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

Monitoring of Environment Parameter and Implementation of Environmental Management Plan During Construction Period Along With Engineering Activities For 2x660 MW Maitree Super Thermal Power Project At Rampal In Bagerhat District of Khulna Division, Bangladesh

14th Quarter Monitoring Report

Monitoring Period: June - October 2017

December 2017

CEGIS Center for Environmental and Geographic Information Services
House 6, Road 23/C, Gulshan-1, Dhaka-1212. Bangladesh. Tel: 88 02 58817649-52; 9842581, 9842551 Fax: 88 02 9843128, http://www.cegisbd.com

Acknowledgements

The Center for Environmental and Geographic Information Services (CEGIS), a Public Trust under the Ministry of Water Resources, is indebted to Bangladesh-India Friendship Power Company (Pvt.) Limited (BIFPCL) for awarding the contract of ***"Monitoring of environment parameter and implementation of environmental management plan during construction period along with engineering activities for 2x660 MW Maitree Super Thermal Power Project at Rampal Bagerhat."*** to CEGIS.

CEGIS is grateful to Dr. Ahmed Kaikaus, NDC, Secretary, Ministry of Power, Energy and Mineral Resources (MoPEMR) and Chairman, BIFPCL for his dynamic leadership in this sector. CEGIS also expresses its gratitude to Mr. Khaled Mahmood, Chairman, Bangladesh Power Development Board (BPDB), for his continuous inspiration and support in all respect for conducting the study successfully. In addition, CEGIS is thankful to Mr. Engr. Naresh Anand, Managing Director of BIFPCL for his direction and guidance during the study. Moreover, CEGIS appreciates the support and guidance of Mr. Atanu Kumar Mitra, Chief Technical Officer, BIFPCL, Arun Chowdhury. Addl. General Manager, Mechanical Engineer & Erection and Mr Nabendu Lodh, Deputy General Manager, BIFPCL, throughout the study period.

Furthermore, CEGIS also appreciates Mr. Abul Kalam Azad, Surveyor, BIFPCL and Md. Abdus Salam, Junior Chemist, DoE Khulna, for accompanying the team while carrying out monitoring activities in the Passur River and adjoining areas of Sundarbans. CEGIS is also grateful to the field officials of different Government and Non-Government Organizations for contribution and sharing their ideas and views on the attitudes of the local people towards the Project and existing problems of the study area as well as their suggestions in solving the problems.

Last but not the least, the Study Team appreciates and acknowledges the concerns and perceptions of local people regarding the Project and their active participations during field visits.

Table of Contents

List of Tables

List of Figures

List of Photographs

List of Maps

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
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 thousand
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 HYV T. 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 (14th 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 for the period from June, 2017 to October, 2017 and CEGIS team has carried out the monitoring activities in October, 2017 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 EMP (Environmental Management plan) (provided in the EIA) summarizes the assessment of effectiveness of the recommended mitigation measures and also to identify further requirement of additional mitigation measures or remedial action associated with Project Phases (Pre-construction/Construction/or Operation). The progress of Project construction activities includes construction of the embankments, slope protection works and the two lane main access road from Babur Bari (at Khulna-Mongla road) to Plant site. The Project Site office has been shifted to the South-West corner of the project boundary and construction of bridges and culverts of the access roads have also been completed. 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 of the Project, CEGIS recommends few site specific measure(s) which should be complied for ensuring environmental and social safeguarding of the Project, such as emphasizing local participants in the training program, standard labour accommodation, demarcation of safety signs in local language, site specific Emergency Response Plan (ERP) for the construction workers; placement of sufficient waste disposal bins at the labour sheds, working areas etc.

Moreover, in the recent monitoring period, the HR policy was found to be developed as the management of site-specific EHS programme have already been established. Occupational Health and Safety Policies; Establishment of the grievance redress mechanism; Emergency preparedness and response plan; fire prevention, protection and control plan; stakeholder engagement plan etc. have been finalized and planned for addressing the current phase (Construction Phase). According to the Project Authority, the work order for the construction of the power plant has been issued to the EPC contractor (BHEL) and it is expected that the construction works will be started very soon. Site-specific Fire and Safety Officer have also been appointed. However, proper documentation of any accident/incident or any health hazard risk issues should be recorded; preventive measures for near 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 arranged.

During this monitoring period weather condition of the locality can be characterized as mild wind flow and lower air temperature. During this monitoring period the concentration of all the ambient air quality monitoring parameters i.e. SOx, NO_2, $PM_{2.5}$, PM_{10}, CO and O_3 were found to be well within the standard limit set by ECR'97. However, newly developed land for setting up industries and associated activities along the Passur River, loading-unloading activities from Ships & Barges and cement industries can be noted as the major known sources of $PM_{2.5}$, PM_{10} and SPM in this area. Other pollutants i.e. SO_2, NOx, CO and O_3 may be generated from the commonly known sources like the local off road vehicles (Human hauler/ Nosimon) and motorized/engine driven marine transport e.g. trawler, barges, ship etc.

The noise generation sources may be divided into two types; one is natural and another one is anthropogenic. Natural sources were observed to be birds' chirping, mild wind, wave breaking on the shoreline, howling of leaves and so on. On the contrary, traffic mobilization, industrial activities, vessels movement across the rivers and local vehicles may be the salient sources of anthropogenic noise. However, during this monitoring season (**14th quarter**); the observed noise level did not exceed the Bangladesh standard limit of noise level at any of the eleven pre-selected monitoring locations. In course of the total fourteen (14) monitoring seasons, it was found that the noise level of eight locations exceeded the Bangladesh standard limit during different monitoring seasons. These were NW (North-West) corner of the Project area (Oct-2016), Chunkuri, Bajua (Mar-2014 & Jan-2017), SW (South-Western) 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). It was also observed that the noise level of Harbaria, crossed the standard value in seven monitoring occasions among the fourteen quarterly monitoring seasons. This might be due to the honk from the marine vessel and ssociated loading unloading activities in the monitoring site. It was also observed, that the noise level in three locations namely Chalna under Dacope upazila, Barni (Gaurambha), and Mongla Port area had never crossed the Bangladesh standard limits. However, any anthropogenic noise producing activities within the study area may contribute to enhance the ambient noise level for the corresponding receptors.

The water samples were collected in this recent monitoring period of October 2017, from the preselected 18 locations (15 locations for surface water and 3 locations for ground water analysis). All the samples were collected and tagged immediately through maintaining the internationally recognized procedures. Later on, the samples were submitted to DPHE and BCSIR laboratory for chemical analysis of the preselected parameters. This 14th quarterly monitoring report includes the laboratory reports of the 13th quarterly monitoring period (April 2017) and in-situ monitoring results of current quarterly monitoring period (14th quarterly monitoring program). The lab test results for the concurrent monitoring period could not be provided in this report as that are yet to be received from the respec. Mentionable that, similar to the earlier results, spatial and seasonal variations were also observed in different parameters analysed in the later period. But the results indicated that, all parameters were 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 power plant (Impact zone) have been selected to monitor the land use, soil fertility/nutrient status, soil contamination with heavy metals and soil salinity. Samples were

collected in the month of October 2017 from three depths (0-15 cm, 15-30 cm and 30-45 cm) from the monitoring plots to analyse the pre-selected parameters. The samples has been submitted to SRDI, Dhaka laboratory for chemical analysis. The test results will be provided in the next monitoring report.

Fisheries resources were monitored at the same locations as done in the earlier monitoring periods. The followings are the key findings of the 14th quarterly monitoring seasons. According to the findings from the consecutive monitoring periods, habitat uses were observed to be changed yearly as compared to the year of 2014-2015, of 2015-2016 and of 2017-18 and caused mainly due to biophysical changes e.g. tidal effect, seasonal variability, food availability and also fisheries resource management practices. Moreover, two types of habitats was found namely: i) Grazing and feeding ground, ii) Nursing ground (through analysing the type of habitat uses by different ages of different fish species and the length-based community structure model).

Highest Shannon-Weiner index (0.88) was found at Maidara-Passur Confluence indicating most evenly distributed fish species. On the contrary, lowest evenness was found at Mongla-Passur Confluence (0.54). The maximum FSR was obtained in Harbaria Khal (n=6), while very low FSR was recorded at Mongla and Maidara Point (n=2). Fries and juveniles for fin fish were widely being distributed among the middle stretches of the Passur River system as observed in the earlier monitoring periods. Among these, Horina Chingri, Motka Chingri, Bele and Tit Punti fishes were more among these two sampling sites. Moreover, fries fish of Horina Chingri was commonly found at Mongla Point. No brood female fishes were observed at sampling sites in this quarter.

Fish species like *Bairagi* attains the maximum abundance of about 72% among the migratory fish species. Three (3) fish species, Poma, Paissa and Golda were observed as long range distributed species. The highest stocking rate as well as the highest mortality rate was observed in Rajnagar ghers. The highest productivity were found in Sheola khal at Chandpai (12kg/haul). On the other hand, the lowest productivity was found in the Mongla Point, because all the fry fishes are not considered as catch. Ber Jal (Poma/Vola Jal), Behundi Jal and Thela Jal were found most frequently used nets in all upper reaches in Passur River System. Charpata Jal was commonly used in middle reach and lower reach of the Passur River. Moreover, the highest total catch was observed in Sheola khal at Chandpai and lowest in the Mongla Point in this monitoring phase. The highest fish production was found in the Gher of Kapasdanga having high growth rate and low mortality rate.

As regard the aquatic Ecosystem Monitoring components, the occurrence of Dolphin in Passur River near Project site, Koramjal, Harbaria, Akrampoint and Dhangmari Khal were recorded in this monitoring season. There only 5 Ganges dolphin were recorded from 13 km boat transect survey along the Passur River and Maidara River with an encounter rate of 0.19 individual/km/hour. On the other hand, 12 dolphins were sighted from 13 km survey transect length of Dhangmari Khal and the encounter rate was 0.48 individual/km/hour.

The 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 are some seasonal effects. The change in re-generation rate is also remarkable in the study area. During this monitoring study, the moisture condition has increased in Hiron point as compared to the previous study while illicit felling observed in Koromjol area. However, based on above indicators it is found that the health condition at

Akram point was worser than the other area. This might due to the physiographic location of this plot, which is facing high environmental stress. The Akram point is situated at the confluence of Shibsa and Passur River and the forest is experiencing retrogation process where the climax species have started to be decaying. Hence, this area is sensitive in terms of disturbance. It is to be noted here that the potential anchorage point for coal transhipment of the proposed power plant project is situated in the periphery of this area. However, the monitoring activities should be continued to know the dynamism of mangrove attributes which are very much interlinked with each other as well as with the environment and more monitoring site should be delineated as control site to compare the potential impact due to coal transportation and transhipment along the Passur River.

Among the five monitoring plots, plot owner of Baranpara, Chunkuri-2 and Basherhula were found cultivating local Aman like Chapshail and Benapole rice in the Kharif-II season. The existing cropping pattern of the five monitoring plots was found as Fallow-Local Aman-Fallow during the monitoring periods. The remaining monitoring plots were found uncultivated due to salinity problem as stated by the landowners. Crop production and damage data will be collected after harvesting in the month of December 2017 and would be included in the next monitoring report.

The compensation process has officially though been completed yet some affected entities still denied to receive any compensation and few entities could not arrange legal documents/papers of their affected land. Among the total 150 informal settlers, eighteen were primarily shifted to Foyla cluster village. But, eight of the shifted households left the shelter village due to mismatch of their occupation of that area and the remaining are seeking sustainable working opportunity within the district and determining to migrate. As the major works of construction phase is not yet started therefore opportunity of recruiting local labours has not been opened up. The works of construction phase may create employment opportunities for local communities as well as people residing in shelter village.

The working condition of the workers i.e. accommodation, drinking water, sanitation and medical facilities remained same as were in the earlier phase of monitoring. The current accommodation facilities should be improved as per international standard by the EPC contractor before staring the major construction works. However, an improvement scenario was observed in terms of using personal protective equipment by the labours. All labours are being forced to use PPEs which is monitored by the Project authority and EPC contractors.

For ensuring community health and safety, each sub-contractor was requested to have at least one Environment, Health and Safety Officer for ensuring safe and hygienic health, safety and environmental condition in the Project and its surroundings. On the other hand, about 2000 trees (coconut & flower) were planted in the project area for the last six months that may help to improve the environmental condition in the project area. The medical camp established as CSR, is performing well to provide medical service in the study area. Moreover, it was informed from the proponent that about 4,122 people received health treatments over the last six months (June, 2017 to Oct, 2017) which was 3,823 in the earlier phase of monitoring. However, the EPC contractor has ensured that, medical services will be improved after initiating the major construction works.

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 duly be 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 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 at 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 during construction phase along with engineering activities during this 14th 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 cimney location. Location of the study area and their 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 10 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 thirteen (13) quarterly monitoring reports have already been submitted to BIFPCL which subsequently submitted all these reports to DoE and Forest Department. In addition, all the monitoring reports were regularly uploaded in BIFPCL website. The current document constitutes the

14th 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

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

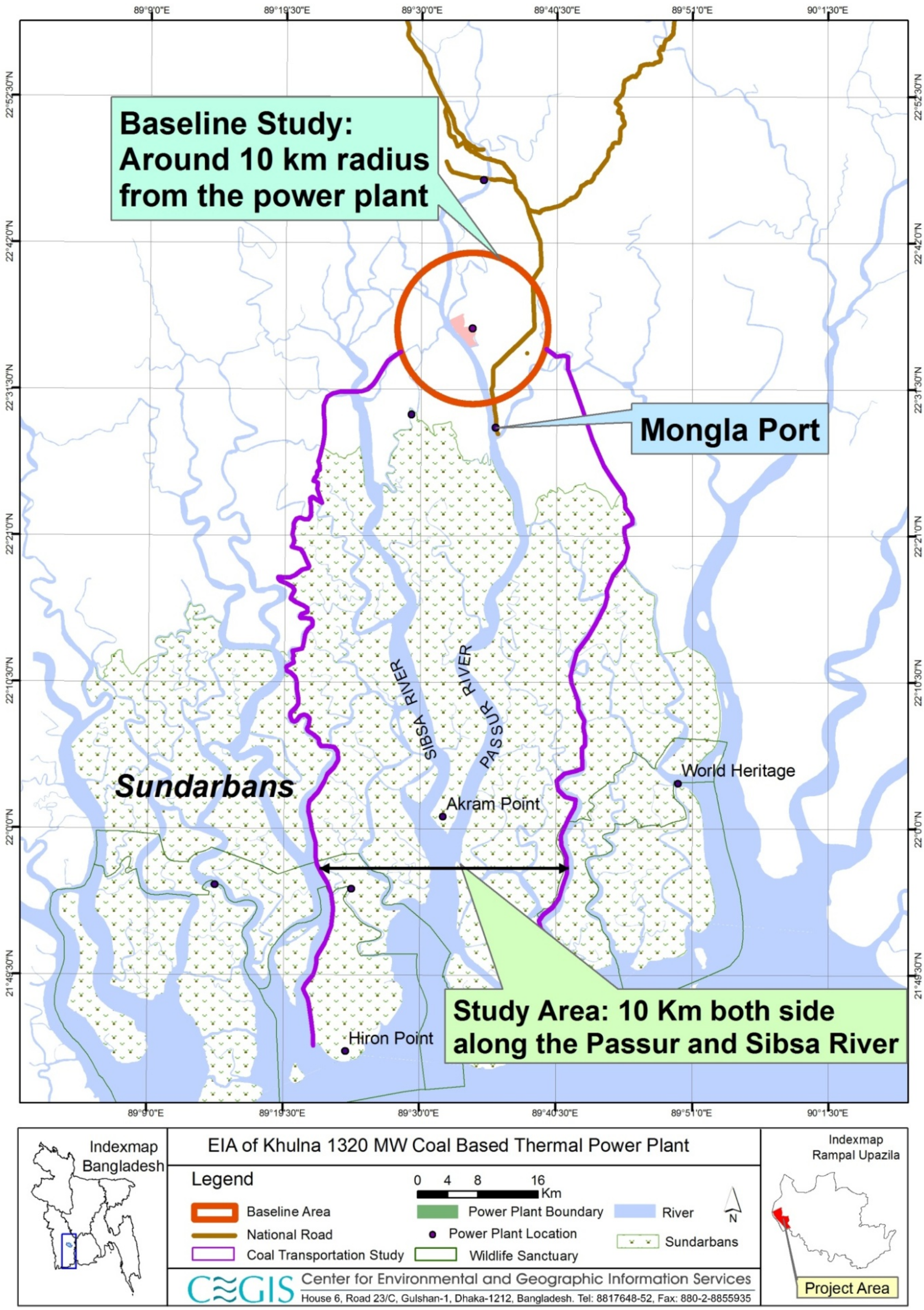
9. The other objective is to compare the ambient state of environment and will later be compared with the environmental condition in future when the Power Plant will be in operation phase. The monitoring activities also include monitoring of environmental compliance of the Power Plant's construction works and associated activities.

1.3 Criteria for Selection of Monitoring sites/locations

10. 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 ambient air quality. Similarly, the same locations selected for monitoring air quality have also been considered for the noise quality monitoring too.
- Sites for ambient water quality were selected by considering the water sources likely to be impacted/ polluted by both the natural and anthropogenic sources.
- Monitoring sites for fisheries resources covers 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 works 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

11. Monitoring of the Sundarbans Reserve forest area need to be complied with the conditions set out by the DoE during the 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 issued permission for carrying out monitoring activities in the Sundarbans under certain conditions which include of keeping close communication with Forest Department, submitting monitoring report to the Forest Department along with the following activities in 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 both above and below the ground level,
- Assessment of impact on canopy cover, leaves phenology, flowers behaviour, pneumatophore and crab hole conditions.

12. The monitoring team was formed as per requirements of the Forest Department. BIFPCL also forwarded each copy of the earlier thirteen quarterly monitoring reports to the Chief Conservator of Forest, Bangladesh Forest Department, Agargaon, Dhaka and Conservator of Forest, Khulna Circle, Boyra, Khulna. Similarly, this 14th monitoring report will also be forwarded to the corresponding Department.

Department of Environment (DoE)

13. The monitoring plan, including indicators, 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 with the experts of DoE to finalize the monitoring plan at CEGIS office.

14. The BIFPCL forwards the monitoring reports and data to the DoE regularly. The monitoring report are also being 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 has also been included to accompany the monitoring team.

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

15. 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) for ensuring environmental and social safeguarding of the project.

Bangladesh Power Development Board (BPDB)

16. BPDB is the main promoter of BIFPCL and is providing lateral support to BIFPCL in every phases (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

17. The Project Affected Peoples (PAPs) were included in the social environment monitoring program. The changes in important socio-economic indicators were 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

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

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

19. 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 October, 2017 to understand the seasonal and spatial variations of the indicators which may further indicates the condition of the concurrent air shed.

2.1.1 Methodology

20. Five (5) major air pollutants i.e., Particulate Matters (PM2.5, PM10, and SPM), SOX, NOX, CO and O3 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 on the basis of model generated pollutant dispersion scenario to determine the maximum ground level concentration of 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

2.1.2 Method of Sampling and Laboratory Testing

21. 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 PM2.5, PM10, and SPM were tested by gravimetric method. The concentration of was analysed by West-Gaeke method. Likewise, the concentration of NO2 was tested by Jacob and Hochheiser method and furthermore the concentration of CO and Ozone (O3) were measured by Metravi CO-10 meter and Tongdy O3 Monitor respectively.

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

2.1.3 Pollution sources in the Sundarbans

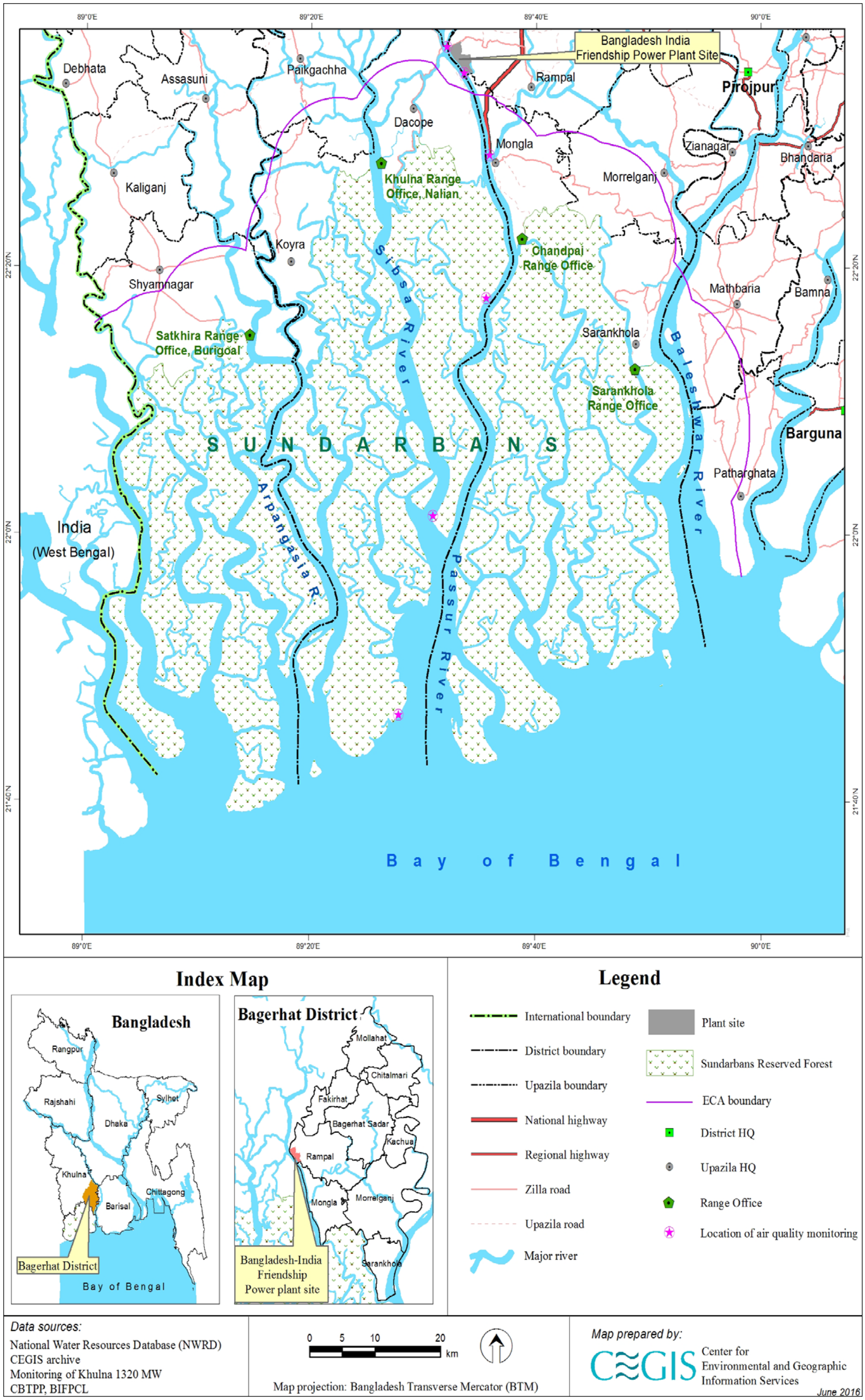
23. Most of the river traffic plying towards and away from Mongla Port area through the Sundarbans may be the prominent sources of Suspended Particulate Matters (SPM), Oxides of Sulphur (SOx) especially SO2, Oxides of Nitrogen (NOx) and Green House Gases (GHGs). In addition, engine boats and other motorized vehicles for fishing, honey collection, Golpata (Nipa palm) & timber collection and tourism business are also currently contributing to the air pollution 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

24. The ambient conditions of air quality in this quarter has also been monitored in the same locations as monitored in the 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	In situ field measurements have been conducted with the facilities of outsourced laboratory. **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		



Map 2.1: Air Quality Monitoring Locations

2.1.5 Status of air quality

25. 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 current standards are listed below. Units of measurement for the standards are parts per million (ppm) by volume, and micrograms per cubic meter of air (µg/m3).

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)

26. The values of **$PM_{2.5}$**, **SPM** and **PM_{10}** were found within the standard limit at all locations and in all the 14 (fourteen) quarters of the monitoring period. During this period the concentration of $PM_{2.5}$ was found maximum (33.2 µg/m3) at Mongla port area among all the locations and is within the standard limit. On the other hand the maximum concentration of PM_{10} was found to be 100.2 µg/m^3 at Bajua Bazar area while the lowest concentration (30.2 µg/m^3) was measured at Gaurambha bazar.

27. Similarly, the concentration of SPM was found as maximum at at Mongla port area (187.2 µg/m3). Large number of two-stroke human haulers, Buses, trucks, small engine boats and other anthropogenic activities were observed during monitoring which could be the reason for the higher concentration of particulate matters. In addition, cement and other industries might also be considered as the sources of particulate matters around the area. All the monitoring data have been attached in Table A1 in Appendix IV. All the observed data of PM 10, PM2.5 and SPM were found to be within the standard limit set by the ECR'97.Sulphur Dioxide (SO2)

28. During this monitoring period, the concentration of Sulphur dioxide (SO_2) in the ambient air were found much below the Bangladesh standard limit of 365 8.2 µg/m^3. The maximum concentration (8.2 µg/m3) was found in Mongla Port area while minimum concentration (4.1 µg/m^3) was found in Gourambha bazar.

Nitrogen Dioxide (NO_2)

29. 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 (10.7 µg/m^3) was found at Mongla port area while the lowest (5.0 µg/m^3) was recorded at Gaurambha bazar. The monitoring results are shown in **Table A1 in Appendix IV.**

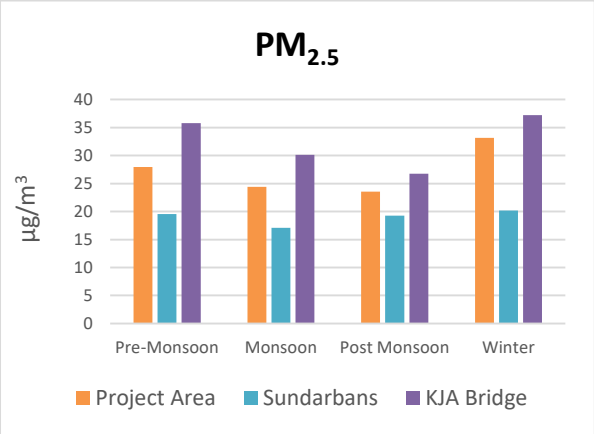
Carbon Monoxide (CO)

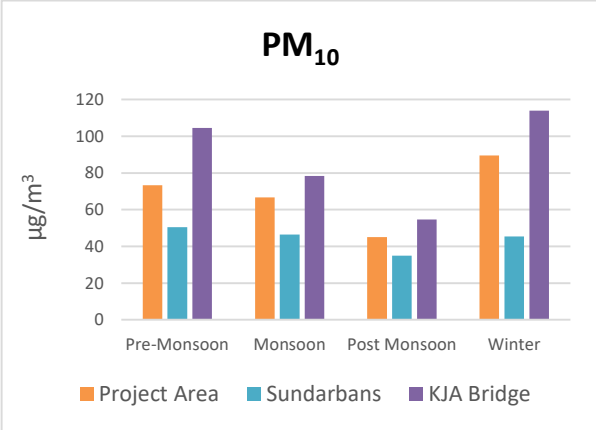
30. The concentration of CO in the monitored locations were found much below than the standard values set by ECR'97. The value ranged in between 69 µg/m^3 and 87 µg/m^3 at Akram point and at chalna bazar respectively which are far above the standard values set by ECR'97. The possible reasons for such CO concentration would be due to movement of numerous types of vehicles on the roads and boats in the river.

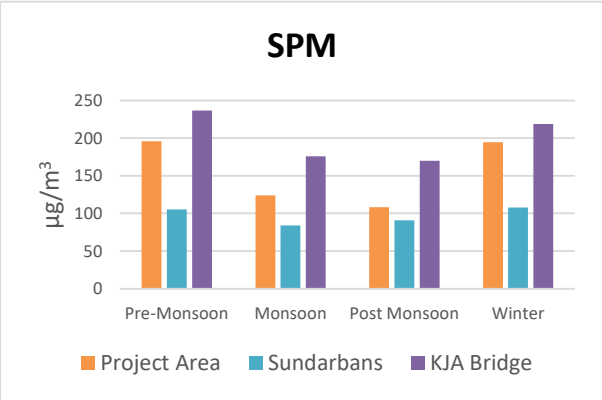
Ozone (O_3)

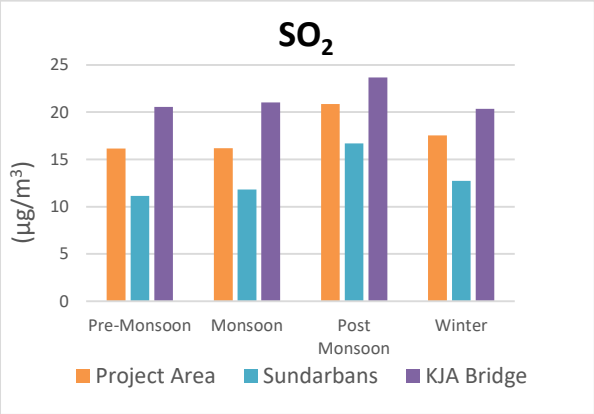
31. Similarly, results of **O_3** both in the Sundarbans Reserve forest area and Project area were found within the range of 0 -25 µg/m^3 which were much below than the Bangladesh standards limits of 157 µg/m^3 for 8 hours. In this 14th monitoring study the maximum concentration (25 µg/m^3) was found in the township area.

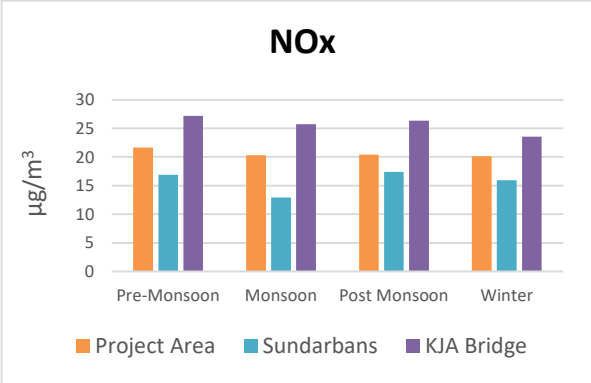
2.1.6 Findings of the previously monitored data

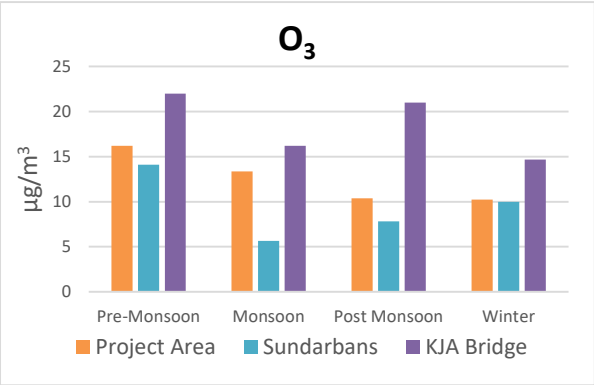












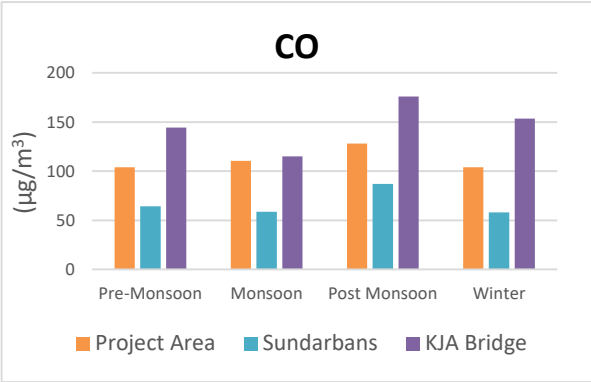


Figure 2.1: Seasonal variation of the Air Quality Parameters

Findings:

32. During this monitoring period, all the preselected parameters i.e. particulate matters (PM2.5, PM10 and SPM), O3, CO SOx and NOx were measured following the proper procedures. The concentration of all the parameters were found within the standard limit set by ECR' 97 except CO. The reason for higher value of CO could is due to the movement of numerous types of vehicles on the roads and boats in the river. A large number of pollution sources i.e. Large number of two-stroke human hauler, Bus, trucks, small engine boats, land development tourism, cement and petroleum industries were observed along the Passur River which are currently contributing to the pollutant's concentration in the surrounding areas.

Noise Quality:

33. Noise levels were monitored during 2014 (March, July, October), 2015 (January, April, July, October), 2016 (January, April, July and October) and 2017 (January, April and October). In this 14th quarter monitoring period, the noise level was recorded in post-monsoon season. The noise was found to be from the common sources i.e., the rural vehicles namely human hauler/ Nosimon, auto-rickshaw etc.; On the other hand in case of the monitoring spot in or around the waterways, the sources were trawler, ship, sometimes waves breaking against the shore, etc. Barges, trawlers and ships were found plying along the waterways during this season.

2.1.7 Methodology

34. Noise levels were measured thrice in a day (morning, afternoon and evening) at eleven (11) locations as had been done in earlier monitoring period. Each time noise level was recorded using portable noise level meter for a five minutes time span at 30 seconds interval. Depending on the site condition and acoustic environment, the noise meter was set up and calibrated following the instruction manual. All the data were collected in Leq, L_{10} and L_{90} dBA values.

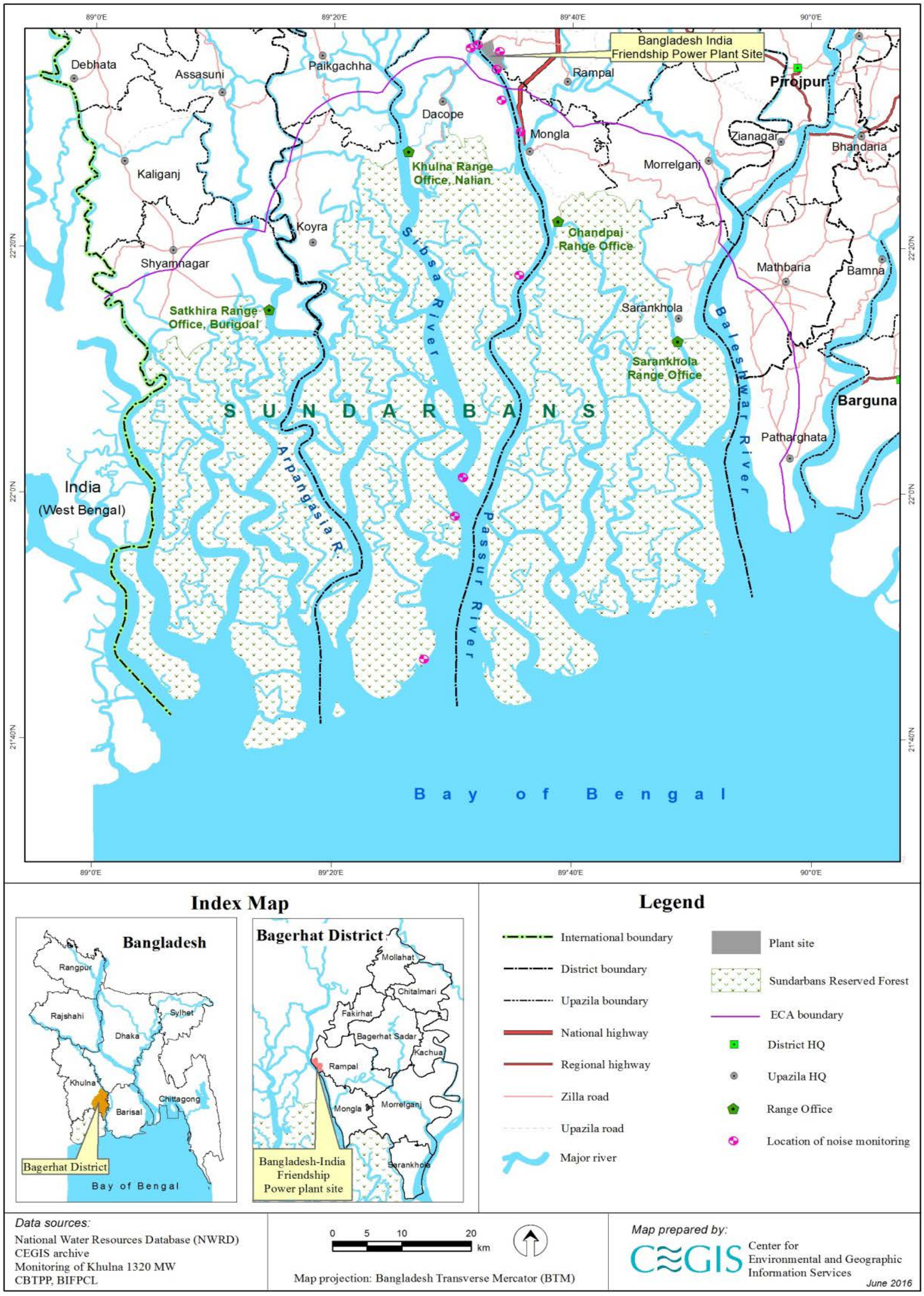
Locations of Noise Level Monitoring

35. 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 one was at Mongla Port (Map 2.2.).

Photo 2.1: 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

36. A brief summary of Noise level data is appended in the Table 2.4; and the detailed field Noise level data is attached in Table nos. C1, C2 and C3 in Appendix IV. Ambient noise data recorded from the different places during this monitoring period are provided below:

Dacope Upazila Parishad

37. The monitoring location under this Upazila is at Chalna Bazar, Pankhali (89.5234°E, 22.6046°N) which is 4km North West from the Chimney location. This area is a commercial area. According to the Environmental Conservation Rules (ECR) 1997, noise level standard for commercial area at day time is 70dB (A). The noise level was recorded as 58.64 dB which was 11.36 dB lower than the Bangladesh standard limit.

38. The significant noise sources at this place are road traffic and crowd. The road traffics are mostly locally made engine van (locally called Nosimon), motorbike, easy bike (battery-operated tri-cycle), etc.

North West Corner of the Project Area (Kaigar Daskati)

39. The monitoring location is at the North West (NW) corner of the Project area [89.5334°E, 22.6093°N] near a Gucchha gram (a cluster village built by the Government for the landless and homeless people) under Kaigar Daskati Mauza of Gaurambha Union. This is a residential area and the standard value for this site is 55 dB at day time (ECR, 1997). In this monitoring period, the average day time noise level was recorded as 46.95 dB which was 08.05 dB lower (08.05 dB) than the standard value.

40. The noise sources were rural road traffic and crowd. The road traffics are mostly locally made engine van (called as Nosimon), motorcycle, bicycle, van, etc.

Chunkuri-2, Bajua

41. The location (89.5669°E, 22.5342°N) is 4km south West from the chimney location. This is a residential area and the standard is 55 dB at day time (ECR, 1997). During this monitoring period (October, 2017), the noise level was found to be 50.44 dB which was below the standard limit.

42. The noise sources were rural road traffic and crowd. The road traffics are mostly locally made engine van (called as Nosimon), motorcycle, bicycle, van, etc.

