



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

*Monitoring of Environmental Parameters and Implementation of  
Environmental Management Plan During Pre-construction and  
Construction period along with Engineering Activities for Site Development  
of Khulna 2×660 MW Moitree Super Thermal Power Plant*



**Third Quarter Monitoring Report of Third Year (2016)**

**Monitoring Period: August 2016 – October 2016**



**November 2016**



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## Acknowledgement

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 Parameters and Implementation of Environmental Management Plan during pre-construction and construction period along with Engineering Activities for Site Development of Khulna 1320 MW Coal Based Thermal Power Plant**” to CEGIS. Now this project has been renamed as “**2x660 MW Moitree Super Thermal Power Project**”.

CEGIS is grateful to Mr. Monowar Islam, NDC, Secretary, Ministry of Power, Energy and Mineral Resources (MoPEMR) and Chairman, BIFPCL for his dynamic leadership. CEGIS 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. CEGIS is also thankful to Mr. U K Bhattacharya, Managing Director of BIFPCL for his direction and guidance. CEGIS appreciates the support and guidance of Mr. Nabendu Lodh, Deputy General Manager, BIFPCL, Mr. Atanu Kumar Mitra, Chief Technical Officer, BIFPCL.

CEGIS is indebted to Mr. Deb Datta Roy, AGM, E&C&I, BIFPCL and Mr. Arun Choudhary, AGM, ME&CCD, BIFPCL for being supportive and concerned, Mr. Md Imdadul Hoque, Deputy Manager, BIFPCL for accompanying the Team during carrying out monitoring activities in the Sundarbans. He has been very helpful to the entire study. The Team found him cordial and persuasive alongwith a sound knowledge of the ambient environmental issues. The Team also grateful to Mr. Abdus Salam, senior Chemist, DoE, Khulna for accompanying the team during the monitoring of Sundarbans Forest Health in Sundarbans.

CEGIS is also grateful for the contribution of the field officials of different Government and Non-Government Organizations for 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 for 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.





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## Abbreviations and Acronyms

|           |   |
|-----------|---|
| AECL      | Adroit Environment Consultants Ltd  |
| AAS       | Atomic Absorption Spectrophotometer   |
| BIFPCL    | Bangladesh-India Friendship Power Company (Pvt.) Limited  |
| BOD       | Biochemical Oxygen Demand   |
| BPDB      | Bangladesh Power Development Board  |
| BCSIR     | Bangladesh Council of Scientific and Industrial Research  |
| BUET-BRTC | Bangladesh University of Engineering and Technology- Bureau of Research, Testing and Consultation |
| CEGIS     | Center for Environmental and Geographic Information Services                                      |
| COD       | Chemical Oxygen Demand  |
| CPUE      | Catch per Unit Effort   |
| DCR       | Duplicate Carbon Receipt  |
| DO        | Dissolved Oxygen  |
| DoE       | Department of Environment   |
| DPHE      | Department of Public Health Engineering   |
| dBH       | Diameter at Breast Height   |
| EC        | Electrical Conductivity   |
| ECR       | Environment Conservation Rules  |
| EIA       | Environmental Impact Assessment   |
| EMP       | Environmental Management Plan   |
| EPC       | Engineering Procurement Construction  |
| FGD       | Focus Group Discussion  |
| FGD       | Flue Gas Desulfurization  |
| FSR       | Fisheries Species Richness  |
| GoB       | Government of Bangladesh  |
| GIS       | Geographic Information System   |
| GPS       | Global Positioning System   |
| GW        | Ground Water  |
| HS        | Household Survey  |
| ISO       | International Organization for Standardization  |
| IUCN      | International Union for Conservation of Nature  |
| IFC       | International Finance Corporation   |
| 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       | Decible            |
| ppm      | parts per million  |
| ppt      | parts per thousand |
| hr       | Hour               |
| Kg       | Kilogram           |
| Km       | Kilometer          |
| KW       | Killo Watt         |
| m        | Meter              |
| mg       | Milligram          |
| ton/year | Ton Per Year       |
| MW       | Mega Watt          |
| Nm       | Normal Meter       |
| s        | Seconds            |
| KV       | Kilo Volt          |

## Unit Conversion Table

### General Units

1 meter = 3.2808 feet

1 kilometer = 0.62137 mile

1 kilogram = 2.20 pound

1 metric ton = 1000 kg

1 square mile = 640 acres = 2.590 km<sup>2</sup>

1 hectare = 10<sup>-2</sup> km<sup>2</sup> = 2.471 acres

1 pascal = 1 N/m<sup>2</sup> = 0.01 millibar

1 liter = 0.001 cubic meter

1°C = 274.15°K = 33.8° F

1 mg/m<sup>3</sup> = 1 µg /L

1 mg/L ≈ 1 g/m<sup>3</sup> ≈ 1 ppm (w/w)

## Energy Unit

1 KWh = 3412 Btu

1MW=1000KW= $10^6$  W

1 KWh =  $3.6 \times 10^6$  J

1 kWh = 859.85 kcal

1 horsepower = 746 W

1 GWyr =  $8.76 \times 10^9$  kWh

## Glossary

|                        |  |
|------------------------|--|
| <i>Aman:</i>           | 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. |
| <i>Aus:</i>            | 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.  |
| <i>B:</i>              | When preceding a crop means broadcast (B. Aus)   |
| <i>Bazar:</i>          | Market   |
| <i>Beel:</i>           | A saucer-shaped natural depression, which generally retains water throughout the year and in some cases seasonally connected to the river system.  |
| <i>Boro:</i>           | 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.   |
| <i>Haat:</i>           | Market place where market exchanges are carried out either once, twice or thrice a week, however not every day.  |
| <i>Gear/Jaal:</i>      | Different types of fishing net to catch fish from the water bodies.  |
| <i>Kutcha:</i>         | A house made of locally available materials with earthen floor, commonly used in the rural areas.  |
| <i>Khal:</i>           | A drainage channel usually small, sometimes man-made. The channel through which the water flows. These may or may not be perennial.  |
| <i>Kharif:</i>         | 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).   |
| <i>Perennial Khal:</i> | Water available in the khal all the year round.  |
| <i>Pacca:</i>          | Well constructed building using modern masonry materials.  |
| <i>Rabi:</i>           | Dry agricultural crop growing season; mainly used for the cool winter season between November and February.  |
| <i>Seasonal Khal:</i>  | Water not available in the khal all the year round.  |
| <i>T. Aman:</i>        | When preceding a crop means transplanted (T. Aman).  |
| <i>Upazila:</i>        | Upazila is an administrative subdivision of a District.  |





## Executive Summary

This is the Eleventh(11<sup>th</sup>) Quarterly (3<sup>rd</sup> quarter of the 3<sup>rd</sup> year) Environmental and Social monitoring report covering status of different environmental and social parameters including environmental compliance related monitoring in regard to EMP of ongoing pre-construction activities. The report represents the period from August to October, 2016 and accordingly CEGIS has carried out the monitoring activities in October, 2016 comprising of 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, fisheries resources which covers fish habitats, migration and production, social environment monitoring, ecosystem monitoring and Sundarbans forest health monitoring. The status of environmental compliance in regard to the EMP (provided in the EIA) summarizes the assessment of the effectiveness of the recommended mitigation measures and also to identify any further need for additional mitigation measures or remedial action associated with pre-construction and construction phases of the Project. In regard to the Project progress it revealed that the land development for the BIFPCL's site (Block A) has been completed under pre-construction phase. Construction of the embankments and slope protection work are about to complete. Site office construction has been continuing. At present, the main access road from Babur Bari to the Plant site is at the completion stage. All the bridges and culverts have been constructed of the access road. 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. The monitoring study found that BIFPCL has been complying with the EMP as suggested in the EIA report. However, as per the EMP approved by DoE and being the Environmental Monitoring Consultant of the Project, CEGIS makes a few Site Specific Measure(s) that should be complied for ensuring environmental and social safeguarding of the Project, such as, demarcation of traffic way and taking precautionary measures like using proper signs in local language; and sediment fences/traps need to be maintained to prevent sediment wash load to Maidara river; stockpile of construction materials should be placed at a safe distance from river bank; sufficient waste disposal bins need to be placed at the labour shed, and working area.

The HR policies which are under preparation shall include: Working Conditions and Management of site specific EHS policy, Worker Relationship, Labour Policy, Occupational Health and Safety Policies, and worker's well beings following OHSAS 18001, ISO 14001; establishment of the grievance redress mechanism ; proper documentation of any accident/incident or any health hazard risk issues needs to be recorded; preventive measures for near miss accidental events and any unforeseeable injury, illness, or damage shall be adopted; an officer responsible for enforcing and monitoring safety procedure shall be appointed; site specific ESMP shall be prepared by the EPC contractors; safety training program for the Project personnel and labor force shall be arranged.

