate dry season. This indicates either natural washout is not taking place perfectly or monitoring land is getting in touch with saline water. It is mentioned that the sampling was done immediately after the event of cyclone BULBUL. pH is decreasing in this monitoring than the previous wet season. pH of this monitoring location shows similarities with alternative year and represent a sine curve when put in a graph.

Top soil organic matter concentration is reduced than the previous year. But lower horizons show increasing trend than both top soil and previous year. On the other hand, all essential nutrients (nitrogen, Phosphorus and Sulphur) concentration is increased. This might be due to the external supply of chemical fertilizers for rice production and natural supply from the lower horizons.

Among the macro nutrient only iron is increased than the previous year. Increasing salinity might be a cause of more availability of Fe. Excess presence of Fe may suppress other elements (Boron, Zinc and Manganese) presence in soil solution.

Lead concentration is increased for the first time. it is also noted that Cadmium presence is identified in the lower horizon of this monitoring site. This might also be an impact of excessive salinity increment. But the good news is both of these carcinogens are under threshold value**.**

Agriculture Plot-2 (Chunkuri-2)

Good agricultural practice is found is this monitoring plot. As a result, soil condition is improved from the previous monitoring. Salinity is decreasing as following the last wet season monitoring. Among the base cations, monovalent cations (Na and K) showed decreasing trend while bivalent cations remain similar. This scenario indicates replacement of mono valent cations by bi-valents which is good for soil health as bivalent cations can help to produce more aggregates and improve soil structure. Noted increasing trend of pH for last two years.

Organic matter, Nitrogen, Phosphorus and Sulphur showed increasing trends during this monitoring. This indicates an increased use of organic manure rather than chemical fertilizer in the field.

Among the macro elements, Mn and B showed decreasing trend while Zn and Fe showed increasing trend during the monitoring period. Mn and B have tendency to form chalet with organic matter. Increasing trend of Organic matter concentration was also observed during this monitoring period. This might be due to the decreased concentration of Mn and B in the soil

Pb concentration was also decreased during this monitoring. This element may form chalet with organic matter and become less available in soil solution. However, Cd concentration is found for the first time in this monitoring site. The most interesting thing is that Cd

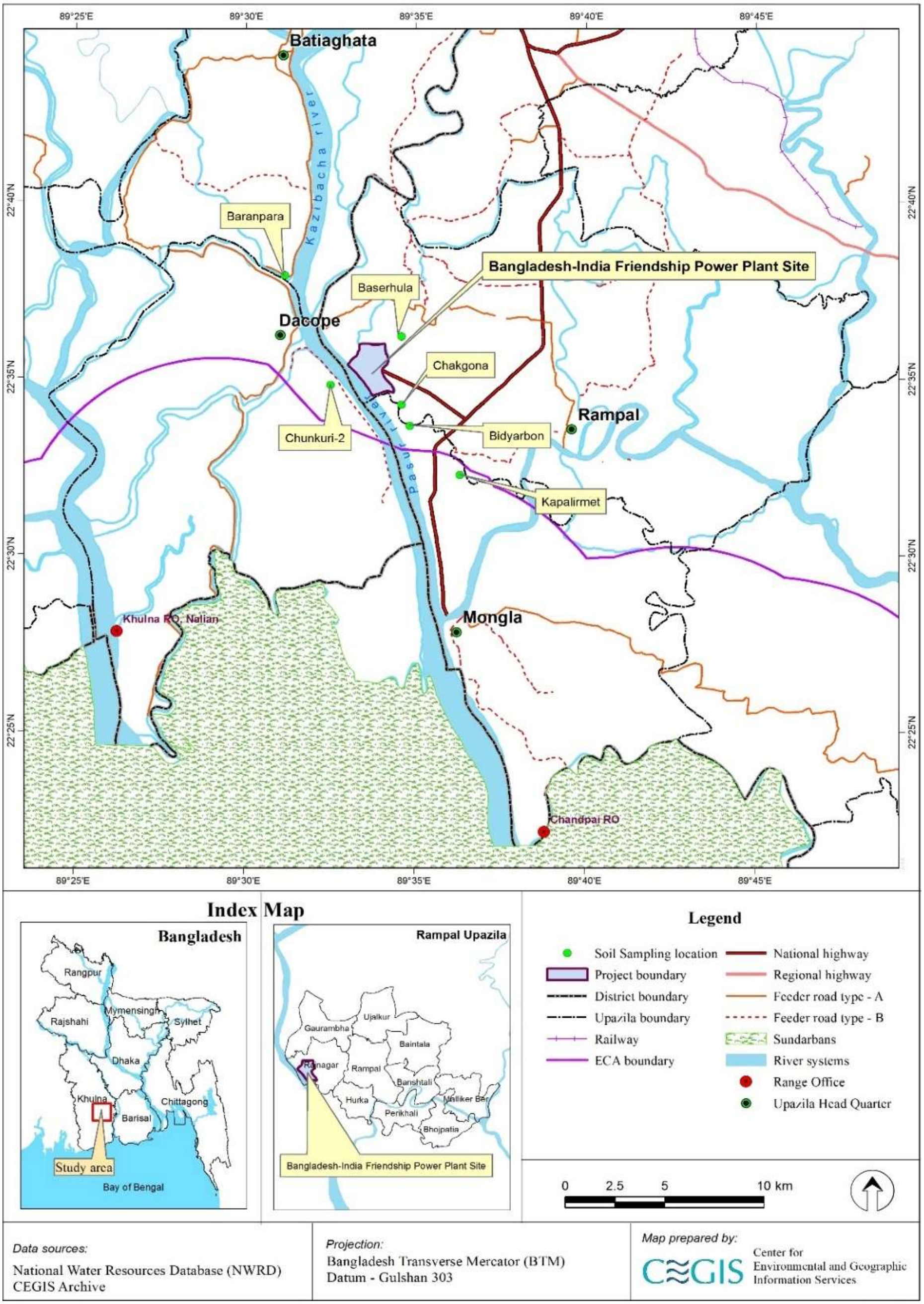


Figure 2.30: Land Resource Monitoring Locations

concentration is higher in the lower horizon than the top soil. This indicates Cd might be available from bed material through weathering or other process**.**

Agriculture Plot-3 (Kapalirmet)

This monitoring plot is used for fish cultivation during pre-monsoon and post monsoon period. During monsoon period this area completely goes under water. Decreasing salinity was a common scenario of this monitoring plot due to leaching and continues lentic ecosystem. But this year, salinity goes up which might be an after effect of tropical cyclone “BULBUL”. All salinity related parameters (EC, SAR, and ESP) showed the similar trend. All base cations are increased where Na showed the most. During this monitoring while pH is slightly decreased.

Due to submerged condition organic matter of this area remain stable for last two years. This trend continues this year too. Nitrogen and Sulphur is increased while Phosphorus concentration is decreased. Phosphorus concentration might be reduced due to leaching effect. Nitrogen and Sulphur might be increased due to application of artificial food for fish growth. All monitored micro nutrients (Mn, Fe, Zn) showed increasing trend where Boron is the only exception. This might be due to increased salinity. Pb concentration is increased for second consecutive year. Cadmium concentration is observed for the first time and the maximum concentration is found in the lower horizon**.**

Agriculture Plot-4 (Chakgona)

Overall salinity (EC) is reduced but SAR and ESP is increased. This scenario is caused as bivalent cations (Ca and Mg) concentration is reduced but single valent cations concentration is increased in soil solution. This might be an after impact of tropical cyclone. pH is slightly decreased in this monitoring than the previous year.

Organic matter is increased so is Nitrogen. Sulphur and Phosphorus concentration is continuing to decrease which is in indication of soil degradation and erosion of top soil of that area during rainy season. Decreasing trend of B and Mn concentration might be a cause of soil erosion. But increase of Zn and Fe might be the impact of using chemical fertilizer.

Pb concentration increases for the first time in this monitoring plot. Cadmium is also identified in the lower horizons which might be an impact of increasing single valent base cations. Moreover, it might be an impact of less washout during rainy season**.**

Agriculture Plot-5 (Basherhula)

One part of this monitoring plot is exposed to river. So there is a good possibility of quick wash out and soil erosion during monsoon period. This scenario also indicates vulnerability to storm surge and salinity intrusion from riverside during extreme events. Overall EC followed the decreasing pattern of previous couple of years. But SAR and ESP increased as Na concentration doubled than last wet season. Potassium concentration is also increased while bivalent cations (Ca and Mg) shows decreasing trend. pH continues to decrease for couple of years.

Organic matter, Nitrogen and Phosphorus concentration is increased which might be due to the impact of using chemical fertilizer while Sulphur concentration remain similar to previous year. Fe and Zn concentration is increased during this monitoring while Mn and B concentration is decreased. Increasing salinity might reduce the presence of these two elements. Pb concentration is decreased in this year. This might also be a cause of wash out

and exposer of sub soil in the monitoring plot. Cd concentration is found for the first time where lower horizon contains more that the upper one**.**

Agriculture Plot-6 (Bidyarbon)

EC is slightly decreased but SAR and ESP is increased as Na and K concentration is increased. Ca and Mg concentration is decreased during this monitoring. pH is also decreasing.

Organic matter concentration is increased. Major nutrients (N, P and S) follow the similar trend. This might be the impact of using organic fertilizer and maintaining good agricultural practice. All micro nutrients show (Fe, Zn, B) increasing trend except Mn. This might be due to the use of chemical fertilizer and increasing Na concentration. Lead concentration continues to increase with presence of cadmium in the lower horizons.

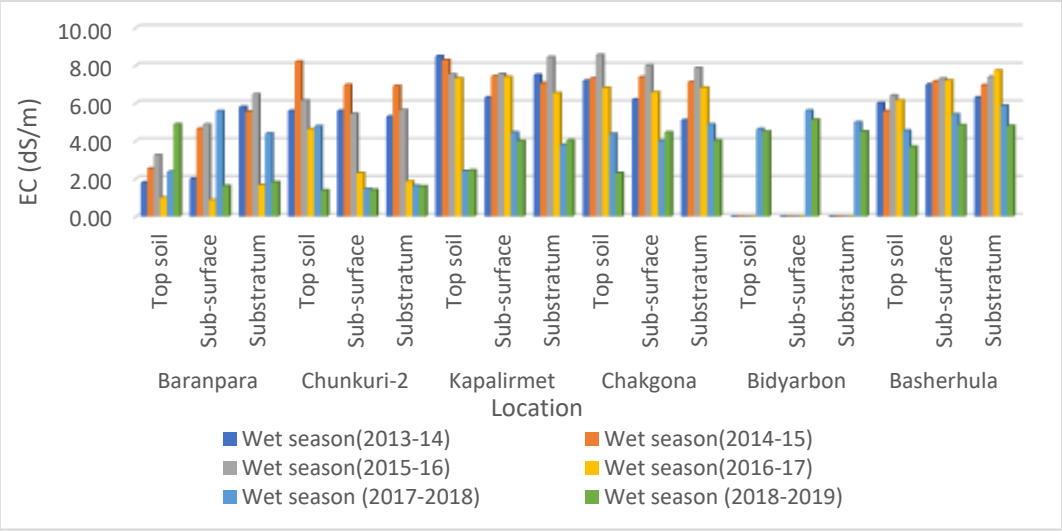


Figure 2.31: Changes of EC (dS/m) in Wet Seasons in Sampling Locations throughout the Monitoring Period

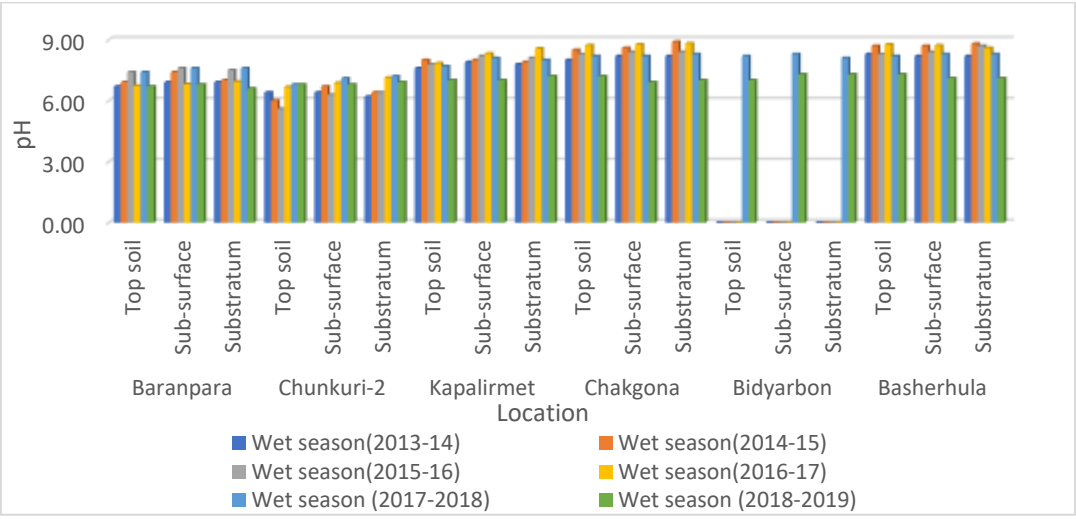


Figure 2.32: Changes of pH in Wet Seasons in Sampling Locations throughout the Monitoring Period

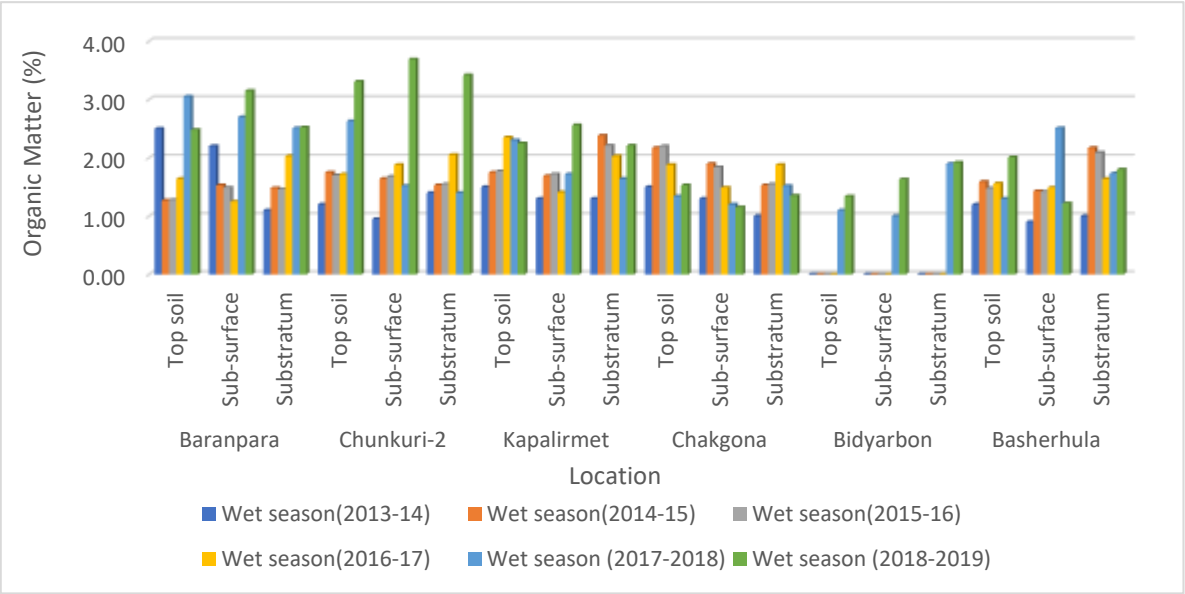


Figure 2.33: Changes of Organic Matter (%) in Wet Seasons in Sampling Locations throughout the Monitoring Period

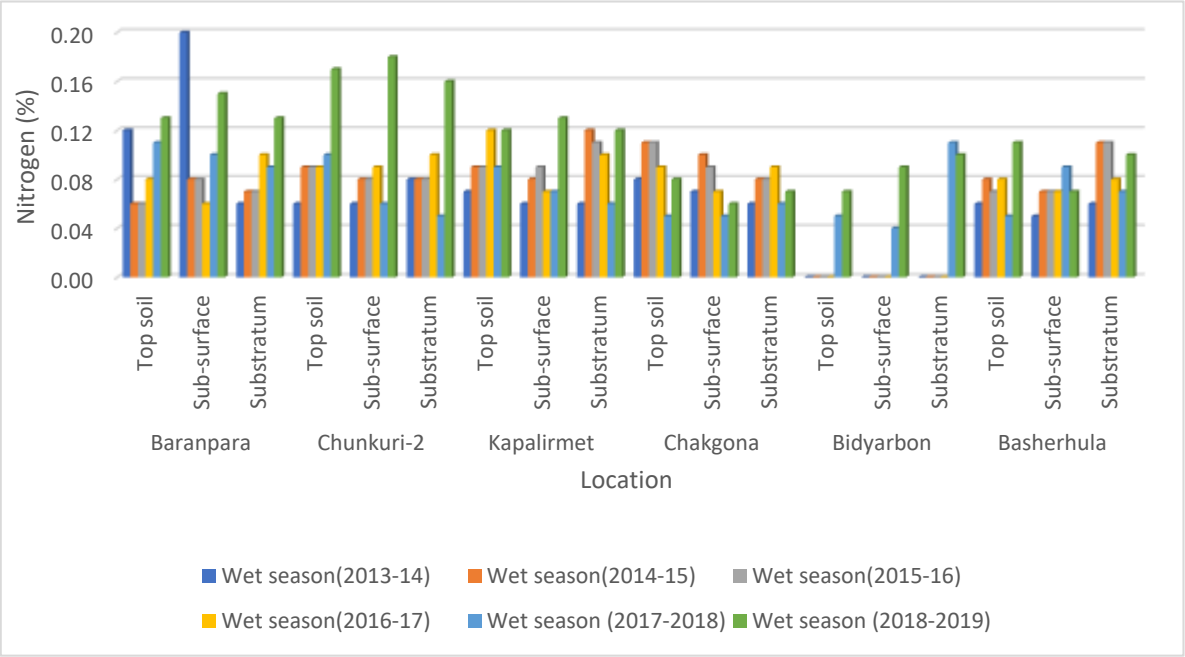


Figure 2.34: Changes of Nitrogen (%) in Wet Seasons in Sampling Locations throughout the Monitoring Period

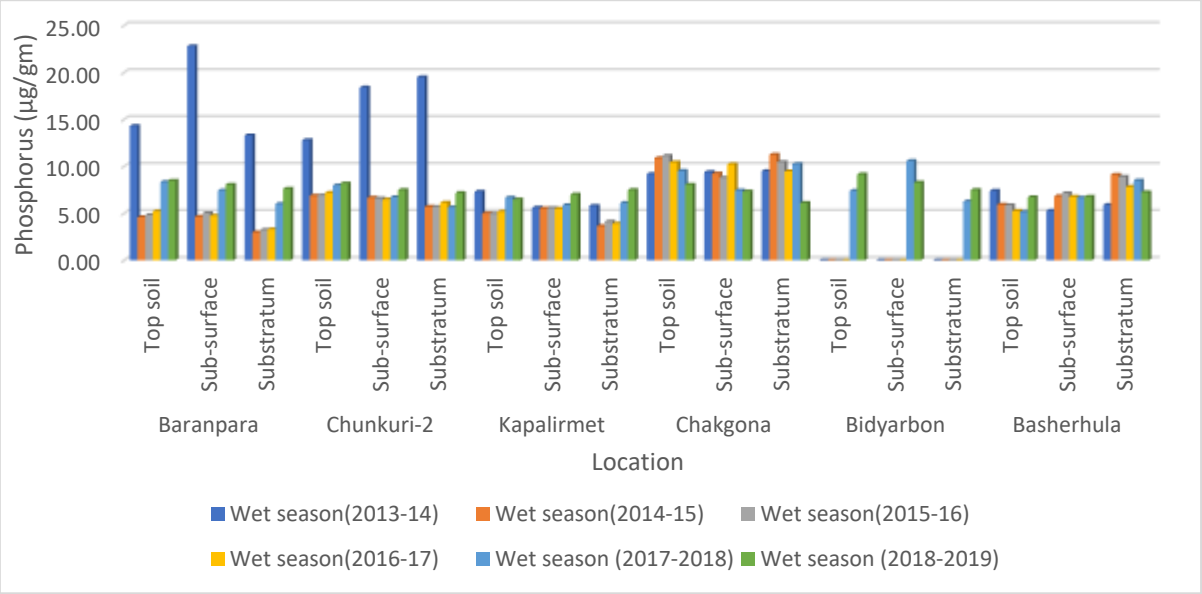


Figure 2.35: Changes of Phosphorus (µg/gm) in Wet Seasons in Sampling Locations throughout the Monitoring Period

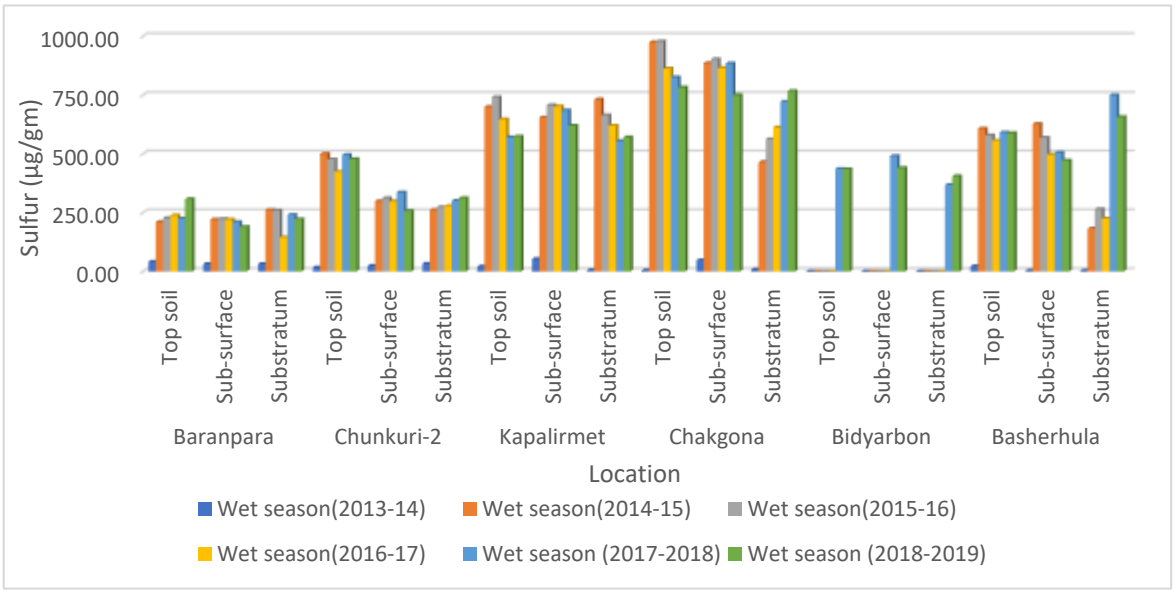


Figure 2.36: Changes of Sulfur (µg/gm) in Wet seasons in Sampling Locations throughout the Monitoring Period

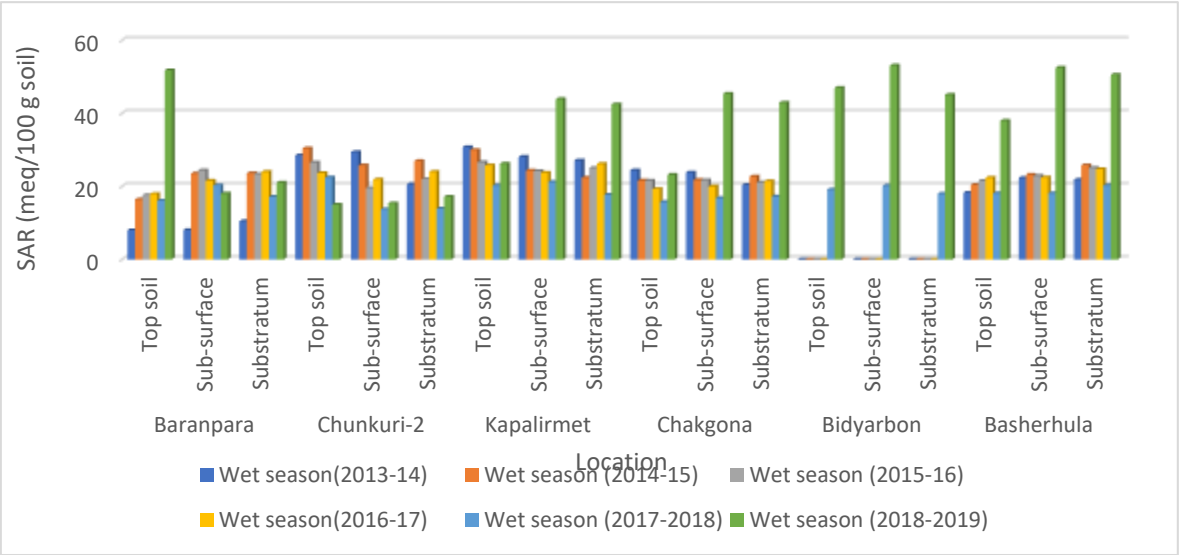


Figure 2.37: Changes of Sodium Absorption Ratio (SAR) (meq/100g) in Wet Seasons in Sampling Locations throughout the Monitoring Period

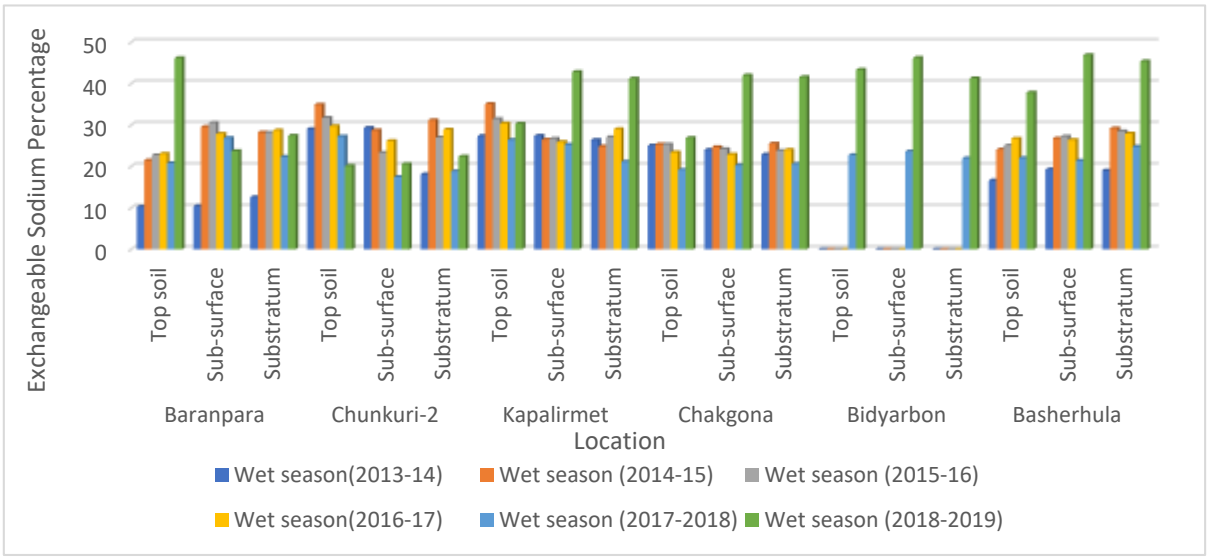


Figure 2.38: Changes of Exchangeable Sodium Percentage (ESP) in Wet Seasons in Sampling Locations throughout the Monitoring Period

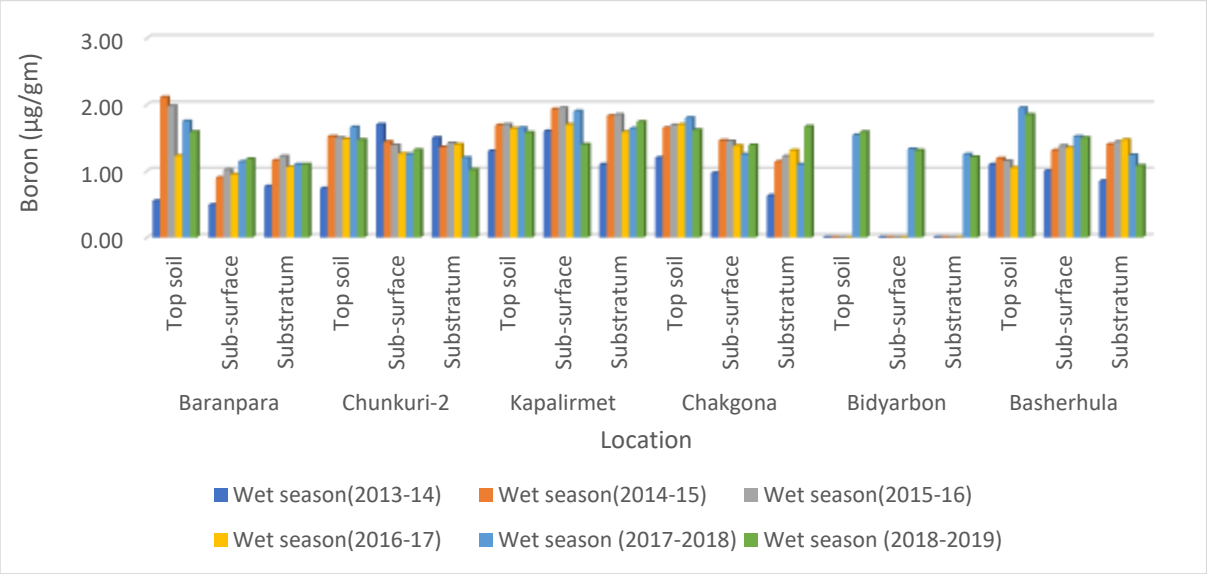


Figure 2.39: Changes of Boron (µg/gm) in Wet Seasons in Sampling Locations throughout the Monitoring Period

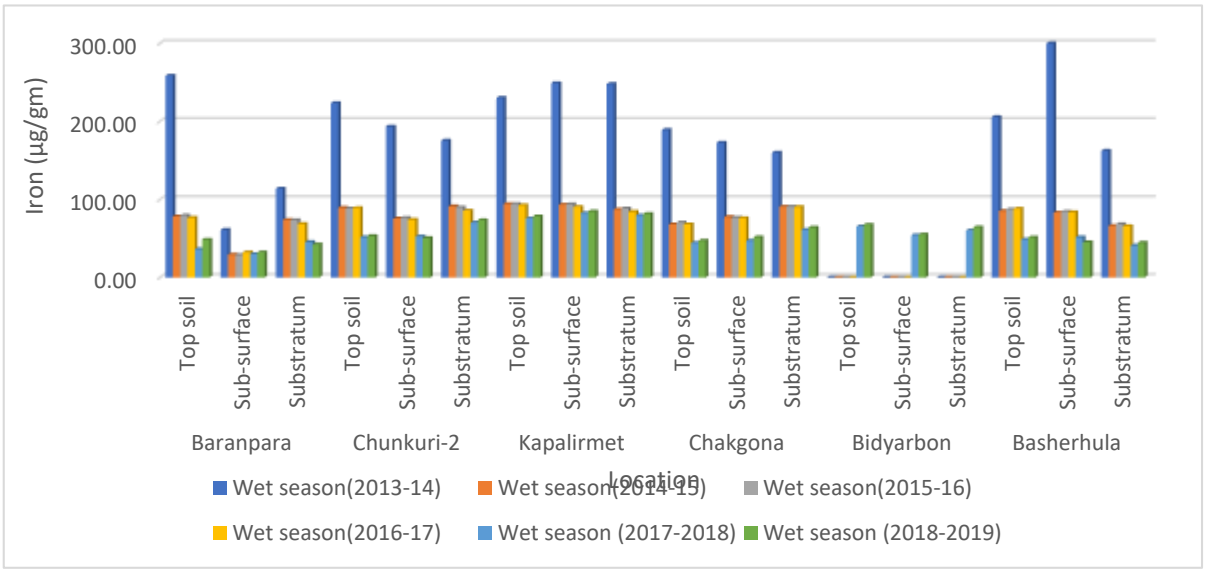


Figure 2.40: Changes of Iron (µg/gm) in Wet Seasons in Sampling Locations throughout the Monitoring Period

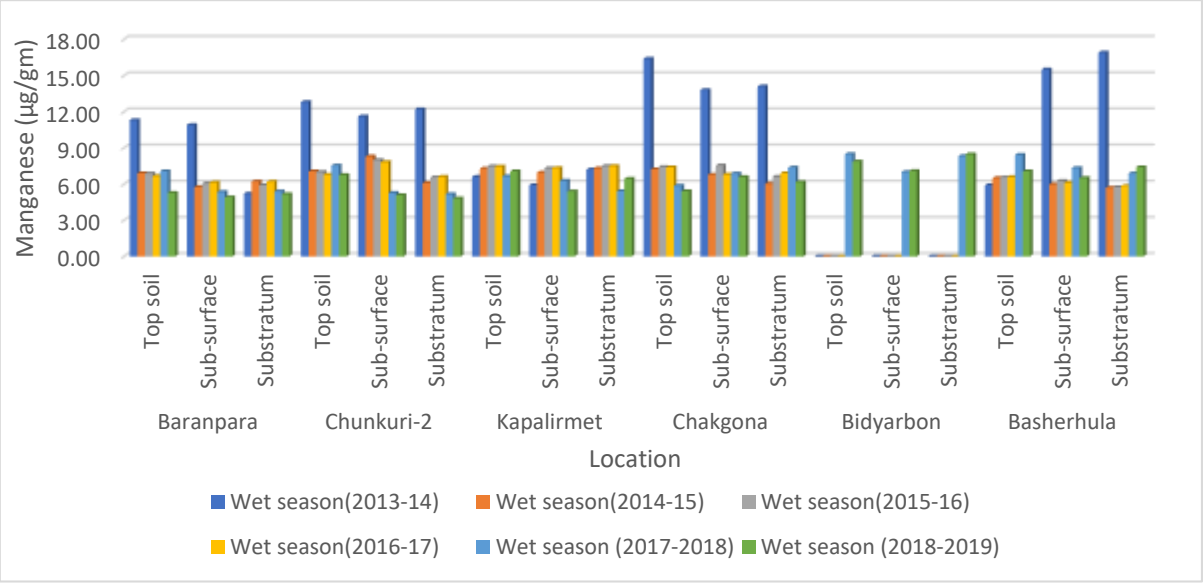


Figure 2.41: Changes of Manganese (µg/gm) in Wet Seasons in Sampling Locations throughout the Monitoring Period

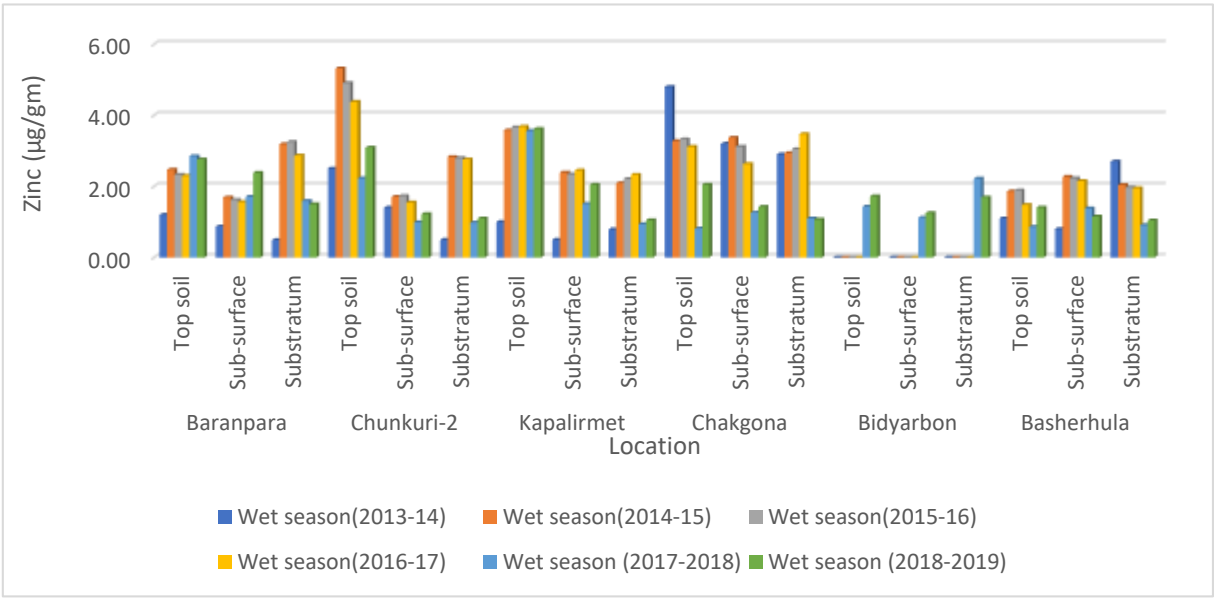


Figure 2.42: Changes of Zinc (µg/gm) in Wet Seasons in Sampling Locations throughout the Monitoring Period

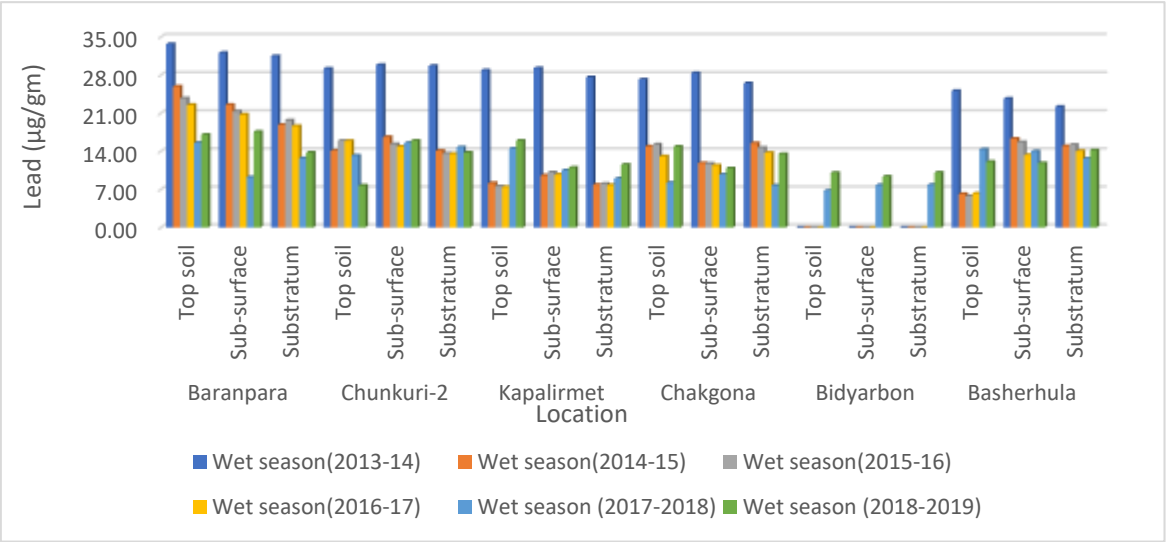


Figure 2.43: Changes of Lead (µg/gm) in Wet Seasons in Sampling Locations throughout the Monitoring Period

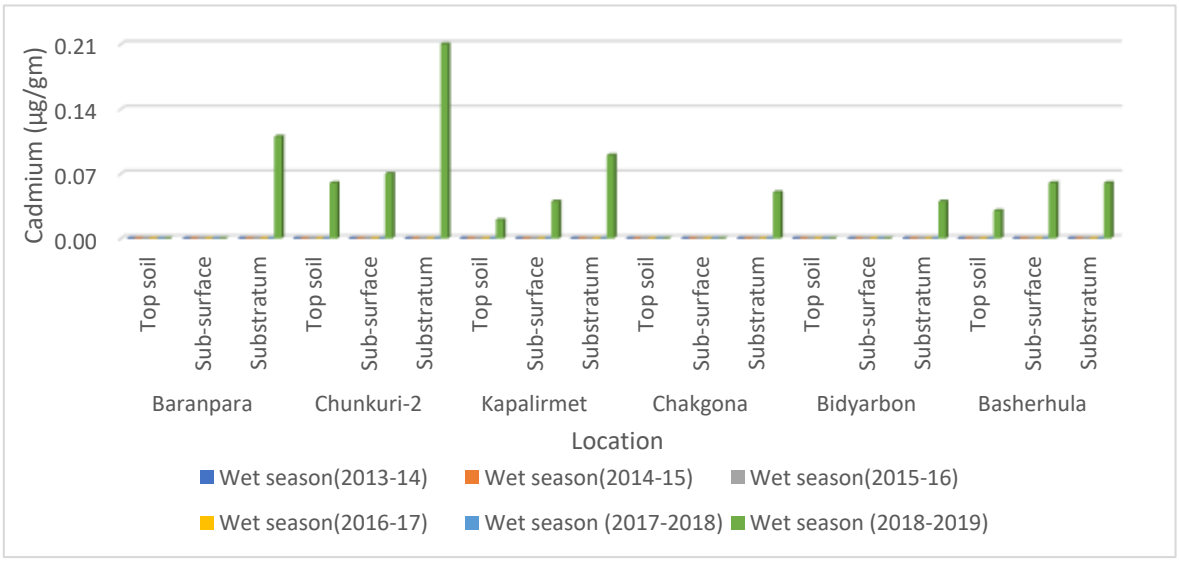


Figure 2.44: Changes of Cadmium (µg/gm) in Wet Seasons in Sampling Locations throughout the Monitoring Period

2.10 Transportation Monitoring

2.10.1 Location of Traffic Survey

The traffic survey for 23rd quarterly monitoring during the construction phase was conducted from February 14 to 17, 2020 on two week days and one on weekend at three pre-selected locations around the project site. 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 presented in the **Figure 2.45**.

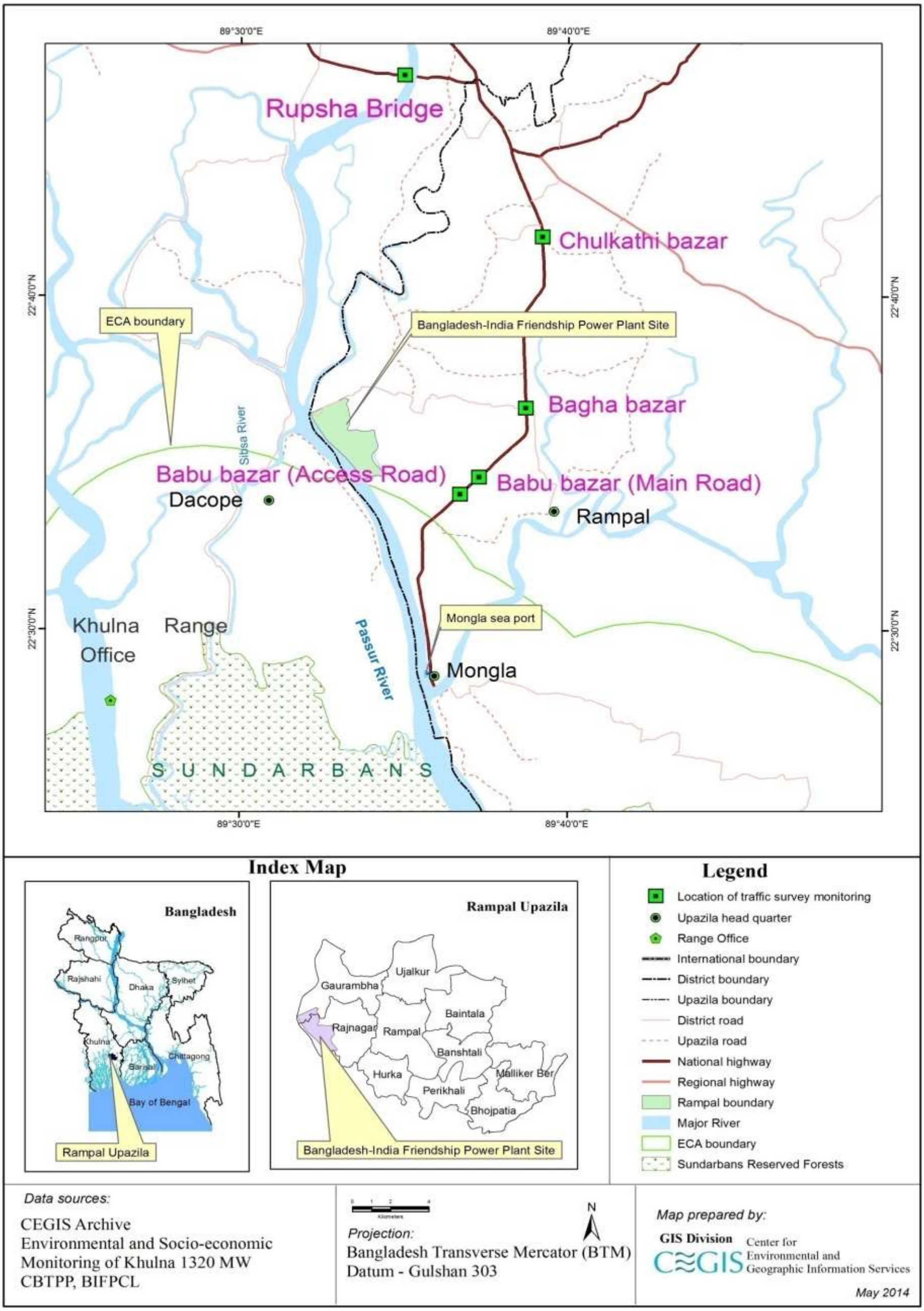


Figure 2.45: Locations of Traffic Survey

2.10.2 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.

2.10.3 Traffic Volume Calculation

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

2.11 Results of Monitoring

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

Table 2.10: Factors used for PCU Calculation

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

Table 2.11: Summary Results of Vehicular Movements at three Different Locations

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	379	432	221
Khulna Mongla Road at Digraj	232	380	200
Power Plant access road at Ichamoti Bridge	111	43	118

Source: Field Survey, February, 2020

Similar to the earlier months monitoring report, vehicular movements observed during the surveys were mostly for the regular construction activities of the Power Plant. Construction activities of the Power Plant are progressing heavily. Traffic volume and traffic nature at all the three surveyed location were similar to earlier monitoring results during the construction period. The detail survey findings regarding the traffic volume surveys as well as the detail calculations are attached in **Table E.1, E.2 and E.3** of **Annex IV**.

2.12 Water resources Monitoring Plan

Bangladesh is a riverine country. Rivers in different hydrological regions have different characteristics. Rivers in the northern parts have fluvial characteristics while it is tidal in the south. The 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 2.46**). 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 erosion, accretion and shifting of the bankline of the Passur River with a half-yearly basis may facilitate the proper planning and management of the development works.

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

For the assessment of the riverbank erosion and accretion, time series satellite images were used. Then 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.

2.12.2 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 September 2019 and February 2020 were collected. After that, satellite images were geo-referenced to have the same projection system. Then, it was found that one image differs with other image. In that case, images were co-registered to avoid the distortion with each image.

2.12.3 Delineation of Bankline

After collection and processing of images, banklines were delineated for the mentioned period using Arc-GIS tool. Then, banklines were analyzed and superimposed to assess the erosion-accretion and shifting of the river during period from September 2019 to February 2020.

2.13 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 September 2019 to February 2020 (**Figure 2.46**) although there is red color in few locations which may be considered as negligible. Additionally, there is no bankline shifting of the Passur River along its both banks during its passage from Chalna to Hiron Point.

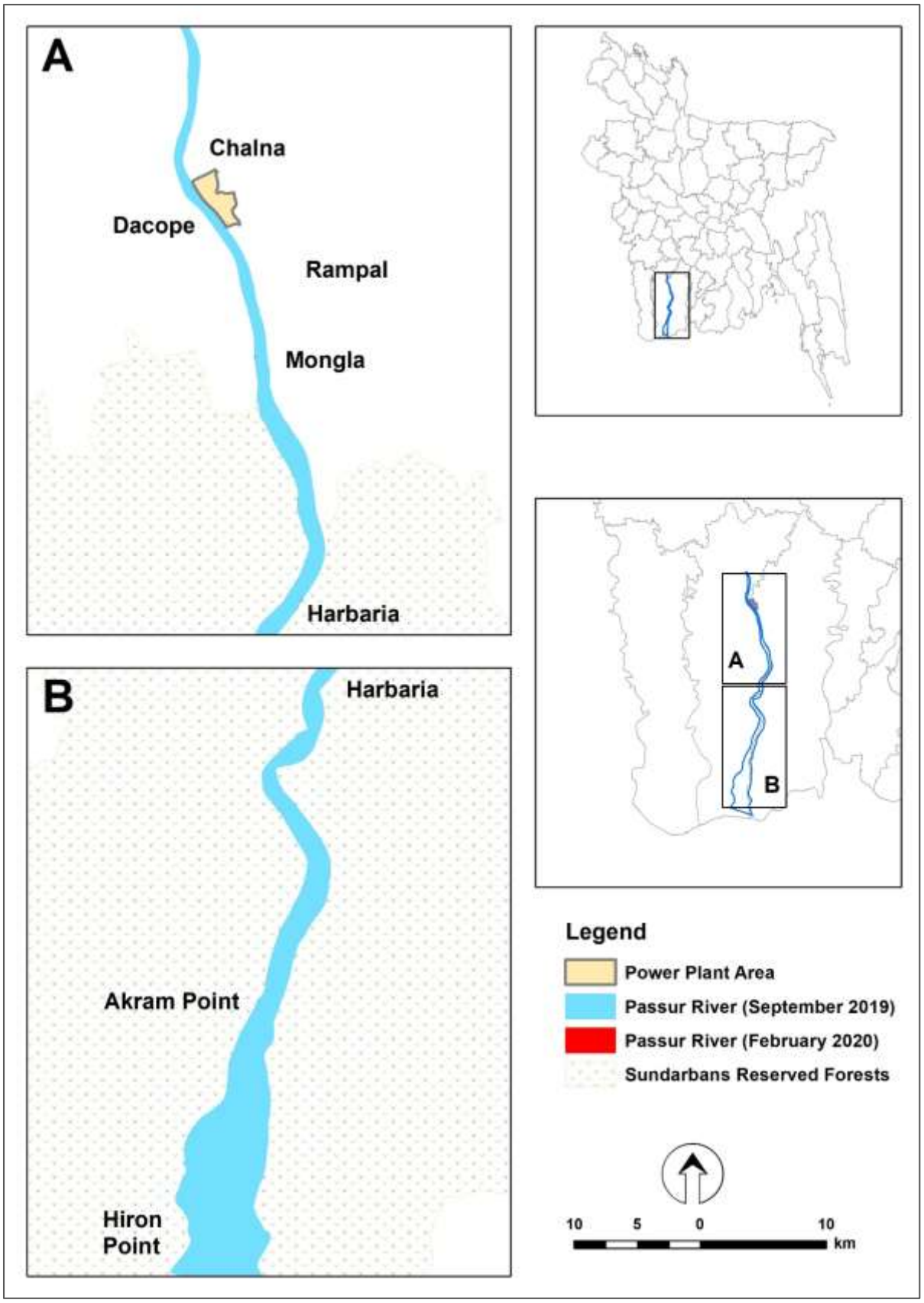


Figure 2.46: Riverbank Erosion and Accretion of the Passur River from September 2019 to February 2020

2.14 Monitoring of Chemical Properties of Bed Materials

2.14.1 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 is done in 23rd monitoring (February, 2020). The sediment quality assessment will be incorporated in 24th 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 have been selected in both near project area and inside the Sundarbans. The sampling locations are stated in **Table 2.12**. Locations of collected samples are presented in **Figure 2.47**.