South West corner of the Project area

43. The South West corner of the Project area [89.5601°E, 22.5761°N] is in Maidara Khal of Rajnagar union. The noise level at this location was found to be 43.26 dB. This area is a residential area and the standard limit of noise is 55 dB at day time (ECR, 1997). The noise level was lower (11.74 db) than the standard value.

44. Frequent movement of water vessels over the Moidara Khal is one of the main reasons of noise generation.

Proposed township area of the Project

45. The proposed township area, Sapmari [89.5644°E, 22.6005°N] of the Power Plant is located at the middle of the eastern portion of the Project area. This area is residential and the standard is 55 dB at daytime (ECR, 1997). In this monitoring period, noise level was

found to be 43.93 dB and was almost close (43.65 dB) to that of the last monitoring season. The value was 11.07 dB lower than the Bangladesh standard limit.

Barni, Gaurambha

46. The location (89.5772°E, 22.6477°N) in this area is 4km North-East from the chimney location. The area comprises both residential and commercial area and the standard for a mixed zone is 60 dB at daytime (ECR, 1997). The noise level was found as 45.52 dB during this monitoring season, which was 14.48 dB lower than the Bangladesh standard value.

Khan Jahan Ali Bridge, Khulna

47. The monitoring location is close to the toll booth of Khan Jahan Ali Bridge, Khulna [89.5935°E, 22.7779°N]. This area is considered as commercial due to activities around the bridge side and the standard for the commercial area is 70dB (A) at daytime (ECR, 1997). The average noise level was found as 62.47 dB, which was lower by 07.53 dB than the Bangladesh standard. The highway traffic was the main source of noise generation.

Mongla Port area

48. The monitoring location [89.5936°E, 22.4916°N] is at Khulna-Mongla highway, 200m northward from the main entrance of the Mongla Port area. The area is industrial and the standard for the industrial area is 75 dB at daytime (ECR, 1997). The average daytime noise level was 49.66 dB which was 25.34 dB lower than the Bangladesh standard value.

49. The sources of noise were mostly road traffic (heavy vehicles, light vehicles, Nosimon, etc) and noise from Mongla Port activities (crane, ships, etc).

Harbaria, Sundarbans

50. Harbaria area of the Sundarbans is very critical considering the richness of biodiversity. The area is important navigation route for Mongla Port Area. Most of the sea going vessels was used to anchor at this site for lighterage operation. The area is under silent class of noise standard and standard limit of ambient noise at daytime is 50 dB (ECR, 1997). The noise level was measured as 46.48 dB in this monitoring period at 100m inside the forest on the right bank of the Passur River [89.5926°E, 22.2968°N] to avoid the disturbance of noise from wave breaking against the shore and was found lower by 03.52 dB) than day time standard value.

51. Distant ship movement, running engines of anchored ships, wind, birds, wave and wind action on tree leaves were the main sources of noise.

Akram point, Sundarbans

52. Akram Point of the Sundarbans beside the Sibsa River is another biodiversity hot spot in the Sundarbans. This area was selected for anchorage point of coal carrying mother vessel for the Power Plant. This area is also under the silent class where the ambient daytime noise standard is 50 dB. The monitoring location [89.5152°E, 22.0219°N] is at the left bank of the Sibsa River. Noise was recorded at 100m inside the forest from the riverbank to avoid noise from wave breaking. The average day time ambient noise level during this monitoring season was 42.38 dB, which was lower by 07.62 dB than that of Bangladesh standard value. Birds' chirping, stormy wind, wave and tree leaves were the main sources of noise here.

Table 2.4: Summary of the ambient noise recorded in consecutive 14th Quarterly monitoring periods in 2014, 2015, 2016 and 2017

Sl No.	Location	QM1 Mar-14	QM2 Jul-14	QM3 Oct-14	QM4 Jan-15	QM5 Apr-15	QM6 Jul-15	QM7 Oct-15	QM8 Jan-16	QM9 Apr-16	QM10 July-16	QM11 Oct-16	QM12 Jan-17	QM13 Apr-17	QM14 Oct-17	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	*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	*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	*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	*55*
5	**Proposed Township area(Sapmari), project site**	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	*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	*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	*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	*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	*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	*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	*50*

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

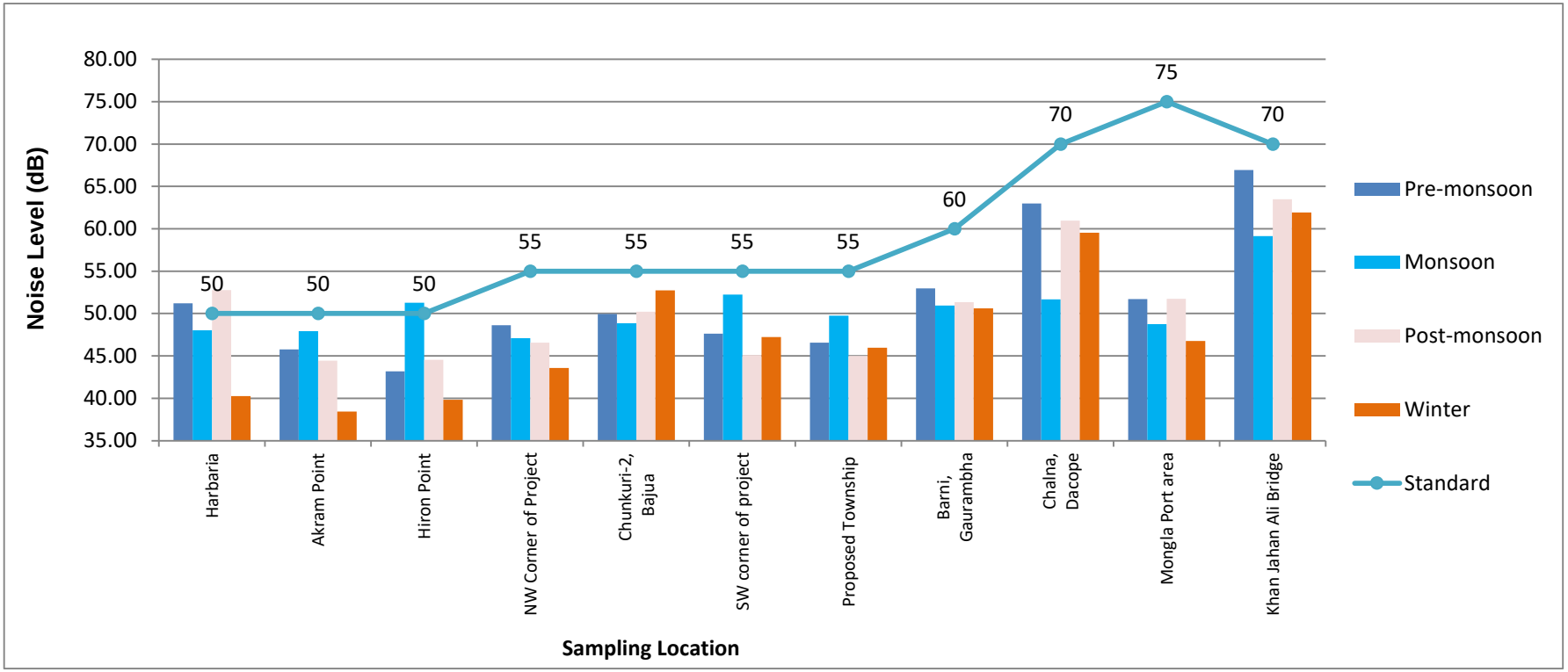


Figure 2.2: Seasonal variation of Noise level at different locations

53. Noise generation sources can be mainly divided into two types; one is natural and the other is anthropogenic. Natural sources are 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 through the rivers and local vehicles are the salient sources of anthropogenic noise. Mentionable that, in this monitoring season (14th quarter); the observed noise level had not exceeded the Bangladesh standard limit in any of the eleven locations (Table 2.4). It was however, found that the noise level of eight locations exceeded the Bangladesh standard limit 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). It is important to note that the noise level of Harbaria, the most ecologically important area crossed the standard value in seven seasons among the fourteen monitoring seasons. On the other hand, it was found that noise level at three locations namely Chalna under Dacope upazila, Barni (Gaurambha), and Mongla Port area had never crossed the Bangladesh standard limit. It was also observed that further anthropogenic noise producing activities, if any, within the study area might contribute to enhance the ambient noise level.

2.2 Water Quality

54. An updated status of various parameters of water quality status of the Passur-Sibsa River system has been incorporated in this section. The methodologies used for the entire monitoring activities and analysis, both the national and international guidelines were followed and adopted. This report includes in-situ data of some water quality parameters collected during 14th quarterly monitoring visit in October, 2017 and the laboratory tested results obtained up to April, 2017 (13th quarterly monitoring). The quality of both surface water and ground water at the respective locations were monitored. A number of identical parameters were selected to understand the quality of the water for community use, aquatic life, and the Sundarbans forest ecosystem.

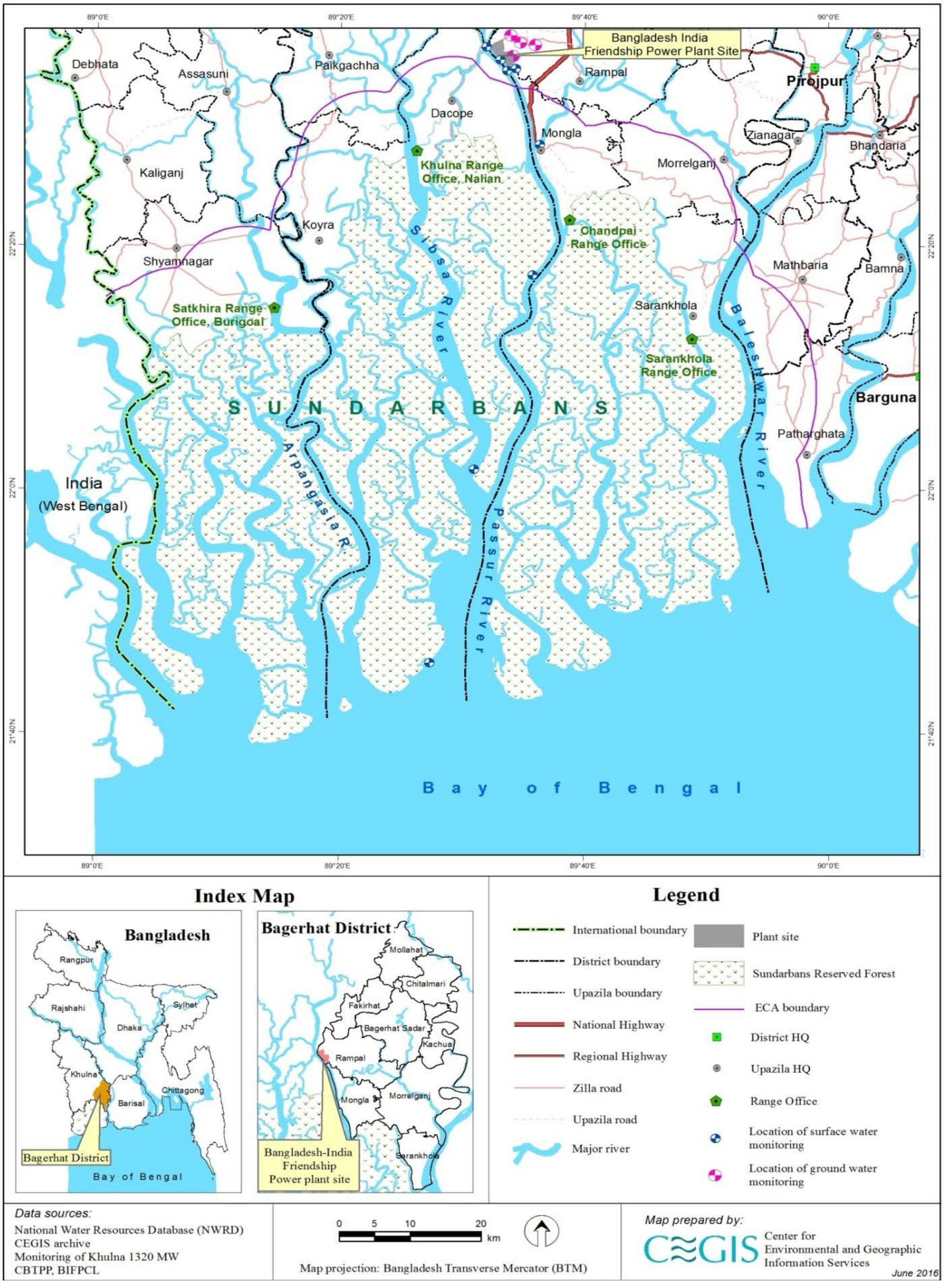
2.2.1 Methodology

55. Monitoring of water quality covers selection of water quality parameters, sampling locations, sampling frequency, evaluation criteria etc. Standard practices were followed for collecting samples and analysing the water quality parameters. Both the surface and ground water quality status in and around the Power Plant and the Sundarbans area were examined. The monitoring results have not only been presented in this report but also been compared with the national standards (ECR, 1997 and all amendments).

56. The samples were collected from Seventeen (17) pre-selected locations (14 locations for surface water along the Passur River, Sibsa River, Maidara 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 preliminarily selected at inception stage and finalized during the 1st quarterly monitoring study. The details of the monitoring plan covering selected water quality parameters, sampling locations, and frequency of sampling at each location) for surface water 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 and Laboratory analysis (TDS, TH, TSS, COD, Nitrate, Sulphate, Phosphate, Arsenic, Lead, Mercury, Oil & Grease). BOD_5 was 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				



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 (April, July, October, January)	In-situ measurement (pH, Temperature, Salinity, DO) and Laboratory analysis (COD, As, Hg, Pb, TH, TDS, TSS, Nitrate, Sulphate, Phosphate)
2	Rajnagar	22.612528˚N	89.576056˚E		
3	Kalekarber	22.609306˚N	89.596278˚E		
4	Kapasdanga	22.622528˚N	89.563000˚E		

Sampling Procedure

57. 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.

Photo 2.2: Professional is collecting water samples from Sundarbans

Surface Water Sampling Procedure for laboratory test

58. 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 50 m away from the riverbank and at a depth of 6 cm below the water surface during the low tides or relative slag period after the low tide for all parameters except oil and grease, samples of which were collected from the river surface. The individual sampling bottle was rinsed with respective water samples before storing. Acidified sampling bottles were used for heavy metal (As, Pb, Hg) analysis and wrinkle bottles were used for BOD5. All the samples were preserved as per standard procedure.

Groundwater Sampling Procedure

59. 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 storing. Acidified sampling bottles were used for heavy metal (As, Pb, Hg) analysis and were preserved following standard procedure.

Selection of Parameters

60. 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 BOD5 were tested in-situ. BOD5 could not be possible to test in the laboratory as transportation time of samples for BOD5 test is only 6 hrs and the sampling locations are within the Sunderbans Reserve Forest area from where it takes 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 BOD5. Samples of rest of the preselected parameters were collected and analysed in the laboratory.

Surface Water Quality Parameters

61. 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 (NO3), 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

62. The parameters of ground water quality include Dissolved Oxygen (DO), Chemical Oxygen Demand (COD), Heavy Metals (As, Pb, Hg), pH, Salinity, Hardness, Nitrate (NO3-), Phosphate (PO43-), Sulphate (SO42-), Total Dissolve Solids (TDS), Total Hardness (TH) and Temperature.

Water quality analysis procedure

63. The collected samples of selected 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 is 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	ppm or mg/L	0.05

Parameters	Methods/Measuring Tools	Unit	BD Standard (ECR 1997)
	Vapor Generating (AAS-HVG)		
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

64. The monitoring report of surface water quality is provided in two ways. 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 Sunderbans 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). The monitoring data of groundwater is presented in the table format.

2.2.3 Status of the surface water quality

In-situ tested parameters

(a) pH

65. During this 14th monitoring season pH values in the monitoring sites ranged between 6.8 and 7.2. The highest value was found in the Middle of Passur River and on the Right side of the river at project jetty site while the lowest value was observed at Ichamoti-Maidara confluence in the South East corner of the Project boundary and at Hiron point It appears that the results in all the locations in this monitoring period and that of the same period of previous years are very close.

66. 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 rises than those of the pre-monsoon and monsoon seasons, which was 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 CO2 by photosynthesis through bicarbonate degradation, dilution of waste with fresh water, reduction in salinity and temperature, and decomposition of organic matter (Rajasegar, 2003).

67. No significant differences in pH 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

68. The monitoring results of temperature of this quarter indicate close conformity with the previously monitored values in the same season. The values in this monitoring period varied from 29.40C to 30.20C among the monitored locations. During all the monitoring period maximum temperature (32-330C for most of the monitoring sites) was found in July

2014 (Summer Season). But all the observed values were within the BD standard (20°C-30^{0}C).

69. 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 data. It was found from the observed data that the average temperatures were similar to all the other seasons' value. No significant spatial variation was observed during the monitoring periods. 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

70. The observed salinity concentration ranged between 0.0-5.0 ppt during this monitoring period. The maximum salinity was observed at Hiron point in the Sunderbans while minimum was found in all the sampling locations specially situated at upstream which are close to the project site. During this monitoring period fresh water flow from upstream was the dominant factor that decreased salinity level at the upstream locations. However, the observed values are found similar in the same seasons of the last two consecutive years (October, 2016-2017). The highest salinity was observed mainly in pre-monsoon followed by winter season (Figure 2.5). Freshwater unavailability from upstream and the dominated tidal factor is the main reason of high salinity concentration in pre-monsoon and winter. The water salinity data at the selected sampling stations of Passur-Sibsa RS of the fourteen 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

71. DO concentrations in the monitored locations were found in between 5.9-7.3 mg/L. The maximum concentration was found at Hiron point while the minimum value was recorded at the Passur River at Mongla-Passur confluence. It may be mentioned here that the maximum concentrations were observed during monsoon and post monsoon in comparison to those of the other seasons. Higher DO was observed in monsoon and post-monsoon season is because of heavy rainfall and freshwater availability (Figure 2.6). During winter, salinity affects the temperature and then water temperature affects holding capacity of DO in water. However, still the DO concentration of Passur-Sibsa RS. 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 (BOD_5)

72. Highest value of BOD_5 of 3.2 mg/L was found at the Passur River at Akram point of Sunderbans while the lowest (1.9 mg/L) concentration was observed at Left Bank of Passur River at 100m u/s of North West corner from the Project boundary. However, all the values were found to be within the standard limit as stated in the ECR' 1997 and in IFC standard. The seasonal fluctuation of BOD5 demand of Passur-Sibsa RS is presented in Figure 2.7.

73. It is also evident from the figure that the highest average value was recorded at Passur-Mongla confluence during summer season because the river received huge amount of organic load and agricultural runoff from the adjacent areas. Thus, BOD_5 was found

higher during summer season than monsoon and the least during winter. The water temperatures normally record low in winter season than that of pre-monsoon, monsoon and post monsoon seasons, which in turn decreases the bacterial and microbial activities and reduces BOD_5.

74. 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.

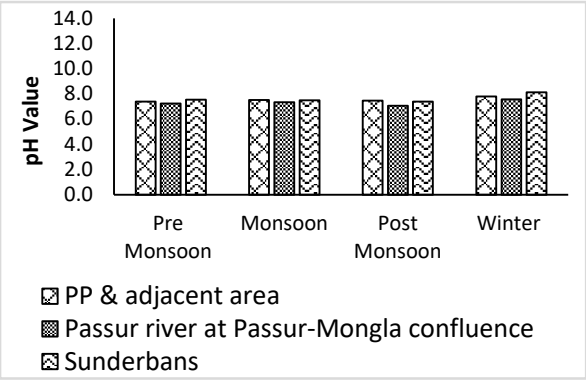


Figure 2.3: Variations in average pH values in sampling spots for the consecutive seasons

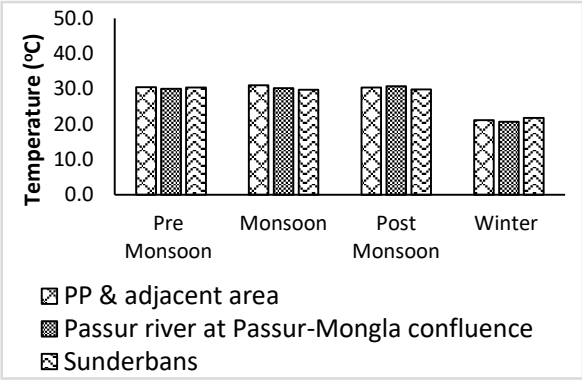


Figure 2.4: Variations in average temperature in sampling spots for the consecutive seasons

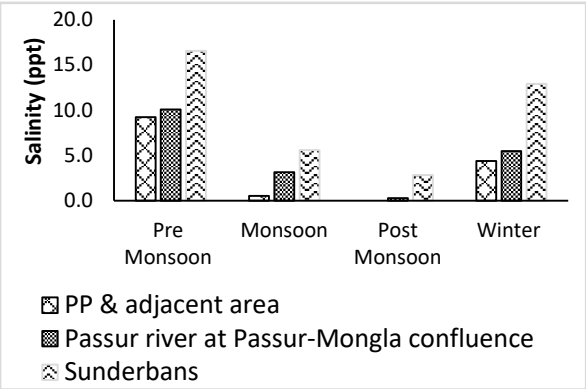


Figure 2.5: Variations in average concentration of salinity in sampling spots for the consecutive seasons

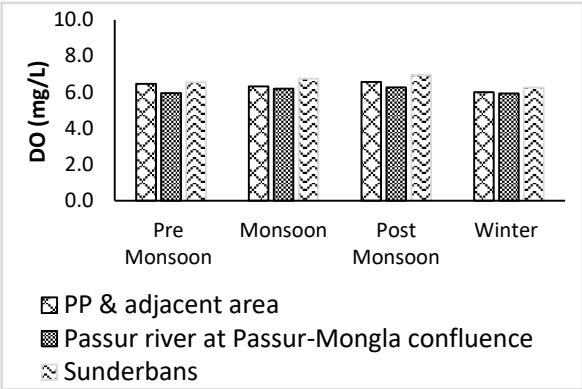


Figure 2.6: Variations in average DO concentration in sampling spots for the consecutive seasons

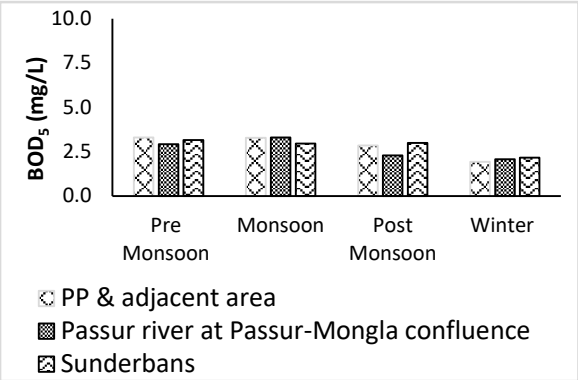


Figure 2.7: Variations in average BOD_5 concentration in sampling spots for the consecutive seasons

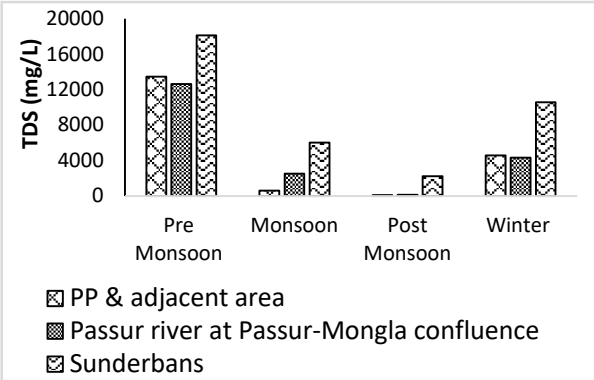


Figure: 2.8: Variations in average TDS concentration in sampling spots for the consecutive seasons

Laboratory tested parameters

The laboratory tested results obtained up to 13th monitoring period are described below:

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

75. TDS mainly indicates the presence of various kinds of minerals like ammonia, nitrate, phosphate, alkalis, some acids, sulphates and metallic ions etc., which comprise both colloidal and dissolved solids in water (Tareq M S et al., 2013). During the previous monitoring period, the TDS values were found to range between 12,340-19,370 mg/L. 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).

76. Total Hardness (TH) follows the similar pattern as that of TDS. High TH during pre-monsoon and winter season. The high the TDS, the high the nutrients and ultimately high TH occurs concentration. Sea water contains high 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 lower whereas it was found remarkably higher in pre-monsoon season. Because, in general cases the hardness is found to be higher in monsoon season but in Passur River it is found higher in pre monsoon season due to the saline water intrusion to the upstream in this season (Rahman et al., 2013).

77. 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 13th monitoring period, the TSS concentrations among the monitoring locations varied from 28mg/L to 52mg/L. The highest value was found at Middle Passur River at Project Site-Jetty while the lowest value was found in Passur River at Akram point of Sunderbans. TSS values in every spots were found to be within the Bangladesh standard limit of 150 mg/L (ECR, 1997).

78. TSS was found higher in pre-monsoon season than those of monsoon except Passur River at Passur-Mongla confluence. During dry season (pre-monsoon and winter season), the TSS value increases, probably due to shortage of sufficient 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 is 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.

79. TDS, TH and TSS of Passur River in pre-monsoon, monsoon, post-monsoon and winter seasons at different monitoring locations are presented in Figure: 2.8, 2.9 and 2.10 respectively and all the observed dataset are attached in Table B.8, Table B.9 and Table B.10 of Appendix- IV.

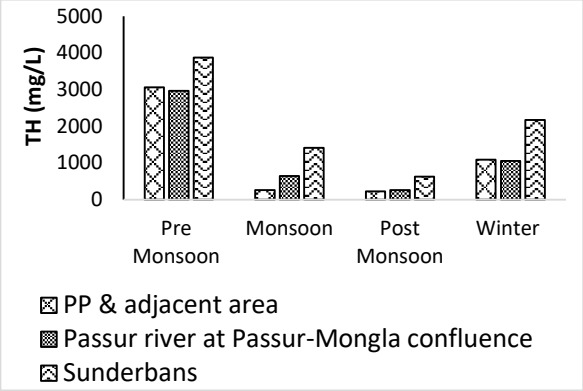


Figure 2.9: Variations in average TH concentration in sampling spots for the consecutive seasons

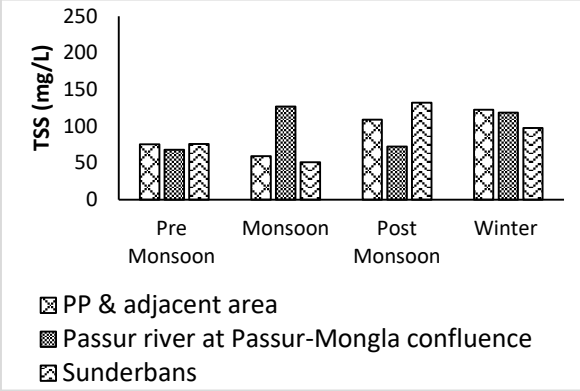


Figure: 2.10: Variations in average TSS concentration in sampling spots for the consecutive seasons

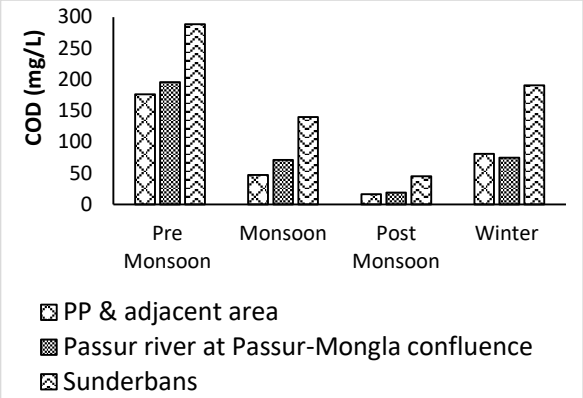


Figure 2.11: Variations in average COD concentration in sampling spots for the consecutive seasons

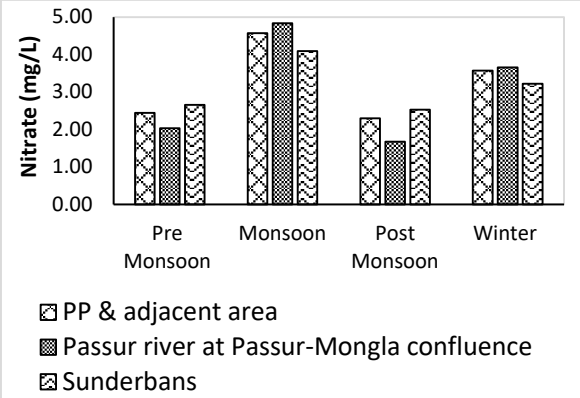


Figure 2.12: Variations in average Nitrate concentration in sampling spots for the consecutive seasons

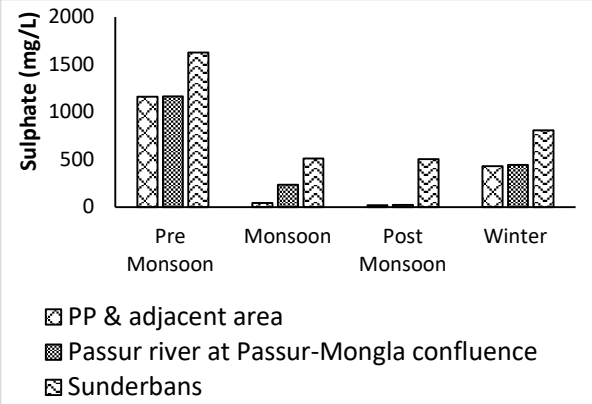


Figure 2.13: Variations in average Sulphate concentration in sampling spots for the consecutive seasons

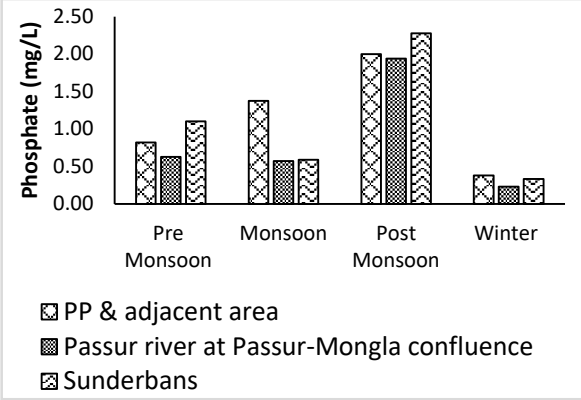


Figure 2.14: Variations in average Phosphate concentration in sampling spots for the consecutive seasons

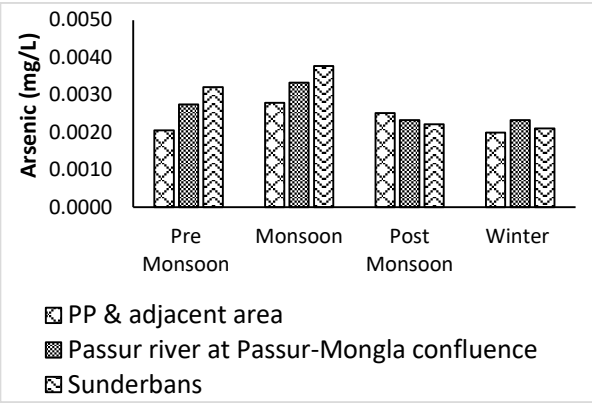


Figure 2.15: Variations in average Arsenic concentration in sampling spots for the consecutive seasons

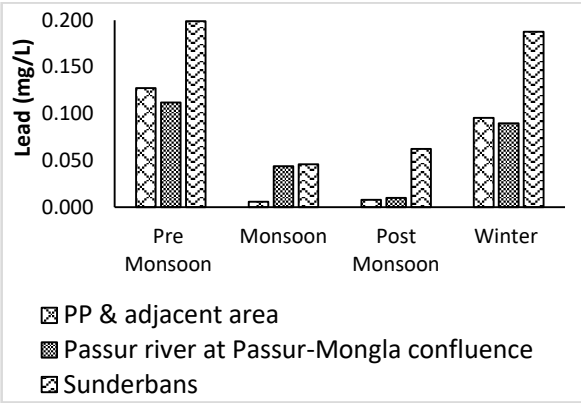


Figure 2.16: Variations in average Pb concentration in sampling spots for the consecutive seasons

(b) Chemical Oxygen Demand

80. 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). Generally, COD concentration was higher in Passur-Sibsa RS as it received high amount of organic matter from the Sundarbans forest area and adjacent community. IN fact, the higher the organic matter, the higher will be the decomposition and hence a higher demand of DO would be present in the water body.

81. It was observed from data from all the spots that the values of COD varied from 36 mg/L to 240 mg/L during the last monitoring period. The highest value was found at Hiron points of the Sundarbans area, which could be due to the organic matters from forests, wastes from the temporary fishery processing zones near ALORKOLE. The lowest were recorded at Middle of Passur River at South West corner from the Project boundary. The high values of COD indicate high levels 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 Harbaria, which might contribute to the high concentration of COD. During the pre-monsoon season, the COD concentration was found

to be higher as this season has insignificant rainfall comparing to those of other season and which actually increase the density of organic matter.

82. 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 in the river, which in turn reduced COD concentration in post monsoon. All the 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

83. During the last monitoring season, nitrate concentrations varied from 1.60 mg/L to 6.11 mg/L. The maximum value of nitrate (6.11 mg/L) was recorded at Left Bank of Passur River at Project Site-Jetty. This may be due to the dumping of bilge water from numerous ships and fishing boats. On the other hand, the lowest value of 1.60 mg/L was recorded at Maidara River near proposed township area. The results obtained from all the monitoring locations were found within the standard concentration stated in ECR'1997. The highest values were found in pre-monsoon season of 1st quarter of 2nd year, which could 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-nitrogen concentration was found in Monsoon period in all over the Sunderbans which could be the result of surface run-off, agricultural run-off, atmospheric deposition and domestic wastes dumping together with industrial pollution from upstream.

84. Naturally, SO_4^{2-} concentration is higher in seawater as well as in river in coastal region due to the tidal interaction with water bodies. The monitored dataset substantiates this fact i.e., SO_4^{2-} concentration of Passur-Sibsa RS increases in the direction of downstream from upstream. The highest value of 1440 mg/L of sulphate was found in Middle of Passur River at South West corner from the Project boundary while the lowest value of 422 mg/L was found at Left Bank of Passur River at 100m u/s of North West corner from the Project boundary. However, all the observed values of Sulphate (SO_4^{2-}) were found within the standard limit of 400 mg/L specified in ECR, 1997.

85. In monsoon and post monsoon seasons, SO_4^{2-} concentrations were comparatively low, which could be due to dilution by upstream fresh water flow.

86. PO_4^{3-} concentrations were found in between 0.18mg/L and 2.77mg/L, which were relatively similar to that of the results of pre-monsoon period in the previous years. The highest value was observed in pre-monsoon period of 2014. The reason could be due to the discharge of bilge water from numerous ships and fishing boats, agricultural and industrial runoff etc. However, all the observed values are found to be within the standard limit of 6 mg/L, specified for surface water. The recorded low phosphates value during dry seasons could be attributed to the limited flow of freshwater from upstream, high salinity and utilization of phosphate by phytoplankton which have also been recorded by *Senthilkumar et al., 2002; Rajasegar, 2003*. Similarly, fertilizers and phosphates in agriculture fields and detergents used in households could be other sources of inorganic phosphatesin the river water. The findings were also supported by Tiwari and Nair, 1993.

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

(d) Heavy Metals

88. It reveals from the observed data that Arsenic (As) concentrations among all the spots vary from 0.001 mg/L to 0.003 mg/L. Slightly higher As (Arsenic) concentration were recorded in pre-monsoon and monsoon season while low concentrations were observed in in post-monsoon and winter season. However, As (Arsenic) concentration is still very low and even lower than the WHO standard of 0.01 mg/L.

89. Lead (Pb) dissolved in water is very harmful to aquatic organisms; due to bioaccumulation, it increases in body tissue of organisms and similar findings was reported by 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- Pb5 (PO4)3 like the way said by Zhu et. al., 2004, which may resulting in higher amount of Pb concentration in river water during winter season. During 13th monitoring period, the lowest concentration of Pb of 0.001 mg/L was observed at Middle of Passur River at 100m u/s of North West corner of the Project boundary and the highest value of 0.009 mg/L was found in Passur River at Akram point of the Sunderbans. This could be due to the dumping of bilge water from large ships, which were seen anchored at the site.

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

91. 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

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

93. 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 spill occurred on the 9th December, 2014. An amount of 350,000 litres (Philips, 2014) of furnace oil had spilled in the river which spread over a 350 km2 area (Welle, 2014).

94. During the last (13th) monitoring period, the concentrations of oil and grease varied from <5 mg/L to 138 mg/L. the lowest concentration was recorded at Harbaria of Sundarbans and the maximum concentration was observed at Akram point of Sundarbans. During the visit, a lot of motorized boats, launch and other tourist boats were observe at the Passur Sibsa confluence for the traditional fair (Rash mela) during the 13th monitoring period in April, 2017. Moreover, for the seasonal fishing at sea during this season, 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 residues from large number of marine vessels in the location; oil discharge from the fishing boats and other anthropogenic activities might contribute to this higher amount of oil and grease concentration.

2.2.4 Status of the Groundwater quality

In-situ tested parameters

a) pH and Temperature

95. The values of pH and temperature of groundwater at observed locations complied with the drinking water quality standards as specified in ECR, 1997. The pH values during 14th monitoring program were found to vary from 7.8 to 8.2, while temperature was found to vary between 26.4°C and 27.2°C. No significant difference were observed during monitoring. Similarly, no significant variation was recorded in groundwater temperature over the monitoring periods.

96. Both the results of pH and Temperature were found more or less consistent with all the previously obtained respective season's data. The fourteen consecutive monitoring results of pH and temperatures of selected locations are presented in Figure: 2.17 and 2.18 and all the observed dataset are attached in Table B.17 of Appendix- IV.