Air quality monitoring inferred that the wind flowed from South-Southeast to North-Northwest direction. The weather condition was rainy, cloudy with little storms and gust of wind. This time all the ambient air quality monitoring parameters (**SO<sub>2</sub>**, **NO<sub>x</sub>**, **PM<sub>2.5</sub>**, **PM<sub>10</sub>**, **CO** and **O<sub>3</sub>**) are found within the standard limit. Newly developed land for industrial activities along the Passur River, loading-unloading activities and cement industries are the known sources of PM<sub>2.5</sub>, PM<sub>10</sub> and SPM in this area. Other pollutants are generated from the commonly known sources like the vehicles (human hauler/ Nosimon) while working beside the roads; whereas

in case of the monitoring spot in or around the waterways, the sources are engines of trawler, barges, ship etc.

The Natural and anthropogenic causes are the main sources of noise generation within the study area. The natural domains are mainly birds' chirping, stormy wind, wave breaking on the shoreline and howling of leaves. On the other hand traffic mobilization, industrial activities, vessels movement within the rivers and local vehicles are the salient sources of anthropogenic noise. Nevertheless, all the average day time noise level data are relatively closer or within the standard limits; some cases it is considerably lower than the standard limit. During this monitoring period (3<sup>rd</sup> quarter of 3<sup>rd</sup> year, i.e., **Oct, 2016**), only two locations were found beyond the standard values within the eleven sampling points. These are North-west corner of the Project boundary (55.48 dB) and Harbaria, Sundarbans (55.33 dB).

In the recent monitoring period of October, 2016 water samples were collected from the preselected 18 locations (15 locations for surface water and 3 locations for ground water analysis). Accordingly, the samples have been submitted to DPHE and BCSIR for laboratory analysis of the preselected parameters. This monitoring report contains laboratory reports of the last monitoring study (July, 2016) and in-situ monitoring results of this quarter (3<sup>rd</sup> quarter of 3<sup>rd</sup> year). The analyzed results of all parameters are found within the standard limit set by ECR' 1997 and are found to be minimal in concentrations compared to the results previous seasons. However, similar to the earlier year, spatial and seasonal variations is still present for the analyzed parameters. For example, the values of TSS and COD are found lower comparing to the last monitoring periods. This may be due to the increase of fresh water flow from upstream and the erosion accretion process of the said river system. On the other hand the concentration of the  $\text{SO}_4^{2-}$  found higher than the previous monitoring results which may be due to the excessive upstream flow containing high concentration of minerals.

The soil samples have been collected for wet season of 2015-16 to determine the soil quality of the selected plots of five mauzas (Baranpara, Chunkuri-2, Kapalirmet, Chakgona and Basherhula). Soil samples were collected in three depths (0-15 cm, 15-30 cm and 30-45 cm) inside the monitoring area. Collected soil samples have been handed over to the SRDI, Dhaka for laboratory analysis. The result will be presented in the 3<sup>rd</sup> year final monitoring report after obtaining analysis results from SRDI.

Fisheries resources have been monitored at the same locations for seven sampling sites as of earlier quarter monitoring. The following are the key finding of the monitoring in third quarter of third year: Habitat uses are observed to be changed yearly (as compare between the year of 2014-2015 and of 2015-2016) caused mainly due to having tidal effect, seasonal variability and also fisheries resource management. Moreover, analysis of the type of habitat uses by different ages of different fish species (based on the length-based community structure model) have also been carried out to understand the habitat structures of the study area.

Shannon-Weiner index has also been observed to vary between 3<sup>rd</sup> quarter of 2016 with that of 2014 and 2015. The highest index has been found at Maidara (0.90). On the contrary, lowest evenness has been found at Akram Point and Haldikhali (0) because only one fish species (Hilsha) has been predominantly found in this survey. Moreover, maximum FSR was recorded in Harbaria (n=4), Sheola Khal at Chandpai, Mongla Point and Maidara (n=3), while very low FSR was recorded in Chalna Point, Akram Point and Haldikhali (n=1). Fry and juveniles for fin fish were more widely distributed among the middle and upper stretches of the Passur River. Among these Khorsula and Hilsha fishes were widely distributed among the sampling sites. Moreover, brood female fishes of Hilsha and Poma have highly observed at Akram Point, Haldikhali and Harbaria sampling sites in this quarter. Fish species like

Gulsha Tengra attains the maximum abundance among the migratory fish species. Moreover, three species like Hilsha, Poma and Gulsha Tengra showed long range of distribution. For the entire selected shrimp/fish farm seeds for seeds for Bagda stock of the entire selected shrimp/fish farm are collected from the hatchery among which some are from Chalna and some are from Phoyla Bazaar. The highest stocking rate has been observed in case of gher in Kapasdanga and mortality rate in case of gher in Rajnagar and Kapasdanga due to viral infection.

The highest productivity has been found in Sheola Khal at Chandpai, and lowest in the Chalna Point because of the abundance of fries, mainly of Khorsula, which are not considered as the production. Moreover, higher productivity was observed in this third quarter of 2016 as compared to that in third quarter monitoring year of 2014 and 2015. It is reported from the commercial fishermen that the Government declared banned fishing period is the main cause of that higher productivity. The most frequently used gear is Chhandi Jal in all reaches in Passur River System. Moreover, Charpata Jal is most frequently used in middle reach and Vola Jal in upper reach of the Passur River. The highest total catch is observed in Sheola khal at Chandpai and lowest in the Chalna Point in this monitoring phase. Highest fish production from Shrimp/fish farm (Gher) has been found in case of gher at Kapasdanga attaining 27 ton of Bagda, Tilapia, Vetki, Tengra, Paissa, Bele, Horina Chingri and Chali Chingri as their catch within the month of September-October.

Plant canopy cover, bird habitat, butterfly occurrences and dolphin occurrence in river water have been monitored for this monitoring season. Canopy status of studied homestead vegetation has been increasing than last monitoring season. This change have been happened due to more foliage growth of tree in rainy season. Coverage of living lichen on tree barks have been observed more or less same in Rajnagar Kalekarber and Chalkghona monitoring sites and recorded less compared to the same season in previous year. No bird nest was observed from any site of the monitoring location during this monitoring period.

Occurrence of butterfly species is recorded same than previous monitoring period and Small Grass Yellow (*Eurema smilax*) is the most common species from all the locations. Dolphins have been sighted at Passur River and Dhangmari khal and most of which are centered inside the Maidara khal and Dhangmari khal. Beside this, Ganges River Dolphin was also found at Passur River near Karamjal and Harbaria.

Seedling Density, Pneumatophores Density, Crab hole Density, Canopy Cover and Leaf Area Index have been observed in the third year third quarter (post monsoon period) monitoring of Sundarbans Reserve Forest (SRF) health at the five permanent sample plots. The observed indicators have been compared with previous findings. Mangroves are dynamic ecosystem and forest health monitoring indicators are interlinked with each other. After comparing the monitoring results, it can be predicted that the changing trend for almost majority of the indicators of forest health in SRF is related to spatial and temporal variation. The temporal variation is distinctive by season like in monsoon to post monsoon period seedlings and pneumatophores density are high whereas at dry period they are low. The indicators even show variation among the monitoring sites (PSPs) that could be due to the different physical environment for respective locations.



# 1 Introduction

## 1.1 Background

1. This study report covers all the monitoring results and a plausible description of the recommended environmental and social parameters, and environmental compliance monitoring of pre-construction activities for this quarter (**3rd quarter of 3rd year**) for the proposed **2x660 MW Moitree Super Thermal Power Project** being constructed at Rampal, Bagerhat.

2. The proposed Plant is a joint venture project of Bangladesh Power Development Board (BPDB) and National Thermal Power Corporation (NTPC) Ltd., India as per the contract signed in January, 2012 and run by Bangladesh-India Friendship Power Company Ltd. (BIFPCL).

3. The proposed coal based thermal power Plant is a the Red category project as per ECA, 1995 and the subsequent rules ECR, 1997, and therefore, needs Site Clearance Certificate (SCC) and Environmental Clearance Certificate (ECC) from Department of Environment (DoE), Bangladesh. To that end, BPDB engaged Center for Environmental and Geographic Information Services (CEGIS) for conducting Initial Environmental Examination (IEE) and Environmental Impact Assessment (EIA) studies under a Contract signed on 13<sup>th</sup> July, 2010 between BPDB and CEGIS.

4. Accordingly, CEGIS has conducted detailed EIA study in mid 2013 encompassing a rational study area which is also ecologically very important by virtue of the existence of the world's largest single tract of Mangrove Forest, the Sundarbans with remarkable biodiversity in this area. As per the scope of EIA study, a detailed Environmental Management Plan (EMP) has been developed suggesting mitigation, enhancement, contingency, and compensation measures that shall duly be implemented during project preconstruction, construction and operation phase in order to minimize the negative impacts considered to be generated by the power plant.

5. Successful implementation of the EMP depends on regular monitoring of the selective indicators at specified locations. Therefore, an independent environmental monitoring team has been proposed under the Department of environmental health and safety. Moreover, compliance monitoring has been suggested mandatory for this Project due to the presence of the Sundarbans. 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.