Table 2.12: Location and 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″		

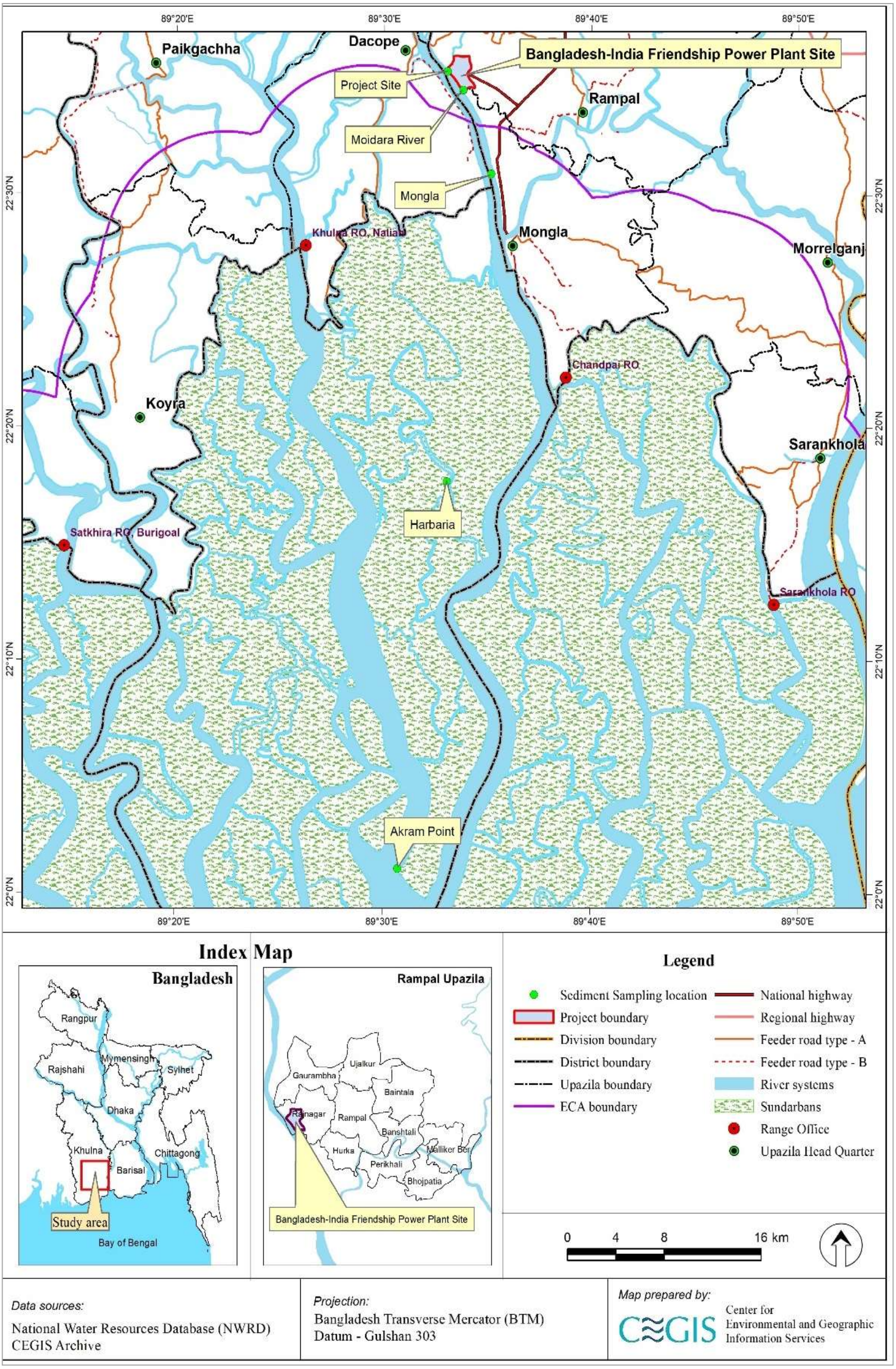


Figure 2.47: Sediment Sampling Locations

2.14.2 Process of Sediment Samples Collection

Plot Selection

The sampling locations are selected on the basis of potential route of coal transhipment and assumed major polluted area. Project site and Moidara 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 was 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 BCSIR, Dhaka for laboratory analysis immediate after 23rd monitoring. After the analysis the data will be incorporated in 24th monitoring report

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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 twenty-two 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 23rd quarter and comparison with the earlier 22 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	Chandpai
B	Haldikhali	G	Jongra
C	Charaputia	H	Mongla Port
D	Bhodra	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.

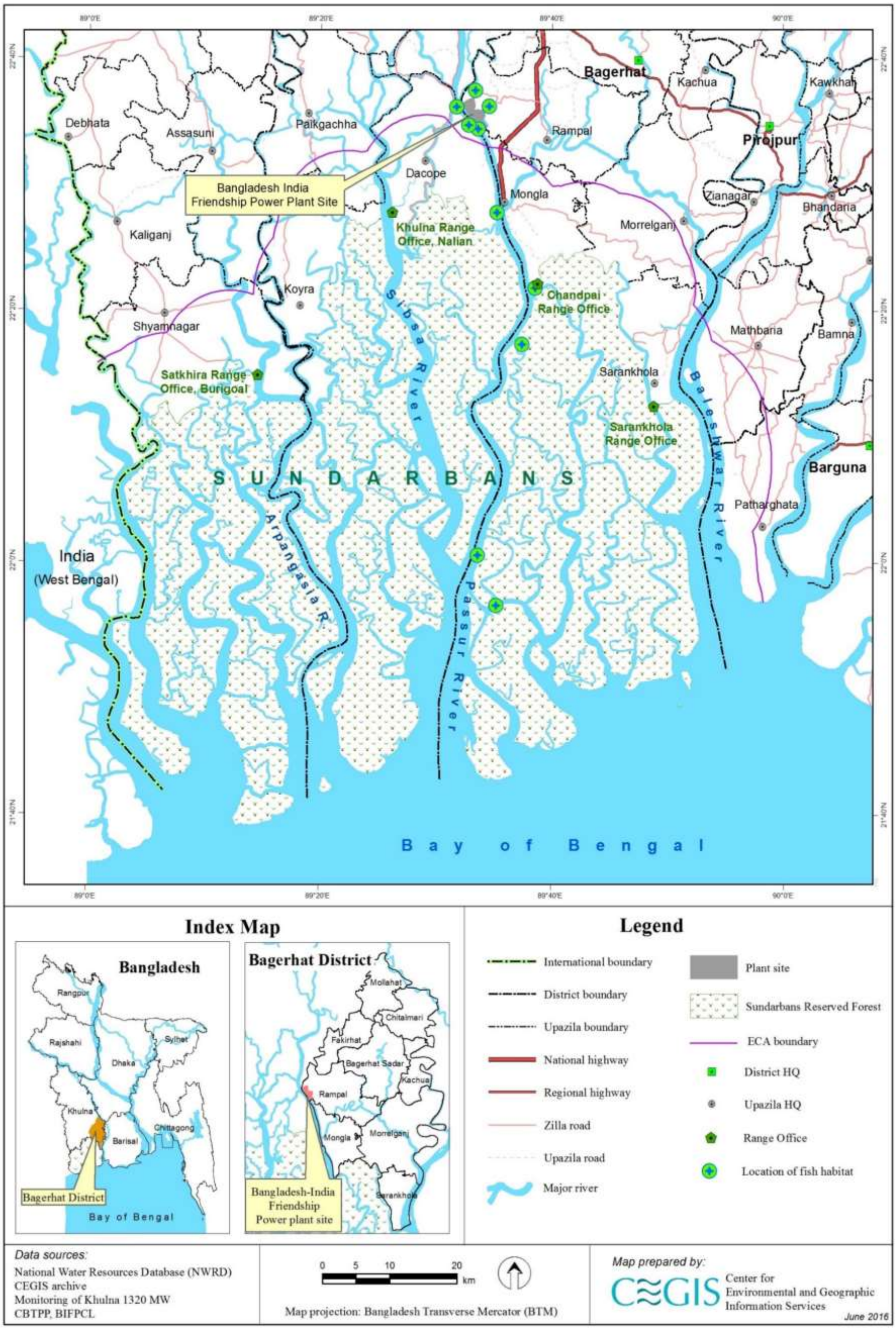


Figure 3.1: Fisheries Resources Monitoring Locations

3.1.2 Status of Monitoring

Followed by the quarter monitoring of the 2014-15, 2015-16, 2016-17, 2017-18 and 2018-19 (up to 22nd quarter monitoring), 23rd quarter monitoring of session 2019-20 was conducted during the period from 16 - 27 February, 2020. No fishing activities were observed at Akram Point (A), Haldikhali Khal (B), and Jongra-Passur Confluence (G) during field visit in this quarter 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.

Habitat Classification

Habitat classification was analyzed by using the length-wise distribution of different fish species in the sampling sites. The length of different life stages of fish species was identified and evaluated from literature review. Linkage distance was calculated with the similarity in distribution. The entire stretch of the Passur River System consists of three major behavioral habitats. The sampling sites were classified on the basis of abundance of different life stages of fish species in those habitats. The following tables show the classification of seven (07) sampling site for 1 to 15th quarter monitoring and ten (10) sampling sites from 16th to 22nd quarter monitoring according to the ToR in respect of habitat uses for previous quarters of fisheries monitoring (**Table D.1 of Appendix IV**).

Table 3.2: Classification of Habitat use of 10 Sampling Sites

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

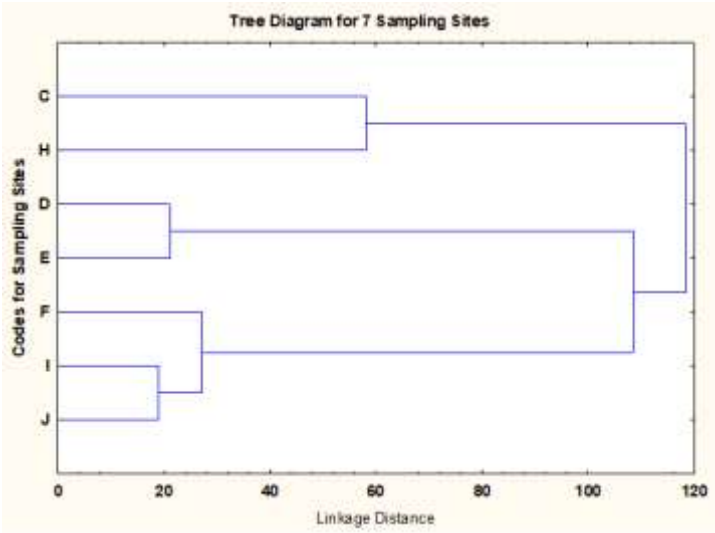
Monitoring Quarter	Type of Habitat Use
	• Nursing Ground
13th QM (April, 2017)	• Grazing and Feeding Ground • Nursing Ground
14th QM (October, 2017)	• Grazing and Feeding Ground • Nursing Ground
15th QM (January, 2018)	• Grazing and Feeding Ground • Nursing Ground
16th QM (April, 2018)	• Feeding ground • Growing ground • Nursing ground
17th QM (July, 2018)	• Spawning and Nursery Ground • Nursery Ground with Feeding and Growing Capacity • Growing and Feeding Ground • Omni-ground
18th QM (November, 2018)	• Ground for Maturation • Omni-Ground: Nursery and Feeding Ground/Migratory Route; Ground for Maturation; Growing and Maturation Ground; Maturation Ground for Juveniles
19th QM (February, 2019)	• Ground for Feeding • Omni-Ground including Nursery Ground and Ground for Maturation
20th QM (April, 2019)	• Ground for Feeding and Maturation • Omni-Ground including Nursery Ground and Ground for Maturation
21st QM (July, 2019)	• Ground for Feeding and Maturation • Omni-Ground including Nursery Ground and Ground for Maturation
22nd QM (November, 2019)	• Spawning and Nursery Ground • Omni-Ground including Feeding and Maturation Ground

During the 23rd quarterly monitoring conducted in February of 2019-20 Session, the sampling sites were divided into three major classes and shown in the **Figure-3.2**.

1) **Nursery Ground:** The catch revealed that availability of Juvenile stage (Length group: 3-5cm and 5-10cm) of different fish species were dominant at Charaputia (C) and nearly dominant at Mongla Point (H) implying that these habitats support these two length groups. It indicates that the mentioned sampling sites were found to be used as nursery ground and ground supporting recruitment into adult age group for many medium and large sized fish species.

2) **Spawning Ground:** The catch revealed that availability of fry and fingerling stage (Length group: <2cm, 2-3cm and 3-5cm as defined in the methodology) of different fish species were dominant at Maidara (I), Chalna Point (J) and Chandpai (F). It indicates that these habitats might function as the spawning ground for various fish species.

3) **Ground for maturation and feeding:** The sampling sites, Bhodra (D) and Harbaria (E) were found to be rich in adult fishes. The length group of 10-20cm and >25cm were dominant in these sites. These sites were thus considered as the ground for maturation and feeding in respect of the observed fish species**.**

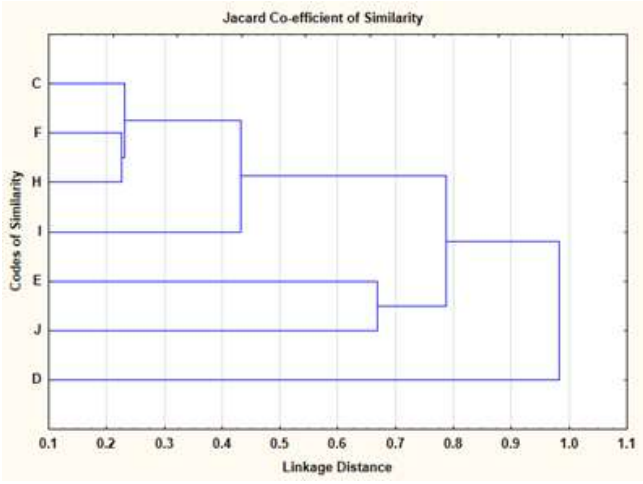


23rd Monitoring, February 2020

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

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

The dendogram indicated the distances among the JI (Jaccard Coefficient Index) indices which are opposite to the JI values. It was found that the length-wise distribution relationship varied not only with the seasons but also with the year to year. In this quarterly monitoring in 2019-20 (23rd), the JI value between the Chandpai Point (F) and Mongla Point (H) sampling sites were the highest (**Figure 3.3**) which indicates the maximum similarity in species occurrence between these two sites out of 7 sampling sites of available fishing (**Table D.2 of Appendix IV**).



23rd Monitoring, February 2020

Figure 3.3: Dendogram showing Similarity in Binary Species Composition in Seven Sampling Sites

Habitat Suitability Index (HSI)

Habitat Suitability Index (HSI) was determined for the year of 2014-15 and 2015-16 considering the exposure to water quality and the production performance of different fish species. Production performance was measured through considering length-structured production assessment model (E. L. Cadima, 2003). Suitability analysis was conducted by applying

Iyengar and Sudarshan (1982) developed model. All data was normalized through using UNDP developed normalization equation (*UNDP, 2006*).

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

Table 3.3: Habitat Suitability Index (HSI) for Selected Spot in the Study Area

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

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

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

Fish Diversity

Shannon-Weiner Index

In this monitoring year of 2019-20, species evenness also varies among the sampling sites. Highest Shannon-Weiner index was found at Charaputia (0.78) indicating most evenly distributed fish species. On the contrary, lowest evenness was found at the Mongla Point (0.4) (**Table 3.4 and 3.5**). It has also been found that both the number of fish species found in in-situ catch and the evenness of their distribution within the sampling sites show high variation with the changing seasonal and yearly bio-physical conditions. The different fish species caught in different catches are shown in **Figure 3.4**.

Fish Species Richness (FSR)

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

[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.

In this monitoring phase, species richness varies with the sampling sites. Maximum FSR was obtained at Maidara site (n=12), while very low FSR was recorded at Bhodra Khal Confluence (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, Chalna Point was home to a rich assemblage of Chali Chingri, Motka Chingri and Paissa, Maidara River was of Chali Chingri. Among the habitats in midstream portion, Chandpai was rich in Chamua Chingri.

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

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

Table 3.5: Site Wise Species Diversity using Shannon–Weiner Index (14th to 23rd QM)

Site	Species Number										Shannon-Weiner Index									
	14th QM	15th QM	16th QM	17th QM	18th QM	19th QM	20th QM	21st QM	22nd QM	23rd QM	14th QM	15th QM	16th QM	17th QM	18th QM	19th QM	20th QM	21st QM	22nd QM	23rd QM
A	0	0	3	0	8	0	2	0	0	0	0	0	0.92	0	0.16	0	0.65	0	0	0
B	0	0	0	0	2	0	-	0	0	0	0	0	0	0	0.92	0	-	0	0	0
C	0	0	12	0	0	24	11	0	0	10	0	0	0.69	0	0	1.69	0.86	0	0	0.78
D	0	0	0	0	0	0	-	0	0	1	0	0	0	0	0	0	-	0	0	0
E	0	0	0	17	12	0	2	0	0	2	0	0	0	0.31	0.73	0	0.99	0	0	0.72
F	6	17	0	0	0	13	22	19	11	11	0.85	0.81	0	0	0	1.44	0.74	0.5	0.81	0.56
G	81	29	21	16	19	0	26	0	0	0	0.62	0.74	0.78	0.85	0.34	0	0.58	0	0	0
H	112	13	3	18	2	13	-	5	11	10	0.54	0.21	0.55	0.49	0	1.44	-	0.14	0.76	0.40
I	3	13	12	10	17	11	8	9	11	12	0.88	0.33	0.21	0.65	0.85	1.46	0.14	0.52	0.80	0.54
J	4	5	10	14	11	21	12	14	9	8	0.78	0.32	0.54	0.52	0.52	0.98	0.50	0.71	0.50	0.64

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

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

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

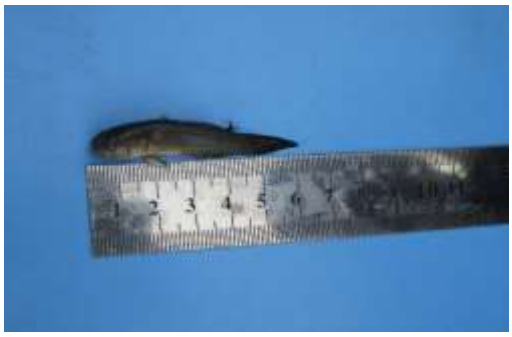
Table 3.7: Site wise Rich Species Number (13th to 23rd QM)

Site	Location	No. of Rich Species										
		2017-18			2018-19				2019-20			
		13th	14th	15th	16th	17th	18th	19th	20th	21st	22nd	23rd
A	Akram Point	2	0	0	4	0	1	0	2	0	0	0
B	Haldikhali	1	0	0	0	0	3	0	-	0	0	0
C	Charaputia	0	0	0	4	0	0	4	7	0	0	5
D	Bhodra	0	0	0	0	0	0	0	-	0	0	1
E	Harbaria	7	6	6	0	2	4	0	2	0	0	2
F	Chandpai	6	5	7	11	9	2	3	7	4	6	2
G	Jongra	0	0	0	0	0	0	0	3	0	0	0
H	Mongla Point	2	2	1	2	3	0	3	-	1	5	2
I	Maidara	1	3	2	1	3	9	3	1	1	6	3
J	Chalna Point	4	2	1	2	3	2	2	2	3	2	3

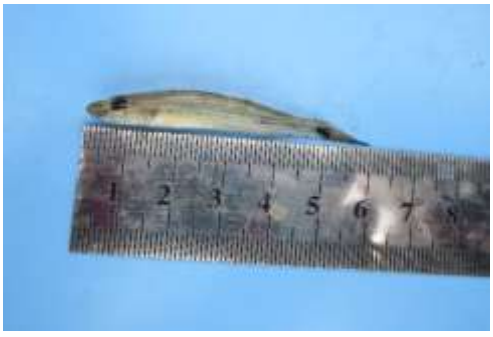
Source: CEGIS Field Survey, April 2014-February 2020

Golda

Poa



Mutkura



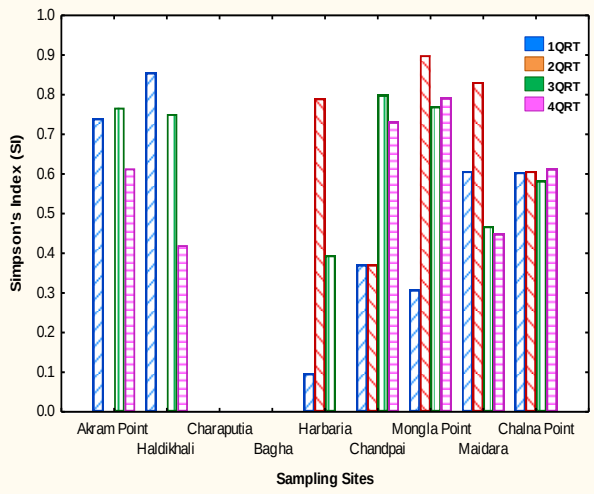
Baila

Paissa

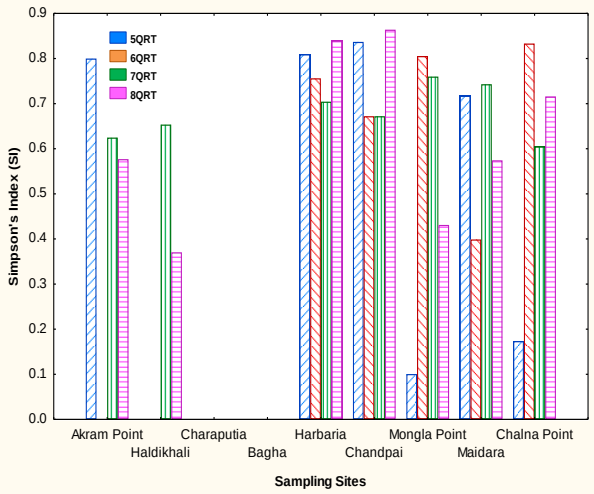
Kain Magur

Source: CEGIS Field Survey, February 2020

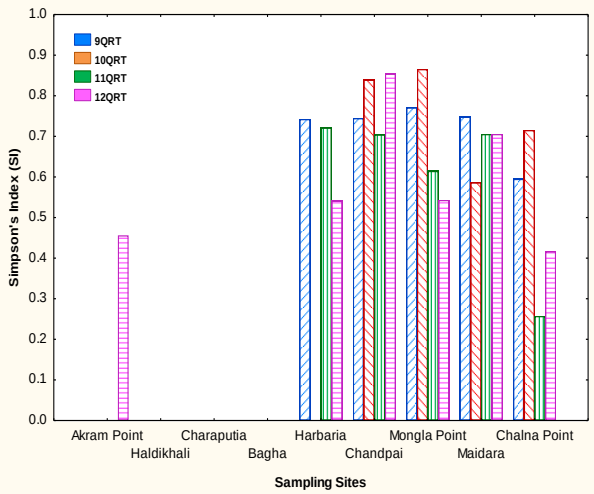
Figure 3.4: Available Fish Species Observed in Different Quarters Monitoring



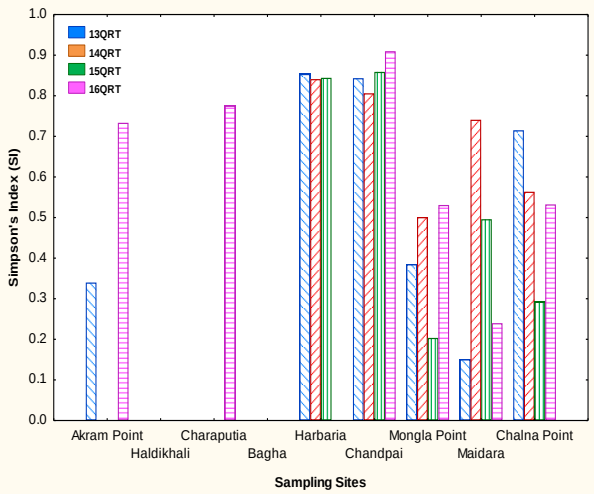
2014-2015



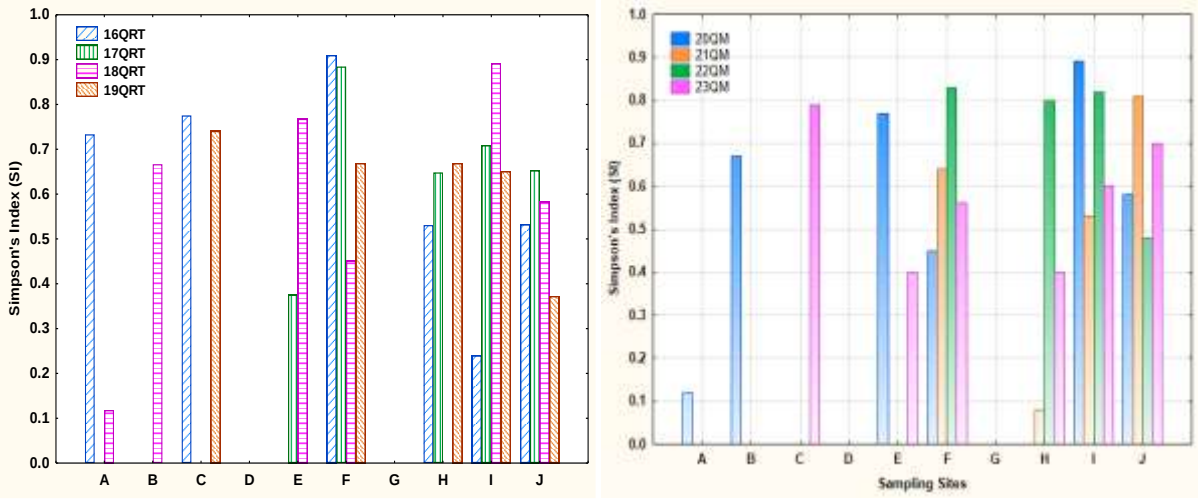
2015-2016



2016-2017



2017-18



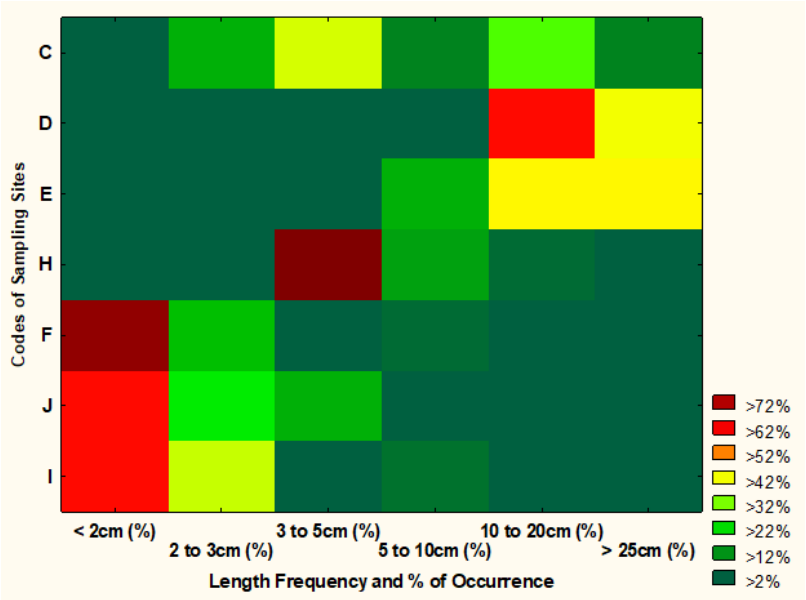
2018-19 **2019-20**

(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 **Figure 3.6** for 23rd quarter of monitoring year of 2019-20 shows that fries were dominant at Chandpai, Maidara and Chalna Point, juvenile to adult age group at Mongla, Maidhara, Charaputia, Bhodra and Harbaria Point. For the previously quarters the findins are provided in **Table D.4 of Appendix IV**. The catch revealed that among the fishes Chamua Chingri, Motka Chingri and Vati Chingri were dominant in the seven sampling sites.



23rd Monitoring, February, 2020

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 *Amadi Chela* attain the maximum abundance among the migratory fish species observed in the 23rd quarter of monitoring year, 2019-20. The relative abundance of the migratory species is given below in the **Figure 3.7**.

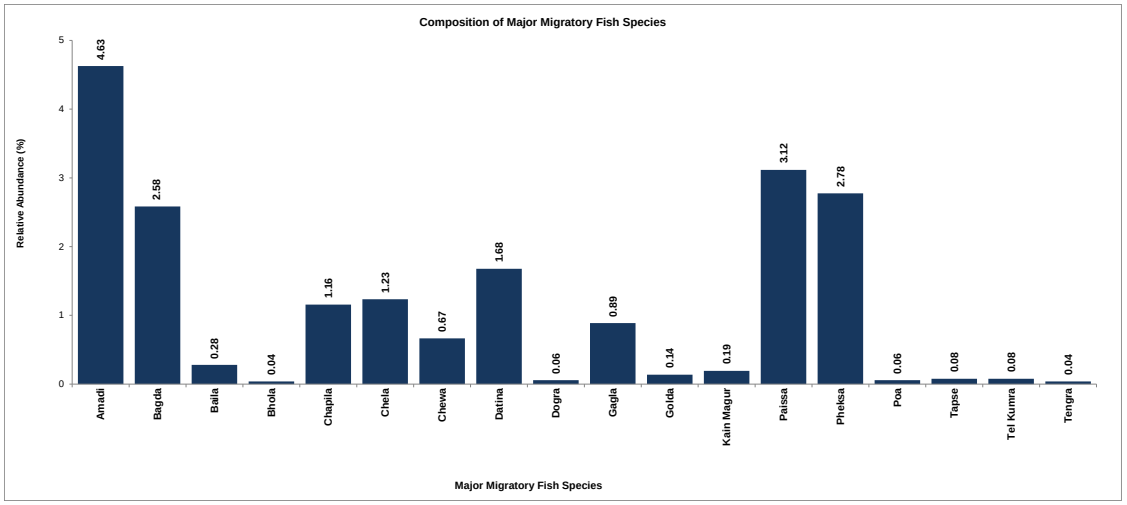


Figure 3.7: Relative Abundance of Major Migratory Fish Species in Sampling Sites

Migration Extent, Time and Purpose

Major fish species showed interesting pattern in distribution for exploiting different purposes mentioned in the following table all along the sampling sites. Among migratory species, Poa, Paissa, Baila, and Daitna were observed to migrate long distance (**Figure 3.8** and **Table D.7 of Appendix IV**).

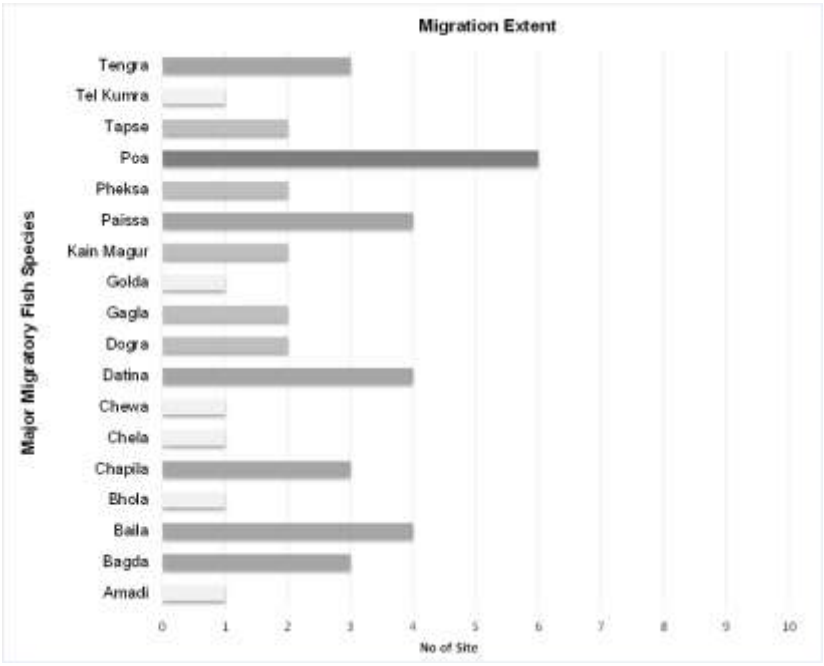


Figure 3.8: Migration Eextent of Major Migratory Fish Species in Sampling Sites

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 fish stocking was started during this monitoring period. The availability of wild seed (PL) was found to be increased during this monitoring. For this reason, most of the farmers collected wild seeds for their farms.

In this monitoring year, the highest stocking rate in respect of Bagda was observed in case of gher in Kapashdanga followed by Rajnagar and that of Chunkuri-2. On the other hand, stocking density in respect of Paissa was highest at Chunkuri-2 followed by Rajnagar and Kapashdanga (**Table 3.8**).

Table 3.8: Stocking Pattern of Fish/Shrimp Farm

Location	Fish Species	Stocking Density (No/ha)	Stocking Date
Rajnagar *(42.09 ha)*	Bagda	4,752	20/01/2020 and 10/02/2020
	Paissa	5,940	
Kapashdanga-Muralia *(115.7ha)*	Bagda	5,436	24/12/2019 and 22/02/2020
	Paissa	5,186	
	Datina	648	
	Kakra	173	
Chunkuri-2 *(6.07ha)*	Paissa	9,885	08/01/2020 and 15/02/2020
	Golda	247	
	Kharul	1647	
	Bagda	824	
	Tilapia	379	
	Kakra	412	

During the 23rd quarter of monitoring, the highest growth rate has been observed in the Kapasdanga Gher. (**Table 3.9** and **Table 3.10**).

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

Gher No.	1st QM (Apr 2014)		2nd QM (Jul 2014)		3rd QM (Oct 2014)		4th QM (Jan 2015)		5th QM (Apr 2015)		6th QM (Aug2015)		7th QM (Oct 2015)		8th QM (Jan 2016)		9th QM		10th QM		11th QM		12th QM		13th QM	
	Growth Rate (cm/day)	Mortality (%)	Growth Rate (cm/day)	Mortality (%)	Growth Rate (cm/day)	Mortality (%)	Growth Rate (cm/day)	Mortality (%)	Growth Rate (cm/day)	Mortality (%)	Growth Rate (cm/day)	Mortality (%)	Growth Rate (cm/day)	Mortality (%)	Growth Rate (cm/day)	Mortality (%)	Growth Rate (cm/day)	Mortality (%)	Growth Rate (cm/day)	Mortality (%)	Growth Rate (cm/day)	Mortality (%)	Growth Rate (cm/day)	Mortality (%)	Growth Rate (cm/day)	Mortality (%)
1	0.3	15-20	0.2	40	0.25	50	-	-	-	30	0.18	25	0.20	60	-	-	-	-	0.2	20	0.20	60	-	-	-	30
2	0.3	30-35	0.3	94	0.25	10	-	-	-	-	0.14	20	0.15	100	-	-	0.21	15	0.3	40	0.25	50	-	-	-	10
3	0.2	25-30	0.2	25	0.20	65	-	-	-	10	0.15	50	0.25	20	-	-	0.17	30	0.15	30	0.20	30	-	-	-	25

Table 3.10: Growth Rate and Mortality of Fish/Shrimp (14th to 23rd QM)

Gher No.	14th QM		15th QM		16th QM		17th QM		18th QM		19th QM		20th QM		21st QM		22nd QM		23rd QM	
	Growth Rate (cm/day)	Mortality (%)	Growth Rate (cm/day)	Mortality (%)	Growth Rate (cm/day)	Mortality (%)	Growth Rate (cm/day)	Mortality (%)	Growth Rate (cm/day)	Mortality (%)	Growth Rate (cm/day)	Mortality (%)	Growth Rate (cm/day)	Mortality (%)	Growth Rate (cm/day)	Mortality (%)	Growth Rate (cm/day)	Mortality (%)	Growth Rate (cm/day)	Mortality (%)
1	0.03	50	-	-	0.28	0.28	0.38	80	-	-	-	-	0.35	50	0.38	-	0.35		-	-
2	0.38	35	-	-	0.42	0.42	0.30	70	0.30	80	-	-	0.45	80	0.44	-	0.45		-	-
3	0.02	25	-	-	0.4	0.4	0.20	50	-	-	-	-	0.34	40	0.36	-	0.37		-	-

Source: CEGIS Field Survey, 2014, 2015, 2016, 2017, 2018, 2019 & 2020

Fish Production

Capture Fish Production

In 23rd quarter monitoring, the highest productivity was found at Mongla Point followed by Charaputia and Maidara river **(Table 3.11**). The Chalna and Chandpai Point were observed mainly to be used for fry collection and fries found in catch was not considered in the productivity assessment. Fishing is shown in **Figure 3.9**.

The present study revealed that the highest catch susceptibility was also found in case of Bepdi Jal (20 kg/haul) (**Table 3.12 and 3.13**).

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

Site	Habitat	Gear Name/Type	Haul Duration (hr)	No of Haul	kg/haul
A	Confluence at Akram Point	Not Found	-	-	-
B	Haldikhali Khal	Not Found	-	-	-
C	Charaputia Khal	Moi Jal	0.5	1	0.1
		Borshi	-	-	-
D	Bhodra Confluence	Borshi	-	-	-
E	Harbaria Khal	Borshi	-		-
F	Passur River	Net Jal	-	-	-
G	Passur-Jongra Confluence	Not Found	-	-	-
H	Passur-Mongla Confluence	Bepdi jal	3	1	20
I	Passur-Maidara Confluence	Net Jal	-	-	-
		Khepla Jal	0.2	10	0.04
J	Passur River, Chalna Point	Net Jal	-	-	-

Source: Catch assessment survey, CEGIS, February 2020

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

Table 3.12: Total Catch in the Sampling Sites (From 1st to 13th QM)

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

Table 3.13: Total Catch in the Sampling Sites (From 14th to 23rd QM)

Sampling Site	Total Catch (kg)									
	13th QM	14th QM	15th QM	16th QM	17th QM	18th QM	19th QM	20th QM	21st QM	22nd QM	23rd QM
A	2	0	0	17	0	16	0	0.40	0	0	0
B	0.25	0	0	0	0	1	0	0.00	0	0	0
C	0	0	0	1.50	0	0	93	17.50	0	0	4.6
D	0	0	0	0	0	0	0	0.00	0	0	1.35

Sampling Site	Total Catch (kg)										
	13th QM	14th QM	15th QM	16th QM	17th QM	18th QM	19th QM	20th QM	21st QM	22nd QM	23rd QM
E	8.13	1.5	2.56	0	0.1	2	0	0.50	0	0	1.17
F	0	0	0	0	0	0	0	0.00	0	0	0
G	77.5	10.5	37.67	3	4	27	0	0.00	0	0	0
H	0	0	0	0.33	22	0	5	0.00	11.5	0.2	20
I	0.3	0.4	0.67	0.13	3	5	1.2	0.00	0.5	1.7	0.4
J	0.12	0.3	0	1	0.25	1.2	0.6	0.17	1.6	0.8	0

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

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

Figure 3.9: Fishing Gears and Crafts used in Fishing at Sampling Sites

Culture Fish Production

The present study on shrimp/fish farm in the 23rd quarter monitoring phase showed that the

few amount of Harina Chingri was caught from the Gher of Rajnagar and Kapashdanga **(Table D.8** of **Annex-IV)**.

3.2 Monitoring of Ecosystem and Bio-diversity

3.2.1 Indicators Selection

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

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

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

Among the terrestrial faunal community, Bird is an important class that is sensitive to their habitat condition. Changes of environmental parameters, 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 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

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

Homestead at Kalekarber Dighi

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

Homestead at Chalkghona

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

Homestead at Barni

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

Random quadrate vegetation survey has been conducted at selected homesteads during recent monitoring tier. A total of 54 plant species (excluding undergrowths) has been recorded from 16 number of surveyed sample quadrates. Details of the survey result is presented in **Table 3.14**.

Plant health

Structure of vegetation community of this area is tree dominant. Random saline water shrimp farming is a big threat to plant health of this area. Hence, Plant health of this area is not

satisfactory. Expansion of shrimp farming in this area triggered incretion of salinity of soils. For this reason, overall plant succession, growth and productivity have changed day by day.

Plant Diseases and symptoms in homestead vegetation

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

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)**.

Table 3.14: Species composition of the sampled homesteads

Sl. No.	Species Name	Local Name	Rajnagar				Borni				Kalekarber				Chalkghona				Tot. No. of individuals	Biodiversity Index
			Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16		
1	*Adhatoda vasica*	Bashok							1										1	**3.98**
2	*Albizia richardiana*	Chambol						2			2	2	20		1	0	0	0	27	
3	*Albizia saman*	Rendi Koroi					4	4		1	1				1	2			13	
4	*Apanomixys polistachya*	Rhyna		1					1			3	1	1					7	
5	*Areca catechu*	Supari						1	15	7		1							24	
6	*Azadirachta indica*	Neem	2		1							1	1	6					11	
7	*Borassus flabeliffer*	Taal	2								4			3				2	11	
8	*Carica papaya*	Pepey													4				4	
9	*Citrus maxima*	Jambura																1	1	
10	*Citrus medica*	Lebu							1						2	0	0	0	3	
11	*Cocos nucifera*	Narikel	2	3	3	5	3	5	3		3	6	8	5	3	1	2		52	
12	*Colocasia esculenta*	Mankochu						10							20	0	0	0	30	
13	*Cordia dichotoma*	Bohal													0	1	0	0	1	
14	*Dentella repens*	Danton													0	1	0	0	1	
15	*Diospyros pregrina*	Gaab					1				4				2	3	0	0	10	
16	*Erythrina ovalifolia*	Mandar													0	0	0	1	1	
17	*Euphorbia tithymaloides*	Rangchita					20	2											22	
18	*Euphorbia tirucalli*	Pencil Tree					10	10											20	
19	*Eucalyptus sp*	Eucalyptus						1											1	
20	*Acrostichum aureum*	Tiger Fern		5			3	12		18	2			10			3	6	59	
21	*Excoecaria agallocha*	Gewa		11	29	18			1	5					0	0	20	15	99	
22	*Ficus benjamina*	Jogadumur						4		1					0	0	0	1	6	
23	*Ficus hispida*	Dumur										1	5		0	0	0	1	7	
24	*Heritiera fomes*	Sundari				9													9	
25	*Hibiscus tiliaceus*	Bola		2			2	2	2		2	1	3	8					22	
26	*Ipomoea fistulosa*	Dhol Kolmi					25												25	
27	*Lawsonia inermis*	Mehedi	2																2	
28	*Lepisanthes rubiginosa*	Amjum/ Baraharina	1																1	

Sl. No.	Species Name	Local Name	Rajnagar				Borni				Kalekarber				Chalkghona				Tot. No. of individuals	Biodiversity Index
			Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16		
29	*Limonia acidissima*	Kotbel	1				1												2	
30	*Mangifera indica*	Aam					3					1			11	4	0	0	19	
31	*Manilkara zapota*	Safeda	1				1				1	-							3	
32	*Mimusops elengii*	Bokul										1							1	
33	*Moringa oleifera*	Sazna									-	-	1		1				2	
34	*Musa sp*	Kola					6	7			21	9			8	0	0	0	51	
35	*Nipa fruticans*	Golpata													0	0	0	5	5	
36	*Pandanus sp*	Keya Kanta				5													5	
37	*Phoenix sylvestris*	Khejur	2	2	5	2		1	2				2	20	1	0	1	4	42	
38	*Phyllanthus acidus*	Orboroi									1					2			3	
39	*Phyllanthus reticulatus*	Sitki							1										1	
40	*Pithecellobium dulce*	Khoi Babla			1														1	
41	*Pongamia pinnata*	Koroach		1											0	2	0	0	3	
42	*Psidium guajava*	Peyara					1		1	1	2				2	0	0	0	7	
43	*Punica granatum*	Bedana													1	0	0	0	1	
44	*Sonneratia apetala*	Kewra			1														1	
45	*Swietenia mahagoni*	Mahagoni					6	6	4	1	29	25	12	6	3	5	0	0	97	
46	*Syzygium cumini*	Jaam	1												1	0	0	0	2	
47	*Tamarindus indica*	Tentul				1									1	0	0	0	2	
48	*Terminalia arjuna*	Arjun							1						1	0	0	0	2	
49	*Terminalia catapa*	Kathbadam					2		2						0	0	0	1	5	
50	*Unknown 2*						2	2	2	14									20	
51	*Singara Tree*														0	0	0	1	1	
52	*Unknown 5*								1										1	
53	*Vachellia nilotica*	Babla													0	0	0	1	1	
54	*Zizyphus sp*	Kul boroi													3	0	0	0	3	

Source: CEGIS field survey

Number of diseases affected trees

Plant health status is more or less same comparing to previous monitoring period except Rajnagar. All the cases, monocots like Coconut (*Cocos nucifera)* and Date Palm (*Phoenix sylvestris)* are the main affected species. At Rajnagar site, Coconut plant observed mostly unhealthy than all other species as the land is surrounded by saline water shrimp farms and local depressions. A total of 10 coconut plants were affected at this site and most of them are signed with lethal bole rot, narrowing upper trunk and radish brown. Except the disease-affected monocots, other plants are followed healthy. However, comparing the February 2019 monitoring, the plant health has followed slightly improving trend in this year due to reduce salinity and saline water saturation at homestead platforms for improvement of drainage systems by functioning the tidal canals flow beside the homesteads. Following table represents the proportion of healthy and unhealthy plants in studied homesteads (**Table 3.15**).

Table 3.15: Number of Healthy and Unhealthy Plants in Studied Homesteads

Location	Plant Name	Total No. of Plant	No. of Unhealthy Plant																	
			Apr 2014	Jun 2014	Oct 2014	Jan 2015	Apr 2015	Aug 2015	Oct 2015	Jan, 2015	Oct, 2016	Jan, 2017	Jan, 2018	Apr, 2018	Jul, 2018	Nov, 2018	Feb 2019	Apr, 2019	Jul, 2019	Nov, 2019	Feb, 2020
Rajnagar	Cocos nucifera	17*	NS	10	5	5	15	4	5	NS	3	4	6	6	9	4	4	3	2	3	10
	Phoenix sylvestris	25	NS	15	4	4	22	9	13	NS	10	2	5	4	7	6	8	9	5	3	4
	Manilkara zapota	1	NS	0	0	0	0	0	0	NS	-	-	-	-	-		-	-	-	-	-
	Albizia saman	2	NS	0	0	0	0	0	0	NS	-	-	-	-	-		-	-	-	-	-
	Excoecaria agallocha	55*	NS	0	1	1	0	0	0	NS	-	-	-	-	-		-	-	-	-	-
	Mangifera indica	3	NS	1	0	0	2	0	0	NS	-	-	1	-	-	1	-	-	-	-	-
	Psidium guajava	2	NS	2	0	0	2	0	0	NS	-	-	-	-	-		-	-	-	-	-
Borni	*Cocos nucifera*	10	7	3	0	0	3	1	2	NS	1	2	3	1	2		1	1	1	2	1
	Phoenix sylvestris	12	0	5	4	4	3	1	4	NS	4	3	4	2	1		-	1	1	-	-
	Borassus flabellifer	6	3	1	0	0	0	0	0	NS	-	-	-	-	-	1	1	-		-	-
	Mangifera indica	6	3	3	1	1	4	0	0	NS	-	-	-	-	-		-	-		-	-
	Excoecaria agallocha	18	0	0	0	0	0	0	0	NS	-	-	-	-	-		1	-		-	-
	Swietenia mehogani	11	0	0	0	0	1	0	0	NS	-	-	-	-	-		-	-		-	-
	Areca catechu	10	0	6	2	2	8	2	2	NS	-	1	-	3	-		-	-		-	-
	Manilkara zapota	1	0	0	0	0	0	0	0	NS	-	-	-	-	-		-	-		-	-
	Psidium guajava	2	2	1	0	0	0	0	0	NS	-	-	-	-	-		-	-		-	-
Kalekarber Dighi	*Cocos nucifera*	56	35	5	1	1	2	2	3	NS	1	1	-	6	3		1	3	1	7	4
	Phoenix sylvestris	10	0	3	0	0	1	0	1	NS	3	-	3	-	-		-	-			-
	Mangifera indica	5	1	1	0	0	0	0	0	NS	-	-	-	-	-		-	-			-
	Manilkara zapota	2	0	0	0	0	1	0	0	NS	-	-	-	-	-		-	-			-
	Borassus flabellifer	8	0	0	0	0	0	0	0	NS	-	-	-	-	-		-	-			-
	Zizyphus sp	1	0	0	0	0	0	0	0	NS	-	-	-	-	-		-	-			-
	Psidium guajava	8	0	0	0	0	0	0	0	NS	-	-	1	-	-		-	-			-
	Tamarindus indica	2	0	0	0	0	1	0	0	NS	-	-	-	-	-		-	-			-
Chalkghona	*Cocos nucifera*	39	25	19	5	5	34	20	0	NS	2	2	4	5	3		3	4	2	4	3
	Phoenix sylvestris	24	0	10	1	1	6	5	1	NS	1	-	5	2	3		-	1	2	2	1
	Albizia saman	3	0	0	0	0	1	0	0	NS	-	-	-	-	-		1	-			-
	Excoecaria agallocha	36	0	0	1	1	0	0	0	NS	-	-	-	-	2		-	-			-
	Manilkara zapota	1	0	0	0	0	0	0	0	NS	-	-	-	-	-		-	-			-
	Psidium guajava	17	1	7	0	0	0	0	0	NS	-	-	-	-	-	1	3	-		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	-	-	-	-	-		-	-			-

*Source: CEGIS Field Survey; Note: NS = Not Surveyed; *=1 Cocos and 45 Excoecaria have been cut*

Vegetation canopy status

Species representation in different canopy layers of homestead vegetation

Coconut (*Cocos nucifera)* occupied top canopy of all the studied homestead vegetation. Date Palm (*Phoenix sylvestris)* is prevalent as second top layer followed by Gewa (*Excoecharia agallocha)*. Most of the fruit yielding trees like Sofeda (*Manilkara zapota),* Mango (*Mangifera indica)* possess upper bole of canopy layer. Lower bole 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

There is no change of plant canopy status all the sites comparing to previous monitoring in Nov 2019. But the canopy coverage has reduced at Rajnagar site comparing to same season monitoring in February 2019. This may be caused due to occurrence of Cyclone Bulbul in last November in this area which caused fall some trees and also fall leaves all the trees. In addition, at, Kalekarber and Rajnagar, the home owners have cleared some trees to make room there and land developed by sand. Comparing the data November 2019 and February 2020, canopy coverage at Borni, Kalekarber and Chalkghona have improved in some extents for extending the canopies of last year planted trees **Table 3.16**

Table 3.16: Vegetation Canopy Cover in different Studied Homesteads

Location	% of canopy Coverage																			
	Apr 2014	Jun 2014	Oct 2014	Jan 2015	Apr 2015	Aug 2015	Oct 2015	Jan 2016	Jul 2016	Oct 2016	Jan 2017	Jan 2018	Apr 2018	Jul 2018	Nov, 2018	Feb, 2019	Apr, 2019	Jul, 2019	Nov, 2019	Feb, 2020
Rajnagar	NS	19	19	17	20	20	20	20	21	23	19	15	18	14	11	22	19	18	**16**	**14**
Borni	NS	26	18	18	12	14	20	20	25	25	23	21	21	23	20	21	21	20	**18**	**20**
Kalekarber	NS	20	24	25	23	24	24	22	24	26	25	23	24	24	25	24	25	25	**24**	**24**
Chalkghona	NS	13	24	22	17	21	21	20	21	27	26	25	16	18	21	22	22	22	**20**	**23**

Note: NS = Not Surveyed

Bird Habitat

Local birds and their nesting behaviour

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

Migratory birds and their habitats

Migratory and local migratory winter birds are followed at large shrimp gher along the study area. According to local people and physical observation, Common Coot, Common Snipe, Black Winged Stilt, Ruddy Shellduck, Little Grebe etc. are common winter visitor of this area.

In addition, local Ruddy Breasted Crake, Common Sandpper, Great Egret, Pond Heron, Little Cormorant are also found at most of the monitoring wetlands of the study area.

Local Migratory birds have been observed at Borocharar Gher, Chotocharar Gher, Putimarir Gher and Koigar Daskati Gher which have been informed during recent field visit. Winter Migratory birds have informed only at Chalkghonar Beel. But the population is very low than previous years as stated in previous monitoring in November 2019. According to local knowledgeable persons, population of migratory birds are reducing day by day from these wetlands for illegal hunting, re-starting shrimp culture within short intervals from shrimp harvesting in past year and shrimp farming round the year in lieu of paddy cultivation. In addition to this, construction vehicle movement through the approach road, vehicle lightings and noise from construction sites are disturbing the migratory birds at which are roaming at the nearby wetlands like Choto Charargher and Boro Charargher (shrimp farms).

Following **Table 3.17** show the presence of migratory birds at the important wetlands inside the study area.

Table 3.17: Presence of Migratory Birds at different Wetland inside the Study Area

Wetland Name	Wetland type	Approximate distance from project Boundary (Km.)	Presence of Birds	
			February 2020	
			LM	M
Choto Charargher	Saline Water Shrimp Farm	0.10	Yes	Yes
Boro Charargher	‘’	0.10	Yes	No
Putimari Gher	‘’	1.10	Yes	No
Golbunia Gher	‘’	0.1	Yes	No
Shukariar Gher	‘’	1.25	No	No
Koigar Daskati Gher	‘’	0.25	Yes	No
Badyamari Gher	‘’	1.00	No	No
Chalkghonar Beel	‘’	1.50	No	No

Note: ‘LM’=Local Migratory, ‘M’=Migratory, ‘Y’=Yes

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.

Figure 3.10: Irrawaddy Dolphin Schools at Akram Point

Dolphin occurrence in Passur and Maidara River

Dolphins occurrences have been monitored within about 12 km length of Passur and 1 km length of Maidara river surround the project area (From Digraz Kheya Ghat to Chalna Bazar including Maidara River) through boat transact during low and mid low tide. The survey was devided in two transects. First transect length was 12.7 km which took about two hours from Chalna Ghat to Maidara River to opposite river bank of Chalna Ghat. A total of 3 dolphins were recorded during this survey. Of which one dolphin was observed at Passur River, one was at Passur-Maidara confluence and another is at Maidara-Ichamati confluence. The second survey was conducted during neap tide from Digraz Kheyaghat to Chalkghona School Ghat through Passur and Maidara River. This survey transect was 7.2 km and total time spend about 1 hour. 2 dolphins were recorded at Maidara-Ichamati confluence. The encounter rate was 0.12 individuals/km/hour for first survey and 0.27 individuals/km/hour for second survey (**Figure 3.11**).

Dolphin occurrence in Dhangmari Khal and Shella Gang

Dolphin occurrence also observed at the Dhangmari Khal, Chandpai Shella Gang Wildlife Sanctuary and Bhadra Khal. In the case of Dhangmari Khal, total transect length was 13.4 km during neap tide from Dhangmari-Passur confluence to Gagramari Forest Patrol Post up and down (**Figure 3.12**). A total of 6 dolphins were recorded in Dhangmari Khal within about 1 hours and 20 min of transact time. The encounter rate was 0.34 individuals/km/hour.