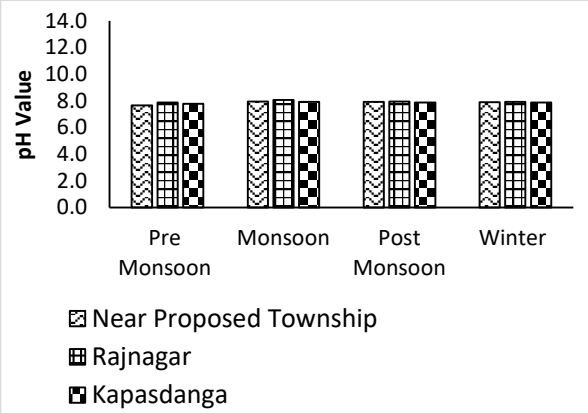


Figure 2.17: Variations in average pH values in sampling spots for the consecutive seasons

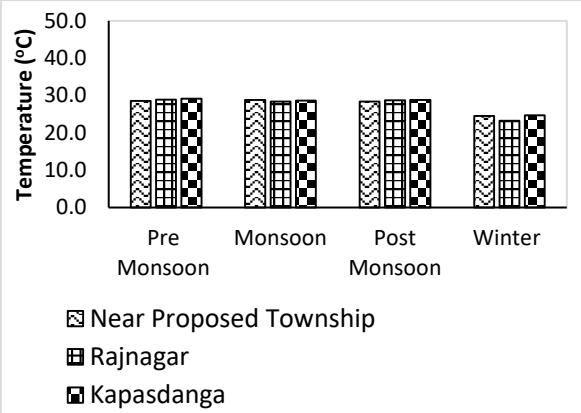


Figure 2.18: Variations in average temperature in sampling spots for the consecutive seasons

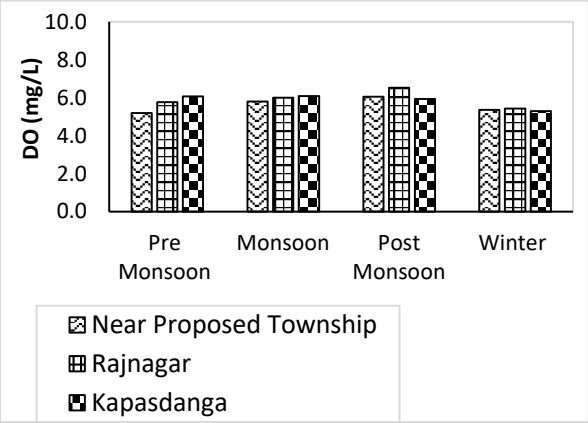


Figure 2.19: Variations in average DO values in sampling spots for the consecutive seasons

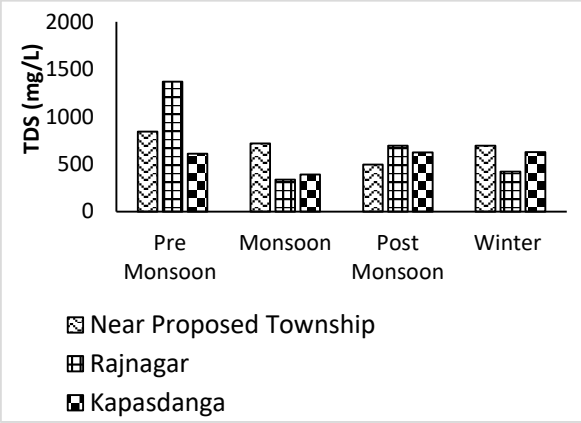


Figure 2.20: Variations in average TDS values in sampling spots for the consecutive seasons

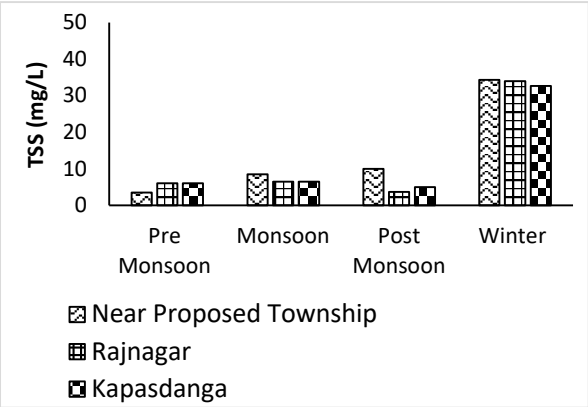


Figure 2.21: Variations in average TSS values in sampling spots for the consecutive seasons

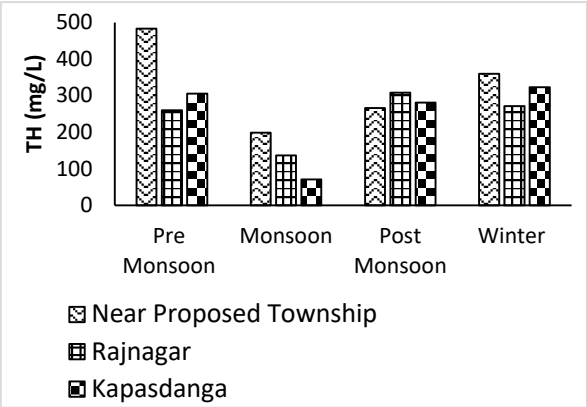


Figure 2.22: Variations in average TH values in sampling spots for the consecutive seasons

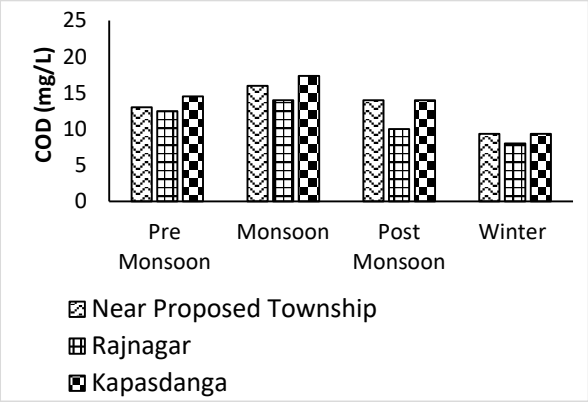


Figure 2.23: Variations in average COD values in sampling spots for the consecutive seasons

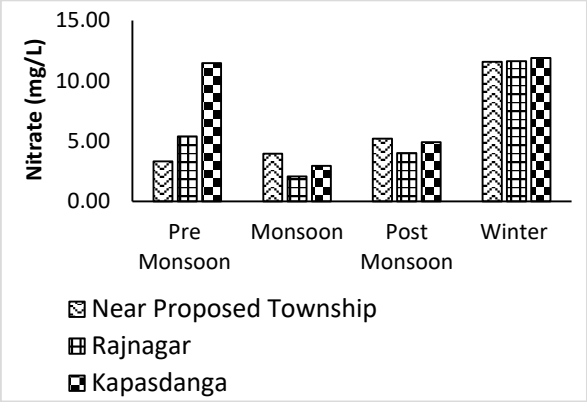


Figure 2.24: Variations in average Nitrate values in sampling spots for the consecutive seasons

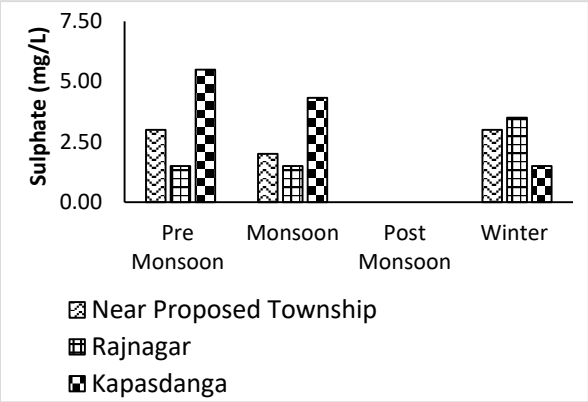


Figure 2.25: Variations in average Sulphate values in sampling spots for the consecutive seasons

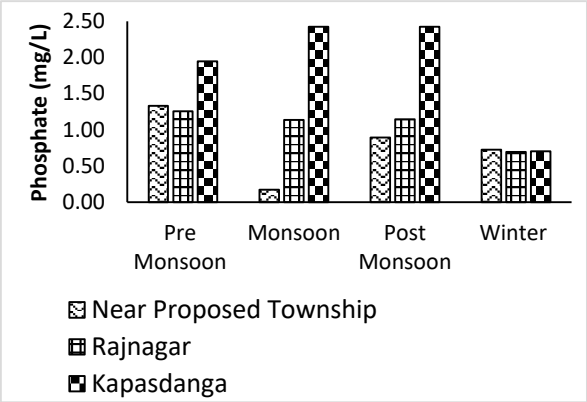


Figure 2.26: Variations in average Phosphate values in sampling spots for the consecutive seasons

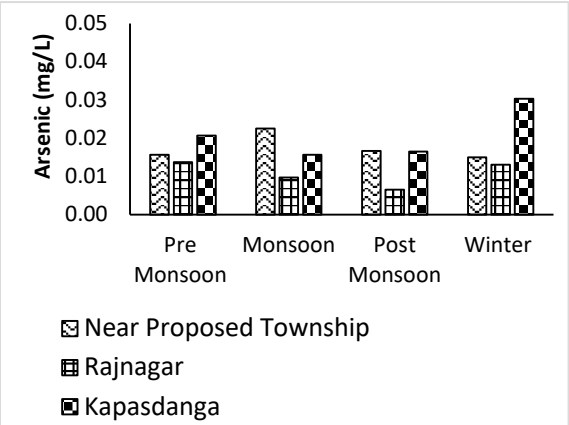


Figure 2.27: Variations in average Arsenic values in sampling spots for the consecutive seasons

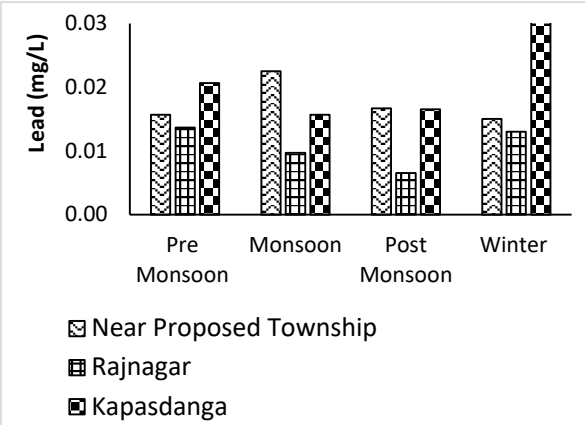


Figure 2.28: Variations in average Lead values in sampling spots for the consecutive seasons

b) Salinity and Dissolved Oxygen (DO)

97. Salinity in the ground water at all the locations were found negligible and below the minimum detectable limits in all the consecutive monitoring seasons. On the other hand, DO of township and Kapasdanga Tube Wells were found same (6.2 mg/L while at Rajnagar DO was around as 5.8 mg/L. The observed DO values were found close to the BD standard of 6.0 mg/L set by ECR, 1997. Higher DO values makes water tastier but causes corrosion to the supply pipe.

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

Laboratory tested parameters

(a) TDS, TSS and TH

99. During this monitoring period, TDS values in all the locations were found within the standard limit of 1000 mg/L. Though the Highest value of 617mg/L was recorded in Rajnagar area but was within the ECR'97 standards. The lowest value of 395mg/L was recorded in Township area. Mentionable that, the TDS concentrations were found to be within the Bangladesh standard (ECR, 1997) in all the monitoring periods.

100. Total Suspended Solids (TSS), also known as non-filterable residue, are those solids (minerals and organic material) that remain trapped on a 1.2µm filter (U.S.EPA, 1998). Among all the monitoring seasons the values were found much higher in winter season which could be due to lack of freshwater availability. In addition, evaporation also condense the water with its suspended matters. During this monitoring period the concentrations among all the locations varied in between 4mg/L and 9mg/L which were similar to the values of other monitoring periods of the same season.

101. TH concentrations of the three monitored spots varied from 420mg/L to 720mg/L. The maximum value was found in Township area near project site while the lowest value was observed in Rajnagar area. The values were found little higher than the standard limit (200-500 mg/L) set by the ECR 1997. However, no incidents of weathering of Ca2+ bearing minerals or excessive application of lime was found during the monitoring period which could

cause excessive amount of TH in ground water. Groundwater TDS, TSS and TH values of the consecutive monitoring periods in all the monitoring period are presented in Figure: 2.20, 2.21 and 2.22 and all the observed dataset are attached in table B.19 and Table 20 of Appendix- IV.

(b) Chemical Oxygen Demand

102. The Bangladesh standard for COD in drinking water is 4.0mg/L. The COD of the tube wells were found within the standard limit. COD concentrations in this monitoring period was a bit lower than the concentration found in 2014 and 2015. 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.

(c) Nitrate, Sulphate and Phosphate

103. Nitrate values ranged between 9.32mg/L and 14.7mg/L. The maximum value (14.7 mg/L) was recorded at Rajnagar while the lowest value was found at the Township area. NO_3^- concentration at Rajnagar was above Bangladesh standard of 10.0mg/L. During the monitoring period, the highest concentration (19.9mg/L) was found at Kapasdanga. The monitoring results indicates that, during winter all the sampling locations gets high nitrate concentration (Figure 2.24).

104. Most of the time, sulphate concentrations were found less than <10mg/L among the monitoring locations. SO42- concentration in groundwater did not show any pattern yet as every season, the results vary quiet a lot (Figure 2.25). However, SO42- is not a problem for this groundwater as the drinking quality standard is 400mg/L which is far high than the observed value.

105. On the other hand, the values of PO43- were found in between 1.80 mg/L and 2.18 mg/L, which was within the standard limit of 6 mg/L. In most of the season, PO43- concentration was comparatively high at Kapasdanga (Figure 2.26). The observed ground water NO3-, SO42- and PO43- concentrations are presented in Figure 2.24, 2.25, 2.26 and all the observed dataset are attached in Table B.22 of Appendix- IV.

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

106. According to Bangladesh Standard (ECR, 1997), the maximum acceptable concentration of Arsenic in groundwater is 0.05 mg/L. The As 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).

107. The Pb and Hg concentrations were also measured and the values were found within the permissible limit specified in ECR 1997. The concentration of Pb was found higher in pre-monsoon and winter season in Kapasdanga while it was higher near proposed township area in monsoon and post-monsoon season (Figure 2.27). However, the water of the tube-wells was found suitable for drinking purposes in terms of metal pollution status.

108. The observed values of As and Pb in all the monitored locations are presented in Figure: 2.25 and 2.26 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

109. 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 were 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

110. The frequency of monitoring of 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

111. 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 district. Locations of collected soil samples are presented in Map 2.4

2.3.2 Process of Soil Samples Collection

Plot Selection

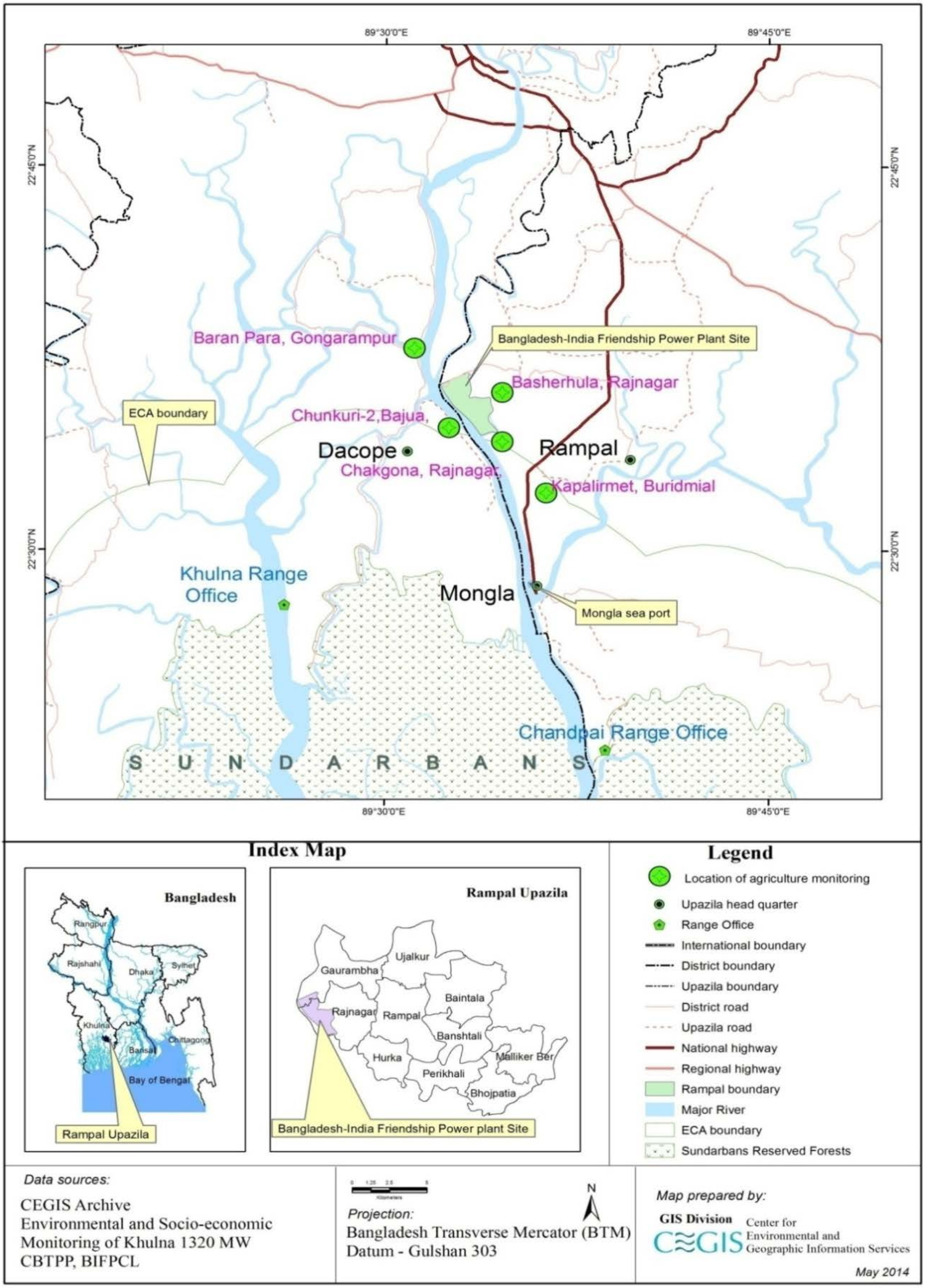
112. Monitoring plots were selected through group discussion, especially with the plot owners and experts such as Upazila Agriculture Officers of Batiaghata, Dacope of Khulna, Rampal and Mongla of Bagerhat Districts and Senior Scientific Officer of Soil Resource Development Institute (SRDI) of Khulna Office. Moreover, wind speed and wind direction was also considered in order to select the potential locations. All the selected plots were characterized as medium high land (F1), which normally get flooded in the range of 30-90 cm and remain inundated continuously for more than two weeks to few months during the flood period.

Soil Samples Collection

113. Soil samples were collected following the standard practices of composite method. At each plot, the samples 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 those area 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

114. Soil samples have been submitted to SRDI, Dhaka laboratory for analysis. Result of the soil quality of would be collected from the same and presented in next monitoring report (15th quarter monitoring report).



Map 2.4: Land Resource Monitoring Locations


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 2.3: Different monitoring plot in the monitoring study area

3. Biological Environment

115. The biological resources around the project site were categorized into three major groups and monitored with the aim to compare the data to understand the probable impact of proposed project in place. These groups include fisheries resources, ecological resources and Sundarbans Reserve Forest (SRF).

3.1 Fisheries Resources

116. The monitoring of all four quarters for the session of 2014-15, of 2015-16 and of 2016-17 as well as 1st quarter of 2017-18 were completed and reported earlier. This chapter contains the outcome of this 2nd quarter monitoring of 2017-18 (14th quarter) along with the comparisons with the earlier thirteenth 13 (thirteen) quarters.

Location of Monitoring Sites

117. 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 of upstream, mid stream and downstream of Passur River system. Shrimp/fish farms were selected based on the project influence area. The fisheries resources monitoring locations are provided in Table 3.1 and also 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

Selection of Parameters

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

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

3.1.1 Methodology

Fish Habitat Status

119. 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

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

Fish Diversity

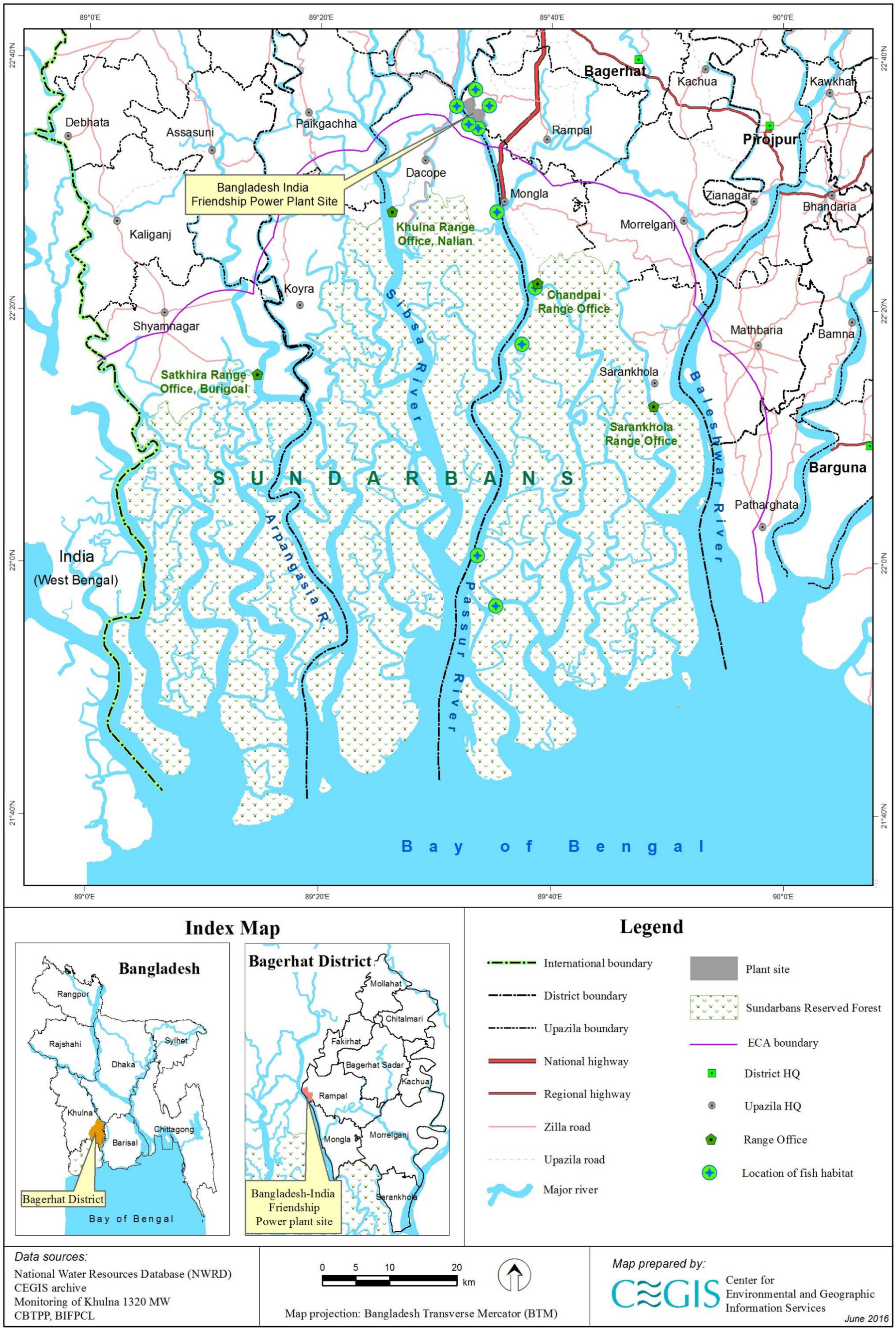
121. Fish diversity was surveyed by Catch Per Unit Effort (CPUE) method. The fish individuals were counted according to the length of each species from the samples. Diversity was estimated by analyzing Shannon-Weiner Index ranges from 0 to 1. Fish species richness (FSR) was analyzed using the Simpson's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

Fish-Shrimp Culture Practice

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

Fish Production

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



Map 3.1: Fisheries Resources monitoring locations

3.1.2 Status of monitoring

124. Followed by the first, second, third and fourth quarter monitoring of the 2014-15, 2015-16 and 2016-17 as well as first quarter of 2017-18, second quarter monitoring was conducted during the period of 24 September to 01 October, 2017.

Fish Habitat Status

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

(a) Habitat Classification

126. 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 behavioural habitats. The sampling sites were classified (shown in the Figure 3.1) on the basis of abundance of different life stages of fish species in those habitats.

127. During 1st quarterly monitoring (April, 2014) fish habitat was classified as the grazing ground (Akram Point and Harbaria), grazing and breeding ground (Haldikhali and confluence of the Passur river at Chalna Point) as well as spawning and nursery ground (Sheola khal at Chandpai, Passur River at Mongla Point and Maidara River). In the second quarter monitoring (June – July 2014) two habitats were identified – i) grazing ground, ii) spawning and nursery ground. However, during third quarter monitoring in the month of October 2014 the similarity of size group distribution of fish species among the habitats were found to be shifted to some extent. In fourth quarter monitoring phase January 2015 three habitats – i) grazing ground, ii) grazing and breeding ground; and iii) spawning, nursery and grazing ground were identified. During the 1st quarter (April, 2015) of the second year three habitats – i) grazing ground, ii) nursery ground; and iii) spawning and nursery were identified. During the 2ndquarter monitoring of 2nd year (October 2015), two habitats were identified as: i) grazing, breeding ground, ii) spawning, and nursery ground. During the 3rd quarter monitoring of 2nd year (October, 2015) three habitats as i) grazing ground, ii) nursery ground and iii) growing and feeding were identified. During the 4th quarter monitoring of 2nd year (January, 2015) two major habitats – i) nursery and feeding ground and ii) feeding and growing ground were identified. During the 1st quarter monitoring of 3rd year (April, 2016) two major habitats – i) spawning and nursery ground and ii) feeding and growing ground were identified. During the 2nd quarter monitoring of 3rd year (July, 2016) two major habitats – i) nursery ground and ii) feeding and breeding ground were identified. During the 3rd quarter monitoring of 3rd year (October, 2016) two major habitats – i) Breeding and spawning ground, mainly for Hilsha and Poma; and ii) feeding and grazing ground were identified. During the 4th quarter monitoring of 3rd year (January, 2017) two major habitats – i) Grazing and spawning ground, mainly for Paissa; and ii) Nursing ground were identified. During the 1st quarter monitoring of 2017-18 two major habitats – i) Grazing and feeding ground, and ii) nursing ground were identified.

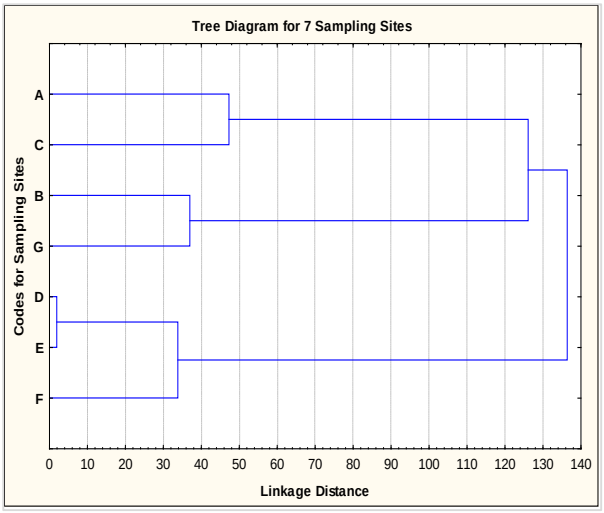
128. During the second quarterly monitoring of 2017-18 (14th quarter) two major habitats – i) Grazing and feeding ground, and ii) Nursing ground were identified as shown in the Figure-3.1.

Grazing and Feeding Ground:

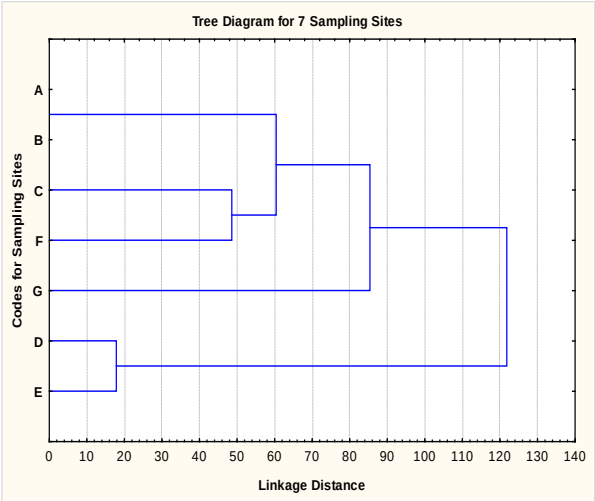
129. Among the sampling sites, Harbaria khal (C), Sheola Khal at Chandpai (D), Maidara-Passure Confluence (F) and Chalna Point (G) were identified as the grazing and feeding ground for abundance of juvenile to adult fishes.

Nursing Ground:

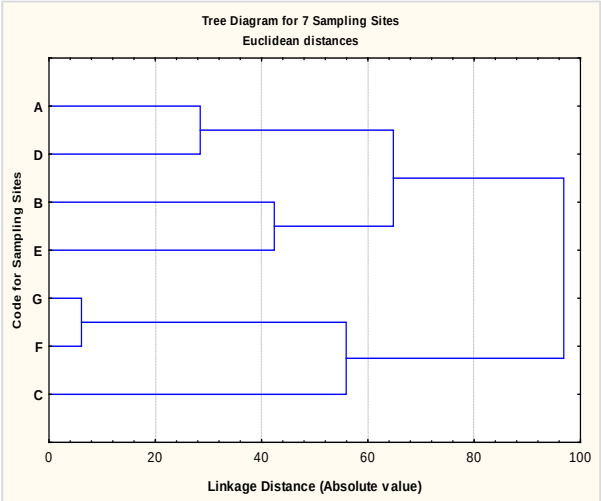
130. Among the sampling sites, mainly the Mongla-Passure Confluence (E) was identified as the nursing ground. Cluster analysis for habitat classification on the basis of different life stages of fish species are shown below:



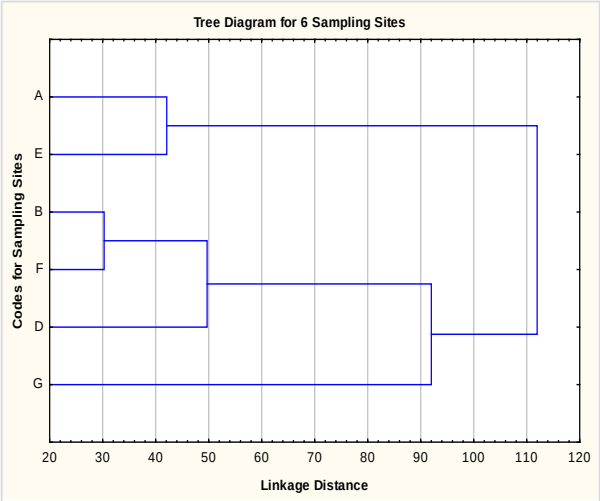
1st Monitoring, April, 2014



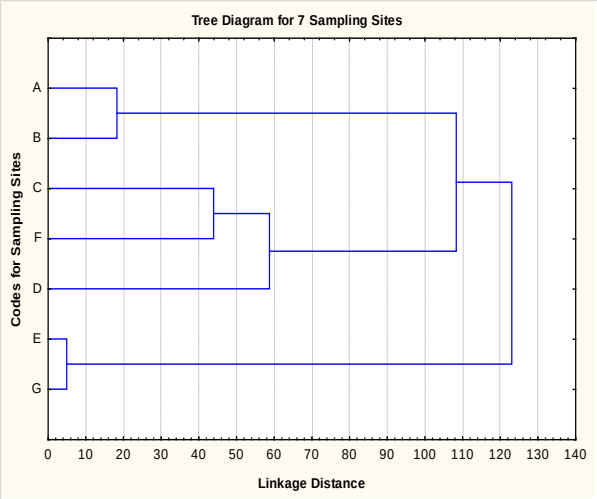
2nd Monitoring, July 2014

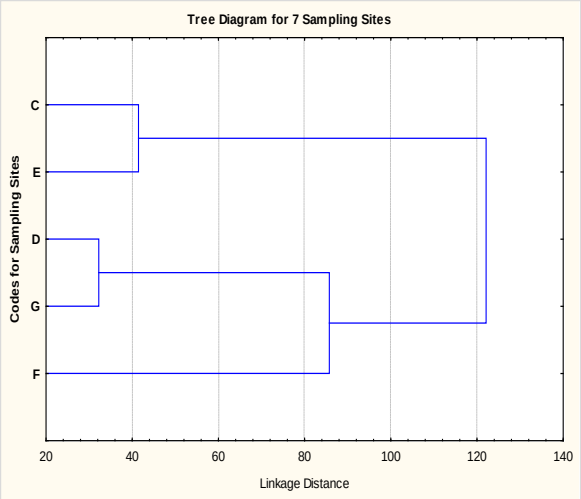


3rd Monitoring, October, 2014

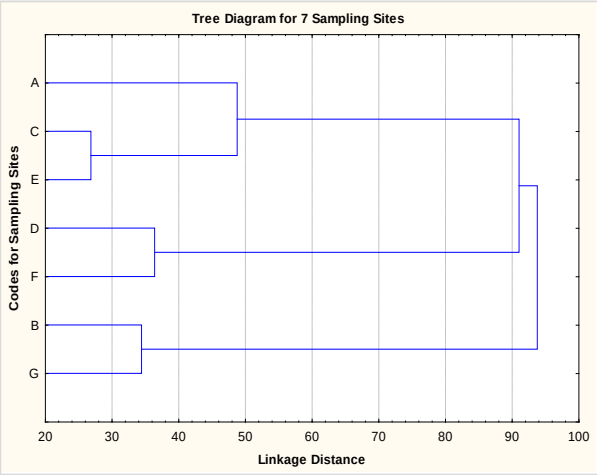


4th Monitoring, January 2015

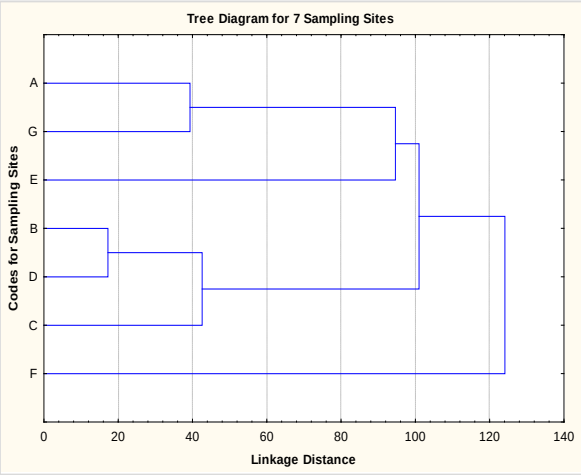




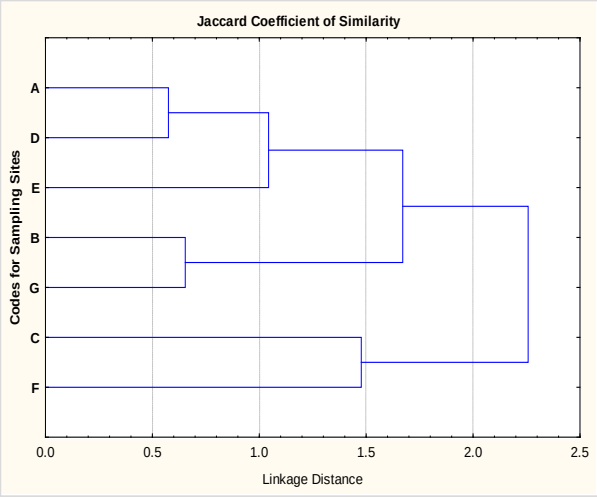
5th Monitoring, April, 2015



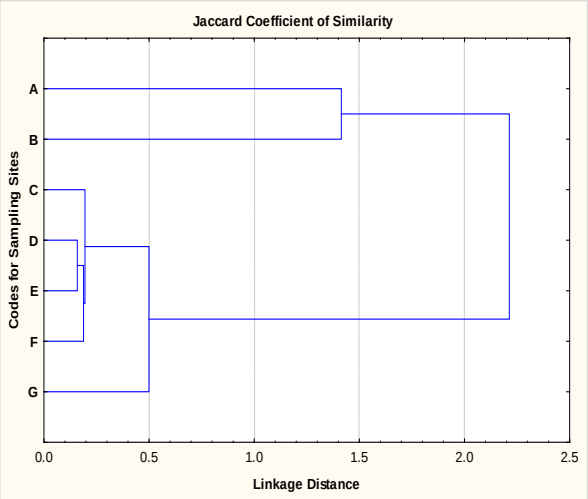
6th Monitoring, August, 2015

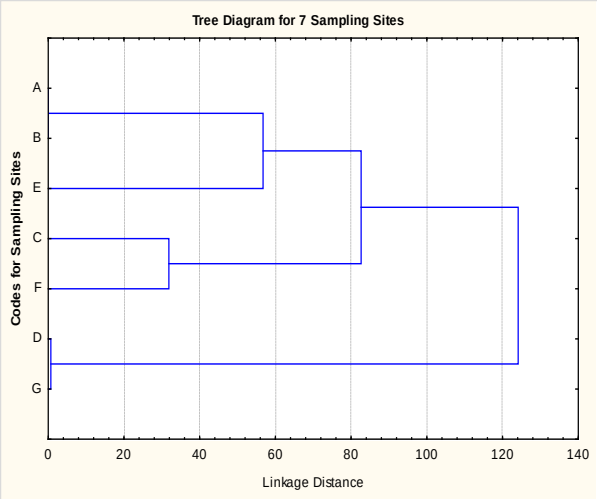


7th Monitoring, October, 2015

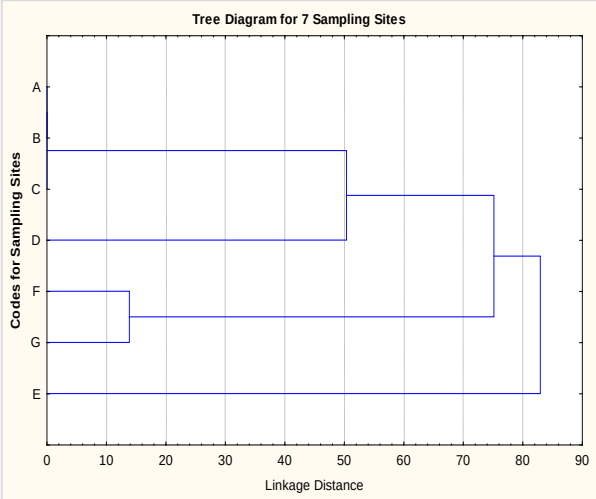


8th Monitoring, January, 2016

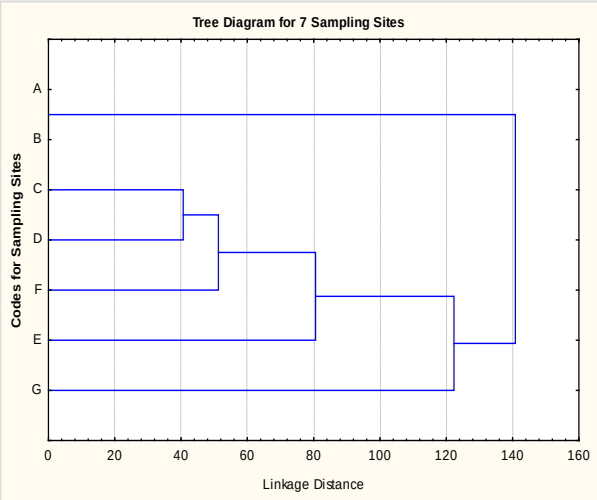




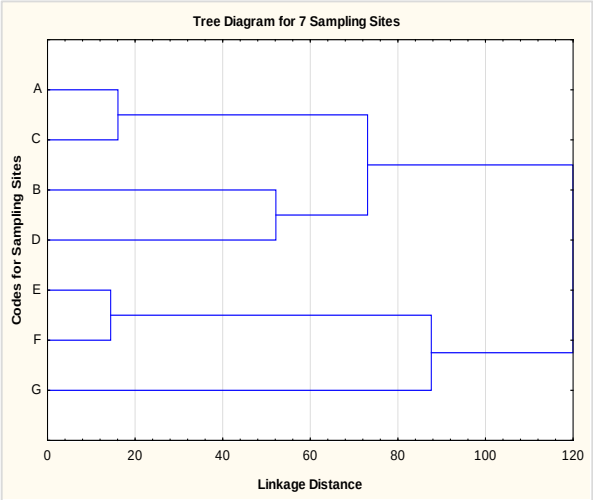
9th Monitoring, April, 2016



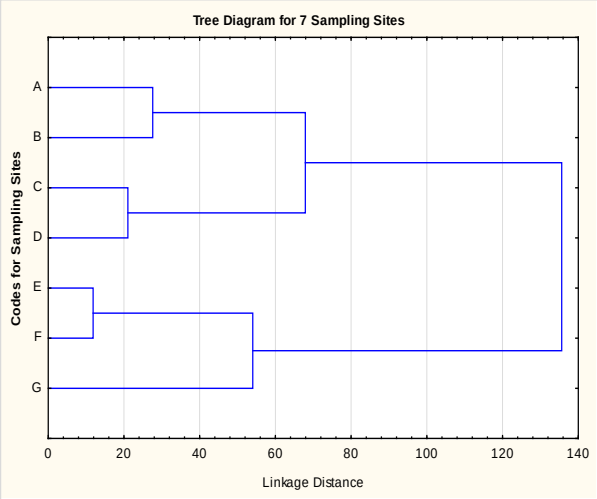
10th Monitoring, July, 2016



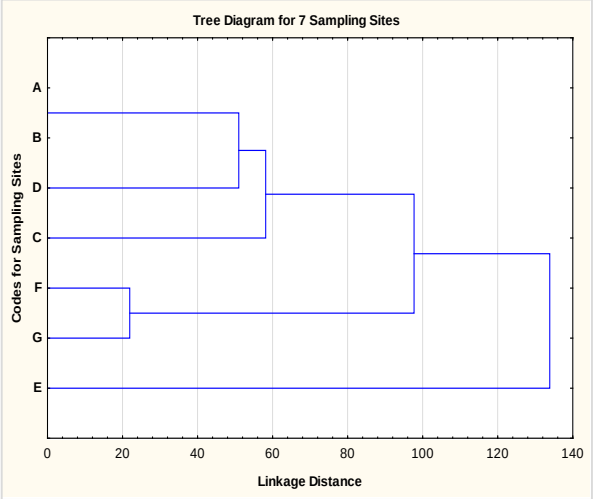
11th Monitoring, October, 2016



12th Monitoring, January, 2017



13th Monitoring, April, 2017

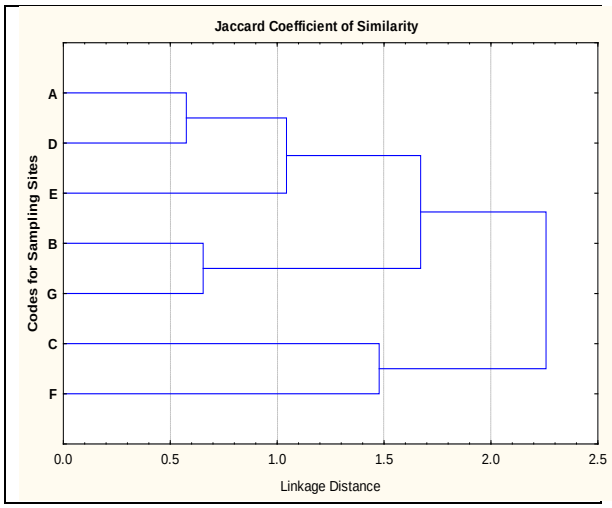


14th Monitoring, October, 2017

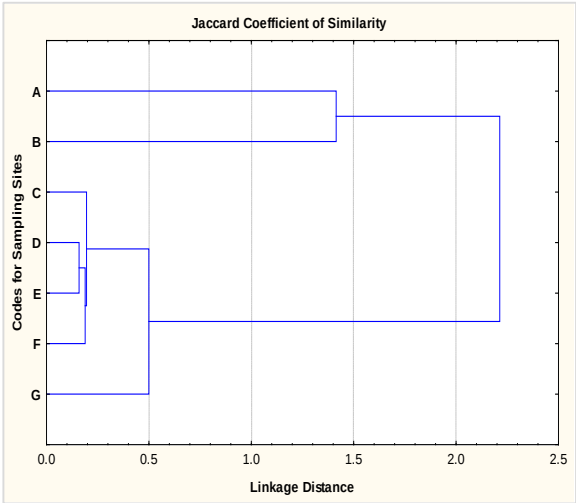
(Note: Life stage is identified through length measurement of the fish individuals)

