Bangladesh – India Friendship Power Company (Pvt.) Limited

(A Joint Venture of NTPC Ltd. and BPDB)

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

17th Quarter Monitoring Report

Monitoring Period: May - July 2018

August 2018

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Abbreviations and Acronyms

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

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

Unit

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

Unit Conversion Table

General Units

1°C = 274.15 K=33.8° F

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

1 kilogram = 2.20 pound

1 kilometre = 0.62137 mile

1 liter = 0.001 cubic meter

1 meter = 3.2808 feet

1 metric ton = 1000 kg

1 mg/L ≈ 1 g/m^3 ≈ 1 ppm (w/w)

1 mg/m^3 = 1 µg /L

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

1 square mile = 640 acre = 2.590 km^2

Energy Unit

1 GWyr = 8.76 x 10^9 kW

1 horsepower = 746 W

1 KWh = 3412 Btu

1 kWh = 859.85 kcal

1 KWh = 3.6 x 10^6 J

1MW=1000KW=10^6W

Glossary

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

Executive Summary

This Environmental and Social Monitoring Report on 17th quarterly program covers the status of different environmental and social parameters about the Environmental Management Plan and of the construction stage as stated in the EIA (Environmental Impact Assessment) study vide Memo No: DoE/Clearance/5062/2011 dtd. 05/08/2013 and EIA report of Coal transportation vide Memo No: DoE/Clearance/5532/2016 dtd.31/01/2018. This report represents the monitoring period from May 2018 to July 2018. Accordingly, the CEGIS team has carried out the monitoring activities in July 2018 covering every monitoring aspects as stated in the EIA study, approved conditions from DoE and valuable suggestions and comments from different national and international organizations. However, the aspects can briefly be mentioned as monitoring of the implementation status of Environmental Compliance with the environmental parameters such as ambient air quality, noise level, water quality, land resource condition, traffic management, water resources management, morphology, agricultural resources monitoring, fisheries resources, social environment monitoring, ecosystem monitoring and the Sundarbans Reserve Forest (SRF) health monitoring.

The progress of Project implementation activities includes extension of roads, site development at jetty areas, construction of townships, labour colony, civil and infrastructure development works and initiation of mechanical construction etc. In this quarter, the environmental due diligence covers: the Environmental Management System and Action Plan, Occupational Health and Safety, Workers' wellbeing, Biodiversity and Sustainable Management of Natural Resources etc. The monitoring team observed that, BIFPCL has mostly been complying with the EMP as suggested in the EIA report of the Power Plant as well as coal transportation. However, as per EMP (approved by DoE) and being the Environmental Monitoring Consultant, CEGIS recommended few measures, which should be complied for ensuring environmental and social safeguarding for the Project adjascent area. Those include raising awareness for using appropriate PPEs, recreation and praying facilities for the labours, proper implementation for the grievance redress mechanism for workers or local community, placement of sufficient waste disposal bins in appropriate locations and most important continuous occupational and health safety monitoring by the project proponent.

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

However, during this monitoring period, all the preselected parameters i.e. particulate matters ($PM_{2.5}$, PM_{10} and SPM), O_3, CO, SOx and NOx were measured at all the preselected locations except in Hiron Point of Sundarbans. Due to bad weather conditions, it was not possible for the Team to reach to Hiron Point of Sundarbans. However, the measured values of all parameters for every location were found within the standard limit set by ECR' 2005 (amended). As the monsoon period prevailed at the time of monitoring hence, the measured values were found much lower in concentration than the previously conducted monioring period i.e.April, 2018. No significant changes were observed among the concentrations of the selected paramenters and it is to be mentioned that, the present air shed is not a degraded air shed. However, the observed pollution sources along the Passur River from Chalna point to Akram point were the movement of numerous types of vehicles on roads (two-stroke human haulers, buses, trucks etc.), land development works, brickworks, refineries, cement industries, commercial & households sources, wind generated dust, river vessel, engine operated fishing boats and sea going vessel.

The noise generation sources in the study area can mainly be divided into two types; one is natural and the other one is anthropogenic. However, the observed noise level were not found to exceed the Bangladesh standard limit of noise level during this monitoring season (**17th quarter**) (**Table 2.4**). Only the observed noise level at Harbaria was found to exceed a little. In course of the total seventeen monitoring seasons, the noise level of eight locations were found to exceed the Bangladesh standard limit of their corresponding standard values in their different monitoring seasons **(Table 2.4**). The eight locations were NW corner of the Project area (Oct-2016), Chunkuri-2 (Mar-2014 & Jan-2017), SW corner of the Project area (Jan-2016 & July-2016), Proposed Township area (July-2016), Khan Jahan Ali Bridge (Mar-2014), Harbaria (July-2014, Oct-2014, Apr-2015, Oct-15, July-2016, Oct-2016, Apr-2017, July-2018), Akram Point of Sundarbans (Apr-2015) and Hiron point of Sundarbans (July-2014). However, any additional anthropogenic noise producing activities within the study area may contribute to enhance the noise level. Natural sources were birds' chirping, stormy wind, wave breaking on the shoreline, howling of leaves and so on. On the other hand, traffic mobilization, industrial activities, vessels movement within the rivers and local vehicles are the generation sources of anthropogenic noise.

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

In this quarter (July 2018), only pH was recorded comparatively higher but still under the recommended value of ECR'1997. DO level is still ok except only one point of project site. Huge construction activities and land filling near the bank side reduces DO level only from that portion of the river for a while. TH, TSS and COD did not increase in respect to the same seasons of last four consecutive years. Nitrate increased a bit but still complying with ECR standard. Sulphate remains almost constant while phosphate concentration reduced a lot during last pre-monsoon. No variation was recorded for As and Hg concentration but Pb concentration was recorded higher than just preceding monitoring season. Presence Pb concentration in river water are not depended on seasonal variation but spatial distribution of sources. Oil & grease concentration was found less than 5 mg/L, which is even less than half of the recommended concentration (10 mg/L) for inland water.

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

Soil salinity and pH govern the varriations in concentration of other parameters. The soil salinity increases in all sampling plots except is Kapalirmet. There is not any significant change in organic matter pole in the sampling sites. In major nutrients N and P follows organic matter's trend while S showed increasing trend. Among the Micronutrients Zn showed increasing trend. Heavy metal concentration in found in all cases but their concentrations still well below the concern. Most of the elements showed increasing trend than that of in wet season due to less washout rainfall and less top soil erosion. It is to be noted that, all changes are caused due to natural reasons as there is no project activities are started yet.

Traffic surveys were carried out at three preselected locations namely Gonabelai, Gachtala and Gonai Bridge around the Project site to understand the nature of traffic flow and traffic load during different phase of the day. The analysis data represents that the Khulna-Mongla Highway receives the largest number of vehicles, compared to other surveyed roads. The vehicular movements observed during the survey were mostly for the regular activities and construction activity of the MSTPP results in a limited number of vehicular movements on the surrounding road network.

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

Fisheries resources have been monitored at the same locations for seven sampling sites as of earlier quarter monitoring. Habitat uses were observed to be changed yearly (as compared to the year of 2014-2015, of 2015-2016, of 2017-18 and of 2018-19) caused mainly due to biophysical changes having tidal effect, seasonal variability, food availability and also fisheries resource management practices. Moreover, through analyzing the type of habitat uses by different ages of different fish species (based on the length-based community structure model) four types of habitats were seen as the i) Spawning and Nursery Ground, ii) Nursery Ground with Feeding and Growing Capacity, iii) Growing and Feeding Ground and iv) Omni-ground. Shannon-Weiner index was found to be varied between 17th quarters with that of the previously quarterly program. Highest Shannon-Weiner index was found at Sheola Khal at Chandpai (0.85 out of 16 species) indicating most evenly distributed fish species. On the contrary, lowest evenness was found at Harbaria (0.31 out of 17 species). However, maximum FSR was obtained in Sheola Khal at Chandpai (n=9), while very low FSR was recorded at Harbaria (n=2). Fries of fin fish were widely distributed from middle stretches to the upper stretches (Harbaria to Chalna Point) and juveniles and adult age group in Sheola Khal at Chandpai, Maidara and Chalna Point of the Passur River system. Among the fishes Bairagi, Banspata, Bele, Chela, Gagra Tengra, etc. were found more between the two sampling sites. Moreover, fries were dominant at the Harbaria-Passur Confluence. Adults of large-sized fishes were not observed during the monitoring period.

Fish species like Bairagi attains the maximum abundance among the migratory fish species. Moreover, Bele, Topse, Golda and Chela species were found in maximum sampling sites. Among these species, Bele and Chela were observed to migrate through a long distance. In this monitoring year, the highest stocking rate in respect of Bagda was observed in case of gher in Kapashdanga and lowest in Rajnagar. The present study revealed that the highest catch susceptibility was also found in case of Behundi Jal (20 kg/haul). Push Net Jals were most frequently used in all upper and middle reaches in the Passur River System, especially for fry collection. The highest total catch was observed at Mongla Point and lowest at Harbaria Point in the Passur and in the Maidara River in this monitoring phase.

Plant health, vegetation canopy status, bird habitat, dolphin occurrence in river systems have been monitored for this monitoring season. Plant heath have been showed slightly improved than previous monitoring time except Rajnagar site. Overall canopy status of studied homestead vegetation has been changed insignificantly except Rajnagar than previous monitoring in April 2018. However, one bird nest was recorded from one monitoring site out of four locations.

Dolphin occurrence was recorded at Passur and Maidara River and some connected tributaries of Passur River like Shella Gang and Dhangmari Khal. The occurrence followed high at Shella Gang and then Dhangmari Khal. Regular patrolling by Bangladesh Coast Guard for banning fishing favored free movement of dolphins in Shella Gang. Moreover, dolphins have been sighted at Akram point.

From the last monitoring activities, it can be said that the forest condition is showing positive changes periodically in terms of seedling density, pneumatophores, crab hole, canopy cover and leaf area index (LAI), although there has some seasonal effect. Based on different indicators it is found that the health condition at Harbaria and Sutarkhali is good .But Sedimentation rates are comparatively high in Sutarkhali site. In addition, logging and human disturbance is severely affected at Karomjol .The complex species Sundari have been died in a part of Akram Point site. 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 Karamjal and Gewa is dominant in Akram point. The Akram point is situated at the confluence of Shibsa and Passur River. It can be assumed that, the forest is experiencing retrogression process where the climax species (Sundari) are started decaying. Hence, this area is sensitive in terms of disturbance.

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

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

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

The Project Authority and the EPC contractor have already recruited environment, health and safety officer for ensuring safe and hygienic health, safety and environment condition in the project as well as in the surrounding areas. In addition, plantation of trees inside the project area may help to improve the environmental condition in the project area. The medical camp (that had been established as CSR) has also performed well in providing medical service in the study area. For ensuring convenient communication to the patients, the authority has shifted the medical camp near the entry gate of the power plant.

1. Introduction

1.1 Background

A detailed Environmental Management Plan (EMP) suggesting mitigation, enhancement, contingency and compensation measures was developed as per scope of the EIA study for every phases of Power Project. The measures must be implemented during the pre-construction, construction and operation phases in order to minimize the degree of impacts expected to be generated by the power plant and its associated activities. It is also to be noted that, successful implementation of the EMP depends on regular monitoring of the selective indicators at the specified locations.

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

In this context, BIFPCL initiated the study to monitor the environmental and social indicators and the implementation status of EMP (Environmental Management Plan) during pre-construction as well as construction phase of the Thermal Power Plant. As per approval of the EIA study of Coal Transportation from DOE Condition No. 26, “Additional environmental baseline data to be collected as suggested in the EIA report”. Subsequently, CEGIS was engaged for conducting the monitoring activities to inspect the status of environmental parameters and progress of the implementation of EMP for safeguarding the environment of the Sundarbans Mangrove Forest and the surrounding ecosystem with its communities holistically.

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

According to the contract, the findings of the previously formulated sixteen (16) quarterly monitoring reports have been submitted to BIFPCL. Subsequently the reports were sent to the DoE and Forest Department. In addition, all the monitoring reports were regularly uploaded in BIFPCL website. The current document constitutes the 17th quarterly monitoring aspects covering all the preselected monitoring parameters and locations, which helped in improving and further upgrading the environmental monitoring database until today.

1.2 Objectives

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

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

1.3 Criteria for Selection of Monitoring sites/locations

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

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

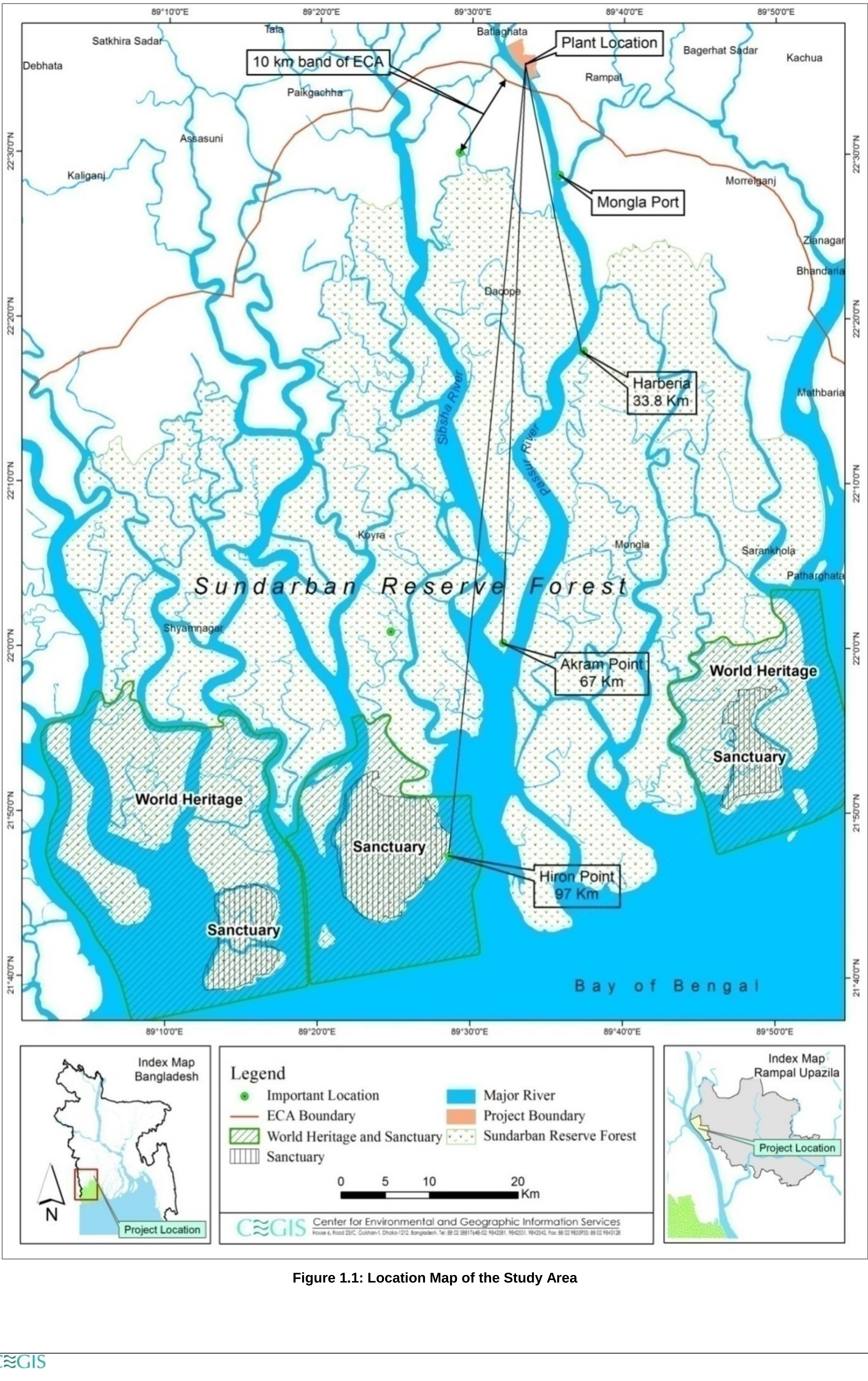


Figure 1.1: Location Map of the Study Area

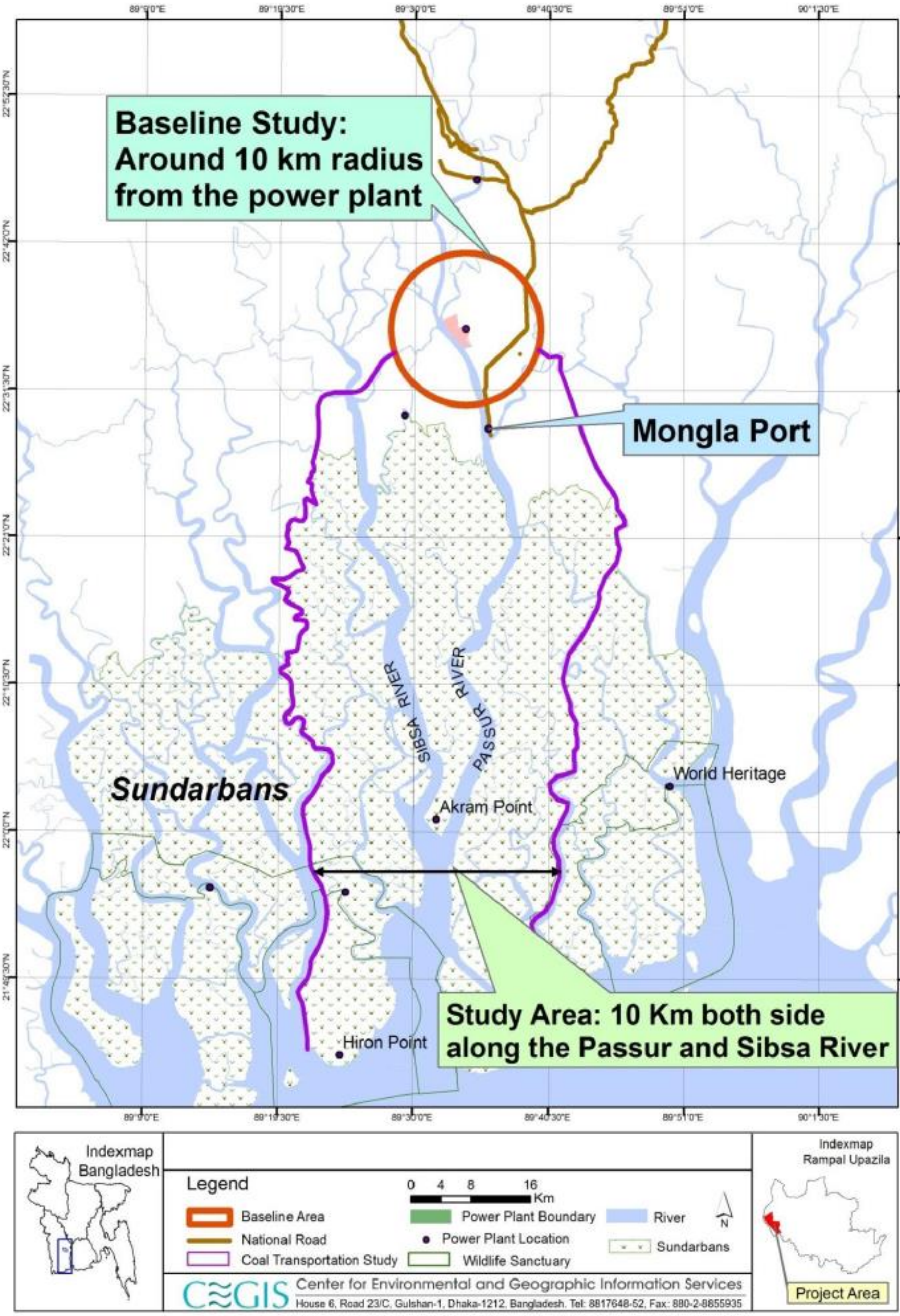


Figure 1.2: AOI of Environmental and Socio-economic Monitoring

1.4 Main stakeholders

1.4.1 Forest Department

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

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

The monitoring team was formed as per requirements of the Forest Department. BIFPCL also forwarded each copy of the earlier quarterly monitoring reports to the Chief Conservator of Forest, Bangladesh Forest Department, Agargaon, Dhaka and Conservator of Forest, Khulna Circle, Boyra, Khulna. Similarly, the report of 17th quarterly monitoring will also be forwarded to the same officials of this Department.

1.4.2 Department of Environment (DoE)

The monitoring plan, including indicators, parameters, location and schedule, have been prepared incorporating the suggestion(s) of the Department of Environment. A discussion meeting was conducted at CEGIS office with the experts of DoE before initiating the monitoring study for finalizing the monitoring plan.

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

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

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

1.4.4 Bangladesh Power Development Board (BPDB)

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

1.4.5 Local Community

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

1.4.6 Major component of monitoring study

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

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

2. Physical Environment

2.1 Air Quality

The air quality during this monitoring period in July 2018 was monitored at the preselected sites considering the major effects to be borne by the Project activities during pre-construction, construction and operation stages. However, due to unfavorable and unavoidable weather condition, the monitoring team could not reach to the Hiron point of the Sundarbans (World heritage site) and therefore, the data regarding air quality, water quality and noise level could be monitored during the visit.

2.2 Methodology

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

2.3 Method of Sampling and Laboratory Testing

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

2.4 Pollution sources in the Sundarbans

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

2.5 Monitoring locations

The ambient conditions of air quality during this quarter has also been monitored in the same locations as monitored in earlier quarters. In addition, two more locations were also included in the monitoring program as per recommendation of the DOE approved coal transportation study monitoring frame work. The monitored locations for the air quality-monitoring program are shown in **Figure 2.2**. The details of the monitoring plan have been provided in **Table 2.1.**

Figure 2.1: Conducting Air Quality monitoring at Harbaria, Sudarbans

Table 2.1: Air Quality Monitoring Plan

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

Sl. No.	Monitoring Indicators	Locations	GPS Points	Frequency	Methods/ Tools/ Techniques
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"E 22°34'37.11"N		

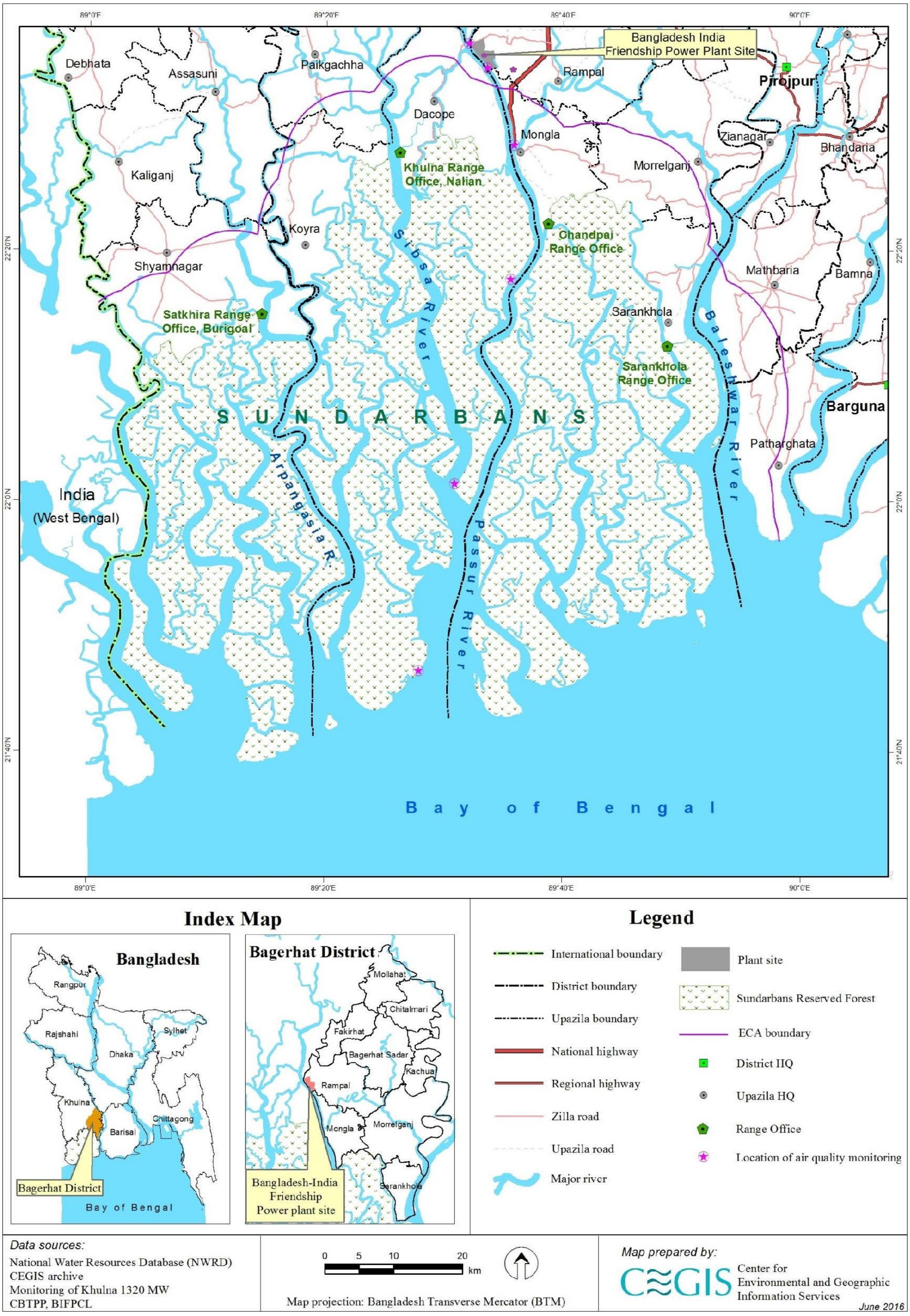


Figure 2.2: Air Quality Monitoring Locations

2.6 Status of air quality

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

Table 2.2: Air Pollutants Emission Standards

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

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

The maximum value (15.8 µg/m^3) of $PM_{2.5}$ was obtained at the access road bridge area whereas the minimum value (10.2 µg/m^3) was recorded at Bajua area. All the values for the corresponding sites during this season were found within the standard limit (65 µg/m^3) set by ECR, 2005. Similar situation was observed in case of PM_{10} concentrations and was found highest (83.7µg/m^3) at the access road bridge area while lowest (20.5 µg/m^3) at the Gaurambha area. However, all the results of PM_{10} for every location were found within the standard limit too. In general, the measured values were significantly lower than the monitoring results of April 2018. From the measured values it can be mentioned that, seasonal variation is the main reason of decreasing of the concentration of the particulate matter concentration. However, major sources of particulate matter as observed were the construction works, land development works of block –B, unpaved roads and vehicle movement in and around the project area. Other sources, which may contribute to the existing pollution sources, are the small industries like i.e. brick kilns, refineries, cement works, etc., diffuse sources like wood stoves, fires, and wind generated dust etc.

Similarly, the concentration of SPM was found higher at the at Shapmari area (113.4 µg/m^3) and whereas, the minimum concentration was observed at Harbaria area of Sundarbans Forest (47.6 µg/m^3). All observed values were found within the standard limit. In this case, construction activities, land development works, wind erosion, large number of two-stroke human haulers, buses, trucks, and other anthropogenic activities were observed during the field visit, which might be the reason for such higher concentration of particulate matters in this area. All the monitoring data have been attached in **Table A1** in **Appendix IV**. All the observed data of PM_{10}, $PM_{2.5}$ and SPM were found to be within the standard limit set by the ECR' 2005.

Sulfur-Dioxide (SO_2)

The concentration of Sulphur dioxide (SO2) in ambient air during this monitoring period were found much lower than the Bangladesh standard limit of (365 µg/m3) at all the sampling locations. Maximum concentration (10.9 µg/m3) was found at Shapmari area while minimum concentration (4.4.9 µg/m3) was found at Harbaria area. The values of SOx were never found to cross the standard value set in ECR' 2005. Emission from local human hauler, car, bus and industries like brickworks, refineries, cement works, iron and steel making, etc. are currently contributing to the concentration of SO2 in this area.

Nitrogen Dioxide (NO_2)

The values of NOx in the Project site and its adjoining areas were observed below than the Bangladesh standard value of 100 µg/m^3. The maximum concentration (13.4 µg/m^3) during this monitoring period was found at theccess road bridge area whereas the lowest (5.4 µg/m^3) was recorded at Harbaria of Sundarbans area. The monitoring results are shown in **Table A1** in **Appendix IV**. However, emission from local human hauler, car, bus and industries like brickworks, refineries, cement works, iron and steel making, etc. are currently contributing to the concentration of NOx in this area

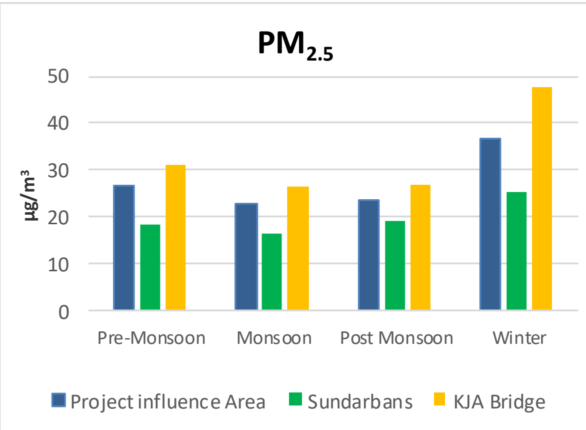
Carbon Monoxide (CO)

CO is generally produced due to the incomplete combustion of fossil fuel. The concentration of CO in the monitored locations were found much lower than the standard values set in ECR'2005. The value was observed as 34 µg/m^3 at the access road bridge area and 20 µg/m^3 at Gaurambha, Harbaria in this season and Akram point of Sundarbans area respectively. The possible reasons for such CO concentration would be due to the movement of various types of vehicles across the Passur River and its adjoining areas.

Ozone (O_3)

Similarly, results of O_3 in both the Sundarbans Forest Area and Project area were found within the range of 9-2 µg/m^3, which are negligible comparing to the Bangladesh standards limits of 157 µg/m^3. In this 17th quarterly monitoring study, the maximum concentration (9 µg/m^3) was found at Moidara area. Ozone are formed due to the mixing of volatile organic carbons and oxides of nitrogen.

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



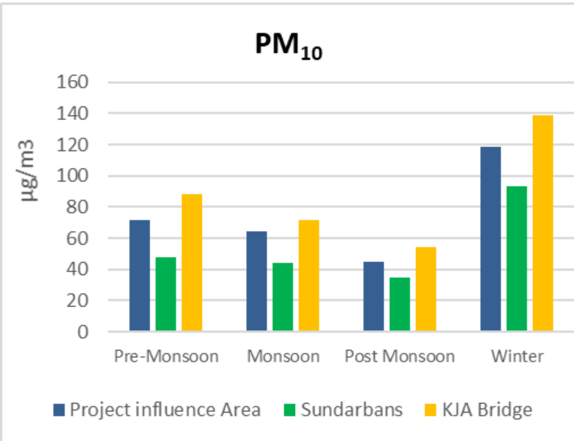


Figure 2.3: Seasonal variation of the Air Quality Parameters

2.6.1 Findings

All the preselected parameters i.e. particulate matters ($PM_{2.5}$, PM_{10} and SPM), O_3, CO, SOx and NOx were measured at all the preselected locations during this monitoring period except in Hiron Point of Sundarbans. Due to rough weather conditions, it was not possible for the team to reach to Hiron Point of Sundarbans. However, the measured values of all parameters for every location were found within the standard limit set by ECR' 2005 (amended). As the monsoon prevailed during the time of monitoring hence, the parameters were measured in July, 18 were found much lower in concentration than the previously conducted monitoring period. No significant changes were observed among the concentrations. However, according to the measured values it can be easily said that, the present air shed is not a degraded air shed and to the observed pollution sources were the movement of numerous types of vehicles on roads (two-stroke human haulers, buses, trucks etc.), land development works, brickworks, refineries, cement works, wood stoves and wind generated dust.

2.7 Noise Quality

Noise levels for the respective locations were monitored during this monsoon season. 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 noted during this monitoring season (17^{th} monitoring program). Generally, the level of noise is monitored at eleven locations during every monitoring season but due to adverse climatic condition, noise level of Hiron Point was not recorded during this monitoring tier.

2.7.1 Methodology

Noise levels were measured thrice in a day (morning, afternoon and evening) at ten (10) locations in and around the project area and inside the Sundarbans forest area. Each time, noise levels were recorded using sound level meter for five minutes of time span with an interval period of 30 second and the meter was properly set up and calibrated following the instruction manual. The monitoring locations were selected considering the sensitivity of the nearest receptors and accordingly, six sites were selected in and around the Project area, two sites were designated inside the Sundarbans Reserve Forest Area, one at Mongla Ghat area and the remaining one was selected at the Khan Jahan Ali Bridge toll plaza area (**Figure 2.5**)

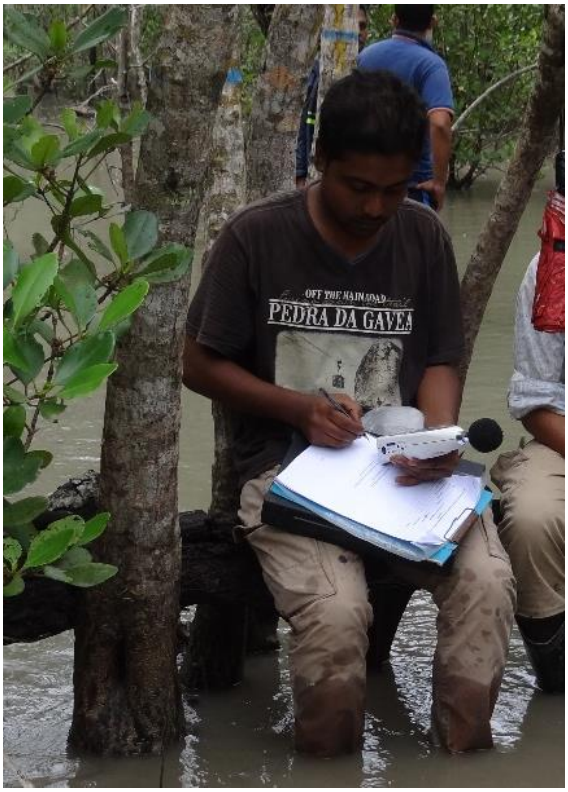


Figure 2.4: Ambient Noise Acquisition in Sundarbans

Table 2.3: Noise Monitoring Plan

SL.No.	Date	Monitoring locations	GPS points	Time of noise monitoring
1	July 22, 2018	South West corner of the Project boundary	89˚33'34.5"E 22˚34'33.8"N	Morning, Noon and evening
2	July 23, 2018	Proposed township area near Chimney location, Mauza: Sapmari Katakhali	89˚32'3.8"E 22˚36'32.5"N	Morning, Noon and evening
3	July 24, 2018	North West corner of the Project boundary (Kaigar Daskati)	89˚33'51.8"E 22˚36'1.06"N	Morning, Noon and evening
4	July 25, 2018	Barni, Gaurambha union (4km North East from the chimney location)	89˚34'37.7"E 22˚38'51.8"N	Morning, Noon and evening
5	July 26, 2018	Chunkuri-2, Bajua Union (4km South West from the chimney location)	89˚34'01.1"E 22˚32'3.3"N	Morning, Noon and evening
6	July 27, 2018	Pankhali, Dacope, (4km North West from the Chimney location)	89˚31'24.2"E 22˚36'6.7"N	Morning, Noon and evening
7	July 28, 2018	Mongla Port Area	89˚35'50.4"E 22˚28'24.8"N	Morning, Noon and evening
8	July 29, 2018	Harbaria, Sundarbans	89˚35'34.2"E 22˚17'43.1"N	Morning, Noon and evening
9	July 30, 2018	Akram point, Sundarbans	89˚30'54.1"E 22˚'23.50"N	Morning, Noon and evening
10	July 31, 2018	Hiron Point, Sundarbans	89˚27'53.2"E21˚46'27.60"N	Not monitored in this season
11	Aug 01, 2018	Khulna city near Khan Jahan Ali Bridge	89˚35'35.5"E 22˚46'36.8"N	Morning, Noon and evening

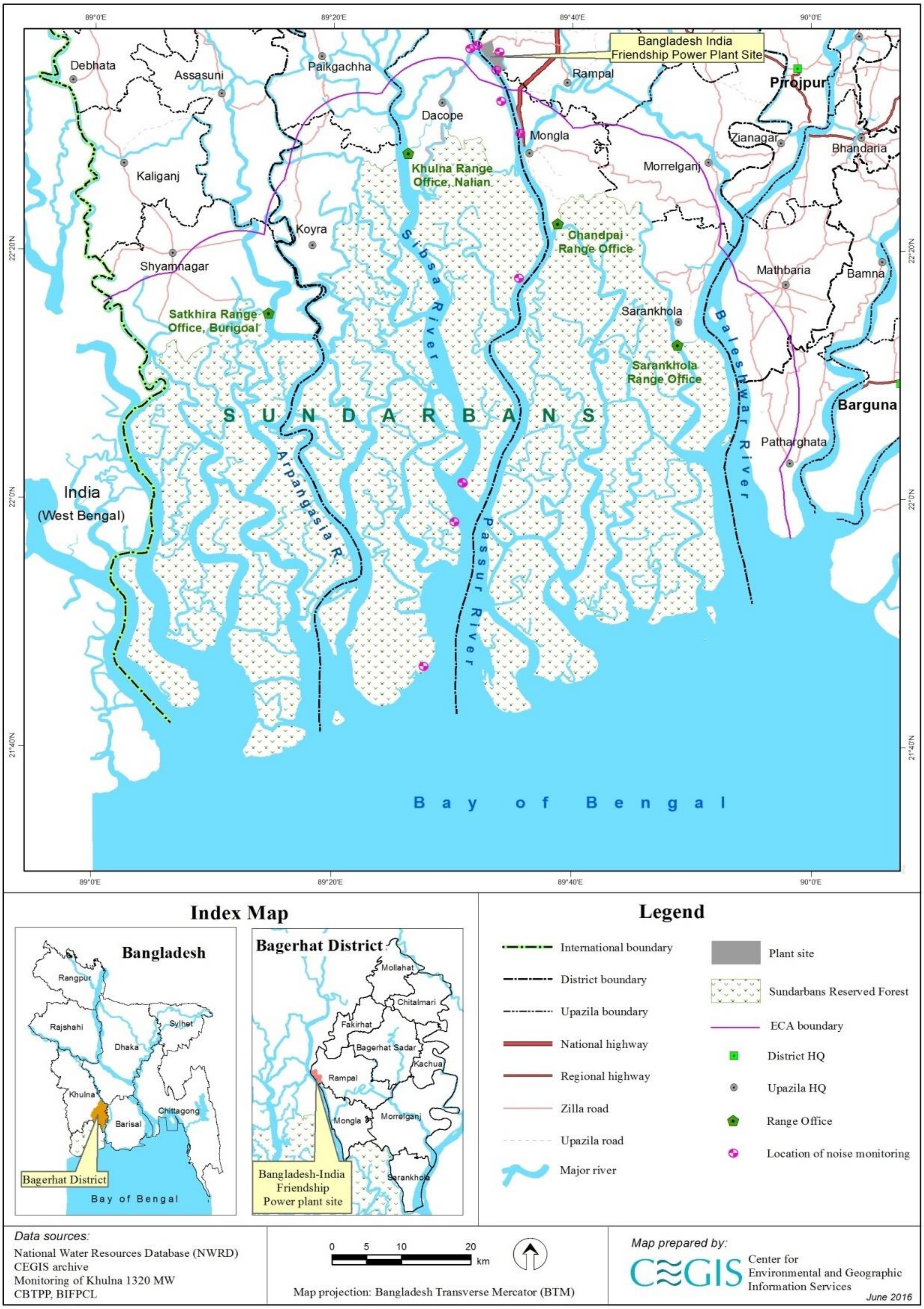


Figure 2.5: Noise Level Monitoring Locations

2.7.2 Status of Noise

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

Dacope Upazila Parishad

This monitoring location is a commercial area and located at a distance of 4 km in the North West direction of the Chimney. According to the Noise Pollution Control Rules (2006), noise level standard for this area during day time is 70 dB and the level of noise was recorded as 57.54 dB (A) in this monitoring season which is 12.46 dB (A) lower than the Bangladesh standard limit (70 dB) (**Table 2.4**). The significant noise sources at this location were found due to the road traffics, engine operated van (locally called Nosimon), motor bikes, easy bikes (battery-operated tri-cycle), hat/bazar etc.

North West Corner of the Project Area (Kaigar Daskati)

The North West (NW) corner of the Project site is under the Kaigar Daskati mauza of Gaurambha union. The selected monitoring site is situated at the Gucchha gram (a cluster village) and can be characterized as a residential area for the resettled people. However, the standard value for this area is 55 dB (A) at day time (Noise Pollution Control Rules, 2006). The average day time noise level during this monitoring period was recorded as 45.63 dB (A) and is lower than the standard value set for noise pollution control rules.

Chunkuri-2, Bajua

The South West corner of the Project area is located at the mouth of Moidara Khal. Here the noise level was found as 52.63 dB (A) and is 2.63 dB (A) lower than the standard value (55 dB). However, frequent movement of water vessels through the Moidara Khal and adjacent Passur River are the main source of noise generation at this site. However, this time noise from the construction site was felt from this location but was found to be insignificant for the corresponding standard noise limit.

Proposed township area of the Project

This is a residential area and the standard has been set as 55 dB (A) at daytime (Noise control rule, 2006). Sound level during this monitoring period was recorded as 44.25 dB (A) in this site which is 10.75 dB (A) lower than that of standard limit. The proposed township area (Sapmari) of the Power Plant is located at the northeast portion of the Project area. The prominent noise sources were the construction activities and some discrete local gathering from the surrounding homesteads.

Barni, Gaurambha

This area can be characterized as both the residential and commercial interests and the standard noise limit for this kind of mixed zone is 60 dB (A) at day time. The noise level was found as 45.52 dB (A) during this monitoring season which is lower than the standard value.

Khan Jahan Ali Bridge, Khulna

This is a commercial zone. The monitoring site is occupied by the toll office of Khan Jahan Ali Bridge, agricultural farms and local tourism spots. The average noise level was found as 63.36 dB (A) which is considerably lower than the Bangladesh standard limit of daytime noise level {(70 dB (A)}. The highway traffic was found to be the main source of noise generation. Besides, the site attracts local visitors for its scenic beauty, which also creates a significant source of noise pollution in this area.

Mongla Port area

This area is heavily occupied with the industrial set up and the corresponding standard value for the industrial area is 75 dB (A) for the day time. During this period, the average day time noise level at this location was observed as 60.97 dB (A) which is 14.03 dB (A) lower than that of Bangladesh standard value. The sources of noise were mostly road traffic (heavy vehicles, light vehicles, etc.), noise from Mongla Port activities (crane, ships, etc.) and local mob in the Ghat area.

Harbaria, Sundarbans

Harbaria area of the Sundarbans is considered as a hot spot of biodiversity and an important anchoring site for most of the large ships. Most of the sea going vessels used to anchor at this site for transhipment of goods and commodities. The area is under the silent zone and the standard limit of ambient noise at daytime is 50 dB (Noise pollution control rules, 2006). The noise level was measured during a distance of 100 m (Inside the forest area) from the River bank and found as 50.28 dB (A) during this monitoring period which is 0.28 dB (A) higher 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 45.20 dB (A) which is much lower (4.80 dB (A)) than that of Bangladesh standard value. However, Birds' chirping, stormy wind, wave breaking sound and falling of leaves from the trees were found as the main sources of noise.

Hiron point of Sundarbans

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

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

Period	Location										
	Chalna, Dacope	NW Corner of the Project area	Chunkuri-2, Bajua	SW corner of the project area	Proposed Township area	Barni, Gaurambha	Khan Jahan Ali Bridge, Khulna	Mongla Port area	Harbaria, Sundarbans	Akram Point, Sundarbans	Hiron Point, Sundarbans
QM 1	68.13	51.89	57.76	49.2	48.75	58.84	71.7	61.24	40.88	40.94	38.63
QM 2	52.87	NM	52.55	47.6	46.68	49.95	60.8	53.84	56.13	47.9	51.29
QM 3	54.63	41.92	51.39	45.95	41.92	49.78	66.28	60.5	55.3	43.98	47.98
QM 4	53.28	35.25	49.29	36.03	41.47	43.6	61.72	38.69	34.38	34.32	37.37
QM 5	57.08	44.67	47.05	43.58	41.47	54.17	73.45	48.15	65.37	54.86	47.84
QM 6	49.77	41.56	40.66	43.75	46.75	46.18	52.82	39.61	35.03	NM	NM
QM 7	65.12	41.94	47.43	42.7	50.52	55.16	64.25	47.01	50.75	49.6	46.06
QM 8	66.07	50.96	53.62	60.44	53.77	59.16	68.45	52.7	45.2	42.95	NM
QM 9	65.08	50.79	44.49	54.5	53.37	53.97	65.85	49.88	44.55	42.95	43.11
QM 10	52.42	52.65	53.4	65.37	55.79	56.75	63.77	52.86	52.9	47.96	NM
QM 11	65.51	55.48	51.55	48.51	43.69	54.91	60.95	49.86	55.33	41.77	44.38
QM-12	59.29	44.52	55.31	45.19	42.62	49.05	55.57	48.95	41.18	38.08	42.29
QM-13	61.62	47.19	50.44	43.25	42.65	44.83	56.72	47.61	54.1	44.3	NM
QM-14	58.64	46.95	50.44	43.26	43.93	45.52	62.47	49.66	46.48	42.38	39.79
QM-15	60.1	49.3	51.4	44.5	53.3	55.6	61.7	59.8	44.4	40.1	38.8
QM-16	59.63	47.9	52.93	47.55	50.81	56.14	64.87	62.95	47.93	45.39	NM
QM-17	57.54	45.63	47.54	52.63	44.25	45.52	63.36	60.97	50.28	45.2	NM
Std* (ECR'2006)	**70**	**55**	**55**	**55**	**55**	**60**	**70**	**75**	**50**	**50**	**50**

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

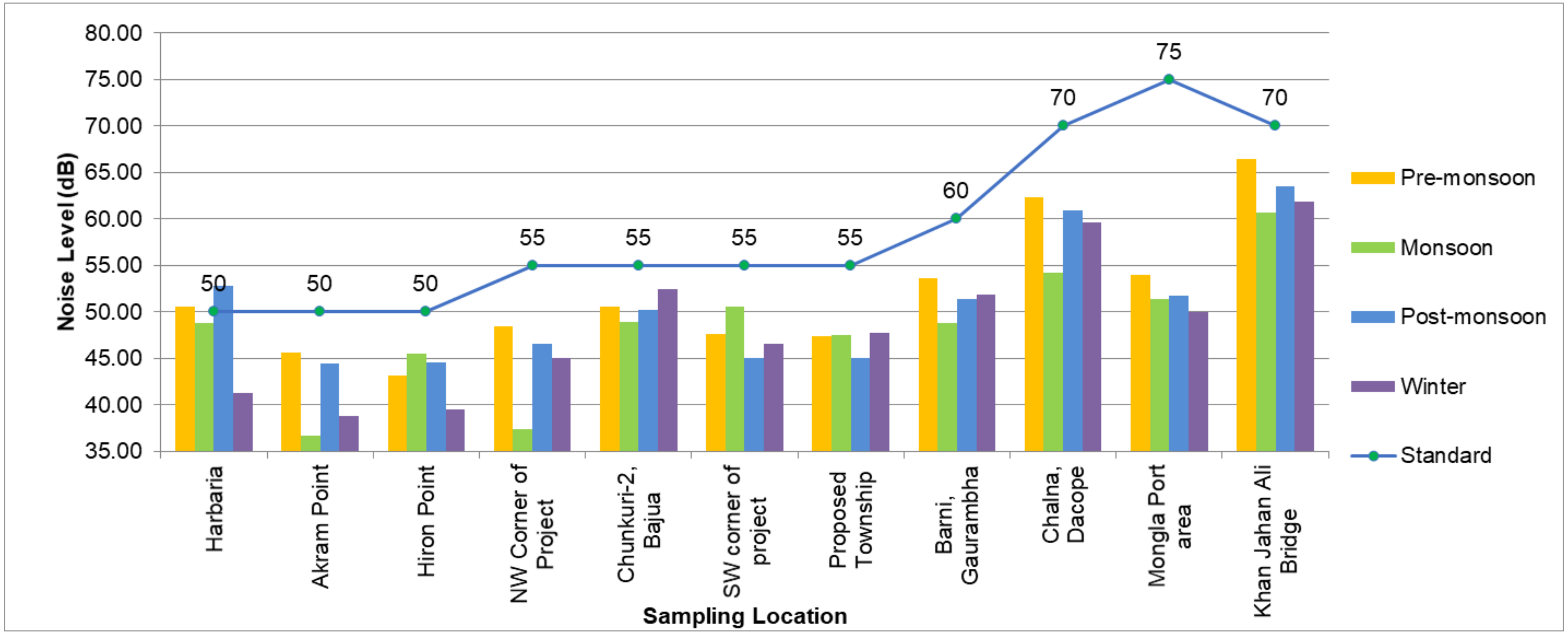


Figure 2.6: Status of Noise level at the monitoring locations

2.7.3 Findings

The noise generation sources in the study area can mainly be divided into two types; one is natural and the other one is anthropogenic. Natural sources were birds' chirping, stormy wind, wave breaking on the shoreline, howling of leaves and so on. On the other hand, traffic mobilization, industrial activities, vessels movement within the rivers and local vehicles are the generation sources of anthropogenic noise. However, the observed noise level were not found to exceed the Bangladesh standard limit of noise level at nine locations during this monitoring season (**17th quarter**). Only the observed noise level at Harbaria was found to exceed a bit. In course of the total seventeen monitoring seasons, the noise level of eight locations were found to exceed the Bangladesh standard limit of their corresponding standard values in their different monitoring seasons. These eight locations were NW corner of the Project area (Oct-2016), Chunkuri-2 (Mar-2014 & Jan-2017), SW corner of the Project area (Jan-2016 & July-2016), Proposed Township area (July-2016), Khan Jahan Ali Bridge (Mar-2014), Harbaria (July-2014, Oct-2014, Apr-2015, Oct-15, July-2016, Oct-2016, Apr-2017, July-2018), Akram Point of Sundarbans (Apr-2015) and Hiron point of Sundarbans (July-2014). However, any additional anthropogenic noise producing activities within the study area may contribute to enhance the noise level.

2.8 Water Quality

An updated water quality status of the Passur-Sibsa River system and adjacent water bodies have been depicted in this section. The methodologies used for the entire monitoring activities, both the national and international guidelines were followed and adopted. This report includes physical water quality parameters collected during 17th quarterly monitoring (July 2018) and the tested results obtained from the laboratory up to April 2018 (16th quarterly monitoring). The surface and groundwater quality were monitored in the respective locations performed during the previous monitoring periods. A number of identical parameters were selected to understand the quality of the water for community use, aquatic life, and for the Sundarbans Forest ecosystem itself.

2.8.1 Methodology

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

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

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

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

Table 2.6: Groundwater Quality Monitoring Parameters, Locations and Plan

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

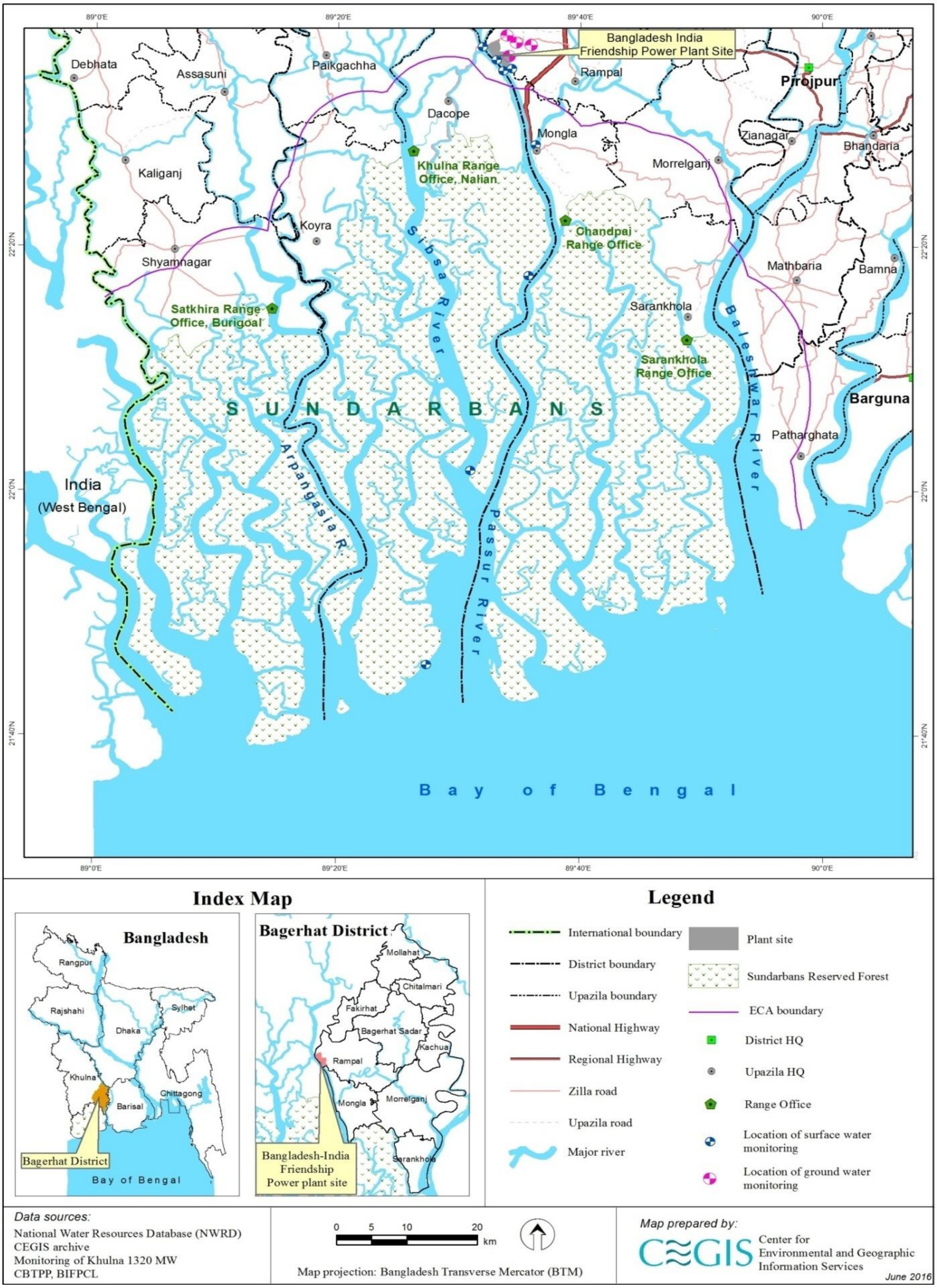


Figure 2.7: Surface water and Groundwater Quality Monitoring Locations

2.8.2 Selection of Parameters

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

2.8.3 Surface Water Quality Parameters

The selected parameters for surface water quality include Temperature, pH, Dissolved Oxygen (DO), Total Dissolve Solids (TDS), Total Suspended Solids (TSS), Total Hardness (TH), Turbidity, Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Salinity, Nitrate (NO3-), Phosphate (PO_4^{3-}), Sulphate ($SO_4^{2-)}$, Heavy Metals (As, Pb, Hg), and Oil and Grease. The parameters were categorized into the following four (04) groups:

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

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

2.8.4 Groundwater Quality Parameters

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

2.8.5 Sampling Procedure

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

2.8.6 Surface Water Sampling Procedure

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

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

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.

Figure 2.9: Ground water collection from Kapashdanga area

Figure 2.10: Ground water collection from Rajnagar area

2.8.8 Water Quality Parameter Analysis Techniques/Methods

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

Table 2.7: Testing Methodology of Water Quality Parameter

Parameters	Methods/Measuring Tools	Unit	BD Standard (ECR 1997)
Temperature	Horiba U-50 multimeter	^0C	20 - 30
pH	Horiba U-50 multimeter	ppm or mg/L	6.5-8.5
TDS	Horiba U-50 multimeter	ppm or mg/L	2100 (SW), 1000 (GW)
TSS	Horiba U-50 multimeter	ppm or mg/L	150 (SW), 10 (GW)
Salinity	Horiba U-50 multimeter	ppt	-
DO	Horiba U-50 multimeter	ppm or mg/L	6
BOD_5	5-Day BOD Test at 20^0C	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 adjacent water bodies of power plants and the Sundarbans deep forests are being observed since April 2014. In this 17th quarterly water quality monitoring report, yearly variations of pre-monsoon (April, 2018) for chemical water quality statuses and yearly variations in Monsoon 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.

Table 2.8: Monitoring sites and characteristics

SL	Monitoring sites	Site Characteristics
(a)	Power plant & adjacent areas	In this monitoring site, total 11 sampling points have been averaged to represent the water quality status of power plant and its adjacent surface water bodies. These 11 sampling points are situated in the same river system and embedded within 1km radius of power plant. In addition, previous monitoring results indicated same water chemistry. Therefore, this study makes the clusters to represent the water quality status of the areas in a more explainable and understandable way.
(b)	Mongla-Passur confluence	This monitoring site comprises with an individual monitoring point situates at least 13km downstream of the power plant. This point is a confluence of Passur river and Mongla-Ghasiakhali channel. The terrestrial ecosystem is mostly dominated by agricultural lands followed by rural settlements.
(c)	Harbaria	Harbaria site comprises with an individual monitoring point situates around 15 km downstream of the Mongla-Passur confluence. This site is dominated by Sundarbans Forest. Heavy activities of mother vessels unloading and small cargo movement for carrying of clinker, coal and LPG gas. Influenced by tidal effects of Bay of Bengal.
(d)	Akram point	Akram point is an individual point, which is, located around 35 km downstream of the Harbaria point. This site is situated on the bank of Sibsa river before mixing with Passur river at Sibsa point. This site is completely dominated by deep forests ecosystems. Influenced by tidal effects of Bay of Bengal.
(e)	Hiron Point	Hiron point is the furthest point of this surface water-monitoring scheme. This point is at 25 km downstream of the Akram point. Deep forests and marine habitats are the main characteristics of the site. This site is completely exposed to Bay of Bengal. This site is also an individual monitoring point.

Status of Surface Water Quality

In-situ tested parameters

The in-situ tested results obtained up to 17th monitoring period (July 2018: monsoon season) are described below and the legend identification has been shown in figure 2.11:

i. pH

Seventeenth (17th) quarterly monitoring has been made in the month of July 2018, usually called the Monsoon season of Bangladesh. During this visit, pH values were found to range between 7.3 and 8.6. The lowest pH value was found in the Maidara River near the proposed Township area while highest at Ichamoti-Maidara confluence (8.6) (**Figure 2.10**). pH value was found to be the highest during this monsoon (2018) season than all other previous years (2014-2017) especially near the river side monitoring points. In addition, last monitoring season showed the highest pH range compare to all other seasons in this monitoring program. Full-scale land development activities, especially filling the lands and strengthening project site banks might increase river water pH through releasing fine sand, soil mixed sands and other coarse particles. Increase of dissolved particles as well could be another reason that can explain this variation of pH during this monsoon. Altogether, pH value was almost 8.4 near the Power Plant areas. However, until now, pH value did not cross the ECR’ 1997 Standard yet (6.5-8.5).

Before the last monsoon visit, pH values of pre-monsoon and monsoon seasons were found to be comparatively lower than those of the post-monsoon and winter seasons (**Table B.1:**

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

Seasonal variations in pH concentrations among the selected monitoring sites during the quarterly monitoring programs of first, second, third, fourth and fifth year of Passur-Sibsa River System are presented in **Figure 2.12** and the observed dataset are attached in **Table B.1 of Appendix- IV.**

ii. Temperature

Surface water temperature indicated close conformity with the previously monitored values for the same seasons. The values in this monitoring period, varied from 29-31^{0}C among the monitored sites, water temperature at Harbaria and Passur-Mongla confluence showed the lowest temperature (29^{0}C) while high temperature was observed at the south side of the power plant and its adjacent areas (31^{0}C). According to the ECR, 1997; 30^{0}C water temperature is still be tolerable by the aquatic organisms in tropical environment. This 1^{0}C variation in water temperature might be the variation in water temperature recording time during the survey day. In addition, deep mangrove forest can influence in reducing water temperate a bit. It can be concluded that, construction works are not influencing water temperature.

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 other season's temperatures. Recorded temperatures indicated that there was spatial variation among the monitoring sites even in the same season. Water temperature inside the Sundarbans tended to be slightly lower than the water temperatures near the power plant sites in monsoon.

The measured monsoon temperatures in the selected sites during the quarterly monitoring programs of first, second, third, fourth and fifth year are presented in **Figure 2.13** and all the observed dataset are attached in **Table B.2 of Appendix- IV.**

iii. Salinity

The observed salinity concentration ranged between 0.2 ppt and 2.8 ppt during the monsoon period. The maximum salinity was observed at Akram point in the Sundarbans while minimum in all the sampling locations close to the project site. During this monitoring period, salinity concentration was supposed to be the lowest meaning near 0.0ppt near the project site. High freshwater flow during monsoon season decline the salinity of the river to a great extent. Being a mangrove areas, the salinity level is not a problem for the riverine animals till now especially during the monsoon.

In the monitored river systems, the highest salinity was observed in pre-monsoon season followed by winter season. Freshwater unavailability from upstream and the dominated tidal factors are the main reason of high salinity concentration in pre-monsoon and winter. The pre-monsoon water salinity data in the selected sampling stations of Passur-Sibsa RS of the Seventeenth consecutive monitoring periods are presented in **Figure 2.14** and all the observed dataset are attached in **Table B.3 of Appendix- IV**.

iv. Dissolved Oxygen

During the seventeenth monitoring period, DO concentrations varied 5.5-6.8 mg/L. The maximum concentration was found in the deep forest (Harbaria and Akram point) while the minimum value was recorded at the project site (5.5 mg/L). In case of surface water standard, DO limit must not be dropped than 6.0mg/L at any cost. Lower DO than the standard limit (ECR' 1997) will first harm the aquatic organisms (plankton) and then the fish community. DO level near the project sites are still suitable for the aquatic lives as except at one point of jetty site and DO level in all other sites found more than 6.0 mg/L. At project site jetty, land-filling activity might increase the TSS of the water together with TDS. This might reduce DO level of the site for a certain period.

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

Monsoon variations of DO at the monitoring sites of Passur-Sibsa RS are shown in **Figure: 2.15** and all the observed dataset are attached in **Table B.4 of Appendix- IV**.