In the case of Chandpai Shella Gang, the survey transact was bounded from Joymonirgho Thota to Jongra Forest Patrol Post during mid spring to full tide which transect length was about 9 km (**Figure 313**). A total of 25 individuals have been sighted during 103 minutes' survey. The encounter rate was 1.54 individuals/km/hour. Another survey was conducted at

Bhadra Khal inside Sundarbans Reserve Forest during full tide. During this monitoring, a total of 13 dolphins were recorded within the 3.5 km reach of Bhadra Khal from Bhadra Patrol Post to Bhadra- Passur confluence.

The distribution of dolphin occurrence at Bhadra Khal is presented in **Figure 3.14**.

Another short survey was conducted Karomjal, Harbaria and Akram Point while passing the river. Different Irrawaddy Dolphin schools has been notified at Harbaria and Akram Point while travelling on boat. However, the survey result is included in **Table 3.18**.

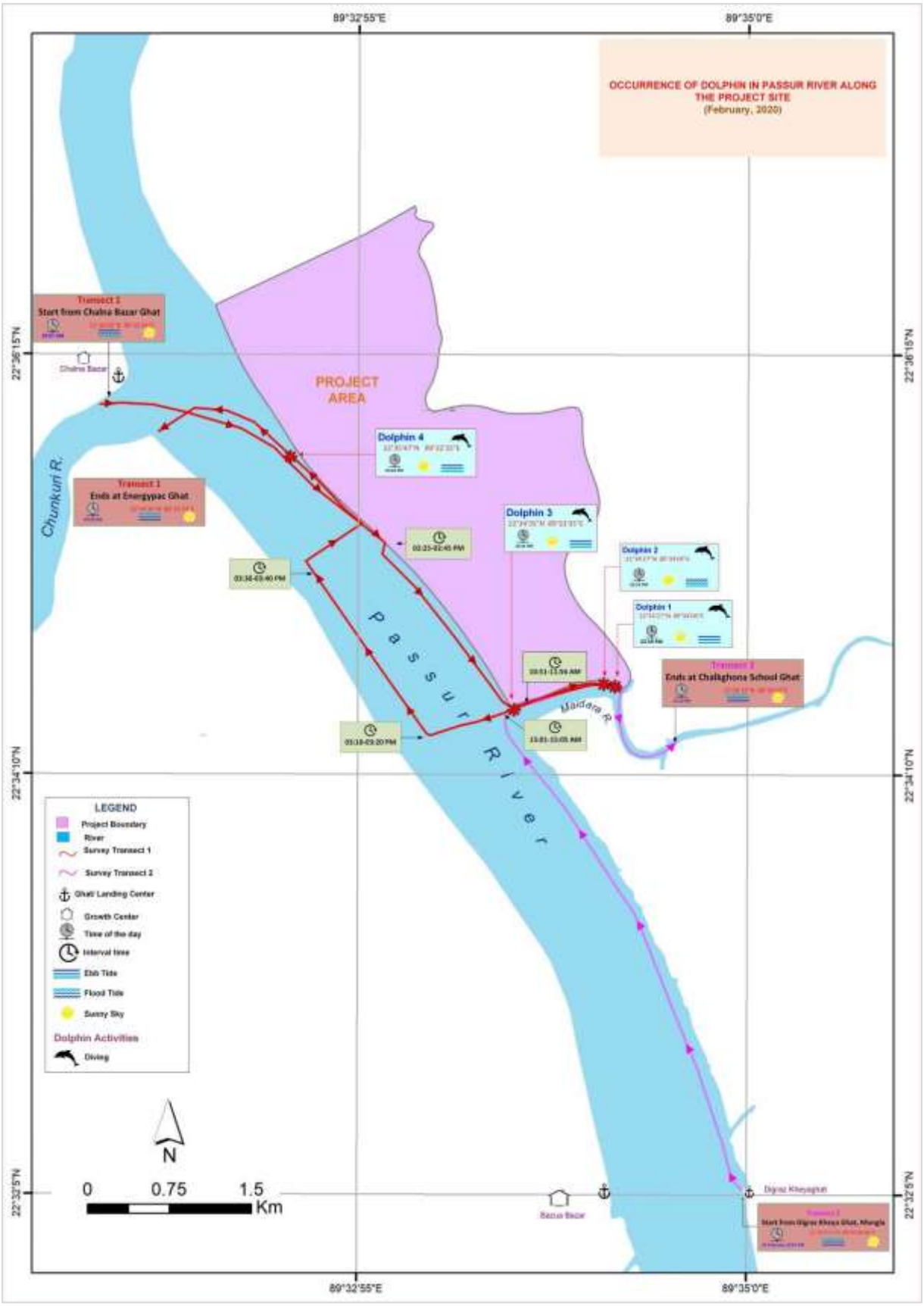


Figure 3.11: Occurrence of Dolphins at Passur and Maidara River along the Project Site

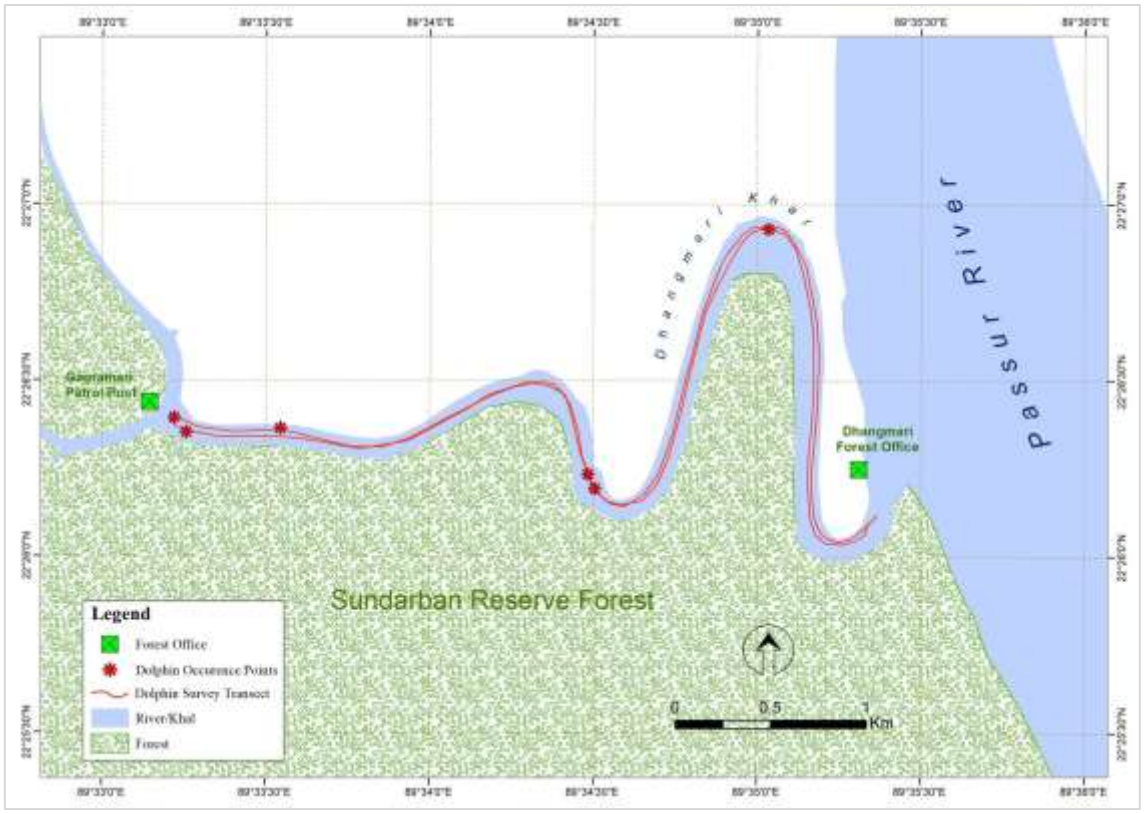


Figure 3.12: Location of Dolphin Occurrence at Dhangmari Khal

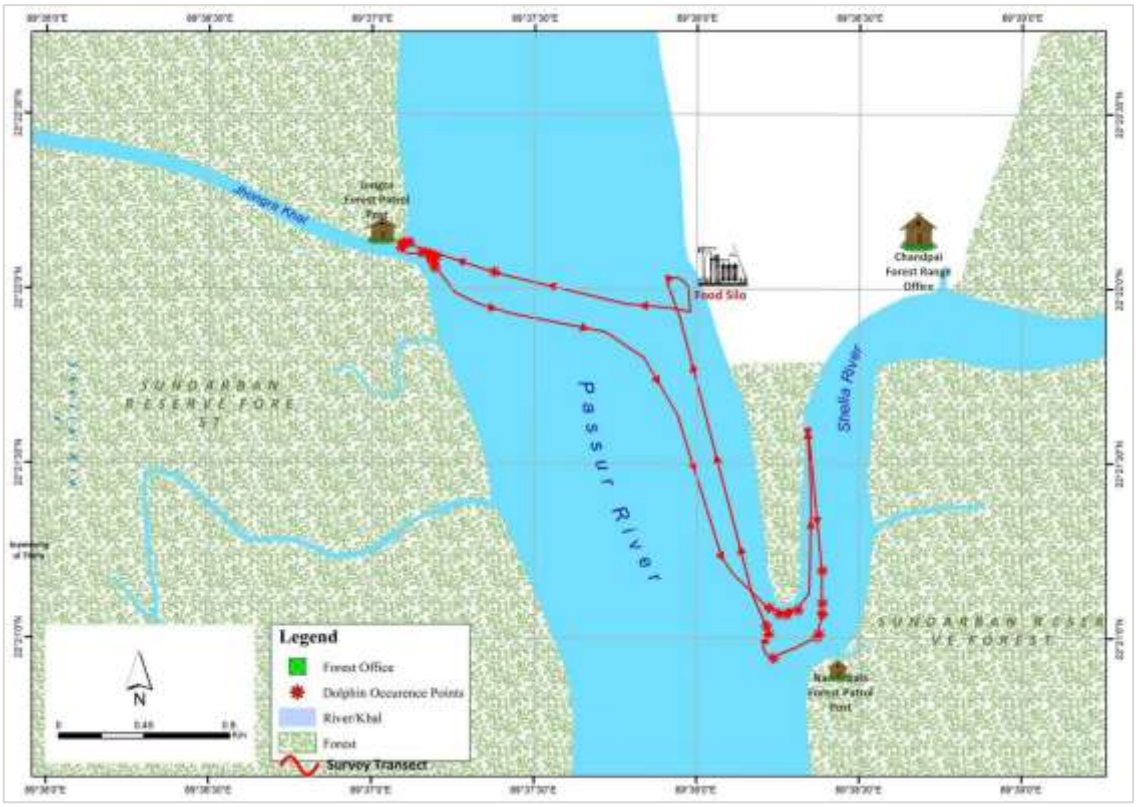


Figure 3.13: Location of Dolphin Occurrence at Chandpai (Shella River to Jongra Khal)

Figure 3.14: Location of Dolphin Occurrence at Bhadra Khal

Table 3.18: Dolphin Observation Datasheet

Location of River systems	Occurrence Status																																					
	Apr 2014		Jun 2014		Oct 2014		Jan 2015		Apr 2015		Aug 2015		Oct 2015		Oct 2015		Jul 2016		Oct 2016		Jan 2017		Jan 2018		Jun 2018		Nov 2018		Feb 2019		Apr 2019		Jul 2019		Nov, 2019		Feb, 2020	
	F T	N T	F T	N T	F T	N T	F T	N T	F T	N T	F T	N T	F T	N T	F T	N T	F T	N T	F T	N T	F T	N T	F T	N T	F T	N T	F T	N T	F T	N T	F T	N T	F T	N T	F T	N T	F T	N T
Project Site	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NS	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	NS	Y	NS	Y	NS	N	Y	Y	NS	Y	Y	Y
Karamjal	NS	NS	NS	N	NS	Y	Y	Y	N	N	NS	Y	NS	Y	Y	N	Y	NS	Y	Y	Y	Y	NS	Y	N	NS	N	N	N	Y	N	Y	N	Y	NS	Y	Y	Y	N
Harbaria	NS	NS	NS	N	NS	Y	Y	N	N	N	N	N	Y	NS	Y	N	Y	Y	Y	NS	N	N	Y	N	N	N	N	N	Y	N	N	Y	N	N	Y	N	Y	NS
Akram Point	NS	NS	NS	N	NS	N	NS	Y	Y	Y	NS	NS	N	Y	Y	NS	NS	NS	N	N	NS	NS	N	N	N	Y	N	N	N	Y	N	N	N	N	N	Y	Y	NS
Moidara River	Y	N	N	N	Y	Y	Y	N	Y	N	Y	N	NS	Y	N	Y	Y	NS	NS	Y	N	Y	NS	Y	Y	Y	NS	Y	NS	N	NS	N	Y	N	NS	Y	Y	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	Y	NS	NS	Y	Y	NS	Y	Y	Y	Y

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

Occurrence Status: Y = Occurred, N = Not occurred

3.3 Sundarbans Forest Health

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

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

3.4 Methodology

3.4.1 Permanent Sample Plot (PSP) Establishment and Layout

To set up permanent sample plots, five plots were established (**Figure 3.15**). Among those, five sites are along the Passur River at Karamjal, Harbaria, Akram point and in Hiron point respectively and the fifth plot is near Sutarkhali forest office (**Table 3.19**). The sites were selected considering the distance from the proposed project site, wind directions, coal transportation route, river systems and vegetation types.

3.4.2 Bio-Indicators for Forest Health Monitoring

There are many Bio-indicators for forest health monitoring. As the study forest is a mangrove forest, some of the mangrove traits were also selected as Bio-indicator. The Bio-indicators observed in this forest health monitoring program were seedling regeneration, pneumatophores, species diversity, crab hole density, canopy cover, leaf phenology, Leaf

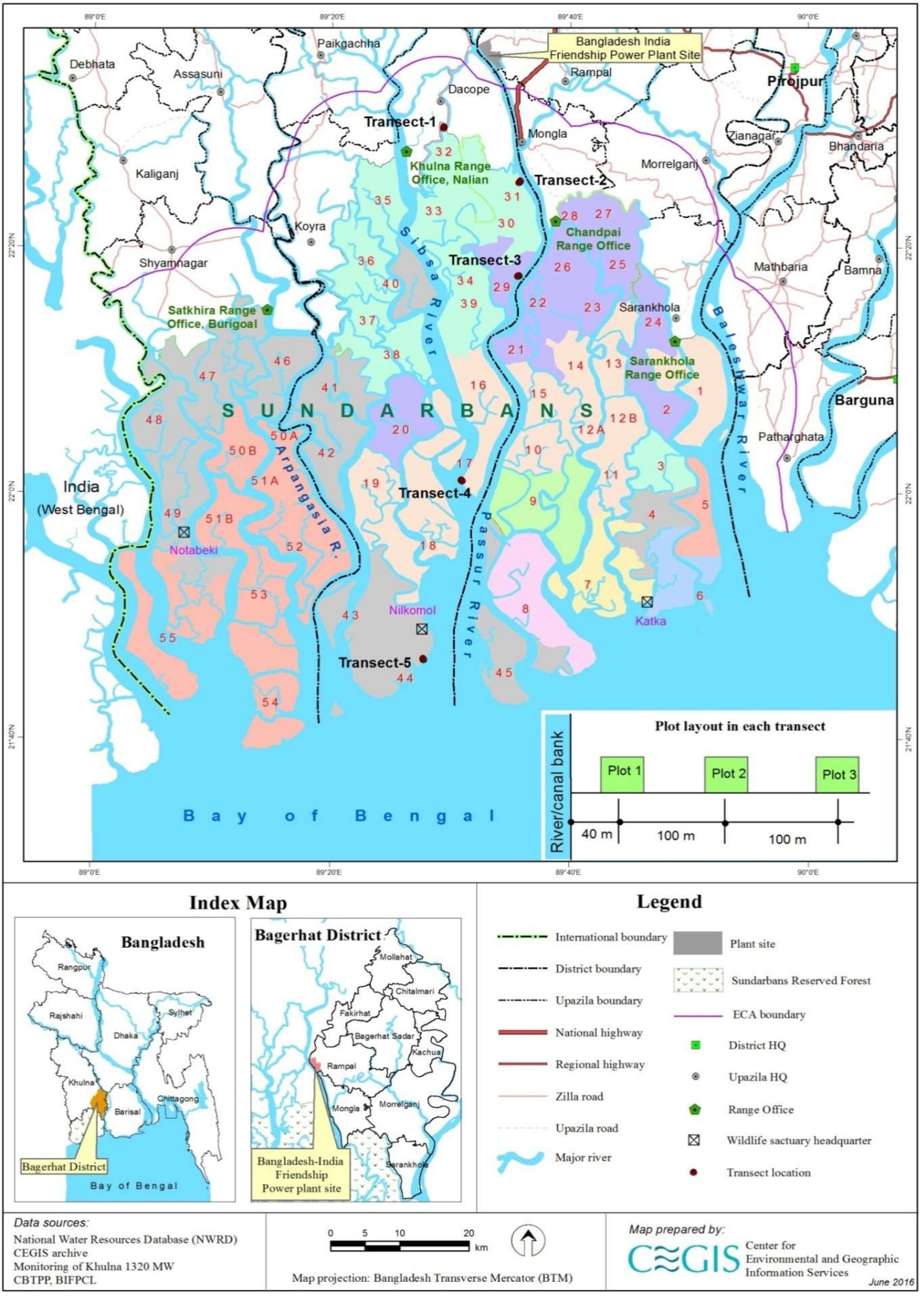
Area Index, Tree growth, phenological behavior, pest and disease.

3.4.3 Sampling Design of Permanent Sample Plots (PSPs)

In each site, a transect line was laid out perpendicular to river or canal bank. Along the transect line, three circular nested subplots of 12.62 m radius have been laid out at 100m intervals in order to capture the maximum tree species. Because of the variation in species composition in SRF, observation plots were laid out from the coast, river or canal side to upper slope zone where forest area is denser. The location of the first subplot was 40m away from ecotone zone in order to save the subplot from river bank erosion (**Figure 3.16**). Each subplot was again subdivided into four quadrates. The plot layout is shown in **Figure 3.17**.

Table 3.19: General Description of Permanent Sampling Plots (PSPs)

Transect	Plot	Range	Compartment No.	GPS ± (m)		Soil Description	Plot Location Notes
				Latitude (N)	Longitude (E)		
Sutar khali	1	Khulna	32	22.4981	89.4875	Hard Clay	Just opposite from Sutar Khali Forest Station and 40m SW from Sutar Khali Canal
	2	Khulna	32	22.4973	89.4871	Hard Clay	Just opposite from Sutar Khali Forest Station and 140m SW from Sutar Khali Canal
	3	Khulna	32	22.4965	89.4866	Hard Clay	Just opposite from Sutar Khali Forest Station and 240m SW from Sutar Khali Canal
Karamjal	1	Chandpai	31	22.4253	89.5943	Hard Clay	Plot center 40m west from Passur River
	2	Chandpai	31	22.4252	89.5934	Hard Clay	Plot center 140m west from Passur River
	3	Chandpai	31	22.4226	89.5925	Hard Clay	Plot center 240m west from Passur River
Harbaria	1	Chandpai	29	22.2061	89.5924	Hard Clay	40m west from Passur River
	2	Chandpai	29	22.2962	89.5917	Hard Clay	140m west from Passur River
	3	Chandpai	29	22.2962	89.5908	Muddy	240m west from Passur River
Akram	1	Khulna	17	22.0195	89.5129	Hard Clay	40m east from Shibsha River
	2	Khulna	17	22.0187	89.5134	Clay	140m east from Shibsha River
	3	Khulna	17	22.0180	89.5140	Hard Clay	240m east from Shibsha River
Hiron Point	1	Khulna	44	22.7753	89.4610	Sandy	350m east from Gogari Canal
	2	Khulna	44	21.9166	89.2333	Sandy	40m north from Bay of Bengal
	3	Khulna	44	22.1833	89.5000	Hard Clay	648m south east from Shibsha River



Index Map

Legend

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

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

0 5 10 20 km

Map projection: Bangladesh Transverse Mercator (BTM)

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

Figure 3.15: Location Map of Sundarbans Forest Health Monitoring Plots (PSP)

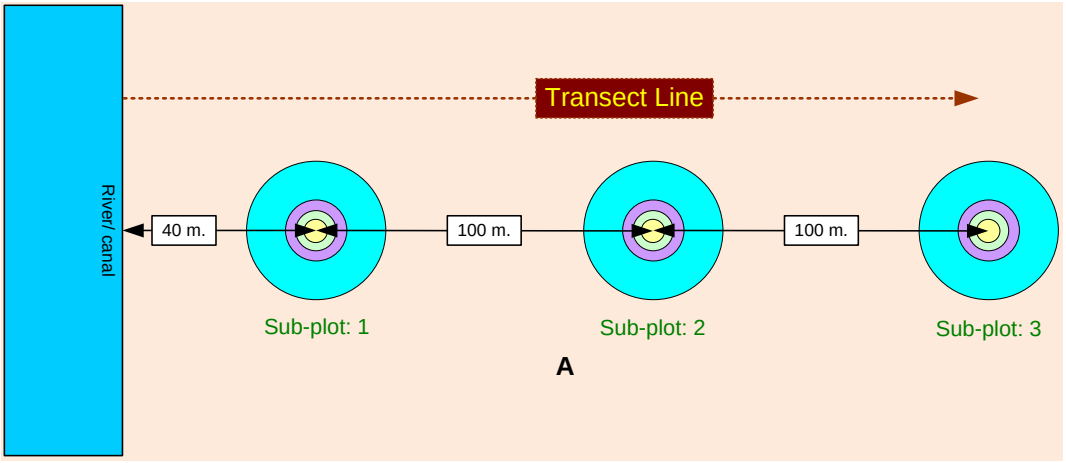


Figure 3.16: Layout of the Subplots and Transect Line Perpendicular from Ecotone (river or canal bank)

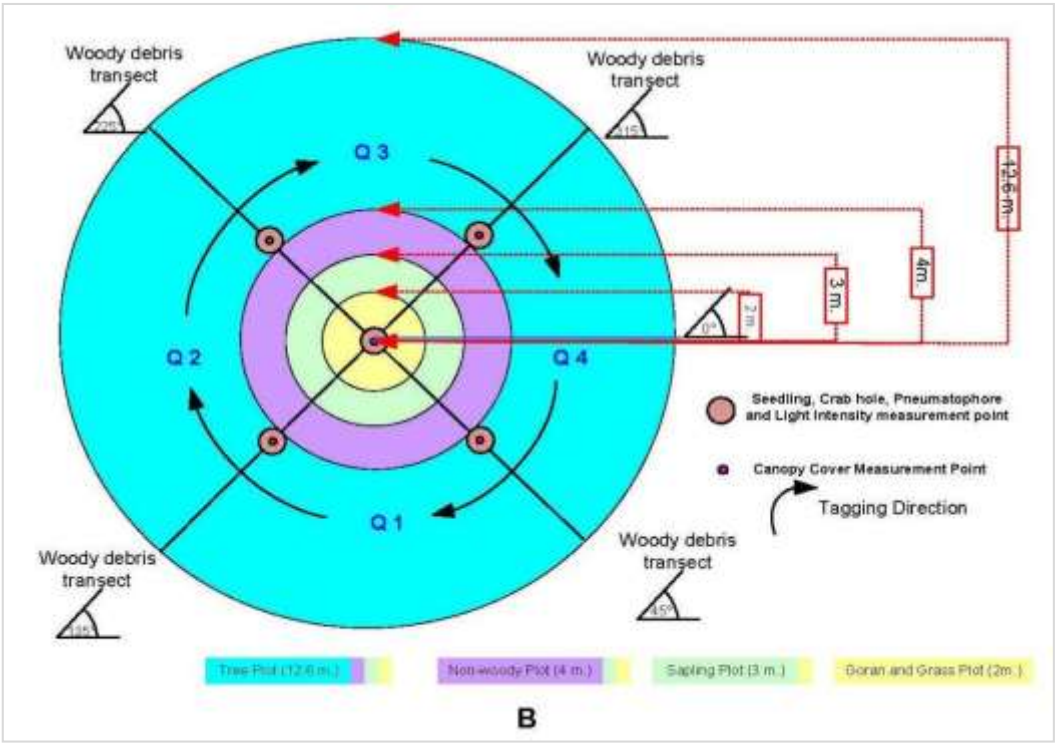


Figure 3.17: Layout of the Survey Activities in each Subplot

3.4.4 Methods

Tree growth

Tree species growth data were obtained from measured tree DBH. Individual tree DBH ≥5cm was considered for growth trend observation.

Vegetation Diversity

Tree species data were collected from the PSPs. Individual tree DBH ≥5cm was considered. Saplings (DBH<5cm and height 1.37m) and seedlings (height<1.37m) were assessed within 3m and 2m radius circle respectively in each PSP. Seedlings were counted species wise and

their status of living was also recorded. For saplings, species name and DBH were recorded along with the living status.

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

Pneumatophores

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

Crab hole

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

Canopy Cover

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

Leaf Area Index

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

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

Biomass and carbon stock estimation in trees

From each plot tree species were identified and each individual was recorded. Diameter at breast height (1.37m) 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 were 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.

Leaf Phenology

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

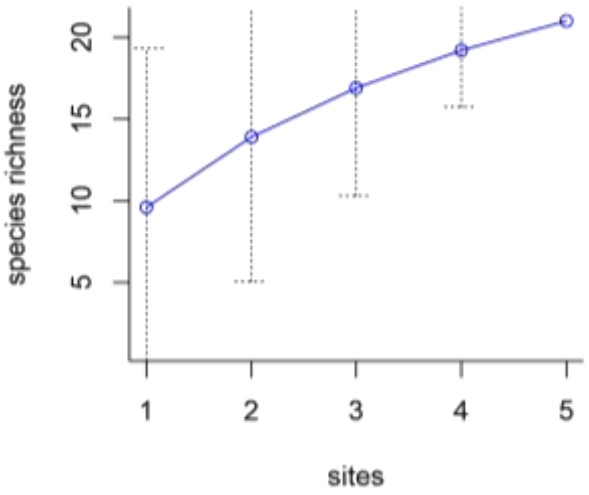
Pest and Diseases

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

3.5 Results and Discussion

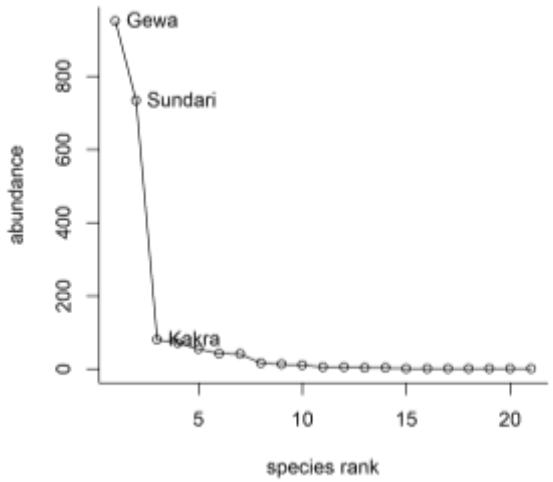
3.5.1 Vegetation Diversity, Richness and Compositional Variation

A species accumulation curve shows the species richness for combinations of sites. These curves portray the average pooled species richness when all sites are combined together. The output shows that the average richness for all possible combinations of 5 sites is 21 (**Figure 3.18**). Gewa was the dominant species among all the PSPs which was confirmed by the Rank-abundance curves followed by Sundari and Kakra (**Figure 3.19**). Vegetation species richness has been identified through Shannon, Simpson and evenness Index (Table 2). Considerable difference was noticed in the species richness in five PSPs. All the three indices show that transect 2 (Karamjal) has more diversity compare to other PSPs (Figure 3.21).



The bars indicate +2 and -2 standard Deviations

Figure 3.18. Species Accumulation Curve for the PSPs Dataset



Hiron point plot data was taken from last survey

Figure 3.19. Rank-abundance Curve for the Sampled PSPs

(N.B. 1=Sutarkhali, 2=Karamjal, 3= Harbaria, 4=Akram Point, 5=Hiron Point. Hiron point plot data was taken from last survey)

Multidimensional scaling (MDS) is a popular approach for graphically representing relationships between objects (e.g. plots or samples) in multidimensional space. The samples are then usually represented graphically in two dimensions such that the distance between points on the plot approximates their multivariate dissimilarity as closely as possible. In the present study, Akram point (T4) and Hiron point (T5) were close to each other indicating similarity in species composition in these two PSPs. In contrast, T1 (Sutarkhali), T2 (Karamjal) and T3 (Harbaria) were far away from T4 and T5 indicating dissimilarity in species composition (**Table 3.20**)

Table 3.20: Different Diversity Indices for Vegetation in the Sampled PSPs

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

N.B. Hiron Point Plot data was not considered in diversity indices analysis.

3.5.2 Carbon Stock in Trees

Over the census period, there was no significant difference (P>0.05) in tree carbon stock for all the PSPs (**Figure 3.20).** However, an increasing trend in carbon stock was observed in all PSPs except harbaria. Sundari has the highest amount of carbon stock (**Table: 3.21**).

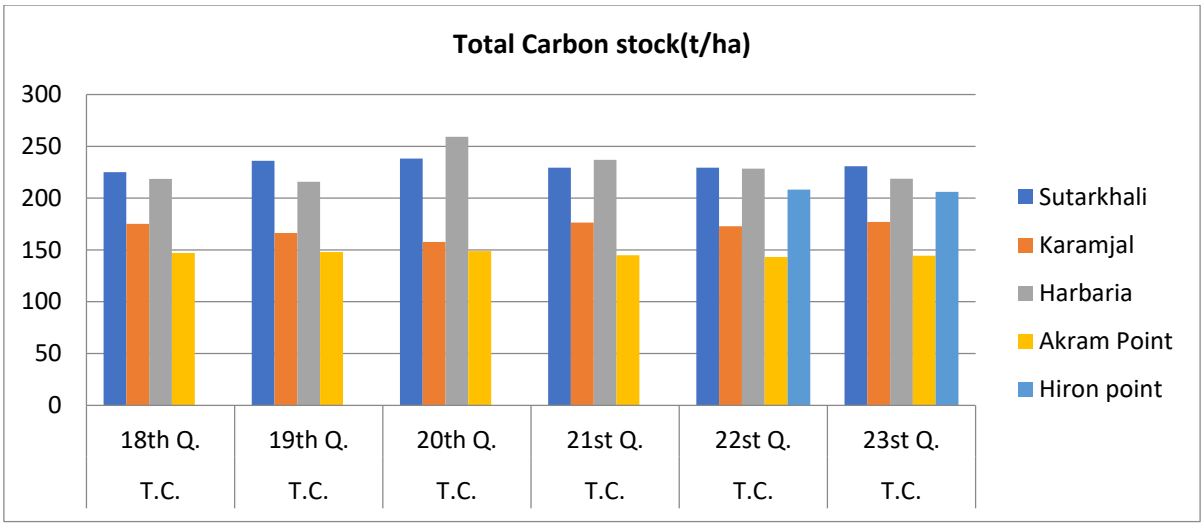


Figure 3.20: Total Carbon Stock over the Census

Table 3.21: Species wise Total Biomass and Carbon Stock (t/ha)

Species	T.C. 18th Q.	T.C. 19th Q.	T.C. 20th Q.	T.C. 21st Q.	T.C. 22st Q.	T.C. 23st Q.
Amoor	1.37	1.28	1.65	1.69	1.54	1.42
Baen	71.46	64.59	66.51	67.42	65.11	64.09
Bhutbutta	0.14	0.18	0.25	0.25	0.25	0.25
Bola	0.13	0.13	0.13	0.13	0.13	0.13
Gewa	125.00	121.15	124.69	126.15	125.01	126.62
Goran	0.66	0.69	0.77	0.78	0.75	0.68
Kakra	53.35	50.93	51.99	52.35	52.15	52.19
Lakur	0.00	0.00	0.00	0.00	0.00	0.00
Passur	62.60	71.33	74.16	67.63	70.50	71.19
Sundori	446.01	450.82	475.60	465.01	468.22	466.09
Urmui	0.41	0.36	0.40	0.44	0.41	0.39
Vaila	0.80	0.83	0.74	0.74	0.74	0.74

N.B. TB-Total Biomass, TC-Total Carbon

3.5.3 Status of Forest Health Indicators

The tag number of trees (DBH ≥ 5cm and lean angle greater than 45º) was monitored and rewritten if any new tree was found within 12.62 m radius circle of the Permanent Sample Plot (PSP). There was no significant variation ($p>0.05$) in tree growth over the monitoring period for all the PSPs The Seedling density among the four PSP was not significantly different ($P>0.05$) except Hiron point (**Figure 3.25**). Hiron Point is subjected to sedimentation. An increasing trend of seedling survival was found in other sites. This is because of the time of seed germination and seedling survival in the observed PSPs.

Figure 3.21: Recording Data at Sutarkhali Site

Figure 3.22: Measuring DBH at Karamjol Site

Figure 3.23: Measuring Height at Akrampoint

Figure 3.24: Measuring Canopy Cover at Hiron Point

Average number of pneumatophores per hectare was comparatively very low in Akram Point area whereas pneumatophores density was highest in Hiron Point sample plots. There is no significant variation ($p>0.05$) in pneumatophores density over the monitoring period for each PSPs (**Figure 3.25**). This indicates that forest health condition is not deteriorating in terms of steady state condition of pneumatophores density over time. There is no significant variation ($p>0.05$) in crab density over the monitoring period for Harbaria, Sutarkhali and Karamjol PSPs (**Figure 3.25**). However, Akram point and Hiron point crab density was significantly different then the other three sample plot ($p<0.05$).

All the PSPs (Sutarkhali, karamjol, herbaria point) canopy cover doesn't vary significantly ($P>0.05$). Hiron point and Akram point PSP's permanent plot canopy cover was lower compare to the rest of PSPs canopy cover percentage (**Figure 3.25**). The LAI (Light Area Index) influences daily rate of net canopy photosynthesis which results in exchange of atmospheric CO2. The minimum the ratio of under canopy to open canopy light intensity value indicates the maximum LAI. There was no significant prominent trend observed for all the PSP's (**Figure 3.25**).

There were no changes observed in phenological behavior of the dominant tree species during the monitoring period. Diseases in trees can also be used as forest health bio-indicator. A number of diseases has been identified by researchers as chief causes of population decline of the tree species Avicennia spp., Rhizophora spp., Heritiera spp., Pandanus spp., Phoenix spp. and Acanthus spp (Rahman et al. 2010). Certain important diseases of Sundarban mangroves are leaf blight, Dieback, stump and collar rot, trunk gall, root rot, leaf blight, leaf necrosis, powdery mildew (Rahman et al. 2010). However, in the present study, 'top dying' of Sundari and bark hollow of gewa was observed in all the PSPs. Almost most of the Sundari trees were suffering from 'top dying' disease.

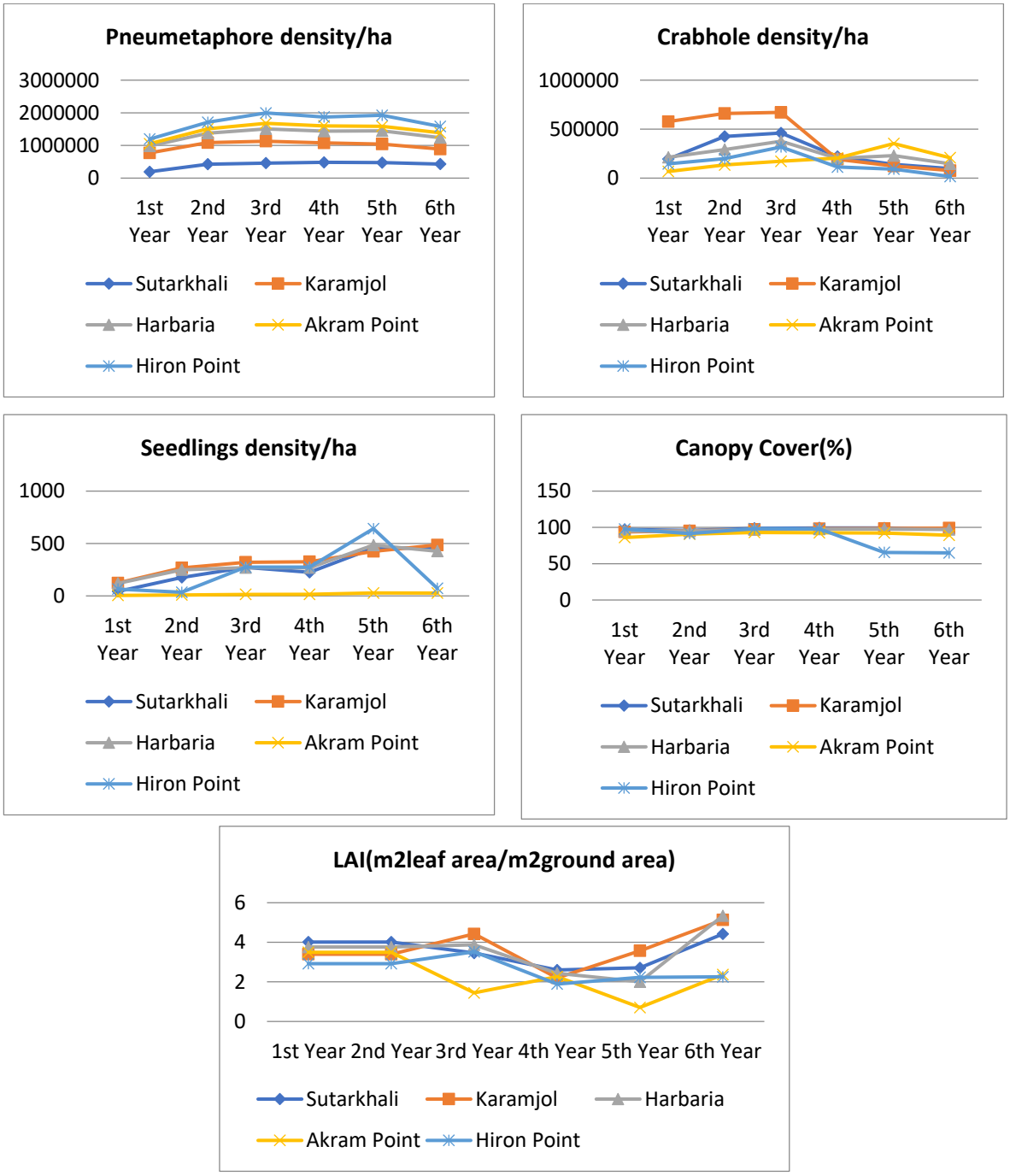


Figure 3.25: Pneumatophore, Crab Hole Density, Seedling Density, canopy cover and LAI over Different Census Period

(N.B. Each year represent average of 4 monitoring period except for 6th year)

3.5.4 Summary

Considering Rampal Power plant establishment, Forest Health Monitoring program intended to decide the status, changes, and patterns in pointers of trees condition on certain time interim premise along the Passur River. The monitoring indicators included plant growth, tree regeneration, tree crown condition, tree damage, lichen communities, plant diversity, soil chemistry, and plant physiology were observed in the permanent sample plots (PSPs).it can be predicted in terms of seedling density, pneumatophores, crab hole, canopy cover and leaf area index (m^2 leaf area/m^2 ground area) that the forest condition is showing positive changes periodically, although there has some seasonal effect. Phonological changes were not seen in all PSPs. But Sedimentation rates are comparatively high in Hiron Point plot. In addition, logging is severely affected at Koromjol and Hiron Point. The complex species sundari have been died in a part of Akram point and Koromjol plot. On the other hand, Harbaria point has no significant change observed during the last visit. Among the species, the height of Sundari is comparatively high in Harbaria and Goran species are dominant in Akram Point. The Akram Point is situated at the confluence of Shibsa and Passur River. The area have subjected to excessive erosion. About 45m area from the river side along the plot (2 quadrate of first subplot) are already effected by erosion. Therefore, during tidal inflow the forest floor carry large amount of soil sediment than other locations but in depth side the number of seedling almost zero so that It can assume that, the forest will be experiencing retrogression process where the climax species are started decaying. Generally, it tends to be said that forest health condition along the Passur River is in stable condition.

4. Social Environment

4.1 Socio-economic Condition and Social Safeguard

The 23rd Social Safeguard Report is prepared as a follow up status of 22nd quarterly social safeguard monitoring. Different social tools and techniques were applied during field visit for collecting relevant information from the project site and communities around the site. The status of social safeguard components as stated in the EMP and DoE conditions was monitored and monitoring results with analyses are focused in this section. Socio economic monitoring locations are presented in **Figure 4.2.**

4.2 Methodology

4.2.1 Physical Observation

The technique of physical observation was applied to understand the construction activities in view of auditing following issues, i.e., occupational health and safety, labor shed condition, toilet facilities for workers, kitchen, drinking water and food condition of labor sheds, use of PPE by the construction workers and waste management.

4.2.2 Consultation

A consultation meeting was conducted at project site for obtaining information on compliance issues in accordance with the DoE conditions for determining their status. In this consultation, relevant officers from different responsibilities stated the status of the pre-set compliance issues comparing the status as framed in the previous monitoring.

4.2.3 Interview

Informal interviews were carried out with the affected people or communities in the project influenced area, such as Foyla and Kapasdanga, and construction workers living in the labor sheds. The issues of concern were as follows: Present condition of activities under Corporate Social Responsibility (CSR) performed by the Power Plant Authority; their discomforts and suggestions for further improvement.

Employment and Livelihood

Responsible BIFPCL official reported that the rate of recruitment of local labor in the project site is increasing over the time. Overcoming personal and social barriers, the local people are communicating the Project Authority to work there and involving themselves if found any scope.

Investigating the information, it was observed that among the total labors involved in various project activities, about 25% were coming from the local community. They were mostly provided as labor based on their skill levels. A bare minimum number of local people were involved in managerial posts as they are lack of proper education and skill. Considering work load and odd type job, some local people abstained themselves from working there. The Project Authority has a plan to make local people semi-skilled to skilled so that they can be involved in construction and post construction phases of the project. Considering this aspect, they made a plan to engage Bangladesh Industrial and Technical Assistance Center (BITAC) for providing trainings on different technical issues like electronics, welding, plumbing, etc. Under this plan, the Project Management Unit (PMU) has fixed selection criteria and consulted

with respective Local Government Institutes (LGIs) for listing and assembling people from the local communities to involve them in different batches of the training program.

BIFPCL maintains a provision of recruiting Project Affected People (PAP) directly through PMU in the construction phase of the project. It is estimated that about 5,000 people coming from local communities worked so far in pre-construction and construction phases at different lengths of time.

Labor and working condition

The motto of *"No training No work"* is working as safeguard to labors on safety issue. Social safeguard monitoring is helping in ensuring fitness of equipment which is giving confidence to the workers and ensuring a congenial environment to them. Giving merit to the monitoring findings, the Project Authority removed old machineries for ensuring more safety and avoiding accidental cases, and also certifying the fitness of machineries by the safety officers with due examination. Moreover, EPC contractors provide PPEs which help them to work with confidence at the project site.

During monitoring period, it was found that labors are well aware of using Personal Protective Equipment (PPE) and regular monitoring system of BIFPCL helps to make them habituated in using PPEs at site. Every day, a toolbox meeting is used to be conducted by the Safety Manager which is being monitored by the PMU, and observation of BHEL written in a document addressing as noncompliance issues. Debriefing to BIFPCL were held so that they could take care on those noncompliance issues.

Monitoring study revealed that labor sheds are quite clean and workers are satisfied with adequate toilet facilities, kitchen, waste management, drainage, and drinking water and supply water facilities.

Figure 4.1: Safety Signsboards inside the Project Premises

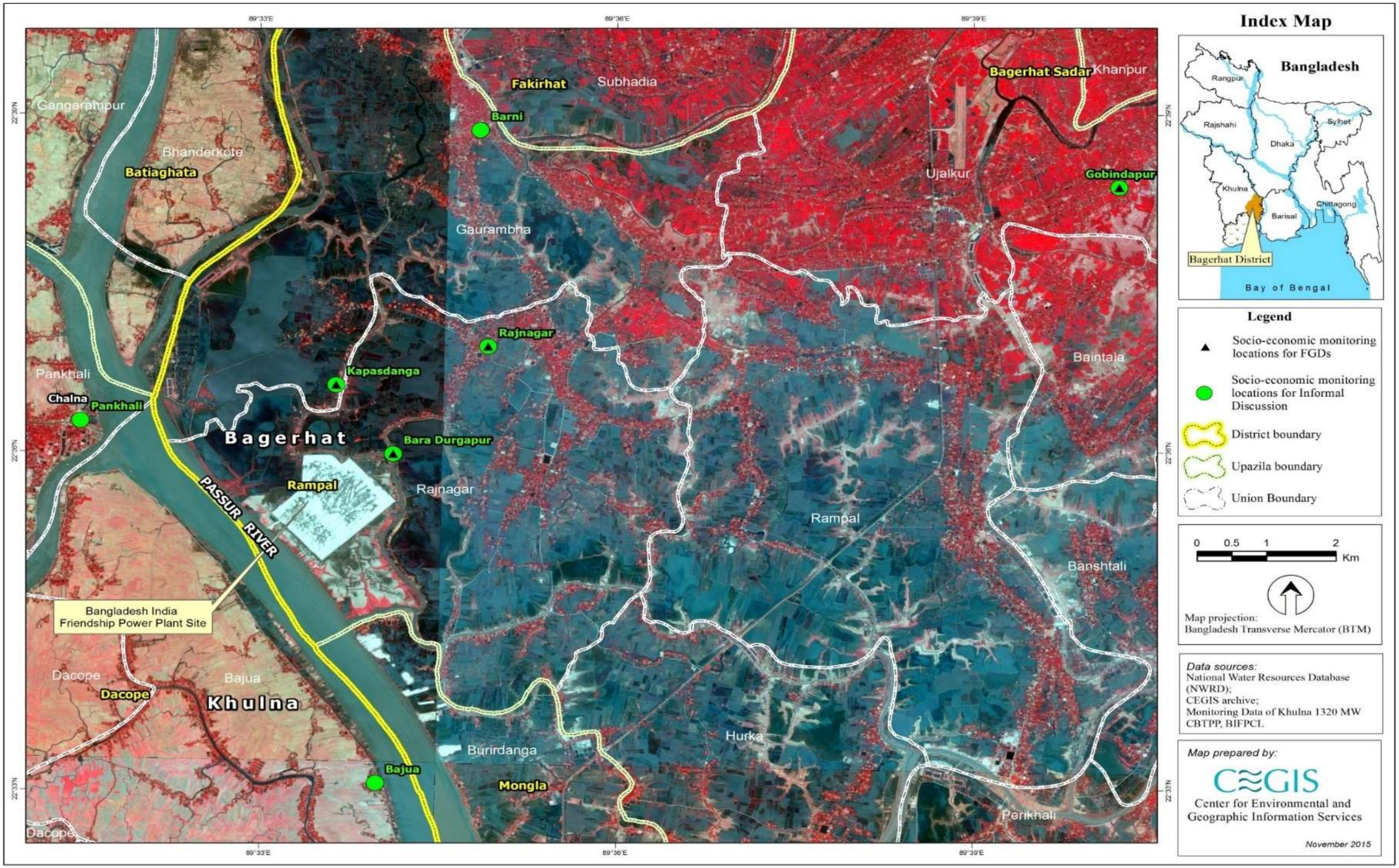


Figure 4.2: Socio-Economic Environment Monitoring Location

Community Health

The Project Authority sprays water on the unpaved road four times a day for suppressing dust and protecting project site and local people around the site from dust pollution. Noise monitoring report helped in awareness building to the construction workers in limiting noise emission. It was reported that there was no noise induced disturbances to local community. Night shift work was also almost stopped including the operation of heavy machineries for avoiding accidental event. For making greenery in the project site, the Authority has planned to plant about two lacs of trees of local species. It was reported that about 65,000 plants were already planted and monitoring is going on to avoid high mortality rate. According to PMU, refilling of about 10,000 trees was done and planted new batch of 15,000 fruit trees and mangrove plants with the technical support of Bangladesh Forest Department (BFD).

Corporate Social Responsibilities

The BIFPCL is committed to observe the Corporate Social Responsibility (CSR) in ways best fitted to the locality. Despite the CSR is usually observed during operation phase, the Authority has already started different activities under CSR program in construction phase. They have been conducting medical campaigns along with different socially demand-based programs including community development, capacity building and social mobilization. With the observance of CSR activities, community people are getting benefits and making positive attitudes towards the project.

Following activities were done under the CSR activities which were monitored in this stage of monitoring

Medical Campaigns

The medical campaigns were found very effective to the poor people, local women and project workers. The ongoing medical campaigns under CSR program are as follows:

The status of medical campaign held under the CSR program is attributed in the following **Table 4.1**. Reviewing the log book of medical campaign, it was observed that a total of 51,946 people received treatment from this campaign.

About 82% of patients received treatment from weekly medical camp, followed by treatment at office medical center, mobile medical camp, monthly labor colony camp and boat medical camp as shown in **Figure 4.3**. The objective of the medical campaign was to ensure free health service to the local community and laborers.

Table 4.1: Status of Medical Campaign under the CSR Activities

Sl. No.	Camp Type	No. of Patients Received Treatment Facilities	Percent (%) of Patients
1	Weekly Medical Camp	42,565	81.9
2	Office Medical Center	3,929	7.6
3	Monthly Mobile Medical Camp	3,379	6.5
4	Monthly Labor Colony Medical Camp	1,508	2.9
5	Boat Medical Camp	565	1.1
	Total=	**51,946**	**100.0**

Source: BIFPCL, February 2020

Figure 4.3: Free Medical Camp at Project Site and Labor Colony

Community Development

As part of community development under CSR program, the Authority has distributed about 4,500 pcs of blankets to the poor and destitute people of the locality in this winter (**Figure 4.4**).

Figure 4.4: Distrib Sewing Training ution of blankets by the Project Authority

Capacity Building Programs

Capacity building trainings were offered to the local people under the CSR program for making the local people skillful. Under such programs, about 211 persons received training on sewing, and about 215 persons received computer literacy skill development training (**Figure 4.5**).

Figure 4.5: Computer Training and Sewing Training under the CSR Activities

Recommendations

a. Heavy machineries should be checked regularly and properly to avoid the risks of accident;

b. It is very essential to improve/refurbish old machineries and ensure fitness certificate;

c. For assessing the needs of local communities and future CSR activities, coordination meetings are required to arrange on a regular basis;

d. Involve more local work forces by building capacity to them on plumbing, masonry, carpentering, electrician & electronics, welding, driving, safety, rock binding, and machineries as they can be prepared as semi-skilled working force for this project;

e. Regular refilling is to be continued for making the desired and committed greenery effectively as per conditions of DoE;

f. Continuing regular health checkup and disease monitoring for the daily labor as well as for the labor residing at labor colony;

g. Though the laborers are satisfied with availability of toilets and beds for labors in the labor sheds but numbers of these two items should be increased for making better living environment and for maintaining the international norms;

h. The labor sheds should be provided with lockers so that the laborers can feel safe with their valuable belongings;

i. Entry of outsiders should be prohibited in the officer as well as in the labor colony;

j. CSR activities should be performed primarily among the PAPs on equitable manner. This should be audited by a third-party monitoring team;

k. Rehabilitees should be given preference in implementing CSR program as they are under serious threat of another shifting;

l. Special Medical Campaign should be arranged for the rehabilitees living at Kapasdanga and Pargovindapur Mouza along with other facilities;

m. Dust suppression by spraying water should be continued on construction sites, and other places where necessary to suppress dust and minimize air pollution;

n. River water should be used for dust suppression activities and ground water should be avoided completely;

o. The PMU should be active and efficient in maintaining vehicle speed limits in the project site;

p. PAPs should be given priority in recruitment of manpower based on their skills

5. Environmental Compliance

5.1 Introduction

According to the project planning the first unit of Maitree Super Thermal Power plant will be in operation by September 2021. The construction activities are now progressing very fast as all the civil as well as mechanical works are being executed simultaneously. The Engineering, Procurement and Construction (EPC) contractor deployed a number of contractors and sub-contractors sequentially or simultaneously for completion of the project works within the stipulated timeframe.

During the monitoring period, it was observed that the construction of major components was initiated. Most of the mechanical and electrical components were kept systematically on the vast open area of Block II. The civil construction activities at the Boiler, Turbine and Generator installation areas, cooling tower, Chimney and other heavy equipment installation areas, Stack point, Jetty, township, Internal road networks, Permanent drainage networks are progressing faster. Even the mechanical works are being continued simultaneously to install the machineries like boiler, ESP, FGD, Turbine etc. Equipment are currently transported to the Project site by road. However, the permanent jetty construction works are advancing for unloading the heavy machineries transported through waterways through the Passur River.

The approach road including extension of the two-lane approach road (5.5 km) from Babur Bari point at Khulna - Mongla Highway to the Project site is completed. All of power transmission poles were restored after falling down during the Cyclone Bulbul. The bridges and culvert area have already been extended to six lane road requirement. Permanent structure for the security staff and visitors have been constructed at the entrance point approach point and entrance point of the power plant project. Boundary wall around the Project area, slope protection, office building, roads and drainage system are also at the completion stage. The main Project Office of BIFPCL and EPC contractor's office are shifted to the newly constructed buildings. Accommodation facilities for number of professionals of BIFPCL have were made in the newly constructed townships. At the same time, the EPC contractor i.e. Bharat Heavy Electricals Limited (BHEL) has already employed different local specialized sub-contractor construction firms such as DIPON, KELLER, AFCON, POWER MAC etc. for progressing the construction works simultaneously.

