Bangladesh – India Friendship Power Company (Pvt.) Limited

(A joint Venture of NTPC Ltd and BPDB)

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

15th Quarter Monitoring Report

Monitoring Period: November 2017 - January 2018

March 2018

CEGIS Center for Environmental and Geographic Information Services

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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 Activities
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
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
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 quarterly (15th quarterly program) Environmental and Social Monitoring Report covers the status of different environmental and social parameters including environmental compliance related with monitoring in regard to the EMP of the construction stage as stated in the EIA (Environmental Impact Assessment) study. This report represents the monitoring period from November 2017 to January 2018. Accordingly, the CEGIS team has carried out the monitoring activities in January, 2018, comprising the monitoring of implementation of Environmental Management Plan (EMP) and Environmental Compliance with the environmental parameters such as ambient air quality, noise level, water quality, land resource condition, agricultural resources monitoring, fisheries resources monitoring which covers fish habitats, migration and production, social environment monitoring, ecosystem monitoring and the Sundarbans Reserve Forest health monitoring.

The status of environmental compliance in regard to the Environmental Management Plan (EMP) provided in the EIA during construction phase are assessed for effectiveness of the recommended mitigation measures and additional mitigation measures or remedial action associated with this Project Phase. The progress of Project construction activities includes appointment of EPC and sub-contractors, extention of roads and embankment, construction equipment aggregation, preparatory of civil and infrastructure development works, labour colony preparation etc. The Project Site office of BIFPCL has been shifted to the South-West corner of the project boundary and EPC contractor has set-up their offices inside the project boundary. 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. However, as per EMP (approved by DoE) and being the Environmental Monitoring Consultant, CEGIS intends to recommend few site specific measures which should be complied for ensuring environmental and social safeguarding for the Project, which include, raising awareness for using appropriate PPEs, recreation and sanitation facilities for the labours, safety signs in local language, proper implementation for the grievance redress mechanism for workers or local community, placement of sufficient waste disposal bins in appropriate locations etc.

Moreover, in the recent monitoring period, the EHS unit of BIFPCL has been found to be strengthened with appointment of a number of professionals. Moreover, the EPC also appointed OHAS expert for daily monitoring, training and regulating the EHS plan during construction stages of this project. All of the documents like Occupational Health and Safety Policies; Establishment of the grievance redress mechanism; Emergency preparedness and has response plan; fire prevention, protection and control plan; stakeholder engagement plan etc. have been finalized and employed professionals for addressing them in the current phase (Construction Phase). Moreover, Site-specific Fire and Safety Officer have also been appointed. However, proper of any accident/incident or any health hazard risk issues should be made recorded; preventive measures for near by accidental events and any unforeseeable injury, illness, or damage should be adopted; an officer responsible for enforcing and monitoring safety procedure needs to be appointed; Site specific ESMP have been prepared by the EPC contractors; Safety training program for the Project personnel and labour force should be continued.

All the preselected parameters i.e. particulate matters ($PM_{2.5}$, PM_{10} and SPM), O_3, CO, SOx and NOx) are measured at the preselected locations during this monitoring period. The concentrations of all the parameters were found within the standard limit set by ECR' 97 except for SPM, $PM_{2.5}$ and PM_{10} values at the Khan Jahan Ali Bridge area. The reason would be due to the movement of numerous types of vehicles on the roads. On the other hand, the land development activities around the sites, brickworks, wood stoves and wind-generated dust may contribute to the pollutant's concentration in this area. In addition, the presence of a large number of industries in the area may also have influence in increasing the pollutants concentration in this locality. On the contrary, large ships, barges, transshippers, engine boats and other motorized vehicles for fishing, honey collection, Golpata (Nipa palm) & timber collection and tourism business are currently contributing to the air pollution in and around the Sundarbans reserve forest area.

Noise generation sources can be divided into two types; one is natural and another one is anthropogenic. Natural sources observed are birds' chirping, stormy wind, wave breaking on the shoreline, howling of leaves and so on in the study area. On the other hand traffic mobilization, industrial activities, vessels movement within the rivers and local vehicles are the salient sources of anthropogenic noise. However, during this monitoring season (15th quarter); the observed noise level did not exceed the Bangladesh standard limit of noise level at any of the eleven locations. However, in the course of total fourteen monitoring seasons, it was found that the noise level of eight locations (Table 2.2.1) exceeded the Bangladesh standard limit for their corresponding standard value in their different monitoring seasons. These 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), Akram Point of Sundarbans (Apr-2015) and Hiron point of Sundarbans (July-2014). Any additional anthropogenic noise producing activities within the study area may contribute to enhance the ambient noise level for the corresponding locations.

The water samples were collected in this recent monitoring period of January 2018, from the preselected 18 locations (15 locations for surface water and 3 locations for ground water analysis). All samples were collected and tagged immediately maintaining the internationally recognized procedures. Later on, the samples were submitted to DPHE and BCSIR laboratory for chemical analysis of the selected parameters. This 15th quarterly monitoring report includes the laboratory reports of the 14th quarterly monitoring period (October, 2017) and in-situ monitoring results of the current quarterly monitoring period (15th quarterly monitoring program). The lab test results for the concurrent monitoring period could not be provided in this report as they are yet to be received from the respective organizations. Similar to the earlier results, spatial and seasonal variations were also observed in different parameters analysed in the later period. Howeverall parameters are well within the standard limit set by ECR' 1997 for both the surface water and groundwater.

Five mauzas (Baranpara, Chunkuri-2, Kapalirmet, Chakgona and Basherhula) within the 10 km radius of the power plant have been selected for monitoring of plot use, soil fertility/nutrient status, soil contamination with heavy metals and soil salinity. Soil samples have been collected from five locations at three depths (0-15 cm, 15-30 cm and 30-45 cm) in the month of April and October 2017 to know the status of the above said parameters. Collected samples were tested from Soil Resource Development Institute (SRDI), Dhaka. It was found from the laboratory analysis report (dry and wet season) that, the status of pH, OM, N, S, Ca, B and Fe

concentration was higher than the dry season in all locations. On the other hand, Ec, N, S, K, Mg, Zn, Na, Mn and Pb concentration showed lower concentration throught the dry season. Cd was not found in this wet season in any monitoring plots. It was also observed from the data that highest Ec (7.31) (ds/m) and pH (8.77) were found at Kapalirmet and Chakgona mauza respectively. Highest organic matter content (2.35%) was found in Kapalirmet mauza whereas highest macronutrients was found in Basherhula, Kapalirmet and Chakgona mauzas. The highest macro nutrients was found in Kapalirmet and Chunkuri-2 and Chakgona mauzas respectively. In contrary to that, the Mg level has decreased from the aforementioned period. Heavy metal concentrations were justified with the analytical results of soil with Indian standard of agricultural soil. The heavy metals analysis data, Pb and Cd was observed to be within the standard limit. The soil was slightly saline with the top soil having sufficient organic matter concentration. Macro and micro nutrient concentrations of the soils were also found sufficient, suggesting that the soil condition is good for supporting plant growth or crop production.

Fisheries resources have been monitored in the same locations for seven sampling sites as of earlier quarter monitoring. Habitat uses are observed to be changed yearly (as compare to the year of 2014-2015, of 2015-2016 and of 2017-18) and mainly caused 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) two types of habitats have been found which are: i) Grazing and feeding ground, ii) Nursing ground as same as found in the previous quarter monitoring. Shannon-Weiner index has also been observed to vary between 15th quarter with that of all previous quarter. Highest Shannon-Weiner index was found at Harbaria Khal (0.81) indicating most evenly distributed fish species. On the contrary, lowest evenness was found at Mongla-Passur Confluence (0.21). However, maximum FSR was obtained in Sheola Khal at Chandpai (n=7), while very low FSR was recorded at Mongla-Passur Confluence and Chalna Point (n=1). Fries for fin fish were widely being distributed among the upper stretches (Chalna Point to Mongla-Passur Confluence) and juveniles and adult age group in Sheola Khal at Chandpai and Harbaria Khal of the Passur River system. Among these Horina Chingri, Motka Chingri, Bele and Tit Punti fishes were more among these two sampling sites. Moreover, fries fishes were dominant at Maidhara and Mongla Point. However, brood female fish of Gagra Tengra was frequently observed at Harbaria Khal in this quarter. Fish species like Paissa and Bairagi attains the maximum abundance among the migratory fish species. Moreover, one (01) fish species was found common in most of the sites. This speciesalong with Bairagi was observed throughout the monitoring period indicating long range of distribution of such species in this area. In this monitoring year, no stocking was observed because of the completion phase of the year-round production cycle. The present study revealed that the highest catch susceptibility was found in case of Charpata Jal (31 kg/haul). Net Jal were most frequently used in all the upper reaches of Passur River System, especially for fry collection. Charpata Jal was commonly used in the middle reach of the Passur River. Moreover, the highest total catch was observed in Harbaria Khal while the lowest catch was found in in Mongla Point, Maidhara River Confluence, and Chalna Point in this monitoring phase.

Plant health, vegetation canopy status, lichen coverage, bird habitat, butterfly occurrences, dolphin occurrence in river systems have been monitored during this monitoring season. Plant heath have shown a deterioration trend than those of previous period. Overall canopy status of studied homestead vegetation has decreased than the same monitoring tier in January

2017 due to cutting of trees like *Excoecaria agallocha* at Rajnagar sites. Out of 8 wetlands, occurrence of migratory bird have been informed from only two sites and local migratory birds from five sites which denotes the occurrence site have increased but, changes of landuse caused negative change status of the aquatic birds. Only one local bird nest have been observed at Chalkghona site. Four species of butterfly have been recorded from two monitoring sites and Evening Brown, Grey Pansy, Peacock Pansy and small Grass Yellow were the other observed species. Dolphins have been sighted in both Passur and Maidar River an encounter rate of 0.27 and 0.36 individuals/km/hour respectively. Beside this, Ganges River Dolphin was also found at Passur River near Karamjal and Harbaria.

In summary of last monitoring activities, it can be predicted in terms of seedling density, pneumatophores, crab hole, canopy cover and leaf area index (m^2 leaf area/m^2 ground area) that the forest condition is showing positive changes periodically, with some seasonal effect. Regeneration rate has also been remarkably changed in the study area. Illicit felling occurs in Koromjol and Akram Point site. However, based on the above indicators it is found that the health condition at Akram Point is worse. This is due to the physiographic location of this site, which is facing high environmental stress. The Akram Point is situated at the confluence point of Shibsa and Passur Rivers. Therefore, during tidal inflow the forest floor carry large amount of soil sediment than other locations. The forest is experiencing retrogation process here, with decading of the climax species. Hence, this area is sensitive in terms of disturbance. From the field visit it is denoted that, the height of Sundari tree is comparatively higher at Harbaria. Goran species are moderately seen in Akram Point and Hiron Point. It is observed that trees at Koromjol, Hiron Point and Akrampoint are facing top dying. Some of the trees at these sites have found to be logged or Death.

Among the five monitoring plots, Baranpara, Chunkuri-2 and Basherhula plot owners were found to cultivate local Aman like Chapshail and Benapole rice in the Kharif-II season respectively. The existing cropping pattern found during monitoring period (14th monitoring period) is Fallow-Local Aman-Fallow in three monitoring plots out of five. The rest two monitoring plots (Kapalirmet and Chakgona) remained fallow due to salinity problem. The highest rice production (2.2 tons) has been observed in monitoring agriculture plot-2 (Chunkuri-2) and the lowest (0.9 tons) in monitoring agricultural plot-1(Baranpara), because all the monitoring plots cultivated Local Aman in 2017-18 during 15th monitoring period when no crop damage is noticed in any monitoring plot.

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. Among the total 150 informal settlers, eighteen were primarily resettled to Foyla cluster village. But, eight of those shifted households left the shelter village due to lack of their potential sources of livelihood in that area and the remaining are badly trying to seek sustainable working opportunity. While starting the major construction works; employment opportunity of local labor can be drastically increased which may 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, none of any 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 under construction. These facilities are developed following international standards. Labors of Dipon Group have already used these facilities as most of their working labors have been migrated from others. Consciousness of using personal protective equipments 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. About 2,653 people received health treatments over the last three months (November, 2017 to January, 2018) which was 2,426 in the earlier phase of monitoring. 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

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

2. As per scope of the EIA study, a detailed Environmental Management Plan (EMP) has been developed suggesting mitigation, enhancement, contingency and compensation measures, which should be duly implemented during project pre-construction, construction and operation phases in order to minimize the degree of negative 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.

3. An independent environmental monitoring team as well as compliance monitoring have been proposed and suggested as mandatory for monitoring the Project 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.

4. In this context, BIFPCL initiated the monitoring study to monitor the environmental and social parameters and also the implementation status of EMP (Environmental Management Plan) during construction phase of the Thermal Power Plant for safeguarding the environment of the Sundarbans Mangrove Forest and the surrounding ecosystem and communities. Subsequently, CEGIS has been engaged for conducting the monitoring activities to inspect the status of environmental parameters and implementation of the EMP.

5. This report is aimed in understanding the baseline condition and a plausible description of the recommended environmental and social parameters of the study area. It provides a complete scenario of environmental compliance status of the construction phase along with engineering activities during this 15th quarterly monitoring program.

6. The location of the proposed project encompasses Sapmari Katakhali and Kaigar Daskati Mauza of Rajnagar Union under Rampal Upazila of Bagerhat district (Map 1.1). The Power Plant lies in between latitude 22˚ 37’ 0’’ N and 22˚ 34’ 30’’ N and longitude 89˚ 32’ 0’’ E and 89˚ 34’ 5’’ E. The plant site is 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 **Map 1.1**. The study area includes: i) area covering 10 km radius from the Plant location, ii) area within 5 km strip from both bank of the Passur and the Sibsa rivers starting from the Plant site to Hiron point have been presented in **Map 1.2**.

7. According to the contract, the findings of all the previously prepared fourteen (14) quarterly monitoring reports have already been submitted to BIFPCL which subsequently to the DoE and Forest Department. In addition, all the monitoring reports were regularly uploaded

in BIFPCL website. The current document constitutes the **15th quarterly monitoring** report covering all the preselected monitoring parameters and locations, which helped in improving and further upgrading the environmental monitoring database until today.

1.2 Objectives

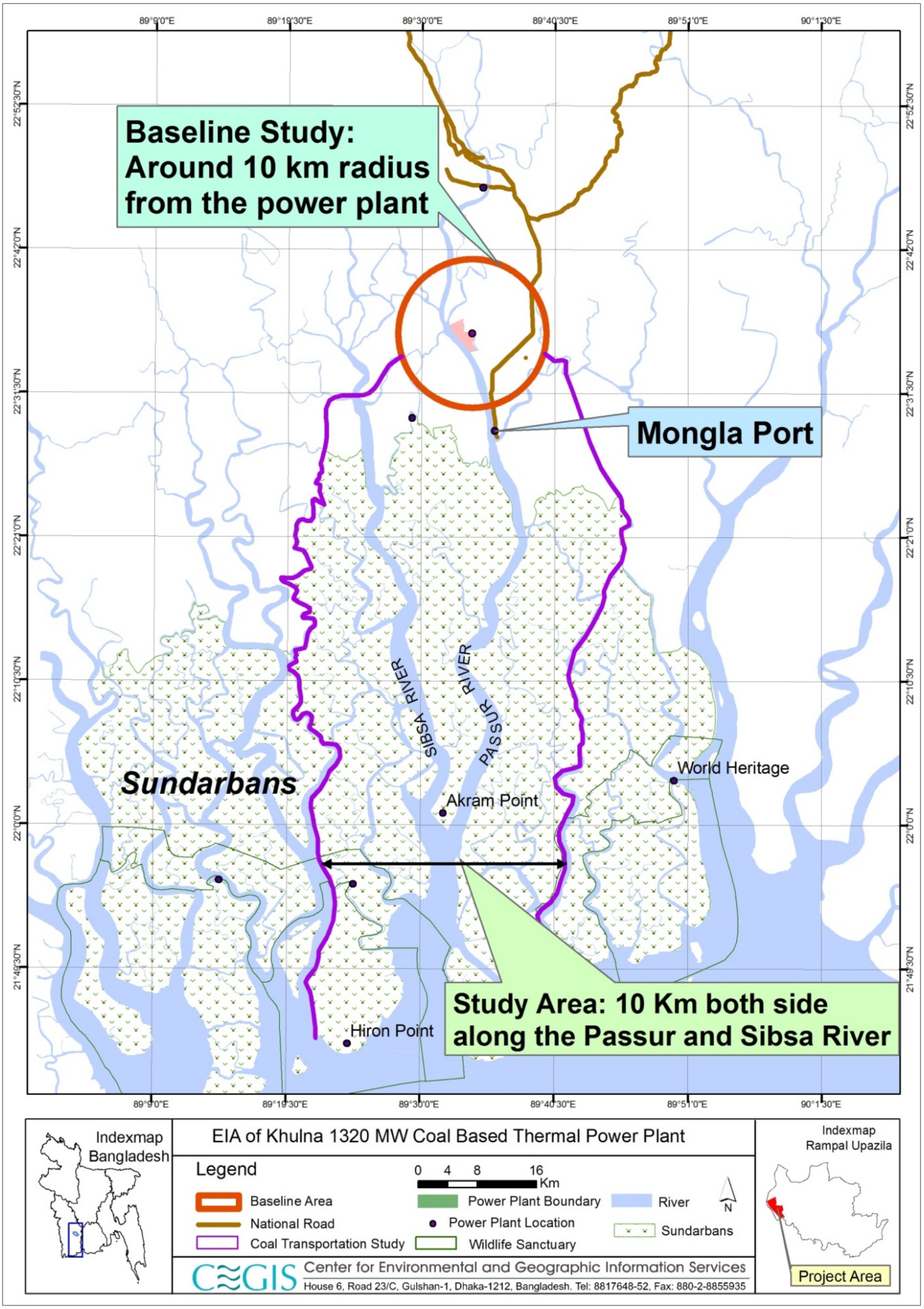
- The overall objective of the study is to monitor the environment and social parameters and the implementation status of Environmental Management Plan (EMP) during construction phase of the Power Plant.
- To monitor, the environmental compliances regarding EMP implementation during Power Plant's construction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

1.3 Criteria for Selection of Monitoring sites/locations

8. 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-

- The wind direction, wind speed, sensitive receptors in and around the vicinity of the Project site have been considered to monitor the ambient air quality. Considering the sensitive receptors in the vicinity potential locations were identified selected for the noise level monitoring in the project influenced area.
- Sites for ambient water quality monitoring were selected by considering the water sources likely to be impacted/ polluted by both the natural and anthropogenic sources.
- Monitoring sites for fisheries resources cover 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 by 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.

Map 1.1: Location Map of the Study Area (Rampal Coal Based Thermal Power Plant)



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

1.4 Main stakeholders

Forest Department

9. 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 for carrying out monitoring activities in the Sundarbans under certain conditions which maintaining of close communication with Forest Department, submitting 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.

10. 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 15th monitoring will also be forwarded to same officials of this Department.

Department of Environment (DoE)

11. The monitoring plan, including indicators, parameters, location and schedule, has been prepared incorporating the suggestion(s) of the Department of Environment. Before initiating the monitoring study, a discussion meeting was held at CEGIS office with the experts of DoE to finalize the monitoring plan.

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

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

13. 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.

Bangladesh Power Development Board (BPDB)

14. 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 Rampal Power Plant. Moreover, BPDB is also ensuring the environmental compliance monitoring of different steps of the Power Plant construction.

Local Community

15. 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) and other informal discussions with local people in different locations of the project influenced area.

Major component of monitoring study

16. 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;
- **Biological environment:** This includes fisheries resources, ecological status, the Sundarbans Reserve Forest (SRF) health conditions and agricultural resources;
- **Social environment:** This covers compensation, resettlement/rehabilitation, project related employment generation, labour and working condition, community health, security and safety and 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

17. Ambient Air quality is one of the most significant component of physical Environment and is presumed to be affected by the proposed Project activities during pre-construction, construction and operation stages. The air quality status was assessed in the preselected sites during the current monitoring period in January, 2018 to understand the seasonal and spatial variations of the parameters which may further indicates the condition of the concurrent air shed.

2.1.1 Methodology

18. 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 proposed Power Plant. The monitoring locations as well as the indicators were selected during the EIA study based on a number of criteria e.g., the sensitivity of the receptors, project activities like coal-carrying vessel movement, transhipment point; wind speed, wind direction and atmospheric deposition (Wet and Dry) and atmospheric stability class. Moreover, the potential location of air pollution assessment has been projected based on model generated pollutant dispersion scenarios to determine the maximum ground level concentration of the potential pollutants. A comprehensive discussion on the recently assessed air quality has been reported in the following sections. It is also to be noted that, the air quality was monitored for eight (8) hours period at all the monitoring sites.

2.1.2 Method of Sampling and Laboratory Testing

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

20. The major air pollution sources currently contributing to the air pollution along the Passur River in between the Project site and Mongla Port area are the cement, LNG and petroleum industries, commercial areas, and other pollution sources like marine vessels, small boat, and other residential sources. These pollution sources are listed in **Table A2** of **Appendix IV**.

Photo 2.1: Air Quality monitoring at Akram Point

2.1.3 Pollution sources in the Sundarbans

21. 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 Suspended Particulate Matters (SPM), Oxides of Sulphur (SOx) especially SO_2, Oxides of Nitrogen (NOx) and Green House Gases (GHGs). In addition, engine boats and other motorized vehicles for fishing, honey collection, Golpata (Nipa palm) & timber collection and 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**.

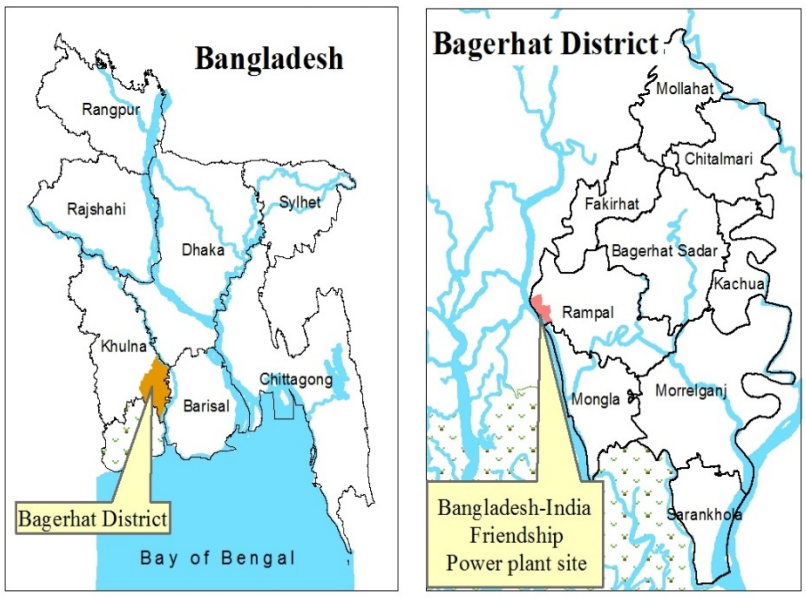
2.1.4 Monitoring locations

22. The ambient conditions of air quality during this quarter has also been monitored in the same locations as monitored in earlier quarters. The monitored locations for the air quality monitoring program are shown in **Map 2.1.** The details of the monitoring plan have been provided in **Table 2.1**.

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 **Method of testing PM_{10}:** USEPA (1997) Method 201 or 201A (as appropriate) **Method of testing SO_X:** USEPA (2000) Method 6 or 6A or 6B or ISO (1998) Method 11632 (as appropriate) **Method of testing NO_X:** USEPA (2000) Method 7 or 7A or 7B or 7C or 7D or ISO (1993)Method 10396 (as appropriate).
2		Proposed township area near Chimney location, Mauza: Sapmari Katakhali	89°32'3.8"E 22°36'32.5"N		
3		North West corner of the Project boundary (Kaigar Daskati)	89°33'51.8"E 22°36'1.06"N		
4		Barni, Gaurambha union (4km North East from the chimney location)	89°34'37.7"E 22°38'51.8"N		
5		Chunkuri-2, Bajua Union (4km South West from the chimney location)	89°34'01.1"E 22°32'3.3"N		
6		Pankhali, Dacope, (4km North West from the Chimney location)	89°31'24.2"E 22°36'6.7"N		
7		Mongla Port Area	89°35'50.4"E 22°28'24.8"N		
8		Harbaria, Sundarbans	89°35'34.2"E 22°17'43.1"N		
9		Akram point, Sundarbans	89°30'54.1"E 22° '23.50"N		
10		Hiron Point, Sundarbans	89°27'53.2"E 21°46'27.60"N		
11		Khulna city near Khan Jahan Ali Bridge	89°35'35.5"E 22°46'36.8"N		

Index Map



Legend

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

Data sources:

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

0 5 10 20 km

Map projection: Bangladesh Transverse Mercator (BTM)

Map prepared by:

CEGIS Center for Environmental and Geographic Information Services

June 2016

Map 2.1: Air Quality Monitoring Locations

2.1.5 Status of air quality

23. 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 standards currentlu followed are listed below. Units of measurement for the standards are parts per million (ppm) by volume, and micrograms per cubic meter of air (µg/m^3). However the air pollution emission standards are attached in the following **Table 2.2**.

Table 2.2: Air Pollutants Emission Standards

Pollutant		Average time	Standard (ECR' 2005)
Carbon Monoxide (CO)		1 Hour	40 mg/m^3
		8 hour	10 mg/m^3
Oxides of Nitrogen (NOx)		Annual	100 µm^3/ 709 µm^3 (calculated for 8 hours)
Ozone (O_3)		8 hour	157 µm^3
		1 Hour	235 µm^3
Particulate matters	$PM_{2.5}$	24 Hour	65 µm^3/ 88 µm^3 (calculated for 8 hours)
	PM_{10}	24 Hour	150 µm^3/ 204 µm^3 (calculated for 8 hours)
	SPM	8 Hour	200 µm^3/
Oxides of Sulfur (SOx)		24 Hour	365 µm^3/ 496 (µm^3) (calculated for 8 hours)
		Annual	80 µm^3

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

24. The values of **$PM_{2.5}$**, were found within the standard limit at all locations and the maximum value (78.7 µg/m^3) was obtained at the toll plaza area of Khan Jahan Ali Bridge whereas the minimum value (31.5 µg/m^3) was recorded at the Proposed Township area. Though the values were found within the standard limit (88 µg/m^3 as calculated for 8 hours concentration), but have shown a significant increase than those mentioned earlier. Similar case was observed in case of PM_{10} concentrations as it was found highest (209.0 µg/m^3) at the toll plaza of Khan Jahan Ali Bridge area which is much higher than all the previously monitored data from all locations. In addition, during this monitoring period, the values of PM_{10} had crossed the standard limit at three sites namely Chalna area, Mongla port area and the Toll Plaza of Khan Jahan Ali Bridge. However, this might be due to the upsurge in road side dust, increased number of small and heavy vehicles on roads, number of small industries i.e. brickworks, refineries, cement works, iron and steel making, etc., diffuse sources i.e. wood stoves, fires, and wind generated dust.

25. Likewise, the concentration of SPM was found comparatively higher at the Toll plaza area of KJA Bridge area (243.4 µg/m^3), Chalna area (223.9 µg/m^3) and Mongla port area (242 µg/m^3). On the other hand, the minimum concentration (145.6 µg/m^3) was observed at the South-West corner of the project Boundary i.e. at the offtake of Moidara Khal. This time the concentration was found to be higher than the standard limit. Large number of two-stroke human haulers, buses, trucks, and other anthropogenic activities were observed during field visit of this time monitoring, which might be the reason for such higher concentration of particulate matters.

26. 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.

Sulphur Dioxide (SO2)

27. During this monitoring period, the concentration of Sulphur dioxide (SO_2) in the ambient air were found much below the Bangladesh standard limit of (496 µg/m^3) in all the sampling locations. The maximum concentration (21.0 µg/m3) was found at KJA Bridge area while minimum concentration (9.6 µg/m^3) was found at the north-west corner of the project area. The values of SOx were never found to cross the standard value set in ECR' 97.

Nitrogen Dioxide (NO_2)

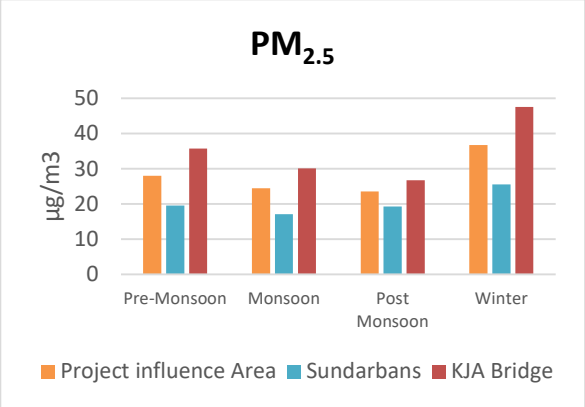
28. The values of NOx in Project site and its adjoining areas were found much below the Bangladesh standard limit of 100 µg/m3. During this monitoring period the maximum concentration (20.7 µg/m3) was found at KJA Bridge area whereas the lowest (11.7 µg/m3) was recorded at the North-west side of the project area. The monitoring results are shown in Table A1 in Appendix IV.

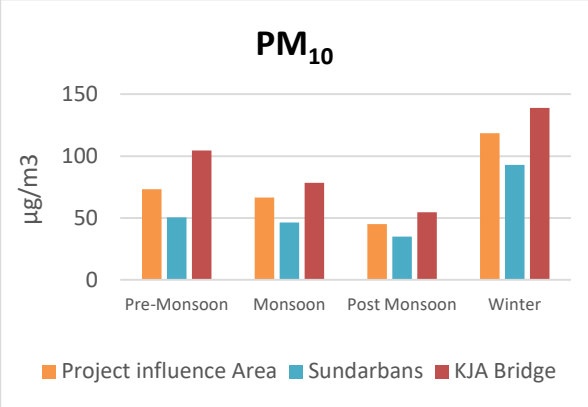
Carbon Monoxide (CO)

29. The concentration of CO in the monitored locations were found much below than the standard values set in ECR'97. The value ranged in between 71 µg/m^3 and 45 µg/m^3 at Hiron point of the Sundarbans Reserve Forest area and at the North-west side of the project area respectively. The possible reasons for such CO concentration would be due to the movement of various types of water vessels across the Passur River and its adjoining areas.

Ozone (O_3)

30. Similarly, results of **O_3** in both the Sundarbans Forest Area and Project area were found within the range of 3-6 µg/m^3 , which were much lower than the Bangladesh standards limits of 157 µg/m^3 for 8 hours. In this 15th monitoring study the maximum concentration (6 µg/m^3) was found in the Chalna area.Findings of the previously monitored data with seasonal variation has been appended in the following section.





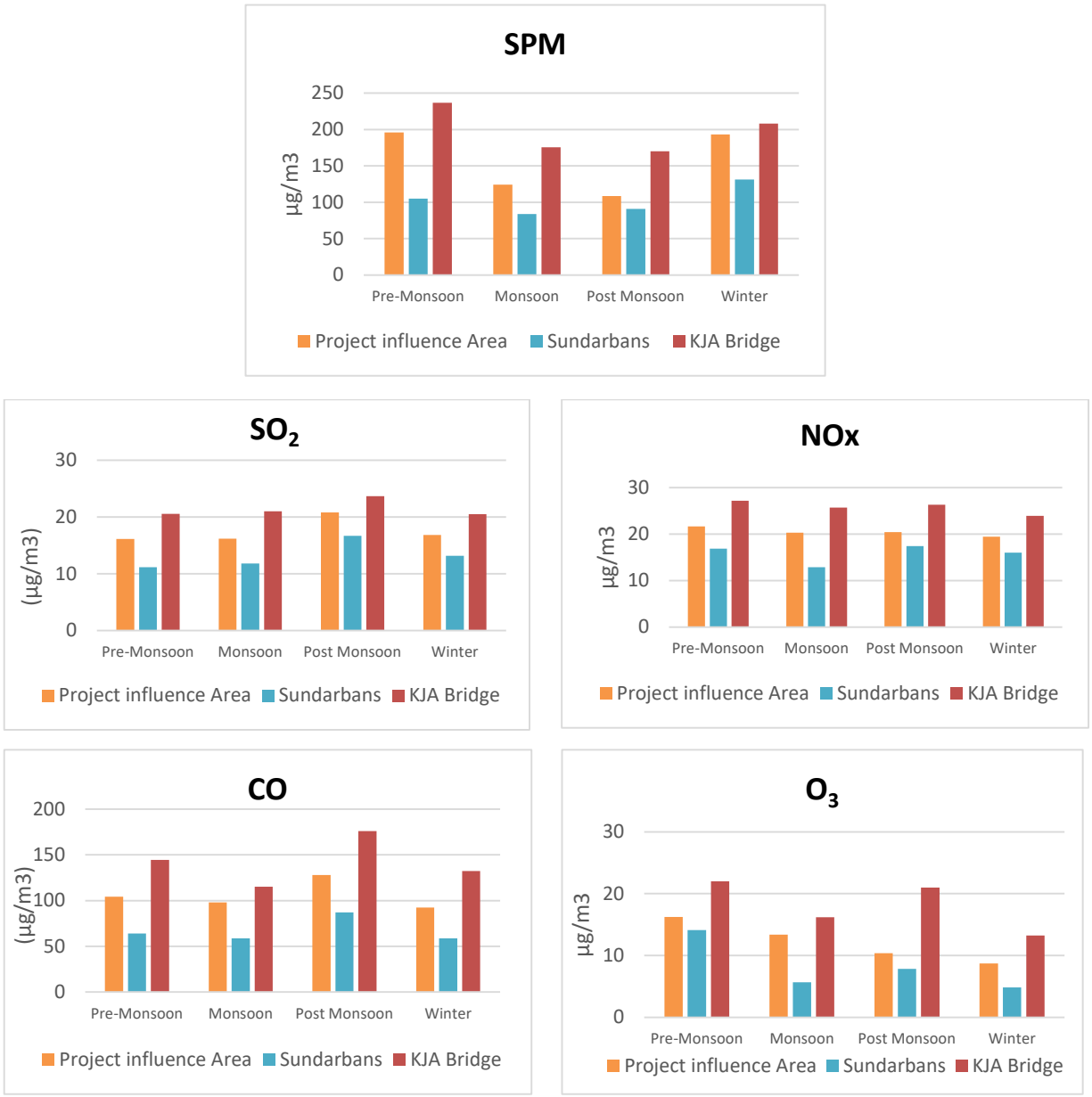


Figure 2.1: Seasonal variation of the Air Quality Parameters

Findings

31. During this monitoring period, all the preselected parameters i.e. particulate matters ($PM_{2.5}$, PM_{10} and SPM), O_3, CO SOx and NOx were measured following the proper procedures. The concentration of all parameters were found within the standard limit set by ECR' 97 at all locations except the SPM, PM2.5 and PM10 values at the Khan Jahan Ali Bridge area. The reasons would be due to the movement of numerous types of vehicles on roads i.e. two-stroke human haulers, buses, trucks, land development works, brickworks, refineries, cement works, wood stoves and wind generated dust which are currently contributing to the pollutant's concentration in this area.

Noise Quality

32. Noise levels for the respective locations were monitored during this winter 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 found during this season (**15th** monitoring program).

2.1.6 Methodology

33. Noise levels were measured thrice in a day (morning, afternoon and evening) at eleven (11) locations in and around the project area and inside the Sundarbans forest area. Each time noise levels were recorded using sound level meter for five minutes of time span with an interval period of 30 second and the meter was properly set up and calibrated following the instruction manual. The monitoring locations were selected considering the sensitivity of the nearest receptors and accordingly, six sites were selected in and around the Project area, three sites were designated inside the Sundarbans Reserve Forest Area, one at Mongla Ghat area and the remaining one was selected at the Khan Jahan Ali Bridge toll plaza area (**Map 2.2**)

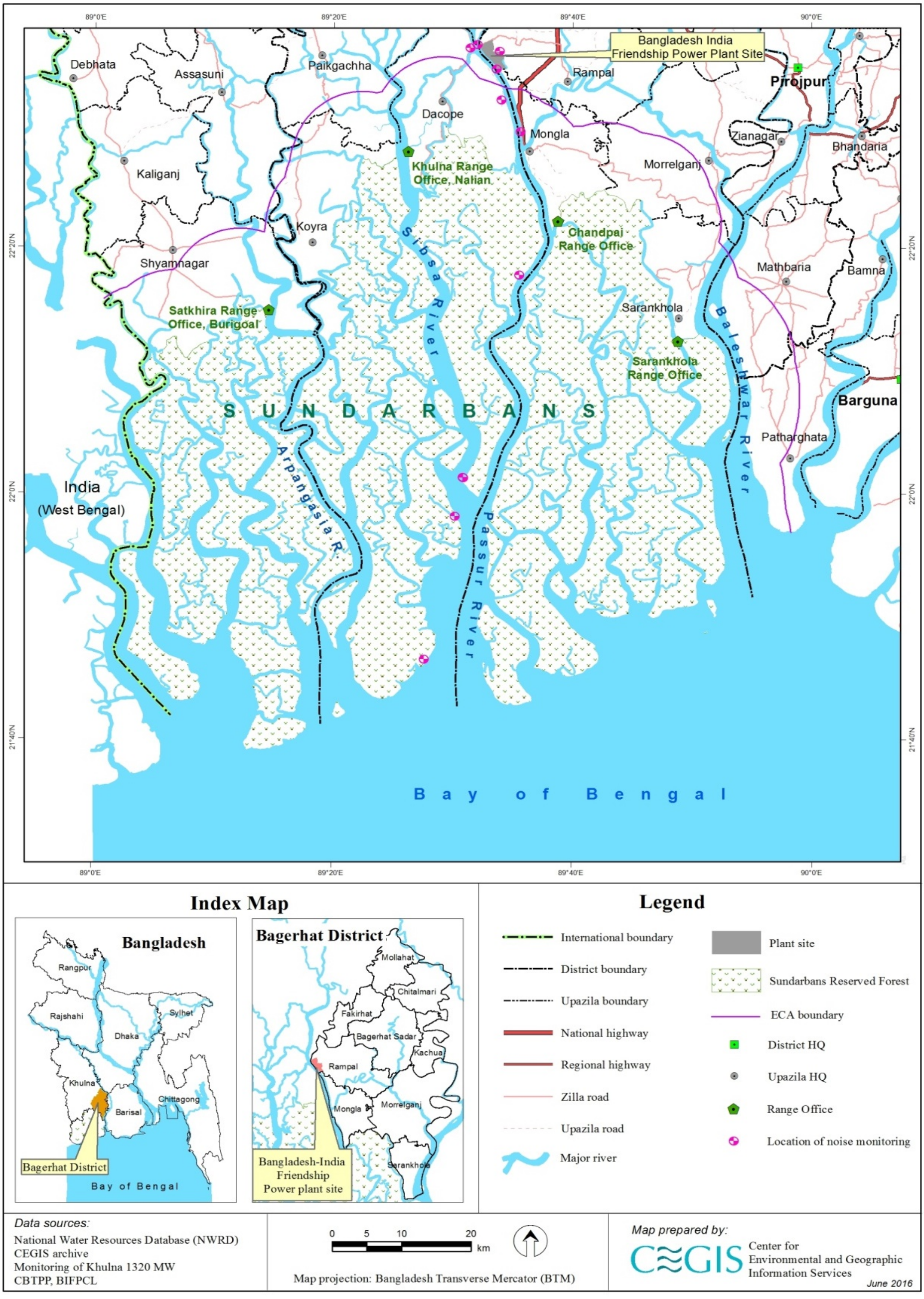
2.1.7 Locations of Noise Level Monitoring

34. Out of eleven (11) locations, three locations were inside the Sundarbans, six locations were in and around the Project site, one was at Khan Jahan Ali Bridge on Rupsha River and the remaining one was at Mongla Port area (**Map 2.2.**).

Photo 2.2: Professional conducting an ambient noise acquisition survey in Sundarbans

Table 2.3: Noise monitoring Plan

SL.no.	Date	Monitoring locations	GPS points	Time of noise monitoring
1	April 17, 2017	South West corner of the Project boundary	89°33'34.5"E 22°34'33.8"N	Morning, Noon and evening
2	April 18, 2017	Proposed township area near Chimney location, Mauza: Sapmari Katakhali	89°32'3.8"E 22°36'32.5"N	Morning, Noon and evening
3	April 19, 2017	North West corner of the Project boundary (Kaigar Daskati)	89°33'51.8"E 22°36'1.06"N	Morning, Noon and evening
4	April 20, 2017	Barni, Gaurambha union (4km North East from the chimney location)	89°34'37.7"E 22°38'51.8"N	Morning, Noon and evening
5	April 21, 2017	Chunkuri-2, Bajua Union (4km South West from the chimney location)	89°34'01.1"E 22°32'3.3"N	Morning, Noon and evening
6	April 22, 2017	Pankhali, Dacope, (4km North West from the Chimney location)	89°31'24.2"E 22°36'6.7"N	Morning, Noon and evening
7	April 23, 2017	Mongla Port Area	89°35'50.4"E 22°28'24.8"N	Morning, Noon and evening
8	April 24, 2017	Harbaria, Sundarbans	89°35'34.2"E 22°17'43.1"N	Morning, Noon and evening
9	April 25, 2017	Akram point, Sundarbans	89°30'54.1"E 22°'23.50"N	Morning, Noon and evening
10	April 26, 2017	Hiron Point, Sundarbans	89°27'53.2"E 21°46'27.60"N	Morning, Noon and evening
11	April 27, 2017	Khulna city near Khan Jahan Ali Bridge	89°35'35.5"E 22°46'36.8"N	Morning, Noon and evening



Map 2.2: Noise Level Monitoring Locations

2.1.8 Status of Noise

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

Dacope Upazila Parishad

36. 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 at day time is 70 dB and the maximum noise level was recorded as 60.1 dB (A) which is about 10 dB (A) lower than the Bangladesh standard limit (70 dB) (**Table 2.4**). The significant noise sources at this place were found as the road traffics, engine operated van (locally called Nosimon), motor bikes, easy bikes (battery operated tri-cycle), hat/bazar etc.

North West Corner of the Project Area (Kaigar Daskati)

37. 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). This time, the average day time noise level during this monitoring was recorded as 49.3 dB (A) and is lower than the standard value set for noise pollution control.

Chunkuri-2, Bajua

38. This area is located at 4km South West direction from the chimney location [89.5669°E, 22.5342°N]. This site is a residential area and the standard has been set as 55 dB (A) at day time (Noise control rule, 2006). During the monitoring period (January, 2018), the noise level was found to be 51.4 dB (A) which never crossed the standard. However, the observed noise sources were rural crowd, noise from river side homesteads etc. in this site.

South West corner of the Project area

39. The South West corner of the Project area is located at the mouth of Maidara Khal. Here the noise level was found to be 44.5 dB (A) and is much lower than the standard value. However, frequent movement of water vessels over the Moidara Khal and adjacent Passur River are the main source of noise generation in 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

40. 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 found as 53.3 dB (A) in this site and was close to that of the Bangladesh standard for the daytime. 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

41. The 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 55.6 dB (A) during this monitoring season which is slightly lower than the standard value. However, the maximum average noise level (58.8 dB) was found at this place during the first quarterly monitoring period which also did not cross the corresponding noise limit.

Khan Jahan Ali Bridge, Khulna

42. 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 61.7 dB (A) which is considerably lower than the Bangladesh standard of day time {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

43. 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 59.8 dB (A) which is 15.2 dB (A) lower than the 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

44. Harbaria area of the Sundarbans is considered as a hot spot of biodiversity and an important anchoring site for most of the large ships. Most of the sea going vessels used to anchor at this site for transhipment of goods and commodities. The area is under the silent zone and the standard limit of ambient noise at daytime is 50 dB (Noise pollution control rules, 2006). The noise level was measured at a distance of 100 m (Inside the forest area) from the River bank and found as 44.4 dB (A) during monitoring period. However, movement of ships, running engines of anchored ships and barges, transhipment activities, bird's chirping, wave breaking sound and wind action on tree leaves were observed to be the main sources of noise in this site.

Akram point, Sundarbans

45. 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 40.1 dB (A) which is much lower than that of Bangladesh standard value. However, Birds' chirping, stormy wind, wave breaking sound and falling of leaves from the trees were found as the main sources of noise.

Hiron point of Sundarbans

46. This area is also under the silent zone where the ambient day time noise standard is 50 dB (A). Noise level was recorded at a distance of 100 m from the riverbank inside the forest area. The average day time ambient noise level during this monitoring season was recorded as 38.8 dB (A) which is much lower than that of Bangladesh standard value.

Table 2.4: Summary of the ambient noise recorded in consecutive monitoring periods of 2014, 2015, 2016, 2017 and 2018 (The values are in dBA)

Sl.	Location	Monitoring periods															
		QM 1	QM 2	QM 3	QM 4	QM 5	QM 6	QM 7	QM 8	QM 9	QM 10	QM 11	QM-12	QM-13	QM-14	QM-15	Std*
1	*Chalna, Dacope*	68.13	52.87	54.63	53.28	57.08	49.77	65.12	66.07	65.08	52.42	65.51	59.29	61.62	58.64	60.1	70
2	*NW Corner of the Project area*	51.89	NM	41.92	35.25	44.67	41.56	41.94	50.96	50.79	52.65	55.48	44.52	47.19	46.95	49.3	55
3	*Chunkuri-2, Bajua*	57.76	52.55	51.39	49.29	47.05	40.66	47.43	53.62	44.49	53.4	51.55	55.31	50.44	50.44	51.4	55
4	*SW corner of the project area*	49.2	47.6	45.95	36.03	43.58	43.75	42.7	60.44	54.50	65.37	48.51	45.19	43.25	43.26	44.5	55
5	*Proposed Township area*	48.75	46.68	41.92	41.47	41.47	46.75	50.52	53.77	53.37	55.79	43.69	42.62	42.65	43.93	53.3	55
6	*Barni, Gaurambha*	58.84	49.95	49.78	43.6	54.17	46.18	55.16	59.16	53.97	56.75	54.91	49.05	44.83	45.52	55.6	60
7	*Khan Jahan Ali Bridge, Khulna*	71.7	60.8	66.28	61.72	73.45	52.82	64.25	68.45	65.85	63.77	60.95	55.57	56.72	62.47	61.7	70
8	*Mongla Port area*	61.24	53.84	60.5	38.69	48.15	39.61	47.01	52.7	49.88	52.86	49.86	48.95	47.61	49.66	59.8	75
9	*Harbaria, Sundarbans*	40.88	56.13	55.3	34.38	65.37	35.03	50.75	45.2	44.55	52.9	55.33	41.18	54.10	46.48	44.4	50
10	*Akram Point, Sundarbans*	40.94	47.9	43.98	34.32	54.86	NM	49.6	42.95	42.95	47.96	41.77	38.08	44.30	42.38	40.1	50
11	*Hiron Point, Sundarbans*	38.63	51.29	47.98	37.37	47.84	NM	46.06	NM	43.11	NM	44.38	42.29	NM	39.79	38.8	50

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

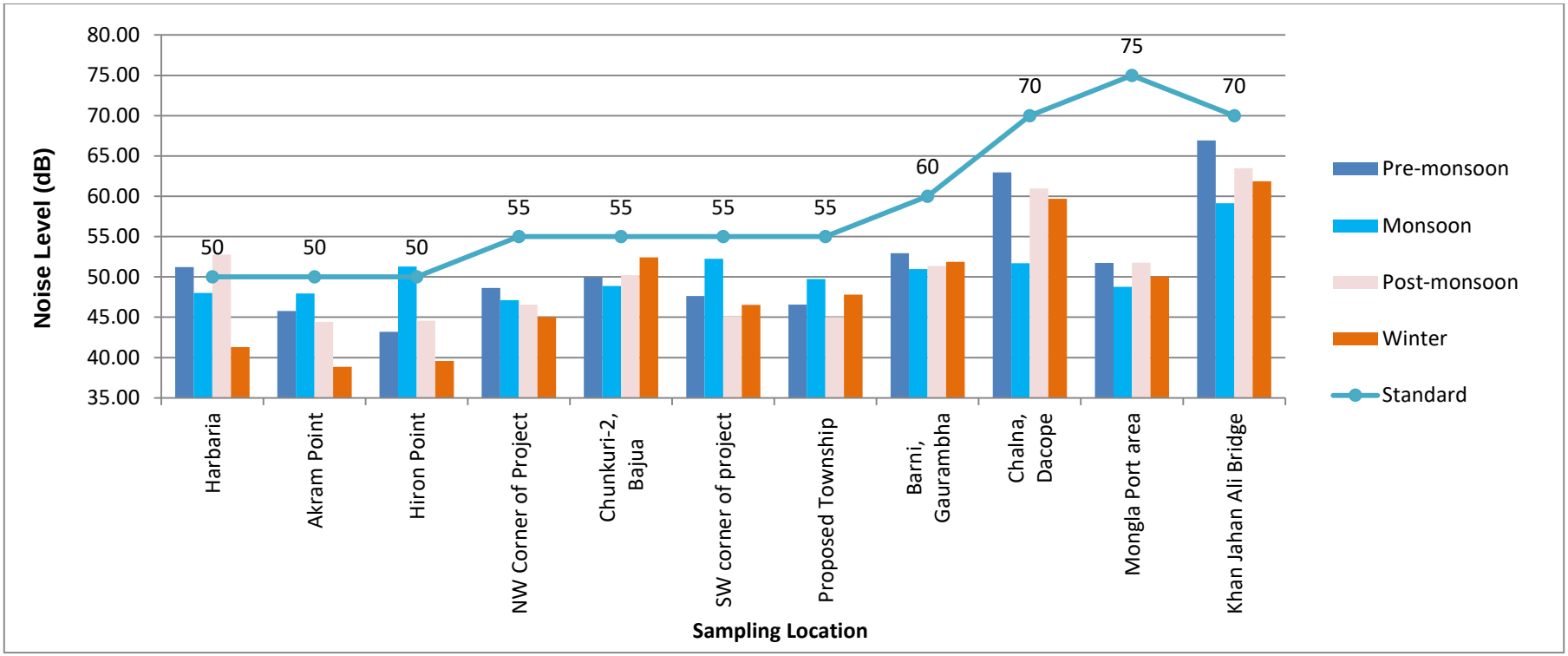


Figure 2.2: Seasonal variation of Noise level at different locations

2.1.9 Findings

47. 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 generationg sources of anthropogenic noise.However, during this monitoring season (**15th quarter**); the observed noise level were not found to exceed the Bangladesh standard limit of noise level in any of the eleven locations (**Table 2.4**). In course of the total fourteen monitoring seasons, the noise level of eight locations were found to exceed the Bangladesh standard limit oftheir 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), 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.