6. Subsequently, BIFPCL has initiated a study on monitoring environmental and social parameters and implementation of EMP during pre-construction and construction phases of the proposed Thermal Power Plant to safeguard the environment of the Sundarbans Mangrove Forest and the surrounding communities. CEGIS has been engaged for carrying out the study since early 2014 and will continue till early 2017 over a span of three (3) years.

7. The location of the proposed project encompasses Sapmari Katakhal 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 to 22°34'30"N and longitude 89°32'0"E to 89°34'5"E and is about 23 km south from the Khulna City and 14 km in the north-west direction from the Sundarbans. Location of the study area and their relative distance from various heritage sites are presented in **Map 1.1**. The study area includes: i) area covering 10

km radius from the Plant location, ii) 10km strip from both bank of Passur and Sibsa rivers starting from the Plant site to Hiron point (**Map 1.2**).

8. The results of all the monitoring study are reported quarterly to BIFPCL through monitoring reports. Eventually, BIFPCL submits these reports to DoE and Forest Department. Accordingly, CEGIS has so far submitted ten (10) monitoring reports on quarterly basis. The current document constitutes 10th monitoring report (i.e. monitoring activities of the 3rd quarter of 3rd year); the field study has been carried out in October, 2016 covering all the monitoring parameters and preselected monitoring locations which upgrades the environmental monitoring database up to date.

## 1.2 Objectives

9. The overall objective is to monitor the environmental parameters and implementation of Environmental Management Plan (EMP) during pre-construction and construction phases of the installation of the Power Plant.

10. The aim of the quarter monitoring is to monitor the ambient state of environment that will be considered as the baseline 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 pre-construction activities.

## 1.3 Criteria for Selection of Monitoring sites/locations

11. The monitoring sites have been selected considering the sensitive receptors and the ambience likely to be impacted from the Project related activities.

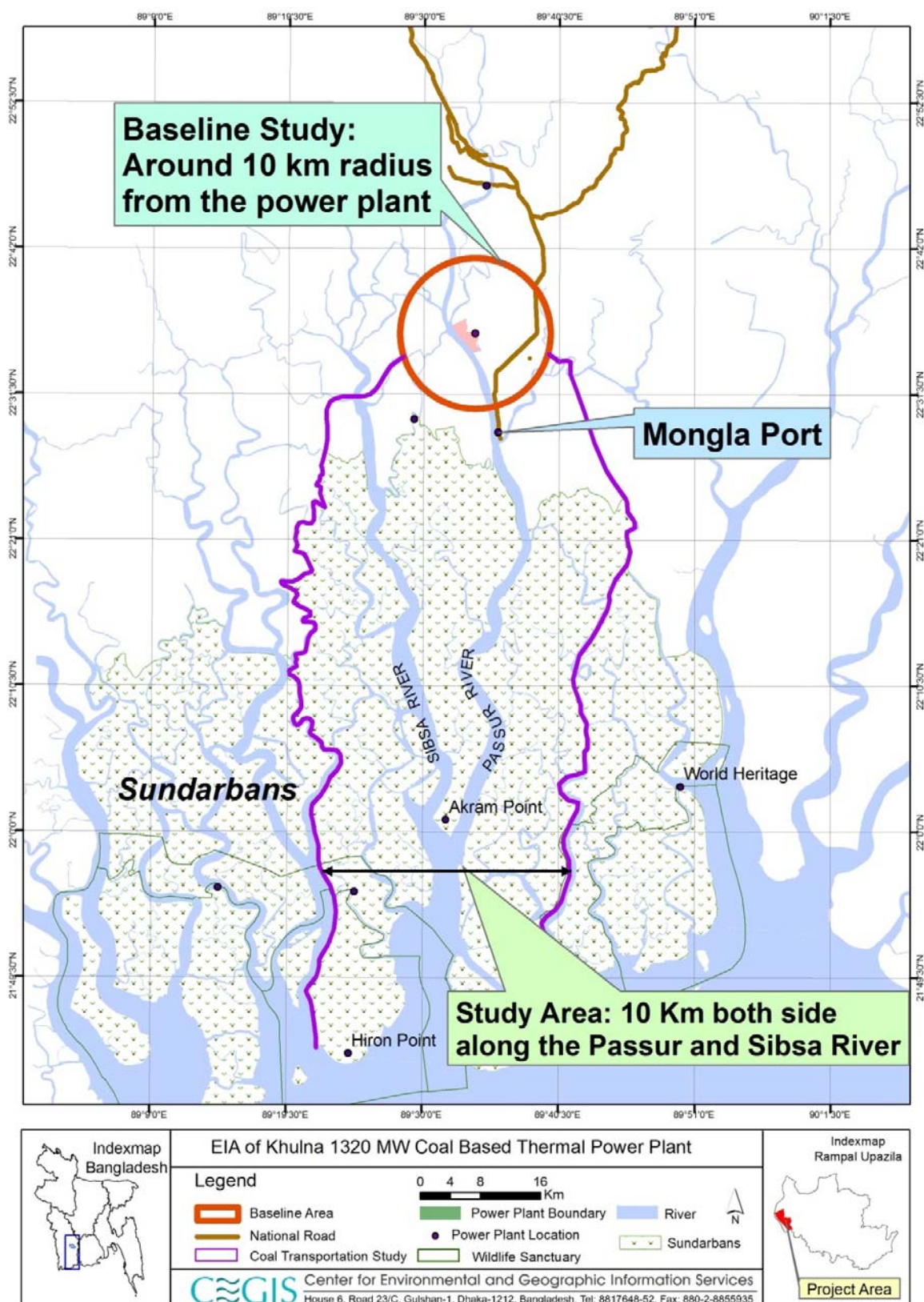
- Monitoring locations for ambient air quality are selected considering the wind direction, sensitive receptors in the vicinity of the Project etc. Site selection for monitoring of ambient noise condition also considers the same as for Air quality.
- Sites for ambient water quality are selected by considering the water sources likely to be impacted/ polluted by the project activities.
- Monitoring sites of fisheries resources covers the fish habitats, biodiversity, migration and production zones likely to be impacted.
- Monitoring locations of ecosystem and biodiversity have been selected considering the induced impacts of the Project.
- Monitoring locations of soil and land resources likely to be impacted by the project activities.
- Monitoring of social environment i.e. the PAPs (project affected peoples) and the changes of socio-economic parameters. Sundarbans forest health Monitoring locations have been selected considering the potential access routes for Power Plant which may have impacts on Sundarbans Reserve Forest (SRF).





Map 1.1: Location Map of the Coal Based Thermal Power Plant





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

## 1.4 Main stakeholders

### Forest Department

12. The monitoring of the study area includes some locations in Sundarbans that needs to comply to the conditions set out by the DoE in the approval of EIA report. Hence, permission from the Forest Department is necessary to carry out monitoring activities in the Sundarbans.

13. The Forest Department has issued the permission of carrying out monitoring activities in the Sundarbans under certain conditions that include keeping close communication with Forest Department, submitting the monitoring report to Forest Department and including the following activities in the monitoring study:

- Inclusion of soil scientist and a botanist in the monitoring team,
- Monitoring of regeneration, ingrowths (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 at above and below ground level,
- Assessment of impact on canopy cover, leaves phenology, flowers behaviour, pneumatophore and crab hole conditions.

14. The monitoring team has been formed as per the requirements of the Forest Department. BIFPCL also forwarded a copy of an earlier quarterly monitoring report to the Chief Conservator of Forest, Bangladesh Forest Department, Agargaon, Dhaka and Conservator of Forest, Khulna Circle, Boyra, Khulna. Similarly, this monitoring report will also be forwarded to the Forest Department.

### Department of Environment (DoE)

15. 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 experts of DoE to finalize the monitoring plan at CEGIS office.

16. 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 the renewal of the site clearance. In each monitoring visit a representative from the local DoE have also been accompanying the monitoring team.

### Bangladesh India Friendship power company (Pvt.) Limited (BIFPCL)

17. Bangladesh India Friendship Power Company (Pvt.) Limited (BIFPCL) is the project proponent. The monitoring plan has been prepared based on the conditions set by DoE which have been suggested in the EIA study. During field survey for baseline study, official(s) from 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)**

18. BPDB is the main promoter of BIFPCL and is giving lateral support the BIFPCL in every phase (pre-construction, construction and operation) of the power plant. In addition, BPDB is also ensuring the environmental compliance monitoring of different stages of the power plant construction.

**Local Community**

19. The project affected peoples (PAPs) were included in the monitoring of social environment. The changes on important socio-economic parameters were examined based on the Focus Group Discussions (FGDs) and informal discussions with local people at different locations surrounding the project area as stated in the monitoring reports.

**1.5 Study Scopes**

20. In this study, the Physical, Biological aspect has been monitored on quarterly basis and the quarterly monitoring report is furnished in the subsequent chapters as such,

- 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 ;
- 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 resource.

## 2 Physical Environment

21. A number of physical environmental parameters including air quality, noise level, water quality, land resources are monitored quarterly as per the monitoring schedule to establish a baseline.