The present environmental compliance monitoring includes the progress corresponding to the status of EMP implementation based on physical observation, investigation and interviews to the proponents, project officials, contractor or sub-contractors, labor or relevant bodies etc. by the study team. A comprehensive due diligence checklist has been prepared to monitor the environmental compliance of different components e.g., Environmental and Social Management System and Action Plan; Labor and Working Condition; Community Health, Safety and Security; Biodiversity and Sustainable Management of Living Natural Resources.

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

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

Sl. No.	Potential Impacts	EMP measures as proposed in the EIA	Actual condition/ Measures already Implemented	Compliance Status	Recommended Action
1	Generation of Noise within the project site construction 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 levels are monitored at different potentially sensitive areas in every month at day and night times and see if there is any exceedances as per permissible limits under Noise Pollution (Control) Rules 2006. • Workers at the place of heavy noise generating activities (i.e. piling, rod cutting, etc.) were found using PPE e.g., ear plug. • Idle machines/equipment/ generators were found switched off/throttled down. • Construction activities were observed continuing till 10 pm at night. • Rubber sealed and air tightened door of office buildings, vehicles with silencer, acoustic hood/enclosure for generator were observed and recorded.	• Mostly complied. • In very limited times works that cannot leave unless completely done only that works continued till 10 pm at night. • Following the norms of Noise Pollution (Control) Rules 2006, locations inside the project site boundary are considered as industrial area for compliance monitoring.	• If construction activity at night is unavoidable, additional measures to limit noise (within permissible standard) should be taken. ○ Use of enclosure to protect the noise sources ○ Schedule to be made for heavy noise generating works. ○ Communicate with the nearby community beforehand about activities and possible noise generation.
2	Dust generation from construction works	• Limiting activities within the project area for avoiding generation and limiting dispersion of fugitive dust particles outside the project area, • Vegetation clearance and base stripping should be minimized. • Vehicle speed restriction must be enforced to control dust generation.	• Periodic air quality monitoring in and around the project site is being conducted and checked against ECR, 2005 standard. • Spraying of water on the unpaved roads, exposed areas, construction sites within the project area four (04) times a day with three (03) tankers.	• Mostly complied • Except a meager number of laborers all use mask as PPE during working hours to keep them free from	• Daily monitoring of dust suppression activities including water spraying is needed for maintaining the air quality within standard limit;

Sl. No.	Potential Impacts	EMP measures as proposed in the EIA	Actual condition/ Measures already Implemented	Compliance Status	Recommended Action
		• Earthen roads and undeveloped roads should be avoided to minimize dust generation • Construction materials must be covered to protect from wind action • Spray water regularly for suppressing fugitive dust • Dust particle generated from access road 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.	• Stockpiles are covered to the extent possible and watering them as required to avoid dust dispersion. • Cement debagging is done inside the godown to inhibit cement dust to open air. • Mixing machine is generating localized dust during cement and concrete mixing. • Wet earthen materials are transported instead of dry sand and silt. • Covered the soil/sand trucks with tent. • Monitoring the vehicular speed limit and load. • Spraying water on the roads regularly and use of register for documenting • Lack of use of the dust musk to the worker	dust related health impact.	• May use Method 22 for visual inspection of dust at construction site. • Clear the mud over the paved roads
3	Water Quality	• Surface water should be kept safe from any contamination of harmful effluent and waste disposal from project site • Provide closed system facilities and wastewater treatment plant to minimize discharge of effluents from worker's colony. • Good housekeeping at workshop and construction site	• Water that generates during construction period is coming mostly from construction material wash water and labor colony. These waters are not chemically contaminated if not oil is mixed. Drainage system for draining of construction period water has been improved and permanent drainage system is being constructed paralelly. Some of the permanent drains are currently being used.	• Mostly complied • Laborers should be aware further for managing the waste water from the labor shed. • Only in emergencies ground water is used for dust	• Clean the vehicles especially the wheel and body from earthen materials weekly

Sl. No.	Potential Impacts	EMP measures as proposed in the EIA	Actual condition/ Measures already Implemented	Compliance Status	Recommended Action
		• Appropriate equipment with safety measures should be used for storage and handling of lubricant • Provide training and awareness building program to the workers during construction. The training and awareness programs are: a) Arrange weekly consultation session among the workers through plant site managers. The duration of consultation is one hour according to ISO-14001 standard, b) Arrange monthly environmental meeting among the mid-level officers through top management when those issues will be discussed under guidance of ECR 1997.	• EPC contractor has been checking the water quality at drainage outfalls on monthly basis through a third-party Independent Monitoring Agency. • Adequate sanitary toilets have been constructed at the labor sheds. • New RO plant is being constructed. • Onsite sanitation facilities have been developed at the working area. • Training and awareness program are being continued. • Drainage system is being maintained properly. • No waste water treatment plant has been found available for treating the discharged waste water from labor shed • Ground water is being withdrawn near the RO plant of ABM Company for using water sprinkling.	suppressing activities.	
4	Waste Generation	• Limiting site clearance and base stripping activities within the project boundary. • Gathering and stocking of construction materials and machinery must be within a limited area in the project boundary. • The project area has to be fenced prior to initiation of construction activities.	• Heavy equipment and mechanical equipment are kept in the demarcated areas. • Solid wastes are being collected from the project site systematically by engaging a third party. The name of the party is Rahman Brothers who in collaboration with the Khulna City Corporation (KCC) collects waste	Maximum Complied	• The number of Waste Disposal Bin/s with labelling should be increased at labor shed, and at working area. • Scrubbing materials should be managed within the designated places

Sl. No.	Potential Impacts	EMP measures as proposed in the EIA	Actual condition/ Measures already Implemented	Compliance Status	Recommended Action
		• Stock piles of construction materials requiring cover up in order to protect them from wind and weathering action. • The existing right of way have to be used for material transportation without creating any block • Location of spoil stock pile ought to be located in safe area and protected from wind and rain action. • No spoil store on River bank/slope • Construction wastes must be reused or recycled as and where possible • 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	and disposes safely to a designated landfill area(s). • Waste bins are installed at different strategic points but lacking with color code. • Burning of waste materials was not observed. • Iron and food packages are separated at sources of waste generation. • Waste management disposal procedure has been included into the induction training of the labor. • Local language (Bengali) with pictures are being included in the signboards. • No spoil or waste dumping recorded during the field investigation. • License has been taken from the Department of Explosive, Fire and Safety for storing petro-chemicals. • Scrubs were observed scattered near the boiler construction site.		

Sl. No.	Potential Impacts	EMP measures as proposed in the EIA	Actual condition/ Measures already Implemented	Compliance Status	Recommended Action
5	Compensation and Resettlement	• Proper resettlement action plan and compensation plan if the Project needs any land acquisition addressing compensation, restoration, livelihood, living standards etc. based on proper socio-economic studies. • Resettlement of the PAPs • Cash for compensation of land (CCL) before resettlement formal agreement with the affected people prior to migration/resettlement • Sufficient standing crop compensation • Compensation for movable structures • Retention of salvageable materials • Compensation for loss of trading income one-time moving assistance grant to cover loss of regular wage income • Has a resettlement plan been developed which includes compensation, restoration, livelihood, living standards etc. based on proper socio-economic studies? • Human provide/ take extra care/caution for the disadvantaged/ vulnerable group/s (i.e. women,	• Compensation has been given to the rightful owners of the land as per the laws of Bangladesh e.g., 'Acquisition and Requisition of Immovable Property Ordinance, 1982'. • Compensation was paid by the local DC office. • Local DC office facilitates to obtain house of the PAPs (settlers of the project area) in cluster villages provided by the GoB. • Almost 32 affected families are now having their houses at Foyla cluster villages. • BIFPCL is giving priority to affected people in Project related employment. • A significant number of affected people (especially who deserve) are working at the construction site. • 136 indirectly affected people were given compensation by the DC Office, Bagerhat. • About one third of the labor has been recorded from the locals. • Two local NGOs trained to the PAPs as per the recommendation of LRAP and DoE approval conditions. • 17 families got their residence who have shifted their houses from project area to Kapashdanga.	In the process of Compliance	• The CSR activities should be oriented towards the affected people or household; • Trained to the Sundarbans dependent livelihoods group as a part of CSR activities

Sl. No.	Potential Impacts	EMP measures as proposed in the EIA	Actual condition/ Measures already Implemented	Compliance Status	Recommended Action
		children, ethnic minorities, indigenous people etc.) • Provision of monitoring the compensation and resettlement process			
6	Livelihood and living condition	• The labor recruitment policy must be formulated in such a way that the local laborers can easily get the chance of employment in the project work force. • Govt./NGOs need to provide support the skill development program and income generation activities to local people; • For the increased movement of people and heavy vehicles, the road networks must be developed. • Keep provision of sanitary toilet, one toilet for 10 persons.	• BIFPCL are recruiting the local people especially PAPs with the help of local government. • Accidental log sheet or injury log book are being maintained. • Provides health facilities to the labor as well as communities • The wage of the labor is compatible with the national standard. • Available drinking water, sanitation facilities, prayer room are provided at site. • No incident has been recorded in this quarter	Complied	• Training and motivational program should be continuously for the worker • Evaluation and monitoring of the workplace safety situation

Sl. No.	Potential Impacts	EMP measures as proposed in the EIA	Actual condition/ Measures already Implemented	Compliance Status	Recommended Action
7	Green House Gas Controlling Measures	• Restriction of any kind of solid waste disposal • Approved pollution control devices to be fitted in equipment and machinery. • Transport vehicles must not be overloaded. • Avoid queuing of vehicles in areas adjacent to site, particularly near sensitive receptors including housing. • Switch off / throttle down all site vehicles, water vessels, generator and machinery when not in use. • Regular maintenance of water vessels, vehicles, generator and machinery in accordance with manufacturer's	• Fitness certification of vehicles and equipment are ensured for the construction works • The EPC Contractor using relatively new equipment and vehicles to reduce the GHGs emission. • Equipment, generators and vehicles were observed switched off during non-operation period. • Vehicles are not kept at the stand regularly • Vehicles are maintaining the road safety regulations. • No GHG inventories were prepared for this project	In the process of Compliance	• GHGs inventory checklist should be prepared immediately at this stage; • Energy efficient component like light, AC, equipment is to be used for the project purposes

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; • Grievance Redress Mechanism.	• BIFPCL is run through the HR polices and switching their professionals as per demand of the project. • EHS department strictly monitoring the occupational safety as no accident has been recorded this quarter; • No discrimination was recorded among at labor level between local or migrating labor in Bangladesh • EPC contractor deployed an OHAS Company named Cholamandalam for ensuring occupational safety. • BIFPCL has ensured minimum wage and working hours for the labor as per GoB rules and regulation. • Induction training and regular training of first aid, toolbox are being continued strictly. • Contractor has taken insurance policy for engaging labors as per labor policy of Bangladesh.	Being Complied	OHAS must be monitored the training for construction workers to protect from- • Falls (from heights); • Trench collapse; • Scaffold collapse; • Electric shock and arc flash/arc blast; • Failure to use proper personal protective equipment; and • Repetitive motion injuries. To develop labor association protecting labor interest Create fund to support the labor/his families in case of any fatalities
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,	• EPC contractors and sub-contractors are not employing any child labor in the project area. • No forced labor has been recorded in the project. • Proper documentation of contract with the worker is being maintained	Being complied	• The insurance policy should cover the accidental case or injuries of the labors; • Awareness work should be continued regarding the local cultural values, STD,

Sl. No.	Potential Impacts	EMP measures as proposed in the EIA	Actual measures already Implemented	Compliance Status	Recommended Action
		spiritual, moral, or social development. • No Forced Labor	which includes working hour, wage and benefit. • First Aid support is provided to the labors as required. • Workers must get the safety clearance before initiating any work like – routine checkup of the work places and administrative clearance • Work in hot condition and height need another permission		redressing of workers grievances, insurance policy related facilities and also contract clauses of the job to get maximum benefit.
3	Safety at site	• Installation/Construction of Safety Fence around the Project area • Use of Personnel Protective Equipment's (i.e. safety vest, safety goggles, ear plug, safety shoes, gloves, dust mask, etc.); • Safety trainings for workers (i.e. fire control, working at height, working in heat, first aid etc.); • Practice of Tool box meeting, safety talks • Safe Storage of Hazardous Chemicals (e.g. fuel, flammable chemical, toxic chemicals, etc.); • Maintaining Material Safety Data Sheet (MSDS); • Provision of Health care facilities such as doctor, hospital etc. available at/nearby the Plant construction site;	• BIFPCL has demarcated the specific construction site with warning sign; • Regular training and awareness program are being maintained strictly. • Most of the Labor and Project personnel are using appropriate PPEs like reflecting vest, helmet, and safety shoes etc. except the dust musk. • Road traffic warning signs (speed limit) to the approach road was not observed. • Increased the capacity of temporary hospital, doctors and 24hr availability of ICU supporting ambulance at the Project site; • Emergency contact address was found on the board at the site for any kind of sudden incident;	Being Complied	• More precautions for avoiding the near miss incidents • Try to develop the habit of the worker for safety 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.

Sl. No.	Potential Impacts	EMP measures as proposed in the EIA	Actual measures already Implemented	Compliance Status	Recommended Action
		• Availability of First Aid at work place; • Preparation and Follow of Emergency Response Plan (ERP); • Adequate fire precautions in place (e. g., fire extinguishers, escape routes etc.); • Documentation and reporting of occupational accidents, diseases, and incidents; • Policies and procedures for managing and monitoring the performance of third-party employers in relation to OHS	• EPC has made a contract with the Gazi Medical of Khulna city for emergency medical support. • The major construction work at site has been performed in presence of safety officer. • Fire extinguisher was found at required places. • Two near miss incidents were taken places in this quarter • Weekly checking of all the safety records and implementation of HERA at site. • 2 Ambulances, 1 MBBS doctor, 2 paramedical doctors and two medical checkup system are amiable for the workers as well as officials		
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	• BIFPCL have separate EHS division incorporating environmental specialist, safety officer, firefighting officers, public relation officers, doctors etc. • Adequate number of safety officers have been employed by the, EPC contractor and Sub-contractors. • The project OHAS policies were revised for functioning the occupational safety system. • Dust musk was not recorded to the maximum labor during the work at site	In the process of Compliance	• Awareness build-up, strict to the safety issues, • Empower and responsible the safety officers at site. • Continued the safety training, buildup the awareness and make the labor habituated with the safety procedure • Use dust musk to the labor at work site

Sl. No.	Potential Impacts	EMP measures as proposed in the EIA	Actual measures already Implemented	Compliance Status	Recommended Action
			• Medical aid, fire extinguisher, PPEs are provided adequately. • Adequate workers shed and sanitation facility has been developed; • Onsite medical facilities have been improved and EPC contractor has made agreement with the government or Private hospital for severe injuries. • BIFPCL has already established a Health unit and BHEL has established a full-fledged EHS unit. • Site-specific Environmental Health & Safety checking is being continued.		
5	Workers Well Being	• Provision of Welfare facilities for Worker/Labor 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 labor group, who will look into workers' well- being.	• Workers are generally satisfied with the residence facilities. • BIFPCL has developed apps https://bifpcl.com/safety.aspx for stepping up the safety issues well. • BIFPCL has ensured the benevolent grant developed by the contractor for the victim's family as per Government' rule. • Workers get lemon or saline water during work period • Grievance of the workers were usually addressed especially for safety issues.	Being Complied	• Freedom of Association, Rights & scope of bargaining should be open for the workers. • The proponent has to look after the following issues – equal benefit for the direct labor, contracted labor, day labor etc., emotional support and health surveillance.

Table 5.3: Monitoring of Community Health, Safety and Security

Sl. no	Potential Impacts	Proposed EMP	Actual measures already Implemented	Compliance Status	Recommended Action
1	Disturbance to nearby community due to dust from developed land and Noise from construction activities	• Construction of boundary wall around the Project area; • Installed water spraying system to control dusts; • Conducting dust monitoring and visual inspection around the site boundary; • Adopted noise management plan.	• Boundary wall has been constructed around the project area. • Water spraying has been conducted 4 times in a day to reduce the dust emission. • CEGIS is routinely communicating with the nearby communities for assessing impacts and related complaints on dust generation issue. • Regular communication and consultation are taken places with the local government and local administration officials. • Environmental parameters are continuously monitored in and around the project site by separate entities.	Being complied	• Any complaint regarding noise and dust from local people must be addressed immediately and recorded accordingly in the register.
2	Grievance of local people	• Availability and operation of Grievance Redress Mechanism; • Maintaining open communication channel with the local community.	• Social liaison officer is working for maintaining relation with local communities especially the CSR activities. • BIFPCL regularly display the progress of the development through their website (https://www.bifpcl.com/) and disclosure meeting at the local government • Local Government and local administration are visiting the site as and when they desire.	Being complied	• Put the grievance register outside the project boundary so that the local community could easily state any grievance properly.

Sl. no	Potential Impacts	Proposed EMP	Actual measures already Implemented	Compliance Status	Recommended Action
			• Grievance register has been placed at the BIFPCL main office inside the project boundary. • BIFPCL is also receiving grievance from local community through local government like Union Chairman or Local Administration • Proponent is observing the community grievance or quarries though the monitoring study conducted by CEGIS or local government		
3	Risk of breaching Community Safety	• Construction of boundary wall/safety fence around the Project area; • Practicing Risk Assessment and Evaluation Process; • Practicing safe management for hazardous materials which may pose threat to the community; • Availability and operation of Emergency Response Plan; • Maintaining open communication channel with the local community; • Training and instruction to the security personnel about their behavior and communication with the local people;	• Implement numbers of pollution mitigating system for protecting the dust and other pollution outside to the project area. • Health check-up is mandatory to every labor during the induction training on which they get pass for work. • No conflict has been noticed between local communities and project authorities or workers • Maintaining communication with local community regarding their grievance about the worker and work facilities. • Community people is now receiving routine (twice in every week) medical checkup with essential medicine facilities from BIFPCL and specialized medical camp nearby village.	Being complied	• Make a liaison with the local government for clarifying any kind of indent/ rumor in local communities related with this project; • Equity and rationality should be maintained for the implementation of CSR fund. • Trained to the Sundarbans dependent community to shift their livelihoods

Sl. no	Potential Impacts	Proposed EMP	Actual measures already Implemented	Compliance Status	Recommended Action
		• Aware the security personnel about the right of the community people.	• The medical camp initiative was so popular that the local government are demanding more free medical camps. • The proponent is also contributing fund from CSR for training, lab development at Digraj College, RO drinking water supply at Mongla which is supplying 1000 liter fresh water per hour and arranged football tournament, gift to the bright student, school lab development etc. to make a congenial relation with the communities.		
4	Community Health and Risk	• Provision of providing health service facilities to community if the Project poses any health risk like sexually transmitted disease, contract disease, vector-borne diseases; • Implement all pollution mitigation measures to ensure safeguarding to community.	• Developed the medical facilities (consisting medical officer, medical assistant, office assistant) at Plant site for checkup the communicable diseases of the workers and staffs; • Arranging twice a weekly health service program (medical consultation and free medicine) for the local community. • A total of 46,767 people has been received medical assistance from BIFPCL where a total of 39872 people received regular treatment and 3234 people revived medical assistance from monthly campaign. • EPC contractor is educating to the labors about protective action taken to avoid vector borne diseases and HIV positives.	Being Complied	• BIFPCL shall communicate regularly with the community to aware them about the health-related issues.

Sl. no	Potential Impacts	Proposed EMP	Actual measures already Implemented	Compliance Status	Recommended Action
5	Youth Employment (Local)	• Providing training/awareness program for the local youth to let them aware about the required qualification to get involved in the Project related activities Emphasis to recruit local labors according to their skills and capacities.	• Numbers of meetings were arranged with the local government and community representatives for labor recruitment; • Significant number of local people are currently working at the construction site; • The proponent has already taken a number of initiatives to encourage local students through awarding them scholarships. • Formal training on computer and sewing machine is running with the youths. • BIFPCL has communicated with BITAC, Khulna office for the training of local youths on wielding.	Being Complied	• Training related to construction work i.e. masonry, rod binding, plumbing, carpenter, electrician, lineman, elevator mechanic, glazier, iron worker, driving, heavy equipment operator or laborer etc. should be introduced immediately; • Need a monitoring and evaluation cell for examine the community development program
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.	• The project authority is Displaying only the Project information on a display board at Project site; • Project related every updated information has been uploaded in BIFPCL website (https://www.bifpcl.com/) • The local people are aware regarding the project activities from multiple sources	Partially Complied	• Disclosure meeting should be arranged to aware the local people regularly • Other print media, social media, digital media might be used for spreading the project right information • The proponent should aware the local people about the rumor regarding the project;

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.	• Construction of permanent drainage system to discharge water from the project area. • The connectivity of Maidara River is being maintained. • EPC Contractor is monitoring the water quality on monthly basis at every outlet of the project site. • Solid waste has been managed by third parties and finally disposed to the KCC disposal areas	Being complied	• Manage the drainage system for the seasonal stormy rainfall
2	Disturbance to nearby ecosystem due to different construction activities	• No cutting/ felling of trees along the river bank; • Implementation of onsite waste and air quality management plan; • Limiting soil extraction activities within the defined area; • Limiting the vegetation clearance and base stripping process within the Project boundary; • Safety fence around the construction site; • Limiting the use of night light; • Using shade (directed downwards) around the outdoor lights;	• Project activities are limited within the project boundary. • Limiting the vegetation clearance within the Project boundary especially around the ash impoundment. • Plantation program is in progress with the help of forest department. • The client is going to plant15000 of fruits and medicinal plants as per the greenbelt position of layout. • 1,16,000 sapling have been planted with local plant species like Goalpata, Sundori, Bain, Keora for green plantation; • BIFPCL has made a contract with the Forest Department to plant 2	Being Complied	• Regular monitoring of the planted trees. • Initiatives should be taken to achieve the target of plantation at schedule time. • Reduce the rate of plant dying at the sapling stages. • Bird sheds shall be created at the green belt areas.

Sl No	Potential Impacts	EMP measures as proposed in the EIA	Actual condition/ Measures already Implemented	Compliance Status	Recommended Action
		• 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.	lakh tree at the end of construction phase. • Motivated the trainees to protect local fauna during training session. • They are maintaining the EMP for protecting the adjacent ecosystem • No alien species has been recorded • Wild species like avifauna and mammals are now recorded in the greenery areas • Employees are aware about the rescues of species and no harm to wild species		
3	Disturbance to river, inter-tidal areas and wet lands	• No encroachment of inter-tidal flood plain area; • No disturbance to Dolphin community; • Monitoring of Ecosystem Health and Monitoring of Sundarbans Forest Health; • If required, embankment should be constructed considering a setback distance from river/canal bank; • Slope protection work along the Maidara River should be completed on	• Monitoring of ecosystem health of Sundarbans, and around the Project site is being continued; • The constructed slope protection works have been eroded at some places; • EPC Contractor is monitoring the discharged water quality at each of the outlet from this project on a monthly basis. • The project authority is constructing the permanent jetty as per approved layout.	Being Complied	• Re-construct the slop protection works • Initiatives should be taken for excavation of silted reach of Maidara river near the proposed township area to facilitate proper functioning of River for maintaining tidal flow dynamics.

Sl No	Potential Impacts	EMP measures as proposed in the EIA	Actual condition/ Measures already Implemented	Compliance Status	Recommended Action
		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			

5.2 Status of Compliance to the Conditions of DoE

Sl No	Condition of DoE	Compliance Status	Remarks
1	This EIA Report is approved only for 1320 MW Khulna Coal Based Power Plant. Any expansion or extension of this Power Plant will require obtaining further Environmental Clearance with additional EIA Study.	BIFPCL has not taken any extension plan of the 2x660 MW Maitree Super Thermal Power Plant.	BIFPCL will comply with the condition prior to initiation of any expansion or extension of the Power Plant.
2	The Coal Specification and Power Plant technology should be maintained as per EIA report. In case any change in design the proponent must obtain consent from DoE.	The Coal Specification and Power Plant technology will be maintained as per EIA report. In case of any change in Plant design and coal specification the proponent shall have to 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 for the block –A area. Infrastructure development activities in the Project are in progress.	Complied.

Sl No	Condition of DoE	Compliance Status	Remarks
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 already been appointed and Equipment & machineries are being imported as per contract.	Being Complied.
5	The activity under Proposed Khulna 1320 MW Coal based Thermal Power Plant Construction and operation shall not release any pollutant that affect human health or will have damaging impact on the environment or natural resources.	BIFPCL engaged CEGIS as an independent entity for monitoring the construction activities for examining environmental impacts on quarterly basis. No significant impact of Power Plant activities on the surrounding environment or on the natural resources has been reported yet. All necessary pollution control measures and technologies i.e. Effluent Treatment Plant, ESP, and FGD etc. have already been incorporated in the technical specification of main Plant of EPC package as per DoE stipulations. The EPC contractor is constructing the Plant as per the contracted technical specification. Moreover, environmental compliance monitoring is also being continued in the project site in order to record emission or discharge pollution from project on monthly and quarterly basis.	Being Complied.
6	Proper and adequate mitigation measures shall be ensured throughout preparation, construction and operation period of the proposed Khulna 1320 MW Coal based Thermal Power Plant Project activities.	BIFPCL is monitoring the mitigation measures on a quarterly basis as per EMP. As a third-party monitor, CEGIS has been appointed to monitor the mitigation measures adopted by the proponent during construction stage.	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. A quarterly monitoring program has been monitored the potentially project influence area of the Sundarbans Reserve Forest, Ecologically Critical Area and World Heritage Site as per the guidance of DOE and FD.	Being Complied.
8	Environment friendly construction and development practices shall be followed that minimize loss of habitats and fish breeding, feeding & nursery sites.	The quarterly monitoring results reveal no noticeable impacts on fish habitats and fish breeding, feeding & nursery sites. In fact, there is no	Being Complied.

Sl No	Condition of DoE	Compliance Status	Remarks
		significant changes over the habitat of fish breeding, feeding and nursery sites of Passur river.	
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 government institute to receive their grievance related to project activities. 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 and avoiding any disturbance of local lives as well as notifying the implementation schedules of the works in advance to nearby residents.	Suggested to comply for the remaining period of construction works.
10	Proper and adequate sanitation facilities shall be ensured in labor camps throughout the proposed Project period.	New residential areas and adequate sanitation facilities are becoming available for the workers. Adequate sanitation facilities are recorded at the labor camps as well as in the work areas.	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 and registration process. Working during sensitive hours like night time and locating machinery close to sensitive receptor like near the labor camps are being tried to avoid or managed through appropriate measures.	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. Now, solid waste is being managed systematic process with the assistance of KCC at this stage.	Being complied
13	Proper and adequate on-site precautionary measures and safety measures shall be ensured so that no habitat of any flora and fauna would be endangered or destructed.	Quarterly monitoring activities are being carried out to examine the impacts. No significant changes are yet recorded. Moreover, monthly environmental monitoring has been performed for noting any harmful emission or discharge pollution form project.	Being Complied

Sl No	Condition of DoE	Compliance Status	Remarks
14	All the required mitigation measures suggested in the EIA report along with the emergency response plan are to be strictly implemented and kept operative / functioning on a continuous basis.	The project authority has increased the medical facilities for workers. An ICU supported ambulance and an MBBS with two paramedical doctors are now available at site. For emergency stages for both BIFPCL and EPC contractor, they have made a contract with government or private hospital (GIZI medical) for emergency medical services. Periodic training has been made as mandatory for the workers.	Being Complied
15	To control dust, spraying of water over the earthen materials should be carried out from time to time.	Periodic air quality monitoring in and around the project sites is being conducted and checked it with ECR, 2005 standard. Four water tanker are dedicated for sprinkling water 4 times on the potentially dust emitting areas.	Being Complied
16	Storage area for soils and other construction materials shall be carefully selected to avoid disturbance of the natural drainage.	BIFPCL authority has selected designated areas for safe storage of construction materials. In addition, BIFPCL has already constructed the permanent drainage system to discharge water from the Project site.	Being Complied
17	Adequate considerations should be given to facilitate drainage system for runoff water from rain/tidal surge.	Adequate considerations have been given to facilitate drainage system for runoff water from rain/tidal surge. They are not interfering any natural drainage system beside the project boundary.	Being Complied.
18	Adequate facilities should be ensured for silt trap to avoid clogging of drain/canal/water bodies	Improving the drainage system and regular maintenance of the drain is carried out for avoiding the water clogging in the canal/drainage network especially during monsoon season.	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 has 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.

Sl No	Condition of DoE	Compliance Status	Remarks
20	Coal Plant should have high-efficiency bag filter for arresting dust emissions.	Integrated dust control system with dust extraction system / bag filter and dust suppression system at crusher house, unloading points, transfer points has been specified in the technical specification of EPC contract. Refer Section V, B4 of Technical Specification (Clause no B4.3.1.4). High-efficient ESP is now at construction stage.	Compliance action initiated.
21	Coal should be stored in a covered storage yard.	All these stipulations have been included in the technical specification of Main Plant EPC contract package, Section V, B4 of Technical Specification (Clause No B4.3.1.6).	Compliance action initiated.
22	The entire coal stockyard should be covered with water sprinkler provided with automated moisture sensor to control self-combustion.	All these stipulations have been included in the technical specification of Main Plant EPC contract package, Section V, B4 of Technical Specification.	Compliance action initiated.
23	100% utilization of fly ash and bottom ash should be planned and implemented throughout the operation of the Plant. There should only be a provision of small ash dyke that will not exceed 25 (twenty-five) acres of land to store residual ash.	100% utilization of fly ash has been planned and shall be implemented throughout the operation of this Plant. EOI has been received in this regard from nearby Cement Industries. Only 25 acres area has been allocated to store residual ash in case of emergencies.	Compliance action initiated.
24	Integrated dry ash handling, loading, unloading and transportation system should be established.	Integrated dry ash handling, loading, unloading and transportation system will be established. Provisions in line with this has been included in Technical Specification of main Plant EPC contract package (Section V, Chapter B4).	Compliance action initiated.
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). The construction work is progressing.	Compliance action initiated

Sl No	Condition of DoE	Compliance Status	Remarks
26	Bottom ash should be extracted, crashed and stored in silos for utilization with proper collection and conveyor system.	Bottom ash shall be extracted, crushed and stored in silos for utilization with proper collection and conveying system. The procedures have been included in the technical Specification of EPC contract package. (Section V, Chapter B4).	Compliance action initiated
27	Resettlement and rehabilitation of the displaced population (including those who do not own land) should be done properly.	Land has been acquired as per the legal procedure of GoB. However, BPDB wrote to Ministry for suitable resettlement and rehabilitation as per DoE requirement. BPDB prepared an assessment (Livelihood Restoration Plan) regarding the rehabilitees (including those who do not own land) for this Power Plant. As per the recommendation of the LRP, a NGO “Samahar” has completed the task. Moreover, DC office has rehabilitated around 32 families at Foyla and 17 families at Koigardaskati yet now.	Compliance action initiated
28	Resettlement plan should be properly implemented and people should be adequately compensated.	Land was acquired by GoB. Resettlement and rehabilitation action had been taken as per the law of the land, Bangladesh. However, BPDB conducted an assessment (Livelihood Restoration Plan) regarding the rehabilitees (including those who do not own land) for this Power Plant. Based on the recommendation of the LRP, local NGO conducted the training and other tasks to the PAPs. DC office is trying to resettle the PAPs at their selected sites according to the LRP.	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 storing the construction materials which is shifting regularly for the necessity of work. Solid Waste Management plan has also been prepared keeping the provisions in line with this (Section-V, B12, and Part 9 of Technical Specification). However, the solid wastes has been managed by the formal procedure with third party. They collect the stored solid waste, transport and dispose to the designated areas of the KCC.	Compliance action initiated

Sl No	Condition of DoE	Compliance Status	Remarks
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 conducting environmental monitoring on a quarterly basis in February 2014. Accordingly, each quarterly monitoring report has been prepared, submitted and shared with DoE, which are also available at BIFPCL web site.	Being Complied.
31	All activities (pre-construction, construction and post-construction stage) should be implemented according to EMP clearly listed in the EIA report.	BIFPCL has adopted the EMP suggestions applicable at relevant stages. CEGIS, as an environmental consultant of BIFPCL is monitoring the implementation status of EMP on a quarterly basis. BIFPCL is taking appropriate actions based on EMP monitoring report. BIFPCL regularly updates the EMP and OHAS which assist to reduce the impacts and accidental events further.	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 has been engaged by BIFPCL as an independent monitoring body for conducting environmental monitoring on a quarterly basis since February 2014. From then on, as per the contract, CEGIS has been serving as consultant and conducting the monitoring programs quarterly and producing monitoring reports on quarterly 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 monitoring of the susceptible places of Sundarbans. 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 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	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 of operation of the Power Plant.	Compliance action initiated.

Sl No	Condition of DoE	Compliance Status	Remarks
	District Office, Khulna Divisional Office and Headquarters of the Department of Environment simultaneously.	All these stipulations have been included in the technical specification of Main Plant EPC contract package. (Section-V, Clause No B0 6.19.13.2 and Clause No. B0 6.19.13.5). However, air, water, soil and biological components are regularly monitored 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.	CEGIS is regularly carrying out public consultation at different levels. All the monitoring reports are being kept available on website of BIFPCL (www.bifpcl.com)	Being Complied.
36	Online air and water quality monitoring system should be made functional throughout the life of the Plant.	The online monitoring system will be installed when the Plant will be in operation phase and will continue throughout the life time of the Plant. All these stipulations have been included in the technical specification of Main Plant EPC contract package. (Section-V, Clause No B0 6.19.13.2 and Clause No. B0 6.19.13.5).	Compliance action initiated
37	Management Information System (MIS) is 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 concerned 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. Specifications of 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. Moreover, the EPC contractor is going to initiate these activities.	Compliance action initiated
38	JVC should provide all sort of logistics support to DoE and other relevant agencies for monitoring environment related items/events.	BIFPCL is ready to provide all sort of logistic support as and when required by DoE and other relevant agencies for monitoring of Plant construction activities and environmental items/events.	Being complied

Sl No	Condition of DoE	Compliance Status	Remarks
39	No ground water should be allowed to use for plant purposes.	In compliance of the DoE approval condition no. 39 of EIA Report, "No ground water should be allowed to use for plant purposes". The Power Plant has been designed considering use of surface water only during all stages of project development and operation. The authority has already installed Reverse Osmosis (RO) Water Treatment Plant (ABM Water) for use ground water for potable and domestic purposes. During the initial stages of construction, the proponent installed a large scale RO plant for treating surface water of Passur to use construction and drinking purposes. In this quarter, they are constructing a second RO plant for treating surface water of Passur to use mostly in construction purposes. But during the last compliance monitoring visit, a 1200ft deep tube well has been recorded still near the ABM water plant. In this regard, the representative of the Proponent informed the Team that due to sudden malfunctioning and maintenance of the RO Water Treatment Plant and emergency water supply for drinking, sprinkling and firefighting, ground water was utilized.	After completion of second RO Water Treatment Plant, withdrawal of ground water ought to be stopped which assist to comply the DOE approval condition.
40	Conduct stakeholder meetings on regular basis for better performance of the Project as a whole.	Pre-construction phase of the Plant was completed and the construction phase has been 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 since February 2014, for preparing Detailed Environmental Baseline. CEGIS has submitted annual monitoring report along with reports of quarterly monitoring containing latest	Being Complied

Sl No	Condition of DoE	Compliance Status	Remarks
		baseline data to BIFPCL for further dissemination to DoE and other concerned authorities.	
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 realistically 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, Khulna Divisional Office and Headquarters on a monthly basis during the construction period of the Project.	Environmental Monitoring Reports as per specific format provided in the EIA Report made available by BIFPCL and submitted to DoE Bagerhat District Office, Khulna Divisional Office and Headquarters accordingly.	Being Complied
45	The following records must be kept in respect if any samples required to be collected for the purpose of environmental monitoring activities: • The date(s) on which the sample was taken; • The time(s) at which the sample was collected; • The point at which the sample was taken; and • The name of the person who collected the sample.	The Monitoring report keeps all the records as suggested.	Being Complied

Sl No	Condition of DoE	Compliance Status	Remarks
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.)	No single emergency incident happened during this quarter (December 2019 to February, 2020). BIFPCL has given top priority on safety issues as like environment. They instructed the EPC contractor to establish best practices on OHAS and keep all records for avoiding any incident as like earlier. However, taking numbers of initiatives by the EPC and proponent which have collectively reduce the incident in this quarter.	Complied at present
48	The Project authority or its employees must notify the department of Environment of incidents causing or threatening material harm to the environment as soon as practicable after the person becomes aware of the incident.	So far, no such incident has occurred in this quarter. BIFPCL has established a proper mechanism for recording such incident as suggested and notify the department of Environment regarding incidents causing or threatening material harm to the environment as soon as practicable after the person becomes aware of the incident. Health and safety management manual has been revised and reshaped for practicing the Environment and Safety Officer. Moreover, CEGIS is monitoring the EMP implementation.	Complied at present.
49	All pollution incidents shall be reported immediately and simultaneously to the Bagerhat District Office, Khulna Divisional Office and Headquarters of the Department of Environment (DoE) in Dhaka.	So far, no such incident has happened. BIFPCL has established a proper mechanism for recording such incident as suggested in the ERP. CEGIS has been engaged to monitor the social and environmental compliance on a regular interval.	Being complied
50	Appropriate permission would require to be obtained from the Forest Department in favor of cutting/felling	There is no need of cutting/felling down of any trees outside the project boundary. However, in future, if any such case arises, BIFPCL would seek for appropriate permission from the Forest Department.	Being complied

Sl No	Condition of DoE	Compliance Status	Remarks
	on any plant/tree/sapling forested by any individual or government before doing such type of activity.		
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.	An MoU has been signed with Forest Dept., Bangladesh on 24.02.2015 for implementation of Afforestation Program. Initial target is to plant 2 lac saplings in 3 years. By this time, Forest Department has targeted initially to plant about 116000 nos. of saplings of different species. A fresh Agreement with BFD was signed on 24.01.2018 for plantation of 5 Lakh trees for at the end of construction stages. In this quarter, the planted 15000 fruits and medicinal plants at the laydown areas in the project site.	Being Complied
52	Climate Change impacts and maximum storm surge height shall have to consider at the design and construction phase.	The design level (elevation) of the land and earthen embankment has been designed and constructed considering the climate change impact and maximum storm surge height.	Being Complied
53	A separate EIA/morphological study shall have to be conducted for coal transportation and river dredging to develop sound environmental management plan towards conservation of ecosystem and biodiversity.	Coal transportation will be done through the existing maritime route, which is Mongla Port Authority (MPA) controlled waterways. M/s. Institute of Water Modelling (IWM) has already completed the EIA study for the dredging activity and submitted the report to MPA. A separate EIA study for Coal Transportation was conducted by M/s. Center for Environment and Geographic Information Services (CEGIS) which has been approved by DoE.	Being Complied.
54	A full-fledged institutional setup for EHS and CSR must be put in place before operation of the Power Plant.	A full-fledged institutional setup for EHS activities have been operated. After the consecutive accidents, the EHS process has been drastically re-arranged and reshaped. Therefore, no incident has been occurred during this quarter. 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, medical campaign, training etc. infrastructure development of nearby school.	In the process of compliance

Sl No	Condition of DoE	Compliance Status	Remarks
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 Honorable Supreme Court/High Court Division shall render this approval void.	Noted by BIFPCL	
58	Without installation of 275 Meter Height Chimney, Effluent Treatment Plant (ETP), Waste Water Treatment Plant (WWTP), Settling Pond, Desalinization Plant, API Oil Water Separator, High Efficiency Electro Static Precipitator (ESP), 'closed-loop' Flue Gas Desulfurization (FGD), Low NOx Burner, online air and water quality monitoring system and other pollution control equipment and obtaining Environmental Clearance Certificate, the proponent shall not start operation of the Project.	At present, the Plant is in construction phase. The functional and technical specification of the main Plant includes 275 Meter high Chimney, Effluent Treatment Plant (ETP), Waste Water Treatment Plant (WWTP), Settling Pond, Desalinization Plant, API, Oil Water Separator, High Efficiency Electro Static Precipitator (ESP), 'closed-loop' Flue Gas Desulfurization (FGD), Low NOx Burner, online air and water quality monitoring system for preventing pollution. All these stipulations have been included in the technical specification of Main Plant EPC contract package. Moreover, BIRPCL has got the Environmental Renewal Certificate each of the year through maintaining the conditions of DOE.	Compliance action initiated
59	This EIA Approval has been issued with the approval of the appropriate authority.	BPDB and BIFPCL are thankful to DoE.	

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

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

Sl. No.	Conditions	Compliance status	Remarks
1	This EIA Report is approved only for Coal Transportation for the Proposed 2x660 MW Maitree Super Thermal Power Plant Project. Any modification of this project as well as Coal Transportation will require further EIA approval with additional EIA Study.	No. modification of this Project as well as Coal Transportation has happened yet. BIFPCL will notify to DOE prior to initiation of any expansion or extension of the Power Plant.	Suggested to comply as and when required.
2	The route of coal Transportation should be maintained as per EIA Report. In case of any changes the proponent must obtain consent from DoE.	The route of coal Transportation will be maintained as per EIA report. In case of any changes in the transportation route, the proponent shall obtain consent from DoE.	Suggested to comply as and when required.
3	Project Proponent may open L/C (Letter of Credit) for importing machineries for the project which shall also include machineries relating to waste treatment plant and plant and other pollution control devices.	EPC contractor has been appointed for this Project. They are importing Power Plant machineries complying the national laws and regulation.	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 status of the environment or natural resources. So far, no activity under Coal Transportation for the Proposed 2x660 MW Maitree Super Thermal Power Plant Project has been started. So, there is no issue for impact on the surrounding environment or natural resources from the coal transportation activities. Moreover, a strong baseline has been prepared throughout the coal transportation route for assessing the impact in future.	Suggested to comply as and when required.
5	Proper and adequate mitigation measures shall be ensured throughout the operation period of the Project	The project proponent has included all the mitigation measures in their BID document. However, BIFPCL is monitoring the implementation of mitigation measures for the construction period.	Suggested to comply at operation phase.

Sl. No.	Conditions	Compliance status	Remarks
6	Any heritage site, ecologically critical areas, and other environmentally, religious and archeologically sensitive places shall be kept protected during project operation.	There is no Religious and Archaeological place in and around the Project site. As a third party, CEGIS is now monitoring the potential locations and indicators which are sensitive to coal transportation in the Sundarbans ECA, Sundarbans Reserve Forest and Sundarbans World Heritage Site	Suggested to comply at operation phase.
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 through best practices and EMPs of EIA of Coal Transportation Report. Since, the environmental monitoring indicators are not observed any anomalies, it can be concluded that the construction work is progressing in environment friendly procedure yet now.	Being Complied
8	Proper and adequate sanitation facilities shall be ensured in labor camps throughout the proposed project period.	At present, the civil construction of the Project including Jetty construction activities are progressing fast. New residential areas and adequate sanitation facilities are available for the labors. Provisions in line with this, condition have been included in Clause no 2.5 of Special Condition of Contract (SCC) and in Health & safety manual.	Being Complied
9	Proper and adequate on-site precautionary Measures and safety measures shall be ensured so that no habitat of any flora and fauna would be endangered or destructed.	The construction of Jetty is being carried as per EMP guidelines. 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 is giving top priorities to occupational health and safety issues after few incidents. They have significantly revised the OHAS guideline and practice it seriously. There is no incident recorded in this quarter.	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 to control the dust over the exposed earthen areas and roads. It is also monitoring and recorded daily.	Being Complied
12	The entire coal handling system should be designed as an enclosed (and not only covered)	In the BID document, the coal handling system has been mentioned as closed system with the integration	Compliance action initiated

Sl. No.	Conditions	Compliance status	Remarks
	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.	of dust control measures. Moreover, continuous monitoring system will be 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 of after the construction work is over.	The proponent now preparing an environmentally friendly procedure for disposing off the construction material like scraps as well as other construction wastes. They have already contracted one organization in association with KCC for solid waste management. They are now working to dispose the solid waste at KCC designated landfill areas.	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 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

Sl. No.	Conditions	Compliance status	Remarks
18	Regular monitoring of the susceptible places of the Sundarbans for protecting ecosystem, biodiversity and forest coverage should be made using latest high-resolution image for keeping ambient environment.	The Monitoring activities have been carried out by CEGIS. The study includes all of this part vastly. The monitoring report contains analysis of ecosystem, habitat, 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.	Being Complied.
19	Air, water, soil, biological and social data should be monitored regularly with a network monitoring system with a view to assess the natural quality of the Sundarbans and other fragile ecosystem and report of monitoring results should be submitted to Bagerhat District Office, Khulna Divisional Office and Headquarters of the Department of Environment simultaneously.	The network monitoring system will be installed as a part of the project construction for online monitoring and it will run at the time in operation phase. All these stipulations have been included in the technical specification of Main Plant EPC contract package. (Section-V, Clause No B0 6.19.13.2 and Clause No. B0 6.19.13.5).	Being Complied.
20	There should be regular disclosure of the report through workshops and websites and responses should be taken care accordingly.	All of the environmental monitoring reports and other relevant reports are available on website of BIFPCL (www.bifpcl.com). CEGIS is regularly carrying out public consultation at local level.	Being Complied.
21	BIFPCL should provide all sort of logistics support to DOE and other relevant agencies for monitoring environment related items/events.	BIFPCL is ready to provide all sort of logistic support as and when required by DoE and other relevant agencies for monitoring of Plant construction activities and environmental items/events.	Suggested to Comply as and when required.
22	In order to control noise pollution, vessels and equipment shall undergo regular maintenance; working during sensitive hours and locating machinery close to sensitive receptor shall be avoided.	Not applicable in this stage	Suggested to Comply as and when required.
23	Vessels of this project should follow the MPA guidelines and protocol to ensure no hindrance to other vessels.	Not applicable in this stage	Suggested to Comply as and when required.

Sl. No.	Conditions	Compliance status	Remarks
24	The vessels used for this project should maintain IMO criteria to enable identification of substances harmful to the marine environment.	Not applicable in this stage	Suggested to Comply as and when required.
25	All the vessels should follow applicable MARPOL Convention, Annex V on the prevention of pollution by garbage from ships.	Not applicable in this stage	Suggested to Comply as and when required.
26	Additional Environmental baseline data to be collected as suggested in the EIA report and conveyed to DOE and other concern authorities.	Environmental baseline data has been collected by third party *i.e.* CEGIS. 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 so far been implementing the EMP measures phase by phase as suggested in EIA report and approval condition of DoE. The status of EMP implementation are also regularly monitored by CEGIS.	Being Complied
28	The project authority shall submit a detail work plan with time schedule of development activities at least 7 (seven) days ahead of the work commences in the field to the Bagerhat District Office, Khulna Divisional Office and Headquarters of the Department of Environment simultaneously.	The jetty construction works is now going on. Beforehand, 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. They will maintain it in future.	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 on monthly basis since April, 2018.	Being Complied
30	The following records must be kept in respect of any samples required to be collected for the purposes of environmental monitoring activities: a) the date(s) on which the sample was taken;	The Monitoring report of CEGIS keeps all the records as suggested.	Being Complied

Sl. No.	Conditions	Compliance status	Remarks
	b) the time(s) at which the sample was collected; c) the point at which the sample was taken; and d) The name of the person who collected the sample.		
31	The results of any monitoring required to be conducted under this EIA report must be recorded.	CEGIS is recording all the monitoring data and submitting to BIFPCL through proper documentation. The report is being shared with DoE on regular basis.	Being Complied
32	In case of any emergency, the following information shall immediately be reported to Bagerhat District Office, Khulna Divisional office and Headquarters of the Department of Environment (DOE) simultaneously: a. Nature of incident (oil spill, fire, accident, collision, land slide etc.) b. Personnel affected (injured, missing, fatalities, etc.) c. Emergency support available and its location (standby transport, medical facilities, etc.) d. Weather conditions e. Current operations (abandoning the site, firefighting, etc.)	Emergency Reporting/ Emergency response Plan have been prepared for the Power Plant which includes the Jetty. Health and safety management manual have been revised for better and precautious implementation of OHAS. They have taken a lot of care regarding occupational health and safety. BIFPCL will adopt the ERP suggested on the EIA study of coal transportation in association with the NOSCOP and NPDM for any future incidents as suggested.	Compliance Action initiated.
33	National Oil Spill Contingency Plan (NOSCOP) should be followed to establish an organizational structure to combat marine pollution	Not applicable in this stage	Suggested to comply as and when required.
34	The project authority or its employees must notify the Department of Environment of incidents causing or threatening material harm to the environment as soon as practicable after the person becomes aware of the incident.	BIFPCL has established a proper mechanism for the project to record such incident as suggested and notify the department of Environment regarding incidents causing or threatening material harm to the environment as soon as practicable after the person becomes aware of the incident. They will prepare the institutional arrangement for managing the	Complied at Present.

Sl. No.	Conditions	Compliance status	Remarks
		incident during coal transportation system before the operation based on the EIA and DoE recommendations. Moreover, monitoring activities is continued for checking any significant changes in natural ecosystem.	
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 incidents as suggested in the ERP. CEGIS has been engaged to monitor the social and environmental compliance monitoring 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. As like previous years, BIFPCL has got the renewal for this year.	Being complied

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Appendices

Appendix I: Checklist of Monitoring Environmental Compliances

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

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

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

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

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

(Labor and Working Condition)

Basic Data

Sl No	Description	Values
1	Direct Workers	
2	Contracted Workers	
3	Supply Chain Workers	
4	Child labor	
5	0 - 12	
6	13 - 14	
7	14 - 18	

Checklist for Labor and Working Condition

Sl No	Potential Impacts	Proposed EMP	Actual Implementation	Recommended Action	Compliance Status
1	Working Conditions and Management of Worker Relationship	• Preparation of Human Resources Policies and Procedures for Direct workers • Defined Working condition and Terms of Employment for direct worker • Sustainably equivalent terms and condition for migrant workers • Compliance to national law of forming workers' organization • No discrimination and equal opportunity for all • Measures for diminishing past discrimination • Grievance Mechanism			
	Protecting Workforce	• The client will not employ children in any manner that is economically exploitative, or is likely to be hazardous or to interfere with the child education, or to be harmful to the child's health or physical, mental, spiritual, moral, or social development. • No Force Labor			
2	Safety at site	• Installation/Construction of Safety Fence around the Project area • Use of Personnel Protective Equipment (i.e. safety suit, safety goggles, ear plug, safety shoes, gloves, dust mask, etc.) • Safety trainings for workers (i.e. fire control, working at height, working in heat, first aid etc.) • Practice of Tool box meeting, safety talks, • Safe Storage of Hazardous Chemicals (e.g. fuel, flammable chemical, toxic chemicals, etc.) • Maintaining Material Safety Data Sheet (MSDS) • Provision of Health care facilities such as doctor, hospital etc. available at/nearby the plant construction site • Availability of First Aid at work place • Preparation and Follow of Emergency Response Plan • Adequate fire precautions in place (for example, fire extinguishers, escape routes etc.)			

Sl No	Potential Impacts	Proposed EMP	Actual Implementation	Recommended Action	Compliance Status
		• Documentation and reporting of occupational accidents, diseases, and incidents • Policies and procedures for managing and monitoring the performance of third party employers in relation to OHS			
3	Occupational Health and Safety Procedure	• Provision of complete EHS division in the Human Resources Planning/Organogram • Preparation of Safety Policy to be adopted during plant operation			
4	Worker's Well Being	• Establishment Grievance Mechanisms • Ensuring fair treatment, non-discrimination and equal opportunity • Compliance of Project's labor policy with the national labor law • No Child Labor • No incident of forced labor • Provision of Welfare facilities for Worker/Labor			

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

(Community Health, Safety and Security)

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

Sl No	Potential Impacts	Proposed EMP	Actual Implementation	Recommended Action	Compliance Status
5	Youth Employment	• Providing training/awareness program for the local youth to let them aware about the required qualification to get involved in the Project related activities			
6	Public Communication, Consultation and Awareness	• Arranging public communication/consultation meeting • Sharing of Project information with local people • Organizing environmental and social awareness programs/meetings			

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

(Biodiversity and Sustainable Management of Living Natural Resources)

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

Sl No	Potential Impacts	Proposed EMP	Actual Implementation	Recommended Action	Compliance Status
		• 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 and Socio-economic Monitoring of Khulna 2×660 MW Power Plant for 23rd monitoring program (February, 2020)

Monitoring team

Ambient Noise level acquisition at KJA bridge area

Measuring the light intensity

Measuring tree height

Collecting Forest soil samples

Measuring canopy cover

Data acquisition for forest health

Surveying Fisherman

Measuring tree DBH

Examining length wise distribution of fish

Monitoring of noise level

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 includes 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, Sundarbans 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 provide more insight about the inter-dependency between flora and fauna in an ecosystem.
- Render any other related services as and when requested.
- Conduct community level consultation in a regular interval and disclose project level information.
- Keep liaison with different organization like Govt department, NGOs, and relevant stakeholders.