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

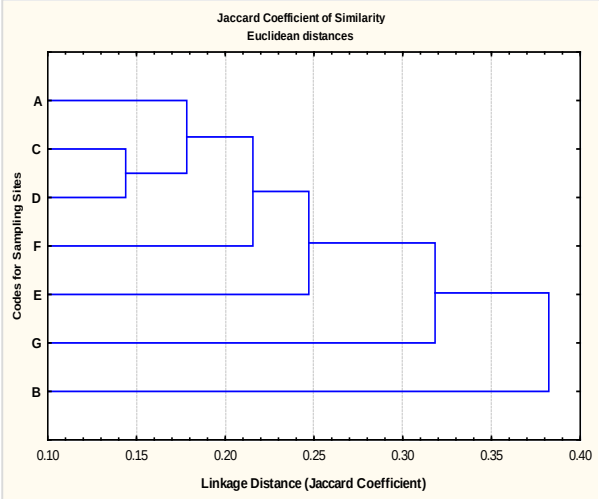
131. The dendogram is indicated the distances among the JI (Jaccard Coefficient Index) indices which are opposite to the JI values. It was found that the length-wise distribution relationship varied not only with the seasons but also with the year to year. In this second quarterly of the monitoring in 2017-18 (14th), the JI value between C and D sampling sites was also the highest (Figure 3.2) which indicates the maximum similarity in species occurrence between these two sites out of seven (7) sampling sites.



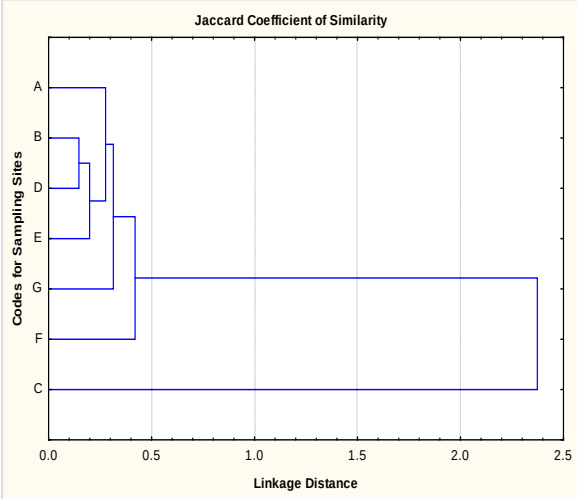
1st Monitoring, April, 2014



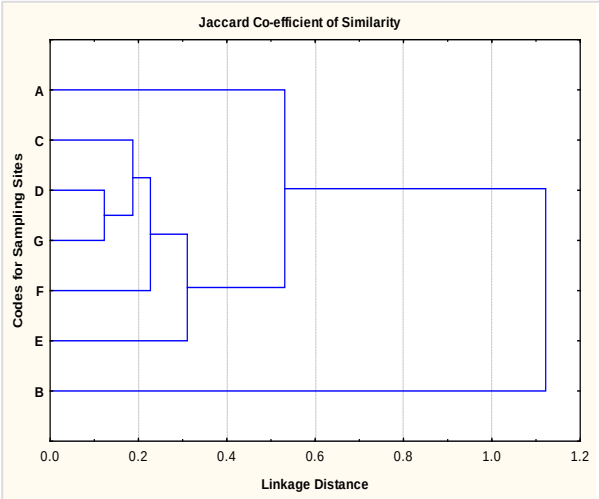
2nd Monitoring, July 2014



3rd Monitoring, October, 2014

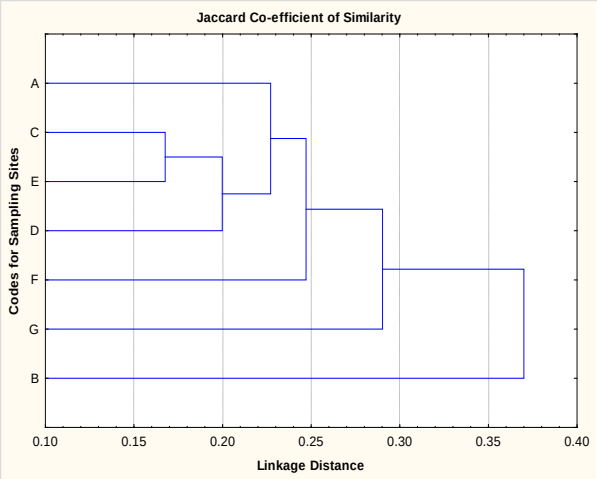


4th Monitoring, January 2015

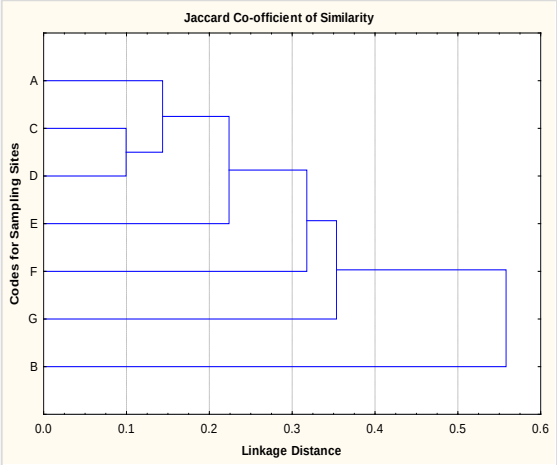


5th Monitoring, April, 2015

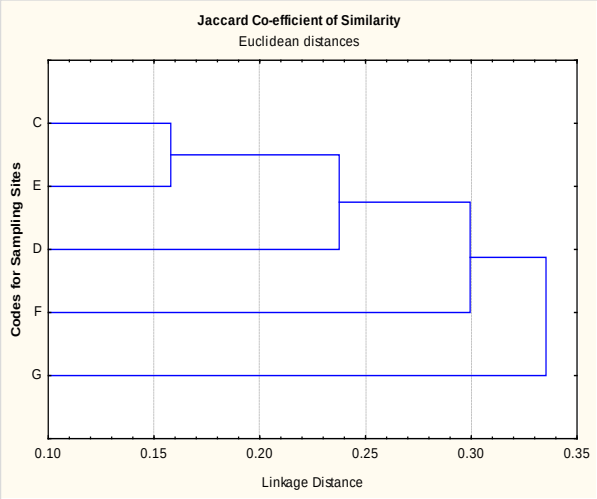
6th Monitoring, August, 2015



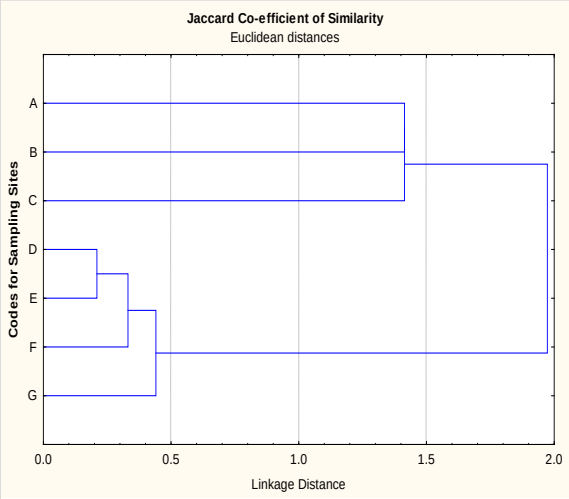
7th Monitoring, October, 2015



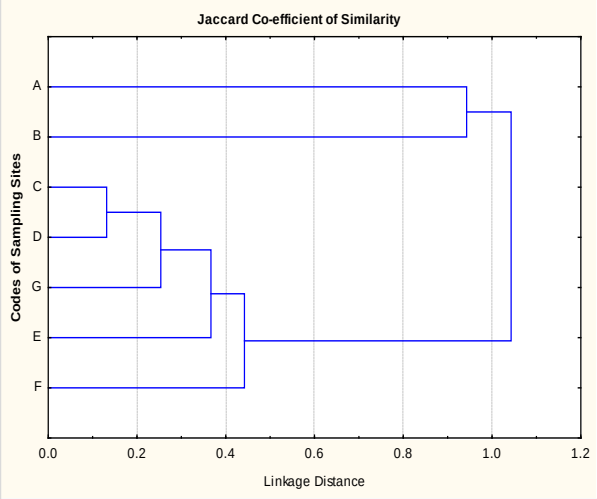
8th Monitoring, January, 2016



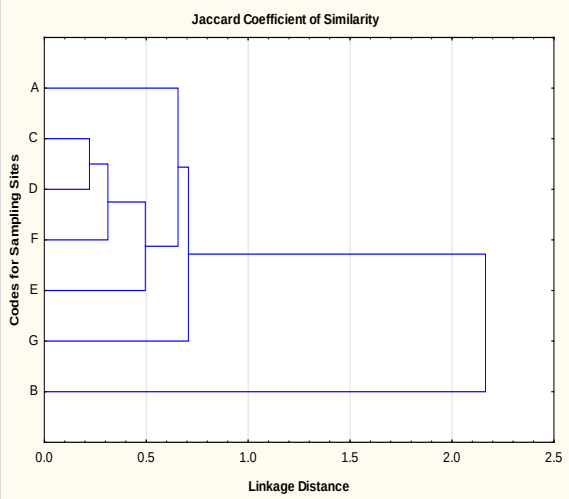
9th Monitoring, April, 2016



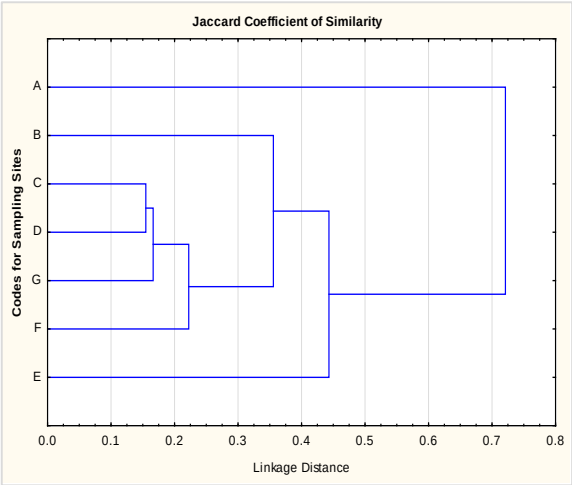
10th Monitoring, July, 2016

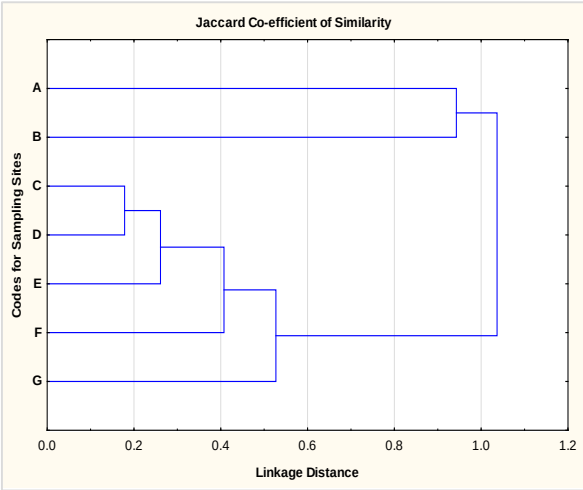


11th Monitoring, October, 2016



12th Monitoring, January, 2017





13th Monitoring, April, 2017 **14th Monitoring, October, 2017**

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

(b) Habitat Suitability Index (HSI)

132. Habitat Suitability Index (HSI) was determined for the years of 2014-15 and 2015-16 considering the exposure to water quality and the production performance of different fish species. Production performance was measured 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*).

133. 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 was also identified as the most suitable one in the second year which was followed by Harbaria, Akram Point, Haldikhali, Mongla Point, Maidara and Chalna Point (Table 3. 2).

Table 3.2: 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

a) Shannon-Weiner Index

134. The species evenness in this 14th quarterly monitoring period also varied among the sampling sites. Highest Shannon-Weiner index was found at Maidara-Passure Confluence (0.88) indicating most evenly distributed fish species. On the contrary, lowest evenness was found at Mongla-Passur Confluence (0.54) (shown in the Table 3.3). The number of fish species found from catch assessment and the evenness of their distribution within the sampling sites show high variation with the change of seasonal and yearly bio-physical conditions.

b) Fish Species Richness (FSR)

135. Fish species richness was identified through Simpson's Index [1]. Considerable difference was noticed in the fish species richness (FSR) in different habitat classes (Table 3.4 and Figure 3. 3).

136. In this monitoring (14th program) phase, species richness varied with the sampling sites. Maximum FSR was obtained in Harbaria Khal (n=6), while very low FSR was recorded at Mongla-Passur Confluence and Maidara-Passur Confluence (n=2). Different scenarios of richness were found in this quarter in comparison to the previously monitoring years. Among habitats in upstream portions of the Passur River, Mongla Point was home to a rich assemblage of Horina and Motka Chingri; Maidara River at Baro Durgapur was of Poma, Tular, Dandi and Banspata; and Chalna Point was of *Poma* and Pheksa. Among the habitats in down stream portions, Chandpai was rich in Bairagi, Chami Chingri, Horina Chingri, Motka *Chingri* and Tit Punti; Harbaria was in Horina Chingri, Motka Chingri, Ghagra, Chami Chingri, Goda Katali Chingri and Mutkura. However, no fishing was observed in Haldikhali and Akram Point during the last monitoring season.

[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 3.3: Site Wise Species Diversity using Shannon–Weiner Index

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

Site	Species Number			Shannon-Weiner Index		
	14th QM (period)			14th QM (period)		
A	0			0		
B	0			0		
C	6			0.85		
D	81			0.62		
E	112			0.54		
F	3			0.88		
G	4			0.78		

**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 3.4: 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			
B	Haldikhali	0			
C	Harbaria	6			
D	Chandpai	5			
E	Mongla Point	2			
F	Maidara	3			
G	Chalna Point	2			

Rupchanda in 1stQuarter of 1st Year

Chela in 2nd Quarter of 1st Year

Phesa, Chela, Hilsa, Gagla Tengra

Harina Chingri

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

Amadi Chela

Banspata

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

Adult Poma in Chalna Point

Fry of Bagda at Chalna Point

Meth and Gagra Tengra

Gagra Tengra

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

Mutkure and Paissa

Khorsula

Menu

Vetki

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

Kain Magur

Banspata, Vetki, Koidda and Poma

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

Poma and Tapse

Tapse

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

Miscellaneous Fish Species

Hilsha

Tapse

Poma and Tapse

Fish species found in 3rd quarterly moniotring of the 3rd 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

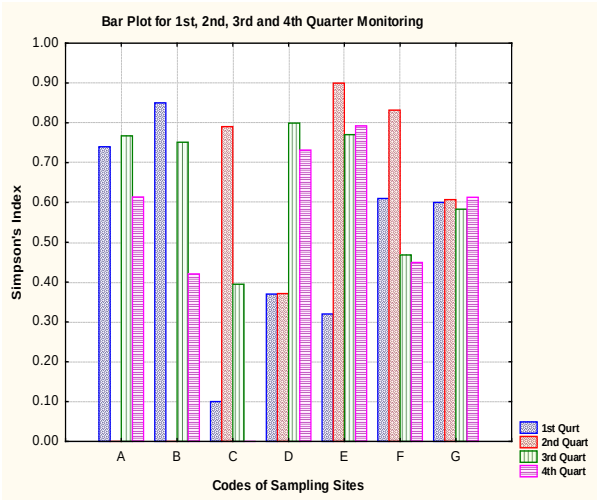
Fish species found in 4th quarterly monitoring of the 3rd year (2016-17)

Horina chingri and Punti

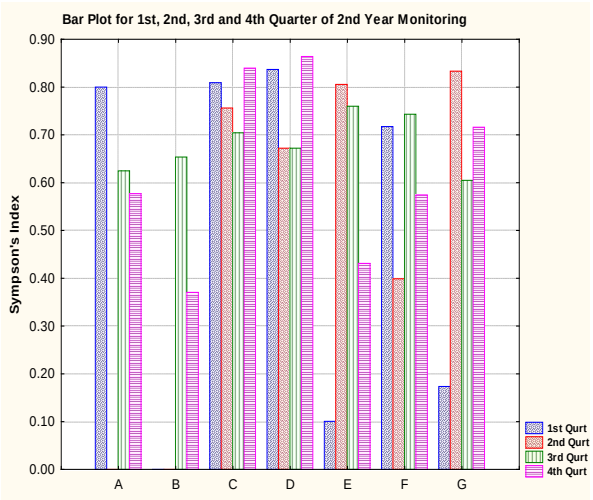
Goldha

Fish species found in 1st quarterly monitoring of the 4th year (April, 2017)

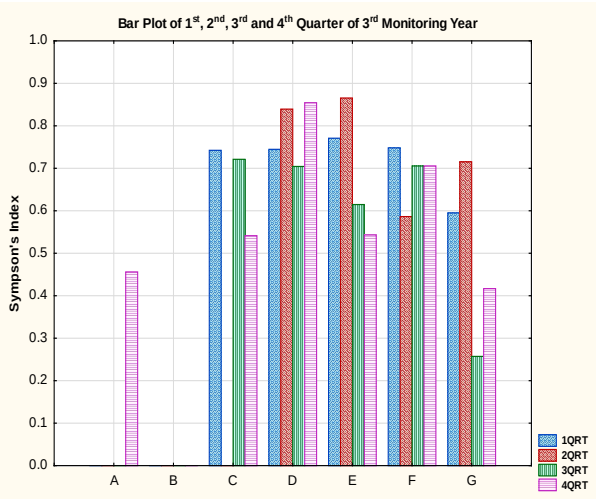
Photo 3.1: Length-wise distribution of fish species



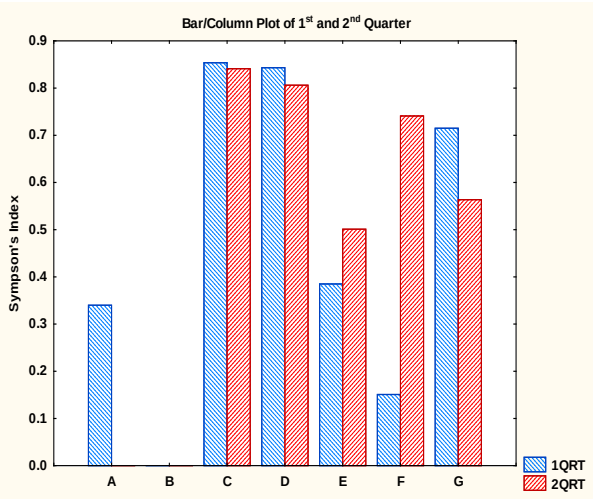
2014-2015



2015-2016



2016-2017



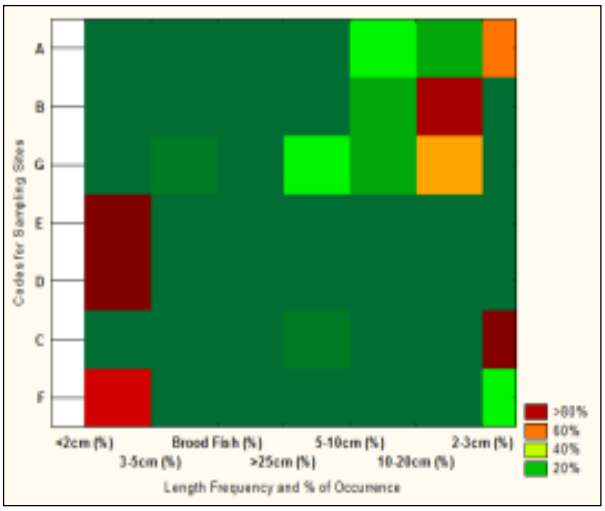
Octtober 2017

(FSR is identified though Simpson's Index)

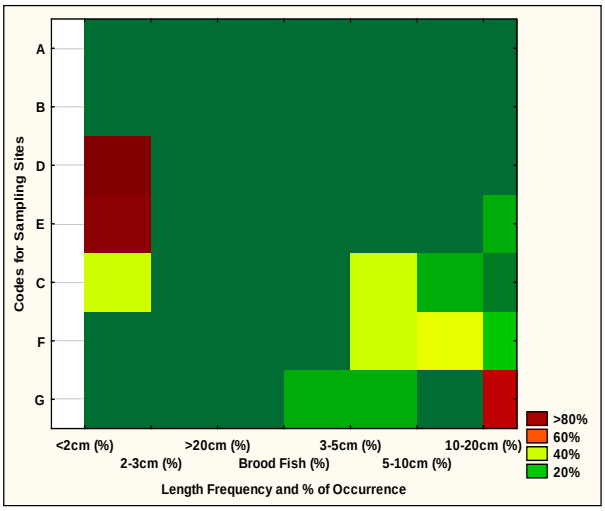
Figure 3.3: Site-wise fish species richness (FSR) in the Passur River System

c) Fish Community Structure

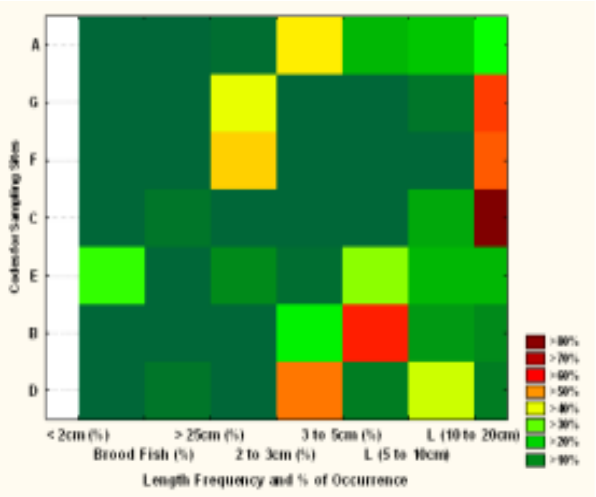
137. Fish community structure was analyzed through counting the length-wise fish individuals (Photo 3.3). The Table D.2 and D.3 of Appendix IV and Figure 3.4 for second quarter of monitoring of 2017-18 show that fries and juveniles for fin fish were widely being distributed among the middle stretches (Mongla-Passur Confluence and Sheola Khal at Chandpai) of the Passur-Sibsa River system. Among these *Horina Chingri, Motka Chingri, Bele* and *Tit Punti* fishes were more in the two sampling sites. Moreover, fries of *Horina Chingri* was commonly found at Mongla Point. However, no brood female fishes were observed at sampling sites in this quarter.



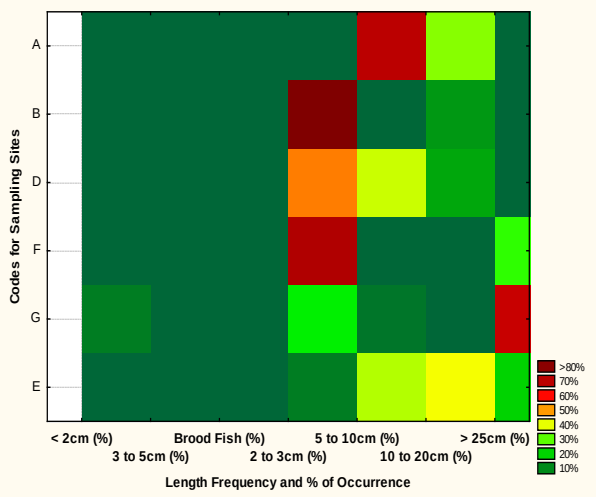
1st Monitoring, April, 2014



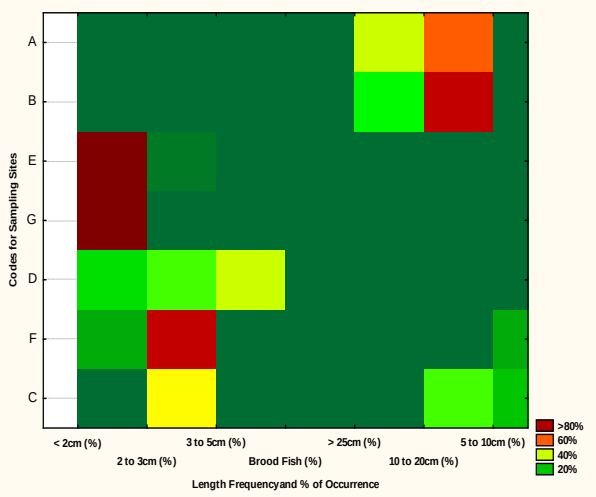
2nd Monitoring, July 2014



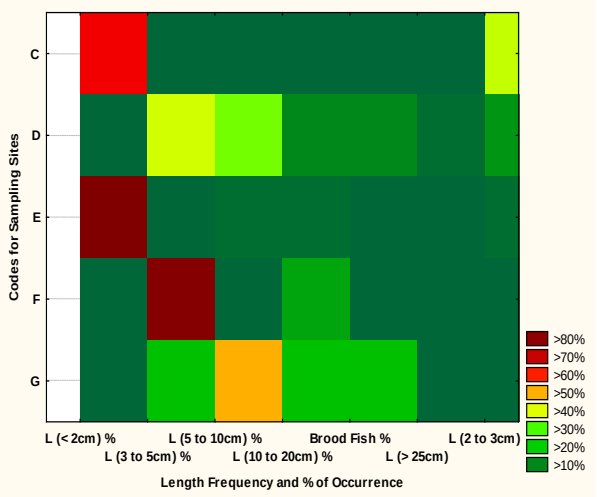
3rd Monitoring, October, 2014



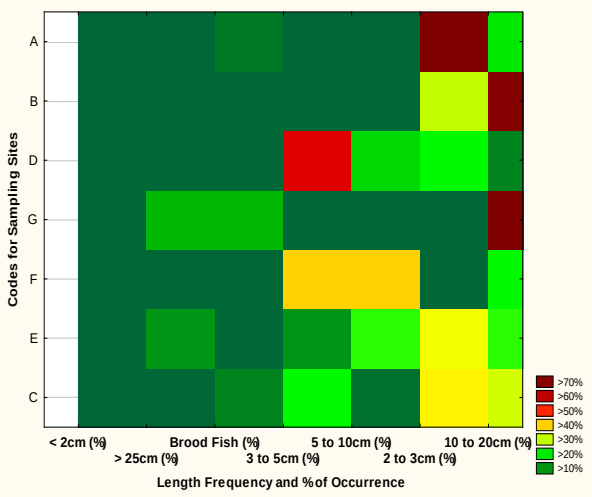
4th Monitoring, January 2015



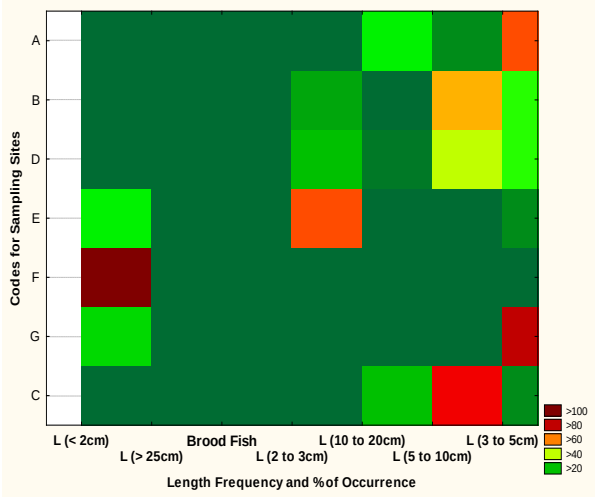
5th Monitoring, April, 2015



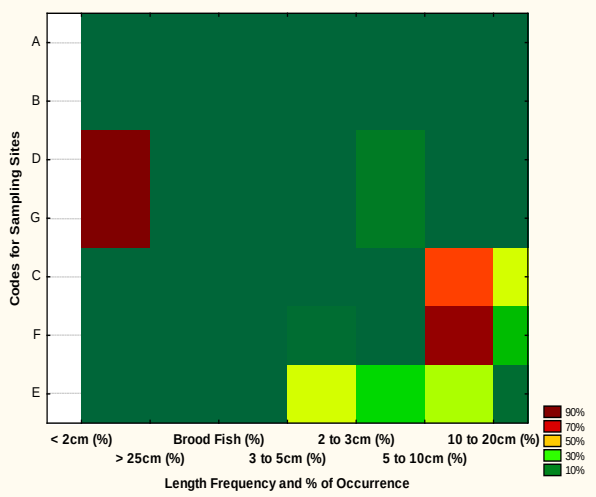
6th Monitoring, August, 2015



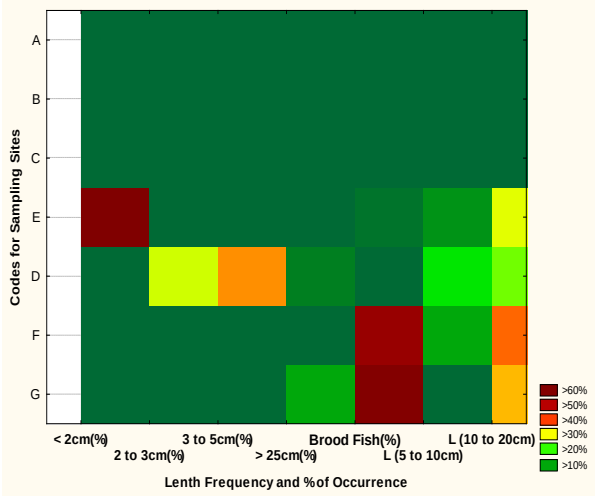
7th Monitoring, October, 2015



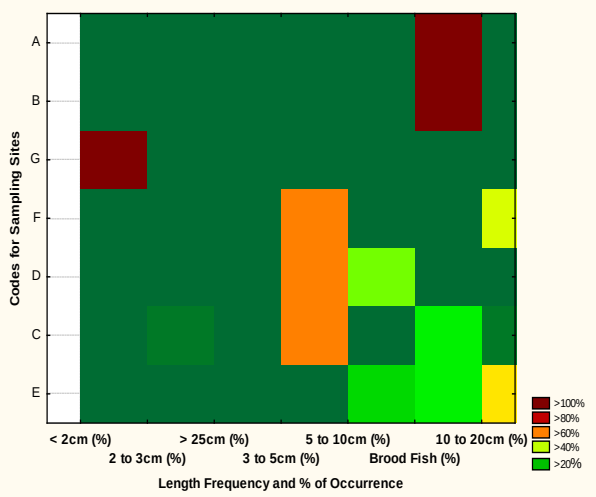
8th Monitoring, January, 2016



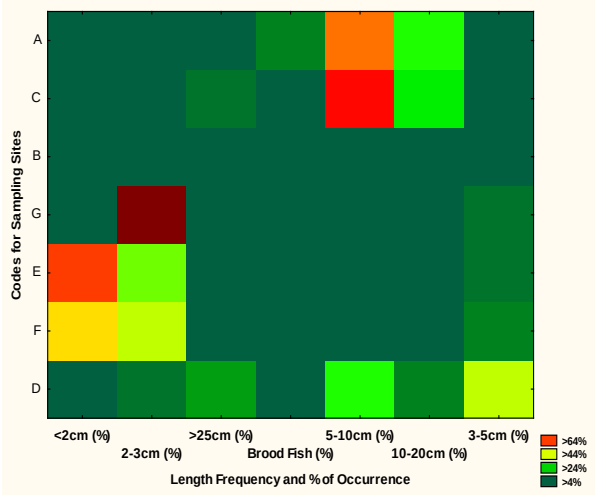
9th Monitoring, April, 2016



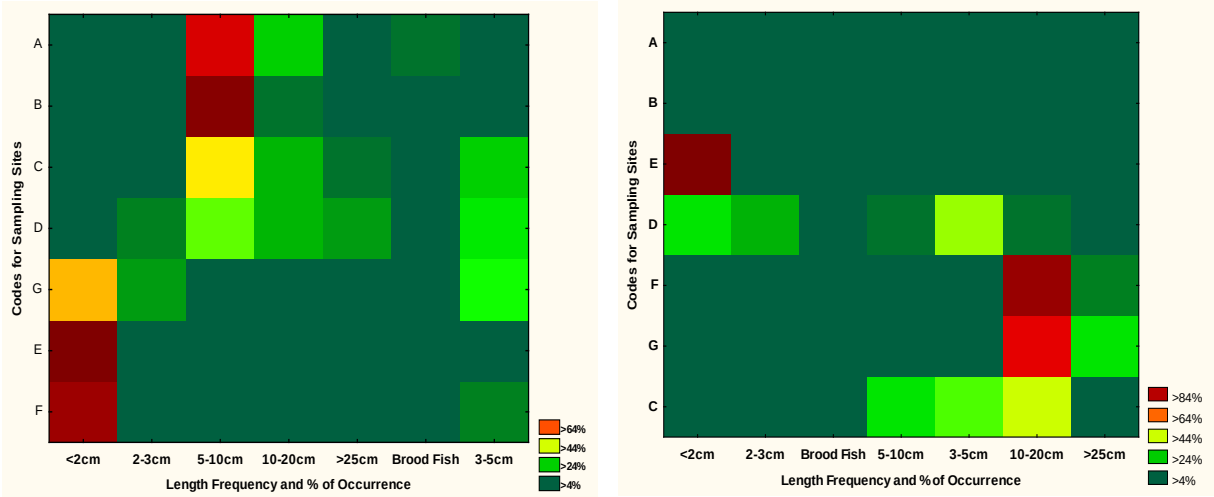
10th Monitoring, July, 2016



11th Monitoring, October, 2016



12th Monitoring, January, 2017



13th Monitoring, April, 2017 **14th Monitoring, October, 2017**

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

138. Migratory species were identified by analyzing the common species available in the regular catch from the sampling sites. It was observed from the data of second quarter monitoring of 2017-18 that fish species like Bairagi attained the maximum abundance of about 72%) among the migratory fish species. The relative abundance of the migratory species is give below in the Figure 3.5.