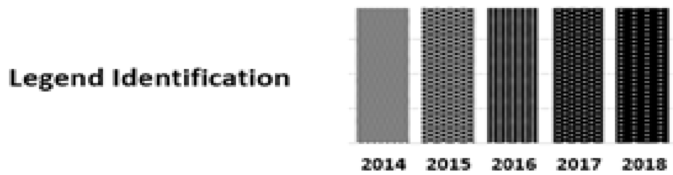


Figure 2.11: Legend direction (left to right: 2014-2018)

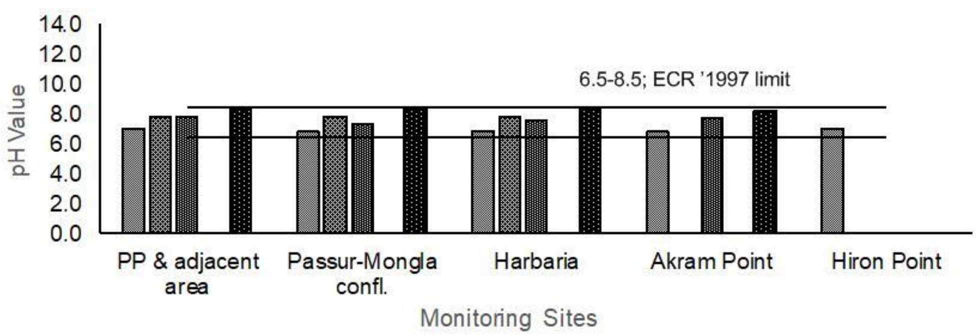


Figure 2.12 Variations in pre-monsoon pH values in different monitoring sites

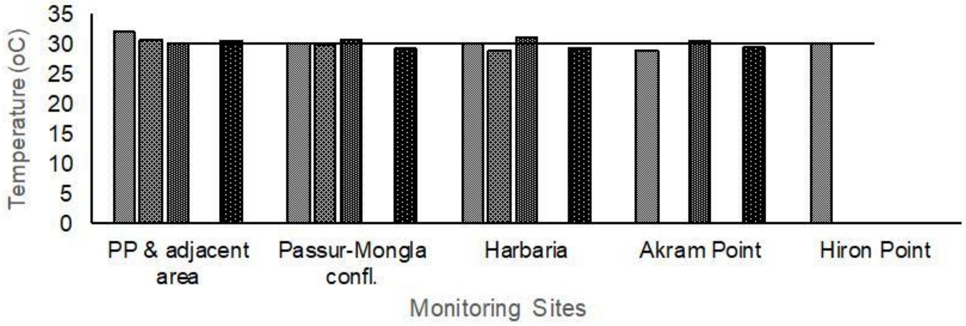


Figure 2.13: Variations in monsoon temperature in different monitoring sites

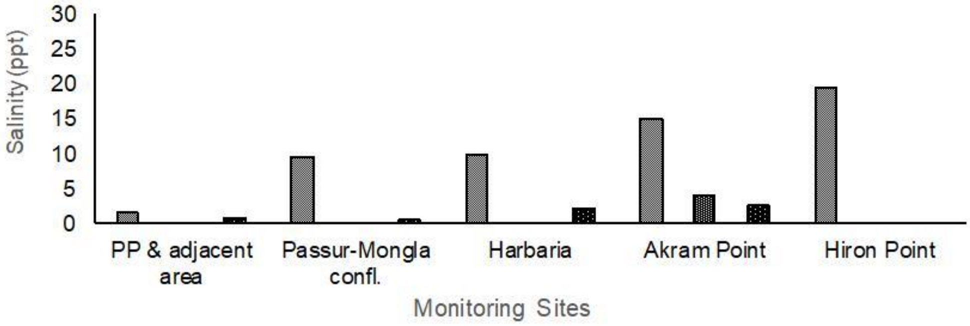


Figure 2.14: Variations in pre-monsoon salinity in different monitoring sites

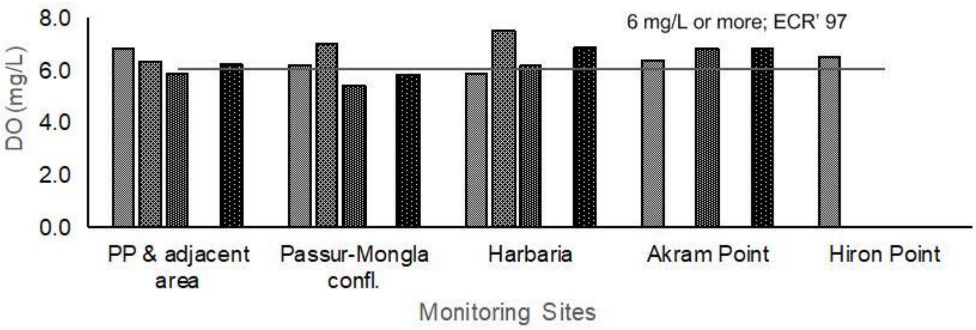


Figure 2.15: Variations in pre-monsoon DO in different monitoring sites

Laboratory tested parameters

The laboratory tested results obtained up to 16th monitoring period (April 2018: pre-monsoon season) are described below and the legend identification has been shown in Figure 2.16:

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

TDS mainly indicates the presence of various kinds of minerals like ammonia, nitrate, phosphate, alkalis, some acids, sulphates and metallic ions etc., which comprise both colloidal and dissolved solids in water (Tareq M S et al., 2013). During the last pre-monsoon period, the TDS values were found to range between 14,160mg/L to 20,600mg/L, which was almost same as all other previous pre-monsoon seasons (**Figure 2.17**). Above all these, the average TDS status are always showing the same pattern. For instance, TDS in power plant and adjacent areas are comparatively less than the deep Sundarbans Forests.

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

Total Hardness (TH) follows similar pattern as that of TDS e.g. high TH during pre-monsoon and winter season. The higher the TDS, the higher the nutrients and therefore higher occurrence of TH. Insufficient freshwater supply due to low rainfall during winter and pre-monsoon period increase the TDS concentrations in Passur-Sibsa RS. Seawater contains huge quantity of calcium and magnesium, which make the water hard. In the last pre-monsoon season, the range was found to be 1,030 and 3,100 mg/L. Water body of power plant and its adjacent areas (average 1200 mg/L) are less harder than the water body of deep Sundarbans Forests (Around 1500 mg/L) (**Figure 2.18**). According to the **Figure 2.18**, it is noticeable that water hardness of last pre-monsoon were found comparatively lower than the other pre-monsoon seasons. During the rainy season, the water hardness in all the monitoring stations in Passur River were found to be low whereas it was found remarkably higher in pre-monsoon season (**Table B.8: Appendix IV**). Generally, water hardness is found to be higher in monsoon season but in Passur River, it is found to be higher in pre monsoon season due to the saline water intrusion toward upstream. (Rahman et al., 2013).

TSS includes solid materials of organic and inorganic in origins, which are normally suspended in water. In Passur-Sibsa RS, the suspended matters generally contain sand, clay, silt and loam. During the 16th quarterly monitoring period, the TSS concentrations among the monitoring sites varied from 14mg/L to 32mg/L. The highest value was found at Maidara River near proposed township area while the lowest value was found at Mongla-Passur confluence and Harbaria followed by Akram point (**Figure 2.19**). TSS values in every spots recorded during the last pre-monsoon period were found to be within the Bangladesh standard limit of 150 mg/L (ECR, 1997). For oil spillage incident in 2014, TSS was found higher than the standard limit in 2015. After that, the issue was not found any more, and might be revived naturally.

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

The status of TDS, TH and TSS of Passur River at different monitoring sites are presented in **Figure 2.17, 2.18 and 2.19** respectively and all the observed dataset are attached in **Table B.8, Table B.9 and Table B.10 of Appendix- IV.**

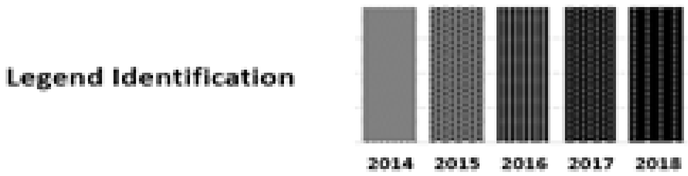


Figure 2.16: Legend identification

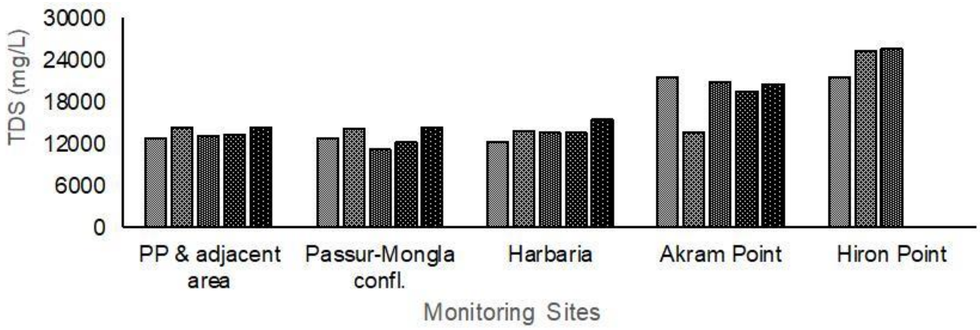


Figure 2.17: Variations in TDS concentrations in different monitoring sites

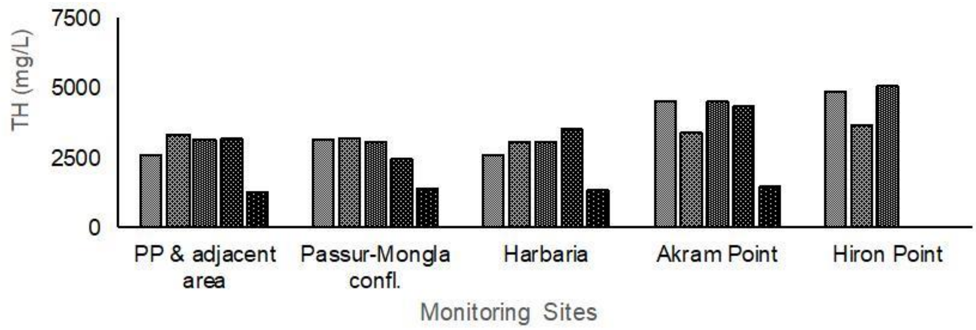


Figure 2.18: Variations in TH status in different monitoring sites

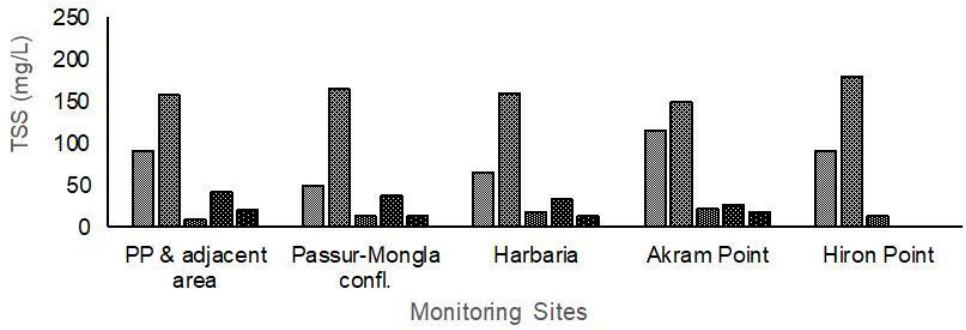


Figure 2.19: Variations in TSS concentrations in different monitoring sites

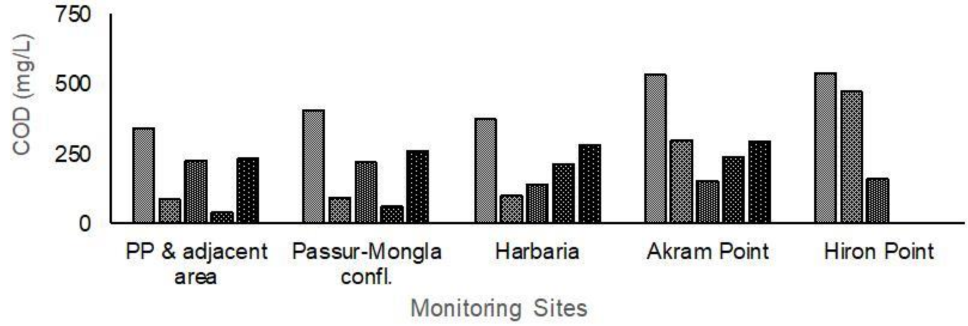


Figure 2.20: Variations in COD concentrations in different monitoring sites

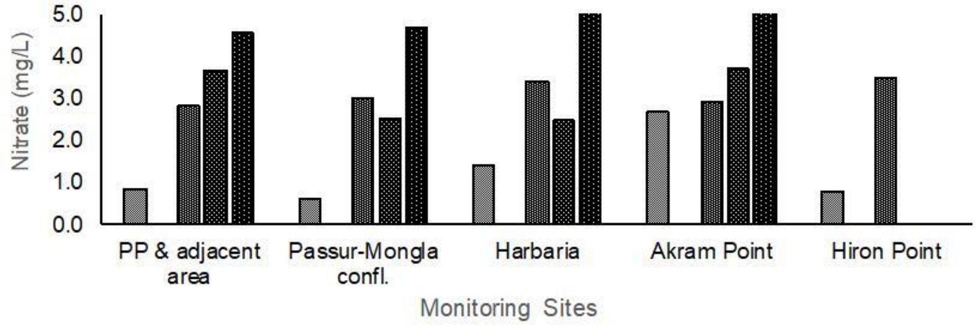


Figure 2.21: Variations in Nitrate concentrations in different monitoring sites

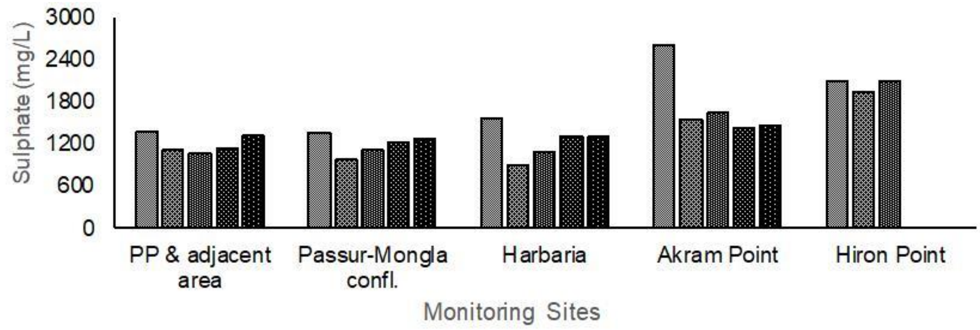


Figure 2.22: Variations in Sulphate concentrations in different monitoring sites

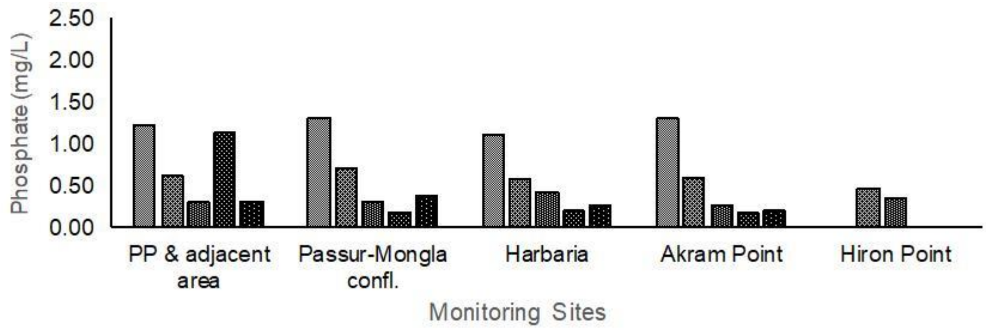


Figure 2.23: Variations in Phosphate concentrations in different monitoring sites

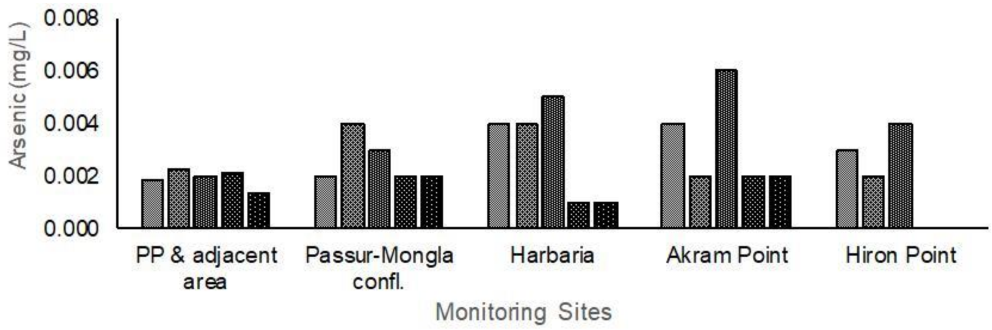


Figure 2.24: Variations in Arsenic concentrations in different monitoring sites

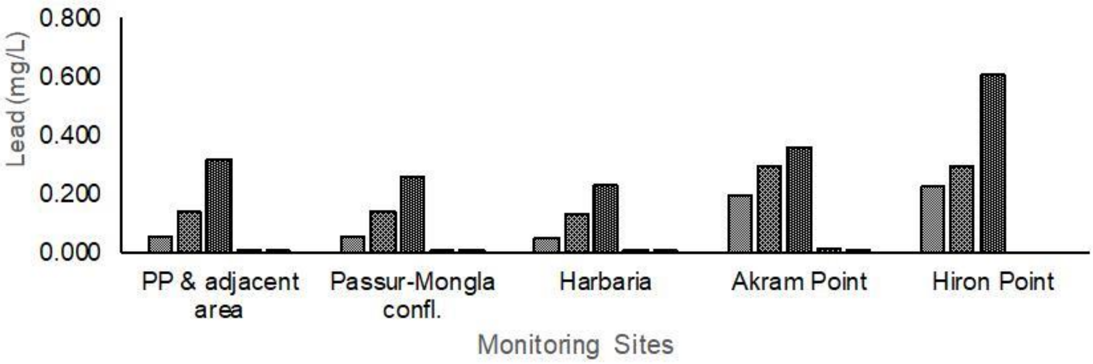


Figure 2.25: Variations in Lead concentrations in different monitoring sites

vi. Chemical Oxygen Demand (COD)

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

COD concentrations varied from 180mg/L to 296mg/L during the last pre-monsoon season. The highest value was found at the Akram point. The high values of COD indicate high level of organic pollution in the river water (Sivasubramanium, 1999). Figure 2.18 indicates that, organic loads are higher in the deep forests of Sundarbans than the upstream areas especially the power plant and its adjacent areas. Deep forests supply many organic loads in the river while upstream loads as well and increase the organic materials concentrations in huge at the downstream of the RS. COD concentrations didn't comply with the ECR' 1997 (200 mg/L) waste discharge standard from any monitoring site during the last pre-monsoon season except Maidara-Ichamoty Confluence (180 mg/L). The extreme high COD at 2014 was the reason of oil spillage of that year which lead the death of planktons and other aquatic life forms and ultimately increased the organic matter decomposition rate.

Over the year, COD concentration was found to be higher in pre-monsoon season followed by winter as these seasons had insignificant rainfall comparing to those of other seasons and which actually increased the density of organic matter. The COD concentrations of pre-monsoon and winter seasons (dry) were found higher than those of monsoon and post-monsoon seasons. In monsoon, higher discharge diluted the COD load of the river water, which in turn reduced COD concentration in post monsoon. All observed values of COD are shown in **Figure 2.20** and the entire monitored dataset are provided in **Table B.6 of Appendix- IV.**

vii. Nitrate, Sulphate and Phosphate

In the last monitoring, NO_3^- concentrations varied from around 3.0mg/L to 7.0 mg/L. The maximum concentration of 7.0 mg/L, recorded at Left Bank of Passur River at 100 m u/s of North West corner from the Project boundary while lowest concentration of 3.0 mg/L was found at Project site jetty. NO_3^- concentration showed both temporal and spatial variations in the same season among 16th quarterly monitoring. As for example, in the last pre-monsoon season, power plant and adjacent areas NO_3^- concentration was around 4.8 mg/L and at Akram point was only 5.5mg/L (**Figure 2.21**). It is noticeable that, during the last pre-monsoon period, the river showed highest nitrate concentration than any other pre-monsoon seasons. However, the results obtained from all the monitoring sites were found to be within the standard limits as stated in ECR'1997 (10 mg/L).

The highest values were found in pre-monsoon season of 1st quarter of 2nd year, which would be due to the higher amount of surface and groundwater runoff, dissolution of nitrogen-rich geological deposits, and biological degradation of organic matter as observed from numerous studies (Spencer, 1975; Kinne, 1984; Gleick, 1993; Wetzel, 2001; Rabalais, 2002).

Naturally, sulphate (SO_4^{2-}) concentration is higher in seawater as well as in coastal river due to tidal interactions. The monitored dataset substantiates this fact i.e., SO_4^{2-} concentration of Passur-Sibsa RS increases in the direction of upstream to downstream. However, this variation is visible in monsoon and pre-monsoon seasons only. Freshwater availability from upstream makes this variation. On the other hand, SO_4^{2-} doesn't have any spatial variations in pre-monsoon and winter seasons as tidal influence suppress the upstream areas due to lack of freshwater availability.

According to the last monitoring results, most of the observed values of SO_4^{2-} didn't meet the standard limit of 400mg/L specified in ECR, 1997 (**Figure 2.22**). In monsoon and post monsoon seasons, SO_4^{2-} concentrations were comparatively low, which would be due to dilution by upstream freshwater flow (Table B.10).

PO_4^{3-} concentrations were found in between 0.2 mg/L and 0.38mg/L during the last monitoring period (April, 2018) (**Figure 2.23**). Based on the **Figure 2.23**, it is verified that, PO_4^{3-} concentration decrease in the direction of upstream to downstream of the RS. Upstream anthropogenic activities might be the reason for this kind of trend. However, all other monitoring sites confirmed the compliance against standard limit of 6mg/L, specified for inland surface water. The recorded low phosphates value during dry seasons might be attributed to the limited flow of upstream freshwater, high salinity and utilization of phosphate by phytoplankton, stated by Senthilkumar et al., 2002; Rajasegar, 2003 (Table B.11).

NO_3^-, SO_4^{2-} and PO_4^{3-} concentrations at different monitoring sites of the 15 consecutive monitoring periods are shown in **Figure 2.21, 2.22** and in **2.23** and all the observed dataset are given in **Table B.11, Table B.12 and Table B.13 of Appendix- IV**.

viii. Heavy Metals

It has earlier been revealed that Arsenic (As) concentrations varied between 0.001 to 0.006

mg/L. During the 16th monitoring, the results again fitted with the said range. Though there were some seasonal variations in As concentrations, but still As concentration complies with the drinking water quality standard of WHO (0.01 mg/L). The Bangladesh limit is as high as of 0.05 mg/L (**Figure 2.24**).

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 16th monitoring period, the concentration of Pb ranged between 0.001-0.007 mg/L (**Figure 2.25**).

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

The average value of As and Pb concentrations at different monitoring sites of the consecutive monitoring periods for winter season are presented in **Figure 2.24** and in **2.25** and all the observed dataset are given in **Table B.14, Table B.15 and Table B.16 of Appendix- IV.**

ix. Oil and Grease

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

The concentration of oil and grease during monsoon and post monsoon periods were found lower than that of winter and pre-monsoon season. It appears from the data that Passur and Sibsa river system recorded high concentration of oil and grease in winter period in 2014, which might be due to the accidental oil spillage occurred on the 9th December 2014. An amount of 350,000 litres (Philips, 2014) of furnace oil had spilled in the river and spreaded over an area of 350 km2 (Welle, 2014).

Oil and grease was found less than 5mg/L in all the monitoring sites during last pre-monsoon season. This organic compound in other seasons (monsoon, post monsoon and winter) has found to be increased in the last three consecutive years. Plying of motorized boats, launches and other tourist boats could be the reasons of high oil and grease including the RASH MELA, the festival inside Sundarbans every year. Moreover, for the seasonal fishing at sea, the engine boats and other fishing boats contributes huge amount of oil and grease in the river water. Oil spillage and discharges of other organic residual from large number of marine vessels in the location; oil discharge from the fishing boats and other anthropogenic activities might be the reason of having such higher quantity of oil and grease concentration.

Findings

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

In this quarter (July 2018), only pH was recorded comparatively higher but still under the recommended value of ECR'1997. DO level is still acceptable except in only one point of project site. Huge construction activities and land filling near the bank side reduced the DO level only at that portion of the river for time being.

TH, TSS and COD have not increased in the same season during last four consecutive years. Nitrate increased a bit but still complying with ECR standard. Sulphate remained almost constant while phosphate concentration has reduced a lot during last pre-monsoon.

No variation has been recorded in the concentration of As and Hg but that of Pb hs been recorded higher than that of the preceding monitoring report. Presence of Pb concentration in river water does not depend on seasonal variation but spatial distribution of sources.

Oil and grease concentration was found less than 5 mg/L, which is even less than half of the recommended concentration (10 mg/L) for inland water.

2.8.10 Status of the Groundwater quality

In-situ tested parameters

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

i. pH and Temperature

The values of pH and temperature of groundwater in the monitored sites complied with the drinking water quality standards as specified in ECR, 1997 (6.5-8.5 and 20-30ºC respectively). The pH values during 17th monitoring scheme were found to vary from 7.6 to 7.9, while temperature was around 30°C at Rajnagar and Kapasdanga site. During this visit, no groundwater is being withdrawn inside the project site (near township area). No significant differences have been observed against the previous winter season results. Similarly, no significant variation was recorded in groundwater temperature over the monitoring periods.

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

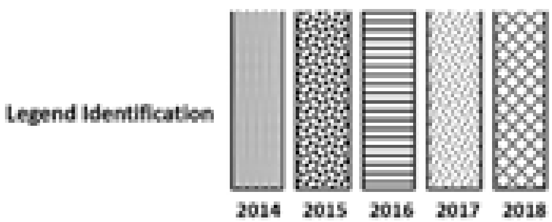


Figure 2.26: Legend direction (left to right: 2014-2018)

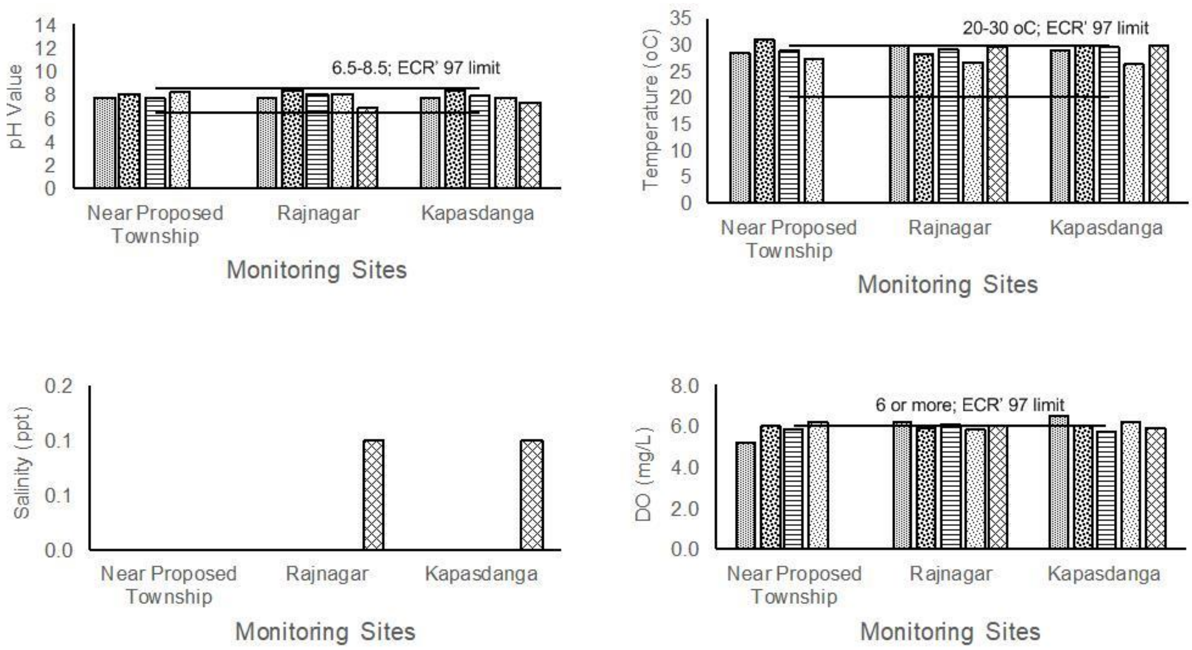


Figure 2.27: Status of pH, Temperature, Salinity and DO of monsoon seasons of the last four consecutive years

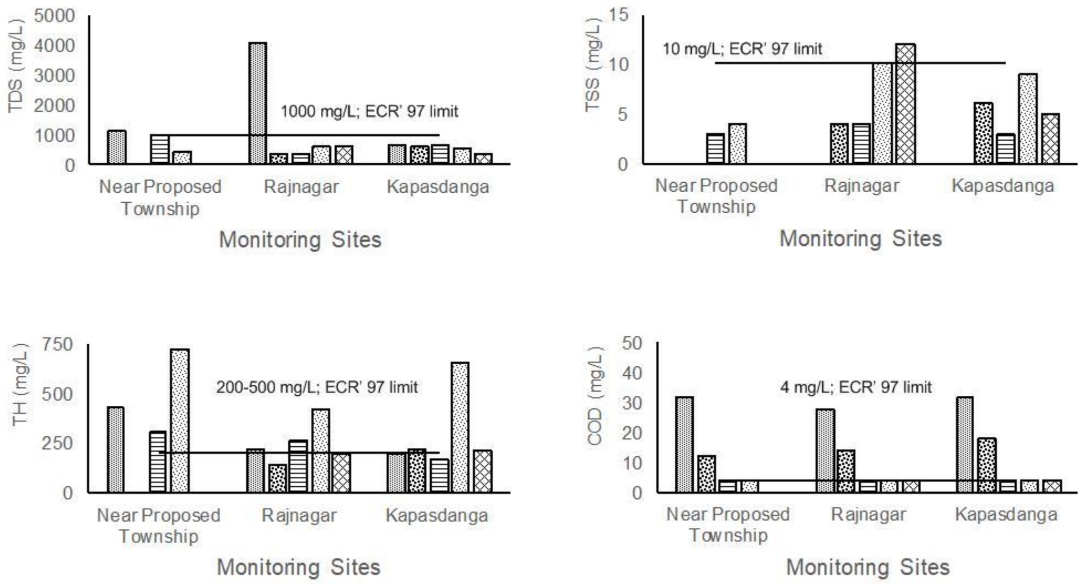


Figure 2.28: Status of TDS, TSS, TH and COD of monsoon seasons of the last four consecutive years

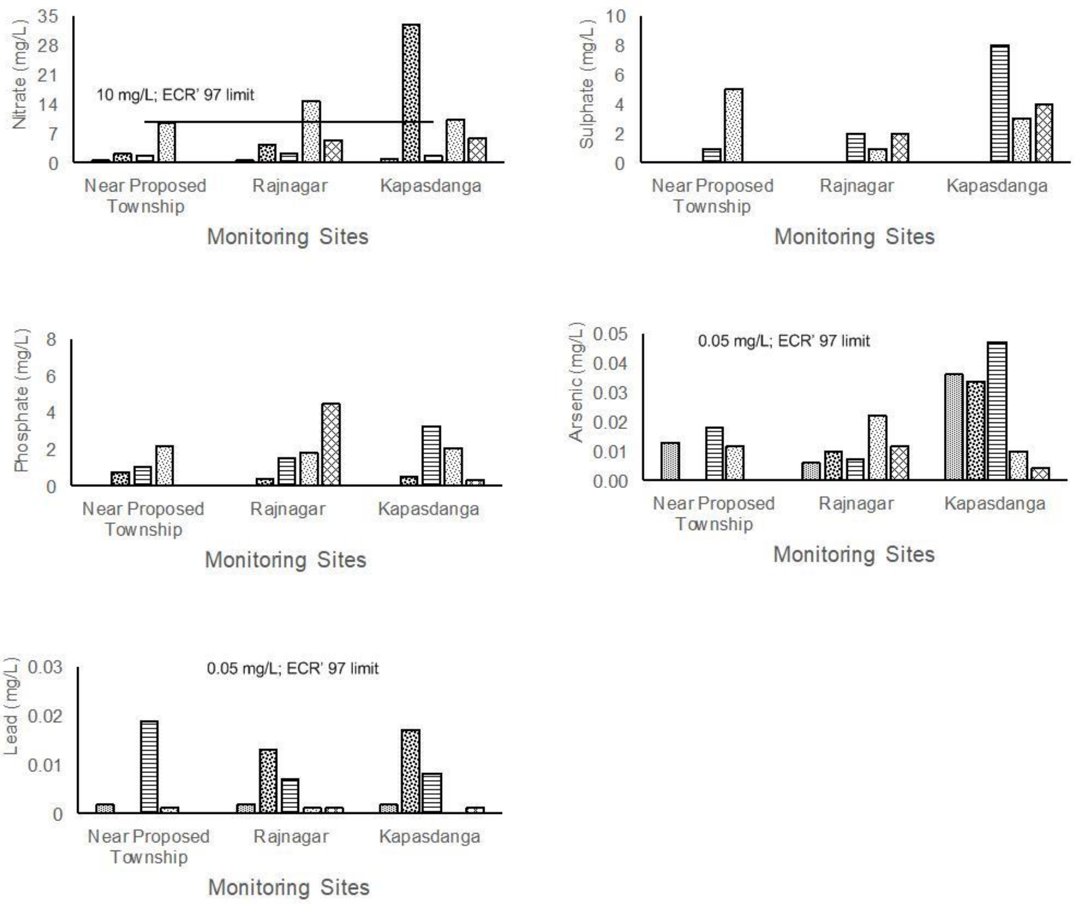


Figure 2.29: Status of Nitrate, Sulphate, Phosphate, Arsenic and Lead of monsoon seasons of the last four consecutive years

ii. Salinity and Dissolved Oxygen (DO)

Groundwater salinity concentration in all the monitoring sites were found to be negligible and in most of the cases lower, the minimum detectable limits in all the consecutive monitoring seasons. During this monitoring season, groundwater salinity of Rajnagar and Kapashdanga sites were found to be 0.1ppt (**Figure 2.27**: Salinity).

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

All monitoring results of salinity and DO of the selected monitoring sites are presented in Figure 2.27: Salinity, DO and all the observed dataset of DO are attached in **Table B.18 of Appendix- IV.**

Laboratory tested parameters

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

i. TDS, TSS and TH

The highest TDS value of 615mg/L was recorded in Rajnagar and the lowest was in Kapasdanga (370mg/L). It is mentionable that, the TDS concentrations during all the winter periods were found within the Bangladesh standard limit of 1000mg/L (ECR, 1997) except in the first quarterly monitoring period (Pre-monsoon of 2014). The TDS concentration during first monitoring have shown an extreme spatial variations (Figure 2.28: TDS).

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). Among all the monitoring seasons, the observed TSS concentrations were much higher in winter season than other monitoring seasons (pre-monsoon, monsoon and post-monsoon) (Table B.21). These variations would be due to lack of freshwater availability for sufficient groundwater recharging. In addition, evaporation have also condensed the water along with its suspended matters. During this monitoring period, the TSS concentrations ranged in between 5mg/L and 12mg/L, which complied with the Standard for Drinking Water, Bangladesh (TSS: 10mg/L, ECR, 1997) except the site Rajnagar where it was found as 12mg/L (Figure 2.28: TSS).

TH concentrations of the two monitored spots varied from 195mg/L to 215mg/L (Figure 2.26: TH) in the last pre-monsoon season. The highest concentration of TH was found in the Kapasdanga site. Drinking water hardness complied with standard limit (200-500 mg/L) set by the ECR 1997 during all the last four pre-monsoon seasons. So far, no incidents of weathering of Ca2+ bearing minerals or excessive application of lime was found during the monitoring periods which could cause excessive amount of TH in groundwater.

Groundwater TDS, TSS and TH values of the consecutive winter periods are presented in Figure: 2.28: TDS, TSS and TH and all observed dataset are attached in **Table B.19 and B.20 of Appendix- IV.**

ii. Chemical Oxygen Demand

The Bangladesh standard for COD in drinking water is 4.0mg/L. COD concentrations for all the monitoring sites in the last pre-monsoon period were found to be complied with the Bangladesh Standard. Except first and second quarterly monitoring period, the COD concentrations at all other pre-monsoon seasons were also within the Bangladesh Standard for Drinking Water.

The COD concentrations of all the pre-monsoon period monitoring sites are shown in Figure 2.28: COD and all observed dataset are attached in **Table B.21 of Appendix- IV.**

iii. Nitrate, Sulphate and Phosphate

Nitrate (NO_3^-) values ranged between 5.3mg/L and 5.7mg/L in the last pre-monsoon period (Figure 2.27: Nitrate). The maximum value was recorded in Rajnagar while the lowest was in Kapasdanga. NO_3^- concentrations were within ECR, 1997 limit (10mg/L) in this 16th monitoring period. NO_3^- in groundwater have shown both spatial and temporal variations in monsoon season.

The sulphate (SO_4^{2-}) concentration in groundwater have been monitored since 2015. Since then SO_4^{2-} concentrations have been complying with the Bangladesh Standard for Drinking Water Quality (400mg/L). SO_4^{2-} concentration in groundwater have not shown any pattern yet (**Figure 2.29: Sulphate**) except a trend of comparatively high concentrations in winter than all other monitoring seasons.

On the other hand, concentrations of PO_4^{3-} were found between 0.3mg/L and 4.5mg/L, which was within the standard limit of 6 mg/L (ECR'1997) (Figure 2.29: Phosphate). PO_4^{3-} concentration reached to its highest peak at 4.5 mg/L during the last monitoring scheme. PO_4^{3-} concentrations actually have both spatial and temporal variations but which is minor for 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 2.29:** Nitrate, Sulphate, Phosphate, and all the observed dataset are attached in **Table B.22 of Appendix- IV.**

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

According to Bangladesh Standard (ECR, 1997), the maximum acceptable concentration of Arsenic in groundwater is 0.05 mg/L. The As (Arsenic) concentrations among all the monitoring locations found to be ranged between 0.01 and 0.03mg/L which are very much within the Bangladesh drinking water limit (ECR, 1997) (**Figure 2.29: Arsenic**). It can therefore, be concluded that, groundwater of the monitoring areas is not yet contaminated by arsenic pollution.

The Pb and Hg concentrations were also measured and the values were found within the permissible limit specified in ECR 1997 (0.05mg/L for Pb and 0.001mg/L for Hg). The concentration of Pb have shown only spatial variation to some extent (**Figure 2.29: Lead**). However, the water of the tube-wells was found suitable for drinking purpose in terms of metal pollution status.

The observed values of As and Pb for all the pre-monsoon period monitored sites are presented in **Figure: 2.29**: Arsenic, Lead and all observed dataset of As, Pb and Hg are presented in **Table B.23 of Appendix-IV.**

Remarks

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

2.9 Land Resources monitoring

2.9.1 Methodology

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

Sampling Frequency

The frequency of monitoring for land resources data collection was considered twice in a year. Accordingly, the plot use data was collected in the 17^{th} monitoring program during July 2018 to September 2018.

<u>*Monitoring Indicators*</u>

The continuous monitoring had given an opportunity to observe the seasonal change along with spatial change of selected indicators of sampling plots. The selected indicators are soil reaction (pH), soil salinity (EC), Organic matter (OM), base cations-Ca, Mg, K and Na, status of macro nutrients (N, P and S), status of micro nutrients (B, Fe, Mn and Zn) and presence of heavy metals (Pb and Cd). Sodium Absorption Ratio (SAR), Exchangeable Sodium Percentage (ESP) can be calculated from the analyzed data. It can also be mentioned that the structural change of soils in the sampling plots may also be identified from these data.

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

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

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

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

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 from:

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

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

Location

The selected mauzas are Baranpara (E-89°30′59.1″, N-22°37′57.0″) of Batiaghataupazila, Chunkuri-2 (E-89°32′20.0″, N-22°34′51.0″) of DacopeUpazila, Kapalirmet (E-89°36′8.8″, N-22°32′18.9″) of Monglaupazila, Chakgona(E-89°34′25.3″,N-22°34′18.3″) of Rampalupazila and Basherhula (E-89°34′25.0″, N-22°36′14.0″) of Rampalupazila under Khulna and Bagerhat districts as stated in **Table 2.9**. Locations of collected soil samples are presented in **Figure 2.30 and in E.1 of Apendix-IV**

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 opinions were 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 consulted for collecting expert's judgement. Wind speed and wind direction were considered as potential local factor for the monitoring purpose. All 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 flood periods.

Soil Sample 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.

Laboratory Analysis

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

Table 2.9: Land Resources Monitoring Plan

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

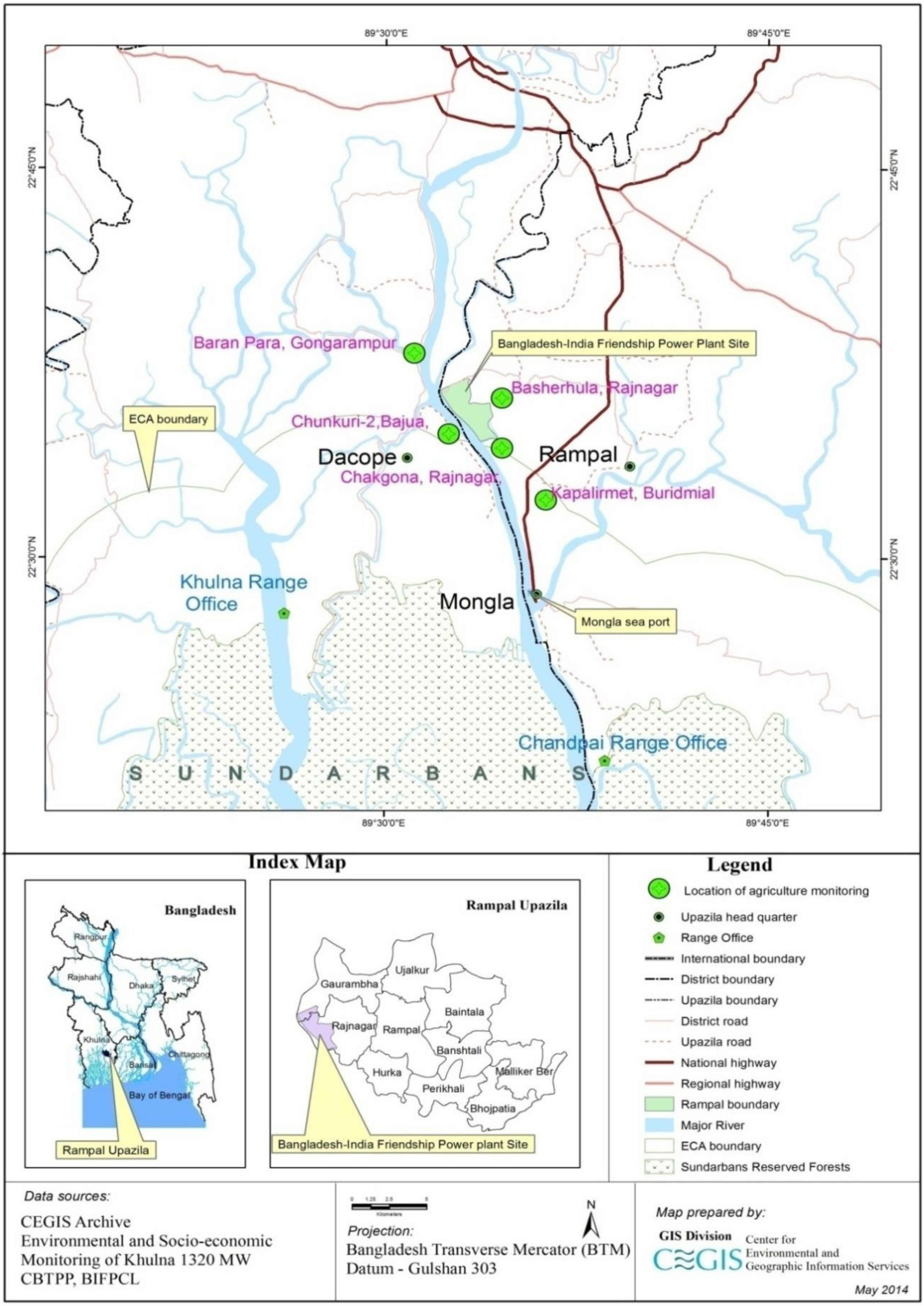


Figure 2.30: Land Resource Monitoring Locations

2.9.3 Status of Soil Quality of Monitoring Plots

The analyzed results for dry season of 2017-2018, were compared with the previously monitored wet season's data of 2016-2017 to observe seasonal variation. Overall changes in the sampling plots in dry season (from 2013-2014 to 2017-2018) were also monitored to detect changes of each parameters due to natural cause.

Monitoring Plot-1 (Baranpara)

Soil salinity of Baranpara sampling site in dry season has increased in first couple of years. However, during the third monitoring period of the dry seasons, it decreased and again increased afterwards. All salinity related data (EC, SAR and ESP) showed the similar trend of the result. It was also observed from monitoring data that, K, Mg and S content is decreasing with the increasing of Na ion. Though rain water and upstream flush out dissolved salt in wet season but were not sufficient in terms of dropping the overall salinity of this vast area. Another reason behind this increasing trend might be the unplanned opening of sluice gate and soil management. Soil pH showed an increasing trend throughout the monitoring period due to the increasing salinity but top soil pH is slightly decreased due to soil management and crop cultivation. This overall situation of soil salinity and pH might be a typical scenario of poldarization of any locality and impact of natural causes rather than any anthropogenic activities such as project intervention.

Organic matter content has been dropped in the 2nd year of monitoring during dry seasons. After that, organic matter content has increased gradually during dry seasons. This might be due to use of rice straw and cultivation of Baiua grass, which improved the soil fertility. Organic matter content improves in dry season than wet ones. During wet season top soil tends to be washed due to rainfall and surface runoff, which carries out organic matter with it. Similar trend has been observed for Nitrogen and Phosphorus concentration for the same reason.

Boron, Iron and Manganese concentration tends to decrease from the 2nd year of monitoring of the dry seasons (dry season 2014-2015). On the other hand, Zn concentration increased from the same year. From this trend analysis, it may be concluded as Zn concentration replaced other three ions.

Lead concentration continues to decrease from the first year of monitoring. Cadmium follows the similar trend. This might be due to increasing pH and organic matter content. Heavy metals might form chalets with acids at high pH or washed out in wet season. Both of the heavy metal concentration were found within the Maximum Allowable Concentration (MAC) range in soil in both seasons as stated in some other studies (**for Pb-100 ppm and for Cd-3 ppm, Kloke, 1980**). All monitoring data for dry season of monitoring period are presented in **figures 2.31-2.44**. Seasonal variations of the parameters is presented in **E.2 of Appendix IV**.

Monitoring Plot-2 (Chunkuri-2)

Chunkuri-2 sampling site's soil salinity in dry season has increased in first couple of years of monitoring of the dry seasons. After which, it decreased for next couple of years of the dry seasons. This monitoring report showed that soil salinityhas again increased. All salinity related data (EC, SAR and ESP) and base cations (Na, K, Ca and Mg) have shown the similar trend. The sampling site is situated in the polder, which is submerged in wet season and washout of top soil is a common scenario of that area. Rain water dissolve salt in wet season which seems to be sufficient but has not sufficient earlier when salinity has decreased. This year's washout might not be sufficient and increased the soil salinity. Soil pH showed a complex scenario and appeared as a sine curve in time series or trend analysis. Both EC and pH have increased in dry season rather than wet ones. Such situation might be a typical impact of natural causes rather than any anthropogenic activities such as project intervention.

Organic matter has increased during second (2^{nd}) monitoring of the dry seasons (dry season 2014-2015). Except this, soil organic matter was around 2% during all the monitoring periods. But major nutrients showed a decreasing trend. This might be due to the uptake of nutrients by plants, poor soil management and less use of organic fertilizers in soil.

Iron concentration maintaind a certain concentration (around 50 ppm) in dry season throughout the monitoring period. Mn and B have shown an increasing trend except during the 3^{rd} and 4^{th} monitoring of the dry seasvons. Zn concentration has previously increased but only dropped during this year. All elements have shown an increasing trend in dry season than wet ones due to flush out by rain water.

Maximum lead and cadmium concentration was found in the 2^{nd} monitoring of the dry seasons (around 30 ppm and 2.3 ppm respectively).The soil Pb and Cd concentration was around 15 and 0.5 ppm respectively for the other monitoring periods, which is well below the MAC level in soil. All monitoring data of dry season of monitoring period are presented in **figure 2.31-2.44**. Seasonal variation of the parameters is presented in **E.2 of Appendix IV.**

Monitoring Plot-3 (Kapalirmet)

Soil sampling point of Kapalirmet remains submerged under water in most of the time. During pre monsoon and post monsoon fish is cultivated in this area, whereas the entire area is submerged under water during monsoon. This specification helps to understand chemical properties of this sampling area. Decreasing trend of soil salinity is a common scenario of this plot except during the 3^{rd} monitoring of the dry seasons. EC, SAR and ESP have also shown similar trend. In terms of base cations, Mg, Na and K showed an overall decreasing trend. These three elements showed theirincrement only in 5^{th} (this monitoring), 3^{rd} and 4^{th} monitoring of the dry seasons. Ca showed an increasing trend in the last couple of years. Leaching of salt due to standing water might be responsible for this decreasing trend of soil salinity. Soil salinity is normally high in dry season than in wet ones. Soil pH also showed the decreasing trend except in the 3^{rd} monitoring of the dry seasons.

Organic matter, Nitrogen and Phosphorus concentrations are maintaining a similar trend of this sampling plot. Organic matter varies around 2%. But during this monitoring organic matter, N and P concentration decreased. This might be due to the wash out of top soil and less use of organic fertilizer. S concentrationhas decreased in this year after increscent of last two years.

Iron and Manganese concentration have increased in this sampling spot. These two elements concentration dropped once in 2^{nd} and 3^{rd} monitoring of the dry seasons respectively. Zinc concentration in soil showed a constant increasing trend. But this element's concentration decreased during this monitoring. This might be due to higher concentration of Ca and Mg in soil. These two elementshave increasing trendinstead of decreasing trend. There might be a chance of Zn replace in soil exchangeable site by these two elements. B concentration showed overall decreasing trend. This element's concentration increased in soil once during 2nd monitoring of the dry seasons. All these elements tend to be decreased in wet season due to dissolve factor.

Maximum lead and cadmium concentration was found in 2nd monitoring of the dry seasons (around 47 ppm and 2.8 ppm respectively). Pb and Cd concentration was around 8 and 0.5 ppm respectively during the other monitoring periods, which is well below the MAC level in soil. Pb concentration has increased for last three years. All monitoring data of dry season of monitoring period are presented in **figure 2.31-2.44**. Seasonal variation of the parameters is presented in **E.2 of Appendix IV**.

Monitoring Plot-4 (Chakghona)

Soil EC and pH showed an increasing trend in last two monitoring after initial drop down in 2nd monitoring of the dry seasons. These two parameters have decreased in current monitoring. Salinity related other parameters (SAR and ESP) also have the similar trend. Three major base cations remained static during last three years (Mg- around 3.85 meq/100g soil, Ca- 15.25 meq/100g soil and K around 087 meq/100g soil). Only Na concentration has decreased iduring this monitoring which might be due to the reason behind the decreasing of pH and EC. Decrease in Na concentration might be due to less sea water intrusion in this area.

Organic matter and Nitrogen retain similar concentration in last three years (Organic matter content-2.15% and Nitrogen-0.11%). This trend continuoued during this monitoring too. Phosphorus and Sulfur continued to decrease since the 2nd and 3rd year of monitoringyears respectively. This might be due to sulphur and phosphorus mining due to continues high pH.

B, Fe and Mn concentrations remained similar except Zn after 2nd monitoring of the dry seasons (B-around 1.75 ppm, Fe- 42 ppm and Mn-7.6 ppm). Zn only showed a significant jump during last two years. This might be due to high pH (over 8). At high pH micro nutrients tends to form chelats with organic compounds and make them unavailable in soil solution.

Lead and Cadmium concentrations continued to decrease during 5th monitoring of the dry seasons. Both of the heavy metals range is well below the MAC level in soil. All monitoring data of dry season of monitoring period are presented in **figure 2.31-2.44**. Seasonal variation of the parameters is presented in **E.2 of Appendix IV**.

Monitoring Plot-5 (Basherhula)

Changes of soil pH and salinity of Basherhula maintains sine curve within a small range. These two parameters increased for one year and then decreased. This sequence continued since last five monitoring of dry season. Increasing trend is found in current year of monitoring. Soil salinity related other parameters showed the similar trend. Among the base cations, only Na concentration relates with this trend which indicate Na is the triggering cation behind this change. Beside this, Ca and Mg continued their decreasing trend while K remained static during last three years. This might be due to increasing of Na in soil solution. This Excessive concentration of Na replaced other cations from clay and as a result, it made soil more dispersed and friable. Continues inundation by the Pasur River and Basherhula Khal might be reason of this matter.

Organic matter and Nitrogen concentrations increasesed after last year’s drop. Beside this, the Organic Matter and Nitrogen concentration have shown an increasing trend. Concentration of P remained around 6 during last three year’s while S concentration is increasing up in every year. This might be forhigher pH.

Fe concentration remained similar from the beginning of the monitoring in this plot. B and Mn concentration slightly increased from the last year while Zn concentration continued it's increasing trend since last second consecutive year.

Lead and Cadmium concentration continues to increase in 5th monitoring of the dry seasons but their range is well below the MAC level in soil. All monitoring data of dry season of monitoring period are presented in **figure 2.31-2.44** Seasonal variation of the parameters is presented in **E.2 of Appendix IV.**

However, the Existing Cropping Pattern, Crop production, crop damage in the selected Monitoring Plots has been attached in **Table E.3, E.4 and E.5 of Appendix-IV.**

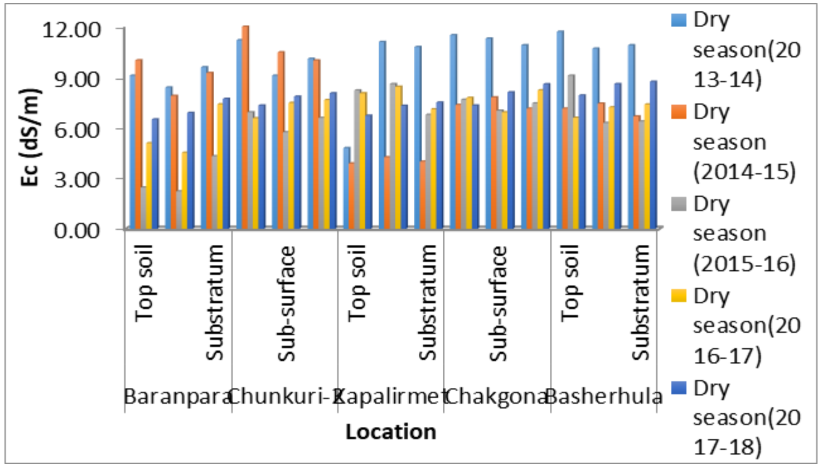


Figure 2.31: Changes of EC (dS/m) in dry seasons in sampling locations throughout the monitoring period

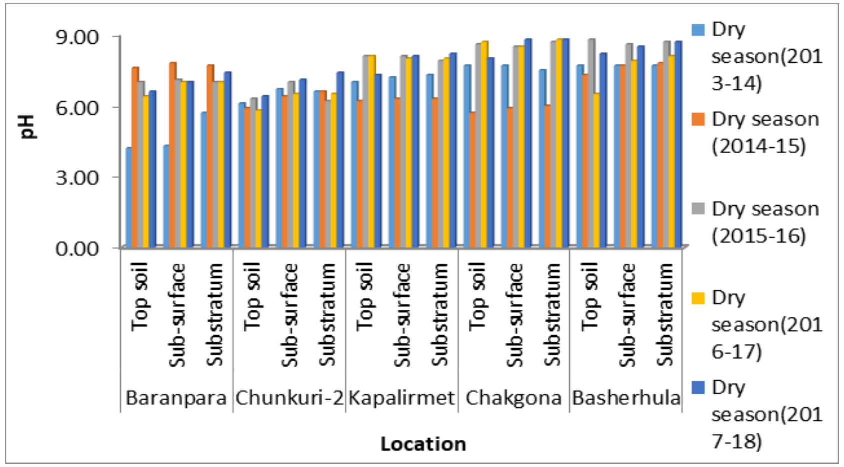


Figure 2.32: Changes of pH in dry seasons in sampling locations throughout the monitoring period

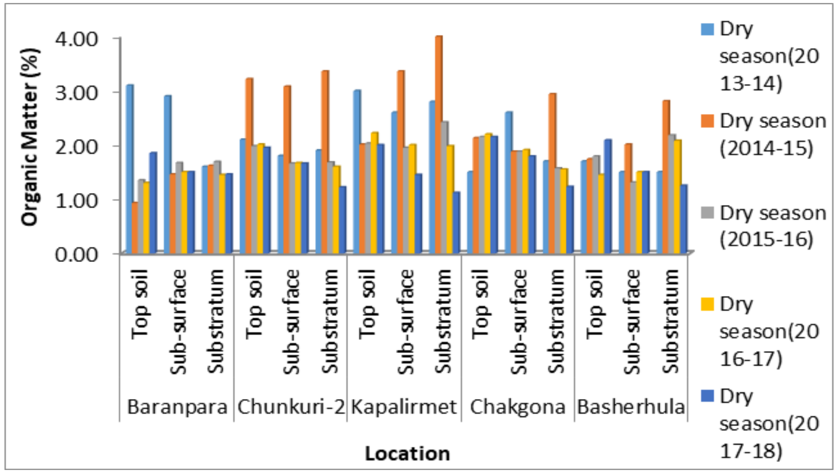


Figure 2.33: Changes of Organic matter (%) in dry seasons in sampling locations throughout the monitoring period

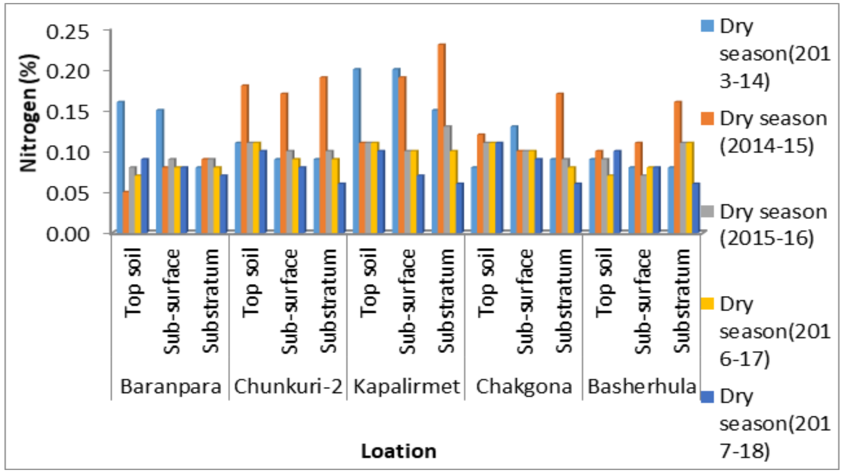


Figure 2.34: Changes of Nitrogen (%) in dry seasons in sampling locations throughout the monitoring period

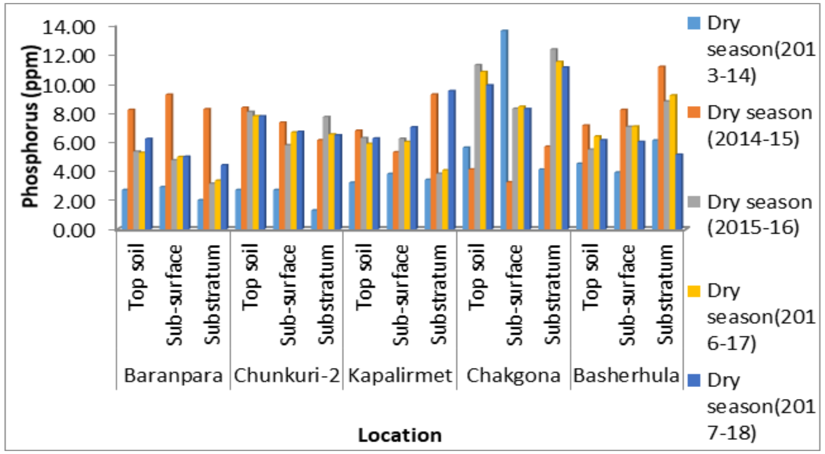


Figure 2.35: Changes of Phosphorus (ppm) in dry seasons in sampling locations throughout the monitoring period

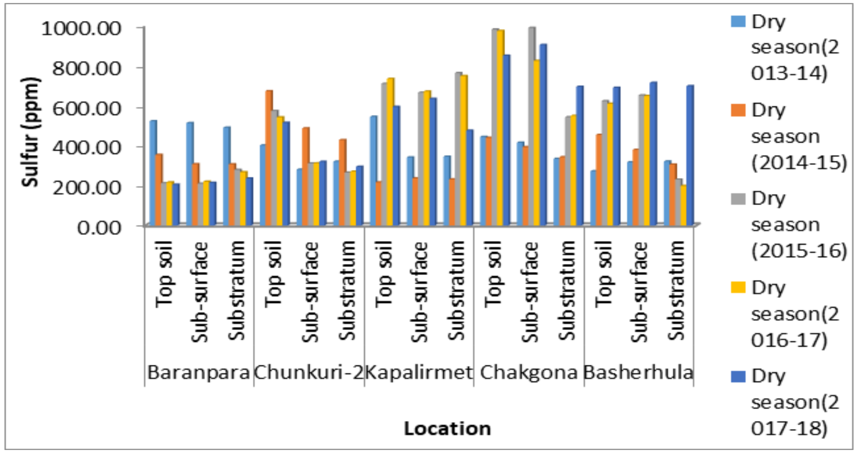


Figure 2.36: Changes of Sulfur (ppm) in dry seasons in sampling locations throughout the monitoring period

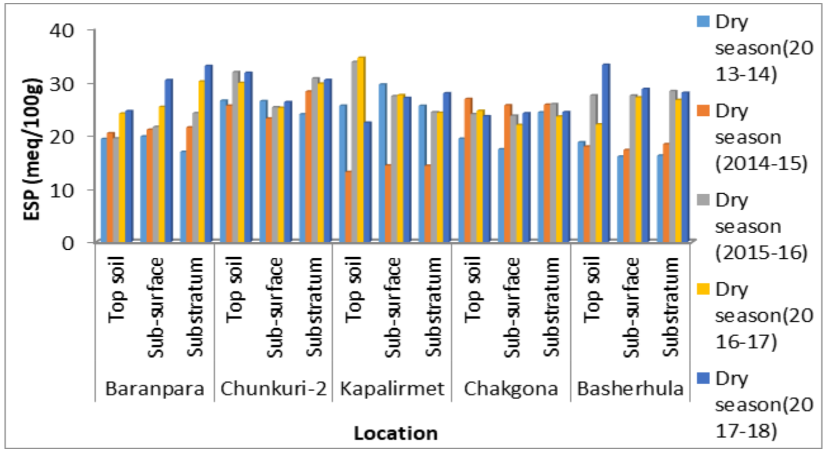


Figure 2.37: Changes of ESP (meq/100g) in dry seasons in sampling locations throughout the monitoring period

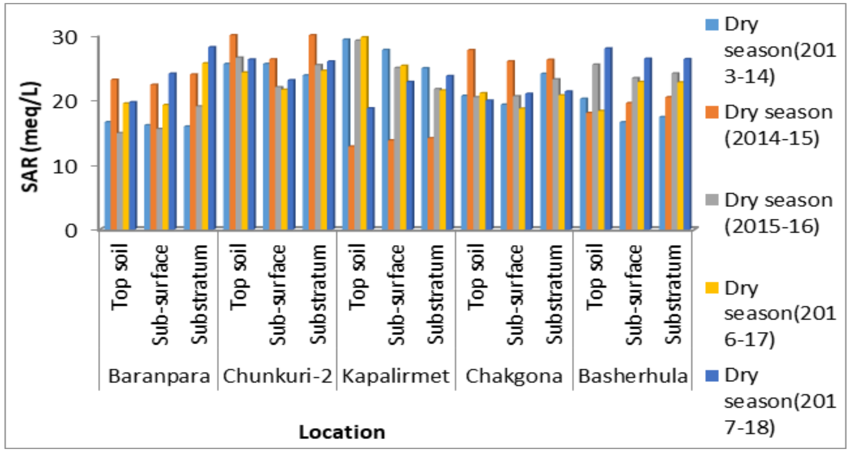


Figure 2.38: Changes of SAR (meq/L) in dry seasons in sampling locations throughout the monitoring period

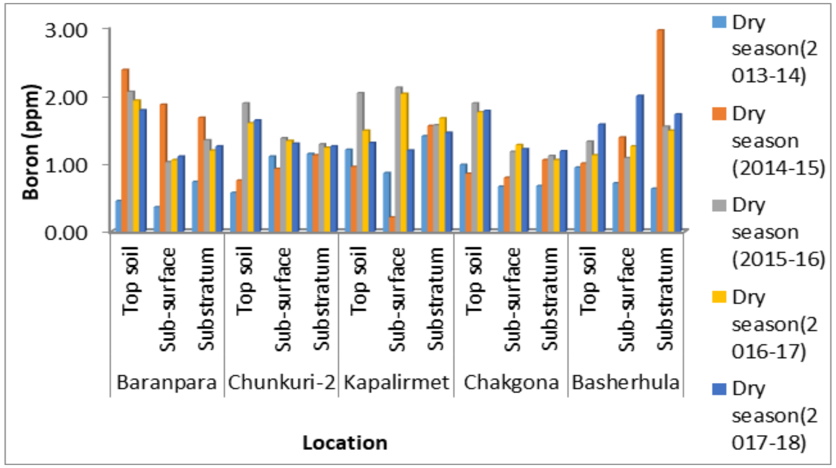


Figure 2.39: Changes of Boron (ppm) in dry seasons in sampling locations throughout the monitoring period

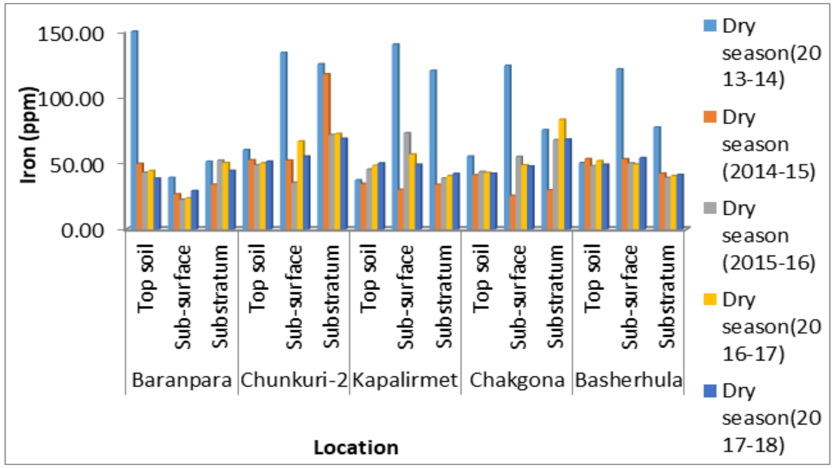


Figure 2.40: Changes of Iron (ppm) in dry seasons in sampling locations throughout the monitoring period

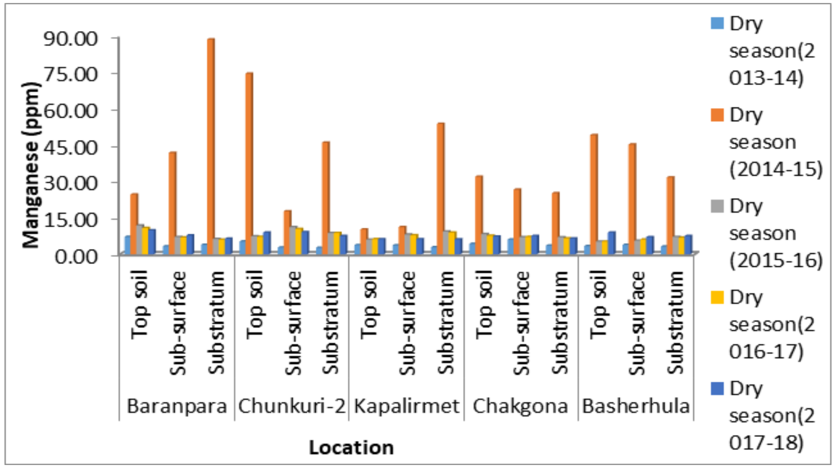


Figure 2.41: Changes of Manganese (ppm) in dry seasons in sampling locations throughout the monitoring period

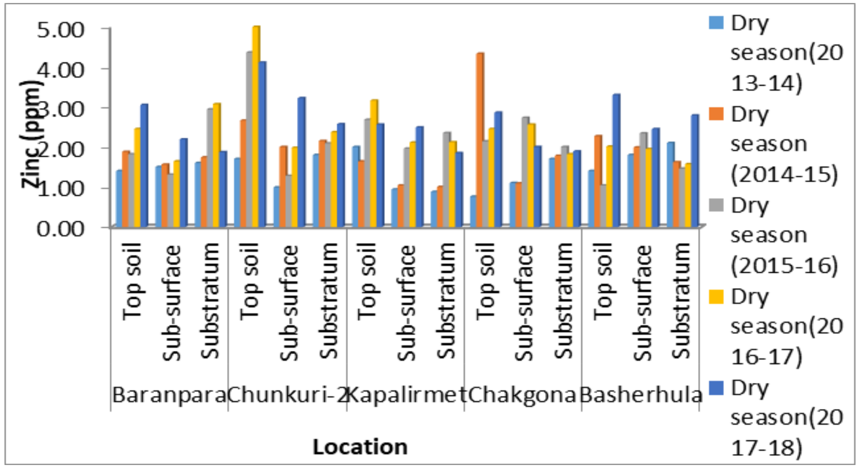


Figure 2.42: Changes of Zinc (ppm) in dry seasons in sampling locations throughout the monitoring period

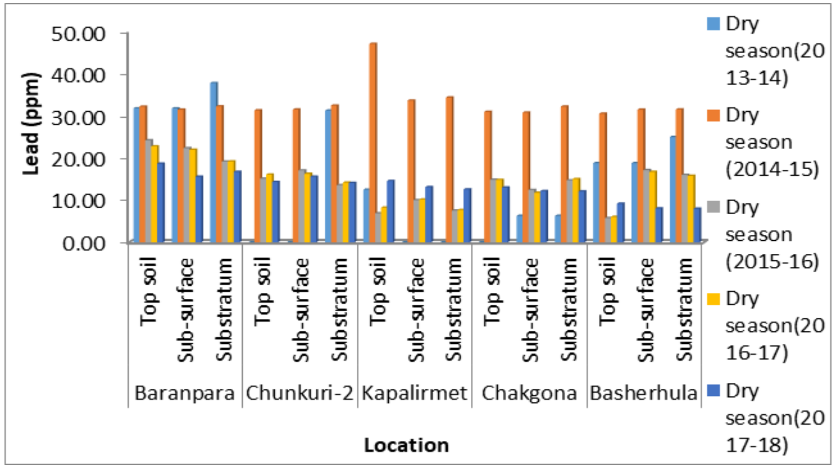


Figure 2.43: Changes of Lead (ppm) in dry seasons in sampling locations throughout the monitoring period

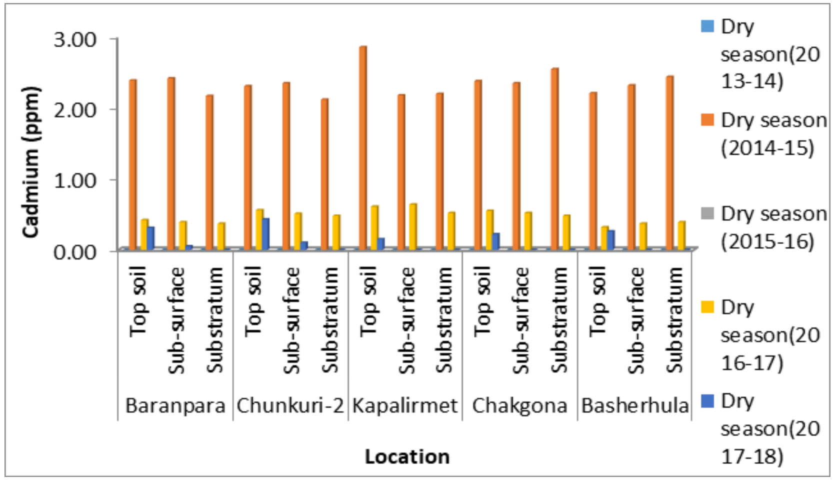


Figure 2.44: Changes of Cadmium (ppm) in dry seasons in sampling locations throughout the monitoring period

Findings

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

2.10 Transportation Monitoring

2.10.1 Location of Traffic Survey

The traffic survey for this quarterly monitoring i.e. during the construction phase was conducted from July 23 to 25, 2018 at three pre-selected locations around the project site (**Figure 2.45**). Weather was cloudy during the three survey conducted. The selected sites were Gonabelai Bridge, Gachtala and Gonai Bridge near the project site.