2.2 Water Quality

48. An updated water quality status of the Passur-Sibsa River system and adjacent aquifers have been incorporated 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 15th quarterly monitoring (January, 2018) and the tested results obtained from the laboratory up to October, 2017 (14th quarterly monitoring). The surface and groundwater quality were monitored in the respective locations performed during the previous monitorings. 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.

2.2.1 Methodology

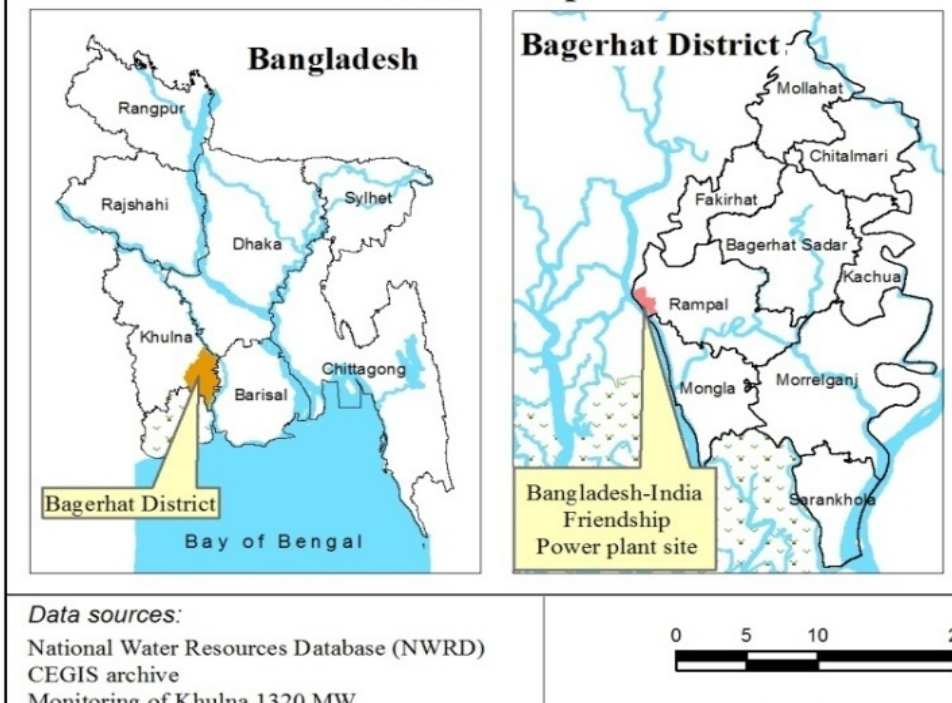
49. Water quality monitoring covers selection of water quality parameters, identification of sampling locations, determination of sampling frequency and evaluation criteria of the monitoring parameters etc. Standard approaches and methodologies were followed for the above mentioned events. Both the surface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

50. The samples were collected from Seventeen (17) pre-selected locations (14 locations for surface water along the Passur River, Sibsa River, Maidhara River, near the proposed township area, and three locations for groundwater around the study area). The selected monitoring locations for the current monitoring program are shown in **Map 2.3**. The sampling locations were selected preliminarily at the inception stage and finalized during the 1st quarterly monitoring study. 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 cornerof the Project boundary	22.609361˚N	89.531417˚E		
4		Left Bank of Passur River at Project site-Jetty	22.584833˚N	89.543583˚E		
5		Middle of Passur River at Project site-Jetty	22.587667˚N	89.546472˚E		
6		Right Bank of Passur River at Project site-Jetty	22.589333˚N	89.548222˚E		
7		Left Bank of Passur River at South West corner of the Project boundary	22.572889˚N	89.552583˚E		
8		Middle of Passur River at South West corner of the Project boundary	22.574611˚N	89.557500˚E		
9		Right Bank of Passur River at South West corner of the Project boundary	22.575667˚N	89.559861˚E		
10		Maidara river at the South East corner of the project boundary at Ichamoti-Maidara confluence	22.600639˚N	89.565611˚E		
11		Maidara river near proposed Township area	22.577472˚N	89.569250˚E		
12		Passur river at Passur – Ghasiakhali confluence	22.473861˚N	89.602361˚E		
13		Passur river at Harbaria of the Sundarbans Reserve Forest area	22.295250˚N	89.593139˚E		
14		Passur river at Akram Point of the Sundarbans Reserve Forest area				
15		Passur river at Hiron point of the Sundarbans Reserve Forest area				

Index Map



Legend

- International boundary
- District boundary
- Upazila boundary
- National Highway
- Regional Highway
- Zilla road
- Upazila road
- Major river
- Plant site
- Sundarbans Reserved Forest
- ECA boundary
- District HQ
- Upazila HQ
- Range Office
- Location of surface water monitoring
- Location of ground water monitoring

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

0 5 10 20 km

Map projection: Bangladesh Transverse Mercator (BTM)

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

Map 2.3: Surface water and Groundwater Quality Monitoring Locations

Table 2.6: Groundwater Quality Monitoring Parameters, Locations and Plan

Sl no	Locations	GPS (Decimal Degree)		Frequency	Methods/Monitoring indicators/ Techniques
		Easting	Northing		
1	Near Proposed Township Area	22.594167˚N	89.566139˚E	Quarterly	▪ In-situ testing of physical water quality parameters by Horiba U-50 multimeter ▪ Sample preserving and Laboratory analysis at DPHE Central Laboratory for chemical 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		

Selection of Parameters

51. Water quality parameters were selected on the basis of tentative potential impacts to be generated during pre-construction, construction and operation phases of the Power Plant Project. Only four parameters namely pH, temperature, salinity, DO and BOD_5 were tested in-situ. BOD_5 could not be tested in the laboratory as transportation time of 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 in-situ DO was considered as BOD_5. Samples of other preselected parameters were collected and analysed in the laboratory.

Surface Water Quality Parameters

52. The selected parameters for surface water quality include Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Heavy Metals (As, Pb, Hg), pH, Salinity, Nitrate (NO_3), Total Dissolve Solids (TDS), Total Suspended Solids (TSS), Total Hardness (TH), Turbidity, Temperature and Oil and Grease. The main parameters were grouped into following four categories:

- Physical and aggregate properties i.e. pH, Temperature, Salinity, Hardness, TDS, TS, Turbidity, Oil & Grease;
- Inorganic non-metallic constituents i.e., DO, NO3-, PO43- and SO42-;
- Aggregate organic constituents i.e. BOD, COD;
- Heavy metals i.e. As, Pb and Hg;

Groundwater Quality Parameters

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

Sampling Procedure

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

Surface Water Sampling Procedure

Photo 2.3: Water sampling during quarterly monitoring

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

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.

Water quality analysis procedure

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

Table 2.7: Testing Methodology of Water Quality Parameter

Parameters	Methods/Measuring Tools	Unit	BD Standard (ECR 1997)
Temperature	Horiba U-50 multimeter	^{0}C	20 - 30
pH	Horiba U-50 multimeter	ppm or mg/L	6.5-8.5
TDS	Horiba U-50 multimeter	ppm or mg/L	1000
TSS	Horiba U-50 multimeter	ppm or mg/L	10
Salinity	Horiba U-50 multimeter	ppt	
DO	Horiba U-50 multimeter	ppm or mg/L	6
BOD_5	5-Day BOD Test at 20^{0}C	ppm or mg/L	50 (SW)
COD	Closed Reflux Method	ppm or mg/L	200 (SW), 4.0 (GW)
Total Hardness (as $CaCO_3$)	Titrimetric	ppm or mg/L	200-500
Ortho-Phosphate (PO_4^{3-})	UV-VIS Spectrophotometers	ppm or mg/L	6
Nitrate (NO_3^-)	UV-VIS Spectrophotometers	ppm or mg/L	10
SO_4^{2-}	UV-VIS Spectrophotometers	ppm or mg/L	400
Oil and Grease	Liquid-liquid extraction with hexane, treatment with silica gel and gravimetric determination	ppm or mg/L	10 (SW)
Arsenic (As)	Atomic Absorption Spectrophotometers–Hydride Vapor Generating (AAS-HVG)	ppm or mg/L	0.05
Lead (Pb)	Atomic Absorption Spectrophotometers–Graphite Furnace (AAS-GF)	ppm or mg/L	0.05
Mercury (Hg)	Mercury Analyzer	ppm or mg/L	0.001

2.2.2 Water quality reporting system

56. Surface water quality monitoring status is presented in two ways in the water quality report. The first one shows seasonal variation of the observed parameters in 3 major groups; (i) Power plant and adjacent water sampling locations (PP & adjacent area), comprised of total 11 sampling points, (ii) Mongla-Passur Confluence, comprised of only 1 sampling location, and (iii) the Sundarbans Reserve Forest area which include 3 sampling locations namely Harbaria, Akram point and Hiron point. The second one shows all the quarterly monitoring data by sampling sites together with seasons in **Appendix-IV (Table B.1)**. In-situ tested parameters

(a) pH

57. Fifteenth (15th) quarterly monitoring has been held in the month of January, 2018, usually called the winter season of Bangladesh. During this visit, pH values in the monitoring sites are found to range between 7.48 and 8.39 pH value in the left bank of Passur River at South East corner of the project jetty is found as while that is the Passur-Mongla as the lowest. The average pH value of the winter season was found as 7.9 which complies with the ECR, 1997 Standard (6.5-8.5). The results in all locations during this monitoring period and in the previous years during same period appeared to be same.

58. 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). During post monsoon and winter season, river flow and water level normally reduced due to inadequate rainfall and

insufficient inflow from U/S (upstream) of Passur-Sibsa RS (River System). As a result, pH values increased than those of the pre-monsoon and monsoon seasons, which has also reported by others (Rahman et al., 2013). Fluctuations in pH values during different season of the year can be attributed to factors like; removal of CO_2 by photosynthesis through bicarbonate degradation, dilution of waste with freshwater, reduction in salinity and temperature, and decomposition of organic matter (Rajasegar, 2003).

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

(b) Temperature

60. Surface water temperatures indicated close conformity with the previously monitored values for the same season. The values in this monitoring periods, varied from 19.10^{0}C to 21.18^{0}C among the monitored locations. During all monitoring period, maximum temperature (32 ^{0}C -33^{0}C) for most of the monitoring sites) was found in summer season (July 2014) and minimum (19^{0}C) in winter season.

61. The surface water temperature largely depends on daily weather condition (Bartram J et al., 1996). According to the seasonal weather pattern of Bangladesh the temperature drops to a minimum level during winter, which is also applicable for the water temperature and thus it, differs largely than the other season's temperatures. Recorded temperatures indicated that there was spatial variation among the monitoring sites even in the same season. Water temperature inside the Sundarbans tended to be slightly higher than the water temperatures near the power plant sites in winter season. The main reason behind this is the higher electrical conductivity due to high salinity inside the Sundarbans (close to the Bay of Bengal), which increases the water temperatures slightly. For an instance, water temperature was found as 21.18^{0}C at the Akram point while at the Maidhara-Ichamoti confluence (behind the power plant site), it is found as 19.0 ^{0}C.

62. The measured temperature in the selected locations during the quarterly monitoring programs of first, second, third and fourth year are presented in **Figure-2.4** and all the observed dataset are attached in Table B.2 of Appendix- IV.

(c) Salinity

63. The observed salinity concentration ranged between 2.0 to 16.5 ppt during this monitoring period. The maximum salinity was observed at Hiron point in the Sundarbans while minimum in all the sampling locations close to the project site. During this monitoring period, fresh water flow from upstream was comparatively low due to insufficient rain falls. On the other side, high salinity from sea water increased water salinity towards down to upstream. However, the observed values are found almost similar to the last three consecutive years (2014-2016).

64. The highest salinity was observed in pre-monsoon season followed by winter season (Figure 2.5). Freshwater unavailability from upstream and the dominated tidal factors are the main reason of high salinity concentration in pre-monsoon and winter. The water salinity data in the selected sampling stations of Passur-Sibsa RS of the fifteen consecutive monitoring

periods are presented in **Figure: 2.5** and all the observed dataset are attached in Table B.3 of Appendix- IV.

(d) Dissolved Oxygen

65. During this monitoring period, DO concentrations ranged between 4.9-5.4mg/L. The maximum concentration was found at Hiron point while the minimum value was recorded at the project jetty site. It is better to mention here that DO concentration of 4.9mg/L was recorded at only one monitoring location while water DO level of other sites are found as more than 5.0mg/L. The low DO at project jetty site was due to complete low tide and no wind action at that time. In case of seasonal variations, maximum concentrations were observed during monsoon and post monsoon seasons. Higher DO was observed in monsoon and post-monsoon season were for heavy rainfall and freshwater availability (**Figure 2.6**). During winter, salinity affects the temperature and then water temperature affects the holding capacity of DO in water. However, still the DO concentration of Passur-Sibsa RS (near project site and inside the Sundarbans), are complying with the water usable for irrigation as irrigation usable DO concentration limit is only 5.0mg/L. (ECR, 1997).

66. Seasonal variations of DO at the monitoring sites of Passur-Sibsa RS are shown in Figure: 2.6 and all the observed dataset are attached in **Table B.4** of **Appendix- IV**.

(e) Biochemical Oxygen Demand (BOD5)

67. Highest value of BOD_5 of 3.1mg/L was found in the Passur River in Akram point of Sundarbans while the lowest (1.9mg/L) was observed at three different locations of near the project site. However, all the values were found to be within the standard limit as stated in the ECR' 1997 usable by fisheries (6mg/L or less). The seasonal fluctuation of BOD_5 of Passur-Sibsa RS is presented in Figure 2.7.

68. It is also evident from the figure that the highest average value was recorded at Passur-Mongla confluence point during monsoon season because of receiving organic load and agricultural runoff from the adjacent areas. Thus, BOD_5 was found comparatively higher during monsoon season than post monsoon and winter. The water temperatures normallyfound as low in winter season than that of pre-monsoon, monsoon and post monsoon seasons, which in turn decreases the bacterial and microbial activities (decomposition) and reduces BOD_5.

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

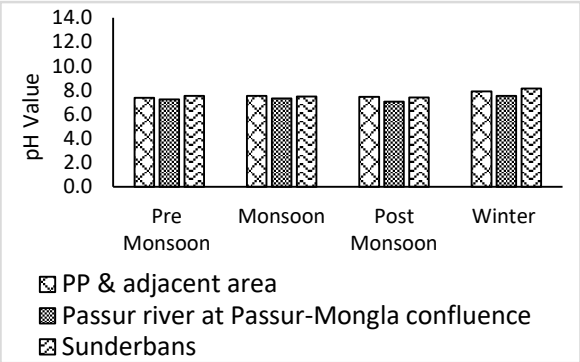


Figure 2.3: Variations in average pH values in sampling spots for the consecutive seasons

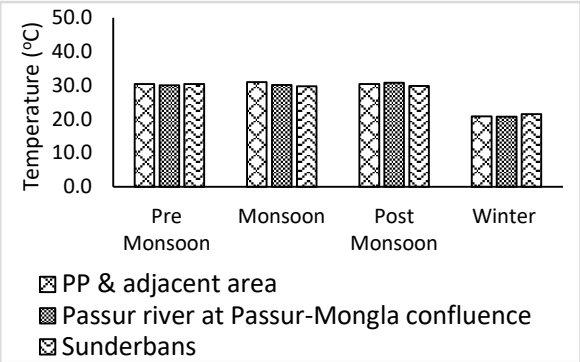


Figure 2.4: Variations in average temperature in sampling spots for the consecutive seasons

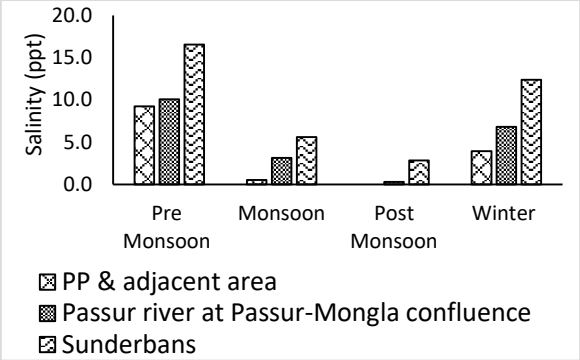


Figure 2.5: Variations in average concentration of salinity in sampling spots for the consecutive seasons

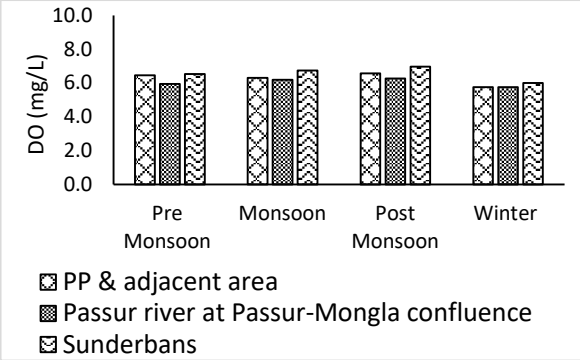


Figure 2.6: Variations in average DO concentration in sampling spots for the consecutive seasons

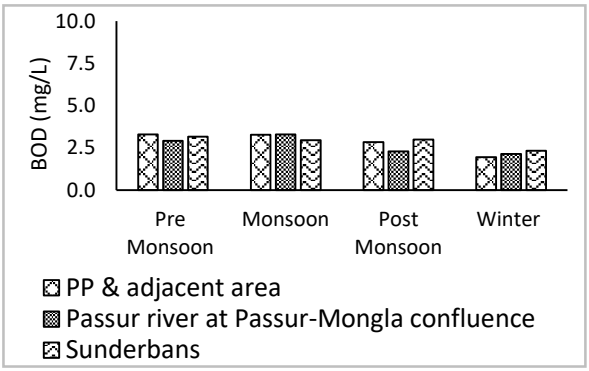


Figure 2.7: Variations in average BOD5 concentration in sampling spots for the consecutive seasons

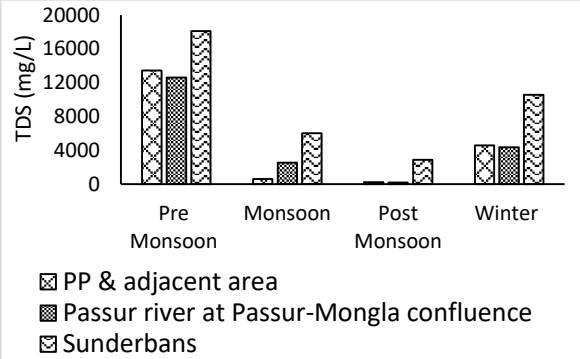


Figure: 2.8: Variations in average TDS concentration in sampling spots for the consecutive seasons

Laboratory tested parameters

70. The laboratory tested results obtained up to 14th monitoring period are described below:

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

71. 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 this winter period, the TDS values were found to range between 122-4450mg/L, which is similar to those of the previous winter seasons.

72. In Passur-Sibsa RS, TDS has both temporal and spatial variations. The TDS values during pre-monsoon is high because of low rainfall and at the same time the tidal effects. The Bay of Bengal contains lots of 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 (**Figure 2.8**). Regarding spatial variation, the more it is downstream of this RS, the higher the TDs concentrations due to tidal influence from the Bay of Bengal, that contains lots of nutrients.

73. 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 occurance of TH. Tidal effects during post monsoon and low freshwater supply due to low rainfall increase the TDS concentrations in Passur-Sibsa RS. Sea water contains huge quantity of calcium and magnesium which basically make the water hard. During the rainy season, the hardness in all monitoring stations in Passur River were found to be low whereas it was found remarkably higher in pre-monsoon season. 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). The average TH concentrations of winter period found to be less than 1000mg/L (**Figure 2.9**).

74. TSS includes solid materials of organic and inorganic in origins which are normally suspended in water. In Passur and Sibsa RS, the suspended matters generally contain sand, clay, silt and loam. During the 14th monitoring period, the TSS concentrations among the monitoring locations varied from 14 to 30mg/L. The highest value was found at Maidara River near township area while the lowest value was found in South West corner of project jetty (right bank). TSS values in every spots recorded found to be within the Bangladesh standard limit of 150 mg/L (ECR, 1997).

75. TSS was found to be higher in post-monsoon and winter seasons than those of pre-monsoon and monsoon. During post-monsoon and winter season, the TSS value increases, probably due to comparatively low amount of rains and less fresh water flow, urban runoff, industrial wastes, bank erosion, bottom feeders (such as carp), algae growth or wastewater discharges. In Mongla-Passur confluence, the concentration of TSS was very high which could be due to the heavy load of marine vehicles, and Mongla Port Authority's development work, and most importantly the domestic and industrial runoff from the adjacent areas of Mongla Port. In addition, high TSS at Maidara River was the result of low freshwater availability and mixed agriculture and fishery activities (**Figure 2.10**).

76. The status of TDS, TH and TSS of Passur River in pre-monsoon, monsoon, post-monsoon and winter seasons at different locatins are presented in figure 2.8, 2.9 ande 2.10 respectively

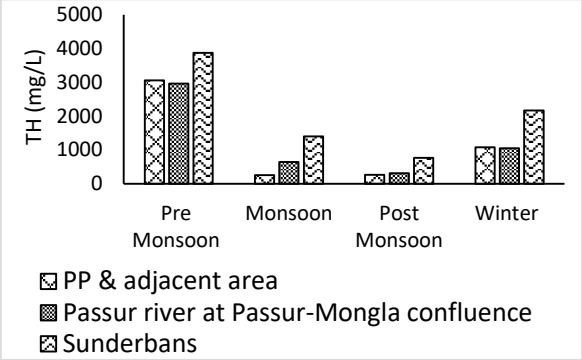


Figure 2.9: Variations in average TH concentration in sampling spots for the consecutive seasons

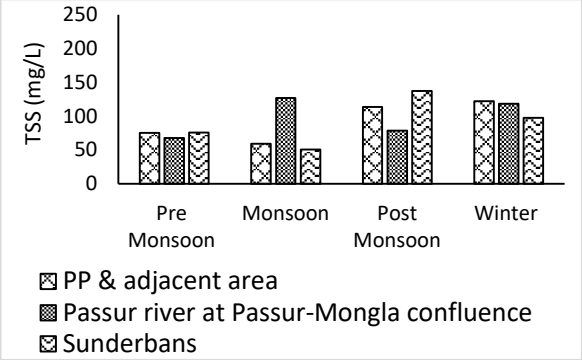


Figure: 2.10: Variations in average TSS concentration in sampling spots for the consecutive seasons

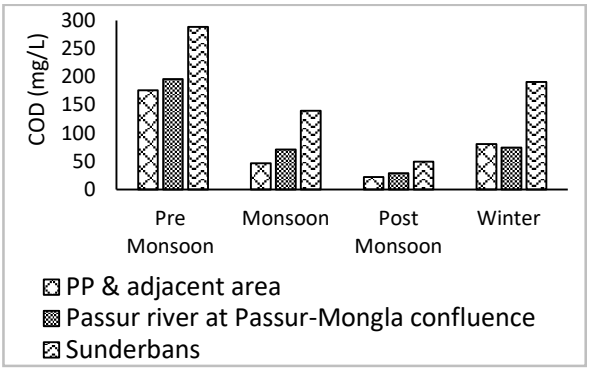


Figure 2.11: Variations in average COD concentration in sampling spots for the consecutive seasons

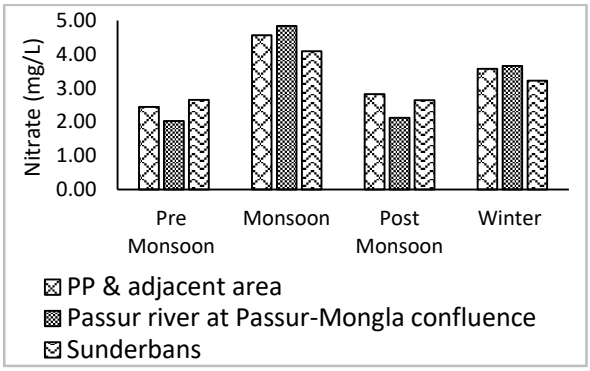


Figure 2.12: Variations in average Nitrate concentration in sampling spots for the consecutive seasons

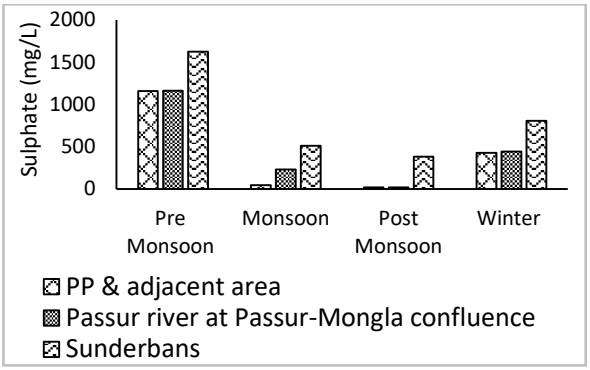


Figure 2.13: Variations in average Sulphate concentration in sampling spots for the consecutive seasons

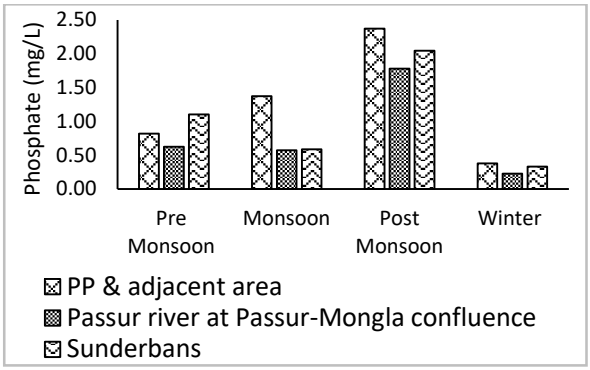


Figure 2.14: Variations in average Phosphate concentration in sampling spots for the consecutive seasons

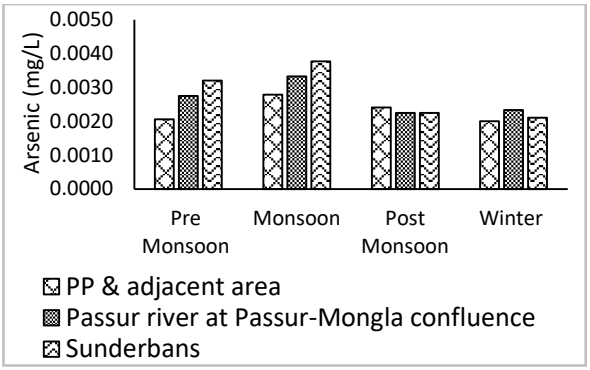


Figure 2.15: Variations in average Arsenic concentration in sampling spots for the consecutive seasons

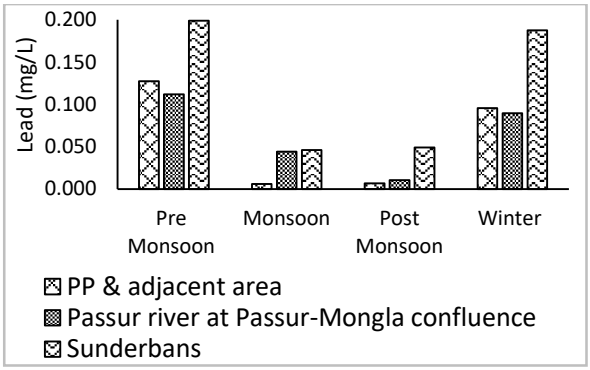


Figure 2.16: Variations in average Pb concentration in sampling spots for the consecutive seasons

(b) Chemical Oxygen Demand

77. COD is an indicator of organic pollution, which is caused by the inflow of 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 wiill be a higher demand of DO in the water body.

78. COD concentrations varied from 4 to 48mg/L during the last monitoring period. The highest value was found at the left bank of Passur River at South West corner from the Project boundary. The high values of COD indicate high level of organic pollution in the river water (Sivasubramanium, 1999). A large scale of industrial activities were observed along the left bank of Passur River from Chalna to almost Harbaria, which might contribute to the high concentration of COD.

79. During the pre-monsoon season, the COD concentration was found to be higher as this season has insignificant rainfall comparing to those of other seasons and which actually increased the density of organic matter. Comparing the 3 different areas (definition is in section 1.1.2) among all the seasons, COD concentration was higher in the Sundarbans as it receives high amount of organic matter from the forests.

80. 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: 2.11** and the dataset are provided in Table B.6 of Appendix- IV.

(c) Nitrate, Sulphate and Phosphate

81. In the last monitoring, NO_3^- concentrations varied from 2.2 to 7.1mg/L. The maximum concentration was 7.1mg/L, recorded at the Left Bank of Passur River at project jetty site. This may be due to dumping of bilge water from numerous ships and fishing boats. On the other hand, the lowest value of 2.2mg/L was recorded at Akram point. The results obtained from all the monitoring locations were found to be within the standard concentration stated in ECR'1997. 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). High nitrate concentration was found in monsoon period across the Passur-Sibsa RS which would be the result of surface run-off, agricultural run-off, atmospheric deposition and domestic wastes dumping together with industrial pollution from upstream.

82. Naturally, SO_4^{2-} concentration is higher in seawater as well as in coastal river due to tidal interactions with water bodies. The monitored dataset substantiates this fact i.e., SO_4^{2-} concentration of Passur-Sibsa RS increases in the direction of upstream to downstream. This time sulphate showed spatial variations indicating altered the direction of higher concentrations towards downstream. However, all the observed values of Sulphate (SO_4^{2-}) were found within the standard limit of 400mg/L specified in ECR, 1997. In monsoon and post monsoon seasons, SO_4^{2-} concentrations were comparatively low, which would be due to dilution by upstream fresh water flow.

83. PO_4^{3-} concentrations were found in between 0.36 and 15.0mg/L, which were relatively similar to those of post-monsoon in the previous year excepting that of Maidara River near township area. In Maidara, phosphate concentration increased 3 folds compare to the last season monitoring result. High PO_4^{3-} at the township area would be due to the agricultural runoff together with fishery activities and surface runoff from the land development enhancement. However, all other monitoring sites confirmed the compliance with standard limit of 6mg/L, specified for 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*. Similarly, fertilizers and phosphates in agriculture fields and detergents used in households would be other the sources of inorganic phosphates in the river water especially at Maidara. The findings are also been supported by Tiwari and Nair, 1993.

84. The average NO_3^-, SO_4^{2-} and PO_4^{3-} concentrations at different monitoring locations of the 14 consecutive monitoring periods are shown in **Figures: 2.12, 2.13 and in 2.14** and all the observed dataset are given in **Table B.11, Table B.12** and T**able B.13** of **Appendix- IV**.

(d) Heavy Metals

85. Previously, it has earliar been revealed that Arsenic (As) concentrations varied between 0.001 to 0.003 mg/L. During this monitoring, the results again found similar. Though there were some seasonal variations in As concentrations, but still As concentration complies with the drinking quality standard of WHO (0.01 mg/L). The Bangladesh limit is as high as of 0.05 mg/L.

86. 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 winter season. During 14th monitoring period, the lowest concentration of Pb (0.001mg/L) was observed at the right bank of Passur River in the South West corner of the Project boundary and at the project jetty site. In contrary, the highest concentration of 0.02mg/L was found in Passur River at Hiron point. This would be due to the dumping of bilge water from large ships, which were found to be anchored at the site.

87. The values of Hg (Mercury) revealed a continuous consistency among all the spots in all the seasons. The values never exceeded 0.00015mg/L. All the observed data found to be within the Bangladesh standard limit set by the ECR, 1997 of Bangladesh.

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

(f) Oil and Grease

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

90. During monsoon and post monsoon periods, the concentration of oil and grease were found lower than that of winter and pre-monsoon season. It appears from the data that Passur and Sibsa river system recorded high concentration of oil and grease in winter period in 2014, which might be due to accidental oil spillage occurred on 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 km^2 (Welle, 2014).

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

2.2.3 Status of the Groundwater quality

In-situ tested parameters

a) pH and Temperature

92. The values of pH and temperature of groundwater in the observed locations complied with the drinking water quality standards as specified in ECR, 1997. The pH values during 15th monitoring program were found to vary from 6.9 to 7.2, while temperature were found to vary between 22.9°C and 23.8°C. 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 o the previously obtained respective season's data. The fifteen consecutive monitoring results of pH and temperatures of selected locations are presented in F**igure: 2.17** and **2.18** and all the observed dataset are attached in **Table B.17** of **Appendix- IV**.

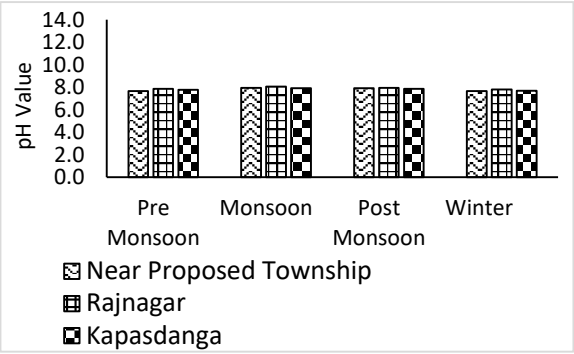


Figure 2.17: Variations in average pH values in sampling spots for the consecutive seasons

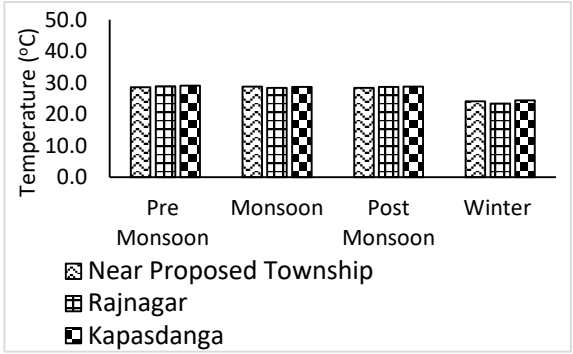


Figure 2.18: Variations in average temperature in sampling spots for the consecutive seasons

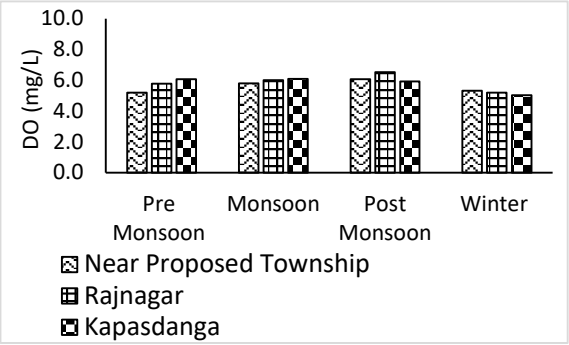


Figure 2.19: Variations in average DO values in sampling spots for the consecutive seasons

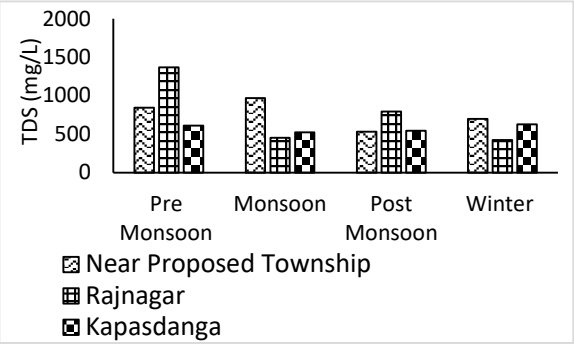


Figure 2.20: Variations in average TDS values in sampling spots for the consecutive seasons

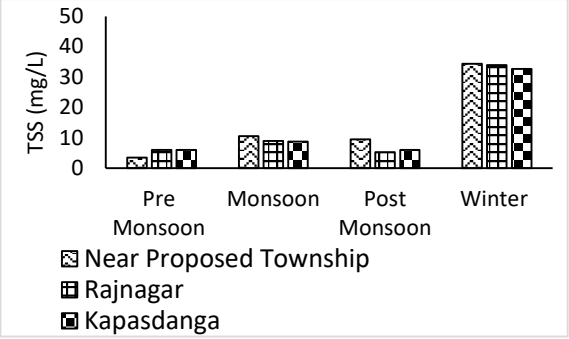


Figure 2.21: Variations in average TSS values in sampling spots for the consecutive seasons

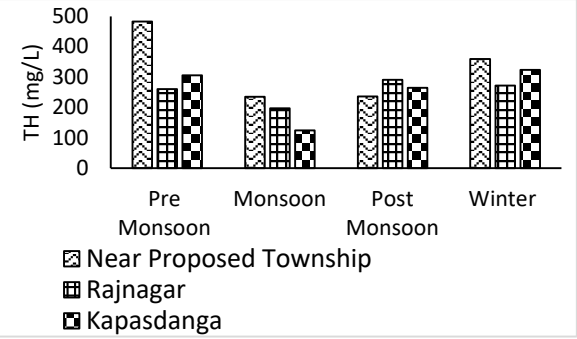


Figure 2.22: Variations in average TH values in sampling spots for the consecutive seasons

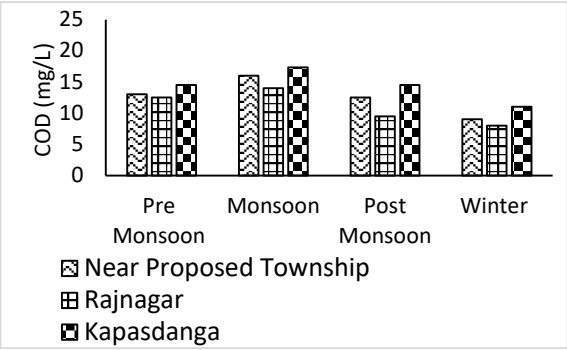


Figure 2.23: Variations in average COD values in sampling spots for the consecutive seasons

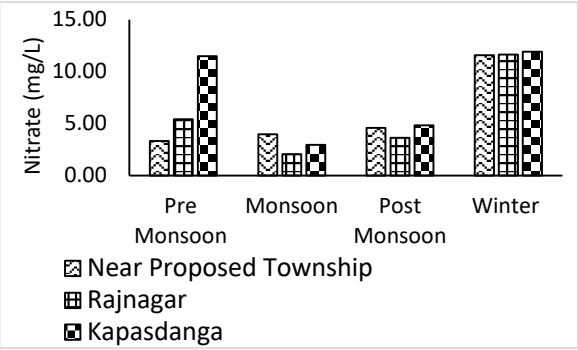


Figure 2.24: Variations in average Nitrate values in sampling spots for the consecutive seasons

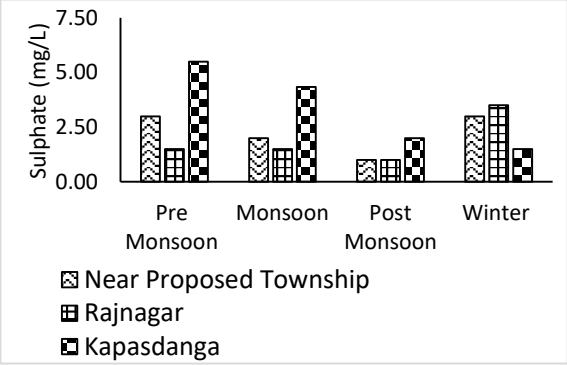


Figure 2.25: Variations in average Sulphate values in sampling spots for the consecutive seasons

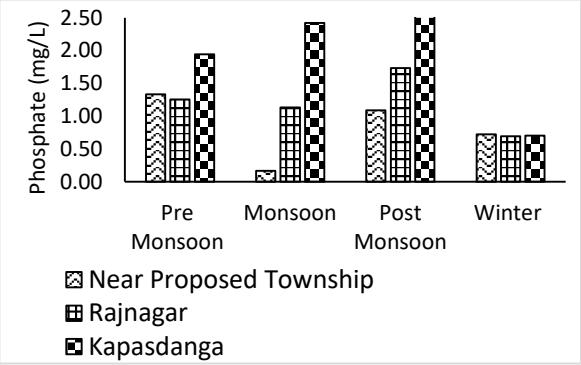


Figure 2.26: Variations in average Phosphate values in sampling spots for the consecutive seasons

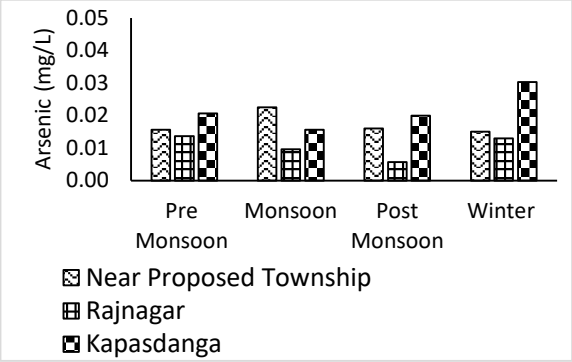


Figure 2.27: Variations in average Arsenic values in sampling spots for the consecutive seasons

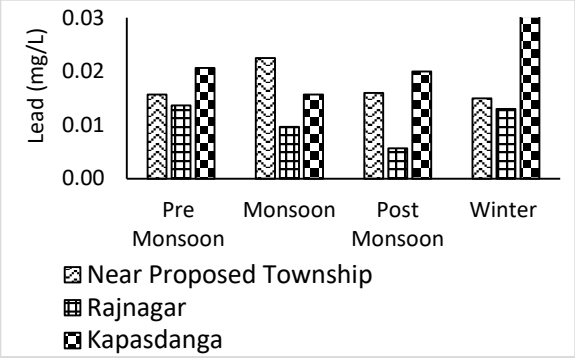


Figure 2.28: Variations in average Lead values in sampling spots for the consecutive seasons

b) Salinity and Dissolved Oxygen (DO)

93. Groundwater salinity concentration in all the monitoring locations were found to be negligible and in most of the cases below the minimum detectable limits in all the consecutive monitoring seasons. During this monitoring season, groundwater salinity of Rajnagar and Kapashdanga were found 0.3ppt and 0.4ppt respectively. This slight changes of groundwater salinity might be probably due to shortage of freshwater availability during winter along with increased salinity concentration of river water.

94. DO ranged between 4.26 mg/L to 5.2 mg/L during this monitoring season. Though DO concertation were found slightly lower than the recommended ECR, 1997 (6.0mg/L), however, it is still drinkable. A slight low DO in water can only reduce the taste of water. Higher DO values make water tastier but causes corrosion to the supply pipe.

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

c) TDS, TSS and TH

96. The highest value of 996mg/L was recorded in Rajnagar and the lowest in Kapasdang (390mg/L). It is Mentionable that, the TDS concentrations were found within the Bangladesh standard limit of 1000 mg/L (ECR, 1997) in all the monitoring periods excepting the first quarterly monitoring periodWhen the TDS concentration was was found highest at Rajnagar showed high TDS concentration only.

97. Total Suspended Solids (TSS), also known as non-filterable residue, are the solids (minerals and organic material) which remain trapped on a 1.2µm filter (U.S.EPA, 1998). Among all the monitoring seasons the values were found much higher (**Figure 2.21**) in winter season which would be due to lack of freshwater availability for groundwater recharging. In addition, evaporation have also condensed the water along with its suspended matters. During this monitoring period, the concentrations among all the locations varied in between 8 and 10mg/L, which complied with the Standard for Drinking Water, Bangladesh (TSS: 10mg/L, ECR, 1997).

98. TH concentrations of the three monitored spots varied from 145 to 240mg/L. The maximum value was found in Rajnagar while the lowest in Township area near the Project site. The values were found lower than the standard limit (200-500 mg/L) set by the ECR 1997 during this monitoring period as well as in all other seasons. So far, no incidents of weathering of Ca^{2+} bearing minerals or excessive application of lime was found during the monitoring period which could cause excessive amount of TH in groundwater.

99. Groundwater TDS, TSS and TH values of the consecutive monitoring periods in all the monitoring periods are presented in **Figure: 2.20, 2.21** and **2.22** and all observed dataset are attached in **table B.19** and **Table 20** of A**ppendix- IV.**

d) Chemical Oxygen Demand

100. The Bangladesh standard for COD in drinking water is 4.0mg/L. COD concentrations during this monitoring period was a bit higher than the ECR, 1997 standard limit. COD in Township area and Rajnagar was twofold higher than the standard limit, of 4.0mg/L while it was four fold higher in kapashdanga. The COD concentrations of all the monitoring locations

are given in **Figure: 2.23** and all the observed dataset are attached in **Table B.21** of **Appendix- IV**

e) Nitrate, Sulphate and Phosphate

101. Nitrate values ranged between 2.5 and 4.6mg/L in this post-monsoon monitoring period. The maximum value (4.6 mg/L) was recorded in Kapasdanga while the lowest in Rajnagar. NO_3^- concentrations found in this monitoring was within ECR, 1997 limit. (10mg/L). The monitoring results indicates that, during winter all the sampling locations gets high nitrate concentration (Figure 2.24). This finding indicates that during winter all the aquifers of the observed locations may face shortage of freshwater availability.

102. During most of the time, sulphate concentrations were found less than <10mg/L among the monitoring locations. SO_4^{2-} concentration in groundwater has so far not show any pattern,c yet the results vary quiet a lot (Figure 2.25). However, SO_4^{2-} is not a problem for this groundwater as the standard of drinking quality is 400mg/L which is far high than the observed value.