The Monitoring parameter & associated indicator are given below

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

Monitoring Parameter	Indicators
	Fish production and availability
	Fisher survey result
Noise level	Sound level at the sensitive zone
Water resources	DO, BOD, COD, Salinity, TDS, TS, pH, Hg, Pb
	Total Hardness, Hg, NO_3 and PO_4
	River Morphology,
	Tidal inundation
	Drainage Network
	Erosion and Accretion
	Ground water quality
Air quality	SOx
	NOx
	SPM (PM_{10} and $PM_{2.5}$)
	CO

Air quality monitoring progress

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

- SOx: measured by Fluorescent signal generated by exiting SO_2 with UV light
- NOx: measured by Chemilumiscent reaction between NOx & O_3
- 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, PM_{10}, $PM_{2.5}$): 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 PM_{10} 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 increase of a contaminate concentration in an environmental medium.

Baseline Monitoring is monitoring in and 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.	12
2	CD-ROM in respect of documents/datasheets	2

Appendix IV: Monitoring Data

(A) Air Quality Data

Table A1: Ambient Air Quality Monitoring Results

Locations of Monitoring	Pollutants	1st QM, Apr 2014	2nd QM, Jul 2014	3rd QM, Oct 2014	4th QM, Jan 2015	5th QM, Apr 2015	6th QM, Jul2015	7th QM, Oct 2015	8th QM, Jan 2016	9th QM, Apr 2016	10th QM, Jul 2016	11th QM, Oct 2016	12th QM, Jan 2017	13th QM, April, 2017	14th QM, Oct, 2017	15th QM Jan, 2018	16th QM April, 2018	17th QM, Jul 2018	18th QM, Nov, 2018	19th QM, Feb, 2019	20th QM, Apr, 2019	21st QM, Jul, 2019	22nd QM, Jul, 2019	23rd QM, Feb, 2020	Bangladesh (DoE) Standard (ECR 2005)
Weather		Sunny	Rainy/ Cloudy	Sunny	Sunny	Sunny	Rainy/ Cloudy	Sunny/ Rainy	Sunny	Sunny	Rainy/ Cloudy	Rainy/ Cloudy	Sunny	Sunny/ Cloudy	Sunny	Sunny	Sunny/ Cloudy	Rainy/ Cloudy	Sunny/ Cloudy	Sunny	Sunny	Sunny/ Cloudy	Sunny/ Cloudy	Sunny	
			Concentrations are in µg/m³																						
SW Corner of the PP area	$PM_{2.5}$	33	37	25	33	47	25	22	34	19	5	9	24.8	8.12	28.2	32.9	28.4	15.2	31.1	27.3	21.7	37.76	51.32	27.12	65^{24hr}
	PM_{10}	78	77	53	79	83	35	52	135	117	32	22	79	43.8	73.6	133	70	15.8	106	105.4	98.2	67.15	127.65	68.12	150^{24hr}
	SPM	207	239	190	200	177	42	91	175	332	51	53	115.7	122.4	169.4	145.6	121.5	12.9	137.4	151.6	128.6	109.25	183.56	108.48	200^{8hr}
	SO_2	21	24	19	23	15	52	35	14	18	9	8	9.5	9.0	7.2	14.3	11.4	11.9	12.7	11.6	13.9	56.5	31.53	18.35	365^{24hr}
	NOx	26	29	27	31	29	35	29	18	18	12	10	11.3	10.7	7.5	17.7	12.8	10.2	14.8	12.4	16	55.08	24.97	12.12	100^{Annual}
	CO	120	188	140	190	144	146	88	74	57	35	119	59	91	73	61	32	11.1	28	15	18	4	16	28	$(10000)^{8hr}$
	O_3	27	26	19	22	26	12	5	4	1	1	1	5	03	10	03	9	13.2	7	9	6	25	10	8	157^{8hr}
Shapmari area	$PM_{2.5}$	39	48	48	39	34	18	17	35	25	3	8	25	14.6	8.5	31.5	26.7	15.8	35.7	30.6	18.9	50.24	19.34	19.14	65^{24hr}
	PM_{10}	814.69	90	74	102	97	31	48	116	44	11	11	99.5	56.9	40.4	147.8	52	64.4	109.9	126.3	106.1	63.94	82.27	83.22	150^{24hr}
	SPM	2156.3	263	217	274	266	47	79	192	187	27	23	154.2	136.7	45.3	181.4	138.7	113.4	143.9	168	150.8	123.56	120.45	106.35	200^{8hr}
	SO_2	19	28	22	21	22	58	27	13	11	4	6	12.9	10	4.3	15	9.6	10.8	12.2	12.3	12.1	31.53	60.26	27.41	365^{24hr}
	NOx	29	39	27	26	24	46	25	16	22	6	8	15.7	11.8	6	18.6	10.2	13.1	13.6	13.8	13.9	24.97	58.39	18.77	100^{Annual}
	CO	165	210	230	164	136	127	102	77	22	31	108	66	78	79	69	27	25	30	21	20	4	11	44	$(10000)^{8hr}$
	O_3	33	26	26	23	21	16	1	1	1	0	0	1	08	25	04	4	8	6	4	1	34	22	9	157^{8hr}
NW Corner of	$PM_{2.5}$	37	44	19	42	59	28	19	24	11	3	10	29	10.3	15.2	40.7	27.7	12.9	32.3	20.3	14.2	37.27	33.2	21.61	65^{24hr}

Locations of Monitoring	Pollutants	1st QM, Apr 2014	2nd QM, Jul 2014	3rd QM, Oct 2014	4th QM, Jan 2015	5th QM, Apr 2015	6th QM, Jul2015	7th QM, Oct 2015	8th QM, Jan 2016	9th QM, Apr 2016	10th QM, Jul 2016	11th QM, Oct 2016	12th QM, Jan 2017	13th QM, April, 2017	14th QM, Oct, 2017	15th QM Jan, 2018	16th QM April, 2018	17th QM, Jul 2018	18th QM, Nov, 2018	19th QM, Feb, 2019	20th QM, Apr, 2019	21st QM, Jul, 2019	22nd QM, Jul, 2019	23rd QM, Feb, 2020	Bangladesh (DoE) Standard (ECR 2005)
Weather		Sunny	Rainy/ Cloudy	Sunny	Sunny	Sunny	Rainy/ Cloudy	Sunny/ Rainy	Sunny	Sunny	Rainy/ Cloudy	Rainy/ Cloudy	Sunny	Sunny/ Cloudy	Sunny	Sunny	Sunny/ Cloudy	Rainy/ Cloudy	Sunny/ Cloudy	Sunny	Sunny	Sunny/ Cloudy	Sunny/ Cloudy	Sunny	
		Concentrations are in µg/m³																							
the PP area	**PM_{10}**	67	78	56	98	91	96	29	125	29	24	14	108.7	31.3	49.9	136.3	100.1	44.3	117.4	93.6	58.7	42.99	1119.34	77.69	150^{24hr}
	SPM	234	217	157	310	244	321	66	187	115	31	35	168	91.7	63.9	161.7	116.2	76.3	156.2	125.5	119.2	60.45	175.13	100.04	200^{8hr}
	SO_2	19	22	18	27	21	56	32	13	17	4	8	12.2	5.8	7.5	9.6	13.2	5.8	13.4	10.7	11.6	60.26	54.02	19.68	365^{24hr}
	NOx	23	28	22	32	39	43	21	18	16	5	11	14.7	7.1	9.2	11.7	14.3	5.9	15	11.3	13.5	58.39	43.45	17.53	100^{Annual}
	CO	110	178	110	210	140	133	87	77	38	47	127	31	74	80	45	43	21	32	20	16	7	0	30	$(10000)^{8hr}$
	O_3	25	19	17	36	44	11	8	2	0	1	1	3	05	10	05	7	6	8	1	5	18	2	9	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	19.3	19.7	57.51	31.28	26.66	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	102	69.9	33.25	69.32	61.11	150^{24hr}
	SPM	233	244	183	277	236	79	112	176	268	69	30	167.8	95.6	57.2	171.9	90.6	5.2	113.5	127.5	92.2	75.13	102.17	98.74	200^{8hr}
	SO_2	21	23	17	22	25	41	31	16	20	10	7	12.2	5.5	4.1	13.8	6.1	6.1	9.5	11.5	12.6	54.02	59.33	18.88	365^{24hr}
	NOx	25	28	22	26	27	44	32	21	16	12	9	19.3	9.8	5.0	16.7	7.3	7.4	10.7	13.8	13.8	43.45	57.02	11.58	100^{Annual}
	CO	175	210	190	150	196	96	96	81	73	41	98	63	85	77	59	24	20	20	17	18	6	0	32	$(10000)^{8hr}$
	O_3	26	29	22	19	15	9	6	4	0	0	3	5	08	6	04	6	6	2	3	4	7	52	12	157^{8hr}
Chunkuri-2, Bajua Dacope	**$PM_{2.5}$**	35	39	46	37	33	35	28	31	25	7	5	25.2	8.7	17.3	33.4	11.4	10.2	26.8	22.8	15	19.46	33.74	39.44	65^{24hr}
	PM_{10}	77	86	69	68	61	109	49	98	60	23	20	74.4	44.4	100.2	157.1	40.6	30.6	105.9	126.7	72.7	46.37	78.27	100.08	150^{24hr}
	SPM	117	113	162	183	188	175	94	167	167	31	48	162	110.6	127.8	200	108	78.6	128.5	146.6	117.6	80.31	100.95	146.72	200^{8hr}
	SO_2	19	24	21	18	11	55	33	21	13	7	9	18.9	8.2	7.9	19	10.4	7.5	12.1	12.4	11.2	45.81	35.42	36.14	365^{24hr}
	NOx	23	26	27	24	18	49	23	16	25	10	8	18	11.2	8.4	20.7	11.6	8.4	14	13.8	13.7	44.92	40.09	20.04	100^{Annual}
	CO	190	205	170	170	33	133	75	70	33	38	79	36	94	69	58	42	23	27	25	20	10	0	18	$(10000)^{8hr}$
	O_3	27	24	18	22	41	21	2	1	1	0	2	2	03	5	05	2	4	5	9	8	2	38	22	157^{8hr}
Pankhali, Dacope	**$PM_{2.5}$**	47	49	57	41	39	34	25	47	15	8	10	38.7	15.8	17	72.3	15.9	11.1	24.8	28.6	15.8	24.03	24.03	33.26	65^{24hr}

Locations of Monitoring	Pollutants	1st QM, Apr 2014	2nd QM, Jul 2014	3rd QM, Oct 2014	4th QM, Jan 2015	5th QM, Apr 2015	6th QM, Jul2015	7th QM, Oct 2015	8th QM, Jan 2016	9th QM, Apr 2016	10th QM, Jul 2016	11th QM, Oct 2016	12th QM, Jan 2017	13th QM, April, 2017	14th QM, Oct, 2017	15th QM Jan, 2018	16th QM April, 2018	17th QM, Jul 2018	18th QM, Nov, 2018	19th QM, Feb, 2019	20th QM, Apr, 2019	21st QM, Jul, 2019	22nd QM, Jul, 2019	23rd QM, Feb, 2020	Bangladesh (DoE) Standard (ECR 2005)
Weather		Sunny	Rainy/ Cloudy	Sunny	Sunny	Sunny	Rainy/ Cloudy	Sunny/ Rainy	Sunny	Sunny	Rainy/ Cloudy	Rainy/ Cloudy	Sunny	Sunny/ Cloudy	Sunny	Sunny	Sunny/ Cloudy	Rainy/ Cloudy	Sunny/ Cloudy	Sunny	Sunny	Sunny/ Cloudy	Sunny/ Cloudy	Sunny	
		Concentrations are in µg/m³																							
	PM_{10}	119	127	139	101	105	144	62	128	46	42	18	141.6	105	63.4	208.9	74.3	58.4	92	125.8	92.7	56.56	119.28	127.52	150^{24hr}
	SPM	297	266	254	208	299	339	183	198	114	78	34	194.6	179	87.5	223.9	154.1	98.4	139	178.2	141.1	93.5	100.95	160.02	200^{8hr}
	SO_2	28	31	31	24	30	58	36	18	9	8	8	16.1	12.9	8	16.3	12.2	9.4	10.4	13.3	10.4	59.41	44.29	30.89	365^{24hr}
	NOx	41	39	36	26	27	47	23	15	19	9	9	19	18.7	10.2	17.7	13.7	12.1	13.4	14.9	11.7	51.09	17.72	19.02	100^{Annual}
	CO	230	217	250	188	177	125	105	101	55	29	112	48	83	87	49	34	29	30	14	14	9	0	11	$(10000)^{8hr}$
	O_3	49	38	36	27	11	13	5	2	2	0	0	3	06	0	06	6	8	8	8	3	22	26	2	157^{8hr}
Mongla Port area	**$PM_{2.5}$**	47	55	39	41	26	33	19	34	21	9	11	25.7	22.6	33.2	70.1	23.2	13.2	30.3	26.6	35	56.67	39.69	38.92	65^{24hr}
	PM_{10}	139	174	77	82	35	52	33	132	45	29	15	119.3	93.6	97	209.1	89.9	47.5	103.7	109.3	131	119	64.12	119.61	150^{24hr}
	SPM	288	303	197	217	214	118	65	189	144	50	6	172.3	196	187.2	242	144.7	73.7	161.9	157.1	183.1	192.17	83.9	173.36	200^{8hr}
	SO_2	27	28	26	24	14	45	36	16	10	8	7	16.8	10.5	8.2	15.5	11.8	6.5	12	10.8	16.8	59.33	57.24	31.33	365^{24hr}
	NOx	44	39	33	27	17	40	20	13	14	10	8	15.3	15.1	10.7	18.4	13.2	7.2	16.8	12.6	17.8	57.02	46.58	13.34	100^{Annual}
	CO	230	320	220	211	24	110	84	71	29	31	97	44	72	79	52	29	20	33	28	17	15	48	29	$(10000)^{8hr}$
	O_3	57	52	37	26	09	15	8	3	1	2	1	4	04	9	02	3	1	9	7	3	5	40	4	157^{8hr}
Harbaria, Sundarbans	**$PM_{2.5}$**	19	22	33	27	24	27	24	26	13	6	10	19.2	10.5	28.3	43.5	11.6	11.4	20.6	15.4	14.2	28.03	39.69	17.81	65^{24hr}
	PM_{10}	41	39	59	56	49	42	50	82	42	20	14	85.2	36.7	89.9	152.4	29.1	24.3	80.5	92.6	63.9	21.85	64.12	63.27	150^{24hr}
	SPM	111	117	129	139	109	70	73	159	91	43	44	93.5	103.7	107	189.9	72.4	47.6	90.3	118.3	90.9	48.09	83.9	87.51	200^{8hr}
	SO_2	9	10	14	12	16	51	34	15	11	6	7	11.9	5.7	7.6	13.2	7.9	4.9	11.6	9.5	11.6	49.72	57.24	16.47	365^{24hr}
	NOx	19	22	27	18	22	34	22	14	16	8	10	13	7.7	9.3	15.2	8.3	5.4	13	10.1	13	41.91	46.58	9.9	100^{Annual}
	CO	65	58	70	64	56	112	81	62	47	32	110	67	73	84	57	31	20	20	25	16	16	48	30	$(10000)^{8hr}$
	O_3	13	12	13	11	14	12	4	2	2	0	1	4	08	0	02	2	6	4	3	5	8	40	12	157^{8hr}
Akram Point,	**$PM_{2.5}$**	17	19	23	18	49	NO	25	18	9	4	4	14.3	13.2	7.5	35.4	13.7	14	29.1	16.2	13	19.68	36.67	23.04	65^{24hr}

Locations of Monitoring	Pollutants	1st QM, Apr 2014	2nd QM, Jul 2014	3rd QM, Oct 2014	4th QM, Jan 2015	5th QM, Apr 2015	6th QM, Jul2015	7th QM, Oct 2015	8th QM, Jan 2016	9th QM, Apr 2016	10th QM, Jul 2016	11th QM, Oct 2016	12th QM, Jan 2017	13th QM, April, 2017	14th QM, Oct, 2017	15th QM Jan, 2018	16th QM April, 2018	17th QM, Jul 2018	18th QM, Nov, 2018	19th QM, Feb, 2019	20th QM, Apr, 2019	21st QM, Jul, 2019	22nd QM, Jul, 2019	23rd QM, Feb, 2020	Bangladesh (DoE) Standard (ECR 2005)
Weather		Sunny	Rainy/ Cloudy	Sunny	Sunny	Sunny	Rainy/ Cloudy	Sunny/ Rainy	Sunny	Sunny	Rainy/ Cloudy	Rainy/ Cloudy	Sunny	Sunny/ Cloudy	Sunny	Sunny	Sunny/ Cloudy	Rainy/ Cloudy	Sunny/ Cloudy	Sunny	Sunny	Sunny/ Cloudy	Sunny/ Cloudy	Sunny	
		Concentrations are in µg/m^3																							
Sundarbans	**PM_{10}**	39	44	32	39	77	NO	32	77	31	15	14	85.5	96.0	37.8	150.6	36.4	41.6	100.2	93.2	51.9	43	87.15	82.91	150^{24hr}
	SPM	114	133	97	88	102	NO	51	128	46	23	27	90.9	137.0	41.8	175.1	90.3	58	121.4	117.8	71.1	83.9	122.62	121.68	200^{8hr}
	SO_2	7	9	12	13	21	NO	27	14	9	4	6	8.4	6	5.8	14	8.3	6.3	10.8	10.1	8.9	57.24	35.23	24.21	365^{24hr}
	NOx	17	19	22	17	27	NO	19	15	10	5	6	12.7	10.1	5.9	15.1	9.9	9.3	11.7	11.3	9.4	46.58	31.26	16.74	100^{Annual}
	CO	49	60	50	46	163	NO	92	64	21	37	101	58	79	69	52	21	25	28	17	14	38	24	20	$(10000)^{8hr}$
	O_3	11	14	9	10	27	NO	8	1	0	0	2	3	0	0	03	3	4	5	3	1	9	90	2	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	18.2	NO	NO	27.76	17.39	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	96.1	NO	NO	67.89	72.45	150^{24hr}
	SPM	101	119	107	97	110	NO	88	NO	132	NO	26	111.4	NO	102	173.7	NO	NO	107.9	127.8	NO	NO	90.31	94.28	200^{8hr}
	SO_2	8	7	13	14	15	NO	28	NO	15	NO	9	13.5	NO	6	15.8	NO	NO	10.6	10.7	NO	NO	45.81	13.33	365^{24hr}
	NOx	18	18	19	22	20	NO	23	NO	19	NO	9	15.9	NO	7.8	18.1	NO	NO	12.5	10.9	NO	NO	44.92	8.65	100^{Annual}
	CO	52	62	65	60	60	NO	93	NO	40	NO	121	43	NO	72	71	NO	NO	22	21	NO	NO	2	36	$(10000)^{8hr}$
	O_3	14	13	11	9	23	NO	2	NO	0	NO	0	4	NO	0	04	NO	NO	6	6	NO	NO	16	7	157^{8hr}
	$PM_{2.5}$	54	39	52	42	55	46	19	35	11	16	9	34.6	23.1	19.5	78.7	12.4	12.5	21.3	20.8	33	38.59	18.65	40.22	65^{24hr}

Locations of Monitoring	Pollutants	1st QM, Apr 2014	2nd QM, Jul 2014	3rd QM, Oct 2014	4th QM, Jan 2015	5th QM, Apr 2015	6th QM, Jul2015	7th QM, Oct 2015	8th QM, Jan 2016	9th QM, Apr 2016	10th QM, Jul 2016	11th QM, Oct 2016	12th QM, Jan 2017	13th QM, April, 2017	14th QM, Oct, 2017	15th QM Jan, 2018	16th QM April, 2018	17th QM, Jul 2018	18th QM, Nov, 2018	19th QM, Feb, 2019	20th QM, Apr, 2019	21st QM, Jul, 2019	22nd QM, Jul, 2019	23rd QM, Feb, 2020	Bangladesh (DoE) Standard (ECR 2005)
Weather		Sunny	Rainy/ Cloudy	Sunny	Sunny	Sunny	Rainy/ Cloudy	Sunny/ Rainy	Sunny	Sunny	Rainy/ Cloudy	Rainy/ Cloudy	Sunny	Sunny/ Cloudy	Sunny	Sunny	Sunny/ Cloudy	Rainy/ Cloudy	Sunny/ Cloudy	Sunny	Sunny	Sunny/ Cloudy	Sunny/ Cloudy	Sunny	
		Concentrations are in µg/m³																							
Ina City, near Khan Jahan Ali Bridge	PM_{10}	139	117	91	84	75	89	49	112	69	68	24	145.9	99.5	39.6	213.9	38.8	45.4	57.9	91.3	125.9	47.05	59.19	116.16	150^{24hr}
	SPM	301	287	239	219	222	181	101	181	112	107	64	189.7	187.2	127.9	243.4	78.9	69.9	102.9	158	173.4	100.95	78.09	157.28	200^{8hr}
	SO_2	33	29	33	28	31	59	28	16	11	10	10	17.1	7.2	7.1	21	7.5	7.5	8.7	10.4	15.3	35.42	49.72	28.31	365^{24hr}
	NOx	49	41	39	36	33	38	26	16	15	15	14	18.6	11.7	8.8	25	8.4	11.1	9.7	11.1	17.1	40.09	41.91	24.14	100^{Annual}
	CO	330	370	330	296	101	89	94	98	68	36	104	66	79	81	69	36	28	121	19	23	11	24	32	$(10000)^{8hr}$
	O_3	59	67	57	39	21	7	4	2	1	0	2	3	07	07	09	9	7	4	5	6	6	18	10	157^{8hr}
Township area	$PM_{2.5}$	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	29.1	13.7	28.6	21.2	17.2	21.24	29.64	44.26	65^{24hr}
	PM_{10}	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	70.3	60.8	111.7	88.7	61.6	96.71	98.15	122.73	150^{24hr}
	SPM	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	120.6	98.1	144.6	129.4	102.5	127.79	127.79	171.29	200^{8hr}
	SO_2	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	13.1	8.4	10.2	11.3	7.9	9.32	19.32	34.12	365^{24hr}
	NOx	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	14	9	11.6	12.1	11.9	15.63	15.63	21.72	100^{Annual}
	CO	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	46	32	30	18	21	9	0	18	$(10000)^{8hr}$
	O_3	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	9	4	9	1	5	19	11	4	157^{8hr}
Access road bridge	$PM_{2.5}$	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	33.1	20.9	40.9	26.9	36.1	39.65	14.65	26.26	65^{24hr}
	PM_{10}	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	118.1	83.7	128.3	112.9	137	142.84	79.92	91.39	150^{24hr}
	SPM	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	142.5	106.2	177.8	168.2	163.2	171.2	109.25	126.13	200^{8hr}
	SO_2	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	12.2	10.9	13.4	12.5	15.7	17.37	56.5	16.16	365^{24hr}
	NOx	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	14.8	13.4	15	13	17.6	21.32	55.08	9.04	100^{Annual}
	CO	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	38	34	32	23	21	8	0	22	$(10000)^{8hr}$
	O_3	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	5	7	9	6	7	6	6	6	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

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

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

Sampling Locations	Criteria Pollutant	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																							
		Apr	July	Oct	Jan	Apr	July	Oct	Jan	Apr	July	Oct	Jan	Apr	Oct	Jan	Apr	July	Nov	Feb	Apr	July	Nov	Feb	
		1QM	2QM	3QM	4QM	5QM	6QM	7QM	8QM	9QM	10QM	11QM	12QM	13QM	14QM	15QM	16QM	17QM	18QM	19QM	20QM	21QM	22QM	23 QM	
1	Left Bank of Passur River at 100m u/s of North West corner from the Project boundary	7.2	7.0	8.1	7.9	7.6	7.8	7.6	7.1	7.5	7.27	6.9	7.6	7.2	7.1	8.28	8.1	8.4	7.9	8.18	9.0	6.8	7.9	8.4	
2	Middle Passur River at 100m u/s of North West corner from the Project boundary	7.2	7.0	8.2	8.0	7.7	7.9	7.58	7.3	7.8	7.3	7	7.5	7.3	6.9	8.25	8.1	8.4	6.04	8.03	9.9	6.8	7.8	8.3	
3	Right Bank of Passur River at 100m u/s of North West corner from the Project boundary	7.2	6.9	8.0	8.1	7.8	7.8	7.64	7.3	7.2	7.93	7.2	7.8	7.3	6.9	8.17	8.1	8.4	8.09	8.06	8.7	7.1	7.8	8.8	
4	Left Bank of Passur River at Project site-Jetty	7.9	7.1	8.1	7.9	7.5	7.9	7.6	7.1	7.4	7.56	7.3	8.2	7.2	6.9	8.2	8.1	8.3	7.65	7.78	8.9	7.5	7.5	8.3	
5	Middle Passur River at Project site-Jetty	7.1	6.9	8.1	7.9	7.6	8	7.58	7.5	7.8	7.6	7	8.5	7.8	7.2	8.21	8.1	8.3	8.20	7.97	8.4	7.2	7.4	8.3	
6	Right Bank of Passur River at Project site-Jetty	7.1	6.9	8.2	7.9	7.7	8	7.62	7.6	7.4	7.9	6.9	8.7	7.4	7.2	8.2	8.1	8.2	7.87	8.04	8.5	6.7	7.4	8.0	
7	Left Bank of Passur River at South West corner from the Project boundary	7.4	7.0	8.1	7.6	7.5	8.1	7.78	8.1	7.6	7.94	7.2	8.1	6.9	7.2	8.39	8.0	8.4	8.11	7.89	9.3	7.4	7.3	8.6	
8	Middle of Passur River at South West corner from the Project boundary	7.4	6.9	8.0	7.5	7.2	8	7.6	8	7.1	8.04	7.5	8.6	6.8	7.1	8.15	8.1	8.5	7.44	7.85	8.7	6.5	7.2	8.2	6.5– 8.5
9	Right Bank of Passur River at South West corner from the Project boundary	7.3	6.8	8.0	7.8	7.3	8.1	7.64	7.9	7.2	8.2	7.3	8.9	7.1	7	8.16	8.1	8.5	7.07	8.06	8.4	7.3	7.2	8.3	
10	Maidara river of the South East corner of the Project at Ichamoti-Maidara confluence	7.4	6.9	8.1	7.7	7.5	8.1	7.3	7.3	7.1	8.1	6.8	8.1	7.2	7.1	8.4	8.1	8.6	7.94	8.05	9.3	7.2	7.4	8.0	
11	Maidara river near proposed township area	7.4	6.8	8.1	7.3	7.6	6.9	7.56	7.1	7.4	7.8	7.1	7.6	7.4	7	7.92	7.6	7.3	7.631	7.8	8.2	7.0	7.3	7.9	
12	Passur river at Passur-Ghasiakhali confluence	7.3	6.8	7.4	8.2	7.5	7.9	7.1	7.4	7.3	7.3	6.9	7.2	6.9	6.8	7.48	7.3	8.3	7.02	8.65	8.1	7.0	8.0	8.3	
13	Passur river at Harbaria of Sundarbans	7.9	6.9	8.0	8.1	7.7	7.9	7.8	8.2	7.3	7.63	7.4	7.8	6.9	7.1	8.19	8.1	8.4	7.19	7.71	8.2	7.2	8.0	8.4	
14	Passur river at Akram point of Sundarbans	7.2	6.9	7.9	8.1	7.7	NS	7.63	8	7.9	7.67	7.1	8.2	7.2	7.1	8.22	8.2	8.2	8	7.77	7.9	7.1	7.8	8.2	
15	Passur river at Hiron po.000int of Sundarbans	7.2	7.0	7.0	8.1	7.7	NS	7.39	NS	7.8	NS	7.6	8.5	NS	6.8	8.2	NS	NS	7.18	7.79	NS	NS	7.8	8.2	

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. No.	Sampling Locations	Temperature (°C)																							
		Apr	Jul	Oct	Apr	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	Apr	Jul	Nov	Feb	Apr	July	Nov	Feb	
		1QM	2QM	3QM	4QM	5QM	6QM	7QM	8QM	9QM	10QM	11QM	12QM	13QM	14QM	15QM	16QM	17QM	18QM	19QM	20QM	21QM	22QM	23QM	
1	Left Bank of Passur River at 100m u/s of North West corner from the Project boundary	31	33	31	19	30	31.8	31.2	22.0	31.2	29.6	30.1	22.8	30	29.8	19.7	30	30	28	22.02	**31**	30	27	25	
2	Middle Passur River at 100m u/s of North West corner from the Project boundary	31	33	31	20	30	30.5	31.8	21.0	31.1	29.1	30.8	22.5	30	30.1	19.8	30	30	26.85	21.96	**31**	30	27	25	
3	Right Bank of Passur River at 100m u/s of North West corner from the Project boundary	31	33	30	20	30	30.5	30.9	21.0	30.8	29.4	30.4	22.1	29.8	30.2	20.2	31	30	27.49	21.82	**31**	30	27	24	
4	Left Bank of Passur River at Project site-Jetty	31	33	31	19	31	30.8	31.3	22.0	31.4	30.1	30.1	22.8	31.3	30.1	20.3	28	30	28.38	22.62	**31**	30	28	24	
5	Middle Passur River at Project Site-Jetty	30	32	31	19	30	30.6	31.6	22.0	30.9	30.5	31.0	21.8	30.0	29.8	20.3	29	30	27.97	22.55	**31**	31	28	24	
6	Right Left Bank of Passur River at Project site-Jetty	30	32	31	19	30	30.4	31.1	21.0	31.0	30.5	31.1	21.9	30.0	29.9	20.3	28	31	28.05	22.35	**31**	30	28	24	
7	Left Bank of Passur River at South West corner from the Project boundary	31	32	30	20	31	30.5	30.3	23.0	30.7	30.7	30.4	22.1	29.9	30.0	20.6	28	31	27.85	22.17	**33**	30	27	25	20°C
8	Middle of Passur River at South West corner from the Project boundary	31	31	29	19	30	30.8	30.5	22.0	30.4	29.8	30.2	22.0	29.8	30.1	20.2	28	31	28	22.27	**31**	30	27	25	–
9	Right Bank of Passur River at South West corner from the Project boundary	31	31	29	19	31	30.6	30.8	21.0	30.1	29.8	31.1	22.1	30.1	30.1	20.3	28	31	28	22.54	**32**	30	27	25	30°C
10	Maidara river of the South East corner of the Project at Ichamoti-Maidara confluence	30	31	28	19	30	30.8	31.8	22.0	31.2	30.4	31.1	21.9	30.3	29.9	19.1	28	31	27.62	22.06	**33**	30	27	25	
11	Maidara river near proposed township area	30	32	27	20	30	31.6	31.2	23.0	30.6	30.7	31.2	21.8	30.1	30.0	21.1	31	31	30.2	21	**32**	30	27	23	
12	Passur river at Passur-Ghasiakhali confluence	29	30	32	19	30	29.8	30.7	21	31.3	30.7	30.38	22.1	30.2	30	20.8	**30**	29	26.82	21.89	**31**	30	28	22	
13	Passur river at Harbaria of Sundarbans	30	30	27	22	30	29.0	30.8	22.0	31.5	30.9	29.9	23.1	30.2	29.8	21	30	29	27.62	21.81	**31**	31	30	24	
14	Passur river at Akram point of Sundarbans	29	29	30	21	30	NS	30.2	21.0	30.8	30.4	30.4	22.5	30.8	29.9	21.2	32	30	27.21	22.42	**31**	31	29	24	
15	Passur river at Hiron point of Sundarbans	29	30	29	21	30	NS	30.4	NS	31.4	NS	31.3	21.4	NS	29.4	21.2			28.66	23.78			31	23	

Source: CEGIS Field Survey

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

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

Sl. No	Sampling Locations	Salinity (ppt)																							
		Apr	Jul	Oct	jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	Apr	Jul	Nov	Feb	Apr	July	Nov	Feb	
		1QM	2QM	3QM	4QM	5QM	6QM	7QM	8QM	9QM	10QM	11QM	12QM	13QM	14QM	15QM	16QM	17QM	18QM	19QM	20QM	21QM	22QM	23QM	
1	Left Bank of Passur River at 100m u/s of North West corner from the Project boundary	11.5	2.5	0.0	4.5	13	0	0	4.1	8	0	0	3.7	6.3	0	2	11.5	0.2	0.9	11.1	**16.6**	**0.5**	0.4	3.8	**No Specific standard for salinity has been mention-ed in the ECR'1997**
2	Middle Passur River at 100m u/s of North West corner from the Project boundary	11.5	0.3	0.0	4.1	15	0	0	4.3	7.4	0	0	3.8	5.9	0	2	11.5	0.2	0.1	11.1	**16.2**	**0.2**	0.3	3.9	
3	Right Bank of Passur River at 100m u/s of North West corner from the Project boundary	11.5	0.2	0.0	4.5	16	0	0	4.3	7	0	0	3.6	6.2	0	2	11.5	0.4	0.8	10.6	**16.5**	**0.3**	0.3	4.0	
4	Left Bank of Passur River at Project site-Jetty	12.0	2.2	0.0	4.7	9	0	0	4.4	6	0	0	4	6.8	0	2.6	12.0	0.3	0.9	10.8	**16.6**	**0.2**	0.5	3.8	
5	Middle Passur River at Project site-Jetty	12.0	0.3	0.0	5.1	13	0	0	5.1	6.2	0	0	3.9	6.9	0	2.6	12.0	0.2	0.8	10.8	**16.9**	**0.2**	0.3	3.9	
6	Right Left Bank of Passur River at Project site-Jetty	12.0	0.5	0.0	5.0	14	0	0	5	9	0	0	4.2	6.1	0	2.7	12.0	0.2	0.8	11	**16.9**	**1.2**	0.3	3.9	
7	Left Bank of Passur River at South West corner from the Project boundary	9.5	4.0	0.0	5.2	14	0	0	5.2	8	0	0	4.2	6.5	0	2.8	9.5	0.2	1	9.9	**12.0**	**0.3**	2.1	3.7	
8	Middle of Passur River at South West corner from the Project boundary	9.0	0.0	0.0	5.2	13	0	0	4.9	7	0	0	4.1	7.1	0	2.8	9.0	0.3	0.2	11.5	**16.7**	**0.2**	0.1	0.1	
9	Right Bank of Passur River at South West corner from the Project boundary	10.0	2.5	0.0	5.1	12	0	0	5.5	6.8	0	0	4.1	7	0	2.8	10.0	0.3	0.3	11.1	**16.9**	**0.3**	0.4	3.5	
10	Maidara river of the South East corner of the Project at Ichamoti-Maidara confluence	10.0	0.5	0.0	5.2	10	0	0	3.8	7.1	0	0	3.9	7	0	2.6	10.0	0.3	0.9	11.3	**16.5**	**0.3**	0.3	4.0	
11	Maidara river near proposed township area	9.0	4.5	0.0	4.5	9	0	0	2.5	6.3	0	0	3.8	6.9	0	2.52	9.0	0.2	0.02	9.9	**8.0**	**1.0**	0.3	4.0	
12	Passur river at Passur-Ghasiakhali confluence	10.0	9.5	0.0	5.0	14	0	0	4.8	6	0	0	6.7	10.4	1.2	10.8	10.0	0.6	1	7.9	**14.9**	**0.4**	0.5	3.6	
13	Passur river at Harbaria of Sundarbans	12.0	10.0	0.0	6.0	15	0	0	5.3	8.9	0	0	8.9	10.4	2.3	2.8	12.0	2.2	1.8	11.9	**15.6**	**0.3**	0.7	3.7	
14	Passur river at Akram point of Sundarbans	19.0	15.0	1.0	16.0	20	NS	5	11.3	9.4	4	3	16.3	16	3.6	13.1	19.0	2.8	9.1	16.7	**22.9**	**0.9**	6.6	8.9	
15	Passur river at Hiron point of Sundarbans	23.0	19.5	2.0	23.0	25	NS	6.2	NS	14	NS	5.8	21.4	NS	5.1	16.45	23.0		13.9	22.7			9.2	11.0	

Source: CEGIS Field Survey

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

Table B.4: Dissolve Oxygen in Passur River

SL	Sampling Locations	Dissolve Oxygen (mg/L)																							
		Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	Apr	Jul	Nov	Feb	Apr	July	Nov	Feb	
		1QM	2QM	3QM	4QM	5QM	6QM	7QM	8QM	9QM	10QM	11QM	12QM	13QM	14QM	15QM	16QM	17QM	18QM	19QM	20QM	21QM	22QM	23QM	
1	Left Bank of Passur River at 100m u/s of North West corner from the Project boundary	5.9	6.1	5.6	5.5	6.2	5.3	6.8	5.1	7.1	6.2	6	6.1	7.1	6.3	5.19	6.575	6.0	6.4	8.7	**5.9**	6.0	7.7	8.4	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	7.9	**6.5**	6.0	7.8	8.6	
3	Right Bank of Passur River at 100m u/s of North West corner from the Project boundary	5.2	6.7	7.7	6.7	6.2	5	7.1	6.2	6.9	5.6	6	6.1	6.8	6.5	5.06	6.275	6.1	6.3	7.3	**6.3**	6.1	7.8	7.6	
4	Left Bank of Passur River at Project Site-Jetty	5.7	6.8	7.6	5.8	6.2	6.7	6.8	5.9	5.8	6.1	6.3	6.2	6.9	6.3	5.1	6.15	5.5	6	8.7	**6.1**	6.5	8.6	8.1	
5	Middle of Passur River at Project Site-Jetty	5.9	6.9	7.2	5.9	6.6	6.6	7.2	5.3	6.1	6.3	5.9	5.9	7.4	6.3	5.03	6.5	6.0	6.2	7.3	**6.5**	6.3	8.0	8.2	
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	7.4	**6.0**	6.4	8.2	7.0	
7	Left Bank of Passur River at South West corner from the Project boundary	6.6	7.3	5.6	6.1	6.3	7.5	6.4	6	6.9	6.3	5.9	6.3	6.4	6.5	5	6.55	6.8	6.1	7.8	**6.1**	6.2	9.9	6.9	
8	Middle of Passur River at South West corner from the Project boundary	6.5	7.1	5.6	6.9	6.5	7.4	6.1	6.1	7.1	6.4	6	6.4	7.2	7.1	4.98	6.825	6.2	6.3	7.1	**6.5**	6.2	10.0	7.2	
9	Right Bank of Passur River at South West corner from the Project boundary	6.5	7.2	5.8	6.6	6.4	7.3	6.3	5.8	6.8	5.6	6	6.4	6.8	6.5	5.11	6.625	6.0	6.2	6.9	**6.1**	6.3	10.5	7.8	
10	Maidara river of the South East corner of the Project at Ichamoti-Maidara confluence	6.0	6.5	8.0	6.0	6.2	6	7.1	4.1	6.4	5.2	6.1	6.7	6.8	6.3	5.17	6.35	6.7	5.8	7.5	**6.3**	6.4	7.1	9.7	
11	Maidara river near proposed township area	6.7	6.8	8.0	6.2	6.5	6.4	7.1	5.2	5.9	5.4	6.4	6.7	7.1	6.2	5.11	6.7	6.3	6	6.0	**6.2**	6.0	7.7	7.5	
12	Passur river at Passur-Ghasiakhali confluence	5.3	6.2	7.0	6.5	6.3	7	6.6	5.4	5.8	5.4	5.6	5.9	6.4	6.4	5.23	5.95	5.8	6	6.9	**6.5**	6.2	7.9		
13	Passur river at Harbaria of Sundarbans	5.4	5.9	7.0	6.6	5.8	7.5	7.1	5.2	6.4	5.4	5.8	6.1	6.4	6.2	5.03	5.8	6.9	8.21	7.5	**6.9**	6.0	8.4		
14	Passur river at Akram point of Sundarbans	7.9	6.4	7.7	6.7	6	NS	7.3	6.2	6.1	6.2	6.7	6.5	7.2	6.8	5.4	6	6.8	6.9	7.7	**7.0**	6.6	7.7		
15	Passur river at Hiron point of Sundarbans	7.5	6.5	7.8	6.5	5.8	NS	7	NS	7.1	6.8	6.9	6.8	NS	7.3	5.4	NS	NS	7.2	8.0	NS		8.6		

Source: CEGIS Field Survey-

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

Table B.5: BOD_5 of Passur River Water

SL	Sampling Locations	Apr 1QM	Jul 2QM	Oct 3QM	Jan 4QM	Apr 5QM	Jul 6QM	Oct 7QM	Jan 8QM	Apr 9QM	Jul 10QM	Oct 11QM	Jan 12QM	Apr 13QM	Oct 14QM	Jan 15QM	Apr 16QM	
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	5 or more (standard for sustaining fisheries)
2	Middle of Passur River at 100m u/s of North West corner from the Project boundary	4.9	3.3	4.1	2.3	3.2	2.4	1.9	2.2	3.2	2.8	2.7	1.9	3.4	2.1	1.9	2	
3	Right Bank of Passur River at 100m u/s of North West corner from the Project boundary	2.2	2.8	3.4	2.7	3.1	2.9	3.4	1.9	3	2.5	2.8	1.9	2.5	2.7	1.9	3	
4	Left Bank of Passur River at Project Site-Jetty	3.2	3.1	4.0	0.8	3	4.4	3.2	1.1	3.6	2.1	3.1	2.1	2.4	2.8	2.0	4	
5	Middle of Passur River at Project Site-Jetty	3.0	2.5	3.5	1.4	3.5	4.3	3.7	2.4	3.3	2.2	2.5	2.2	2.6	2.4	2.0	4	
6	Right Bank of Passur River at Project Site-Jetty	5.8	3.5	3.6	2.0	3.4	3.7	2.9	1.7	3.1	3.1	2.9	2.1	3.1	2.1	2.3	4	
7	Left Bank of Passur River at South West corner from the Project boundary	3.9	2.8	2.6	1.0	3.1	5.3	2.2	1.2	3.1	2.9	2.4	2.1	3.2	2.4	2.0	5	
8	Middle of Passur River at South West corner from the Project boundary	3.8	3.3	2.8	2.6	3.2	5.2	2.3	2.3	2.6	2.7	2.7	1.9	2.5	2.7	1.9	5	
9	Right Bank of Passur River at South West corner from the Project boundary	6.5	3.8	2.9	2.1	3.4	5	3.1	2.4	3	3.1	3.1	2.1	2.6	2.3	2.1	5	
10	Maidara river of the South East corner of the Project at Ichamoti-Maidara confluence	3.2	3.3	5.5	1.5	3.2	3.9	4.2	2.7	3.3	3.4	2.8	1.8	3.4	2.4	2.1	4	
11	Maidara river near proposed township area	4.1	3.7	4.0	2.0	3.4	4.2	1.6	1.8	3.5	3.2	2.9	2.1	3.2	2.1	2.0	4	
12	Passur river at Passur-Ghasiakhali confluence	2.3	2.2	1.7	2.0	3.3	4.9	2.1	2.2	3.4	2.8	2.3	2	2.7	3.1	2.4	3.1	
13	Passur river at Harbaria of Sundarbans	2.2	2.5	2.6	1.9	2.4	3.9	2.7	2.1	3.2	2.8	2.7	2.1	2.7	3.1	2.9	2.3	
14	Passur river at Akram point of Sundarbans	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	
15	Passur river at Hiron point of Sundarbans	4.9	3.3	4.1	2.3	3.2	2.4	1.9	2.2	3.2	2.8	2.7	1.9	3.4	2.1	1.9	2	

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)																					
		Apr 1QM	Jul 2QM	Oct 3QM	Jan 4QM	Apr 5QM	Jul 6QM	Oct 7QM	Jan 8QM	Apr 9QM	Jul 10QM	Oct 11QM	Jan 12QM	Apr 13QM	Oct 14QM	Jan 15QM	Apr 16QM	Jul 17QM	Nov 18QM	Feb 19QM	Apr 20QM	July 21QM	Nov 22QM
1	Left Bank of Passur River at 100m u/s of North West corner from the Project boundary	288	24	6	128	87	42	32	124	220	8	12	56	52	24	48	276	20	56	72	188	36	56
2	Middle Passur River at 100m u/s of North West corner from the Project boundary	284	20	30	68	58	43	36	100	240	8	8	40	48	8	28	240	24	44	60	180	24	40
3	Right Bank of Passur River at 100m u/s of North West corner from the Project boundary	328	56	14	92	132	18	28	96	280	8	8	44	56	40	40	230	12	48	48	176	32	26
4	Left Bank of Passur River at Project Site-Jetty	376	28	18	84	102	26	36	100	280	8	12	48	40	32	36	232	30	60	44	192	20	40
5	Middle Passur River at Project Site-Jetty	400	60	14	116	110	21	36	108	240	12	16	52	36	40	32	254	16	36	56	180	28	28
6	Right Bank of Passur River at Project Site-Jetty	364	496	18	108	88	24	40	80	260	8	12	42	48	16	28	252	12	42	64	172	24	24
7	Left Bank of Passur River at South West corner from the Project boundary	364	108	10	104	96	32	42	100	240	12	8	56	42	48	40	212	10	48	88	200	28	20
8	Middle of Passur River at South West corner from the Project boundary	400	40	22	16	18	25	28	100	180	8	8	52	36	8	44	218	24	32	36	160	20	32
9	Right Bank of Passur River at South West corner from the Project boundary	408	120	10	100	106	25	48	124	200	12	12	44	52	4	36	230	16	28	68	180	32	20
10	Maidara river of the South East corner of the project at Ichamoti-Maidara confluence	276	32	10	116	88	51	40	100	160	8	8	36	44	16	40	180	40	36	72	160	24	24
11	Maidara river near proposed township area	284	96	26	84	94	36	42	108	210	30	8	48	40	32	32	252	20	42	68	172	20	36
12	Passur river at Passur - Ghasiakhali confluence	408	172	14	96	92	30	46	88	220	12	16	40	64	**40**	48	260	10	20	32	178	24	40
13	Passur river at Harbaria of Sundarbans	372	216	14	96	102	26	36	100	140	16	12	**40**	216	32	40	280	16	58	56	184	32	32
14	Passur river at Akram point of Sundarbans	536	520	54	316	302	NS	84	96	156	4	68	56	240	**16**	72	296	110	44	**180**	160	220	92
15	Passur river at Hiron point of Sundarbans	540	416	122	472	470	NS	96	NS	160	NS	56	196	NS	4	88	NS	NS	76	140	NS	NS	72

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)																						
		Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	Apr	Jul	Nov	Feb	Apr	July	Nov	
		1QM	2QM	3QM	4QM	5QM	6QM	7QM	8QM	9QM	10QM	11QM	12QM	13QM	14QM	15QM	16QM	17QM	18QM	19QM	20QM	21QM	22 QM	
1	Left Bank of Passur River at South West corner from the Project boundary	<5	<5	<5	>15	16.9	9	<5	39	61	5	<5	9.2	*5.73*	<5	16.6	<5	<1	<2.0	<2.0	<2.0	<2.0	<2.0	
2	Passur-Ghasiakhali Confluence	<5	<5	<5	>15	13	7.63	9.87	21	30.3	13.5	<5	15.6	<5	<5	<5	<5	<5	<2.0	<2.0	<2.0	<2.0	<2.0	
3	Passur river at Harbaria of Sundarbans	<5	6.3	<5	>20	39.1	10.1	<5	14	26	5.73	<5	<5	<5	<5	<5	<5	<1	<2.0	<2.0	<2.0	<2.0	<2.0	10
4	Passur river at Hiron point of Sundarbans	<5	<5	<5	>20	<5	NS	10.8	ND	31	NS	10.1	13.8	7.71	<5	<5	<5	NS	<2.0	<2.0	<2.0	<2.0	<2.0	
5	Akram Point of Sundarbans	<5	<5	<5	>20	<5	NS	9.73	36	82	5.87	<5	14.2	ND	<5	<5	<5	<1	<2.0	<2.0	<2.0	<2.0	<2.0	

Source: CEGIS Field Survey

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

able B.8: TDS of Passur River System

SL	Sampling Locations	TDS (mg/L)																					
		Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	Apr	Jul	Nov	Feb	Apr	July	Nov
		1QM	2QM	3QM	4QM	5QM	6QM	7QM	8QM	9QM	10QM	11QM	12QM	13QM	14QM	15QM	16QM	17QM	18QM	19QM	20QM	21QM	22QM
1	Left Bank of Passur River at 100m u/s of North West corner from the Project boundary	13060	251	176	4360	14400	937	158	5570	13400	179	138	3100	13400	496	1913	14500	315	855	9940	15800	290	480
2	Middle of Passur River at 100m u/s of North West corner from the Project boundary	12630	246	162	3950	14700	941	169	5910	13280	112	106	3140	13480	122	1919	14420	224	733	9950	15600	150	175
3	Right Bank of Passur River at 100m u/s of North West corner from the Project boundary	12900	383	153	4330	14900	127	152	5490	13560	125	108	3330	13400	123	1915	14650	232	722	9730	15500	152	170
4	Left Bank of Passur River at Project site-Jetty	13190	445	169	4750	14600	175	172	5720	12830	162	147	3630	13560	172	2500	14300	328	824	9860	15700	205	190
5	Middle Passur River at Project Site-Jetty	13330	353	156	4920	14500	132	162	5850	13100	185	110	3600	13490	125	2520	14450	235	716	9980	16000	142	175
6	Right Bank of Passur River at Project site-Jetty	13380	402	152	4870	14200	156	160	5480	13460	143	112	3520	13330	125	2500	14540	208	732	9800	16100	150	174
7	Left Bank of Passur River at South West corner from the Project boundary	13180	655	162	5040	14500	336	192	5650	12820	205	113	3470	13640	160	2840	14400	205	945	10190	15640	208	325
8	Middle of Passur River at South West corner from the Project boundary	13390	587	153	5050	14600	158	164	5740	12960	195	108	3790	13680	126	2710	14500	286	784	10280	16000	145	180
9	Right Bank of Passur River at South West corner from the Project boundary	13240	916	154	5130	14250	160	164	5650	13590	140	146	3770	13360	127	2720	14610	296	786	10080	15800	154	172
10	Maidara river of the South East corner of the project at Ichamoti-Maidara confluence	12400	455	214	5050	14000	2320	183	5450	13340	165	196	2920	13490	1616	2500	14160	265	992	10040	15700	940	1405
11	Maidara river near proposed Township area	10970	2510	257	4390	13900	355	176	4420	11700	5170	238	3960	13110	1200	2970	14450	340	827	8860	15100	365	875
12	Passur river at Passur - Mongla confluence	12800	6410	209	5130	14050	298	227	4540	11330	893	162	3370	12340	204	2570	14500	580	940	8350	15722	172	350
13	Passur river at Harbaria of Sundarbans	12280	9360	285	4780	13900	683	205	4940	13580	1321	301	3370	13600	245	2690	15350	2190	1715	10950	15400	560	474
14	Passur river at Akram point of Sundarbans	21500	15960	3400	12350	13600	NS	4220	13330	20720	7330	2550	3580	19370	3270	11390	20600	7680	8100	17200	14800	12500	3950
15	Passur river at Hiron point of Sundarbans	21500	14050	5720	17900	25300	NS	5830	NS	25500	NS	4120	12210	NS	4450	14190	NS	NS	12500	21110	NS	NS	5750

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)																					
		Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	Apr	Jul	Nov	Feb	Apr	July	Nov
		1QM	2QM	3QM	4QM	5QM	6QM	7QM	8QM	9QM	10QM	11QM	12QM	13QM	14QM	15QM	16QM	17QM	18QM	19QM	20QM	21QM	22QM
1	Left Bank of Passur River at 100m u/s of North West corner from the Project boundary	2900	250	216	930	3000	245	250	1270	3130	240	255	1090	3640	200	430	3100	210	335	2050	3000	2100	215
2	Middle of Passur River at 100m u/s of North West corner from the Project boundary	2500	180	218	870	3050	110	330	1380	3090	205	250	980	3420	150	510	1040	205	310	3900	5000	1950	125
3	Right Bank of Passur River at 100m u/s of North West corner from the Project boundary	2650	170	335	870	3250	105	360	1240	3140	205	190	1030	3300	155	498	1030	185	313	4100	5000	1900	190
4	Left Bank of Passur River at Project site-Jetty	2550	175	390	940	3450	118	365	1220	3010	220	265	1020	3400	160	570	1060	200	285	4600	5200	1850	175
5	Middle Passur River at Project site-Jetty	2600	275	340	990	3250	103	355	1300	3070	232	237	915	3440	145	590	1040	210	255	4200	5000	2500	178
6	Right Bank of Passur River at Project site-Jetty	2625	350	355	970	3200	105	350	1260	3100	218	242	1070	3380	140	480	1085	215	275	4400	4800	2550	155
7	Left Bank of Passur River at South West corner from the Project boundary	2550	325	330	1045	3600	153	345	1370	3060	235	205	935	3540	150	505	1080	205	295	4400	4400	1700	175
8	Middle of Passur River at South West corner from the Project boundary	2800	350	345	1125	3670	105	390	1340	3130	242	217	1100	3480	155	530	1110	212	265	4300	5100	1850	150
9	Right Bank of Passur River at South West corner from the Project boundary	2500	475	325	975	3540	165	445	1270	3110	224	238	1110	3600	175	512	1100	205	325	4600	4900	2000	115
10	Maidara river of the South East corner of the project at Ichamoti-Maidara confluence	2500	450	350	980	3260	470	183	950	3180	220	250	1040	1960	165	505	1300	210	295	4000	5200	2000	350
11	Maidara river near proposed township area	2400	725	330	970	3190	130	340	1075	3080	875	240	1170	2300	320	478	1120	220	315	4100	5000	2200	285
12	Passur river at Passur - Mongla confluence	3150	1400	377	1000	3210	135	410	1090	3060	405	245	1070	2450	220	1070	1410	245	325	4000	4782	1800	200
13	Passur river at Harbaria of Sundarbans	2625	2150	345	970	3080	200	430	1100	3050	415	282	1070	3560	200	610	1330	530	2550	4500	4500	1400	185
14	Passur river at Akram point of Sundarbans	4500	3625	980	2380	3420	NS	1090	2850	4520	1750	670	1130	4300	640	1475	1440	2030	2750	5900	4500	4300	830
15	Passur river at Hiron point of Sundarbans	4850	3050	1440	2690	3640	NS	1460	NS	5050	NS	810	2870	NS	905	1740	NS	NS	4200	6900	NS	NS	1225