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**

Table 2.10: Factors Used for PCU estimation

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

**Source: Roads and Highway department of Bangladesh*

Results of Monitoring

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

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

Location	7:00 AM to 10:00AM	12:00 PM to 2:00PM	17:00 PM to 19:00PM
Gonabela Bridge	464	427	443
Gachtala	552	773	349
Gonai Bridge	121	65	166

Source: Field Survey, April, 2018

The vehicular movements observed during the surveys were mostly for the regular activities. Construction activities of the Power Plant has been started and traffic volume at the access road of Babubari has increased compared to the traffic volume during preconstruction phase of the power plant. The detail survey findings regarding the traffic volume surveys as well as the detail calculations are attached in **Table F.1, F.2 and F.3 of APPendix-IV.**

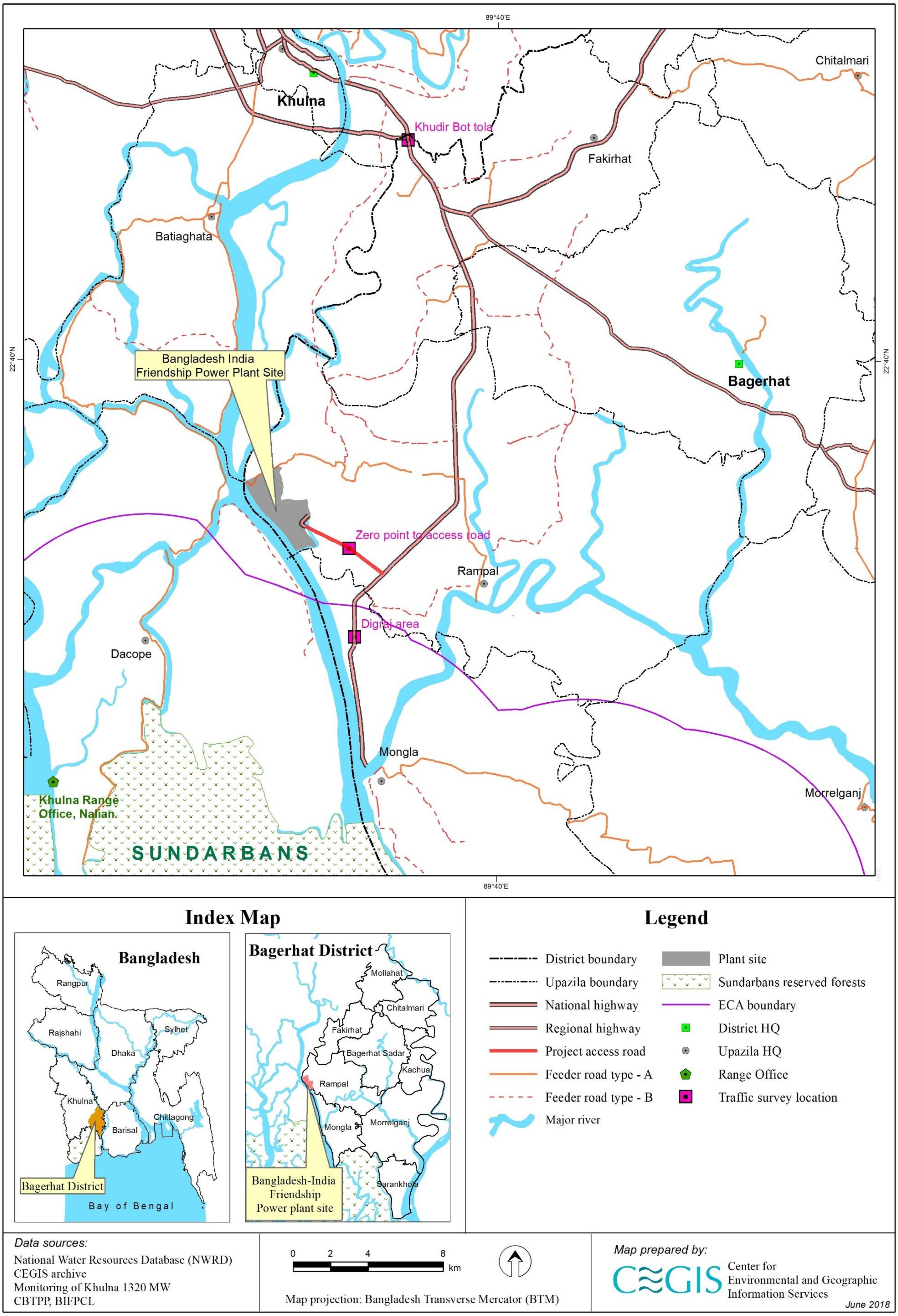


Figure 2.45: Traffic Monitoring Locations

2.11 Water resources Monitoring Plan

Bangladesh is a land of rivers. Rivers in different regions have different characteristics. Rivers in the northern parts have fluvial characteristics while it is tidal in the southern parts of Bangladesh. Passur River is one of the dynamic and major rivers in the southern parts of Bangladesh. Rampal power plant is being constructed along the left bank of the Passur River (Figure 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 riverbank erosion & erosion and shifting of the bankline of the Passur River with a half-yearly basis may facilitate the proper management and planning of the power plant.

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

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

Collection and Processing of Images

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

Delineation of Banklines

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

2.11.2 Monitoring of Erosion and Accretion

For monitoring the half yearly riverbank erosion and accretion at the project site, Mongla, Harbaria and Akram point areas, banklines of the Passur River were superimposed with each other. It was found that the river is very stable and there is no riverbank erosion or accretion as the river has not shifted from January 2018 to June 2018 (Figure 1). Hence, there is no bankline shifting of the Passur River along its both banks during its passage from Chalna to Hiron Point (Figure 2.46).

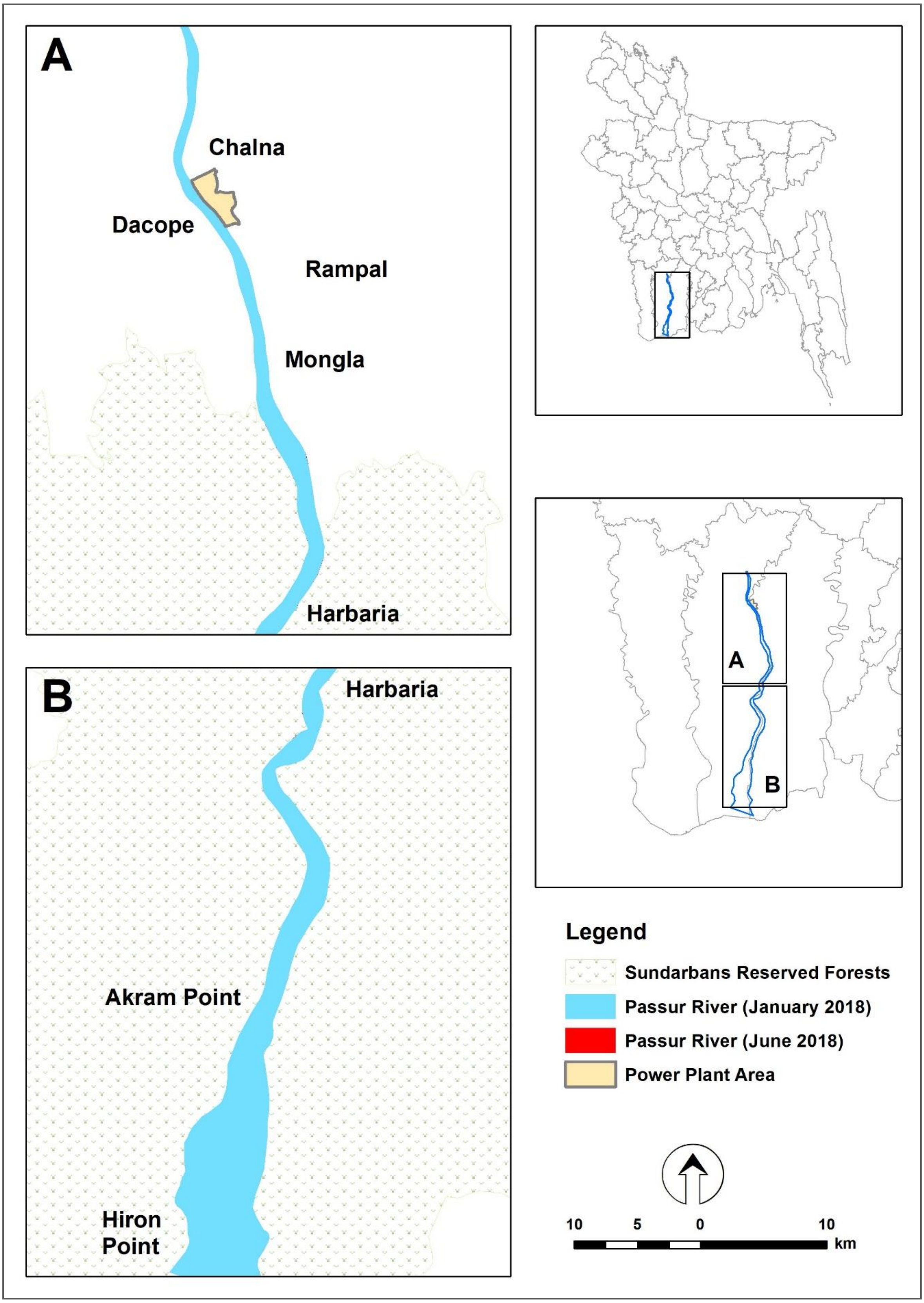


Figure 2.46: Riverbank Erosion and Accretion of the Passur River from January to June 2018

2.11.3 Monitoring changes in tidal penetration and inundation

All the data and analysis on tidal inundation and penetration will be incorporated in the next report.

2.11.4 Monitoring of Sedimentation

For river bed monitoring sediment samples have been collected and submitted to the laboratory for analysis. Sediment analysis results are yet to receive from the laboratory. After collecting the data and associated analysis result will be incorporated in the next monitoring report (18th quarterly report).

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 all four quarters for the session of 2014-15, 2015-16 and 2016-17 as well as 1st, 2nd, 3rd and 4th (13th, 14th, 15th and 16th in total) quarter of 2017-18 were completed and reported earlier. This chapter contains the findings of 17th quarter and comparison with the earlier sixteen (16) quarters.

3.1.1 Location of Monitoring Sites

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

Table 3.1: The Sampling Locations for monitoring of Fisheries Resources

Site	Capture Habitat Location	Site	Capture Habitat Location
A	Akram Point	F	Jongra
B	Haldikhali	G	Chandpai
C	Charaputia	H	Mongla Port
D	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		

3.1.2 Selection of Parameters

According to the 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 as capture and shrimp/fish farm production.

3.1.3 Methodology

Fish Habitat Status

Fish habitat status was monitored through determination of Habitat Suitability Index (HSI) by applying numerical habitat model based on the habitat classification and sensitivity of fish diversity and survival success of different life stages of fish to abiotic and biotic factors. Fish habitat classification was analyzed by calculating 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 through analyzing the common species found in the Catch Assessment Survey and on the basis of 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 which generates two types of values. The first one includes values from 0 to 1 expressing normalization scores for species richness status and the second one includes values from one (01) to values equal to the total number of species found in the sample which suggests that how many species are dominant in this fish community. Fish community structure has also been analyzed through counting the length-wise fish individuals.

Fish-Shrimp Culture Practice

Three farms within the direct impact zone of the proposed Power Plant were surveyed for monitoring shrimp/fish farm. Stocking pattern of the shrimp/fish farm is the major issue for successful production, because of having natural genetic resources from the wild source of the Passur River System. Moreover, mortality rate are 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 were collected from the selected farms for the last catch.

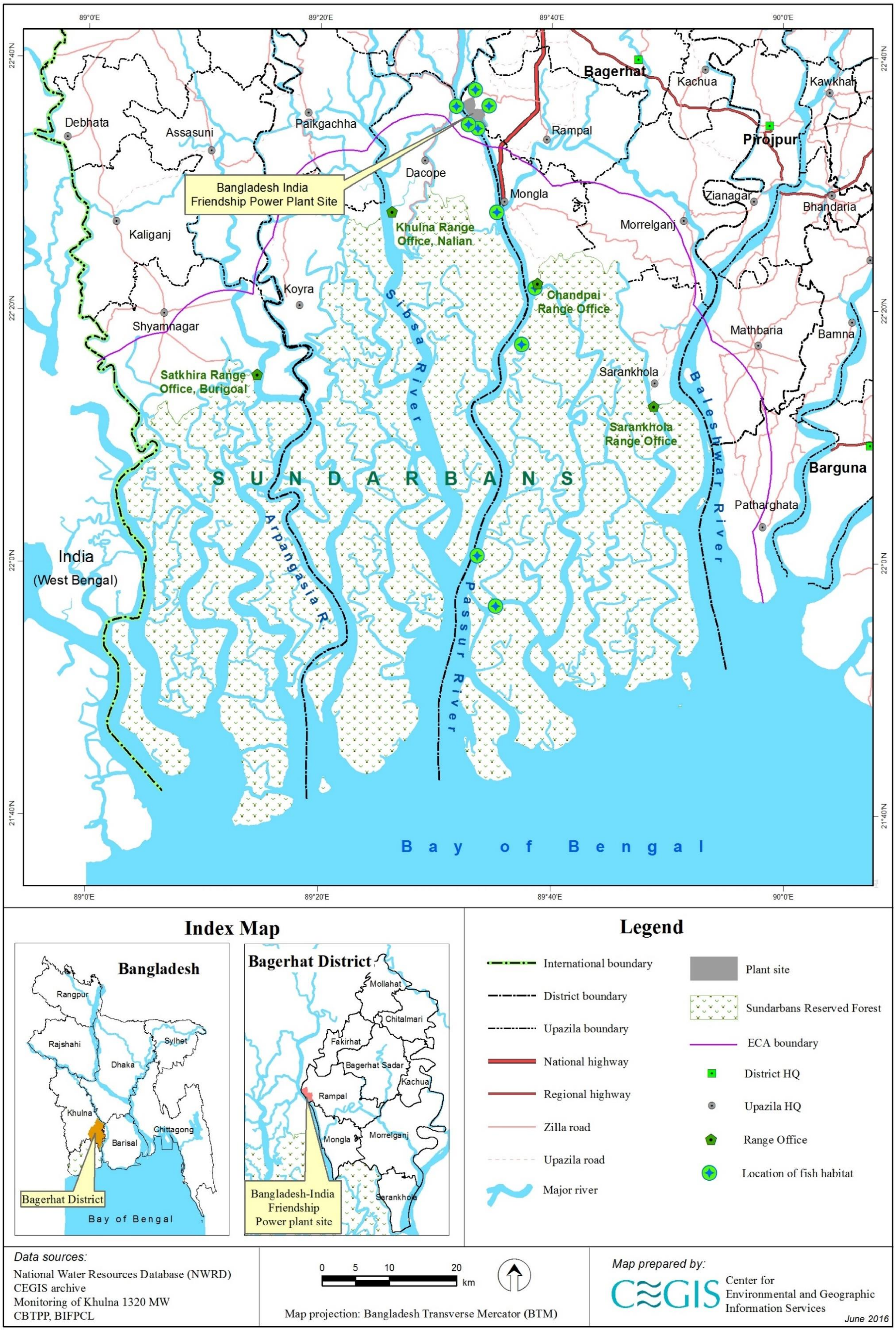


Figure 3.1: Fisheries Resources monitoring locations

3.1.4 Status of monitoring

Following the quarterly monitoring of the 2014-15, 2015-16, 2016-17 and 2017-2018 (up to 16th quarter monitoring), 17th quarter monitoring of session 2018-19 was conducted during the period from 25 July to 02 August, 2018. No fishing activities were observed in Akram Point (A), Haldikhali Khal (B), Charaputia (C), Bhodra Khal (D) and Jongra Khal (F) during field visit of this monitoring.

3.1.5 Fish Habitat Status

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

3.1.6 Habitat Classification

Habitat classification was analyzed by using the length-wise distribution of different fish species in the sampling sites. The length of different life stages of fish species were identified and evaluated from literature review. Linkage distance was calculated with the similarity in distribution. The entire stretch of the Passur River System consists of three major behavioral habitats. The sampling sites were classified on the basis of abundance of fish species of different life stages in those habitats. The table below shows the classification of seven (07) sampling sites for 01 to 15th quarter monitoring and ten (10) sampling sites for 16th and 17th quarter monitoring according to the ToR in respect of habitat uses for previous quarters of fisheries monitoring (**Table 3.2**).

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

Monitoring Quarter	Type of Habitat Use
1st QMR (April, 2014)	Grazing Ground; Grazing and Breeding Ground
2nd QMR (July, 2014)	Grazing Ground; Spawning and Nursery Ground
3rd QMR (October, 2014)	Grazing Ground; Grazing and Breeding Ground; Spawning, Nursery and Grazing Ground
4th QMR (January, 2015)	Grazing Ground; Grazing and Breeding Ground; Spawning, Nursery and Grazing Ground
5th QMR (April, 2015)	Grazing Ground; Nursery Ground; Spawning and Nursery
6th QMR (August, 2015)	Grazing, Breeding Ground; Spawning, and Nursery Ground
7th QMR (October, 2015)	Grazing Ground; Nursery Ground and Growing and Feeding
8th QMR (January, 2016)	Nursery and Feeding Ground; Growing and Feeding
9th QMR (April, 2016)	Spawning and Nursery Ground; Feeding and Growing Ground
10th QMR (July, 2016)	Nursery Ground; Feeding and Breeding Ground
11th QMR (October, 2016)	Breeding and Spawning Ground; Feeding and Grazing Ground
12th QMR (January, 2017)	Grazing and Spawning Ground; Nursing Ground
13th QMR (April, 2017)	Grazing and Feeding Ground; Nursing Ground
14th QMR (October, 2017)	Grazing and Feeding Ground; Nursing Ground
15th QMR (January, 2018)	Grazing and Feeding Ground; Nursing Ground
16th QMR (April, 2018)	Grazing and Feeding Ground; Nursing Ground
17th QMR (July, 2018)	Spawning and Nursery Ground

During the 17th quarterly monitoring of 2017-18 four major habitats - i) Spawning and Nursery Ground, ii) Nursery Ground with Feeding and Growing Capacity, iii) Growing and Feeding Ground and iv) Omni-ground were also identified as more or less similar as found in the month of July during previous monitoring year and are shown in the **Figure-3.2.**

Spawning and Nursery Ground

The Confluence of Harbaria Khal and the Passur River (E) among the sampling sites were identified as spawning ground for very high abundance of fry fishes.

Nursery Ground with Feeding and Growing Capacity

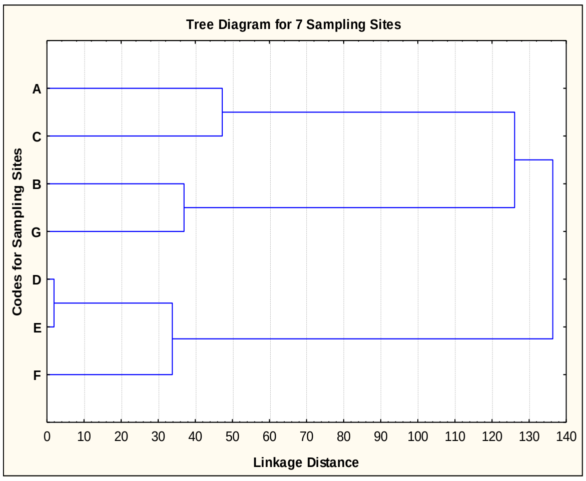
Chalna Point (J) among the sampling sites was identified as the nursery ground for abundance of fry and fingerling fishes with having capacity to support growing and feeding for juvenile and adult fishes.

Growing and Feeding Ground

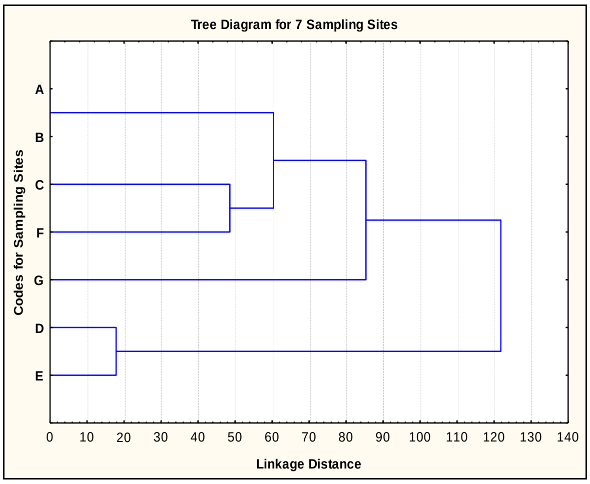
Mongla Point (H) among the sampling sites was identified as the growing and feeding ground for especially juvenile and age-1 adult of medium to large-sized fishes and adult of small-sized fishes.

Omni-ground

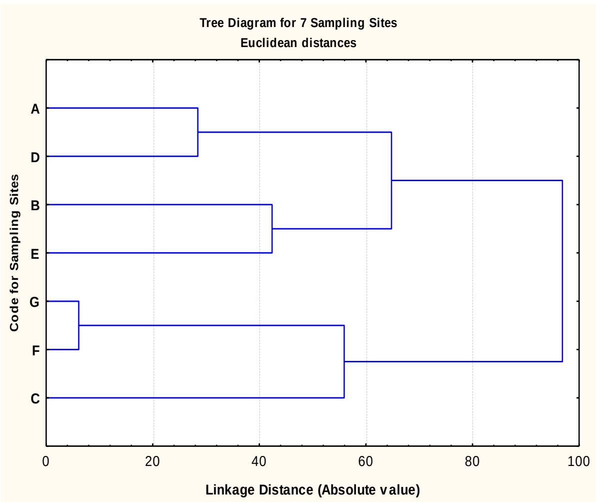
Among the sampling sites, Maidara-Passur Confluence (I) and Sheola Khal at Chandpai (G) were identified as the Omni-gr ound for supporting multi-group of fish species of different length-groups.



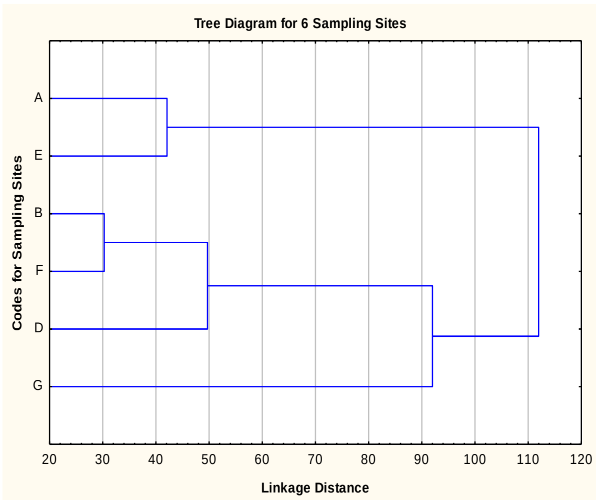
1st Monitoring, April, 2014



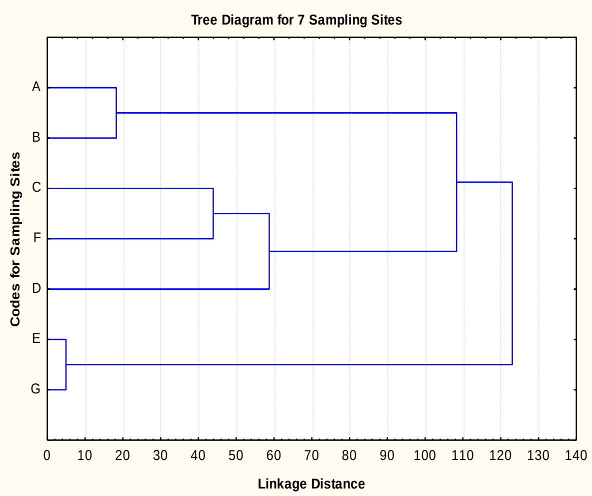
2nd Monitoring, July 2014



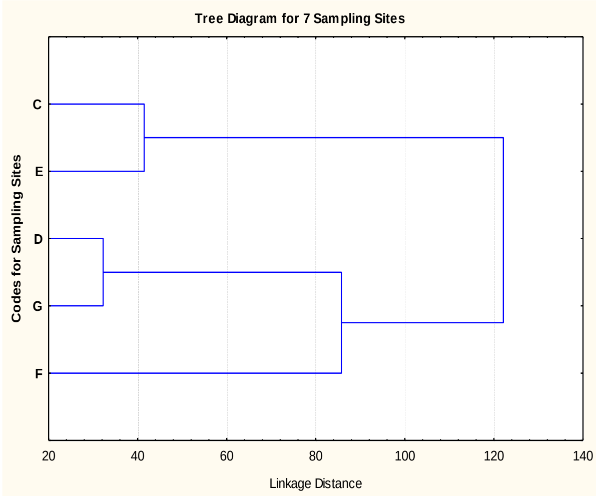
3rd Monitoring, October, 2014



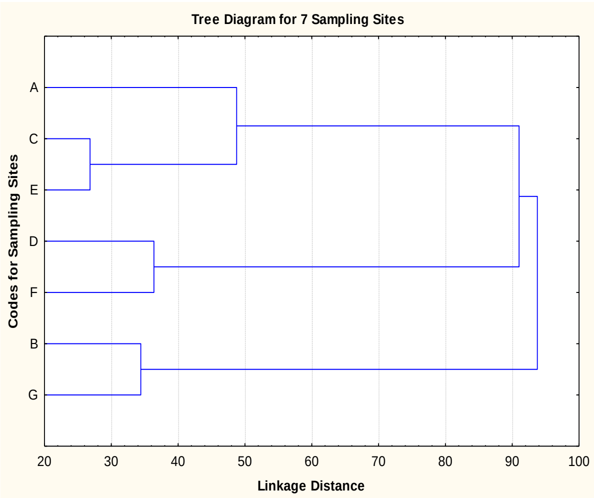
4th Monitoring, January 2015



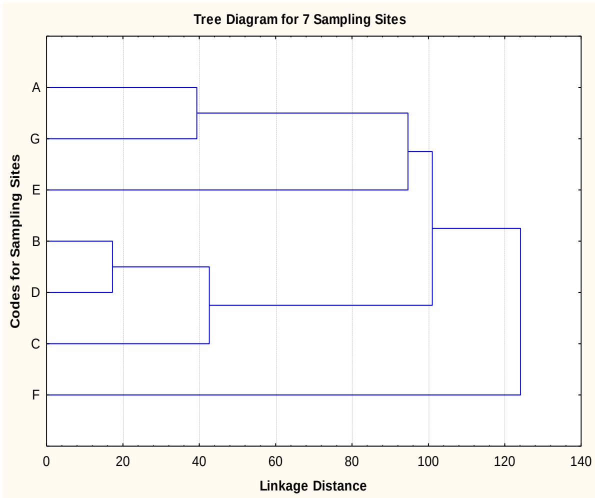
5th Monitoring, April, 2015



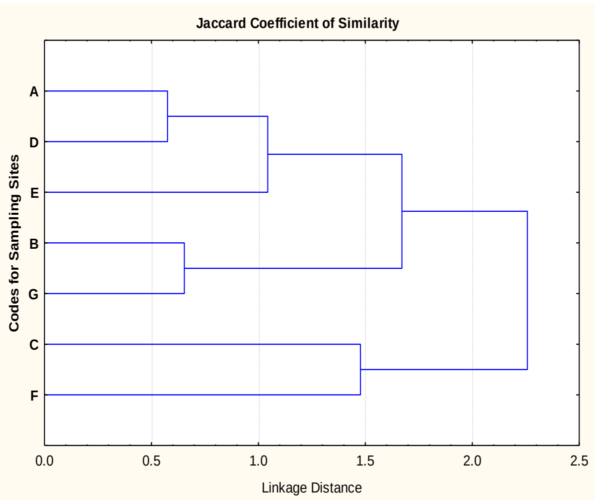
6th Monitoring, August, 2015

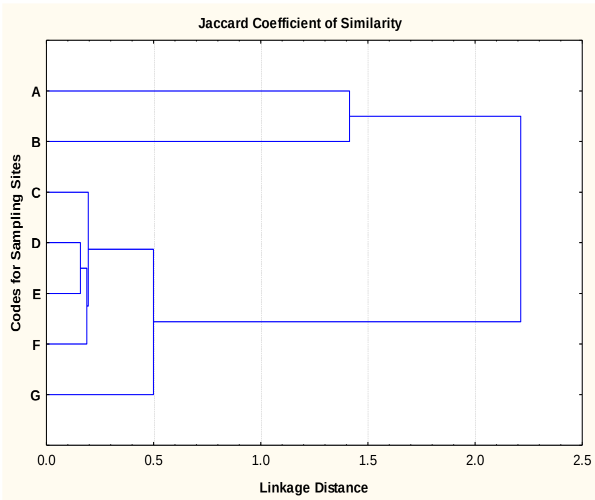


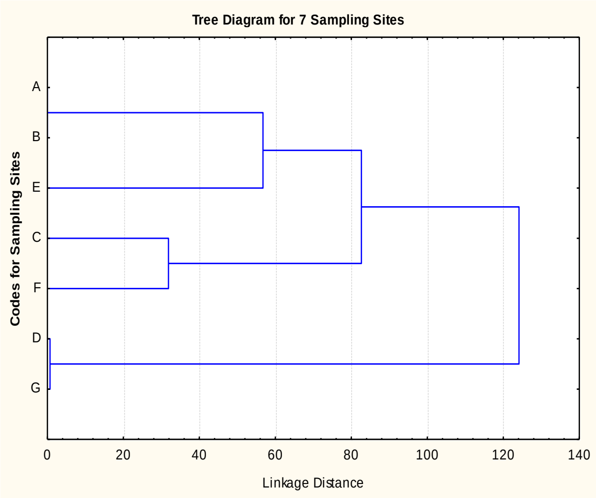
7th Monitoring, October, 2015



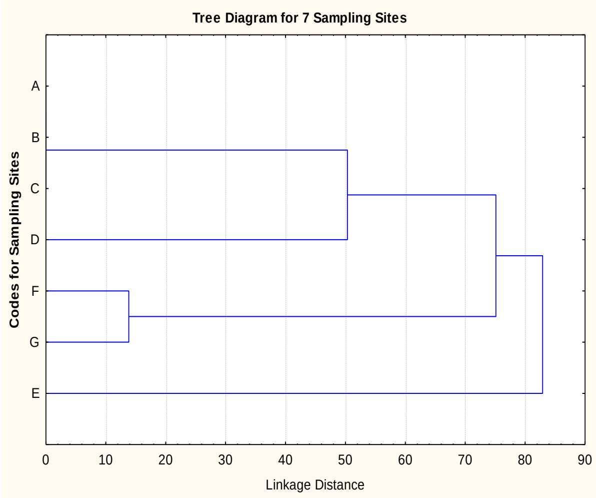
8th Monitoring, January, 2016



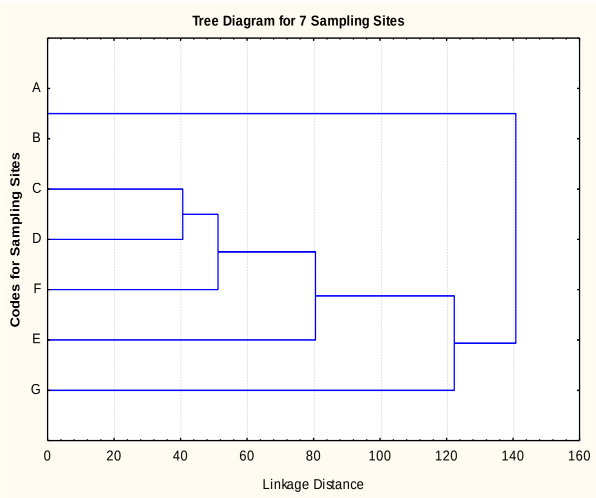




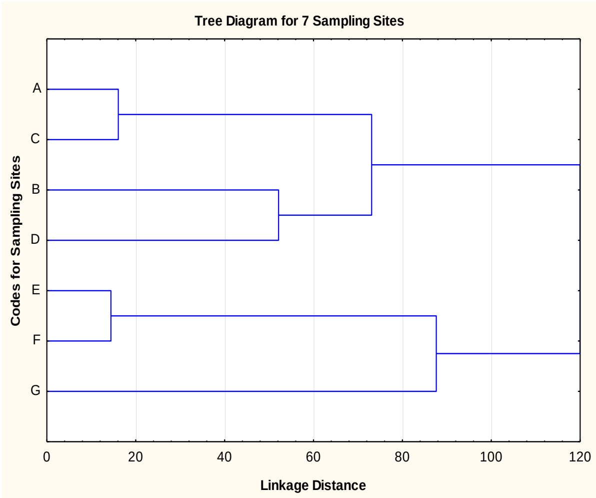
9th Monitoring, April, 2016



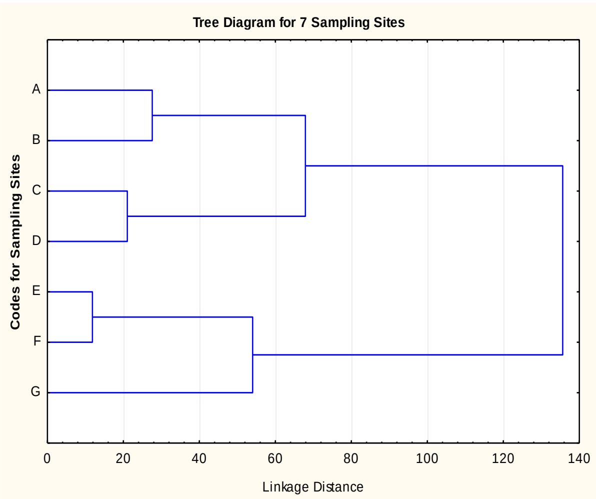
10th Monitoring, July, 2016



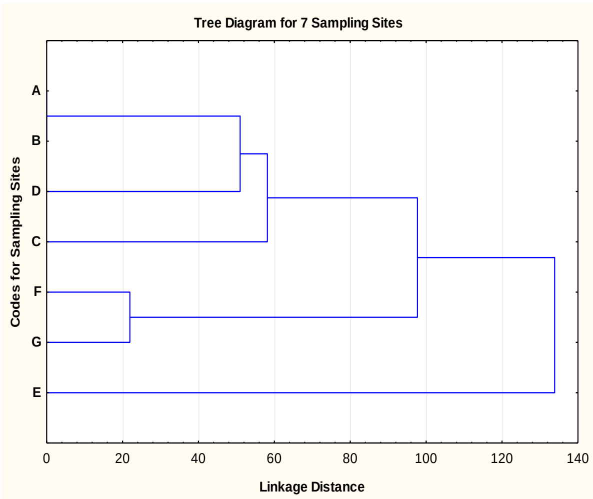
11th Monitoring, October, 2016



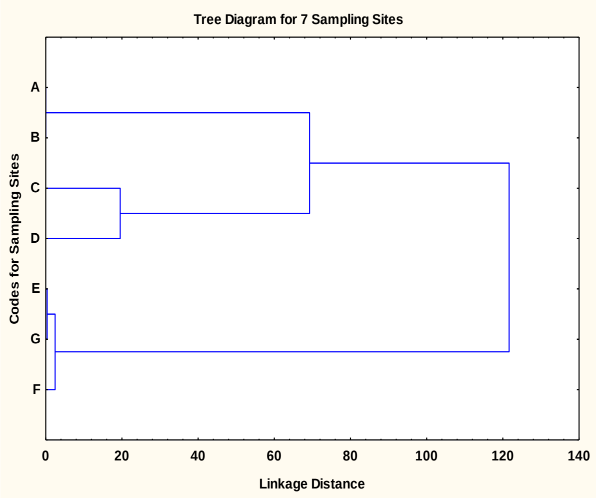
12th Monitoring, January, 2017



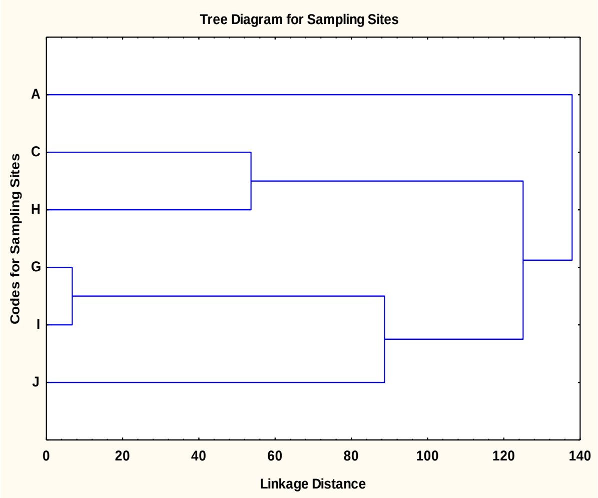
13th Monitoring, April, 2017



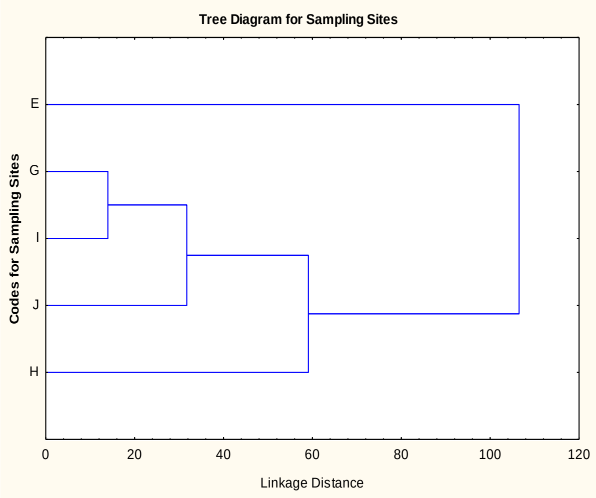
14th Monitoring, October, 2017



15th Monitoring, January, 2018



16th Monitoring, April, 2018

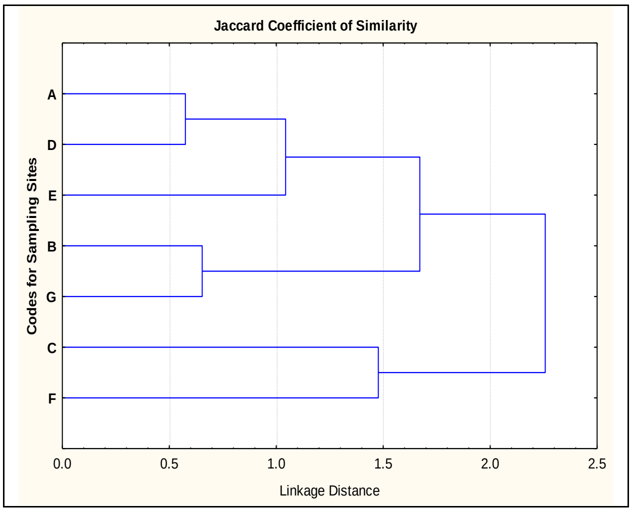


17th Monitoring, July, 2018

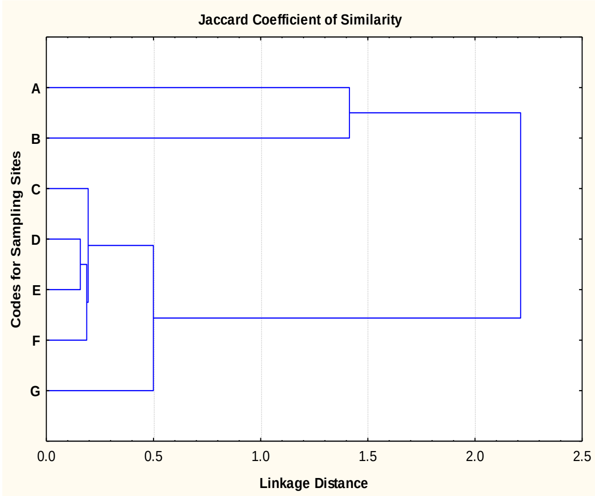
(Note: Life stages are identified through length measurement of the fish individuals)

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

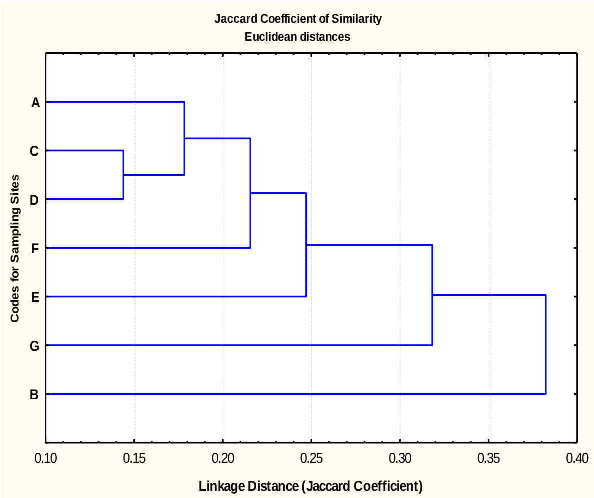
The dendogram indicated the distances among the JI (Jaccard Coefficient Index) indices which are opposite to the JI values. It has found that the length-wise distribution relationship varied not only with the seasons but also from year to year. The JI value between Harbaria (E) and Mongla Point (H) sampling sites during this quarterly monitoring in 2018-19 (17th) was also the highest (**Figure 3.3**) which indicates the maximum similarity in species occurrence between these two sites among the 10 sampling sites.



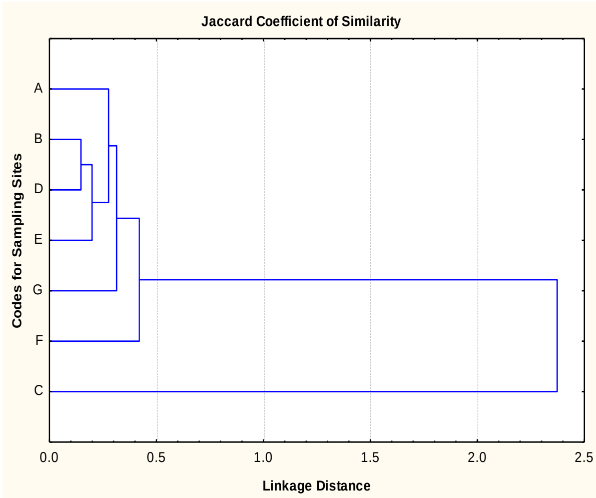
1st Monitoring, April, 2014



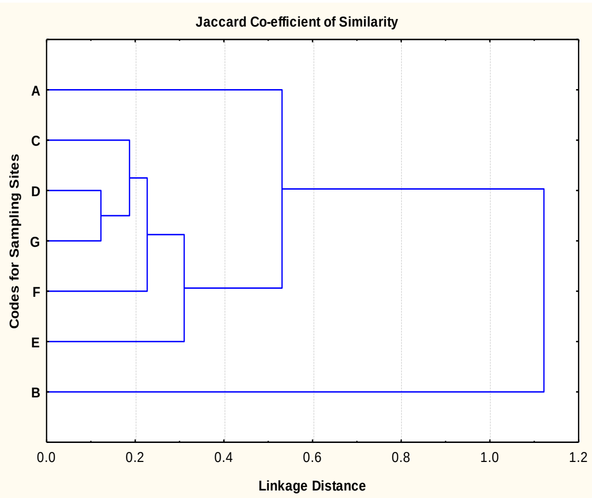
2nd Monitoring, July 2014



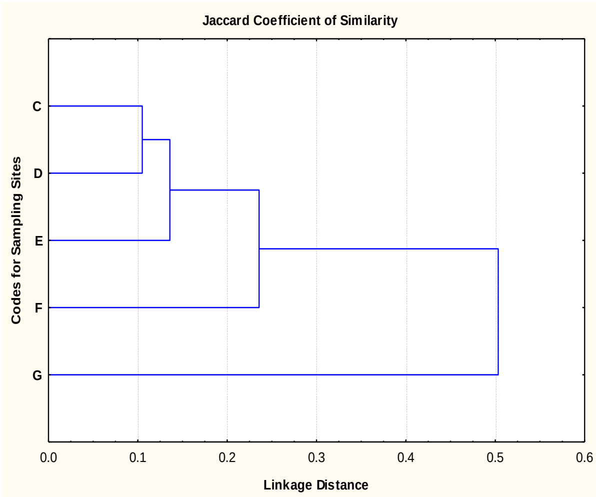
3rd Monitoring, October, 2014



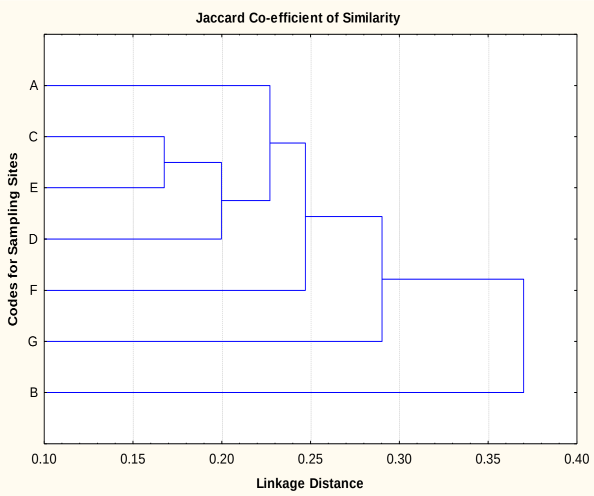
4th Monitoring, January 2015



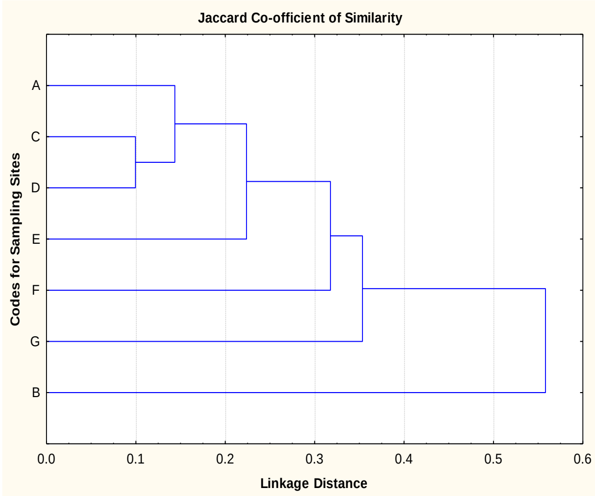
5th Monitoring, April, 2015



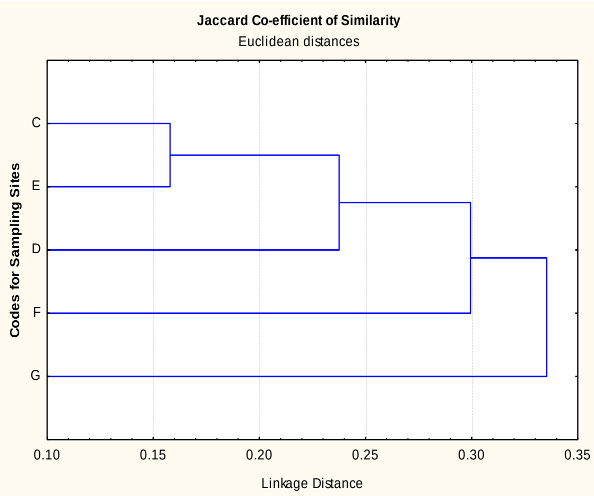
6th Monitoring, August, 2015



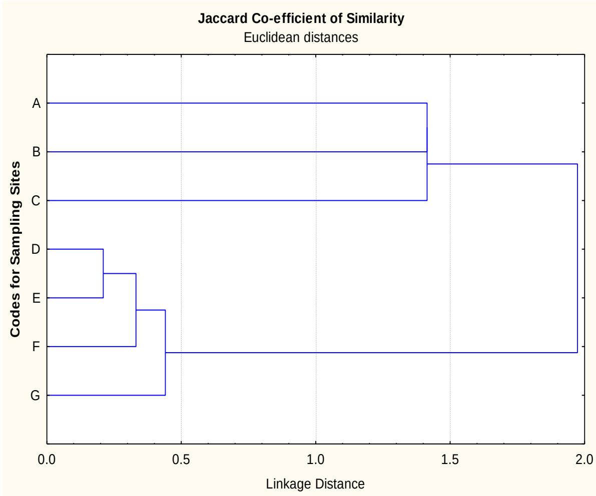
7th Monitoring, October, 2015



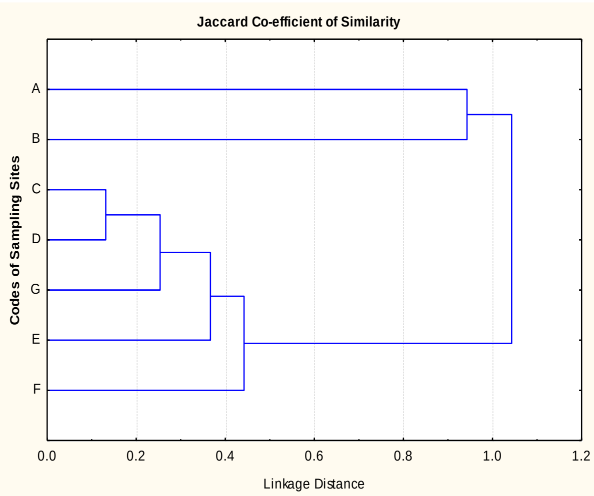
8th Monitoring, January, 2016



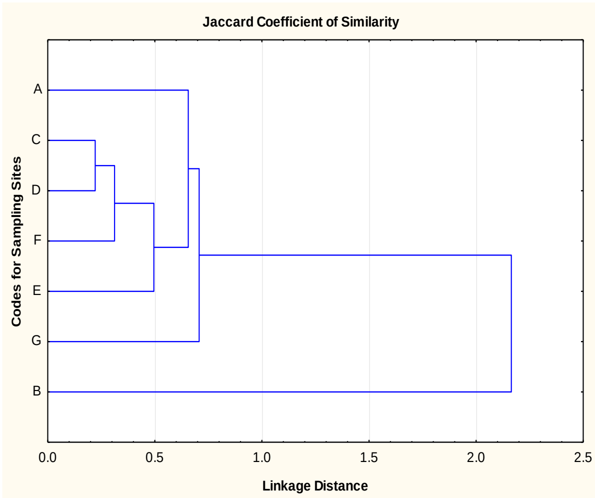
9th Monitoring, April, 2016



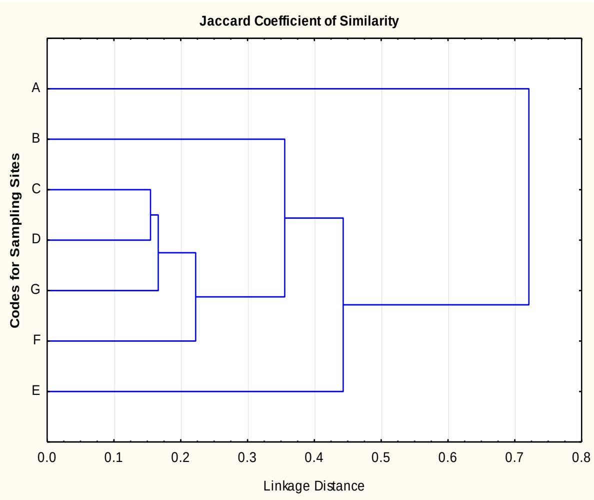
10th Monitoring, July, 2016



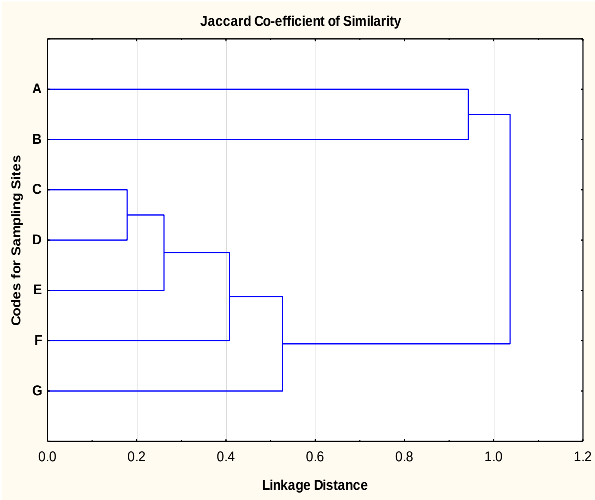
11th Monitoring, October, 2016



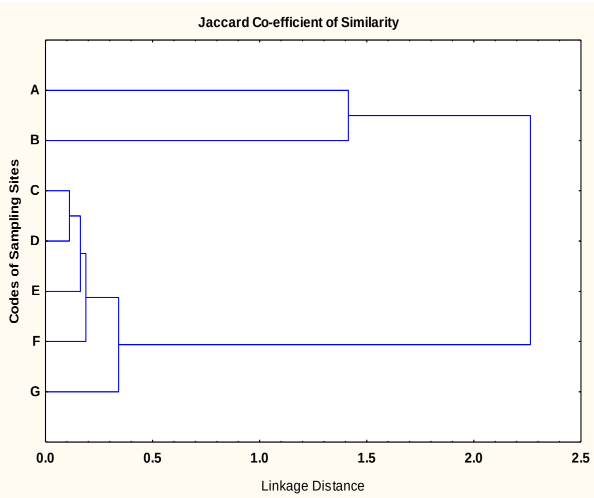
12th Monitoring, January, 2017



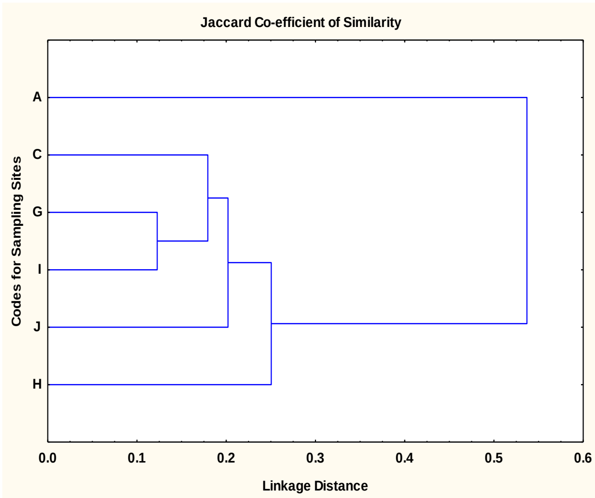
13th Monitoring, April, 2017



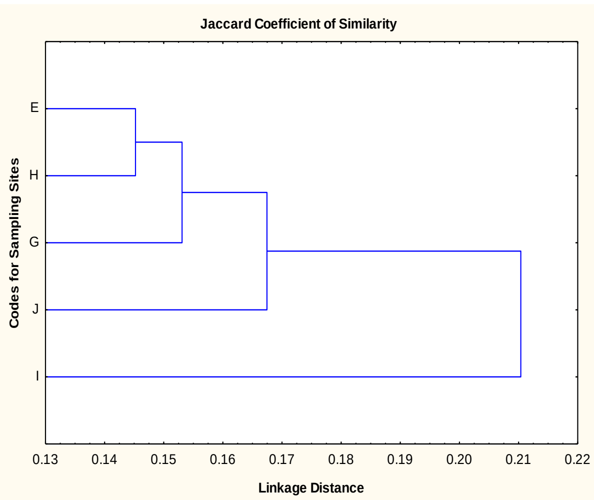
14th Monitoring, October, 2017



15th Monitoring, January, 2018



16th Monitoring, April, 2018



17th Monitoring, July, 2018

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

Habitat Suitability Index (HSI)

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

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

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

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

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

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

3.1.7 Fish Diversity

Shannon-Weiner Index

Species evenness in the monitoring year of 2018-19, also varied among the sampling sites. Highest Shannon-Weiner index was found in Sheola Khal at Chandpai (0.85 out of 16 species) indicating most evenly distributed fish species. On the contrary, lowest evenness was found at Harbaria (0.31 out of 17 species) (shown in the **Table 3.4**). Both the number of fish species found in in-situ catch and the evenness of their distribution within the sampling sites have shown high variation with the changing of seasonal and yearly bio-physical conditions. The different fish species caught in different catches are shown in **Figure 3.4**.

Table 3.4: Shannon-Weiner Index for the selected sites

Sl	Site	Species Number	Shannon-Weiner Index	Simpson's Index	Dominant Fish No.
1	Akram Point	0	0	0	0
2	Haldikhali	0	0	0	0
3	Harbaria	17	0.31	0.38	2
4	Chandpai	16	0.85	0.88	9
5	Mongla Point	18	0.49	0.65	3
6	Baro Durgapur	10	0.65	0.71	3
7	Botiaghata, Chalna Point	14	0.52	0.65	3

Fish Species Richness (FSR)

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

Fish Species Richness in this monitoring phase varied with the sampling sites. Maximum FSR was obtained in Sheola Khal at Chandpai (n=9), while very low was recorded at Harbaria (n=2). Different scenarios of richness were found during this quarter in comparison to the previous monitoring years. Among the habitats at the upstream portions of the Passur River, Mongla Point was found as home of rich assemblage of Bairagi, Horina Chingri and Gulsha Tengra; Maidara River was of Bagda, Kuchia and Tengra; and Chalna Point was of Chela, Horina and Motka Chingri. Among the habitats at the down stream portions, Chandpai was rich in Bairagi, Banspata, Chela, Cheng, Daitna, Desi Tengra, Gulsha Tengra, Kain Magur and Chapila; Harbaria was of Motka and Horina Chingri. No catch was observed in Jongra, Bhodra, Charaputia, Haldikhali and Akram Point of monitoring of this quarter.

[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 to measure the species richness in the sampling sites.