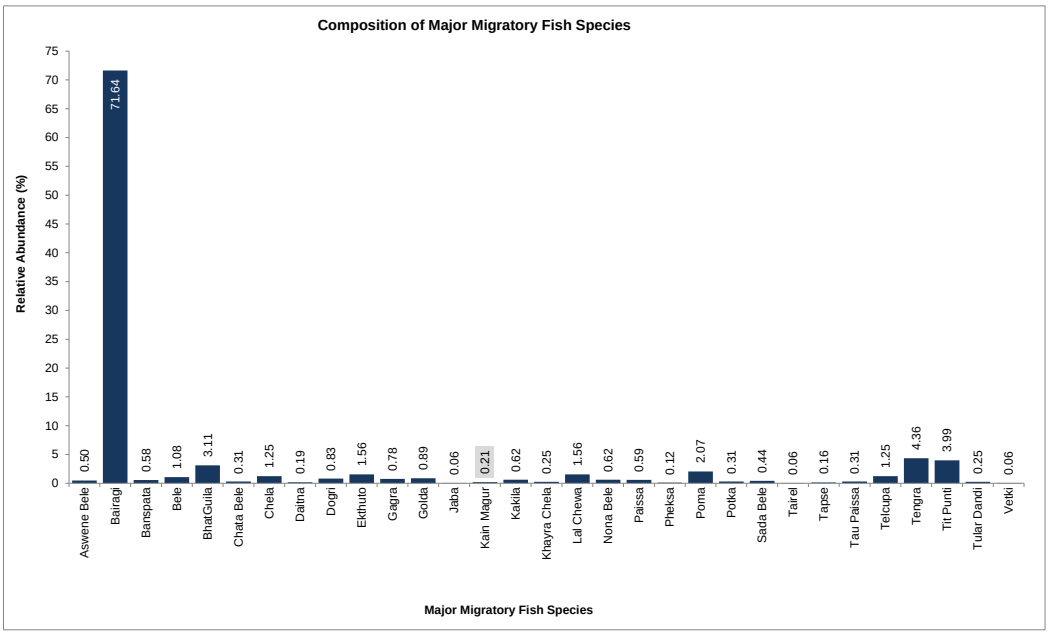


Figure 3.5: Relative abundance of major migratory fish species in sampling sites

(b) Migration Extent, Time and Purpose

139. Major fish species along the sampling sites showed interesting pattern in distribution (Fig. 3.6). Three (3) fish species viz. *Poma, Paissa* and *Golda* were found common in most of the sites. These species, were observed indicating long range of distribution (Table D.4 of Appendix IV).

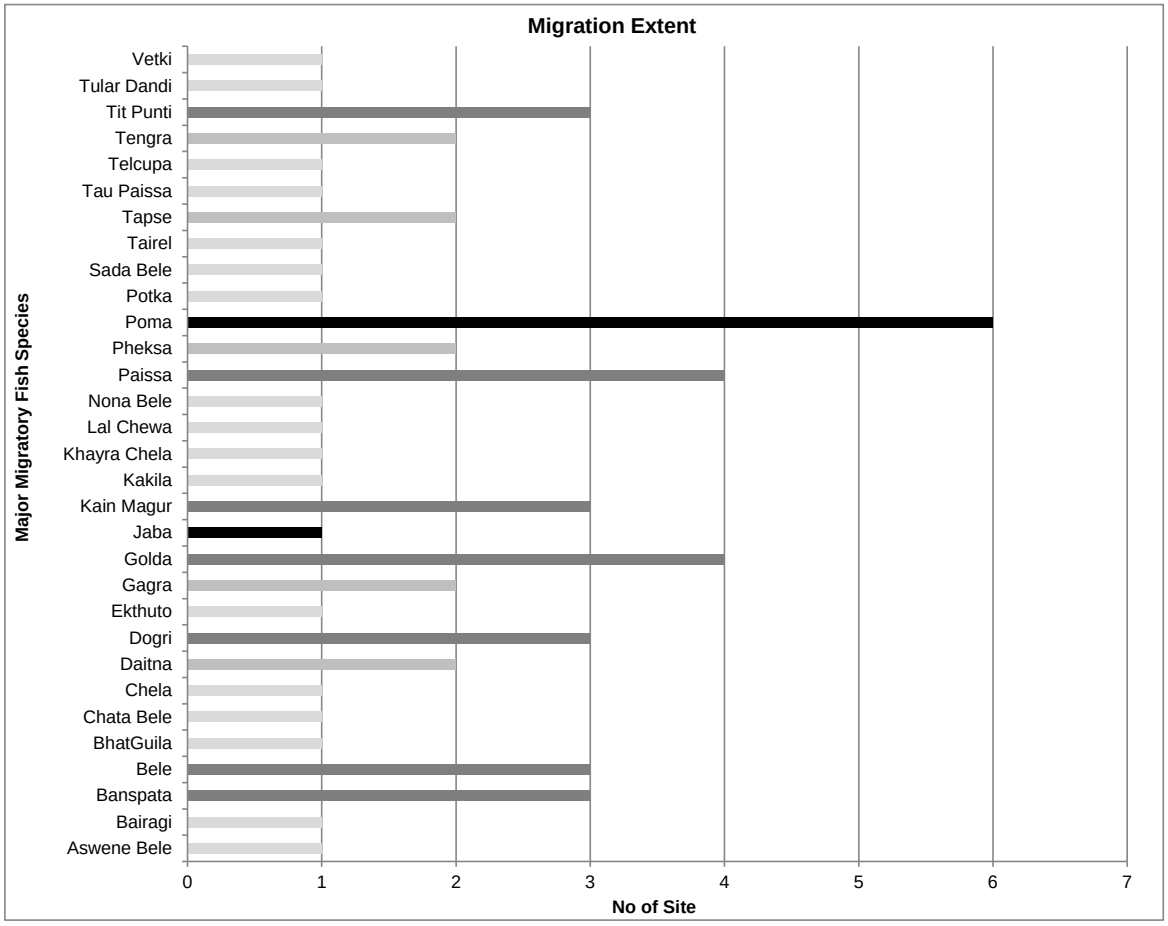


Figure 3.6: Migration extent of major migratory fish species in sampling sites

Shrimp/Fish Farm

140. Three farms situated in the directly impacted 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 i.e. the Passur River System. Moreover, maximization of growth rate and minimization of mortality rate should be ensured for getting more economic output from the farms. So, stocking pattern, growth rate and mortality rate and its causes were surveyed intensively.

Stocking Pattern

141. 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.

142. In this monitoring year (2017-18), the seeds for Bagda stock of the selected shrimp/fish farm were collected partly from the wild sources and partly from nearby Hatchery. The stocking density varied with the size of the ghers, socio-economic status of the gher owners and seed availability. The highest stocking rate was observed in case of gher in Rajnagar (Table 3.5).

Table 3.5: Stocking Pattern of Fish/Shrimp farm

Location	Fish Species	Stocking Density (No/ha)	Stocking Date	Mortality Rate (%)	Food Item	Total Production (ton)
Bhekatkhali Khal, Rajnagar	Bagda	16,631	February, March and April	50	Natural	4.8
	Golda	546				0
	Rui	399,145				0
	Grass Carp	399,145				0
	Minor Carp	399,145				0
	Catla	399,145				0
	Tilapia	399,145				0
	Horina	0				0.8
	Gusha	0				0.2
	Paissa	0				0
	Khorulla	0				0
	Vetki	0				0.02
	Tairel	0				0.01
	Bhangan	0				0
	Gulsha	0				0.02
	Bele	0				0.04
				Sub-total =		**5.89**
Kapashdanga-Muralia	Bagda	14,526	March and July	35		3.01
	Golda	449				0.00
	Horina	0				1.63
	Chali	0				0.82
	Bele	0				0.39
	Gulsha	0				0.07
	Sar Punti	15,644				0.01
	Vetki	0				0.26
	Paissa	0				0.04
	Rui	3,241				1.56
	Catla	3,241				0.00
	Mrigel	3,241				0.00
	Grass Carp	3,241				0.00
	Tilapia	6,742				0.23
	Nilotica	88				0.00
	Shole	0				0.00
	Common	0				0.02

Location	Fish Species	Stocking Density (No/ha)	Stocking Date	Mortality Rate (%)	Food Item	Total Production (ton)
	Carp					
	Pheksa	0				0.00
	Tairel	0				0.00
					Sub-total =	**8.03**
Chunkuri-2	Bagda	8,237	July	25		**0.40**
	Tilapia	0				**3.20**
	Tengra	0				**0.40**
	Paissa	0				**0.06**
	Horina Chingri	0				**0.35**
					Sub-total =	**4.41**
					Grand Total =	**18.33**

Source: Field Survey, 2014

Shrimp/Fish Growth Rate and Mortality

143. During the second quarter (14th) of this monitoring year, the highest growth rate was found in gher of Kapasdanga. Moreover, highest mortality rate was found in case of gher at Rajnagar (about 50%) (Table 3.6).

Table 3.6: Growth Rate and Mortality of Fish/Shrimp

Gher No.	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	
	Growth Rate (cm/day)	Mortality (%)	Growth Rate (cm/day)	Mortality (%)	Growth Rate (cm/day)	Mortality (%)	Growth Rate (cm/day)	Mortality (%)	Growth Rate (cm/day)	Mortality (%)	Growth Rate (cm/day)	Mortality (%)	Growth Rate (cm/day)	Mortality (%)	Growth Rate (cm/day)	Mortality (%)	Growth Rate (cm/day)	Mortality (%)	Growth Rate (cm/day)	Mortality (%)	Growth Rate (cm/day)	Mortality (%)	Growth Rate (cm/day)	Mortality (%)	Growth Rate (cm/day)	Mortality (%)
1	0.3	15-20	0.2	40	0.25	50	-	-	-	30	0.18	25	0.20	60	-	-	-	-	0.2	20	0.20	60	-	-	-	30
2	0.3	30-35	0.3	94	0.25	10	-	-	-	-	0.14	20	0.15	100	-	-	0.21	15	0.3	40	0.25	50	-	-	-	10
3	0.2	25-30	0.2	25	0.20	65	-	-	-	10	0.15	50	0.25	20	-	-	0.17	30	0.15	30	0.20	30	-	-	-	25

Gher No.	14th QM	
	Growth Rate (cm/day)	Mortality (%)
1	0.03	50
2	0.38	35
3	0.02	25

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

Fish Production

(a) Capture Fish Production

144. The highest productivity in this monitoring period was found in Sheola khal at Chandpai (Table 3.7) while the lowest was found in the Mongla area. This is because all fry fishes were not considered as for captured.

145. The present study revealed that the highest catch of 77.5 kg/haul was also found in case of Charpata Jal (a type of gear) (Table 3.7). The following table also expresses that Ber Jal (Poma/Vola Jal), Behundi Jal and Thela Jal were most frequently used in all upper reaches in Passur River System. Charpata Jal was commonly used in middle reach and lower reach of the Passur River. Moreover, the highest total catch was observed in Sheola khal at Chandpai and lowest in the Mongla Point in 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	Khalpata Jal	1:00	1	3.5	0.00
			Mui Jal	1:00	4	0.5	0.13
			Spear	4:50	204	1	0.00
D	Chandpai	Sheola Khal	Behundi	5:00	7	9	1.29
			Charpata Jal	12:00	1	12	12.00
E	Mongla Point	Passur River	Thela Jal	1:00	3.25	0	0.00
F	Maidara	Maidara River	Vola Jal	0:30	1	0.4	0.40
G	Chalna Point	Passur River	Vola Jal	1:00	1	0.3	0.30

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
A	2	0
B	0.25	0
C	8.13	1.5

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
D					77.5				10.5				
E					0				0				
F					0.3				0.4				
G					0.12				0.3				

**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

146. The study on shrimp/fish farm in the second quarter monitoring (14th) of 4th year 2017-18) shows that the fish production was found only in the Gher of Kapasdanga (Table D.5 in Appendix IV).

3.2 Ecosystem Monitoring

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

a. Monitoring Locations

148. 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.

b. Dolphin Occurrence

Dolphin migration route in study area

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

Dolphin occurrence in Passur River

150. A Boat transect survey was conducted along about 13 km length of Passur River and 1.02 km length of Maidara River around the project area (From Mongla to Moidara Village) using mechanized vessel. A total of 5 Ganges River Dolphins were recorded with an occurrence rate of 0.19 individual/km/hour. All of which are diving and occurrence concentrated at the confluence points of the Maidara-Ichamoti River beside the project area (Figure 3.7).

151. Other short surveys were conducted at Karomjal, Harbaria and Akram Point, while passing the river. Both at Akram Point and Harbaria, Ganges Dolphin was observed. However, the survey result is included in Table: 3.8.

Dolphin occurrence in Dhangmari Khal

152. Dolphin occurrence was also surveyed at the Dhangmari Khal Wildlife Sanctuary. Total transect length was 13.58 km from Dhangmari-Passur confluence to Gagramari Patrol Post of Forest Department. There only 12 dolphin individuals were recorded during this quarterly survey among which 6 individuals were found at river confluence point in front of Gagramari Patrol Post and another 6 individuals were recorded from the three meander points of Dhangmari Khal. The average encounter rate was observed as 0.48/km/hr (Figure 3.7 and 3.8).

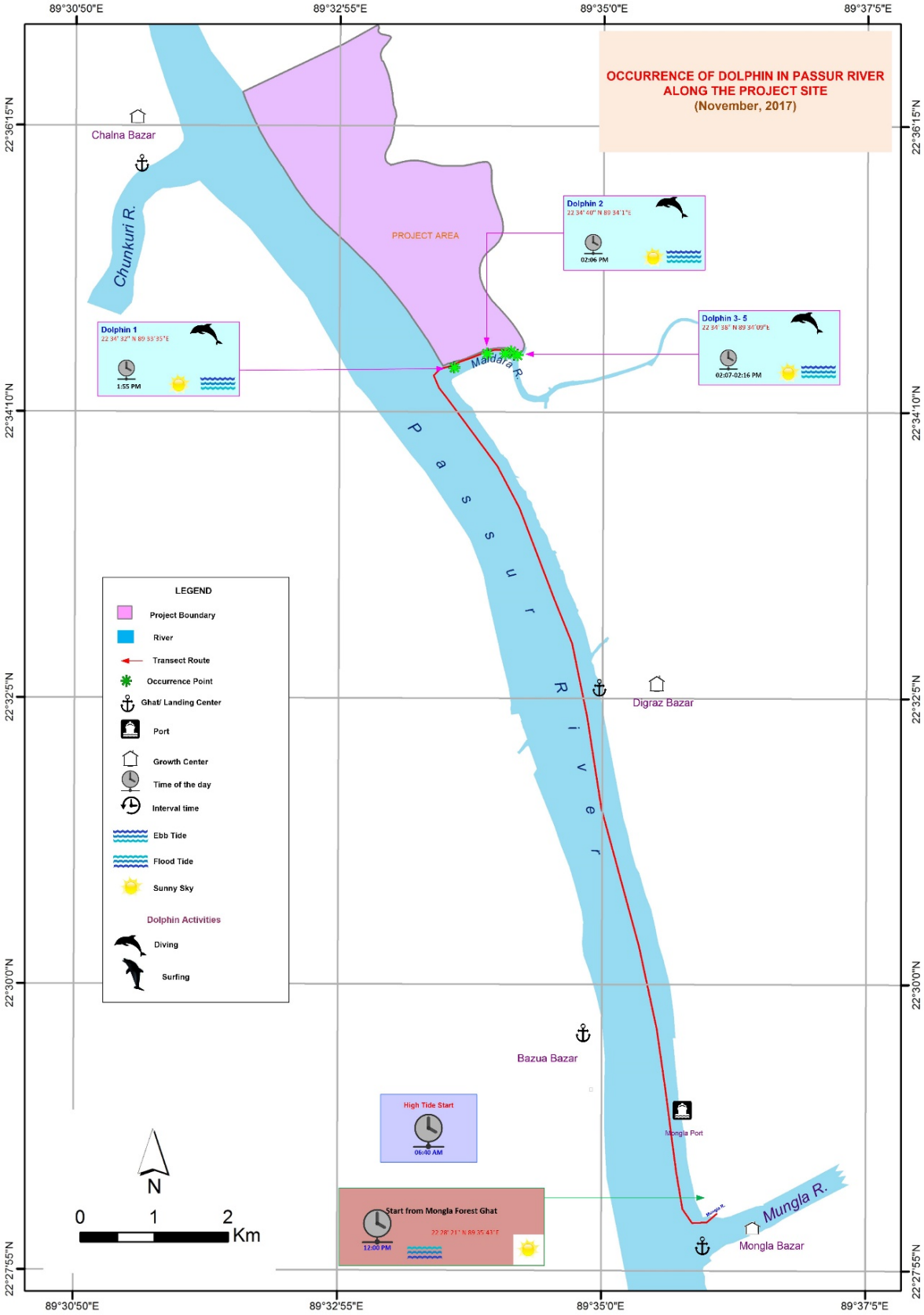


Figure 3.7: Occurrence of Dolphin at Passur and Maidara River along the project site (October, 2017)

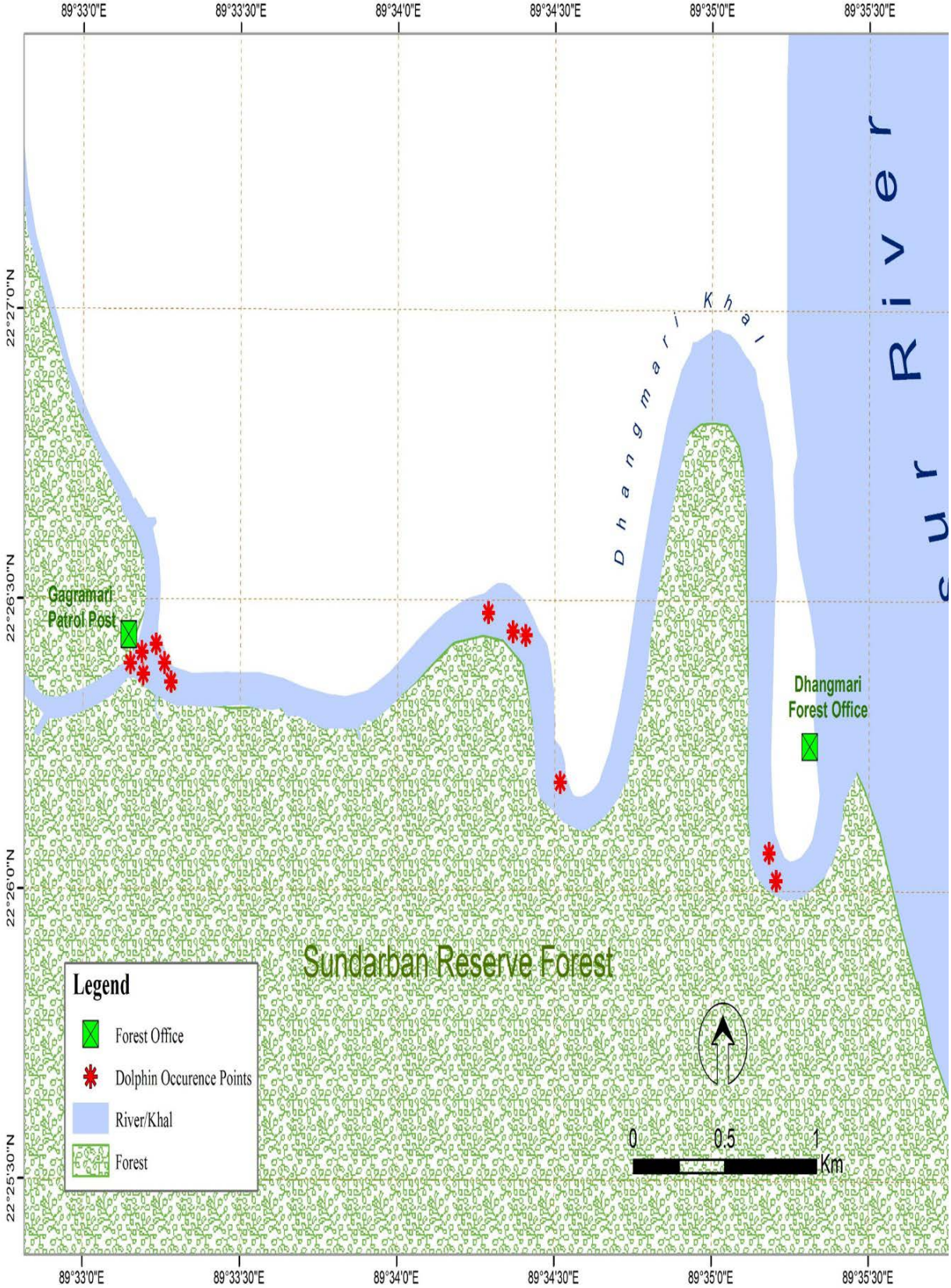


Figure 3.8: Location of dolphin occurrence at Dhangmari Khal (October 2017)

Table 3.9: 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		April 2017		Oct 2017	
	FT	N T	F T	NT	F T	NT	F T	NT	FT	NT	FT	N T	F T	N T	FT	N T	F T	N T	F T	N T	F T	N T	F T	NT	F T	N T
Project Site	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NS	Y	Y	Y	Y	Y	N	Y	Y	Y	NS	Y	Y	Y
Karamjal	NS	NS	NS	N	NS	Y	Y	Y	N	N	NS	Y	NS	Y	Y	N	Y	NS	Y	Y	Y	Y	Y	Y	NS	N
Harbaria	NS	NS	NS	N	NS	Y	Y	N	N	N	N	N	Y	NS	Y	N	Y	Y	Y	NS	N	N	N	Y	Y	Y
Akram Point	NS	NS	NS	N	NS	N	NS	Y	Y	Y	NS	NS	N	Y	Y	NS	NS	NS	N	N	NS	NS	N	N	Y	NS
Moidara River	Y	N	N	N	Y	Y	Y	N	Y	N	Y	N	NS	Y	N	Y	Y	NS	NS	Y	N	Y	NS	NS	Y	N

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

Occurrence Status: Y = Occurred, N = Not occurred

3.3 Sundarbans Forest Health

153. CEGIS team has been periodically monitoring the Sundarbans Reserve Forest health to oversee the probable impacts of Rampal Thermal Coal Power Plant Project under implementation. This monitoring program will also support in determining the status, trend and changes in the indicators of the forest condition. The Sundarbans forest health is being monitored quarterly as per monitoring schedule and so far, fourteen (14) surveys were conducted at five locations, namely Sutarkhali, Karamjal, Harbaria, Akram point and Hiron point. The overall monitoring indicators observed in all the fourteen 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

Indicators Selected for this monitoring period

154. Frequency of Monitoring for different indicators was determined considering efficiency with respect to time, cost and applicability. The indicators observed in this monitoring period were as follows:

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

Forest Health Monitoring Location

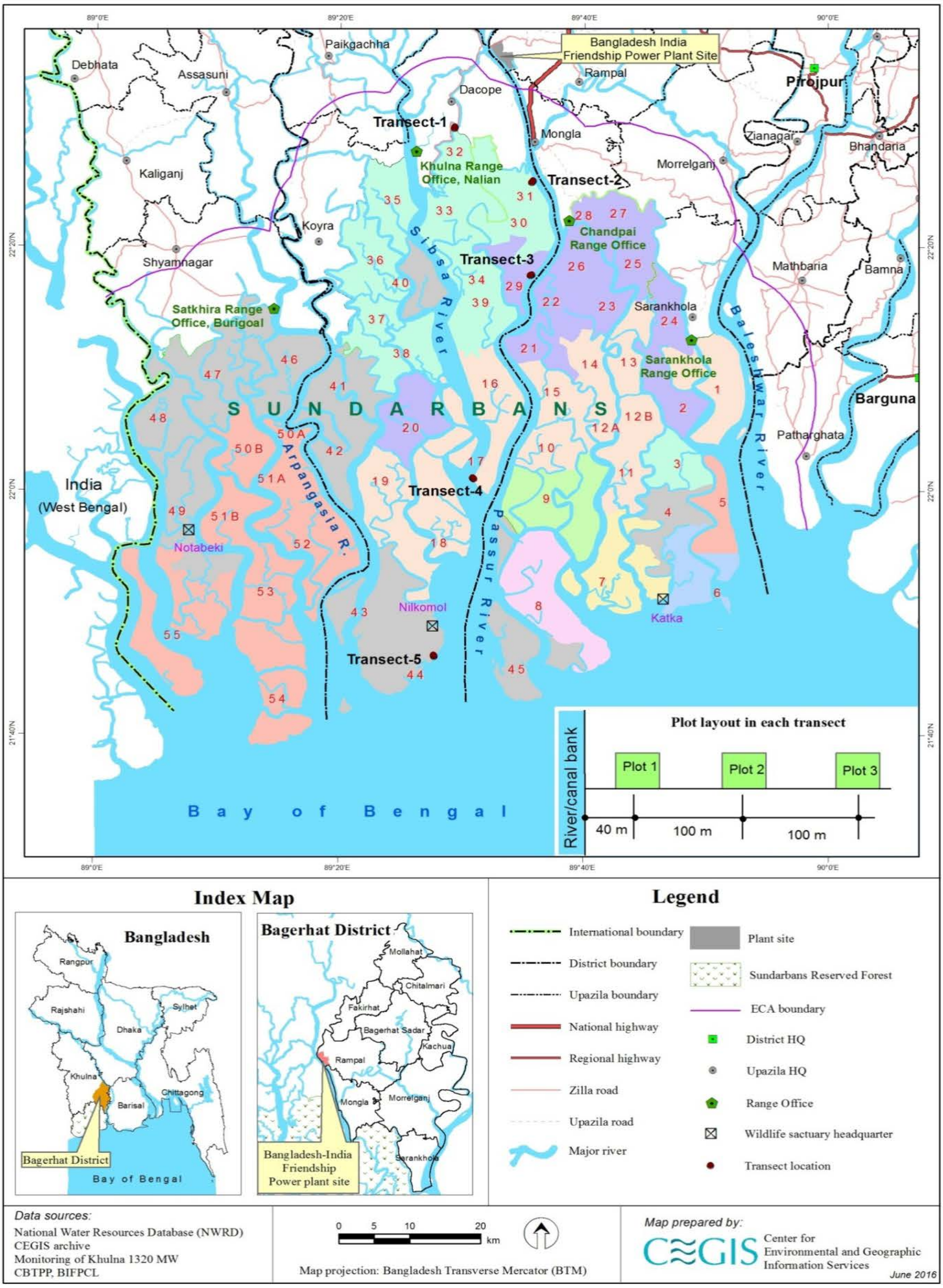
155. To set up permanent sample plots five sites were selected on the basis of the survey conducted from October 27 to October 31 (Map 3.2). Among those, four sites were along the Passur River at Karamjal, Harbaria, Akram point and Hiron point, and the fifth one was near Sutarkhali forest office (Table 3.10). The sites were selected considering the distance from the proposed Project site, wind directions, coal transportation route, river systems and vegetation types.

Sampling Design of Permanent Sample Plots (PSPs)

156. 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 were laid out at 100 m intervals in order to capture maximum tree species (Figure 3.7). Because of the variation in species composition in SRF, observation plots were laid out from the coast, river or canal side to landward zone (forest proper side). The location of the first subplot was 40 m away from the 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

Table 3.10: General Description of Permanent Sampling Plots (PSPs)

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



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

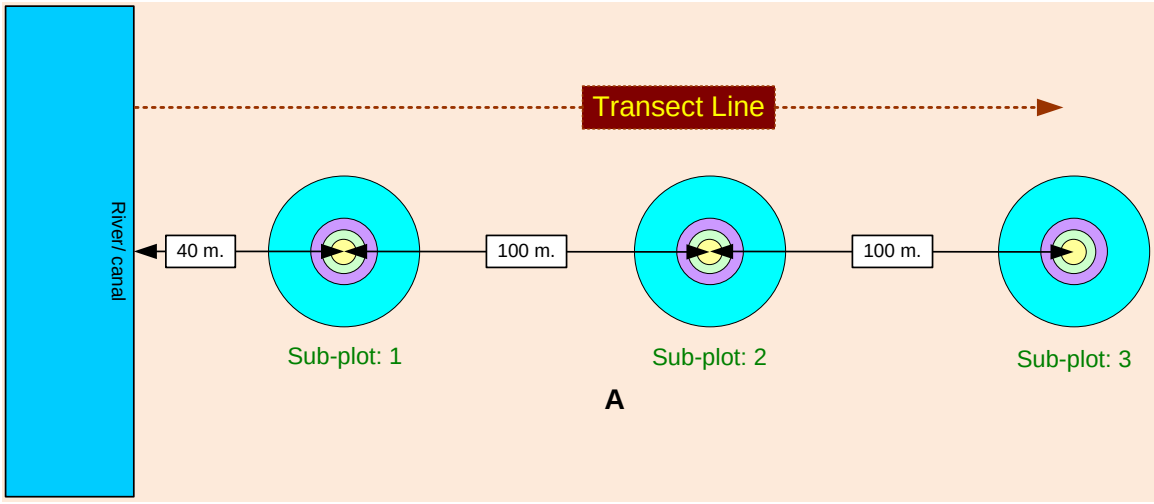


Figure 3.9: Layout of the subplots and transect line perpendicular to the ecotone (river or canal bank)

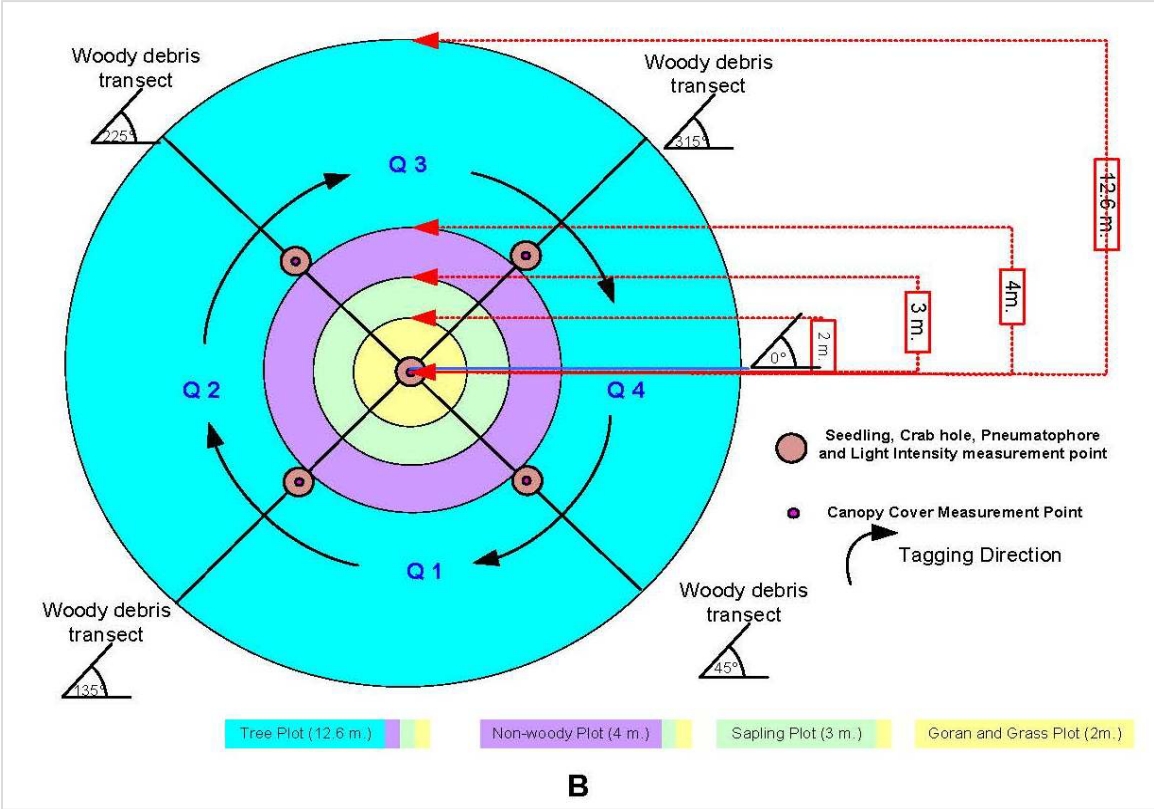


Figure 3.10: Layout of the survey activities in each subplot

Forest Health Survey

(a) Trees

157. The tag numbers of the trees (DBH ≥ 5cm and lean angle greater than 45º) were monitored and rewritten if any new tree was found within 12.62 m radius circle of the Permanent Sample Plot (PSP). A map showing location of all the trees (tag number) was developed in the same monitoring period to ease the next data collection (Photo 3.2). The tree height and diameter were also measured by the surveyor (Photo 3.3 and Photo 3.4).

Photo 3.2: Team Member recording and cross checking data in the field sheet

Photo 3.3: Team member measuring height of trees at Akram point

Photo 3.4: Measuring the DBH of trees at Herbaria

(b) Sapling and seedling

158. Saplings (DBH < 5 cm and height 1.37 m) and seedlings (height < 1.37 m) were assessed within a circular area of 3m and 2m radius circle, respectively in each PSP. Seedlings have been counted species wise, and their status of living were also recorded (Photo 3.5). For saplings, species name and DBH were recorded along with the living status (Photo 3.6)

Photo 3.5: Team member counting the seedlings at Koromjol

Photo 3.6: Team member measuring the DBH of saplings at Sutarkhali

(c) Pneumatophores

159. The total numbers of living pneumatophores were recorded within a circular area of 1 m radius centring each of the five points in all the subplots. The first point was laid out in the centre of each subplot and other four was in the midpoint of the four woody debris transects that are facing at 45°, 135°, 225° and 315° angles (Photo 3.7).

(d) Crab hole

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

Photo 3.7: Team member counting pnuematophores and crab hole in forest floor

(e) Canopy Cover

161. Percentage (%) of canopy cover was estimated by a spherical densiometer, a gridded convex mirror that provides a simple and inexpensive approach of measuring canopy cover. The densiometer was held at a distance of 30–40 cm away from the body and at an elbow height so that head not become visible in the mirror (Photo 3.8). After levelling the instrument using the level bubble, the dots, which had not been occupied by canopy, were systematically counted. In each subplot, the meter readings were taken at five points facing north, south, east, and west direction including the centre point of the subplot. The canopy cover was calculated by taking the average of these five readings.

(f) Leaf Area Index

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

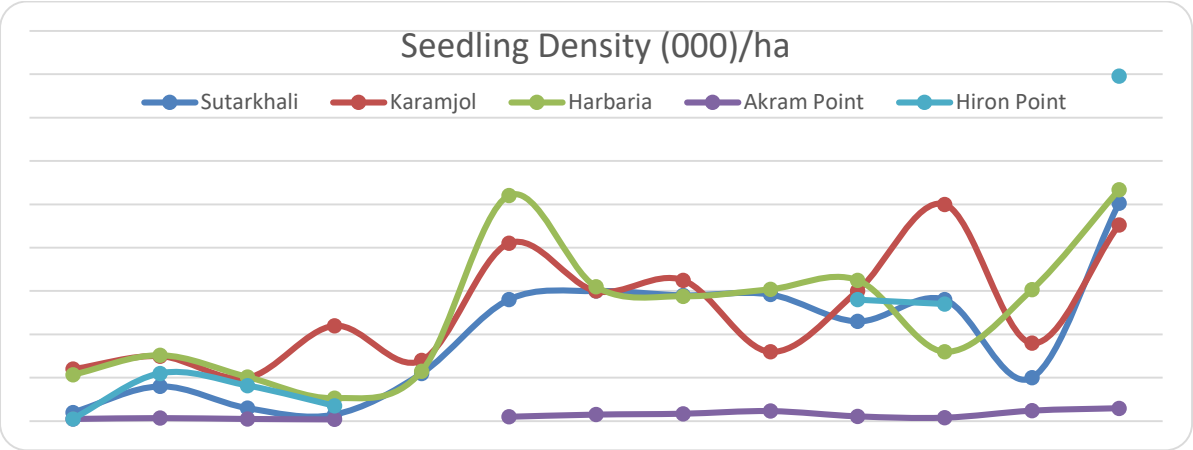
Leaf Area Index (LAI) = $\log_e (I/I_o)/-K$ m^2 ; leaf area /m^2area of ground
(Where, I = Under Canopy Light Intensity, I_o = Open Canopy Light Intensity and K is Canopy light extension coefficient i.e., 0.5)

Photo 3.8: Team member taking canopy cover using Densiometer

3.3.2 Status of monitoring of SRF Health

Seedling

163. It was observed from the last field monitoring (14th program) that number of seedlings per hectare to be increasing in almost all the monitoring locations (Figure 3.11). The graph also indicated higher number of seedlings during post-monsoon period while lower number during winter to pre-monsoon period. The inclusion of new seedlings depends on regeneration and survival rate. These two indicators also depend on canopy cover and 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 light intensity. The result of this 14th monitoring period have shown comparatively higher number of seedlings at Hiron point than that of the other post-monsoon seasons of the previous years. This may be due to non-disturbance in the at forest floor. The dominant species were Gewa. Other than the silvicultural competition, the seedlings at Akram point also face natural stresses due to their location being very much closer to the sea. In the Sundarbans, most of the mangroves' seeds disperse during the rainy season and go up to forest floor.The seedlings therefore, are usually found more just after the rainy season (monsoon to post monsoon) than in other seasons.

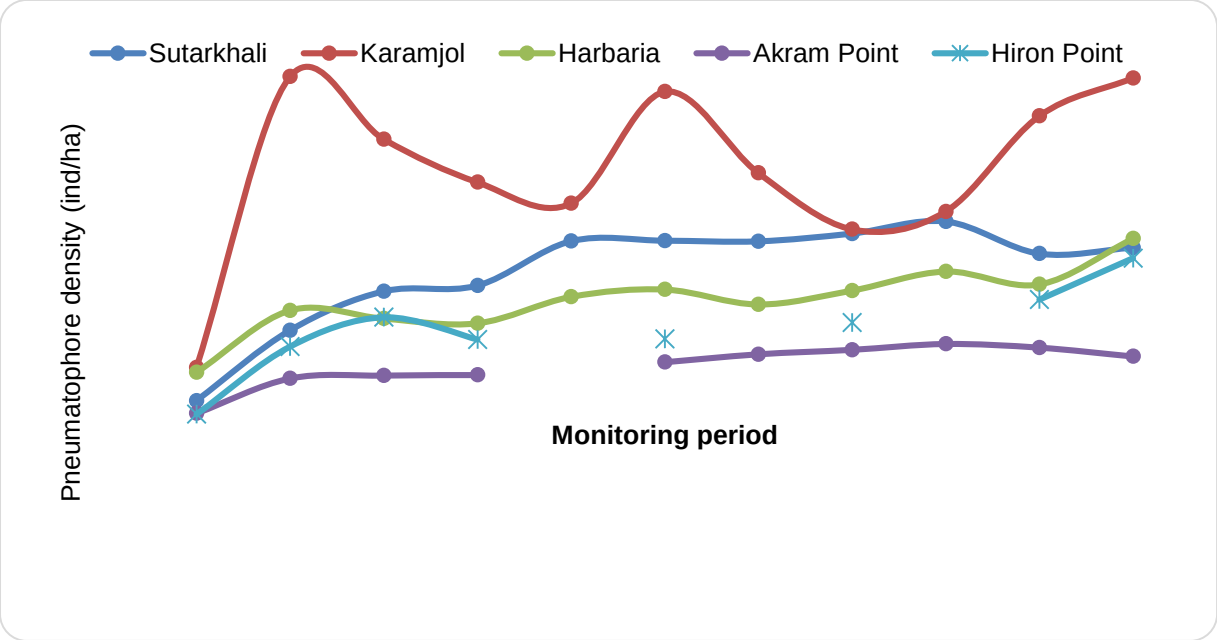


(Seedlings density was not monitored at Akram Point during Monsoon 2nd Year)

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

Pneumatophores

164. Pneumatophores density also changes with seasonal variability (Figure 3.12). Pneumatophores usually dry up and die during dry season. The number of pneumatophores per hectare was found comparatively higher in karamjol area in post-monsoon period. 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, it was found that Gewa (Exoecaria agallocha) was the dominating species at these monitoring sites. On the contrary, Karamjol is mainly dominated by Baen (Avicennia officinalis) tree and it has numerous tender pneumatophores compared to the others. The number of pneumatophores may also vary due to the elevation of the forest floor from the mean sea level (MSL). The major function of pneumatophores is to exchange gas into the atmosphere during tidal inundation. Hence, the highly elevated plot with less effect of inundation may have lesser number of pneumatophores.