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)																					
		Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	Apr	Jul	Nov	Feb	Apr	July	Nov
		1QM	2QM	3QM	4QM	5QM	6QM	7QM	8QM	9QM	10QM	11QM	12QM	13QM	14QM	15QM	16QM	17QM	18QM	19QM	20QM	21QM	22QM
1	Left Bank of Passur River at 100m u/s of North West corner from the Project boundary	598	126	234	180	160	26	76	14	8	61	20	46	51	18	14	18	17	14	15	12	14	8
2	Middle of Passur River at 100m u/s of North West corner from the Project boundary	45	92	193	210	167	25	80	12	7	48	18	52	42	15	15	17	16	11	12	14	11	7
3	Right Bank of Passur River at 100m u/s of North West corner from the Project boundary	53	112	174	230	170	127	65	14	10	56	16	48	48	22	14	22	15	15	14	13	13	6
4	Left Bank of Passur River at Project Site-Jetty	54	99	227	450	160	30	92	17	10	62	20	42	52	16	13	20	18	11	12	11	12	8
5	Middle Passur River at Project Site-Jetty	60	100	232	250	165	27	85	18	8	45	24	54	43	20	13	19	16	13	13	12	13	7
6	Right Bank of Passur River at Project Site-Jetty	55	105	186	200	155	40	97	22	7	49	19	46	38	17	14	21	15	12	15	15	14	6
7	Left Bank of Passur River at South West corner from the Project boundary	24	116	185	300	150	32	104	20	12	51	20	61	32	15	15	17	16	14	16	12	13	7
8	Middle of Passur River at South West corner from the Project boundary	27	112	536	530	147	40	90	7	10	43	18	58	44	16	17	19	14	13	13	11	12	6
9	Right Bank of Passur River at South West corner from the Project boundary	67	37	459	450	155	44	82	18	11	39	16	63	40	14	12	18	20	15	14	13	13	5
10	Maidara river of the South East corner of the project at Ichamoti-Maidara confluence	7	65	798	280	148	36	96	11	7	42	24	55	37	26	14	23	13	11	14	14	15	9
11	Maidara river near proposed township area	9	24	389	206	160	28	92	10	6	11	30	66	49	30	15	32	12	42	8	12	12	7
12	Passur river at Passur - Mongla confluence	50	310	203	280	165	24	60	15	13	47	27	61	38	**25**	13	14	17	27	15	13	13	15
13	Passur river at Harbaria of Sundarbans	65	90	869	400	160	42	74	22	18	31	18	**61**	33	27	17	15	13	22	12	11	12	11
14	Passur river at Akram point of Sundarbans	115	99	28	103	150	NS	110	16	23	16	41	34	28	22	14	18	14	15	11	10	7	7
15	Passur river at Hiron point of Sundarbans	91	72	267	200	180	NS	144	NS	15	NS	33	49	NS	16	13	NS	NS	6	9	NS	NS	5

Source: CEGIS Field Survey

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

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

Sl	Sampling Locations	NO_3^{2-} (mg/L)																					
		Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	Apr	Jul	Nov	Feb	Apr	July	Nov
		1QM	2QM	3QM	4QM	5QM	6QM	7QM	8QM	9QM	10QM	11QM	12QM	13QM	14QM	15QM	16QM	17QM	18QM	19QM	20QM	21QM	22QM
1	Left Bank of Passur River at 100m u/s of North West corner from the Project boundary	0.9	2.89	0.32	3	33	9.1	4	6.3	3	3.9	0.25	3.62	4.35	5.8	3	6.8	0.8	2.8	3.5	0.3	0.1	3.5
2	Middle of Passur River at 100m u/s of North West corner from the Project boundary	0.7	2.4	1.57	1.5	13	7.5	7.1	4.3	2.9	6.2	0.39	2.89	5.05	6.8	4.2	4.9	1.7	0.1	2.6	0.3	1.1	2.7
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	0.11	1.9	3.7	1.2	3.4
4	Left Bank of Passur River at Project Site-Jetty	1.3	0.76	1.64	3.1	48	6.6	5.7	3.1	2	5.1	0.76	2.25	6.11	7.1	3	2.8	2.8	1.7	2.1	3.0	1.5	3.0
5	Middle Passur River at Project Site-Jetty	1.4	2.69	1.42	2.2	69	6.1	3.3	5.2	3.1	2.7	0.52	2.46	3.4	3.1	4.7	5.2	1.8	0.9	2.2	1.2	1.5	1.7
6	Right Bank of Passur River at Project Site-Jetty	1.1	2.98	1.33	8.5	8	6.6	4.7	4.1	3.6	3.9	0.31	3.01	3.16	5	7.6	5.5	3.2	0.1	3.5	4.8	2.1	2.1
7	Left Bank of Passur River at South West corner from the Project boundary	0.75	2.13	1.85	2.7	87	14.9	4.4	4.9	2.6	3.6	0.2	3.64	3.14	4.1	8.8	2.6	4	0.1	4.2	0.5	1.5	2.0
8	Middle of Passur River at South West corner from the Project boundary	1.1	2.43	2.09	1.8	48	4	6.2	3.7	2.9	5.1	0.41	1.93	3.34	3.4	8.5	4.5	3.7	3.4	3.0	3.4	1.7	1.3
9	Right Bank of Passur River at South West corner from the Project boundary	1.2	2.05	2.21	1.9	128	4.9	4.4	4.4	2.6	4.9	0.63	2.17	2.00	3.1	2.8	5.3	3.8	0.7	3.1	4.1	0.5	2.2
10	Maidara river of the South East corner of the project at Ichamoti-Maidara confluence	0.3	2.18	2.26	6	62	7	4.9	5.6	2.7	5.2	0.4	2.46	3.61	2.3	1.6	5.9	4.4	2.3	2.1	5.0	3.1	2.9
11	Maidara river near proposed township area	0.5	0.88	1.98	4	48	3.1	2.9	3.9	3.1	5.3	0.32	3.1	1.60	3.2	3.4	3.9	3.1	0.12	1.3	2.9	2.5	1.6
12	Passur river at Passur - Mongla confluence	0.6	1.52	1.64	4.5	29	7.8	3.1	3.7	3	5.2	0.27	2.78	2.49	3.5	4.5	4.7	2.4	1.6	3.7	2.7	1.8	2.0
13	Passur river at Harbaria of Sundarbans	1.4	1.75	1.67	2.7	18	4.4	4.4	5.1	3.4	5.1	0.39	2.78	2.46	4.2	4.6	5.2	2.7	0.1	4.7	4.4	1.7	2.1
14	Passur river at Akram point of Sundarbans	2.7	3.32	0.59	1.5	25	NS	3.2	4.9	2.9	5.4	0.25	3.08	3.69	2.2	1.8	5.5	4.2	0.1	1.8	2.7	1.3	1.6
15	Passur river at Hiron point of Sundarbans	0.8	2.84	0.4	2	28	NS	11.5	NS	3.5	NS	0.38	2.28	NS	2.6	6.1	NS	NS	0.9	2.6	NS	NS	2.5

Source: CEGIS Field Survey

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

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

Sl	Sampling Locations	SO_4^{2-} (mg/L)																					
		Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	Apr	Jul	Nov	Feb	Apr	July	Nov
		1QM	2QM	3QM	4QM	5QM	6QM	7QM	8QM	9QM	10QM	11QM	12QM	13QM	14QM	15QM	16QM	17QM	18QM	19QM	20QM	21QM	22QM
1	Left Bank of Passur River at 100m u/s of North West corner from the Project boundary	1840	20	26	580	1360	67	7	570	1080	18	5	230	422	29	630	1400	24	51	760	1460	23	37
2	Middle of Passur River at 100m u/s of North West corner from the Project boundary	1320	23	28	450	1260	11	8	590	1040	10	3	210	460	3	370	1320	18	49	756	1380	19	6
3	Right Bank of Passur River at 100m u/s of North West corner from the Project boundary	1280	36	34	480	1240	9	11	560	1020	13	4	200	1340	5	410	1440	20	46	764	1420	21	6
4	Left Bank of Passur River at Project Site-Jetty	1360	45	33	550	1240	26	10	550	1060	15	4	230	1380	2	310	1260	22	52	748	1410	16	5
5	Middle Passur River at Project Site-Jetty	1040	32	30	520	1120	6	8	580	980	17	6	280	1280	1	310	1200	21	38	760	1440	17	4
6	Right Bank of Passur River at Project Site-Jetty	1320	20	27	540	820	8	9	565	1100	14	5	230	1400	2	490	1400	16	42	762	1400	19	8
7	Left Bank of Passur River at South West corner from the Project boundary	1640	60	40	630	880	9	12	640	1060	15	6	230	880	2	700	1300	10	56	768	1500	15	25
8	Middle of Passur River at South West corner from the Project boundary	1520	40	35	560	1180	19	8	560	1020	18	5	231	1440	1	340	1380	24	52	760	1450	16	9
9	Right Bank of Passur River at South West corner from the Project boundary	1280	80	64	620	900	12	6	550	1080	12	8	250	1340	3	340	1240	22	39	770	1460	14	6
10	Maidara river of the South East corner of the project at Ichamoti-Maidara confluence	1120	20	63	570	1220	72	11	96	1040	11	14	160	1220	120	270	1200	21	65	758	1500	18	71
11	Maidara river near proposed township area	1320	210	63	460	840	27	9	480	1020	480	14	200	1340	76	350	1250	18	46	760	1490	12	55
12	Passur river at Passur - Mongla confluence	1360	620	44	630	980	39	13	482	1100	42	14	220	1220	**5**	280	1260	28	30	765	1446	14	33
13	Passur river at Harbaria of Sundarbans	1560	860	69	590	900	51	7	500	1080	60	19	220	1300	13	220	1300	35	20	756	1500	16	38
14	Passur river at Akram point of Sundarbans	2600	1400	1390	850	1540	NS	84	760	1650	620	190	230	1420	30	760	1460	620	250	764	1500	980	370
15	Passur river at Hiron point of Sundarbans	2080	1160	2360	1500	1920	NS	97	NS	2100	NS	320	1090	NS	2	510	NS	NS	780	769	NS	NS	540

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: Phosphate (PO_4^{2-}) concentration of Passur River System

Sl	Sampling Locations	PO_4^{2-} (mg/L)																					
		Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	Apr	Jul	Nov	Feb	Apr	July	Nov
		1QM	2QM	3QM	4QM	5QM	6QM	7QM	8QM	9QM	10QM	11QM	12QM	13QM	14QM	15QM	16QM	17QM	18QM	19QM	20QM	21QM	22QM
1	Left Bank of Passur River at 100m u/s of North West corner from the Project boundary	0.52	2.23	0.67	0.32	0.86	10	1.27	0.269	0.22	1.14	3.39	0.67	1.31	0.49	0.21	0.38	1.03	0.25	0.25	0.25	10.1	0.3
2	Middle Passur River at 100m u/s of North West corner from the Project boundary	0.5	1.99	1.12	0.61	0.53	0.23	1.97	0.269	0.36	1.76	4.11	0.31	1.72	2.5	0.16	0.25	0.83	0.3	0.30	0.32	0.6	0.3
3	Right Bank of Passur River at 100m u/s of North West corner from the Project boundary	1.1	2.55	0.95	0.7	0.72	0.67	1.94	0.179	0.27	1.77	4.58	0.09	2.73	2.8	0.3	0.29	0.76	0.22	0.17	0.40	0.5	0.4
4	Left Bank of Passur River at Project site-Jetty	2.1	0.45	0.92	0.43	0.49	0.27	2.53	0.357	0.31	2.31	2.76	0.07	2.77	3.3	0.19	0.38	0.88	0.24	0.20	0.30	0.6	0.2
5	Middle Passur River at Project Site-Jetty	2.2	2.13	1.11	0.41	0.68	0.59	1.3	0.536	0.3	0.98	3.2	0.12	0.66	3.9	0.17	0.34	1.07	0.4	0.35	0.27	0.6	0.3
6	Right Bank of Passur River at Project Site-Jetty	2	2.42	0.99	0.55	0.61	0.13	1.32	0.269	0.43	1.01	2.48	0.16	0.62	3.9	0.47	0.27	0.67	0.53	0.27	0.25	0.9	0.4
7	Left Bank of Passur River at South West corner from the Project boundary	0.57	1.25	1.18	0.76	0.65	0.1	0.99	0.536	0.63	0.87	4.16	0.09	0.65	4.6	1.31	0.29	1.16	0.32	0.20	0.41	11.1	0.5
8	Middle of Passur River at South West corner from the Project boundary	1.2	1.51	1.25	0.85	0.53	0.18	1.02	0.625	0.21	0.96	2.76	0.04	0.37	0.41	0.39	0.29	0.86	0.43	0.20	0.35	0.8	0.7
9	Right Bank of Passur River at South West corner from the Project boundary	1.5	1.1	1	0.53	0.6	0.1	1.39	0.536	0.33	1.123	2.71	0.07	0.45	0.63	0.62	0.42	1.03	0.57	0.37	0.27	0.8	0.5
10	Maidara river of the South East corner of the project at Ichamoti-Maidara confluence	0.55	2.1	1.27	0.59	0.7	0.5	1.27	0.351	0.19	1.06	2.836	0.07	0.61	0.51	0.38	0.24	0.83	0.27	0.40	0.28	0.5	0.6
11	Maidara river near proposed township area	1.1	0.53	1.04	0.64	0.55	0.29	1.28	0.269	0.13	1	5.23	0.2	0.47	15.3	0.71	0.28	1.2	0.22	0.28	0.30	0.8	0.4
12	Passur river at Passur - Mongla confluence	1.3	0.35	0.86	0.42	0.71	0.59	0.95	0.179	0.31	0.78	4.01	0.09	0.18	1.3	0.63	0.37	0.86	0.33	0.29	0.31	0.6	0.6
13	Passur river at Harbaria of Sundarbans	1.1	0.56	1.22	0.61	0.59	0.89	0.35	0.269	0.42	0.53	1.16	**0.09**	0.21	3.15	0.81	0.26	0.5	0.25	0.30	0.52	0.6	0.7
14	Passur river at Akram point of Sundarbans	1.3	0.29	0.8	0.42	0.61	NS	0.43	0.357	0.26	0.47	9.08	0.1	0.19	0.36	0.97	0.20	0.67	0.5	0.19	0.63	0.5	0.3
15	Passur river at Hiron point of Sundarbans	7.51	0.29	1.09	0.44	0.47	NS	0.45	NS	0.36	NS	5.9	0.23	NS	0.55	1.45	NS	NS	0.61	0.18	NS	NS	0.3

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.14: Arsenic (As) concentration of Passur River System

Sl	Sampling Locations	As (mg/L)																					
		Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	Apr	Jul	Nov	Feb	Apr	July	Nov
		1QM	2QM	3QM	4QM	5QM	6QM	7QM	8QM	9QM	10QM	11QM	12QM	13QM	14QM	15QM	16QM	17QM	18QM	19QM	20QM	21QM	22QM
1	Left Bank of Passur River at 100m u/s of North West corner from the Project boundary	0.002	0.003	0.004	0.003	0.002	0.002	0.001	0.001	0.001	0.002	0.002	0.002	0.002	0.002	0.002	0.001	0.004	0.003	0.002	0.003	0.002	0.002
2	Middle Passur River at 100m u/s of North West corner from the Project boundary	0.002	0.003	0.004	0.003	0.002	0.002	0.001	0.001	0.003	0.003	0.003	0.001	0.002	0.001	0.002	0.001	0.005	0.002	0.001	0.002	0.002	0.003
3	Right Bank of Passur River at 100m u/s of North West corner from the Project boundary	0.001	0.003	0.004	0.003	0.003	0.002	0.001	0.001	0.003	0.005	0.002	0.001	0.001	0.002	0.003	0.001	0.004	0.002	0.003	0.003	0.002	0.002
4	Left Bank of Passur River at Project Site-Jetty	0.002	0.004	0.004	0.004	0.002	0.002	0.001	0.002	0.002	0.004	0.002	0.002	0.001	0.002	0.002	0.002	0.005	0.002	0.001	0.003	0.002	0.003
5	Middle Passur River at Project Site-Jetty	0.002	0.004	0.004	0.003	0.002	0.001	0.001	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.001	0.003	0.002	0.001	0.003	0.002	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	0.001	0.002	0.003	0.002	0.002
7	Left Bank of Passur River at South West corner from the Project boundary	<0.001	0.003	0.006	0.003	0.002	0.002	0.001	0.002	0.001	0.003	0.002	0.002	0.002	0.003	0.001	0.002	0.005	0.002	0.003	0.003	0.003	0.003
8	Middle of Passur River at South West corner from the Project boundary	<0.002	0.004	0.004	0.003	0.002	0.002	0.001	0.001	0.002	0.003	0.003	0.001	0.002	0.002	0.001	0.001	0.003	0.002	0.001	0.002	0.002	0.002
9	Right Bank of Passur River at South West corner from the Project boundary	0.002	0.003	0.006	0.003	0.002	0.003	0.001	0.001	0.002	0.004	0.002	0.002	0.003	0.002	0.001	0.001	0.004	0.002	0.001	0.002	0.002	0.002
10	Maidara river of the South East corner of the project at Ichamoti-Maidara confluence	<0.001	0.003	0.006	0.004	0.003	0.002	0.001	0.002	0.002	0.005	0.002	0.001	0.003	0.003	0.002	0.002	0.004	0.001	0.002	0.003	0.003	0.003
11	Maidara river near proposed township area	0.002	0.002	0.003	0.003	0.003	0.002	0.001	0.001	0.002	0.002	0.002	0.001	0.003	0.001	0.001	0.001	0.003	0.001	0.005	0.003	0.004	0.004
12	Passur river at Passur - Mongla confluence	0.002	0.004	0.003	0.003	0.004	0.002	0.001	0.002	0.003	0.004	0.003	0.002	0.002	0.002	0.001	0.002	0.003	0.001	0.007	0.003	0.002	0.004
13	Passur river at Harbaria of Sundarbans	0.004	0.003	0.004	0.004	0.004	0.002	0.001	0.002	0.005	0.002	0.003	0.002	0.001	0.003	0.002	0.001	0.003	0.002	0.001	0.002	0.001	0.002
14	Passur river at Akram point of Sundarbans	0.004	0.002	0.002	0.003	0.002	NS	0.001	0.002	0.006	0.001	0.003	0.001	0.002	0.002	0.001	0.002	0.002	0.001	0.002	0.002	0.001	0.002
15	Passur river at Hiron point of Sundarbans	0.003	0.002	0.003	0.002	0.002	NS	0.001	NS	0.004	NS	0.002	0.002	NS	0.002	0.001	NS	NS	0.001	0.001	NS	NS	0.002

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)																					
		Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	Apr	Jul	Nov	Feb	Apr	July	Nov
		1QM	2QM	3QM	4QM	5QM	6QM	7QM	8QM	9QM	10QM	11QM	12QM	13QM	14QM	15QM	16QM	17QM	18QM	19QM	20QM	21QM	22QM
1	Left Bank of Passur River at 100m u/s of North West corner from the Project boundary	0.053	0.004	0.002	0.104	0.098	0.0059	0.007	0.168	0.203	0.01	0.009	0.024	0.002	0.003	0.001	0.002	0.002	0.003	0.004	0.003	0.001	0.001
2	Middle Passur River at 100m u/s of North West corner from the Project boundary	0.055	0.002	0.003	0.104	0.102	0.0038	0.006	0.092	0.302	0.009	0.007	0.034	0.001	0.003	0.001	0.001	0.001	0.007	0.005	0.002	0.003	0.002
3	Right Bank of Passur River at 100m u/s of North West corner from the Project boundary	0.055	0.005	0.002	0.111	0.138	0.0058	0.008	0.176	0.347	0.017	0.01	0.03	0.003	0.003	0.002	0.004	0.02	0.017	0.007	0.004	0.002	0.001
4	Left Bank of Passur River at Project Site-Jetty	0.057	0.002	0.003	0.154	0.142	0.011	0.01	0.115	0.336	0.014	0.007	0.036	0.001	0.002	0.002	0.001	0.018	0.013	0.005	0.003	0.009	0.001
5	Middle Passur River at Project Site-Jetty	0.06	0.002	0.002	0.139	0.135	0.002	0.009	0.148	0.317	0.006	0.006	0.046	0.003	0.002	0.001	0.003	0.008	0.01	0.003	0.003	0.003	0.001
6	Right Bank of Passur River at Project Site-Jetty	0.058	0.002	0.002	0.138	0.156	0.0021	0.007	0.112	0.298	0.01	0.005	0.041	0.002	0.001	0.001	0.001	0.041	0.012	0.007	0.002	0.009	0.003
7	Left Bank of Passur River at South West corner from the Project boundary	0.053	0.002	0.003	0.16	0.142	0.0076	0.01	0.134	0.396	0.007	0.006	0.048	0.003	0.001	0.001	0.007	0.012	0.011	0.003	0.002	0.120	0.001
8	Middle of Passur River at South West corner from the Project boundary	0.054	0.003	0.004	0.153	0.148	0.002	0.011	0.099	0.323	0.006	0.007	0.044	0.009	0.002	0.001	0.003	0.015	0.014	0.004	0.003	0.006	0.002
9	Right Bank of Passur River at South West corner from the Project boundary	0.056	0.005	0.004	0.139	0.163	0.002	0.009	0.093	0.331	0.012	0.007	0.056	0.003	0.002	0.002	0.005	0.03	0.019	0.006	0.002	0.004	0.001
10	Maidara river of the South East corner of the project at Ichamoti-Maidara confluence	0.053	0.004	0.004	0.143	0.135	0.002	0.07	0.023	0.35	0.008	0.008	0.038	<LOQ	0.003	0.002	0.002	0.01	0.008	0.004	0.002	0.003	0.002
11	Maidara river near proposed township area	0.048	0.004	<0.002	0.133	0.14	0.002	0.008	0.067	0.275	0.015	0.007	0.056	0.001	0.011	0.001	0.003	0.016	0.017	0.005	0.003	0.004	0.003
12	Passur river at Passur - Mongla confluence	0.05	0.032	<0.002	0.141	0.14	0.002	0.009	0.078	0.258	0.098	0.011	0.05	0.0001	0.011	0.001	0.002	0.015	0.009	0.007	0.003	0.002	0.002
13	Passur river at Harbaria of Sundarbans	0.043	0.044	0.004	0.137	0.13	0.002	0.012	0.135	0.228	0.02	0.01	0.05	0.001	0.005	0.003	0.003	0.017	0.009	0.015	0.002	0.006	0.014
14	Passur river at Akram point of Sundarbans	0.194	0.071	0.032	0.309	0.297	NS	0.084	0.302	0.359	0.142	0.126	0.033	0.009	0.004	0.169	0.001	0..062	0.018	0.013	0.002	0.001	0.019
15	Passur river at Hiron point of Sundarbans	0.224	0.05	0.07	0.309	0.291	NS	0.073	NS	0.607	NS	0.151	0.129	NS	0.019	0.175	NS	NS	0.014	0.017	NS	NS	0.008

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)																					
		Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	Apr	Jul	Nov	Feb	Apr	July	Nov
		1QM	2QM	3QM	4QM	5QM	6QM	7QM	8QM	9QM	10QM	11QM	12QM	13QM	14QM	15QM	16QM	17QM	18QM	19QM	20QM	21QM	22QM
1	Left Bank of Passur River at 100m u/s of North West corner from the Project boundary	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.001	< 0.001	< 0.001	0.004	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
2	Middle Passur River at 100m u/s of North West corner from the Project boundary	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.001	< 0.001	< 0.001	0.002	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
3	Right Bank of Passur River at 100m u/s of North West corner from the Project boundary	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.001	< 0.001	< 0.001	0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
4	Left Bank of Passur River at Project Site-Jetty	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.001	< 0.001	< 0.001	0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
5	Middle Passur River at Project Site-Jetty	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.001	< 0.001	< 0.001	0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
6	Right Bank of Passur River at Project Site-Jetty	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.001	< 0.001	< 0.001	0.001	< 0.001	< 0.001	< 0.001	< 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	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
8	Middle of Passur River at South West corner from the Project boundary	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.001	< 0.001	< 0.001	0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
9	Right Bank of Passur River at South West corner from the Project boundary	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.001	< 0.001	< 0.001	0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
10	Maidara river of the South East corner of the project at Ichamoti-Maidara confluence	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.001	< 0.001	< 0.001	0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
11	Maidara river near proposed township area	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.001	< 0.001	< 0.001	0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
12	Passur river at Passur - Mongla confluence	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.001	< 0.001	< 0.001	0.001	< 0.001	< 0.001	< 0.001	< 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	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
14	Passur river at Akram point of Sundarbans	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.001	< 0.001	< 0.001	0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
15	Passur river at Hiron point of Sundarbans	< 0.00015	NS	< 0.00015	< 0.00015	< 0.00015	< 0.00015	NS	NS	< 0.00015	NS	< 0.00015	< 0.00015	< 0.001	< 0.001	< 0.001	NS	NS	< 0.001	< 0.001	NS	< 0.001	< 0.001

Source: CEGIS Field Survey

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

Parameters for ground water quality monitoring

Table B.17: pH and Temperature of Ground Water

Sl	Locations	Tube Well Type	pH value																					
			Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	Apr	Jul	Nov	Feb	Apr	July	Nov	Feb
			1QM	2QM	3QM	4QM	5QM	6QM	7QM	8QM	9QM	10QM	11QM	12QM	13QM	14QM	15QM	16QM	17QM	18QM	19QM	20QM	21QM	22QM	23QM
1	Near Proposed Township	Deep (>600 ft)	7.6	7.7	7.9	8	TC	8.1	7.49	7.6	7.8	7.8	8.4	8.1	7.4	8.2	6.9	NF	NF	MF	7.1	8.3	8.2	7.2	7.8
2	Rajnagar	Deep (>600 ft)	7.6	7.8	8	8.2	7.8	8.3	7.93	8.1	8.3	8.1	7.9	7.5	7.8	8.1	7.4	6.9	7.9	7.3	6.9	8.4	7.9	7.6	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	6.5	8.9	8.1	7.4	7.5
4	Kalekharber	Shallow (<250 ft)	6.3	6.5	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	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-Not Functional.

Locations	Tube Well Type	Temperature (ºC)																					
		Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	Apr	Jul	Nov	Feb	Apr	July	Nov	Feb
		1QM	2QM	3QM	4QM	5QM	6QM	7QM	8QM	9QM	10QM	11QM	12QM	13QM	14QM	15QM	16QM	17QM	18QM	19QM	20QM	21QM	22QM	23QM
Near Proposed Township	Deep (>600 ft)	27.3	28.5	26	24.5	TC	31	30	24	29.8	28.6	29.1	25.1	28.7	27.2	22.9	NF	NF	NF	23.8	29	31.4	27	24
Rajnagar	Deep (>600 ft)	29.6	29.9	28	22.5	28.6	28	27.8	23	29.6	29.1	30.4	24.3	27.7	26.5	23.8	30.3	29.3	30	23.7	30	30.0	27	23
Kapasdanga	Deep (>600 ft)	29.2	28.9	28	25.1	28.8	30	28.7	25	30.1	29.4	29.8	24	28.4	26.4	23.6	30.1	29.7	29	23.2	30	31.2	26	23
Kalekharber	Shallow (<250 ft)	27.5	28.7	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	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-Not Functional.

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

Table B.18: Salinity and DO in Groundwater

Sl	Locations	Tube Well Type	Salinity (ppt)																					
			Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	Apr	Jul	Nov	Feb	Apr	July	Nov	Feb
			1QM	2QM	3QM	4QM	5QM	6QM	7QM	8QM	9QM	10QM	11QM	12QM	13QM	14QM	15QM	16QM	17QM	18QM	19QM	20QM	21QM	22QM	23QM
1	Near Proposed Township	Deep (>600 ft)	0	0	0	1	TC	0	0	0	0	0	0	0	0	0	0	NF	NF	NF	0.1	0.1	0.1	0.0	0.1
2	Rajnagar	Deep (>600 ft)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.3	0.3	0.1	0.1	0.1	0.5	0.1	0.0	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	0.1	0.7	0.1	0.0	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	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-Not Functional.

Sl	Locations	Tube Well Type	DO (mg/L)																					
			Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	Apr	Jul	Nov	Feb	Apr	July	Nov	Feb
			1QM	2QM	3QM	4QM	5QM	6QM	7QM	8QM	9QM	10QM	11QM	12QM	13QM	14QM	15QM	16QM	17QM	18QM	19QM	20QM	21QM	22QM	23QM
1	Near Proposed Township	Deep (>600 ft)	4.4	5.2	6.5	6.7	TC	6	5.4	4.9	**6.1**	**5.8**	**6.3**	**4.5**	**5.1**	**6.2**	**5.2**	**NF**	**NF**	NF	6.0	6.0	6.1	6.0	6.0
2	Rajnagar	Deep (>600 ft)	6	6.2	7.7	6.3	6	5.9	6.1	5.2	**5.8**	**6.1**	**5.8**	**4.8**	**5.3**	**5.8**	**4.47**	**6.0**	**6**	**5.9**	6.1	6.5	6.0	6.2	6.1
3	Kapasdanga	Deep (>600 ft)	6.4	6.5	6.1	6.5	6.6	6	5.6	4.8	**5.6**	**5.7**	**6.1**	**4.6**	**5.7**	**6.2**	**4.26**	**5.4**	**5.9**	**6.1**	6.2	6.2	6.0	6.0	6.0
4	Kalekharber	Shallow (<250 ft)	4.4	6	NF	NF	NF	NF	NF	NF	**NF**	**NF**	**NF**	**NF**	**NF**	**NF**	**NF**	**NF**	**NF**	NF	NF	NF	NF	NF	NF

Source: CEGIS Field Survey

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

*NF=Non-functional *Drinking water quality standards, The Environment Conservation Rules, 1997*

Table B.19: TDS and TSS concentrations in Groundwater

SL	Locations	Type of tube wells	TDS (mg/L)																					
			Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	Apr	Jul	Nov	Feb	Apr	July	Nov
			1QM	2QM	3QM	4QM	5QM	6QM	7QM	8QM	9QM	10QM	11QM	12QM	13QM	14QM	15QM	16QM	17QM	18QM	19QM	20QM	21QM	22nd QM
1	Township near project site	Deep (>600 ft)	1113	999	-	1021	NO	881	377	447	1025	1000	617	623	395	602	405	NF	NF	NF	1315	915	25	900
2	Rajnagar	Deep (>600 ft)	4090	371	-	378	390	574	1007	491	384	408	382	401	617	996	602	615	390	365	376	380	602	385
3	Kapasdanga	Deep (>600 ft)	643	635	-	600	600	328	611	284	645	607	636	998	558	390	994	370	608	610	927	610	360	603
4	Kalekharber	Shallow (<250 ft)	1055	970	-	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF

Source: CEGIS Field Survey

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

SL	Locations	Type of tube wells	TSS (mg/L)																					
			Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	Apr	Jul	Nov	Feb	Apr	July	Nov
			1QM	2QM	3QM	4QM	5QM	6QM	7QM	8QM	9QM	10QM	11QM	12QM	13QM	14QM	15QM	16QM	17QM	18QM	19QM	20QM	21QM	22nQM
1	Township near project site	Deep (>600 ft)	-	6	19	40	NF**	23	4	31	3	5	7	32	4	8	12	NF	NF	NF	3	3	2	4
2	Rajnagar	Deep (>600 ft)	-	6	2	28	4	16	5	46	4	4	4	28	10	10	6	12	2	6	3	2	1	3
3	Kapasdanga	Deep (>600 ft)	-	8	6	32	6	14	4	41	3	4	5	25	9	9	7	5	3	8	4	4	4	4
4	Kalekharber	Shallow (<250 ft)	-	48	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	Nf

Source: CEGIS Field Survey

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

Table B.20: TH concentrations in Groundwater

Sl No	Locations	Type of tubewell	TH (mg/L)*																				
			Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	Apr	Jul	Nov	Feb	Apr	July	Nov
			1QM	2QM	3QM	4QM	5QM	6QM	7QM	8QM	9QM	10QM	11QM	12QM	13QM	14QM	15QM	16QM	17QM	18QM	19QM	20QM	21QM	22QM
1	Township near project site	Deep (>600 ft)	425	250	300	235	NO	225	325	295	305	320	175	550	720	145	NF	NF	NF	NF	355	235	97	145
2	Rajnagar	Deep (>600 ft)	220	175	180	110	138	125	450	195	263	248	295	510	420	240	265	195	235	178	215	182	167	245
3	Kapasdanga	Deep (>600 ft)	190	140	180	125	216	115	480	225	163	28	183	620	654	215	305	215	170	138	270	167	212	137
4	Kalekarber	Shallow (<250 ft)	780	450	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF

Source: CEGIS Field Survey

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

*NF=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)																					
			Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	Apr	Jul	Nov	Feb	Apr	July	Nov
			1QM	2QM	3QM	4QM	5QM	6QM	7QM	8QM	9QM	10QM	11QM	12QM	13QM	14QM	15QM	16QM	17QM	18QM	19QM	20QM	21QM	22QM
1	Township near project site	Deep (>600 ft)	32	32	34	20	NO	12	4	4	4	4	4	4	4	8	NF	NF	NF	NF	4	352	4	4
2	Rajnagar	Deep (>600 ft)	28	28	18	16	14	10	8	4	4	4	4	4	4	8	4	4	4	4	3	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	4	4	4	4
4	Kalekarber	Shallow (<250 ft)	32	36	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	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^- Concentrations in Ground Water

Sl	Locations	Type of tube well	NO_3^{2-} (mg/L) *BD Standard (10 mg/L)																					
			Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	Apr	Jul	Nov	Feb	Apr	July	Nov
			1QM	2QM	3QM	4QM	5QM	6QM	7QM	8QM	9QM	10QM	11QM	12QM	13QM	14QM	15QM	16QM	17QM	18QM	19QM	20QM	21QM	22QM
1	Township near project site	Deep (>600 ft)	0.20	0.48	<0.10	28	-	7.6	4.3	2.1	1.7	3.8	6.1	4.65	9.32	3.3	5.9	NF	NF	NF	1.7	4.4	1.4	1.8
2	Rajnagar	Deep (>600 ft)	0.60	0.68	0.31	26	-	2.2	4.2	1.9	2.3	3.3	7.51	7.02	14.7	2.5	7.2	5.3	8.6	0.9	4.4	2.7	2.7	3.1
3	Kapasdanga	Deep (>600 ft)	0.80	0.40	0.80	13	-	4.7	3.8	2.8	1.9	3.7	10.16	4.65	10.2	4.6	1.7	5.7	7.8	1.4	2.1	8.3	1.7	1.6
4	Kalekarber	Shallow (<250 ft)	0.40	0.56	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	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: SO_4^{2-} Concentrations in Ground Water

Sl	Location	Typeof Tubewell	SO_4^{2-} (mg/L) *BD Standard (400 mg/L)																					
			Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	Apr	Jul	Nov	Feb	Apr	July	Nov
			1QM	2QM	3QM	4QM	5QM	6QM	7QM	8QM	9QM	10QM	11QM	12QM	13QM	14QM	15QM	16QM	17QM	18QM	19QM	20QM	21QM	22QM
1	**Township near project site**	**Deep (>600 ft)**	-	3	-	-	-	-	1	5	1	1	1	1	5	1	8	NF	NF	NF	1	4	1	2
2	**Rajnagar**	**Deep (>600 ft)**	-	2	-	-	-	-	2	6	2	1	1	1	1	1	2	2	4	1	2	1	2	2
3	**Kapasdanga**	**Deep (>600 ft)**	-	10	-	-	-	-	2	2	8	1	1		3	2	6	4	6	1	1	4	1	1
4	**Kalekarber**	**Shallow (<250 ft)**	NF	3	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.24: PO43- Concentrations in Ground Water

Sl	Location	Typeof Tubewell	PO_4^{2-} (mg/L) *BD Standard (6.0 mg/L)																				
			Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Nov	Feb	Apr	July	Nov
			1QM	2QM	3QM	4QM	5QM	6QM	7QM	8QM	9QM	10QM	11QM	12QM	13QM	14QM	15QM	16QM	17QM	18QM	19QM	20QM	21QM	22QM	
1	Township near project site	Deep (>600 ft)	NF	2.2	-	0.74	NO	1.4	0.31	0.267	1.08	0.17	0.167	1.18	2.18	1.68	0.13	NF	NF	NF	2.1	2.3	0.3	1
2	Rajnagar	Deep (>600 ft)	-	2.5	-	0.44	1.98	1.6	0.27	0.179	1.53	0.29	0.67	1.21	1.8	3.5	0.17	4..5	2.9	0.15	1.3	2.5	4.0	0.5
3	Kapasdanga	Deep (>600 ft)	-	6.2	-	0.48	4.54	4.1	0.48	0.179	3.26	0.31	0.6	1.18	2.1	4.7	0.18	0.27	4.8	0.26	3.6	3.2	2.0	1.5
4	Kalekarber	Shallow (<250 ft)	NF	1.2	NF	NF	NF	NF	NF	NF	NF	NF	NF	1.23	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.25: As concentrations (mg/L) of monitored ground water locations

Sl	Locations	As (mg/L) *BD Standard (0.05 mg/L)																						
		Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Nov	Feb	Apr	July	Nov
		1QM	2QM	3QM	4QM	5QM	6QM	7QM	8QM	9QM	10QM	11QM	12QM	13QM	14QM	15QM	16QM	17QM	18QM	19QM	20QM	21QM	21QM	22QM
1	Township near project site	0.013	0.020	0.012	0.014	NO	0.015	0.002	0.008	0.018	0.012	0.033	0.028	0.012	0.014	0.002	0.001	NF	NF	0.014	0.012	0.014	0.001	0.018
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	0.022	0.012	0.007	0.003	0.012	0.006	0.027	0.006
3	Kalekarber	0.376	0.407	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF
4	Kapasdanga	0.036	0.033	0.020	0.017	0.034	0.024	0.011	0.002	0.047	0.005	0.016	0.028	0.010	0.027	0.002	0.001	0.004	0.050	0.004	0.012	0.022	0.001	0.033

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.

Table B.26: Pb concentrations (mg/L) of monitored ground water locations

Sl	Locations	Pb (mg/L) *BD Standard (0.05 mg/L)																						
		Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Nov	Feb	Apr	July	Nov
		1QM	2QM	3QM	4QM	5QM	6QM	7QM	8QM	9QM	10QM	11QM	12QM	13QM	14QM	15QM	16QM	17QM	18QM	19QM	20QM	21QM	22QM	22QM
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	0.001	0.001	NF	NF	0.008	0.004	0.018	0.002
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	0.001	0.001	0.004	0.003	0.004	0.002	0.008
3	Kalekarber	0.002	0.008	NF	NF	D	D	NF	NF	NF	NF	NF	NF	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	0.001	0.001	0.056	0.004	0.006	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*

Table B.27: Hg concentrations (mg/L) of monitored ground water locations

Sl	Locations	Hg (mg/L) *BD Standard (0.001 mg/L)																						
		Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Nov	Feb	Apr	July	Nov
		1QM	2QM	3QM	4QM	5QM	6QM	7QM	8QM	9QM	10QM	11QM	12QM	13QM	14QM	15QM	16QM	17QM	18QM	19QM	20QM	21QM	21QM	22QM
1	Township near project site	<0.00015	<0.00015	<0.0005	<0.0005	<0.0005	0.00015	<0.00015	<0.00015	<0.00015	<0.00015	<0.00015	<0.00015	0.001	<0.0001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	<0.001	<0.001
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	<0.001	<0.001	<0.001	0.003	<0.001	<0.001
3	Kalekarber	<0.00015	<0.00015	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	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	<0.001	<0.001	0.001	<0.001	<0.001

Source: CEGIS Field Survey

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

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

(C) Noise Level monitoring data

Table C.1: Ambient noise monitoring status at the monitored locations

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
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: Ambient noise monitoring status at the monitored locations

Sl No	Location	QM 5(Noise Level in dB (A)) Apr-15				QM 6 (Noise Level in dB (A)) Jul-15				QM 7 (Noise Level in dB (A)) Oct-15				QM 8 (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
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: Ambient noise monitoring status at the monitored locations

Sl No	Location	QM9 (Noise Level in dB (A)) Apr-16				QM 10 (Noise Level in dB (A)) Jul-16				QM 11 (Noise Level in dB (A)) Oct-16				QM 12 (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
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: Ambient noise monitoring status at the monitored locations

Sl No	Location	QM13 (Noise Level in dB (A)) Apr-17				QM 14 (Noise Level in dB (A)) Oct-17				QM 15 (Noise Level in dB (A)) Jan-2018				QM 16 (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
1	Chalna, Dacope	58.21	59.00	66.57	61.62	47.65	51.06	50.27	49.66	60.2	60.2	60.5	60.3	64.09	59.30	65.43	62.94	70
2	NW Corner of the Project area	44.97	49.30	47.31	47.19	47.65	45.12	46.65	46.47	47.8	48.1	49.2	48.37	47.92	54.32	61.14	54.46	55
3	Chunkuri-2, Bajua	45.60	52.29	53.42	50.44	39.82	45.60	41.73	42.38	51.1	51.2	52.1	51.47	44.77	46	63.14	51.30333	55
4	SW corner of the Project area	39.62	42.64	47.48	43.25	60.80	64.08	62.52	62.47	43.5	43.5	45.7	44.23	64.45	63.49	66.63	64.85667	55
5	Project site near Shapmari area	41.40	43.09	43.45	42.65	43.05	48.52	45.01	45.53	53.2	54	52.82	53.34	51.95	59.66	56.8	56.13667	55
6	Barni, Gaurambha	43.05	46.45	45.01	44.83	45.60	52.29	53.42	50.44	56.5	54.2	56.1	55.6	55.6	51.80	51.39	52.93	60
7	Khan Jahan Ali Bridge, Khulna	54.01	57.50	58.66	56.72	40.60	42.64	46.55	43.26	60.2	62.1	62.2	61.5	49.4	45.25	47.98	47.54333	70
8	Mongla Port area	47.78	47.45	45.25	47.61	41.40	44.68	45.71	43.93	60.2	60.2	58.4	59.6	50.84	48.33	53.25	50.80667	75
9	Harbaria, Sundarbans	50.79	53.67	57.84	54.10	44.25	46.67	47.31	46.08	45.8	44.7	43.8	44.7	50.23	45.55	65.43	53.73667	50
10	Akram Point, Sundarbans	43.41	45.60	43.89	44.30	58.21	58.59	58.70	58.50	39.4	40.5	41.1	40.3	58.31	60.93	64.87	61.37	50
11	Hiron Point, Sundarbans	NM	NM	NM	NM	39.92	39.79	33.5	37.74	37.2	39	38.4	38.2					50

Source: CEGIS field Survey

Note: NM-Not measured.

Table C.5 Ambient noise monitoring status at the monitored locations

Sl No	Location	QM 17 (Noise Level in dB (A)) July-2018				QM 18 (Noise Level in dB (A)) Nov-2018				QM 19 (Noise Level in dB (A)) Feb-2019				QM 20 (Noise Level in dB (A)) Apr-2019				Std*
		Morning (9:00)	A. noon (13:00)	Evening (18:00)	Day time AVG	Morning (9:00)	A.noon (13:00)	Evening (18:00)	Day time AVG	Morning (9:00)	A. noon (13:00)	Evening (18:00)	Day time AVG	Morning (9:00)	A.noon (13:00)	Evening (18:00)	Day time AVG	Day time
1	Chalna, Dacope	57.64	56.94	58.03	57.54	61.3	56.3	57.1	70	56.14	59.28	53.95	56.45	62.02	61.91	61.08	61.67	70
2	NW Corner of the Project area	42.80	47.51	46.57	45.63	56.5	60.1	59.85	55	45.15	54.11	53	50.75	53.70	58.92	57.92	56.85	55
3	Chunkuri-2, Bajua	46.23	49.02	47.34	47.53	45.8	48.9	51.3	55	50.19	49.35	51	50.18	49.66	54.02	51.35	51.68	55
4	SW corner of the Project area	58.84	48.00	51.03	52.63	64.5	60.6	60.2	55	53.50	58.01	55.88	55.79	58.08	54.79	55.27	56.05	55
5	Project site near Shapmari area	42.66	45.82	48.78	45.75	45.1	51.2	55.8	55	58.48	61.21	54.70	58.13	61.35	58.97	56.16	58.83	55
6	Barni, Gaurambha	42.67	47.95	45.90	45.51	58.3	50.6	50.2	60	54.32	57.65	45.75	52.57	58.58	51.05	49.92	53.18	60
7	Khan Jahan Ali Bridge, Khulna	64.1	64.06	61.90	63.35	64.6	60.9	60.9	70	65.72	69.04	66.03	66.93	67.95	63.09	69.82	66.95	70
8	Mongla Port area	63.12	59.00	60.77	60.96	55.8	53.1	59.0	75	64.33	63.37	70.85	66.18	64.12	62.41	65.45	63.99	75
9	Harbaria, Sundarbans	51.98	48.58	50.28	50.28	49.9	47.6	NM	50	51.43	47.90	NM	49.67	49.42	47.45	NM	48.43	50
10	Akram Point, Sundarbans	46.52	43.88	45.2	45.20	41.9	40.1	NM	50	47.35	45.55	NM	46.45	46.16	38.49	NM	42.33	50
11	Hiron Point, Sundarbans	NM	NM	NM	57.54	39.7	39.1	NM	50	33.8	44.62	NM	39.21	NM	NM	NM	-	50

Source: CEGIS field Survey

Note: NM-Not measured.

Table C.6 Ambient noise monitoring status at the monitored locations

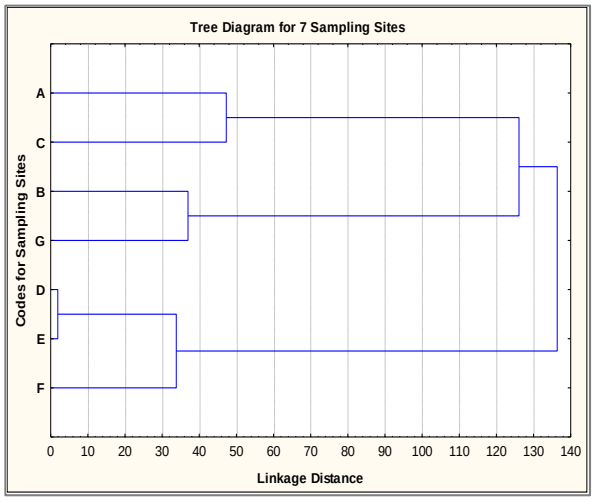
Sl No	Location	QM 21 (Noise Level in dB (A)) July-2019				QM 22 (Noise Level in dB (A)) November-2019				QM 23 (Noise Level in dB (A)) February 2020			
		Morning (9:00)	A. noon (13:00)	Evening (18:00)	Day time AVG	Morning (9:00)	A. noon (13:00)	Evening (18:00)	Day time AVG	Morning (9:00)	A. noon (13:00)	Evening (18:00)	Day time AVG
1	Chalna, Dacope	55.92	60.88	61.23	59.34	58.98	61.03	55.78	58.60	56.24	54.09	53.45	54.59
2	NW Corner of the Project area	56.44	53.21	55.88	55.18	48.92	53.45	50.97	51.11	40.96	43.33	51.98	45.42
3	Chunkuri-2, Bajua	56.15	63.34	58.60	59.36	58.39	52.92	54.51	55.27	59.78	51.59	54.96	55.44
4	SW corner of the Project area	66.94	58.41	65.65	63.66	47.67	49.98	42.05	46.57	56.35	54.05	56.40	55.60
5	Project site near Shapmari area	53.14	55.40	55.05	54.53	53.97	55.80	54.77	54.86	51.02	47.91	47.93	48.95
6	Barni, Gaurambha	51.36	57.98	NM	54.67	53.69	49.37	48.53	50.53	57.37	60.48	68.05	61.97
7	Khan Jahan Ali Bridge, Khulna	63.38	60.55	66.44	63.46	65.19	67.65	65.32	66.05	60.75	62.81	63.05	62.20
8	Mongla Port area	60.49	62.10	63.43	62.01	60.24	55.66	55.85	57.25	59.74	62.38	61.07	61.06
9	Harbaria, Sundarbans	47.62	42.18	NM	44.90	43.48	44.71	NM	44.10	45.59	42.29	41.35	43.94
10	Akram Point, Sundarbans	44.05	45.62	NM	44.84	47.12	42.60	NM	44.86	NM	36.59	40.46	36.59
11	Hiron Point, Sundarbans	NM	NM	NM	-	39.2	41.34	NM	40.28	41.3	39.41	NM	40.34

Source: CEGIS field Survey

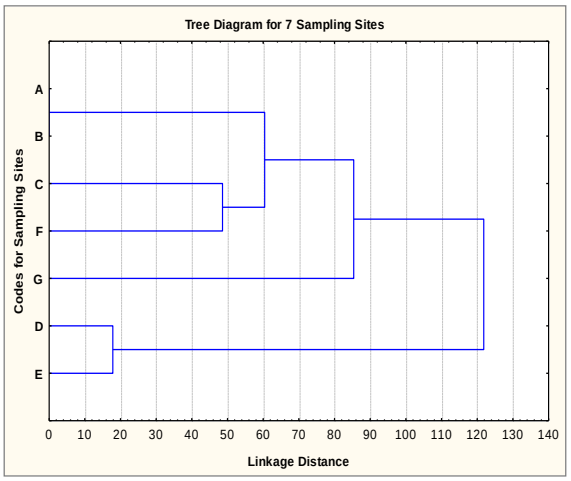
Note: NM-Not measured.