Table 3.5: Site Wise Species Diversity using Shannon–Weiner Index

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

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

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

Table 3.6: Site wise Rich Species Number

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

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

Rupchanda in 1st Quarter of 1st Year

Chela in 2nd Quarter of 1st Year

Phesa, Chela, Hilsa, Gagla Tengra

Harina Chingri

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

Amadi Chela

Banspata

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

Adult Poma in Chalna Point

Fry of Bagda at Chalna Point

Meth and Gagra Tengra

Gagra Tengra

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

Mutkure and Paissa

Khorsula


Menu


Vetki

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


Gulsha Tengra, Bele, Aswine Bele and Paissa


Gangania


Telcupa


Golda


Kain Magur


A Mix of Culture and Capture Fishes

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


Tau Paissa


Bele


Horina Chingri


Gulsha and Gagra Tengra


Jaba


Female Gulsha Tengra


Fry Fishes


Chata Bele

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


Kain Magur | Banspata, Vetki, Koidda and Poma

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


Poma and Tapsi | Tapsi

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


Miscellaneous Fish Species | Hilsha


Tapse


Poma and Tapse

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


Catch Sample


Juvenile of Kain Magur


Khayra Chela


Jevenile of Pangas

Brood Paissa

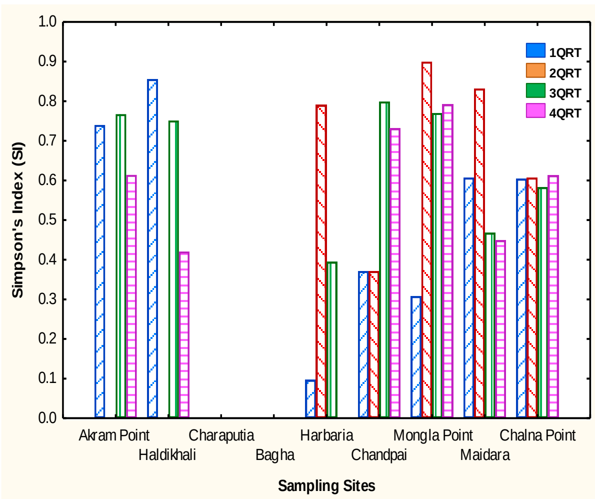
Paissa and Gagra Tengra

Aswene Bele, Daitna, Tapse and Chitra

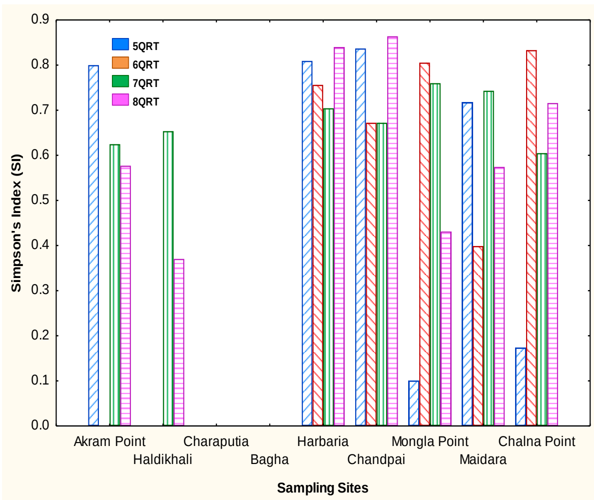
Dry Fish of Khayra Chela

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

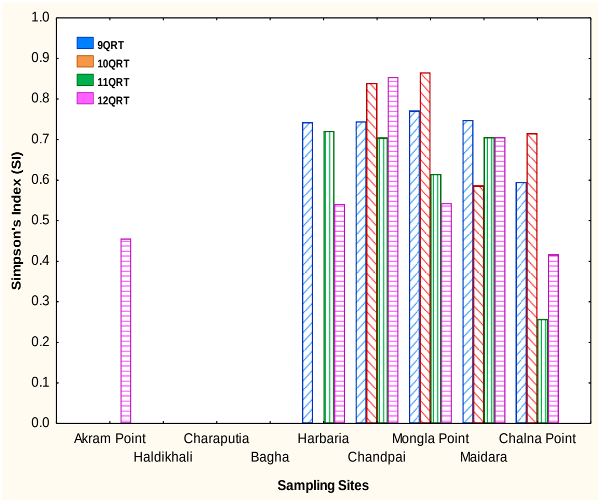
Figure 3.4: Length-wise distribution of fish species



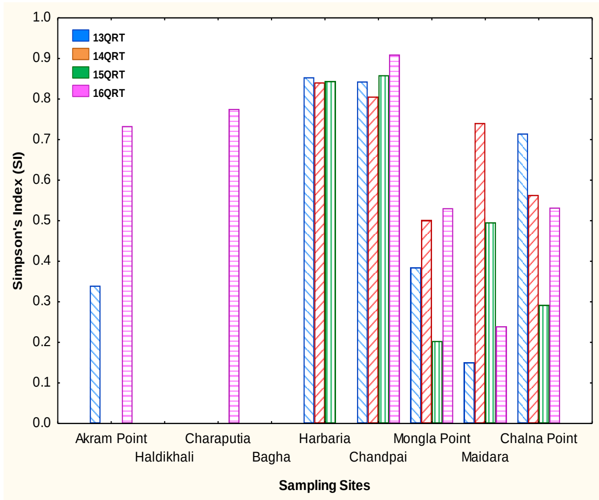
2014-2015



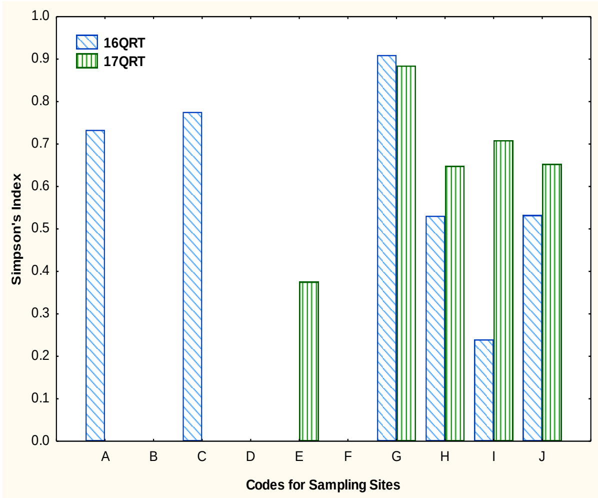
2015-2016



2016-2017



2017-18



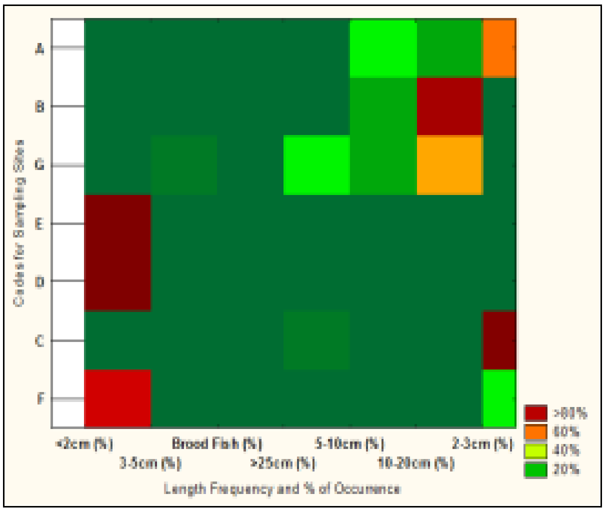
2018-19

(FSR is identified though Simpson's Index)

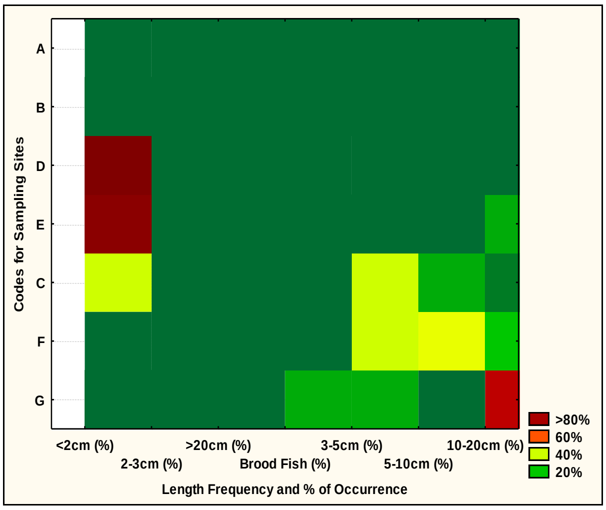
Figure 3.5: Site-wise fish species richness (FSR) in the Passur River System

3.1.8 Fish Community Structure

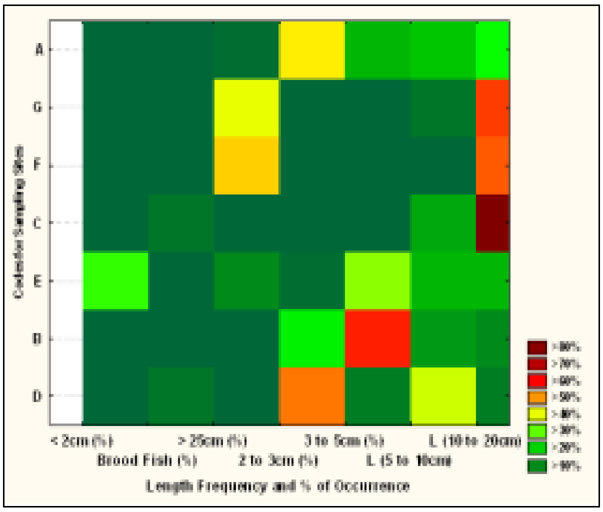
Fish community structure was analyzed through counting the length-wise fish individuals (**Figure 3.4**). Tables **D.2** and **D.3** of **Appendix IV** and **Figure 3.6** represents the 17th quarter of monitoring year of 2018-19 show that fries of fin fish were widely distributed from middle stretches to the upper stretches (Harbaria to Chalna Point) and juveniles and adult age group in Sheola Khal at Chandpai, Maidara and Chalna Point of the Passur River system. Among the fishes Bairagi, Banspata, Bele, Chela, Gagra Tengra, etc. were more between the two sampling sites. Moreover, fries were dominant at the Harbaria-Passur Confluence. Adults of large-sized fishes were not observed during monitoring of this quarter.



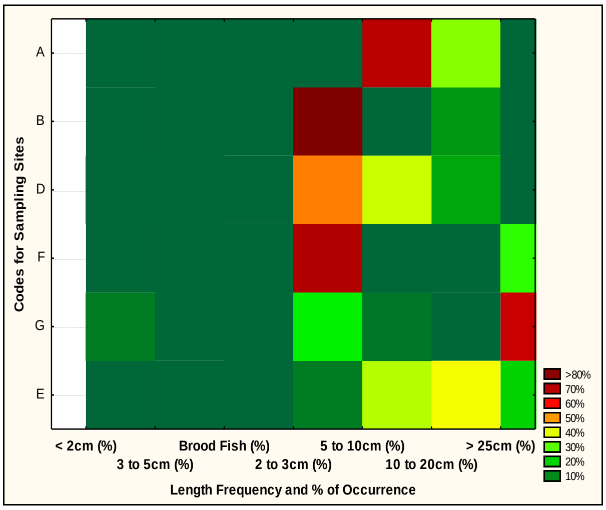
1st Monitoring, April, 2014



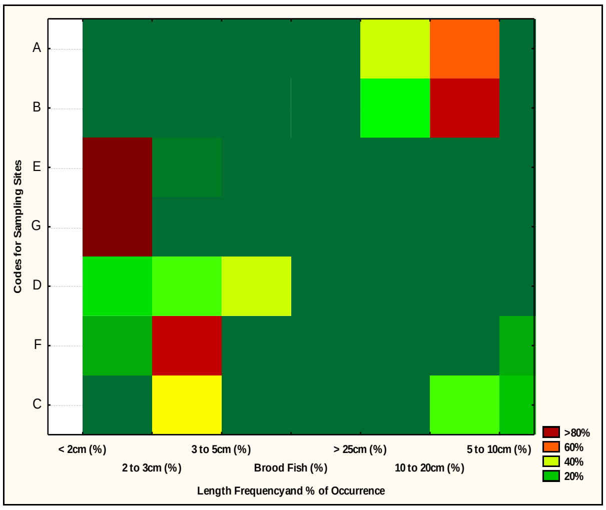
2nd Monitoring, July 2014



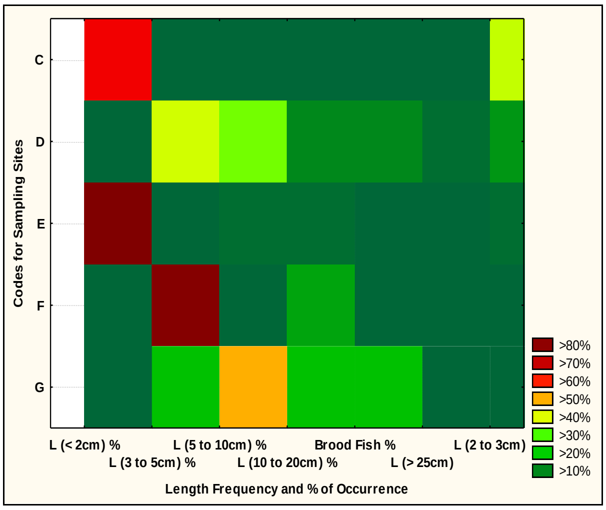
3rd Monitoring, October, 2014



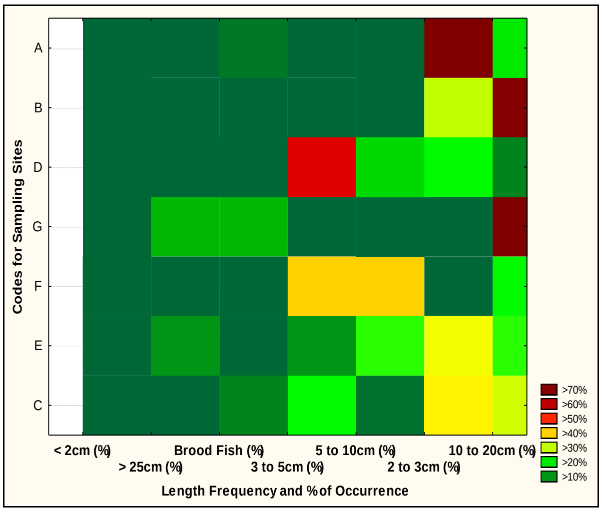
4th Monitoring, January 2015



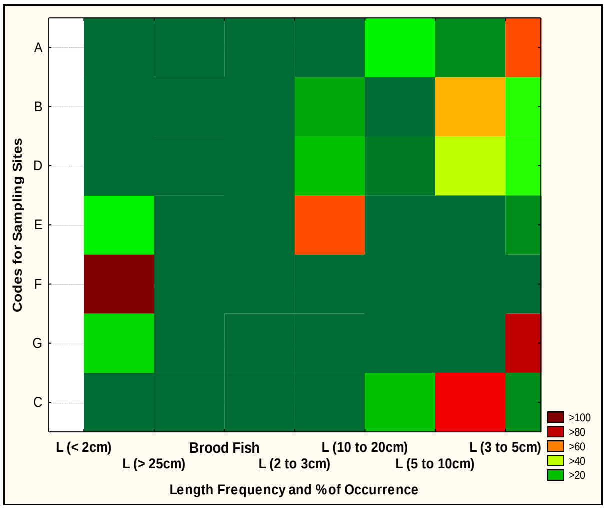
5th Monitoring, April, 2015



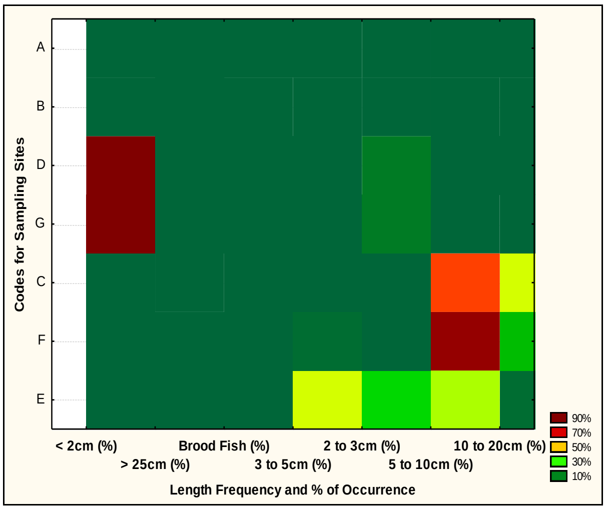
6th Monitoring, August, 2015



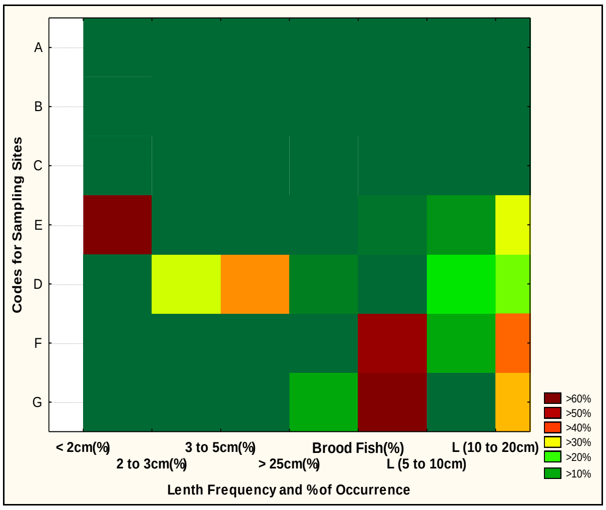
7th Monitoring, October, 2015



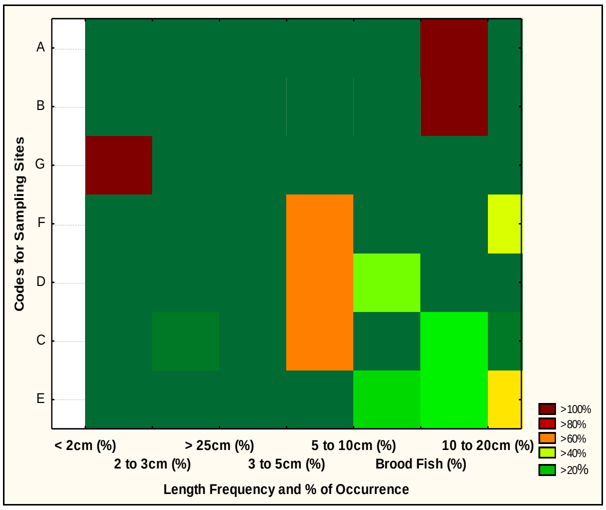
8th Monitoring, January, 2016



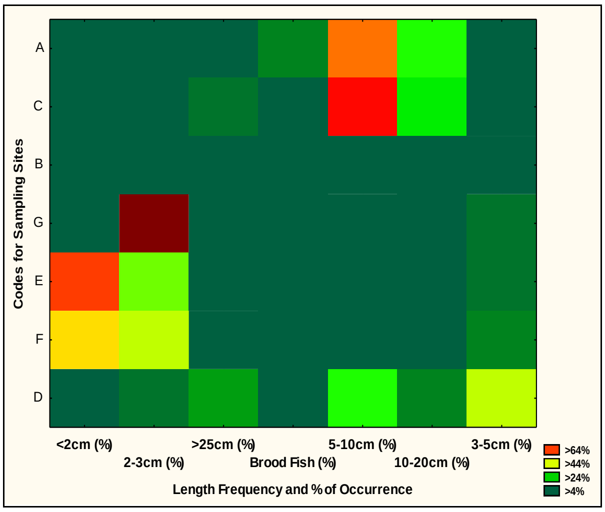
9th Monitoring, April, 2016



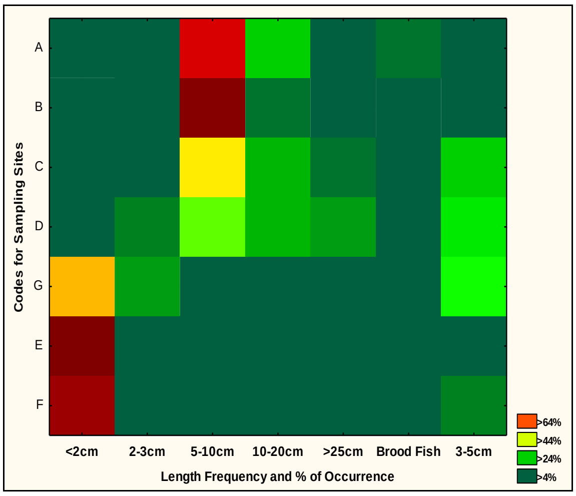
10th Monitoring, July, 2016



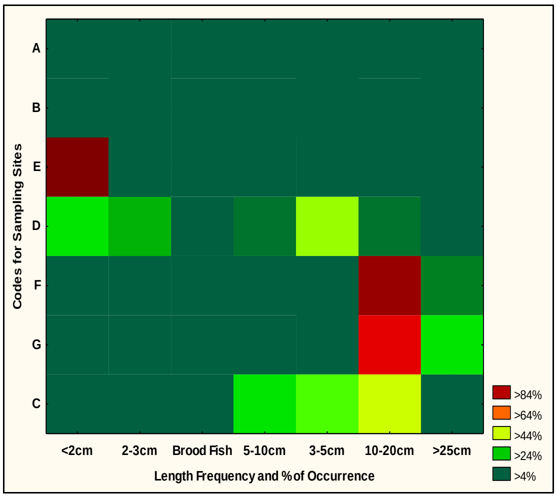
11th Monitoring, October, 2016



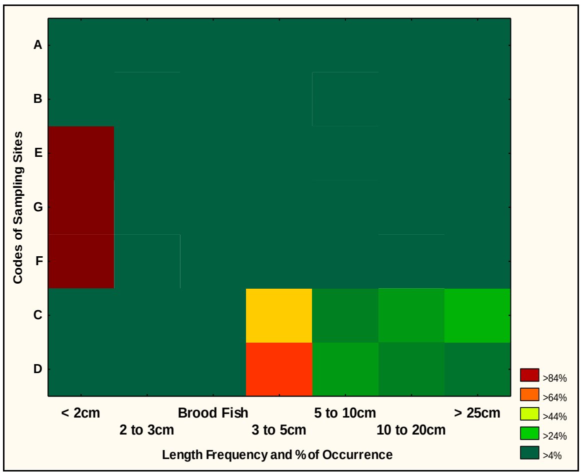
12th Monitoring, January, 2017



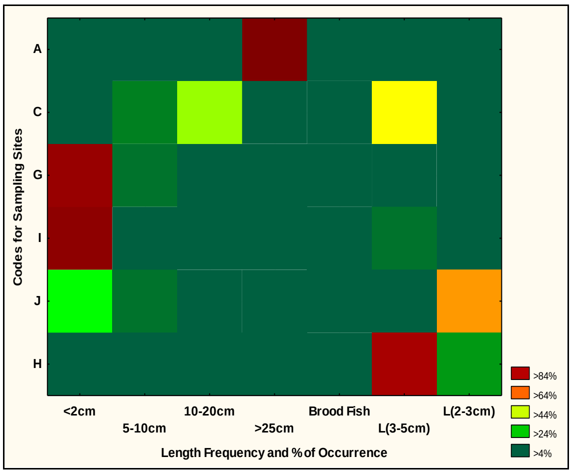
13th Monitoring, April, 2017



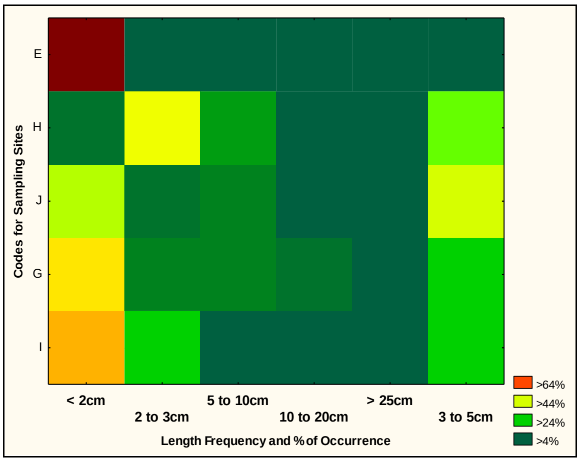
14th Monitoring, October, 2017



15th Monitoring, January, 2018



16th Monitoring, April, 2018



17th Monitoring, July, 2018

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

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

3.1.9 Fish Migration

Migratory Species Diversity

Migratory species were identified by analyzing the common species available in the regular catch from the sampling sites. Fish species like Bairagi (Amadi Chela) attains the maximum abundance among the migratory fish species observed in the 17th quarter of monitoring year, 2018-19. The relative abundance of the migratory species is shown in the **Figure 3.7** below-

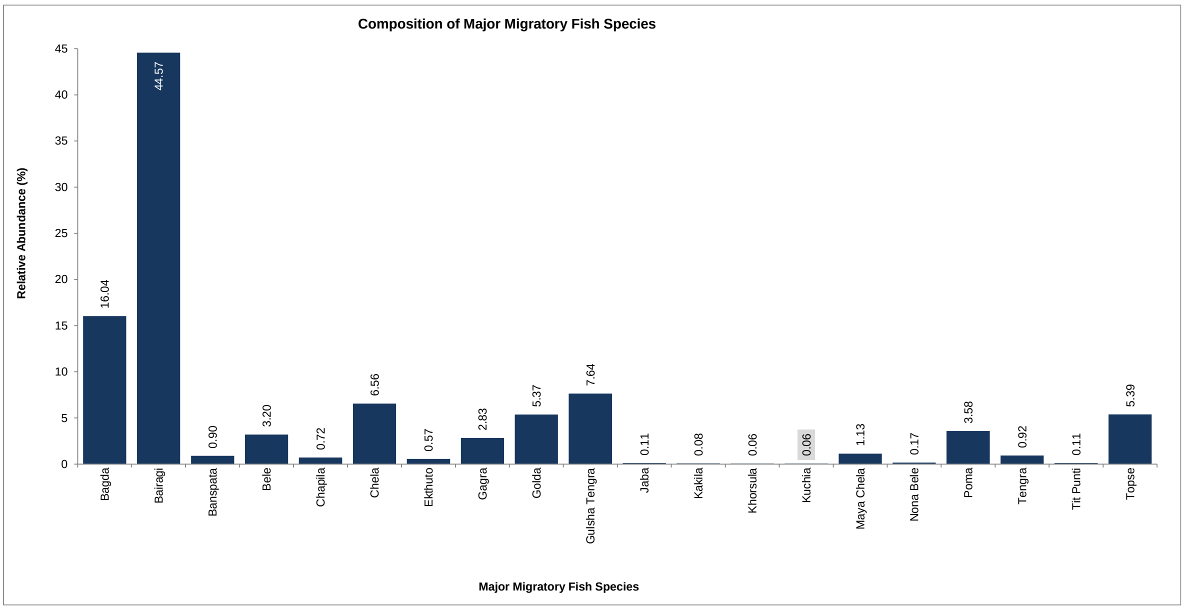


Figure 3.7: Relative abundance of major migratory fish species in sampling sites

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. Bele, Topse, Golda and Chela species were found in maximum sampling sites. Among these species, Bele and Chela were observed to migrate from long distance (**Table D.4 of Appendix IV**).

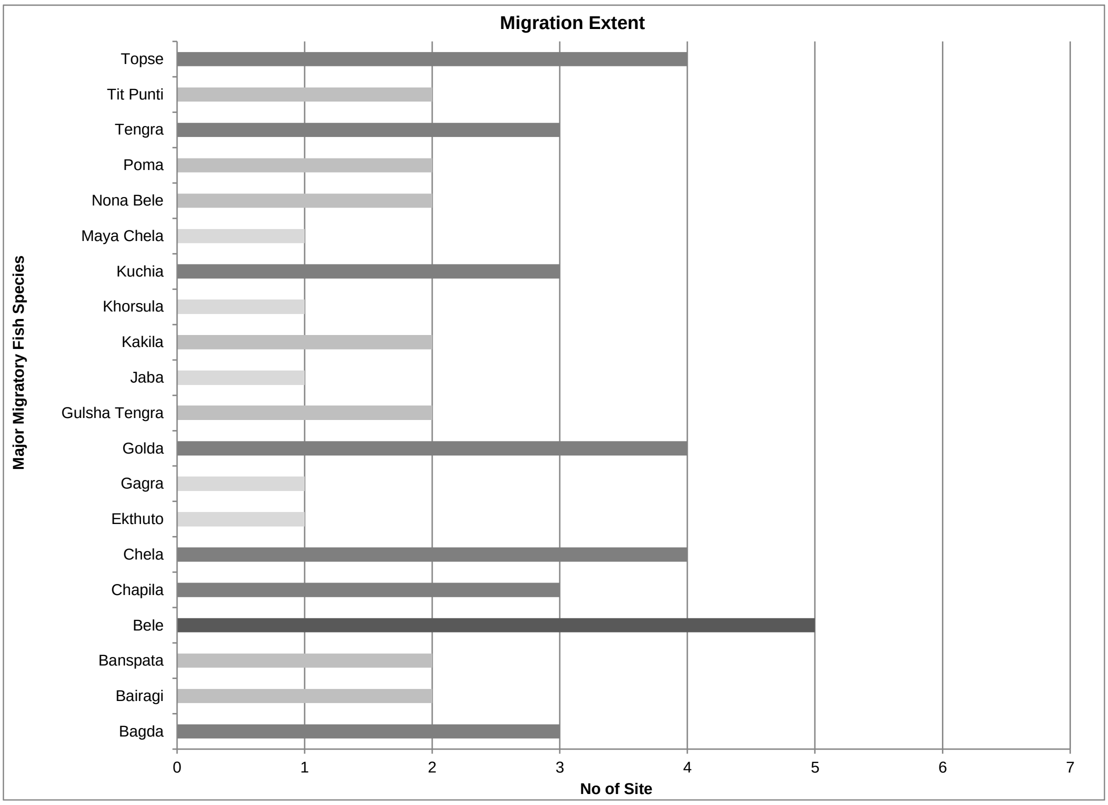


Figure 3.8: Migration extent of major migratory fish species in sampling sites

3.1.10 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.

3.1.11 Stocking Pattern

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

The highest stocking rate in respect of Bagda was observed in case of gher in Kapashdanga and lowest in Rajnagar during this monitoring year, (**Table 3.7**).

Table 3.7: Stocking Pattern of Fish/Shrimp farm

Location	Fish Species	Stocking Density (No/ha)	Stocking Date
Rajnagar *(42.09ha)*	Bagda	4,752	May and June
	Tilapia	1,901	May
	Paissa	1,188	May
	Golda	713	June
	Horina	0	-
	Chali	0	-
	Bele	0	-
Kapashdanga-Muralia *(115.7ha)*	Bagda	8,211	May, June and July
	Rui	212	July
	Catla	69	-
	Tilapia	0	-
	Golda	0	-
	Horina	0	-
	Bele	0	-
	Tengra	0	-
	Paissa	0	-
	Chel	0	-
	Bhangan	0	-
	Chali	0	-
	Vetki	0	-
	Motka	0	-
Chunkuri-2 *(6.07ha)*	Bagda	6,590	June
	Tilapia	3,295	June
	Tengra	0	-
	Paissa	0	-
	Horina Chingri	0	-

Source: CEGIS Field Survey, 2018

3.1.12 Shrimp/Fish Growth Rate and Mortality

During this 17th quarterly monitoring, the highest growth rate has been observed in the case of Gher at Rajnagar and lowest at Gher of Chunkuri-2. The highest mortality has been reported in case of gher in Kapashdanga due to viral infection (**Table 3.8**).

Table 3.8: Growth Rate and Mortality of Fish/Shrimp

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

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

Source: CEGIS Field Survey, 2014, 2015& 2016

3.1.13 Fish Production

Capture Fish Production

The highest productivity In 17th quarter monitoring was found in Mongla Point (Table 3.9). The lowest productivity was found at Harbaria Point in the Pssur and at the Maidara-Passur Confluence Point. it is to be noted that fries found in the catch were not considered in the productivity assessment. On the other hand, there was no fishing was observed at Akram Point, Haldikhali, Bhodra, Charaputia, and Jongra sampling sites.

The present study revealed that the highest catch susceptibility was also found in case of Behundi Jal (20 kg/haul). The following table also expresses that Push Net Jals were most frequently used in all upper and middle reaches in the Passur River System, especially for fry collection. The highest total catch was observed at Mongla Point and lowest at Harbaria Point in the Passur and in the Maidara River during this monitoring phase (Table-3.10 and figure 3.

Table 3.9: Total Catch in Different Gears in the Sampling Sites

Sl. No	Site	Habitat	Gear Name/Type	Haul Duration (hr)	No of Haul	Total Catch (kg)	kg/haul
A	Akram Point	Kukilmoni Khal	Not Found	0	0	0	0.00
B	Haldikhali	Haldekhali Khal	Not Found	0	0	0	0.00
C	Charaputia	Charaputia Khal	Not Found	0	0	0	0.00
D	Bhodra	Bhodra Khal	Not Found	0	0	0	0.00
E	Harbaria	Harbaria Khal	Net Jal	3	3	0.1	0.00
F	Jongra	Jongra Khal	Not Found	0	0	0	0.00
G	Chandpai	Sheola Khal	Behundi	7	1	3.5	3.50
			Net Jal	3	1	0	0.00
H	Mongla Point	Passur River	Behundi	7	1	20	20.00
			Jhaki Jal	0.15	7	0.5	0.07
			Net Jal	3.5	2	1	0.50
I	Maidara	Maidara River	Jhaki Jal	2.5	65	0.65	0.01
			Net Jal	6	8	0	0.00
		Passur-Maidara Confluence	Behundi	7	1	2	2.00
J	Chalna Point	Passur River	Thela Jal	2	150	0.25	0.00

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

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

Table 3.10: Total Catch in the Sampling Sites

Sampling Site	Total Catch (kg)												
	1st QM	2nd QM	3rd QM	4th QM	5th QM	6th QM	7th QM	8th QM	9th QM	10th QM	11th QM	12th QM	13th QM
A	28	0	3	28.7	6	0	20	276.2	0	0	10	2	2
B	65	0	1	3.3	0	0	10	12.8	0	0	4	0	0.25
C	1,559	0.5	8	8.7	1.05	0.33	19.5	173.6	2.8	0	2.6	10	8.13
D	0	12	3	30	10.5	5.08	10.75	189	0	12	18	56	77.5
E	0	0.6	5	0	0.5	0.4	0.6	7.8	5	7.5	2.6	0	0
F	0	1.2	13	3.7	1.5	0.7	0.8	0	1.5	0.8	0.5	0	0.3
G	0	1.6	4	0.7	2.9	0.83	0.825	70	1	0.8	0.1	0	0.12

Sampling Site	Total Catch (kg)				
	13th QM	14th QM	15th QM	16th QM	17th QM
A	2	0	0	17	0
B	0.25	0	0	0	0
C	0	0	0	1.50	0
D	0	0	0	0	0
E	8.13	1.5	2.56	0	0.1
F	0	0	0	0	0
G	77.5	10.5	37.67	3	4
H	0	0	0	0.33	22
I	0.3	0.4	0.67	0.13	3
J	0.12	0.3	0	1	0.25

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

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

3.1.14 Culture Fish Production

The culture fish production during this monitoring was observed ashighest production in the Gher of Rajnagar and lowest in the Gher of Chunkuri-2 **(Table D.5 of Appendix-IV)**




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

3.2 Monitoring of Ecosystem and Bio-diversity

3.2.1 Indicators Selection

Indicators for terrestrial and aquatic ecosystems have been selected through 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 be changed for changing of different environmental parameters like temperature, composition of gaseous components, soil salinity, humidity and nutrients, dust particles etc. Plant diseases and proportion of healthy/ unhealthy plant has been studied to observe plant health condition.

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

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

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

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

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

3.2.2 Rationales for selection of locations

Four (4) homesteads have been selected for monitoring terrestrial ecosystem to observe the impact of the Power Project. Locations of the homesteads have been selected considering wind direction and spatial distribution of pollutants from the project boundary. All the selected homesteads for terrestrial ecosystem monitoring are situated at the northern sidse of the project area and considering the wind rose diagram it can be assumed that the anticipated impacts may take part according to this area. Beside this, the nearest peak off the Sundarbans Forest area is located at a distance of 14 km south from the chimney location.

3.2.3 Terrestrial Ecosystem

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

Description of the selected homestead

The homestead in Rajnagar is located at 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 Figure 3.10. Water retention capacity of surface soil of this homestead is very low for which reason very little number of grasses and other herbs are present here. 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 at about 0.5 km south from south-east boundary of the project. The selected homestead of this village is close to the 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 that of Rajnagar site. Vegetation of this homestead have been severely been damaged by the Cyclone Aila.

Figure 3.10: Homesteads vegetation patterns at monitoring sites

Species Composition of selected homestead vegetation

Homestead at Rajnagar

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

Homestead at Kalekarber dighi

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

Homestead at Chalkghona

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

Homestead at Barni

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

Random quadrate vegetation survey has been conducted at selected homesteads during recent monitoring tier. A total of 40 plant species (excluding herbs and shrubs) have been recorded from 16 nos of surveyed sample quadrates. Details of the survey result is presented in Table 3.9 below.

Table 3.11: Species composition of the sampled homesteads

Species Name	No. of Individuals in each quadrate																Total Number of individuals	pi	Ln pi	pi*ln pi	Biodiversity Index
	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16					
Acacia auriculiformis									2	-	-	-					2	0.00	-5.46	-0.02	**2.79**
Albizia richardiana					-	1	-	-	-	1	-	-	5	-	2	2	11	0.02	-3.76	-0.09	
Albizia saman	-	1	-	-	2	2	1	-	3	1	-	-	1	-	-	-	11	0.02	-3.76	-0.09	
Aphanamixis polystachya					12	20	-	-									32	0.07	-2.69	-0.18	
Areca catechu					-	-	1	-					-	1	-	-	2	0.00	-5.46	-0.02	
Azadirachta indica					-	1	-	-	2	-	-	-	1	-	1	-	5	0.01	-4.55	-0.05	
Bombax ceiba									-	2	-	-					2	0.00	-5.46	-0.02	
Borassus flabellifer					2	-	-	-	-	-	2	-	2	-	-	-	6	0.01	-4.37	-0.06	
Carica papaya									-	1	-	-					1	0.00	-6.16	-0.01	
Citrus medica									-	1	-	-					1	0.00	-6.16	-0.01	
Cocos nucifera	2	2	1	3	1	1	2	1	1	3	-	2	1	2	5	4	31	0.07	-2.72	-0.18	
Diospyros blancoi													1	-	-	-	1	0.00	-6.16	-0.01	
Diospyros peregrina									2	-	-	-					2	0.00	-5.46	-0.02	
Excoecaria agallocha	4	40	38	20	-	-	2	-	-	-	3	25					132	0.28	-1.27	-0.36	
Ficus benghalensis													-	-	-	1	1	0.00	-6.16	-0.01	
Ficus benjamina					-	-	1	-									1	0.00	-6.16	-0.01	
Heritiera fomes	1	-	-	-													1	0.00	-6.16	-0.01	
Hibiscus rosa sinensis	4	-	4	1													9	0.02	-3.96	-0.08	
Hibiscus tiliaceus													-	-	-	8	8	0.02	-4.08	-0.07	
Lannea coromandelica									1	-	6	6					13	0.03	-3.59	-0.10	
Limonia acidissima									5	-	-	-					5	0.01	-4.55	-0.05	
Mangifera indica									2	1	-	-					3	0.01	-5.06	-0.03	
Manilkara zapota					1	-	-	-									1	0.00	-6.16	-0.01	
Mimusops elengi													-	1	-	-	1	0.00	-6.16	-0.01	
Moringa oleifera					-	1	-	-					-	-	1	-	2	0.00	-5.46	-0.02	
Musa sp					-	6	-	1	-	7	-	-	2	1	-	-	17	0.04	-3.32	-0.12	
Nephrolepis exaltata									-	-	-	3					3	0.01	-5.06	-0.03	
Nipa fruticans									-	-	1	10					11	0.02	-3.76	-0.09	
pandanus sp	20	-	-	-													20	0.04	-3.16	-0.13	
Phoenix sylvestris					-	1	-	2	2	-	3	6	-	-	14	-	28	0.06	-2.82	-0.17	
Pongamia pinnata									-	-	1	4					5	0.01	-4.55	-0.05	
Psidium guajava									-	5	-	-					5	0.01	-4.55	-0.05	
Streblus asper					-	-	2	-									2	0.00	-5.46	-0.02	
Swietenia mahagoni	2	1	-	-	3	4	1	-	10	2	-	-	12	13	-	5	53	0.11	-2.19	-0.25	
Tamarindus indica	-	-	-	1	-	-	2	-	1	1	-	-					5	0.01	-4.55	-0.05	
Terminalia arjuna									-	1	-	-					1	0.00	-6.16	-0.01	
Terminalia catapa									1	-	-	-					1	0.00	-6.16	-0.01	
Thevetia peruviana									-	-	1	10					11	0.02	-3.76	-0.09	
Zatropa sp	-	22	-	-													22	0.05	-3.07	-0.14	
Ziziphus mauritiana									1	3	-	-					4	0.01	-4.77	-0.04	

Plant health

Vegetation structure of this area is tree dominant. Random saline water shrimp farming is a big threat to plant health of this area. Hence, Plant health of this area is not satisfactory. Expansion of shrimp farming in this area triggered incretion of salinity of soils. For this reason, overall plant succession, growth and productivity is decreasing with time.

Plant Diseases and symptoms in homestead vegetation

Plant diseases of any area need to be observed 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 (Figure 3.11).

Lethal yellowing, leaf spot, leaf blast, nut fall, Mite damage on nut fruit are common diseases of the plants in the study area. A brief discussion was made with home owners about diseases of selected economic plants which exist in thehomesteads. Most symptoms for plant diseases are descriptive. Although, all plant diseases symptoms are not visibleat a time in the year but it was tried to observe the existing disease symptoms. Leaf spot and mite damage on fruits are 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 3.11: Unhealthy plants at monitoring sites (Photo taken July, 2018)

Number of disease affected trees

Number of disease affected trees observed are more or less similar to the previous monitoring in April 2018. Coconut (Cocos nucifera) and Date Palm (Phoenix sylvestris) were observed as main affected species during this monitoring tier. A total of 09 coconut plants were affected at Rajnagar site, 02 at Borni and 03 were at Kalekarber Dighi. In most cases trunk narrowing and heart rot were found. In case of Date Palm, Lethal Yellowing and Terminal Bud destruction were detected at 03 monitoring sites. Except these, other monitoring trees followed in healthy condition. Health condition of Coconut and Date Palm were observed in deteriorating status due to saturated soil condition and saline water intrusion from nearby shrimp farms in dry season. However, following table represents the proportion of healthy and unhealthy plants in studied homesteads till last monitoring period. (**Table 3.10**).

Table 3.12: Status of Umhealthy plants

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
Rajnagar	*Cocos nucifera*	17*	NS	10	5	5	15	4	5	NS	3	4	6	6	9
	Phoenix sylvestris	25	NS	15	4	4	22	9	13	NS	10	2	5	4	7
	Manilkara zapota	1	NS	0	0	0	0	0	0	NS	-	-	-	-	-
	Albizia saman	2	NS	0	0	0	0	0	0	NS	-	-	-	-	-
	Excoecaria agallocha	55*	NS	0	1	1	0	0	0	NS	-	-	-	-	-
	Mangifera indica	3	NS	1	0	0	2	0	0	NS	-	-	1	-	-
	Psidium guajava	2	NS	2	0	0	2	0	0	NS	-	-	-	-	-
Borni	*Cocos nucifera*	10	7	3	0	0	3	1	2	NS	1	2	3	1	2
	Phoenix sylvestris	12	0	5	4	4	3	1	4	NS	4	3	4	2	1
	Borassus flabellifer	6	3	1	0	0	0	0	0	NS	-	-	-	-	-
	Mangifera indica	6	3	3	1	1	4	0	0	NS	-	-	-	-	-
	Excoecaria agallocha	18	0	0	0	0	0	0	0	NS	-	-	-	-	-
	Swietenia mehogani	11	0	0	0	0	1	0	0	NS	-	-	-	-	-
	Areca catechu	10	0	6	2	2	8	2	2	NS	-	1	-	3	-
	Manilkara zapota	1	0	0	0	0	0	0	0	NS	-	-	-	-	-
	Psidium guajava	2	2	1	0	0	0	0	0	NS	-	-	-	-	-
Kalekarber Dighi	*Cocos nucifera*	56	35	5	1	1	2	2	3	NS	1	1	-	6	3
	Phoenix sylvestris	10	0	3	0	0	1	0	1	NS	3	-	3	-	-
	Mangifera indica	5	1	1	0	0	0	0	0	NS	-	-	-	-	-
	Manilkara zapota	2	0	0	0	0	1	0	0	NS	-	-	-	-	-
	Borassus flabellifer	8	0	0	0	0	0	0	0	NS	-	-	-	-	-
	Zizyphus sp	1	0	0	0	0	0	0	0	NS	-	-	-	-	-
	Psidium guajava	8	0	0	0	0	0	0	0	NS	-	-	1	-	-
	Tamarindus indica	2	0	0	0	0	1	0	0	NS	-	-	-	-	-
Chalkghona	*Cocos nucifera*	39	25	19	5	5	34	20	0	NS	2	2	4	5	3
	Phoenix sylvestris	24	0	10	1	1	6	5	1	NS	1	-	5	2	3
	Albizia saman	3	0	0	0	0	1	0	0	NS	-	-	-	-	-
	Excoecaria agallocha	36	0	0	1	1	0	0	0	NS	-	-	-	-	2
	Manilkara zapota	1	0	0	0	0	0	0	0	NS	-	-	-	-	-
	Psidium guajava	17	1	7	0	0	0	0	0	NS	-	-	-	-	-
	Mangifera indica	7	2	1	0	0	0	0	0	NS	-	1	-	1	-
	Borassus flabellifer	2	0	0	0	0	0	0	0	NS	-	-	-	-	-

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

Vegetation canopy status

v. Species representation in different canopy layers of homestead vegetation

Coconut (*Cocos nucifera)* occupied top canopy among all the studied homestead vegetation. Date Palm (*Phoenix sylvestris)* is prevalent as top layer and 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 observed in the studied homesteads.

vi. Estimated Canopy cover in homestead vegetation of sampling sites

Canopy status of homestead vegetation have insignificantly been changed from the last monitoring period at three monitoring locations. At the Rajnagar site, canopy coverage have been reduced due to unhealthy condition of Coconut and Date Palm trees. In addition to this, the homeowner felled some of the Gewa trees at the southeast side for land feeling. In the case of Borni and Chalkghona sites, foliage expansion of planted saplings added canopy coverage. Canopy coverage of the studied homesteads are presented in following **table 3.11**.

Table 3.13: 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
Rajnagar	NS	19	19	17	20	20	20	20	21	23	19	15	18	14
Borni	NS	26	18	18	12	14	20	20	25	25	23	21	21	23
Kalekarber	NS	20	24	25	23	24	24	22	24	26	25	23	24	24
Chalkghona	NS	13	24	22	17	21	21	20	21	27	26	25	16	18

Note: NS = Not Surveyed

Lichen Cover

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

Bird Habitat

Local Birds and Their Nesting Behavior

Numerous local bird species are observed within the study area. Homestead vegetation are the prime habitat for local birds. Existence of vast shrimp farms as well as canals and rivers also favor good number of water dependent bird species in this area. Most of the birds are nesting on tall trees of the homesteads. Cocos nucifera and Excoecharia agallocha followed top priority for nesting. Small birds 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 and bird Species and Number of Bird Nests in Sampling Sites (Table 3.12)

No bird nests were observed except in the Rajnagar site. One nest of Magpie Robin was recorded at Rajnagar. Although, thtime monitoring tier was not for the nesting season for most of the local birds. However, the table below represents the bird nests monitoring datasheet over the monitoring periods.

Table 3.14: Bird nest monitoring datasheet

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

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

3.2.4 Aquatic Ecosystem Monitoring

Rivers, canals, ponds and saline water shrimp farms are main wetland forms in the study area. Canals of this area have been merged with shrimp farms. Shrimp farms covers a large portion of the total watershed of the study area, which are intervened by human.

Monitoring Locations

Passur is the only external river along 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 the river systems are supporting Dolphin through out the year. Hence, status of aquatic mammals (Dolphin) in these river systems has been monitored.

Dolphin Occurrence

Dolphin migration route in study area

In general, two species of dolphin (Ganges River Dolphin and Irrawaddi Dolphin) travel along the Passur River throughout the year. The Ganges river dolphin migrates from estuary regions to upstream-connected rivers like Rupsha and Madhumoti. Though Irrawardi Dolphin is mostly habituated in estuary regions of Bangladesh, yet 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 with time.

Dolphin occurrence in Passur and Maidara River

Occurrence of dolphins have been monitored within a total f length of 17 km of Passur and Madara river surrounding the project area (From Chalna to Mongla including Maidara River) through two boat transact in different tidal conditions. A total of 10 dolphins have been recorded in Passur River during spring tide with an encounter rate of 0.47 individuals/km/hour from Chalna to Digraz Ghat. Besides, 6 dolphins have been recorded while another boat transact from Chalna to Mongla Bazar Kheya Ghat during ebb tide. The encounter rate was 0.28 individuals/km/hour. All the dolphins were observed to be in diving mode and most of them concentrated at Moidara River and its surroundings (**Figure 3.12**).

Dolphin occurrence in Dhangmari Khal and Bhadra River

Dolphin occurrence also surveyed at the Dhangmari Khal and Shella Gang Wildlife Sanctuary. Total transect length was 13.7 km from Dhangmari-Passur confluence to Gagramari Forest Patrol Post of Forest Department (up and down). A total of 9 dolphins of different sizes were recorded. Of which, 4 individuals were found at river confluence point in front of Gagramari Forest Patrol Post and another 4 were sighted at the 1st meander point of Dhangmari Khal near Dhangmari Forest Station (**Figure 3.1**3). The encounter rate was 0.57 individuals/km/hr.

A total of 9 dolphin individuals were recorded from Shella Gang at Chandpai Forest Range within the 3.5 km reach with an encounter rate of 2.36 individuals/km/hour. The occurrence rate increased in this tributary due for minimizing fishing activities through regular patrolling by Bangladesh Coast Guard. The distribution of dolphin occurrence at this river is presented in Figure 3.14.

Another short survey was conducted Karomjal, Harbaria and Akram Point while passing the river. No dolphin has been notified from Karomjal and Harbaria point but a Irrawaddy dolphin pod was observed at Akram Point during this monitoring tier. However, the survey result is included in Table: 3.12.

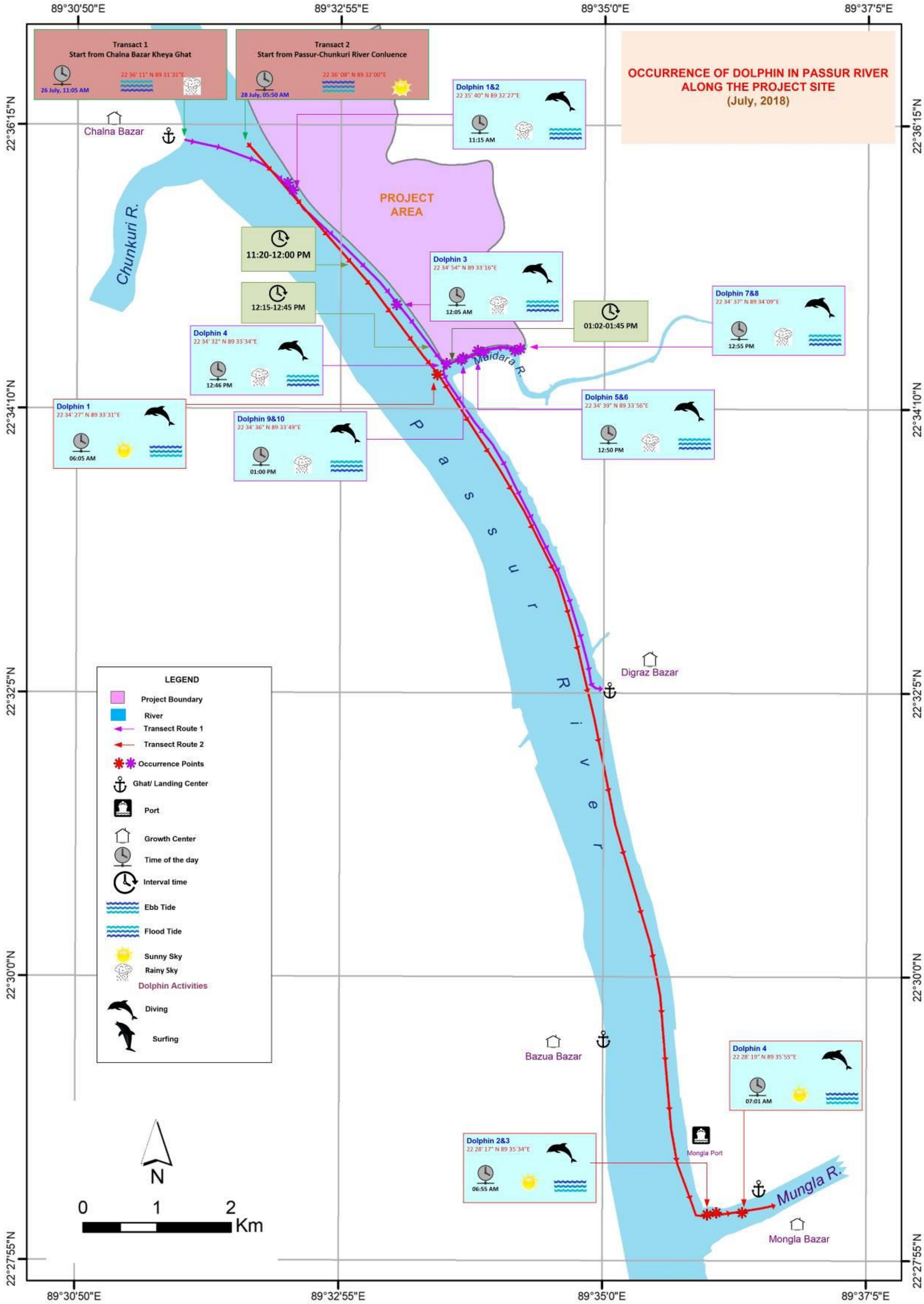


Figure 3.12: Occurrence of dolphins at Passur and Maidara River along the project site (April 2018)

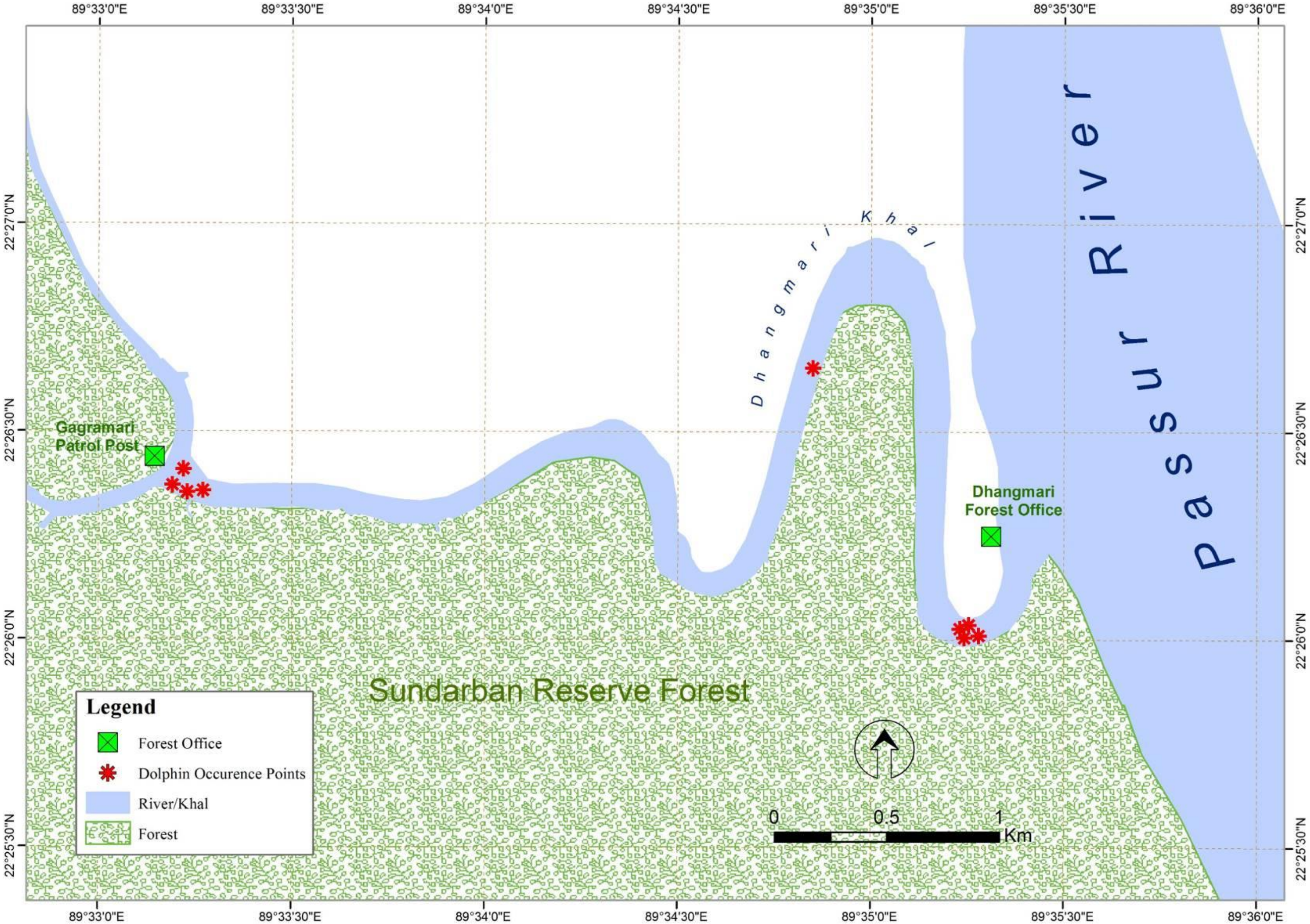


Figure 3.13: Location of dolphin Occurrence at Dhangmari Khal (April 2018)

Table 3.15.: 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	
	F T	N T	F T	N T	F T	N T	F T	N T	F T	N T	F T	N T	F T	N T	F T	N T	F T	N T	F T	N T	F T	N T	F T	N T	F T	N T
Passur River Near Project Site	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NS	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y
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
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
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
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
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

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

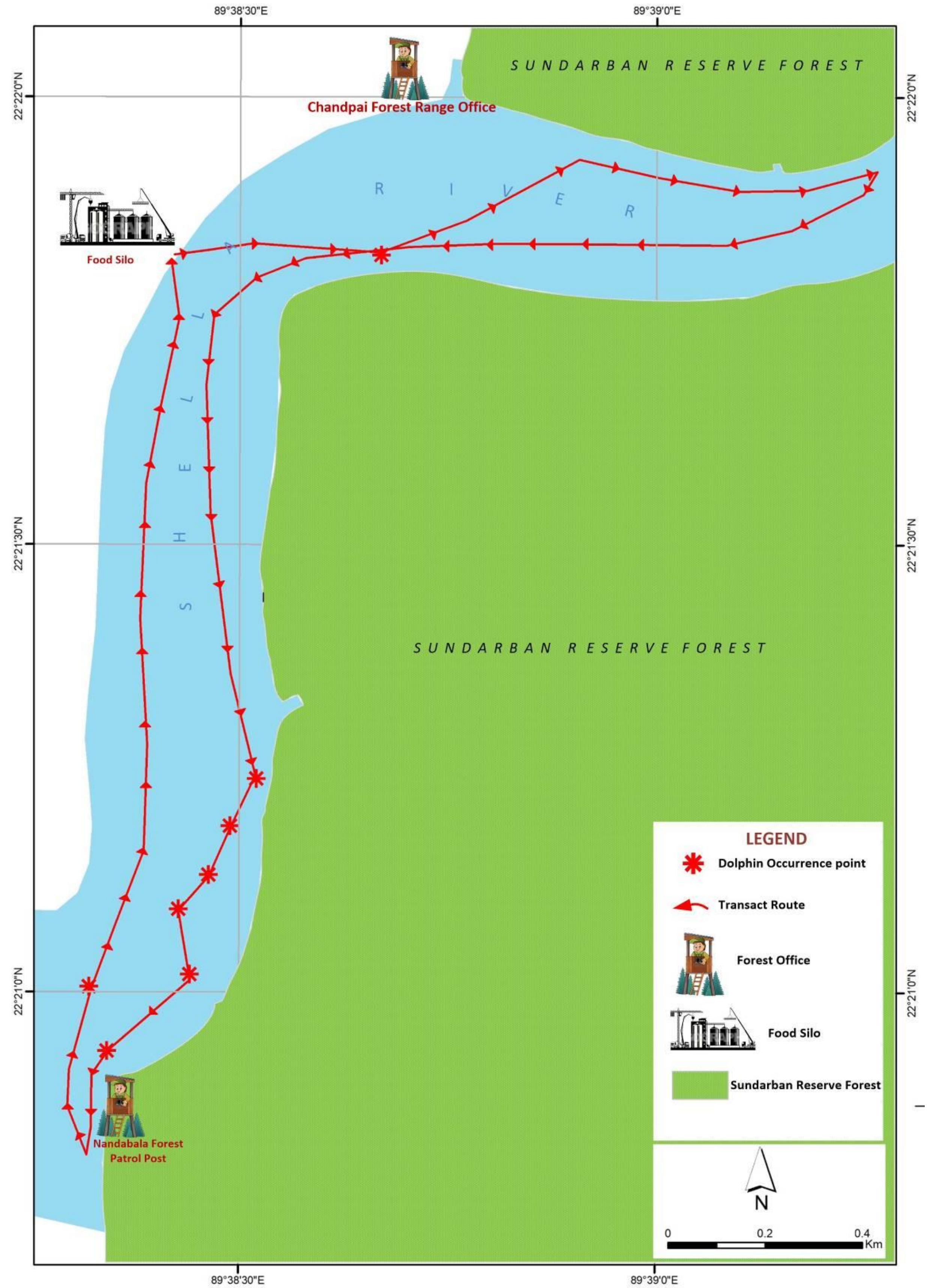


Figure 3.14: Location of dolphin Occurrence at Shella River (July 2018)

3.3 Sundarbans Forest Health

CEGIS team has been periodically monitoring the Sundarbans Reserve Forest health to oversee the probable impacts of Rampal Thermal Coal Power Plant Project under implementation. This monitoring program will also support in determining the status, trend and changes in the indicators of the forest condition. The Sundarbans forest health is being monitored quarterly as per monitoring schedule and seventeen (17) surveys were conducted at four locations, namely Sutarkhali, Karamjal, Harbaria, Akram point. Due to worse weather condition, status of forest health at Hiron point could not be monitored. The overall monitoring indicators observed during this monitoring schedules broadly included plant growth, tree regeneration, tree crown condition, tree damage, lichen communities, plant diversity, soil chemistry, and plant physiology. It was cross checking monitoring to measure the data quality

3.4 Methodology

Frequency of Monitoring for different indicators has been determined considering efficiency. The indicators observed during this periodwere as follows:

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

Forest Health Monitoring Location

To set up permanent sample plots, five sites were selected based on the survey conducted from July 27 to July 31 (**Figure 3.15**). Among them, four sites were along the Passur River at Karamjal, Harbaria, Akram point and Hiron point and the fifth one site was near Sutarkhali forest office (**Table 3.13**). The sites were selected considering the distance from the proposed Project site, wind directions, coal transportation route, river systems and vegetation types.

Sampling Design of Permanent Sample Plots (PSPs)

In each site, a transect line was laid out perpendicular to the river or canal bank. Along the transect line three circular nested subplots of 12.62 m radius have been laid out at 100 m intervals in order to capture the maximum tree species (**Figure 3.16**). Due to the variation in species composition in SRF, observation plots were laid out from the coast, river or canal side to landward zone (forest proper side). The location of the first subplot was 40 m away from ecotone (riverside) to inner ward of forest in order to save the subplot from riverbank erosion. Each subplot was again subdivided into four quadrates for the ease of data detection and recording (**Figure 3.17**).