### 2.1 Air Quality

22. The ambient air quality has been monitored in this 3<sup>rd</sup> quarter of 3<sup>rd</sup> year at 11(Eleven) specific locations.

#### 2.1.1 Methodology

23. Five (5) major air pollutants i.e., **Particulate Matters (PM<sub>2.5</sub>, PM<sub>10</sub>, SPM), SO<sub>x</sub>, NO<sub>x</sub>, CO and O<sub>3</sub>** are expected to generate from the proposed Power Plant in the ambient air which have been also considered for monitoring in this study. The locations for monitoring have been selected during the EIA study. In this context, eleven (11) sites have been selected based on a number of criteria e.g., the sensitivity of the receptors, project activities like coal-carrying vessel movement, transshipment point etc.; wind direction and atmospheric stability class. Moreover, the potential location of air pollution has been projected on the basis of model generated pollutant dispersion scenario. U.S. EPA approved regulatory air quality software SCREEN 3.0 has been used to select the location of potential pollutants which may be dispersed from the Power Plant. On the other hand due to the bad weather condition air quality could not be monitored in the Hiron Point of Sunderbans. However, in this part the monitored air quality of the remaining locations will be discussed comprehensively.

#### *Method of Sampling and Laboratory Testing*

24. Respirable Dust Sampler (Model-Envirotech India APM-460BL) and Fine Particulate Sampler (Model-Envirotech India APM-550) have been used to collect the air samples. The PM<sub>2.5</sub>, PM<sub>10</sub>, and SPM have been tested by gravimetric method. The concentration of SO<sub>x</sub> has been tested by West-Gaeke method. Likewise the NO<sub>2</sub> has been tested by Jacob and Hochheiser method.

#### *Monitoring locations*

25. Ambient air quality has been monitored in the same locations as monitored in the earlier quarters. The locations of the air quality monitoring points have been shown in **Map 2.1**. The details of the monitoring plan have been provided in the **Table 2.1**.

#### *Pollution sources at Project area*

26. The major pollution sources currently contributing to the ambient air pollution along the Passur River in between the Project site and Mongla Port area are the existing infrastructures (i.e., cement and petroleum industries) and other pollution sources (i.e., marine vessels and residential sources) are listed in **Table A.2** of Appendix IV.

#### *Pollution sources in the Sunderbans*

27. Mostly river traffic of Mongla Port travelling across the Sunderbans are the sources of Suspended Particulate Matter (SPM), Oxides of Sulphur (SO<sub>2</sub>), Oxides of Nitrogen (NO<sub>x</sub>) and Green House Gas (GHGs).

28. An inventory of the existing emission types and sources in the study area have been provided in **Table A.2 of Appendix IV**.

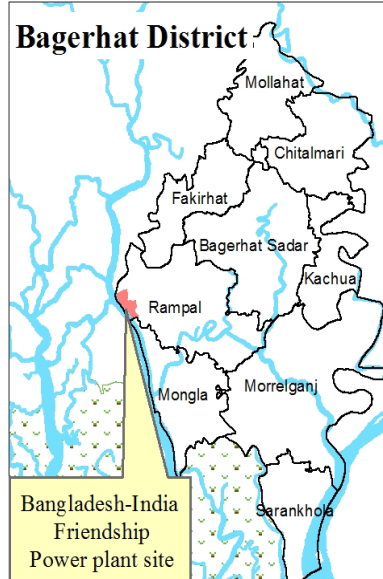
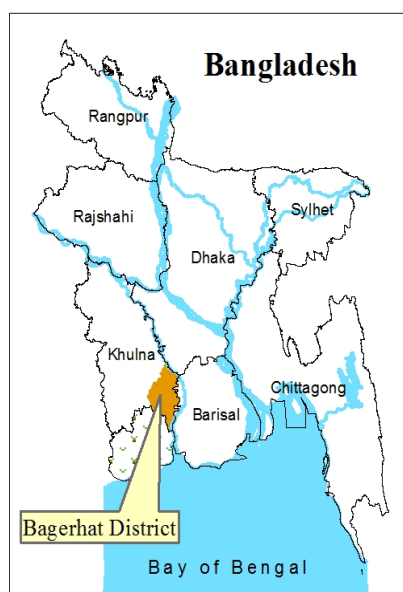
**Table 2.1: Air Quality Monitoring Plan**

| SI no | Monitoring Indicators  | Locations   | GPS Points                    | Frequency | Methods/Tools/Techniques   |
|-------|--|---|-------------------------------|-----------|--|
| 1     | Particulate Matter (PM <sub>2.5</sub> , PM <sub>10</sub> , SPM)<br>SO <sub>x</sub> , NO <sub>x</sub> , CO and O <sub>3</sub> | South West corner of the Project boundary                             | 89°33'34.5"E<br>22°34'33.8"N  | Quarterly | In situ field measurement conducted with the facilities of outsourced laboratory.<br><b>Method of testing PM<sub>2.5</sub>:</b><br>Gravimetric<br><b>Method of testing PM<sub>10</sub>:</b><br>USEPA (1997) Method 201 or 201A (as appropriate)<br><b>Method of testing SO<sub>x</sub>:</b><br>USEPA (2000) Method 6 or 6A or 6B or ISO (1998) Method 11632 (as appropriate)<br><b>Method of testing NO<sub>x</sub>:</b><br>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 Katakhal | 89°32'3.8"E<br>22°36'32.5"N   |           |  |
| 3     |  | North West corner of the Project boundary (Kaigar Daskati)            | 89°33'51.8"E<br>22°36'1.06"N  |           |  |
| 4     |  | Barni, Gaurambha union (4km North East from the chimney location)     | 89°34'37.7"E<br>22°38'51.8"N  |           |  |
| 5     |  | Chunkuri-2, Bajua Union (4km South West from the chimney location)    | 89°34'01.1"E<br>22°32'3.3"N   |           |  |
| 6     |  | Pankhali, Dacope, (4km North West from the Chimney location)          | 89°31'24.2"E<br>22°36'6.7"N   |           |  |
| 7     |  | Mongla Port Area  | 89°35'50.4"E<br>22°28'24.8"N  |           |  |
| 8     |  | Harbaria, Sundarbans  | 89°35'34.2"E<br>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<br>21°46'27.60"N |           |  |
| 11    |  | Khulna city near Khan Jahan Ali Bridge                                | 89°35'35.5"E<br>22°46'36.8"N  |           |  |





## Index Map

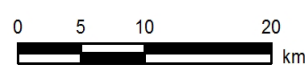


## Legend

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

## Data sources:

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



Map projection: Bangladesh Transverse Mercator (BTM)

## Map prepared by:

**CEGIS** Center for  
Environmental and Geographic  
Information Services

June 2016

**Map 2.1: Air Quality Monitoring Locations**





### 2.1.2 Status of air quality

29. Air quality is expressed in terms of standards set forth for public health and welfare protection (against decreased visibility and damage to 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 ( $\mu\text{g}/\text{m}^3$ ).

**Table 2.2: Air Pollutants Emission Standards**

| Pollutant                          |                   | Averaging Time | IFC/WB Standard                                 | Bangladesh (DoE) Standard for ambient Air (ECR 2005) |
|------------------------------------|-------------------|----------------|---|--|
| Carbon Monoxide (CO)               |                   | 1 hour         | -   | 40 $\text{mg}/\text{m}^3$                            |
|                                    |                   | 8 hours        | 10 $\text{mg}/\text{m}^3$                       | 10 $\text{mg}/\text{m}^3$                            |
| Nitrogen Dioxide ( $\text{NO}_2$ ) |                   | 1 hour         | 200 $\mu\text{g}/\text{m}^3$                    | -  |
|                                    |                   | Annual         | 40 $\mu\text{g}/\text{m}^3$                     | 100 $\mu\text{g}/\text{m}^3$                         |
| Ozone ( $\text{O}_3$ )             |                   | 8 hours        | 100 $\mu\text{g}/\text{m}^3$                    | 157 $\mu\text{g}/\text{m}^3$                         |
|                                    |                   | 1 hour         | -   | 235 $\mu\text{g}/\text{m}^3$                         |
| Particle Pollution (PM)            | PM <sub>2.5</sub> | 24 hours       | 75 $\mu\text{g}/\text{m}^3$ (Interim Target-1)  | 65 $\mu\text{g}/\text{m}^3$                          |
|                                    | PM <sub>10</sub>  | 24 hours       | 150 $\mu\text{g}/\text{m}^3$ (Interim Target-1) | 150 $\mu\text{g}/\text{m}^3$                         |
|                                    | SPM               | 8 hours        | -   | 200 $\mu\text{g}/\text{m}^3$                         |
| Sulphur Dioxide ( $\text{SO}_2$ )  |                   | 24 hours       | 125 $\mu\text{g}/\text{m}^3$ (Interim target-1) | 365 $\mu\text{g}/\text{m}^3$                         |

#### **Particulate Matter (PM<sub>2.5</sub>, PM<sub>10</sub> and SPM)**

30. The values of PM<sub>2.5</sub> and PM<sub>10</sub> have been found within the standard limit at each location. Among those locations, the maximum concentration of PM<sub>2.5</sub> (10.6  $\mu\text{g}/\text{m}^3$ ) is found in Bajua, Chlna bazar which was the highest in this season comparing to the observed results of other location. Similarly, during this time of monitoring, PM<sub>10</sub> and SPM concentration have been recorded also lower comparing to the same season of the previous years, which may be due to the prevailing rain at the sampling sites. Though a large number of two-stroke human hauler, small engine boats and the anthropogenic activities are experienced during the time of monitoring. In addition, cement industries and road traffic may also be considered as other source of the particulate matters. However, all the monitoring data are given in **Table A.1 in Appendix IV**.