103. On the other hand, the values of PO_4^{3-} were found between 1.68 mg/L and 4.70 mg/L, which was within the standard limit of 6 mg/L. In most of the season, PO_4^{3-} concentration was comparatively higher at Kapasdanga (Figure 2.26) than those of other monitoring locations. The observed NO_3^-, SO_4^{2-} and PO_4^{3-} concentrations of ground water are presented in **Figure 2.24, 2.25, 2.26** and all observed dataset are attached in T**able B.22** of **Appendix- IV.**

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

104. 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 ranged between 0.01 and 0.02 mg/L which are very much within the Bangladesh standard limit (ECR, 1997). It can therefore, be concluded that, groundwater are not contaminated by arsenic pollution (**Figure 2.27**).

105. 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 showed only spatial variation to some extent. However, the water of the tube-wells was found suitable for drinking purpose in terms of metal pollution status.

106. The observed values of As and Pb in all the monitored locations are presented in **Figure: 2.27** and **2.28** and all the observed dataset for these 3 parameters are provided in Table B.23 of Appendix-IV. .

2.3 Land Resources

2.3.1 Methodology

Monitoring Indicators

107. Monitoring of the 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.

Sampling Frequency

108. The frequency of monitoring for land resources data collection was considered twice in a year. Accordingly, the plot use data was collected in the 14th monitoring program during June, 2017 to October, 2017.

Location

109. The selected mauzas are Baranpara (E-89°30′59.1″, N-22°37′57.0″) of Batiaghata upazila, Chunkuri-2 (E-89°32′20.0″, N-22°34′51.0″) of Dacope Upazila, Kapalirmet (E-89°36′8.8″, N-22°32′18.9″) of Mongla upazila, Chakgona(E-89°34′25.3″,N-22°34′18.3″) of Rampal upazila and Basherhula (E-89°34′25.0″, N-22°36′14.0″) of Rampal upazila under Khulna and Bagerhat districts as stated in **Table 2.8**. Locations of collected soil samples are presented in **Map 2.4**

Table 2.8: 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 fieldsampling and Laboratory Testing in SRDI
2		Mauza:Chunkuri-2,Union:Bajua Upazila: Dacope, District :Khulna	E-89°32′20.0″	N-22°34′51.0″		
3		Mauza: Kapalirmet/Buridmial Union: Burirdanga, Upazila: Mongla District: Bagerhat	E-89°36′8.8″	N-22°32′18.9″		
4		Mauza: Chakgona, Union: Rajnagar Upazila: Rampal, District: Bagerhat	E-89°34′25.3″	N-22°34′18.3″		
5		Mauza: Basherhula, Union: Rajnagar Upazila: Rampal, District: Bagerhat	E-89°34′25.0″	N-22°36′14.0″		

2.3.2 Process of Soil Samples Collection

Plot Selection

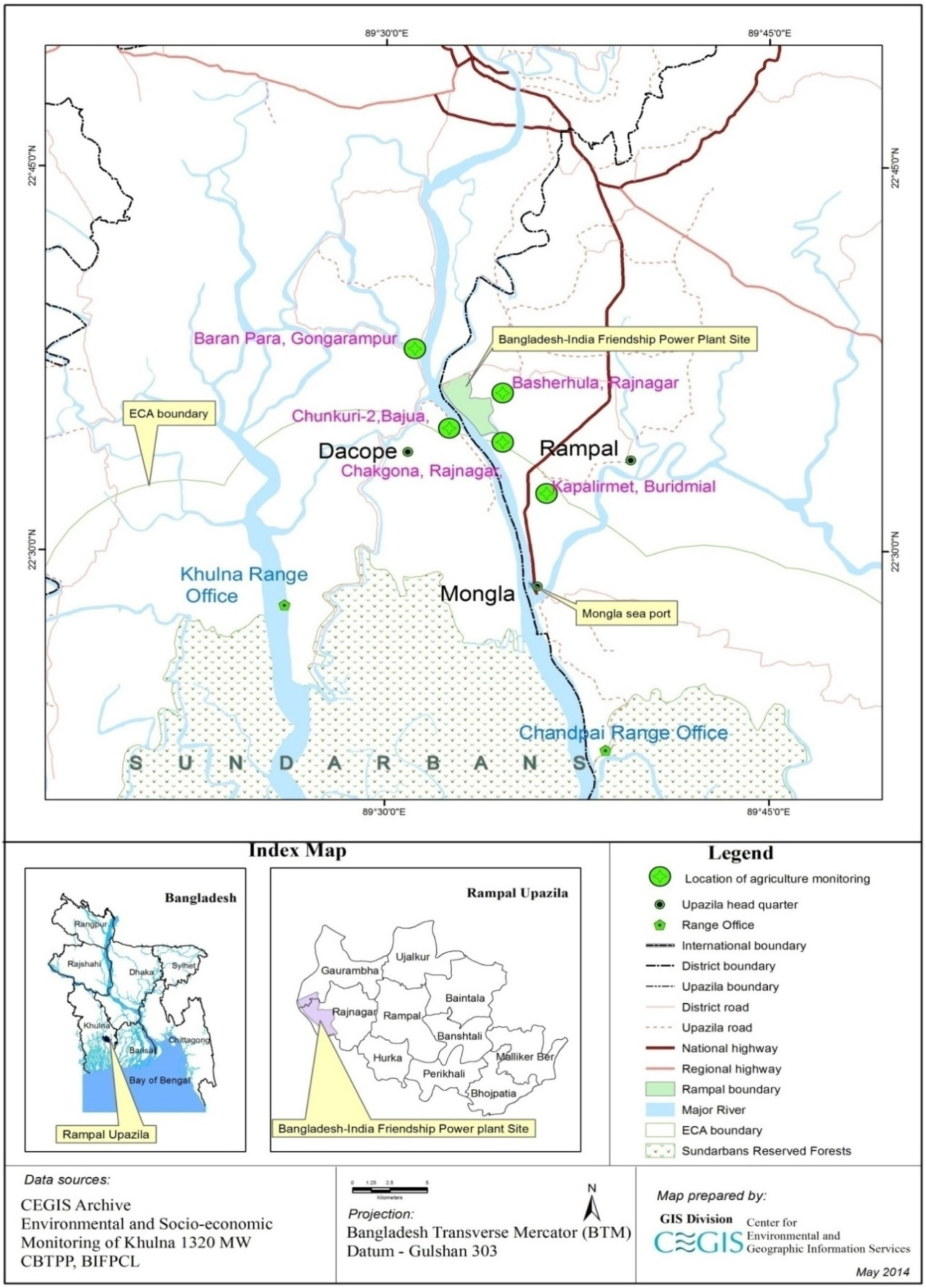
110. Monitoring plots were selected through group discussions, especially with the plot owners and experts such as Upazila Agriculture Officers of Batiaghata and Dacope of Khulna, Rampal and Mongla of Bagerhat District and Senior Scientific Officer of Soil Resource Development Institute (SRDI) of Khulna. Wind speed and wind direction was also consideringthe potential locations for the monitoring purpose. All the selected plots were characterized as medium high land (F_1), which are normally flooded in the range of 30-90 cm and remain inundated for more than two weeks to few months during the flood period.

Soil Samples Collection

111. Soil samples were collected following the standard practices of composite method. The samples in each plot were collected using augur from three dug pit. From each pit, three soil samples were collected from three different depths (0-15cm, 15-30cm and 30-45cm) and then mixed properly to make a composite sample. After that a 500g of soil mass was taken and stored into an air tight poly bag for laboratory analysis. However, continuous monitoring of these plots has given an opportunity to observe the seasonal change of the indicators of each locality. The selected indicators are soil reaction (pH), soil salinity (EC), Organic matter (OM), base cations-Ca, Mg, K and Na, status of macro nutrients (N, P and S), status of micro nutrients (B, Fe, Mn and Zn) and presence of heavy metals (Pb and Cd).

Laboratory Analysis

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



Map 2.4: Land Resource Monitoring Locations

2.3.3 Status of Soil Quality of Monitoring Plots

113. The analyzed results of dry and wet seasons of 2016-17 were compared with the previously monitored periods and provided in this 15th monitoring report. Location wise seasonal variations for these indicators are described in the following sections. The parameter considered in the earlier monitoring studies were also considered in this quarter as well. The results of the monitoring plots of dry and wet seasons of 2016-17 are provided in the following sections and in Table C.1 of Appendix IV.

Monitoring Plot-1 (Baranpara)

114. It has been observed that, the overall values of Ec has reduced significantly from 7.40 (ds/m) to 0.88 (ds/m) in wet season. Similarly, pH has increased from 6.74 to 7.0 in wet season than the same season of 2016-17as, this is a poldered area and most of the openings of this locality were found confined. In addition, soil salinity has decreased and the values of pH has increased in the wet season. This might be due to repeated flushing of land by rain water in monsoon period. Though the rain water can dissolve a portion of salt, but is not sufficient in terms of dropping the overall salinity of a vast area. However, it might be an impact of polderization of that locality.

115. In terms of organic matter concentration of the soil, increasing pattern from 1.30% to 2.03% was found in the entire layer. This might be happened due to use of Rice straw and Bajua grass to improve the soil fertility. In addition, repeated precipitation also influenced the improvement of the soil fertility level.

116. Sulfur content was found significantly higher (238.12 µg/gm) whereas the other nutrient e.g. Ca (4.56 meq/100g), N (0.10%), K (0.60 meq/100g), P (5.22 µg/gm), Mg (2.62 meq/100g), and Na (6.89 meq/100g), was found lower in wet season than those found in dry season of 2016-17. Moreover, Mg content might be suppressed by Ca intrusion as both of them are divalent cations. On the contrary, Micro nutrients contenti.e. Fe (76.48 µg/gm) was found significantly higher whereas B (1.23 µg/gm), Mn (6.66 µg/gm) and Zn (2.87 µg/gm) were found lower than the dry season of 2016-17.

117. It might be due to the reduction in salinity level. It has also been found that all the micronutrients have decreased in wet season than that of the dry season, which may be an effect of leaching and percolation during wet season. Highest concentration of Pb (22.55 µg/gm) was found in top soil though it was found in every layer. It was also observed that, concentration of Pb was minimum in wet season than that of those dry season. The analysis results of soil were matched with the Indian Guidelines for agricultural soil [mgkg-1/dry weights] to know the Maximum Acceptable Concentrations (MAC) of the trace as well as of heavy metals, as there is no such research in Bangladesh. Concentration of Pb in the leachate did not exceed the permissible limit of Indian Guidelines for nutrient contents in agricultural soil. Similarly, Cd was not found in any layers in the monitoring plots in 2016-17 and have not crossed the standard limit too, as compared with the Indian Guidelines for agricultural soil. Similar results have also been observed by *Awashthi, 2000* and Pendias et. al., 1992. All the monitoring findings are presented in **Table C.1** of **Appendix IV**.

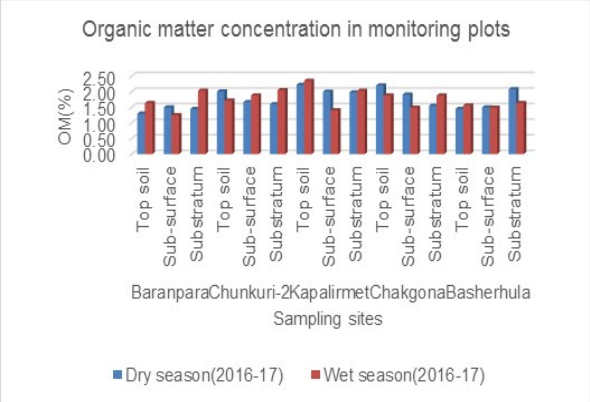


Figure 2.29: Organic matter concentration at the sampling plots (seasonal variation, 2016-17)

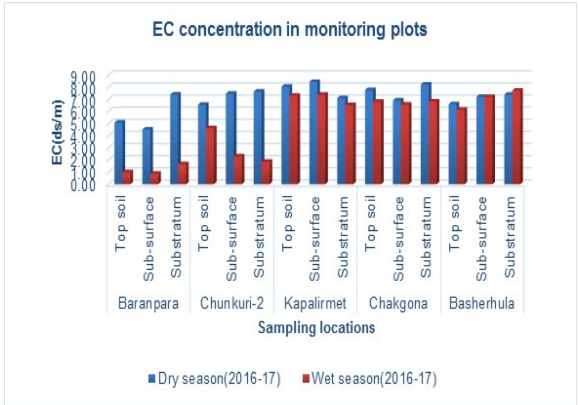


Figure 2.30: Ec concentration at the sampling plots (seasonal variation, 2016-17)

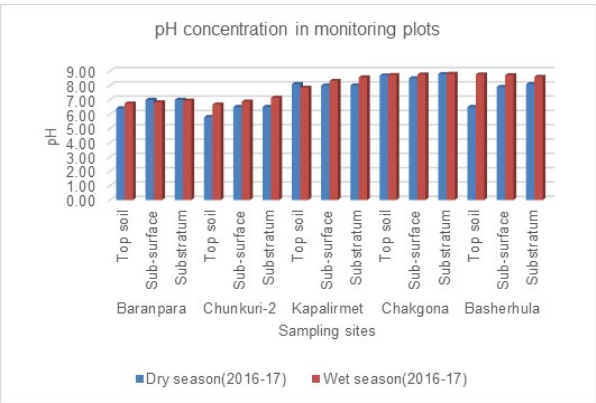


Figure 2.31: pH concentration at the sampling plots (seasonal variation, 2016-17)

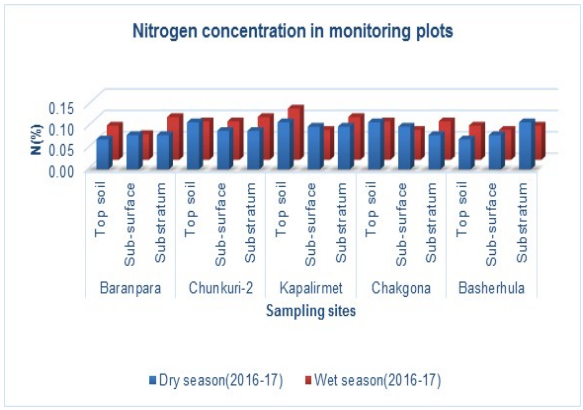


Figure 2.32: Nitrogen concentration at the sampling plots (seasonal variation, 2016-17)

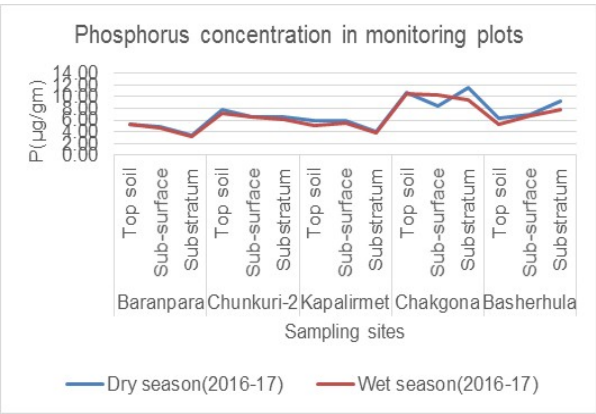


Figure 2.33: Phosphorus concentration at the sampling plots (seasonal variation, 2016-17)

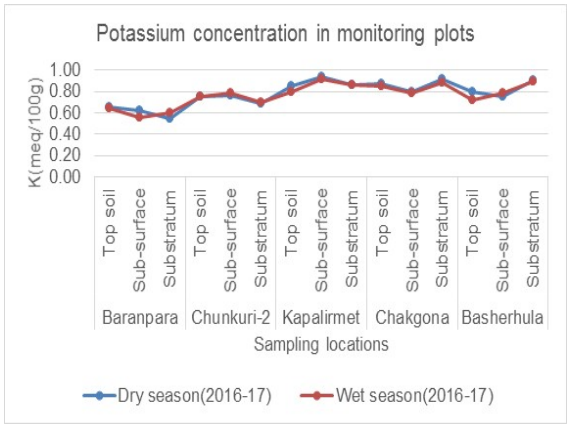


Figure 2.34: Potassium concentration at the sampling plots (seasonal variation, 2016-17)

Monitoring Plot-2 (Chunkuri-2)

118. The Ec content in this plot has significantly reduced from 7.65 (ds/m) to 1.86-(ds/m) in the wet season. On the other hand, pH value has increased from 5.8 to 7.14 in the wet season than the dry season. In addition, the organic matter concentration of the soil, an increasing pattern was observed (from 1.60% to 2.05 %) and this might be due to organic matter restoration in the monitoring land. On the contrary, the Macro nutrients i.e. N (0.10 %), P (7.20 µg/gm), S (278.15 µg/gm), Ca (11.55 meq/100g) and Na (6.27 meq/100g) were found to be decreased while K (0.78 meq/100g) and Mg (3.09 meq/100g) were found increasing than those of the dry season of 2016-17. Amount of Ca might be suppressed by Mg intrusion as both of them are divalent cations. However, Micro nutrients, B (1.26 µg/gm), Mn (6.60 µg/gm) and Zn (1.55 µg/gm) were found lower and Fe (74.05 µg/gm) was found higher than the dry season of 2016-17 the reason of which might be due to leaching and percolation process in wet season and found enough to dissolve the content. Lead was found in all the layers and the highest value (15.9 µg/gm) was found in the top soil. All the nutrients concentration were found within the standard limit. The monitored data is attached in **Table C.1** of **Appendix IV**.

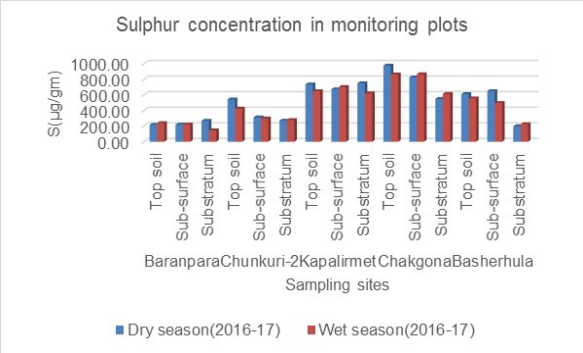


Figure 2.35: Sulphur concentration at the sampling plots (seasonal variation, 2016-17)

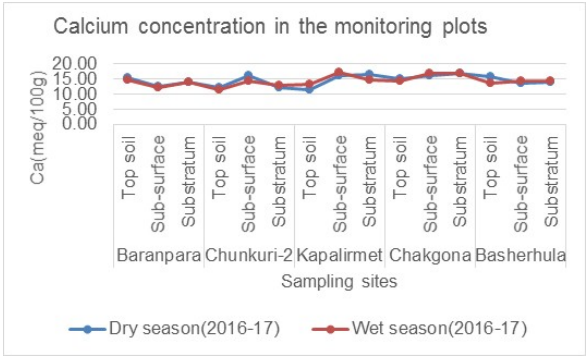


Figure 2.36: Calcium concentration at the sampling plots (seasonal variation, 2016-17)

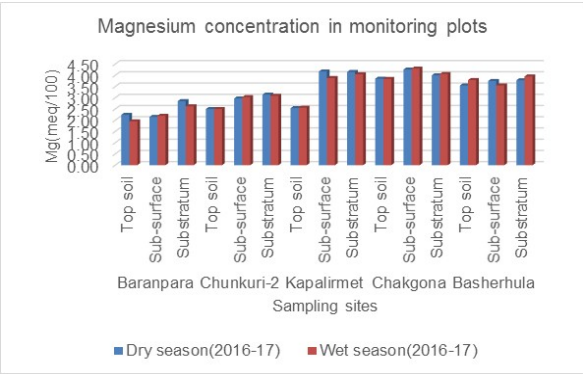


Figure 2.37: Magnesium concentration at the sampling plots (seasonal variation, 2016-17)

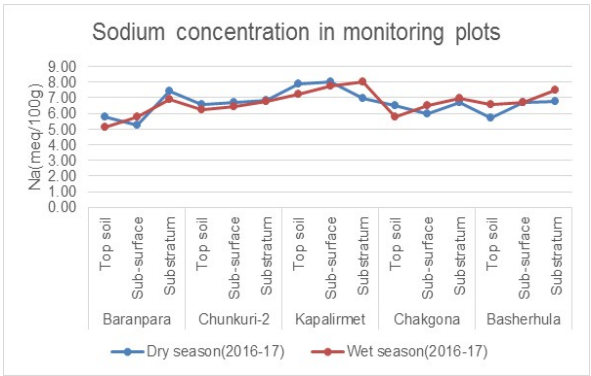


Figure 2.38: Sodium concentration at the sampling plots (seasonal variation, 2016-17)

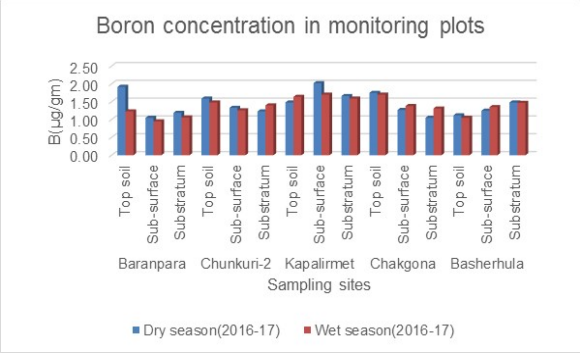


Figure 2.39: Boron concentration at the sampling plots (seasonal variation, 2016-17)

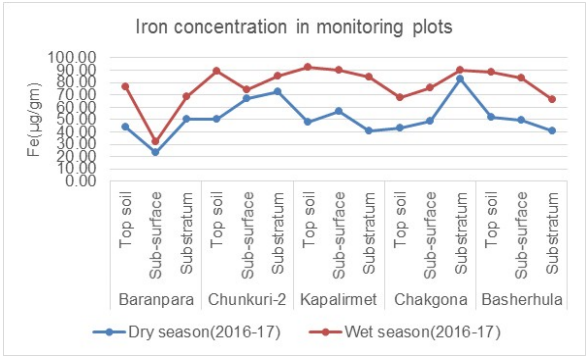


Figure 2.40: Iron concentration at the sampling plots (seasonal variation, 2016-17)

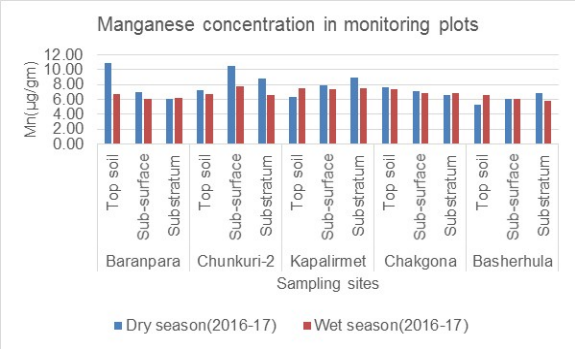


Figure 2.41: Manganese concentration at the sampling plots (seasonal variation, 2016-17)

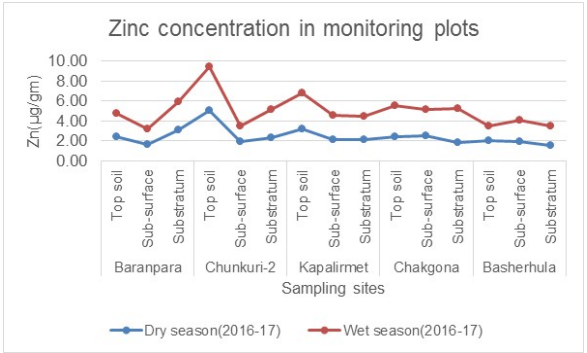


Figure 2.42: Zinc concentration at the sampling plots (seasonal variation, 2016-17)

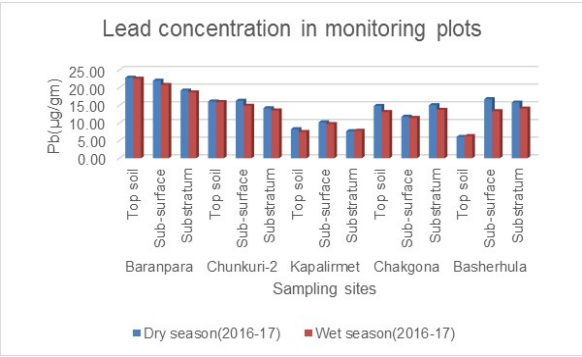


Figure 2.43: Lead concentration at the sampling plots (seasonal variation, 2016-17)

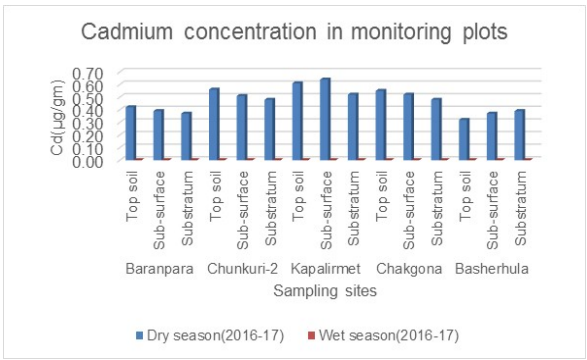


Figure 2.44: Cadmium concentration at the sampling plots (seasonal variation, 2016-17)

Monitoring Plot-3 (Kapalirmet)

119. Soil salinity in coastal belt generally decreases in wet season. Ec has slightly decreased from 8.44 (ds/m) to 7.39 (ds/m) in this wet season than the dry season of 2016-17. On the other hand the pH level has slightly increased to 8.57 from 8.1 in the wet season which could be an impact of shrimp culture in this zone. Aman was the only crop of Kapalirmet but its practice was very limited. Moreover, an increasing pattern (2.35% from 1.98%) of organic matter concentration was found in wet season of monitoring period.

120. Macro nutrient i.e. N (1.2 %) was found to be increasing while P (3.92 µg/gm), K (0.80 meq/100g), Ca (13.10 meq/100g), Na (7.20 meq/100g), Mg (2.56 meq/100g) and S (620.0 µg/gm) were found decreasing over the monitoring periods. People used to store saline water for shrimp cultivation and as a consequence base cation has not been significantly changed. However, micro nutrients, Fe (92.36 µg/gm), B (1.70 µg/gm), and Zn (3.68 µg/gm) showed a increasing trend and Mn (7.50 µg/gm) showed the decreasing trend in wet season than the dry season of 2016-17. It might be due to increase in salinity, which cannot be completely diluted by rainwater. On the other hand, highest value of Pb (9.71 µg/gm) was found in subsurface layer. Cd was not observed in any layer in the monitoring plot during wet season of 2016-17.All the monitored values is presented in Table C.1 of Appendix IV.

Monitoring Plot-4 (Chakghona)

121. Salinity and pH play vital roles for distribution of elements in Chakghona. The salinity level has decreased from 8.23 (ds/m) to 6.58(ds/m) in wet season than that of the dry season respectively. Similarly, pH level significantly increased from 8.5 to 8.82 in the wet season than the dry season 2016-17. The pH level is found to be higher which helped to move up the cation concentrations. Organic matter concentration of the soil was found decreasing pattern from 2.22% to 1.49%.

122. Macro nutrients, Ca: 17.03 (meq/100g), Mg: 4.30 (meq/100g), S: 865.48 (µg/gm) and Na: 6.95 (µg/gm) was found significantly increased while N: 0.9%, K: 0.79 (meq/100g), P: 9.47 (µg/gm) had a decreasing trend. This scenario indicates that sulphur has replaced other cations from clay.

123. Micro nutrients, Fe: 90.15 (µg/gm), B: 1.70 (µg/gm) and Zn: 3.47 (µg/gm) was found significantly higher while Mn: 6.90 (µg/gm) was found in decreasing trend. This is due to impact of shrimp culture in this plot. It might be due to increased salinity, which cannot be removed properly by rainwater. Highest Pb: 13.74 (µg/gm) was in substratum layer and Cd was not appeared in any layers in the monitoring plot in wet season of 2016-17. Pb and Cd concentration were observed within the limit and are presented in Table C.1 of Appendix IV.

Monitoring Plot-5 (Basherhula)

124. Level of Ec has increased from 6.60 (ds/m) to 7.39 (ds/m) in wet season than that of the dry season of 2016-17 in the monitoring plots respectively. Similarly, the pH level has increased from 6.5 to 8.77 in wet season. Level of Organic matter in the soil has decreased from 2.08% to 1.49%. The macro nutrients of this plot was found significantly reduced while Ca: 13.54 (meq/100g), Mg: 3.55 (meq/100g), Na: 6.56 (meq/100g) was found increasing trend. The overall situation indicates that there was a possibility of replacing other elements by S and Fe from clay. This area was flooded by Passur River and Basherhula Khal in rainy season.

125. Micro nutrients i.e. Fe (88.11 µg/gm), Mn (6.58 µg/gm) and Zn (2.15 µg/gm) has significantly increased while B (1.05 µg/gm) ahs decreased. It would be due to sedimentation, which was not removed properly by rainwater. In terms of heavy metal concentration, highest Pb (14.06 µg/gm) was found in the substratum layer. Pb was observed within the limit and is presented in **T*able C.1* of *Appendix IV*.**

2.3.4 Findings

126. The soil is slightly saline with the top soil having sufficient organic matter concentration. Macro and micro nutrient concentration of the soils are also sufficient, suggesting that the soil condition is good for supporting plant growth or crop production.


Monitoring plot at Baranpara,Batiaghata,Khulna


Monitoring plot at Chunkuri-2,Dacope,Khulna


Monitoring plot at Kapalirmet,Mongla,Bagerhat

Monitoring plot at Chakgona, Rampal, Bagerhat

Monitoring plot in Basherhula, Ramapal,Bagerhat

Photo 2.4: Different monitoring plot in the monitoring study area

3 Biological Environment

127. The biological resources around the project site were categorized into three major groups and monitored with an aim to understand the probable impact of proposed project on the biological rsources. These groups include fisheries resources, ecological resources and Sundarbans Reserve Forest (SRF).

3.1 Fisheries Resources

128. The monitoring of all the four quarters for the session of 2014-15, 2015-16 and 2016-17 as well as 1st and 2nd (13th and 14th in total) quarter of 2017-18 have been completed and reported earlier. This chapter contains the outcome of th 3rd quarter monitoring of 2017-18 (15th quarter in total) as well as the comparisons with the earlier fourteen (14) quarters.

3.1.1 Locations of Monitoring Sites

129. The monitoring activities were carried out in ten pre-selected locations among which seven (7) were capture fish habitat and three (3) were shrimp/fish farms (culture fish). The capture sampling sites were selected based on the available fishing ground at the upstream, mid stream and downstream of Passur River system. Shrimp/fish farms were selected based on the project influenced area. The fisheries resources monitoring locations are provided in **Table 3.1** and shown in **Map 3.1.**

Table 3.1: The Sampling Locations for monitoring of Fisheries Resources

Site	Capture Habitat Location
A	Akram Point
B	Haldikhali
C	Harbaria
D	Chandpai
E	Mongla Port
F	Maidara
G	Chalna Point, Batiaghata

SL	Culture Habitat Location
1	Bhekatkhali Khal, Rajnagar
2	Kapasdanga-Muralia
3	Chunkuri-2

3.1.2 Selection of Parameters

130. Five major components were selected in fisheries monitoring as per the TOR, which are fish habitat status, fish migration, fish diversity, shrimp/fish farm practices and fish production. Fish habitat status was monitored through investigating habitat suitability index in view of habitat classification based on length frequencies of different fish species, sensitivity of fish diversity and survival success of different life stages of fish to abiotic factors (water quality, bed material, morphological aspects and biotic factors (food cover). Fish migration status was monitored through assessing migratory fish species diversity, migration pattern, migration purpose, period and extent of migration etc. Species evenness, species richness and community structure were investigated for monitoring fish diversity. Shrimp/fish farm

practice was monitored by viewing stocking pattern, growth rate and mortality rate. Fish production monitoring was divided into capture and shrimp/fish farm production.

3.1.3 Methodology

Fish Habitat Status

131. Fish habitat status was monitored through determination of Habitat Suitability Index (HSI) by applying numerical habitat model based on the habitat classification and sensitivity of fish diversity and survival success of different life stages of fish to abiotic and biotic factors. Fish habitat classification was analyzed by calculating Ecludean Distance among sampling sties. Moreover, the similarities in species composition among the sites were analyzed using the Jaccard Index (JI) for estimating the extent of similarity between pairs of data sets. Basic life requirements for fish community are given in **Table D.1 of Appendix IV.**

Fish Migration

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

Fish Diversity

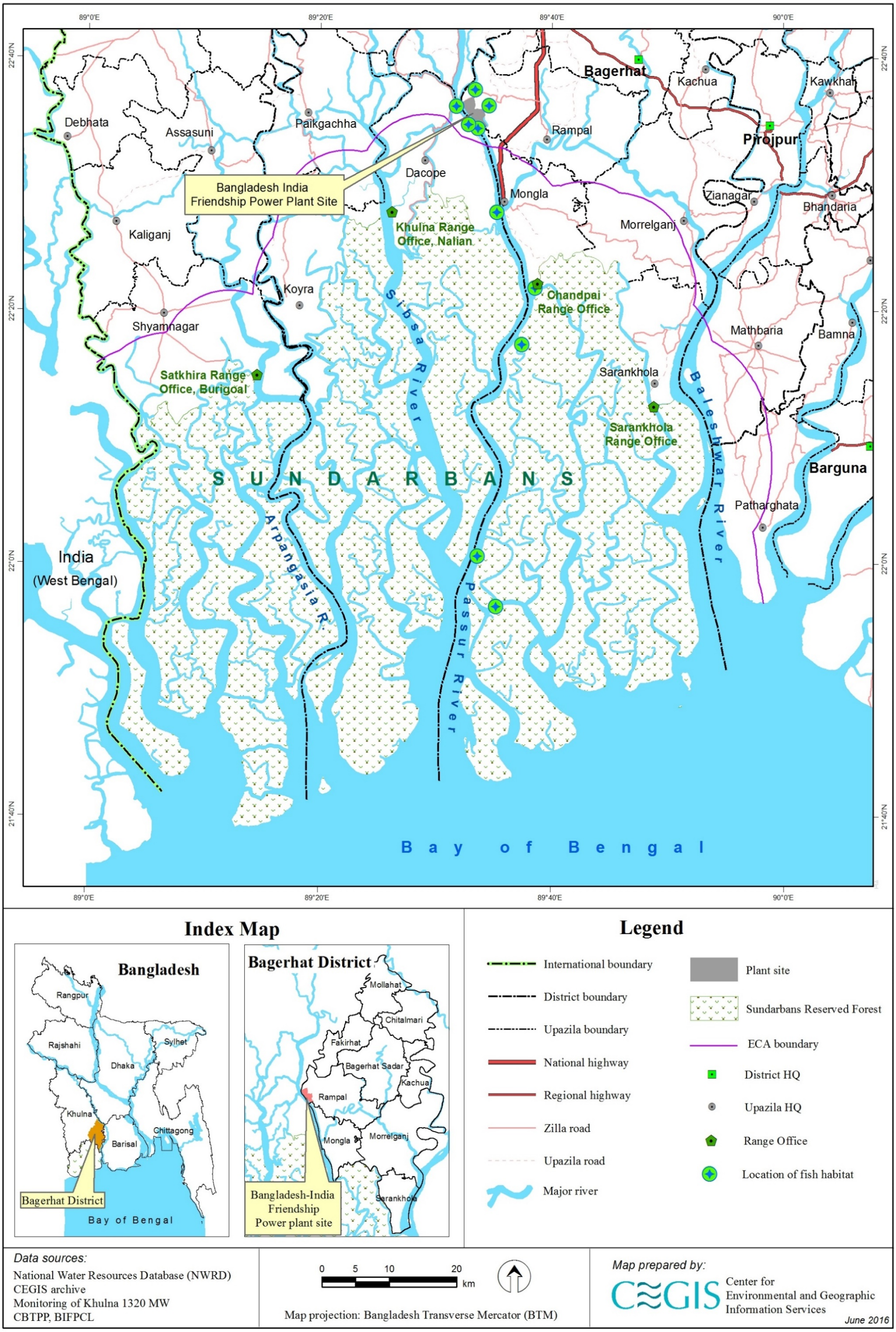
133. Fish diversity was surveyed by Catch Per Unit Effort (CPUE) method. The fish individuals were counted according to the length of each species from the samples. Diversity was estimated by analyzing Shannon-Weiner Index (ranged from 0 to 1). Fish species richness (FSR) was analyzed using the Simpson's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

134. 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 should be minimized for getting more economical output from the farms. So, stocking pattern and mortality rate and their causes were intensively surveyed.

Fish Production

135. 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.



Map 3.1: Fisheries Resources monitoring locations

3.1.4 Status of monitoring

136. Followed by the first, second, third and fourth quarter monitoring of the FY 2014-15, 2015-16 and 2016-17 as well as first and second quarter of 2017-18, third quarter monitoring of 2017-18 (15th quarter in total) was conducted during the period of 06 January to 14 January, 2018

Fish Habitat Status

137. Fish habitat status has been observed from the aspect of habitat classification and habitat use pattern of different life stages of different fish species and was found varied throughout the monitoring periods.

(a) Habitat Classification

138. 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 the abundance of different life stages of fish species in those habitats. The following tables shows the classification of seven sampling sites 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 Quarters	Type of Habitat Use
1st Quarter	• Grazing Ground • Grazing and Breeding Ground
2nd Quarter	• Grazing Ground • Spawning and Nursery Ground
3rd Quarter	• Grazing Ground • Grazing and Breeding Ground • Spawning, Nursery and Grazing Ground
4th Quarter	• Grazing Ground • Grazing and Breeding Ground • Spawning, Nursery and Grazing Ground
5th Quarter	• Grazing Ground • Nursery Ground • Spawning and Nursery
6th Quarter	• Grazing, Breeding Ground • Spawning, and Nursery Ground
7th Quarter	• Grazing Ground, • Nursery Ground and • Growing and Feeding
8th Quarter r	• Nursery and Feeding Ground • Growing and Feeding
9th Quarter	• Spawning and Nursery Ground • Feeding and Growing Ground
10th Quarter	• Nursery Ground • Feeding and Breeding Ground
11th Quarter	• Breeding and Spawning Ground • Feeding and Grazing Ground
12th Quarter	• Grazing and Spawning Ground • Nursing Ground
13th Quarter	• Grazing and Feeding Ground

Monitoring Quarters	Type of Habitat Use
	• Nursing Ground
14th Quarter	• Grazing and Feeding Ground • Nursing Ground
15th Quarter	• Grazing and Spawning Ground • Nursing Ground

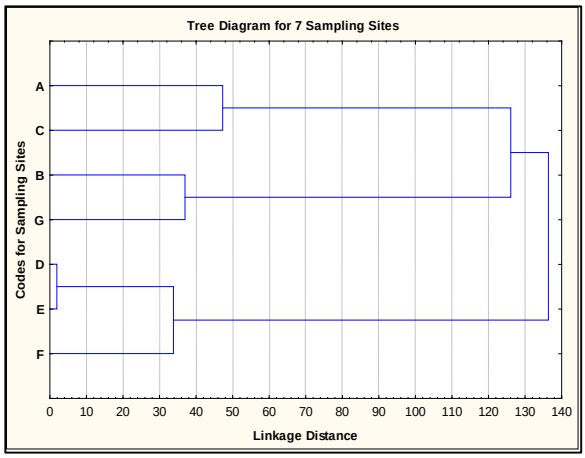
139. The two major habitats - i) Grazing and feeding ground, and ii) Nursing ground were observed during this period i.e. third quarterly monitoring of 2017-18 (15th quarter) were also as identified in the last two quarterly monitoring periods and are shown shown in the **Figure-3.1**.

Grazing and Feeding Ground:

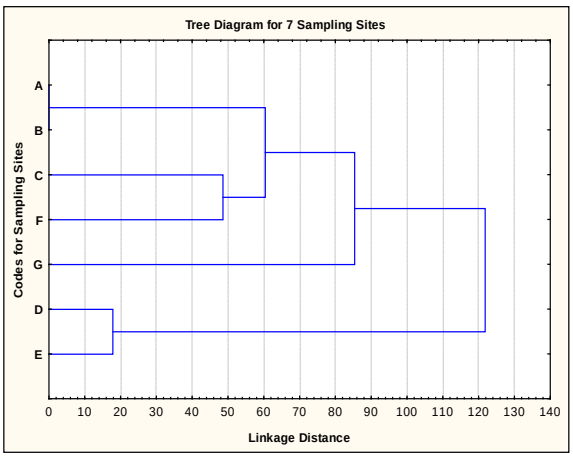
140. Among the sampling sites, Harbaria khal (C) and Sheola Khal at Chandpai (D) were identified as the grazing and feeding ground for abundance of juvenile to adult fishes.

Nursing Ground:

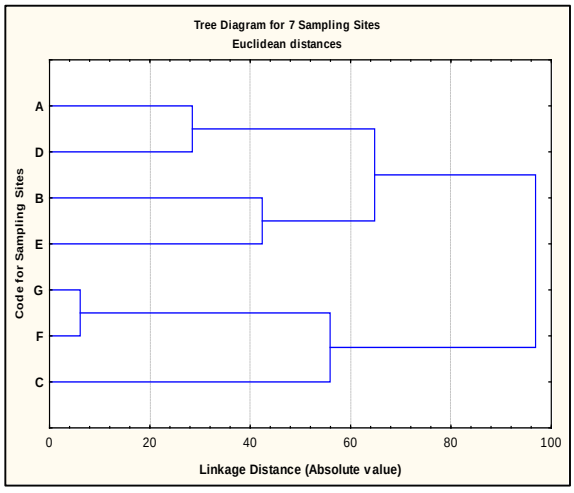
141. Among the sampling sites, mainly the Mongla-Passure Confluence (E), Maidara-Passure Confluence (F) and Chalna Point (G) were identified as the nursing ground.