Table 3.16: General Description of Permanent Sampling Plots (PSPs)

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

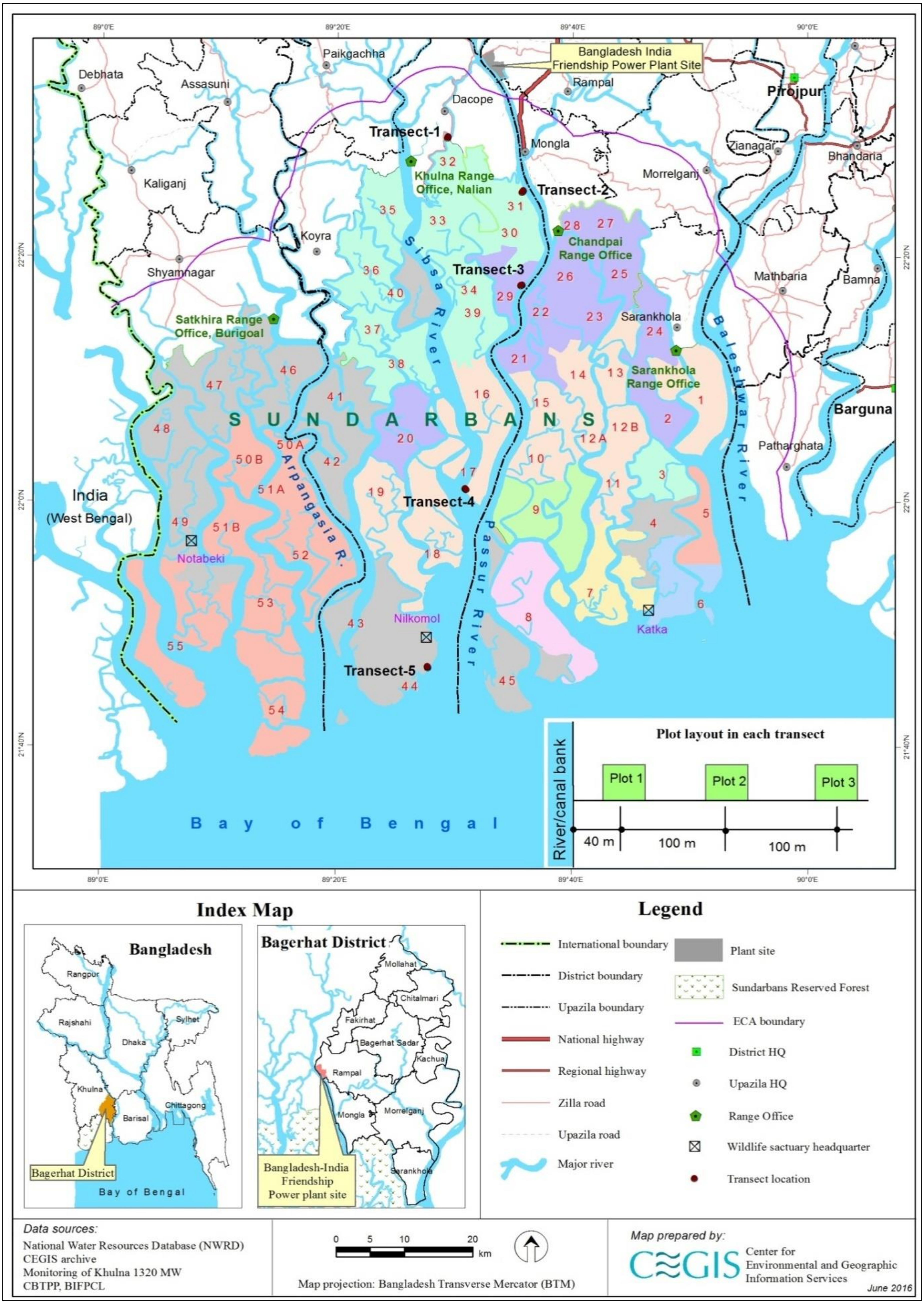


Figure 3.15: Location Map of Sundarbans Forest Health Monitoring Plots (PSPs)

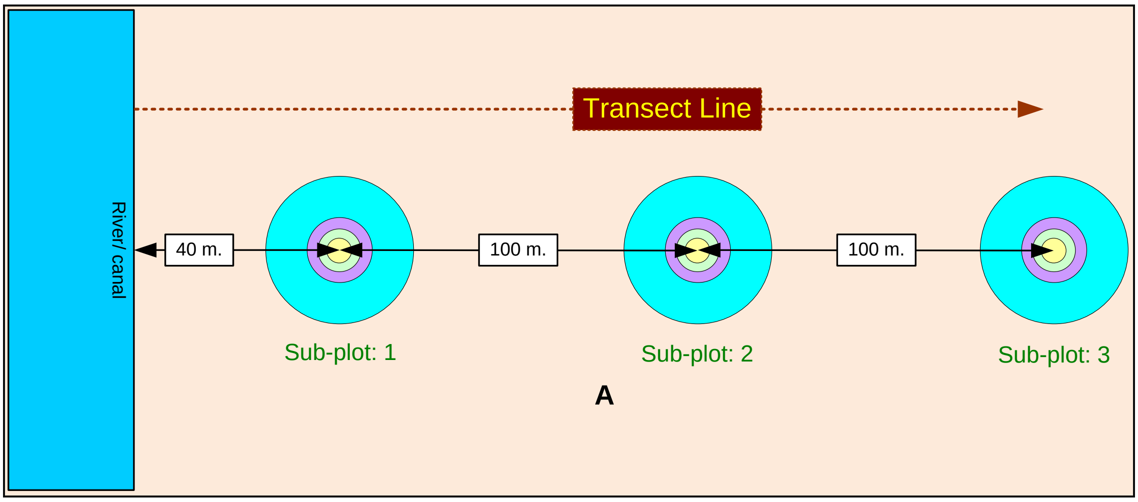


Figure 3.16: Layout of the subplots and transect line perpendicular to the ecotone (river or canal bank)

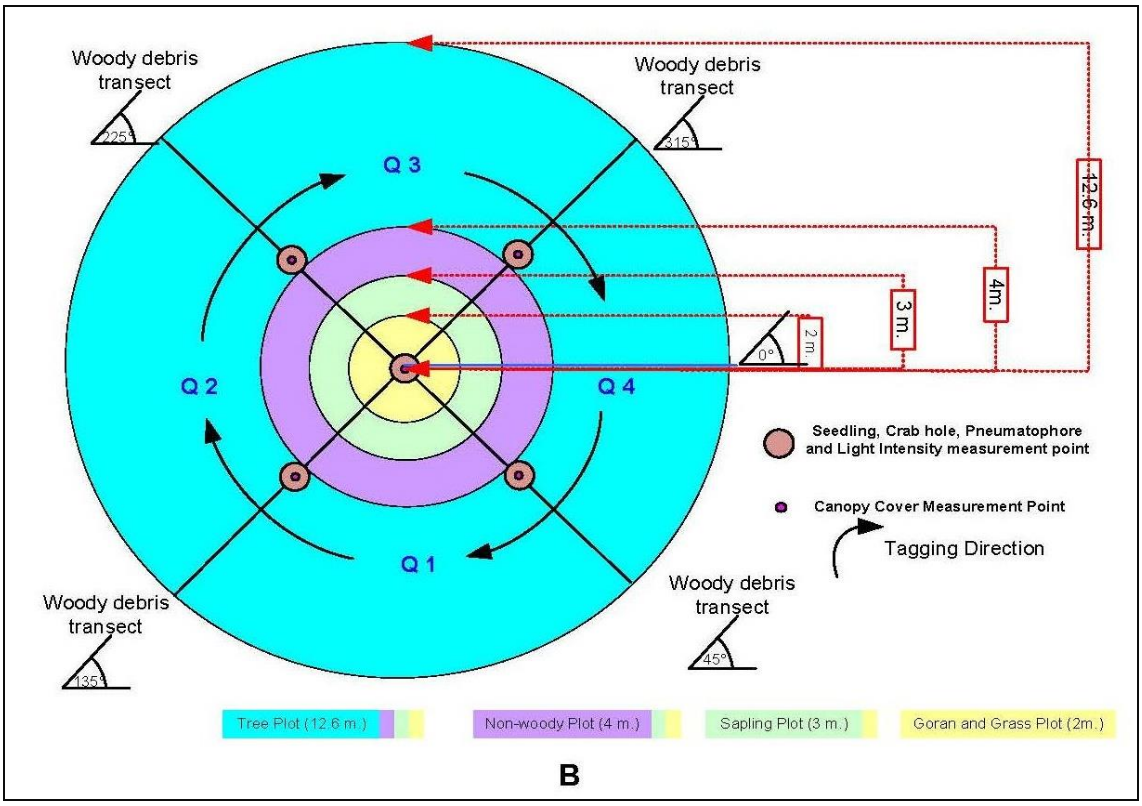


Figure 3.17: Layout of the survey activities in each subplot

3.4.1 Forest Health Survey

Trees

The tag number of trees (DBH ≥ 5cm and lean angle greater than 45º) was monitored and rewritten if any new tree was found within 12.62 m radius circle of the Permanent Sampling Plot (PSP). The surveyor (**Figure 3.18, 3.19 and 3.20**) also took the tree height and diameter.

Figure 3.18: Team Member recording and cross checking the data in the field sheet

Figure 3.19: Team member measuring height of trees at Akram point

Figure 3.20: Measuring the DBH of trees at Sutarkhali

Sapling and seedling

Saplings (DBH < 5 cm and height 1.37 m) and seedlings (height < 1.37 m) were assessed within 3m and 2m radius circle, respectively in each PSP. Seedlings have been counted species wise (**Photo 3.21**). For living saplings, species name and DBH were recorded.

Figure 3.21: Team member measuring the DBH of saplings at Akrampoint and Sutarkhali

Pneumatophores

The total numbers of living pneumatophores were recorded within a circular area of 1 m radius centring each of the five points of all the subplots. The first point was laid out in the centre of each subplot and other four was in the midpoint of the four woody debris transects that are facing at 45°, 135°, 225° and 315° angles (**Photo 3.22)**

Crab hole

Crab plays important role in mangrove ecosystems such as decomposing litter fall thereby increasing fertility. In order to work out the crab density, usually crab hole abundance is monitored. For this purpose, the crab holes were counted within an area of 1 m radius circle in each subplot's centre and in the midpoint of four transects **(Photo 3.23**).

Figure 3.22: Team member counting pneumatophores on forest floor

Figure 3.23: Counting of crab holes on forest floor

Canopy Cover

Percentage (%) of canopy cover was estimated by a spherical densiometer, a gridded convex mirror that provides a simple and inexpensive approach of measuring canopy cover. The densiometer was positioned at a distance of 30–40 cm from the body and at an elbow height so that head not become visible in the mirror (**Photo 3.24).** After levelling the instrument using the level bubble, the dots, which had not been occupied by canopy, were systematically counted. In each subplot, the meter readings have been taken at five points facing north, south, east, and west direction including the centre point of the subplot. The canopy cover was calculated by taking the average of these five readings.

Leaf Area Index

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

Leaf Area Index (LAI) = loge (I/Io)/-K m^2 leaf area /m^2 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)

Figure 3.24: Team member taking canopy cover using Densiometer

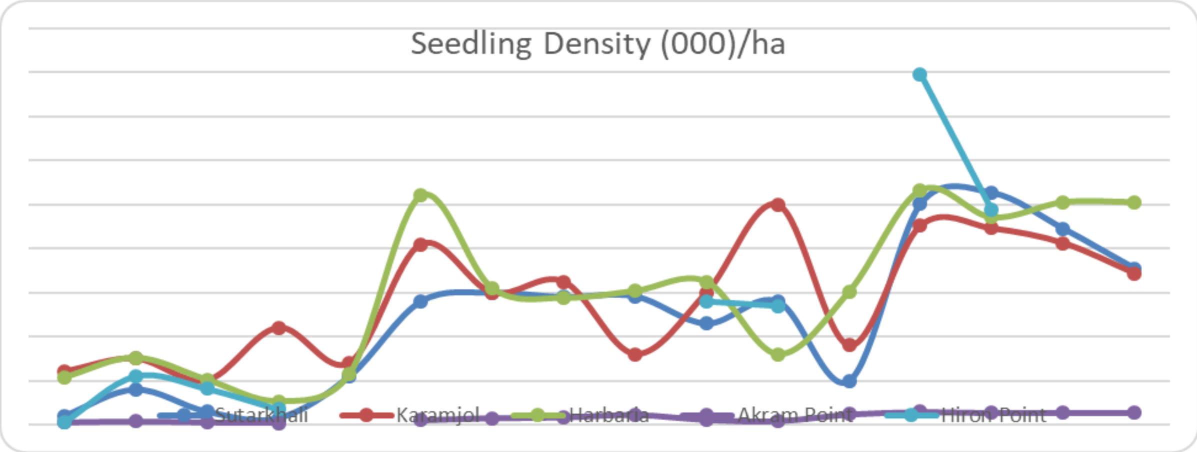
Soil sampling

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

3.4.2 Status of monitoring of SRF Health

Seedling

From the last field observation, it was found that the number of seedlings per hectare has increased in almost all the monitoring locations except Akram Point (**Figure 3.2**5). The graph has also shown that higher number of seedlings was found during monsoon period where as the number decreased during winter to pre-monsoon period. The recruitment of new seedlings depends on regeneration and survival rate. These two indicators also depend on canopy cover, soil chemistry (pH, salinity, organic matter etc.). Seedlings usually die at an early stage of its life span inside the natural forest due to competition for nutrients as well as light intensity. The result of this monitoring period showed comparatively higher number of seedling at Sutarkhali and Harbaria site than that of the other monsoon of the previous years. This may be due to reduce human interventions at forest floor of the site, which has sustained huge number of seedlings. The dominant species were Sundari. The seedling at Karamjal subjected to illicit cutting. Other than the silvicultural competition, the seedlings at Akram point also faced natural stresses due to their location being very much closer to the sea. In the Sundarbans, most of the mangroves' seeds disperse during the rainy season and go up to forest floor. In this relation, seedlings are usually found more just after the rainy season (monsoon to post monsoon) than in other seasons.

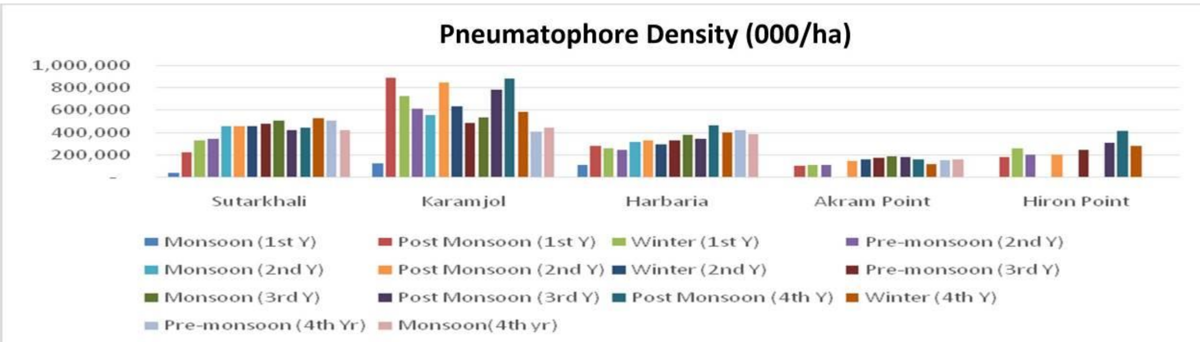


(Seedlings density was not monitored at Hiron Point during Monsoon 4th Year)

Figure 3.25: Mean (±95%CI) seedlings density among the quarterly surveys in five PSPs

Pneumatophores

Pneumatophores density also changes due to seasonal variability (**Figure 3.26**). Pneumatophores usually dry up and die during dry season. The number of pneumatophores per hectare is found comparatively medium in Karamjal and Harbaria area in -monsoon period. However, among five monitoring sites, the mean pneumatophores density was found lower at Akram point due to dominance of Gewa (*Excoecaria agallocha*) and over siltation. On the contrary, in Karamjal mainly dominated by Baen (*Avicennia officinalis*) and Sundari (*Heritiera fomes*) tree and they have numerous tender pneumatophores compared to others. The number of pneumatophores may also vary due to the elevation of the forest floor from the Mean Sea Level (MSL). The major function of pneumatophores is to exchange gas into the atmosphere during tidal inundation. Hence, the highly elevated plot with less effect of inundation may have lesser number of pneumatophores.



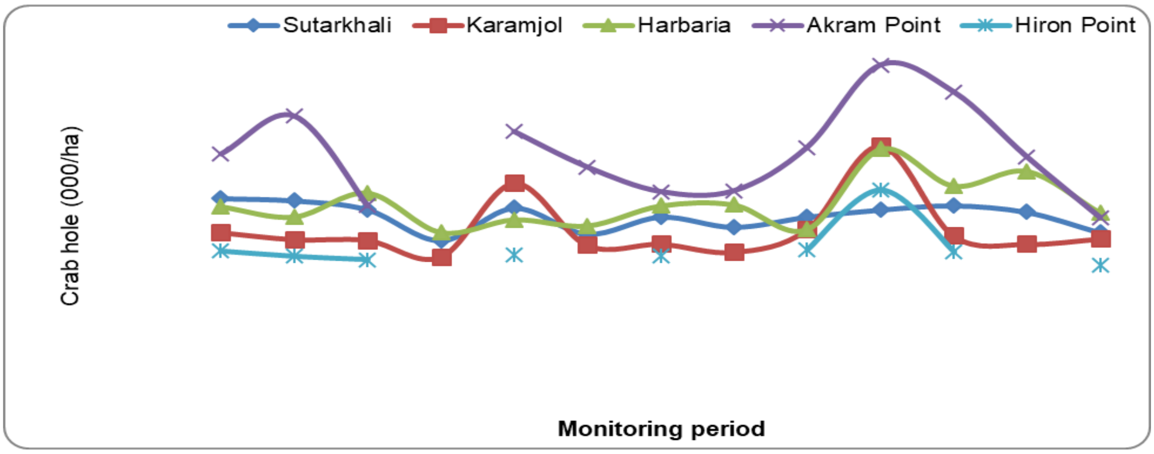
(Pneumatophores density was not monitored at Hiron Point during Monsoon 4th Year)

Figure 3.26: Mean Pneumatophores Densifty among the quarterly surveys in five PSPs

Crab hole

The crab hole density is the indicator of availability of crab in a site. Crab holes were found the highest at Herbaria and Akram Point among the five monitoring sites (**Figure 3.27**). This would be due to sandy and sediment forest floor at Harbaria and Akram Point because they love to drag hole on that particular habitat. In monsoon period, tidal and sedimentation subjected in all plots during work time. Therefore, it was difficult to count the crab holes.

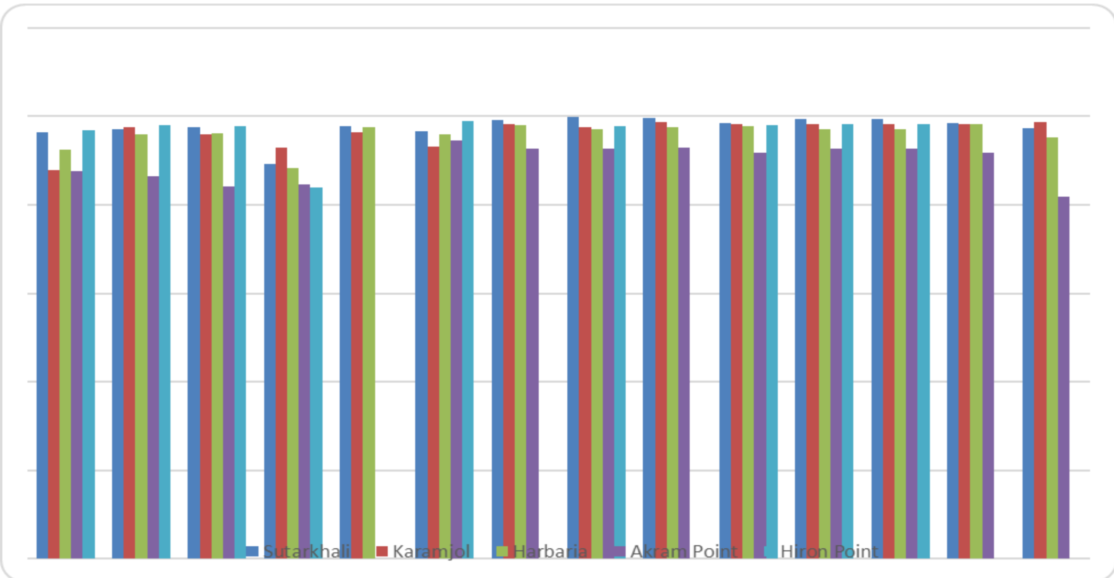
Crab holes have been found similar to that of the last monsoon period at Karmajal and Sutarkhali sites. Crabs are the major macro fauna, ecologically engineering the mangroves through digging burrows. Therefore, it is clear that, forest condition is in good conditionsince long time at Herbaria and Akram Point. It is difficult to predict the relationship of crab hole with seasonal variability. This might be due to the soil nature of mangrove (evergreen forest) forest floor. Although mangroves are hold marshy land, so there are differences in terms of area in dry period (winter) and wet period (monsoon) which shows some influences on crab hole abundance.



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

Figure 3.27: Mean crab hole density among the quarterly surveys in five PSPs

In the monitoring plots, the canopy cover percentages did not varied significantly. From the third year of monitoring to fourth year monsoon, the highest canopy cover percentages were observed during monsoon to post monsoon, which started decreasing during winter and was found the lowest in pre-monsoon period. However, from post monsoon of fourth year monitoring to the monsoon of fourth year, it was found that the canopy cover percentages are similar among the all monitoring sites (**Figure 3.28**). Every monitoring site was found in good condition, as each site possess more than 60% of the canopy coverages.



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

Figure 3.28: Mean canopy cover (%) among the quarterly surveys in five PSPs

Leaf Area Index (LAI)

The LAI (Light Area Index) influences daily rate of net canopy photosynthesis, which results exchange of atmospheric CO_2. The minimum ratio of under canopy to open canopy light intensity values indicate the maximum LAI. It was found that the LAI has increased in all monitoring locations from previous values except at Karamjal Point. The frequent sunlight and cloudy weather made some variation in data but canopy coverage shows almost same in their condition. So it can be concluded that the forest is in good condition. However, at Akram point the LAI like other indicators was found much lower due to high under canopy light intensity.

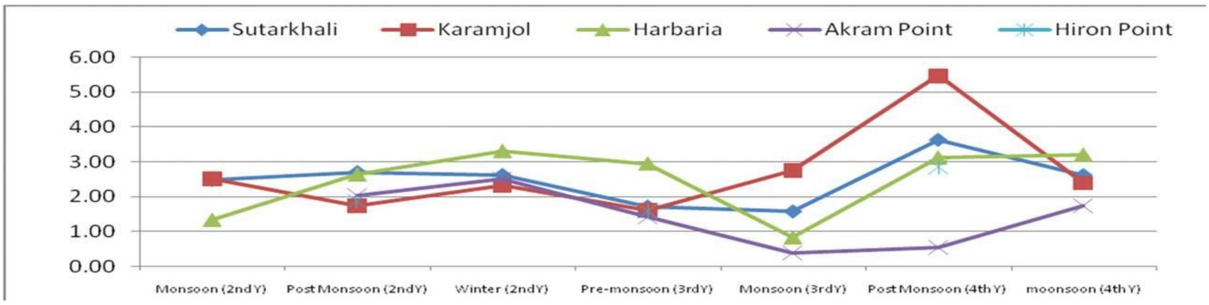


Figure 3.29: Mean LAI among the quarterly surveys in five PSPs

3.4.3 Findings

Overall summary of last monitoring activities, it can be concluded that the forest condition is showing positive changes periodically in terms of seedling density, pneumatophores, crab hole, canopy cover and leaf area index (LAI), although there has some seasonal effect. Based on different indicators it can be mentioned that the health condition of Harbaria and Sutarkhali forest is good .But sedimentation rate are comparatively higher in Sutarkhali site. In addition, logging activities and =other disturbances due to human interfere is severely affecting the Karomjol site.The complex species i.e.*Sundari* was found died in some of the subplots of Akram Point site. On the other hand, no significant changes were observed at Harbaria point during the last visit. Among the species, the height of Sundari was found comparatively higher in Harbaria and Karamjal and Gewa was found as dominant in Akram point. However, the Akram point is situated at the confluence of Shibsa and Passur River and as during tidal inflow the forest floor receive large amount of sediment than other locations. Moreover the number of seedling was found almost nill and hence considering the abovementioned aspects, it can be assumed that, the forest is experiencing retrogression process where the climax species (Sundari) are started decaying. Hence, this area is actually much sensitive in terms of disturbance than other locations.

4. Social Environment

4.1 Socio-economic Condition and Social Safeguard

The 17th quarter monitoring reflects the changes (either improvement or deterioration) in environmental and social indicators/parameters compared to the findings of previous monitoring results. In this regard, employment status, labor and working condition, community health and safety, corporate social responsibilities of project authority etc. parameters were investigated for socio-economic monitoring purposes. The monitoring parameters and location may be changed as per the nature of construction work and process of local labors recruitment. The selected monitoring indicators are surveyed quarterly in a year (simultaneously with Environmental Monitoring) but in can be reduced considering the nature of construction activities. Discussions in this chapter have been based on the comparison of 1st quarter monitoring (from 3rd May to 7th May, 2018) and this survey (from 27th July to 30th July, 2018).

4.1.1 Methodology

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

The locally recruited labors stated that they hailed from Rampal, Rajnagar, Gaurambha and Burirdanga unions. Therefore, from the next phase of monitoring these unions may also be included in social monitoring aspects as per requirement.

In this phase, Informal discussions were held with local communityin the project surrounding mouzas(Kapasdanga, Barni, Rajnagar, Gaurambha and Baradurgapur)-to identify labor recruitment status, health safety of local community, status of CSR and status of Livelihood Restoration Program (LRP).Due to less involvement of project affected people of Foyla Shelter Home with the present activities of the project, they were not surveyed in this phase. It is also noted there are only 10 project affected households residing in the Foyla Shelter Home who are found to have already adapted to alternative livelihood opportunities.

Interviews and discussion was also held with the project authority and workers of some subcontractors in the project site, for identifying working condition, accommodation facilities and recruitment process as well.

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

4.1.2 Exploration of Monitoring Parameters

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

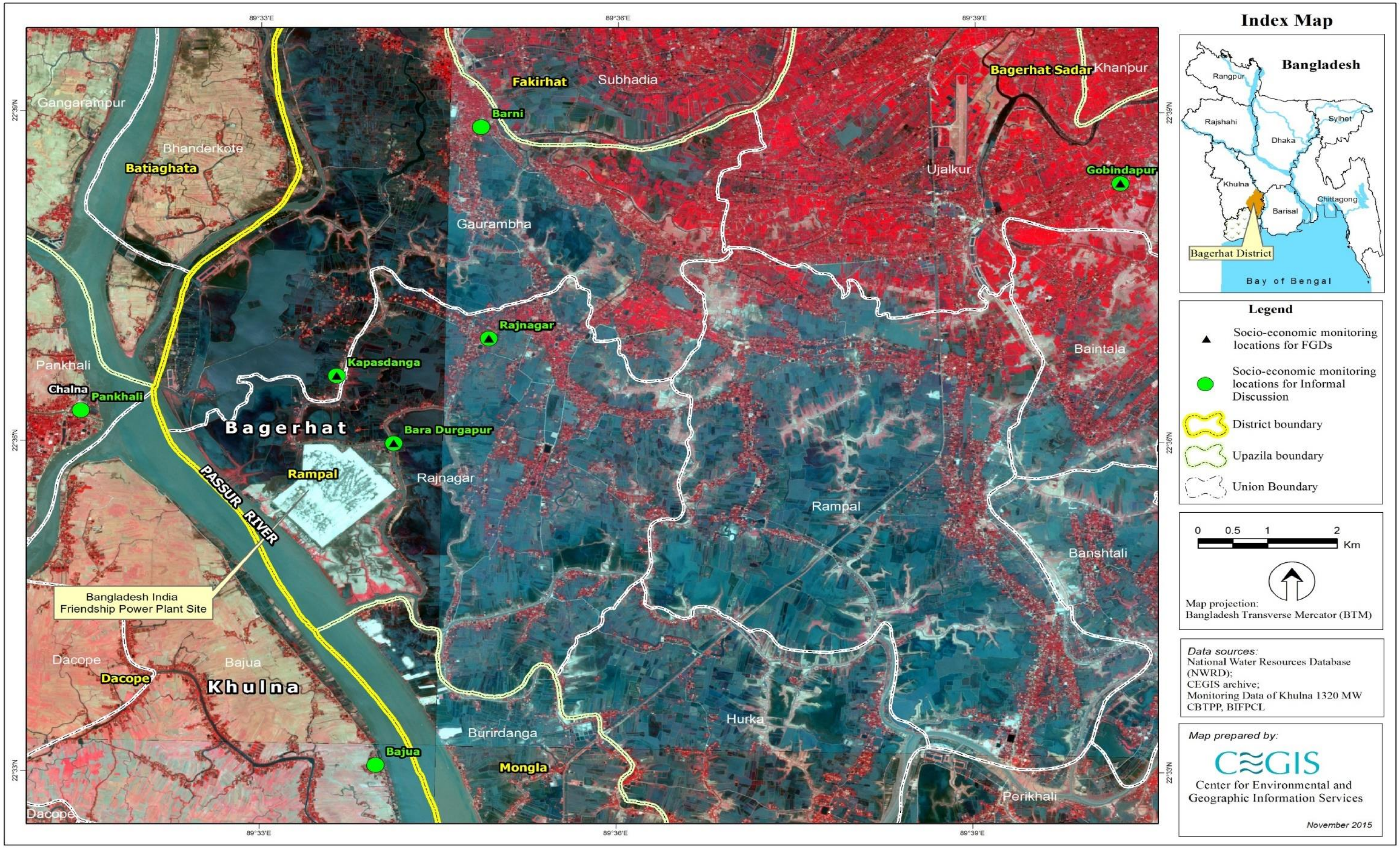


Figure 4.1: Socio-Economic Environment Monitoring Location

Project Related Employment Generation

Some subcontractors have started the construction activities under the supervision of EPC Contractor named Bharat Heavy Electricals Limited (BHEL).The BIFPCL and BHEL monitored the recruitment process of local labors as per the available scope of their engagement in construction activity.In the field survey, local laborers were considerably found to be involved in non-technical activities i.e. load carrying, laboring in civil works, masonry and so on. The local laborers stated that scope of more engagement of local labors will be generated when structure construction work will be started. It is noted that piling and load testing related activities are conducted in present days where mostly the technical and experienced laborers are recruited.

Though the project authority had plan to train the local unskilled people to elevate them to the level of semi skilled and skilled laborers, it may not be possible to arrange training in this early stage. However, the authority opened the opportunity for the local people to gain technical knowledge through ‘learning by doing’ approach under the supervision of skilled technical persons. They can be engaged in working sectors of their own interest as work assistant then learn by doing work closely with the seniors and experts. In this way, project activities may create a huge scope for local people to develop their skills in numerous types of positions e.g. mason, carpenter, electrician, welding, sanitary fittings, tiles fittings and so on. This opportunity has been opened for all the interested workable local people, but with careful supervision to avoid any irregularity in availing of these opportunities.

According to the EPC Contractor BHEL, at present about 2000 laborers are engaged in different project activities and most of them are migrant workers. In terms of recruiting local laborers, it has been sourced consulting with local labor supplier and when local labors are not available in closest unions, then labor from other possible areas are sourced.

In terms of recruiting local laborers, the authority prioritized to recruit project affected people as per their availability. But it is difficult for them to identify actual project affected people. Therefore, they have introduced the provision of grievance redress mechanism which will solve all types of grievances. A grievance box has already been installed in the project office, but no complaint has been received yet. May be the proponent strictly maintaining the EMP or the people are not aware of the drop box. The grievance box may be installed at the entry gate of the plant site as an experimental case.

Labor and working condition

The labor sheds are separately constructed beside the project boundary. Each sub-contractor separately constructed the sheds for their residential workers, which are made by concrete wall and floor; and tin shed roof. In general, condition of housing, sanitation, bathing and cooking facilities of the labor sheds were found to be good. However, water should be made available in the toilets at the earliest in order to maintain hygiene condition.

Two kitchens of Dipon Group (construction firm) were found to be broken in previous phase while those were not functioning. In this phase, those kitchens have been repaired and functioning well after necessary action taken from the BIFPCL and BHEL authorities. Water of the concrete cistern in labor sheds is cleaned twice in a month usually. But, residential labors stated that bathing water contains excessive salinity that gets itching problem in their body.

LPG Cylinder Gas is used in the kitchen of those sheds which is really a good initiative and a fire extinguisher is placed beside the cooking stove.

In terms of drinking and cooking water facilities, treated water is supplied to the workers shed. In this regard, 2 drums (200x2=400 liter) of water supplied daily to each shed for drinking and cooking purposes. The quantity of water is enough for normal days, however during hot days more drinking water need to be supplied. The management of BIFPCL has assured to take care of this matter.

The only confectionery shop which is located at the labor sheds compound is found to function well. In previous phase, labors alleged the issue of charging high rate of all the food items which is have been managed in this phase through efficient supervision of the authority.

Standard safety awareness approach was observed through hanging up a number of safety signboards in the project site. Workers were also found aware enough to use Personal Protective Equipment (PPEs) and that is strictly monitored by the safety officials of BHEL and BIFPCL. For ensuring laborers' safety and security, following protective equipment need to be provided of which some are already found to be used in the project site, as per its requirement in respective working activities. Present practice of using PPEs as well as it's probable requirement in the project site is specified in separate column in the following table 4.1.

Table 4.1: Protective equipment of risky limb in human body

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

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

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

The residential labors previously urged to allocate a prayer room within the campus. The authority stated that they have taken initiative to construct a mosque for the labors. However, at present labors use prayer room of Ansar Camp in the Project site for saying their prayers which is quite far from the labor shed area.

Safety Signboards in the project site

Drinking and Cooking Water Storage in Sheds

Separate Kitchen in the Labor Sheds

Cistern for bathing of Residential Labours

Community Health Safety and Security

To reduce dust blow and keep the inside environment cool project authority has planned for tree plantation around and inside of the project area. In this regard, the authority has already planted 30000 trees in the project site. In addition, a deal has been signed with Bangladesh Forest Department (BFD) and BIFPCL, in which 2 lac trees will be planted in the project site under supervision of BFD. In line with this, 3000 Sundari trees have already been planted and 12,000 more trees are ready to plant under this contact. The project authority stated that, this type of initiatives may help to reduce sand blowing as well as to ensure environment friendly working space in the project site.

Construction works goes round the clock. The construction noise creates disturbance for the surrounding community during night time. However if it necessitates to work at night the management should take permission from the competent authority as stipulated in the approved EIA.

For ensuring people's safety and security during construction activity, access of unauthorized people inside of the project area was prohibited. Guards were recruited to the entry points to check/monitor people's movement toward the project area. The authority should monitor all the entry points for 24 hours those are prohibited for the access of general people.

Activities under Corporate Social Responsibilities (CSRs)

Project authority initiated to implement some program for restoring the livelihood of the Project Affected People (PAP). For doing so, an NGO (namely SAMAHAR) was appointed for implementing the Livelihood Restoration Plan (LRP). The SHAMAHARalready started their works over two months ago. In the meantime, project authority already trained 60 poor people on sewing and computer literacy from Rajnagar Union over last one and half years.

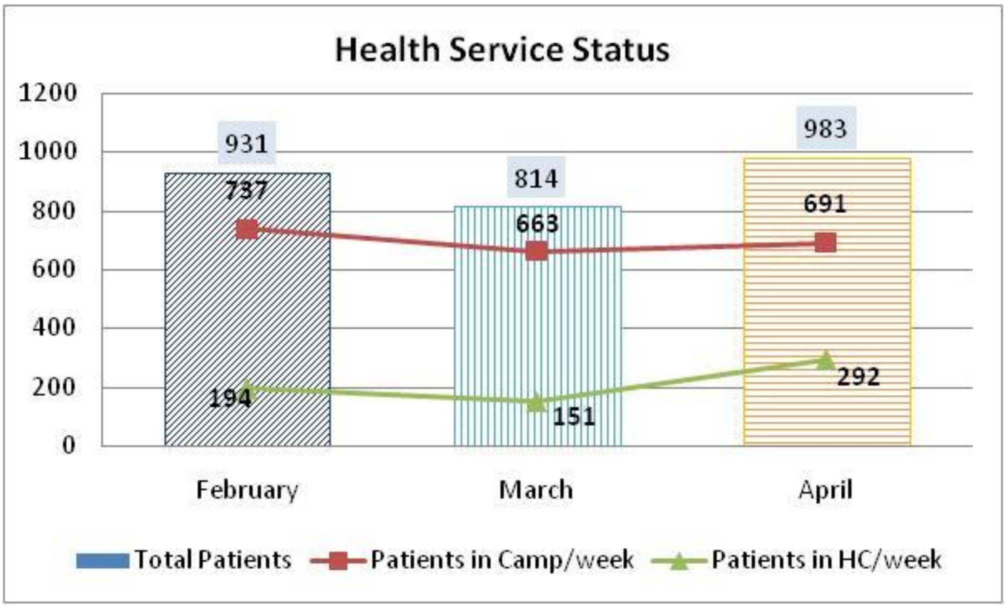
Project authority has planned to develop sustainable livelihood option for the educated member of the project affected households, according to the scope of their recruitment. In line with this, a person (passed HSC) in the affected household is already provided job at BIFPCL Dhaka Office.

Project authority also initiated to provide free medical facilities for the local people over last four years, as health treatment facility in these rural area was quite poor. This treatment facility has been highly appreciated by the local communities and people felt gratitude to the project authority for the services. Popularity of the service has gradually increased over the years.

Considering the convenience of local people, a medical camp is set up just beside the access road near the entry point of the Power Plant. Twice in a week the camp provides free medical facilities. The medical center is well equipped with including all necessary tools. The EPC contractor has not yet developed their own medical center, so they took medical support from existing BIFPCL center. As per the contract documents, EPC contractor will recruit adequate no. of qualified paramedic at the earliest for the benefit of the labors working at the project site.

As per the information on providing treatment facilities from BIFPCL, about 1,829 patients got treatment over last three months from May2018 to July2018, at the rate of 610 patients per month.

An Ambulance service has been introduced to expedite the movement in emergency situation in case of critical accidental occurrences during construction activity. According to the information of paramedic in BIFPCL, the existing medical center of BIFPCL is well equipped to provide all types of medical facilities those are provided form Upazila Health Complexes.



Source: BIFPCL Office at Rampal, 2018

Figure 4.2: Record of health service recipients under CSR program

In figure 4.2, it is observed that 2,728 people received treatment from the BIFPCL health services during February 2018 to April 2018. Health services are provided in two ways - 1) Medical Camp and 2) Health Center (HC). Expert physician provides free service in the medical camp, therefore gathering of patients are quite high on those camping days. During last three months, highest service recipients were in April (983 patients) from both medical camp and health center (Figure: 4.2).

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

5. Environmental Compliance

5.1 Introduction

During the last quarterly monitoring program held on July 2018, it was observed that all the civil construction activities are being carried out in a massive manner especially at the Boiler and Turbine installation areas and other heavy equipment installation areas. Development of township areas, internal road communications, temporary drainage networks, water treatment system for the construction activities etc. are progressing fast in this stage.

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

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

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

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

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

Sl. No.	Potential Impacts	EMP measures as proposed in the EIA	Actual condition/ Measures already Implemented	Compliance Status	Recommended Action
		water during dry season • Stock piles of construction materials must be covered in order to protect from wind action. • An appropriate freeboard must be maintained in trucks hauling construction materials			
3	Water Quality	• Surface water must be saved from any harmful effluent emission and waste dumping from project site • Provide closed system facilities and wastewater treatment plant to minimize emission of effluents from workers colony. • Good housekeeping at workshop and construction site • Appropriate equipment with safety measures should be used for storage and handling of lubricant • Provide training and awareness building program to the workers during construction. The training and awareness programs are: a) arrange weekly consultation session among the workers through plant site managers. The duration of consultation is one hour according to ISO-14001 standard, b) arrange monthly environmental meeting among the mid-level officers through top management when those issues will be discussed under guidance of ECR 1997.	• Harmful disposal was not recorded which is reflected in the monitoring parameters. • Existing drainage system has been rearranged and temporary drainage system is being developed to carry out the monsoon rainfall runoff. • Rainfall runoff discharge to nearby river through existing temporary drainage network or fixed pipe and is being cleared occasionally. • EPC contractor is now going to re-check the water quality of outfalls. • Reuse of rainwater stored at temporary drainage areas for sprinkling and curing • Good housekeeping for storing the materials. • Labour colony is being prepared with good sanitation facilities. • Onsite sanitation facilities has been developed at the labour sheds as well as the working places.	Being Complied	• The plant should follow the zero discharge concept during this construction stages • Introduce temporary sewerage treatment system.
4	Waste	• Limiting site clearance and base	• Heavy equipment and mechanical	Being	• Sufficient waste disposal

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

Sl. No.	Potential Impacts	EMP measures as proposed in the EIA	Actual condition/ Measures already Implemented	Compliance Status	Recommended Action
		reusable and recyclable wastes. • Keep provision of awareness building meeting and training for employees			
5	Compensation and Resettlement	• Prepare Proper resettlement action plan and compensation plan if the Project needs any land acquisition addressing compensation, restoration, livelihood, living standards etc. based on proper socio economic studies. • Resettlement of the PAPs • Cash for compensation of land (CCL) before resettlement • formal agreement with the affected people prior to migration/resettlement • Sufficient standing crop compensation • Compensation for movable structures? • Retention of salvageable materials? • Compensation for loss of trading income? • one time moving assistance • grant to cover loss of regular wage income • Has a resettlement plan been developed which includes compensation, restoration, livelihood, living standards etc. based on proper socio economic studies? • Human provide/ take extra care/caution for the disadvantaged/ vulnerable group/s (i.e. women, children, ethnic minorities, indigenous people etc.) • Provision of monitoring the	• Compensation has been given to the rightful owners of the land as per the laws of Bangladesh e.g., 'Acquisition and Requisition of Immovable Property Ordinance, 1982'. • Compensation made by local DC office • Local DC office facilitates unauthorized occupants of the acquired land to get home in the shelter houses or cluster villages provided by the GoB. • BIFPCL gives priority to affected people in Project related employment • A significant number of affected people (especially who desires) are working at the construction site. • List of 136 indirectly affected people was given by the DC Office, Bagerhat. • One third of the labour are now recruited from the local which include the PAPs • Livelihood Restoration Plan (LRP) for the PAPs have been prepared by BPDB. • BPDB already appointed an NGO for implementation of LRP. • Local NGOs are working with the PAPs as per the recommendation of LRAP and DoE approval conditions	In the process of Compliance	• Initiatives has been taken of the resettled people as per the LRP; • Giving top most priority to the PAPs for getting training and associated jobs as per their skill; • The authorities may give directives to the EPC/Sub-contractor/local contractor to recruit more local labours especially from the affected peoples.

Sl. No.	Potential Impacts	EMP measures as proposed in the EIA	Actual condition/ Measures already Implemented	Compliance Status	Recommended Action
		compensation and resettlement process			
6	Livelihood and living condition	• The labor recruitment policy must be formulated in such a way that the local laborers can easily get the chance of employment in the project • Govt./NGOs need to provide support the skill development program and income generation activities to local people • For the increased movement of people and heavy vehicles, the road networks must be developed	• BIFPCL is maintaining the social liaison especially with the local Government and DC office • They are implementing the HR policies, Labour recruitment Policies, Manpower set up etc.; • One third potion of the total labour are recruited from the local areas. • Most of the local labours are – directly project affected people, nearest communities or within the Rampal/Mongla areas • The wage of the labour is compatible with the national standard. • Following the procedure of safety at site of the workers • Provision of first aid is present; • Medical unit capable of dealing emergency situations like injury, ICU supported ambulance, accident, etc. already set up. • New planned residential areas for the labour are under construction, which includes good sanitation facilities, living condition, medical facilities and recreational facilities. • Prayer room has been constructed. • Available drinking water, sanitation facilities are recorded at site	In the process of Compliance	• The proponent should recruit more number of local labour for the project works according to their skill. • Training and motivational program should be run for the worker of shrimp farm, local labour, Bauali, Mauali or farmers; • Accidental log sheet or injury log book should be put into display in office premise and entry check post; • Training should be given sequentially to the PAPs, on Local or regional basis;
7	Green House Gas Controlling Measures	Restriction of any kind of solid waste burning. Regular maintenance of water vessels, vehicles, generator and machinery in accordance with manufacturer's	Relatively new equipment and machineries are used for construction purposes The EPC are implemented the project as per IFC guidelines standard, EIA	In the process of Compliance	Prepare checklist on equipment and their condition owned by the contractors; GHGs inventory checklist should be prepared

Sl. No.	Potential Impacts	EMP measures as proposed in the EIA	Actual condition/ Measures already Implemented	Compliance Status	Recommended Action
		specifications. Approved pollution control devices to be fitted in equipment and machinery. Transport vehicles must not be overloaded. Avoid queuing of vehicles in areas adjacent to site, particularly near sensitive receptors including housing. Switch off / throttle down all site vehicles, water vessels, generator and machinery when not in use	approval of DoE, and EMP of the EIA, etc. mentioned in the bid document. Monitoring program is being run successfully Vehicles and Vessels were not recorded as overloaded during the investigation		immediately at this stage; Select low GHGs emission machineries and CDM; Use of energy efficient and CDM technologies and equipment.

Table 5.2: Monitoring of Labor and Working Condition

Sl. no	Potential Impacts	EMP measures as proposed in the EIA	Actual measures already Implemented	Compliance Status	Recommended Action
1	Working Conditions and Management of Worker Relationship	• Preparation of Human Resources Policies and Procedures for Direct workers; • Defined Working condition and Terms of Employment for direct worker; • Sustainably equivalent terms and condition for migrant workers; • Compliance to national law of forming workers' organization; • No discrimination and equal opportunity for all; • Measures for diminishing past discrimination; • Grievance Redress Mechanism.	• Engaged HR consultant to prepare relevant policies; • Occupation Health and Safety department working ; • ERP and ESMS has been finalized; • No force and child labour is recorded • The EPC has signed contract with the sub-contractors about labour policies • EPC has also appointed Occupational Health and Safety Officers at site • Ensure minimum wage and working hours as per GoB for the labour. • Induction training and regular training of first aid, toolbox are continued.	Being complied	• Appointment of Local workers should be given priority for the jobs according to their skill. • No discrimination, equal opportunity and employment terms and conditions for local and migrated labours have to be carefully maintained. • Look after the workers wellbeing, relationships with the contractor and other labour groups, health and recreation. • Awareness and motivational training should be continued about workers safety, benefits, health and relationships with others and

Sl. no	Potential Impacts	EMP measures as proposed in the EIA	Actual measures already Implemented	Compliance Status	Recommended Action
			• Following the '*Bangladesh Labour Law (Revised) 2013', 'Bangladesh Labour Rule, 2015'.*		communities
2	Protecting Work Force	• The client will not employ children in any manner that is economically exploitative, or is likely to be hazardous or to interfere with the child's education, or to be harmful to the child health or physical, mental, spiritual, moral, or social development. • No Forced Labour	• Ensured no child labour employment • Ensured no forced labour • First Aid support to the labours during any accident. • Immediate first aid medical treatment has been given to 581 numbers of labour by the BIFPCL medical centre from April to June 2018. • ERP has already been developed and implemented. • Increasing the medical facilities for the labour. Labours are using PPEs during works at site. • EPC has also appointed Occupational Health and Safety officers at site • First aid, fire and safety, awareness training are conducted every week at project site. • ICU support ambulance and medical support are also improved in this quarter. • Contractor has taken insurance policy for engaged labours as per labour policy of Bangladesh.	Being complied	• Proper documentation of contract with the worker is required, which includes working hour, wage and benefit. They should emphasise for recruitment of the local labours; • The insurance policy should cover the accidental case or injuries of the labours; • Awareness work should be continued regarding the local cultural values, STD and redress of workers grievances
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	• Putting safety sign at every strategic places; • Protecting the specific areas with fence; • A number of designated areas	Being complied	• All electric distribution lines at project site required to be fixed as safe and tidy; • Insurance of the labour and employer should be introduced for any accidental

Sl. no	Potential Impacts	EMP measures as proposed in the EIA	Actual measures already Implemented	Compliance Status	Recommended Action
		shoes, gloves, dust mask, etc.); • Safety trainings for workers (i.e. fire control, working at height, working in heat, first aid etc.); • Practice of Tool box meeting, safety talks • Safe Storage of Hazardous Chemicals (e.g. fuel, flammable chemical, toxic chemicals, etc.); • Maintaining Material Safety Data Sheet (MSDS); • Provision of Health care facilities such as doctor, hospital etc. available at/nearby the plant construction site; • Availability of First Aid at work place; • Preparation and Follow of Emergency Response Plan; • Adequate fire precautions in place (e. g., fire extinguishers, escape routes etc.); • 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.	were recorded in the project site; • Labour and Project personnel are using appropriate PPEs like reflecting vest, helmet, and safety shoos etc. • Safety training for workers are regularly conducted at project site; • BIFPCL is very much strict to use PPEs by the construction labours and the labours are getting accustomed with the PPEs • Increasing the capacity of temporary hospitals, doctors and 24hr available of ICU support ambulance at the Project site ; • Emergency contact address are found at the site for any kind of sudden incident; • Safety manual has been followed at the construction site; • Available fire extinguisher and Fire safety mock drill is being conducted at some regular intervals. • Preparing a register for any kind of accidental events and incidents; • Third party OHS check-up is continued; • Project site protection and security system are being strictly maintained by Bangladesh Ansar. They are maintaining the register log and gate pass.		case. • Training should be repeated on personal safety of the worker like protecting the dangerous part of machine, vigilant for moving cranes, hooks or other lifting equipment, fall protection, extra-attention on electrical works etc. • Ensure the workers are using the appropriate PPEs, no drink or drug at work, personal hygiene and inform immediately to the supervisors for any unsafe condition.
4	Occupational Health and Safety procedure	• Provision of complete EHS division in the Human Resources Planning/	• Medical aid, fire extinguisher, PPEs are provided; • Worker's shed and sanitation	Being complied.	• Regular training, awareness, motivational and mock drill should continue to be

Sl. no	Potential Impacts	EMP measures as proposed in the EIA	Actual measures already Implemented	Compliance Status	Recommended Action
		Organogram • Preparation of Safety Policy to be adopted during Plant operation	facilities are available; • Onsite medical facilities have been continuing. • EHS Department of BIFPCL is now operating in full swing; • Moreover, EPC also appointed one OHS expert at site; • Site-specific Environmental Health & Safety checking is continued. • RO Water treatment plant and canteen has been operated for supplying safe drinking water for the labours.		arranged at the construction and operation phase; • Place the grievance register in a suitable place where the workers could easily make their comments or develop a more flexible procedure for grievance redress. • Formal training on Good Practices and OHS should be implemented regularly
5	Workers Well Being	• Provision of Welfare facilities for Worker/Labour such as, timely bonuses, wage, overtime, sick leaves, vacations etc.; • Routine medical check-up and emergency medical care for the sick and injured; • Appointment of a leader amongst the labour group, who will look into workers' well-being.	• Consultation with the proponent, EPC, Sub-contractor and labours, no forced labour is recorded. • Workers have no complain with the wage, working condition and the residence facilities. • Numerous provisions have been kept for Health care & information services, canteen facilities, water supply etc. • Proponent is now pushing to established fare wage of labours and the benefits for every labours • Free first aid medical treatment are being facilitated by BIFPCL to the labour and to the community too. • Grievance register are being initiated for the worker.	Being Complied	• Introduce occupational code of practices/best practices compatible with their own culture • Freedom of Association, Rights & scope of bargaining and tripartite consultation should be open for the workers. • Flexible procedure for grievance redress mechanisms • The proponent has to look after the following issues – equal benefit among the direct labour, contracted labour, day labour etc, workers work and non-work life balance, emotional supervisory support, organizational support and health surveillance

Table 5.3: Monitoring of Community Health, Safety and Security

Sl no	Potential Impacts	Proposed EMP	Actual measures already Implemented	Compliance Status	Recommended Action
1	Disturbance to nearby community due to dust from developed land and Noise from construction activities	• Construction of boundary wall around the Project area; • Installation of water spraying system to control dusts; • Conducting dust monitoring and visual inspection around the site boundary; • Adoption of Noise management plan.	• They are spraying water to reduce the dust emission especially the dry days of monsoon. • Temporary and permanent Construction of boundary wall around the project area has been completed. • Block-B is highly responsible for spreading dust to the nearest community • CEGIS is regularly communicate with the nearby communities for assessing any kind of impacts • Regular communication and consultation are taken places with the local government and local administration.	Being complied	• BIFPCL may inform BPDB for taking initiatives to control dust emission from Block-B area. • Continue the water spraying to the exposed land areas beyond the boundary all for the upcoming winter • Local people should be aware about the construction activities relevant to noise and dust.
2	Grievance of local people	• Availability and operation of Grievance Redress Mechanism; • Maintaining open communication channel with the local community.	• Social liaison officer is working on this issue • National level stakeholder consultation has been conducted occasionally • Grievance register is prepared for the community • Good communication has been established with the local government and proponent • BIFPCL has tried to redress the grievance of the local people though offering job, training and other CSR activities. • Proponent is observing the community grievance or quarries though the monitoring study conducted by CEGIS	Being complied	• Regular local level consultation is necessary for impact monitoring as well as updating the local communities. • Flexible grievance register procedure and redresses process. • Training on behavioural development on the security personnel should be introduced to eliminate the any misunderstanding with the local peoples
3	Risk of breaching Community Safety	• Construction of boundary wall/safety fence around the	• Project site is now protected as the construction of boundary wall has been	Being complied	• Continue the training and motivational work for

Sl no	Potential Impacts	Proposed EMP	Actual measures already Implemented	Compliance Status	Recommended Action
		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.	completed. • Regular monitoring not only the bio-physical but also the ecological and ultimately the social system are monitored by third parties (CEGIS) • Implement high security system for the project; • Health check-up is mandatory to every labours during the induction training. • Maintaining communication with local community; • Negotiation with local DC office and Bangladesh Ansar and VDP (who are responsible for security). • The project proponent has engaged the local governments for improving their livelihood status		maintaining local norms and values and have a good relation with the local workers and communities; • Make a liaison with the local government for clarifying any kind of indent/ rumour in local communities related with this project • Safe driving and vehicular movement should be implemented for the approach lane (Babubari to Project site)
4	Community Health Risk	• Provision of providing health service facilities to community if the Project poses any health risk like sexually transmitted disease, contract disease, vector-borne diseases; • Implement all pollution mitigation measures to ensure safeguarding to community.	• Increased the medical facilities (consisting medical officer, medical assistant, office assistant) at Plant site; • Arranging twice a weekly health service program (medical consultation and free medicine) for the local community. 1829 number of patient has been served through BIFPCL medical camp from April to June 2018 • Protective action are taking to avoid vector borne diseases and HIV positives	Being Complied	• Continued the training activities for migrated labour regarding the local culture and customs; • The proponent may establish business development activities (markets) for the workers and local communities as CSR activities.
5	Youth Employment (Local)	• Providing training/awareness program for the local youth to let them aware about the required qualification to get involved in the Project related activities	• Informal sitting was arranged with the local government and community representatives for labour recruitment; • Significant number of local people (700-1000) are currently working at the construction site;	Being Complied	• Increasing the number of local labours; • training related to construction work i.e. carpenter, electrician, lineman, elevator mechanic,

Sl no	Potential Impacts	Proposed EMP	Actual measures already Implemented	Compliance Status	Recommended Action
		• Emphasis to recruit local labours according to their skills and capacities.	• Regular training/workshop are being organized by the proponents especially on swinging and computer ; • The proponents have already taken few initiatives to encourage local students through awarding them; • Local labours are working at this project engaged by the sub-contractors companies • Formal training on computer literacy and sewing machine has been initiated in the site and already 3 batches has completed the training program. • Recently, a 3days taring was held on Computer for 20 students/ unemployed locals on 17th July2018.		glazier, iron worker, heavy equipment operator or labourer etc. would be introduced immediately; • Support Income generating activities and business development activities for the local potential youth. • Recruit locals according to their skills as much as possible.
6	Public Communication, Consultation and Awareness	• Arranging public communication/consultation meeting; • Sharing of Project information with local people; • Organizing environmental and social awareness programs/meetings.	• Informal sitting with the community; • Display Project related information on a display board at Project site; • Regular meetings are being carried out at different level; • Advertisement was broadcasted • Publishing Project related discussion/article in different print media. • Project related every information has been uploaded in BIFPCL website	Being Complied	• Continue the dissemination workshop in Dhaka and Khulna and Bagerhat or Rampal Upazila to aware the community, civil society, environmentalists about the environmental safeguarding measures considered in basic design. • The EPC contractor should follow the social code of conducts / good practices

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

Sl No	Potential Impacts	EMP measures as proposed in the EIA	Actual condition/ Measures already Implemented	Compliance Status	Recommended Action
1	Rainfall runoff from the construction site would cause deterioration of aquatic ecosystem.	• Installation of proper runoff drains; • Use of sediment fences, traps and basins for trapping the sediment, if required.	• Water logged area is not found inside the project boundary • Construction of sediment traps is mentioned in the Bid documents to instruct the bidders; • Develop temporary drainage network inside the Project boundary. • Rainfall runoff is drained out though temporary drainage system or formal pipe network • The connectivity of Maidara River is being maintained. • EPC is monitoring the water quality at every outlet from the project site. • RO plant is operating for supplying fresh water supply system both for construction and domestic uses.	Being complied	• The proponent has to maintain the temporary drainage system for this monsoon rainfall • Storm water drainage network must be separated from any kind of contamination of chemicals or oily water. • Evaporation pond might be used for brine discharge from the RO Plant
2	Disturbance to nearby ecosystem due to different construction activities	• No cutting/ felling of trees along the river bank; • Implementation of onsite waste and air quality management plan; • Limiting soil extraction activities within the defined area; • 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;	• Rudimentary processing followed for waste collection and disposal system for this construction stages • Limiting the vegetation clearance and base stripping process within the Project boundary; • Boundary wall around the project is completed along with compartmentalization • Provision of cut-off time to switch off unnecessary lights at night; • Selection of local plant species like Goalpata, Sundori, Bian, Kaora for green plantation; • No degradation of the habitat out site the power plant area • EPC contractor is monitoring the air	Being Complied	• If possible using of light shade (directed downwards) around the outdoor lights; • Regular monitoring of the trees planted around the Project site. • Bird sheds can be developed at the green belt areas or on the bank slope. • Awareness program for ecosystem conservation and development should be introduced as a part of Corporate Environmental Responsibility • Ecosystem monitoring

Sl No	Potential Impacts	EMP measures as proposed in the EIA	Actual condition/ Measures already Implemented	Compliance Status	Recommended Action
		• Initiate Green plantation; • No plantation of non-native species; • Retaining top soil for future habitat restoration; • No degradation of sensitive habitat.	quality, water quality and noise level more intensively in the project area • Working activities are now limited to the project boundary • No lighting and noise effect is noticed significantly outside the project boundary wall • Motivational works are introduced to protect local fauna during training session		must be continued simultaneously with the power plant construction and operation works.
3	Disturbance to river, inter-tidal areas and wet lands	• No encroachment of inter-tidal flood plain area; • No disturbance to Dolphin community; • Monitoring of Ecosystem Health and Monitoring of Sundarbans Forest Health; • If required, embankment should be constructed considering a setback distance from river/canal bank; • Slope protection work along the Maidara River should be completed on an urgent basis before rainy season come, and; • BIFPCL may take initiatives of excavating of silted reach of Maidara river near proposed township area to facilitate proper functioning of River for maintaining tidal flow dynamics	• Monitoring of forest health and ecosystem health in Sundarbans and around the Project site are being carried out by CEGIS; • Completion of slope protection work; • Protection works along the Maidara River maintained setback distance from Maidara River. • EPC is monitoring the discharge quality at each of the outlet from this project • The natural stream flow of Maidara River near access road has been recorded.	Being Complied	• Care should be taken during navigation, discharging water and construction activities at inter tidal areas. • Necessary action should be taken if the discharge water quality cross the standard limit (ECR'1997)

5.2 Compliance to the Conditions of DoE

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

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

Sl No	Condition of DoE	Compliance Status	Remarks
	environment friendly solid waste management should be in place during the whole period of the Project in the field.	line with this, condition have been included in Clause No 14.9 of SCC. Solid Waste Management system has been prepared (Section-V, B12, Part-9 of Technical Specification).	
13	Proper and adequate on-site precautionary measures and safety measures shall be ensured so that no habitat of any flora and fauna would be endangered or destructed.	The construction activity is being carried within the project boundary. Moreover, regular monitoring activities are carried out to compare the impacts. No significant changes are yet recorded.	Being Complied
14	All the required mitigation measures suggested in the EIA report along with the emergency response plan are to be strictly implemented and kept operative / functioning on a continuous basis.	The construction activities has been continued. The project authority has increased the medical facilities for workers. An ICU support ambulance and Doctors are now available for emergency stages. Villagers of surrounding areas also availing the healthcare facilities. The authority is trying to make aware the labours/workers on occupational health and safety through safety signboards, safety training and strong implementation of safety measures. The Emergency response plan is now functioning.	Being Complied
15	To control dust, spraying of water over the earthen materials should be carried out from time to time.	Water spraying for dust suppression are currently functioning especially for the dry days of this monsoon. Moreover, frequent dust monitoring has been conducted at sensitive points.	Being Complied
16	Storage area for soils and other construction materials shall be carefully selected to avoid disturbance of the natural drainage.	Construction materials have been stock piled far away from river bank and other natural water bodies at selected site to avoid disturbance of the natural drainage. For the time being BIFPCL have constructed temporary drainage network to evacuate drainage water from the Project site. Designed Drainage network will be constructed at the end of Project construction works.	Being Complied
17	Adequate considerations should be given to facilitate drainage system for runoff water from rain/tidal surge.	Temporary drainage system has been developed to facilitate safe drainage of rainfall runoff water accumulated from rain/tidal surge. A setback distance from the river has been tried to maintain during construction stage for this Project.	Being Complied.

Sl No	Condition of DoE	Compliance Status	Remarks
18	Adequate facilities should be ensured for silt trap to avoid clogging of drain/canal/water bodies	Run off/ storm water drainage system have silt trap before ultimate discharge of rainfall runoff. Contractor is working to clean the temporary drainage system.	Being Complied.
19	The entire coal handling system should be designed as an enclosed (and not only covered) conveyor system. There should be integrated dust control system with dust extraction and bag filters at unloading areas and at each transfer points on the conveyor system.	Entire coal handling system have been designed as an enclosed conveyor system as per DoE requirement. Integrated dust control system with dust extraction system / bag filter and dust suppression system at crusher house, unloading points, transfer points has been specified in the technical specification of Main Plant EPC contract package. Refer Section V, B4 of Technical Specification.	Compliance action initiated.
20	Coal Plant should have high-efficiency bag filter for arresting dust emissions.	Integrated dust control system with dust extraction system / bag filter and dust suppression system at crusher house, unloading points, transfer points has been specified in the technical specification of EPC contract package and will be implemented accordingly. Refer Section V, B4 of Technical Specification (Clause no B4.3.1.4).	Compliance action initiated.
21	Coal should be stored in a covered storage yard.	All these stipulations have been included in the technical specification of Main Plant EPC contract package, Section V, B4 of Technical Specification (Clause No B4.3.1.6).	Compliance action initiated.
22	The entire coal stockyard should be covered with water sprinkler provided with automated moisture sensor to control self-combustion.	All these stipulations have been included in the technical specification of Main Plant EPC contract package, Section V, B4 of Technical Specification.	Compliance action initiated.
23	100% utilization of fly ash and bottom ash should be planned and implemented throughout the operation of the Plant. There should only be a provision of small ash dyke that will not exceed 25 (twenty five) acres of land to store residual ash.	100% utilization of fly ash has been planned and shall be implemented throughout the operation of this Plant. EOI has been received in this regards from nearby Cement Industries. Only 25 acres area has been allocated to store residual ash.	Complied at present and will be complied throughout Operation phase.
24	Integrated dry ash handling, loading, unloading and transportation system should be established.	Integrated dry ash handling, loading, unloading and transportation system will be established. Provisions in line with this has been included in Technical Specification of main	Compliance action initiated.