#### **Sulphur Dioxide (SO<sub>2</sub>)**

31. Concentration of Sulphur dioxide ( $\text{SO}_2$ ) in the ambient air is found within the Bangladesh standard limit of 365  $\mu\text{g}/\text{m}^3$ . The  $\text{SO}_2$  values in and around the Project ranged between 5.5  $\mu\text{g}/\text{m}^3$  and 10  $\mu\text{g}/\text{m}^3$  which are the lowest among all the monitored data.  $\text{SO}_2$  concentration has also been measured in the Sundarbans reserve forest; the result indicates a low condition ranging from 5.5 to 9.2  $\mu\text{g}/\text{m}^3$ .

### Nitrogen Dioxide (NO<sub>2</sub>)

32. NO<sub>2</sub> concentration in the ambient air of Sundarbans ranged between 6.1 µg/m<sup>3</sup> and 14 µg/m<sup>3</sup>. In Project site and its adjoining areas, the values are found lower than the previous season and within the Bangladesh standard limit of 100 µg/m<sup>3</sup>. The monitoring results are shown in **Table A.1** in **Appendix IV**.

### Carbon Monoxide (CO)

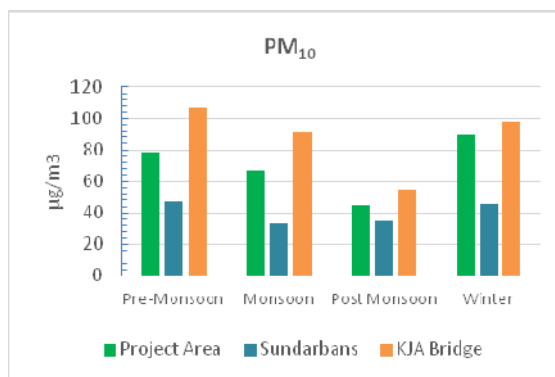
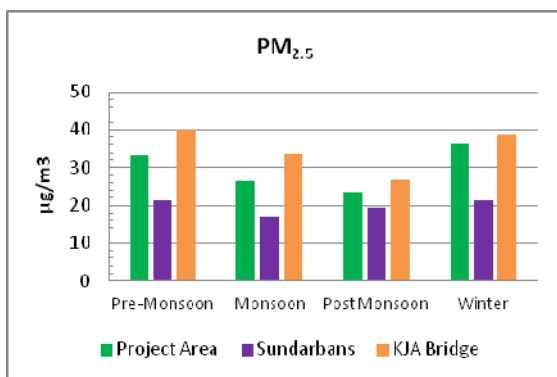
33. CO concentration is found in between 79 µg/m<sup>3</sup> to 127 µg/m<sup>3</sup> in and around Project area. The possible causes for the CO concentration could be the movement of numerous types of vehicles in roads and boats in the river. However, most importantly the concentration in the Sundarbans ranges between 121 and 127 µg/m<sup>3</sup> which may be contributed by the ship's anchorage beside the sampling point and for the loading-unloading activity. The values are found very insignificant in the context of national standard (10,000 µg/m<sup>3</sup> for 8 hours).

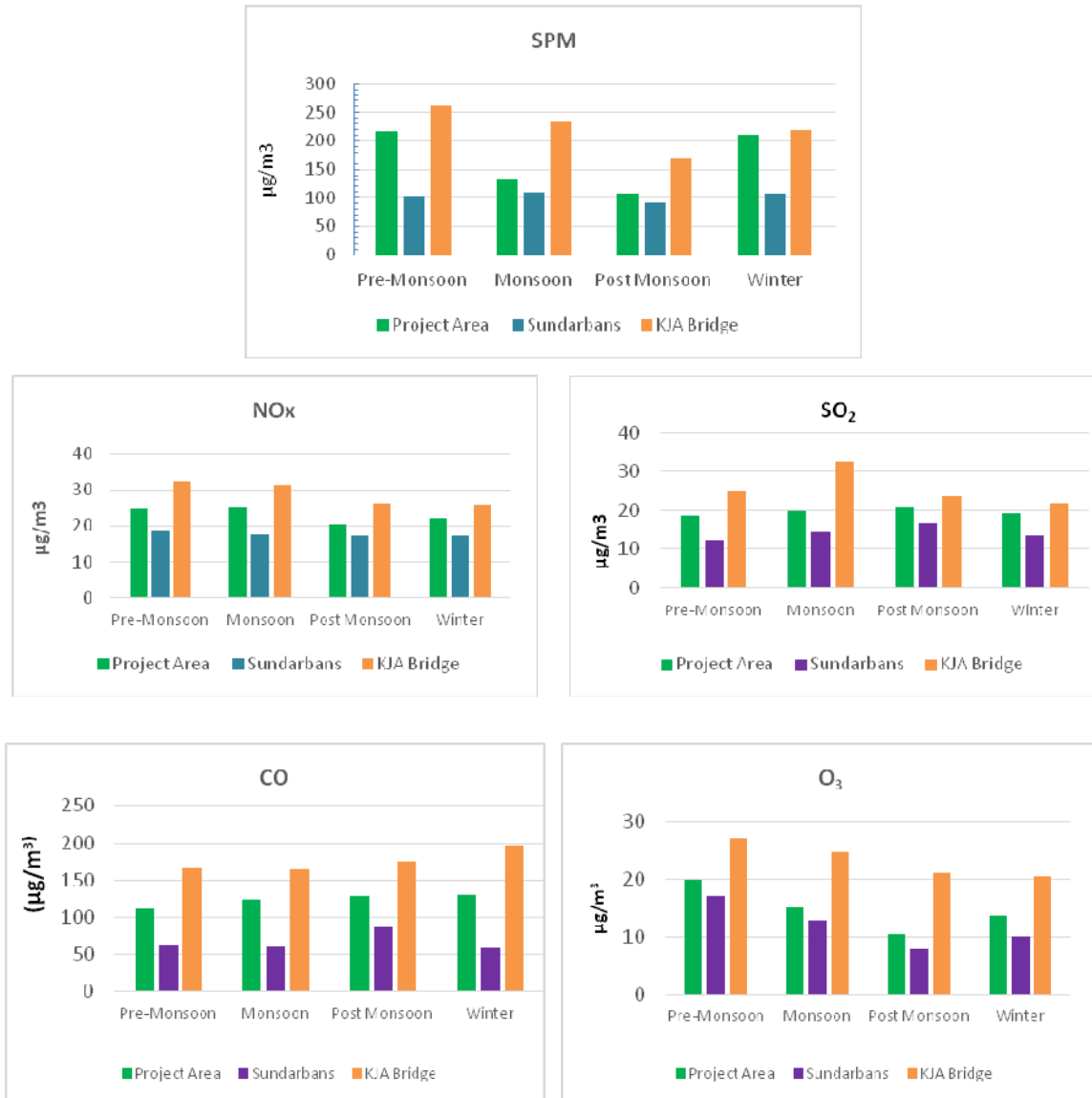
### Ozone (O<sub>3</sub>)

34. Similarly, results of O<sub>3</sub> both in the Sundarbans and Project area are lower (0 - 3 µg/m<sup>3</sup>) than the Bangladesh standards of 100 µg/m<sup>3</sup> for 8 hours. In this recent monitoring study the maximum concentration was found in Chalna Bazar, Khulna. Ground-level or "bad" ozone is not emitted directly into the air, but is created by chemical reactions between oxides of nitrogen (NO<sub>x</sub>) and volatile organic compounds (VOC) in the presence of sunlight.

#### 2.1.3 Findings

35. All the air pollutant data satisfactorily comply with the national standards and showed lowest concentration in this season (monsoon). This may be due to the prevailing rain experienced in the monitoring sites and minimal movement of the traffics both in roads and river. (**Figure 2.1**).





**Figure 2.1: Seasonal variation of the Air Quality Parameters**

## 2.2 Noise

36. Noise is the sound that is not wanted by the perceiver, because it is unpleasant, loud, or interferes with hearing. By extension, in experimental sciences, "noise" refers to any random fluctuations of data that makes more difficult the perception of an expected signal. From a physics standpoint, noise is indistinguishable from sound as both are vibrations through a medium, like air or water. In general point of view, noise is the chaotic feeling of sound where many sound waves are mixed and difficult to distinguish a single signal.