(D) Fisheries resources monitoring data

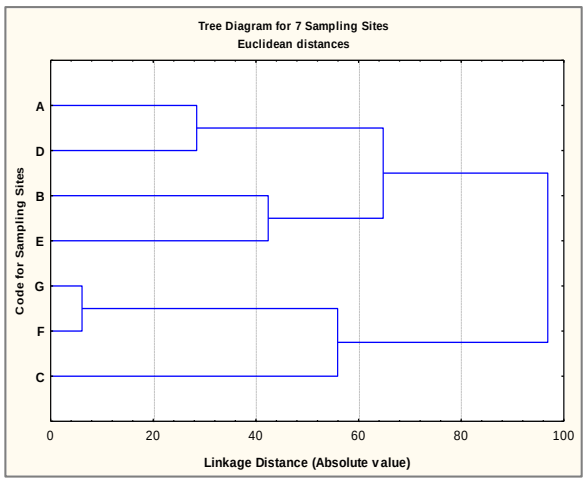
D1: Classification of functional habitat



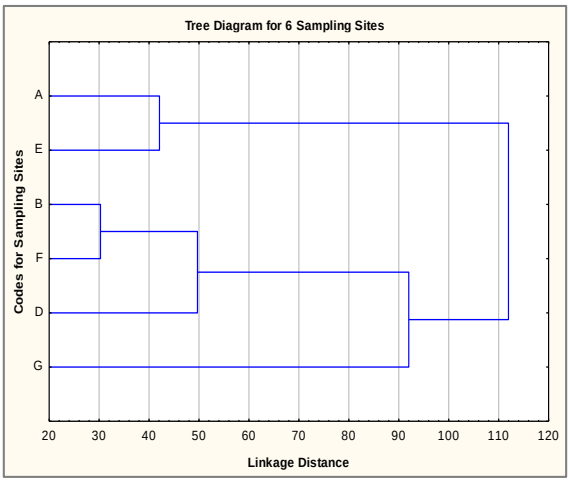
1st Monitoring, April, 2014



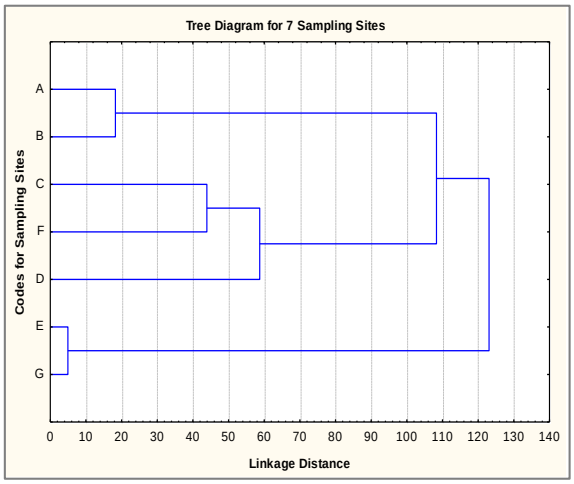
2nd Monitoring, July 2014



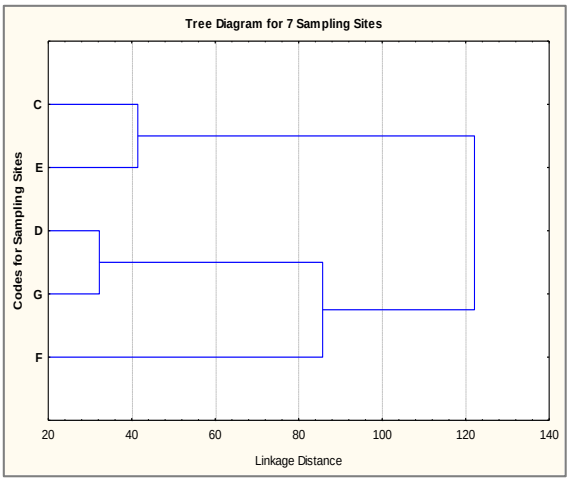
3rd Monitoring, October, 2014



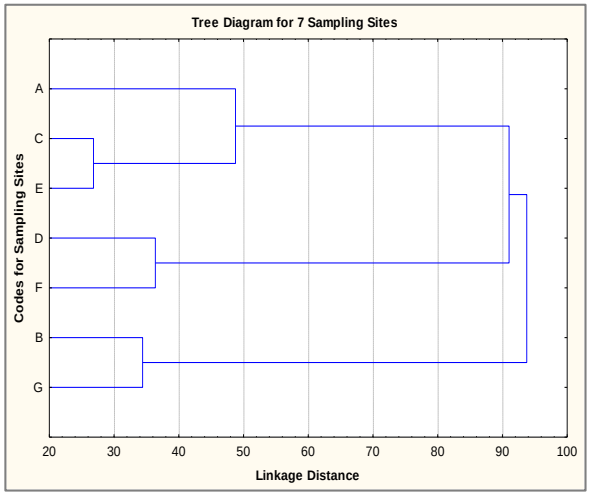
4th Monitoring, January 2015



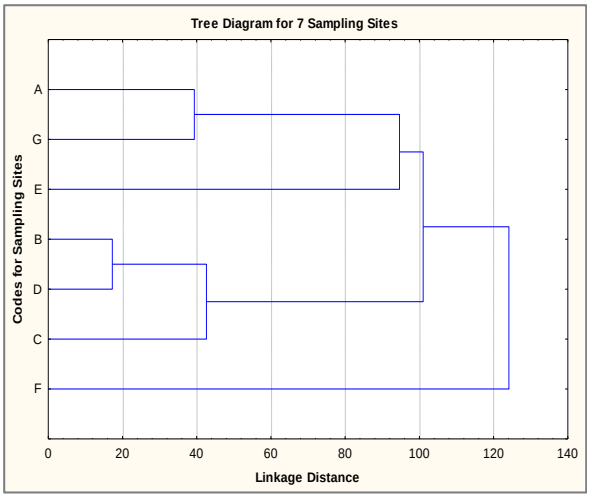
5th Monitoring, April, 2015



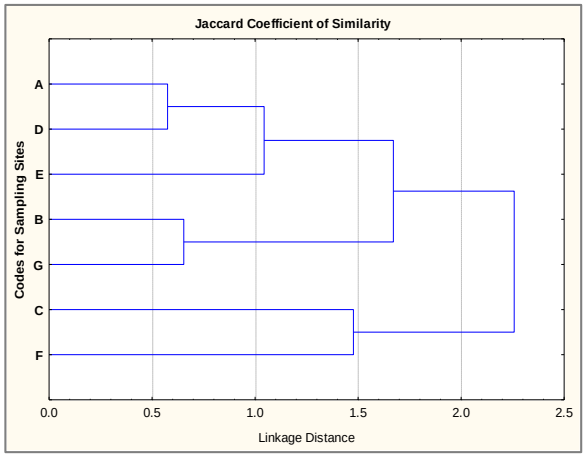
6th Monitoring, August, 2015

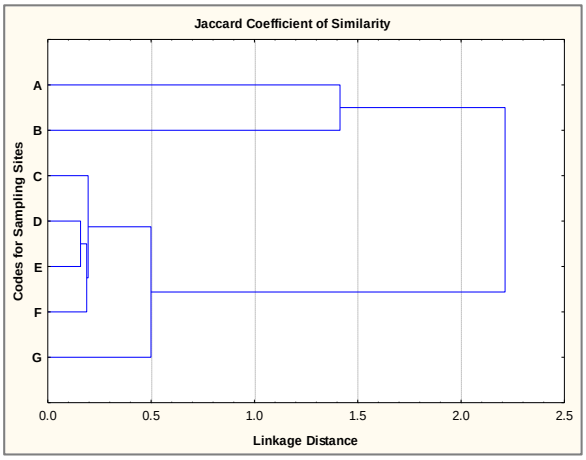


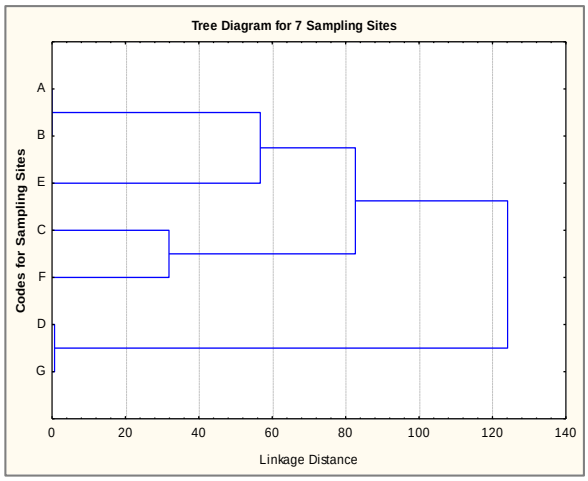
7th Monitoring, October, 2015



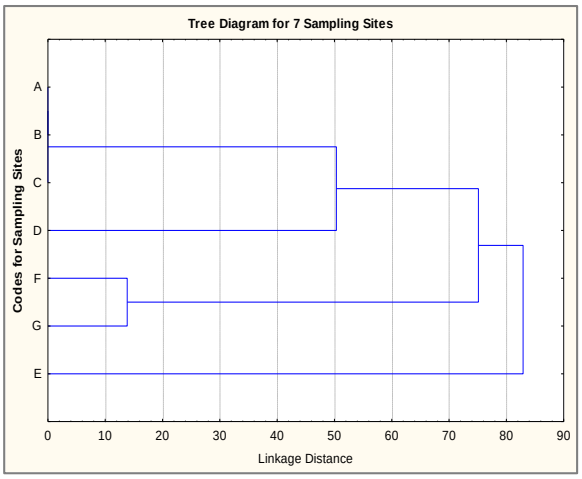
8th Monitoring, January, 2016



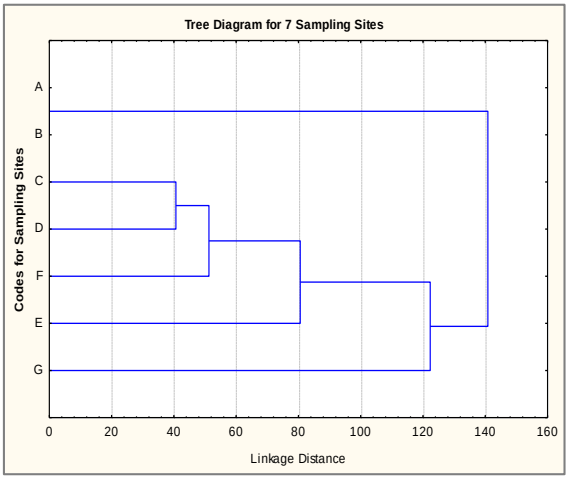




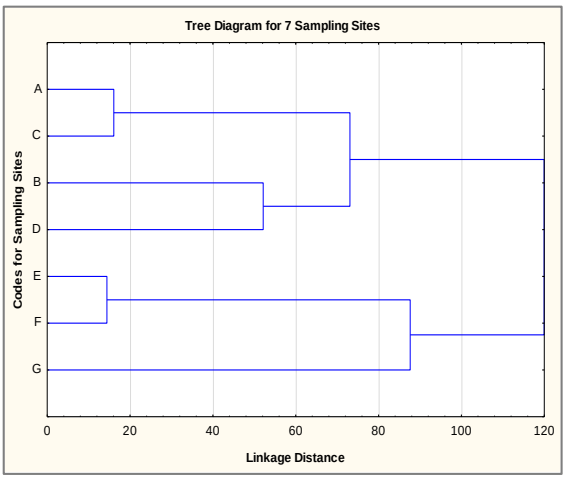
9th Monitoring, April, 2016



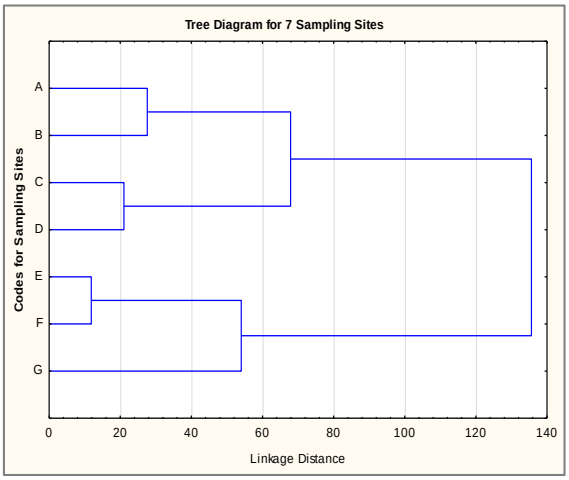
10th Monitoring, July, 2016



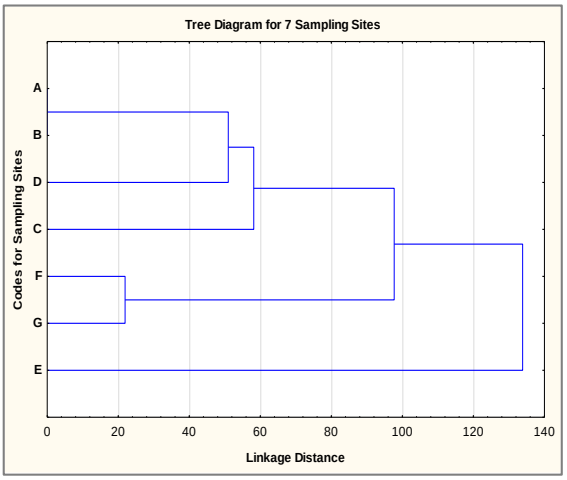
11th Monitoring, October, 2016



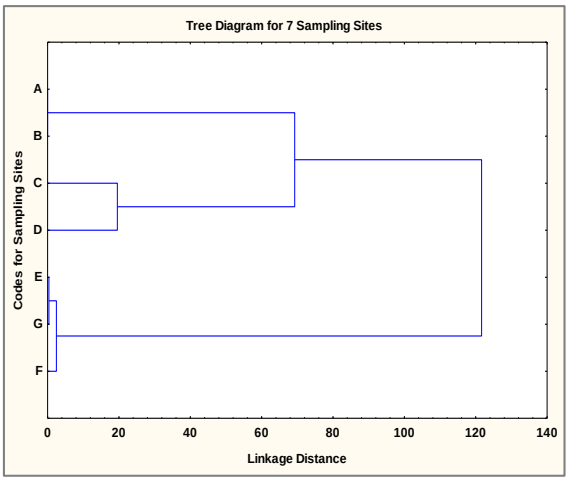
12th Monitoring, January, 2017



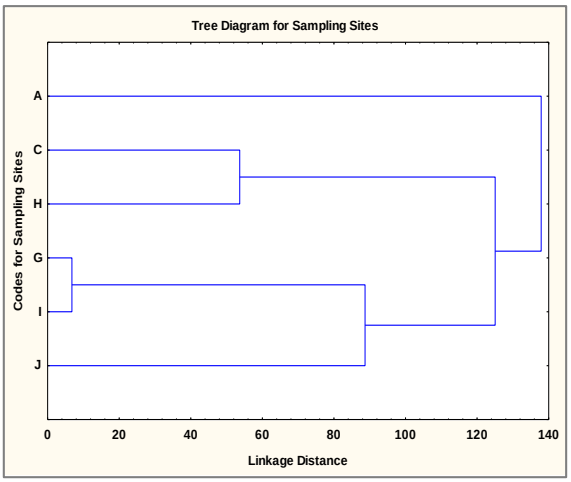
13th Monitoring, April, 2017



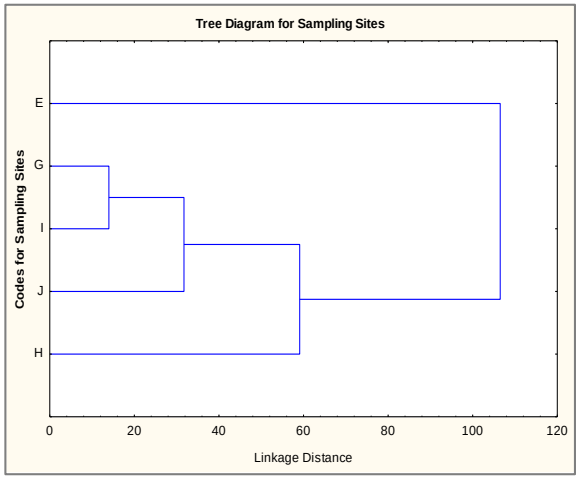
14th Monitoring, October, 2017



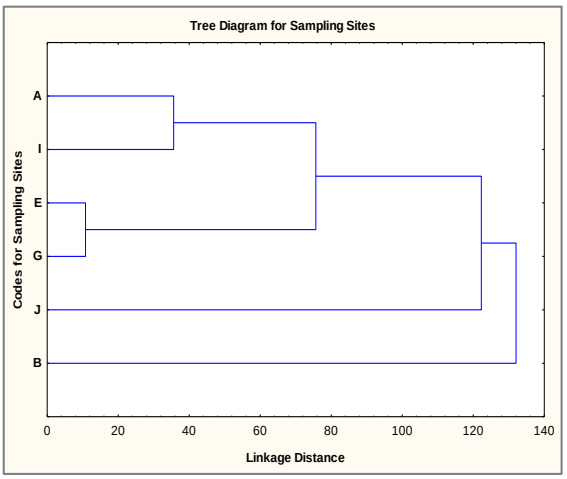
15th Monitoring, January, 2018



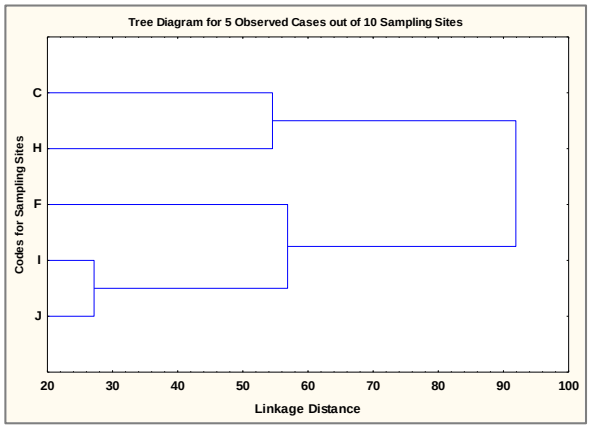
16th Monitoring, April, 2018



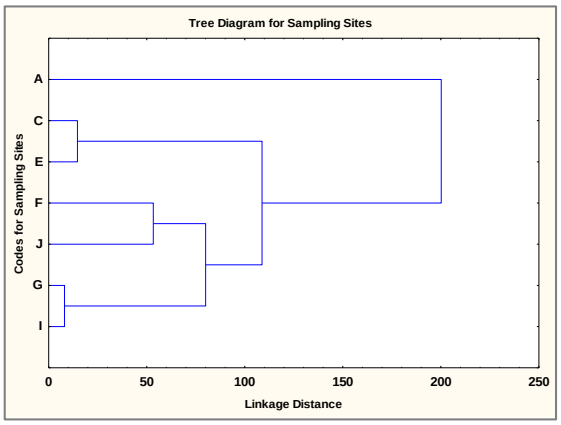
17th Monitoring, July, 2018



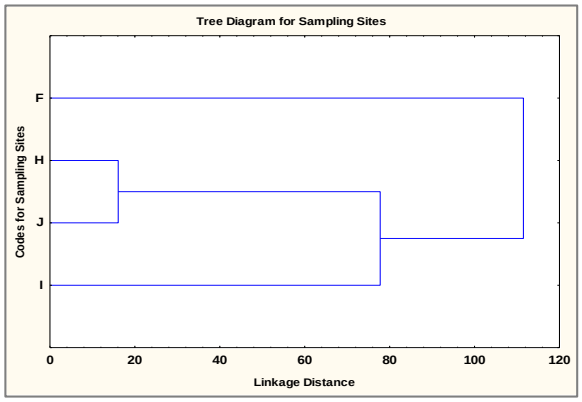
18th Monitoring, November, 2018



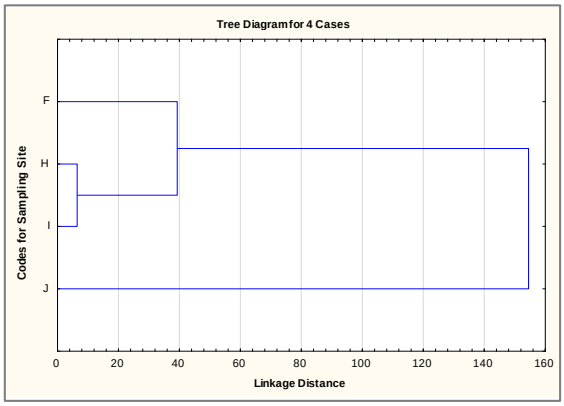
19th Monitoring, February, 2019



20th Monitoring, April, 2019

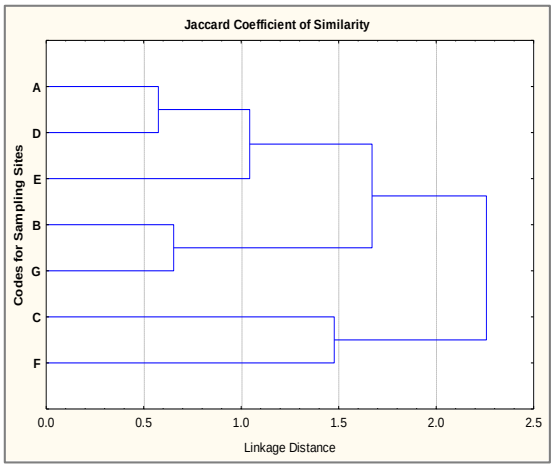


21st Monitoring, July 2019

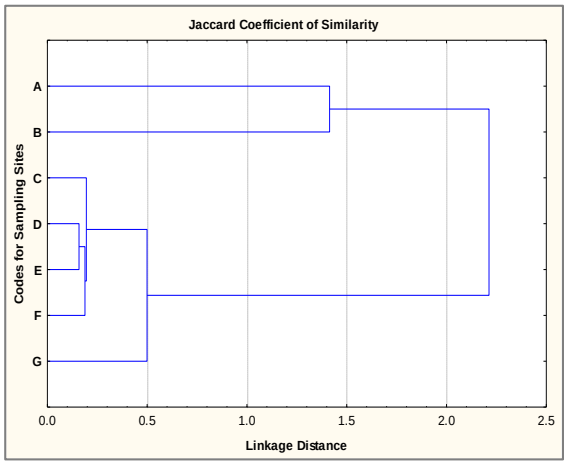


22nd Monitoring, November, 2019

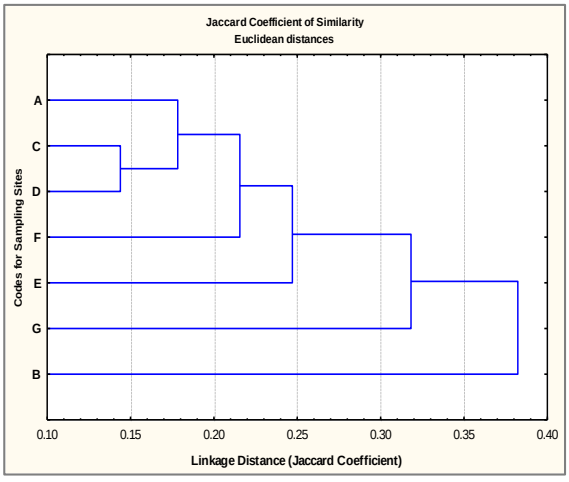
D2: Jaccard Co-efficient of Similarity of Habitats respecting fish species occurrence



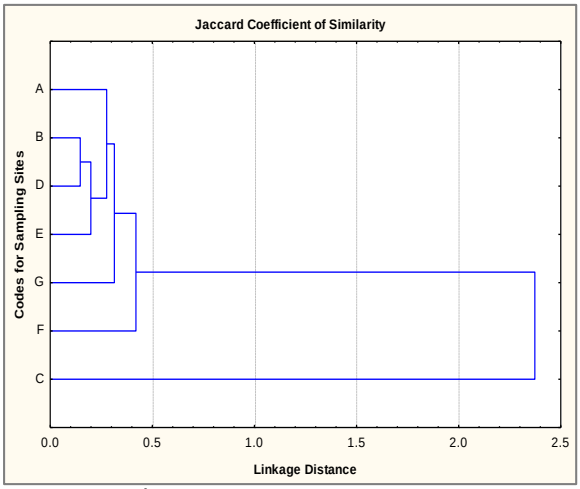
1st Monitoring, April, 2014



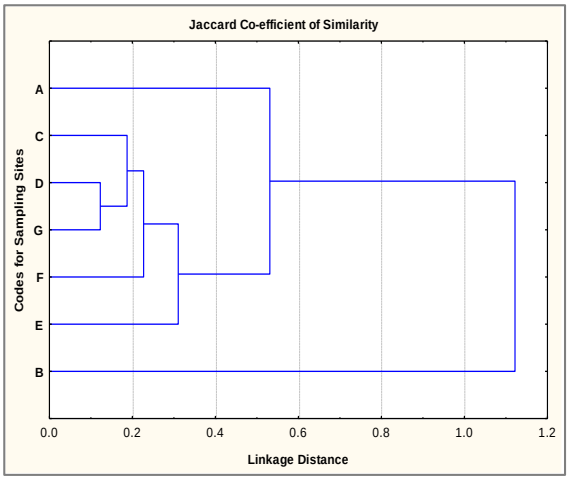
2nd Monitoring, July 2014



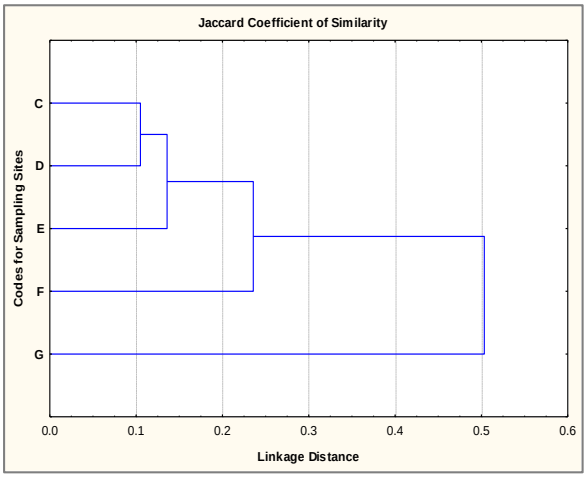
3rd Monitoring, October, 2014



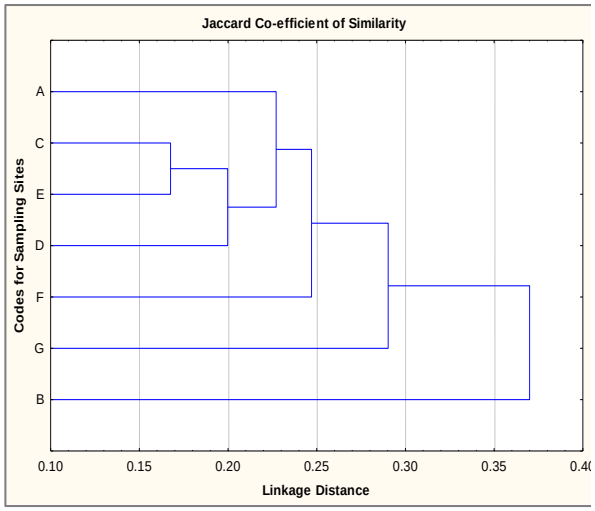
4th Monitoring, January 2015



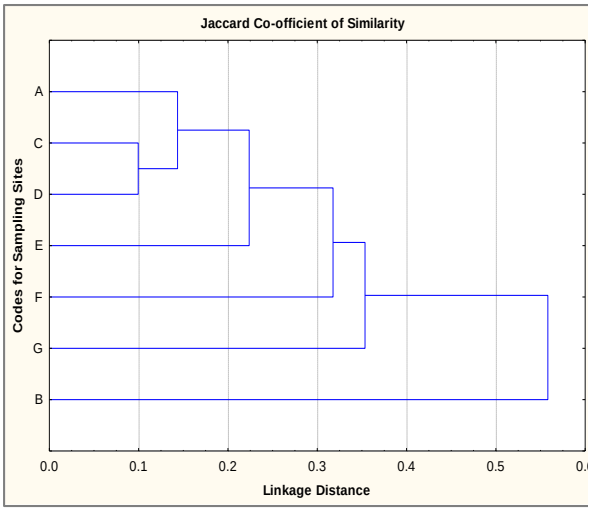
5th Monitoring, April, 2015



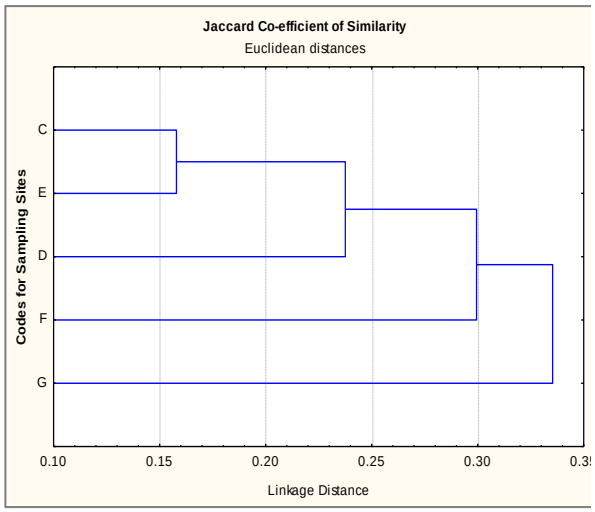
6th Monitoring, August, 2015



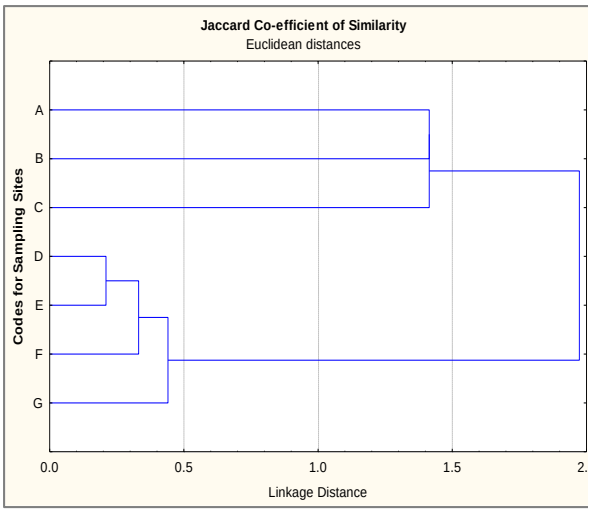
7th Monitoring, October, 2015



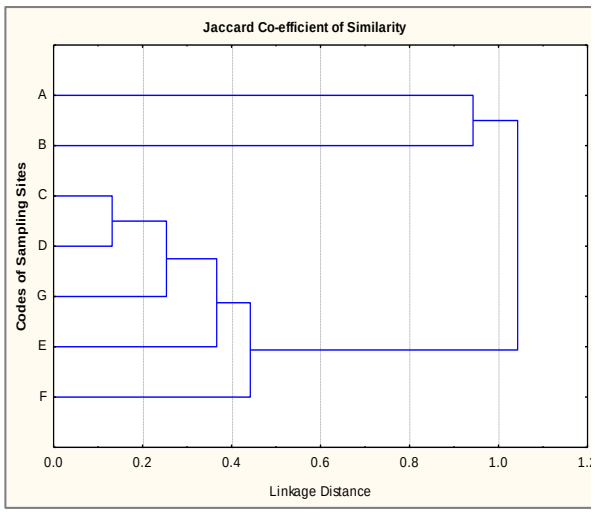
8th Monitoring, January, 2016



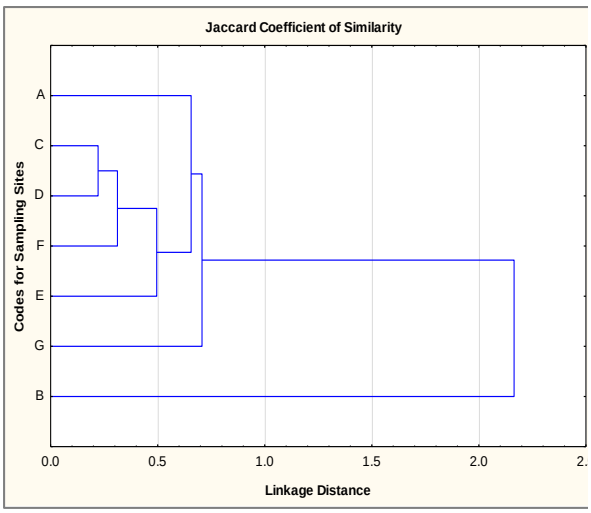
9th Monitoring, April, 2016



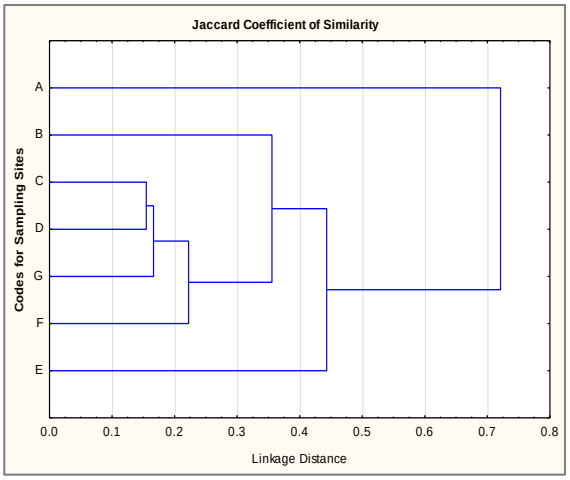
10th Monitoring, July, 2016



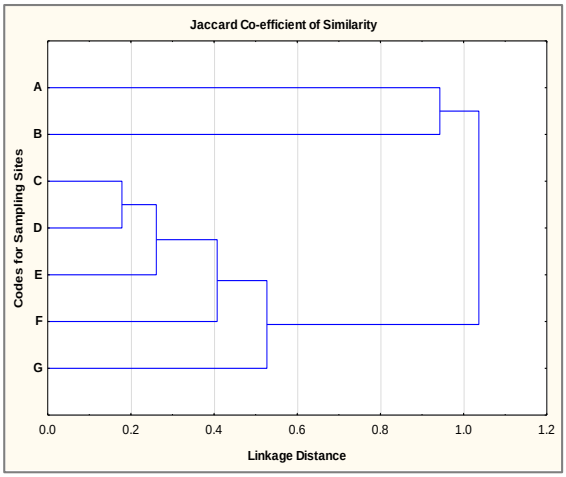
11th Monitoring, October, 2016



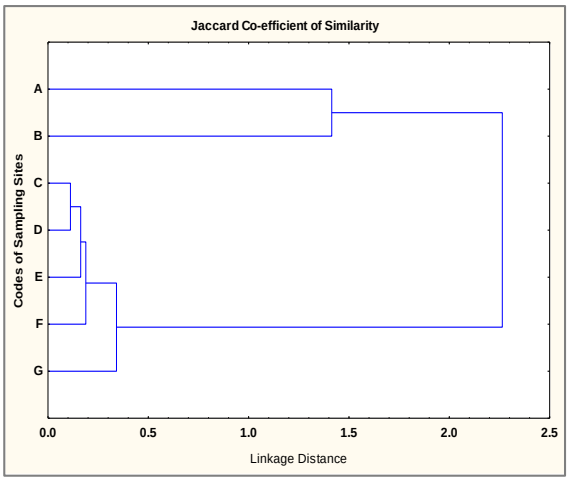
12th Monitoring, January, 2017



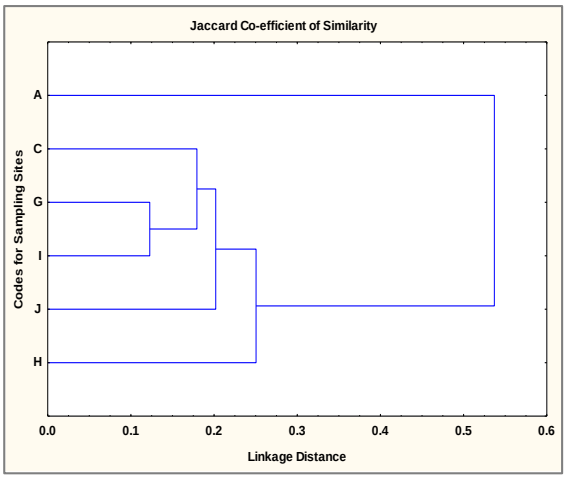
13th Monitoring, April, 2017



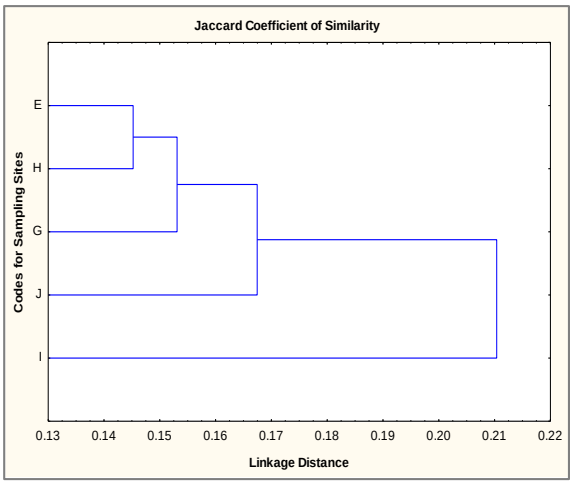
14th Monitoring, October, 2017



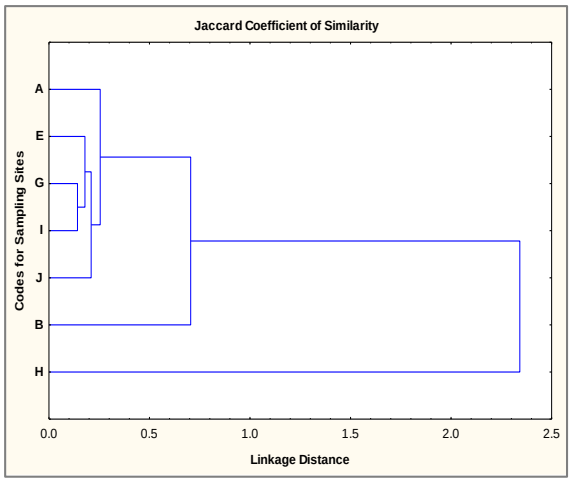
15th Monitoring, January, 2018



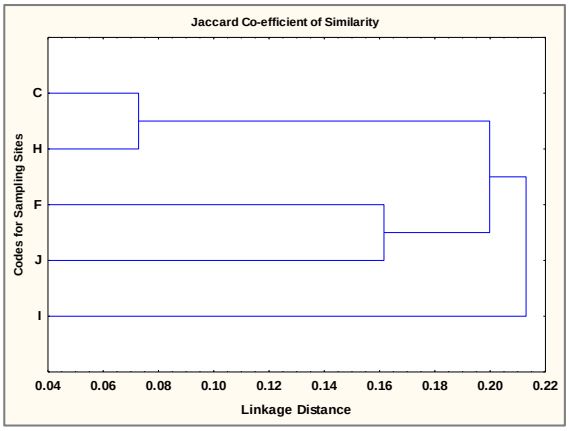
16th Monitoring, April, 2018



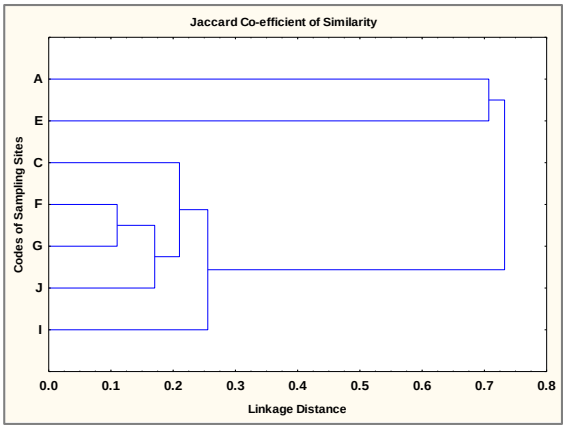
17th Monitoring, July, 2018



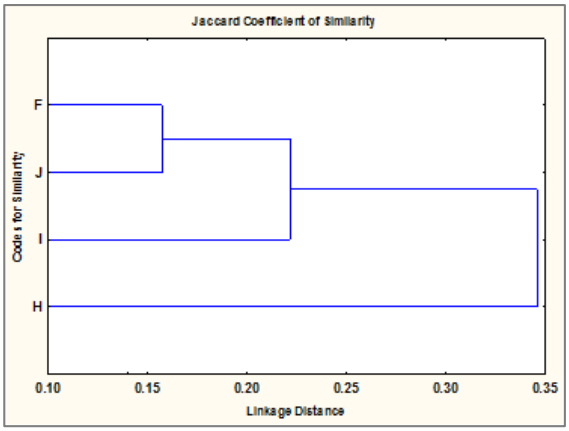
18th Monitoring, November, 2018



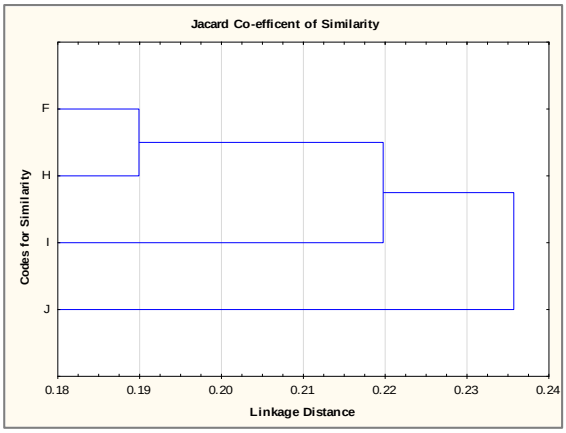
19th Monitoring, February, 2019



20th Monitoring, April, 2019



21st Monitoring, July 2019



22nd Monitoring, November 2019

D3: Different Fish Species in different quarter monitoring

Rupchanda in 1st Quarter of 1st Year

Chela in 2nd Quarter of 1st Year

Phesa, Chela, Hilsa, Gagla Tengra

Harina Chingri

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

Amadi Chela

Banspata

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

Adult Poma in Chalna Point

Fry of Bagda at Chalna Point

Meth and Gagra Tengra

Gagra Tengra

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

Mutkure and Paissa

Khorsula

Menu

Vetki

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

Gulsha Tengra, Bele, Aswine Bele and Paissa

Gangania

Telcupa

Golda

Kain Magur

A Mix of Culture and Capture Fishes

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

Tau Paissa

Bele

Horina Chingri

Gulsha and Gagra Tengra

Jaba

Female Gulsha Tengra

Fry Fishes

Chata Bele

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

Kain Magur

Banspata, Vetki, Koidda and Poma

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

Poma and Tapsi

Tapsi

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

Miscellaneous Fish Species

Hilsha

Tapse

Poma and Tapse

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

Catch Sample

Juvenile of Kain Magur

Khayra Chela

Jevenile of Pangas

Brood Paissa

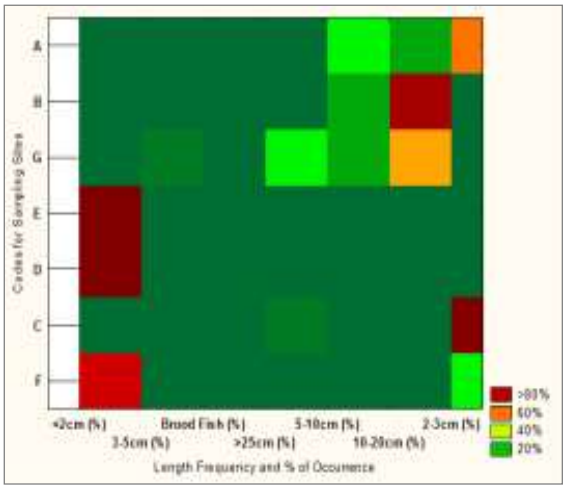
Paissa and Gagra Tengra

Aswene Bele, Daitna, Tapse and Chitra

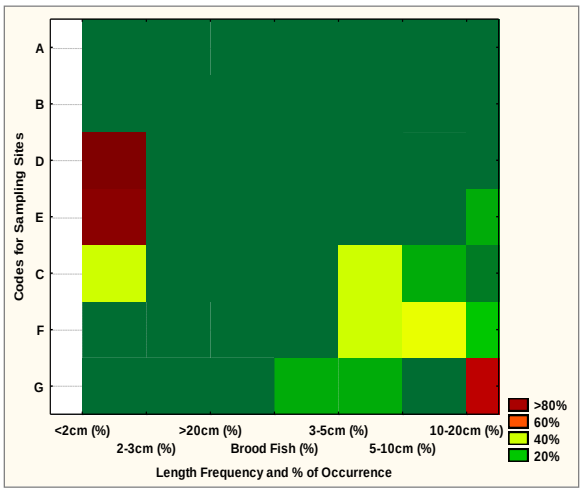
Dry Fish of Khayra Chela

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

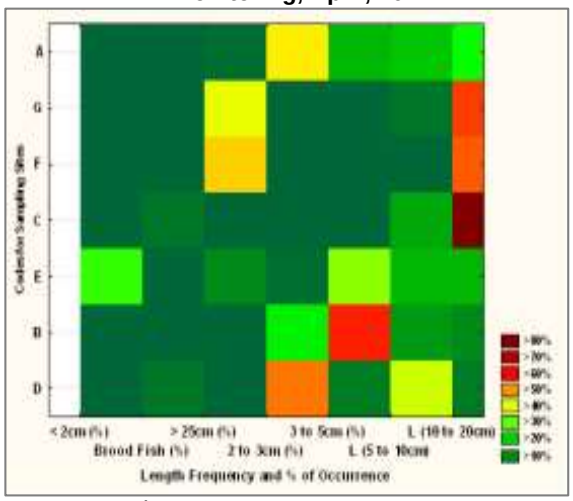
D4: Fish Community Structure



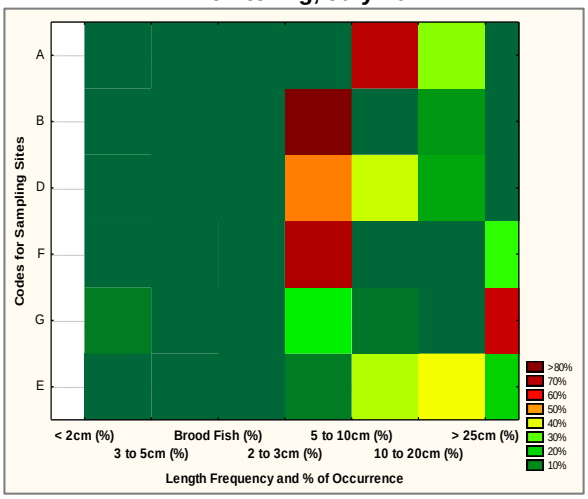
1st Monitoring, April, 2014



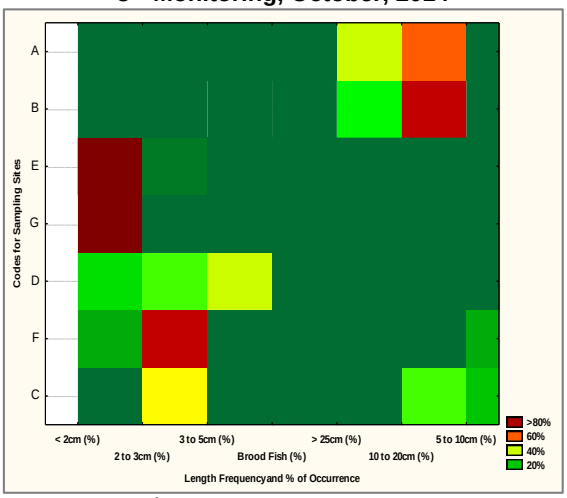
2nd Monitoring, July 2014



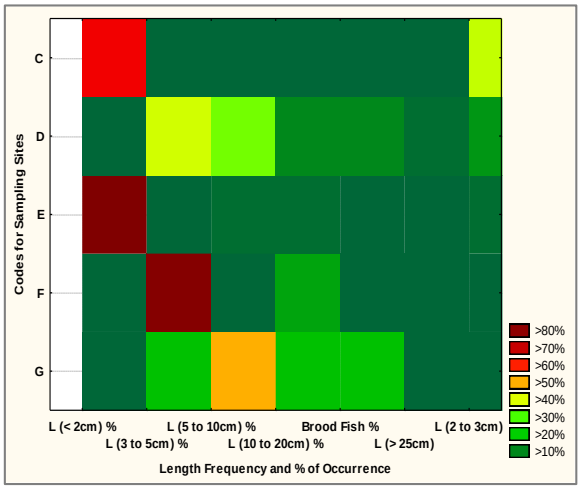
3rd Monitoring, October, 2014



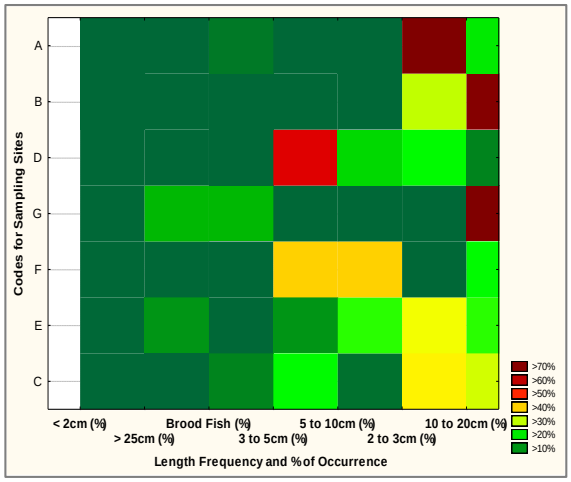
4th Monitoring, January 2015



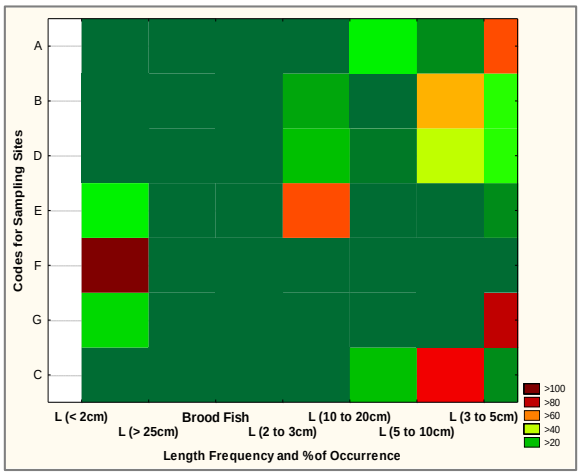
5th Monitoring, April, 2015



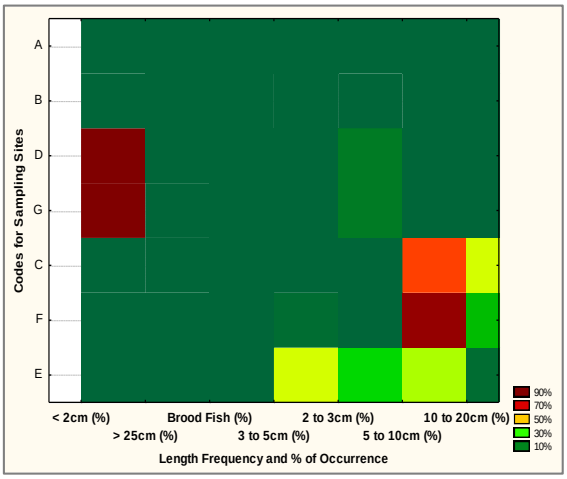
6th Monitoring, August, 2015



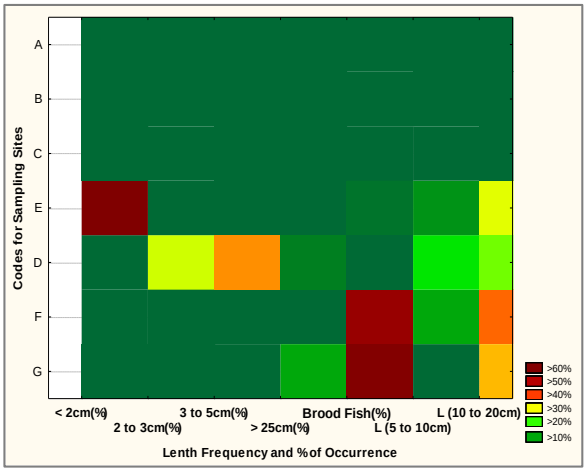
7th Monitoring, October, 2015



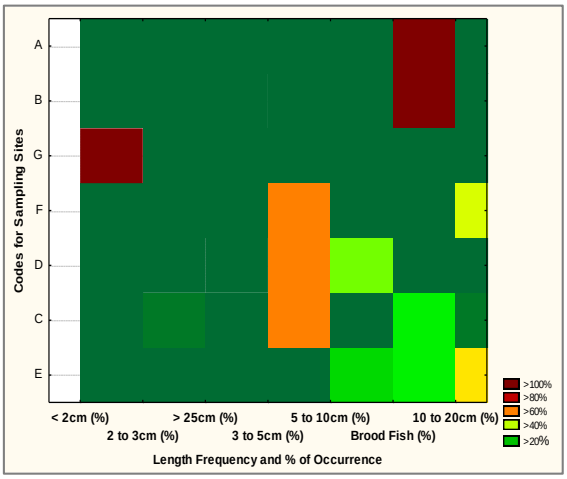
8th Monitoring, January, 2016



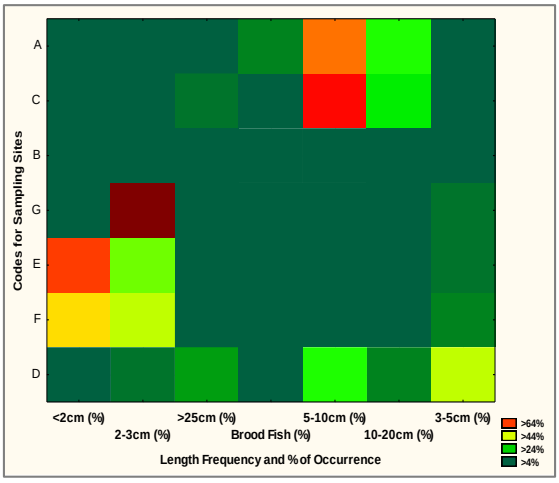
9th Monitoring, April, 2016



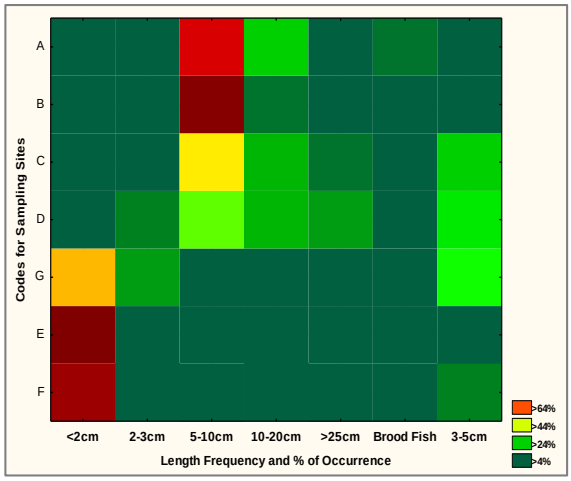
10th Monitoring, July, 2016



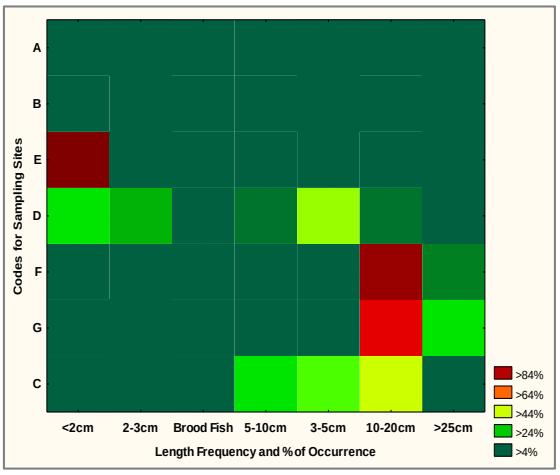
11th Monitoring, October, 2016



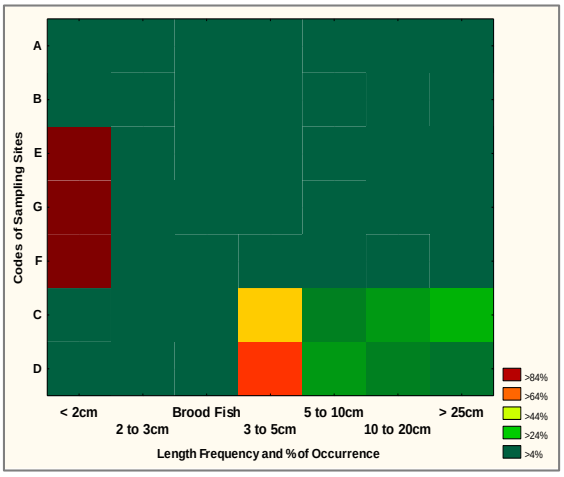
12th Monitoring, January, 2017



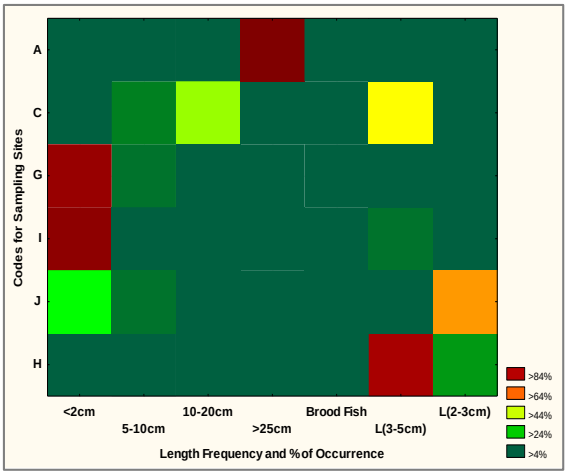
13th Monitoring, April, 2017



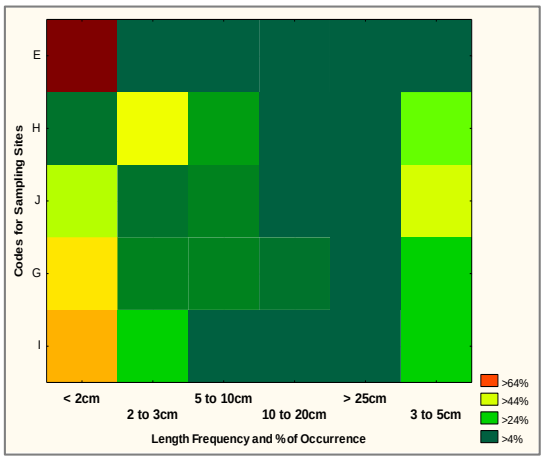
14th Monitoring, October, 2017



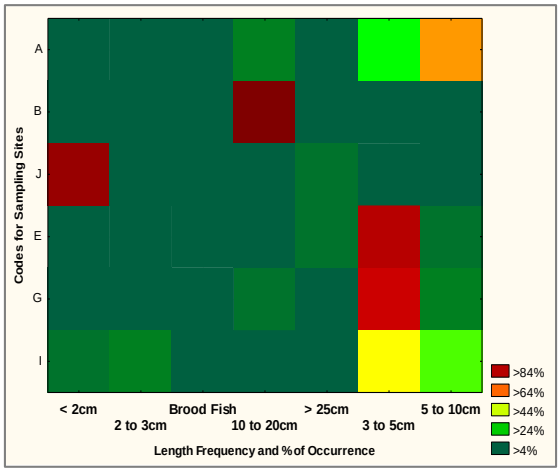
15th Monitoring, January, 2018



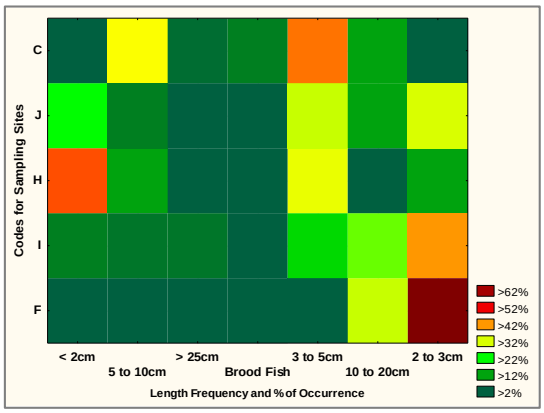
16th Monitoring, April, 2018



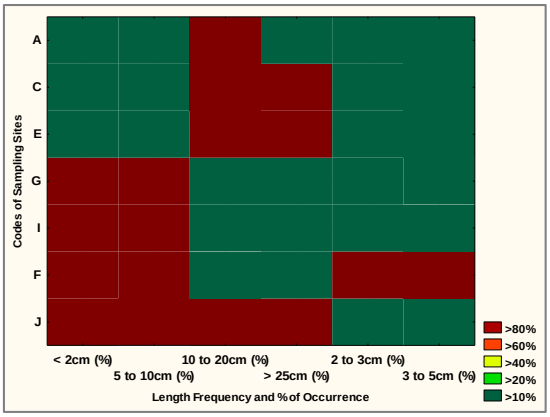
17th Monitoring, July, 2018



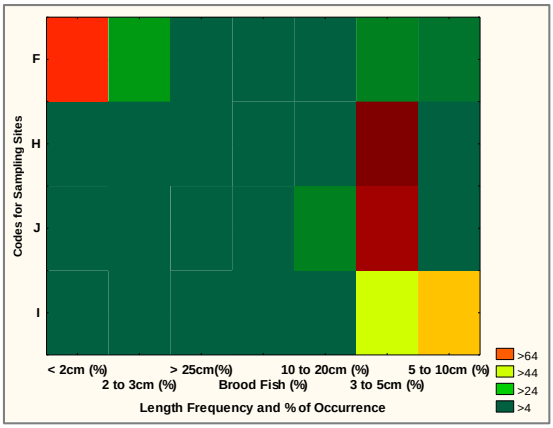
18th Monitoring, November, 2018



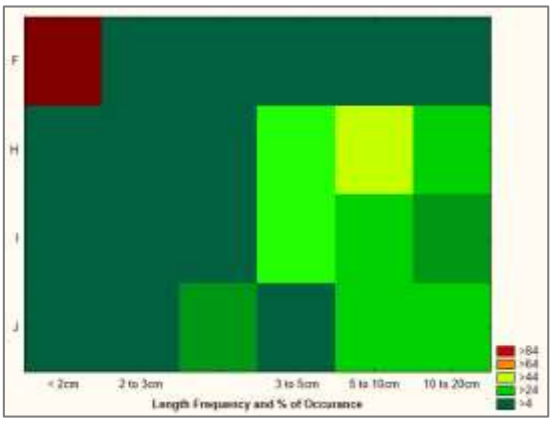
19th Monitoring, February, 2019



20th Monitoring, April, 2019



21st Monitoring, July 2019



22nd Monitoring, July 2019

D.5: 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	+	-	-	-	-	-	-	-	-	-	+	-
Chapila	*Gudusia chapra*	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											
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	19th QM	20th QM	21st QM	22nd QM	23rd 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	+	+	+	+	+	+	+	+	+	+	+