Sl No	Condition of DoE	Compliance Status	Remarks
		Plant EPC contract package (Section V, Chapter B4).	
25	There should be adequate and properly sized and designed dry ash silo with appropriate conveyor system.	Adequate and properly sized dry ash silo with appropriate conveying system have been specified in Technical Specification of main Plant EPC contract package (Section V, Chapter B4).	Compliance action initiated
26	Bottom ash should be extracted, crashed and stored in silos for utilization with proper collection and conveyor system.	Bottom ash shall be extracted, crushed and stored in silos for utilization with proper collection and conveying system. The procedures have been included in the technical Specification of EPC contract package. (Section V, Chapter B4).	Compliance action initiated
27	Resettlement and rehabilitation of the displaced population (including those who do not own land) should be done properly.	Land has been acquired by GoB. Resettlement and rehabilitation action was taken as per the law of the Bangladesh. However, BPDB has already written to Ministry for suitable resettlement and rehabilitation as per DoE requirement. In the meantime, BPDB have prepared an assessment (Livelihood Restoration Plan) regarding the rehabilitees (including those who do not own land) for this Power Plant. In this regard BPDB has selected NGO –"Samahar" for implementation of the recommendation of the LRP. This NGO is working for last two months.	Compliance action initiated
28	Resettlement plan should be properly implemented and people should be adequately compensated.	Land has been acquired by GoB. Resettlement and rehabilitation action was taken as per the law of the Bangladesh. However, BPDB have prepared an assessment (Livelihood Restoration Plan) regarding the rehabilitees (including those who do not own land) for this Power Plant. In this regard BPDB has already invited Tender from local NGO for implementation of the recommendation of the LRP Report.	Compliance action initiated
29	Construction material should be properly disposed-off after construction work is over.	At present, the construction work is going on. Storage room has been prepared for the construction works. Solid Waste Management system has been prepared keeping the provisions in line with this (Section-V, B12, and Part 9 of Technical	Complied at present.

Sl No	Condition of DoE	Compliance Status	Remarks
		Specification).	
30	As described in the report environmental monitoring should be strictly followed and monitoring report should be shared with DoE to ensure the environmental management properly.	BIFPCL has engaged CEGIS for environmental monitoring in February 2014. Accordingly, each quarterly monitoring report has been submitted and shared with DoE, which are also available at BIFPCL web site.	Being Complied.
31	All activities (pre-construction, construction and post-construction stage) should be implemented according to EMP clearly listed in the EIA report.	BIFPCL has adopted all of the EMP applicable at relevant stages. CEGIS, as an environmental consultant of BIFPCL is monitoring implementation of EMP. BIFPCL is taking all possible actions based on EMP monitoring report.	Complied at present.
32	A third party/independent monitoring bodies excluding JVC/BPDB should be engaged immediately for monitoring of all activities during pre-construction, construction and operation phases as per monitoring plan of EIA report and monitoring report must be submitted to Bagerhat District Office, Khulna Divisional Office and Headquarters of the Department of Environment simultaneously.	CEGIS, as an independent monitoring body has been engaged by BIFPCL since February 2014 and it is still continued. . From then on, CEGIS has been conducting the monitoring programs quarterly and producing monitoring reports on regular basis which are submitted by CEGIS to BIFPCL for onward submission to the Bagerhat District Office, Khulna Divisional Office and Headquarters of the Department of Environment as directed by DoE.	Being Complied
33	Regular monitoring of the susceptible places of Sundarbans for protecting ecosystem, biodiversity and forest coverage should be made using latest high resolution image for keeping ambient environment.	The Monitoring activities of CEGIS included this part vastly. The monitoring report contains analysis of biodiversity and forest coverage. However, in addition to this, Forest Department has also suggested some survey & analysis which have also been monitored and reported by CEGIS through the quarterly compliance monitoring report.	Being Complied.
34	Air, water, soil, biological and social data should be monitored regularly with a network monitoring system with a view to assess the natural quality of the Sundarbans and other fragile ecosystem and report of monitoring results should be submitted to Bagerhat District Office, Khulna Divisional Office and Headquarters of the Department of Environment simultaneously.	The network monitoring system will be installed as a part of the project construction for online monitoring and it will be run at the time in operation. All these stipulations have been included in the technical specification of Main Plant EPC contract package. (Section-V, Clause No B0 6.19.13.2 and Clause No. B0 6.19.13.5). However, air, water, soil and biological components are regularly monitored manually as	Compliance action initiated.

Sl No	Condition of DoE	Compliance Status	Remarks
		per recommendation of EMP.	
35	There should be regularly disclosure of the report through workshops and websites and responses should be taken care accordingly.	All the reports are available on website of BIFPCL (www.bifpcl.com). CEGIS is regularly carrying out public consultation.	Being Complied.
36	Online air and water quality monitoring system should be made functional throughout the life of the Plant.	The online monitoring system will be installed when the Plant will be in operation and will continue throughout the life time of the Plant. All these stipulations have been included in the technical specification of Main Plant EPC contract package. (Section-V, Clause No B0 6.19.13.2 and Clause No. B0 6.19.13.5).	Compliance action initiated
37	Management Information System (MIS) are to be developed for this coal based Power Plant. The scope of MIS services will obviously include representing the real time monitored data especially environmental parameters displaying at Bagerhat District Office, Khulna Divisional Office and Headquarters of the Department of Environment, BPDB and other concern agencies/Ministries. The MIS should be web based for accessing every individual to show the real time monitored records.	The MIS will be prepared before commissioning of the Plant. The consultant for developing MIS will be engaged at least one year earlier. Specification for elaborate MIS system is already included in EPC contract document. Technical Specification like DDCMIS, DDCS, PADO System, HART system, Plant MMS, Information management security system etc. have been included.	Compliance action initiated
38	JVC should provide all sort of logistics support to DoE and other relevant agencies for monitoring environment related items/events.	BIFPCL is ready to provide all sort of logistic support as and when required by DoE and other relevant agencies for monitoring of Plant construction activities and environmental items/events.	Being complied
39	No ground water should be allowed to use for plant purposes.	No ground water has been used so far for Plant purposes. The Plant has been designed considering use of surface water only. Therefore, they have already installed RO water treatment plant for potable water and for construction water sourcing from the river water of Passur. This RO plant is running now.	Complied at this stage.
40	Conduct stakeholder meetings on regular basis for better performance of the Project as a whole.	Pre-construction phase of the Plant has been completed and the construction phase is continued. BIFPCL has appointed a social worker who regularly	Being Complied

Sl No	Condition of DoE	Compliance Status	Remarks
		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.	
41	Additional Environmental baseline data to be collected as suggested in the EIA report and conveyed to DoE and other concern authorities.	CEGIS has been engaged in February 2014, for preparing Detailed Environmental Baseline. CEGIS has submitted reports of quarterly monitoring containing latest baseline data to BIFPCL for further dissemination to DoE and other concerned authorities.	Being Complied
42	The Environmental Management Plan under the EIA study shall strictly be implemented and kept functioning on a continuous basis.	BIFPCL has been implementing all the EMP measures phase by phase as suggested in EIA report and approval condition of DoE. The status of EMP implementation are also regularly monitored by CEGIS.	Being Complied
43	The Project authority shall submit a detail work plan with time schedule of development activities at least 7 (seven) days ahead of the work commences in the field to the Bagerhat District Office, Khulna Divisional Office and Headquarters of the Department of Environment simultaneously.	The construction works is now going on. BIFPCL has submitted the detailed work plan seven (7) days before starting of the construction activities to the Bagerhat District Office, Khulna Divisional Office and Headquarters of the Department of Environment simultaneously.	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 since October 2017.	Being Complied
45	The following records must be kept in respect if any samples required to be collected for the purpose of environmental monitoring activities: the date(s) on which the sample was taken; the time(s) at which the sample was collected; the point at which the sample	The Monitoring report of CEGIS keeps all the records as suggested.	Being Complied

Sl No	Condition of DoE	Compliance Status	Remarks
	was taken; and the name of the person who collected the sample.		
46	The results of any monitoring required to be conducted under this EIA report must be recorded.	CEGIS is recording all the monitoring data and submitting to BIFPCL through proper documentation. The report is being shared with DoE on regular basis.	Being Complied
47	In case of any emergency, the following information shall be immediately be reported to Bagerhat District Office, Khulna Divisional Office and Headquarters of the Department of Environment (DoE) simultaneously Nature of incident (oil spill, fire, accident. Collision, land slide, etc.) Personnel affected (injured, missing, fatalities, etc.) Emergency support available and its location (standby transport, medical facilities, etc.) Weather conditions Current operations (abandoning the site, firefighting, etc.)	So far no such emergency has occurred. Emergency Reporting/ Emergency response plan have been prepared. Health and safety management manual have been prepared and it is a part of technical specification. BIFPCL has established a proper mechanism for recording such incident as suggested during the construction period of the Project.	Compliance action initiated.
48	The Project authority or its employees must notify the department of Environment of incidents causing or threatening material harm to the environment as soon as practicable after the person becomes aware of the incident.	So far no such incident has occurred. BIFPCL has established a proper mechanism for recording such incident as suggested and notify the department of Environment regarding incidents causing or threatening material harm to the environment as soon as practicable after the person becomes aware of the incident. Health and safety management manual has been practised and Environment, safety officer has been employed and CEGIS is monitoring EMP.	Complied at present.
49	All pollution incidents shall be reported immediately and simultaneously to the Bagerhat District Office, Khulna Divisional Office and Headquarters of the Department of Environment (DoE) in Dhaka.	So far no such incident has happened. BIFPCL has established a proper mechanism for recording such incident as suggested in the ERP. CEGIS has been engaged to monitor the social and environmental compliance on a regular interval.	Complied at present.
50	Appropriate permission would require to be obtained from the Forest Department in favour of cutting/felling on any	There will be no need of cutting/felling down of any trees. However, in future, if any such case arises, BIFPCL would seek	Being complied

Sl No	Condition of DoE	Compliance Status	Remarks
	plant/tree/sapling forested by any individual or government before doing such type of activity.	for appropriate permission from the Forest Department.	
51	Re-vegetation and re-plantation under green belt activities shall be undertaken in consultation with the Forest Department according to those mentioned in the EIA report.	A MoU has been signed with Forest Dept., Bangladesh on 24.02.2015 for implementation of Afforestation Programme. Initial target is to plant 2 lac saplings in 3 years. By this time, Forest Department has already planted about 23000 nos. of saplings of different species. A fresh Agreement with BFD has been signed on 24.01.2018 for plantation of 2 Lakh trees. In the mean time they have planted 25,000 trees from May-July, 2018.	Being Complied
52	Climate Change impacts and maximum storm surge height shall have to consider at the design and construction phase.	The design level (elevation) of the land and earthen embankment has been fixed considering the climate change impact and maximum storm surge height.	Being Complied
53	A separate EIA/morphological study shall have to be conducted for coal transportation and river dredging to develop sound environmental management plan towards conservation of ecosystem and biodiversity.	Mongla Port Authority (MPA) is the Implementing Agency for dredging. Coal transportation will be done through the existing maritime route, which is Mongla port controlled waterways. M/s IWM has already completed the EIA study for the dredging activity and submitted the report to MPA. A separate EIA study for Coal Transportation has been conducted by M/s CEGIS as per approved ToR of DoE and already obtained the approval from DoE.	Being Complied.
54	A full-fledged institutional setup for EHS and CSR must be put in place before operation of the Power Plant.	A full-fledged institutional setup for EHS activities shall be in place before operation of the Plant (Project). Meanwhile, a number of CSR activities are ongoing at Project site, like free medical facilities and medicines, free potable water supply to the local people. Infrastructure development of nearby school. BIFPCL has appointed a social worker to collect relevant social data. Health and Safety manual has been prepared.	Being complied
55	The Project authority shall extend active cooperation to DoE officials to facilitate their	BIFPCL is extending its all-out cooperation to DoE	Being Complied

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

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Appendices

Appendix I: Checklist of Monitoring Environmental Compliances

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

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

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

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

(Labor and Working Condition)

Basic Data

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

Checklist for Labor and Working Condition

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

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

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

(Community Health, Safety and Security)

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

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

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

(Biodiversity and Sustainable Management of Living Natural Resources)

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

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

Appendix II: Photo Album

Environmental Monitoring of Khulna 2×660 MW Power Plant for 17th monitoring program (July, 2018)

TheOnioring Team

Measuring the Canopy coverage

Collection of DBH data

Measuring the light intensity

Counting seedlings and pneumetaphores

Noise level measurement at Akram point of Sundarbans

Professionals is is discussing with Gher owner

Professionals are collecting river bed sediment samples

Experts are checking the forest health data

collection of surface water samples

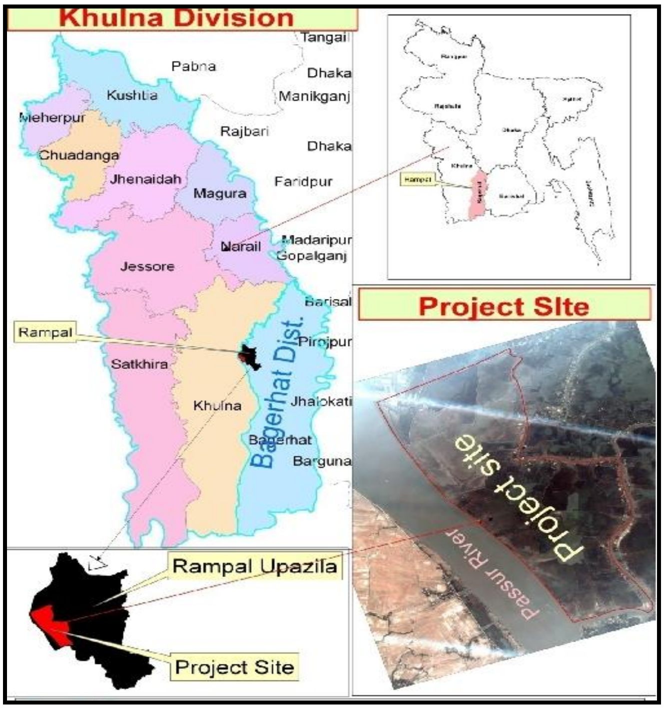
Collection of groundwater samples

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

<table>
<tr><td>Project Location:</td><td>Upazila: Rampal, District: Bagerhat
Site is located at 23 kms Southward of Khulna City and 14 kms.
North-Eastward from Mongla Port.


</td></tr>
<tr><td>Project Capacity:</td><td>1320 MW (2x660 MW), based on Ultra Super-critical Technology</td></tr>
<tr><td>Mode of Operation:</td><td>Base Load</td></tr>
<tr><td>Fuel:</td><td>Imported Coal</td></tr>
<tr><td>Fuel Transportation:</td><td>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.</td></tr>
<tr><td>Land& Land Development:</td><td>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</td></tr>
</table>

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

Broad Scope of Works

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

The Broad objectives of independent monitoring covers the following activities

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

The main objectives of this works are

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

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

- Develop specific monitoring indicators, checklists, and questionnaires to undertake independent monitoring (a preliminary list of monitoring indicators has been given in the EMP) in consultation with BIFPCL, DoE, Forest Department and the Financer;

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

Socio-economic environment, Sundarban Forest health etc. according to the monitoring framework in construction phase.

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

The Monitoring parameter & associated indicator are given below

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

Monitoring Parameter	Indicators
	Total Hardness, Hg, NO_3 and PO_4
	River Morphology,
	Tidal inundation
	Drainage Network
	Erosion and Accretion
	Ground water quality
Air quality	SOx
	NOx
	SPM (PM_{10} and $PM_{2.5}$)
	CO

Air quality monitoring progress

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

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

Expected Output

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

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

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

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

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

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

Reporting Requirements

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

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

Appendix IV: Monitoring Data

(A) Air Quality Data

Table A.1: Ambient Air Quality Monitoring Results

Locations of Monitoring	Pollutants	1st QM, Apr 2014	2nd QM, Jul 2014	3rd QM, Oct 2014	4th QM, Jan 2015	5th QM, Apr 2015	6th QM, Jul2015	7th QM, Oct 2015	8th QM, Jan 2016	9th QM, Apr 2016	10th QM, Jul 2016	11th QM, Oct 2016	12th QM, Jan 2017	13th QM, April, 2017	14th QM, Oct, 2017	15th QM Jan, 2018	16th QM April, 2018	17th QM, Jul 2018	Bangladesh (DoE) Standard (ECR 2005)
Weather		Sunny	Rainy/ Cloudy	Sunny	Sunny	Sunny	Rainy/ Cloudy	Sunny/ Rainy	Sunny	Sunny	Rainy/ Cloudy	Rainy/ Cloudy	Sunny	Suny/ Cloudy	Sunny	Sunny	Suny/ Cloudy	Rainy/ Cloudy	
			Concentrations are in $\mu g/m^3$																
SW Corner of the PP area	$PM_{2.5}$	33	37	25	33	47	25	22	34	19	5	9	24.8	8.12	28.2	32.9	28.4	15.2	65^{24hr}
	PM_{10}	78	77	53	79	83	35	52	135	117	32	22	79	43.8	73.6	133	70	15.8	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	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	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	100^{Annual}
	CO	120	188	140	190	144	146	88	74	57	35	119	59	91	73	61	32	11.1	$(10000)^{8hr}$
	O_3	27	26	19	22	26	12	5	4	1	1	1	5	03	10	03	9	13.2	157^{8hr}
Proposed Township area	$PM_{2.5}$	39	48	48	39	34	18	17	35	25	3	8	25	14.6	8.5	31.5	26.7	15.8	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	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	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	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	100^{Annual}
	CO	165	210	230	164	136	127	102	77	22	31	108	66	78	79	69	27	25	$(10000)^{8hr}$
	O_3	33	26	26	23	21	16	1	1	1	0	0	1	08	25	04	4	8	157^{8hr}
NW Corner of the PP area	$PM_{2.5}$	37	44	19	42	59	28	19	24	11	3	10	29	10.3	15.2	40.7	27.7	12.9	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	Bangladesh (DoE) Standard (ECR 2005)
Weather		Sunny	Rainy/ Cloudy	Sunny	Sunny	Sunny	Rainy/ Cloudy	Sunny/ Rainy	Sunny	Sunny	Rainy/ Cloudy	Rainy/ Cloudy	Sunny	Suny/ Cloudy	Sunny	Sunny	Suny/ Cloudy	Rainy/ Cloudy	
			Concentrations are in μg/m³																
	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	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	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	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	100^{Annual}
	CO	110	178	110	210	140	133	87	77	38	47	127	31	74	80	45	43	21	$(10000)^{8hr}$
	O_3	25	19	17	36	44	11	8	2	0	1	1	3	05	10	05	7	6	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	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	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	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	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	100^{Annual}
	CO	175	210	190	150	196	96	96	81	73	41	98	63	85	77	59	24	20	$(10000)^{8hr}$
	O_3	26	29	22	19	15	9	6	4	0	0	3	5	08	6	04	6	6	157^{8hr}
Chunkuri-2, Bajua Dacope	$PM_{2.5}$	35	39	46	37	33	35	28	31	25	7	5	25.2	8.7	17.3	33.4	11.4	10.2	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	150^{24hr}
	SPM	117	113	162	183	188	175	94	167	167	31	48	162	110.6	127.8	200	108	78.6	200^{8hr}
	SO_2	19	24	21	18	11	55	33	21	13	7	9	18.9	8.2	7.9	19	10.4	7.5	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	100^{Annual}
	CO	190	205	170	170	33	133	75	70	33	38	79	36	94	69	58	42	23	$(10000)^{8hr}$
	O_3	27	24	18	22	41	21	2	1	1	0	2	2	03	5	05	2	4	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	65^{24hr}
	PM_{10}	119	127	139	101	105	144	62	128	46	42	18	141.6	105	63.4	208.9	74.3	58.4	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	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	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	100^{Annual}
	CO	230	217	250	188	177	125	105	101	55	29	112	48	83	87	49	34	29	$(10000)^{8hr}$
	O_3	49	38	36	27	11	13	5	2	2	0	0	3	06	0	06	6	8	157^{8hr}
Mongla Port area	$PM_{2.5}$	47	55	39	41	26	33	19	34	21	9	11	25.7	22.6	33.2	70.1	23.2	13.2	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	Bangladesh (DoE) Standard (ECR 2005)
Weather		Sunny	Rainy/ Cloudy	Sunny	Sunny	Sunny	Rainy/ Cloudy	Sunny/ Rainy	Sunny	Sunny	Rainy/ Cloudy	Rainy/ Cloudy	Sunny	Suny/ Cloudy	Sunny	Sunny	Suny/ Cloudy	Rainy/ Cloudy	
			Concentrations are in µg/m³																
	PM_{10}	139	174	77	82	35	52	33	132	45	29	15	119.3	93.6	97	209.1	89.9	47.5	150^{24hr}
	SPM	288	303	197	217	214	118	65	189	144	50	6	172.3	196	187.2	242	144.7	73.7	200^{8hr}
	SO_2	27	28	26	24	14	45	36	16	10	8	7	16.8	10.5	8.2	15.5	11.8	6.5	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	100^{Annual}
	CO	230	320	220	211	24	110	84	71	29	31	97	44	72	79	52	29	20	$(10000)^{8hr}$
	O_3	57	52	37	26	09	15	8	3	1	2	1	4	04	9	02	3	1	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	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	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	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	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	100^{Annual}
	CO	65	58	70	64	56	112	81	62	47	32	110	67	73	84	57	31	20	$(10000)^{8hr}$
	O_3	13	12	13	11	14	12	4	2	2	0	1	4	08	0	02	2	6	157^{8hr}
Akram Point, Sundarbans	**$PM_{2.5}$**	17	19	23	18	49	NO	25	18	9	4	4	14.3	13.2	7.5	35.4	13.7	14	65^{24hr}
	PM_{10}	39	44	32	39	77	NO	32	77	31	15	14	85.5	96.0	37.8	150.6	36.4	41.6	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	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	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	100^{Annual}
	CO	49	60	50	46	163	NO	92	64	21	37	101	58	79	69	52	21	25	$(10000)^{8hr}$
	O_3	11	14	9	10	27	NO	8	1	0	0	2	3	0	0	03	3	4	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	65^{24hr}
	PM_{10}	44	38	34	41	60	NO	45	NO	40	NO	14	104.5	NO	92.1	149.8	NO	NO	150^{24hr}
	SPM	101	119	107	97	110	NO	88	NO	132	NO	26	111.4	NO	102	173.7	NO	NO	200^{8hr}
	SO_2	8	7	13	14	15	NO	28	NO	15	NO	9	13.5	NO	6	15.8	NO	NO	365^{24hr}
	NOx	18	18	19	22	20	NO	23	NO	19	NO	9	15.9	NO	7.8	18.1	NO	NO	100^{Annual}
	CO	52	62	65	60	60	NO	93	NO	40	NO	121	43	NO	72	71	NO	NO	$(10000)^{8hr}$
	O_3	14	13	11	9	23	NO	2	NO	0	NO	0	4	NO	0	04	NO	NO	157^{8hr}
Khulna City, near Khan Jahan Ali Bridge	**$PM_{2.5}$**	54	39	52	42	55	46	19	35	11	16	9	34.6	23.1	19.5	78.7	12.4	12.5	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	Bangladesh (DoE) Standard (ECR 2005)
Weather		Sunny	Rainy/ Cloudy	Sunny	Sunny	Sunny	Rainy/ Cloudy	Sunny/ Rainy	Sunny	Sunny	Rainy/ Cloudy	Rainy/ Cloudy	Sunny	Suny/ Cloudy	Sunny	Sunny	Suny/ Cloudy	Rainy/ Cloudy	
			Concentrations are in µg/m^3																
	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	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	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	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	100^{Annual}
	CO	330	370	330	296	101	89	94	98	68	36	104	66	79	81	69	36	28	$(10000)^{8hr}$
	O_3	59	67	57	39	21	7	4	2	1	0	2	3	07	07	09	9	7	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	65^{24hr}
	PM_{10}	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	70.3	60.8	150^{24hr}
	SPM	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	120.6	98.1	200^{8hr}
	SO_2	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	13.1	8.4	365^{24hr}
	NOx	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	14	9	100^{Annual}
	CO	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	46	32	$(10000)^{8hr}$
	O_3	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	9	4	157^{8hr}
Near the 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	65^{24hr}
	PM_{10}	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	118.1	83.7	150^{24hr}
	SPM	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	142.5	106.2	200^{8hr}
	SO_2	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	12.2	10.9	365^{24hr}
	NOx	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	14.8	13.4	100^{Annual}
	CO	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	38	34	$(10000)^{8hr}$
	O_3	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	5	7	157^{8hr}

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

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

Table A.2: Baseline conditions of emission from different sources

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

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

Legend X-Absence of source or no emission, √-

Presence of source, emission of pollutant

(B) Water Quality Data

Surface Water Quality Monitoring Data

Table B.1: pH Values of Passur River Water

Sl	Sampling Locations	pH Values																		BD Standard
		1st year				2nd Year				3rd year				4th year			5th year			
		Apr	July	Oct	Jan	Apr	July	Oct	Jan	Apr	July	Oct	Jan	Apr	Oct	Jan	Apr	July		
		1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	1QM	2QM		
1	Left Bank of Passur River at 100m u/s of North West corner from the Project boundary	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		6.5– 8.5
2	Middle Passur River at 100m u/s of North West corner from the Project boundary	7.2	7.0	8.2	8.0	7.7	7.9	7.58	7.3	7.8	7.3	7	7.5	7.3	6.9	8.25	8.1	8.4		
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		
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		
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		
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	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	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		
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		
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		
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		
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		
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		
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		
15	Passur river at Hiron po.000int of Sundarbans	7.2	7.0	7.0	8.1	7.7	NS	7.39	NS	7.8	NS	7.6	8.5	NS	6.8	8.2	NS			

Source: CEGIS Field Survey

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

Table B.2: Surface Water Temperature in Passur River

Sl	Sampling Locations	Temperature (°C)																			BD Standard
		1st Year				2nd Year				3rd year				4th year			5th year				
		Apr	Jul	Oct	Apr	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	Apr	Jul			
		1QM	2QM	3QM	1QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	1QM	2QM			
1	Left Bank of Passur River at 100m u/s of North West corner from the Project boundary	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			20°C – 30°C
2	Middle Passur River at 100m u/s of North West corner from the Project boundary	31	33	31	20	30	30.5	31.8	21.0	31.1	29.1	30.8	22.5	30	30.1	19.8	30	30			
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			
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			
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			
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			
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			
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			
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			
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			
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			
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			
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			
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			
15	Passur river at Hiron point of Sundarbans	29	30	29	21	30	NS	30.4	NS	31.4	NS	31.3	21.4	NS	29.4	21.2					

Source: CEGIS Field Surve

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

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

Sl	Sampling Locations	Salinity (ppt)																
		1st Year				2nd Year				3rd year				4th year			5th year	
		Apr	Jul	Oct	Apr	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	Apr	Jul
		1QM	2QM	3QM	1QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	1QM	2QM
1	Left Bank of Passur River at 100m u/s of North West corner from the Project boundary	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
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
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
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
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
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
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
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
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
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
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
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
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
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
15	Passur river at Hiron point of Sundarbans	23.0	19.5	2.0	23.0	25	NS	6.2	NS	14	NS	5.8	21.4	NS	5.1	16.45	23.0	

Source: CEGIS Field Survey

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

Table B.4: Dissolve Oxygen in Passur River

SL	Sampling Locations	Dissolve Oxygen (mg/L)																	
		1st Year				2nd Year				3rd year				4th year			5th year		BD Standard
		Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	Apr	Jul	
		1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	1QM	2QM	
1	Left Bank of Passur River at 100m u/s of North West corner from the Project boundary	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	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	
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	

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

Source: CEGIS Field Survey-

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

Table B.5: BOD5 of Passur River Water

SL	Sampling Location	Biochemical Oxygen Demand (mg/L)																	BD Standard
		1st Year				2nd Year				3rd year				4th year					
		Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	Apr		
		1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	1QM		
1	Left Bank of Passur River at 100m u/s of North West corner from the Project boundary	3.4	2.2	1.9	1.6	3.1	3	2.1	2.1	2.8	2.4	2.8	1.8	2.1	1.9	2.1	3		6 or less (for sustaining fisheries)
2	Middle of Passur River at 100m u/s of North West corner from the Project boundary	4.9	3.3	4.1	2.3	3.2	2.4	1.9	2.2	3.2	2.8	2.7	1.9	3.4	2.1	1.9	2		
3	Right Bank of Passur River at 100m u/s of North West corner from the Project boundary	2.2	2.8	3.4	2.7	3.1	2.9	3.4	1.9	3	2.5	2.8	1.9	2.5	2.7	1.9	3		
4	Left Bank of Passur River at Project site-Jetty	3.2	3.1	4.0	0.8	3	4.4	3.2	1.1	3.6	2.1	3.1	2.1	2.4	2.8	2.0	4		
5	Middle Passur River at Project site-Jetty	3.0	2.5	3.5	1.4	3.5	4.3	3.7	2.4	3.3	2.2	2.5	2.2	2.6	2.4	2.0	4		
6	Right Left Bank of Passur River at Project site-Jetty	5.8	3.5	3.6	2.0	3.4	3.7	2.9	1.7	3.1	3.1	2.9	2.1	3.1	2.1	2.3	4		
7	Left Bank of Passur River at South West corner from the Project boundary	3.9	2.8	2.6	1.0	3.1	5.3	2.2	1.2	3.1	2.9	2.4	2.1	3.2	2.4	2.0	5		
8	Middle of Passur River at South West corner from the Project boundary	3.8	3.3	2.8	2.6	3.2	5.2	2.3	2.3	2.6	2.7	2.7	1.9	2.5	2.7	1.9	5		

SL	Sampling Location	Biochemical Oxygen Demand (mg/L)																	BD Standard
		1st Year				2nd Year				3rd year				4th year					
		Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	Apr		
		1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	1QM		
9	Right Bank of Passur River at South West corner from the Project boundary	6.5	3.8	2.9	2.1	3.4	5	3.1	2.4	3	3.1	3.1	2.1	2.6	2.3	2.1	5		
10	Maidara river of the South East corner of the Project at Ichamoti-Maidara confluence	3.2	3.3	5.5	1.5	3.2	3.9	4.2	2.7	3.3	3.4	2.8	1.8	3.4	2.4	2.1	4		
11	Maidara river near proposed township area	4.1	3.7	4.0	2.0	3.4	4.2	1.6	1.8	3.5	3.2	2.9	2.1	3.2	2.1	2.0	4		
12	Passur river at Passur-Ghasiakhali confluence	2.3	2.2	1.7	2.0	3.3	4.9	2.1	2.2	3.4	2.8	2.3	2	2.7	3.1	2.4	3.1		
13	Passur river at Harbaria of Sundarbans	2.2	2.5	2.6	1.9	2.4	3.9	2.7	2.1	3.2	2.8	2.7	2.1	2.7	3.1	2.9	2.3		
14	Passur river at Akram point of Sundarbans	5.0	2.9	3.7	2.2	3	NS	2.2	2.4	3.3	2.5	3.4	2.1	3.1	3.2	3.1	3		
15	Passur river at Hiron point of Sundarbans	4.3	2.7	3.9	2.3	2.7	NS	2.5	NS	2.4	2.1	3.1	2.2	NS	2.9	2.4			

Source: CEGIS Field Survey

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

Table B.6: COD of Passur River System

Sl	Sampling Locations	COD (mg/L)															
		1st Year				2nd year				3rd year				4th Year			
		Apr	Jul	Oct	Jan	Apr	July	Oct	Jan	Apr	July	Oct	Jan	Apr	Oct	Jan	
		1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	
1	Left Bank of Passur River at 100m u/s of North West corner from the Project boundary	288	24	6	128	87	42	32	124	220	8	12	56	52	24	48	276
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
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
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
5	Middle Passur River at Project site-Jetty	400	60	14	116	110	21	36	108	240	12	16	52	36	40	32	254
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
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
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
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
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
11	Maidara river near proposed township area	284	96	26	84	94	36	42	108	210	30	8	48	40	32	32	252
12	Passur river at Passur - Ghasiakhali confluence	408	172	14	96	92	30	46	88	220	12	16	40	64	**40**	48	260
13	Passur river at Harbaria of Sundarbans	372	216	14	96	102	26	36	100	140	16	12	**40**	216	32	40	280
14	Passur river at Akram point of Sundarbans	536	520	54	316	302	NS	84	96	156	4	68	56	240	**16**	72	296
15	Passur river at Hiron point of Sundarbans	540	416	122	472	470	NS	96	NS	160	NS	56	196	NS	4	88	

Source: CEGIS Field Survey

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

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

Sl	Sampling Locations	Oil and Grease (mg/L)																ECR, 1997 (mg/L)*
		1st Year				2nd year				3rd year				4th year			5th year	
		Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	Apr	
		1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	1QM	
1	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	10
2	Passur-Ghasiakhali Confluence	<5	<5	<5	>15	13	7.63	9.87	21	30.3	13.5	<5	15.6	<5	<5	<5	<5	
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	
4	Passur river at Hiron point of Sundarbans	<5	<5	<5	>20	<5	NS	10.8	ND	31	NS	10.14	13.8	7.71	<5	<5	<5	
5	Akram Point of Sundarbans	<5	<5	<5	>20	<5	NS	9.73	36	82	5.87	<5	14.2	ND	<5	<5	<5	

Source: CEGIS Field Survey

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

Table B.8: TDS of Passur River System

SL	Sampling Locations	TDS (mg/L)															
		1st Year				2nd year				3rd year				4th Year			5th year
		Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	Apr
		1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	1QM
1	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
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
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
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
5	Middle Passur River at Project site-Jetty	13330	353	156	4920	14500	132	162	5850	13100	185	110	3600	13490	125	2520	14450
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
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
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
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
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
11	Maidara river near proposed Township area	10970	2510	257	4390	13900	355	176	4420	11700	5170	238	3960	13110	1200	2970	14450
12	Passur river at Passur - Mongla confluence	12800	6410	209	5130	14050	298	227	4540	11330	893	162	3370	12340	204	2570	14500
13	Passur river at Harbaria of Sundarbans	12280	9360	285	4780	13900	683	205	4940	13580	1321	301	3370	13600	245	2690	15350
14	Passur river at Akram point of Sundarbans	21500	15960	3400	12350	13600	NS	4220	13330	20720	7330	2550	3580	19370	3270	11390	20600
15	Passur river at Hiron point of Sundarbans	21500	14050	5720	17900	25300	NS	5830	NS	25500	NS	4120	12210	NS	4450	14190	

Source: CEGIS Field Survey

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

Table B.9: TH Passur River System

SL	Sampling Locations	TH (mg/L)															
		1st Year				2nd year				3rd year				4th year			5th year
		Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	Apr
		1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	1QM
1	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
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
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
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
5	Middle Passur River at Project site-Jetty	2600	275	340	990	3250	103	355	1300	3070	232	237	915	3440	145	590	1040
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
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
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
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
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
11	Maidara river near proposed township area	2400	725	330	970	3190	130	340	1075	3080	875	240	1170	2300	320	478	1120
12	Passur river at Passur - Mongla confluence	3150	1400	377	1000	3210	135	410	1090	3060	405	245	1070	2450	220	1070	1410
13	Passur river at Harbaria of Sundarbans	2625	2150	345	970	3080	200	430	1100	3050	415	282	1070	3560	200	610	1330
14	Passur river at Akram point of Sundarbans	4500	3625	980	2380	3420	NS	1090	2850	4520	1750	670	1130	4300	640	1475	1440
15	Passur river at Hiron point of Sundarbans	4850	3050	1440	2690	3640	NS	1460	NS	5050	NS	810	2870	NS	905	1740	

Source: CEGIS Field Survey

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

Table B.10: TSS Passur River System

SL	Sampling Locations	TSS (mg/L)															
		1st Year				2nd year				3rd year				4th year			5th year
		Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	Apr
		1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	1QM
1	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
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
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
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
5	Middle Passur River at Project site-Jetty	60	100	232	250	165	27	85	18	8	45	24	54	43	20	13	19
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
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
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
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
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

SL	Sampling Locations	TSS (mg/L)															
		1st Year				2nd year				3rd year				4th year			5th year
		Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	Apr
		1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	1QM
11	Maidara river near proposed township area	9	24	389	206	160	28	92	10	6	11	30	66	49	30	15	32
12	Passur river at Passur - Mongla confluence	50	310	203	280	165	24	60	15	13	47	27	61	38	**25**	13	14
13	Passur river at Harbaria of Sundarbans	65	90	869	400	160	42	74	22	18	31	18	**61**	33	27	17	15
14	Passur river at Akram point of Sundarbans	115	99	28	103	150	NS	110	16	23	16	41	34	28	22	14	18
15	Passur river at Hiron point of Sundarbans	91	72	267	200	180	NS	144	NS	15	NS	33	49	NS	16	13	

Source: CEGIS Field Survey

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

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

Sl	Sampling Locations	NO_3^{2-} (mg/L)															
		1st Year				2nd year				3rd year				4th year			5th year
		Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	Apr
		1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	1QM
1	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
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
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
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
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
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
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
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
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
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
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
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
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
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
15	Passur river at Hiron point of Sundarbans	0.8	2.84	0.4	2	28	NS	11.5	NS	3.5	NS	0.38	2.28	NS	2.6	6.1	

Source: CEGIS Field Survey

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

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

SI	Sampling Locations	SO_4^{2-} (mg/L)															
		1st Year				2nd year				3rd year				4th year			5th year
		Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	Apr
		1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	1QM
1	Left Bank of Passur River at 100m u/s of North West corner from the Project boundary	1840	20	26	580	1360	67	7	570	1080	18	5	230	422	29	630	1400
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
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
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
5	Middle Passur River at Project site-Jetty	1040	32	30	520	1120	6	8	580	980	17	6	280	1280	1	310	1200
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
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
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
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
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
11	Maidara river near proposed township area	1320	210	63	460	840	27	9	480	1020	480	14	200	1340	76	350	1250
12	Passur river at Passur - Mongla confluence	1360	620	44	630	980	39	13	482	1100	42	14	220	1220	**5**	280	1260
13	Passur river at Harbaria of Sundarbans	1560	860	69	590	900	51	7	500	1080	60	19	220	1300	13	220	1300
14	Passur river at Akram point of Sundarbans	2600	1400	1390	850	1540	NS	84	760	1650	620	190	230	1420	30	760	1460
15	Passur river at Hiron point of Sundarbans	2080	1160	2360	1500	1920	NS	97	NS	2100	NS	320	1090	NS	2	510	

Source: CEGIS Field Survey

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

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

SI	Sampling Locations	PO_4^{2-} (mg/L)															
		1st Year				2nd year				3rd year				4th year			5th year
		Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	Apr
		1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	1QM
1	Left Bank of Passur River at 100m u/s of North West corner from the Project boundary	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
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
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
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
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
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
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
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
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

Sl	Sampling Locations	PO_4^{2-} (mg/L)															
		1st Year				2nd year				3rd year				4th year			5th year
		Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	Apr
		1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	1QM
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
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
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
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
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
15	Passur river at Hiron point of Sundarbans	7.51	0.29	1.09	0.44	0.47	NS	0.45	NS	0.36	NS	5.9	0.23	NS	0.55	1.45	

Source: CEGIS Field Survey

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

Table B.14: As concentration of Passur River System

Sl	Sampling Locations	As (mg/L)															
		1st Year				2nd year				3rd year				4th year			5th year
		Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	Apr
		1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	1QM
1	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
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
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
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
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
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
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
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
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
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
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
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
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
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
15	Passur river at Hiron point of Sundarbans	0.003	0.002	0.003	0.002	0.002	NS	0.001	NS	0.004	NS	0.002	0.002	NS	0.002	0.001	

Source: CEGIS Field Survey

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

Table B.15: Pb concentration of Passur River System

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

Source: CEGIS Field Survey

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

Table B.16: Hg concentration of Passur River System

Sl	Sampling Locations	Hg (mg/L)																
		1st Year				2nd year				3rd year				4th year			5th year
		Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	Apr
		1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	1QM
1	Left Bank of Passur River at 100m u/s of North West corner from the Project boundary	< 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
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
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
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
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
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
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
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
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
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
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
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
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
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
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

Source: CEGIS Field Survey

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

Parameters for ground water quality monitoring

Table B.17: pH and Temperature of Ground Water

Sl	Locations	Tube Well Type	pH value																
			1st Year				2nd year				3rd year				4th year			5th year	
			Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	Apr	Jul
			1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	1QM	2QM
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
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
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
4	Kalekharber	Shallow (<250 ft)	6.3	6.5	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF

Locations	Tube Well Type	Temperature (°C)																
		1st Year				2nd year				3rd year				4th year			5th year	
		Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	Apr	Jul
		1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	1QM	2QM
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
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
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
Kalekharber	Shallow (<250 ft)	27.5	28.7	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF

Source: CEGIS Field Survey

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

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

Table B.18: Salinity and DO in Groundwater

Sl	Locations	Tube Well Type	Salinity (ppt)																
			1st Year				2nd year				3rd year				4th year			5th year	
			Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	Apr	Jul
			1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	1QM	2QM
1	Near Proposed Township	Deep (>600 ft)	0	0	0	1	TC	0	0	0	0	0	0	0	0	0	0	NF	NF
2	Rajnagar	Deep (>600 ft)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.3	0.3	0.1
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
4	Kalekharber	Shallow (<250 ft)	0	0	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF

Sl	Locations	Tube Well Type	DO (mg/L)																
			1st Year				2nd year				3rd year				4th year			5 th year	
			Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	Apr	Jul
			1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	1QM	2QM
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**
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**
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**
4	Kalekharber	Shallow (<250 ft)	4.4	6	NF	NF	NF	NF	NF	NF	**NF**	**NF**	**NF**	**NF**	**NF**	**NF**	**NF**	**NF**	**NF**

Source: CEGIS Field Survey

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

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

Table B.19: TDS and TSS concentrations in Groundwater

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

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

Source: CEGIS Field Survey

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

Table B.20: TH concentrations in Groundwater

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

Source: CEGIS Field Survey

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

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

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

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

Source: CEGIS Field Survey

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

Table B.22: NO_3^-, SO_4^{2-} and PO_4^{3-} Concentrations in Ground Water

Sl	Locations	Type of tube well	NO_3^{2-} (mg/L) *BD Standard (10 mg/L)																SO_4^{2-} (mg/L) *BD Standard (400 mg/L)																PO_4^{2-} (mg/L) *BD Standard (6.0 mg/L)															
			1st Year				2nd year				3rd year				4th Year			5th year	1st Year				2nd year				3rd year				4th Year			5th year	1st Year				2nd year				3rd year				4th Year			5th year
			Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	Apr	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	Apr	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	Apr
			1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	1QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	1QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	1QM
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	-	3	-	-	-	-	1	5	1	1	1	1	5	1	8	NF	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
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	-	2	-	-	-	-	2	6	2	1	1	1	1	1	2	2	-	2.5	-	0.44	1.98	1.6	0.27	0.179	1.53	0.29	0.67	1.21	1.8	3.5	0.17	4..5
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	-	10	-	-	-	-	2	2	8	1	1		3	2	6	4	-	6.2	-	0.48	4.54	4.1	0.48	0.179	3.26		0.6	1.18	2.1	4.7	0.18	0.27
4	Kalekarber	Shallow (<250 ft)	0.40	0.56	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	3	NF	-	-	-	-	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	1.2	NF	NF	NF	NF	NF	NF	NF	0.31	NF	1.23	NF	NF	NF	NF

Source: CEGIS Field Survey

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

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

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

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

Source: CEGIS Field Survey

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

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

(C) Noise Level monitoring data

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

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

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

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

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

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

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

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

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

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

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

Sl No	Location	QM2 (Noise Level in dB (A)) July-2018			
		Morning (9:00)	A.noon (13:00)	Evening (18:00)	Day time AVG
1	Chalna, Dacope	57.64	56.94	58.03	57.54
2	NW Corner of the Project area	42.80	47.51	46.57	45.63
3	Chunkuri-2, Bajua	46.23	49.02	47.34	47.53
4	SW corner of the Project area	58.84	48.00	51.03	52.63
5	Proposed Township area, Project site	42.66	45.82	48.78	45.75
6	Barni, Gaurambha	42.67	47.95	45.90	45.51
7	Khan Jahan Ali Bridge, Khulna	64.1	64.06	61.90	63.35
8	Mongla Port area	63.12	59.00	60.77	60.96
9	Harbaria, Sundarbans	51.98	48.58	50.28	50.28
10	Akram Point, Sundarbans	46.52	43.88	45.2	45.20
11	Hiron Point, Sundarbans	NM	NM	NM	57.54

Source: CEGIS field Survey

Note: NM-Not measured

(D) Fisheries resources monitoring data

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

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

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

Table D.2: Occurrence of Species

Local Name	Scientific Name	Local Tatus*	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	+	+	-	-	-	-	-	-	-	+	-	-
Kuchia	*Monopterus cuchia*	DD	+	+	-	+	+	+	+	+	+	+	+	+
Loitta	*Harpodon nehereus*	NO	+	+	+	-	+	-	-	-	+	+	-	-

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

Local Nam	Scientific Name	Local Status*	13th QM	14th QM	15th QM	16th QM	17th 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	+	+	+	+	+

Local Nam	Scientific Name	Local Status*	13th QM	14th QM	15th QM	16th QM	17th QM
		‘-‘ = No; ‘+’ = Occurrence					
Aswine Bele	*Butis butis*	NO	+	+	+	+	+
Bairagi	*Coilia dussumieri*	NO	+	+	+	+	+
Boishakhi Chingri	*Macrobrachium* sp.	NO	-	-	-	-	+
Chammu Chingri	*Metapenaeus brevicornis*	DD	-	+	+	+	+
Chaka Chingri	*Penaeus indicus*	DD	+	-	+	+	+
Ghora Chela	*Securicula gora*	-	-	-	-	-	-
Chanda Chela	*Securicula* sp.		-	-	+	+	+
Sada Chewa	*Trepauchen vagina*	NO	-	-	-	+	-
Lal Chewa	*Taenioides cirratus*	NO	+	+	-	+	+
Chhuri	*Trichiurus muticus*	NO	-	-	-	+	-
Sagor Chela	*Megalops cyprinoids*	NO	-	-	-	-	-
Purabi Chela	*Thryssa purava*	NO	-	-	-	-	-
Kabashi Tengra	*Mystus cavasius*	DD	-	-	-	-	+
Gagra Tengra	*Nemapteryx nenga*	DD	+	+	+	+	+
Gulsha Tengra	*Mystus bleekery*	DD	+	+	+	+	+
Harina Chingri	*Metapenaeus ensis*	DD	+	+	+	+	+
Ekthuto	*Hyporhampus limbatus*	NO	+	+	-	-	+
Kakila	*Xenentodon cancila*	NO	-	+	-	-	+
Chapila	*Gudusia chapra*	NO	-	-	-	-	+
Kuchia	*Monopterus cuchia*	DD	+	+	+	+	+
Loitta	*Harpodon nehereus*	NO	+	-	+	-	-
Motka Chingri	*Macrobrachium villosimanusless*	DD	+	+	+	+	+
Mud Crab	*Scylla serrata*	NO	+	+	+	+	-
Tular Dandi	*Sillaginopsis panijus*	NO	-	+	-	-	-
Paira Chanda	*Scatophagus argus*	DD	-	-	-	-	-
Paissa	*Liza parsia*	NO	+	+	+	+	-
Pangas	*Pangasius pangasius*	CR	-	-	-	-	-
Tak Chanda	*Leiognathus equulus*	NO	-	-	-	-	-
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	-	-	-	-	-

Local Nam	Scientific Name	Local Status*	13th QM	14th QM	15th QM	16th QM	17th QM
		'-' = No; '+' = Occurrence					
Tapse	*Polynemus paradiseus*	DD	-	+	+	+	+
Daitna	*Acanthopagrus latus*	DD	-	+	+	+	-
Shole	*Channa striatus*	DD	-	+	+	-	-
Magur	*Clarias batrachus*	DD	-	+	+	-	-
Koi	*Anabas testudineus*	DD	-	-	-	-	-
Vetki	*Lates calcarifer*	DD	+	+	+	+	-

**Local Status Source: IUCN Red List*

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

Fish Species	Site	L (< 2cm)	L (2 to 3cm)	L (3 to 5cm)	L (5 to 10cm)	L (10 to 20cm)	L (> 25cm)	Brood Fish
Bagda	Chandpai	100	0	0	0	0	0	0
	Harbaria	100	0	0	0	0	0	0
	Maidara	100	0	0	0	0	0	0
Bairagi	Harbaria	0	0	100	0	0	0	0
	Mongla Point	0	94	6	0	0	0	0
Baisakhi	Chandpai	0	0	0	56	44	0	0
Banspata	Chandpai	0	0	0	100	0	0	0
	Mongla Point	0	0	0	100	0	0	0
Bele	Chalna Point	0	100	0	0	0	0	0
	Chandpai	100	0	0	0	0	0	0
	Harbaria	100	0	0	0	0	0	0
	Maidara	0	0	0	100	0	0	0
	Mongla Point	99	0	0	0	1	0	0
Chaka Chingri	Chandpai	100	0	0	0	0	0	0
	Harbaria	100	0	0	0	0	0	0
Chali Chingri	Maidara	0	0	100	0	0	0	0
	Mongla Point	0	0	0	100	0	0	0
Chami Chingri	Chandpai	0	67	33	0	0	0	0
	Harbaria	100	0	0	0	0	0	0
	Mongla Point	0	0	100	0	0	0	0
Chanda	Chalna Point	17	83	0	0	0	0	0
Chapila	Chalna Point	0	0	0	50	50	0	0
	Harbaria	0	0	100	0	0	0	0

Fish Species	Site	L (< 2cm)	L (2 to 3cm)	L (3 to 5cm)	L (5 to 10cm)	L (10 to 20cm)	L (> 25cm)	Brood Fish
	Mongla Point	9	42	36	12	0	0	0
Chata Bele	Mongla Point	50	0	50	0	0	0	0
Chela	Chalna Point	93	6	1	0	0	0	0
	Chandpai	0	44	56	0	0	0	0
	Harbaria	50	0	50	0	0	0	0
	Mongla Point	0	72	28	0	0	0	0
Chitra	Harbaria	100	0	0	0	0	0	0
Ekthuto	Harbaria	0	0	0	0	100	0	0
Gagra	Chandpai	0	0	100	0	0	0	0
Golda	Chalna Point	0	0	0	0	100	0	0
	Chandpai	100	0	0	0	0	0	0
	Maidara	100	0	0	0	0	0	0
	Mongla Point	100	0	0	0	0	0	0
Guda Chingri	Maidara	0	100	0	0	0	0	0
	Mongla Point	0	0	100	0	0	0	0
Gulsha Tengra	Harbaria	0	0	100	0	0	0	0
	Mongla Point	0	0	1	99	0	0	0
Horina	Chalna Point	0	0	80	20	0	0	0
	Chandpai	87	0	13	0	0	0	0
	Harbaria	85	15	0	0	0	0	0
	Maidara	0	0	100	0	0	0	0
	Mongla Point	7	0	93	0	0	0	0
Jaba	Maidara	0	0	0	0	100	0	0
Kakila	Chalna Point	0	0	0	0	100	0	0
	Harbaria	100	0	0	0	0	0	0
Khorsula	Chalna Point	0	0	0	0	0	100	0
Kuchia	Harbaria	0	0	0	0	100	0	0
	Maidara	0	0	0	0	0	100	0
	Mongla Point	0	0	0	0	0	100	0
Lal Chewa	Chalna Point	0	0	0	0	100	0	0
	Chandpai	0	0	100	0	0	0	0
	Mongla Point	0	79	18	0	0	3	0
Maya Chela	Harbaria	0	75	25	0	0	0	0
Motka	Chalna Point	0	0	100	0	0	0	0

Fish Species	Site	L (< 2cm)	L (2 to 3cm)	L (3 to 5cm)	L (5 to 10cm)	L (10 to 20cm)	L (> 25cm)	Brood Fish
	Chandpai	0	0	100	0	0	0	0
	Harbaria	100	0	0	0	0	0	0
	Mongla Point	0	0	100	0	0	0	0
Mutkura	Chalna Point	0	100	0	0	0	0	0
	Chandpai	500	0	0	0	0	0	0
Nona Bele	Chalna Point	0	0	5	0	0	0	0
	Harbaria	1	0	0	0	0	0	0
Poma	Chandpai	50.5	0	0	0	0	0	0
	Mongla Point	7	33	34.5	1.5	0	0	0
Tengra	Chandpai	0	0	0	40	0	0	0
	Maidara	0	4	0	0	0	0	0
	Mongla Point	0	1	4	0	0	0	0
Tit Punti	Chalna Point	0	1	0	0	0	0	0
	Harbaria	3	0	0	0	0	0	0
Topse	Chalna Point	0	0	0	1	1	0	0
	Chandpai	0	0	300	0	0	0	0
	Maidara	0	0	0	0	8	0	0
	Mongla Point	0	0	15	56	0	0	0

Source: CEGIS field survey, 2017

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

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

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

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 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	-	-	-	-	-		-	-
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		-	-	-	-	-	-	-	-		-	-

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	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 Growin g	-	Feeding and Growing		-	Feeding and Growing		-	-
		Juvenile	-	-	-	-	-	-	Feeding and Growing		-		Feeding and Growing	-
	Harbaria	Juvenile	-	-	-	-	-	-	Feeding and Growing		-			-
		Age-1 adult	-	-	-	-	-	-	-	-	Feeding and Growing		-	-
	Maidara	Juvenile and Age-1 Adult	-	-	-	-	-	-	Feeding and Growing	-			-	-
	Chalna Point	Juvenile	-	-	-	-	-	-	-	-	-		Feeding and Growing	-
Potka	Haldikhali	Adult	Feeding and Breeding	-	-	-	-	-	-	-	-		-	-
	Chandpai	Fry	Spawning	Spawning and Nursing	-	-	-	-	-	-	-		-	-
		Juvenile	-	-	-	-	-	-	-	Feeding and Growing	-		-	Feeding
		Adult	-	-	-	Feeding	-	-	-	-	-		Feeding	-
	Mongla Point	Fry	Spawning	-	-	-	-	-	-	-	-		-	-
		Juvenile	-	-	-	-	-	-	-	-	Feeding and Growing		-	-
	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	-	-	-	-	-			-	-

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

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
					Growing									
	Mongla Point	Juvenile and Adult	-	-	-	Feeding	Feeding and Growing	Feeding	Feeding and Growing	-	-		-	-
	Chalna Point	Fry	Breeding and Spawning	Nursing	-	-	Nursing	-	-	Nursing	-		-	-
	Chalna Point	Adult	-	-	-	Feeding	-	-	-	-	-		-	-
	Maidara	Juvenile and Age-1 adult	-	Feeding and Growing	Feeding and Growing	Feeding	Feeding and Growing	-	-	-	Feeding and Growing		-	-
		Fry	-	-	-	-	-	-	-	Nursing	-		-	Nursing
Tular Dandi (Nona bele)	Akram Point	Adult	Feeding	-	-	-	-	-	-	-	-		-	-
	South-west of the Project	Adult	-	-	Feeding	-	-	-	-	-	-		Feeding	-
	Chalna Point	Adult	Feeding	-	Feeding	-	Feeding	-	Feeding	-	-		-	-
Tairel	Akram Point	Adult	Feeding	-	-	-	-	-	-	Feeding	-		-	-
	Harbaria	Age-1 Adult	-	-	-	-	-	-	-	-	Feeding and Growing		-	-
	Mongla Point	Juvenile	Feeding	-	-	-	-	-	-	-	-		-	-
Pekssa	Akram Point	Adult	Feeding	-	-	-	-	-	-	Feeding	-		-	-
		Juvenile	-	-	Feeding and Growing	-	-	-	-	-	-		-	-
	Haldikhali	Juvenile	-	-	Feeding and Growing	-	-	-	-	-	-		-	-
	Haldikhali	Adult	-	-	-	Feeding	-	-	-	-	-		-	-
	Harbaria	Juvenile	-	-	-	-	-	-	-	-	Feeding and Growing		-	-
	Chalna Point	Juvenile and Adult	Feeding	Feeding and Growing	-	-	-	-	Feeding and Growing	-			-	-
		Adult	-	-	Feeding	Feeding	Feeding	-	Feeding	-	-		-	-
	Mongla Point	Adult	-	-	Feeding	Feeding	-	-	Feeding and Growing	-	-		Feeding	-
	Chandpai	Juvenile and Adult	Feeding	Feeding and Growing	-	-	Feeding and Growing	-		-	-		-	-

<table>
<tr><th rowspan="2">Migratory Fish Species</th><th rowspan="2">Sampling Sites</th><th rowspan="2">Year Class*</th><th colspan="12">Migration Purpose</th></tr>
<tr><th>1st QM</th><th>2nd QM</th><th>3rd QM</th><th>4th QM</th><th>5th QM</th><th>6th QM</th><th>7th QM</th><th>8th QM</th><th>9th QM</th><th>10th QM</th><th>11th QM</th><th>12th QM</th></tr>
<tr><td rowspan="3"></td><td rowspan="3">Maidara</td><td>Juvenile and Adult</td><td>Feeding</td><td>Feeding and Growing</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td></td><td>-</td><td>-</td></tr>
<tr><td>Juvenile</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>Feeding and Growing</td><td>-</td><td>-</td><td></td><td>-</td><td>-</td></tr>
<tr><td>Adult</td><td>-</td><td>-</td><td>Feeding</td><td>Feeding</td><td>-</td><td>Feeding</td><td>-</td><td>-</td><td>-</td><td></td><td>-</td><td>-</td></tr>
<tr><td rowspan="14">Paissa</td><td rowspan="3">Akram Point</td><td>Juvenile and Adult</td><td>Feeding</td><td>-</td><td>Feeding and Growing</td><td>Feeding</td><td>-</td><td>-</td><td>-</td><td>Feeding and Growing</td><td>-</td><td></td><td>-</td><td>Feeding</td></tr>
<tr><td>Brood</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td></td><td>-</td><td>Spawning</td></tr>
<tr><td>Juvenile</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td colspan="2">Feeding and Growing</td><td></td><td>-</td><td>-</td><td>-</td></tr>
<tr><td rowspan="2">Haldikhali</td><td>Juvenile and Adult</td><td>Feeding</td><td>-</td><td>Feeding and Growing</td><td>Feeding</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td></td><td>-</td><td>-</td></tr>
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<tr><td rowspan="2">Harbaria</td><td>Juvenile-1 and Juvenile</td><td>-</td><td>-</td><td>Feeding</td><td>-</td><td>Feeding and Growing</td><td>-</td><td>Feeding and Growing</td><td>-</td><td>-</td><td></td><td>-</td><td>-</td></tr>
<tr><td>Adult</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>Feeding</td><td>-</td><td></td><td>-</td><td>-</td></tr>
<tr><td>Chandpai</td><td>Fry</td><td>Breeding and Spawning</td><td>-</td><td>-</td><td>-</td><td>Nursing</td><td>-</td><td>-</td><td>-</td><td>Nursery</td><td></td><td>-</td><td>-</td></tr>
<tr><td>Chandpai</td><td>Juvenile and Adult</td><td>-</td><td>-</td><td>Feeding and Growing</td><td>-</td><td>-</td><td>Nursery and Feeding</td><td>-</td><td>-</td><td>-</td><td></td><td rowspan="2">Feeding and Growing</td><td>Feeding</td></tr>
<tr><td>Harbaria</td><td>Juvenile</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>Feeding and Growing</td><td>-</td><td>-</td><td></td><td>-</td></tr>
<tr><td rowspan="3">Mongla Point</td><td>Fry</td><td>Breeding and Spawning</td><td>-</td><td>-</td><td>-</td><td>-</td><td>Nursery</td><td>-</td><td>-</td><td>Nursery</td><td></td><td>-</td><td>-</td></tr>
<tr><td>Age-1 Juvenile</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-Nursing, Feeding and Growing</td><td>-</td><td rowspan="3">Feeding and Growing</td><td></td><td>-</td><td>-</td></tr>
<tr><td>Age-1 Adult</td><td>-</td><td>-</td><td>-</td><td>-</td><td>Feeding and Growing</td><td>Feeding</td><td>-</td><td>-</td><td></td><td>-</td><td>-</td></tr>
<tr><td>Maidara</td><td>Fry, Juvenile and Age-1 adult</td><td>Breeding and Spawning</td><td>Feeding and Growing</td><td>-</td><td>-</td><td>Feeding and Growing</td><td>-</td><td>-</td><td>-</td><td></td><td>-</td><td>-</td></tr>
</table>

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

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

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

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

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

Migration Purpose							
Migratory Fish Species	**Sampling Sites**	**Year Class***	**13th QM**	**14th QM**	**15th QM**	**16th QM**	**17th QM**
		Fingerling	-	-	-	-	Nursing
		Adult	-	-	-	-	-
	Maidara	Juvenile and Age-1 adult	-	-	Feeding and Growing	-	Feeding and Growing
		Fry	Nursing	-	Nursing		-
Tular Dandi (Nona bele)	Akram Point	Adult	-	-	-	-	-
	Chandpai	Age-1 Adult	-	-	Feeding	-	-
	South-west of the Project	Adult	-	Feeding	-	-	-
	Chalna Point	Adult	-	-	-	-	-
Tairel	Akram Point	Adult	-	-	-	Feeding	-
	Harbaria	Age-1 Adult	-	Feeding and Growing	-	-	-
	Mongla Point	Juvenile	-	-	-	-	-
Pheksa	Akram Point	Adult	-	-	-	-	-
		Juvenile	-	-	-	-	-
	Haldikhali	Juvenile	-	-	-	-	-
	Haldikhali	Adult	-	-	-	-	-
	Harbaria	Juvenile	-	-	-	-	-
	Chalna Point	Juvenile and Adult	-	-	-	Feeding and Growing	-
		Adult	-	Feeding	-	-	-
	Mongla Point	Adult	-	-	-	-	-
		Juvenile	-	-	-	Growing	-
	Chandpai	Juvenile and Adult	-	-	-	Feeding and Growing	-
	Maidara	Juvenile and Adult	-	-	-	-	-
		Juvenile	-	-	-	-	-
		Adult	-	Feeding	-	-	-
Paissa	Akram Point	Juvenile and Adult	Feeding	-	-	-	-
		Brood	Spawning	-	-	-	-
		Juvenile	-	-	-	-	-
	Haldikhali	Juvenile and Adult	-	-	-	-	-
		Juvenile	-	-	-	-	-
	Charaputia	Brood Fish	-	--	-	Spawning	-
	Harbaria	Juvenile-1 and Juvenile	-	Feeding and Growing	-	-	-
		Adult	-	Feeding	-	-	-
	Chandpai	Fry	-	-	-	Nursing	-
	Chandpai	Juvenile and Adult	Feeding	Feeding and Growing	-	Feeding and Growing	-
	Harbaria	Juvenile	-	-	Feeding and Growing	-	-

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

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

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

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

Sampling Site	Total Catch (kg): 2015-2016							
	5th QM		6th QM		7th QM		8th QM	
	Species	ton	Species	ton	Species	ton	Species	ton
	-	-	-	-	Bele	0	-	0
	-	-	-	-	Tairel	0.06	-	0
	-	-	-	-	Bhangan	0	-	0
Sub-total =	**-**	**-**	**-**	**-**	**-**	**5.17**	**-**	**0**
Grand-total =	**-**	**1**		**3.5**		**36.17**	**-**	**9**

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

Sampling Site	Total Catch (kg): 2016-2017							
	9th QM		10th QM		11th QM		12th QM	
	Species	ton	Species	ton	Species	ton	Species	ton
	-	0	-	-	Paissa	0.06	-	0
	-	0	-	-	Tengra	0.4	-	0
	-	0	-	-	Tilapia	3.2	-	0
Sub-total =	**-**	**2**	**-**		**-**	**4**	**-**	**2.01**
Grand-total =	**-**	**3.14**	**-**		**-**	**19**	**-**	**2.01**

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

Sampling Site	Total Catch (kg): 2017-2018 and 2018-19							
	13th QM		14th QM		15th QM		16th QM	
	Species	ton	Species	ton	Species	ton	Species	ton
							Sarpunti	**0.53**
							Horina	**1.91**
							Chali Chingri	**1.16**
							Bele	**0.43**
							Vetki	**1.96**
							Tengra	**4.20**
							Paissa	**0.14**
							Tairel	**0.003**
							Pheksa	**0.001**
Sub-total =		**0**		**14.2**	-	-	=	**34.38**
3	Bagda	0	Bagda	2	-	-	Bagda	**0.50**
	-	-	Paissa	8	-	-	Tilapia	**1.50**
	-	-	Tengra	2	-	-	Tengra	**0.12**
	-	-	Tilapia	5	-	-	Paissa	**0.00**
	-	-	Rui	3	-	-	Horina Chingri	**0.60**
	-	-	Vetki	2	-	-		
	-	-	Catla	10	-	-		
Sub-total =	**-**	**0**	**-**	**32**	-	-		
Grand-total =	**-**	**1**	**-**	**49.8**	-	-	**=**	**2.72**