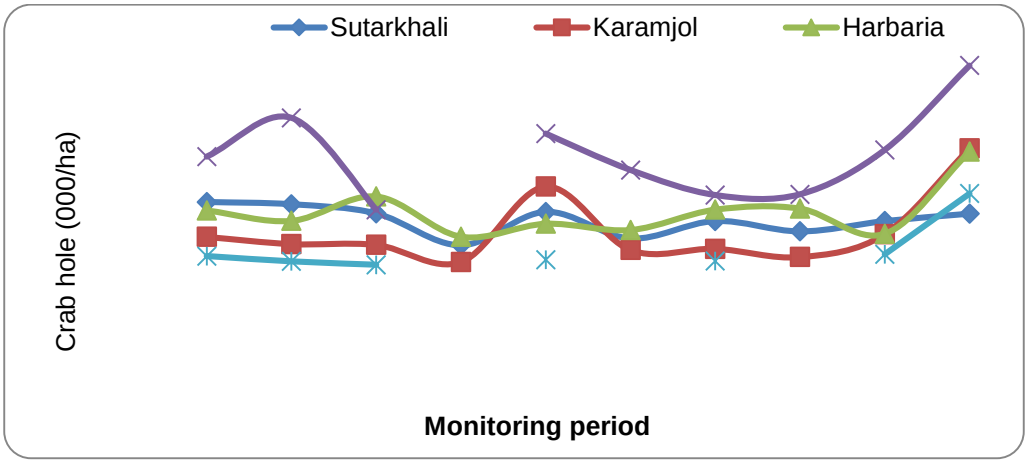


(Pneumatophores density was not monitored at Akram Point during Monsoon 2nd Year)

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

Crab hole

165. The crab hole density, the indicator of availability of crab in a site, was found the highest at Akram point among the five monitoring sites (Figure 3.13). This could be due to sandy forest floor at Akram point because they love to drag hole on that particular habitat. Harbaria point crab hole also showed remarkable increase from the last post monsoon period. Crabs are the major macro fauna, ecologically engineering the mangroves through digging burrows. So it is clear that the forest condition at Harbaria, and Koromjal point has been progressively improving overtime. From the figure, 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.

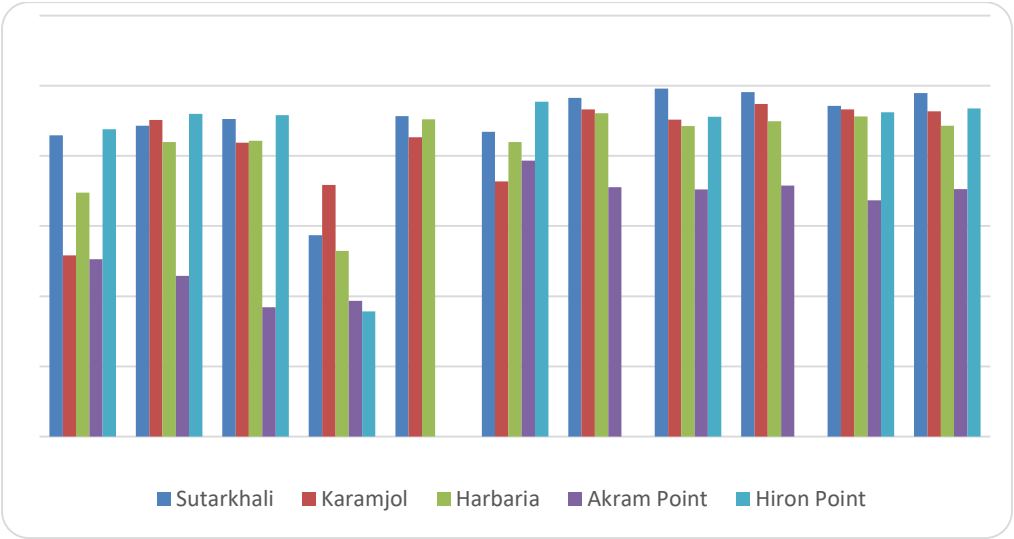


(Crab hole density was not monitored at Akram Point during Monsoon 2nd Year)

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

Canopy cover

166. The canopy cover percentages in the monitoring plots did not vary 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 was found to be lowest in pre-monsoon period. It was found, from the 3rd year post monsoon to 4th year post monsoon that the canopy cover percentages were similar among the monitoring sites except Akrampoint (Figure 3.14). Since of the canopy coverage in a site is treated as healthy. All the locations of the monitoring sites were in good condition since the canopy coverages were more than 60%.



(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)

167. The LAI influences the daily rate of net canopy photosynthesis, which results in exchange of atmospheric CO2. The minimum the ratio of under canopy to the open canopy light intensity value indicates the maximum LAI. It was found that the LAI has increased in all the monitoring locations from those of the previous values. This indicates a good health of the forest. However, at Akram point, like other indicators the LAI was much lower due to high under canopy light intensity.

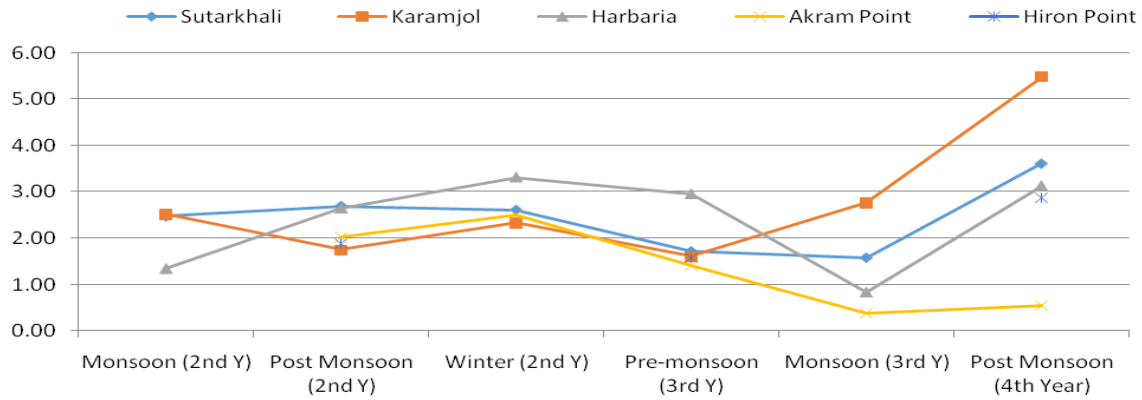


Figure 3.15: Leaf Area Index (LAI) among the quarterly surveys in five PSPs

3.4 Agriculture Resources Monitoring

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

3.4.1 Methodology

Monitoring Indicators

169. Major cropped area, crop production and crop damages were considered as major indicators for agriculture resources monitoring. During the 14th quarter field 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

170. For data collection, five sampling plots were selected on random basis within the project influence area. The same mauzas selected for land resources were also considered for agricultural resources monitoring purpose. The locations of agriculture monitoring plots are presented in Map 3.3.

3.4.2 Description of the Selected Agriculture Plot for Monitoring

171. Detailed information of the selected plot for agriculture monitoring is presented in Table 2.4.1 in land resources monitoring portion under physical environment.

3.4.3 Present Cropping Patterns of Monitoring Plots

172. Detailed data on cropping pattern for the last three years were obtained through extensive discussion with the plot owners. Based on the discussion, the plot based cropping patterns was identified and the associated data was collected in October, 2017 and described in the following paragraphs. Detailed cropping pattern are presented in Table E.2 of Appendix IV.

Agriculture Plot-1(Baranpara)

173. This plot is located at Baranpara mouza 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 to improve the soil fertility level in 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 pesticide, the pest infestation reduced to a minimum level. Detailed cropping pattern is shown in Table E.2 of Appendix IV.

174. 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 due to water logging in this plot caused by heavy rainfall. The excess amount of water couldn't be drained out properly from the plot. No chemical fertilizers were applied in this plot. Rice straw and Bajua grass were mixed to improve the soil fertility level. Occurrence of Pest like Leaf folder caterpillars was reported. To protect crop from pest infestation, powder pesticides Virtako was applied @ 75gm/plot. Detailed cropping pattern is shown in Table E.2 of Appendix IV.

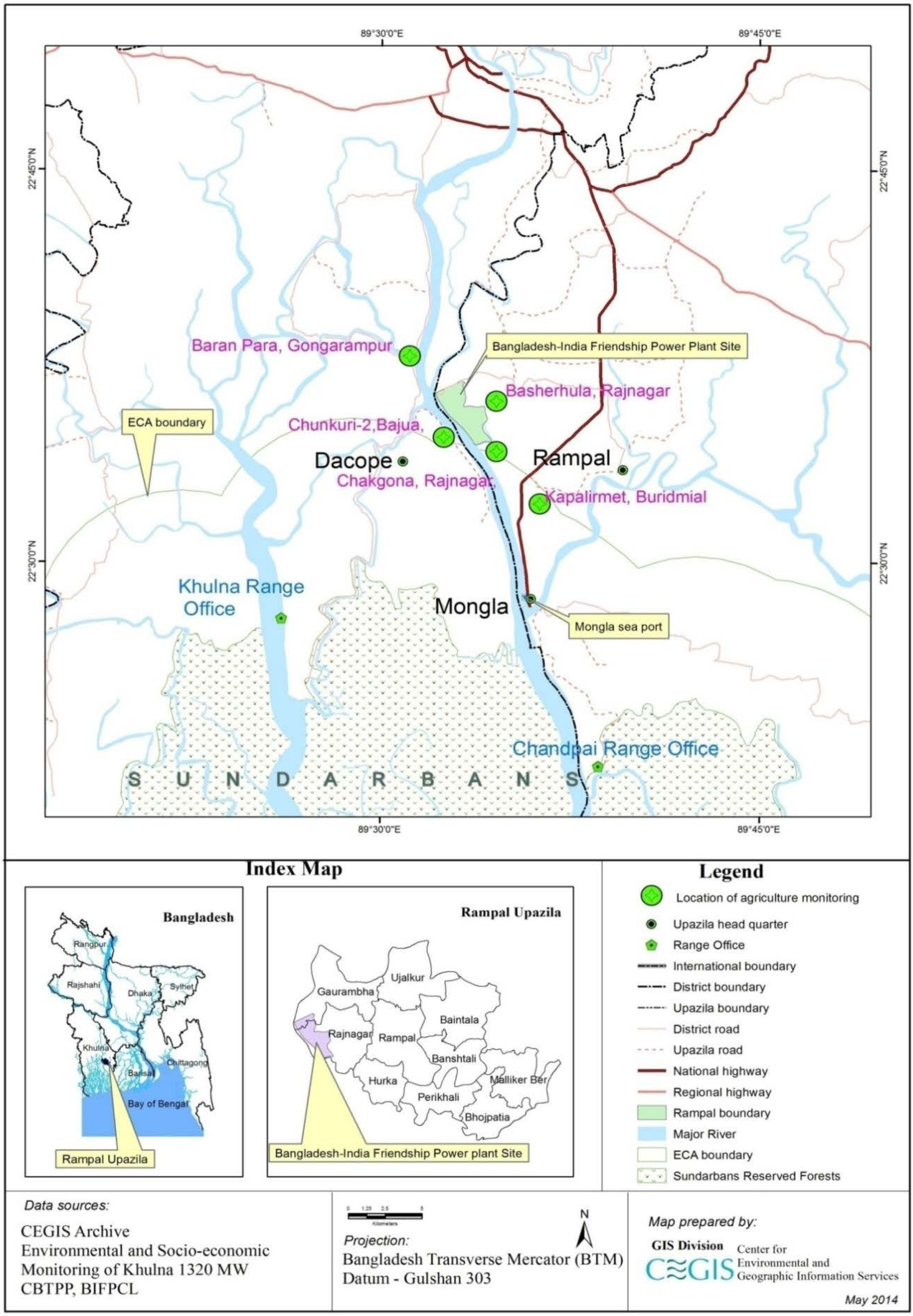
Agriculture Plot-2(Chunkuri-2)

175. This monitoring plot is located at Chunkuri-2 and the size of the plot is about 0.93 ha. During the recent monitoring period in October 2017, it was observed that, farmer of this plot cultivated Local Aman (Benapole) due to the high market price of local variety than HYV variety in. Rice straw and Bajua grass were used to improve the soil fertility level. Stem borer infestation was observed in this plot. Urea: 130 kg/plot, TSP: 45 kg/plot and MP: 25 kg/plot were used in this plot. To protect crop from pest infestation, liquid pesticide Karate 2.5 EC were applied @700ml/plot. Detailed cropping pattern is shown in Table E.2 of Appendix IV.

176. 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.2 of Appendix IV.

Agriculture Plot-3 (Kapalirmet)

177. This plot remained fallow from the 2nd and 3rd year monitoring period (2014-15 and 2015-16) due to increase in salinity. According to the opinion of the local people, Bangladesh Water Development Board (BWDB) had 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 the water could enter into the settlement areas including their cultivated plots during the year 2014-15. As a result, the whole area was inundated by saline water and farmers practiced shrimp culture instead of cultivating traditional crops. Though many of the farmers cultivated crops in their plot in this adverse condition, but due to this fact all crops were damaged by river water and rain waterin that season. Shrimp gher owners of this area have been allowing entry of saline water in these plots from Ghona River every year for shrimp culture. 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 culture only shrimp/fish. It was observed during this 14th 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.2 of Appendix IV.



Map 3.3: Agriculture Resources Monitoring Locations

Agriculture Plot-4 (Chakgona)

178. It was observed during the 2nd and 3rd year of monitoring, this plot remained fallow due to increase in salinity concentration. And therefore, 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. This plot remained fallow too in the Kharif-II season of 2017-18. It may be mentioned that the plot owner has given part of the plot (0.07 ha out of 0.28 ha) voluntarily for the construction of cyclone shelter at Chakgona mouza. The detailed cropping pattern is presented in Table E.2 of Appendix IV.

Agriculture Plot-5 (Basherhula)

179. During the 12th quarterly monitoring local aman (Chapsail) was found in the field insteed of HYV beacause of its high tolerance capacity to salt and high market value. Farmers use urea as only chemical fertilizer (35 kg/plot) and rat flap as only insecticide (50gm/plot). Crop damage was found in this plot due to lack of proper management practice. Detailed cropping pattern is shown in Table E.2 of Appendix IV.

180. During this monitoring period (14th 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 infestaion. Detailed cropping pattern is shown in Table E.2 of Appendix IV.

3.4.4 Crop Production in Monitoring Plots

181. The information on crop production will be collected after harvesting in December, 2017-18 and presented in the next monitoring report.

3.4.5 Crop Damage in Monitoring Plots

182. Crop damage information will be collected too after harvesting in December 2017-18 and presented in the next monitoring report.

4. Social Environment

4.1 Socio-economic Condition and Social Safeguard

183. During this 14th quarterly monitoring period, changes on socio economic indicators/parameters were investigated (interms of improvement or deterioration) with reference to the previous monitoring results. It intends to recommend for further improvement of present construction activities. Methodologically, these indicators are surveyed twice in a year (six months successive interval), though in any emergency (if any important issue arises that requires intensive investigation) the survey methodologies can be changed or revised. This chapter reflects the discussion on comparative results or changes based on survey conducted in the 13th quarter (from April 24 to April 28, 2017) and the 14th quarter (from October 23 October to 26, 2017).

4.1.1 Methodology

184. The important parameters/indicators were examined only in this phase with reference to its earlier condition. The monitoring locations adopted in this study were similar to the earlier monitoring study following the same methodology.

185. There were in total 6 informal discussions conducted in the surroundings of Project Mouzas and influenced area. Among them, one was conducted at Foyla bazaar comprising of resettled people and the remaining five were conducted in Kapasdanga (1), Barni (1), Rajnagar (2), and Baradurgapur (1) respectively with the directly and indirectly affected people. On the other hand, according to the conversation with respective LGIs (Local Government Institutions), there were hardly any change in Pankhali and Bajua mouzas in comparison with the information of earlier monitoring (13th quarter). So, no detailed discussion was held in those mouzas with the respective peoples. Besides, informal discussions were held in the project site with different workers of respective construction firms (Map 4.1).

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

4.1.2 Exploration of Monitoring Parameters

Compensation

187. The compensation process has been officially completed. However, the local people informed the team that ‘some of the affected landowners, who were against the power plant installation from the very beginning of the land acquisition, did not receive the compensation money yet. Besides, a few landowners who lost their land but are still remained unpaid due to problems in their legal documents of land. 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 compensation.

188. BPDB has prepared a LRP (Livelihood Restoration Plan) for the non-titled affected households, who were in fact used to cultivate shrimp in the project area by taking lease (locally called hari) from private lands for a certain contract period. BPDB now invited experienced Non-Governmental Implementing Agency (IA); NGO for Execution of Resettlement Action Plan (Implementation of Livelihood & Income-Loss Restoration and

Compensation Plan) for acquired 1834 acre land at Rampal, Bagerhat. Meanwhile, the project authority initiated training programs for the affected non-titled people. In line with this, sewing and computer literacy trainings have been introduced over the last two years. The trainees informed that there were limited opportunities of employment in these areas of activities in which trainings were provided as they are saturated by the previously experienced occupants.

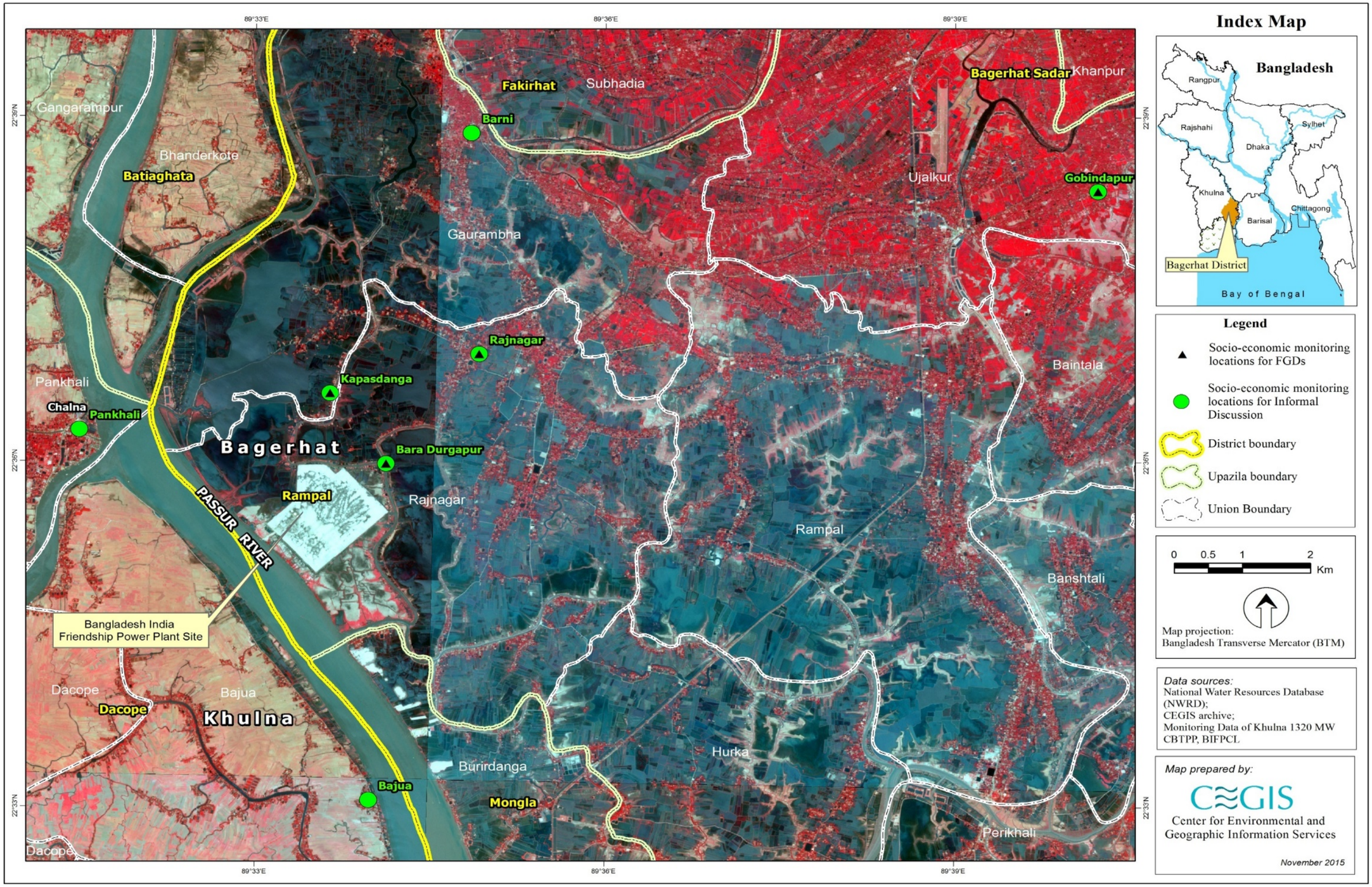
189. On the other hand, people of Gaurambha union (including Kapasdanga and Barni mauzas) expressed their disappointment for not getting any support for livelihood improvement yet though more than half of the land of the project area was owned by these people. They urged that if the project authority should provide trainings to the affected people in this union, based on the potentiality of the job market before selecting the field; so that the trainees could have better opportunity of employment after receiving the training for skill development and livelihood restoration. It is pertinent to mention that an independent agency M/s EQMS has prepared the LRP (Livelihood Restoration Plan) in consultation with these people and comprehensive training programme has been drawn. BPDB already are in the process of appointing an NGO for implementation of LRP. (EOI already published in the News paper).

Resettlement/Rehabilitation

190. About 18 of the total 150 non-titled households (informal settlers) who used to live in the project site before eviction from the acquired land, were provided shelter to the Foyla Shelter Home. However, eight of that resettled households moved out the shelter home over the last three years due to lack of potential source of livelihoods and income in this area. The remaining household members are somehow trying to cope with the surrounding socio-economic features of that cluster village. But they are in search of sustainable working opportunity within the District and determining to migrate, if badly needed. It is to be noted that about thirty (30) non-titled affected households are still residing to the edge of the project boundary.

191. In terms of income restoration and livelihood improvement programs, project authority trained 60 people on sewing and computer literacy so that theycould restore their livelihoods using training skills. Accordingly, training on sewing and computer literacy were organized at the project site. The trainees were satisfied with these trainings but they could not find out possible linkages in job fields. In this respect, they demanded for some logistic supports i.e. sewing machine, sewing yarn and computer buying facilities in installment with zero interest and so on to the project authority. They stated that the job sectors related to these trainings have already been saturated. Thus the people urged that it would be better if the project authority introduces trainings on welding, painting, driving, electrical work, mechanical work, and security works. It is to be noted that two trainees got sewing machines from the project authority, but they do not have any order for sewing clothes in their handas stated by Chairman, Rajnagar unionThe chairman also stated that project authority has appointed one person in official work in Dhaka. He added that, there would be more opportunities to employ officials in BIFPCL field office in the coming days.

192. It is expected that BPDB will implement LRP (Livelihood Restoration Plan) in expeditious manner which were prepared in consultation with the local people and comprehensive training programme has been drawn and are already are in the process of appointing an NGO for implementation of LRP. (EOI already published in the news paper. Once the LRP is implemented, the local people will be immensely benefited.



Map 4.1: Socio-Economic Environment Monitoring Location

Project Related Employment Generation

193. The construction activities have been started by the assigned contractors under the lead construction firm named Bharat Heavy Electricals Limited (BHEL). The BIFPCL authority expressed their hope that the construction firm would recruit local laborers according to their area of expertise. During field survey it was observed that, 10 out of 30 non-titled affected households' members (those were residing adjacent to the project boundary) got chance to engage themselves in construction activities. The local working laborers stated that scope of engaging more laborers would be created soon.

194. The project authority stated earlier that they would train the local people to fit them as semi-skilled and skilled laborers, if possible. But, such type of initiatives was not observed during field survey. The EPC contractor and some sub-contractors have followed this instruction yet. However, in near future this instruction would be followed while huge volume of labors will be required. At present, Test piling, load test, road construction, water treatment plant having 20,000 liter water storing capacity and other minor activities were being carried out to be initiated in the project site. According to a working laborer, at present about 200 laborers are working in the site in which about seventy (70) working laborers are migrated to project site from Nilphamari, Kurigram districts.

195. The placement of a Grievance Box in the project office indicates that project authority has taken some initiatives to redress the grievance of unexpected occurrences that have occurred due to the project interventions. But, the matter of disappointmen is that not a single complaint has still been dropped in that box over last one year. People of the project surrounding mouzas stated that they were unaware about the matter of grievance.

196. Project authority is requested to give wide publicity that grievance are available and people can lodge their complain. So, the initiative of installing grievance box will be successful if all the people of the surrounding mouzas are well aware about it.

Labor and Working Conditions

197. During the field monitoring, the laborers were found living with some temporary accommodation facilities. The labor sheds is under construction by the EPC contractor. They will provide every facilities as informed by the authority during construction phase. Moreover the labourer's sheds are constructed outside the project boundary wall so the matter of their security needs to be given due considerations for the construction stages. The previous accommodation facilities provided to the labourers during pre-construction phase have already been saturated by some of the laborers working from the earlier stage of the project activities. So it has become essential to ensure adequate accommodation facilities using standard materials, safe drinking water, hygienic sanitation and proper medical facilities for the laborers. For creating those facilities gender issues should be kept in priority; even a separate feeding room should be arranged for the mothers to feed their children. Presently some of the activities of the construction phase though been started It was recommended to the project authority to pursue the EPC contractor as well as subcontractors to ensure standard accommodation facilities for the laborers.

198. A number of safety signboards were found in the project site which indicated a good initiative for reducing accidental occurrences. Workers are also found to use Personal Safety Equipments (PPEs). They stated that the contractor and project authority strictly monitored this issue. 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 shown separately in the following table 4.1.

Table 4.1: Protective equipments of risky limb in human body

Risky limbs of human body	Protective Equipments	Present practice in project site
Eye	Safety spectacles/goggles	✓
Ear	Earplugs	X
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	X

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

199. The labors of the construction site expressed satisfaction about their wages in comparison to the wage rate of project surroundings. The wage rate of unskilled/semiskilled labors varied from BDT 380 to BDT450 in the project site while for the skilled workers it is up to BDT 700 for the respective works.

200. The BIFPCL authority earlier stated that festival allowance will be given to all the temporary and permanent workers as per the law of Bangladesh Government. Recreational arrangement and prayer facilities will also be established for mental, and physical refreshment. Mentionable that a mosque is already exists inside the project area.

Safety Signboard

Safety Signboard

Labors working in road construction

Temporary Laborshed of newly migrated labors

Community Health Safety and Security

201. The people expressed that dust particles generated from the project area was being mitigated by adopting some suggested mitigation measures. The boundary wall in project surroundings played an important role to reduce dust flow in the study area. Howeverr, 12,118 fruit/ wooden/medicinal trees and 10,426 Golpata planted trees (12,118 fruit/ wooden/medicinal trees and 10,426 Golpata) by the project also played an important role to mitigate the dust problem. In addition, about 1000 coconut trees and 1000 different flower trees have been planted over the last six months in the project area. Moreover, heavy construction works during quiet time (8 pm to 7 am) should be restricted and strictly monitored as well.

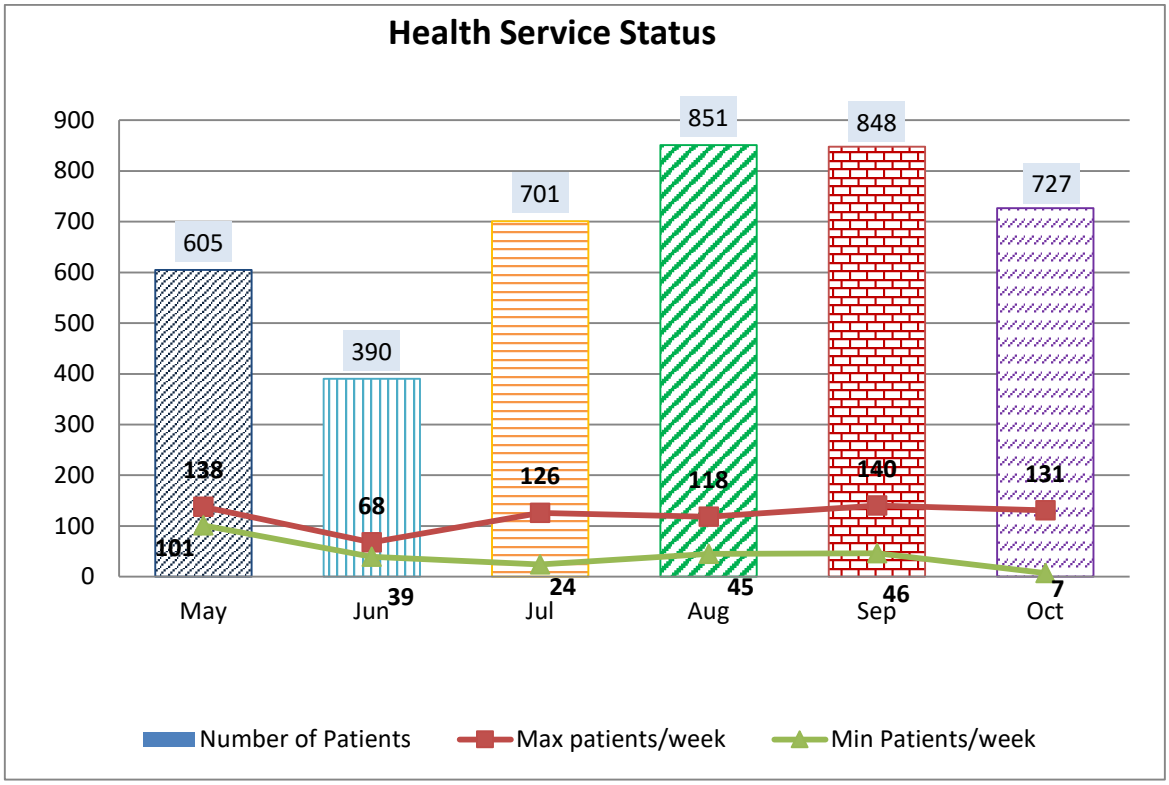
202. For ensuring community safety and security, watch towers have also been constructed to monitor people's movement in and around the project area. The project authority stated that after finishing the construction work permanent drainage, sewerage and water supply network will be prepared as per detail design. Till then these utility networks will be temporarily managed using possible sustainable ways. However, the assigned contractor can prepare/arrange some temporary utility facility according to their needs. The BIFPCL authority stated that, each sub-contractor were asked to have at least one environment, health and safety officer for ensuring safe and hygienic health, safety and environment condition in the project surroundings. The EHS officials monitored the compliance of all applicable environmental and safety norms on the construction activities.

Activities under Corporate Social Responsibilities (CSRs)

203. Free medical services have satisfatorily been sustainably performed over last four years, targeted to ensure better treatment facilities in project surrounding areas. T the services have gained popularity among the local people day by day. The medical camp is still organized twice a week where patients are treated by an expert physician. In general, the official medical center remains open during all the seven days in a week. At that time period, patients could get medicine and other general facilities from the medical center by the guidance of medical assistants.

204. An equipped separate compartment from the BIFPCL office compartment has been formed for setting up medical unit. There are 2 shelves for keeping medicines and instruments, a 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. It was stated in earlier phase of monitoring that 'some equipment will be included in existing medical facilities to extend the facilities' but those are not included yet. In addition, EPC contractor may set up a medical center for their laborers and workers in construction phase, where one qualified first aider/ paramedical staff will be assigned for each 50 laborers.



Source: Field visit to Medical Center at Project area, CEGIS, 2017

Figure 4.1: Record of health service recipients under CSR program

205. From the patient's record, it was found that 4,122 people had received free health services in the last six months (from May 2017 to October 2017) from the medical camp. In addition, some workers were treated in official medical center. The highest recipients were in August-2017 and the lowest in June-2017 (Figure: 4.1).

206. People expressed satisfactions with the services of medical unit, though there are some disappointing issues. Some poor patients stated that after bounding the area patients have to move towards medical camp by existing road only where unavailability of vehicle as well as excessive fare charges are usual matter. They urged for vehicle facilities from the project authority at least for the critical patients; if possible. The authority stated that they also have planned to introduce ambulance facilities with commencing the activity of construction phase. It was conditioned to arrange the cost of CSRs as the rate of BDT 0.03 per kW on total profit while they had run the medical service on their own fund as the plant did not start its production yet. Therefore, by the progression of project operation, more medical facilities will be introduced according to the availability of funds.

5. Environmental Compliance

5.1 Introduction

207. The construction activities ran massively in this quarter. The EPC contractor has started the work after the monsoon period. Geotechnical study at the Boiler and Turbine site, internal road communications, temporary drainage system development, water treatment system test piling work, construction power, construction of store, living accommodation, office building for the construction activities etc. is progressing in this stages.

208. Now, the approach road from Khulna – Mongla Highway to Power Plant Project site has also been completed and one can easily access to the project site office easily. New section wise boundaries have been demarcated for safety and harmonise the work effectively. Boundary wall around the first Phase of Project and the slope protection works have also been completed. The pre-fabricated building is being used for the main project office of BIFPCL and the previous office has been left over for the EPC office. BHEL have already employed different local specialized construction firms for construction simultaneously.

209. The 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.

210. 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 Table 5.1, 5.2, 5.3 and 5.4 present the summary of findings of the environmental compliance monitoring.

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 on project boundary • Limit vehicle speed and monitor it at every suitable point	• CEGIS is being carried out noise survey under environmental monitoring study. • Machines/equipment/ generators which are passing idle period were observed switched off/throttled down. • Developed EHS documents for construction works. • Using sound proof room for the officers	Being Complied.	• Use of earplug as PPE should be obligatory for the workers during construction works, pile drive etc. • Workingof the heavy noise generating equipment (e.g. stone/brick crusher) should not be operated during sunset to sun riseEHS register and Grievance redress register should be properly maintained;
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	• CEGIS is quarterly monitoring the dust generated at the sensitive receptors like boundary corners, project site, nearby communities and inside Sundarbans • New road network is being developed to prepare as per layout • Boundary wall for the main Plant has been completed. • Dust generation is minimal due to heavy monsoon rainfall • The worker are using PPE properly • Notification, sign has been hanged on the strategic points • Medical treatment and medication are provided to the workers working in the project	Being Complied and will be complied as and when needed.	• EPC contractor should include vehicular sprinkler for spraying water twice in a day especially during upcoming winter to control fugitive dust; • Vehicular speed should be limited and monitored regularly; • Location/task oriented dust suppression system should be adopted at workplace and workers residence • Harvesting the reeds or uncovering top soil should be carried out as and when required • Redressal mechanism should be implemented for any kind of grievance from the community related to dust;

Sl. No.	Potential Impacts	EMP measures as proposed in the EIA	Actual condition/ Measures already Implemented	Compliance Status	Recommended Action
		spraying water during dry season • Stock piles of construction materials must be covered in order to protect from wind action • An appropriate freeboard must be maintained in trucks hauling construction materials			
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 trainings and awareness building programs 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 and the issues will be discussed under	• Harmful disposal was not recorded which is reflected in the monitoring parameters • Exiting drainage system has been rearranged and temporary drainage system being developedfor the construction period • Rainfall runoff are discharged to nearby river through existing drainage network, which is being cleared occasionally. • Onsite sanitation facilities have been developed in 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 wastes should be disposed at the designated places; • Awareness building training and good practises should be introduced; • Temporary sewerage treatment system • The solid waste on-site dumping system, collection system and offsite disposal system should be developed

Sl. No.	Potential Impacts	EMP measures as proposed in the EIA	Actual condition/ Measures already Implemented	Compliance Status	Recommended Action
		guidance of ECR 1997.			
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 are required to be covered 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 blockage • Keep provision of sanitary toilets (one toilet for 10 persons) • Location of spoil stockpile ought to be located in safe area and protected from wind and rain action. • No spoil to store on River bank/slope • Construction wastes must be reused or recycled as and where possible • Burning of waste material should be restricted	• Heavy equipment and mechanical equipment are kept in the demarcated places • 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	Being complied	• Sufficient waste disposal bins with labelling should be installed in labour sheds, and working area before starting of the main construction works; • Sanitation facilities should be increased in future • Reduce, reuse and recycle of the construction waste as much as possible • Different coloured waste bin for dumping biodegradable, reusable and recyclable wastes should be introduced • Introduce colored waste bins for dumping individual wastes. • Quality housekeeping practice should be maintained through regular inspection and checking • Proper trainings/ awareness building programs should be given/arranged for the labours for waste collection and management;

Sl. No.	Potential Impacts	EMP measures as proposed in the EIA	Actual condition/ Measures already Implemented	Compliance Status	Recommended Action
		• Quality housekeeping practice must be maintained through regular inspection and checking • Keep onsite waste collection and disposal facilities • Keep provision of different colored waste bins 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 • Make formal agreement with the affected people prior to migration/resettlement • Provide sufficient standing crop compensation • Provide compensation for movable structures • Retention of salvageable materials • Compensation for loss of trading income • One time moving assistance	• Compensation has been given to the actual owners of the land as per the laws of Bangladesh e.g., Acquisition and Requisition of Immovable Property Ordinance, 1982 • Compensation has been made by the 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 give priority to the project affected people in Project related employment • List of 136 people indirectly affected was givento the DC office, Bagerhat. • Livelihood Restoration Plan (LRP) for the PAPs have	In the process of Compliance	• Initiatives should be taken for resettlement of the people as per the LRP; • Introduce trainings to the PAPs, so that they can get job according to their skill during construction stages; • Should implement LRP expeditiously.