Local Name	Scientific Name	Local Status*	13th QM	14th QM	15th QM	16th QM	17th QM	18th QM	19th QM	20th QM	21st QM	22nd QM	23rd QM
		'-' = No; '+' = Occurrence											
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	-	-	-	-	-	-	-	-	-	-	-
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	+	+	+	+	-	+	+	-	+	-	-

D6: 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
Amadi	H	0	0	0	100	0	0	0
Bagda	F	100	0	0	0	0	0	0
	I	100	0	0	0	0	0	0
	J	100	0	0	0	0	0	0
Baila	C	0	0	100	0	0	0	0
	F	0	100	0	0	0	0	0
	I	0	0	0	30	70	0	0
	J	0	100	0	0	0	0	0
Bhola	C	0	0	0	100	0	0	0
Boishaki Chingri	I	0	0	0	0	100	0	0
Chaka Chingri	C	0	0	100	0	0	0	0
	I	0	100	0	0	0	0	0
Chamua Chingri	C	0	0	100	0	0	0	0
	F	84	16	0	0	0	0	0
Chapila	H	0	0	0	100	0	0	0
Chela	F	22	78	0	0	0	0	0
Chewa	F	0	0	0	100	0	0	0
	H	0	0	0	25	75	0	0
	J	0	0	0	100	0	0	0
Datina	F	0	100	0	0	0	0	0
	I	27	73	0	0	0	0	0
Dogra	I	0	0	0	100	0	0	0
	J	0	0	100	0	0	0	0
Gagla	C	0	0	0	22	78	0	0
Golda	D	0	0	0	0	58	42	0
	E	0	0	0	0	50	50	0
	H	0	0	0	0	100	0	0
Harina	F	29	71	0	0	0	0	0

Fish Species	Site	L (< 2cm)	L (2 to 3cm)	L (3 to 5cm)	L (5 to 10cm)	L (10 to 20cm)	L (> 25cm)	Brood Fish
	H	0	0	100	0	0	0	0
	I	0	0	0	100	0	0	0
Kain Magur	C	0	0	0	0	0	100	0
Kathali Chingri	H	0	0	100	0	0	0	0
Motka Chigri	C	0	0	100	0	0	0	0
	F	0	100	0	0	0	0	0
	H	0	0	100	0	0	0	0
	J	81	19	0	0	0	0	0
Mutkura	C	0	0	100	0	0	0	0
	F	0	100	0	0	0	0	0
Paissa	C	0	50	50	0	0	0	0
	F	50	50	0	0	0	0	0
	I	23	76	0	0	2	0	0
	J	18	82	0	0	0	0	0
Pheksa	H	0	0	0	0	100	0	0
	J	0	0	100	0	0	0	0
Poa	C	0	0	0	0	50	50	0
	E	0	0	0	100	0	0	0
	H	0	0	0	0	100	0	0
	I	0	0	0	0	100	0	0
Tapse	H	0	0	0	0	100	0	0
Tel Kumra	F	0	0	0	50	50	0	0
Tengra	I	0	0	0	100	0	0	0
Tiger Chingri	I	0	0	0	0	100	0	0
Vati Chingri	J	87	13	0	0	0	0	0
Chali Chingri	I	74	26	0	0	0	0	0

Source: CEGIS field survey

D7: Purpose, timing and extent of migration for different year-class of migratory fish species

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

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

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

Migratory Fish Species	Sampling Sites	Year Class*	Migration Purpose											
			1st QM	2nd QM	3rd QM	4th QM	5th QM	6th QM	7th QM	8th QM	9th QM	10th QM	11th QM	12th QM
		Age-1 Adult	-	-	-	-	-	-	Feeding	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	-	-	-	-	-	-		-	-
	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	-	-	-	-	-		-	-

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
Gagra Tengra	Chandpai	Juvenile and Age-1 adult	-	Feeding and Growing	-	-	Feeding and Growing	-	-	-	-		-	-
	Chalna Point	Age-1 adult	-	-	-	-	Feeding and Growing	-	-	-	-		-	-
	Mongla Point	Age-1 adult	-	Feeding and Growing	-	-	-	-	-	-	-		-	-
	Akram Point	Juvenile and Adult	-	-	Feeding and Growing	-	-	-	-	-	-		-	Feeding
		Adult	-	-	-	-	-	-	Feeding	-	-		-	-
	Haldikhali	Juvenile	-	-	-	-	-	-	Feeding and Growing	-	-		-	-
	Harbaria	Adult	-	-	Feeding	-	Feeding and Growing	-	-	-	Feeding		Feeding	
Gulsha Tengra	Haldikhali	Adult	Feeding and Breeding	-	-	-	-	-	-	-	-		-	-
	Akram Point	Adult		-	-	-	-	-	-	-	-		-	-
	Chandpai	Age-1 adult	-	-	-	Feeding	-	Feeding	Feeding and Growing	-	-		-	Feeding
		Juvenile	-	-	-	-	-	-	Feeding and Growing		-		Feeding and Growing	-
	Mongla Point	Age-1 adult	-	Feeding and Growing	-	Feeding and Growing	-	Feeding and Growing		-	Feeding and Growing		-	-
		Juvenile	-	-	-	-	-	-	Feeding and Growing		-		Feeding and Growing	-
	Harbaria	Juvenile	-	-	-	-	-	-	Feeding and Growing		-			-
		Age-1 adult	-	-	-	-	-	-	-	-	Feeding and Growing		-	-
	Maidara	Juvenile and Age-1 Adult	-	-	-	-	-	-	Feeding and Growing	-			-	-
	Chalna Point	Juvenile	-	-	-	-	-	-	-	-	-		Feeding and Growing	-

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

Migratory Fish Species	Sampling Sites	Year Class*	Migration Purpose											
			1st QM	2nd QM	3rd QM	4th QM	5th QM	6th QM	7th QM	8th QM	9th QM	10th QM	11th QM	12th QM
	Chalna Point	Adult	-	-	-	-	Feeding	-	-	-	-		-	-
		Age-1 Juvenile	-	-	-	-	-	-	-	-	Feeding and Growing		-	-
Bele	Akram Point	Adult	Feeding	-	Feeding	Feeding	-	-	-	-	-		-	-
		Juvenile	-	-	-	-	-	-	-	Feeding and Growing	-		-	-
	Haldikhali	Juvenile-1, Juvenile and Adult	-	-	Nursing and Growing	Feeding	-	-	-	-	-		-	-
	Harbaria	Juvenile and Adult	-	-	Feeding and Growing	-	Feeding and Growing	Nursery and Feeding	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

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
Tular Dandi (Nona bele)	Akram Point	Adult	Feeding	-	-	-	-	-	-	-	-		-	-
	South-west of the Project	Adult	-	-	Feeding	-	-	-	-	-	-		Feeding	-
	Chalna Point	Adult	Feeding	-	Feeding	-	Feeding	-	Feeding	-	-		-	-
Tairel	Akram Point	Adult	Feeding	-	-	-	-	-	-	Feeding	-		-	-
	Harbaria	Age-1 Adult	-	-	-	-	-	-	-	-	Feeding and Growing		-	-
	Mongla Point	Juvenile	Feeding	-	-	-	-	-	-	-	-		-	-
Pheksa	Akram Point	Adult	Feeding	-	-	-	-	-	-	Feeding	-		-	-
		Juvenile	-	-	Feeding and Growing	-	-	-	-	-	-		-	-
	Haldikhali	Juvenile	-	-	Feeding and Growing	-	-	-	-	-	-		-	-
	Haldikhali	Adult	-	-	-	Feeding	-	-	-	-	-		-	-
	Harbaria	Juvenile	-	-	-	-	-	-	-	-	Feeding and Growing		-	-
	Chalna Point	Juvenile and Adult	Feeding	Feeding and Growing	-	-	-	-	Feeding and Growing	-			-	-
		Adult	-	-	Feeding	Feeding	Feeding	-	Feeding	-	-		-	-
	Mongla Point	Adult	-	-	Feeding	Feeding	-	-	Feeding and Growing	-	-		Feeding	-
	Chandpai	Juvenile and Adult	Feeding	Feeding and Growing	-	-	Feeding and Growing	-		-	-		-	-
	Maidara	Juvenile and Adult	Feeding	Feeding and Growing	-	-	-	-	-	-	-		-	-
		Juvenile	-	-	-	-	-	-	Feeding and Growing	-	-		-	-
		Adult	-	-	Feeding	Feeding	-	Feeding	-	-	-		-	-
Paissa	Akram Point	Juvenile and Adult	Feeding	-	Feeding and Growing	Feeding	-	-	-	Feeding and Growing	-		-	Feeding
		Brood	-	-	-	-	-	-	-	-	-		-	Spawning

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
		Juvenile	-	-	-	-	-	-	Feeding and Growing			-	-	-
	Haldikhali	Juvenile and Adult	Feeding	-	Feeding and Growing	Feeding	-	-	-	-	-		-	-
		Juvenile	-	-	-	-	-	-	Feeding and Growing	-	-		-	-
	Harbaria	Juvenile-1 and Juvenile	-	-	Feeding	-	Feeding and Growing	-	Feeding and Growing	-	-		-	-
		Adult	-	-	-	-	-	-	-	Feeding	-		-	-
	Chandpai	Fry	Breeding and Spawning	-	-	-	Nursing	-	-	-	Nursery		-	-
	Chandpai	Juvenile and Adult	-	-	Feeding and Growing	-	-	Nursery and Feeding	-	-	-		Feeding and Growing	Feeding
	Harbaria	Juvenile	-	-	-	-	-	-	Feeding and Growing	-	-			-
	Mongla Point	Fry	Breeding and Spawning	-	-	-	-	Nursery	-	-	Nursery		-	-
		Age-1 Juvenile	-	-	-	-	-	-	-Nursing, Feeding and Growing	-	Feeding and Growing		-	-
		Age-1 Adult	-	-	-	-	Feeding and Growing	Feeding	-	-			-	-
	Maidara	Fry, Juvenile and Age-1 adult	Breeding and Spawning	Feeding and Growing	-	-	Feeding and Growing	-	-	-			-	-
		Age-1 Juvenile, Juvenile and Age-1 Adult	-	-	-	-	-	-	Nursing, Feeding and Growing	-	-		Feeding and Growing	-
		Adult	-	-	-	-	-	Feeding	-	-	-		-	
Banshpata	Chandpai	Juvenile	Feeding	-	-	-	-	-	-	-	-		-	

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

Migratory Fish Species	Sampling Sites	Year Class*	Migration Purpose											
			1st QM	2nd QM	3rd QM	4th QM	5th QM	6th QM	7th QM	8th QM	9th QM	10th QM	11th QM	12th QM
Pangas	Haldikhali	Juvenile	-	-	Feeding and Growing	-	-	-	-	-	-		-	
	Harbaria	Adult	-	-	-	-	-	-	-	Feeding	-		-	
	Mongla Point	Juvenile and Adult	-	-	Feeding	-	-	-	-	-	-		-	

Migratory Fish Species	Sampling Sites	Year Class*	Migration Purpose										
			13th QM	14th QM	15th QM	16th QM	17th QM	18th QM	19th QM	20th QM	21st QM	22nd QM	23rd QM
Tapsi	Haldikhali	Juvenile and Age-1 adult	-	-	Grazing	-	-	-	-	-	-		-
	Akram Point	Juvenile and Age-1 adult	-	-	-	-	-	-	-	-	-		-
		Adult	-	-	-	-	-	-	-	-	-		-
	Chalna Point	Age-1 adult and Brood fish	-	-	-	-	-	-	-	-	-		-
		Adult	-	Feeding	-	-	Feeding	-	-	Feeding	Feeding		-
	Harbaria	Juvenile and Age-1 adult	Feeding	-	-	-	-	-	-	-	-		-
		Adult and Brood Fish	-	-	-	-	-	-	-	-	-		-
	Chandpai	Juvenile	-	Feeding and Growing	-	Feeding and Growing	Feeding and Growing	-	-	-	-		-
	Mongla Point	Juvenile	-	-	-	-	-	-	Feeding and Growing	-	-		-
		Adult	-	-	-	-		-	-	-	-		Feeding
		Age-1 adult	-	-	-	-	Feeding and Growing	-	-	-	-		-
		Fry	-	-	Nursing	-	-	-	-	-	-		-
	Maidara	Age-1 adult	-	-	-	-	-	-	-	-	-		-
		Juvenile	-	-	-	-	-	Maturation	-	-	-		-
		Adult	-	-	-	-	Feeding	-	-	-	-		-
		Brood Fish	-	-	-	-	-	-	-	-	-		-

Migratory Fish Species	Sampling Sites	Year Class*	Migration Purpose										
			13th QM	14th QM	15th QM	16th QM	17th QM	18th QM	19th QM	20th QM	21st QM	22nd QM	23rd QM
Bairagi/Amadi	Haldikhali	Juvenile and Age-1 adult	-	-	-	-	-	-	-	-	-		-
	Akram Point	Juvenile and Age-1 adult	-	-	-	-	-	-	-	-	-		-
		Juvenile and Adult	-	-	-	-	-	-	-	-	-		-
	Chandpai	Fry	-	Nursing	-	Nursing	-	-		Nursing	-		-
		Juvenile	-	Feeding and Growing	Feeding and Growing	Feeding and Growing	-	Maturation	Feeding and Growing	-	Nursing		-
	Chalna Point	Juvenile and Age-1 adult	-	-	-	-	-	-	-	Feeding	-		-
		Fry	Nursing	-	-	-	-	Nursing	-	Nursing	-		-
	Harbaria	Juvenile	-	-	Feeding and Growing	-	Feeding and Growing	-	-	-	-		-
	Mongla Point	Fry	Nursing	-	Nursing	-	-	-	-	-	-		Nursing
		Juvenile	-	-	-	-	Feeding and Growing	-	-	-	-		-
	Maidara	Juvenile	-	-	-	-	-	Maturation	-	-	-	Feeding and Growing	-
		Fry	Nursing	-	Nursing	-	-	Nursing	-	Nursing	-		-
	Charaputia	Adult	-	-	-	-	-	-	-	Feeding	-		-
	Jongra	Fry	-	-	-	-	-	-	-	Nursing	-		-
Chapila	Haldikhali	Juvenile	-	-	-	-	-	-	-	-	-		-
	Akram Point	Juvenile	-	-	-	-	-	-	-	-	-		-
	Harbaria	Juvenile	-	-	-	-	Feeding and Growing	-	-	-	-		-
	Mongla Point	Fry	-	-	-	-	Nursing	-	-	-	-		-
		Juvenile	-	-	-	-	Feeding and Growing	-	-	-	-		-
		Adult	-	-	-	-	Feeding	-	Maturation	-	-		-
	Chalna Point	Adult	-	-	-	-	Feeding	-	Maturation	-	Maturation	Feeding	-
		Fry	-	-	-	-	-	Nursing	-	-	-		-

Migratory Fish Species	Sampling Sites	Year Class*	Migration Purpose										
			13th QM	14th QM	15th QM	16th QM	17th QM	18th QM	19th QM	20th QM	21st QM	22nd QM	23rd QM
	Maidara	Juvenile to Age-1 adult	-	-	-	-	-	Growing and Maturation	-	-	-		-
Loitta	Haldikhali	Juvenile and Age-1 adult	-	-	-	-	-	-	-	-	-		-
	Akram Point	Juvenile	-	-	-	-	-	-	-	-	-		-
	Akram Point	Age-1 adult	-	-	-	-	-	-	-	-	-		-
	Chandpai	Juvenile	-	-	-	-	-	-	-	-	-		-
	Jongra	Fry	-	-	-	-	-	-	-	Nursing	-		-
	Harbaria	Fry, Juvenile and Age-1 adult	-	-	-	-	-	-	-	-	-		-
	Mongla Point	Fry	-	-	Nursing	-	-	-	-	-	-		-
	Chalna Point	Age-1 adult	-	-	-	-	-	-	-	-	-		-
		Fry	-	-	-	-	-	-	-	-	-		-
Poma	Haldikhali	Juvenile	-	-	-	-	-	-	-	-	-		-
	Akram Point	Juvenile	-	-	-	-	-	-	-	-	-		-
		Age-1 adult	-	-	-	-	-	-	-	-	-		-
		Adult	-	-	-	-	-	-	-	-	-		-
	Charaputia	Brood Fish	-	-	-	Spawning	-	-		-	-		-
		Juvenile and Adult	-	-	-	Feeding	-	-	Growing and Maturation	Feeding	-		Growing and Maturation
	Chandpai	Fry and Juvenile	-	-	-	Nursing	-	-	-	-	-		-
		Fry	-	-	-	-	Nursing	-	-	-	-		-
		Juvenile	Feeding and Growing	-	-	Feeding and Growing	-	-	-	-	-		-
		Adult		Feeding	Feeding	Feeding	-	-	-	-	-		-
		Brood Fish	-	-	-	-	-	-	-	-	-		-
	Jongra	Fry	-	-	-	-	-	-	-	Nursing	-		-
	Haldikhali	Fry and Juvenile	-	-	-	-	-	-	-	-	-		-
	Harbaria	Adult and Brood Fish	-	-	-	-	-	-	-	-	-		
		Adult	Feeding	-	-	-	-	Feeding	-	-	-		-
		Fry and Juvenile	-	-	-	-	-	-	-	-	-		Nursing

Migratory Fish Species	Sampling Sites	Year Class*	Migration Purpose										
			13th QM	14th QM	15th QM	16th QM	17th QM	18th QM	19th QM	20th QM	21st QM	22nd QM	23rd QM
	Mongla Point	Fry, Juvenile and Age-1 adult	Nursing	-	-	-	Nursing	-	Feeding and Growing	-	-		Nursing and Maturation
		Fry	-	Nursing	-	-	-	-	-	-	-		-
		Juvenile	-	-	-	-	-	-	-	-	Nursing		-
		Age-1 Adult	-	-	-	-	-	-	-	-	-		-
		Adult	-	-	-	-	-	-	-	-	-		-
		Brood Fish	-	-	-	-	-	-	-	-	-		-
	Maidara	Adult	-	Feeding	-	-	-	-	Maturation and Feeding	-	-		Feeding
		Fry	-	-	-	-	-	Nursing	-	-	-	Nursing	-
	Chalna Point	Juvenile, Adult and Brood Fish	-	-	-	-	-	-	-	-	-		-
		Juvenile and Adult	-	Feeding and Growing	-	-	-	Maturation and Feeding	Maturation and Feeding	-	Maturation and Feeding		-
		Fry	Nursing	-	-	-	-	-	-	-	-		-
Chhuri	Haldikhali	Adult	-	-	-	-	-	-	-	-	-		-
	Akram Point		-	-	-	-	-	-	-	-	-		-
Chela	Haldikhali	Adult	-	-	-	-	-	-	-	-	-		-
	Akram Point	Juvenile and Adult	-	-	-	-	-	-	-	-	-		-
	Harbaria	Fry and Juvenile	-	-	-	-	-	-	-	-	-		-
	Chalna Point		-	-	-	Nursing and Feeding	-	-	-	-	-	Nursing and Maturation	-
	Chandpai		-	-	Feeding and Growing		-	-	-	Nursing	Nursing		-
	Mongla Point		-	Nursing	-	-	-	-	-	-	-	Nursing and Maturation	-
	Jongra	Fry	-	-	-	-	-	-	-	Nursing	-		-
Gang Tengra	Haldikhali	Adult	-	-	-	-	-	-	-	-	-		-
	Akram Point	Adult	-	-	-	-	-	-	-	-	-		-
	Harbaria	Adult	-	-	-	-	-	-	-	-	-		-

Migratory Fish Species	Sampling Sites	Year Class*	Migration Purpose										
			13th QM	14th QM	15th QM	16th QM	17th QM	18th QM	19th QM	20th QM	21st QM	22nd QM	23rd QM
	Chandpai	Adult	-	-	-	-	Feeding	-	-	-	-		-
	Maidara	Fingerling	-	-	-	-	Nursing	-	-	-	-		-
	Mongla Point	Fingerling					Nursing	-	-	-	-		-
		Age-1 Adult					Feeding and Growing	-	-	-	-		-
Ghagra Tengra	Chandpai	Juvenile and Age-1 adult	-	-	-	-	-	Maturation		-	-		-
		Brood Fish	-	-	Breeding	-	-	-	-	-	-		-
		Fry	-	-	-	-	Nursing	-	-	-	-		-
	Chalna Point	Age-1 adult	-	-	-	-	-	-	-	-	-		-
	Mongla Point	Age-1 adult	-	-	-	-	-	-	Maturation and Feeding	-	Maturation and Feeding		-
	Akram Point	Juvenile and Adult	Feeding	-	-	-	-	-	-	Feeding and Growing	-		-
		Adult	-	-	-	-	-	-	-	-	-		-
	Haldikhali	Juvenile	-	-	-	-	-	-	-	-	-		-
	Harbaria	Adult	Feeding		Breeding	-	-	-	-	Feeding	-		-
		Juvenile	-		-	-	-	Maturation	-	Maturation	-		-
	Charaputia	Juvenile and Age-1 adult	-						Maturation	-	-		Maturation
Gulsha Tengra	Haldikhali	Adult	-	-	-	-	-	-	-	-	-		-
	Akram Point	Adult	-	-	-	-	-	-	-	-	-		-
	Chandpai	Age-1 adult	Feeding	-	Feeding and Growing	-	-	-	-	-	-		-
		Juvenile	-	Feeding and Growing	-	Feeding and Growing	-	-	-	-	-		-
	Charaputia		-	-	-		-	-	Feeding and Growing	-	-		-
	Mongla Point	Age-1 adult	-	-	-	-	Feeding and Growing	-	-	-	-		-

Migratory Fish Species	Sampling Sites	Year Class*	Migration Purpose										
			13th QM	14th QM	15th QM	16th QM	17th QM	18th QM	19th QM	20th QM	21st QM	22nd QM	23rd QM
		Juvenile	-	-	-	-	Feeding and Growing	-	-	-	-		-
	Harbaria	Juvenile	-	-	-	-	Feeding and Growing	-	-	-	-		-
		Age-1 adult	-	-	-	-	Feeding and Growing	-	-	-	-		-
	Maidara	Juvenile and Age-1 Adult	-	-	-	-	-	-	-	-	-		-
	Chalna Point	Juvenile	-	-	-	-	-	-	-	-	-		-
Potka	Haldikhali	Adult	-	-	-	-	-	-	-	-	-		-
	Chalna Point	Fry	-	-	-	-	-	Nursing	-		-		-
	Chandpai	Fry	-	-	-	-	-	-	-	Nursing	-		-
		Juvenile	Feeding	-	-	-	-	-	Feeding and Growing	-	-		-
		Adult	-	Feeding and Growing	Feeding	-	-	-	-	-	-		-
	Jongra	Fry	-	-	-	-	-	-	-	Nursing	-		-
	Mongla Point	Fry	-	-	-	-	-	-	-	-	-		-
		Juvenile	-	-	-	-	-	-	-	-	-		-
	Maidara	Fry	-	-	-	Nursing	-	Nursing	-	Nursing	-		-
		Juvenile	-	-	-	-	-	Maturation	-	-	-		-
	Harbaria	Fry	-	-	-	-	-	-	-	-	-		-
		Juvenile	-	-	-	-	-	-	-	-	-		-
	Charaputia	Juvenile	-	-	-	-	-	-	Feeding and Growing	-	-		-
Paira Chanda	Akram Point	Adult	-	-	-	-	-	-	-	-	-		-
	Chandpai	Fry	-	-	-	-	-	-	-	-	-		-
Chewa	Akram Point	Juvenile and Adult	-	-	-	-	-	-	-	-	-		-
	Chandpai	Fry and Juvenile	-	-	-	-	-	-	-	Nursing	-		-

Migratory Fish Species	Sampling Sites	Year Class*	Migration Purpose										
			13th QM	14th QM	15th QM	16th QM	17th QM	18th QM	19th QM	20th QM	21st QM	22nd QM	23rd QM
		Juvenile	-	Feeding and Growing	-	-	-	-	-	-	Feeding and Growing		-
		Adult	-	-	-	-	-	-	-	-	-		-
	Jongra	Fry	-	-	-	-	-	-	-	Nursing	-		-
	Haldikhali	Juvenile and Adult	-	-	-	-	-	-	-	-	-		-
	Harbaria	Juvenile and Adult	-	-	-	-	-	-	-	-	-		-
		Fry and Juvenile	-	-	-	-	-	-	-	-	-	-	Nursing
	Chandpai	Juvenile-1	-	-	-	-	Feeding and Growing	-	-	-	-		-
	Mongla Point	Juvenile	-	-	-	-	-	-	-	-	Nursing	Maturation	Maturation
		Fry	-	-	-	-	Nursing	-	-	-	-		-
	Maidara	Juvenile	-	-	-	-	-	-	-	-	-	Maturation	-
		Fry	-	-	Nursing		-	-	-	-	-		-
	Chalna Point	Adult	-	-	-	-	Feeding	-	-	-	-	Feeding	-
		Age-1 Juvenile	-	-	-	-	-	-	-	-	-		Maturation
Bele	Akram Point	Adult	-	-	-	-	-	-	-	-	-		-
		Juvenile	-	-	-	-	-	-	-				-
	Haldikhali	Juvenile-1, Juvenile and Adult	-	-	-	-	-	-	-		-		-
	Harbaria	Juvenile and Adult	-	-	-	-	-	-	-		-		-
	Chandpai	Fry	-	-	-	Nursing	Nursing	-	-	Nursing	-	Nursing	-
		Juvenile and Adult	Feeding and Growing	-	Feeding and Growing		-	-	-	-	Feeding and Growing-		-
	Jongra	Fry	-	-	-		-	-	-	Nursing	-		-
	Harbaria	Juvenile and Age-1 Adult	-	-	-	-	-	-	-	-	-		
	Mongla Point	Fry	-	Nursing	-	-	Nursing	-	-	-	-		
		Fry, Juvenile-1 and Juvenile	-	-	-	-	-	-	-	-	-		
		Juvenile and Adult	-	-	-	-	-	-	-	-	Maturation and Feeding		
	Chalna Point	Fry	-	-	Nursing		Nursing	-	-	-	-		
		Fingerling	-	-	-	-	Nursing	-	-	-	-		Nursing
		Adult	-	-	-	-	-	-	-	-	-		-

Migratory Fish Species	Sampling Sites	Year Class*	Migration Purpose										
			13th QM	14th QM	15th QM	16th QM	17th QM	18th QM	19th QM	20th QM	21st QM	22nd QM	23rd QM
	Maidara	Juvenile and Age-1 adult	-	-	Feeding and Growing	-	Feeding and Growing	Feeding and Growing	-	-	Maturation and Feeding	Maturation and Feeding	Maturation and Feeding
		Fry	Nursing	-	Nursing		-	-	-	-	-		-
	Charaputia	Juvenile and Age-1 adult	-	-	-		-	-	Maturation	-	-		-
Tular Dandi (Nona bele)	Akram Point	Adult	-	-	-	-	-	-	-	Feeding and Maturation	-		-
	Chandpai	Age-1 Adult	-	-	Feeding	-	-	-	-	-	-		-
		Juvenile	-	-	-	-	-	Growing	-	-	-		-
		Fry	-	-	-	-	-	-	-	Nursing	-		-
	Jongra	Fry	-	-	-	-	-	-	-	Nursing	-		-
	Maidara	Adult	-	Feeding	-	-	-	-	Maturation	-	-		-
	Chalna Point	Adult	-	-	-	-	-	-	Maturation	Maturation	Maturation and Feeding		-
Tairel	Akram Point	Adult	-	-	-	Feeding	-	-	-	-	-		-
	Charaputia	Juvenile	-	-	-	-	-	-	-	Maturation	-		-
	Harbaria	Age-1 Adult	-	Feeding and Growing	-	-	-	-	-	-	-		-
	Chandpai	Juvenile	-	-	-	-	-	Growing	-	-	Feeding and Growing		-
	Chalna Point	Juvenile	-	-	-	-	-	-	-	-	Growing		-
	Maidara	Juvenile	-	-	-	-	-	Growing	-	-	-		-
	Mongla Point	Juvenile	-	-	-	-	-	-	-	-	-		-
Pheksa	Akram Point	Adult	-	-	-	-	-	-	-	-	-		-
		Juvenile	-	-	-	-	-	-	-	-			
	Haldikhali	Juvenile	-	-	-	-	-	-	-	-	-		-
	Haldikhali	Adult	-	-	-	-	-	-	-	-	-		

Migratory Fish Species	Sampling Sites	Year Class*	Migration Purpose										
			13th QM	14th QM	15th QM	16th QM	17th QM	18th QM	19th QM	20th QM	21st QM	22nd QM	23rd QM
	Charaputia	Juvenile and Adult	-	-	-	-	-	-	-	Feeding and Maturation	-		
	Harbaria	Juvenile	-	-	-	-	-	-	-	-	-		
	Chalna Point	Juvenile and Adult	-	-	-	Feeding and Growing	-	-	-	Maturation	Maturation		
		Adult	-	Feeding	-	-	-	-	Maturation	-	-	Feeding	
	Mongla Point	Adult	-	-	-	-	-	-	Maturation	-	-		Feeding
		Juvenile	-	-	-	Growing	-	-		-	-		-
	Chandpai	Juvenile and Adult	-	-	-	Feeding and Growing	-	-	Maturation	--	-		-
	Maidara	Juvenile and Adult	-	-	-	-	-	-	-	-	-		-
		Juvenile	-	-	-	-	-	-	-	-	-		-
		Adult	-	Feeding	-	-	-	-	-	-	-		-
Paissa	Akram Point	Juvenile and Adult	Feeding	-	-	-	-	Growing and Maturation	-	-	-		-
		Brood	Spawning	-	-	-	-	-	-	-	-		-
		Juvenile	-	-	-	-	-	-	-	-	-		-
	Haldikhali	Juvenile and Adult	-	-	-	-	-	-	-	-	-		-
		Juvenile	-	-	-	-	-	-	-	-	-		-
	Charaputia	Brood Fish	-	--	-	Spawning	-	-	-	-	-		-
		Fry											Nursing
	Harbaria	Juvenile-1 and Juvenile	-	Feeding and Growing	-	-	-	-	-	-	-		-
		Adult	-	Feeding	-	-	-	-	-	-	-		-
	Chalna	Fry	-	-	-	-	-	-	Feeding and Growing	-	Feeding and Growing		Nursing
	Chandpai	Fry	-	-	-	Nursing	-	-	Feeding and Growing	Nursing	Nursing	Nursing	Nursing

Migratory Fish Species	Sampling Sites	Year Class*	Migration Purpose										
			13th QM	14th QM	15th QM	16th QM	17th QM	18th QM	19th QM	20th QM	21st QM	22nd QM	23rd QM
		Juvenile and Adult	Feeding	Feeding and Growing	-	Feeding and Growing	-	Maturation	-	-			-
	Jongra	Fry	-	-	-	-	-	-	-	Nursing			-
	Harbaria	Juvenile	-	-	Feeding and Growing	-	-	Maturation	-	-			-
	Mongla Point	Fry	-	-	Nursing	-	-	-	-	-			-
		Age-1 Juvenile	-	-	-	-	-	-	-	-			-
		Age-1 Adult	-	-	-	-	-	-	-	-		Maturation	-
	Maidara	Fry, Juvenile and Age-1 adult	-	-	-	-	-	-	Feeding and Growing	-	Feeding and Growing		-
		Age-1 Juvenile, Juvenile and Age-1 Adult	-	-	-	-	-	-	-	-	-		-
		Juvenile	-	-	-	-	-	Growing	-	-	-		Maturation
		Adult	-	-	-	-	-	-	-	-	-		-
Banshpata	Chandpai	Juvenile	-	-	-	Growing	Feeding and Growing	-	-	-	-		-
		Adult	-	Feeding	Feeding	-	-	-	-	-	-		-
	Jongra	Juvenile	-	-	-	-	-	-	-	Maturation	-		-
	Charaputia	-	-	-	-	Feeding	-	-	Growing and Maturation	-	-		-
	Akram Point	Juvenile	-	-	-	-	-	-	-	-	-		-
		Adult	-	-	-	-	-	-	-	-	-		-
	Haldikhali	Juvnile and adult	-	-	-	-	-	-	-	-	-		-
	Harbaria	Adult	-	-	-	-	-	-	-	-	-		-
	Mongla Point	Fry and Adult	-	-	-	-	-	-	-	-	-		-
		Adult	-	-	-	-	-	-	-	-	-		-
		Juvenile	-	-	-	-	Feeding and Growing	-	-	-	-		-
	Maidara	Juvenile and Age-1 Adult	-	-	-	-	-	Growing and Maturation	Growing and Maturation	-	-		-
		Adult	-	Feeding	-	-	-	Feeding	-	-	-		-

Migratory Fish Species	Sampling Sites	Year Class*	Migration Purpose										
			13th QM	14th QM	15th QM	16th QM	17th QM	18th QM	19th QM	20th QM	21st QM	22nd QM	23rd QM
	Chalna Point	Juvenile and Age-1 Adult	-	-	-	-	-	-	Growing and Maturation	Feeding	Growing and Maturation		-
Hilsa	Akram Point	Brood Fish	-	-	-	-	-	-	-	-	-		-
	Haldikhali	Brood Fish	-	-	-	-	-	-	-	-	-		-
		Juvenile	-	-	-	-	-	-	-	-	-		-
	Harbaria	Brood Fish	-	-	-	-	-	-	-	-	-		-
	Chandpai	Adult and Brood Fish	-	-	-	-	-	-	-	-	-		-
	Mongla Point	Adult	-	-	-	-	-	-	-	-	-		-
		Brood Fish	-	-	-	-	-	-	-	-	-		-
	Maidara	Age-1 Adult	-	-	-	-	-	-	-	-	-	Maturation	-
	Chalna Point	Adult	-	-	-	-	-	Maturation	-	-	-	Feeding	-
		Brood fish	-	-	-	-	-	-	-	-	-		-
Pangas	Haldikhali	Juvenile	-	-	-	-	-	-	-	-	-		-
	Charaputia	Adult	-	-	-	-	-	-	-	Feeding	-		-
	Harbaria	Adult	-	-	-	-	-	-	-	-	-		-
	Mongla Point	Juvenile	-	-	-	-	-	-	Feeding and Growing	-	Feeding and Growing		-
	Maidara	Juvenile and Age-1 Adult	-	-	-	-	-	-	-	-	-	Feeding and Growing	-

Source: Field findings at different times

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

D8: The Present Catch in Three Sampling Ghers

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

Source: CEGIS Field Survey, 2014-2015

Sampling Site	Total Catch (kg): 2015-2016							
	5th QM		6th QM		7th QM		8th QM	
	Species	ton	Species	ton	Species	ton	Species	ton
1	Bagda	-	Bagda	1.6	Bagda	2	Catla	2
	Horina Chingri	1	Horina Chingri	1	Horina Chingri	3.2	Glass Carp	0.1
	Tengra	-	Chali Chingri	0.5	Gusha Chingri	0.8	Horina Chingri	0.8
	Paissa	-	Paissa	0.25	Paissa	24	Minar Carp	0.1
	Chela	-	Bele	0.25	Vetki	0.2	Nilotica	1.6
	Vetki	-	-	-	Kailla	0.4	Paissa	0.6
	-	-	-	-	Bele	0	Rui	3
	-	-	-	-	Tilapia	0	Vetki	0.8
	-	-	-	-	Catla	0	-	0
	-	-	-	-	Minar Carp	0	-	0
	-	-	-	-	Glass Carp	0	-	0
	-	-	-	-	Kakra	0.4	-	0
Sub-total=	**-**	**1**	**-**	**3.06**	**-**	**31**	**-**	**9**
2	Bagda	-	Bagda	1.67	Bagda	0	-	0
	-	-	Chali Chingri	0.30	Horina Chingri	0	-	0
	-	-	Horina Chingri	0.50	Chali Chingri	0	-	0
	-	-	Bele	0.30	Tilapia	0	-	0
	-	-	Paissa	0.25	Vetki	0	-	0
	-	-	-	-	Tengra	0	-	0
	-	-	-	-	Paissa	0	-	0
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
	-	0	-	-	Tengra	0.4	-	0
	-	0	-	-	Tilapia	3.2	-	0
Sub-total =	**-**	**2**	**-**		**-**	**4**	**-**	**2.01**
Grand-total =	**-**	**3.14**	**-**		**-**	**19**	**-**	**2.01**

Source: CEGIS Field Survey, 2016-2017

Sampling Site	Total Catch (kg): 2017-2018 and 2018-19													
	13th QM		14th QM		15th QM		16th QM		17th QM		18th QM		19th QM	
	Species	ton	Species	ton	Species	ton	Species	ton	Species	ton	Species	ton	Species	ton
1	Bagda	0	Bagda	3	-	-	Bagda	2.00	Bagda	0.76	Bagda	0	Bagda	-
	Horina Chingri	1	Rui (kg)	1.3	-	-	Golda	0.10	Bele	0.20	Catla	1.2	Paissa	-
	Tengra	0	Catla (kg)	1	-	-	Rui	0.12	Chali	1.20	Common Carp	0.3		
	Paissa	0	-	-	-	-	Grass Carp	0.20	Golda	0.00	Grass Carp	0.3		
	Chela	0	-	-	-	-	Catla	0.30	Horina	1.60	Rui	4.2		
	Vetki	0	-	-	-	-	Tilapia	0.45	Paissa	0.00				
							Horina	0.10	Tilapia	12.80				
							Gusha	0.00						
							Paissa	0.00						
							Khorulla	0.00						
							Vetki	0.00						
							Gulsha	0.00						
							Bele	0.00						
Sub-total =	**-**	**1**	**-**	**3.6**	-	-	=	**3.27**	=	**16.56**	**=**	**6**		
2	Bagda	0	Bagda	5	-	-	Bagda	**3.93**	Bagda	1.48	Bagda	5	Bagda	-
	-	-	Vetki	0.5	-	-	Golda	**0.13**	Bele	0.06	Bhangan	0.05	Paissa	-
	-	-	Paissa	7	-	-	Rui	**8.41**	Bhangan	0.01	Catla	3	Datina	-
	-	-	Phessa	1	-	-	Tilapia	**5.90**	Catla	0.00	Chali	0.4		
	-	-	Bhangan	0.7	-	-	Nilotica	**0.00**	Chali	0.04	Golda	0.08		
							Khorulla	**0.00**	Chel	0.01	Horina	1.8		
							Mrigel	**0.00**	Golda	0.00	Paissa	0.8		
							Catla	**0.00**	Horina	0.50	Rui	3		
							Grass Carp	**0.11**	Motka	0.05	Tengra	0.8		
							Common Carp	**5.55**	Paissa	0.03	Tilapia	8		
							Sarpunti	**0.53**	Rui	0.00	Vetki	2		

Sampling Site	Total Catch (kg): 2017-2018 and 2018-19													
	13th QM		14th QM		15th QM		16th QM		17th QM		18th QM		19th QM	
	Species	ton	Species	ton	Species	ton	Species	ton	Species	ton	Species	ton	Species	ton
							Horina	**1.91**	Tengra	0.13				
							Chali Chingri	**1.16**	Tilapia	0.41				
							Bele	**0.43**	Vetki	0.01				
							Vetki	**1.96**						
							Tengra	**4.20**						
							Paissa	**0.14**						
							Tairel	**0.003**						
							Pheksa	**0.001**						
Sub-total =		**0**		**14.2**	-	-	=	**34.38**	=	**2.75**	**=**	**25**		
3	Bagda	0	Bagda	2	-	-	Bagda	**0.50**	Bagda	0.10	-	0	Bagda	-
	-	-	Paissa	8	-	-	Tilapia	**1.50**	Horina Chingri	0.00			Golda	-
	-	-	Tengra	2	-	-	Tengra	**0.12**	Paissa	0.00			Paissa	-
	-	-	Tilapia	5	-	-	Paissa	**0.00**	Tengra	0.00			Nilotica	-
	-	-	Rui	3	-	-	Horina Chingri	**0.60**	Tilapia	0.20			Khorsul	-
	-	-	Vetki	2	-	-								
	-	-	Catla	10	-	-								
Sub-total =	**-**	**0**	**-**	**32**	-	-								
Grand-total =	**-**	**1**	**-**	**49.8**	-	-	**=**	**2.72**	**=**	**0.30**	**=**	**0**		

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

Total Catch (kg): 2019-2020

Location	20th QM		21st QM		22nd QM		23rd QM	
	Fish Species	Total Production (ton)	Fish Species	Total Production (ton)	Fish Species	Total Production (ton)	Fish Species	Total Production (ton)
Bhekatkhali Khal, Rajnagar	Bagda	32	Bagda	2.72	Bagda	0.8	Harina	0.02
	Horina	48	Harina	3.44	Harina	1.0	-	-
	-	-	Tilapia	0.7	Chali	0.2	-	-
	-	-	Parse	0.17	Patari	0.3	-	-
	-	-	-	-	Tairel	0.03	-	-
	-	-	-	-	Tilapia	0.5	-	-
	-	-	-	-	Datina	0.02	-	-
Sub-total =		**80**		**7.0**		**2.8**		**0.02**
Kapashdanga-Muralia	Bagda	1.41	Bagda	6.74	Bagda	3.42	Harina	0.01
	Paissa	0.60	Golda	0.01	Harina	3.96	-	-
	Crab	0.00	Harina	0.65	Chali	0.38	-	-
	Tilapia	0.30	Chali	0.04	Bele	2.11	-	-
	Golda	0.10	Bele	0.09	Paissa	2.62	-	-
	Horina Chingri	2.92	Tilapia	0.22	Tilapia	9.85	-	-
	Chali Chingri	1.52	Tengra	0.57	Golda	0.04	-	-
	Bele	1.35	Bhangan	0.08	Tengra	0.17	-	-
	Tengra	0.27	-	-	Patari	2.25	-	-
	Major Carp	0.55	-	-	Chemo	0.02	-	-
	-	-	-	-	Datina	1.01	-	-
	-	-	-	-	Rui	1.27	-	-
	-	-	-	-	Chaka	0.01	-	-
	-	-	-	-	Kailla	0.96	-	-
	-	-	-	-	Nundi Bele	0.02	-	-
	-	-	-	-	Kakra	0.49	-	-
Sub-total =		**9**		**8.0**		**29**		**0.01**

Location	20th QM		21st QM		22nd QM		23rd QM	
	Fish Species	**Total Production (ton)**	**Fish Species**	**Total Production (ton)**	**Fish Species**	**Total Production (ton)**	**Fish Species**	**Total Production (ton)**
Chunkuri-2	Bagda	0.04	Patari	0.01	Tilapia	0.02	-	-
	Paissa	0.00	Tair/Tailla	0.01	Paissa	0.066	-	-
	Khorsula	0.00	Bhangan	0.01	Khorsul	0.009	-	-
	Horina Chingri	0.10	Datina	0.03	Bagda	0.015	-	-
	Motka	0.04	Bagda	0.02	Golda	0.006	-	-
	Chali Chingri	0.03	Golda	0.03	Patari	0.015	-	-
	Chaka Chingri	0.01	Faissa	0.01	Harina	0.008	-	-
	Bele	0.01	Chaka Chingri	0.01	Chali	0.009	-	-
	Crab	0.03	Harina	0.02	China Punti	0.047	-	-
	-	-	-	-	Tengra	0.008	-	-
	-	-	-	-	Baila	0.003	-	-
	-	-	-	-	Datina	0.02	-	-
Sub-total =		**0.24**		**0.15**		**0.46**		**0.00**

(E) Traffic Survey data

Table E.1: Traffic Volume Survey at Khulna Mongla Road (Khudir Bottola)

Date: February 17, 2020 (Monday)

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	33	33	0	25	29	0	38	39	0
Auto Rickshaw	0.8	8	8	13	14	6	16	4	11	11
Van	0.6	20	26	27	23	31	32	4	15	11
Cycle	0.2	22	22	9	18	11	6	1	13	3
Human Howler	0.6	9	23	19	10	12	13	4	13	10
CNG	0.5	3	3	3	5	4	4	0	2	1
Private Car	1	13	13	26	17	16	32	2	15	17
Motor Cycle	0.3	29	28	17	60	37	29	4	44	14
Jeep	1	2	2	4	3	4	7	1	3	3
Pick-up	2	11	7	36	15	10	50	4	14	35
Micro	1	15	18	32	7	15	22	1	18	19
Bus	2.5	16	16	80	19	18	91	4	15	46
Light Truck	2	8	13	42	6	10	30	4	5	17
Medium Truck	2	11	11	44	14	18	62	6	4	20
Heavy Truck	2	10	5	28	10	10	39	4	4	15
			Total	**379**			**432**			**221**

Table E.2: Traffic Volume Survey at Khulna Mongla Road (Gonai Bridge)

Date: February 15, 2020 (Saturday)

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	22	19	0	25	27	0	23	15	0
Auto Rickshaw	0.8	7	5	9	8	5	10	3	5	6
Van	0.6	13	15	17	18	25	26	10	14	14
Cycle	0.2	10	11	4	21	14	7	7	11	3
Human Howler	0.6	11	9	12	7	4	6	11	9	11
CNG	0.5	2	1	2	3	2	2	1	2	1
Private Car	1	9	7	16	20	12	32	10	8	18
Motor Cycle	0.3	22	23	14	51	27	23	21	22	13
Jeep	1	2	2	4	5	3	8	1	2	3
Pick-up	2	8	6	28	15	13	54	5	7	24
Micro	1	7	6	14	13	14	27	4	9	13
Bus	2.5	9	8	41	13	11	58	5	10	38
Light Truck	2	6	6	23	12	12	47	3	9	22
Medium Truck	2	7	7	27	11	16	53	6	5	22
Heavy Truck	2	4	7	22	4	10	27	3	4	13
			Total	**232**			**380**			**200**

Table E.3: Traffic Volume Survey at Power Plant access road (Gonabelai Bridge)

Date: February 14, 2020 (Friday)

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	24	21	0	8	13	0	12	23	0
Auto Rickshaw	0.8	5	3	7	3	2	4	4	4	6
Van	0.6	20	14	20	4	9	7	4	9	8
Cycle	0.2	18	8	5	3	4	1	1	2	1
Human Howler	0.6	14	9	14	4	11	8	4	9	8
CNG	0.5	3	2	3	1	0	1	0	0	0
Private Car	1	3	3	6	2	1	3	2	4	6
Motor Cycle	0.3	16	13	9	4	7	3	4	6	3
Jeep	1	0	0	0	0	1	1	1	1	1
Pick-up	2	2	2	9	1	1	4	4	3	14
Micro	1	1	2	3	1	1	1	1	0	1
Bus	2.5	1	1	5	0	0	0	4	1	13
Light Truck	2	2	2	8	1	0	1	4	5	18
Medium Truck	2	3	3	12	2	1	5	6	5	22
Heavy Truck	2	2	3	10	2	0	4	4	5	18
			Total	**111**			**43**			**118**