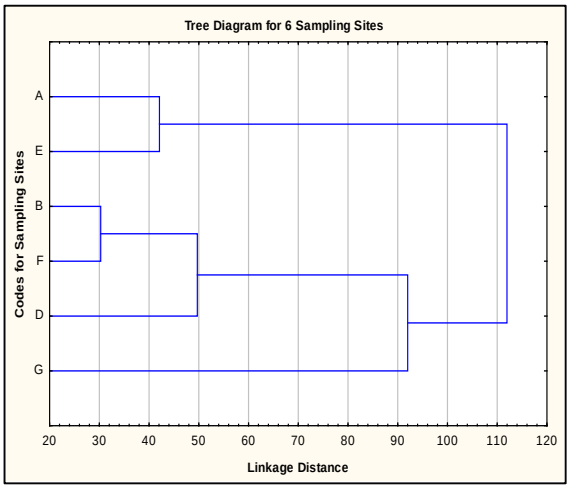
1st Monitoring, April, 2014



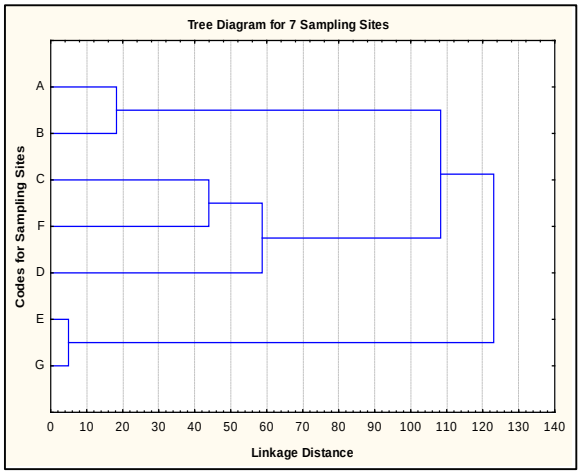
2nd Monitoring, July 2014



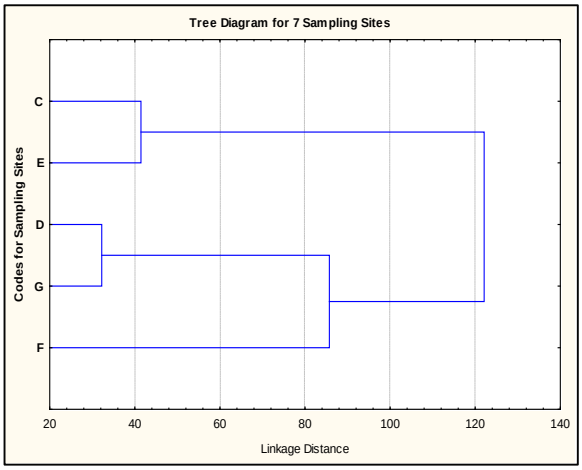
3rd Monitoring, October, 2014



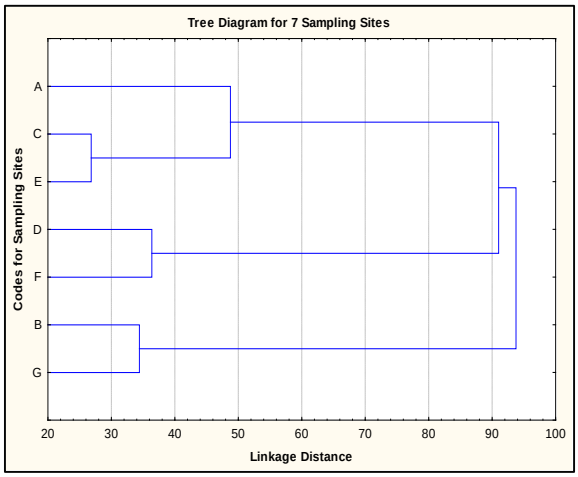
4th Monitoring, January 2015



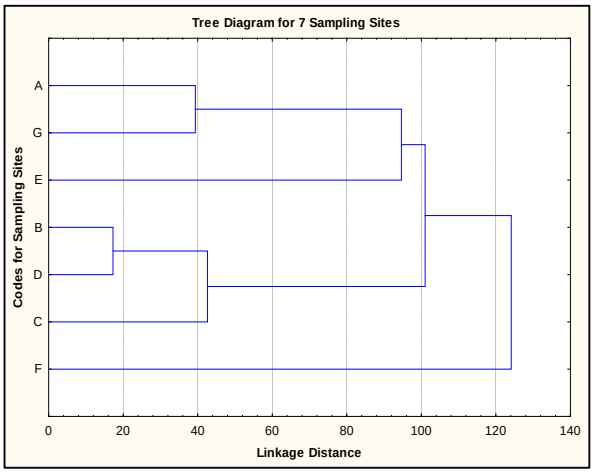
5th Monitoring, April, 2015



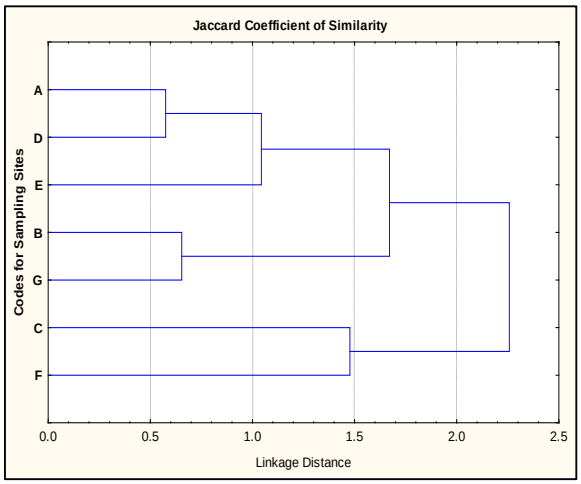
6th Monitoring, August, 2015

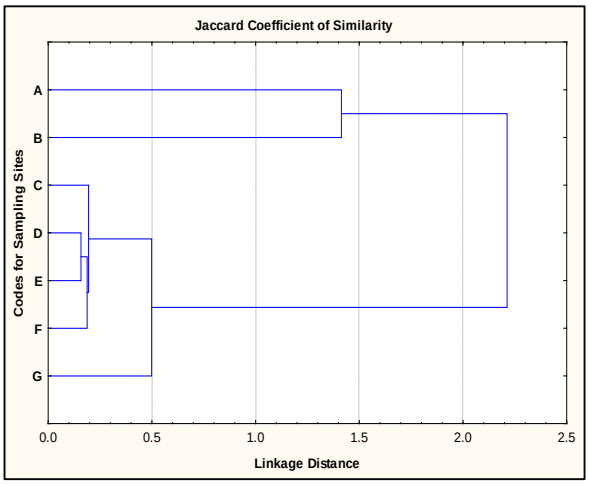


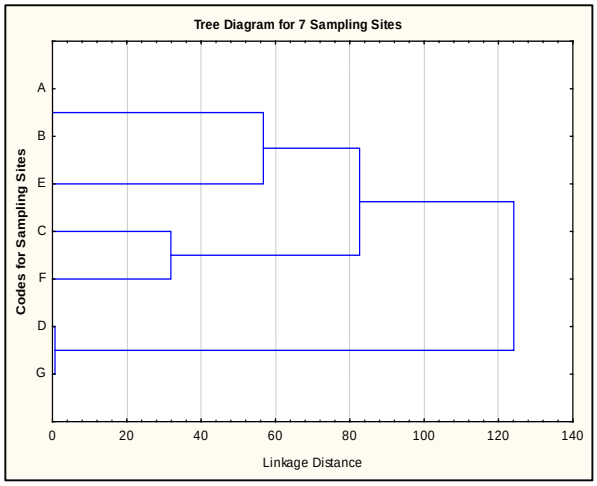
7th Monitoring, October, 2015



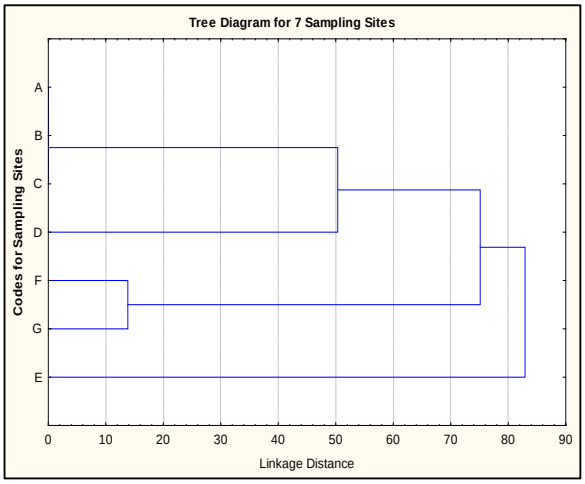
8th Monitoring, January, 2016



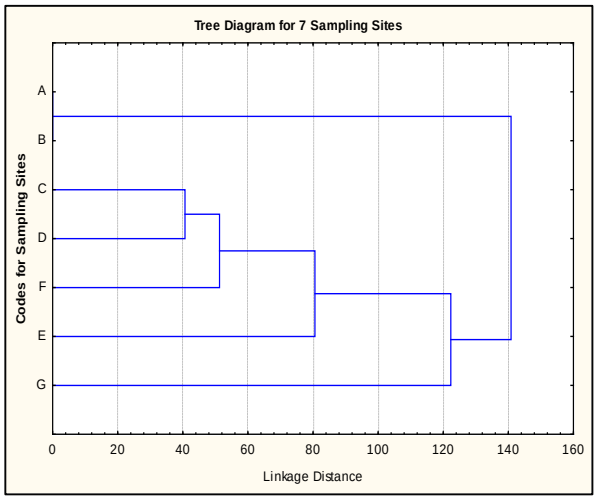




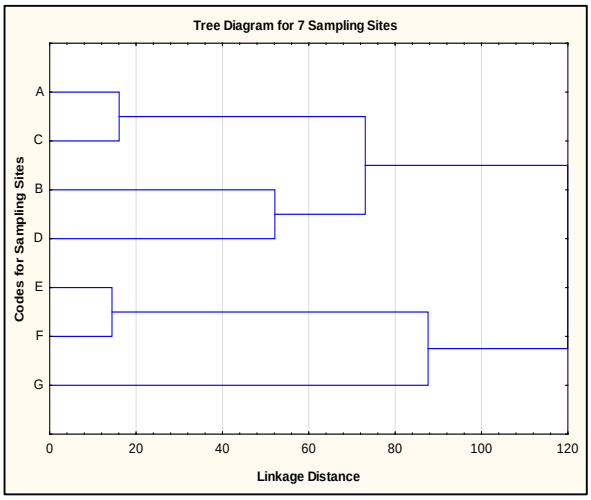
9th Monitoring, April, 2016



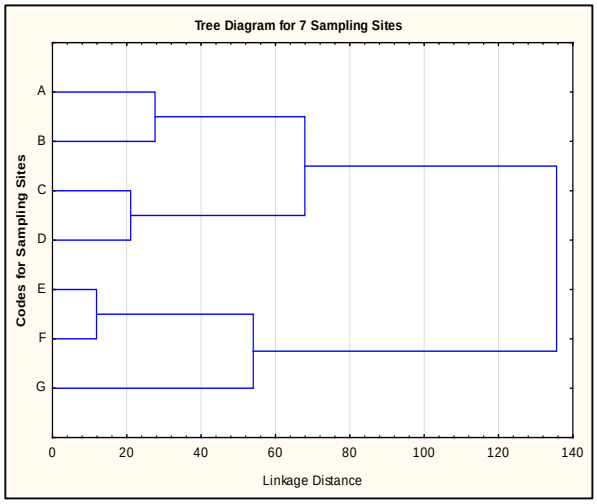
10th Monitoring, July, 2016



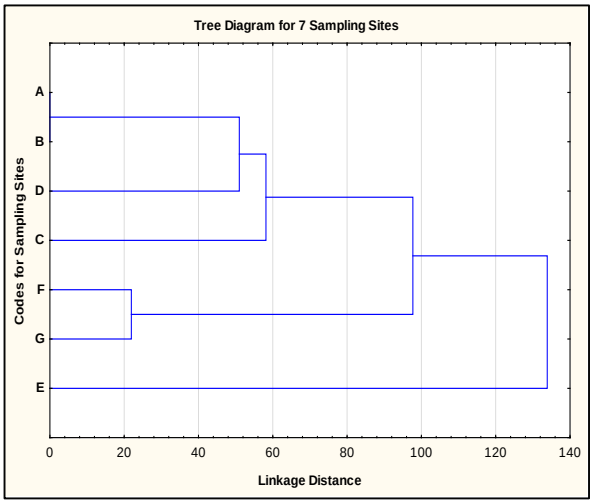
11th Monitoring, October, 2016



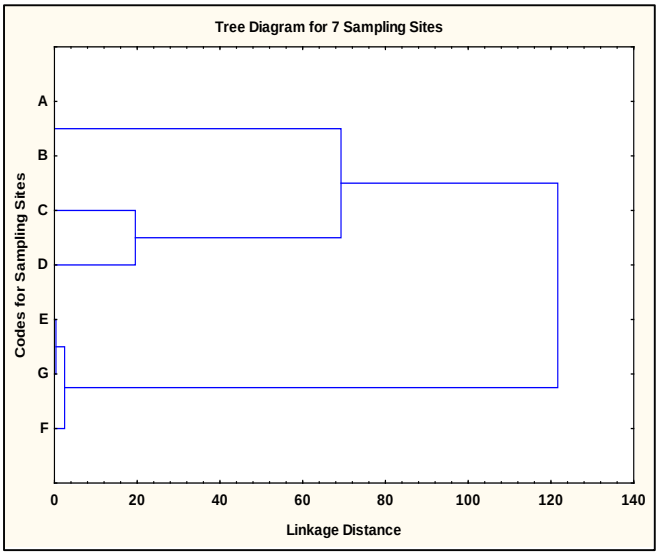
12th Monitoring, January, 2017



13th Monitoring, April, 2017



14th Monitoring, October, 2017

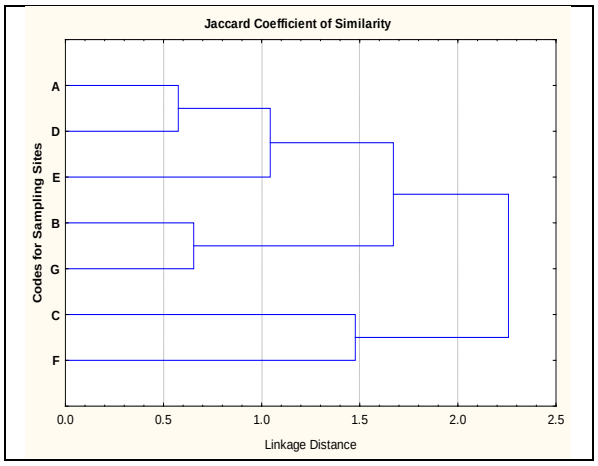


15th Monitoring, January, 2018

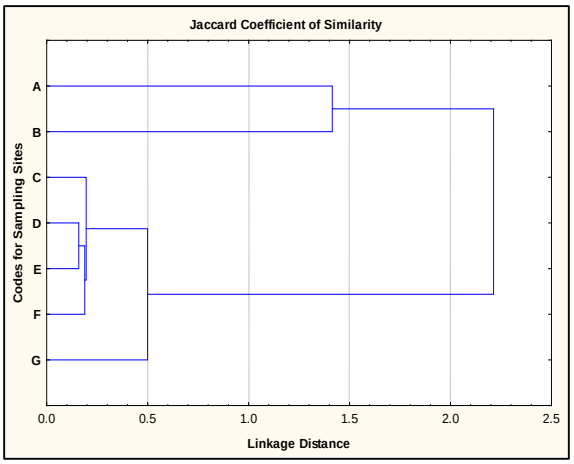
(Note: Life stage is identified through length measurement of the fish individuals)

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

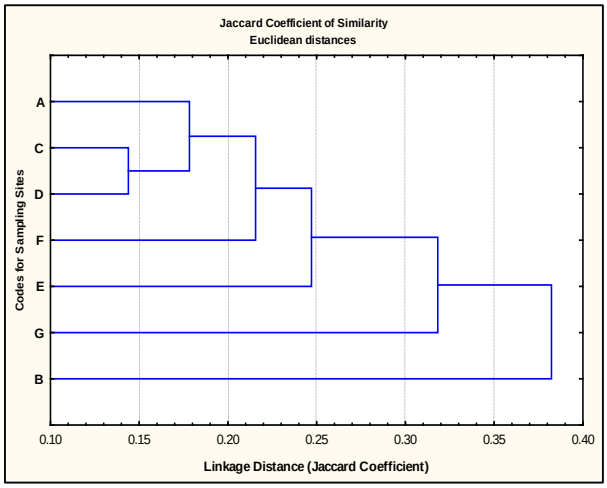
142. The dendogram is indicated the distances among the JI indices (Jaccard Coefficient Index) which are opposite to the JI values. It was found that the length-wise distribution relationship varied not only with seasons but also from year to year. In this third quarterly of the monitoring in 2017-18 (15th), the JI values between C and D sampling sites was also the highest (Figure 3.3) which indicate the maximum similarity in species occurrence between these two sites out of seven (7) sampling sites. Moreover, the length of the similarity linkage distance indicate that the species distribution was sporadic (dissimilar species occurrence) among the sampling sites as they were more or less same as found in the first, second, fourth, tenth and twelve quarter monitoring. It has been observed that fish distributions differ with different length (distance from fishing date from Full Moon), tidal condition of different seasons. Moreover, yearly variability was also being observed in fish distribution among sampling sites.



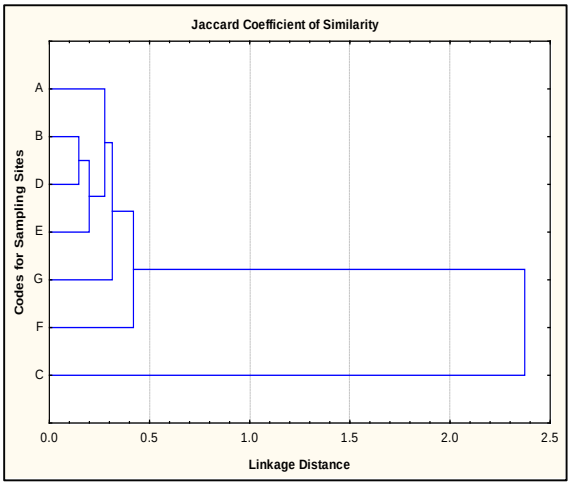
1st Monitoring, April, 2014



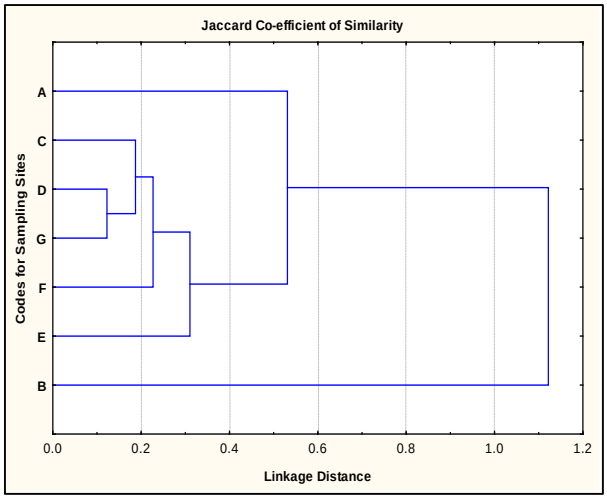
2nd Monitoring, July 2014



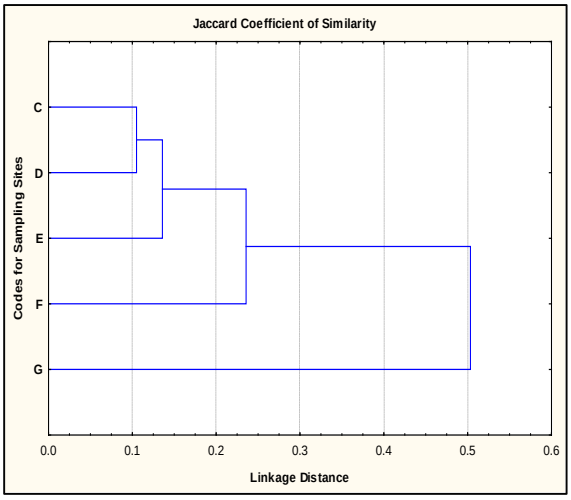
3rd Monitoring, October, 2014



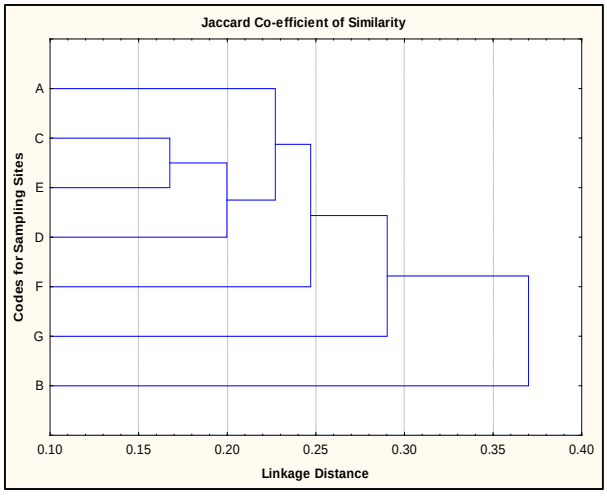
4th Monitoring, January 2015



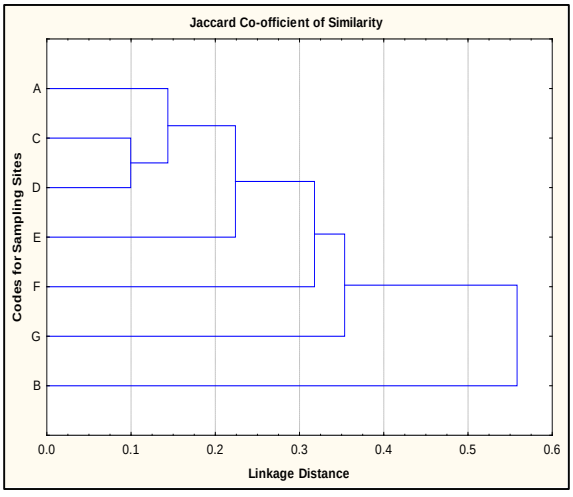
5th Monitoring, April, 2015



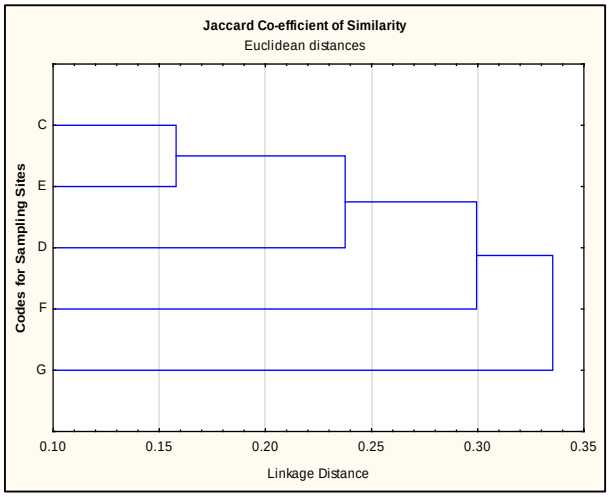
6th Monitoring, August, 2015



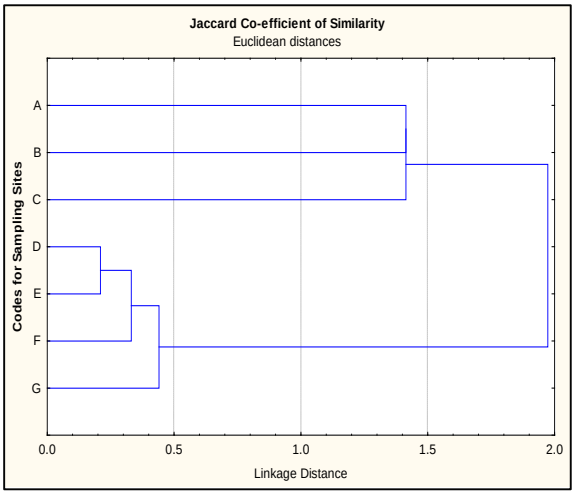
7th Monitoring, October, 2015



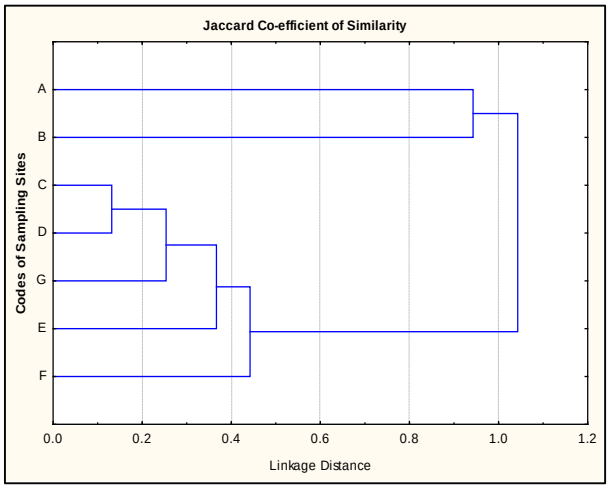
8th Monitoring, January, 2016



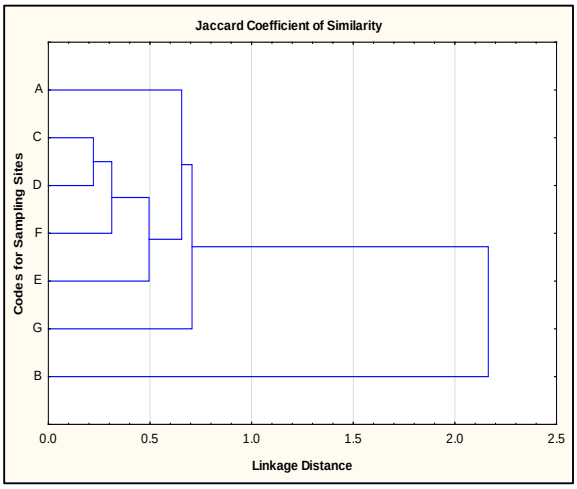
9th Monitoring, April, 2016



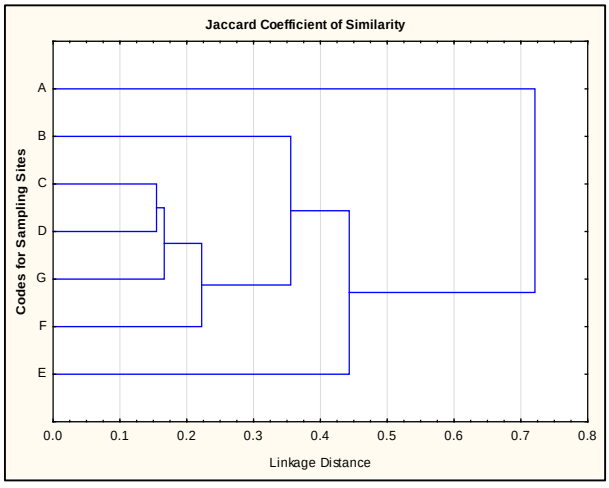
10th Monitoring, July, 2016



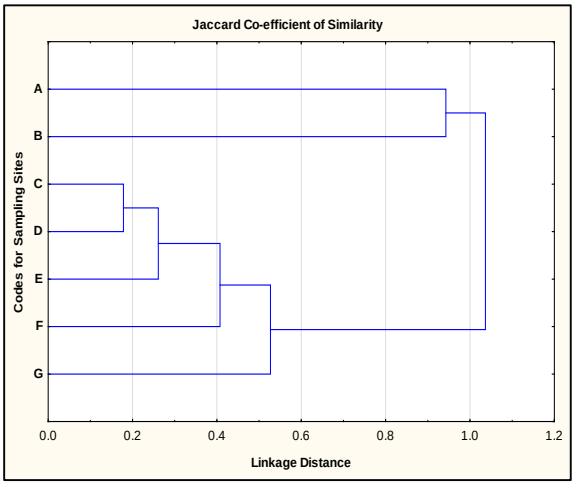
11th Monitoring, October, 2016



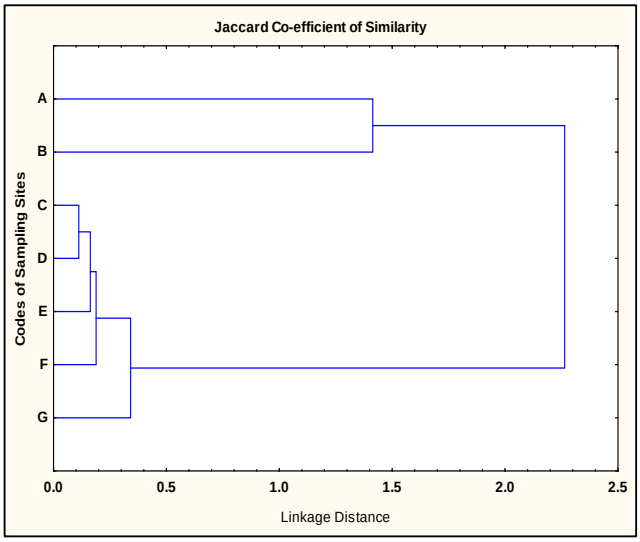
12th Monitoring, January, 2017



13th Monitoring, April, 2017



14th Monitoring, October, 2017



15th Monitoring, October, 2017

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

(b) Habitat Suitability Index (HSI)

143. Habitat Suitability Index (HSI) has been 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 has been 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***)..

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

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

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

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

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

Fish Diversity

(c) Shannon-Weiner Index

145. In the second quarter monitoring year 2017-18, species evenness are also found to varry among the sampling sites. Highest Shannon-Weiner index was found at Harbaria Khal (0.81) indicating most evenly distributed fish species. On the contrary, lowest evenness was found at Mongla-Passur Confluence (0.21) (shown in **Table 3.4**). Both the number of fish species found in in-situ catch and the evenness of their distribution within the sampling sites found to show high variation with the changing seasonal and yearly bio-physical conditions. The different fish species caught in different catch are shown in **Figure 3.4.**

(d) Fish Species Richness (FSR)

146. 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-3.3**).

147. Species richness during this monitoring season was found varying with the sampling sites. Maximum FSR was obtained in Sheola Khal at Chandpai (n=7), while very low was recorded at Mongla-Passur Confluence and Chalna Point (n=1). Different scenarios of richness were found in this quarter in comparison to those of the previous monitoring years. Among the habitats in upstream portions of the Passur River, Mongla Point was home for a rich assemblage of Paissa; Maidara River was of Bairagi and Jabi Chingri; and Chalna Point was of Katali Chingri. Among the habitats in down stream portions, Chandpai was rich in Bairagi, Chali Chingri, Horina Chingri, Golda Chingri, Chela, Jaba and Gagra; Harbaria was of Motka Chingri, Mutkura, Golda Chingri, Gagra, Chami Chingri and Kain Magur. However, in this season fishing activities was not found in Haldikhali and Akram Point.

[1]Simpson's index is a method to calculate the community characteristics of fish in a particular habitat. It is mainly used to know about the species richness of a particular habitat to tell how many species are rich in their abundance. The value of this index ranges from 0 to 1. There is other kind of value which is described in the methodology section. The second value is mainly used tomeasure the species richness in the sampling sites.

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

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

Site	Species Number			Shannon-Weiner Index		
A	0	0		0	0	
B	0	0		0	0	
C	6	17		0.85	0.81	
D	81	29		0.62	0.74	
E	112	13		0.54	0.21	
F	3	13		0.88	0.33	
G	4	5		0.78	0.32	

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

Table 3.5: Site wise Rich Species Number

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

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

Rupchanda in 1stQuarter of 1st Year

Chela in 2nd Quarter of 1st Year

Phesa, Chela, Hilsa, Gagla Tengra

Harina Chingri

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

Amadi Chela

Banspata

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

Adult Poma in Chalna Point

Fry of Bagda at Chalna Point

Meth and Gagra Tengra

Gagra Tengra

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

Mutkure and Paissa

Khorsula

Menu

Vetki

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

Gulsha Tengra, Bele, Aswine Bele and Paissa

Gangania

Telcupa

Golda

Kain Magur

A Mix of Culture and Capture Fishes

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

Tau Paissa

Bele

Horina Chingri

Gulsha and Gagra Tengra

Jaba

Female Gulsha Tengra

Fry Fishes

Chata Bele

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

Kain Magur

Banspata, Vetki, Koidda and Poma

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

Poma and Tapsi

Tapsi

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

Miscellaneous Fish Species

Hilsha

Tapse

Poma and Tapse

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

Catch Sample

Juvenile of Kain Magur

Khayra Chela

Jevenile of Pangas

Brood Paissa

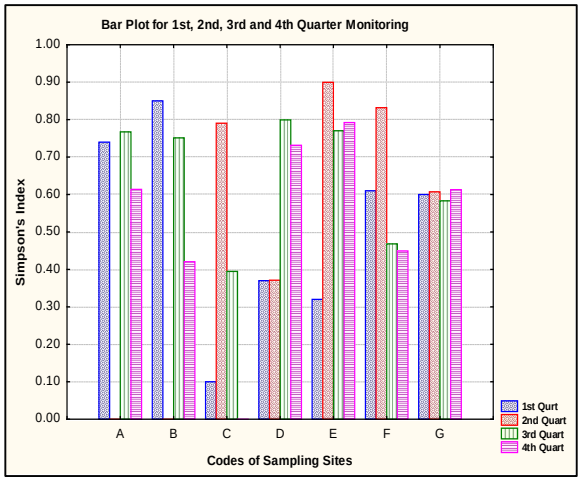
Paissa and Gagra Tengra

Aswene Bele, Daitna, Tapse and Chitra

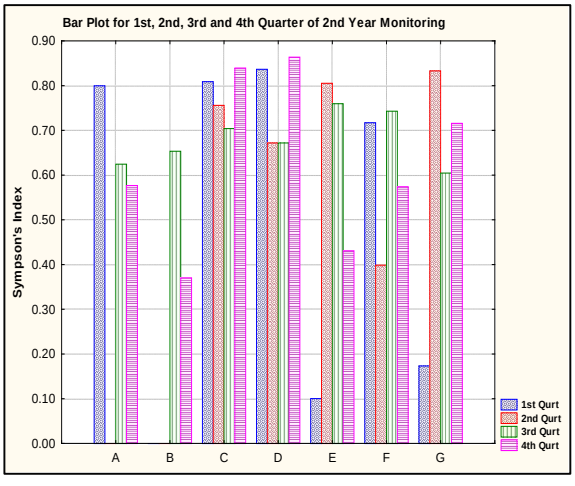
Dry Fish of Khayra Chela

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

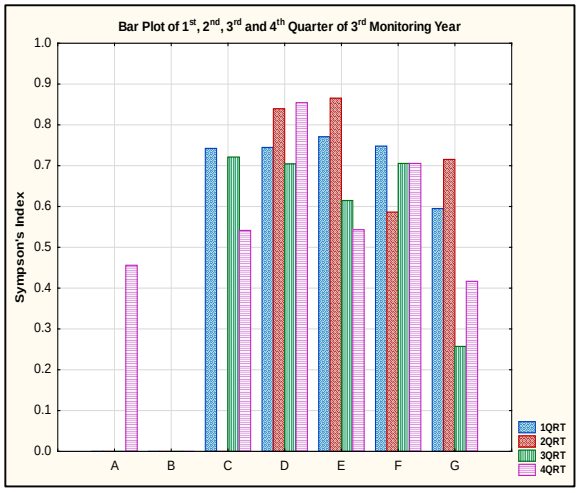
Photo 3.1: Length-wise distribution of fish species



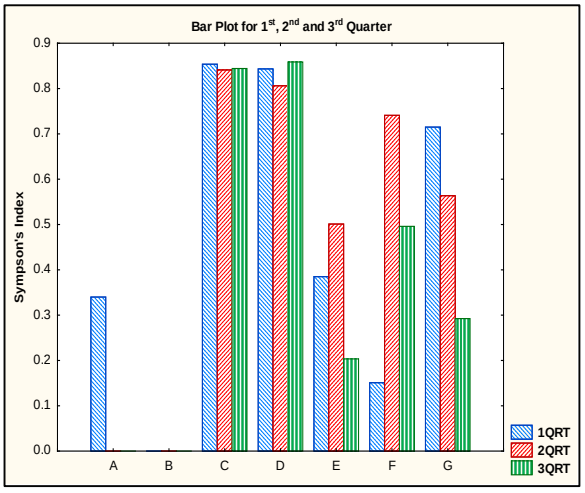
2014-2015



2015-2016



2016-2017

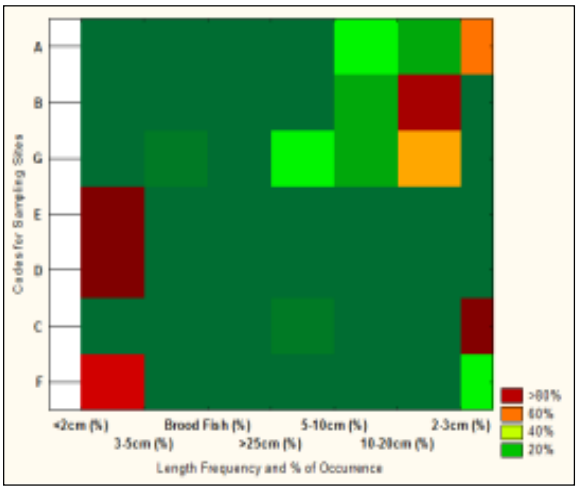


2017-18

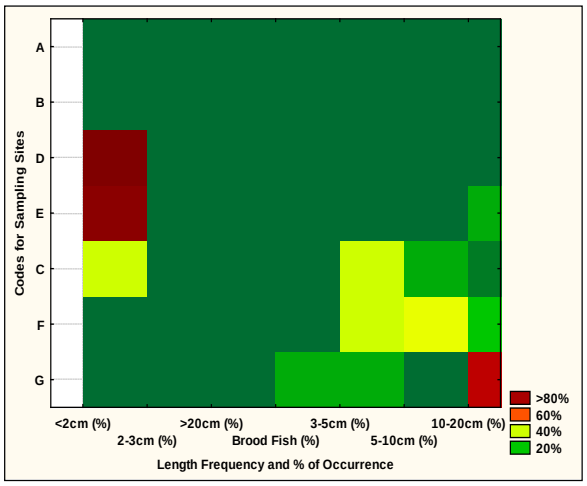
(FSR is identified though Simpson's Index)

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

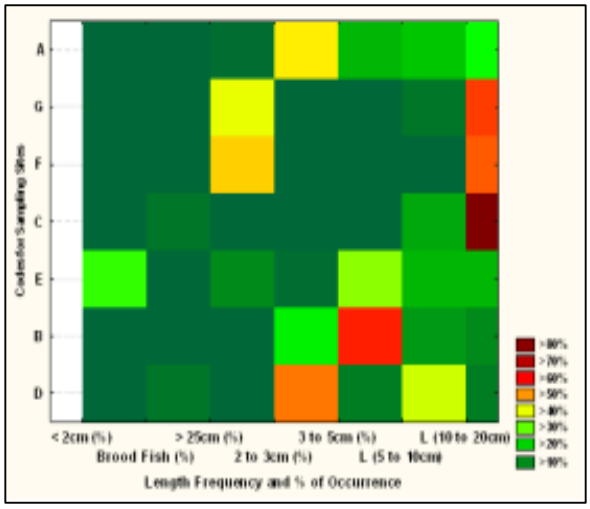
148. Fish community structure was analyzed by counting the length-wise fish individuals (**Figure 3.4**). Tables **D.2** and **D.3** of **Appendix IV** and **Figure 3.5** for third quarter of monitoring year of 2017-18 show that fries for fin fish were widely being distributed among the upper stretches (Chalna Point to Mongla-Passur Confluence) and juveniles while the adult age group in Sheola Khal at Chandpai and Harbaria Khal) of the Passur River system. Among these Horina Chingri, Motka Chingri, Bele and Tit Punti fishes were more in these two sampling sites. Again, fries fishes were dominant at Maidara and Mongla Point. However, brood female fish of Gagra Tengra was frequently observed at Harbaria Khal in this quarter.



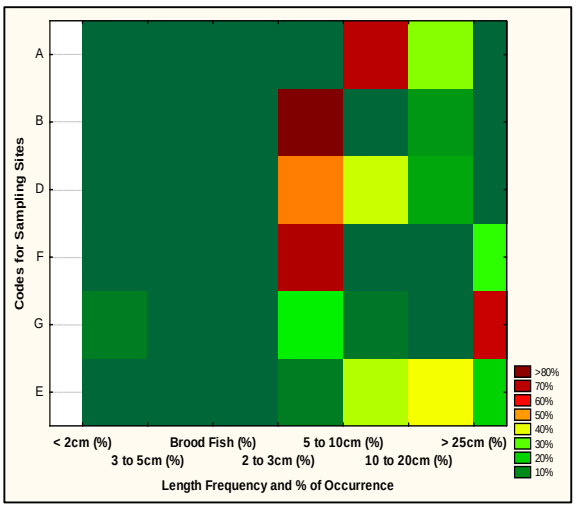
1st Monitoring, April, 2014



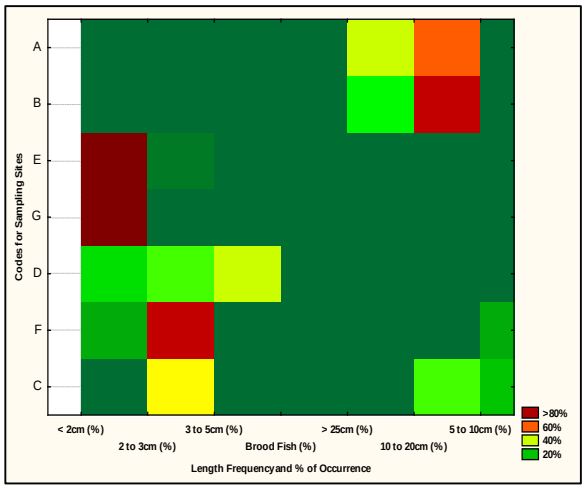
2nd Monitoring, July 2014



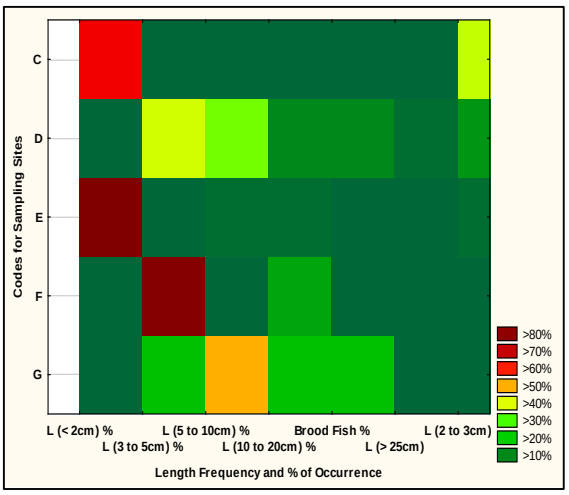
3rd Monitoring, October, 2014



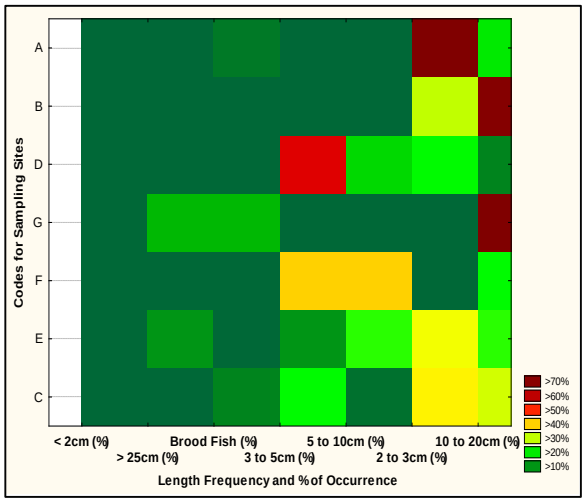
4th Monitoring, January 2015



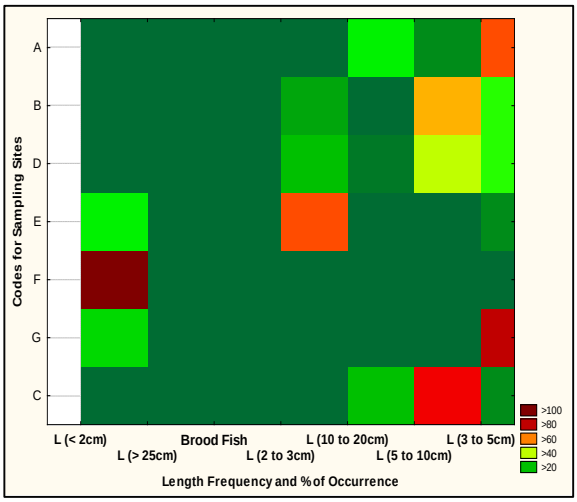
5th Monitoring, April, 2015



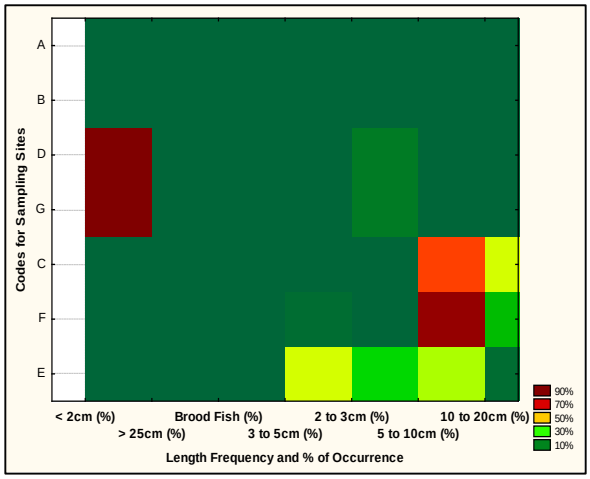
6th Monitoring, August, 2015



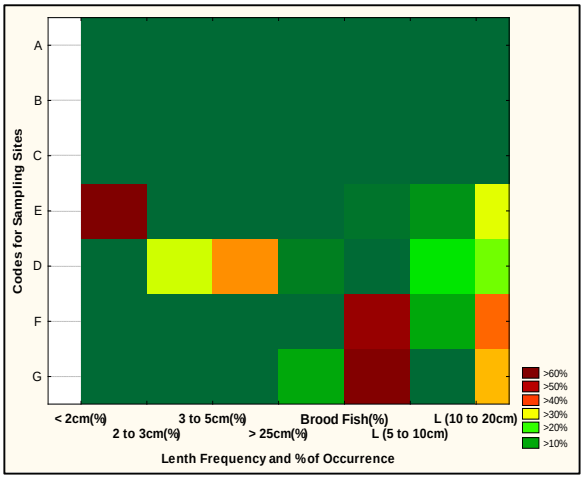
7th Monitoring, October, 2015



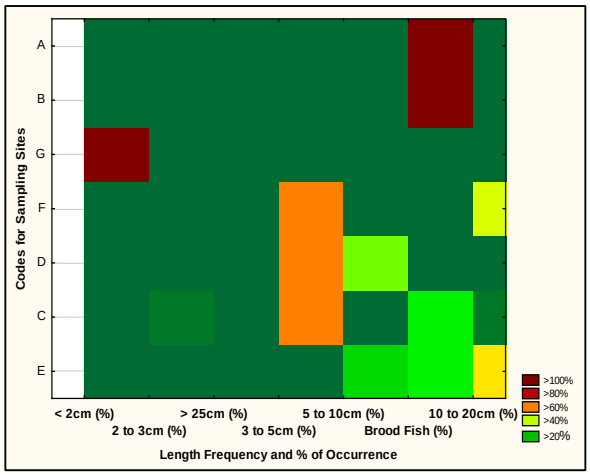
8th Monitoring, January, 2016



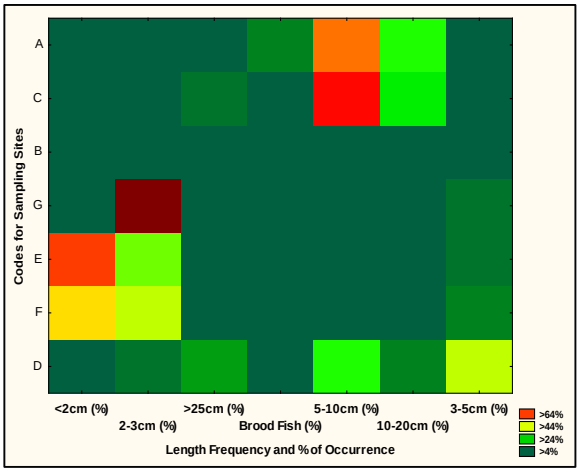
9th Monitoring, April, 2016



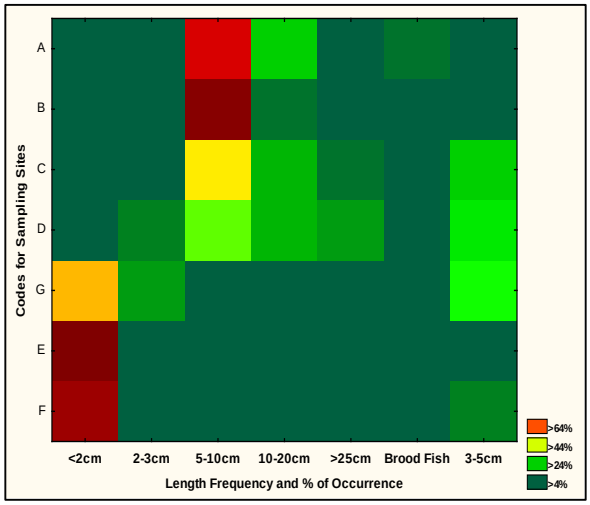
10th Monitoring, July, 2016



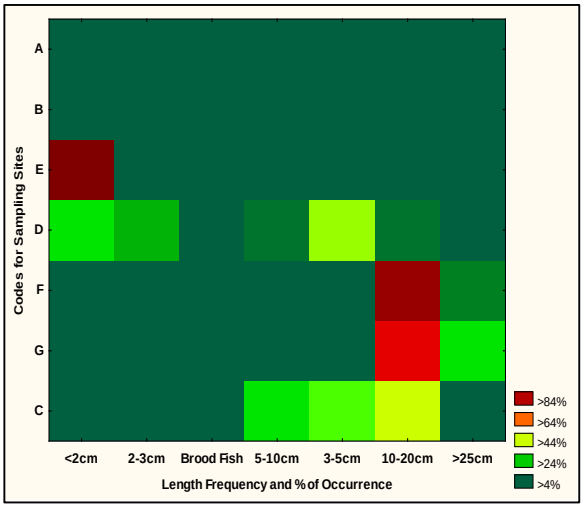
11th Monitoring, October, 2016



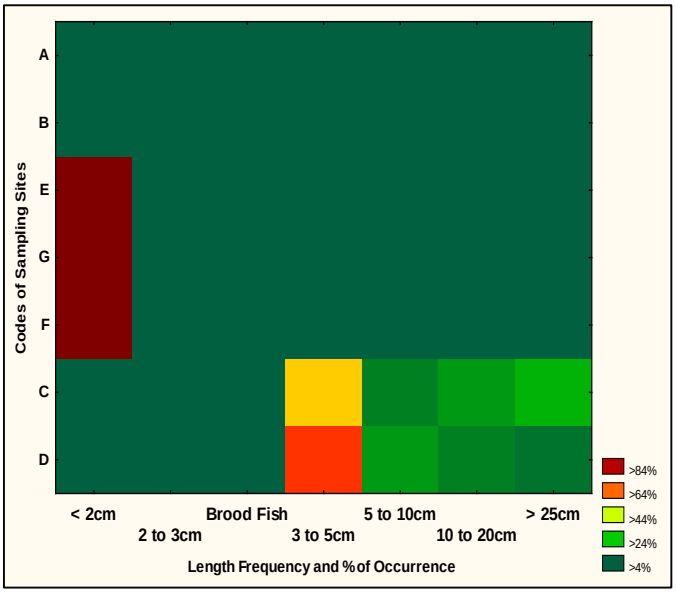
12th Monitoring, January, 2017



13th Monitoring, April, 2017



14th Monitoring, October, 2017



15th Monitoring, January, 2017

Figure 3.4: Habitat Distribution of Different Life Stages of Fish Species

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

Fish Migration

(a) Migratory Species Diversity

149. Migratory species were identified by analyzing the common species available in the regular catch from the sampling sites. Fish species like Paissa and Bairagi attains the maximum abundance among the migratory fish species observed in the third quarter of monitoring year of 2017-18 (15th quarter in total). The relative abundance of the migratory species is give below in the **Figure 3.1.5**.

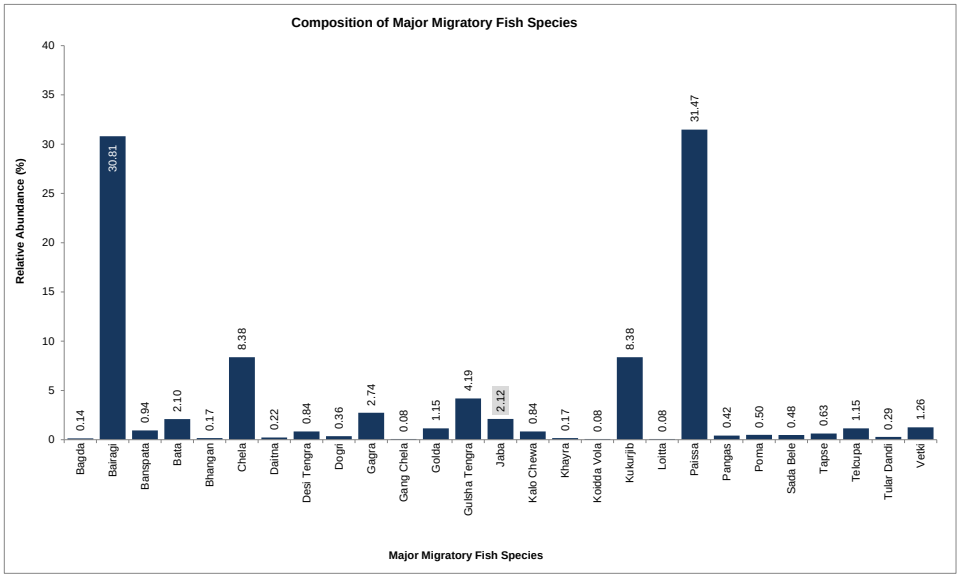


Figure 3.5: Relative abundance of major migratory fish species in sampling sites

(b) Migration Extent, Time and Purpose

150. Major fish species have shown interesting pattern in distribution for exploiting different purposes mentioned in the following table all along the sampling sites. One (01) fish species was found common in most of the sites. This species along withBairagi was observed indicating long range of distribution (**Table D.4 of Appendix IV**).