Sl. No.	Potential Impacts	EMP measures as proposed in the EIA	Actual condition/ Measures already Implemented	Compliance Status	Recommended Action
		• Grant to cover loss of regular wage income • A resettlement plan been developed which includes compensation, restoration, livelihood, living standards etc. based on proper socio economic studies? • Human provide/ take extra care/caution for the disadvantaged/ vulnerable group/s (i.e. women, children, ethnic minorities, indigenous people etc.) • Provision for monitoring the compensation and resettlement process	been prepared by BPDB. . BPDB already are in the process of appointing an NGO for implementation of LRP. (EOI already published in the newspaper.)		
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 • Road networks must be developed for the increased movement of people and heavy vehicles	• BIFPCL is maintaining the social liaison • Prepared HR policies, Labour recruitment Policies, Manpower set up etc.; • Local labours are working on the project construction activities according to their capabilities • Most of the local labours are – directly project affected people, nearest communities and within the Rampal/Mongla areas • The wage of the labour is compatible with the standard one • Provision of first aid is present; • Medical unit capable of dealing emergency like injury, accident, etc. already been developed. • Surprisingly communication	In the process of Compliance	• Increase the number of the local labour • Trainings, awareness building programs and grievance redress mechanisms should be adopted in a formal way; • Accidental log sheet or injury log book should be displayed; • 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, Mauali of Sundarbans as future labor forces; • Trainings should be given sequentially to the PAPs, on Local or regional basis;

Sl. No.	Potential Impacts	EMP measures as proposed in the EIA	Actual condition/ Measures already Implemented	Compliance Status	Recommended Action
			system has been developed in this area		• Site specific EHS plan must be implemented;
7	Green House Gas Controlling Measures	• Restrict of all kind of solid waste burning • Regular maintenance of water vessels, vehicles, generator and machinery in accordance with manufacturer's specifications to be adopted. • 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 machineries when not in use	• Make IFC guidelines, EIA approval of DoE, and EMP of the EIA, etc. as a part of the bid document. • Monitoring program is running successfully • Burning of solid waste was not observed. • Vehicles and Vessels are not recorded to be overloaded during the investigation • Third party inspection report of all heavy machines are available.	Being complied	• EPC should adopt energy efficient, CDM measures for selection of technologies; • 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

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 conditions for migrant workers; • Compliance to national law of forming workers' organization; • No discrimination but equal opportunity for all; • Measures for diminishing past discrimination; • Grievance Redress Mechanism.	• Engaged HR consultant to prepare relevant policies; • Occupation Health and Safety department is working ; • ERP and ESMS has been finalized • The EPC has contracted with the sub-contractors about labour policies Ensured minimum wage as per GoB for the labour;Following the Bangladesh Labour Law (Revised) 2013, Bangladesh Labour Rule, 2015	Being complied	• Appointment of Local workers should be given priority for non-technical/non-skilled jobs. • Motivational and training works should be introduced regularly. • No discriminationbut equal opportunity and employment terms and conditions for local and migrated labours have to be carefully maintained
2	Protecting Work Force	• The client will not employ child labours 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	• No child labour employment is ensured • No forced labour is ensured • First Aid support to the labours during any accident • Immediate first aid medical treatment has been given to about 25 numbers of labours • ERP has been developed • Increasing the medical facilities for the labour	Being complied	• The HR policy should cover child labour policy and Labour Law (Revised) 2013 and all other amendments; • 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
3	Safety at site	• Installation/Construction of Safety Fence around the Project area; • Use of Personnel Protective Equipment (i.e. safety vest, safety goggles, ear plug, safety shoes, gloves, dust mask, etc.); • Safety trainings to be arranged for workers (i.e. fire control, working at height, working in heat, first aid etc.); • Practice of Tool box meeting, safety talks to be introduced • Safe Storage of Hazardous Chemicals (e.g. fuel, flammable chemical, toxic chemicals, etc.) to be ensured; • Maintaining Material Safety Data Sheet (MSDS); • Provision of Health care facilities such as doctor, hospital etc. to be made available at/nearby the plant construction site; • Availability of First Aid at work place; • Prepare and follow the Emergency Response Plan; • Adequate fire precautions equipment to be 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	• Safety sign at every strategic places are observed • Specific areas are protected with fence • Encouraged labour and Project personnel to use appropriate PPEs; • Safety Policy of DoE and IFC, Safety measures proposed in EIA report have been incorporated in the contract with EPC; • BIFPCL is very much pro-active to use PPEs to the construction labours • ERP is being followed by the proponent during construction and operation stages. • Safety manual has been followed at the construction site • Fire safety mock drill is being conducted at some regular intervals. • Proponent is going to increase the medical facilities • Project site protection and security system has been maintained by Bangladesh Ansar. They are maintaining the register logs. • Tool box meeting and Pep Talk are being undertaken regularly. • All labours were given induction training	Being complied	• Increase manpower in EHS Department; • Pep talk and tool box meeting should be continued. • All electric distribution lines in the project site are required to be fixed as safe and tidy; • The proponent should implement the ERP at their project site and communicate with the other organizations to following the ERP holistically for coal transportation; • Insurance of the labours and employers 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
		employers in relation to OHS.			
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	• Prepared HR policy and with the organogram; • Medical aid, fire extinguisher, PPE are provided; • Worker's shed and sanitation facilities are available • Onsite medical facilities have been continuing. • Site-specific Environmental Health & Safety checking is continued. • RO Water treatment plant and canteen has been operaing for supplying safe drinking water and food. • Grievance procedure for labour are being practised.	Being complied.	• The OHS unit should be functional before starting of the Power Plant construction works • Regular trainings, awareness building, motivational and mock drill should be arranged at the construction and operation phases; • OHS procedure should also be followed by all workers including the labours from sub-contractors. • Insurance system should be introduced • Introduce formal mechanism of grievance redressal of the labour
5	Workers Well Being	• Provision of Welfare facilities for Worker/Labor such as, timely bonuses, salaries, sick leaves, vacations etc.; • Routine medical check-up and emergency medical care for the sick and injured; • Appointment of a leader amongst the labor group, who will look over the workers' well-being.	• Health care & information, canteen facilities and, water supply are provided by the proponents. • Proponent is now pushing to establishfare wage of labours and the benefits • Free first aid medical treatment are being facilitated by BIFPCL to the labours • Grievance register are being initiated for the worker.	Being Complied	• The workers well-being should be protected in the contract documents among the proponent, EPC, sub-contractor • Introduce occupational code of practices/best practices compatible with their own culture • Freedom of Association, Rights & scope of bargaining

Sl no	Potential Impacts	EMP measures as proposed in the EIA	Actual measures already Implemented	Compliance Status	Recommended Action
					and tripartite consultation should be opened for the workers. • Continue the Implementation of formal procedure for grievance redress mechanisms • The proponent has to look after the 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; • Conduc 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 • Block-B is highly responsible for spreading dust to the nearest community • Grievance redressal mechanism is in foce.	Being complied	• Regular communication with the local community • Spraying of water to the exposed land in the after noon of the upcoming winter • Low noise generating vehicles and equipment should be used by the EPC contractor
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 is conducted to identify the grievance of the nearby communities; • National level stakeholder consultations are conducted occasionally • Proponent is observing the community grievance or quarries though the monitoring study conducted by CEGIS • Grievance register is available at site office.	Being complied	• Regular local level consultation is necessary for impact monitoring as well as updating the local communities • Register the redressal activities • Proponent should develop a frame work to eliminate any conflict between migrated labors and local communities
3	Risk of breaching Community Safety	• Construction of boundary wall/safety fence around the Project area; • Practice 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; • Maintain open communication channel with the local community;	• Constructed the boundary wall around the Project area; • Implemented high security system for the project; • Preparing a safety checklist that is to be followed during selection of construction contractors; • Maintaining communication with local community; • Negotiation with local DC office and Bangladesh Ansar and VDP (who are responsible for security).	Being complied	• Occupational and Health safety officer need to monitor this issue • Aware labours and all employees about the safety procedure and health check-up. • Arrange trainings and motivational work for maintaining local norms and values and have a good relation with the local

Sl no	Potential Impacts	Proposed EMP	Actual measures already Implemented	Compliance Status	Recommended Action
		• Training and instruction to the security personnel about their behaviour and communication with the local people; • Aware the security personnel about the rights of the community people.	• The project proponent has engaged the local governments and communities for improving their livelihood status • Protective measures are under taking to avoid vector borne diseases and HIV positives		workers and communities; • Make a liaison with the local government for any kind of indent related with the local communities • 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; • Implement all pollution mitigation measures to ensure safeguarding to community.	• Increasing medical facilities (consisting medical officer, medical assistant, office assistant) at Plant site; • Arranging weekly health service program (medical consultation and free medicine) for the local community; • health services has been from May 2017 to October 2017 due to development of approach road communication Protective measures are taking to avoid vector borne diseases and HIV positives	Being Complied	• The proponent should train the migrated labors regarding the local culture and customs • Health check-up must be carried out to the labors • The proponent may arrange consultation meetings with the local communities • The proponent may establish business development activities (markets) for the workers and local communities as CSR activities.Awareness building program should be introduce to reduce any transmitted disease, HIV and violence toward communities
5	Youth Employment (Local)	• Provide trainings/awareness building programs to the local youth to let them aware about the required qualification to be involved in the Project related activities • Emphasise to recruit local labours as per their skills and capacities	• Informal sittings have been made with the local government • Regular trainings workshop on tailoring and computer has been organized by the proponents • The proponents have already taken few initiatives to encourage local students/youths through awaring	Being coimplied	• Increase the number of local labours • Create opportunity for the local youth to get involved in the Project construction activities; • Assign job responsibilities based on skills and training

Sl no	Potential Impacts	Proposed EMP	Actual measures already Implemented	Compliance Status	Recommended Action
			them. • Local labours are working in this project engaged by the sub-contracting companies • Formal trainings on computer literacy and sewing machine have been initiated in the site and already 3 batches have completed the training program. • BIFPCL has also taken initiatives to send the local youth for industrial trainings in Khulna divisional area. • At present 250 to 300 labour are working in MSTPP project site and 70 to 80% of them are locally recruited.		for the locals • Proponent can hire trainer to train the local and regional youths on vocational trainings. • Support Income generating activities and business development activities for the local potential youths.
6	Public Communication, Consultation and Awareness	• Arranging public communication/consultation meeting; • Sharing of Project information with local people; • Organizing environmental and social awareness programs/meetings.	• Informal sittings have been made with the community; • Displayed Project related information on a display board at Project site; • Regular public consultation meetings are consulting at different level; • Advertisement of this power plant was broadcasted • Published Project related discussions/articles in different print media. • Project related every information has been uploaded in BIFPCL website. • Various programmes like painting, essay, and slogan competition are being organised at local school and colleges.	Being Complied	• Continue the dissemination workshop in Dhaka and Khulna to aware the community, civil society, environmentalists about the environmental safeguarding measures considered in basic design. • The proponent is to be confirmed firmly about the technologies, fuel, pollution control measures and emission • 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. • Construction of fresh water supply system both for construction and domestic uses are been made.	Being complied	• The proponent has to maintain and clear the temporary drainage system as huge construction work is going on. • The proponent needs to monitor that there is continuous connectivity of the free flow of Maidara River. • Storm water drainage network must be separated from any other contamination of chemicals or oily water. EPC should manage the waste water generated during the constructions and they should manage the by-products from the water treatment plant
2	Disturbance to nearby ecosystem due to different construction activities	• No cutting/ felling of trees along the river bank to be ensured; • Implement the onsite waste and air quality management plan; • Limit soil extraction activities within the defined area; • Limit the vegetation clearance and base stripping process within the Project boundary; • Safety fence around the construction site; • Limit the use of night light; • Use 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;	• No cutting/ felling of trees took place along the river bank; • Soil extraction activities is limited within the defined area; • The vegetation clearance and base stripping process within the Project boundary has been limited; • Boundary wall around the project is completed along with compartmentalization • Provision has been made of cut-off time to switch off unnecessary lights at night; • Local plant species for green plantation has been selected; • No degradation is made to the habitat out site the power plant area	Being Complied	• Inforce no harm/ no kill of the wild animals and habitats for the project personals and build up awareness for local people • 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 building 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

Sl no	Potential Impacts	EMP measures as proposed in the EIA	Actual condition/ Measures already Implemented	Compliance Status	Recommended Action
		• Retaining top soil for future habitat restoration; • No degradation of sensitive habitat.	• Working activities are now limited within the project boundary • Trainings and motivational works are gradually been introducing to protect local fauna.		• 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 to be ensured; • No disturbance to Dolphin community to be ensured; • Monitoring of Ecosystem Health and Monitoring of Sundarbans Forest Health to be ensured; • If required, embankment should be constructed considering a setback distance from river/canal bank; • Slope protection works along the Maidara River should be completed on an urgent basis before the next rainy season, and; • BIFPCL may take initiatives for excavating the silted reaches of Maidara river near proposed township area to facilitate proper functioning of the River for maintaining tidal flow dynamics	• Monitoring of forest health and ecosystem health in Sundarbans and around the Project site are being carried out by CEGIS; • Maintaining significant setback distance from Passur river to the Project site; • The slope protection work has been completed; • Protection works along the Maidara River maintaining setback distance from Maidara River. • The natural stream of Maidara River near the access road has been opened.	Being Complied	• EPC contractor will maintain the natural flow of the Maidara river • Do not make any disturb to navigation, water quality and ecosystem for heavy equipment transportation

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
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 already been appointed. They are processing all activities in connection to import Power Plant machineries.	Strongly Suggested to comply as and when required
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 yet been reported. All necessary measures have already been incorporated in the technical specification of main Plant of EPC package as per DoE stipulations. Pollution control measures have widely been covered in the 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 also monitoring the mitigation measures adopted through an environmental consultant CEGIS. Site development activities have been completed and construction work has been started. Mitigation measures appropriate at this Proper and adequate mitigation measuresare being undertaken.	Complied at present
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).	Complied at present
8	Environment friendly construction and development practices shall be	The construction activity is being carried within the project boundary. The	Being Complied

Sl no	Condition of DoE	Compliance	Remarks
	followed that minimize loss of habitats and fish breeding, feeding & nursery sites.	equipment and labours/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.	
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.	The present activities are limited to day time only. BIFPCL is keeping close communication with local people to receive the grievance related to project activities.	Being Complied
10	Proper and adequate sanitation facilities shall be ensured in labour camps throughout the proposed Project period.	At present, the construction activities have been initiated. Sanitation facilities have been provided for this initial stage. 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 environment friendly solid waste management should be in place during the whole period of the Project in the field.	No solid waste is burnt inside the project boundary. Provisions in line with this condition have been included in Clause No 14.9 of SCC. Solid Waste Management system has been prepared (Section-V, B12, Part 9 of Technical Specification).	Being Complied and suggested to 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 have been initiated. BIFPCL has appointed a paramedical staff and visiting Doctor is also made available for regular health checkup of the workers. Villagers of the surrounding areas are also availing the health facilities. They are trying to aware the labours/worker on occupational health and safety through safety sign board, 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

Sl no	Condition of DoE	Compliance	Remarks
15	To control dust, spraying of water over the earthen materials should be carried out from time to time.	No complain of dust pollution has yet been received from the labours. Contractors will use water as dust suppression from this winter. Besides, a boundary wall around the Plant has been constructed to control dust within the project boundary.	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 stocked and piled far away from river banks and other natural water bodies. They are preparing temporary drainage system to evacuate water from the project site	Being Complied
17	Adequate considerations should be given to facilitate drainage system for runoff water from rain/tidal surge.	Temporary drainage system is going todeveloped, maintaining the layout drawing. 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 before the next monsoon. Contractor is preparing to construct 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	100% utilization of fly ash has been planned and shall be implemented throughout the operation of this plant.	Complied at present and Will be

Sl no	Condition of DoE	Compliance	Remarks
	operation of the Plant. There should only be a provision of small ash dyke that will not exceed 25 (twenty five) acres of land to store residual ash.	EOI has been received in this regards from nearby Cement Plants. Only 25 acres area has been allocated to store residual ash.	Complied throughout Operation phase
24	Integrated dry ash handling, loading, unloading and transportation system should be established.	Integrated dry ash handling, loading, unloading and transportation system will be established. Provisions in line with this have 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 (LRP) regarding the rehabilitees (including those who do not own land) for this power plant.	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 (LRP) regarding the rehabilitees (including those who do not own land) for this power plant.	Compliance action initiated
29	Construction material should be properly disposed-off after construction work is over.	At present, the construction work is being initiated. 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,	BIFPCL has adopted all of the EMP	Complied at

Sl no	Condition of DoE	Compliance	Remarks
	construction and post-construction stage) should be implemented according to EMP clearly listed in the EIA report.	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.	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 continued till December, 2017. 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 monitored regularly with a network monitoring system with a view to assess the natural quality of the Sundarbans and other fragile ecosystem and report of monitoring results should be submitted to Bagerhat District Office, Khulna Divisional Office and Headquarters of the Department of Environment simultaneously.	The network of monitoring system will be installed as a part of the project construction for online monitoring and it will be run at the time e 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.	Compliance action initiated
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	The MIS will be prepared before	Compliance

Sl no	Condition of DoE	Compliance	Remarks
	(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.	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.	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 are installing potable and construction water treatment plant sourcing from the river water of Passur	Being complied
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. During the construction phase, 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.	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 being 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	The construction works is now initiated. BIFPCL has submitted the detailed work plan to various offices of DoE seven (7) days before start of the construction activities	complied

Sl no	Condition of DoE	Compliance	Remarks
	Bagerhat District Office, Khulna Divisional Office and Headquarters of the Department of Environment simultaneously.		
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 shall be made available by BIFPCL simultaneously to DoE Bagerhat District Office, Khulna Divisional Office and Headquarters on a monthly basis during the construction period of the Project.	being complied
45	The following records must be kept in respect if any samples required to be collected for the purpose of environmental monitoring activities: the date(s) on which the sample was taken; the time(s) at which the sample was collected; the point at which the sample was taken; and the name of the person who collected the sample.	The Monitoring report 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, landslide, 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 yet 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, when main plant construction activities start.	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 would establish 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 been employed and CEGIS	Complied at present

Sl no	Condition of DoE	Compliance	Remarks
		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 would establish a proper mechanism for recording such incident as suggested in the ERP. CEGIS has been engaged to monitor the social and environmental compliance after 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 as suggested	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. Another NGO has planted 1000 coconut 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 yet to obtain the approval from DoE.	Being Complied
54	A full-fledged institutional setup for EHS and CSR must be put in place before operation of the Power Plant.	A full-fledged institutional setup for EHS activities shall be in place before operation of the Plant (Project). Meanwhile, a number of CSR activities are ongoing at Project site, like free medical facilities and medicines, free potable water supply to the local people. BIFPCL has appointed a social worker to collect relevant social data. Health and Safety manual has been prepared.	Being complied
55	The Project authority shall extend active cooperation to DoE officials to facilitate their visit to the site as and when necessary.	BIFPCL is extending its all-out cooperation to DoE	Being Complied

Sl no	Condition of DoE	Compliance	Remarks
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 systematic for preventing pollution. All these stipulations have been included in the technical specification of Main Plant EPC contract package. Moreover, the area of those 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.	-

References

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Raman S M B, Sarder L, Rahaman M S, Ghosh A K, Biswas S K, Siraj S S, Huq K A, Hasanuzzaman A F M and Islam S S (2013), Nutrient dynamics in the

Sundarbans mangrove estuarine system of Bangladesh under different weather and tidal cycle, Ecological process, springer, page 5.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Appendix I: Checklist of Monitoring Environmental Compliances

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

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

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

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

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

(Labor and Working Condition)

Basic Data

Sl No	Description	Values
1	Direct Workers	
2	Contracted Workers	
3	Supply Chain Workers	
	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			

Sl no	Potential Impacts	Proposed EMP	Actual Implementation	Recommended Action	Compliance Status
		• Availability of First Aid at work place • Preparation and Follow of Emergency Response Plan • Adequate fire precautions in place (for example, fire extinguishers, escape routes etc.) • Documentation and reporting of occupational accidents, diseases, and incidents • Policies and procedures for managing and monitoring the performance of third party employers in relation to OHS			
	Occupational Health and Safety Procedure	• Provision of complete EHS division in the Human Resources Planning/Organogram • Preparation of Safety Policy to be adopted during plant operation			
	Worker's Well Being	• Establishment Grievance Mechanisms • Ensuring fair treatment, non-discrimination and equal opportunity • Compliance of Project's labor policy with the national labor law • No Child Labor • No incident of forced labor • Provision of Welfare facilities for Worker/Labor			

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

(Community Health, Safety and Security)

Sl no	Potential Impacts	Proposed EMP	Actual Implementation	Recommended Action	Compliance Status
1	Disturbance to nearby community due to dust from newly developed land and Noise from construction activities	• Construction of boundary wall around the Project are • Installation of water spraying system to control dusts • Conducting dust monitoring and visual inspection around the site boundary • Adoption of Noise management plan			
2	Grievance of local people	• Availability and operation of Grievance Redress Mechanism • Maintaining open communication channel with the local community			
3	Risk of breaching Community Safety	• Construction of boundary wall/safety fence around the Project area • Practicing Risk Assessment and Evaluation Process • Practicing safe management for hazardous materials which may pose threat to the community • Availability and operation of Emergency Response Plan • Maintaining open communication channel with the local community • Training and instruction to the security personnel about their behaviour and communication with the local people • Aware the security personnel about the right of the community people			

(Continued)

Sl no	Potential Impacts	Proposed EMP	Actual Implementation	Recommended Action	Compliance Status
	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			
	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			

Sl no	Potential Impacts	Proposed EMP	Actual Implementation	Recommended Action	Compliance Status
		within the Project boundary • Safety fence around the construction site • Limiting the use of night light • Using shade (directed downwards) around the outdoor lights • Provision of cut-off time to switch off unnecessary lights at night • Initiate Green plantation • No plantation of non-native species • Retaining top soil for future habitat restoration • No degradation of critical habitat?			
3	Occupation of river, inter-tidal areas and wetlands	• No encroachment of inter-tidal flood plain area • No disturbance to Dolphin community • Monitoring of Ecosystem Health and Monitoring of Sundarbans Forest Health • If required, embankment should be constructed considering a setback distance from river/canal bank • Slope protection work along the Maidara River should be completed on an urgent basis before rainy season come and • BIFPCL may take initiatives of excavating of silted reach of Maidara river near proposed township area to facilitate proper functioning of River for maintaining tidal dynamics			

Appendix II: Photo Album

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

The Monitoring Team

Estimation of tree height

Collection of DBH data

Collection of water samples

Monitoring team at Harbaria

Collection of sapling data

Project details is outlined on a board

Newly built toilets inside the project area

Accomodation facilities of the labours

Drinking facilities for the labours

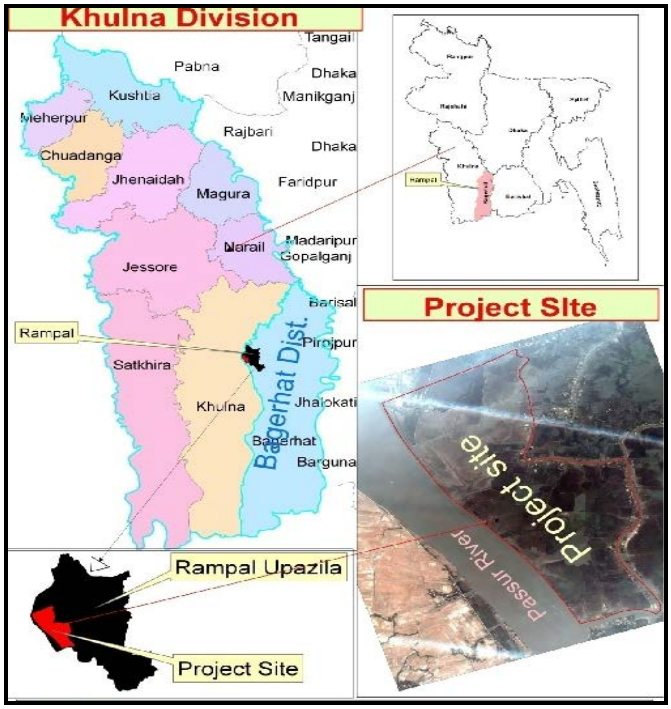
Uses of PPEs are being examined

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

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

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, April, 2017	Bangladesh (DoE) Standard (ECR 2005)	IFC/WB Standard
eather		Sunny	Rainy/ Cloudy	Sunny	Sunny	Sunny	Rainy/ Cloudy	Sunny to Rainy	Sunny	Sunny	Rainy/ Cloudy	Rainy/ Cloudy	Sunny	Suny- /cloudy	Suny		
		Concentrations are in µg/m³															
SW Corner of the PP area	**$PM_{2.5}$**	33	37	25	33	47	25	22	34	19	5	9	24.8	8.12	28.2	65^{24hr}	75^{24hr} (IT-1)
	PM_{10}	78	77	53	79	83	35	52	135	117	32	22	79	43.8	73.6	150^{24hr}	150^{24hr}(IT-1)
	SPM	207	239	190	200	177	42	91	175	332	51	53	115.7	122.4	169.4	200^{8hr}	NF
	SO_2	21	24	19	23	15	52	35	14	18	9	8	9.5	9.0	7.2	365^{24hr}	125^{24hr} (IT-1)
	NOx	26	29	27	31	29	35	29	18	18	12	10	11.3	10.7	7.5	100^{Annual}	200^{1hr}, 40^{Annual}
	CO	120	188	140	190	144	146	88	74	57	35	119	59	91	73	(10000) ^{8hr}	NF
	O_3	27	26	19	22	26	12	5	4	1	1	1	5	03	10	157^{8hr}	100^{8hr}
Proposed Township area	**$PM_{2.5}$**	39	48	48	39	34	18	17	35	25	3	8	25	14.6	8.5	65^{24hr}	75^{24hr} (IT-1)
	PM_{10}	814.69	90	74	102	97	31	48	116	44	11	11	99.5	56.9	40.4	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	200^{8hr}	NF
	SO_2	19	28	22	21	22	58	27	13	11	4	6	12.9	10	4.3	365^{24hr}	125^{24hr} (IT-1)
	NOx	29	39	27	26	24	46	25	16	22	6	8	15.7	11.8	6	100^{Annual}	200^{1hr}, 40^{Annual}
	CO	165	210	230	164	136	127	102	77	22	31	108	66	78	79	(10000) ^{8hr}	NF
	O_3	33	26	26	23	21	16	1	1	1	0	0	1	08	25	157^{8hr}	100^{8hr}
NW Corner of	**$PM_{2.5}$**	37	44	19	42	59	28	19	24	11	3	10	29	10.3	15.2	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, April, 2017	Bangladesh (DoE) Standard (ECR 2005)	IFC/WB Standard
eather		Sunny	Rainy/ Cloudy	Sunny	Sunny	Sunny	Rainy/ Cloudy	Sunny to Rainy	Sunny	Sunny	Rainy/ Cloudy	Rainy/ Cloudy	Sunny	Suny- /cloudy	Suny		
		Concentrations are in µg/m³															
	PM_{10}	67	78	56	98	91	96	29	125	29	24	14	108.7	31.3	49.9	150^{24hr}	150^{24hr}(IT-1)
	SPM	234	217	157	310	244	321	66	187	115	31	35	168	91.7	63.9	200^{8hr}	NF
	SO_2	19	22	18	27	21	56	32	13	17	4	8	12.2	5.8	7.5	365^{24hr}	125^{24hr} (IT-1)
	NOx	23	28	22	32	39	43	21	18	16	5	11	14.7	7.1	9.2	100^{Annual}	200^{1hr}, 40^{Annual}
	CO	110	178	110	210	140	133	87	77	38	47	127	31	74	80	$(10000)^{8hr}$	NF
	O_3	25	19	17	36	44	11	8	2	0	1	1	3	05	10	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	65^{24hr}	75^{24hr} (IT-1)
	PM_{10}	103	122	67	97	82	65	26	97	82	45	13	105.4	30.5	30.2	150^{24hr}	150^{24hr}(IT-1)
	SPM	233	244	183	277	236	79	112	176	268	69	30	167.8	95.6	57.2	200^{8hr}	NF
	SO_2	21	23	17	22	25	41	31	16	20	10	7	12.2	5.5	4.1	365^{24hr}	125^{24hr} (IT-1)
	NOx	25	28	22	26	27	44	32	21	16	12	9	19.3	9.8	5.0	100^{Annual}	200^{1hr}, 40^{Annual}
	CO	175	210	190	150	196	96	96	81	73	41	98	63	85	77	$(10000)^{8hr}$	NF
	O_3	26	29	22	19	15	9	6	4	0	0	3	5	08	6	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	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	150^{24hr}	150^{24hr}(IT-1)
	SPM	117	113	162	183	188	175	94	167	167	31	48	162	110.6	127.8	200^{8hr}	NF
	SO_2	19	24	21	18	11	55	33	21	13	7	9	18.9	8.2	7.9	365^{24hr}	125^{24hr} (IT-1)
	NOx	23	26	27	24	18	49	23	16	25	10	8	18	11.2	8.4	100^{Annual}	200^{1hr}, 40^{Annual}
	CO	190	205	170	170	33	133	75	70	33	38	79	36	94	69	$(10000)^{8hr}$	NF
	O_3	27	24	18	22	41	21	2	1	1	0	2	2	03	5	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	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, April, 2017	Bangladesh (DoE) Standard (ECR 2005)	IFC/WB Standard
eather		Sunny	Rainy/ Cloudy	Sunny	Sunny	Sunny	Rainy/ Cloudy	Sunny to Rainy	Sunny	Sunny	Rainy/ Cloudy	Rainy/ Cloudy	Sunny	Suny- /cloudy	Suny		
			Concentrations are in µg/m³														
	PM_{10}	119	127	139	101	105	144	62	128	46	42	18	141.6	105	63.4	150^{24hr}	150^{24hr}(IT-1)
	SPM	297	266	254	208	299	339	183	198	114	78	34	194.6	179	87.5	200^{8hr}	NF
	SO_2	28	31	31	24	30	58	36	18	9	8	8	16.1	12.9	8	365^{24hr}	125^{24hr} (IT-1)
	NOx	41	39	36	26	27	47	23	15	19	9	9	19	18.7	10.2	100^{Annual}	200^{1hr}, 40^{Annual}
	CO	230	217	250	188	177	125	105	101	55	29	112	48	83	87	$(10000)^{8hr}$	NF
	O_3	49	38	36	27	11	13	5	2	2	0	0	3	06	0	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	65^{24hr}	75^{24hr}(IT-1)
	PM_{10}	139	174	77	82	35	52	33	132	45	29	15	119.3	93.6	97	150^{24hr}	150^{24hr}(IT-1)
	SPM	288	303	197	217	214	118	65	189	144	50	6	172.3	196	187.2	200^{8hr}	NF
	SO_2	27	28	26	24	14	45	36	16	10	8	7	16.8	10.5	8.2	365^{24hr}	125^{24hr} (IT-1)
	NOx	44	39	33	27	17	40	20	13	14	10	8	15.3	15.1	10.7	100^{Annual}	200^{1hr}, 40^{Annual}
	CO	230	320	220	211	24	110	84	71	29	31	97	44	72	79	$(10000)^{8hr}$	NF
	O_3	57	52	37	26	09	15	8	3	1	2	1	4	04	9	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	65^{24hr}	75^{24hr}(IT-1)
	PM_{10}	41	39	59	56	49	42	50	82	42	20	14	85.2	36.7	89.9	150^{24hr}	150^{24hr}(IT-1)
	SPM	111	117	129	139	109	70	73	159	91	43	44	93.5	103.7	107	200^{8hr}	NF
	SO_2	9	10	14	12	16	51	34	15	11	6	7	11.9	5.7	7.6	365^{24hr}	125^{24hr} (IT-1)
	NOx	19	22	27	18	22	34	22	14	16	8	10	13	7.7	9.3	100^{Annual}	200^{1hr}, 40^{Annual}
	CO	65	58	70	64	56	112	81	62	47	32	110	67	73	84	$(10000)^{8hr}$	NF
	O_3	13	12	13	11	14	12	4	2	2	0	1	4	08	0	157^{8hr}	100^{8hr}
Akram Point,	**$PM_{2.5}$**	17	19	23	18	49	NO	25	18	9	4	4	14.3	13.2	7.5	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, April, 2017	Bangladesh (DoE) Standard (ECR 2005)	IFC/WB Standard
eather		Sunny	Rainy/ Cloudy	Sunny	Sunny	Sunny	Rainy/ Cloudy	Sunny to Rainy	Sunny	Sunny	Rainy/ Cloudy	Rainy/ Cloudy	Sunny	Suny- /cloudy	Suny		
			Concentrations are in µg/m³														
	PM_{10}	39	44	32	39	77	NO	32	77	31	15	14	85.5	96.0	37.8	150^{24hr}	150^{24hr}(IT-1)
	SPM	114	133	97	88	102	NO	51	128	46	23	27	90.9	137.0	41.8	200^{8hr}	NF
	SO_2	7	9	12	13	21	NO	27	14	9	4	6	8.4	6	5.8	365^{24hr}	125^{24hr} (IT-1)
	NOx	17	19	22	17	27	NO	19	15	10	5	6	12.7	10.1	5.9	100^{Annual}	200^{1hr},40^{Annual}
	CO	49	60	50	46	163	NO	92	64	21	37	101	58	79	69	(10000) ^{8hr}	NF
	O_3	11	14	9	10	27	NO	8	1	0	0	2	3	0	0	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	65^{24hr}	75^{24hr}(IT-1)
	PM_{10}	44	38	34	41	60	NO	45	NO	40	NO	14	104.5	NO	92.1	150^{24hr}	150^{24hr}(IT-1)
	SPM	101	119	107	97	110	NO	88	NO	132	NO	26	111.4	NO	102	200^{8hr}	NF
	SO_2	8	7	13	14	15	NO	28	NO	15	NO	9	13.5	NO	6	365^{24hr}	125^{24hr} (IT-1)
	NOx	18	18	19	22	20	NO	23	NO	19	NO	9	15.9	NO	7.8	100^{Annual}	200^{1hr}, 40^{Annual}
	CO	52	62	65	60	60	NO	93	NO	40	NO	121	43	NO	72	(10000) ^{8hr}	NF
	O_3	14	13	11	9	23	NO	2	NO	0	NO	0	4	NO	0	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	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	150^{24hr}	150^{24hr}(IT-1)
	SPM	301	287	239	219	222	181	101	181	112	107	64	189.7	187.2	127.9	200^{8hr}	NF
	SO_2	33	29	33	28	31	59	28	16	11	10	10	17.1	7.2	7.1	365^{24hr}	125^{24hr} (IT-1)
	NOx	49	41	39	36	33	38	26	16	15	15	14	18.6	11.7	8.8	100^{Annual}	200^{1hr}, 40^{Annual}
	CO	330	370	330	296	101	89	94	98	68	36	104	66	79	81	(10000) ^{8hr}	NF
	O_3	59	67	57	39	21	7	4	2	1	0	2	3	07	07	157^{8hr}	100^{8hr}

Note(s): *Concentrations are in µg/m³.*

- *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,	PM	√	X	X	X	√	√	√	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	√

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

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

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														
		1st year				2nd Year				3rd year				4th year		BD Standard
		Apr	July	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	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	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	
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	
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	
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	
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	
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	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	
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	
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	
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	
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	
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	
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	
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	

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	
		1QM	2QM	3QM	1QM	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	31	33	31	19	30	31.8	31.2	22.0	31.2	29.6	30.1	22.8	30	29.8	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	
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	
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	
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	
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	
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	
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	
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	
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	
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	
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	
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	
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	
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	

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
		1st QM	2nd QM	3rd QM	4th QM	1st QM	2nd QM	3rd QM	4th QM	1st QM	2nd QM	3rd QM	4th QM	1st QM	2nd QM
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	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
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
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
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
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
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
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
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
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
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
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
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
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
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

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)														BD Standard
		1st Year				2nd Year				3rd year				4th year		
		Apr	Jul	Oct	Apr	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	
		1QM	2QM	3QM	1st QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2nd QM	
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 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	
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	
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	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	
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	
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	
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	
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	
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	
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	
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	
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	
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	
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	

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

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
		1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM
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
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
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
4	Left Bank of Passur River at Project site-Jetty	376	28	18	84	102	26	36	100	280	8	12	48	40
5	Middle Passur River at Project site-Jetty	400	60	14	116	110	21	36	108	240	12	16	52	36
6	Right Bank of Passur River at Project site-Jetty	364	496	18	108	88	24	40	80	260	8	12	42	48
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
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
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
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
11	Maidara river near proposed township area	284	96	26	84	94	36	42	108	210	30	8	48	40
12	Passur river at Passur - Ghasiakhali confluence	408	172	14	96	92	30	46	88	220	12	16	40	64
13	Passur river at Harbaria of Sundarbans	372	216	14	96	102	26	36	100	140	16	12	**40**	216
14	Passur river at Akram point of Sundarbans	536	520	54	316	302	NS	84	96	156	4	68	56	240
15	Passur river at Hiron point of Sundarbans	540	416	122	472	470	NS	96	NS	160	NS	56	196	NS

Source: CEGIS Field Survey

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

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

Sl	Sampling Locations	Oil and Grease (mg/L)													ECR, 1997 (mg/L)*
		1st Year				2nd year				3rd year				4th year	
		Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	
		1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	
1	Left Bank of Passur River at South West corner from the Project boundary	<5	<5	<5	>15	16.9	9	<5	39	61	5	<5	9.2	*5.73*	10
2	Passur-Ghasiakhali Confluence	<5	<5	<5	>15	13	7.63	9.87	21	30.3	13.5	<5	15.6	*<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*	
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	Akram Point of Sundarbans	<5	<5	<5	>20	<5	NS	9.73	36	82	5.87	<5	14.2	*ND*	

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
		1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM
1	Left Bank of Passur River at 100m u/s of North West corner from the Project boundary	13060	251	176	4360	14400	937	158	5570	13400	179	138	3100	13400
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
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
4	Left Bank of Passur River at Project site-Jetty	13190	445	169	4750	14600	175	172	5720	12830	162	147	3630	13560
5	Middle Passur River at Project site-Jetty	13330	353	156	4920	14500	132	162	5850	13100	185	110	3600	13490
6	Right Bank of Passur River at Project site-Jetty	13380	402	152	4870	14200	156	160	5480	13460	143	112	3520	13330
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
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
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
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
11	Maidara river near proposed Township area	10970	2510	257	4390	13900	355	176	4420	11700	5170	238	3960	13110
12	Passur river at Passur - Mongla confluence	12800	6410	209	5130	14050	298	227	4540	11330	893	162	3370	12340
13	Passur river at Harbaria of Sundarbans	12280	9360	285	4780	13900	683	205	4940	13580	1321	301	**3370**	13600
14	Passur river at Akram point of Sundarbans	21500	15960	3400	12350	13600	NS	4220	13330	20720	7330	2550	3580	19370
15	Passur river at Hiron point of Sundarbans	21500	14050	5720	17900	25300	NS	5830	NS	25500	NS	4120	12210	NS

Source: CEGIS Field Survey

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

Table B.9: TH Passur River System

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

Source: CEGIS Field Survey

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

Table B.10: TSS Passur River System

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

Source: CEGIS Field Survey

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

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

Sl	Sampling Locations	NO_3^{2-} (mg/L)												
		1st Year				2nd year				3rd year				4th year
		Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr
		1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM
1	Left Bank of Passur River at 100m u/s of North West corner from the Project boundary	0.9	2.89	0.32	3	33	9.1	4	6.3	3	3.9	0.25	3.62	4.35
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
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	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
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
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
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
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
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
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
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
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
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
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
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