37. Noise is described by a weighted sound intensity (or level), which represents sound heard by the human ear and is measured in units called decibels (dBA). Noise is recorded through Noise Level (Sound Pressure Level) Meter for a certain period of time for determining the ambient noise level in the study area.

38. Noise levels have been monitored during 2014 (April, July, October), 2015 (January, April, July, October) and 2016 (January, April, July and October). Ambient noise levels have been monitored quarterly at eleven (11) locations during this session.

39. In this 3<sup>rd</sup> quarter monitoring of 3<sup>rd</sup> year, the noise level has been recorded at post-monsoon period.

40. The noise is generated from the common sources i.e., the rural vehicles (human hauler/ Nosimon, auto-rickshaw); whereas in case of the monitoring spot in or around the waterways, the sources are trawler, ship, sometimes waves breaking against the shore, etc. Barges, trawlers and ships are found plying over the waterway during this season.

### **2.2.1 Methodology**

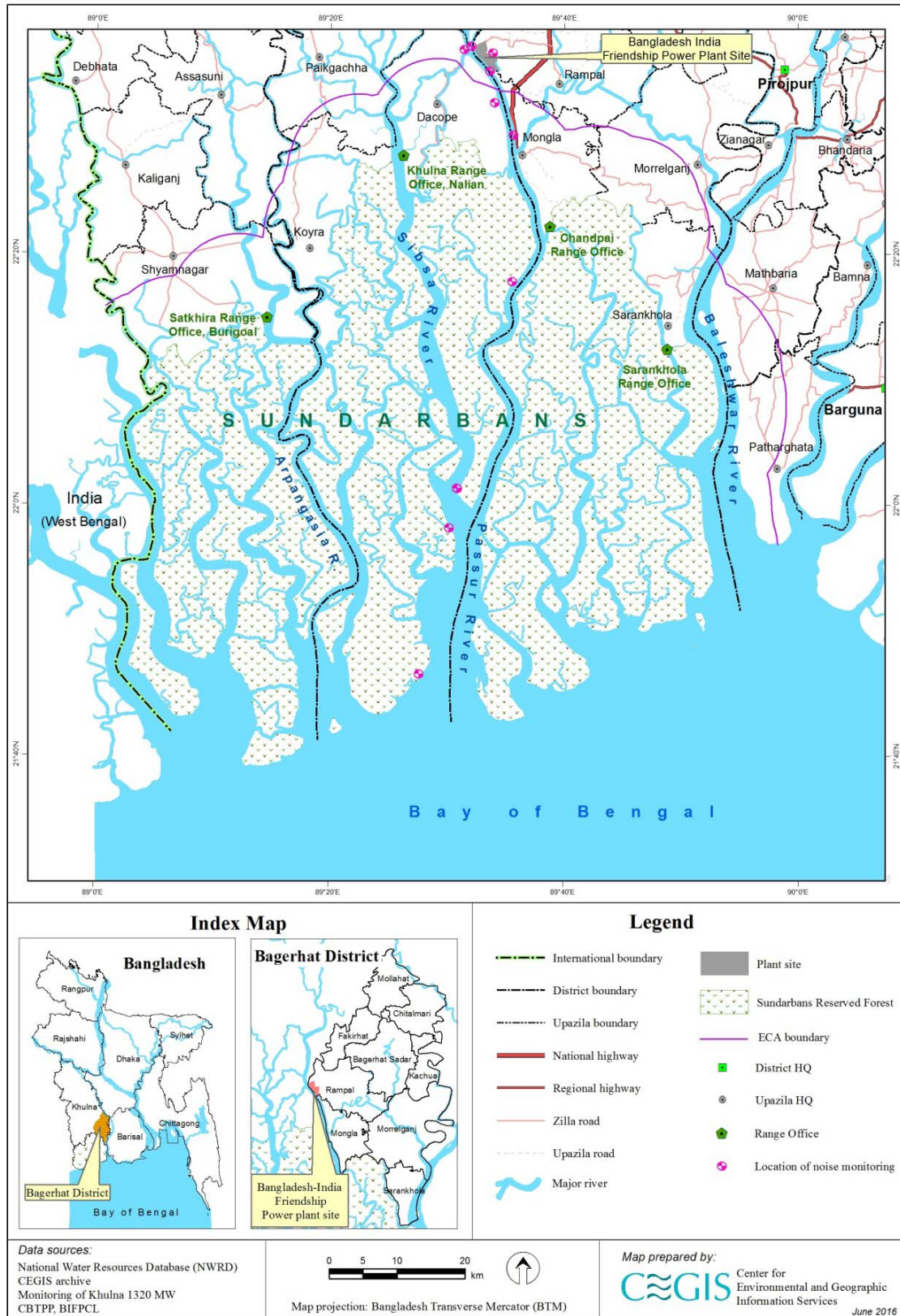
41. Noise level has been measured thrice in a day (morning, afternoon and evening) at Eleven (11) locations. Each time noise level is recorded using portable noise level meter for a five minutes time span with a 30 seconds interval. Depending on the site condition and acoustic environment, the noise meter is set up and calibrated following the instruction manual. All the data are collected in Leq, L10 and L90 dBA values.

#### **Locations of Noise level Monitoring**

42. There are eleven (11) locations for the noise level monitoring of which three locations are inside the Sundarbans, six locations are in and around the Project site, one is at Khan Jahan Ali Bridge on Rupsha River and one is at Mongla Port (**Map 2.2**).



**Photo 2.1: Professional conducting an ambient noise acquisition survey in Harbaria, Sundarbans**



Map 2.2: Noise Level Monitoring Locations



### 2.2.2 Status of Noise

43. The brief summary of Noise level data is appended in the **Table 2.3**; but the detailed field Noise level data is attached to the **Table no. C1, C2 and C3** in the **Appendix IV**. Ambient noise data have been recorded at the following places:

#### ***Dacope Upazila Parishad***

44. The monitoring location is at Chalna Bazar [Pankhali, Dacope (4km North West from the Chimney location); 89.5234° E, 22.6046° N] which 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 has been recorded as 65.51 dB which is less than the Bangladesh standard (**Table 2.3**) for allowable noise level.

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

#### ***North- West (NW) corner of the Project area***

46. The North West (NW) corner of the Project area [89.5334° E, 22.6093° N] is under Kaigar Daskati mauza of Gaurambha union. The monitoring location is nearby Gucchha gram (a cluster village built by the Government for the landless and homeless people). This area is residential and the standard is 55dB (A) at day time (**ECR, 1997**). This time the average day time noise level has been recorded as 55.48 dB, which is found slightly higher than the day time standard value.

#### ***Chunkuri-2, Bajua***

47. This area [4km South West from the chimney location, 89.5669°E, 22.5342°N] is residential and the standard is 55 dB (A) at day time (ECR, 1997). Noise levels in two consecutive years are found abrupt and fluctuating around the day time. During this time (Oct, 2016), it is found to be 51.55 dB which is also within the day time standard value.

48. It is observed that the sound level has a fluctuation about 1.83 dB in this monitoring season than that of last monitoring season. The noise sources are 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***

49. The South West corner of the Project area [89.5601°E, 22.5761°N] is in Maidara Khal of Rajnagar union. This area is residential area and the standard is 55dB (A) at day time (ECR, 1997). The noise level is found much lower (48.51 dB) than the standard value. It was 65.37 dB during the last monitoring period which is much higher than the standard value. Frequent movement of water vessel over the Moidara Khal is one of the main reasons for exceeding the standard value.

#### ***Proposed township area of the Project***

50. 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 55dB (A) at day time (ECR, 1997). Compared to the previous quarterly monitoring data collected in the 1st and 2nd monitoring year, the noise level of the last couple of quarters is found considerably higher (53.37dB, 55.79 dB) in level and this is due to accelerated construction works in the area but within the day time standard. In this

monitoring period, sound level is found to be 43.69 dB which is very close to that of first year and first half of the second years' monitoring periods.

***Barni, Gaurambha***

51. This area [4km North East from the chimney location; 89.5772°E, 22.6477°N] is both residential and commercial and the standard for a mixed zone is 60dB (A) at day time (ECR, 1997). The noise level is found 54.91dB during this monitoring season which is still lower than the standard value but it shows an increasing trend compared to the previous monitoring years and this changing trend may be due to the gradual increasing of different human activities like establishment of new homes, shops etc. The traffic load and crowd are higher than most of the past which has also accelerated the increase of the noise level.

***Khan Jahan Ali Bridge, Khulna***

52. 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 70 dB (A) at day time (ECR, 1997). The average noise level is found 60.95 dB which is below the standard of day time. The highway traffic is the main source of noise. The highest noise level has been recorded both in the morning and evening due to higher traffic load.

***Mongla Port area***

53. 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 (A) at day time (ECR, 1997). The average day time noise level is found 49.86 dB which 25.14 dB lower than the standard.

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

***Harbaria, Sundarbans***

55. 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 is used to anchor at this site for lighterage operation. The area is under silent class of noise standard and standard of ambient at day time is 50 dB (A) (ECR, 1997). The noise level is 55.33 dB measured 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 is found higher than day time standard value. This relatively higher value is for the higher wind action on this day.