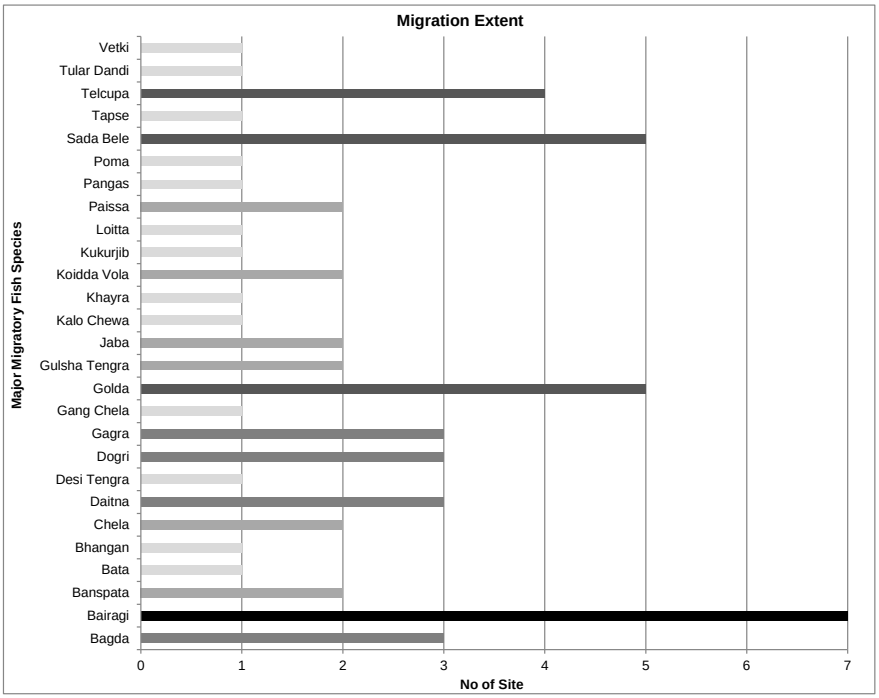


Figure 3.6: Migration extent of major migratory fish species in sampling sites

Shrimp/Fish Farm

151. Three farms situated in the direct impact zone of Power Plant were surveyed for monitoring shrimp/fish farm. Stocking pattern of the shrimp/fish farm is one of the major issues for successful production because of having natural genetic resources from the wild source of the Passur River System. Moreover, maximization of growth rate and minimization of mortality rate should be ensured for getting more economical output from the farms. So, stocking pattern, growth rate and mortality rate and theircauses were surveyed intensively.

Stocking Pattern

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

153. In this monitoring year, no stocking was observed because of the completion phase of the year-round production cycle.

Shrimp/Fish Growth Rate and Mortality

154. During the third quarter of this monitoring year, no growth rate and mortality rate were measured because of no production cycle. The following table shows the previous result of growth and mortality rate (**Table 3. 6)**.

Table 3.6: Growth Rate and Mortality of Fish/Shrimp

Gher No.	1st QM (Apr 2014)		2nd QM (Jul 2014)		3rd QM (Oct 2014)		4th QM (Jan 2015)		5th QM (Apr 2015)		6th QM (Aug2015)		7th QM (Oct 2015)		8th QM (Jan 2016)		9th QM		10th QM		11th QM		12th QM		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-	0.2	40	0.25	50	-	-	-	30	0.18	25	0.20	60	-	-	-	-	0.2	20	0.20	60	-	-	-	30
2	0.3	30-	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	
	Growth Rate (cm/day)	Mortality (%)
1	0.03	50
2	0.38	35
3	0.02	25

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

Fish Production

(a) Capture Fish Production

155. In second quarter monitoring, the highest productivity was found in Harbaria Khal **(Table 3.7**). The lowest productivity was found at the Mongla Point, Maidara River and Confluence and Chalna Point as becauseall fry fishes are not considered as catch.

156. The present study revealed that the highest catch susceptibility was also found in case of Charpata Jal (31 kg/haul). The following table also expresses that Net Jal were most frequently used in all the upper reaches in Passur River System, especially for fry collection. Charpata Jal was commonly used in the middle reach of the Passur River. Moreover, the highest total catch was observed in Harbaria Khal and lowest in the Mongla Point, Maidara River and Confluence and Chalna Point during this monitoring phase (**Table-3. 8**).

Table 3.7: Total Catch in Different Gears in the Sampling Sites

Sl. No	Site	Habitat	Gear Name/Type	Haul Duration (hr)	No of Haul	Total Catch (kg)	kg/haul
A	Akram Point	Kukilmoni Khal	Not Found	0	0	0	0
B	Haldikhali	Haldekhali Khal	Not Found	0	0	0	0
C	Harbaria	Harbaria Khal	Mui Jal	1	12	0.1	0
			Spear	5.25	410	3.175	0.01
D	Chandpai	Sheola Khal	Behundi	5	5	20	4
			Charpata Jal	16.65	1.5	46.5	31
E	Mongla Point	Passur River	Net Jal	4.18	1	0*	0*
			Tana Jal	3.47	20	0*	0*
F	Maidara	Maidara River	Box Net	0.01	1	0*	0*
			Jhaki Jal	1	500	0.5	0*
			Net Jal	3.3	1	1.5	1.5
G	Chalna Point	Passur River	Net Jal	3	1	0*	0*

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

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

Table 3.8: Total Catch in the Sampling Sites

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

Sampling Site	Total Catch (kg)		
	13th QM	14th QM	15th QM
A	2	0	0.00
B	0.25	0	0.00
C	8.13	1.5	2.56
D	77.5	10.5	37.67
E	0	0	0.00
F	0.3	0.4	0.67
G	0.12	0.3	0.00

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

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

(b) Culture Fish Production

157. Culture fish production was not assessed from the selected Ghers (Shrimp/Fish Farm).

3.2 Ecosystem Monitoring

158. Ecological indicators for terrestrial and aquatic ecosystems have been selected by considering the probable impacts on ecological resources in different phases of the proposed power project. The following indicators have been selected to identify and evaluate the impacts on the adjacent ecosystem and the associated functions.

Composition and diversity of flora

159. This is an important indicator for identifying the vegetation structure of any selected area. Another important indicator is the biomass productivity which may be change due to changes in different environmental parameters like temperature, soil salinity, humidity and nutrients, air dust etc. In addition, Plant diseases and proportion of healthy/ unhealthy plant is also needed to understand the plant health condition.

Status of Canopy structure

160. The canopy structure directly depends on plant growth rate, soil properties, plant physiological disorders, climatic parameters or even for different human interventions. To monitor canopy status of various homestead vegetation, canopy cover has been examined in different time intervals.

Lichen coverage

161. Lichens often grow on trees and shrubs and usually absorb nutrients from the atmosphere. They are very much sensitive to air pollution, particularly to sulfur dioxide, fluorides, and ammonia. The presence or absence of Lichen is an important indicator for homestead forest health study. The acidity of tree's bark can also affect the abundance of lichen abundance.

Bird's habitat

162. Among the terrestrial faunal community, birds are the most sensitive to their habitat conditions. Changes of environmental parameters, land use and vegetation composition may have direct influence on bird's habitat of a locality. Generally, two types of bird can be found in an area; local and migratory. To observe the suitability of bird habitat, number of bird nest and nesting species has been monitored. Numbers of wetlands where migratory birds usually come in each season have also been considered to observe the habitat suitability of migratory bird of the area.

Butterfly occurrence

163. Insects are by far the richest group among the faunas, representing major portions of terrestrial biodiversity. Contrary to that most other groups of insects, butterflies are well visible and considered as highly sensitive to the changes of environmental parameters like air temperature, gaseous components etc.

Occurrence of Dolphin

164. Dolphin is an ecological indicator which indicates the water quality as well as aquatic habitat suitability. This aquatic mammal has been observed in all the river systems of the study area. Any changes of water quality and river bed siltation may change the occurance of dolphin in a river system. So, dolphin occurrence is needed to be monitored for this study.

3.2.1 Monitoring Locations

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

3.2.2 Rationales for selection of the locations

166. Indicators for terrestrial ecosystem study have been selected and monitored at 4 homesteads around the project influence area. Similarly, the locations of the homesteads have been selected considering the wind direction and spatial distribution derived from the wind rose diagram. On the other hand, the nearest peak of the Sundarban Reserve Forest Area is located at a distance of 14 km in the southwest direction from the proposed chimney locationand hence a number of considerable indicators at different locations of the forest area are also being observed for forest ecosystem monitoring.

3.2.3 Terrestrial Ecosystem

167. Terrestrial ecosystem supports most of the floral and faunal communities which are directly related to the environmental parameters e.g. temperature, air quality, sunlight, soil nutrients etc. Homesteads occupy maximum portions of terrestrial ecosystems in the study area. As such, observation on different indicators of selected homestead vegetation and dweller wildlife would be helpful to determine the probable ecological impacts for the proposed project.

3.2.4 Description of the selected homestead

168. The homestead in Rajnagar is located at 2.5 km. east from North-east boundary of the project site. This is situated inside the damp area as numerous small swamps exist inside and surrounding areas of the homesteads. A very few number of species of grasses and other herbs were found in the study area. Again, most of the land area of selected homestead at Kalekarber village is comparatively non water logged area.

169. Chalkghona village is located at 0.5 km south-ward from the south-east corner of the project boundary and the selected homestead of this village is close to the Maidara Khal. Presence of shallow ditches and peripheral waterbodies support the growing of staple coverage of saline tolerant plant species which is a prominent ecological aspect of this area. Similarly, Barni village is located at about 3.0 km north from north-east corner of the project boundary. The selected homesteads are situated at the middle portionof the village. These homesteads are dominated by planted tree species. Vegetation of thes homesteads were severely damaged by Cyclone Aila.


Photo 3.2: Homesteads vegetation at the monitoring sites (Left: Chalkghona, Right: Kalekarber)

3.2.5 Species Composition of selected homestead vegetation

Homestead at Rajnagar

170. Among the tree species, Gewa *(Excoecaria agallocha)* was found as dominant species as because moist and saline soil favors luxurious succession of this kind of mangrove plant in homestead vegetation. Beside this, Safeda *(Manilkara zapota)* and Boroi *(Zizyphus sp)* were observed as fruit trees in this area. Monocots including Narikel *(Cocos nucifera)* and Khejur *(Phoenix sylvestris)* occupied the top level canopy of the vegetation. In addition, three Bola *(Hibiscus tiliaceus)* and one Sundari (*Heritiera fomes)* with very few grasses or undergrowth vegetation were also found in this homestead.

Homestead at Kalekarber dighi

171. In this plot Narikel (Cocos nucifera) and Khejur *(Phoenix sylvestris)* were found occupying the top canopy. Aam (Mangifera indica), Safeda (Manilkara zapota), Peyara (Psidium guajava) and Boroi (Zizyphus sp) were found as common fruit trees and the measured height of which about in between 3-5 m. On the other hand, Rendi Koroi *(Albizia saman)* and Raj Koroi *(A. richardiana)* were found occupying the top canopy at a height of more than 10m. Some of the creepers and herbs, e.g. Swarnalata *(Cuscuta reflexa)* and Durba *(Cynodon sp)* were also present in the selected homestead. Beside this, Bakul (Mimusops elengii) and few number of Kola (Musa sp) were also found in these homestead platforms too.

Homestead at Chalkghona

172. Similar to the above homesteads, Narikel was found as the dominating tree species as well as occupying the top canopy in the selected homestead of Chalkghona. As the homestead is near the peripheries of river and shrimp ghers, soil salinity supports luxurious growth of mangrove plant like Gewa (Excoecaria agallocha) in this area. This homestead has two shallow ditches which contain brackish water throughout the year and 2 Gol pata *(Nipa fruticans)* bushes too. Prominent fruit bearing trees found were Safeda *(Manilkara zapota),* Aam *(Mangifera indica),* Peyara *(Psidium guajava)*, Papay *(Carica papaya)*.

Homestead at Barni

173. This homestead contains 21 tree species. Except Narikel *(Cocos nucifera),* Khejur *(Phoenix sylvestris)* and Taal *(Borassus flabellifer)*, most of trees were seen as young in age. The devastating cyclone Aila caused huge damage to the tree species of this homestead. However, the house owner planted number of timber and fruit yielding trees surrounding the house after the cyclone AILA.

3.2.6 Plant health

174. Saline water intrusion from the shrimp farm is a big threat to the plant health in this area as triggering the increase of salinity in the top soil. Therefore, the overall succession rate, plant growth and productivity were found to be receding with time.

Plant Diseases and symptoms in homestead vegetation

175. Observation of Plant diseases is needed to evaluate plant health and productivity of any area. Some tree species were selected for regular observation from the beginning of the monitoring study. Accordingly, a number of common tree species have been observed in each homesteads.

176. Leaf spot, leaf blast, nut fall, Mite damage on nut fruit were found as common diseases of the plants of the study area. A brief discussion was made with the home owners about the diseases of the selected economic plants which were found in their homesteads. Although, all plant diseases symptoms are not visible during same time of the year, but initiatives were taken to observe the existing symptoms of the disease.

177. However, 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 the top portion of this monocot are common symptom of this plant species in all locations. Fungal/bacterial Infection was not remarkable in all the homesteads. But Leaf Anthracnose on *Mangifera indica* and Bacteriosis on *Psidium guajava* were commonly found in most of the trees. *Phoenix sylvestris* were also found unhealthy due to leaf yellowing which might be due to the manganese deficiency.

Photo 3.3: Unhealthy plants at monitoring sites (Photo taken Jan, 2018)

Number of affected trees

Number of affected trees were found increasaing than the previous monitoring period. Coconut (*Cocos nucifera)* and Date Palm (*Phoenix sylvestris)* were found mostly affected species during this monitoring tier. In the case of Rajnagar and Chalkghona sites, a total of 10 coconut plants were affected by heart rot. Lethal Yellowing and Terminal Bud destruction was

detected in 17 nos of Date Palm plants at all the monitoring sites. Except these, other monitoring trees were found in healthy condition. However, the following table represents the proportion of healthy and unhealthy plants in the studied homesteads. (Table 3.9).

Table 3.9: Proportion of healthy and unhealthy plants in studied homesteads

Location	Plant Name	Total No. of Plant	No. of Unhealthy Plant										
			Apr 2014	Jun 2014	Oct 2014	Jan 2015	Apr 2015	Aug 2015	Oct 2015	Jan, 2015	Oct, 2016	Jan, 2017	Jan, 2018
Rajnagar	*Cocos nucifera*	17*	NS	10	5	5	15	4	5	NS	3	4	6
	Phoenix sylvestris	25	NS	15	4	4	22	9	13	NS	10	2	5
	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
	Phoenix sylvestris	12	0	5	4	4	3	1	4	NS	4	3	4
	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	-
	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	-
	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
	Phoenix sylvestris	24	0	10	1	1	6	5	1	NS	1	-	5
	Albizia saman	3	0	0	0	0	1	0	0	NS	-	-	-
	Excoecaria agallocha	36	0	0	1	1	0	0	0	NS	-	-	-
	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	-
	Borassus flabellifer	2	0	0	0	0	0	0	0	NS	-	-	-

Note: NS = Not Surveyed

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

3.2.7 Vegetation canopy status

Status of canopy layers of different trees

178. Coconut (*Cocos nucifera)* were found occupying top canopy among all the monitored homestead vegetation. Date Palm (*Phoenix sylvestris)* was prevalent as second top layer of canopy which was again followed by Gewa (*Excoecharia agallocha)*. Most of the fruit yielding trees like Sofeda (*Manilkara zapota),* Mango(*Mangifera indica)* possessed the upper bole of

canopy layer. Lower bole were found to be occupied by small fruit yielding trees like Guava (*Psidium guajava)*, Musa sp. On the other hand, a few grass species and undergrowth vegetation were found in the studied homesteads.

Estimated Canopy cover in homestead vegetation of sampling sites

179. Canopy status of the homestead vegetation have slightly decreased from the last monitoring period at all the monitoring locations. This was due to the seasonal changes in leaf density and the canopy cover by *Excoecaria agallocha* treesshown deciduous in nature in the winter season. On the contrary, Canopy cover has remarkably decreased at Rajnagar site due to felling of about 45 nos of *Excoecaria* trees by the house owner. However, *Excoecaria* had a significant contribution to the canopy coverage at all the homesteads in the study area. Canopy coverage of the studied homesteads has been represented in following table.

Table 3.10: 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
Rajnagar	NS	19	19	17	20	20	20	20	21	23	19	15
Borni	NS	26	18	18	12	14	20	20	25	25	23	21
Kalekarber	NS	20	24	25	23	24	24	22	24	26	25	23
Chalkghona	NS	13	24	22	17	21	21	20	21	27	26	25

Note: NS = Not Surveyed

3.2.8 Lichen cover

Lichen Coverage on tree barks have been found to an increasing trend at Rajnagar and Chalkghona sites. This would be due to the presence of optimum moisture in tree barks. Lichen coverage at another two sites was recorded less than the previously monitored tier. Highest coverage of Lichen was recorded in Kalekarber Site. Bird Habitat

Local birds and their nesting behavior

180. Numerous types of local bird species were observed in the study area. Homestead vegetations are the prime habitats for the local birds. Existence of vast shrimp farms as well as canals and rivers also favor good number of water bird species in this area. Most of the birds were observed nesting on tall trees of the homesteads. *Cocos nucifera* and *Excoecharia agallocha* were found as top priority for nesting. Small bird like Tailor bird, prefer small bushy shrubs for nesting. Although, birds do not follow any local boundaries, a clear conception on available bird species have been gathered through discussions with studied homestead owners as well as physical observation.

Migratory birds and their habitats

181. Migratory birds were mainly found at large shrimp gher within the study area. According to local people and physical observation, Common Coot, Common Snipe, Black Winged Stilt, Bar Headed Goose, Red Crested Pochard, Ruddy Shellduck, etc. were witnessed as common winter visitor in this area. In addition, local Ruddy Breasted Crake, Common Sandpiper, Great Egret, Pond Heron, Little Cormorant were also found at most of the monitoring wetlands of the study area.

182. Some of the winter visitor migratory birds have been informed during the recent field visit at Borocharar Gher and Chotocharar Gher. According to local experts, population of migratory birds are reducing day by day for illegal hunting, re-starting shrimp culture within short intervals and indiscriminate use of pesticides in agriculture field and shrimp farms. The following table shows the presence of migratory birds in the prominent wetlands inside the study area-

Table 3.12: Presence of migratory birds at different wetland inside the study area

Wetland Name	Wetland type	Approximate distance from project Boundary (Km.)	Presence of Birds							
			Jan 2015		Jan 2016		Jan 2017		Jan 2018	
			LM	M	LM	M	LM	M	LM	M
Choto Charargher	Saline Water Shrimp Farm	0.10	Y	N	Y	Y	Y	Y	Y	Y
Boro Charargher	‘’	0.10	Y	Y	Y	Y	Y	Y	Y	Y
Putimari Gher	‘’	1.10	Y	N	N	N	N	N	Y	N
Golbunia Gher	‘’	0.1	Y	Y	Y	N	N	N	Y	N
Shukariar Gher	‘’	1.25	Y	N	N	N	N	N	N	N
Koigar Daskati Gher	‘’	0.25	N	N	Y	N	Y	N	Y	N
Badyamari Gher	‘’	1.00	N	N	Y	N	N	N	N	N
Chalkghonar Beel	‘’	1.50	Y	N	N	N	N	N	N	N

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

Source: Field Monitoring, January 2015, January 2016 and January 2017

Bird species and number of Bird nests in sampling sites

183. One little egrets nest was found on Excoecaria tree at Chalkghona. Except Chalkghona site, no bird nest was observed during this monitoring. the table below table represents the monitoring datasheet the bird nest during the monitoring periods.

Table 3.13: Bird nest monitoring datasheet

Bird Name	No. of Bird Nest observed																																							
	Apr 2014				Jun 2014				Oct 2014				Jan 2015				Apr 2015				Aug 2015				Oct 2015				Jan 2016				Jul 2016				Jan 2017				Jan 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	R	B	K	C	R	B	K	C	R	B	K	C	R	B	K	C
Little Cormorant	NS	-	NS	-	12	-	-		-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	NS	NS	NS	NS	10	-	-	1	-	-	-	-	-	-	-	-
Little Egret	NS	-	NS	1	4	-	-		-	-	-	-	-	-	-	-	-	-	-	-	5	-	-	-	-	-	-	-	NS	NS	NS	NS	5	-	-	1	-	-	-	-	-	-	-	1
Asian Pied Starling	NS	1	NS	-	-	-	-	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	NS	NS	NS	NS	-	-	-	-	-	-	-	-	-	-	-	-
Tailor Bird	NS	-	NS	1		-	-		-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	NS	NS	NS	NS	-	-	-	-	-	-	-	-	-	-	-	-
Spotted Dove	NS	-	NS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	NS	NS	NS	NS	-	-	-	-	-	-	-	-	-	-	-	-
Great Egret	NS		NS																										NS	NS	NS	NS	3	-	-	-	-	-	-	-	-	-	-	-

Note: R = Rajnagar, B = Barni, K = Kalekarber C= Chakgona, NS = Not Surveyed, '-'= Not Found

3.2.9 Butterfly occurrence

184. In total of 32 butterfly species were recorded from the studied sites during the last monitoring tiers. Of which Common crow, Common Emigrant, Common Rose, Grass yellow, Peacock Pansy etc were observed int most of the homesteads during most of the monitoring season. 4 species of butterflies have been observed during this monitoring tier from Borni and Kalekarber sites. Evening Brown, Grey Pansy, Peacock Pansy and small Grass Yellow were also observed among the species.

Table 3.14: Occurrences of Butterflies in the study area

Common Name	Scientific Name	Time and locations for Occurrence of Butterfly species																																					
		Jun 2014				Oct 2014				Jan 2015				Apr 2015				Aug 2015				Oct 2015				Jan 2016				Oct 2016				Jan 2017				Jan 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	R	B	K	C	R	B	K	C	R	B	K	C
Common Albatross	*Appias albina*																					*	*	***	**																
Blue Tiger	*Tirumala hamata*						**	*																*							**										
Lime Butterfly	*Papilio demoleus*				*				*		*		*												*		**														
Chocolate Argus	*Junonia hedonia*	*		*						*																															
Common albatross	*Appias albina*															*																									
Common Cerulean	*Jamides celeno*							*																																	
Common Crow	*Euploea core*	*		*	*	*	*		*				*		*							*	*	*	*															
Common Emigrant	*Catopsilia pomona*					*	*	**	*		*	*																													
Common Gull	*Cepora nerissa*						*																																		
Common Leopard	*Papilo phalantha*						*	*																																	
Common palmfly	*Elymnias hypermnestra*						*	*			*		*		*									*	*		*					*									
Common Pierrot	*Castalius rosimon*						*		*			*															*					*	*								
Common Rose	*Pachliopta aristolochiae*								*					*				*					*	*			*														
Common Sailor	*Neptis hylas*													*																											
Dainty Grass-blue	*Zizula hylax*						*	*												*	*		*	**				*		*	*										
Danaid Eggfly	*Hypolimnas misippus*											*																													
Evening Brown	*Melanitis leda*				*						*		*			***												*						*	**	*		*		
Foscus Swallowtail	*Papilio fuscus*																																							
Grey Pansy	*Junonia atlites*						*											*												*								*	
Indian sunbeam	*Curetis thetis*								*						*																									
Lemon Pansy	*Junonia lemonius*						*					*																												
Mangrove Jewel	*Hypochrysops epicurus*		*		**																																			
Stripped Tiger	*Danaus genutia*					*		*															**		*															

Common Name	Scientific Name	Time and locations for Occurrence of Butterfly species																																					
		Jun 2014				Oct 2014				Jan 2015				Apr 2015				Aug 2015				Oct 2015				Jan 2016				Oct 2016				Jan 2017				Jan 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	R	B	K	C	R	B	K	C	R	B	K	C
Orchard Swallowtail	*Papilio aegeus*	*	**													*																								
Pale Grass Blue	*Pseudozizeeria maha*														**	**																									
Three spot Grass Yellow	*Eurema blanda*					*	**		*																															
Peacock pansy	*Junonia almana*						**								*								***		*		*				**				**				*	
Rice Swift	*Borbo cinnara*						**	*	**				*																											
Small Grass-yellow	*Eurema smilax*		**									*			*	**		**		**	*					*	**	*	*		**	**	**						*	
Spotted Pea-blue	*Euchrysops cnejus*																																							
Swamp Tiger	*Danaus affinis*												*			*																								
Common Red Eye	*Matapa aria*																							*				*												

3.2.10 Aquatic Ecosystem Monitoring

185. Rivers, canals, ponds and saline water shrimp farms are the main wetland forms in the study area. Of which, river can be characterized as the flowing/ lotic ecosystem while ponds and other inland waterbodies bear the stagnant/lentic aquatic ecosystem. But the Canals of this area were merged with shrimp farms, thus the shrimp farms have occupied a large proportion of total watershed of the study area. Therefore, canals are not an actual flowing or stagnant aquatic ecosystem in this area.

3.2.11 Monitoring Locations

186. Passur is the only river along the project area, which maintains connectivity with all the flowing water resources of the study area. Similarly, Maidara River including its two branches (Sailtakhali and Ichamoti) are also the flowing aquatic ecosystem in this area. Both the waterbodies support Dolphin habitats for the entire year. Hence, status of aquatic mammals (Dolphin) in these river systems have been monitored throughout the monitoring periods.

3.2.12 Dolphin Occurrence

Dolphin migration route in study area

187. Two dolphin species (Ganges River Dolphin and Irrawaddi Dolphin) were observed while travelling across the Passur river during this monitoring period. The Ganges river dolphin migrates from estuary regions to the upstream like Rupsha and Madhumoti. Though Irrawardi Dolphin is mostly habituated in estuary regions of Bangladesh, but this aquatic mammal was also occasionally sighted in Passur river. Ganges Dolphins also roam through Maidara River mainly during high tide. Siltation and narrowing of upstream branches are limiting the length of migration area with time.

Dolphin occurrence in Passur and Maidara River

188. Occurrences of Dolphin have been monitored through boat transact within the total area of 20 km length of Passur and Madara River surrounding the project area (From Chalna to Mongla). A total number of 11 Ganges River Dolphins were recorded in different locations of the surveyed transect. Of which 8 individuals were recorded from straight transact of Passur River, 2 individuals from Passur-Maidara confluence and 1 individual at Maidara River. The average encounter rate was calculated as 0.271 Individuals/km/hr and were found diving in water (**Figure 3.7**).

189. Another short survey was conducted at Karomjal, Harbaria and Akram Point while passing the river., Evidence of Ganges Dolphin was recorded in both at Karamjal and Harbaria. However, the survey results are included in **Table: 3.15**.

Dolphin occurrence in Dhangmari Khal

190. Occurrence of Dolphin has also been surveyed in the Dhangmari Khal Wildlife Sanctuary. Total transect length was 12.25 km from Dhangmari-Passur confluence to Gagramari Patrol Post of Forest Department. A total of 9 dolphins were recorded during the survey. Among which, 8 individuals have been recorded at confluence point of the river in front of Gagramari Patrol Post and the average encounter rate have been calculated as 0.36 individuals/km/hr (**Figure 3.8**).

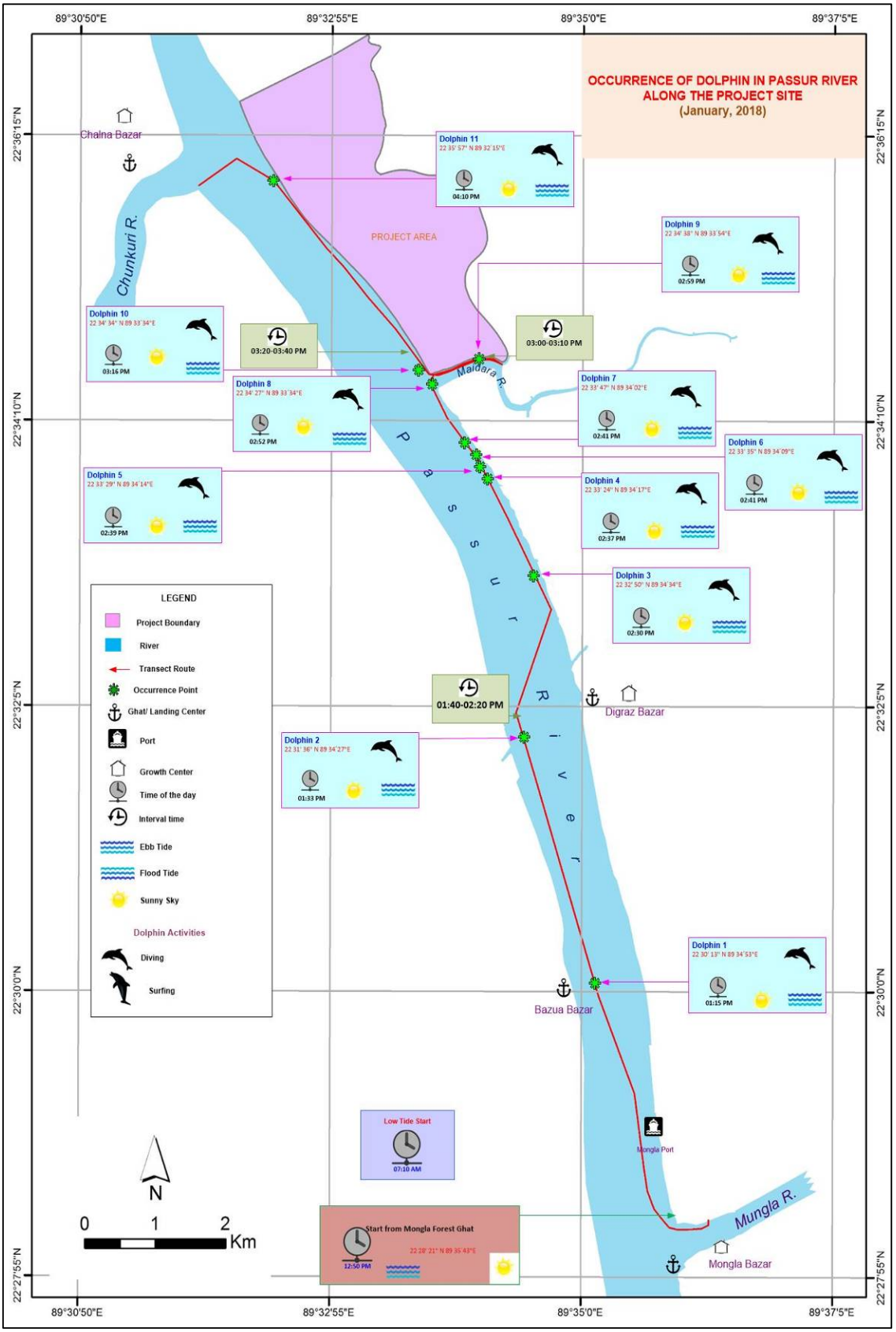


Figure 3.7: Occurrence of dolphins at Passur and Maidara River along the project site (January 2018)

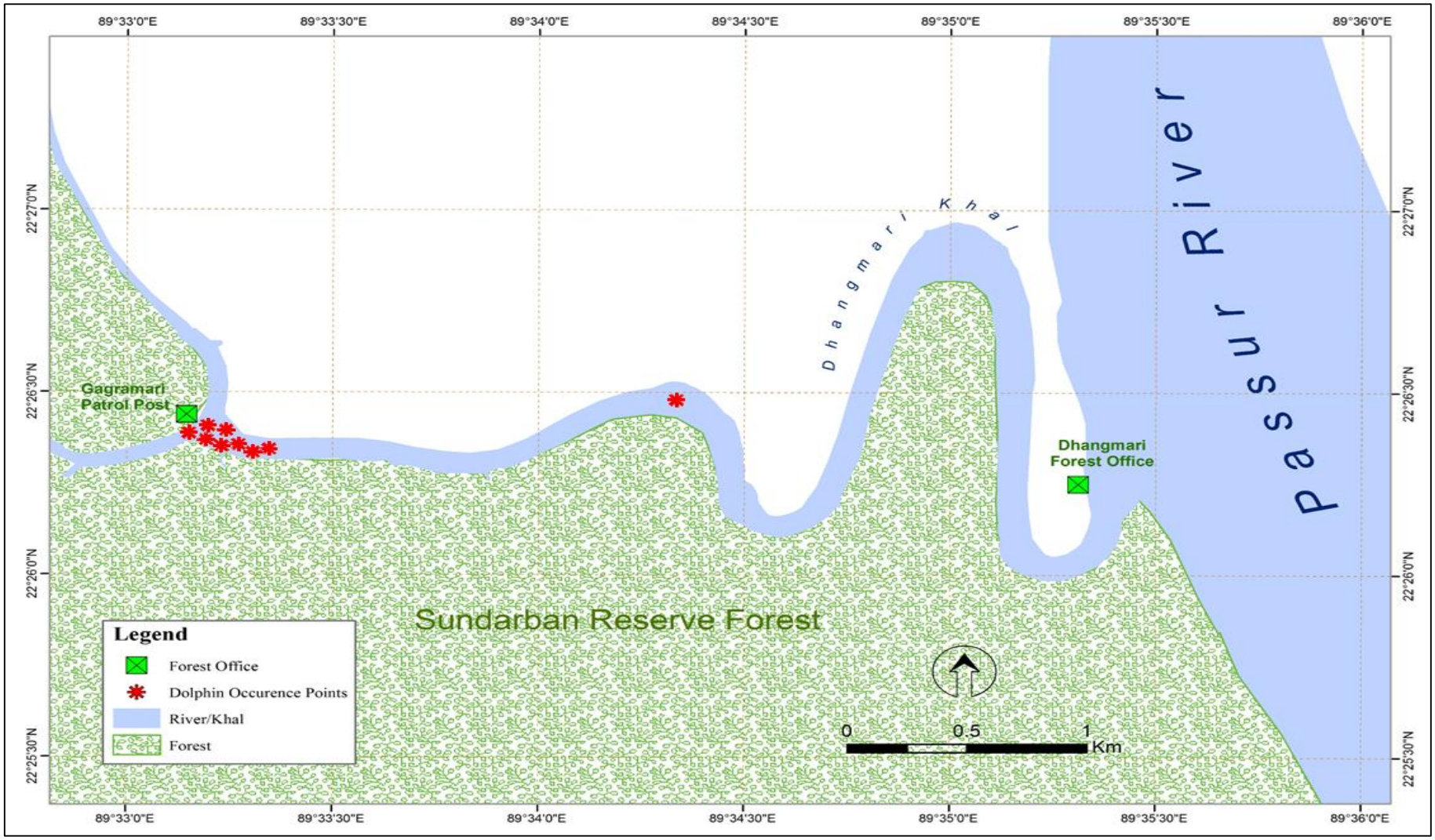


Figure 3.8: Location of dolphin Occurrence at Dhangmari Khal (January 2018)

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	
	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
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
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
Akram Point	NS	NS	NS	N	NS	N	NS	Y	Y	Y	NS	NS	N	Y	Y	NS	NS	NS	N	N	NS	NS	N	N
Moidara River	Y	N	N	N	Y	Y	Y	N	Y	N	Y	N	NS	Y	N	Y	Y	NS	NS	Y	N	Y	NS	Y

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

Occurrence Status: Y = Occurred, N = Not occurred

3.3 Sundarbans Forest Health

191. CEGIS team has been periodically monitoring the Sundarbans Reserve Forest health to oversee the probable impacts of Rampal Thermal Coal Power Plant Project. 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 the ToR and this time surveys were conducted at five locations, namely Sutarkhali, Karamjal, Harbaria, Akram Point and Hiron Point as surveyed before. The overall monitoring indicators observed in fifteenth monitoring schedules broadly included plant growth, tree regeneration, tree crown condition, tree damage, lichen communities, plant diversity, soil chemistry, and plant physiology.

3.3.1 Methodology

The indicators observed in this tier were as follows:

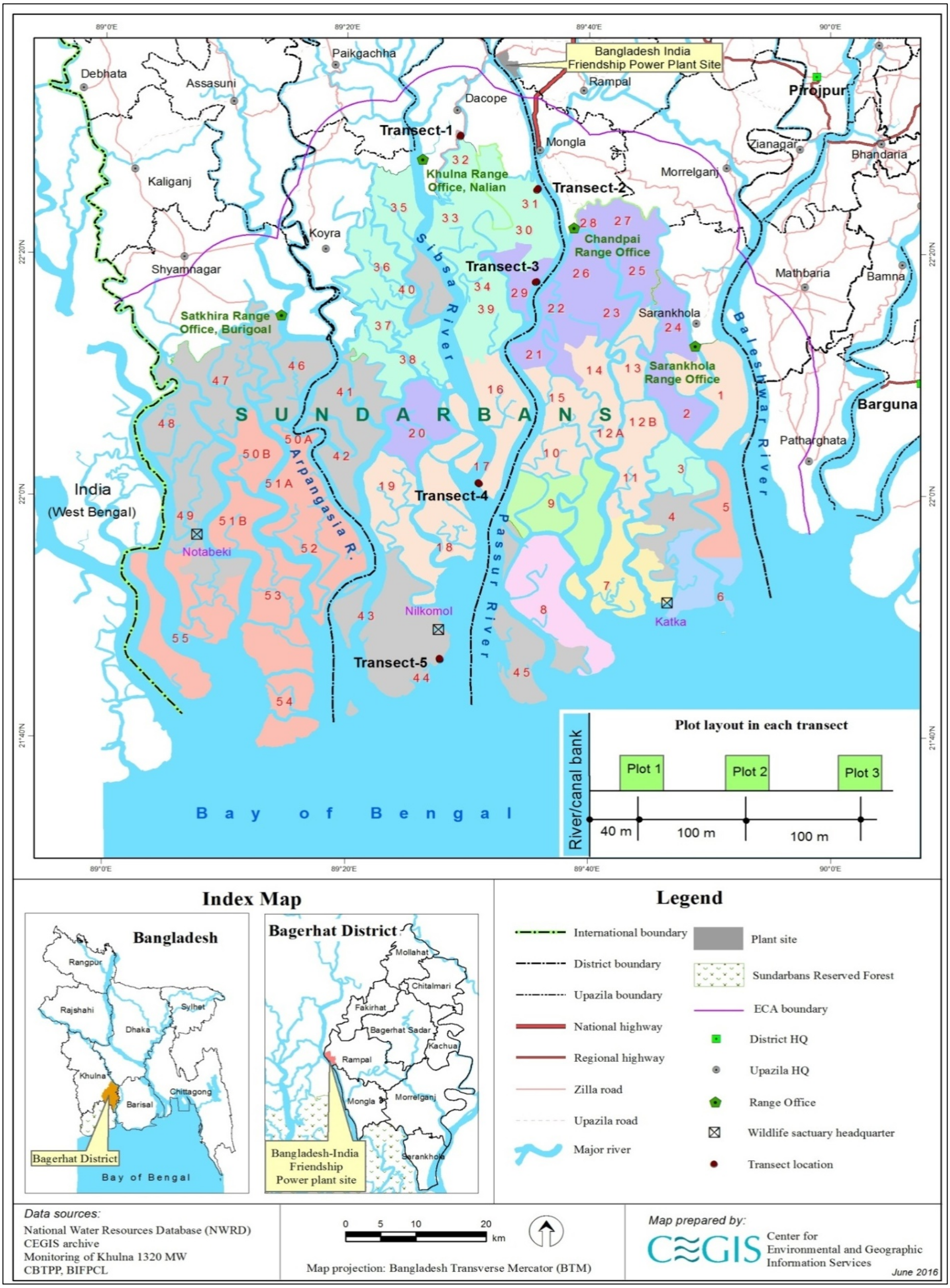
- Seedling Regeneration
- Pneumatophores density
- Crab hole density
- Canopy cover
- Leaf Area Index
- Soil moisture

3.3.2 Sampling Design of Permanent Sample Plots (PSPs)

192. In each site, a transect line was laid out perpendicularly 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. Because of variations in species composition in SRF, observation plots were laid out from the coast, river or canal side to landward zone (forest proper side). The location of the first subplot was 40 m away from ecotone (riverside) to inner ward of forest in order to save the subplot from river bank erosion. Each subplot was again subdivided into four quadrates for the ease of data detection and recording (**Figure 3.9**). The layout of the survey activities are shown in **Figure 3.10.** However, The general description of the permanent sampling plot has been appended in **Table 3.16.**

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	40 m west from Passur River
	2	Chandpai	31	22.42521	89.59341	Hard Clay	140 m west from Passur River
	3	Chandpai	31	22.42261	89.59254	Hard Clay	240 m west from Passur River
Harbaria	1	Chandpai	29	22.2061	89.5924	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	22.2962	89.5908	Muddy	240 m west from Passur River
Akram Point	1	Khulna	17	22.01953	89.51291	Hard Clay	40 M east from Shibsha River
	2	Khulna	17	22.01873	89.51344	Clayee	140 M east from Shibsha River
	3	Khulna	17	22.01805	89.51408	Hard Clay	240 M east from Shibsha River
Hiron Point	1	Khulna	44	22.77535	89.46104	Sandy	350m east from Gogari Canal
	2	Khulna	44	21.91667	89.23333	Sandy	40m north from Bay of Bengal
	3	Khulna	44	22.18333	89.50000	Hard Clay	648m south east from Shibsa River



Index Map

Legend

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

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

0 5 10 20 km

Map projection: Bangladesh Transverse Mercator (BTM)

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

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

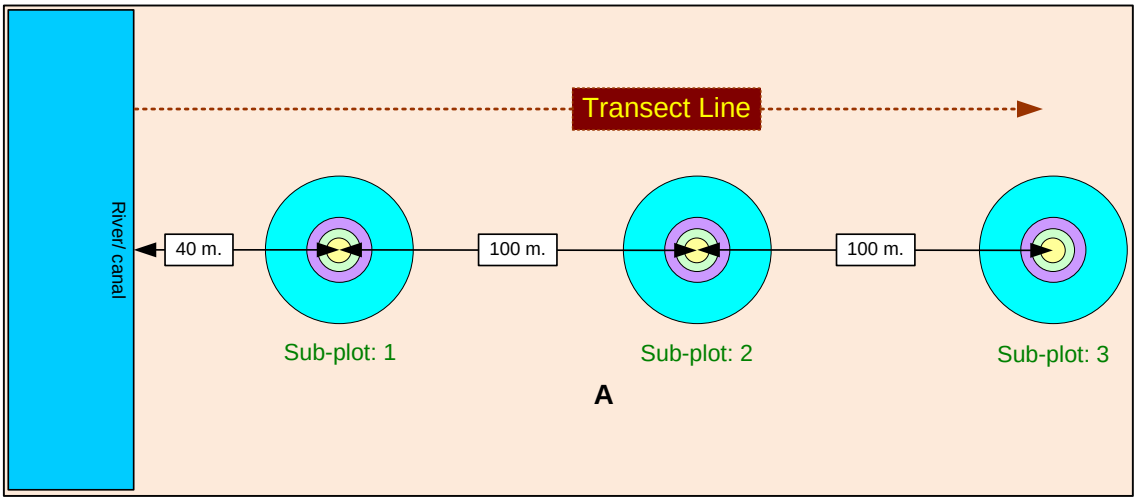


Figure 3.9: Layout of the subplots and transect line perpendicular to the ecotone (river or canal bank)

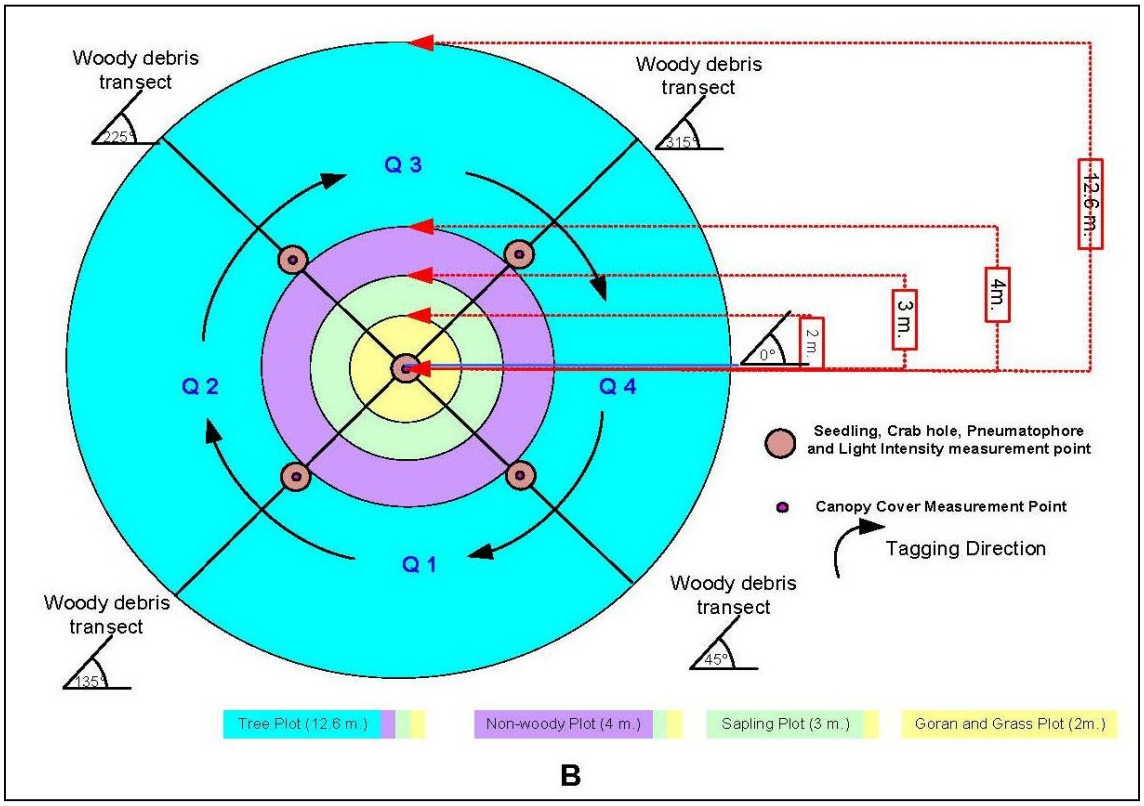


Figure 3.10: Layout of the survey activities in each subplot

Forest Health Survey

(a) Trees

193. Plants with DBH ≥ 5 cm and lean angle greater than 45º have been counted as trees and monitored within a circular area covering with a radious of 12.62 m at each sub-plot ofthe Permanent Sampling Plots (PSP). A map showing the location of all trees has been prepared in this monitoring period to ease the next term data collection (**Photo 3.4**). Tree height and DBH was also measured to examine the overall plant growth (**Photo 3.5** and **Photo 3.6**).