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

(E) Land Resource Monitoring Data

Table E.1: Detailed Information of the Selected Monitoring Plot

Site No.	Monitoring indicators	Location	GPS(Decimal Degree)		Sampling Frequency	Methods/Tools/Techniques
			Easting	Northing		
1	Plot use, Soil fertility and Nutrient, Chemical Properties of Soil (pH, Pb, CdCrop production, and damage	Mauza: Baranpara, Union: Gangarampur Upazila: Batiaghata, District: Khulna	E-89°30′59.1″	N-22°37′57.0″	Bi-yearly (April and October)	In situ field sampling and Laboratory Testing in SRDI
2		Mauza:Chunkuri-2,Union:Bajua Upazila: Dacope, District :Khulna	E-89°32′20.0″	N-22°34′51.0″		
3		Mauza: Kapalirmet/Buridmial Union: Burirdanga, Upazila: Mongla District: Bagerhat	E-89°36′8.8″	N-22°32′18.9″		
4		Mauza: Chakgona, Union: Rajnagar Upazila: Rampal, District: Bagerhat	E-89°34′25.3″	N-22°34′18.3″		
5		Mauza: Basherhula, Union: Rajnagar Upazila: Rampal, District: Bagerhat	E-89°34′25.0″	N-22°36′14.0″		
6		Mauza: Barni, Union: Gauramba, Upazila:Rampal,District: Bagerhat	E-89°34′40.0″	N-22°38′53.44″		

Source: Field survey; 2017

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

Location	Parameter	2013-2014				2014-2015				2015-2016				2016-2017				2017-2018			
		Dry season (April)	Remarks	Wet season (October)	Remarks	Dry season (April)	Remarks	Wet season (October)	Remarks	Dry season (April)	Remarks	Wet season (October)	Remarks	Dry season (April)	Remarks	Wet season (October)	Remarks	Dry season (April)	Remarks	Wet season (October)	Remarks
Baranpara	Top Soil (0-15 cm)																				
	EC(ds/m)	9.1	Moderately saline	1.8	Non saline	10.01	Moderately saline	2.54	Very slightly saline	2.46	Very slightly saline	3.25	Very slightly saline	5.09	Slightly saline	1.00	Non saline	6.5	Slightly saline		
	pH	4.2	Very strongly acid	6.7	Neutral	7.6	Slightly alkaline	6.9	Neutral	7.0	Neutral	7.4	Slightly alkaline	6.4	Slightly acid	6.74	Neutral	6.6	Neutral		
	OM (%)	3.1	Medium	2.5	Medium	0.93	Very low	1.27	Low	1.35	Low	1.28	Low	1.30	Low	1.64	Low	1.85	Medium		
	N (%)	0.16	Low	0.12	Low	0.05	Very low	0.06	Very low	0.08	Very low	0.06	Very low	0.07	Very low	0.08	Very low	0.09	Very low		
	K (meq/100g)	1.00	Very high	0.59	Very high	1.61	Very high	0.57	Very high	0.69	Very high	0.61	Very high	0.65	Very high	0.64	Very high	0.60	Very High		
	Ca (meq/100g)	11.3	Very high	14.3	Very high	31.50	Very high	14.75	Very high	15.12	Very high	14.68	Very high	15.29	Very high	14.56	Very high	14.72	Very High		
	Mg (meq/100g)	10.7	Very high	8.6	Very high	6.00	Very high	2.06	Very high	2.58	Very high	1.92	Very high	2.24	Very high	1.95	Very high	2.39	Very High		
	Na(meq/100g)	5.50	*	2.7	*	10.01	*	4.76	*	4.43	*	5.07	*	5.76	*	5.15	*	5.75	*		
	P(µg/gm)	2.7	Very low	14.3	Medium	8.19	Low	4.60	Very low	5.33	Low	4.82	Very low	5.25	Very low	5.22	Very low	6.20	Low		
	S(µg/gm)	523.2	Very high	41.4	Very high	354.40	Very high	210.0	Very high	212.18	Very high	226.43	Very high	216.42	Very high	238.12	Very high	205.11	Very High		
	B(µg/gm)	0.45	Medium	0.55	Very high	2.37	Very high	2.11	Very high	2.05	Very high	1.98	Very high	1.92	Very high	1.23	Very high	1.78	Very High		
	Fe(µg/gm)	150.3	Very high	258.6	Very high	49.72	Very high	78.25	Very high	42.96	Very high	79.39	Very high	44.31	Very high	76.48	Very high	38.54	Very High		
	Mn(µg/gm)	7.2	Very high	11.3	Very high	24.72	Very high	6.89	Very high	11.90	Very high	6.87	Very high	10.87	Very high	6.66	Very high	9.88	Very High		
	Zn(µg/gm)	1.4	Medium	1.2	Medium	1.88	High	2.47	Very high	1.82	High	2.33	Very high	2.45	Very high	2.30	Very high	3.05	Very High		
	Lead(Pb) (µg/gm)	31.8	Safe limit	33.7	Safe limit	32.21	Safe limit	25.95	Safe limit	24.23	Safe limit	23.75	Safe limit	22.80	Safe limit	22.55	Safe limit	18.67	Safe limit		
	Cadmium (Cd)(µg/gm)	0	Safe limit	0	Safe limit	2.39	Safe limit	00	Safe limit	00	Safe limit	00	Safe limit	0.42	Safe limit	0.00	Safe limit	0.31	Safe limit		
	Subsurface Soil (15-30 cm)																				
	EC(ds/m)	8.4	Moderately saline	2.0	Non saline	7.90	Slightly saline	4.65	Slightly saline	2.23	Very slightly saline	4.88	Slightly saline	4.52	Slightly saline	0.88	Non saline	6.89	Slightly saline		
	pH	4.3	Very strongly acid	6.9	Neutral	7.8	Slightly alkaline	7.4	Slightly alkaline	7.1	Neutral	7.6	Slightly saline	7.0	Neutral	6.82	Neutral	7.0	Neutral		
	OM (%)	2.9	Medium	2.2	Medium	1.46	Low	1.53	Low	1.67	Low	1.49	Low	1.50	Low	1.25	Low	1.50	Low		
	N (%)	0.15	Low	0.2	Medium	0.08	Very low	0.08	Very low	0.09	Very low	0.08	Very low	0.08	Very low	0.06	Very low	0.08	Very low		
	K (meq/100g)	1.0	Very high	0.61	Very high	1.46	Very high	0.59	Very high	0.58	Very high	0.60	Very high	0.62	Very low	0.56	Very low	0.54	Very High		
	Ca (meq/100g)	10.48	Very high	14.3	Very high	26.84	Very high	12.31	Very high	12.67	Very high	11.96	Very high	12.70	Very high	12.13	Very high	12.03	Very High		
	Mg (meq/100g)	8.8	Very high	8.2	Very high	5.30	Very high	2.15	Very high	2.10	Very high	2.17	Very high	2.15	Very high	2.20	Very high	2.12	Very High		
	Na(meq/100g)	5.00	*	2.7	*	8.95	*	6.32	*	4.22	*	6.48	*	5.24	*	5.77	*	6.40	*		
	P(µg/gm)	2.9	Very low	22.8	High	9,23	Low	4.65	Very low	4.74	Very low	5.03	Very low	4.96	Very low	4.76	Very low	4.98	Very Low		
	S(µg/gm)	513.7	Very high	31.4	High	307.65	Very high	221.0	Very high	210.06	Very high	222.75	Very high	220.36	Very high	220.46	Very high	214.25	Very High		
	B(µg/gm)	0.36	Medium	0.49	Optimum	1.86	Very high	0.90	Very high	1.02	Very high	1.02	Very high	1.05	Very high	0.95	Very high	1.10	Very High		
	Fe(µg/gm)	39.1	Very high	60.9	Very high	26.60	Very high	29.27	Very high	22.53	Very high	28.65	Very high	23.63	Very high	32.15	Very high	29.12	Very High		
	Mn(µg/gm)	3.3	High	10.9	Very high	41.87	Very high	5.75	Very high	7.11	Very high	6.04	Very high	6.95	Very high	6.12	Very high	7.79	Very High		
	Zn(µg/gm)	1.5	Optimum	0.87	Low	1.56	Optimum	1.69	Optimum	1.31	Medium	1.62	Medium	1.64	Optimum	1.56	Optimum	2.19	High		
	Lead(Pb) (µg/gm)	31.8	Safe limit	32.1	Safe limit	31.54	Safe limit	22.56	Safe limit	22.35	Safe limit	21.32	Safe limit	21.97	Safe limit	20.77	Safe limit	15.58	Safe limit		
	Cadmium (Cd)(µg/gm)	0	Safe limit	0	Safe limit	2.42	Safe limit	00	Safe limit	00	Safe limit	00	Safe limit	0.39	Safe limit	0.00	Safe limit	0.05	Safe limit		

Location	Parameter	2013-2014				2014-2015				2015-2016				2016-2017				2017-2018			
		Dry season (April)	Remarks	Wet season (October)	Remarks	Dry season (April)	Remarks	Wet season (October)	Remarks	Dry season (April)	Remarks	Wet season (October)	Remarks	Dry season (April)	Remarks	Wet season (October)	Remarks	Dry season (April)	Remarks	Wet season (October)	Remarks
	Substratum Soil (30-45 cm)																				
	EC(ds/m)	9.6	Moderately saline	5.8	Slightly saline	9.26	Moderately saline	5.56	Slightly saline	4.32	Slightly saline	6.48	Slightly saline	7.40	Slightly saline	1.67	Non saline	7.72	Slightly saline		
	pH	5.7	Slightly acid	6.9	Neutral	7.7	Slightly alkaline	7.0	Neutral	7.0	Neutral	7.5	Slightly alkaline	7.0	Neutral	6.94	Neutral	7.4	Slightly Alkaline		
	OM (%)	1.6	Low	1.1	Low	1.62	Low	1.48	Low	1.69	Low	1.46	Low	1.45	Low	2.03	Medium	1.46	Low		
	N (%)	0.08	Very low	0.06	Very low	0.09	Very low	0.07	Very low	0.09	Very low	0.07	Very low	0.08	Very low	0.10	Low	0.07	Very low		
	K (meq/100g)	1.0	Very high	0.6	Very high	2.00	Very high	0.60	Very high	0.51	Very high	0.58	Very high	0.55	Very high	0.60	Very high	0.52	Very High		
	Ca (meq/100g)	12.6	Very high	16.3	Very high	28.69	Very high	14.06	Very high	13.78	Very high	13.87	Very high	13.83	Very high	13.87	Very high	12.48	Very High		
	Mg (meq/100g)	15.9	Very high	8.8	Very high	5.57	Very high	2.71	Very high	3.03	Very high	2.66	Very high	2.85	Very high	2.62	Very high	2.80	Very High		
	Na(meq/100g)	6.00	*	3.7	*	9.91	*	6.83	*	5.51	*	6.71	*	7.41	*	6.89	*	7.78	*		
	P(µg/gm)	2.00	Very low	13.3	Medium	8.24	Low	2.99	Very low	3.13	Very low	3.24	Very low	3.34	Very high	3.29	Very high	4.40	Very Low		
	S(µg/gm)	490.9	Very high	31.9	High	307.29	Very high	262.0	Very high	279.37	Very high	259.66	Very high	267.70	Very high	245.33	Very high	235.85	Very High		
	B(µg/gm)	0.73	High	0.77	Very high	1.67	Very high	1.16	Very high	1.34	Very high	1.22	Very high	1.19	Very high	1.06	Very high	1.25	Very High		
	Fe(µg/gm)	51.3	Very high	113.9	Very high	33.91	Very high	73.87	Very high	52.21	Very high	73.56	Very high	50.38	Very high	68.55	Very high	44.33	Very High		
	Mn(µg/gm)	3.9	Very high	5.2	Very high	88.75	Very high	6.21	Very high	6.34	Very high	5.90	Very high	6.04	Very high	6.19	Very high	6.45	Very High		
	Zn(µg/gm)	1.6	Optimum	0.49	Low	1.74	Optimum	3.19	Very high	2.94	Very high	3.25	High	3.07	Very high	2.87	Very high	1.87	High		
	Lead(Pb) (µg/gm)	37.8	Safe limit	31.5	Safe limit	32.29	Safe limit	18.89	Safe limit	19.18	Safe limit	19.68	Safe limit	19.19	Safe limit	18.64	Safe limit	16.74	Safe limit		
	Cadmium (Cd)(µg/gm)	0	Safe limit	0	Safe limit	2.17	Safe limit	00	Safe limit	00	Safe limit	00	Safe limit	0.37	Safe limit	0.00	Safe limit	0.0	Safe limit		
Chunkuri-2	**Top Soil (0-15 cm)**																				
	EC(ds/m)	11.2	Moderately saline	5.6	Slightly saline	13.05	Strongly saline	8.20	Moderately saline	6.92	Slightly saline	6.15	Slightly saline	6.57	Slightly saline	4.63	Slightly saline	7.33	Slightly saline		
	pH	6.1	Slightly acid	6.4	Slightly acid	5.9	Slightly acid	6.0	Slightly acid	6.3	Slightly acid	5.6	Slightly acid	5.8	Slightly acid	6.67	Neutral	6.4	Slightly Acid		
	OM (%)	2.1	Medium	1.2	Low	3.22	Medium	1.75	Low	1.98	Medium	1.70	Low	2.01	Medium	1.72	Low	1.95	Medium		
	N (%)	0.11	Low	0.06	Very low	0.18	Low	0.09	Very low	0.11	Low	0.09	Very low	0.11	Low	0.09	Very low	0.10	Low		
	K (meq/100g)	1.5	Very high	1.14	Very high	2.97	Very high	0.79	Very high	0.86	Very high	0.77	Very high	0.75	Very high	0.75	Very high	0.73	Very High		
	Ca (meq/100g)	12.3	Very high	12.9	Very high	27.15	Very high	11.88	Very high	11.89	Very high	12.15	Very high	12.27	Very high	11.55	Very high	12.15	Very High		
	Mg (meq/100g)	9.8	Very high	8.9	Very high	6.33	Very high	2.50	Very high	2.47	Very high	2.52	Very high	2.50	Very high	2.50	Very high	2.35	Very High		
	Na(meq/100g)	8.5	*	9.4	*	12.51	*	8.16	*	7.11	*	7.19	*	6.59	*	6.27	*	7.07	*		
	P(µg/gm)	2.7	Very low	12.8	Medium	8.34	Low	6.89	Low	8.05	Low	6.90	Low	7.76	Low	7.20	Low	7.75	Low		
	S(µg/gm)	401.9	Very high	16.9	Medium	673.58	Very high	500.0	Very high	574.26	Very high	476.51	Very high	542.38	Very high	423.74	Very high	515.35	Very High		
	B(µg/gm)	0.57	Optimum	0.74	High	0.75	High	1.52	Very high	1.88	Very high	1.50	Very high	1.59	Very high	1.48	Very high	1.63	Very High		
	Fe(µg/gm)	60.2	Very high	223.6	Very high	52.46	Very high	89.23	Very high	48.75	Very high	88.47	Very high	50.15	Very high	89.12	Very high	51.44	Very High		
	Mn(µg/gm)	5.3	Very high	12.8	Very high	74.59	Very high	7.05	Very high	7.44	Very high	7.00	Very high	7.21	Very high	6.78	Very high	8.97	Very High		
	Zn(µg/gm)	1.7	Medium	2.5	Very high	2.66	Very high	5.32	Very high	4.36	Very high	4.91	Very high	5.03	Very high	4.38	Very high	4.11	Very High		
	Lead(Pb) (µg/gm)	0.00	Safe limit	29.2	Safe limit	31.34	Safe limit	14.09	Safe limit	15.12	Safe limit	15.91	Safe limit	16.09	Safe limit	15.90	Safe limit	14.33	Safe limit		

Location	Parameter	2013-2014				2014-2015				2015-2016				2016-2017				2017-2018			
		Dry season (April)	Remarks	Wet season (October)	Remarks	Dry season (April)	Remarks	Wet season (October)	Remarks	Dry season (April)	Remarks	Wet season (October)	Remarks	Dry season (April)	Remarks	Wet season (October)	Remarks	Dry season (April)	Remarks	Wet season (October)	Remarks
	Cadmium (Cd)(µg/gm)	0	Safe limit	0	Safe limit	2.31	Safe limit	00	Safe limit	00	Safe limit	00	Safe limit	0.56	Safe limit	0.00	Safe limit	0.43	Safe limit		
	Subsurface Soil (15-30 cm)																				
	EC(ds/m)	9.1	Moderately saline	5.6	Slightly saline	10.48	Moderatel y saline	6.97	Slightly saline	5.74	Slightly saline	5.44	Slightly saline	7.48	Slightly saline	2.30	Very slightly saline	7.85	Slightly saline		
	pH	6.7	Neutral	6.4	Slightly acid	6.4	Slightly acid	6.7	Neutral	7.00	Neutral	6.3	Slightly acid	6.5	Slightly acid	6.86	Neutral	7.1	Neutral		
	OM (%)	1.8	Low	0.95	Very low	3.08	High	1.64	Low	1.66	Low	1.68	Low	1.67	Low	1.88	Medium	1.66	Low		
	N (%)	0.09	Very low	0.06	Very low	0.17	Low	0.08	Very low	0.10	Low	0.08	Very low	0.09	Very low	0.09	Very low	0.08	Very low		
	K (meq/100g)	1.6	Very high	1.1	Very high	2.68	Very high	0.75	Very high	0.77	Very high	0.77	Very high	0.76	Very high	0.78	Very high	0.78	Very High		
	Ca (meq/100g)	12.6	Very high	13.8	Very high	26.29	Very high	15.65	Very high	16.44	Very high	16.07	Very high	16.13	Very high	14.38	Very high	16.58	Very High		
	Mg (meq/100g)	9.5	Very high	8.9	Very high	6.29	Very high	3.13	Medium	3.16	Very high	2.95	Very high	2.97	Very high	3.03	Very high	2.89	Very High		
	Na(meq/100g)	8.5	*	9.9	Very high	10.61	*	7.89	*	6.88	*	6.03	*	6.67	*	6.46	*	7.19	*		
	P(µg/gm)	2.7	Very low	18.4	Optimum	7.32	Low	6.67	Low	5.77	Low	6.59	Low	6.65	Low	6.48	Low	6.69	Low		
	S(µg/gm)	280.5	Very high	23.8	Optimum	487.29	Very high	298.0	Very high	311.15	Very high	312.20	Very high	311.90	Very high	298.11	Very high	320.11	Very High		
	B(µg/gm)	1.1	Very high	1.7	Very high	0.92	Very high	1.44	Very high	1.37	Very high	1.39	Very high	1.33	Very high	1.26	Very high	1.29	Very High		
	Fe(µg/gm)	133.9	Very high	193.3	Very high	52.20	Very high	75.51	Very high	35.34	Very high	76.44	Very high	66.73	Very high	74.05	Very high	55.20	Very High		
	Mn(µg/gm)	2.8	Optimum	11.6	Very high	17.75	Very high	8.29	Very high	11.21	Very high	7.98	Very high	10.47	Very high	7.82	Very high	9.18	Very High		
	Zn(µg/gm)	0.99	Medium	1.4	Optimum	2.00	High	1.71	Optimum	1.28	Medium	1.73	Optimum	1.98	High	1.55	Optimum	3.22	Very High		
	Lead(Pb) (µg/gm)	0.00	Safe limit	29.9	Safe limit	31.52	Safe limit	16.63	Safe limit	17.07	Safe limit	15.34	Safe limit	16.28	Safe limit	14.88	Safe limit	15.99	Safe limit		
	Cadmium (Cd)(µg/gm)	0	Safe limit	0	Safe limit	2.35	Safe limit	00	Safe limit	00	Safe limit	00	Safe limit	0.51	Safe limit	0.00	Safe limit	0.10	Safe limit		
	Substratum Soil (30-45 cm)																				
	EC(ds/m)	10.1	Moderately saline	5.3	Slightly saline	10.00	Moderatel y saline	6.91	Slightly saline	6.59	Slightly saline	5.64	Slightly saline	7.65	Slightly saline	1.86	Non saline	8.05	Moderatel y saline		
	pH	6.6	Neutral	6.2	Slightly acid	6.6	Neutral	6.4	Slightly acid	6.2	Slightly acid	6.4	Slightly acid	6.5	Slightly acid	7.14	Neutral	7.4	Slightly Alkaline		
	OM (%)	1.9	Medium	1.4	Low	3.36	High	1.53	Low	1.68	Low	1.55	Low	1.60	Low	2.05	Medium	1.22	Low		
	N (%)	0.09	Low	0.08	Low	0.19	Medium	0.08	Low	0.10	Low	0.08	Very low	0.09	Very low	0.10	Low	0.06	Very low		
	K (meq/100g)	1.5	Very high	1.2	Very high	2.60	Very high	0.72	Very high	0.67	Very high	0.69	Very high	0.69	Very high	0.70	Very high	0.70	Very High		
	Ca (meq/100g)	13.7	Very high	34.4	Very high	18.87	Very high	13.16	Very high	11.99	Very high	13.11	Very high	12.34	Very high	12.77	Very high	12.90	Very High		
	Mg (meq/100g)	11.8	Very high	6.4	Very high	6.34	Very high	3.08	Very high	3.12	Very high	3.11	Very high	3.14	Very high	3.09	Very high	3.40	Very High		
	Na(meq/100g)	8.5	*	9.3	*	10.92	*	7.69	*	6.98	*	6.25	*	6.82	*	6.75	*	7.41	*		
	P(µg/gm)	1.3	Very low	19.5	Optimum	6.11	Low	5.71	Low	7.70	Low	5.70	Low	6.51	Low	6.14	Low	6.45	Low		
	S(µg/gm)	320.4	Very high	32.8	High	428.10	Very high	262.0	Very high	265.61	Very high	273.38	Very high	270.62	Very high	278.15	Very high	295.12	Very High		
	B(µg/gm)	1.14	Very high	1.5	Very high	1.12	Very high	1.36	Very high	1.28	Very high	1.42	Very high	1.23	Very high	1.40	Very high	1.25	Very High		
	Fe(µg/gm)	125.3	Very high	175.5	Very high	117.70	Very high	91.20	Very high	71.63	Very high	89.71	Very high	72.44	Very high	85.64	Very high	68.69	Very High		
	Mn(µg/gm)	2.7	Optimum	12.2	High	46.08	Very high	6.09	Very high	8.79	Very high	6.55	Very high	8.82	Very high	6.60	Very high	7.54	Very High		
	Zn(µg/gm)	1.8	Optimum	0.5	Low	2.15	High	2.83	Very high	2.09	High	2.80	Very high	2.37	Very high	2.76	Very high	2.57	Very High		
	Lead(Pb) (µg/gm)	31.3	Safe limit	29.7	Safe limit	32.46	Safe limit	14.10	Safe limit	13.58	Safe limit	13.59	Safe limit	14.94	Safe limit	13.56	Safe limit	14.11	Safe limit		
	Cadmium (Cd)(µg/gm)	0	Safe limit	0	Safe limit	2.12	Safe limit	00	Safe limit	00	Safe limit	00	Safe limit	0.48	Safe limit	0.00	Safe limit	0.00	Safe limit		
Kapalirmet	**Top Soil (0-15 cm)**																				
	EC(ds/m)	4.8	Slightly saline	8.5	Moderately saline	3.89	Very slightly saline	8.29	Moderatel y saline	8.22	Moderatel y saline	7.53	Slightly saline	8.05	Slightly saline	7.31	Slightly saline	6.72	Slightly saline		
	pH	7.0	Neutral	7.6	Slightly alkaline	6.2	Slightly acid	8.0	Slightly alkaline	8.1	Slightly alkaline	7.8	Slightly alkaline	8.1	Slightly alkaline	7.84	Slightly alkaline	7.3	Neutral		
	OM (%)	3.0	Medium	1.5	Low	2.01	Medium	1.75	Low	2.03	Medium	1.77	Low	2.22	Medium	2.35	Medium	2.0	Medium		
	N (%)	0.2	Low	0.07	Very low	0.11	Low	0.09	Very low	0.11	Low	0.09	Very low	0.11	Low	0.12	Low	0.10	Low		
	K (meq/100g)	1.5	Very high	1.7	Very high	1.32	Very high	0.92	Very high	0.89	Very high	0.87	Very high	0.85	Very high	0.80	Very high	0.90	Very High		

Location	Parameter	2013-2014				2014-2015				2015-2016				2016-2017				2017-2018			
		Dry season (April)	Remarks	Wet season (October)	Remarks	Dry season (April)	Remarks	Wet season (October)	Remarks	Dry season (April)	Remarks	Wet season (October)	Remarks	Dry season (April)	Remarks	Wet season (October)	Remarks	Dry season (April)	Remarks	Wet season (October)	Remarks
	Ca (meq/100g)	18.2	Very high	19.9	Very high	27.04	Very high	10.77	Very high	11.09	Very high	12.47	Very high	11.56	Very high	13.10	Very high	15.59	Very High		
	Mg (meq/100g)	15.3	Very high	10.0	Very high	6.21	Very high	2.67	Very high	3.48	Very high	2.49	Very high	2.54	Very high	2.56	Very high	3.65	Very High		
	Na(meq/100g)	12.0	*	11.9	*	5.22	*	7.77	*	7.87	*	7.28	*	7.88	*	7.20	*	5.80	*		
	P(µg/gm)	3.2	Very low	7.3	Low	6.76	Very high	5.01	Very low	6.26	Low	4.98	Very low	5.86	Very high	5.18	Very high	6.23	Low		
	S(µg/gm)	545.2	Very high	20.8	Medium	216.69	Very high	700.0	Very high	710.4	Very high	741.10	Very high	734.80	Very high	647.53	Very high	595.18	Very High		
	B(µg/gm)	1.2	Very high	1.3	Very high	0.95	Very high	1.69	Very high	2.03	Very high	1.70	Very high	1.48	Very high	1.64	Very high	1.30	Very High		
	Fe(µg/gm)	37.3	Very high	230.2	Very high	34.56	Very high	94.22	Very high	45.52	Very high	94.20	Very high	48.29	Very high	92.36	Very high	50.09	Very High		
	Mn(µg/gm)	3.8	Very high	6.6	Very high	10.26	Very high	7.28	Very high	6.05	Very high	7.47	Very high	6.27	Very high	7.45	Very high	6.23	Very High		
	Zn(µg/gm)	2.0	High	1.0	Low	1.64	Optimum	3.58	Very high	2.68	Very high	3.66	Very high	3.16	Very high	3.68	Very high	2.56	Very High		
	Lead(Pb) (µg/gm)	12.5	Safe limit	28.9	Safe limit	47.12	Safe limit	8.17	Safe limit	6.89	Safe limit	7.53	Safe limit	8.25	Safe limit	7.46	Safe limit	14.58	Safe limit		
	Cadmium (Cd)(µg/gm)	0	Safe limit	0	Safe limit	2.86	Safe limit	00	Safe limit	00	Safe limit	00	Safe limit	0.61	Safe limit	0.00	Safe limit	0.15	Safe limit		
	Subsurface Soil (15-30 cm)																				
	EC(ds/m)	11.1	Moderately saline	6.3	Slightly saline	4.26	Slightly saline	7.43	Slightly saline	8.60	Moderately saline	7.55	Slightly saline	8.44	Moderately saline	7.39	Slightly saline	7.31	Slightly saline		
	pH	7.2	Neutral	7.9	Slightly alkaline	6.3	Slightly acid	8.0	Slightly alkaline	8.1	Slightly alkaline	8.2	Slightly alkaline	8.0	Slightly alkaline	8.32	Slightly alkaline	8.1	Slightly Alkaline		
	OM (%)	2.6	Medium	1.3	Low	3.36	High	1.69	Low	1.95	Medium	1.72	Low	2.00	Medium	1.41	Low	1.45	Low		
	N (%)	0.2	Low	0.06	Very low	0.19	Medium	0.08	Very low	0.10	Low	0.09	Very low	0.10	Low	0.07	Very low	0.07	Very low		
	K (meq/100g)	1.5	Very high	1.6	Very high	1.13	Very high	0.98	Low	0.98	Very high	0.96	Very high	0.94	Very high	0.92	Very high	0.78	Very High		
	Ca (meq/100g)	11.7	Very high	14.4	Very high	25.16	Very high	16.89	Very high	16.12	Very high	16.00	Very high	16.07	Very high	17.25	Very high	13.87	Very High		
	Mg (meq/100g)	7.1	Very high	9.9	Very high	6.22	Very high	3.94	Very high	3.88	Very high	4.03	Very high	4.17	Very high	3.88	Very high	3.53	Very High		
	Na(meq/100g)	8.5	*	9.8	*	5.45	*	7.86	*	7.89	*	7.66	*	8.04	*	7.72	*	6.72	*		
	P(µg/gm)	3.8	Very low	5.6	Low	5.29	Low	5.52	Low	6.21	Low	5.55	Low	6.00	Low	5.50	Low	7.0	Low		
	S(µg/gm)	341.4	Very high	52.1	Very high	236.58	Very high	655.0	Very high	666.23	Very high	707.00	Very high	672.09	Very high	701.68	Very high	635.29	Very High		
	B(µg/gm)	0.86	Very high	1.6	Very high	0.21	Low	1.93	Very high	2.11	Very high	1.95	Very high	2.02	Very high	1.70	Very high	1.19	Very High		
	Fe(µg/gm)	140.2	Very high	249.0	Very high	30.03	Very high	93.15	Very high	73.04	Very high	93.69	Very high	56.83	Very high	90.42	Very high	49.10	Very High		
	Mn(µg/gm)	3.7	High	5.9	Very high	11.23	Very high	6.95	Very high	8.16	Very high	7.30	Very high	7.85	Very high	7.32	Very high	6.25	Very High		
	Zn(µg/gm)	0.94	Medium	0.5	Low	1.04	Medium	2.39	Very high	1.96	High	2.34	Very high	2.11	High	2.45	Very high	2.49	Very High		
	Lead(Pb) (µg/gm)	0.00	Safe limit	29.3	Safe limit	33.66	Safe limit	9.58	Not polluted	10.03	Safe limit	10.14	Safe limit	10.18	Safe limit	9.71	Safe limit	13.12	Safe limit		
	Cadmium (Cd)(µg/gm)	0	Safe limit	0	Safe limit	2.18	Safe limit	00	Not polluted	00	Safe limit	00	Safe limit	0.64	Safe limit	0.00	Safe limit	0.00	Safe limit		
	Substratum Soil (30-45 cm)																				
	EC(ds/m)	10.8	Moderately saline	7.5	Slightly saline	3.99	Very slightly saline	7.06	Slightly saline	6.77	Slightly saline	8.44	Moderately saline	7.10	Slightly saline	6.54	Slightly saline	7.50	Slightly saline		
	pH	7.3	Neutral	7.8	Slightly alkaline	6.3	Slightly acid	7.9	Slightly alkaline	7.9	Slightly alkaline	8.1	Slightly alkaline	8.0	Slightly alkaline	8.57	Slightly alkaline	8.2	Slightly Alkaline		
	OM (%)	2.8	Medium	1.3	Low	4.03	High	2.38	Medium	2.42	Medium	2.21	Medium	1.98	Medium	2.03	Medium	1.12	Low		
	N (%)	0.15	Low	0.06	Very low	0.23	Medium	0.12	Low	0.13	Low	0.11	Low	0.10	Low	0.10	Low	0.06	Very low		
	K (meq/100g)	1.5	Very high	1.6	Very high	1.16	Very high	0.87	Very high	0.88	Very high	0.88	Very high	0.86	Very high	0.86	Very high	0.84	Very High		
	Ca (meq/100g)	12.9	Very high	15.4	Very high	27.13	Very high	17.20	Very high	16.88	Very high	16.78	Very high	16.68	Very high	14.64	Very high	13.33	Very High		
	Mg (meq/100g)	10.4	Very high	9.7	Very high	6.25	Very high	3.90	Very high	4.12	Very high	4.00	Very high	4.15	Very high	4.05	Very high	3.77	Very High		
	Na(meq/100g)	8.5	*	9.6	*	5.76	*	7.27	*	7.03	*	8.05	*	6.93	*	8.00	*	6.93	*		
	P(µg/gm)	3.4	Very low	5.8	Low	9.24	Optimum	3.65	Very low	3.81	Very low	4.12	Very low	4.05	Very low	3.92	Very low	9.48	Low		
	S(µg/gm)	345.1	Very high	5.6	Very low	231.67	Very high	732.0	Very high	764.07	Very high	664.37	Very high	749.36	Very high	620.39	Very high	475.47	Very High		
	B(µg/gm)	1.4	Very high	1.1	Very high	1.55	Very high	1.83	Very high	1.56	Very high	1.85	Very high	1.66	Very high	1.59	Very high	1.45	Very High		
	Fe(µg/gm)	120.3	Very high	247.8	Very high	33.82	Very high	87.26	Very high	38.64	Very high	88.40	Very high	40.51	Very high	84.18	Very high	42.13	Very High		
	Mn(µg/gm)	2.9	Optimum	7.2	Very high	53.90	Very high	7.31	Very high	9.43	Very high	7.50	Very high	8.97	Very high	7.50	Very high	6.19	Very High		
	Zn(µg/gm)	0.88	Low	0.79	Low	1.00	Medium	2.09	High	2.35	High	2.21	High	2.12	High	2.33	Very high	1.85	High		
	Lead(Pb)	0.00	Safe limit	27.6	Safe limit	34.37	Safe limit	7.88	Safe limit	7.57	Safe limit	8.05	Safe limit	7.69	Safe limit	7.80	Safe limit	12.57	Safe limit		

Location	Parameter	2013-2014				2014-2015				2015-2016				2016-2017				2017-2018			
		Dry season (April)	Remarks	Wet season (October)	Remarks	Dry season (April)	Remarks	Wet season (October)	Remarks	Dry season (April)	Remarks	Wet season (October)	Remarks	Dry season (April)	Remarks	Wet season (October)	Remarks	Dry season (April)	Remarks	Wet season (October)	Remarks
	(µg/gm)																				
	Cadmium (Cd)(µg/gm)	0	Safe limit	0	Safe limit	2.20	Safe limit	00	Safe limit	00	Safe limit	00	Safe limit	0.52	Safe limit	0.00	Safe limit	0.00	Safe limit		
Chalkghona	**Top Soil (0-15 cm)**																				
	EC(ds/m)	11.5	Moderately saline	7.2	Slightly saline	7.36	Slightly saline	7.31	Slightly saline	7.67	Slightly saline	8.56	Moderately saline	7.78	Slightly saline	6.82	Slightly saline	7.33	Slightly saline		
	pH	7.7	Slightly alkaline	8.0	Slightly alkaline	5.7	Slightly acid	8.5	Strongly alkaline	8.6	Strongly alkaline	8.3	Slightly alkaline	8.7	Strongly alkaline	8.73	Strongly alkaline	8.0	Slightly Alkaline		
	OM (%)	1.5	Low	1.5	Low	2.13	Medium	2.17	Medium	2.15	Medium	2.20	Medium	2.20	Medium	1.88	Medium	2.15	Medium		
	N (%)	0.08	Low	0.08	Low	0.12	Low	0.11	Low	0.11	Low	0.11	Low	0.11	Low	0.99	Low	0.11	Low		
	K (meq/100g)	1.5	Very high	1.4	Very high	1.72	Very high	0.86	Very high	0.88	Very high	0.88	Very high	0.87	Very high	0.85	Very high	0.88	Very High		
	Ca (meq/100g)	22.2	Very high	14.3	Very high	18.79	Very high	14.58	Very high	15.31	Very high	14.44	Very high	15.22	Very high	14.18	Very high	15.11	Very High		
	Mg (meq/100g)	11.7	Very high	9.4	Very high	6.29	Very high	3.87	Very high	3.89	Very high	3.85	Very high	3.85	Very high	3.84	Very high	3.92	Very High		
	Na(meq/100g)	8.5	*	8.4	*	9.81	*	6.56	*	6.33	*	6.52	*	6.50	*	5.79	*	6.14	*		
	P(µg/gm)	5.6	Very low	9.2	Low	4.11	Very low	10.88	Medium	11.26	Medium	11.13	Medium	10.79	Medium	10.43	Medium	9.87	Low		
	S(µg/gm)	444.2	Very high	4.1	Very low	440.19	Very high	975.0	Very high	982.55	Very high	978.43	Very high	975.48	Very high	862.34	Very high	851.22	Very High		
	B(µg/gm)	0.98	Very high	1.2	Very high	0.85	Very high	1.65	Very low	1.88	Very high	1.69	Very high	1.75	Very high	1.70	Very high	1.77	Very High		
	Fe(µg/gm)	55.3	Very high	189.0	Very high	41.14	Very high	68.05	Very high	43.62	Very high	70.23	Very high	42.89	Very high	68.09	Very high	42.17	Very High		
	Mn(µg/gm)	4.3	High	16.4	Very high	32.04	Very high	7.23	Very high	8.34	Very high	7.42	Very high	7.68	Very high	7.38	Very high	7.34	Very High		
	Zn(µg/gm)	0.76	Low	4.8	Very high	4.33	Very high	3.28	Very high	2.14	High	3.33	Very high	2.45	Very high	3.12	Very high	2.86	Very High		
	Lead(Pb) (µg/gm)	0.00	Safe limit	27.2	Safe limit	30.99	Safe limit	14.94	Safe limit	14.88	Safe limit	15.26	Safe limit	14.82	Safe limit	13.09	Safe limit	13.02	Safe limit		
	Cadmium (Cd)(µg/gm)	0	Safe limit	0	Safe limit	2.38	Safe limit	00	Safe limit	00	Safe limit	00	Safe limit	0.55	Safe limit	0.00	Safe limit	0.22	Safe limit		
	Subsurface soil (15-30 cm)																				
	EC(ds/m)	11.3	Moderately saline	6.2	Slightly saline	7.81	Slightly saline	7.38	Slightly saline	7.02	Slightly saline	7.99	Slightly saline	6.92	Slightly saline	6.58	Slightly saline	8.11	Moderately saline		
	pH	7.7	Slightly alkaline	8.2	Slightly alkaline	5.9	Slightly acid	8.6	Strongly alkaline	8.5	Strongly alkaline	8.4	Slightly alkaline	8.5	Strongly alkaline	8.77	Strongly alkaline	8.8	Strongly Alkaline		
	OM (%)	2.6	Medium	1.3	Low	1.88	Medium	1.90	Medium	1.88	Medium	1.84	Medium	1.91	Medium	1.49	Medium	1.79	Low		
	N (%)	0.13	Low	0.07	Very low	0.10	Low	0.10	Low	0.10	Low	0.09	Very low	0.10	Low	0.07	Very low	0.09	Very low		
	K (meq/100g)	1.5	Very high	1.1	Very high	1.54	Very high	0.81	Very high	0.84	Very high	0.79	Very high	0.80	Very high	0.79	Very high	0.81	Very High		
	Ca (meq/100g)	22.6	Very high	17.8	Very high	18.96	Very high	16.05	Very high	16.00	Very high	17.10	Very high	16.19	Very high	16.74	Very high	15.95	Very High		
	Mg (meq/100g)	16.3	Very high	8.3	Very high	6.30	Very high	4.25	Very high	4.33	Very high	4.33	Very high	4.26	Very high	4.30	Very high	4.17	Very High		
	Na(meq/100g)	8.5	*	8.6	*	9.23	*	6.93	*	6.56	*	7.10	*	5.97	*	6.48	*	6.65	*		
	P(µg/gm)	13.6	Medium	9.4	Low	3.23	Very low	9.23	Low	8.27	Low	8.79	Low	8.41	Low	10.22	Low	8.25	Low		
	S(µg/gm)	415.6	Very high	47.7	Very high	393.37	Very high	886.0	Very high	990.48	Very high	903.11	Very high	825.13	Very high	865.48	Very high	905.44	Very High		
	B(µg/gm)	0.66	High	0.97	Very high	0.79	Very high	1.46	Very high	1.17	Very high	1.45	Very high	1.27	Very high	1.38	Very high	1.21	Very High		
	Fe(µg/gm)	124.1	Very high	172.7	Very high	25.52	Very high	77.47	Very high	55.06	Very high	76.67	Very high	48.68	Very high	76.12	Very high	47.71	Very High		
	Mn(µg/gm)	6.1	Very high	13.8	Very high	26.59	Very high	6.78	Very high	7.05	Very high	7.53	Very high	7.18	Very high	6.79	Very high	7.59	Very High		
	Zn(µg/gm)	1.1	Medium	3.2	Very high	1.09	Medium	3.37	Very high	2.73	Very high	3.12	Very high	2.56	Very high	2.63	Very high	2.00	High		
	Lead(Pb) (µg/gm)	6.3	Safe limit	28.4	Safe limit	30.81	Safe limit	11.83	Safe limit	12.43	Safe limit	11.72	Safe limit	11.78	Safe limit	11.43	Safe limit	12.16	Safe limit		
	Cadmium (Cd)(µg/gm)	0	Safe limit	0	Safe limit	2.35	Safe limit	00	Safe limit	00	Safe limit	00	Safe limit	0.52	Safe limit	0.00	Safe limit	0.00	Safe limit		
	Substratum Soil (30-45 cm)																				
	EC(ds/m)	10.9	Moderately saline	5.1	Slightly saline	7.14	Slightly saline	7.12	Slightly saline	7.45	Slightly saline	7.87	Slightly saline	8.23	Moderately saline	6.83	Slightly saline	8.59	Moderately saline		
	pH	7.5	Slightly alkaline	8.2	Slightly alkaline	6.0	Slightly acid	8.9	Strongly alkaline	8.7	Strongly alkaline	8.4	Slightly alkaline	8.8	Strongly alkaline	8.82	Strongly alkaline	8.8	Strongly Alkaline		
	OM (%)	1.7	Low	1.0	Very low	2.94	Medium	1.53	Low	1.57	Low	1.55	Low	1.55	Low	1.88	Medium	1.23	Low		
	N (%)	0.09	Very low	0.06	Very low	0.17	Low	0.08	Very low	0.09	Very low	0.08	Very low	0.08	Very low	0.09	Very low	0.06	Very low		
	K (meq/100g)	1.5	Very high	0.95	Very high	1.57	Very high	0.89	Very high	0.90	Very high	0.95	Very high	0.92	Very high	0.88	Very high	0.73	Very High		
	Ca (meq/100g)	13.9	Very high	14.4	Very high	19.10	Very high	15.95	Very high	16.25	Very high	16.72	Very high	16.85	Very high	17.03	Very high	16.49	Very High		

Location	Parameter	2013-2014				2014-2015				2015-2016				2016-2017				2017-2018			
		Dry season (April)	Remarks	Wet season (October)	Remarks	Dry season (April)	Remarks	Wet season (October)	Remarks	Dry season (April)	Remarks	Wet season (October)	Remarks	Dry season (April)	Remarks	Wet season (October)	Remarks	Dry season (April)	Remarks	Wet season (October)	Remarks
	Mg (meq/100g)	11.1	Very high	7.2	Very high	6.26	Very high	4.15	Very high	4.06	Very high	3.97	Very high	4.00	Very high	4.06	Very high	4.0	Very High		
	Na(meq/100g)	8.5	*	6.7	*	9.33	*	7.20	Very high	7.39	*	6.77	*	6.69	*	6.95	*	6.82	*		
	P(µg/gm)	4.1	Very low	9.5	Low	5.67	Low	11.26	Medium	12.33	Medium	10.46	Low	11.48	Optimum	9.47	Low	11.09	Medium		
	S(µg/gm)	334.6	Very high	8.3	Low	343.00	Very high	465.0	Very high	543.04	Very high	562.60	Very high	550.09	Very high	612.47	Very high	695.78	Very High		
	B(µg/gm)	0.67	High	0.63	High	1.05	Very high	1.14	Very high	1.11	Very high	1.22	Very high	1.05	Very high	1.31	Very high	1.18	Very High		
	Fe(µg/gm)	75.3	Very high	160.0	Very high	29.70	Very high	90.55	Very high	67.84	Very high	90.64	Very high	83.17	Very high	90.15	Very high	68.21	Very High		
	Mn(µg/gm)	3.6	Very high	14.1	Very high	25.22	Very high	6.03	Very high	7.03	Very high	6.61	Very high	6.59	Very high	6.90	Very high	6.55	Very High		
	Zn(µg/gm)	1.7	Optimum	2.9	Very high	1.78		2.94	Very high	2.00	High	3.05	Very high	1.82	Very high	3.47	Very high	1.89	High		
	Lead(Pb) (µg/gm)	6.3	Safe limit	26.5	Safe limit	32.23	Safe limit	15.50	Safe limit	14.71	Safe limit	14.64	Safe limit	15.03	Safe limit	13.74	Safe limit	12.1	Safe limit		
	Cadmium (Cd)(µg/gm)	0	Safe limit	0	Safe limit	2.55	Safe limit	00	Safe limit	00	Safe limit	00	Safe limit	0.48	Safe limit	0.00	Safe limit	0.00	Safe limit		
Basherhula	**Top Soil (0-15 cm)**																				
	EC(ds/m)	11.7	Moderately saline	6.0	Slightly saline	7.14	Slightly saline	5.58	Slightly saline	9.10	Moderaely saline	6.41	Slightly saline	6.60	Slightly saline	6.15	Slightly saline	7.92	Slightly saline		
	pH	7.7	Slightly alkaline	8.3	Slightly alkaline	7.3	Neutral	8.7	Strongly alkaline	8.8	Strongly alkaline	8.3	Slightly alkaline	6.5	Slightly alkaline	8.77	Strongly alkaline	8.2	Slightly Alkaline		
	OM (%)	1.7	Low	1.2	Low	1.74	Low	1.59	Low	1.79	Medium	1.48	Low	1.45	Low	1.56	Low	2.09	Medium		
	N (%)	0.09	Low	0.06	Very low	0.10	Low	0.08	Very low	0.09	Very low	0.07	Very low	0.07	Very low	0.08	Very low	0.1	Low		
	K (meq/100g)	1.5	Very high	1.2	Very high	1.67	Very high	0.75	Very high	0.81	Very high	0.77	Very high	0.80	Very high	0.72	Very high	0.82	Very High		
	Ca (meq/100g)	23.6	Very high	31.4	Very high	25.26	Very high	15.11	Very high	16.53	Very high	15.08	Very high	15.78	Very high	13.45	Very high	11.49	Very High		
	Mg (meq/100g)	11.9	Very high	7.9	Very high	5.50	Very high	4.05	Very high	4.42	Very high	3.90	Very high	3.55	Very high	3.79	Very high	2.64	Very High		
	Na(meq/100g)	8.5	*	8.1	*	7.06	*	6.32	*	8.24	*	6.61	*	5.69	*	6.56	*	7.43	*		
	P(µg/gm)	4.5	Very low	7.4	Low	7.12	Low	5.92	Low	5.47	Low	5.87	Low	6.37	Very high	5.26	Low	6.11	Low		
	S(µg/gm)	272.3	Very high	21.8	Medium	454.19	Very high	607.0	Very high	623.73	Very high	579.39	Very high	610.52	Very high	556.10	Very high	690.58	Very High		
	B(µg/gm)	0.94	Very high	1.1	Very high	1.00	Very high	1.19	Very high	1.32	Very high	1.15	Very high	1.12	Very high	1.05	Very high	1.57	Very High		
	Fe(µg/gm)	50.3	Very high	205.6	Very high	53.37	Very high	85.08	Very high	48.00	Very high	87.22	Very high	51.78	Very high	88.11	Very high	49.05	Very High		
	Mn(µg/gm)	3.4	High	5.9	Very high	49.22	Very high	6.50	Very high	5.22	Very high	6.55	Very high	5.25	Very high	6.58	Very high	8.99	Very High		
	Zn(µg/gm)	1.4	Medium	1.1	Medium	2.27	Very high	1.86	High	1.04	Medium	1.89	High	2.01	High	1.84	High	3.3	Very High		
	Lead(Pb) (µg/gm)	18.8	Safe limit	25.1	Safe limit	30.55	Safe limit	6.19	Safe limit	5.77	Safe limit	5.77	Safe limit	6.06	Safe limit	6.29	Safe limit	9.18	Safe limit		
	Cadmium (Cd)(µg/gm)	0	Safe limit	0	Safe limit	2.21	Safe limit	00	Safe limit	00	Safe limit	00	Safe limit	0.32	Safe limit	0.00	Safe limit	0.26	Safe limit		
	Subsurface Soil (15-30 cm)																				
	EC(ds/m)	10.7	Moderately saline	7.0	Slightly saline	7.44	Slightly saline	7.16	Slightly saline	6.29	Slightly saline	7.30	Slightly saline	7.22	Slightly saline	7.21	Slightly saline	8.60	Moderately saline		
	pH	7.7	Slightly alkaline	8.2	Slightly alkaline	7.7	Slightly alkaline	8.7	Strongly alkaline	8.6	Strongly alkaline	8.4	Slightly alkaline	7.9	Slightly alkaline	8.72	Strongly alkaline	8.5	Strongly Alkaline		
	OM (%)	1.5	Low	0.9	Low	2.01	Medium	1.43	Low	1.31	Low	1.42	Low	1.50	Low	1.49	Low	1.5	Low		
	N (%)	0.08	Very low	0.05	Very low	0.11	Low	0.07	Very low	0.07	Very low	0.07	Very low	0.08	Very low	0.07	Very low	0.08	Very low		
	K (meq/100g)	1.0	Very high	1.2	Very high	2.20	Very high	0.76	Very high	0.77	Very high	0.71	Very high	0.75	Very high	0.78	Very high	0.79	Very High		
	Ca (meq/100g)	24.0	Very high	32.6	Very high	33.28	Very high	14.75	Very high	13.87	Very high	13.77	Very high	13.53	Very high	14.33	Very high	15.95	Very High		
	Mg (meq/100g)	11.7	Very high	8.4	Very high	6.10	Very high	3.76	Very high	3.69	Very high	3.52	Very high	3.75	Very high	3.55	Very high	3.95	Very High		
	Na(meq/100g)	7.0	*	10.1	*	8.66	*	7.06	*	6.93	*	6.74	*	6.70	*	6.70	*	8.32	*		
	P(µg/gm)	3.9	Very low	5.3	Low	8.19	Low	6.82	Low	7.03	Low	7.14	Low	7.05	Low	6.77	Low	6.00	Low		
	S(µg/gm)	317.2	Very high	2.8	Very low	379.38	Very high	627.0	Very high	652.28	Very high	568.50	Very high	649.47	Very high	496.55	Very high	715.33	Very High		
	B(µg/gm)	0.71	High	1.0	Very high	1.38	Very high	1.31	Very high	1.08	Very high	1.38	Very high	1.25	Very high	1.35	Very high	1.99	Very High		
	Fe(µg/gm)	121.4	Very high	307.0	Very high	53.18	Very high	83.13	Very high	50.12	Very high	84.36	Very high	49.26	Very high	83.64	Very high	54.11	Very High		
	Mn(µg/gm)	3.9	Very high	15.5	Very high	45.34	Very high	5.98	Very high	5.62	Very high	6.26	Very high	6.08	Very high	6.10	Very high	7.10	Very High		
	Zn(µg/gm)	1.8	Optimum	0.8	Low	1.99	High	2.27	Optimum	2.34	Very high	2.23	Very high	1.95	Very high	2.15	Very high	2.45	Very High		
	Lead(Pb) (µg/gm)	18.8	Safe limit	23.7	Safe limit	31.49	Safe limit	16.35	Safe limit	17.15	Safe limit	15.69	Safe limit	16.73	Safe limit	13.34	Safe limit	8.05	Safe limit		
	Cadmium	0	Safe limit	0	Safe limit	2.32	Safe limit	00	Safe limit	00	Safe limit	00	Safe limit	0.37	Safe limit	0.00	Safe limit	0.0	Safe limit		

Location	Parameter	2013-2014				2014-2015				2015-2016				2016-2017				2017-2018			
		Dry season (April)	Remarks	Wet season (October)	Remarks	Dry season (April)	Remarks	Wet season (October)	Remarks	Dry season (April)	Remarks	Wet season (October)	Remarks	Dry season (April)	Remarks	Wet season (October)	Remarks	Dry season (April)	Remarks	Wet season (October)	Remarks
	(Cd)(µg/gm)																				
	Substratum soil (30-45 cm)																				
	EC(ds/m)	10.9	Moderately saline	6.3	Slightly saline	6.68	Slightly saline	6.96	Slightly saline	6.38	Slightly saline	7.39	Slightly saline	7.39	Slightly saline	7.73	Slightly saline	8.74	Moderately saline		
	pH	7.7	Slightly alkaline	8.2	Slightly alkaline	7.8	Slightly alkaline	8.8	Strongly alkaline	8.7	Strongly alkaline	8.7	Strongly alkaline	8.1	Slightly alkaline	8.60	Strongly alkaline	8.7	Strongly Alkaline		
	OM (%)	1.5	Low	1.0	Low	2.81	Medium	2.17	Medium	2.18	Medium	2.09	Medium	2.08	Medium	1.64	Low	1.25	Low		
	N (%)	0.08	Very low	0.06	Very low	0.16	Low	0.11	Low	0.11	Low	0.11	Low	0.11	Low	0.08	Very low	0.06	Very low		
	K (meq/100g)	1.5	Very high	1.2	Very high	2.20	Very high	0.86	Very high	0.85	Very high	0.90	Very high	0.91	Very high	0.89	Very high	0.94	Very High		
	Ca (meq/100g)	24.4	Very high	32.1	Very high	30.68	Very high	13.95	Very high	12.92	Very high	14.05	Very high	13.97	Very high	14.49	Very high	16.73	Very High		
	Mg (meq/100g)	12.9	Very high	8.3	Very high	6.11	Very high	3.80	Very high	4.01	Very high	3.78	Very high	3.78	Very high	3.95	Very high	4.33	Very High		
	Na(meq/100g)	7.5	*	9.8	*	8.76	*	7.68	*	7.01	*	7.48	*	6.77	*	7.50	*	8.54	*		
	P(µg/gm)	6.1	Low	5.9	Low	11.14	Medium	9.12	Low	8.77	Low	8.90	Low	9.18	Low	7.83	Low	5.12	Very Low		
	S(µg/gm)	321.1	Very high	3.1	Very low	305.69	Very high	182.0	Very high	230.62	Very high	264.81	Very high	198.85	Very high	22.16	Optimum	699.11	Very High		
	B(µg/gm)	0.63	High	0.85	Very high	2.95	Very high	1.40	Very high	1.54	Very high	1.44	Very high	1.48	Very high	1.47	Very high	1.72	Very High		
	Fe(µg/gm)	77.3	Very high	162.4	Very high	42.36	Very high	66.29	Very high	39.40	Very high	68.25	Very high	40.51	Very high	65.89	Very high	41.32	Very High		
	Mn(µg/gm)	3.2	High	16.9	Very high	31.74	Very high	5.69	Very high	7.16	Very high	5.74	Very high	6.87	Very high	5.85	Very high	7.54	Very High		
	Zn(µg/gm)	2.1	High	2.7	Very high	1.62	Optimum	2.04	High	1.46	Optimum	1.97	High	1.57	Very high	1.95	Very high	1.79	High		
	Lead(Pb) (µg/gm)	25.00	Safe limit	22.2	Safe limit	31.54	Safe limit	14.96	Safe limit	16.02	Safe limit	15.20	Safe limit	15.79	Safe limit	14.06	Safe limit	7.98	Safe limit		
	Cadmium (Cd)(µg/gm)	0	Safe limit	0	Safe limit	2.44	Safe limit	00	Safe limit	00	Safe limit	00	Safe limit	0.39	Safe limit	0.00	Safe limit	0.00	Safe limit		

Source: SRDI Laboratory analysis (2014, 2015, 2016, 2017 and 2018)

Table E.3: Existing Cropping Pattern of Monitoring Agriculture Plot

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

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

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

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

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

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

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

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

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

Table F.1: Results of Traffic Volume Datasheet

Traffic Volume Survey from Babur Bari to Mongla

Date: July 25, 2018 (Wednesday)

Vehicles		7:00 AM to 10:00AM			12:00 PM to 2:00PM			17:00 PM to 19:00PM		
Direction	**Factor**	**Zero point to Plant site**	**Plant site to Zero point**	**PCU**	**Zero point to Plant site**	**Plant site to Zero point**	**PCU**	**Zero point to Plant site**	**Plant site to Zero point**	**PCU**
Pedestrian	0	19	18	0	21	20	0	8	11	0
Rickshaw	0.8	22	26	39	32	36	54	25	28	42
Van	0.6	31	22	32	13	19	19	17	16	19
Cycle	0.2	14	7	4	5	4	2	4	11	3
Human Howler	6	2	1	18	3	3	30	5	5	57
CNG	0.5	1	0	1	1	2	1	8	5	6
Private Car	1	15	11	26	10	9	19	7	16	23
Motor Cycle	0.3	46	29	23	47	52	30	17	41	17
Jeep	1	2	1	3	1	1	1	0	0	0
Pick-up	2	12	6	37	7	5	23	6	10	32
Micro	1	13	7	20	5	6	11	11	6	16
Bus	2.5	16	14	75	11	12	58	9	15	59
Light Truck	2	16	7	46	20	10	59	14	12	50
Medium Truck	2	20	15	70	29	16	88	17	22	77
Heavy Truck	2	23	12	70	8	9	33	9	13	42
			Total	**464**			**427**			**443**

Source: CEGIS field survey

Recorder: Gazi A. R. Nahid and Abdur Rahman

Table F.2: Results of Traffic Volume Datasheet

Traffic Volume Survey from Khudir Bottola to Babur Bari

July 23, 2018 (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	11	3	0	6	2	0	9	2	0
Rickshaw	0.8	0	9	7	2	2	3	9	3	9
Van	0.6	45	53	59	35	45	47	6	33	23
Cycle	0.2	24	16	8	7	14	4	1	8	2
Human Howler	6	4	5	48	6	9	87	9	3	69
CNG	0.5	2	3	3	2	1	1	1	1	1
Private Car	1	13	29	41	20	23	42	9	15	24
Motor Cycle	0.3	63	105	50	72	71	43	4	55	18
Jeep	1	0	2	2	2	2	4	0	1	1
Pick-up	2	10	19	56	21	21	83	5	11	31
Micro	1	5	12	16	15	12	27	9	5	14
Bus	2.5	23	36	145	30	32	154	9	23	79
Light Truck	2	5	13	36	20	21	82	4	8	24
Medium Truck	2	13	16	58	31	29	120	5	15	40
Heavy Truck	2	8	5	24	22	17	77	3	5	15
			Total	**552**			**773**			**349**

Source: CEGIS field survey

Recorder: Gazi A. R. Nahid and Abdur Rahman

Table F.3: Results of Traffic Volume Datasheet

Traffic Volume Survey from Babur Bari to Plant site

Date: July 24, 2018 (Tuesday)

Vehicles		7:00 AM to 10:00AM			12:00 PM to 2:00PM			17:00 PM to 19:00PM		
Direction	**Factor**	**Babubari to Plant site**	**Plant site to Babubari**	**PCU**	**Babubari to Plant site**	**Plant site to Babubari**	**PCU**	**Babubari to Plant site**	**Plant site to Babubari**	**PCU**
Pedestrian	0	11	10	0	6	8	0	19	9	0
Rickshaw	0.8	9	9	14	5	9	10	9	5	12
Van	0.6	13	10	14	11	12	14	6	8	8
Cycle	0.2	4	4	1	2	1	0	1	1	0
Human Howler	6	2	1	16	1	0	3	9	0	54
CNG	0.5	0	0	0	1	1	1	1	0	0
Private Car	1	4	4	8	2	1	2	9	2	11
Motor Cycle	0.3	10	14	7	9	6	4	4	3	2
Jeep	1	0	0	0	0	0	0	0	0	0
Pick-up	2	3	4	14	2	4	11	5	0	10
Micro	1	6	7	13	3	2	5	9	1	10
Bus	2.5	2	2	8	1	2	5	9	4	31
Light Truck	2	1	2	6	2	2	7	4	0	8
Medium Truck	2	4	3	15	1	0	2	5	2	14
Heavy Truck	2	1	1	3	1	0	1	3	0	6
			Total	**121**			**65**			**166**

Source: CEGIS field survey

Recorder: Gazi A. R. Nahid and Abdur Rahman

Appendix V: Monitoring Data observed During EIA Study

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

Date	Sample location	SPM (μg/m³)	SOx (μg/m³)	NOx (μg/m³)
01/05/2012	Shibbari More, Khulna	410.0	<25	46.0
	College More, Khulna	320.0	<25	36.0
	Natunrasta More, Khulna	350.0	<25	33.0
	Sonadanga Bus stand	335.0	<25	41.0
Bangladesh Standard (ECR 1997) for residential and rural area		200	80	80
02/05/2012	Bus stand more, Sharankhola Sadar	155.0	10.0	21.0
	In front of Upazila Palli Unnoyon Board Office, Sharankhola Sadar	140.0	11.0	20.
	Thana More, Sharankhola Sadar	150.0	09.0	18.0
	In front of Upazila Health Complex Office, Sharankhola Sadar	148.0	08.0	16.0
Bangladesh Standard (ECR 1997) for sensitive area as the location is within the ECA of Sundarbans		100	30	30
ECR Amendment, 2005		150 (24-hr)	365 (24-hr)	100 (Annual)

Source: CEGIS investigation, 2012

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

Table F.2: Water Quality Monitoring Results

Location	Date	Temp.	pH	EC	Cl^-	T.Alkalinity	Turbidity	T S	TDS	SS	DO	BOD	COD	Salinity
		ºC		μS/cm	mg/l	mg/l	NTU	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
1	7-Jan	27.4	7.74	3010	879	36	68.7	1565	1510	55	5.1	0.8	55	1.6
2	7-Jan	27.1	7.72	3020	878.8	36	68.5	1570	1510	60	5.1	0.8	55	1.6
3	7-Jan	27.8	7.71	3030	879	36	68.8	1565	1510	55	5.1	0.8	55	1.6
1	11-Feb	29.8	7.66	4380	1262	36	182	2390	2180	210	4.7	1	76	2.3
2	11-Feb	29.2	7.63	4380	1268	36	178	2390	2190	200	4.7	1	76	2.3
3	11-Feb	29.1	7.65	4380	1263	36	179	2380	2180	200	4.7	1	76	2.3
1	9-Mar	32.6	7.56	11780	2944.4	38	176	6080	5890	190	4.7	1.2	76	6.7
2	9-Mar	32.6	7.57	11780	2945.2	38	178	6080	5890	190	4.7	1.2	76	6.7
3	9-Mar	32.1	7.55	11780	2946.4	38	177	6090	5890	200	4.7	1.2	76	6.7
1	17-Apr	32.6	7.59	25300	8273	36	185.6	12950	12700	250	4.6	0.7	136	15.5
2	17-Apr	32.6	7.59	25300	8273	36	186.2	12950	12700	250	4.6	0.7	138	15.5

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

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

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

Appendix VI: Monitoring Results

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

বাংলাদেশ বিজ্ঞান ও শিল্প গবেষণা পরিষদ (বিসিএসআইআর)

BANGLADESH COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH(BCSIR)

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

Analysis Report

Analytical Service Cell Ref No: May2018010250	Unit (Lab/Inst.) Ref No: A-390
Lab ID: INS-390	Sample Receiving Date: 24/05/2018
Sample ID: A-390	Submission Date: 24/May/2018
	Report Delivery Date: 30/05/2018
Sample Description: SW(Mercury)-1	
Client's Details: Mahadi Hassan Center For Environmental And Geographic Information Services House#House No. 06, , Road No. 23/C, Dhaka-1216	
Number of Sample: 1	

Report Details:

Lab ID	Particulars of supplied Sample	Parameters	Concentration	Test Method (APHA)
A-390	Water (SW-01)	Mercury (Hg)	0.004 mg/L	3112.B

30.05.18 | 30.05.18 | 30.05.2018

Analyst | Section/Division In-Charge | In-Charge/Director

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

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

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

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

বাংলাদেশ বিজ্ঞান ও শিল্প গবেষণা পরিষদ (বিসিএসআইআর)

BANGLADESH COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH(BCSIR)

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

Analysis Report

Analytical Service Cell Ref No: May2018010251	Unit (Lab/Inst.) Ref No: A-391
Lab ID: INs-391	Sample Receiving Date: 24/05/2018
Sample ID: A391	Submission Date: 24/May/2018
	Report Delivery Date: 30/05/2018
Sample Description: SW(Mercury)-2	
Client's Details: Mahadi Hassan Center For Environmental And Geographic Information Services House#House No. 06, , Road No. 23/C, Dhaka-1216	
Number of Sample: 1	

Report Details:

Lab ID	Particulars of supplied Sample	Parameters	Concentration	Test Method (APHA)
A-391	Water (SW-02)	Mercury (Hg)	0.002 mg/L	3112.B

30.05.18 | 30.05.18 | 30-05-18

Analyst | Section/Division In-Charge | In-Charge/Director

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

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

Note:
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জীবনের জন্য বিজ্ঞান

'শেখ হাসিনার দর্শন,সব মানুষের উন্নয়ন'

বাংলাদেশ বিজ্ঞান ও শিল্প গবেষণা পরিষদ (বিসিএসআইআর)

BANGLADESH COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH(BCSIR)

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

Analysis Report

Analytical Service Cell Ref No: May2018010252	Unit (Lab/Inst.) Ref No: A-392
Lab ID: INS-392	Sample Receiving Date: 24/05/2018
Sample ID: A-392	Submission Date: 24/May/2018
	Report Delivery Date: 31/05/2018

Sample Description: SW(Mercury)-3

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

Number of Sample: 1

Report Details:

Lab ID	Particulars of supplied Sample	Parameters	Concentration	Test Method (APHA)
A-392	Water (SW-03)	Mercury (Hg)	Less than 0.001 mg/L	3112.B

03.06.18
Analyst
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BCSIR, Dhaka

03.06.18
Section/Division In-Charge

03-06-2018
In-Charge/Director
Md. Aminul Ahsan
Director (Addl. Charge)
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BCSIR, Dhaka.