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

***Akram point, Sundarbans***

57. Akram Point of the Sundarbans is another biodiversity hot spot in the Sundarbans. This area has been selected for anchorage point of coal carrying mother vessel for the Power Plant. This area is also under the silent class where the ambient day time noise standard is 50 dB (A). The monitoring location [89.5152°E, 22.0219°N] is at the left bank of the Sibsa River. Noise is recorded at about 100m inside the forest from the river bank to avoid noise from wave breaking. The average day time ambient noise level during this monitoring period is found to be 41.77 dB which is much lower than the standard. Birds' chirping, stormy wind, wave and tree leaves are the main sources of noise here.

***Hiron Point, Sundarbans***

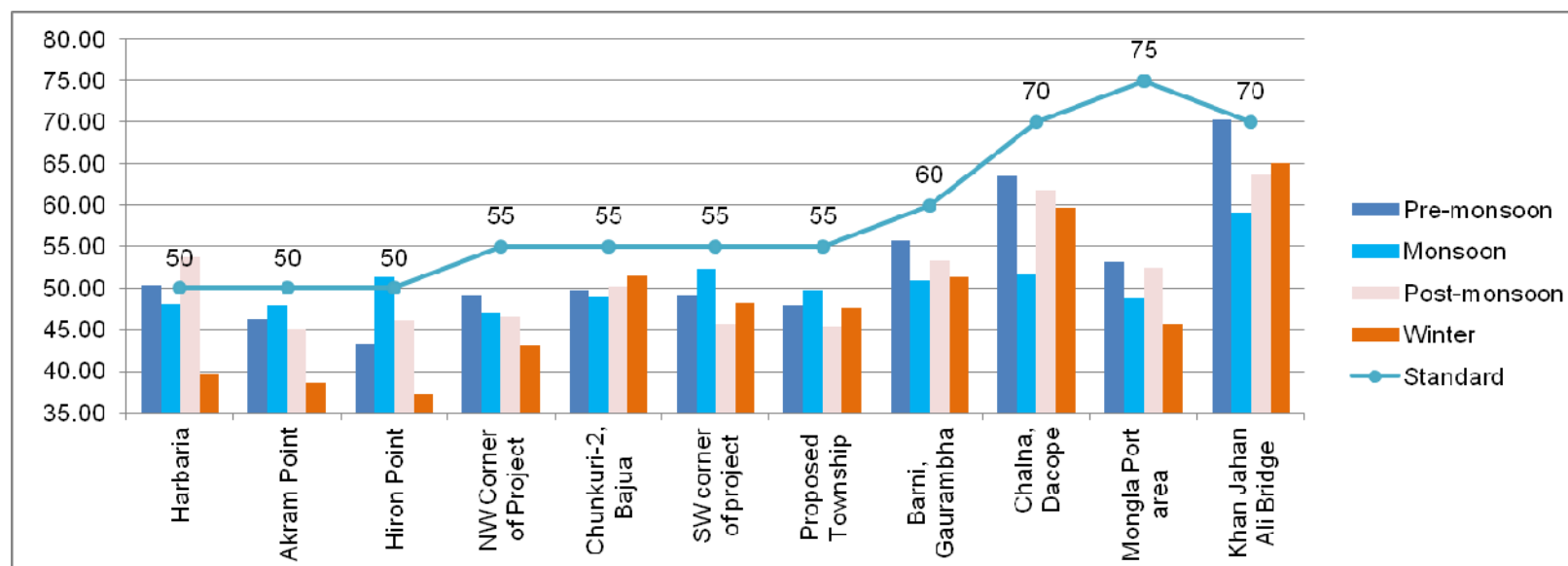
58. This noise sampling location [89.4614°E, 21.7755°N] falls under the demarcated area of World Heritage Site. Noise level is measured at the western bank of Passur river mouth and eastern side of the Sundarbans South Sanctuary. This location is highly important as the Mother vessels enter into the Passur river adjacent to this point. However, the river is roughly 5-6 km wide between two banks at the confluence point. Noise level has been recorded 44.38dB during at this monitoring season. This is the place where sound level shows less fluctuation and always remains lower than the standard values; even in the winter, it goes below 40dBA. Sound of sea shore, wind blow, creeping of birds and small mechanized sea going boat might be responsible for the present noise level.



**Table 2.3: Summary of the ambient noise recorded in consecutive eleven (11<sup>th</sup>) Quarter monitoring sessions in 2014, 2015 & 2016**

| SI No. | Location                                      | QM1<br>Mar-14 | QM2<br>Jul-14 | QM3<br>Oct-14 | QM4<br>Jan-15 | QM5<br>Apr-15 | QM6<br>Jul-15 | QM7<br>Oct-15 | QM8<br>Jan-16 | QM9<br>Apr-16 | QM10<br>July-16 | QM11<br>Oct-16 | 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          | 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          | 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   |
| 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          | 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          | 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          | 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          | 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          | 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          | 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          | 50   |
| 11     | Hiron Point, Sundarbans                       | 38.63         | 51.29         | 47.98         | 37.37         | 47.84         | NM            | 46.06         | NM            | 43.11         | NM              | 44.38          | 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**

### 2.2.3 Findings

59. The Natural and anthropogenic causes are the main sources of noise generation within the study area. The natural domains are mainly birds' chirping, stormy wind, wave breaking on the shoreline and howling of leaves. On the other hand traffic mobilization, industrial activities, vessels movement within the rivers and local vehicles are the salient sources of anthropogenic noise. Nevertheless, all the average day time noise level data are relatively closer or within the standard limits; some cases it is considerably lower than the standard limit (Figure 2.2). During this monitoring period (3rd quarter of 3rd year, i.e., Oct, 2016), only two locations were found beyond the standard values within the eleven sampling points. These are North-west corner of the Project boundary (55.48 dB) and Harbaria, Sundarbans (55.33dB). These two higher values warn that any additional anthropogenic noise producing activities may aggravate the sound pollution within the study area.

## 2.3 Water Quality

60. A detail description of the current water quality status of Passur-Sibsa river system has been updated in this section. The entire monitoring activities and analyzing methodologies has been adopted following both the national and international guidelines. A systematic sampling design has also been adopted in order to emphasize the multiple lines of evidence of the water quality. This report includes in-situ water quality data collected during the **3<sup>rd</sup> quarter of 3<sup>rd</sup> year (11<sup>th</sup> program, October, 2016)** and the available laboratory data obtained up to **July 2016**.

61. The water quality monitoring activities include surface water and ground water at the respective locations. A number of identical parameters are chosen to understand the quality of the water for community use, aquatic life, and the Sundarbans forest ecosystem.

62. The samples collected for the 10<sup>th</sup> monitoring program (July, 2016) have been analyzed for the specific parameters which is included in this report and the data of the recently collected samples (October, 2016) will be discussed in the next 12<sup>th</sup> Monitoring report due to timing of laboratory analysis.

### 2.3.1 Methodology

63. Monitoring of water quality directly depends on selection of water quality parameters, sampling locations, sampling frequency, evaluation criteria etc. Standard practices have been followed to analyze the water quality. Both the surface and ground water quality have been assessed to examine the water quality status in and around the Power Plant and the Sundarbans. The monitoring results have not only been presented but also been compared with the national standards (ECR, 1997 and all amendments).

64. The samples have been collected from Eighteen (18) preselected sites (15 locations for surface water along Passur River, Sibsa River, Maidara River, near the plant site, and three locations for groundwater around the study area) for 11<sup>th</sup> monitoring program as shown in the **Map 2.3**. However, one tube well, once used for collecting groundwater sample, has been found damaged near Kalekarber from the 3<sup>rd</sup> monitoring program; hence the site has not been monitored since then. Recently, these sampling locations are preliminarily selected at inception stage and finalized during the 1<sup>st</sup> monitoring study. The details of the monitoring plan (selected water quality parameters, sampling locations, and frequency of sampling at each location) for surface water is shown in **Table 2.4** and for groundwater in **Table 2.5**.