Photo 3.4: Team Members are recording and cross checking data on tree

Photo 3.5: Measuring height of trees at Akram Point

Photo 3.6: Measuring the DBH of trees at Herbaria

(b) Sapling and seedling

194. Status of saplings (DBH < 5 cm and height ≥1.37 m) and seedlings (height < 1.37 m) were monitored within the circular area with 3 m and 2 m radius, respectively in each PSP (Parmqanent sampling plots). In case of seedlings, only species wise individual numbers have been counted ***(Photo 3.7)***. For the saplings, species name and DBH were recorded along with the living status ***(Photo 3.8)***.

Photo 3.7: Counting the seedlings at Koromjol

Photo 3.8: Measuring the DBH of saplings at Sutarkhali

(c) Pneumatophores

195. The total numbers of pneumatophores were counted 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 were in the midpoint of the four woody debris transects which were facing at 45°, 135°, 225° and 315° angles ***(Photo 3.9)***.

(d) Crab hole

196. Generally, crabs play important role in mangrove ecosystems i.e. decomposing litter fall. In order to work out on the crab density, usually crab hole abundance are monitored. For this purpose, the crab holes were counted within a circular area with a radious of 1 m radius circle from each subplot's centre and in the midpoint of four woody debris transect (***Photo 3.10)*.**

Photo 3.9: Counting pneumatophores on forest floor

Photo 3.10: Counting of crab holes on forest floor

Photo 3.11: Taking measurement of Moisture, soil temperature and EC on forest floor

Photo 3.12: Counting of wood debris on forest floor

(e) Canopy Cover

197. Percentage (%) of canopy cover was estimated by using Densiometer, (a gridded convex mirror that provides a simple and inexpensive approach of measuring canopy cover). The Densiometer was held at a distance of 30 to 40 cm from the body (**Photo 3.13**). After levelling the bubble position the dots, which had not been occupied by canopy, were

systematically counted. In each subplot, the 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 considered as the average of these five readings.

(f) Leaf Area Index

198. 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. It influences net canopy photosynthesis. Light absorption by the forest canopy can be used to estimate the Leaf Area Index.The LAI was calculated by using the formulagiven below:

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

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

Photo 3.13: Taking canopy cover using Densiometer

(g) Soil sampling

199. The soil samples from the forest floor were collected in post monsoon season of the fourth monitoring year and the data has been incorporated in this tier after colmpleting the analysis (**Table 3.17**). An open face split auger (1m long) was used to pull out one-meter depth soil core. Soil core was then collected from the centre 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).

Bulk Density

200. Bulk density was measured according to Maynard and Curran (2007). Collected samples were dried at a temperature of 105°C until a constant weight being found using an air flow oven (Wisd, WOF-W305, Korea). The oven-dried samples were weighted and the corresponding volume of the core has been measured and bulk density (BD) of the soil sample has been calculated with the following equation:

Bulk Density (BD) = Wt105°C/Vcore; Vcore = πDcore^2 Lcore/4

Where, Wt105°C = The weight of oven dried soil,
Vcore = The volume of the core,
Dcore = The inner diameter of the core and
Lcore = The length of the core.

Soil Salinity (EC)

201. The soil salinity (EC) was measured according to Mostara and Roy (2008) study. A 1:2 ratio of soil and water (w/v) extraction was used to determine soil EC. 10 g of soil was then added with 20 ml distilled water in a 250 ml Erlenmeyer flask. This mixture was shaken by a reciprocating shaker for 1 hour and was filtered through Whatman No.1 filter paper. EC of the filtrated extraction was then measured by using an EC meter (Neomet EC-470L, IstekInc, Korea).

Soil pH

202. The soil pH was measured according to Miller and Kissel (2010). A 1:2 ratio of soil and water (w/v) extraction was used to determine soil EC. 10 g of soil was then added with 20 ml distilled water in a 250 ml Erlenmeyer flask. This mixture was shaken by a reciprocating shaker for 30 minutes and has been allowed the slurry to settle for 30 minutes. The pH of the slurry was measured by a pH meter (Hach, sension-3, USA).

Total Organic Carbon

203. Loss of ignition (LOI) method was adapted to analyse the organic carbon in the soil samples (Allen *et al.*, 1974). One gram of soil was taken in a pre-weighted porcelain cup and in next, it was dried at a temperature of 105°C for 24 hours. The oven-dried sample was then placed in a digital Muffle furnace (Wise Therm F, Wisd, Korea) at a temperature of 450°C for four (4) hours. After completion of the process, the sample was finally placed in a descicators to allow it to stay in room temperature and again to calculate the loss of ignition (LOI %) by using the following formula-

LOI% = (Wt105 °C – Wt450 °C)/Wt105 °C

Where, Wt105 °C is the weight of soil at 105 °C,
Wt450 °C is the weight of soil at 450 °C.

204. The percentage of LOI is usually counted as organic matter percentage. A total of 50% of LOI or ash free mass has been considered as the C (carbon) content in the sample (Allen, 1989). However, the LOI or organic matter can be converted to organic carbon according to Nelson and Sommers (1996) by using a universal conversion factor 1.724 (Van Bemmelen factor) based on the assumption that organic matter contains 58% organic C (i.e., Organic C% = Organic matter (%)/1.724).

Soil Total Kjeldahl Nitrogen

205. Soil Total Kjeldahl Nitrogen has been measured according to Baethgen and Alley (1989). The digestion of soil sample has been conducted with concentrated H_2SO_4 catalyst mixture (100:10:1 of K_2SO_4: $CuSO_4$: Se) (Bremner and Mulvaney, 1982) in a block digester (VELP DK-6, VELP Scientifica) and diluted the digest with distilled water to a final volume of 100 ml. The Nitrogen concentration of the digest has been then analyzed colorimetrically by using UV-VIS Spectrophotometer (Hitachi U-2910, Japan). A 5.5 ml working buffer solution

(0.1M Na_2HPO_4, 5% Na-K tartrate, 5.4% NaOH), 4 ml Na Salicylate-Na nitroprusside solution (15% - 0.03%), 2 ml Na hypochlorite solution have added to a 1 ml of aliquots. The absorbance of the sample has been then measured at 650 nm wavelength after 45 minutes.

Soil Total Phosphorus

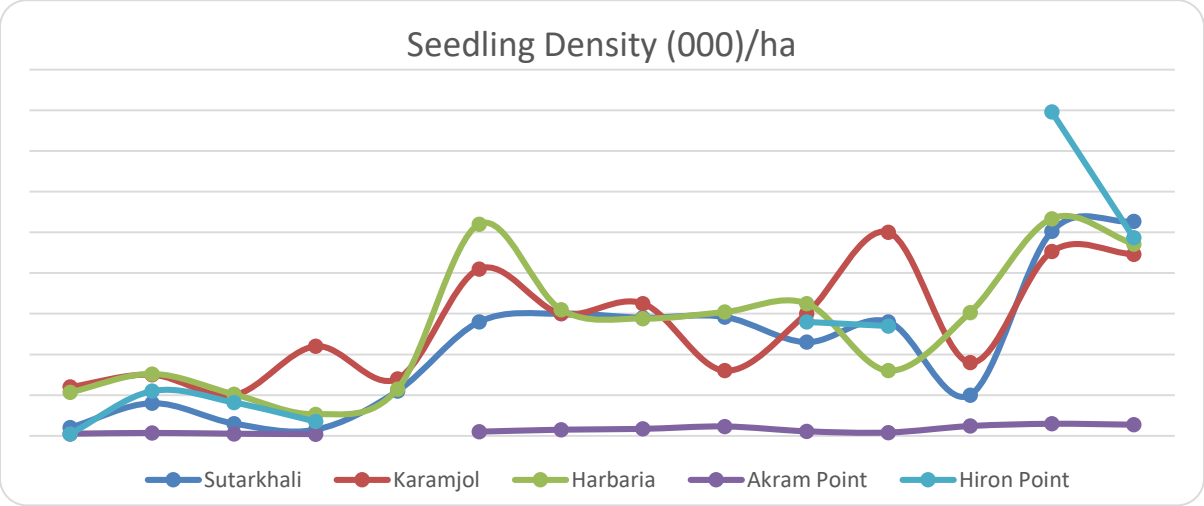
206. Total phosphorus in soil was measured according to Olsen and Sommers (1982). The digestion of soil sample has been carried out with concentrated HNO_3 and 60% Perchloric acid ($HClO_4$). The digest has then been diluted to a final volume of 100 ml with distilled water. 10 ml of Ammonium Paramolybdate-Vanadate reagent was added in 2 ml of sample aliquots and diluted the solution to 25 ml with distilled water. The phosphorus concentration has been then analyzed colorimetrically with UV-VIS Spectrophotometer (Hitachi U-2910, Japan) at 470 nm wavelength after 20 minutes of sample preparation.

3.3.3 Status of monitoring of SRF Health

Seedling

207. Higher number of seedlings were found during post-monsoon period where as the same had decreased during winter to pre-monsoon period. The recruitment of new seedlings depends on regeneration and survival rate for the respective species. These two indicators also depend on canopy coverand soil chemistry (pH, salinity, organic matter etc.). Seedlings usually die at an early stage in natural forest due to competition for nutrients as well as the intensity of light.

208. However, the result of this monitoring period have shown higher number of seedling at Hiron Point I comparison to thoseof the previous years. This may be due to stabilization of forest floor. Gewa was observed as the most dominant The dominant species were observed as Gewa. The seedling density at Koromjol subjected to illicit cutting. Other than the silvicultural competition, the seedlings at Akram Point also faced natural stresses due to their location which are 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. As such, seedlings are usually found in abundance just after the rainy season (monsoon to post monsoon) than in other seasons.

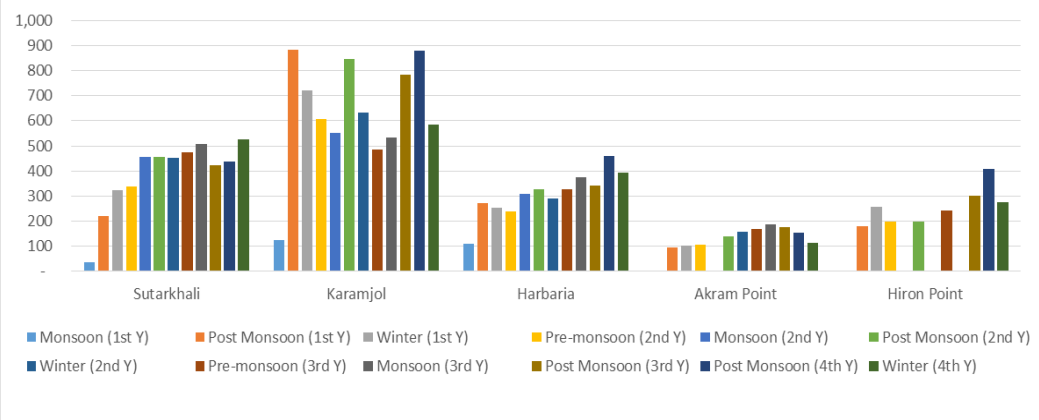


(Seedlings density was not monitored at Akram Point during Monsoon 2nd Year)

Figure 3.11: Mean (±95% CI) seedlings density among the quarterly surveys in five PSPs

Pneumatophores

209. Pneumatophores density have also changed due to seasonal variability (**Figure 3.12**). Pneumatophores usually dry up and die during dry season. The number of pneumatophores per hectare is found comparatively higher in Karamjol and Sutarkhali area during the post-monsoon period. However, among five monitoring sites, the mean pneumatophores density was found lower at Akram Point and Hiron Point due to floristic composition and over siltation. From the species composition inventory, Gewa (Excoecaria agallocha) was observed as the dominating species in these monitoring sites. On the contrary, Karamjol site was observed to be mainly dominated by Baen (Avicennia officinalis) tree and it has numerous tender pneumatophores compared to the others. The variation in the number of pneumatophores may be 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 plots with less effect of inundation may have lesser number of pneumatophores. It should be mentioned here that, Pneumatophores density has not been monitored at Akram Point during Monsoon of 2nd Year.

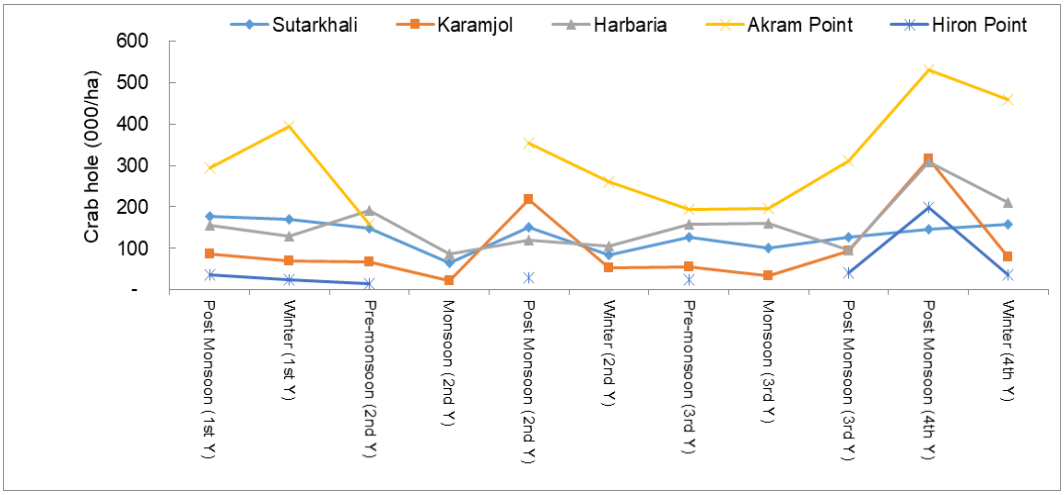


(Pneumatophores density was not monitored at Akram Point during Monsoon 2nd Year)

Figure 3.12: Pneumatophores Density among the quarterly surveys in five PSPs

Crab hole

210. Crab hole density is an indicator of availability of crab in a site and was found highest at Akram Point among the five monitoring sites **(Figure 3.13**). This would be due to sandy forest floor at Akram Point because they love to drag hole on that particular habitat. Harbaria crab hole has also been notably increased from that of the last winter period .Crabs are the major macro fauna, ecologically engineering the mangroves through digging burrows. So, it can be said that the forest health is comparatively better in Herbaria and Koromjal area. From the figure 3.15, it was difficult to predict the relationship of crab hole with seasonal variability. This might be due to the nature of mangrove (evergreen forest) forest floor. Although mangroves are 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

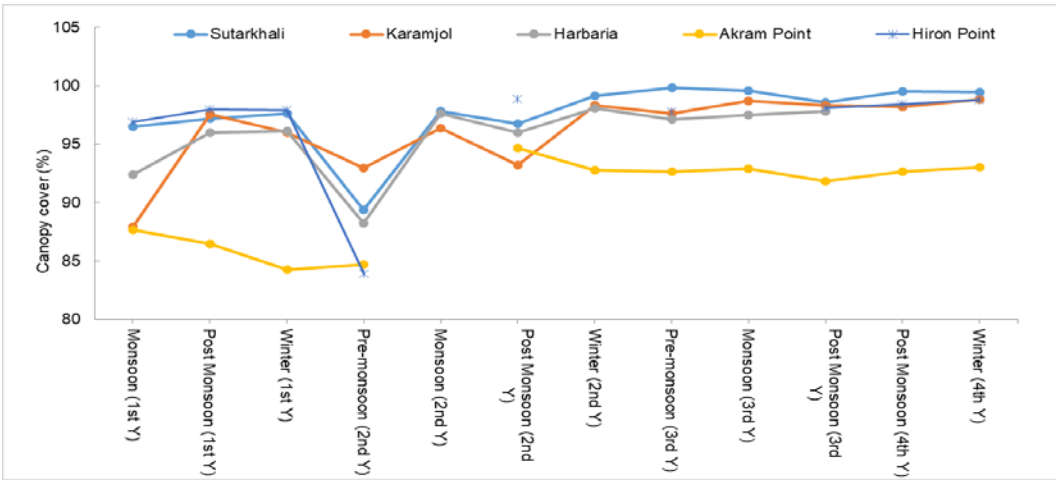


(Crab hole density was not monitored at Akram Point during Monsoon 2nd Year)

Figure 3.13: Mean crab hole density among the quarterly surveys in five PSPs

Canopy cover

211. Within the monitoring plots, the canopy cover percentages did not varied significantly. From the first year to second year pre-monsoon, the highest canopy cover percentages were observed during monsoon to post monsoon which started decreasing during winter and found as the lowest in pre-monsoon period. However, from post monsoon to winter of the fourth year, the percentage of the canopy cover was found similar among all the monitoring sites (**Figure 3.14**). Since greater than 60% of the canopy coverage in a site is considered as healthy therefore all the locations of the monitoring plots can be assumed to be in a good condition.



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

Figure 3.14: Mean canopy cover (%) among the quarterly surveys in five PSPs

Leaf Area Index (LAI)

212. The LAI influences daily rate of net canopy photosynthesis results in exchange of atmospheric CO_2. The minimum ratio between canopy coverage by trees to open canopy light intensity values indicate of having the maximum LAI. The LAI was found to be increased in all monitoring locations from the previously obtained values. This is a sign of good health of forest. However, at Akram Point, like other indicators the LAI was much lower due to high under canopy light intensity.

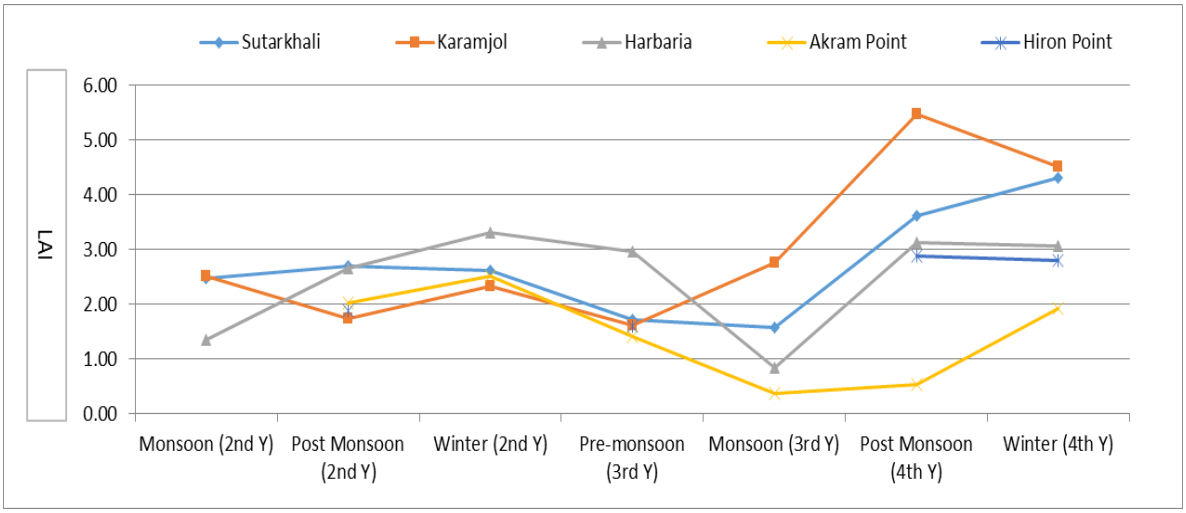


Figure 3.15: Mean LAI among the quarterly surveys in five PSPs

Soil properties

213. The soil properties were obtained by analysing the collected samples from the third year scecond quarter (post-monsoon period) from the preselected monitoring sites. The analysed data of mean bulk density, soil pH, soil salinity, OC (%), N and P content for the five monitoring sites are given in **table 3.17**. No significant change was found in mean soil properties except N and P concentration among the monitoring sites. The lower bulk density indicates that the sites have more organic matter. According to the analysed result, the Harbaria site's soil was rich in organic matter, less compact, and more porous. The soil salinity found highest in Karamjol Point (6.53 ms cm-1), while the lowest in Hiron Point (3.19 ms cm^{-1}, Table 3.17). The OC% found almost similar to all monitoring locations except Hiron point which represents the lower amount of OC (1.88%). The N concentration found similar in Karamjol, Harbaria and Akram Point (Table 3.15). Lowest N concentration also found at Sutar Khali site (Table 3.15). The P content found lowest in the Hiron point. The Hiron point shows also the poor concentration of soil properties because the location is at high elevation compared to others and results in lower litter decomposition.

Table 3.17: Mean soil properties among the four monitoring sites in Sundarbans Reserved Forest

Soil depth (cm)	Soil parameters					
	Bulk density (g cm^{-3})	Soil pH	Soil Salinity (EC) ms cm^{-1}	OC %	N(mg g^{-1})	P (mg g^{-1})
Sutar Khali						
0-15	112.36	7.36	1.90	1.84	0.59	0.37
15-30	122.23	7.51	4.45	2.06	0.67	0.38
30-50	117.94	7.51	5.61	2.21	0.72	0.45
50-100	110.19	7.07	6.61	2.50	0.69	0.45
0-100	115.68	7.36	4.64	2.15	0.67	0.41
Karamjol						
0-15	90.86	6.98	2.63	2.28	0.70	0.44
15-30	110.08	7.11	5.47	2.45	0.67	0.34
30-50	127.79	7.22	5.74	1.71	0.52	0.33
50-100	117.01	7.07	6.70	1.76	0.55	0.41
0-100	111.43	7.10	5.14	2.05	0.61	0.38
Harbaria						
0-15	100.05	6.98	1.42	2.14	0.67	0.34
15-30	109.71	7.12	2.54	2.69	0.83	0.42
30-50	113.45	7.31	3.74	2.24	0.73	0.40

Soil depth (cm)	Soil parameters					
	Bulk density (g cm^{-3})	Soil pH	Soil Salinity (EC) ms cm^{-1}	OC %	N(mg g^{-1})	P (mg g^{-1})
50-100	109.47	7.08	4.95	2.61	0.69	0.34
0-100	108.17	7.12	3.16	2.42	0.73	0.38
Akram Point						
0-15	116.03	7.43	3.04	1.92	0.68	0.35
15-30	119.21	7.46	3.71	2.17	0.72	0.39
30-50	115.36	7.58	3.54	1.93	0.67	0.38
50-100	117.92	7.12	6.12	1.92	0.62	0.33
0-100	117.13	7.40	4.10	1.98	0.67	0.36
Hiron Point						
0-15	127.21	6.91	1.73	0.99	0.31	0.23
15-30	134.93	6.62	3.14	1.92	0.56	0.41
30-50	129.26	7.05	2.96	1.93	0.54	0.34
50-100	129.19	7.34	3.67	1.65	0.42	0.35
0-100	130.15	6.98	2.87	1.62	0.46	0.33

3.4 Findings

214. From the last monitoring activities, it can be predicted in terms of seedling density, pneumatophores, crab hole, canopy cover and leaf area index (m^2 leaf area/m^2 ground area) that, the forest condition is showing positive changes periodically, although there is some seasonal effects. Regeneration rate has also been found to have remarkable changes in the study area. Illicit felling of trees was observed in Koromjol and Akram Point site. However, based on above indicators it was found that the health condition at Akram Point is worser than the other site. This might be due to the physiographic location of this site, which is facing high environmental stresses. Because the Akram Point is situated at the confluence of Shibsa and Passur River. Therefore, during tidal inflow the forest floor carry large amount of soil sediment than other locations. Here, the forest is experiencing retrogation process where the climax species have started decaying. Hence, this area is sensitive in terms of disturbance. From the field visit it was denoted that, the height of Sundari tree is comparatively higher at Harbaria. Goran species were moderately seen in Akram Point and Hiron Point. It was also observed that trees at Koromjol, Hiron Point and Akram point is facing top dying. Some of the trees at these sites was found to be logged or Death.

3.5 Agriculture Resources Monitoring

215. Monitoring of agriculture resources has been scheduled twice a year as per the monitoring plan. Accordingly, the survey was conducted in October, 2017 and December 2017 and data on Local Aman was collected through informal interview (KII, RRA and FGD) with the local farmers from the monitoring plots.

3.6 Methodology

Monitoring Indicators

216. Major cropped area, crop production and crop damages were considered as major indicators for agriculture resources monitoring. During the 14th and 15th quarterly visit, some extensive consultations/group discussions were organized with local people to know the use of agricultural inputs, present cropping patterns by land type, crop damages and other conditions like drainage congestion/water logging, salinity intrusion or other natural calamities induced impacts, diseases and pest infestation as well as management practices and crop production in the selected locations of the monitoring area.

Location

217. For data collection, five sampling plots were selected on random basis within the project influence area. The mauzas which were selected for land resources monitoring were considered as well as monitored for agricultural resources monitoring too. The locations of agriculture monitoring plots are presented in **Map 3.3**.

3.7 Description of the Selected Plot

218. Detailed information of the selected plot is presented in **Table 2.8** of land resources monitoring part under physical environment.

3.8 Present Cropping Patterns of Monitoring Plots

219. Detailed data on cropping pattern for the last three years were obtained through extensive discussions with the plot owners. Based on the discussions, the plot based cropping patterns was identified and the associated data was collected in October, 2017 and December 2017 and described in the following sections.

Agriculture Plot-1(Baranpara)

220. This plot is located at Baranpara mauza and the area is about 0.4 ha. During the monitoring period in 2016-17, HYV (High Yielding Variety) Aman (BRRI Dhan-30) was found to be cultivated in this plot for Kharif-II season. It was also observed that, rice straw and Bajua grass were mixed and used as fertilizer to improve the soil fertility level of the plot. On the other hand, the occurrence of Pest like Stem borer and Rat infestation were reported for crop damage. In this connection, granular pesticides e.g. Virtako @ 500gm/plot and Rat flap: 50gm/plot were applied to protect crop from pest infestation. Due to the application of pesticides, the pest infestation has been reduced to a minimum level. Detailed cropping pattern is shown in **Table E.1** of **Appendix IV**.

221. During this monitoring period in 2017-18, Local Aman (Chapshail) was also found to be cultivated in this plot in Kharif-II season. This was for the water logging in this plot. The excess amount of water couldn't be drained out properly from the plot. No chemical fertilizers were applied in this plot. Detailed cropping pattern is shown in **Table E.1** of **Appendix IV**.

Agriculture Plot-2(Chunkuri-2)

222. This monitoring plot is located at Chunkuri-2 and the size of the plot is about 0.93 ha. During the previously monitored period in October 2017, it was observed that, the farmers of this plot cultivated Local Aman (Benapole) due to the high market price of local variety than HYV variety. Similar fertilizer and pesticides were found to be used in this plot. Detailed cropping pattern is shown in Table E.1 of Appendix IV.

223. Local Aman (Benapole) was found to be cultivated in this plot in Kharif-II season. However, no chemical fertilizers were applied in this plot. Occurrence of Pest like Leaf folder caterpillars was reported. To protect crop from pest infestation, powder pesticides Amithin plus was applied @ 70gm/plot. Detailed cropping pattern is shown in **Table E.1** of **Appendix IV**

Agriculture Plot-3 (Kapalirmet)

224. This plot remained fallow from the 2nd and 3rd year monitoring period due to increase in salinity. According to the opinion of the local people, Bangladesh Water Development Board (BWDB) decided to re-excavate the Ghona River and hence they had to remove all the obstacles to facilitate the re-excavation of the Golbunia khal mouth. Thus water entered into the settlement areas including their cultivated plots during the year 2014-15 and remained inundated by saline water. As a result farmers started practicing shrimp culture instead of cultivating traditional crops in these plots. However, a number of farmers cultivated crops in their plot in this adverse condition, but all crops were damaged by river water and rainwater in that season due to this fact.

225. Owners of Shrimp farms of this area were used the saline water in these plots for shrimp culture as there was no scope to drain out saline water from this area. The situation is still not in farmers' favour. Farmer of this land decided that they would not cultivate crops in future due to increase in salinity. Rather they would only practice the shrimp culture in future. It was observed during the recent monitoring period that this plot still remained fallow in the Kharif-II season of 2017-18. Detailed cropping pattern for this plot is presented in **Table E.1** of **Appendix IV**.

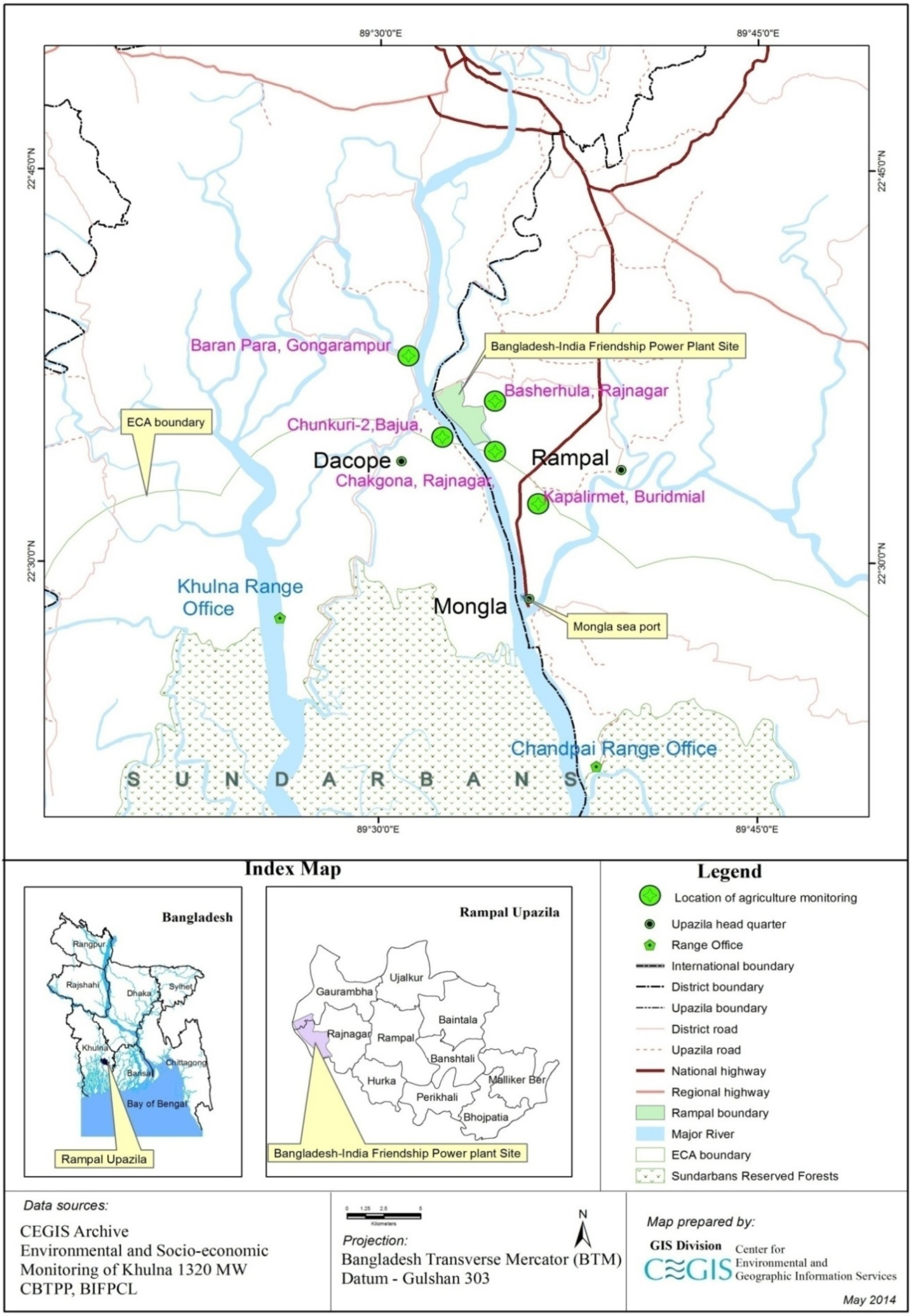
Agriculture Plot-4 (Chakgona)

226. During the 2nd and 3rd year of monitoring tiers, this plot remained fallow due to increase in salinity concentration. The farmers could not grow Aman crops in the Kharif-II season. Farmer of this land have decided not to grow crops in future. However, shrimp/fish was found to be cultured in this plot during the Kharif-II season of 2016-17. It may be mentioned that the plot owner has given part of the plot (0.07 ha out of 0.28 ha) voluntarily for construction of the cyclone shelter at Chakgona mauza.

Agriculture Plot-5 (Basherhula)

227. During the 12th quarterly monitoring Local Aman (Chapsail) was found in the field instead of HYV because of its high tolerance capacity against salt and high market value. Farmers used urea fertilizer as only chemical fertilizer (35 kg/plot) and rat flap as insecticide (50gm/plot). Crop damage was found in this plot due to lack of proper management practice.

228. During this monitoring period (15th program), Local Aman (Chapshail) was found to be cultivated in this plot in Kharif-II season of 2017-18. This time Chemical fertilizer (Urea @ 50kg/plot) and granular pesticides (Basudin @1kg/plot) were found to be used in the plot. Only Leaf folder was observed in this plot as pest infestation. Detailed cropping pattern is shown in Table E.1 of Appendix IV.



Map 3.3: Agriculture Resources Monitoring Locations

4 Social Environment

4.1 Socio-economic Condition and Social Safeguard

229. In this 15th quarter of environmental monitoring, changes (either improvement or deterioration) in socio economic condition through selected indicators/parameters are captured with reference to the previous monitoring results. It is intended to recommend for further improvement of the present construction activities in this monitoring report. Methodologically, the selected monitoring indicators are surveyed twice in a year (six months successive interval), but in emergencies (if any important issue arises and that requires intensive investigation) survey methodologies can be changed or revised. This chapter also included discussions in this chapter reflect a comparative results or changes based on survey completed in 14th quarter (from 23rd October to 26th October 2017) and 15th quarter (from 13th January to 17th January 2018).

4.1.1 Methodology

230. Only the important parameters/indicators were examined in this phase with reference to their earlier conditions.

231. In total six informal discussions were made in the surroundings mauzas of the Project area and one in the outside of the project surroundings giving a special influence to the resettled households at Foyla Bazaar. One discussion session was conducted at Foyla Bazar comprising the resettled people while the remaining five were conducted in Kapasdanga (1), Barni (1), Rajnagar (2), Baradurgapur (1) with directly and indirectly project affected people. As per the the conversation made with the representatives of respective LGIs (Local Government Institutes), there was hardly any change in Pankhali and Bajua mauzas comparing to those of the informations obtained from earlier monitoring program (13th & 14th quarters). So, no detailed discussions were made in those mauzas. Besides, informal discussions were made within the project site with different workers of respective contractors (**Map 4.1**). An informal interview was also conducted at LA office, Bagerhat to identify compensation status of land, assets and trees of the project area.

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

4.1.2 Exploration of Monitoring Parameters

Compensation

233. Compensation for structures, trees and crops has been officially completed. Compensation for land against about 85% of entire land (including phase A & phase B) has been paid. In the remaining 15% of land, about 7% are owned by Bagerhat DC Office, 5% of land having inconsistency of legal documents or under sue in courts and the owner of about 3% of land are not interested to receive anny compensation. As per the Act of Bangladesh Government (Acquisition and Requisition of Immovable Property Ordinance, 1982 (Ordinance II of 1982 including amendments up to 1994 - ARIPO 1982), people who have no legal documents of land are not eligible for having any compensation.

234. Some shrimp farmers were used to cultivate shrimp by taking lease (locally called *hari*) of private land in the project area for a certain contract period. BPDB has a plan to restore the

livelihood of these indirectly affected households and for that reason a LRP (Livelihood Restoration Plan) has been prepared. Engagement of the respective NGOs for implementation of LRP is under process. During monitoring survey, the affected people due to loss of income and livelihood urged for quick implementation of that LRP. Meanwhile, the project authority initiated training programs where representatives from some of these affected non-titled households participated. Sewing and computer literacy training had been introduced in the training program over last two years. The trainees stated that there were limited opportunities of employment insewing/tailoring and computer related works and the existing fields are saturated by the preceded occupants.

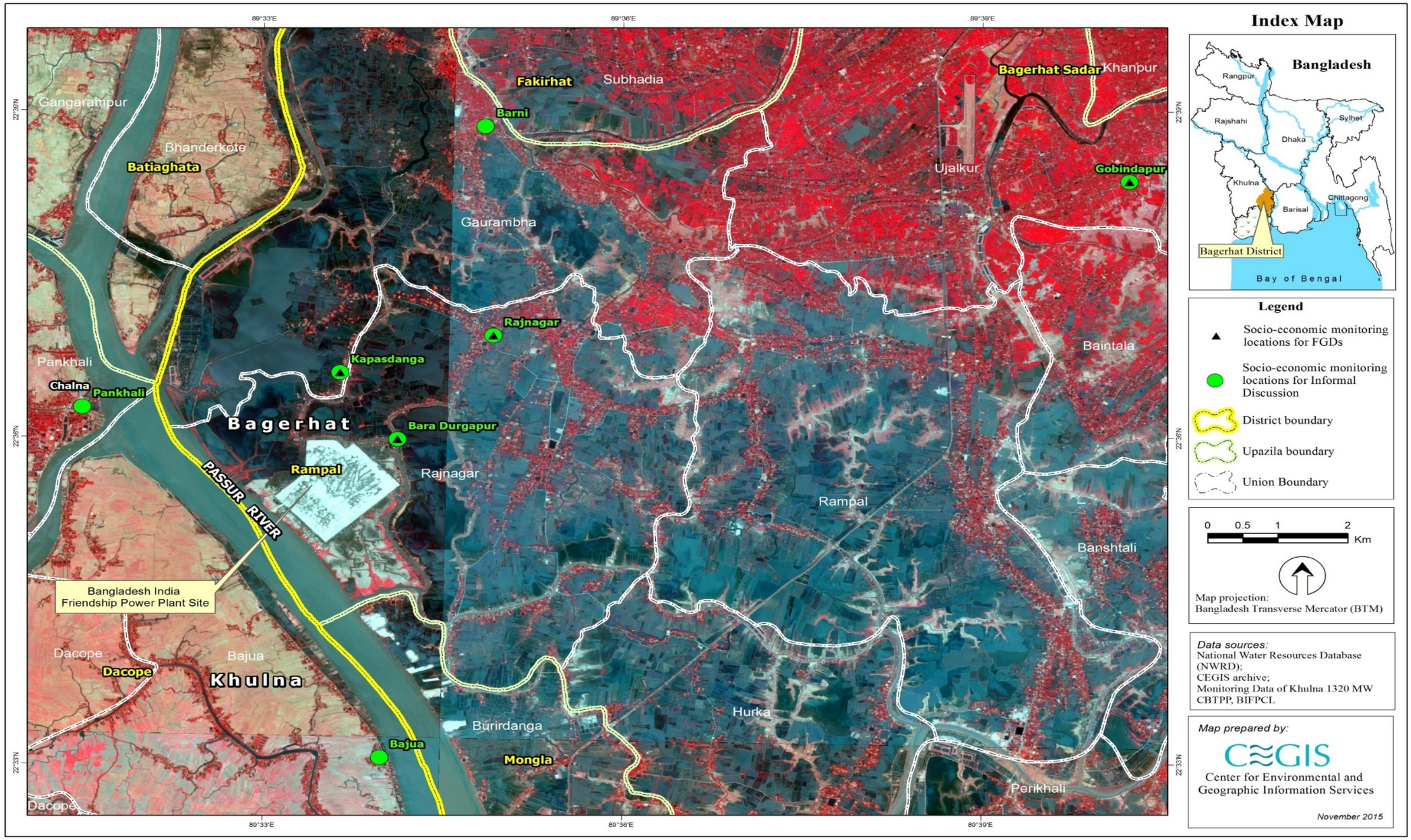
235. Among the two studied unions (Rajnagar & Gaurambha) of Rampal upazila, people of Gaurambha union (including Kapasdanga and Barni mauzas) shown their disappointment regarding livelihood restoration issue. They have not yet received any support for livelihood restoration though they are the owner of about half of the entire project area. Livelihood of a number of people in the Gaurambha union was also dependent on the project land with fish farming. On the other hand, people of Rajnagar were the owner of a very small portion of land but getting priority in selection as trainees, laborers and for other activities by the project authority. The chairman of Gaurambha union also urged to assess the potential job market before selecting the training modules; so that the trainees could have the opportunity of employment just after successfully completion of the training.

Resettlement/Rehabilitation

236. Eight (8) out of eighteen (18) resettled households moved out from the Foyla shelter home over last three and a half years. Major cause behind their moving out is lack of sustainable source of livelihoods that they can able to adapt in the surrounding of Foyla Bazaar area. The households those are still struggling for surviving are badly seeking for the sustainable working opportunities.

237. In terms of income restoration and livelihood improvement programs, project authority trained 60 people on sewing and computer literacy so that they can restore their livelihoods using training skills. In line with this trainings for one batch on sewing and two batches on computer literacy were organized. The trainees are satisfied with these trainings but they cannot find out possible linkages in job fields. In this respect, they demanded for some logistic supports i.e. sewing machine, sewing yarn, buying computer in installment with zero interest from the project authority. The local people stated that trainings on rod welding, wall painting, driving, and skill development as electrical technician, mechanics, and security force are needed to be introduced instead of existing trainings. It was informed that the participants completion of the sewing and computer trainings do not have any opportunities of jobs in the relavent field (stated by Chairman, Rajnagar union). After implementation of LRP, which was prepared in consultation with indirectly affected person, the required training in the relevant field and the issue of capital money to start business will get resolved hopefully.

238. The chairman of Rajnagar Union Parishad stated that project authority had appointed one person for official work in Dhaka. He also added that, there were more opportunities to employ them in BIFPCL field office.



Map 4.1: Socio-Economic Environment Monitoring Location

Project Related Employment Generation

239. Under the lead construction firm named Bharat Heavy Electricals Limited (BHEL) some sub-contractors i.e. Dipon Group, Simplex, Keller, Afcon Group, Energypac, NS Construction etc. have started their assigned works. The BIFPCL affirmed the sub-contractors to recruit local laborers according to their area of expertise and they have already monitored it. During field survey it was observed that, local laborers are considerably recruited in non-technical activities i.e. load carrying, laboring in civil works and so on. The local working laborers stated that scope of their engagement is increasing. They stated that these types of working labor forces were available among the affected community of the area surrounding the project.

240. The LRP, which was prepared in consultation with indirectly affected person, the issue of required training in the relevant field shall get resolved. The contractors are in general recruiting labours from the near by locality. Presently more than 500 people are engaged in construction work including un-skilled labours. However, in near future huge volume of laborers will be required. At present test piling, load test, Job piling, electric wire stringing, compact substation, labor shed construction, office construction, Accommodation construction, road & drainage works etc. activities were observed in the project site. According to a working laborer, at present about 150-200 un-skilled laborers are working in the site. All other sub-contractors except Dipon Group have recruited numbers of local laborers; the Dipon Group utilized most of their personal laborers, as they have to involve in technical pilling activity.

241. The project authority has taken initiatives to redress the grievance of unexpected occurrences those are occurred due to their interventions. A grievance box has already been installed in the project office but the disappointing matter is that still not a single complaint has been dropped in that box. People of the project surrounding mauzas stated that they were aware of this from the monitoring survey team only. Project authority is requested to give wide publicity that grievance are available and people can lodge their complains if any. So, the initiative of installing grievance box will be successful if all the people of the surrounding mauzas are well aware about it. So, ensuring proper function of grievance redress mechanism, people of the project surrounding mauzas are needed to be well aware about it.

Labour and working condition

242. All the sub-contractors have separately constructed labor sheds in the allotted space. These sheds are made as semi pucca structure with concrete wall and floor; and tin shed roof. Separate semi pucca toilets (1 for every 10 laborers) with water sealed sanitation system, concrete cistern for bathing; separate cooking sheds are also constructed for the working laborers. The demand of drinking water will be met by the newly constructed water treatment plant with the capacity of 20,000 liter. Gender issue should be kept in priority to create separate breast feeding room for female workers that has not been constructed yet.

243. A number of safety signboards were found in the project site which is good initiative for decreasing accidental occurrences. Workers are also found to use Personal Protective Equipments (PPEs) and that is regularly monitored by the project authority. For ensuring laborers safety and security, following protective equipments should be provided as per their requirement and working activity. Present practice in the project site is specified in separate column in the following **Table 4.1**.

Table 4.1: Protective equipments of risky limb in human body

Risky limbs of human body	Protective Equipments	Practice in project site
Eye	Safety spectacles/goggles	✓
Ear	Earplugs	As per requirement
Head and neck	Safety helmets	✓
Hands and arms	Gloves, gauntlets and sleeves that covers part or all of the arm	✓
Legs and feet	Safety boots and shoes	✓
Lungs	Half and full masks filtering dust	✓
Whole body	Boiler suits/aprons/chemical suits	Reflective colour apron are being used

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

244. The laborers of the construction area are satisfied by their wages in comparison to the wage rate of project surroundings. The wage rate of unskilled/semiskilled laborers varies from BDT 400 to BDT 500 in the project site while for the skilled workers it is up to BDT 700 according to types of work.

Photo 4.1: Safety Signboards in the project site

Photo 4.2: Safety Signboards in the project site

Photo 4.3: New Labor shed for the working labors

Photo 4.4: Toilets for the working labors

Community Health Safety and Security

245. Dust generated from the project area can be mitigated by executing some mitigation measures as well as stability of soil. As wind blows in low speed during winter, therefore people's complaint against dust problem was not raised. Nevertheless, the boundary wall in project surroundings played an important role to reduce dust flow in the study area. Moreover, the planted trees (12,118 fruit/ wooden/medicinal trees and 10,426 *Golpata*) by the project authority also played an important role to mitigate the dust problem. In addition, about 1000 of coconut trees and 1000 different flower trees are planted over last six months in the project area.

246. Heavy construction activities (especially pilling) may pollute the environment through creating noise and dust, which may affect the surrounding community causing different health diseases. Though to some extent, most of these problems can be mitigated by taking above-mentioned measures (boundary wall, tree plantation etc.), In addition to this, Water is being sprinkled on roadside inside the plant boundary. In addition, heavy construction works during quiet time (8 pm to 7 am) should be restricted and strictly monitored as well.

247. For ensuring community safety and security, armed ANSAR guards were recruited and appointed at the entrance site of the project area. People's movement toward the project area is being monitored through the watchtowers. However, there are some pockets, which have access to the surrounding villages i.e. Durgapur, Sapmari etc. where no guard has been found during monitoring survey. This might be the matter of insecurity for both of the project authority and the villagers;of course no single occurrence has been recorded yet.

248. Temporary drainage systems have been formed that will be functioned up to the end of main construction work. The project authority stated that after finishing the plant construction work permanent drainage, sewerage and water supply network kwill be prepared following detail design. However, the assigned contractors can prepare/arrange some additional utility facilitiesas per their necessity but it would not be the matter of disturbance for others.

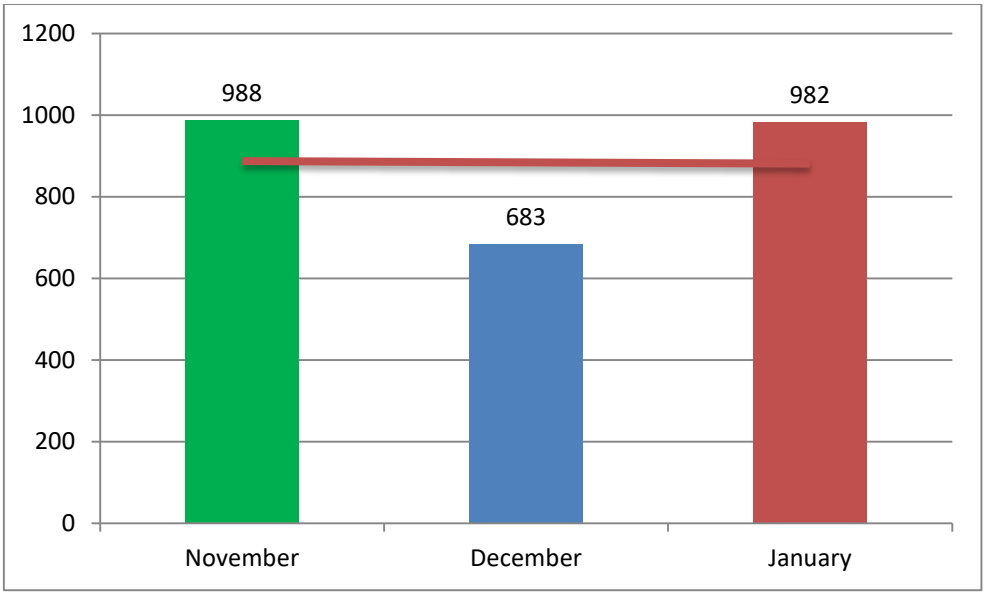
249. The BIFPCL authority stated that each sub-contractor were asked to have at least one environment, health and safety officer for ensuring hygienic and safety environment in the project surroundings and the same are being implemented.The EPC contractor - Bharat Heavy Electrical Limited (BHEL) has recruited an Safety and EHS officer to monitor environment, health & safety issues of the sub-contractors.