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জীবনের জন্য বিজ্ঞান

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BANGLADESH COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH(BCSIR)

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

Analysis Report

Analytical Service Cell Ref No: May2018010253	Unit (Lab/Inst.) Ref No: A-392
Lab ID: INS-393	Sample Receiving Date: 24/05/2018
Sample ID: A393	Submission Date: 24/May/2018
	Report Delivery Date: 31/05/2018

Sample Description: SW(Mercury)-4

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

Number of Sample: 1

Report Details:

Lab ID	Particulars of supplied Sample	Parameters	Concentration	Test Method (APHA)
A-393	Water (SW-04)	Mercury (Hg)	Less than 0.001 mg/L	3112.B

03.06.18
Analyst
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03.06.18
Section/Division In-Charge

03-06-2018
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Md. Aminul Ahsan
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BCSIR, Dhaka.

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31st of May 2018 12:03 PM

জীবনের জন্য বিজ্ঞান

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BANGLADESH COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH(BCSIR)

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

Analysis Report

Analytical Service Cell Ref No: May2018010254	Unit (Lab/Inst.) Ref No: A-394
Lab ID: INS-394	Sample Receiving Date: 24/05/2018
Sample ID: A394	Submission Date: 24/May/2018
	Report Delivery Date: 31/05/2018
Sample Description: SW(Mercury)-5	
Client's Details: Mahadi Hassan Center For Environmental And Geographic Information Services House#House No. 06, , Road No. 23/C, Dhaka-1216	
Number of Sample: 1	

Report Details:

Lab ID	Particulars of supplied Sample	Parameters	Concentration	Test Method (APHA)
A-394	Water (SW-05)	Mercury (Hg)	Less than 0.001 mg/L	3112.B

03.06.18
Analyst
Md. Abu Bakar Siddique
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BCSIR, Dhaka

03.06.18
Section/Division In-Charge
শামীম আহমেদ
ঊর্ধ্বতন বৈজ্ঞানিক কর্মকর্তা
ইন্সটিটিউট অব ন্যাশনাল এনালাইটিক্যাল রিসার্চ এন্ড সার্ভিস (আইএনএআরএস)
বিসিএসআইআর, ঢাকা

03-06-2018
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Md. Aminul Ahsan
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31st of May 2018 12:07 PM

জীবনের জন্য বিজ্ঞান

'শেখ হাসিনার দর্শন,সব মানুষের উন্নয়ন'

বাংলাদেশ বিজ্ঞান ও শিল্প গবেষণা পরিষদ (বিসিএসআইআর)

BANGLADESH COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH(BCSIR)

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

Analysis Report

Analytical Service Cell Ref No: May2018010255	Unit (Lab/Inst.) Ref No: A-395
Lab ID: INS-395	Sample Receiving Date: 24/05/2018
Sample ID: A-395	Submission Date: 24/May/2018
	Report Delivery Date: 31/05/2018
Sample Description: SW(Mercury)-6	
Client's Details: Mahadi Hassan Center For Environmental And Geographic Information Services House#House No. 06, , Road No. 23/C, Dhaka-1216	
Number of Sample: 1	

Report Details:

Lab ID	Particulars of supplied Sample	Parameters	Concentration	Test Method (APHA)
A-395	Water (SW-06)	Mercury (Hg)	Less than 0.001 mg/L	3112.B

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শামীম আহমেদ
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BCSIR, Dhaka.

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31st of May 2018 12:08 PM

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BANGLADESH COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH(BCSIR)

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

Analysis Report

Analytical Service Cell Ref No: May2018010256	Unit (Lab/Inst.) Ref No: A-396
Lab ID: INS-396	Sample Receiving Date: 24/05/2018
Sample ID: A-396	Submission Date: 24/May/2018
	Report Delivery Date: 31/05/2018
Sample Description: SW(Mercury)-7	
Client's Details: Mahadi Hassan Center For Environmental And Geographic Information Services House#House No. 06, , Road No. 23/C, Dhaka-1216	
Number of Sample: 1	

Report Details:

Lab ID	Particulars of supplied Sample	Parameters	Concentration	Test Method (APHA)
A-396	Water (SW-07)	Mercury (Hg)	Less than 0.001 mg/L	3112.B

03.06.18
Analyst
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BCSIR, Dhaka

03.06.18
Section/Division In-Charge
শামীম আহমেদ
ঊর্ধ্বতন বৈজ্ঞানিক কর্মকর্তা
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বিসিএসআইআর, ঢাকা

03-06-2018
In-Charge/Director
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Director (Addl. Charge)
Institute of National Analytical Research & Service (INARS)
BCSIR, Dhaka.

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

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BANGLADESH COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH(BCSIR)

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

Analysis Report

Analytical Service Cell Ref No: May2018010257	Unit (Lab/Inst.) Ref No: A-397
Lab ID: INS-397	Sample Receiving Date: 24/05/2018
Sample ID: A-397	Submission Date: 24/May/2018
	Report Delivery Date: 31/05/2018
Sample Description: SW(Mercury)-8	
Client's Details: Mahadi Hassan Center For Environmental And Geographic Information Services House#House No. 06, , Road No. 23/C, Dhaka-1216	
Number of Sample: 1	

Report Details:

Lab ID	Particulars of supplied Sample	Parameters	Concentration	Test Method (APHA)
A-397	Water (SW-08)	Mercury (Hg)	Less than 0.001 mg/L	3112.B

03.06.18
Analyst
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BCSIR, Dhaka

03.06.18
Section/Division In-Charge
শামীম আহমেদ
ঊর্ধ্বতন বৈজ্ঞানিক কর্মকর্তা
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বিসিএসআইআর, ঢাকা

03-06-2018
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Institute of National Analytical Research & Service (INARS)
BCSIR, Dhaka.

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BANGLADESH COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH(BCSIR)

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

Analysis Report

Analytical Service Cell Ref No: May2018010258	Unit (Lab/Inst.) Ref No: A-398
Lab ID: INS-398	Sample Receiving Date: 24/05/2018
Sample ID: A-398	Submission Date: 24/May/2018
	Report Delivery Date: 31/05/2018

Sample Description: SW(Mercury)-9

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

Number of Sample: 1

Report Details:

Lab ID	Particulars of supplied Sample	Parameters	Concentration	Test Method (APHA)
A-398	Water (SW-09)	Mercury (Hg)	Less than 0.001 mg/L	3112.B

03.06.18
Analyst
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03.06.18
Section/Division In-Charge

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BANGLADESH COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH(BCSIR)

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

Analysis Report

Analytical Service Cell Ref No: May2018010259	Unit (Lab/Inst.) Ref No: A-399
Lab ID: INS-399	Sample Receiving Date: 24/05/2018
Sample ID: A-399	Submission Date: 24/May/2018
	Report Delivery Date: 31/05/2018

Sample Description: SW(Mercury)-10

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

Number of Sample: 1

Report Details:

Lab ID	Particulars of supplied Sample	Parameters	Concentration	Test Method (APHA)
A-399	Water (SW-10)	Mercury (Hg)	Less than 0.001 mg/L	3112.B

03.06.18
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03.06.18
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BANGLADESH COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH(BCSIR)

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

Analysis Report

Analytical Service Cell Ref No: May2018010260	Unit (Lab/Inst.) Ref No: A-400
Lab ID: INS-400	Sample Receiving Date: 24/05/2018
Sample ID: A-400	Submission Date: 24/May/2018
	Report Delivery Date: 31/05/2018
Sample Description: SW(Mercury)-11	
Client's Details: Mahadi Hassan Center For Environmental And Geographic Information Services House#House No. 06, , Road No. 23/C, Dhaka-1216	
Number of Sample: 1	

Report Details:

Lab ID	Particulars of supplied Sample	Parameters	Concentration	Test Method (APHA)
A-400	Water (SW-11)	Mercury (Hg)	Less than 0.001 mg/L	3112.B

03.06.18
Analyst
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Institute of National Analytical Research & Service (INARS)
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03.06.18
Section/Division In-Charge

03-06-2018
In-Charge/Director
Md. Aminul Ahsan
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Note:
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জীবনের জন্য বিজ্ঞান "শেখ হাসিনার দর্শন,সব মানুষের উন্নয়ন"

বাংলাদেশ বিজ্ঞান ও শিল্প গবেষণা পরিষদ (বিসিএসআইআর)

BANGLADESH COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH(BCSIR)

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

Analysis Report

Analytical Service Cell Ref No: May2018010261	Unit (Lab/Inst.) Ref No: A-401
Lab ID: INS-401	Sample Receiving Date: 24/05/2018
Sample ID: A-401	Submission Date: 24/May/2018
	Report Delivery Date: 31/05/2018
Sample Description: SW(Mercury)-12	
Client's Details: Mahadi Hassan Center For Environmental And Geographic Information Services House#House No. 06, , Road No. 23/C, Dhaka-1216	
Number of Sample: 1	

Report Details:

Lab ID	Particulars of supplied Sample	Parameters	Concentration	Test Method (APHA)
A-401	Water (SW-12)	Mercury (Hg)	Less than 0.001 mg/L	3112.B

03.06.18
Analyst
Md. Abu Bakar Siddique
Scientific Officer
Institute of National Analytical Research & Service (INARS)
BCSIR, Dhaka

03.06.18
Section/Division In-Charge

03-06-2018
In-Charge/Director
Md. Aminul Ahsan
Director (Addl. Charge)
Institute of National Analytical Research & Service (INARS)
BCSIR, Dhaka.

Note:
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Analytical Service Cell
Dr. Qudrat-I-Khuda Road, Dhanmondi, Dhaka-1205,Bangladesh
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জীবনের জন্য বিজ্ঞান "শেখ হাসিনার দর্শন,সব মানুষের উন্নয়ন"

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BANGLADESH COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH(BCSIR)

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

Analysis Report

Analytical Service Cell Ref No: May2018010262	Unit (Lab/Inst.) Ref No: A-402
Lab ID: INS-402	Sample Receiving Date: 24/05/2018
Sample ID: A-402	Submission Date: 24/May/2018
	Report Delivery Date: 31/05/2018
Sample Description: SW(Mercury)-13	
Client's Details: Mahadi Hassan Center For Environmental And Geographic Information Services House#House No. 06, , Road No. 23/C, Dhaka-1216	
Number of Sample: 1	

Report Details:

Lab ID	Particulars of supplied Sample	Parameters	Concentration	Test Method (APHA)
A-402	Water (SW-13)	Mercury (Hg)	Less than 0.001 mg/L	3112.B

03.06.18
Analyst
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BCSIR, Dhaka.

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

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BANGLADESH COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH(BCSIR)

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

Analysis Report

Analytical Service Cell Ref No: May2018010263	Unit (Lab/Inst.) Ref No: A-403
Lab ID: INS-403	Sample Receiving Date: 24/05/2018
Sample ID: A-403	Submission Date: 24/May/2018
	Report Delivery Date: 31/05/2018
Sample Description: SW(Mercury)-14	
Client's Details: Mahadi Hassan Center For Environmental And Geographic Information Services House#House No. 06, , Road No. 23/C, Dhaka-1216	
Number of Sample: 1	

Report Details:

Lab ID	Particulars of supplied Sample	Parameters	Concentration	Test Method (APHA)
A-403	Water (SW-14)	Mercury (Hg)	Less than 0.001 mg/L	3112.B

03.06.18
Analyst
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BCSIR, Dhaka

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জীবনের জন্য বিজ্ঞান

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BANGLADESH COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH(BCSIR)

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

Analysis Report

Analytical Service Cell Ref No: May2018010264	Unit (Lab/Inst.) Ref No: A-404
Lab ID: INS-404	Sample Receiving Date: 24/05/2018
Sample ID: A-404	Submission Date: 24/May/2018
	Report Delivery Date: 31/05/2018

Sample Description: GW(Mecury-1

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

Number of Sample: 1

Report Details:

Lab ID	Particulars of supplied Sample	Parameters	Concentration	Test Method (APHA)
A-404	Water (GW-01)	Mercury (Hg)	Less than 0.001 mg/L	3112.B

03.06.18
Analyst
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BCSIR, Dhaka

03.06.18
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ঊর্ধ্বতন বৈজ্ঞানিক কর্মকর্তা
ইন্সটিটিউট অব ন্যাশনাল এনালাইটিক্যাল রিসার্চ এন্ড সার্ভিস (আইএনএআরএস)
বিসিএসআইআর, ঢাকা

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BCSIR, Dhaka.

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জীবনের জন্য বিজ্ঞান

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BANGLADESH COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH(BCSIR)

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

Analysis Report

Analytical Service Cell Ref No: May2018010266	Unit (Lab/Inst.) Ref No: A-405
Lab ID: INS-405	Sample Receiving Date: 24/05/2018
Sample ID: A-405	Submission Date: 24/May/2018
	Report Delivery Date: 31/05/2018

Sample Description: GW(Mecury-2

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

Number of Sample: 1

Report Details:

Lab ID	Particulars of supplied Sample	Parameters	Concentration	Test Method (APHA)
A-405	Water (GW-02)	Mercury (Hg)	Less than 0.001 mg/L	3112.B

03.06.18
Analyst
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03-06-2018
In-Charge/Director
Md. Aminul Ahsan
Director (Addl. Charge)
Institute of National Analytical Research & Service (INARS),
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31st of May 2018 02:32 PM

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BANGLADESH COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH(BCSIR)

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

Analysis Report

Analytical Service Cell Ref No: May2018010267	Unit (Lab/Inst.) Ref No: A-406
Lab ID: INS-406	Sample Receiving Date: 24/05/2018
Sample ID: A-406	Submission Date: 24/May/2018
	Report Delivery Date: 31/05/2018

Sample Description: Surface water (Oil and Grease)-1

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

Number of Sample: 1

Report Details:

Lab ID	Particulars of supplied Sample	Parameters	Concentration	Test Method (APHA)
A-406	Surface water (Sample-01)	Oil and Grease	Less than 5 mg/L	5520.B

03.06.18
Analyst
A.H.M. Shofiul Islam Molla Jamal
Scientific Officer
Institute of National Analytical Research & Service (INARS)
BCSIR, Dhaka

03.06.18
Section/Division In-Charge

03-06-2018
In-Charge/Director
Md. Aminul Ahsan
Director (Addl. Charge)
Institute of National Analytical Research & Service (INARS)
BCSIR, Dhaka.

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বাংলাদেশ বিজ্ঞান ও শিল্প গবেষণা পরিষদ (বিসিএসআইআর)

BANGLADESH COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH(BCSIR)

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

Analysis Report

Analytical Service Cell Ref No: May2018010269	Unit (Lab/Inst.) Ref No: A-407
Lab ID: INS-407	Sample Receiving Date: 24/05/2018
Sample ID: A-407	Submission Date: 24/May/2018
	Report Delivery Date: 31/05/2018

Sample Description: Surface water (Oil and Grease)-2

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

Number of Sample: 1

Report Details:

Lab ID	Particulars of supplied Sample	Parameters	Concentration	Test Method (APHA)
A-407	Surface water (Sample-02)	Oil and Grease	Less than 5 mg/L	5520.B

03.06.18
Analyst
A.H.M. Shofiul Islam Molla Jamal
Scientific Officer
Institute of National Analytical Research & Service (INARS)
BCSIR, Dhaka

03.06.18
Section/Division In-Charge

03-06-2018
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Director (Addl. Charge)
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BCSIR, Dhaka.

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Pages 1 of 1   31st of May 2018 02:35 PM

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

বাংলাদেশ বিজ্ঞান ও শিল্প গবেষণা পরিষদ (বিসিএসআইআর)
BANGLADESH COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH(BCSIR)

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

Analysis Report

Analytical Service Cell Ref No: May2018010270	Unit (Lab/Inst.) Ref No: A-408
Lab ID: INS-408	Sample Receiving Date: 24/05/2018
Sample ID: A-408	Submission Date: 24/May/2018
	Report Delivery Date: 31/05/2018

Sample Description: Surface water (Oil and Grease)-3

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

Number of Sample: 1

Report Details:

Lab ID	Particulars of supplied Sample	Parameters	Concentration	Test Method (APHA)
A-408	Surface water (Sample-03)	Oil and Grease	Less than 5 mg/L	5520.B

03.06.18
Analyst
A.H.M. Shofiul Islam Molla Jamal
Scientific Officer
Institute of National Analytical Research & Service (INARS)
BCSIR, Dhaka

03.06.18
Section/Division In-Charge
শামীম আহমেদ
ঊর্ধ্বতন বৈজ্ঞানিক কর্মকর্তা
ইনস্টিটিউট অব ন্যাশনাল এনালাইটিক্যাল রিসার্চ এন্ড সার্ভিস (আইএনএআরএস)
বিসিএসআইআর, ঢাকা

03-06-2018
In-Charge/Director
Md. Aminul Ahsan
Director (Addl. Charge)
Institute of National Analytical Research & Service (INARS)
BCSIR, Dhaka.

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

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BANGLADESH COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH(BCSIR)

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

Analysis Report

Analytical Service Cell Ref No: May2018010271	Unit (Lab/Inst.) Ref No: A-409
Lab ID: INS-409	Sample Receiving Date: 27/05/2018
Sample ID: A-409	Submission Date: 24/May/2018
	Report Delivery Date: 31/05/2018

Sample Description: Surface water (Oil and Grease)-4

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

Number of Sample: 1

Report Details:

Lab ID	Particulars of supplied Sample	Parameters	Concentration	Test Method (APHA)
A-409	Surface water (Sample-04)	Oil and Grease	Less than 5 mg/L	5520.B

03.06.18
Analyst
A.H.M. Shofiul Islam Molla Jamal
Scientific Officer
Institute of National Analytical Research & Service (INARS)
BCSIR, Dhaka

03.06.18
Section/Division In-Charge
শামীম আহমেদ
ঊর্ধ্বতন বৈজ্ঞানিক কর্মকর্তা
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বিসিএসআইআর, ঢাকা

03-06-2018
In-Charge/Director
Md. Aminul Ahsan
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BCSIR, Dhaka.

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

Lab Memo: 966/ CC, DPHE, CL, Dhaka. Date: 28-08-2018

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: CEN2018080011	Sample Receiving date: 17-05-2018
Ref. Memo No: 42.06.2626.119.37.001.18-0771 & Dated: 17-05-2018	Sample Source: Suface Water
Sent by:Engr. Md Waji Ullah ,Executive Director , CEGIS, Gulshan-1, Dhaka-1212.	Dist:Bagerhat, Upa:Rampal
Care Taker: CEGIS (SW-01)	Union:, Vill.:
Sample Collection date: 09-05-2018	Date of Testing: 17/05/2018-25/07/2018

LABORATORY TEST RESULTS:

Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Arsenic (As)	0.05	0.001	mg/L	AAS	0.001
2	Cadmium (Cd)	0.005	0.0004	mg/L	AAS	0.00015
3	Calcium (Ca)	75	497	mg/L	AAS	0.17
4	Chemical Oxygen Demand (COD)	4.0	276	mg/L	CRM	-
5	Chloride	150-600	8160	mg/L	Titrimetic	-
6	Silica (Sio2)	0.0	26.2	mg/L	UVS	-
7	Bi-Carbonate (HCO3-)	0.0	105	mg/L	Titrimetic	-
8	Cr (Total)	0.05	0.031	mg/L	AAS	0.0003
9	Hardness	200-500	3100	mg/L	Titrimetic	-
10	Iron (Fe)	0.3-1	4.49	mg/L	AAS	0.05
11	Lead (Pb)	0.05	0.002	mg/L	AAS	0.001
12	Magnesium (Mg)	30-35	228	mg/L	AAS	0.05
13	Nitrogen (Nitrate)	10.0	6.8	mg/L	UVS	0.10
14	Phosphate	6.0	0.38	mg/L	UVS	-
15	Potassium (K)	12.0	94	mg/L	AAS	-
16	Sodium (Na)	200	2349	mg/L	AAS	0.34
17	Sulphate	400	1400	mg/L	UVS	1.0
18	Total Dissolved Solid (TDS)	1000	14500	mg/L	Multimeter	-
19	Total Suspended Solid (TSS)	10	18	mg/L	Gravity Multimeter	-
20	Turbidity	10	116	NTU	Turbidity Meter	-
21	Carbonate (CO3)	-	0.614	mg/L	Titrimetic	-

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

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

Test Performed by:	Signature	Countersigned/Approved by:	Signature
1.) Name: Mahabuba Sabina Motin Designation: Sample Analyzer	28.08.18	1.) Name: Md. Biplab Hossain Designation: Chief Chemist	28/08/2018 Md. Biplab Hossain Chief Chemist Department of Public Health Engineering Central Laboratory Mohakhali, Dhaka.
2.) Name: Taslima Akhter Designation: Sample Analyzer	28.08.18	2.) Name: Designation:	

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Lab Memo: 966/ CC, DPHE, CL, Dhaka. Date: 28-08-2018

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: CEN2018080012	Sample Receiving date: 17-05-2018
Ref. Memo No: 42.06.2626.119.37.001.18-0771 & Dated: 17-05-2018	Sample Source: Suface Water
Sent by:Engr. Md Waji Ullah ,Executive Director , CEGIS, Gulshan-1, Dhaka-1212.	Dist:Bagerhat, Upa:Rampal
Care Taker: CEGIS (SW-02)	Union:, Vill.:
Sample Collection date: 09-05-2018	Date of Testing: 17/05/2018-25/07/2018

LABORATORY TEST RESULTS:

Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Arsenic (As)	0.05	0.001	mg/L	AAS	0.001
2	Cadmium (Cd)	0.005	0.0002	mg/L	AAS	0.00015
3	Chemical Oxygen Demand (COD)	4.0	240	mg/L	CRM	-
4	Cr (Total)	0.05	0.029	mg/L	AAS	0.0003
5	Hardness	200-500	1040	mg/L	Titrimetic	-
6	Lead (Pb)	0.05	0.001	mg/L	AAS	0.001
7	Nitrogen (Nitrate)	10.0	4.9	mg/L	UVS	0.10
8	Phosphate	6.0	0.25	mg/L	UVS	-
9	Sulphate	400	1320	mg/L	UVS	1.0
10	Total Dissolved Solid (TDS)	1000	14420	mg/L	Multimeter	-
11	Total Suspended Solid (TSS)	10	17	mg/L	Gravity Multimeter	-

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

Test Performed by:	Signature	Countersigned/Approved by:	Signature
1.) Name: Mahabuba Sabina Motin Designation: Sample Analyzer	28.08.18	1.) Name: Md. Biplab Hossain Designation: Chief Chemist	28/08/2018 Md. Biplab Hossain Chief Chemist Department of Public Health Engineering Central Laboratory Mohakhali, Dhaka.
2.) Name: Taslima Akhter Designation: Sample Analyzer	28.08.18	2.) Name: Designation:	

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Lab Memo: 966/ CC, DPHE, CL, Dhaka. Date: 28-08-2018

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: CEN2018080013	Sample Receiving date: 17-05-2018
Ref. Memo No: 42.06.2626.119.37.001.18-0771 & Dated: 17-05-2018	Sample Source: Suface Water
Sent by:Engr. Md Waji Ullah ,Executive Director , CEGIS, Gulshan-1, Dhaka-1212.	Dist:Bagerhat, Upa:Rampal
Care Taker: CEGIS (SW-03)	Union:, Vill.:
Sample Collection date: 09-05-2018	Date of Testing: 17/05/2018-25/07/2018

LABORATORY TEST RESULTS:

Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Arsenic (As)	0.05	0.001	mg/L	AAS	0.001
2	Cadmium (Cd)	0.005	0.0003	mg/L	AAS	0.00015
3	Chemical Oxygen Demand (COD)	4.0	230	mg/L	CRM	-
4	Cr (Total)	0.05	0.026	mg/L	AAS	0.0003
5	Hardness	200-500	1030	mg/L	Titrimetic	-
6	Lead (Pb)	0.05	0.004	mg/L	AAS	0.001
7	Nitrogen (Nitrate)	10.0	5.1	mg/L	UVS	0.10
8	Phosphate	6.0	0.29	mg/L	UVS	-
9	Sulphate	400	1440	mg/L	UVS	1.0
10	Total Dissolved Solid (TDS)	1000	14650	mg/L	Multimeter	-
11	Total Suspended Solid (TSS)	10	22	mg/L	Gravity Multimeter	-

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

Test Performed by:	Signature	Countersigned/Approved by:	Signature
1.) Name: Mahabuba Sabina Motin Designation: Sample Analyzer	28.08.18	1.) Name: Md. Biplab Hossain Designation: Chief Chemist	28/08/2018 Md. Biplab Hossain Chief Chemist Department of Public Health Engineering Central Laboratory Mohakhali, Dhaka.
2.) Name: Taslima Akhter Designation: Sample Analyzer	28.08.18	2.) Name: Designation:	

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Lab Memo: 966/ CC, DPHE, CL, Dhaka.

Date: 28-08-2018

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: CEN2018080014	Sample Receiving date: 17-05-2018
Ref. Memo No: 42.06.2626.119.37.001.18-0771 & Dated: 17-05-2018	Sample Source: Suface Water
Sent by:Engr. Md Waji Ullah ,Executive Director , CEGIS, Gulshan-1, Dhaka-1212.	Dist:Bagerhat, Upa:Rampal
Care Taker: CEGIS (SW-04)	Union:, Vill.:
Sample Collection date: 09-05-2018	Date of Testing: 17/05/2018-25/07/2018

LABORATORY TEST RESULTS:

Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Arsenic (As)	0.05	0.002	mg/L	AAS	0.001
2	Cadmium (Cd)	0.005	0.0002	mg/L	AAS	0.00015
3	Calcium (Ca)	75	456	mg/L	AAS	0.17
4	Chemical Oxygen Demand (COD)	4.0	232	mg/L	CRM	-
5	Chloride	150-600	8120	mg/L	Titrimetic	-
6	Silica (Sio2)	0.0	22	mg/L	UVS	-
7	Bi-Carbonate (HCO3-)	0.0	125	mg/L	Titrimetic	-
8	Cr (Total)	0.05	0.032	mg/L	AAS	0.0003
9	Hardness	200-500	1060	mg/L	Titrimetic	-
10	Iron (Fe)	0.3-1	7.91	mg/L	AAS	0.05
11	Lead (Pb)	0.05	0.001	mg/L	AAS	0.001
12	Magnesium (Mg)	30-35	230	mg/L	AAS	0.05
13	Nitrogen (Nitrate)	10.0	0.10	mg/L	UVS	0.10
14	Phosphate	6.0	0.38	mg/L	UVS	-
15	Potassium (K)	12.0	87	mg/L	AAS	-
16	Sodium (Na)	200	2418	mg/L	AAS	0.34
17	Sulphate	400	1260	mg/L	UVS	1.0
18	Total Dissolved Solid (TDS)	1000	14300	mg/L	Multimeter	-
19	Total Suspended Solid (TSS)	10	20	mg/L	Gravity Multimeter	-
20	Turbidity	10	315	NTU	Turbidity Meter	-
21	Carbonate (CO3)	-	0.586	mg/L	Titrimetic	-

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

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

Test Performed by:	Signature	Countersigned/Approved by:	Signature
1.) Name: Mahabuba Sabina Motin Designation: Sample Analyzer	28.08.18	1.) Name: Md. Biplab Hossain Designation: Chief Chemist	28/08/2018 Md. Biplab Hossain Chief Chemist Department of Public Health Engineering Central Laboratory Mohakhali, Dhaka.
2.) Name: Taslima Akhter Designation: Sample Analyzer	28.08.18 Sample Analyzer DPHE, Central Laboratory Mohakhali, Dhaka.	2.) Name: Designation:	

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Lab Memo: 966/ CC, DPHE, CL, Dhaka. Date: 28-08-2018

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: CEN2018080015	Sample Receiving date: 17-05-2018
Ref. Memo No: 42.06.2626.119.37.001.18-0771 & Dated: 17-05-2018	Sample Source: Suface Water
Sent by:Engr. Md Waji Ullah ,Executive Director , CEGIS, Gulshan-1, Dhaka-1212.	Dist:Bagerhat, Upa:Rampal
Care Taker: CEGIS (SW-05)	Union:, Vill.:
Sample Collection date: 09-05-2018	Date of Testing: 17/05/2018--25/07/2018

LABORATORY TEST RESULTS:

Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Arsenic (As)	0.05	0.001	mg/L	AAS	0.001
2	Cadmium (Cd)	0.005	0.0003	mg/L	AAS	0.00015
3	Chemical Oxygen Demand (COD)	4.0	254	mg/L	CRM	-
4	Cr (Total)	0.05	0.036	mg/L	AAS	0.0003
5	Hardness	200-500	1040	mg/L	Titrimetic	-
6	Lead (Pb)	0.05	0.003	mg/L	AAS	0.001
7	Nitrogen (Nitrate)	10.0	5.2	mg/L	UVS	0.10
8	Phosphate	6.0	0.34	mg/L	UVS	-
9	Sulphate	400	1200	mg/L	UVS	1.0
10	Total Dissolved Solid (TDS)	1000	14450	mg/L	Multimeter	-
11	Total Suspended Solid (TSS)	10	19	mg/L	Gravity Multimeter	-

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

Test Performed by:	Signature	Countersigned/Approved by:	Signature
1.) Name: Mahabuba Sabina Motin ✓ Designation: Sample Analyzer	28.08.18	1.) Name: Md. Biplab Hossain Designation: Chief Chemist	B.Hossain 28/08/2018 Md. Biplab Hossain Chief Chemist Department of Public Health Engineering Central Laboratory Mohakhali, Dhaka.
2.) Name: Taslima Akhter Designation: Sample Analyzer	28.08.18	2.) Name: Designation:	

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Lab Memo: 966/ CC, DPHE, CL, Dhaka. Date: 28-08-2018

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: CEN2018080016	Sample Receiving date: 17-05-2018
Ref. Memo No: 42.06.2626.119.37.001.18-0771 & Dated: 17-05-2018	Sample Source: Suface Water
Sent by:Engr. Md Waji Ullah ,Executive Director , CEGIS, Gulshan-1, Dhaka-1212.	Dist:Bagerhat, Upa:Rampal
Care Taker: CEGIS (SW-06)	Union:, Vill.:
Sample Collection date: 09-05-2018	Date of Testing: 17/05/2018--25/07/2018

LABORATORY TEST RESULTS:

Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Arsenic (As)	0.05	0.002	mg/L	AAS	0.001
2	Cadmium (Cd)	0.005	0.0002	mg/L	AAS	0.00015
3	Chemical Oxygen Demand (COD)	4.0	252	mg/L	CRM	-
4	Cr (Total)	0.05	0.024	mg/L	AAS	0.0003
5	Hardness	200-500	1085	mg/L	Titrimetic	-
6	Lead (Pb)	0.05	0.001	mg/L	AAS	0.001
7	Nitrogen (Nitrate)	10.0	5.5	mg/L	UVS	0.10
8	Phosphate	6.0	0.27	mg/L	UVS	-
9	Sulphate	400	1400	mg/L	UVS	1.0
10	Total Dissolved Solid (TDS)	1000	14540	mg/L	Multimeter	-
11	Total Suspended Solid (TSS)	10	21	mg/L	Gravity Multimeter	-

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

Test Performed by:	Signature	Countersigned/Approved by:	Signature
1.) Name: Mahabuba Sabina Motin ✓ Designation: Sample Analyzer	28.08.18	1.) Name: Md. Biplab Hossain Designation: Chief Chemist	B.Hossain 28/08/2018 Md. Biplab Hossain Chief Chemist Department of Public Health Engineering Central Laboratory Mohakhali, Dhaka.
2.) Name: Taslima Akhter Designation: Sample Analyzer	28.08.18	2.) Name: Designation:	

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Lab Memo: 966/ CC, DPHE, CL, Dhaka.   Date: 28-08-2018

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: CEN2018080017	Sample Receiving date: 17-05-2018
Ref. Memo No: 42.06.2626.119.37.001.18-0771 & Dated: 17-05-2018	Sample Source: Suface Water
Sent by:Engr. Md Waji Ullah ,Executive Director , CEGIS, Gulshan-1, Dhaka-1212.	Dist:Bagerhat, Upa:Rampal
Care Taker: CEGIS (SW-07)	Union:, Vill.:
Sample Collection date: 09-05-2018	Date of Testing: 17/05/2018-25/07/2018

LABORATORY TEST RESULTS:

Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Arsenic (As)	0.05	0.002	mg/L	AAS	0.001
2	Cadmium (Cd)	0.005	0.0002	mg/L	AAS	0.00015
3	Calcium (Ca)	75	642	mg/L	AAS	0.17
4	Chemical Oxygen Demand (COD)	4.0	212	mg/L	CRM	-
5	Chloride	150-600	8125	mg/L	Titrimetic	-
6	Silica (Sio2)	0.0	26	mg/L	UVS	-
7	Bi-Carbonate (HCO3-)	0.0	140	mg/L	Titrimetic	-
8	Cr (Total)	0.05	0.027	mg/L	AAS	0.0003
9	Hardness	200-500	1080	mg/L	Titrimetic	-
10	Iron (Fe)	0.3-1	7.05	mg/L	AAS	0.05
11	Lead (Pb)	0.05	0.007	mg/L	AAS	0.001
12	Magnesium (Mg)	30-35	194	mg/L	AAS	0.05
13	Nitrogen (Nitrate)	10.0	2.6	mg/L	UVS	0.10
14	Phosphate	6.0	0.29	mg/L	UVS	-
15	Potassium (K)	12.0	65	mg/L	AAS	-
16	Sodium (Na)	200	2527	mg/L	AAS	0.34
17	Sulphate	400	1300	mg/L	UVS	1.0
18	Total Dissolved Solid (TDS)	1000	14400	mg/L	Multimeter	-
19	Total Suspended Solid (TSS)	10	17	mg/L	Gravity Multimeter	-
20	Turbidity	10	271	NTU	Turbidity Meter	-
21	Carbonate (CO3)	-	0.656	mg/L	Titrimetic	-

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

BHossain

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

Test Performed by:	Signature	Countersigned/Approved by:	Signature
1.) Name: Mahabuba Sabina Motin Designation: Sample Analyzer	28.08.18	1.) Name: Md. Biplab Hossain Designation: Chief Chemist	BHossain 28/08/2018 Md. Biplab Hossain Chief Chemist Department of Public Health Engineering Central Laboratory Mohakhali, Dhaka.
2.) Name: Taslima Akhter Designation: Sample Analyzer	28.08.18 Sample Analyzer DPHE, Central Laboratory Mohakhali, Dhaka.	2.) Name: Designation:	

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Lab Memo: 966/ CC, DPHE, CL, Dhaka.

Date: 28-08-2018

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: CEN2018080018	Sample Receiving date: 17-05-2018
Ref. Memo No: 42.06.2626.119.37.001.18-0771 & Dated: 17-05-2018	Sample Source: Suface Water
Sent by:Engr. Md Waji Ullah ,Executive Director , CEGIS, Gulshan-1, Dhaka-1212.	Dist:Bagerhat, Upa:Rampal
Care Taker: CEGIS (SW-08)	Union:, Vill.:
Sample Collection date: 09-05-2018	Date of Testing: 17/05/2018--25/07/2018

LABORATORY TEST RESULTS:

Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Arsenic (As)	0.05	0.001	mg/L	AAS	0.001
2	Cadmium (Cd)	0.005	0.0002	mg/L	AAS	0.00015
3	Chemical Oxygen Demand (COD)	4.0	218	mg/L	CRM	-
4	Cr (Total)	0.05	0.019	mg/L	AAS	0.0003
5	Hardness	200-500	1110	mg/L	Titrimetic	-
6	Lead (Pb)	0.05	0.003	mg/L	AAS	0.001
7	Nitrogen (Nitrate)	10.0	4.5	mg/L	UVS	0.10
8	Phosphate	6.0	0.29	mg/L	UVS	-
9	Sulphate	400	1380	mg/L	UVS	1.0
10	Total Dissolved Solid (TDS)	1000	14500	mg/L	Multimeter	-
11	Total Suspended Solid (TSS)	10	19	mg/L	Gravity Multimeter	-

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

Test Performed by:	Signature	Countersigned/Approved by:	Signature
1.) Name: Mahabuba Sabina Motin Designation: Sample Analyzer	28.08.18	1.) Name: Md. Biplab Hossain Designation: Chief Chemist	28/08/2018 Md. Biplab Hossain Chief Chemist Department of Public Health Engineering Central Laboratory Mohakhali, Dhaka.
2.) Name: Taslima Akhter Designation: Sample Analyzer	28.08.18	2.) Name: Designation:	

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Lab Memo: 966/ CC, DPHE, CL, Dhaka.

Date: 28-08-2018

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: CEN2018080019	Sample Receiving date: 17-05-2018
Ref. Memo No: 42.06.2626.119.37.001.18-0771 & Dated: 17-05-2018	Sample Source: Suface Water
Sent by:Engr. Md Waji Ullah ,Executive Director , CEGIS, Gulshan-1, Dhaka-1212.	Dist:Bagerhat, Upa:Rampal
Care Taker: CEGIS (SW-09)	Union:, Vill.:
Sample Collection date: 09-05-2018	Date of Testing: 17/05/2018--25/07/2018

LABORATORY TEST RESULTS:

Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Arsenic (As)	0.05	0.001	mg/L	AAS	0.001
2	Cadmium (Cd)	0.005	0.0002	mg/L	AAS	0.00015
3	Chemical Oxygen Demand (COD)	4.0	230	mg/L	Multi Meter	-
4	Cr (Total)	0.05	0.011	mg/L	AAS	0.0003
5	Hardness	200-500	1100	mg/L	Titrimetic	-
6	Lead (Pb)	0.05	0.005	mg/L	AAS	0.001
7	Nitrogen (Nitrate)	10.0	5.3	mg/L	UVS	0.10
8	Phosphate	6.0	0.42	mg/L	UVS	-
9	Sulphate	400	1240	mg/L	UVS	1.0
10	Total Dissolved Solid (TDS)	1000	14610	mg/L	Multimeter	-
11	Total Suspended Solid (TSS)	10	18	mg/L	Gravity Multimeter	-

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

Test Performed by:	Signature	Countersigned/Approved by:	Signature
1.) Name: Mahabuba Sabina Motin Designation: Sample Analyzer	28.08.18	1.) Name: Md. Biplab Hossain Designation: Chief Chemist	28/08/2018 Md. Biplab Hossain Chief Chemist Department of Public Health Engineering Central Laboratory Mohakhali, Dhaka.
2.) Name: Taslima Akhter Designation: Sample Analyzer	28.08.18	2.) Name: Designation:	

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Lab Memo: 966/ CC, DPHE, CL, Dhaka. Date: 28-08-2018

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: CEN2018080020	Sample Receiving date: 17-05-2018
Ref. Memo No: 42.06.2626.119.37.001.18-0771 & Dated: 17-05-2018	Sample Source: Suface Water
Sent by:Engr. Md Waji Ullah ,Executive Director , CEGIS, Gulshan-1, Dhaka-1212.	Dist:Bagerhat, Upa:Rampal
Care Taker: CEGIS (SW-10)	Union:, Vill.:
Sample Collection date: 09-05-2018	Date of Testing: 17/05/2018--25/07/2018

LABORATORY TEST RESULTS:

Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Arsenic (As)	0.05	0.002	mg/L	AAS	0.001
2	Cadmium (Cd)	0.005	0.0003	mg/L	AAS	0.00015
3	Chemical Oxygen Demand (COD)	4.0	180	mg/L	CRM	-
4	Cr (Total)	0.05	0.014	mg/L	AAS	0.0003
5	Hardness	200-500	1300	mg/L	Titrimetic	-
6	Lead (Pb)	0.05	0.002	mg/L	AAS	0.001
7	Nitrogen (Nitrate)	10.0	5.9	mg/L	UVS	0.10
8	Phosphate	6.0	0.24	mg/L	UVS	-
9	Sulphate	400	1200	mg/L	UVS	1.0
10	Total Dissolved Solid (TDS)	1000	14160	mg/L	Multimeter	-
11	Total Suspended Solid (TSS)	10	23	mg/L	Gravity Multimeter	-

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

Test Performed by:	Signature	Countersigned/Approved by:	Signature
1.) Name: Mahabuba Sabina Motin Designation: Sample Analyzer	28.08.18	1.) Name: Md. Biplab Hossain Designation: Chief Chemist	28/08/2018 Md. Biplab Hossain Chief Chemist Department of Public Health Engineering Central Laboratory Mohakhali, Dhaka.
2.) Name: Taslima Akhter Designation: Sample Analyzer	28.08.18 Sample Analyzer DPHE, Central Laboratory Mohakhali, Dhaka.	2.) Name: Designation:	

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

Lab Memo: 966/ CC, DPHE, CL, Dhaka. Date: 28-08-2018

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: CEN2018080021	Sample Receiving date: 17-05-2018
Ref. Memo No: 42.06.2626.119.37.001.18-0771 & Dated: 17-05-2018	Sample Source: Suface Water
Sent by:Engr. Md Waji Ullah ,Executive Director , CEGIS, Gulshan-1, Dhaka-1212.	Dist:Bagerhat, Upa:Rampal
Care Taker: CEGIS (SW-11)	Union:, Vill.:
Sample Collection date: 09-05-2018	Date of Testing: 17/05/2018--25/07/2018

LABORATORY TEST RESULTS:

Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Arsenic (As)	0.05	0.001	mg/L	AAS	0.001
2	Cadmium (Cd)	0.005	0.0002	mg/L	AAS	0.00015
3	Chemical Oxygen Demand (COD)	4.0	252	mg/L	CRM	-
4	Cr (Total)	0.05	0.008	mg/L	AAS	0.0003
5	Hardness	200-500	1120	mg/L	Titrimetic	-
6	Lead (Pb)	0.05	0.003	mg/L	AAS	0.001
7	Nitrogen (Nitrate)	10.0	3.9	mg/L	UVS	0.10
8	Phosphate	6.0	0.28	mg/L	UVS	-
9	Sulphate	400	1250	mg/L	UVS	1.0
10	Total Dissolved Solid (TDS)	1000	14450	mg/L	Multimeter	-
11	Total Suspended Solid (TSS)	10	32	mg/L	Gravity Multimeter	-

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

Test Performed by:	Signature	Countersigned/Approved by:	Signature
1.) Name: Mahabuba Sabina Motin Designation: Sample Analyzer	28.08.18	1.) Name: Md. Biplab Hossain Designation: Chief Chemist	28/08/2018 Md. Biplab Hossain Chief Chemist Department of Public Health Engineering Central Laboratory Mohakhali, Dhaka.
2.) Name: Taslima Akhter Designation: Sample Analyzer	28.08.18 Sample Analyzer DPHE, Central Laboratory Mohakhali, Dhaka.	2.) Name: Designation:	

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Lab Memo: 966/ CC, DPHE, CL, Dhaka. Date: 28-08-2018

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: CEN2018080022	Sample Receiving date: 17-05-2018
Ref. Memo No: 42.06.2626.119.37.001.18-0771 & Dated: 17-05-2018	Sample Source: Suface Water
Sent by:Engr. Md Waji Ullah ,Executive Director , CEGIS, Gulshan-1, Dhaka-1212.	Dist:Bagerhat, Upa:Rampal
Care Taker: CEGIS (SW-12)	Union:, Vill.:
Sample Collection date: 09-05-2018	Date of Testing: 17/05/2018--25/07/2018

LABORATORY TEST RESULTS:

Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Arsenic (As)	0.05	0.002	mg/L	AAS	0.001
2	Cadmium (Cd)	0.005	0.0002	mg/L	AAS	0.00015
3	Chemical Oxygen Demand (COD)	4.0	260	mg/L	CRM	-
4	Cr (Total)	0.05	0.006	mg/L	AAS	0.0003
5	Hardness	200-500	1410	mg/L	Titrimetic	-
6	Lead (Pb)	0.05	0.002	mg/L	AAS	0.001
7	Nitrogen (Nitrate)	10.0	4.7	mg/L	UVS	0.10
8	Phosphate	6.0	0.37	mg/L	UVS	-
9	Sulphate	400	1260	mg/L	UVS	1.0
10	Total Dissolved Solid (TDS)	1000	14500	mg/L	Multimeter	-
11	Total Suspended Solid (TSS)	10	14	mg/L	Gravity Multimeter	-

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

Test Performed by:	Signature	Countersigned/Approved by:	Signature
1.) Name: Mahabuba Sabina Motin Designation: Sample Analyzer	28.08.18	1.) Name: Md. Biplab Hossain Designation: Chief Chemist	BHossain 28/08/2018 Md. Biplab Hossain Chief Chemist Department of Public Health Engineering Central Laboratory Mohakhali, Dhaka.
2.) Name: Taslima Akhter Designation: Sample Analyzer	28.08.18 Sample Analyzer DPHE, Central Laboratory Mohakhali, Dhaka.	2.) Name: Designation:	

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Lab Memo: 966/ CC, DPHE, CL, Dhaka. Date: 28-08-2018

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: CEN2018080023	Sample Receiving date: 17-05-2018
Ref. Memo No: 42.06.2626.119.37.001.18-0771 & Dated: 17-05-2018	Sample Source: Suface Water
Sent by:Engr. Md Waji Ullah ,Executive Director , CEGIS, Gulshan-1, Dhaka-1212.	Dist:Bagerhat, Upa:Rampal
Care Taker: CEGIS (SW-13)	Union:, Vill.:
Sample Collection date: 09-05-2018	Date of Testing: 17/05/2018--25/07/2018

LABORATORY TEST RESULTS:

Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Arsenic (As)	0.05	0.001	mg/L	AAS	0.001
2	Cadmium (Cd)	0.005	0.0003	mg/L	AAS	0.00015
3	Chemical Oxygen Demand (COD)	4.0	280	mg/L	CRM	-
4	Cr (Total)	0.05	0.009	mg/L	AAS	0.0003
5	Hardness	200-500	1330	mg/L	Titrimetic	-
6	Lead (Pb)	0.05	0.003	mg/L	AAS	0.001
7	Nitrogen (Nitrate)	10.0	5.2	mg/L	UVS	0.10
8	Phosphate	6.0	0.26	mg/L	UVS	-
9	Sulphate	400	1300	mg/L	UVS	1.0
10	Total Dissolved Solid (TDS)	1000	15350	mg/L	Multimeter	-
11	Total Suspended Solid (TSS)	10	15	mg/L	Gravity Multimeter	-

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

Test Performed by:	Signature	Countersigned/Approved by:	Signature
1.) Name: Mahabuba Sabina Motin Designation: Sample Analyzer	28.08.18	1.) Name: Md. Biplab Hossain Designation: Chief Chemist	BHossain 28/08/2018 Md. Biplab Hossain Chief Chemist Department of Public Health Engineering Central Laboratory Mohakhali, Dhaka.
2.) Name: Taslima Akhter Designation: Sample Analyzer	28.08.18 Sample Analyzer DPHE, Central Laboratory Mohakhali, Dhaka.	2.) Name: Designation:	

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Lab Memo: 966/ CC, DPHE, CL, Dhaka. Date: 28-08-2018

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: CEN2018080024	Sample Receiving date: 17-05-2018
Ref. Memo No: 42.06.2626.119.37.001.18-0771 & Dated: 17-05-2018	Sample Source: Suface Water
Sent by:Engr. Md Waji Ullah ,Executive Director , CEGIS, Gulshan-1, Dhaka-1212.	Dist:Bagerhat, Upa:Rampal
Care Taker: CEGIS (SW-14)	Union:, Vill.:
Sample Collection date: 09-05-2018	Date of Testing: 17/05/2018--25/07/2018

LABORATORY TEST RESULTS:

Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Arsenic (As)	0.05	0.002	mg/L	AAS	0.001
2	Cadmium (Cd)	0.005	0.00018	mg/L	AAS	0.00015
3	Chemical Oxygen Demand (COD)	4.0	296	mg/L	CRM	-
4	Cr (Total)	0.05	0.013	mg/L	AAS	0.0003
5	Hardness	200-500	1440	mg/L	Titrimetic	-
6	Lead (Pb)	0.05	0.001	mg/L	AAS	0.001
7	Nitrogen (Nitrate)	10.0	5.5	mg/L	UVS	0.10
8	Phosphate	6.0	0.20	mg/L	UVS	-
9	Sulphate	400	1460	mg/L	UVS	1.0
10	Total Dissolved Solid (TDS)	1000	20600	mg/L	Multimeter	-
11	Total Suspended Solid (TSS)	10	18	mg/L	Gravity Multimeter	-

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

Test Performed by:	Signature	Countersigned/Approved by:	Signature
1.) Name: Mahabuba Sabina Motin Designation: Sample Analyzer	28.08.18	1.) Name: Md. Biplab Hossain Designation: Chief Chemist	BHossain 28/08/2018 Md. Biplab Hossain Chief Chemist Department of Public Health Engineering Central Laboratory Mohakhali, Dhaka.
2.) Name: Taslima Akhter Designation: Sample Analyzer	28.08.18 Sample Analyzer DPHE, Central Laboratory Mohakhali, Dhaka.	2.) Name: Designation:	

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Lab Memo: 966/ CC, DPHE, CL, Dhaka. Date: 28-08-2018

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: CEN2018080025	Sample Receiving date: 17-05-2018
Ref. Memo No: 42.06.2626.119.37.001.18-0771 & Dated: 17-05-2018	Sample Source: Tube Well
Sent by:Engr. Md Waji Ullah ,Executive Director , CEGIS, Gulshan-1, Dhaka-1212.	Dist:Bagerhat, Upa:Rampal
Care Taker: CEGIS (TW-01)	Union:, Vill.:Kapashdanga
Sample Collection date: 09-05-2018	Date of Testing: 17/05/2018--25/07/2018

LABORATORY TEST RESULTS:

Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Arsenic (As)	0.05	0.004	mg/L	AAS	0.001
2	Chemical Oxygen Demand (COD)	4.0	4	mg/L	CRM	-
3	Hardness	200-500	215	mg/L	Titrimetic	-
4	Lead (Pb)	0.05	0.001	mg/L	AAS	0.001
5	Nitrogen (Nitrate)	10.0	5.7	mg/L	UVS	0.10
6	Phosphate	6.0	0.27	mg/L	UVS	-
7	Sulphate	400	4	mg/L	UVS	1.0
8	Total Dissolved Solid (TDS)	1000	370	mg/L	Multimeter	-
9	Total Suspended Solid (TSS)	10	5	mg/L	Gravity Multimeter	-

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

Test Performed by:	Signature	Countersigned/Approved by:	Signature
1.) Name: Mahabuba Sabina Motin Designation: Sample Analyzer	28.08.18	1.) Name: Md. Biplab Hossain Designation: Chief Chemist	BHossain 28/08/2018 Md. Biplab Hossain Chief Chemist Department of Public Health Engineering Central Laboratory Mohakhali, Dhaka.
2.) Name: Taslima Akhter Designation: Sample Analyzer	28.08.18 Sample Analyzer DPHE, Central Laboratory Mohakhali, Dhaka.	2.) Name: Designation:	

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

Lab Memo: 966/ CC, DPHE, CL, Dhaka.

Date: 28-08-2018

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: CEN2018080026	Sample Receiving date: 17-05-2018
Ref. Memo No: 42.06.2626.119.37.001.18-0771 & Dated: 17-05-2018	Sample Source: Tube Well
Sent by:Engr. Md Waji Ullah ,Executive Director , CEGIS, Gulshan-1, Dhaka-1212.	Dist:Bagerhat, Upa:Rampal
Care Taker: CEGIS (TW-02)	Union:, Vill.:Rajnagar
Sample Collection date: 09-05-2018	Date of Testing: 17/05/2018--25/07/2018

LABORATORY TEST RESULTS:

Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Arsenic (As)	0.05	0.012	mg/L	AAS	0.001
2	Chemical Oxygen Demand (COD)	4.0	4	mg/L	CRM	-
3	Hardness	200-500	195	mg/L	Titrimetic	-
4	Lead (Pb)	0.05	0.001	mg/L	AAS	0.001
5	Nitrogen (Nitrate)	10.0	5.3	mg/L	UVS	0.10
6	Phosphate	6.0	4.5	mg/L	UVS	-
7	Sulphate	400	2	mg/L	UVS	1.0
8	Total Dissolved Solid (TDS)	1000	615	mg/L	Multimeter	-
9	Total Suspended Solid (TSS)	10	12	mg/L	Gravity Multimeter	-

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

Test Performed by:	Signature	Countersigned/Approved by:	Signature
1.) Name: Mahabuba Sabina Motin Designation: Sample Analyzer	28.08.18	1.) Name: Md. Biplab Hossain Designation: Chief Chemist	28/08/2018 Md. Biplab Hossain Chief Chemist Department of Public Health Engineering Central Laboratory Mohakhali, Dhaka.
2.) Name: Taslima Akhter Designation: Sample Analyzer	28.08.18 Sample Analyzer DPHE, Central Laboratory Mohakhali, Dhaka.	2.) Name: Designation:	

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Air quality monitoring Data

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

AECL LABORATORY ANALYSIS REPORT
AMBIENT AIR QUALITY TEST REPORT

Memo # AECL : AECL - 671
Subject : Ambient air Quality analysis for Environmental Monitoring of Khulna 1320 MW CBTPP
Project Location : Rampal, Bagherhat.

Description of sample : Ambient air quality analysis report at different locations.
Sample collector : Adroit Environment Consultants Ltd. (Monitoring Team).
Sampling date : 20th July to 1st August, 2018
Reporting date : 14th August, 2018

Sampling locations ID and Name with Longitude-Latitude:

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

1/2

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

Description of analysis:

Experiment Date	Sample Location ID	Concentration present of different parameter in ambient air (µg/m³)							Remarks
		$PM_{2.5}$	PM_{10}	SPM	SO_2	NO_x	CO	O_3	
20-21/07/2018	SL1	13.7	60.8	98.1	8.4	9.0	32	04	Good.
21/07/2018	SL2	20.9	83.7	106.2	10.9	13.4	34	07	Good
22/07/2018	SL3	15.2	50.7	94.7	10.4	11.0	29	09	Good
23/07/2018	SL4	10.2	30.6	78.6	7.5	8.4	23	04	Good
24/07/2018	SL 5	12.9	44.3	76.3	5.8	5.9	21	06	Good
25/07/2018	SL 6	13.2	47.5	73.7	6.5	7.2	20	01	Good
26/07/2018	SL 7	11.4	24.3	47.6	4.9	5.4	20	06	Good.
28/07/2018	SL 8	14.0	41.6	58.0	6.3	9.3	25	04	Good.
27/07/2018	SL-9	11.1	58.4	98.4	9.4	12.1	29	08	Good.
29/07/2018	SL10	15.8	64.4	113.4	10.8	13.1	25	08	Good.
30/07/2018	SL11	11.9	20.5	50.2	6.1	7.4	20	06	Good.
01/08/2018	SL12	12.5	45.4	69.9	7.5	11.1	28	07	Good.
Units		µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	ppb	
Test Duration (Hours)		8	8	8	8	8	8	8	
Method of Analysis		Gravimetric	Gravimetric	Gravimetric	West-Gaeke	Jacob and Hochheiser	CO Meter	O_3 Meter	
Bangladesh (DoE) Standard for ambient Air		65	150	200	365	100	10,000	157	
IFC/WB Standard		75	150	NF	125	200	NF	160	

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

Terminology:

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

Weather Condition: The weather varied from sunny to light raining & cloudiness.

14.08.2018
Nigar Sultana
Sr. Chemist

19.08.2018
Saiful Islam
Sr. Environmental Engineer

Muhammad Zulfiker Noman
Chief Operating Officer.

2/2

Soil analysis result

Government of the People's Republic of Bangladesh
Soil Resource Development Institute
Regional Laboratory
Krishi Khamar Sarak, Dhaka-1215

Result : 15 analyzed soil samples
Project Name : Proposed Coal Based Power Plant Rampal
Ref : 42.06.2626.119.37.001.18-0774

Lab no.	Sample no.	EC ds/m	pH	OM	N	K	Ca	Mg	Na
				%		Meq/100g			
1121	Baran para 1	6.50	6.6	1.85	0.09	0.60	14.72	2.39	5.75
1122	Baran para 2	6.89	7.0	1.50	0.08	0.54	12.03	2.12	6.40
1123	Baran para 3	7.72	7.4	1.46	0.07	0.52	12.48	2.80	7.78
1124	Chunkuri-2 4	7.33	6.4	1.95	0.10	0.73	12.15	2.35	7.07
1125	Chunkuri-2 5	7.85	7.1	1.66	0.08	0.78	16.58	2.89	7.19
1126	Chunkuri-2 6	8.05	7.4	1.22	0.06	0.70	12.90	3.40	7.41
1127	Basherhula 7	6.72	7.3	2.00	0.10	0.90	15.59	3.65	5.80
1128	Basherhula 8	7.31	8.1	1.45	0.07	0.78	13.87	3.53	6.72
1129	Basherhula 9	7.50	8.2	1.12	0.06	0.84	13.33	3.77	6.93
1130	Chakgona 10	7.33	8.0	2.15	0.11	0.88	15.11	3.92	6.14
1131	Chakgona 11	8.11	8.8	1.79	0.09	0.81	15.95	4.17	6.65
1132	Chakgona 12	8.59	8.8	1.23	0.06	0.73	16.49	4.00	6.82
1133	Kapalirmet 13	7.92	8.2	2.09	0.10	0.82	11.49	2.64	7.43
1134	Kapalirmet 14	8.60	8.5	1.50	0.08	0.79	15.95	3.95	8.32
1135	Kapalirmet 15	8.74	8.7	1.25	0.06	0.94	16.73	4.33	8.54

05/08/18

Cont'd

Result : 15 analyzed soil samples
Project Name : Proposed Coal Based Power Plant Rampal
Ref : 42.06.2626.119.37.001.18-0774

Lab no.	Sample no.	P	S	B	Fe	Mn	Zn	Pb	Cd
		µg/g							
1121	Baran para 1	6.20	205.11	1.78	38.54	9.88	3.05	18.67	0.31
1122	Baran para 2	4.98	214.25	1.10	29.12	7.79	2.19	15.58	0.05
1123	Baran para 3	4.40	235.85	1.25	44.33	6.45	1.87	16.74	0.00
1124	Chunkuri-2 4	7.75	515.35	1.63	51.44	8.97	4.11	14.33	0.43
1125	Chunkuri-2 5	6.69	320.11	1.29	55.20	9.18	3.22	15.59	0.10
1126	Chunkuri-2 6	6.45	295.12	1.25	68.69	7.54	2.57	14.11	0.00
1127	Basherhula 7	6.23	595.18	1.30	50.09	6.23	2.56	14.58	0.15
1128	Basherhula 8	7.00	635.29	1.19	49.10	6.25	2.49	13.12	0.00
1129	Basherhula 9	9.48	475.47	1.45	42.13	6.19	1.85	12.57	0.00
1130	Chakgona 10	9.87	851.22	1.77	42.17	7.34	2.86	13.02	0.22
1131	Chakgona 11	8.25	905.44	1.21	47.71	7.59	2.00	12.16	0.00
1132	Chakgona 12	11.09	695.78	1.18	68.21	6.55	1.89	12.10	0.00
1133	Kapalirmet 13	6.11	690.58	1.57	49.05	8.99	3.30	9.18	0.26
1134	Kapalirmet 14	6.00	715.33	1.99	54.11	7.10	2.45	8.05	0.00
1135	Kapalirmet 15	5.12	699.11	1.72	41.32	7.54	2.79	7.98	0.00

05/08/18

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Regional Laboratory
Krishi Khamar Sarak, Dhaka-1215

Result : 15 analyzed soil samples
Project Name : Proposed Coal Based Power Plant Rampal
Ref : 42.06.2626.119.37.001.18-0774

Lab no.	Sample no.	EC ds/m	pH	OM	N	K	Ca	Mg	Na
				%		Meq/100g			
1121	Baran para 1	6.50	6.6	1.85	0.09	0.60	14.72	2.39	5.75
1122	Baran para 2	6.89	7.0	1.50	0.08	0.54	12.03	2.12	6.40
1123	Baran para 3	7.72	7.4	1.46	0.07	0.52	12.48	2.80	7.78
1124	Chunkuri-2 4	7.33	6.4	1.95	0.10	0.73	12.15	2.35	7.07
1125	Chunkuri-2 5	7.85	7.1	1.66	0.08	0.78	16.58	2.89	7.19
1126	Chunkuri-2 6	8.05	7.4	1.22	0.06	0.70	12.90	3.40	7.41
1127	Basherhula 7	6.72	7.3	2.00	0.10	0.90	15.59	3.65	5.80
1128	Basherhula 8	7.31	8.1	1.45	0.07	0.78	13.87	3.53	6.72
1129	Basherhula 9	7.50	8.2	1.12	0.06	0.84	13.33	3.77	6.93
1130	Chakgona 10	7.33	8.0	2.15	0.11	0.88	15.11	3.92	6.14
1131	Chakgona 11	8.11	8.8	1.79	0.09	0.81	15.95	4.17	6.65
1132	Chakgona 12	8.59	8.8	1.23	0.06	0.73	16.49	4.00	6.82
1133	Kapalirmet 13	7.92	8.2	2.09	0.10	0.82	11.49	2.64	7.43
1134	Kapalirmet 14	8.60	8.5	1.50	0.08	0.79	15.95	3.95	8.32
1135	Kapalirmet 15	8.74	8.7	1.25	0.06	0.94	16.73	4.33	8.54

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1122	Baran para 2	6.89	7.0	1.50	0.08	0.54	12.03	2.12	6.40
1123	Baran para 3	7.72	7.4	1.46	0.07	0.52	12.48	2.80	7.78
1124	Chunkuri-2 4	7.33	6.4	1.95	0.10	0.73	12.15	2.35	7.07
1125	Chunkuri-2 5	7.85	7.1	1.66	0.08	0.78	16.58	2.89	7.19
1126	Chunkuri-2 6	8.05	7.4	1.22	0.06	0.70	12.90	3.40	7.41
1127	Basherhula 7	6.72	7.3	2.00	0.10	0.90	15.59	3.65	5.80
1128	Basherhula 8	7.31	8.1	1.45	0.07	0.78	13.87	3.53	6.72
1129	Basherhula 9	7.50	8.2	1.12	0.06	0.84	13.33	3.77	6.93
1130	Chakgona 10	7.33	8.0	2.15	0.11	0.88	15.11	3.92	6.14
1131	Chakgona 11	8.11	8.8	1.79	0.09	0.81	15.95	4.17	6.65
1132	Chakgona 12	8.59	8.8	1.23	0.06	0.73	16.49	4.00	6.82
1133	Kapalirmet 13	7.92	8.2	2.09	0.10	0.82	11.49	2.64	7.43
1134	Kapalirmet 14	8.60	8.5	1.50	0.08	0.79	15.95	3.95	8.32
1135	Kapalirmet 15	8.74	8.7	1.25	0.06	0.94	16.73	4.33	8.54