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
		1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM
1	Left Bank of Passur River at 100m u/s of North West corner from the Project boundary	1840	20	26	580	1360	67	7	570	1080	18	5	230	422
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	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
4	Left Bank of Passur River at Project site-Jetty	1360	45	33	550	1240	26	10	550	1060	15	4	230	1380
5	Middle Passur River at Project site-Jetty	1040	32	30	520	1120	6	8	580	980	17	6	280	1280
6	Right Bank of Passur River at Project site-Jetty	1320	20	27	540	820	8	9	565	1100	14	5	230	1400
7	Left Bank of Passur River at South West corner from the Project boundary	1640	60	40	630	880	9	12	640	1060	15	6	230	880
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
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
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
11	Maidara river near proposed township area	1320	210	63	460	840	27	9	480	1020	480	14	200	1340
12	Passur river at Passur - Mongla confluence	1360	620	44	630	980	39	13	482	1100	42	14	220	1220
13	Passur river at Harbaria of Sundarbans	1560	860	69	590	900	51	7	500	1080	60	19	220	1300
14	Passur river at Akram point of Sundarbans	2600	1400	1390	850	1540	NS	84	760	1650	620	190	230	1420
15	Passur river at Hiron point of Sundarbans	2080	1160	2360	1500	1920	NS	97	NS	2100	NS	320	1090	NS

Source: CEGIS Field Survey

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

Table B.13: PO42- 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
		1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM
1	Left Bank of Passur River at 100m u/s of North West corner from the Project boundary	0.52	2.23	0.67	0.32	0.86	10	1.27	0.269	0.22	1.14	3.39	0.67	1.31
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
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
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
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
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
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
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
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
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
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
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
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
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
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

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

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

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

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
			1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM
1	Near Proposed Township	Deep (>600 ft)	7.6	7.7	7.9	8	TC	8.1	7.49	7.6	7.8	7.8	8.4	8.1	7.4	8.2
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
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
4	Kalekharber	Shallow (<250 ft)	6.3	6.5	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF

Locations	Tube Well Type	Temperature (ºC)													
		1st Year				2nd year				3rd year				4th year	
		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
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
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
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
Kalekharber	Shallow (<250 ft)	**27.5**	**28.7**	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
			1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM
1	Near Proposed Township	Deep (>600 ft)	0	0	0	1	TC	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
3	Kapashdanga	Deep (>600 ft)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	Kalekharber	Shallow (<250 ft)	0	0	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
			1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM
1	Near Proposed Township	Deep (>600 ft)	4.4	5.2	6.5	6.7	TC	6	5.4	4.9	6.1	5.8	6.3	4.5	5.1	6.2
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
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	Kalekharber	Shallow (<250 ft)	4.4	6	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
			1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM
1	Township near project site	Deep (>600 ft)	1113	999	-	1021	NO	881	377	447	1025	1000	617	623	395
2	Rajnagar	Deep (>600 ft)	4090	371	-	378	390	574	1007	491	384	408	382	401	617
3	Kapasdanga	Deep (>600 ft)	643	635	-	600	600	328	611	284	645	607	636	998	558
4	Kalekharber	Shallow (<250 ft)	1055	970	-	NF	D	D	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
			1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM
1	Township near project site	Deep (>600 ft)	-	6	19	40	NF**	23	4	31	3	5	7	32	4
2	Rajnagar	Deep (>600 ft)	-	6	2	28	4	16	5	46	4	4	4	28	10
3	Kapasdanga	Deep (>600 ft)	-	8	6	32	6	14	4	41	3	4	5	25	9
4	Kalekharber	Shallow (<250 ft)	-	48	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
			1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM
1	Township near project site	Deep (>600 ft)	425	250	300	235	NO	225	325	295	305	320	175	550	720
2	Rajnagar	Deep (>600 ft)	220	175	180	110	138	125	450	195	263	248	295	510	420
3	Kapasdanga	Deep (>600 ft)	190	140	180	125	216	115	480	225	163	28	183	620	654
4	Kalekarber	Shallow (<250 ft)	780	450	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
			1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM
1	Township near project site	Deep (>600 ft)	32	32	34	20	NO	12	4	4	4	4	4	4	4
2	Rajnagar	Deep (>600 ft)	28	28	18	16	14	10	8	4	4	4	4	4	4
3	Kapasdanga	Deep (>600 ft)	48	32	34	20	18	14	4	4	4	2	4	4	4
4	Kalekarber	Shallow (<250 ft)	32	36	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

S I	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	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr
			1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM
1	Township near project site	Deep (>600 ft)	0.20	0.48	<0.10	28	-	7.6	4.3	2.1	1.7	3.8	6.1	4.65	9.32	-	3	-	-	-	-	1	5	1	1	1	1	5	-	2.2	-	0.74	NO	1.4	0.31	0.267	1.08	0.17	0.167	1.18	2.18
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	-	-	-	-	2	6	2	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	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	-	10	-	-	-	-	2	2	8	1	1		3	-	6.2	-	0.48	4.54	4.1	0.48	0.179	3.26		0.6	1.18	2.1
4	Kalekarber	Shallow (<250 ft)	0.42	0.52	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	3	NF	-	-	-	-	NF	NF	NF	NF	NF	NF	NF	1.2	NF	NF	NF		NF	NF		0.31		1.22	

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

S I	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	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr
		1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM	2QM	3QM	4QM	1QM
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	0.002	<0.002	0.004	0.023	NO	0.002	0.006	0.026	0.019	0.002	0.001	0.01	0.001	<0.00015	<0.00015	<0.0005	<0.0005	NO	0.00015	<0.00015	<0.00015	<0.00015	<0.00015	<0.00015	<0.00015	0.001
2	Rajnagar	0.006	0.009	0.006	0.008	0.01	0.014	0.012	0.002	0.007	0.018	0.011	0.005	0.022	<0.002	<0.002	<0.002	0.016	0.013	0.0027	0.021	0.011	0.007	0.002	0.001	0.009	0.001	<0.00015	<0.00015	<0.0005	<0.0005	<0.00015	0.00015	<0.00015	<0.00015	<0.00015	<0.00015	<0.00015	<0.00015	0.001
3	Kalekarber	0.376	0.407	NF	NF	D	D	NF	NF	NF	NF	NF			0.002	0.008	NF	NF	D	D	NF	NF	NF	NF	NF	0.016	0.001	<0.00015	<0.00015	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	0.001
4	Kapasdanga	0.036	0.033	0.020	0.017	0.034	0.024	0.011	0.002	0.047	0.005	0.016	0.028	0.010	<0.002	0.004	<0.002	0.013	0.017	0.002	0.005	0.012	0.008	0.002	0.001	0.01	0.001	<0.00015	<0.00015	<0.0005	<0.0005	<0.00015	0.00015	<0.00015	<0.00015	<0.00015	<0.00015	<0.00015	<0.00015	0.001

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												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									Day time AVG
1	Chalna, Dacope	58.21	59.00	66.57	61.62	47.65	51.06	50.27	49.66									70
2	NW Corner of the Project area	44.97	49.30	47.31	47.19	47.65	45.12	46.65	46.47									55
3	Chunkuri-2, Bajua	45.60	52.29	53.42	50.44	39.82	45.60	41.73	42.38									55
4	SW corner of the Project area	39.62	42.64	47.48	43.25	60.80	64.08	62.52	62.47									55
5	Proposed Township area, Project site	41.40	43.09	43.45	42.65	43.05	48.52	45.01	45.53									55
6	Barni, Gaurambha	43.05	46.45	45.01	44.83	45.60	52.29	53.42	50.44									60
7	Khan Jahan Ali Bridge, Khulna	54.01	57.50	58.66	56.72	40.60	42.64	46.55	43.26									70
8	Mongla Port area	47.78	47.45	45.25	47.61	41.40	44.68	45.71	43.93									75
9	Harbaria, Sundarbans	50.79	53.67	57.84	54.10	44.25	46.67	47.31	46.08									50
10	Akram Point, Sundarbans	43.41	45.60	43.89	44.30	58.21	58.59	58.70	58.50									50
11	Hiron Point, Sundarbans	NM	NM	NM	NM	39.92	39.79	33.5	37.74									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	+	+	-	+	+	+	+	+	+	+	+	+

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											
Loitta	Harpodon nehereus	NO	+	+	+	-	+	-	-	-	+	+	-	-
Motka Chingri	Macrobrachium villosimanusless	DD	+	+	+	+	+	+	+	+	+	+	+	-
Mud Crab	Scylla serrata	NO	+	-	+	+	+	+	+	+	+	-	+	+
Tular Dandi	Sillaginopsis panijus	NO	+	-	+	-	+	-	+	-	-	-	+	-
Paira Chanda	Scatophagus argus	DD	+	-	-	-	-	-	-	-	-	+	-	-
Paissa	Liza parsia	NO	+	+	+	+	+	+	+	+	+	+	+	+
Pangas	Pangasius pangasius	CR	+	-	+	-	-	-	-	+	-	-	-	+
Tak Chanda	Leiognathus equulus	NO	+	-	-	-	-	-	+	-	-	+	-	-
Phessa	Setipinna phasa	NO	+	+	+	+	+	+	+	+	+	-	+	-
Teli Phessa	Setipinna phasa	DD	-	-	+	-	-	-	-	-	-	+	-	-
Poma	Poma poma	NO	+	+	+	+	+	+	+	+	+	+	+	+
Potka	Chelonodon patoca	NO	+	+	-	+	+	+	-	+	+	-	+	+
Shilong	Silonia silondia	EN	+	-	+	-	-	-	-	-	-	-	+	-
Tailla	Eleutheronema tetradactylum	DD	+	-	-	-	-	-	-	-	-	+	-	-
Tapse	Polynemus paradiseus	DD	+	+	+	-	-	+	+	+	-	-	+	+
Daitna	Acanthopagrus latus	DD	-	-	-	+	-	-	-	+	+	-	+	+
Shole	Channa striatus	DD	-	-	-	+	-	-	-	+	-	-	-	-
Magur	Clarias batrachus	DD	-	-	-	+	-	-	-	+	-	-	-	+
Koi	Anabas testudineus	DD	-	-	-	+	-	-	-	+	-	+	-	-
Vetki	Lates calcarifer	DD	-	-	-	+	+	+	+	+	+	-	+	+

Local Name	Scientific Name	Local Status*	13th QM	14th QM
		'-' = 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	+	-

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

Local Name	Scientific Name	Local Status*	13th QM	14th QM
		'-' = No; '+' = Occurrence		
Poma	Poma poma	NO	+	+
Potka	Chelonodon patoca	NO	+	+
Shilong	Silonia silondia	EN	+	+
Tailla	Eleutheronema tetradactylum	DD	-	-
Tapse	Polynemus paradiseus	DD	-	+
Daitna	Acanthopagrus latus	DD	-	+
Shole	Channa striatus	DD	-	+
Magur	Clarias batrachus	DD	-	+
Koi	Anabas testudineus	DD	-	-
Vetki	Lates calcarifer	DD	+	+

*Local Status Source: IUCN Red List

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

Fish Species	Site	L (< 2cm)	L (2 to 3cm)	L (3 to 5cm)	L (5 to 10cm)	L (10 to 20cm)	L (> 25cm)	Brood Fish
Aswene Bele	Chandpai	0	0	0	100	0	0	0
Bairagi	Chandpai	87	0	13	0	0	0	0
Banspata	Chandpai	0	0	0	0	100	0	0
	Maidara	0	0	0	0	67	33	0
Bele	Mongla Point	100	0	0	0	0	0	0
BhatGuila	Chandpai	0	0	100	0	0	0	0
Chami	Chandpai	0	0	100	0	0	0	0
	Harbaria	0	0	100	0	0	0	0
Chata Bele	Chandpai	0	0	0	0	100	0	0
Chela	Mongla Point	100	0	0	0	0	0	0
Chitra	Chandpai	0	0	100	0	0	0	0
Daitna	Chandpai	0	0	0	100	0	0	0
Dogri	Mongla Point	100	0	0	0	0	0	0
Ekthuto	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
Ghagra	Harbaria	0	0	0	0	100	0	0
Gangania	Chandpai	0	0	0	100	0	0	0
Goda Katali	Chandpai	0	0	0	100	0	0	0
	Harbaria	0	0	0	100	0	0	0
Golda	Chandpai	0	0	0	8	92	0	0
	Harbaria	0	0	0	25	75	0	0
Horina	Chandpai	0	0	100	0	0	0	0
	Harbaria	0	0	67	33	0	0	0
	Mongla Point	100	0	0	0	0	0	0
Jaba	Chandpai	0	0	0	100	0	0	0
Kain Magur	Chandpai	0	0	0	0	0	100	0
	Harbaria	0	0	0	0	0	100	0
Kakila	Chandpai	0	0	0	100	0	0	0
Khayra Chela	Mongla Point	100	0	0	0	0	0	0
Kuchia	Chandpai	0	0	0	0	0	100	0
Lal Chewa	Chandpai	0	0	0	0	100	0	0
Magur	Chandpai	0	0	0	0	100	0	0
Motka	Chandpai	0	100	0	0	0	0	0
	Harbaria	0	0	53	47	0	0	0
	Mongla Point	100	0	0	0	0	0	0
Mutkura	Chandpai	0	0	100	0	0	0	0
	Harbaria	0	0	75	25	0	0	0
Nona Bele	Chandpai	0	0	100	0	0	0	0
Paissa	Chandpai	0	0	0	23	77	0	0
	Harbaria	0	0	67	0	33	0	0
Pheksa	Chalna Point	0	0	0	0	0	100	0
	Maidara	0	0	0	0	100	0	0
Poma	Chalna Point	0	0	0	0	100	0	0

Fish Species	Site	L (< 2cm)	L (2 to 3cm)	L (3 to 5cm)	L (5 to 10cm)	L (10 to 20cm)	L (> 25cm)	Brood Fish
	Chandpai	0	0	0	68	32	0	0
	Maidara	0	0	0	0	100	0	0
	Mongla Point	100	0	0	0	0	0	0
Potka	Chandpai	0	0	100	0	0	0	0
Rekha	Chandpai	0	0	0	100	0	0	0
Sada Bele	Chandpai	0	0	0	100	0	0	0
Shole	Chandpai	0	0	0	100	0	0	0
Tairel	Harbaria	0	0	0	0	100	0	0
Taki	Chandpai	0	0	0	100	0	0	0
Tapse	Chalna Point	0	0	0	0	100	0	0
	Chandpai	0	0	0	100	0	0	0
Tau Paissa	Chandpai	0	0	0	0	100	0	0
Telcupa	Chandpai	0	0	0	0	0	100	0
TelGuila	Chandpai	0	0	0	100	0	0	0
Tengra	Chandpai	0	0	71	29	0	0	0
Tit Punti	Chandpai	0	50	50	0	0	0	0
	Mongla Point	100	0	0	0	0	0	0
Tular Dandi	Maidara	0	0	0	0	75	25	0
Utkal	Chandpai	0	0	0	100	0	0	0
Vetki	Chandpai	0	0	0	0	100	0	0

Source: CEGIS field survey, 2017

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

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

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	-	-	-	-	-	-	-		-	-
Loitta	Haldikhali	Juvenile and Age-1 adult	Feeding and Growing	-	Feeding and Growing	-	-	-	-	-	-		-	-
	Akram Point	Juvenile	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
			and Growing				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		-			
		Brood Fish	-	-	-	-	-	-	-		-		Spawning	-
	Haldikhali	Fry and Juvenile	-	-	Nursing	-	-	-	-	-	-		-	-
	Harbaria	Adult	-	-	Breeding	-	-	-	-	-	-		Feeding	-

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

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

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

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

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

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

Migratory Fish Species	Sampling Sites	Year Class*	Migration Purpose		
			12th QM	13th QM	14th QM
Tapsi	Haldikhali	Juvenile and Age-1 adult	-	-	-
	Akram Point	Juvenile and Age-1 adult	-	-	-
		Adult	-	-	-
	Chalna Point	Age-1 adult and Brood fish	Feeding and Growing	-	-
		Adult		-	Feeding
	Harbaria	Juvenile and Age-1 adult	-	Feeding	
		Adult and Brood Fish	-	-	
	Chandpai	Juvenile	Feeding	-	Feeding and Growing
	Mongla Point	Adult		-	-
	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
	Chalna Point	Juvenile and Age-1 adult	-	-	-
		Fry	-	Nursing	-
	Harbaria	Juvenile	-	-	-
	Mongla Point	Fry	-	Nursing	-
		Juvenile	-	-	-
	South-west of the Project	Juvenile	-	-	-
		Fry	-	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	-	-	-

Migratory Fish Species	Sampling Sites	Year Class*	Migration Purpose		
			12th QM	13th QM	14th QM
	Chalna Point	Age-1 adult	-	-	-
		Fry	-	-	-
Poma	Haldikhali	Juvenile	-	-	-
	Akram Point	Juvenile	-	-	-
		Age-1 adult	-	-	-
		Adult	-	-	-
	Chandpai	Fry and Juvenile	-	-	-
		Juvenile	Feeding and Growing		-
		Adult			Feeding
		Brood Fish	Spawning	-	-
	Haldikhali	Fry and Juvenile	-	-	-
	Harbaria	Adult and Brood Fish	Feeding and Spawning	-	-
		Adult	-	Feeding	-
		Fry and Juvenile	-	-	-
	Mongla Point	Fry, Juvenile and Age-1 adult	-	Nursing	-
		Fry	-	-	Nursing
		Juvenile	-	-	-
		Age-1 Adult	-	-	-
		Adult	Feeding	-	-
		Brood Fish	Spawning	-	-
	South-west of the Project	Adult	-	-	Feeding
	Chalna Point	Juvenile, Adult and Brood Fish	Feeding, Growing and Spawning	-	-
		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		-	-	-
	Mongla Point		-	-	Nursing
Gang Tengra	Haldikhali	Adult	-	-	-

Migratory Fish Species	Sampling Sites	Year Class*	Migration Purpose		
			12th QM	13th QM	14th QM
	Akram Point	Adult	-	-	-
	Harbaria	Adult	-	-	-
	Chandpai	Adult	-	-	-
Ghagra Tengra	Chandpai	Juvenile and Age-1 adult	-	-	-
	Chalna Point	Age-1 adult	-	-	-
	Mongla Point	Age-1 adult	-	-	-
	Akram Point	Juvenile and Adult	-	Feeding	-
		Adult	-	-	-
	Haldikhali	Juvenile	-	-	-
	Harbaria	Adult	Feeding		
Gulsha Tengra	Haldikhali	Adult	-	-	-
	Akram Point	Adult	-	-	-
	Chandpai	Age-1 adult	-	Feeding	-
		Juvenile	Feeding and Growing	-	Feeding and Growing
	Mongla Point	Age-1 adult	-	-	-
		Juvenile	Feeding and Growing	-	-
	Harbaria	Juvenile		-	-
		Age-1 adult	-	-	-
	Maidara	Juvenile and Age-1 Adult	-	-	-
	Chalna Point	Juvenile	Feeding and Growing	-	-
Potka	Haldikhali	Adult	-	-	-
	Chandpai	Fry	-	-	-
		Juvenile	-	Feeding	-
		Adult	Feeding	-	Feeding and Growing
	Mongla Point	Fry	-	-	-
		Juvenile	-	-	-
	Harbaria	Fry	-	-	-
		Juvenile	-	-	-
Paira Chanda	Akram Point	Adult	-	-	-
	Chandpai	Fry	-	-	-
Chewa	Akram Point	Juvenile and Adult	-	-	-
	Chandpai	Fry and Juvenile	-	-	-

Migratory Fish Species	Sampling Sites	Year Class*	Migration Purpose		
			12th QM	13th QM	14th QM
		Juvenile	-	-	Feeding and Growing
		Adult	-	-	-
	Haldikhali	Juvenile and Adult	-	-	-
	Harbaria	Juvenile and Adult	-	-	-
	Mongla Point	Juvenile	-	-	-
	South-west of the Project	Juvenile	-	-	-
	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	-	-	-
	Chalna Point	Adult	-	-	-
	Maidara	Juvenile and Age-1 adult	-	-	-
		Fry	-	Nursing	-
Tular Dandi (Nona bele)	Akram Point	Adult	-	-	-
	South-west of the Project	Adult	Feeding	-	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	-	-	-

Migratory Fish Species	Sampling Sites	Year Class*	Migration Purpose		
			12th QM	13th QM	14th QM
	Harbaria	Juvenile	-	-	-
	Chalna Point	Juvenile and Adult	-	-	-
		Adult	-	-	Feeding
	Mongla Point	Adult	Feeding	-	-
	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 and Growing	Feeding	Feeding and Growing
	Harbaria	Juvenile		-	-
	Mongla Point	Fry	-	-	-
		Age-1 Juvenile	-	-	-
		Age-1 Adult	-	-	-
	Maidara	Fry, Juvenile and Age-1 adult	-	-	-
		Age-1 Juvenile, Juvenile and Age-1 Adult	Feeding and Growing	-	-
		Adult	-	-	-
Banshpata	Chandpai	Juvenile	-	-	-
		Adult	-	-	Feeding
	Akram Point	Juvenile	-	-	-
		Adult	-	-	-
	Haldikhali	Juvnile and adult	-	-	-
	Harbaria	Adult	Feeding	-	-
	Mongla Point	Fry and Adult	-	-	-
		Adult	-	-	-

Migratory Fish Species	Sampling Sites	Year Class*	Migration Purpose		
			12th QM	13th QM	14th QM
	Maidara	Adult	-	-	Feeding
	Chalna Point	Adult	-	-	-
Hilsa	Akram Point	Brood Fish	Breeding and Spawning	-	-
	Haldikhali	Brood Fish		-	-
		Juvenile	-	-	-
	Harbaria	Brood Fish	Breeding and Spawning	-	-
	Chandpai	Adult and Brood Fish	-	-	-
	Mongla Point	Adult	-	-	-
		Brood Fish	Breeding and Spawning	-	-
	Maidara	Age-1 Adult	Feeding	-	-
	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

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

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

Source: CEGIS Field Survey, 2015-2016

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

Source: CEGIS Field Survey, 2016-2017

Sampling Site	Total Catch (kg): 2016-2017							
	14th QM		15th QM		16th QM		17th QM	
	Species	ton	Species	ton	Species	ton	Species	ton
1	Bagda	0						
	Horina Chingri	1						
	Tengra	0						
	Paissa	0						
	Chela	0						
	Vetki	0						
Sub-total =	-	1						
2	Bagda	0						
Sub-total =		0						
3	Bagda	0						
Sub-total =	-	0						
Grand-total =	-	1						

Source: CEGIS Field Survey, 2017-2018

(E) Land Resource Monitoring Data

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

Site No.	Monitoring indicators	Location	GPS(Decimal Degree)		Sampling Frequency	Methods/ Tools/ Techniques
			Easting	Northing		
1	Plot use, Soil fertility and Nutrient, Chemical Properties of Soil (pH, Pb, CdCrop production, and damage	Mauza: Baranpara, Union: Gangarampur Upazila: Batiaghata, District: Khulna	E-89°30′59.1″	N-22°37′57.0″	Bi-yearly (April and October)	In situ field sampling and Laboratory Testing in SRDI
2		Mouza: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

Sl. No.	Location	Parameter	13th monitoring (April-2017)		14th monitoring (October-2017)	
			Dry season (April)	Remarks	Wet season (October)	Remarks
1.	Baran para	**Top soil (0-15cm)**				
		EC(ds/m)	5.09	Slightly saline		
		pH	6.4	Slightly acid		
		OM (%)	1.30	Low		
		N (%)	0.07	Very low		
		K (meq/100g)	0.65	Very high		
		Ca (meq/100g)	15.29	Very high		
		Mg (meq/100g)	2.24	Very high		
		Na(meq/100g)	5.76	*		
		P(µg/gm)	5.25	Low		
		S(µg/gm)	216.42	Very high		
		B(µg/gm)	1.92	Very high		
		Fe(µg/gm)	44.31	Very high		
		Mn(µg/gm)	10.87	Very high		
		Zn(µg/gm)	2.45	Very high		
		Lead(Pb)(µg/gm)	22.80	Safe limit		
		Cadmium(Cd)(µg/gm)	0.42	Safe limit		
		Subsurface soil (15-30cm)				
		EC(ds/m)	4.52	Slightly saline		
		pH	7.0	Neutral		
		OM (%)	1.50	Low		
		N (%)	0.08	Very low		
		K (meq/100g)	0.62	Very high		
		Ca (meq/100g)	12.70	Very high		
		Mg (meq/100g)	2.15	Very high		
		Na(meq/100g)	5.24	*		
		P(µg/gm)	4.96	Low		
		S(µg/gm)	220.36	Very high		
		B(µg/gm)	1.05	Very high		
		Fe(µg/gm)	23.63	Very high		
		Mn(µg/gm)	6.95	Very high		
		Zn(µg/gm)	1.64	Optimum		
		Lead(Pb)(µg/gm)	21.97	Safe limit		
		Cadmium(Cd)(µg/gm)	0.39	Safe limit		
		Substratum soil (30-45cm)				
		EC(ds/m)	7.40	Slightly saline		
		pH	7.0	Neutral		
		OM (%)	1.45	Low		
		N (%)	0.08	Very low		
		K (meq/100g)	0.55	Very high		
		Ca (meq/100g)	13.83	Very high		
		Mg (meq/100g)	2.85	Very high		
		Na(meq/100g)	7.41	*		

Sl. No.	Location	Parameter	13th monitoring (April-2017)		14th monitoring (October-2017)	
			Dry season (April)	Remarks	Wet season (October)	Remarks
		P(µg/gm)	3.34	Very high		
		S(µg/gm)	267.70	Very high		
		B(µg/gm)	1.19	Very high		
		Fe(µg/gm)	50.38	Very high		
		Mn(µg/gm)	6.04	Very high		
		Zn(µg/gm)	3.07	Very high		
		Lead(Pb)(µg/gm)	19.19	Safe limit		
		Cadmium(Cd)(µg/gm)	0.37	Safe limit		
2.	Chunkuri-2	**Top soil (0-15cm)**				
		EC(ds/m)	6.57	Slightly saline		
		pH	5.8	Slightly acid		
		OM (%)	2.01	Medium		
		N (%)	0.11	Low		
		K (meq/100g)	0.75	Very high		
		Ca (meq/100g)	12.27	Very high		
		Mg (meq/100g)	2.50	Very high		
		Na(meq/100g)	6.59	*		
		P(µg/gm)	7.76	Medium		
		S(µg/gm)	542.38	Very high		
		B(µg/gm)	1.59	Very high		
		Fe(µg/gm)	50.15	Very high		
		Mn(µg/gm)	7.21	Very high		
		Zn(µg/gm)	5.03	Very high		
		Lead(Pb)(µg/gm)	16.09	Safe limit		
		Cadmium(Cd)(µg/gm)	0.56	Safe limit		
		Subsurface soil (15-30cm)				
		EC(ds/m)	7.48	Slightly saline		
		pH	6.5	Slightly acid		
		OM (%)	1.67	Low		
		N (%)	0.09	Very low		
		K (meq/100g)	0.76	Very high		
		Ca (meq/100g)	16.13	Very high		
		Mg (meq/100g)	2.97	Very high		
		Na(meq/100g)	6.67	*		
		P(µg/gm)	6.65	Low		
		S(µg/gm)	311.90	Very high		
		B(µg/gm)	1.33	Very high		
		Fe(µg/gm)	66.73	Very high		
		Mn(µg/gm)	10.47	Very high		
		Zn(µg/gm)	1.98	High		
		Lead(Pb)(µg/gm)	16.28	Safe limit		
		Cadmium(Cd)(µg/gm)	0.51	Safe limit		
		Substratum soil (30-45cm)				
		EC(ds/m)	7.65	Slightly saline		

Sl. No.	Location	Parameter	13th monitoring (April-2017)		14th monitoring (October-2017)	
			Dry season (April)	Remarks	Wet season (October)	Remarks
		pH	6.5	Slightly acid		
		OM (%)	1.60	Low		
		N (%)	0.09	Very low		
		K (meq/100g)	0.69	Very high		
		Ca (meq/100g)	12.34	Very high		
		Mg (meq/100g)	3.14	Very high		
		Na(meq/100g)	6.82	*		
		P(µg/gm)	6.51	Low		
		S(µg/gm)	270.62	Very high		
		B(µg/gm)	1.23	Very high		
		Fe(µg/gm)	72.44	Very high		
		Mn(µg/gm)	8.82	Very high		
		Zn(µg/gm)	2.37	Very high		
		Lead(Pb)(µg/gm)	14.94	Safe limit		
		Cadmium(Cd)(µg/gm)	0.48	Safe limit		
3.	Kapalirmet	**Top soil (0-15cm)**				
		EC(ds/m)	8.05	Slightly saline		
		pH	8.1	Slightly alakaline		
		OM (%)	2.22	Medium		
		N (%)	0.11	Low		
		K (meq/100g)	0.85	Very high		
		Ca (meq/100g)	11.56	Very high		
		Mg (meq/100g)	2.54	Very high		
		Na(meq/100g)	7.88	*		
		P(µg/gm)	5.86	Medium		
		S(µg/gm)	734.80	Very high		
		B(µg/gm)	1.48	Very high		
		Fe(µg/gm)	48.29	Very high		
		Mn(µg/gm)	6.27	Very high		
		Zn(µg/gm)	3.16	Very high		
		Lead(Pb)(µg/gm)	8.25	Safe limit		
		Cadmium(Cd)(µg/gm)	0.61	Safe limit		
		Subsurface soil (15-30cm)				
		EC(ds/m)	8.44	Moderately saline		
		pH	8.0	Slightly alkaline		
		OM (%)	2.00	Medium		
		N (%)	0.10	Low		
		K (meq/100g)	0.94	Very high		
		Ca (meq/100g)	16.07	Very high		
		Mg (meq/100g)	4.17	Very high		
		Na(meq/100g)	8.04	*		
		P(µg/gm)	6.00	Low		
		S(µg/gm)	672.09	Very high		

Sl. No.	Location	Parameter	13th monitoring (April-2017)		14th monitoring (October-2017)	
			Dry season (April)	Remarks	Wet season (October)	Remarks
		B(µg/gm)	2.02	Very high		
		Fe(µg/gm)	56.83	Very high		
		Mn(µg/gm)	7.85	Very high		
		Zn(µg/gm)	2.11	High		
		Lead(Pb)(µg/gm)	10.18	Safe limit		
		Cadmium(Cd)(µg/gm)	0.64	Safe limit		
		Substratum soil (30-45cm)				
		EC(ds/m)	7.10	Slightly saline		
		pH	8.0	Slightly alkaline		
		OM (%)	1.98	Medium		
		N (%)	0.10	Low		
		K (meq/100g)	0.86	Very high		
		Ca (meq/100g)	16.68	Very high		
		Mg (meq/100g)	4.15	Very high		
		Na(meq/100g)	6.93	*		
		P(µg/gm)	4.05	Low		
		S(µg/gm)	749.36	Very high		
		B(µg/gm)	1.66	Very high		
		Fe(µg/gm)	40.51	Very high		
		Mn(µg/gm)	8.97	Very high		
		Zn(µg/gm)	2.12	High		
		Lead(Pb)(µg/gm)	7.69	Safe limit		
		Cadmium(Cd)(µg/gm)	0.52	Safe limit		
4.	Chakghona	**Top soil (0-15cm)**				
		EC(ds/m)	7.78	Slightly saline		
		pH	8.7	Strongly alkaline		
		OM (%)	2.20	Medium		
		N (%)	0.11	Low		
		K (meq/100g)	0.87	Very high		
		Ca (meq/100g)	15.22	Very high		
		Mg (meq/100g)	3.85	Very high		
		Na(meq/100g)	6.50	*		
		P(µg/gm)	10.79	Medium		
		S(µg/gm)	975.48	Very high		
		B(µg/gm)	1.75	Very high		
		Fe(µg/gm)	42.89	Very high		
		Mn(µg/gm)	7.68	Very high		
		Zn(µg/gm)	2.45	Very high		
		Lead(Pb)(µg/gm)	14.82	Safe limit		
		Cadmium(Cd)(µg/gm)	0.55	Safe limit		
		Subsurface soil (15-30cm)				
		EC(ds/m)	6.92	Slightly saline		
		pH	8.5	Strongly alkaline		

Sl. No.	Location	Parameter	13th monitoring (April-2017)		14th monitoring (October-2017)	
			Dry season (April)	Remarks	Wet season (October)	Remarks
		OM (%)	1.91	Medium		
		N (%)	0.10	Low		
		K (meq/100g)	0.80	Very high		
		Ca (meq/100g)	16.19	Very high		
		Mg (meq/100g)	4.26	Very high		
		Na(meq/100g)	5.97	*		
		P(µg/gm)	8.41	Medium		
		S(µg/gm)	825.13	Very high		
		B(µg/gm)	1.27	Very high		
		Fe(µg/gm)	48.68	Very high		
		Mn(µg/gm)	7.18	Very high		
		Zn(µg/gm)	2.56	Very high		
		Lead(Pb)(µg/gm)	11.78	Safe limit		
		Cadmium(Cd)(µg/gm)	0.52	Safe limit		
		Substratum soil (30-45cm)				
		EC(ds/m)	8.23	Moderately saline		
		pH	8.8	Strongly alkaline		
		OM (%)	1.55	Low		
		N (%)	0.08	Very low		
		K (meq/100g)	0.92	Very high		
		Ca (meq/100g)	16.85	Very high		
		Mg (meq/100g)	4.00	Very high		
		Na(meq/100g)	6.69	*		
		P(µg/gm)	11.48	Optimum		
		S(µg/gm)	550.09	Very high		
		B(µg/gm)	1.05	Very high		
		Fe(µg/gm)	83.17	Very high		
		Mn(µg/gm)	6.59	Very high		
		Zn(µg/gm)	1.82	Very high		
		Lead(Pb)(µg/gm)	15.03	Safe limit		
		Cadmium(Cd)(µg/gm)	0.48	Safe limit		
5.	Basherhula	**Top soil (0-15cm)**				
		EC(ds/m)	6.60	Slightly saline		
		pH	6.5	Slightly saline		
		OM (%)	1.45	Low		
		N (%)	0.07	Very low		
		K (meq/100g)	0.80	Very high		
		Ca (meq/100g)	15.78	Very high		
		Mg (meq/100g)	3.55	Very high		
		Na(meq/100g)	5.69	*		
		P(µg/gm)	6.37	Very high		
		S(µg/gm)	610.52	Very high		
		B(µg/gm)	1.12	Very high		

Sl. No.	Location	Parameter	13th monitoring (April-2017)		14th monitoring (October-2017)	
			Dry season (April)	Remarks	Wet season (October)	Remarks
		Fe(µg/gm)	51.78	Very high		
		Mn(µg/gm)	5.25	Very high		
		Zn(µg/gm)	2.01	High		
		Lead(Pb)(µg/gm)	6.06	Safe limit		
		Cadmium(Cd)(µg/gm)	0.32	Safe limit		
		Subsurface soil (15-30cm)				
		EC(ds/m)	7.22	Slightly saline		
		pH	7.9	Slightly alkaline		
		OM (%)	1.50	Low		
		N (%)	0.08	Very low		
		K (meq/100g)	0.75	Very high		
		Ca (meq/100g)	13.53	Very high		
		Mg (meq/100g)	3.75	Very high		
		Na(meq/100g)	6.70	*		
		P(µg/gm)	7.05	Very high		
		S(µg/gm)	649.47	Very high		
		B(µg/gm)	1.25	Very high		
		Fe(µg/gm)	49.26	Very high		
		Mn(µg/gm)	6.08	Very high		
		Zn(µg/gm)	1.95	Very high		
		Lead(Pb)(µg/gm)	16.73	Safe limit		
		Cadmium(Cd)(µg/gm)	0.37	Safe limit		
		Substratum soil (30-45cm)				
		EC(ds/m)	7.39	Slightly saline		
		pH	8.1	Slightly alkaline		
		OM (%)	2.08	Medium		
		N (%)	0.11	Low		
		K (meq/100g)	0.91	Very high		
		Ca (meq/100g)	13.97	Very high		
		Mg (meq/100g)	3.78	Very high		
		Na(meq/100g)	6.77	*		
		P(µg/gm)	9.18	Very high		
		S(µg/gm)	198.85	Very high		
		B(µg/gm)	1.48	Very high		
		Fe(µg/gm)	40.51	Very high		
		Mn(µg/gm)	6.87	Very high		
		Zn(µg/gm)	1.57	Very high		
		Lead(Pb)(µg/gm)	15.79	Safe limit		
		Cadmium(Cd)(µg/gm)	0.39	Safe limit		

Source: SRDI laboratory analysis, May 2017

(E) Agriculture Resources Monitoring Data

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

Monitoring agriculture plot	Cropping pattern					
	13th monitoring(2016-17)			14th monitoring(2017-18)		
	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	HYV Aman	Fallow	Fallow	Local Aman	Fallow
Monitoring agriculture plot-2(Chunkuri-2)	Fallow	Local Aman	Fallow	Fallow	Local Aman	Fallow
Monitoring agriculture plot-3(Kapalirmet)	*Fallow	*Fallow	*Fallow	*Fallow	*Fallow	*Fallow
Monitoring agriculture plot-4(Chakgona)	*Fallow	*Fallow	*Fallow	*Fallow	*Fallow	*Fallow
Monitoring agriculture plot-5(Basherhula)	Fallow	Local Aman	Fallow	Fallow	Local Aman	Fallow

*Source: Based on field information and farmers interviewed, April, 2017 and October, 2017 *Fallow-Shrimp/Fish culture*

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

Monitoring agriculture Plot	Crop Production(tons)					
	13th monitoring(2016-17)			15th monitoring(2017-18)		
	Kharif I (March–June)	Kharif-II (July-October)	Rabi (Nov-February)	Kharif I (March–June)	Kharif-II (July-October)	Rabi (Nov-February)
Agriculture plot - 1(Baranpara)						
Production (Ton/Plot)	-	0.27*	-			
Yield (ton/Ha)	-	2.5*	-			
Agriculture plot-2(Chunkuri-2)						
Production (Ton/Plot)	-	0.44*	-			
Yield (ton/Ha)	-	2.4*	-			
Agriculture plot-3(Kapalirmet)						
Production (Ton/Plot)	-	-	-			
Yield (ton/Ha)	-	-	-			
Agriculture plot-4(Chakgona)						

Monitoring agriculture Plot	Crop Production(tons)					
	13th monitoring(2016-17)			15th monitoring(2017-18)		
	Kharif I (March–June)	Kharif-II (July-October)	Rabi (Nov-February)	Kharif I (March–June)	Kharif-II (July-October)	Rabi (Nov-February)
Production (Ton/Plot)	-	-	-			
Yield (ton/Ha)	-	-	-			
Agriculture plot-5(Basherhula)						
Production (Ton/Plot)	-	0.15*	-			
Yield (ton/Ha)	-	1.9*	-			

*Source: Based on field information and farmers interviewed, April 2017 * indicates cleaned rice*

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

Monitoring agriculture plot	Crop damage(tons)					
	13th monitoring(2016-17)			15th monitoring(2017-18)		
	Area (ha)	Prod (tons)	Causes	Area (ha)	Prod (tons)	Causes
Agriculture plot-1(Baranpara)	0.06	0.024*	E			
Agriculture plot-2(Chunkuri-2)	-	-	-			
Agriculture plot-3(Kapalirmet)	-	-	-			
Agriculture plot-4(Chakgona)	-	-	-			
Agriculture plot-5(Basherhula)	0.09	0.019*	E			
Total	**0.15**	**0.043***				

*Source: Based on field information and farmers interviewed, April 2017 * indicates cleaned rice*

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

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