Activities under Corporate Social Responsibilities (CSRs)

250. Free medical service sustainably performed over last four years, targeted to ensure better treatment facilities in project surrounding areas.Popularity of the service is uplifted among the local people day by day. The medical camp is organized twice a week where patients are treated by an expert physician.In general, the medical centeris openedfor all the seven days in a week.At that time, patients can get medicine and other general facilities from the medical center by the guidance of medical assistants.

251. Considering the convenience of local people, the medical camp is set up just beside the access road of the power plant. Considering the security of local people and project authority this camp has been placed just outside of the project boundary where office of some sub-contractors is also found. An equipped separate space/room in the BIFPCL office has been formed for setting up medical unit. There are shelves for keeping medicines and instruments, separate check-up room for keeping privacy, a bed with oxygen support, 3 supporting staffs

including paramedics, available necessary medicines etc in this medical compartment.In addition, EPC contractor also has set up a medical center for their laborers and workers, where one qualified first aider/ paramedical staff are available round the clock during construction time. An ambulance also been round the clock available, hired by EPC contractor.



Source: BIFPCL Office, 2018

Figure 4.1: Record of health service recipients under CSR program

252. From the patient's record, it was found that 4,122 people had received free health services in the last six months (from May2017 to October2017) from the medical camp. In addition some workers are treated in office medical center. The highest recipients were in August- As emergency response measures in case of mishap occurrences during commence of plant construction activity an Ambulance has been stationed round the clock. The authority mentioned that they had sufficient medicine to provide all types of general ailments. However, they also mentioned that they are not efficient to treat critical diseases like cancer, kidney, cardiac etc. due to lacking of diagnosis tools and other expensive equipment. The project authority has to expense BDT 0.03 per kW on total profit for the CSRs while they had run the medical service on their own fund for humanitarian aspect only not for any obligation. In this regards, it is assumed that this facilities can be explored more when they have sustainable source of liquidity.

Photo 4.5: The health services provided by the BIFPCL authority

5 Environmental Compliance

5.1 Introduction

253. During the field visit in this quarter it was observed that the EPC contractor has started the works and .the civil construction activities has been going on in a massive manner . Specially Geotechnical study for foundation design at the Boiler and Turbine site and other heavy equipment areas, development of internal road communications, temporary drainage networks development, water treatment system for the construction activities etc. are progressing fast in this stage.

254. The two-lane approach road of about 6.0 km. from Babubari point at Khulna – Mongla Highway to Power Plant Project site has been completed and as result now one can easily access to the Project site easily. According to the new plan of the Government extension of approach road from existing two lane to six lane is progressing fast. Boundary wall around the first Phase of Project and the slope protection works 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 BHEL's office. BHEL have already employed different local specialized construction firms for progressing the construction works simultaneously.

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

256. 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 **Table 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.	• CEGIS is carrying out noise survey in ambient environment under environmental monitoring study. • Noise level is within the limit in the project boundary. • Use of PPE by the workers at working period. • Machines/equipment/ generators which are passing idle period are switched off/throttled down. • Developed EHS documents for construction works. • Using sound proof room for the office workers.	Being Complied.	• Limit the noise level 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 water during dry season	• CEGIS is quarterly monitoring the dust generated at the sensitive receptors like boundary corners, project site, nearby communities and inside the Sundarbans Reserve Forest Area. • Water spraying for reducing the dust emission. • Boundary wall for the main Plant is being completed. • The workers are using PPE properly. • 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
		• 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 oil • 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 ISO14001 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 developed. • Rainfall runoff discharge to nearby river through existing temporary drainage network which is being cleared occasionally. • EPC contractor is now going to recheck the water quality of outfalls. • 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	• Stockpile of construction material should be placed at a safe distance from drainage network; • The solid kitchen waste should be disposed on the designated places; • Use of evaporation pond for the RO rejection (brine) ; • Awareness training and good practises should be continued ; • Introduce temporary sewerage treatment system; • Development of the solid waste on-site dumping system, collection system and offsite disposal system.

Sl. No.	Potential Impacts	EMP measures as proposed in the EIA	Actual condition/ Measures already Implemented	Compliance Status	Recommended Action
4	Waste Management System	• Limiting site clearance and base stripping activities within the project boundary • Dispersed 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 be required to cover 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 blocked • 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	• Heavy equipment and mechanical equipment has been 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 at Plant office and kitchen has been initiated. • Not only the project area but also different areas within the project boundary are compartmentalized by fence • Sanitation facilities are available • Burning of waste materials was not recorded • Material transport is being done by regular route • This project is maintaining significant setback distance from the river especially along the Passur river. • A number of sign board has been put at the strategic points some of which are in English language only. • They are trying to improve good house keeping • Waste management is included in the induction training to the labour	Being complied	• Sufficient waste disposal bin/s with labelling should be installed at labour shed, and working area before starting of the main construction works; • As much as possible reduce, reuse and recovery of the construction waste. • Introduce coloured bins to store different types of waste. • Local language should be included in all the signboards. • Communicate with the local administration for offside waste transportation and disposal.

Sl. No.	Potential Impacts	EMP measures as proposed in the EIA	Actual condition/ Measures already Implemented	Compliance Status	Recommended Action
		• Keep provision of different colored waste bin for dumping biodegradable, 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.	• Compensation has been given to the rightful owners of the land as per the laws of Bangladesh e.g., Acquisition and Requisition of Immovable Property Ordinance, 1982 • Compensation made by local DC office • Local DC office facilitates unauthorized occupants of the acquired land to get home in the Government's shelter homes or cluster villages. • BIFPCL gives priority to affected people in Project related employment • 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. • Livelihood Restoration Plan (LRP). for the PAPs have been prepared by BPDB. • BPDB already are in the process of appointing an NGO for implementation of LRP. (proposal from prospective NGOs are under evaluation.)	In the process of Compliance	• Initiatives should be taken for resettlement of the people as per the LRP; • Introduce training to the PAPs, so that they could get job according to their skill during construction stages; • The authorities may give directives to the EPC/Sub-contractor/local contractor/local Government 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
		based on proper socio economic studies? • Human provide/ take extra care/caution for the disadvantaged/ vulnerable group/s (i.e. women, children, ethnic minorities, indigenous people etc.) • Provision of monitoring the compensation and resettlement process			
6	Livelihood and living condition	• The labor recruitment policy must be formulated in such a way that the local laborers can easily get chance of employment in the power plant project • Gov/NGOs need to provide support 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 • Prepared HR policies, Labour recruitment Policies, Manpower set up etc.; • Local labours are involved in the project construction activities • Most of the local labours are – directly project affected people, nearest communities or within the Rampal/Mongla areas • The wage of the labour is compatible with the national standard. • Provision of first aid is present; • Medical unit capable of dealing emergency like injury, ICU supported ambulance, accident, etc. already set up. • Communication system has developed surprisingly in this area • New planned residential areas for the labour are under construction, which includes good sanitation facilities, living condition, medical facilities and recreation facilities.	In the process of Compliance	Increasing the number of the local labour • Training, awareness program and grievance redress mechanism should be adopted in a formal way; • Accidental log sheet or injury log book should be put into display in office premise and entry check post; • Improve the sanitary facilities for the labours who are employed directly or indirectly for this project related activities; • Training should be given to the Bouali, seasonal fishermen, small boatman,

Sl. No.	Potential Impacts	EMP measures as proposed in the EIA	Actual condition/ Measures already Implemented	Compliance Status	Recommended Action
					Mauali of Sundarbans as future labor force; • Training should be given sequentially to the PAPs, on Local or regional basis;
7	Green House Gas Controlling Measures	• Restrict of any kind of solid waste burning • Regular maintenance of water vessels, vehicles, generator and machinery in accordance with manufacturer's 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	• EPC should adopts energy efficient, CDM measures for selection of technologies; • Making IFC guidelines, EIA approval of DoE, and EMP of the EIA, etc. as a part of the bid document. • Monitoring program has been running successfully • Solid waste burning is not recorded • The construction machineries are mostly new • Vehicles and Vessels are not recorded as overloaded during the investigation	To be complied during construction and operation stage.	• Prepare checklist on equipment and their condition owned by the contractors; • GHGs inventory checklist should be prepared immediately at this stage • Select low GHG emission machineries and CDM • Use of energy efficient 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, tool box are continued • Following the Bangladesh Labour Law (Revised) 2013, Bangladesh Labour Rule, 2015	Being complied	• Appointment of Local workers should be given priority for non-technical jobs. • 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.
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 about 100 numbers of labour • ERP has been developed • Increasing the medical facilities for the labour	Being complied	• Proper documentation of contract with the worker is required which includes working hour, wage and benefit and emphasise recruitment of the local labours; • The insurance policy should cover the accident or injuries of the labours;

Sl no	Potential Impacts	EMP measures as proposed in the EIA	Actual measures already Implemented	Compliance Status	Recommended Action
			• 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.		• Awareness work should be continued regarding the local cultural values, STD and redressal 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 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;	• Putting safety sign at every strategic places; • Protecting the specific areas with fence; • A number of designated areas are recorded in the project site; • Labour and Project personnel are using appropriate PPEs like reflecting vest, helmet, safety shoos etc. • Safety training for workers are regularly conducted at project site; • Developed storage area for storing the materials, equipment etc.; • 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 ;	Being complied	• Increase the manpower in EHS Department; • = • 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 case. .

Sl no	Potential Impacts	EMP measures as proposed in the EIA	Actual measures already Implemented	Compliance Status	Recommended Action
		• Preparation and Follow of Emergency Response Plan; • Adequate fire precautions in place (e. g., fire extinguishers, escape routes etc.); • Documentation and reporting of occupational accidents, diseases, and incidents; • Policies and procedures for managing and monitoring the performance of third party employers in relation to OHS.	• Emergency contact address 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 has been maintained by Bangladesh Ansar. They are maintaining the register log and gate pass.		
4	Occupational Health and Safety Procedure	• Provision of complete EHS division in the Human Resources Planning/ Organogram • Preparation of Safety Policy to be adopted during Plant operation	• Medical aid, fire extinguisher, PPEs are provided; • Worker's shed and sanitation facilities are available; • Onsite medical facilities have been continuing. • EHS Department of BIFPCL is now operating in full swing; • Moreover, EPC also appointed one OHS expert at site; • Site-specific Environmental Health & Safety checking is continued. • RO Water treatment plant and canteen has been operated for	Being complied.	• Regular training, awareness, motivational and mock drill should be arranged at the construction and operation phase; • OHS procedure should also be followed by all workers including the labour from sub-contractors. • Insurance system may be introduced • Place the grievance register in a suitable place where the workers could easily make their comments or develop a

Sl no	Potential Impacts	EMP measures as proposed in the EIA	Actual measures already Implemented	Compliance Status	Recommended Action
			supplying safe drinking water and food.		more flexible procedure for grievance redress.
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 residence • Health care & information, canteen facilities water supply are provided by the proponents. • 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 • 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 - job satisfaction, worker capacity development , work and non-work life balance, emotional supervisory support, organizational support and health surveillance

Table 5.3: Monitoring of Community Health, Safety and Security

Sl no	Potential Impacts	Proposed EMP	Actual measures already Implemented	Compliance Status	Recommended Action
1	Disturbance to nearby community due to dust from newly developed land and Noise from construction activities	• Construction of boundary wall around the Project area; • Installation of water spraying system to control dusts; • Conducting dust monitoring and visual inspection around the site boundary; • Adoption of Noise management plan.	• The BIFPCL power project is far away from the local communities for making disturbance to the local communities except dust dispersion at this stage • They are spraying water to reduce the dust emission • 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	• Spraying water to the exposed land areas especially to the township areas • 24 hr dust monitoring is necessary inside the project boundary at the sensitive places • More noise monitoring may be installed at the potential sensitive receptors area.
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 • Regular monitoring has been conducted to identify the grievance of the nearby communities; • 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	Being complied	• Regular local level consultation is necessary for impact monitoring as well as updating the local communities • Flexible grievance register procedure and redressal process • Proponent should developed a frame work to eliminate any conflict between migrated labors and local communities

Sl no	Potential Impacts	Proposed EMP	Actual measures already Implemented	Compliance Status	Recommended Action
			• Proponent is observing the community grievance or quarries though the monitoring study conducted by CEGIS		
3	Risk of breaching Community Safety	• Construction of boundary wall/safety fence around the Project area; • Practicing Risk Assessment and Evaluation Process; • Practicing safe management for hazardous materials which may pose threat to the community; • Availability and operation of Emergency Response Plan; • Maintaining open communication channel with the local community; • Training and instruction to the security personnel about their behaviour and communication with the local people; • Aware the security personnel about the right of the community people.	• Project site is protected through construction of boundary wall • 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 • Preparing a safety checklist to be followed by EPC and sub-contractors; • 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 and communities for improving their livelihood status • Protective action are taking to avoid vector borne diseases and HIV positives	Being complied	• Arrange training and motivational work for maintaining local norms and values and have a good relation with the local workers and communities; • Make a liaison with the local government for clarifying any kind of indent/ rumour in local communities related with this project • Aware the security personnel about safeguarding environment and community.
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;	• Increasing medical facilities (consisting medical officer, medical assistant, office assistant) at Plant site; • Arranging twice a weekly health service program (medical	Being Complied	• The proponent should train the migrated labour regarding the local culture and customs • The proponent may establish business

Sl no	Potential Impacts	Proposed EMP	Actual measures already Implemented	Compliance Status	Recommended Action
		• Implement all pollution mitigation measures to ensure safeguarding to community.	consultation and free medicine) for the local community; • Increasing the patient for health services fromDecember 2017 due to development of approach road communication • Protective action are taking to avoid vector borne diseases and HIV positives		development activities (markets) for the workers and local communities as CSR activities. • Awareness program should be introduce to reduce any transmitted disease, HIV and violence toward communities
5	Youth Employment (Local)	• Providing training/awareness program for the local youth to let them aware about the required qualification to get involved in the Project related activities • Emphasis to recruit local labours according to their skills and capacities	• Informal sitting with the local government and community representatives for labour recruitment • Significant local people are working at the construction site • Regular training workshop on tailoring and computer has been organized by the proponents • The proponents have already taken few initiatives to encourage local students through awarding them. • 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. • BIFPCL has also taken initiatives to send the local youth for industrial training at Khulna divisional area.	Being Complied	• Increasing the number of local labours • Construction work related training like carpenter, electrician, lineman, elevator mechanic, glazier, iron worker, heavy equipment operator or labourer etc. would be introduced immediately • Assign job responsibilities based on skills and training for the locals • Support Income generating activities and business development activities for the local potential youth.
6	Public Communication, Consultation and Awareness	• Arranging public communication/consultation meeting;	• Informal sitting with the community; • Display Project related information on a display board at Project site;	Being Complied	• Continue the dissemination workshop in Dhaka and Khulna to aware the community, civil society,

Sl no	Potential Impacts	Proposed EMP	Actual measures already Implemented	Compliance Status	Recommended Action
		• Sharing of Project information with local people; • Organizing environmental and social awareness programs/meetings.	• Regular public consultation meetings are taken places at different level; • Advertisement of this power plant was broadcasted • Publishing Project related discussion/article in different print media. • Project related every information has been uploaded in BIFPCL website		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. • The connectivity of Maidara River is being maintained. • EPC is going to monitor 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 as huge construction work is going on. • The proponent needs to monitor that connectivity of the free flow of Maidara River. • Storm water drainage network must be separated from any kind of contamination of chemicals or oily water. • EPC must monitor the waste water generated during the constructions • Evaporation pond might be used for brine discharge from the RO Plant
2	Disturbance to nearby	• No cutting/ felling of trees along the river bank;	• No cutting/ felling of trees occurred along the river bank;	Being Complied	• Inforce no harm/ no kill of the wild animals and habitats for the project

Sl no	Potential Impacts	EMP measures as proposed in the EIA	Actual condition/ Measures already Implemented	Compliance Status	Recommended Action
	ecosystem due to different construction activities	• Implementation of onsite waste and air quality management plan; • Limiting soil extraction activities within the defined area; • Limiting the vegetation clearance and base stripping process within the Project boundary; • Safety fence around the construction site; • Limiting the use of night light; • Using shade (directed downwards) around the outdoor lights; • Provision of cut-off time to switch off unnecessary lights at night; • Initiate Green plantation; • No plantation of non-native species; • Retaining top soil for future habitat restoration; • No degradation of sensitive habitat.	• Rudimentary processis followed for Waste collection and disposal system • 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 for green plantation; • No degradation of the habitat out site the power plant area • EPC contractor is going to monitor air quality, water quality and noise level more intensively in the project area • Working activities are now limited to the project boundary • No lighting and noise effect is noticed significantly outside the project boundary wall • Training and motivational works are introducing to protect local fauna.		personals and build up awareness for local people • 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 development, dolphin conservation etc should be introduced as a part of Corporate Environmental Responsibility • The pollution prevention technologies and chemicals should be introduced by the EPC contractor • Limiting the noise level within the project boundary for the project working activities any time. • Ecosystem monitoring must be continued simultaneously with the power plant construction and operation
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 forest health and ecosystem health in Sundarbans and around the Project site are being carried out by CEGIS;	Being Complied	• EPC contractor will maintain the natural flow of the Maidara river • Do not make any disturb to navigation, water quality and

Sl no	Potential Impacts	EMP measures as proposed in the EIA	Actual condition/ Measures already Implemented	Compliance Status	Recommended Action
		• 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	• Maintaining significant setback distance from Passur river to the Project site; • Completion of slope protection work; • Protection works along the Maidara River maintained setback distance from Maidara River. • EPC is going to monitor the discharge quality at each of the outlet from this project • The natural stream flow of Maidara River near access road has been recorded.		ecosystem for heavy equipment transportation • Take necessary action if the discharge water quality breach the standard limit.

5.2 Compliance to the Conditions of DoE

Sl no	Condition of DoE	Compliance	Remarks
1	This EIA Report is approved only for 1320 MW Khulna Coal Based Power Plant. Any expansion or extension of this Power Plant will require obtaining further Environmental Clearance with additional EIA Study.	Not applicable now	BPDB will comply with the condition prior to initiation of any expansion or extension of 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 and construction activities for examining environmental impacts. No damaging impact on the environment or natural resources impact has been reported yet. All necessary measures have already been incorporated in the technical specification of main Plant EPC package as per DoE stipulations. Pollution control measures have widely been covered in technical specification like Effluent Treatment Plant, ESP, FGD etc.	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 an 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	Remarks
7	Any heritage sight, ecologically critical area, and other environmentally, religious and archaeologically sensitive places shall be kept protected during Project construction phase.	There is no religious, archaeological place in and around the site. The pre-construction activities has been carried out ensuring safeguarding of the Sundarbans Reserve Forest area and **ECA** (Ecologically Critical Area).	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 activity is being carried within the project boundary. The equipment and labour/workers are coming to the project through designed/conventional route. Moreover, regular monitoring activities are 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 initiated. New residential areas and adequate sanitation facilities arebecoming 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. BIFPCL will ensure the same when massive construction work would start..	Being Complied
11	In order to control noise pollution, vehicles & equipment shall undergo regular maintenance; working during sensitive hours and locating machinery close to sensitive receptor shall be avoided.	All vehicle & equipment used at site are under regular maintenance. Working during sensitive hours and locating machinery close to sensitive receptor are being avoided.	Being Complied
12	No solid waste can be burnt in the Project area. An	No solid waste is burnt inside the project boundary. Provisions	Being Complied and suggested to

Sl no	Condition of DoE	Compliance	Remarks
	environment friendly solid waste management should be in place during the whole period of the Project in the field.	in line with this, condition have been included in Clause No 14.9 of SCC. Solid Waste Management system has been prepared (Section-V, B12, Part 9 of Technical Specification).	continue the same throughout the remaining periods
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 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.	At present, the construction activities has been initiated. BIFPCL 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 health facilities. BIFPCL are trying to aware the labours/workers on occupational health and safety through safety signboard, using safety equipment and strong implementation of safety. The Emergency response plan shall be strictly implemented and kept operative/ functioning on a continuous basis.	Being Complied
15	To control dust, spraying of water over the earthen materials should be carried out from time to time.	There is no complain of dust pollution yet received from labours. Contractor will use water spraying for dust suppression from this winter season. Besides, a boundary wall around the Plant has been constructed to control dust within the project boundary. Moreover, intensive dust monitoring system is going to be implemented around the project site as the massive construction works begin.	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 riverbank 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.	Being Complied

Sl no	Condition of DoE	Compliance	Remarks
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 drainage of runoff water accumulated from rain/tidal surge.. A setback distance from the river has been maintained for this Project.	Being Complied.
18	Adequate facilities should be ensured for silt trap to avoid clogging of drain/canal/water bodies	Run off/ storm water drainage system shall have silt trap constructed before the next monsoon. Contractor is working to complete the construction works of 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.	Being Complied.
20	Coal Plant should have high-efficiency bag filter for arresting dust emissions.	Integrated dust control system with dust extraction system / bag filter and dust suppression system at crusher house, unloading points, transfer points has been specified in the technical specification of EPC contract package and will be 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	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 Plants.	Complied at present and will be complied throughout Operation phase.

Sl no	Condition of DoE	Compliance	Remarks
	five) acres of land to store residual ash.	Only 25 acres area has been allocated to store residual ash.	
24	Integrated dry ash handling, loading, unloading and transportation system should be established.	Integrated dry ash handling, loading, unloading and transportation system will be established. Provisions in line with this has been included in Technical Specification of main Plant EPC contract package (Section V, Chapter B4).	Compliance action initiated.
25	There should be adequate and properly sized and designed dry ash silo with appropriate conveyor system.	Adequate and properly sized dry ash silo with appropriate conveying system have been specified in Technical Specification of main Plant EPC contract package (Section V, Chapter B4).	Compliance action initiated
26	Bottom ash should be extracted, crashed and stored in silos for utilization with proper collection and conveyor system.	Bottom ash shall be extracted, crushed and stored in silos for utilization with proper collection and conveying system. The procedures have been included in the technical Specification of EPC contract package. (Section V, Chapter B4).	Compliance action initiated
27	Resettlement and rehabilitation of the displaced population (including those who do not own land) should be done properly.	Land has been acquired by GoB. Resettlement and rehabilitation action was taken as per the law of the Bangladesh. However, BPDB has already written to Ministry for suitable resettlement and rehabilitation as per DoE requirement. 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 already invited Tender from local NGO for implementation of the recommendation of the LRP Report.	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	Compliance action initiated

Sl no	Condition of DoE	Compliance	Remarks
		recommendation of the LRP Report.	
29	Construction material should be properly disposed-off after construction work is over.	At present, the construction work is going on.. Storage room has been prepared for the construction works.. Solid Waste Management system has been prepared keeping the provisions in line with this (**Section-V**, **B12**, and Part 9 of Technical Specification).	Complied at present.
30	As described in the report environmental monitoring should be strictly followed and monitoring report should be shared with DoE to ensure the environmental management properly.	BIFPCL has engaged CEGIS for environmental monitoring in February 2014. Accordingly, each quarterly monitoring report has been submitted and shared with DoE, which are also available at BIFPCL web page.	Being Complied.
31	All activities (pre-construction, construction and post-construction stage) should be implemented according to EMP clearly listed in the EIA report.	BIFPCL has adopted all of the EMP applicable at 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 as environmental consultant 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. 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	The network monitoring system will be installed as a part of the	Compliance action initiated.

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

Sl no	Condition of DoE	Compliance	Remarks
		already installed RO water treatment plant for potable water and for construction water sourcing from the river water of Passur.	
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 has already started. BIFPCL has appointed a social worker who regularly visits nearby community to consult with the local people. Besides, CEGIS, appointed by the Project authority as environmental monitoring consultant, is also carrying out consultation with the local people on regular basis for better performance of the Project as a whole.	Being Complied
41	Additional Environmental baseline data to be collected as suggested in the EIA report and conveyed to DoE and other concern authorities.	CEGIS has been engaged in February 2014, for preparing Detailed Environmental Baseline. CEGIS has submitted annual monitoring report along with reports of quarterly monitoring containing latest baseline data to BIFPCL for further dissemination to DoE and other concerned authorities.	Being Complied
42	The Environmental Management Plan under the EIA study shall strictly be implemented and kept functioning on a continuous basis.	BIFPCL has been implementing all the EMP measures phase by phase as suggested in EIA report and approval condition of DoE. Those are regularly monitored by CEGIS.	Being Complied
43	The Project authority shall submit a detail work plan with time schedule of development activities at least 7 (seven) days ahead of the work commences in the field to the Bagerhat District Office, Khulna Divisional Office and Headquarters of the Department of Environment simultaneously.	The construction works is now going on. . BIFPCL has submitted the detailed work plan seven (7) days before start of the construction activities.	Being complied
44	Environmental Monitoring Reports according to specific format specified in the EIA Report shall be made available simultaneously to DoE Bagerhat District Office, Khulna Divisional Office and Headquarters on a monthly basis during the construction period of the Project.	Environmental Monitoring Reports as per specific format provided in the EIA Report made available by BIFPCL simultaneously to DoE Bagerhat District Office, Khulna Divisional Office and Headquarters on starting from October 2017. After getting Notice to proceed from BIFPCL, the EPC Contractor	. Being Complied

Sl no	Condition of DoE	Compliance	Remarks
		BHEL started mobilising from May 2017 and after monsoon significant construction work started from October 2018.	
45	The following records must be kept in respect if any samples required to be collected for the purpose of environmental monitoring activities: the date(s) on which the sample was taken; the time(s) at which the sample was collected; the point at which the sample was taken; and the name of the person who collected the sample.	The Monitoring report of CEGIS keeps all the records as suggested.	Being Complied
46	The results of any monitoring required to be conducted under this EIA report must be recorded.	CEGIS is recording all the monitoring data and submitting to BIFPCL through proper documentation. The report is being shared with DoE on regular basis.	Being Complied
47	In case of any emergency, the following information shall be immediately be reported to Bagerhat District Office, Khulna Divisional Office and Headquarters of the Department of Environment (DoE) simultaneously Nature of incident (oil spill, fire, accident. Collision, land slide, etc.) Personnel affected (injured, missing, fatalities, etc.) Emergency support available and its location (standby transport, medical facilities, etc.) Weather conditions Current operations (abandoning the site, firefighting, etc.)	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 prepared and Environment, safety officer has	Complied at present.

Sl no	Condition of DoE	Compliance	Remarks
		been employed and CEGIS is monitoring EMP.	
49	All pollution incidents shall be reported immediately and simultaneously to the Bagerhat District Office, Khulna Divisional Office and Headquarters of the Department of Environment (DoE) in Dhaka.	So far no such incident has happened. BIFPCL has established a proper mechanism for recording such incident as suggested in the ERP. CEGIS has been engaged to monitor the social and environmental compliance on a regular interval.	Complied at present.
50	Appropriate permission would require to be obtained from the Forest Department in favour of cutting/felling on any plant/tree/sapling forested by any individual or government before doing such type of activity.	There will be no need of cutting/felling down of any trees. However, in future, if any such case arises, BIFPCL would seek for appropriate permission from the Forest Department.	Being complied
51	Re-vegetation and re-plantation under green belt activities shall be undertaken in consultation with the Forest Department according to those mentioned in the EIA report.	A MoU has been signed with Forest Dept., Bangladesh on 24.02.2015 for implementation of Afforestation Programme. Initial target is to plant 2 lac saplings in 3 years. By this time, Forest Department has already planted about 23000 nos. of saplings of different species. A fresh Agreement with BFD has been signed on 24.01.2018 for plantation of 2 Lakh trees.	Being Complied
52	Climate Change impacts and maximum storm surge height shall have to consider at the design and construction phase.	The 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	Being complied

Sl no	Condition of DoE	Compliance	Remarks
		local people. BIFPCL has appointed a social worker to collect relevant social data. Health and Safety manual has been prepared.	
55	The Project authority shall extend active cooperation to DoE officials to facilitate their visit to the site as and when necessary.	BIFPCL is extending it's all-out cooperation to DoE	Being Complied
56	Violation of any of the above conditions shall render this approval void.	Noted by BIFPCL	-
57	Any injunction on this Project from the Honourable Supreme Court/High Court Division shall render this approval void.	Noted by BIFPCL	-
58	Without installation of 275 Meter Height Chimney, Effluent Treatment Plant (ETP), Waste Water Treatment Plant (WWTP), Settling Pond, Desalinization Plant, API Oil Water Separator, High Efficiency Electro Static Precipitator (ESP), 'closed-loop' Flue Gas Desulfurization (FGD), Low NOx Burner, online air and water quality monitoring system and other pollution control equipment and obtaining Environmental Clearance Certificate, the proponent shall not start operation of the Project.	At present, the Plant is in construction phase. The functional and technical specification of the main Plant includes 275 Meter high Chimney, Effluent Treatment Plant (ETP), Waste Water Treatment Plant (WWTP), Setting Pond, Desalinization Plant, API, Oil Water Separator, High Efficiency Electro Static Precipitator (ESP), 'closed-loop' Flue Gas Desulfurization (FGD), Low NOx Burner, online air and water quality monitoring system for preventing pollution. All these stipulations have been included in the technical specification of 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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Appendix I: Checklist of Monitoring Environmental Compliances

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

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

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

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

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

(Labor and Working Condition)

Basic Data

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

Checklist for Labor and Working Condition

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

Sl no	Potential Impacts	Proposed EMP	Actual Implementation	Recommended Action	Compliance Status
		• Documentation and reporting of occupational accidents, diseases, and incidents • Policies and procedures for managing and monitoring the performance of third party employers in relation to OHS			
	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)***

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

Table D: Checklist of Monitoring ESMP Implementation (During 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			

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

Appendix II: Photo Album

Environmental Monitoring of Khulna 2×660 MW Power Plant for 14th monitoring program (October, 2017)

The Monitoring Team

Estimation of tree height

Collection of DBH data

Consultaion with the fishermen at Sundarbans

Counting seedlings and pneumetaphores

Collection of water samples

Monitoring team at Hiron Point

Collection of sapling data

Professional is observing biodiversity status

Noise level measurement at Akram point of Sundarbans

Professionals are examining the safety status inside the project boundary

Accomodation facilities for labour

Accomodation facilities for labour

Safety sign at project area

Newly built toilet for labor

Appendix III: Terms of References (ToR)

Background:

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

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

Project Location:	Upazila: Rampal, District: Bagerhat Site is located at 23 kms Southward of Khulna City and 14 kms. North-Eastward from Mongla Port. 
Project Capacity:	1320 MW (2x660 MW), based on Ultra Super-critical Technology
Mode of Operation:	Base Load
Fuel:	Imported Coal
Fuel Transportation:	It is envisaged that imported coal from countries like Indonesia, Australia shall be transported through bigger ships, up to trans-shipment point, from where the coal shall be transported through barges to the coal unloading jetty at the plant end. From jetty to the power plant coal shall be transported through coal conveyor system.
Land& Land Development:	Based on the layout in the FR, it is estimated that approx. 575 acres of land will be required for the project. (375 Acres for Main Plant, 50 Acres for Township, 50 Acres for Jetty).
Evacuation of power:	Provision of line bays in generation switchyard for one no. 400 kV Double Circuit line and one no. 230 kV Double Circuit line have been kept. The Power

	evacuation (transmission line) system from the Project shall be at 400 kV level and will be outside the scope of the Project. 400 kV is being introduced for the first time in Bangladesh.
Expected Timeline for project implementation	The first unit of capacity 660 MW is scheduled to be synchronised in 41 months from the date of NTP to the EPC contractor for the Power project. Commissioning of the first unit of capacity 660 MW is envisaged at an interval of 5 months thereafter.

2.0 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).

2.1 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.

3.0 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.

4.0 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.

5.0 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
	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

6.0 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.

8.0 Expected Output:

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

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

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

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

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

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

- Express the residual environmental impacts for proper compensation.

Reporting Requirements

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

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

Appendix IV: Monitoring Data

(A) Air Quality Data

Table A.1: Ambient Air Quality Monitoring Results

Locations of Monitoring	Pollutants	1st QM, Apr 2014	2nd QM, Jul 2014	3rd QM, Oct 2014	4th QM, Jan 2015	5th QM, Apr 2015	6th QM, Jul2015	7th QM, Oct 2015	8th QM, Jan 2016	9th QM, Apr 2016	10th QM, Jul 2016	11th QM, Oct 2016	12th QM, Jan 2017	13th QM, April, 2017	14th QM, Oct, 2017	15th QM Jan, 2018	Bangladesh (DoE) Standard (ECR 2005)	IFC/WB Standard
Weather		Sunny	Rainy/ Cloudy	Sunny	Sunny	Sunny	Rainy/ Cloudy	Sunny to Rainy	Sunny	Sunny	Rainy/ Cloudy	Rainy/ Cloudy	Sunny	Suny/ Cloudy	Sunny	Sunny		
		Concentrations are in µg/m^3																
SW Corner of the PP area	**$PM_{2.5}$**	33	37	25	33	47	25	22	34	19	5	9	24.8	8.12	28.2	32.9	65^{24hr}	75^{24hr} (IT-1)
	PM_{10}	78	77	53	79	83	35	52	135	117	32	22	79	43.8	73.6	133	150^{24hr}	150^{24hr} (IT-1)
	SPM	207	239	190	200	177	42	91	175	332	51	53	115.7	122.4	169.4	145.6	200^{8hr}	NF
	SO_2	21	24	19	23	15	52	35	14	18	9	8	9.5	9.0	7.2	14.3	365^{24hr}	125^{24hr} (IT-1)
	NOx	26	29	27	31	29	35	29	18	18	12	10	11.3	10.7	7.5	17.7	100^{Annual}	200^{1hr}, 40^{Annual}
	CO	120	188	140	190	144	146	88	74	57	35	119	59	91	73	61	$(10000)^{8hr}$	NF
	O_3	27	26	19	22	26	12	5	4	1	1	1	5	03	10	03	157^{8hr}	100^{8hr}
	$PM_{2.5}$	39	48	48	39	34	18	17	35	25	3	8	25	14.6	8.5	31.5	65^{24hr}	75^{24hr} (IT-1)

Locations of Monitoring	Pollutants	1st QM, Apr 2014	2nd QM, Jul 2014	3rd QM, Oct 2014	4th QM, Jan 2015	5th QM, Apr 2015	6th QM, Jul2015	7th QM, Oct 2015	8th QM, Jan 2016	9th QM, Apr 2016	10th QM, Jul 2016	11th QM, Oct 2016	12th QM, Jan 2017	13th QM, April, 2017	14th QM, Oct, 2017	15th QM Jan, 2018	Bangladesh (DoE) Standard (ECR 2005)	IFC/WB Standard
Weather		Sunny	Rainy/ Cloudy	Sunny	Sunny	Sunny	Rainy/ Cloudy	Sunny to Rainy	Sunny	Sunny	Rainy/ Cloudy	Rainy/ Cloudy	Sunny	Suny/ Cloudy	Sunny	Sunny		
			Concentrations are in µg/m³															
Proposed Township area	**PM_{10}**	814.69	90	74	102	97	31	48	116	44	11	11	99.5	56.9	40.4	147.8	150^{24hr}	150^{24hr} (IT-1)
	SPM	2156.3	263	217	274	266	47	79	192	187	27	23	154.2	136.7	45.3	181.4	200^{8hr}	NF
	SO_2	19	28	22	21	22	58	27	13	11	4	6	12.9	10	4.3	15	365^{24hr}	125^{24hr} (IT-1)
	NOx	29	39	27	26	24	46	25	16	22	6	8	15.7	11.8	6	18.6	100^{Annual}	200^{1hr}, 40^{Annual}
	CO	165	210	230	164	136	127	102	77	22	31	108	66	78	79	69	$(10000)^{8hr}$	NF
	O_3	33	26	26	23	21	16	1	1	1	0	0	1	08	25	04	157^{8hr}	100^{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	65^{24hr}	75^{24hr} (IT-1)
	PM_{10}	67	78	56	98	91	96	29	125	29	24	14	108.7	31.3	49.9	136.3	150^{24hr}	150^{24hr} (IT-1)
	SPM	234	217	157	310	244	321	66	187	115	31	35	168	91.7	63.9	161.7	200^{8hr}	NF
	SO_2	19	22	18	27	21	56	32	13	17	4	8	12.2	5.8	7.5	9.6	365^{24hr}	125^{24hr} (IT-1)
	NOx	23	28	22	32	39	43	21	18	16	5	11	14.7	7.1	9.2	11.7	100^{Annual}	200^{1hr}, 40^{Annual}
	CO	110	178	110	210	140	133	87	77	38	47	127	31	74	80	45	$(10000)^{8hr}$	NF
	O_3	25	19	17	36	44	11	8	2	0	1	1	3	05	10	05	157^{8hr}	100^{8hr}
Barni, Gaurambha	**$PM_{2.5}$**	39	47	57	39	41	34	11	29	23	9	10	21.7	7.9	13.8	52.3	65^{24hr}	75^{24hr} (IT-1)

Locations of Monitoring	Pollutants	1st QM, Apr 2014	2nd QM, Jul 2014	3rd QM, Oct 2014	4th QM, Jan 2015	5th QM, Apr 2015	6th QM, Jul2015	7th QM, Oct 2015	8th QM, Jan 2016	9th QM, Apr 2016	10th QM, Jul 2016	11th QM, Oct 2016	12th QM, Jan 2017	13th QM, April, 2017	14th QM, Oct, 2017	15th QM Jan, 2018	Bangladesh (DoE) Standard (ECR 2005)	IFC/WB Standard
Weather		Sunny	Rainy/ Cloudy	Sunny	Sunny	Sunny	Rainy/ Cloudy	Sunny to Rainy	Sunny	Sunny	Rainy/ Cloudy	Rainy/ Cloudy	Sunny	Suny/ Cloudy	Sunny	Sunny		
			Concentrations are in µg/m^3															
	PM_{10}	103	122	67	97	82	65	26	97	82	45	13	105.4	30.5	30.2	140	150^{24hr}	150^{24hr} (IT-1)
	SPM	233	244	183	277	236	79	112	176	268	69	30	167.8	95.6	57.2	171.9	200^{8hr}	NF
	SO_2	21	23	17	22	25	41	31	16	20	10	7	12.2	5.5	4.1	13.8	365^{24hr}	125^{24hr} (IT-1)
	NOx	25	28	22	26	27	44	32	21	16	12	9	19.3	9.8	5.0	16.7	100^{Annual}	200^{1hr}, 40^{Annual}
	CO	175	210	190	150	196	96	96	81	73	41	98	63	85	77	59	$(10000)^{8hr}$	NF
	O_3	26	29	22	19	15	9	6	4	0	0	3	5	08	6	04	157^{8hr}	100^{8hr}
Chunkuri-2, Bajua Dacope	**$PM_{2.5}$**	35	39	46	37	33	35	28	31	25	7	5	25.2	8.7	17.3	33.4	65^{24hr}	75^{24hr} (IT-1)
	PM_{10}	77	86	69	68	61	109	49	98	60	23	20	74.4	44.4	100.2	157.1	150^{24hr}	150^{24hr} (IT-1)
	SPM	117	113	162	183	188	175	94	167	167	31	48	162	110.6	127.8	200	200^{8hr}	NF
	SO_2	19	24	21	18	11	55	33	21	13	7	9	18.9	8.2	7.9	19	365^{24hr}	125^{24hr} (IT-1)
	NOx	23	26	27	24	18	49	23	16	25	10	8	18	11.2	8.4	20.7	100^{Annual}	200^{1hr}, 40^{Annual}
	CO	190	205	170	170	33	133	75	70	33	38	79	36	94	69	58	$(10000)^{8hr}$	NF
	O_3	27	24	18	22	41	21	2	1	1	0	2	2	03	5	05	157^{8hr}	100^{8hr}
Pankhali, Dacope	**$PM_{2.5}$**	47	49	57	41	39	34	25	47	15	8	10	38.7	15.8	17	72.3	65^{24hr}	75^{24hr} (IT-1)

Locations of Monitoring	Pollutants	1st QM, Apr 2014	2nd QM, Jul 2014	3rd QM, Oct 2014	4th QM, Jan 2015	5th QM, Apr 2015	6th QM, Jul2015	7th QM, Oct 2015	8th QM, Jan 2016	9th QM, Apr 2016	10th QM, Jul 2016	11th QM, Oct 2016	12th QM, Jan 2017	13th QM, April, 2017	14th QM, Oct, 2017	15th QM Jan, 2018	Bangladesh (DoE) Standard (ECR 2005)	IFC/WB Standard
Weather		Sunny	Rainy/ Cloudy	Sunny	Sunny	Sunny	Rainy/ Cloudy	Sunny to Rainy	Sunny	Sunny	Rainy/ Cloudy	Rainy/ Cloudy	Sunny	Suny/ Cloudy	Sunny	Sunny		
			Concentrations are in µg/m³															
	PM_{10}	119	127	139	101	105	144	62	128	46	42	18	141.6	105	63.4	208.9	150^{24hr}	150^{24hr} (IT-1)
	SPM	297	266	254	208	299	339	183	198	114	78	34	194.6	179	87.5	223.9	200^{8hr}	NF
	SO_2	28	31	31	24	30	58	36	18	9	8	8	16.1	12.9	8	16.3	365^{24hr}	125^{24hr} (IT-1)
	NOx	41	39	36	26	27	47	23	15	19	9	9	19	18.7	10.2	17.7	100^{Annual}	200^{1hr}, 40^{Annual}
	CO	230	217	250	188	177	125	105	101	55	29	112	48	83	87	49	$(10000)^{8hr}$	NF
	O_3	49	38	36	27	11	13	5	2	2	0	0	3	06	0	06	157^{8hr}	100^{8hr}
Mongla Port area	**$PM_{2.5}$**	47	55	39	41	26	33	19	34	21	9	11	25.7	22.6	33.2	70.1	65^{24hr}	75^{24hr} (IT-1)
	PM_{10}	139	174	77	82	35	52	33	132	45	29	15	119.3	93.6	97	209.1	150^{24hr}	150^{24hr} (IT-1)
	SPM	288	303	197	217	214	118	65	189	144	50	6	172.3	196	187.2	242	200^{8hr}	NF
	SO_2	27	28	26	24	14	45	36	16	10	8	7	16.8	10.5	8.2	15.5	365^{24hr}	125^{24hr} (IT-1)
	NOx	44	39	33	27	17	40	20	13	14	10	8	15.3	15.1	10.7	18.4	100^{Annual}	200^{1hr}, 40^{Annual}
	CO	230	320	220	211	24	110	84	71	29	31	97	44	72	79	52	$(10000)^{8hr}$	NF
	O_3	57	52	37	26	09	15	8	3	1	2	1	4	04	9	02	157^{8hr}	100^{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	65^{24hr}	75^{24hr} (IT-1)

Locations of Monitoring	Pollutants	1st QM, Apr 2014	2nd QM, Jul 2014	3rd QM, Oct 2014	4th QM, Jan 2015	5th QM, Apr 2015	6th QM, Jul2015	7th QM, Oct 2015	8th QM, Jan 2016	9th QM, Apr 2016	10th QM, Jul 2016	11th QM, Oct 2016	12th QM, Jan 2017	13th QM, April, 2017	14th QM, Oct, 2017	15th QM Jan, 2018	Bangladesh (DoE) Standard (ECR 2005)	IFC/WB Standard
Weather		Sunny	Rainy/ Cloudy	Sunny	Sunny	Sunny	Rainy/ Cloudy	Sunny to Rainy	Sunny	Sunny	Rainy/ Cloudy	Rainy/ Cloudy	Sunny	Suny/ Cloudy	Sunny	Sunny		
			Concentrations are in µg/m³															
	PM_{10}	41	39	59	56	49	42	50	82	42	20	14	85.2	36.7	89.9	152.4	150^{24hr}	150^{24hr} (IT-1)
	SPM	111	117	129	139	109	70	73	159	91	43	44	93.5	103.7	107	189.9	200^{8hr}	NF
	SO_2	9	10	14	12	16	51	34	15	11	6	7	11.9	5.7	7.6	13.2	365^{24hr}	125^{24hr} (IT-1)
	NOx	19	22	27	18	22	34	22	14	16	8	10	13	7.7	9.3	15.2	100^{Annual}	200^{1hr}, 40^{Annual}
	CO	65	58	70	64	56	112	81	62	47	32	110	67	73	84	57	$(10000)^{8hr}$	NF
	O_3	13	12	13	11	14	12	4	2	2	0	1	4	08	0	02	157^{8hr}	100^{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	65^{24hr}	75^{24hr} (IT-1)
	PM_{10}	39	44	32	39	77	NO	32	77	31	15	14	85.5	96.0	37.8	150.6	150^{24hr}	150^{24hr} (IT-1)
	SPM	114	133	97	88	102	NO	51	128	46	23	27	90.9	137.0	41.8	175.1	200^{8hr}	NF
	SO_2	7	9	12	13	21	NO	27	14	9	4	6	8.4	6	5.8	14	365^{24hr}	125^{24hr} (IT-1)
	NOx	17	19	22	17	27	NO	19	15	10	5	6	12.7	10.1	5.9	15.1	100^{Annual}	200^{1hr}, 40^{Annual}
	CO	49	60	50	46	163	NO	92	64	21	37	101	58	79	69	52	$(10000)^{8hr}$	NF
	O_3	11	14	9	10	27	NO	8	1	0	0	2	3	0	0	03	157^{8hr}	100^{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	65^{24hr}	75^{24hr} (IT-1)

Locations of Monitoring	Pollutants	1st QM, Apr 2014	2nd QM, Jul 2014	3rd QM, Oct 2014	4th QM, Jan 2015	5th QM, Apr 2015	6th QM, Jul2015	7th QM, Oct 2015	8th QM, Jan 2016	9th QM, Apr 2016	10th QM, Jul 2016	11th QM, Oct 2016	12th QM, Jan 2017	13th QM, April, 2017	14th QM, Oct, 2017	15th QM Jan, 2018	Bangladesh (DoE) Standard (ECR 2005)	IFC/WB Standard
Weather		Sunny	Rainy/ Cloudy	Sunny	Sunny	Sunny	Rainy/ Cloudy	Sunny to Rainy	Sunny	Sunny	Rainy/ Cloudy	Rainy/ Cloudy	Sunny	Suny/ Cloudy	Sunny	Sunny		
			Concentrations are in µg/m^3															
	PM_{10}	44	38	34	41	60	NO	45	NO	40	NO	14	104.5	NO	92.1	149.8	150^{24hr}	150^{24hr} (IT-1)
	SPM	101	119	107	97	110	NO	88	NO	132	NO	26	111.4	NO	102	173.7	200^{8hr}	NF
	SO_2	8	7	13	14	15	NO	28	NO	15	NO	9	13.5	NO	6	15.8	365^{24hr}	125^{24hr} (IT-1)
	NOx	18	18	19	22	20	NO	23	NO	19	NO	9	15.9	NO	7.8	18.1	100^{Annual}	200^{1hr}, 40^{Annual}
	CO	52	62	65	60	60	NO	93	NO	40	NO	121	43	NO	72	71	$(10000)^{8hr}$	NF
	O_3	14	13	11	9	23	NO	2	NO	0	NO	0	4	NO	0	04	157^{8hr}	100^{8hr}
Khulna City, near Khan Jahan Ali Bridge	$PM_{2.5}$	54	39	52	42	55	46	19	35	11	16	9	34.6	23.1	19.5	78.7	65^{24hr}	75^{24hr} (IT-1)
	PM_{10}	139	117	91	84	75	89	49	112	69	68	24	145.9	99.5	39.6	213.9	150^{24hr}	150^{24hr} (IT-1)
	SPM	301	287	239	219	222	181	101	181	112	107	64	189.7	187.2	127.9	243.4	200^{8hr}	NF
	SO_2	33	29	33	28	31	59	28	16	11	10	10	17.1	7.2	7.1	21	365^{24hr}	125^{24hr} (IT-1)
	NOx	49	41	39	36	33	38	26	16	15	15	14	18.6	11.7	8.8	25	100^{Annual}	200^{1hr}, 40^{Annual}
	CO	330	370	330	296	101	89	94	98	68	36	104	66	79	81	69	$(10000)^{8hr}$	NF
	O_3	59	67	57	39	21	7	4	2	1	0	2	3	07	07	09	157^{8hr}	100^{8hr}

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

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

All data presented here are 8 hrs. Monitoring data.

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

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

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

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

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			
		Apr	July	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	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	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	
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	
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	
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	
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	
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	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	
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	
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	
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	
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	
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	
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	
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	

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			
		Apr	Jul	Oct	Apr	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	
		1QM	2QM	3QM	1QM	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	31	33	31	19	30	31.8	31.2	22.0	31.2	29.6	30.1	22.8	30	29.8	19.7	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	
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	
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	
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	
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	
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	
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	
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	
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	
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	
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	
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	
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	
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		
		Apr	Jul	Oct	Apr	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan
		1QM	2QM	3QM	4 QM	1st QM	2nd QM	3rd QM	4th QM	1st QM	2nd QM	3rd QM	4th QM	1st QM	2nd QM	3QM
1	Left Bank of Passur River at 100m u/s of North West corner from the Project boundary	11.5	2.5	0.0	4.5	13	0	0	4.1	8	0	0	3.7	6.3	0	2
2	Middle of Passur River at 100m u/s of North West corner from the Project boundary	11.5	0.3	0.0	4.1	15	0	0	4.3	7.4	0	0	3.8	5.9	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
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
5	Middle of Passur River at Project site-Jetty	12.0	0.3	0.0	5.1	13	0	0	5.1	6.2	0	0	3.9	6.9	0	2.6
6	Right Bank of Passur River at Project site-Jetty	12.0	0.5	0.0	5.0	14	0	0	5	9	0	0	4.2	6.1	0	2.7
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
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	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	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
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

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

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			BD Standard
		Apr	Jul	Oct	Apr	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	
		1QM	2QM	3QM	1st QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2nd QM	3QM	
1	Left Bank of Passur River at 100m u/s of North West corner from the Project boundary	5.9	6.1	5.6	5.5	6.2	5.3	6.8	5.1	7.1	6.2	6	6.1	7.1	6.3	5.19	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	
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	
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	
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	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	
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	
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	
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	
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	
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	
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	
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	
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	
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: BOD_5 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	
		1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2nd QM	3QM	
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	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	
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	
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	
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	
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	
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	
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	
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	
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	
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	
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	
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	
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	
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
		1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM
1	Left Bank of Passur River at 100m u/s of North West corner from the Project boundary	288	24	6	128	87	42	32	124	220	8	12	56	52	24
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
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
4	Left Bank of Passur River at Project site-Jetty	376	28	18	84	102	26	36	100	280	8	12	48	40	32
5	Middle Passur River at Project site-Jetty	400	60	14	116	110	21	36	108	240	12	16	52	36	40
6	Right Bank of Passur River at Project site-Jetty	364	496	18	108	88	24	40	80	260	8	12	42	48	16
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
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
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
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
11	Maidara river near proposed township area	284	96	26	84	94	36	42	108	210	30	8	48	40	32
12	Passur river at Passur - Ghasiakhali confluence	408	172	14	96	92	30	46	88	220	12	16	40	64	**40**
13	Passur river at Harbaria of Sundarbans	372	216	14	96	102	26	36	100	140	16	12	**40**	216	32
14	Passur river at Akram point of Sundarbans	536	520	54	316	302	NS	84	96	156	4	68	56	240	**16**
15	Passur river at Hiron point of Sundarbans	540	416	122	472	470	NS	96	NS	160	NS	56	196	NS	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.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		
		Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	
		1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	
1	Left Bank of Passur River at South West corner from the Project boundary	<5	<5	<5	>15	16.9	9	<5	39	61	5	<5	9.2	*5.73*	<5	10
2	Passur-Ghasiakhali Confluence	<5	<5	<5	>15	13	7.63	9.87	21	30.3	13.5	<5	15.6	*<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	
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	Akram Point of Sundarbans	<5	<5	<5	>20	<5	NS	9.73	36	82	5.87	<5	14.2	*ND*	<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	
		Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct
		1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM
1	Left Bank of Passur River at 100m u/s of North West corner from the Project boundary	13060	251	176	4360	14400	937	158	5570	13400	179	138	3100	13400	496
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
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
4	Left Bank of Passur River at Project site-Jetty	13190	445	169	4750	14600	175	172	5720	12830	162	147	3630	13560	172
5	Middle Passur River at Project site-Jetty	13330	353	156	4920	14500	132	162	5850	13100	185	110	3600	13490	125
6	Right Bank of Passur River at Project site-Jetty	13380	402	152	4870	14200	156	160	5480	13460	143	112	3520	13330	125
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
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
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
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
11	Maidara river near proposed Township area	10970	2510	257	4390	13900	355	176	4420	11700	5170	238	3960	13110	1200
12	Passur river at Passur - Mongla confluence	12800	6410	209	5130	14050	298	227	4540	11330	893	162	3370	12340	**204**
13	Passur river at Harbaria of Sundarbans	12280	9360	285	4780	13900	683	205	4940	13580	1321	301	**3370**	13600	245
14	Passur river at Akram point of Sundarbans	21500	15960	3400	12350	13600	NS	4220	13330	20720	7330	2550	3580	19370	3270
15	Passur river at Hiron point of Sundarbans	21500	14050	5720	17900	25300	NS	5830	NS	25500	NS	4120	12210	NS	4450

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	
		Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct
		1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM
1	Left Bank of Passur River at 100m u/s of North West corner from the Project boundary	2900	250	216	930	3000	245	250	1270	3130	240	255	1090	3640	200
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
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
4	Left Bank of Passur River at Project site-Jetty	2550	175	390	940	3450	118	365	1220	3010	220	265	1020	3400	160
5	Middle Passur River at Project site-Jetty	2600	275	340	990	3250	103	355	1300	3070	232	237	915	3440	145
6	Right Bank of Passur River at Project site-Jetty	2625	350	355	970	3200	105	350	1260	3100	218	242	1070	3380	140
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
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
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
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
11	Maidara river near proposed township area	2400	725	330	970	3190	130	340	1075	3080	875	240	1170	2300	320
12	Passur river at Passur - Mongla confluence	3150	1400	377	1000	3210	135	410	1090	3060	405	245	1070	2450	**220**
13	Passur river at Harbaria of Sundarbans	2625	2150	345	970	3080	200	430	1100	3050	415	282	1070	3560	200
14	Passur river at Akram point of Sundarbans	4500	3625	980	2380	3420	NS	1090	2850	4520	1750	670	1130	4300	640
15	Passur river at Hiron point of Sundarbans	4850	3050	1440	2690	3640	NS	1460	NS	5050	NS	810	2870	NS	905

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	
		Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct
		1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM
1	Left Bank of Passur River at 100m u/s of North West corner from the Project boundary	598	126	234	180	160	26	76	14	8	61	20	46	51	18
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
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
4	Left Bank of Passur River at Project site-Jetty	54	99	227	450	160	30	92	17	10	62	20	42	52	16
5	Middle Passur River at Project site-Jetty	60	100	232	250	165	27	85	18	8	45	24	54	43	20
6	Right Bank of Passur River at Project site-Jetty	55	105	186	200	155	40	97	22	7	49	19	46	38	17
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
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
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
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
11	Maidara river near proposed township area	9	24	389	206	160	28	92	10	6	11	30	66	49	30
12	Passur river at Passur - Mongla confluence	50	310	203	280	165	24	60	15	13	47	27	61	38	**25**
13	Passur river at Harbaria of Sundarbans	65	90	869	400	160	42	74	22	18	31	18	**61**	33	27
14	Passur river at Akram point of Sundarbans	115	99	28	103	150	NS	110	16	23	16	41	34	28	22
15	Passur river at Hiron point of Sundarbans	91	72	267	200	180	NS	144	NS	15	NS	33	49	NS	16

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	
		Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct
		1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM
1	Left Bank of Passur River at 100m u/s of North West corner from the Project boundary	0.9	2.89	0.32	3	33	9.1	4	6.3	3	3.9	0.25	3.62	4.35	5.8
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
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
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
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
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	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	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
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
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
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
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
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
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
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

Source: CEGIS Field Survey

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

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

Sl	Sampling Locations	SO_4^{2-} (mg/L)													
		1st Year				2nd year				3rd year				4th year	
		Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct
		1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM
1	Left Bank of Passur River at 100m u/s of North West corner from the Project boundary	1840	20	26	580	1360	67	7	570	1080	18	5	230	422	29
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
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
4	Left Bank of Passur River at Project site-Jetty	1360	45	33	550	1240	26	10	550	1060	15	4	230	1380	2
5	Middle Passur River at Project site-Jetty	1040	32	30	520	1120	6	8	580	980	17	6	280	1280	1
6	Right Bank of Passur River at Project site-Jetty	1320	20	27	540	820	8	9	565	1100	14	5	230	1400	2
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
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
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
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
11	Maidara river near proposed township area	1320	210	63	460	840	27	9	480	1020	480	14	200	1340	76
12	Passur river at Passur - Mongla confluence	1360	620	44	630	980	39	13	482	1100	42	14	220	1220	**5**
13	Passur river at Harbaria of Sundarbans	1560	860	69	590	900	51	7	500	1080	60	19	220	1300	13
14	Passur river at Akram point of Sundarbans	2600	1400	1390	850	1540	NS	84	760	1650	620	190	230	1420	30
15	Passur river at Hiron point of Sundarbans	2080	1160	2360	1500	1920	NS	97	NS	2100	NS	320	1090	NS	2

Source: CEGIS Field Survey

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

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

Sl	Sampling Locations	PO_4^{2-} (mg/L)													
		1st Year				2nd year				3rd year				4th year	
		Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct
		1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM
1	Left Bank of Passur River at 100m u/s of North West corner from the Project boundary	0.52	2.23	0.67	0.32	0.86	10	1.27	0.269	0.22	1.14	3.39	0.67	1.31	0.49
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
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
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
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
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
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
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
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
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
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
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**
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
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
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

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	
		Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct
		1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM
1	Left Bank of Passur River at 100m u/s of North West corner from the Project boundary	0.002	0.003	0.004	0.003	0.002	0.002	0.001	0.001	0.001	0.002	0.002	0.002	0.002	0.002
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
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
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
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
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
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
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
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
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
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
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
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
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
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

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	
		Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct
		1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM
1	Left Bank of Passur River at 100m u/s of North West corner from the Project boundary	0.053	0.004	0.002	0.104	0.098	0.0059	0.007	0.168	0.203	0.01	0.009	0.024	0.002	0.003
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
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
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
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
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
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
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
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
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
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
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
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
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
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

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	
		Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct
		1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM
1	Left Bank of Passur River at 100m u/s of North West corner from the Project boundary	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.001	< 0.001
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
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
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
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
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
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
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
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
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
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
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
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
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
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

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		
			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
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
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
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
4	Kalekharber	Shallow (<250 ft)	6.3	6.5	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		
		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
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
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
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
Kalekharber	Shallow (<250 ft)	**27.5**	**28.7**	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		
			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
1	Near Proposed Township	Deep (>600 ft)	0	0	0	1	TC	0	0	0	0	0	0	0	0	0	0
2	Rajnagar	Deep (>600 ft)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.3
3	Kapashdanga	Deep (>600 ft)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.4
4	Kalekharber	Shallow (<250 ft)	0	0	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		
			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
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
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
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
4	Kalekharber	Shallow (<250 ft)	4.4	6	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	
			Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct
			1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM
1	Township near project site	Deep (>600 ft)	1113	999	-	1021	NO	881	377	447	1025	1000	617	623	395	602
2	Rajnagar	Deep (>600 ft)	4090	371	-	378	390	574	1007	491	384	408	382	401	617	996
3	Kapasdanga	Deep (>600 ft)	643	635	-	600	600	328	611	284	645	607	636	998	558	390
4	Kalekharber	Shallow (<250 ft)	1055	970	-	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	
			Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct
			1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM
1	Township near project site	Deep (>600 ft)	-	6	19	40	NF**	23	4	31	3	5	7	32	4	8
2	Rajnagar	Deep (>600 ft)	-	6	2	28	4	16	5	46	4	4	4	28	10	10
3	Kapasdanga	Deep (>600 ft)	-	8	6	32	6	14	4	41	3	4	5	25	9	9
4	Kalekharber	Shallow (<250 ft)	-	48	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	
			Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct
			1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM
1	Township near project site	Deep (>600 ft)	425	250	300	235	NO	225	325	295	305	320	175	550	720	145
2	Rajnagar	Deep (>600 ft)	220	175	180	110	138	125	450	195	263	248	295	510	420	240
3	Kapasdanga	Deep (>600 ft)	190	140	180	125	216	115	480	225	163	28	183	620	654	215
4	Kalekarber	Shallow (<250 ft)	780	450	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	
			Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct
			1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM
1	Township near project site	Deep (>600 ft)	32	32	34	20	NO	12	4	4	4	4	4	4	4	8
2	Rajnagar	Deep (>600 ft)	28	28	18	16	14	10	8	4	4	4	4	4	4	8
3	Kapasdanga	Deep (>600 ft)	48	32	34	20	18	14	4	4	4	2	4	4	4	16
4	Kalekarber	Shallow (<250 ft)	32	36	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^- and PO_4^- Concentrations in Ground Water

Sl	Locations	Type of tube well	NO_3^{2-} (mg/L) *BD Standard (10 mg/L)														SO_4^{2-} (mg/L) *BD Standard (400 mg/L)														PO_4^{2-} (mg/L) *BD Standard (6.0 mg/L)													
			1st Year				2nd year				3rd year				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	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct
			1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM
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	-	3	-	-	-	-	1	5	1	1	1	1	5	1	-	2.2	-	0.74	NO	1.4	0.31	0.267	1.08	0.17	0.167	1.18	2.18	1.68
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	-	2	-	-	-	-	2	6	2	1	1	1	1	1	-	2.5	-	0.44	1.98	1.6	0.27	0.179	1.53	0.29	0.67	1.21	1.8	3.5
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	-	10	-	-	-	-	2	2	8	1	1		3	2	-	6.2	-	0.48	4.54	4.1	0.48	0.179	3.26		0.6	1.18	2.1	4.7
4	Kalekarber	Shallow (<250 ft)	0.40	0.56	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	3	NF	-	-	-	NF	NF	NF	NF	NF	NF	NF	NF	1.2	NF	NF	NF		NF	NF	NF	0.31	NF	1.23	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	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct
		1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM
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	0.004	0.023	NO	0.002	0.006	0.026	0.019	0.002	0.001	0.01	0.001	0.003	<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
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	<0.002	<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	<0.00015	<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
3	Kalekarber	0.376	0.407	NF	NF	D	D	NF	NF	NF	NF	NF	NF	NF	NF	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
4	Kapasdanga	0.036	0.033	0.020	0.017	0.034	0.024	0.011	0.002	0.047	0.005	0.016	0.028	0.010	0.027	<0.002	0.004	<0.002	0.013	0.017	0.002	0.005	0.012	0.008	0.002	0.001	0.016	0.001	0.002	<0.00015	<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

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								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					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						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						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						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						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						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						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						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						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						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						50
11	Hiron Point, Sundarbans	NM	NM	NM	NM	39.92	39.79	33.5	37.74	37.2	39	38.4						50

(D) Fisheries resources monitoring data

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

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

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

Table D.2: Occurrence of Species

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

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

Local Name	Scientific Name	Local Status*	13th QM	14th QM	15th QM
		'-' = No; '+' = Occurrence			
Amadi Chela	*Chela sp.*	DD	+	+	+
Hilsa	*Tenualosa ilisha*	NO	-	-	-
Sagor Baim	*Anguilla bengalensis*	NT	-	-	-
Bacha	*Eutropiichthys vacha*	CR	+	-	-
Bagda Chingri	*Penaeus monodon*	DD	+	-	+
Banspata	*Brachypleura novae-zeelandiae*	NO	+	+	+
Kukurjib	*Cynoglossus lingua*	NO	-	-	+
Bele	*Glossogobius giuris*	NO	+	+	+

Local Name	Scientific Name	Local Status*	13th QM	14th QM	15th 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	-	-	-
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	-	-	-

Local Name	Scientific Name	Local Status*	13th QM	14th QM	15th 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	Chalna Point	100	0	0	0	0	0	0
	Maidara	100	0	0	0	0	0	0
	Mongla Point	100	0	0	0	0	0	0
Bairagi	Chandpai	0	0	0	46	54	0	0
	Harbaria	0	0	0	0	100	0	0
	Maidara	100	0	0	0	0	0	0
	Mongla Point	100	0	0	0	0	0	0
Banspata	Chandpai	0	0	0	0	44	56	0
Bata	Mongla Point	100	0	0	0	0	0	0
Bhangan	Mongla Point	100	0	0	0	0	0	0
Chaka Chingri	Harbaria	0	100	0	0	0	0	0
Chali Chingri	Chalna Point	100	0	0	0	0	0	0
	Chandpai	0	0	100	0	0	0	0
	Maidara	100	0	0	0	0	0	0
	Mongla Point	100	0	0	0	0	0	0
Chami Chingri	Harbaria	0	0	100	0	0	0	0
Chanda	Chalna Point	100	0	0	0	0	0	0
	Mongla Point	100	0	0	0	0	0	0
Chela	Chandpai	0	0	38	63	0	0	0
Cheng	Chandpai	0	0	0	50	50	0	0
Daitna	Chandpai	0	0	0	0	100	0	0
	Harbaria	0	0	0	0	100	0	0
Desi Tengra	Chandpai	0	0	0	100	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
Dogri	Harbaria	0	0	0	0	0	100	0
	Maidara	80	0	0	0	20	0	0
Gagra	Chandpai	0	0	0	0	0	0	100
	Harbaria	0	0	0	33	0	0	67
Gang Chela	Maidara	0	100	0	0	0	0	0
Goda Katali	Harbaria	0	0	17	83	0	0	0
	Maidara	100	0	0	0	0	0	0
	Mongla Point	100	0	0	0	0	0	0
Golda	Chandpai	0	0	0	0	76	24	0
	Harbaria	0	0	0	0	63	38	0
Gulsha Tengra	Chandpai	0	0	0	15	85	0	0
Horina	Chandpai	0	0	100	0	0	0	0
	Harbaria	0	0	33	67	0	0	0
	Maidara	50	50	0	0	0	0	0
	Mongla Point	100	0	0	0	0	0	0
Jaba	Chandpai	0	0	0	0	100	0	0
	Harbaria	0	0	0	0	0	100	0
Jabi Chingri	Maidara	100	0	0	0	0	0	0
Kain Magur	Chandpai	0	0	0	0	91	9	0
	Harbaria	0	0	0	0	0	100	0
Kalo Chewa	Maidara	100	0	0	0	0	0	0
Katali Chingri	Chalna Point	100	0	0	0	0	0	0
	Maidara	100	0	0	0	0	0	0
Khayra	Chandpai	0	0	0	100	0	0	0
Koidda Vola	Harbaria	0	0	0	75	25	0	0
Kuchia	Chandpai	0	0	0	0	0	100	0
	Maidara	0	0	0	100	0	0	0
	Mongla Point	0	0	80	20	0	0	0
Kukurjib	Chandpai	0	0	0	100	0	0	0
Loitta	Mongla Point	100	0	0	0	0	0	0
Magur	Chandpai	0	0	0	0	74	26	0
Motka	Chandpai	0	0	100	0	0	0	0
	Harbaria	0	0	100	0	0	0	0
Mud Crab	Harbaria	0	0	100	0	0	0	0
	Maidara	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
Mutkura	Harbaria	0	0	94	6	0	0	0
Paissa	Harbaria	0	0	0	100	0	0	0
	Mongla Point	100	0	0	0	0	0	0
Pangas	Chandpai	0	0	0	0	10	0	0
Poikka	Chandpai	0	0	0	12	0	0	0
Poma	Chandpai	0	0	0	0	12	0	0
Potka	Chandpai	0	0	60	175	0	0	0
	Mongla Point	1	0	0	0	0	0	0
Sada Bele	Chalna Point	2	0	0	0	0	0	0
	Chandpai	0	0	0	0	20	0	0
	Maidara	1	0	34	0	0	0	0
Shole	Chandpai	0	0	0	0	12	12	0
Tapse	Mongla Point	15	0	0	0	0	0	0
Telcupa	Chandpai	0	0	0	0	0	105	0
	Harbaria	0	0	0	0	0	5	0
Tiger Chingri	Chandpai	0	0	0	50	0	0	0
Tit Punti	Chandpai	0	0	100	0	0	0	0
Tular Dandi	Chandpai	0	0	0	0	7	0	0
Vetki	Chandpai	0	0	0	0	15	15	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	-	-	-	-	-	-		-	-

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

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
Loitta	Haldikhali	Juvenile and Age-1 adult	Feeding and Growing	-	Feeding and Growing	-	-	-	-	-	-		-	-
	Akram Point	Juvenile	Feeding and Growing	-	-	-	Feeding and Growing	-	-	-	-		-	-
	Akram Point	Age-1 adult	-	-	Feeding and Growing	-	Feeding and Growing	-	-	-	-		-	-
	Chandpai	Juvenile	Feeding and Growing	-	-	-	-	-	-	-	-		-	-
	Harbaria	Fry, Juvenile and Age-1 adult	-	Nursing, Feeding and Growing	-	-	-	-	-	-	-		-	-
	Chalna Point	Age-1 adult	-	Feeding and Growing	-	-	Feeding and Growing	-	-	-	-		-	-
		Fry	-	-	-	-	-	-	-	-	Nursing		-	-
Poma	Haldikhali	Juvenile	Feeding and Growing	-	-	Feeding	-	-	-		-		-	-
	Akram Point	Juvenile	Feeding and Growing	-	-	-	-	-	-	Growing and Feeding	-		-	-
		Age-1 adult	-	-	Feeding and Growing	-	-	-	Feeding	Feeding	-		-	-
		Adult	-	-	-	-	-	-			-		-	-
	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		-			

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

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

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

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

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

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

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

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

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

Migratory Fish Species	Sampling Sites	Year Class*	13th QM	14th QM	15th 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	-
	Harbaria	Juvenile and Age-1 adult	Feeding		-
		Adult and Brood Fish	-		-
	Chandpai	Juvenile	-	Feeding and Growing	-
	Mongla Point	Adult	-	-	-
		Fry	-	-	Nursing
	South-west of the Project	Age-1 adult	-	-	-
		Brood Fish	-	-	-
Bairagi	Haldikhali	Juvenile and Age-1 adult	-	-	-
	Akram Point	Juvenile and Age-1 adult	-	-	-
		Juvenile and Adult	-	-	-
	Chandpai	Fry	-	Nursing	-
		Juvenile	-	Feeding and Growing	Feeding and Growing
	Chalna Point	Juvenile and Age-1 adult	-	-	-
		Fry	Nursing	-	-
	Harbaria	Juvenile	-	-	Feeding and Growing
	Mongla Point	Fry	Nursing	-	Nursing
		Juvenile	-	-	-
	South-west of the Project	Juvenile	-	-	-
		Fry	Nursing	-	Nursing
Chapila	Haldikhali	Juvenile	-	-	-
	Akram Point	Juvenile	-	-	-
	Mongla Point	Fry	-	-	-
	South-west of the Project	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	-	-	-
	Chandpai	Fry and Juvenile	-	-	-
		Juvenile	-	-	-
		Adult	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	-	-
		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 Growing	-
		Fry	Nursing	-	-
Chhuri	Haldikhali	Adult	-	-	-
	Akram Point		-	-	-
Chela	Haldikhali	Adult	-	-	-
	Akram Point	Juvenile and Adult	-	-	-
	Harbaria	Fry and Juvenile	-	-	-
	Chandpai		-	-	Feeding and Growing
	Mongla Point		-	Nursing	-
Gang Tengra	Haldikhali	Adult	-	-	-
	Akram Point	Adult	-	-	-
	Harbaria	Adult	-	-	-
	Chandpai	Adult	-	-	-
Ghagra Tengra	Chandpai	Juvenile and Age-1 adult	-	-	-

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

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

		Adult	-	Feeding	-
Paissa	Akram Point	Juvenile and Adult	Feeding	-	-
		Brood	Spawning	-	-
		Juvenile	-	-	-
	Haldikhali	Juvenile and Adult	-	-	-
		Juvenile	-	-	-
	Harbaria	Juvenile-1 and Juvenile	-	Feeding and Growing	-
		Adult	-	Feeding	-
	Chandpai	Fry	-	-	-
	Chandpai	Juvenile and Adult	Feeding	Feeding and Growing	-
	Harbaria	Juvenile	-	-	Feeding and Growing
	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	-	-	-
		Adult	-	Feeding	Feeding
	Akram Point	Juvenile	-	-	-
		Adult	-	-	-
	Haldikhali	Juvnile and adult	-	-	-
	Harbaria	Adult	-	-	-
	Mongla Point	Fry and Adult	-	-	-
		Adult	-	-	-
	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	-	-	-

Source: Field findings at different times

**Only Age-1 to Brood fish was allowed to interpret the migration purpose; F = Feeding; Sp = Spawning; (-) = Not Found*

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

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

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

Sampling Site	Total Catch (kg): 2015-2016							
	5th QM		6th QM		7th QM		8th QM	
	Species	ton	Species	ton	Species	ton	Species	ton
1	Bagda	-	Bagda	1.6	Bagda	2	Catla	2
	Horina Chingri	1	Horina Chingri	1	Horina Chingri	3.2	Glass Carp	0.1
	Tengra	-	Chali Chingri	0.5	Gusha Chingri	0.8	Horina Chingri	0.8
	Paissa	-	Paissa	0.25	Paissa	24	Minar Carp	0.1
	Chela	-	Bele	0.25	Vetki	0.2	Nilotica	1.6
	Vetki	-	-	-	Kailla	0.4	Paissa	0.6
	-	-	-	-	Bele	0	Rui	3
	-	-	-	-	Tilapia	0	Vetki	0.8
	-	-	-	-	Catla	0	-	0
	-	-	-	-	Minar Carp	0	-	0
	-	-	-	-	Glass Carp	0	-	0
	-	-	-	-	Kakra	0.4	-	0
Sub-total=	**-**	**1**	**-**	**3.06**	**-**	**31**	**-**	**9**
2	Bagda	-	Bagda	1.67	Bagda	0	-	0
	-	-	Chali Chingri	0.30	Horina Chingri	0	-	0
	-	-	Horina Chingri	0.50	Chali Chingri	0	-	0
	-	-	Bele	0.30	Tilapia	0	-	0
	-	-	Paissa	0.25	Vetki	0	-	0
	-	-	-	-	Tengra	0	-	0
	-	-	-	-	Paissa	0	-	0
Sub-total=	**-**	**0**	**-**	**3.02**	**-**	**0**	**-**	**0**
3	Bagda	-	Bagda	3.5	Bagda	0.4	-	0
	-	-	-	-	Paissa	3.2	-	0
	-	-	-	-	Vetki	0.4	-	0
	-	-	-	-	Tilapia	0.06	-	0
	-	-	-	-	Horina Chingri	0.35	-	0
	-	-	-	-	Chali Chingri	0.6	-	0
	-	-	-	-	Chaka Chingri	0.1	-	0
	-	-	-	-	Tengra	0	-	0
	-	-	-	-	Bele	0	-	0
	-	-	-	-	Tairel	0.06	-	0
	-	-	-	-	Bhangan	0	-	0
Sub-total =	**-**	**-**	**-**	**-**	**-**	**5.17**	**-**	**0**
Grand-total =	**-**	**1**		**3.5**		**36.17**	**-**	**9**

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

Sampling Site	Total Catch (kg): 2016-2017							
	9th QM		10th QM		11th QM		12th QM	
	Species	ton	Species	ton	Species	ton	Species	ton
1	-	0	-	-	Bagda	3	-	0
	-	0	-	-	Tengra	0.1	-	0
	-	0	-	-	Horina Chingri	0.8	-	0
	-	0	-	-	Paissa	0.1	-	0
	-	0	-	-	Vetki	2	-	0
	-	0	-	-	-	0	-	0
	-	0	-	-	-	0	-	0
	-	0	-	-	-	0	-	0
	-	0	-	-	-	0	-	0
	-	0	-	-	-	0	-	0
	-	0	-	-	-	0	-	0
	-	0	-	-	-	0	-	0
Sub-total =	**-**	**0**	-	-	**-**	**6**	**-**	**0**
2	Bagda	1	-	-	Bagda	2	Bagda	0.0035
	Horina	0.14	-	-	Bele	1.6	Horina Chingri	0.288
	-	0	-	-	Chali Chingri	4	Paissa	0.22
	-	0	-	-	Horina Chingri	8	Tengra	0.305
	-	0	-	-	Paissa	0.28	Chela	0.45
	-	0	-	-	Tengra	0.8	Tilapia	0.53
	-	0	-	-	Tilapia	8	Vetki	0.06
	-	-	-	-	Vetki	2.4	Bele	0.15
Sub-total =		**1.14**	-	-	**-**	**9**	**-**	**0**
3	Bagda	2	-	-	Bagda	0.4	-	0
	-	0	-	-	Horina Chingri	0.35	-	0
	-	0	-	-	Paissa	0.06	-	0
	-	0		-	Tengra	0.4	-	0
	-	0		-	Tilapia	3.2	-	0
Sub-total =	**-**	**2**	**-**	-	**-**	**4**	**-**	**2.01**
Grand-total =	**-**	**3.14**	**-**	-	**-**	**19**	**-**	**2.01**

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

Sampling Site	Total Catch (kg): 2017-2018					
	13th QM		14th QM		15th QM	
	Species	ton	Species	ton	Species	Ton
1	Bagda	0	Bagda	3	-	-
	Horina Chingri	1	Rui (kg)	1.3	-	-
	Tengra	0	Catla (kg)	1	-	-
	Paissa	0	-	-	-	-
	Chela	0	-	-	-	-
	Vetki	0	-	-	-	-
Sub-total =	**-**	**1**	**-**	**3.6**	-	-
2	Bagda	0	Bagda	5	-	-
	-	-	Vetki	0.5	-	-
	-	-	Paissa	7	-	-
	-	-	Phessa	1	-	-
	-	-	Bhangan	0.7	-	-
Sub-total =		**0**	**-**	**14.2**	-	-
3	Bagda	0	Bagda	2	-	-
	-	-	Paissa	8	-	-
	-	-	Tengra	2	-	-
	-	-	Tilapia	5	-	-
	-	-	Rui	3	-	-
	-	-	Vetki	2	-	-
	-	-	Catla	10	-	-
Sub-total =	**-**	**0**	**-**	**32**	-	-
Grand-total =	**-**	**1**	**-**	**49.8**	-	-

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

(E) Land Resource Monitoring Data

Table E.0: 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.1: Chemical Properties of Soil on Monitoring Plots

I. No.	Location	Parameter	2013-2014				2014-2015				2015-2016				2016-17			
			Dry season (April)	Remarks	Wet season (October)	Remarks	Dry season (April)	Remarks	Wet season (October)	Remarks	Dry season (March)	Remarks	Wet season (October)	Remarks	Dry season	Remarks	Wet season (October)	Remarks
1	Baranpara	Top soil(0-15cm)																
		EC(ds/m)	9.1	Moderately saline	1.8	Non saline	10.01	Moderately saline	2.54	Very slightly saline	2.46	Very slightly saline	3.25	Very slightly saline	5.09	Slightly saline	1.00	Non 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
		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
		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
		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
		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
		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
		Na(meq/100g)	5.50	*	2.7	*	10.01	*	4.76	*	4.43	*	5.07	*	5.76	*	5.15	*
		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
		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
		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
		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
		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
		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
		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
		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
		Subsurface soil(15-30cm)																
		EC(ds/m)	8.4	Moderately saline	2.0	Non saline	7.90	Slightly saline	4.65	Slightly saline	2.23	Very slightly saline	4.88	Slightly saline	4.52	Slightly saline	0.88	Non 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
		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
		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
		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
		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
		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
		Na(meq/100g)	5.00	*	2.7	*	8.95	*	6.32	*	4.22	*	6.48	*	5.24	*	5.77	*
		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
		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
		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
		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
		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

l. No.	Location	Parameter	2013-2014				2014-2015				2015-2016				2016-17			
			Dry season (April)	Remarks	Wet season (October)	Remarks	Dry season (April)	Remarks	Wet season (October)	Remarks	Dry season (March)	Remarks	Wet season (October)	Remarks	Dry season	Remarks	Wet season (October)	Remarks
		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
		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
		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
		Substratum(30-45cm)																
		EC(ds/m)	9.6	Moderately saline	5.8	Slightly saline	9.26	Moderately saline	5.56	Slightly saline	4.32	Slightly saline	6.48	Slightly saline	7.40	Slightly saline	1.67	Non 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
		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
		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
		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
		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
		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
		Na(meq/100g)	6.00	*	3.7	*	9.91	*	6.83	*	5.51	*	6.71	*	7.41	*	6.89	*
		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
		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
		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
		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
		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
		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
		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
		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
2	Chunkuri-2	Top soil (0-15cm)																
		EC(ds/m)	11.2	Moderately saline	5.6	Slightly saline	13.05	Strongly saline	8.20	Moderately saline	6.92	Slightly saline	6.15	Slightly saline	6.57	Slightly saline	4.63	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
		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
		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
		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
		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
		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
		Na(meq/100g)	8.5	*	9.4	*	12.51	*	8.16	*	7.11	*	7.19	*	6.59	*	6.27	*
		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
		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

l. No.	Location	Parameter	2013-2014				2014-2015				2015-2016				2016-17			
			Dry season (April)	Remarks	Wet season (October)	Remarks	Dry season (April)	Remarks	Wet season (October)	Remarks	Dry season (March)	Remarks	Wet season (October)	Remarks	Dry season	Remarks	Wet season (October)	Remarks
		B(µg/gm)	0.57	Optimum	0.74	High	0.75	High	1.52	Very high	1.88	Very high	1.50	Very high	1.59	Very high	1.48	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
		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
		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
		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
		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
		Subsurface soil(15-30cm)																
		EC(ds/m)	9.1	Moderately saline	5.6	Slightly saline	10.48	Moderately saline	6.97	Slightly saline	5.74	Slightly saline	5.44	Slightly saline	7.48	Slightly saline	2.30	Very 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
		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
		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
		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
		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
		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
		Na(meq/100g)	8.5	*	9.9	Very high	10.61	*	7.89	*	6.88	*	6.03	*	6.67	*	6.46	*
		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
		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
		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
		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
		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
		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
		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
		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
		Substratum(30-45cm)																
		EC(ds/m)	10.1	Moderately saline	5.3	Slightly saline	10.00	Moderately saline	6.91	Slightly saline	6.59	Slightly saline	5.64	Slightly saline	7.65	Slightly saline	1.86	Non 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
		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
		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
		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
		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
		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
		Na(meq/100g)	8.5	*	9.3	*	10.92	*	7.69	*	6.98	*	6.25	*	6.82	*	6.75	*
		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
		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
		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

l. No.	Location	Parameter	2013-2014				2014-2015				2015-2016				2016-17			
			Dry season (April)	Remarks	Wet season (October)	Remarks	Dry season (April)	Remarks	Wet season (October)	Remarks	Dry season (March)	Remarks	Wet season (October)	Remarks	Dry season	Remarks	Wet season (October)	Remarks
		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
		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
		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
		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
		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
3	Kapalirmet	Top soil(0-15cm)																
		EC(ds/m)	4.8	Slightly saline	8.5	Moderately saline	3.89	Very slightly saline	8.29	Moderately saline	8.22	Moderately saline	7.53	Slightly saline	8.05	Slightly saline	7.31	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
		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
		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
		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
		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
		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
		Na(meq/100g)	12.0	*	11.9	*	5.22	*	7.77	*	7.87	*	7.28	*	7.88	*	7.20	*
		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
		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
		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
		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
		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
		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
		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
		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
		Subsurface soil(15-30cm)																
		EC(ds/m)	11.1	Moderately saline	6.3	Slightly saline	4.26	Slightly saline	7.43	Slightly saline	8.60	Moderately saline	7.55	Slightly saline	8.44	Moderately saline	7.39	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
		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
		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
		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
		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
		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
		Na(meq/100g)	8.5	*	9.8	*	5.45	*	7.86	*	7.89	*	7.66	*	8.04	*	7.72	*
		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
		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
		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
		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
		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
		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

Sl. No.	Location	Parameter	2013-2014				2014-2015				2015-2016				2016-17			
			Dry season (April)	Remarks	Wet season (October)	Remarks	Dry season (April)	Remarks	Wet season (October)	Remarks	Dry season (March)	Remarks	Wet season (October)	Remarks	Dry season	Remarks	Wet season (October)	Remarks
		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
		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
		Substratum(30-45cm)																
		EC(ds/m)	10.8	Moderately saline	7.5	Slightly saline	3.99	Very slightly saline	7.06	Slightly saline	6.77	Slightly saline	8.44	Moderately saline	7.10	Slightly saline	6.54	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
		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
		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
		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
		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
		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
		Na(meq/100g)	8.5	*	9.6	*	5.76	*	7.27	*	7.03	*	8.05	*	6.93	*	8.00	*
		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
		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
		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
		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
		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
		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
		Lead(Pb) (µg/gm)	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
		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
4	Chalkghona	Top soil(0-15cm)																
		EC(ds/m)	11.5	Moderately saline	7.2	Slightly saline	7.36	Slightly saline	7.31	Slightly saline	7.67	Slightly saline	8.56	Moderately saline	7.78	Slightly saline	6.82	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
		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
		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
		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
		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
		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
		Na(meq/100g)	8.5	*	8.4	*	9.81	*	6.56	*	6.33	*	6.52	*	6.50	*	5.79	*
		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
		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
		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
		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
		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
		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
		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
		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

I. No.	Location	Parameter	2013-2014				2014-2015				2015-2016				2016-17			
			Dry season (April)	Remarks	Wet season (October)	Remarks	Dry season (April)	Remarks	Wet season (October)	Remarks	Dry season (March)	Remarks	Wet season (October)	Remarks	Dry season	Remarks	Wet season (October)	Remarks
		Subsurface soil(15-30cm)																
		EC(ds/m)	11.3	Moderately saline	6.2	Slightly saline	7.81	Slightly saline	7.38	Slightly saline	7.02	Slightly saline	7.99	Slightly saline	6.92	Slightly saline	6.58	Slightly saline
		pH	7.7	Slightly alkaline	8.2	Slightly alkaline	5.9	Slightly acid	8.6	Strongly alkaline	8.5	Strongly alkaline	8.4	Slightly alkaline	8.5	Strongly alkaline	8.77	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
		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
		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
		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
		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
		Na(meq/100g)	8.5	*	8.6	*	9.23	*	6.93	*	6.56	*	7.10	*	5.97	*	6.48	*
		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
		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
		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
		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
		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
		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
		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
		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
		Substratum(30-45cm)																
		EC(ds/m)	10.9	Moderately saline	5.1	Slightly saline	7.14	Slightly saline	7.12	Slightly saline	7.45	Slightly saline	7.87	Slightly saline	8.23	Moderately saline	6.83	Slightly 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
		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
		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
		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
		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
		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
		Na(meq/100g)	8.5	*	6.7	*	9.33	*	7.20	Very high	7.39	*	6.77	*	6.69	*	6.95	*
		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
		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
		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
		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
		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
		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
		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
		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
5	Basherhula	Top soil(0-15cm)																
		EC(ds/m)	11.7	Moderately saline	6.0	Slightly saline	7.14	Slightly saline	5.58	Slightly saline	9.10	Moderaely saline	6.41	Slightly saline	6.60	Slightly saline	6.15	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

l. No.	Location	Parameter	2013-2014				2014-2015				2015-2016				2016-17			
			Dry season (April)	Remarks	Wet season (October)	Remarks	Dry season (April)	Remarks	Wet season (October)	Remarks	Dry season (March)	Remarks	Wet season (October)	Remarks	Dry season	Remarks	Wet season (October)	Remarks
		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
		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
		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
		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
		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
		Na(meq/100g)	8.5	*	8.1	*	7.06	*	6.32	*	8.24	*	6.61	*	5.69	*	6.56	*
		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
		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
		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
		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
		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
		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
		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
		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
		Subsurface soil(15-30cm)																
		EC(ds/m)	10.7	Moderately saline	7.0	Slightly saline	7.44	Slightly saline	7.16	Slightly saline	6.29	Slightly saline	7.30	Slightly saline	7.22	Slightly saline	7.21	Slightly saline
		pH	7.7	Slightly alkaline	8.2	Slightly alkaline	7.7	Slightly alkaline	8.7	Strongly alkaline	8.6	Strongly alkaline	8.4	Slightly alkaline	7.9	Slightly alkaline	8.72	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
		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
		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
		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
		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
		Na(meq/100g)	7.0	*	10.1	*	8.66	*	7.06	*	6.93	*	6.74	*	6.70	*	6.70	*
		P(µg/gm)	3.9	Very low	5.3	Low	8.19	Low	6.82	Low	7.03	Low	7.14	Low	7.05	Low	6.77	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
		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
		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
		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
		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
		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
		Cadmium (Cd)(µg/gm)	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
		Substratum(30-45cm)																
		EC(ds/m)	10.9	Moderately saline	6.3	Slightly saline	6.68	Slightly saline	6.96	Slightly saline	6.38	Slightly saline	7.39	Slightly saline	7.39	Slightly saline	7.73	Slightly saline
		pH	7.7	Slightly alkaline	8.2	Slightly alkaline	7.8	Slightly alkaline	8.8	Strongly alkaline	8.7	Strongly alkaline	8.7	Strongly alkaline	8.1	Slightly alkaline	8.60	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
		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
		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

I. No.	Location	Parameter	2013-2014				2014-2015				2015-2016				2016-17			
			Dry season (April)	Remarks	Wet season (October)	Remarks	Dry season (April)	Remarks	Wet season (October)	Remarks	Dry season (March)	Remarks	Wet season (October)	Remarks	Dry season	Remarks	Wet season (October)	Remarks
		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
		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
		Na(meq/100g)	7.5	*	9.8	*	8.76	*	7.68	*	7.01	*	7.48	*	6.77	*	7.50	*
		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
		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
		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
		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
		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
		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
		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
		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

Source: SRDI laboratory analysis, May 2017

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

Monitoring agriculture plot	Cropping pattern														
	2013-14			2014-15			2015-16			(2016-17)			(2017-18)		
	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.3: 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.4: 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)

Appendix V: Monitoring Data observed During EIA Study

Table F.1: Air quality monitoring results of different location

Date	Sample location	SPM (µg/m^3)	SO_x (µg/m^3)	NO_x (µg/m^3)
01/05/2012	Shibbari More, Khulna	410.0	<25	46.0
	College More, Khulna	320.0	<25	36.0
	Natunrasta More, Khulna	350.0	<25	33.0
	Sonadanga Bus stand	335.0	<25	41.0
Bangladesh Standard (ECR 1997) for residential and rural area		200	80	80
02/05/2012	Bus stand more, Sharankhola Sadar	155.0	10.0	21.0
	In front of Upazila Palli Unnoyon Board Office, Sharankhola Sadar	140.0	11.0	20.
	Thana More, Sharankhola Sadar	150.0	09.0	18.0
	In front of Upazila Health Complex Office, Sharankhola Sadar	148.0	08.0	16.0
Bangladesh Standard (ECR 1997) for sensitive area as the location is within the ECA of Sundarbans		100	30	30
ECR Amendment, 2005		150 (24-hr)	365 (24-hr)	100 (Annual)

Source: CEGIS investigation, 2012

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

Table F.2: Water quality monitoring results

location	Date	Temp.	pH	EC	Cl^-	T.Alkalinity	Turbidity	T S	TDS	SS	DO	BOD	COD	Salinity
		°C		µS/cm	mg/l	mg/l	NTU	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
1	7-Jan	27.4	7.74	3010	879	36	68.7	1565	1510	55	5.1	0.8	55	1.6
2	7-Jan	27.1	7.72	3020	878.8	36	68.5	1570	1510	60	5.1	0.8	55	1.6
3	7-Jan	27.8	7.71	3030	879	36	68.8	1565	1510	55	5.1	0.8	55	1.6
1	11-Feb	29.8	7.66	4380	1262	36	182	2390	2180	210	4.7	1	76	2.3
2	11-Feb	29.2	7.63	4380	1268	36	178	2390	2190	200	4.7	1	76	2.3
3	11-Feb	29.1	7.65	4380	1263	36	179	2380	2180	200	4.7	1	76	2.3
1	9-Mar	32.6	7.56	11780	2944.4	38	176	6080	5890	190	4.7	1.2	76	6.7
2	9-Mar	32.6	7.57	11780	2945.2	38	178	6080	5890	190	4.7	1.2	76	6.7
3	9-Mar	32.1	7.55	11780	2946.4	38	177	6090	5890	200	4.7	1.2	76	6.7
1	17-Apr	32.6	7.59	25300	8273	36	185.6	12950	12700	250	4.6	0.7	136	15.5
2	17-Apr	32.6	7.59	25300	8273	36	186.2	12950	12700	250	4.6	0.7	138	15.5
3	17-Apr	32.6	7.59	25300	8273	36	184.8	12950	12700	250	4.6	0.7	136	15.5
1	5-May	32.6	7.59	29200	9480	36	198.6	14900	14600	300	4.5	1.2	177	17.6
2	5-May	32.9	7.54	29200	9470	36	198.6	14900	14600	300	4.4	1.2	177	17.6
3	5-May	33.2	7.57	29200	9470	36	199.6	14900	14600	300	4.5	1.2	177	17.6
1	13-Jun	31.6	7.69	18000	5820	36	112.6	9200	9000	200	4.7	1.1	97	10.8
2	13-Jun	31.6	7.69	18000	5800	36	113.2	9200	9000	200	4.7	1.1	97	10.8
3	13-Jun	31.6	7.69	18000	5810	36	112.4	9200	9000	200	4.7	1.1	97	10.8
1	1-Jul	31.6	7.69	440	32.6	36	76.6	285	220	65	5.2	0.8	26	-
2	1-Jul	31.6	7.69	440	32.6	36	76.6	285	220	65	5.2	0.8	26	-
3	1-Jul	31.6	7.69	440	32.6	36	76.6	285	220	65	5.2	0.8	26	-
1	5-Aug	31.6	7.69	275	16.6	36	68.6	192	137	55	5.3	0.7	22	-
2	5-Aug	31.6	7.69	275	16.6	36	68.6	192	137	55	5.3	0.7	22	-
3	5-Aug	31.6	7.69	275	16.6	36	68.6	192	137	55	5.3	0.7	22	-
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	-

location	Date	Temp.	pH	EC	Cl^-	T.Alkalinity	Turbidity	T S	TDS	SS	DO	BOD	COD	Salinity
		°C		µS/cm	mg/l	mg/l	NTU	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
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.