Table 2.4: 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 <sub>5</sub> , 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 from the Project boundary  | 22.604167°N          | 89.527222°E | Quarterly | In-situ measurement (pH, Temperature, Salinity, DO and BOD <sub>5</sub> ) and Laboratory analysis (TDS, TH, TSS, COD, Nitrate, Sulphate, Phosphate, Arsenic, Lead, Mercury, Oil & Grease) |
| 2     |   | Middle of Passur River at 100m u/s of North West corner from the Project boundary     | 22.607222°N          | 89.528889°E |           |   |
| 3     |   | Right Bank of Passur River at 100m u/s of North West corner from 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 from the Project boundary              | 22.572889°N          | 89.552583°E |           |   |
| 8     |   | Middle of Passur River at South West corner from the Project boundary                 | 22.574611°N          | 89.557500°E |           |   |
| 9     |   | Right Bank of Passur River at South West corner from the Project boundary             | 22.575667°N          | 89.559861°E |           |   |
| 10    |   | Maidara river at the South East corner of the project 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 Sundarbans  | 22.295250°N          | 89.593139°E |           |   |
| 14    |   | Passur river at Akram Point of Sundarbans   |                      |             |           |   |
| 15    |   | Passur river at Hiron point of Sundarbans   |                      |             |           |   |



Map 2.3: Surface water and Groundwater Quality Monitoring Locations



**Table 2.5: Groundwater Quality Monitoring Parameters, Locations and Plan**

| SI no | Monitoring Indicators  | Locations                                  | GPS (Decimal Degree) |              | Frequency                                 | Methods/Tools/ Techniques                   |
|-------|--|--|----------------------|--------------|---|---|
|       |  |  | Easting              | Northing     |   |   |
| 1     | pH, Temperature, Salinity, DO, COD, As, Hg, Pb, TH, TDS, TSS, Nitrate, Sulphate, Phosphate | Near Proposed Township Area of the Project | 22.594167° N         | 89.566139° E | Quarterly (April, July, October, January) | In-situ measurement and Laboratory analysis |
| 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**

65. The standard sampling procedure has been followed for both surface and groundwater sampling to reduce the probability of error. Each sample is tagged at the time of sampling.



**Photo 2.2: Professional is collecting water samples at monqila-Passur confluence**

### **Surface Water Sampling Procedure**

66. The study area is highly influenced by tidal variation. Hence, temporal and spatial variations of tides have been considered significantly in sampling procedure. Surface water samples are collected during the low tides or relative slag period after the low tide. Samples are taken 50 m away from the riverbank and at a depth of 6 cm below the river surface, whereas for oil and grease, samples are collected from the river surface. The individual sampling bottle is rinsed with respective water samples before storing. Acidified sampling bottles are used for heavy metal (As, Pb, Hg) analysis and wrinkle bottles are used for BOD<sub>5</sub>. All the samples are preserved as per standard practices.

### **Groundwater Sampling Procedure**

67. Groundwater availability depends on the recharge factor of aquifer, seasonal variation in water table, excessive water extraction from nearby agricultural field. Groundwater samples are collected from hand operated tube wells after 5-7 minutes of water extraction. Each sampling bottle is rinsed with respective water samples before storing. Acidified sampling bottles are used for heavy metal (As, Pb, Hg) analysis and are preserved following standard practices.



**Photo 2.3: Professional is taking reading of water parameter**

### **Parameters tested for water quality**

68. Water quality parameters have been selected on the basis of tentative potential impacts generated during pre-construction, construction and operation phases of the Power Plant Project. Only five parameters namely pH, temperature, salinity, DO and BOD5 have been tested while conducting the monitoring study and the rest of the preselected parameters are analyzed in the laboratories.

### **Surface Water Quality Parameters**

69. The selected parameters for surface water quality includes Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Heavy Metals (As, Pb, Hg), pH, Salinity, Nitrate ( $\text{NO}_3^-$ ), Total Dissolve Solids (TDS), Total Suspended Solids (TSS), Total Hardness (TH), Turbidity, Temperature and Oil and Grease. The main parameters are 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,  $\text{NO}_3^-$ ,  $\text{PO}_4^{3-}$  and  $\text{SO}_4^{2-}$
- Aggregate organic constituents i.e. BOD, COD
- Heavy metals i.e. As, Pb and Hg

### **Groundwater Quality Parameters**

70. The parameters for ground water quality includes Dissolved Oxygen (DO), Chemical Oxygen Demand (COD), Heavy Metals (As, Pb, Hg), pH, Salinity, Hardness, Nitrate ( $\text{NO}_3^-$ ), Total Dissolve Solids (TDS), Total Hardness (TH) and Temperature.

### **Water quality analysis procedure**

71. The collected samples of selected water quality parameters are analyzed as per the procedure of American Public Health Association (APHA) standard. The analysis procedures along with the standards have been appended in **Table 2.6**.

**Table 2.6: Testing Methodology of Water Quality Parameter**

| Parameters                             | Methods/Measuring Tools                                      | Unit               | BD Standard (ECR 1997) |
|--|--|--------------------|------------------------|
| Temperature                            | Thermometer  | $^{\circ}\text{C}$ | 20 - 30                |
| pH                                     | Microprocessor pH meter                                      |                    | 6.5-8.5                |
| TDS                                    | TDS meter (Multimeter)                                       | ppm                | 1000                   |
| TSS                                    | Drying and Filtration  | ppm                | 10                     |
| Salinity                               | Salinity Refractometer (Master-S/Millm Cal. No. 2493, ATAGO) | ppt                |                        |
| DO                                     | Dissolved Oxygen meter DO-5509                               | ppm or mg/l        | 6                      |
| BOD <sub>5</sub>                       | 5-Day BOD Test at 20 $^{\circ}\text{C}$                      | ppm or mg/l        | 50 (SW)                |
| COD                                    | Closed Reflux Method   | ppm or mg/l        | 200 (SW), 4.0 (GW)     |
| Total Hardness (as $\text{CaCO}_3$ )   | Titrimetric  | ppm or mg/l        | 200-500                |
| Ortho-Phosphate ( $\text{PO}_4^{3-}$ ) | UV-VIS Spectrophotometers                                    | ppm                | 6                      |
| Nitrate ( $\text{NO}_3^-$ )            | UV-VIS Spectrophotometers                                    | ppm or mg/l        | 10                     |
| $\text{SO}_4^{2-}$                     | UV-VIS Spectrophotometers                                    | ppm or mg/l        | 400                    |
| Oil and Grease                         | Liquid-liquid extraction with                                | ppm or mg/l        | 10 (SW)                |

| Parameters   | Methods/Measuring Tools   | Unit        | BD Standard (ECR 1997) |
|--------------|---|-------------|------------------------|
|              | hexane, treatment with silica gel and gravimetric determination         |             |                        |
| Arsenic (As) | Atomic Absorption Spectrophotometers–Hydride Vapor Generating (AAS-HVG) | ppm or mg/l | 0.05                   |
| Lead (Pb)    | Atomic Absorption Spectrophotometers–Graphite Furnace (AAS-GF)          | ppm or mg/l | 0.05                   |
| Mercury (Hg) | Mercury Analyzer  | ppm or mg/l | 0.001                  |

### 2.3.2 Status of the surface water quality

#### *In-situ tested parameters*

##### (a) pH

72. During this period of monitoring pH values ranged in between 6.9 to 7.6 among the monitoring sites. The highest value is found in Hiron Point at Sundarbans while the lowest value is observed in Maidara river of the South East corner of the Project at Ichamoti-Maidara confluence and Passur River at Passur-Mongla confluence. The results show close conformity among all the locations and the monitoring results of the same period of previous years.

73. pH values of pre-monsoon and monsoon seasons are found to be comparatively lower than post-monsoon and winter seasons. During post monsoon and winter seasons, river water level normally goes down because of less rainfall and less from u/s (upstream) flow of Passur-Sibsa RS and as a result, pH values becomes higher than pre-monsoon and monsoon seasons as reported by others (Rahman et al., 2013). Fluctuations in pH values during different season of the year can be attributed to factors like removal of CO<sub>2</sub> by photosynthesis through bicarbonate degradation, dilution of waste with fresh water, reduction in salinity and temperature, and decomposition of organic matter (Rajasegar, 2003).

74. No significant pH differences are observed except spatial variation in the river water. Seasonal variations in pH concentrations among the selected monitoring locations during first, second and third year quarterly monitoring of Passur-Sibsa RS are presented in **Figure-2.3** and all the observed dataset are attached in **Table B.1** of **Appendix- IV**.

##### (b) Temperature

75. Recent monitoring results of temperature show close conformity with the previously monitored values in the same season of 1<sup>st</sup> and 2<sup>nd</sup> year. The latest values vary from 29.9°C to 31.3°C among the monitored locations. During all the monitoring period maximum temperature is found in July 2014 which seemed to be slightly higher than the standard limit set by environmental conservation rules (ECR), 1997 and may be due to the temperature rise in the month of June & July (Summer Season). But all the observed values are found to be within the BD standard (20°C-30°C).

76. 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 others season's data. However, the average temperature in all the other seasons is seen to be very similar with each other. No significant spatial variation had been observed during the monitoring periods. The measured temperature



values of selected monitoring locations during quarterly monitoring of first and second year are presented in **Figure-2.4** and all the observed dataset are attached in **Table B.2** of **Appendix- IV**

### (c) Salinity

77. The observed salinity values vary from 0 ppt to 5.8 ppt during this monitoring period and the maximum value is observed at Hiron point in Sunderbans while salinity level has been found zero in all the observed locations.

78. During this monitoring period dominant fresh water flow from upstream was found significant and thus the tidal inflow could not acts as a dominant factor in increasing the salinity level. However, the observed results are found similar for the same seasons in the previous years. The highest average values are found in pre-monsoon season of the previous years. Water salinity data at the selected sampling stations of Passur-Sibsa RS of eleven consecutive periods are presented in **Figure: 2.5** and all the observed dataset are attached in **Table B.3** of **Appendix- IV**.

### (d) Dissolved Oxygen

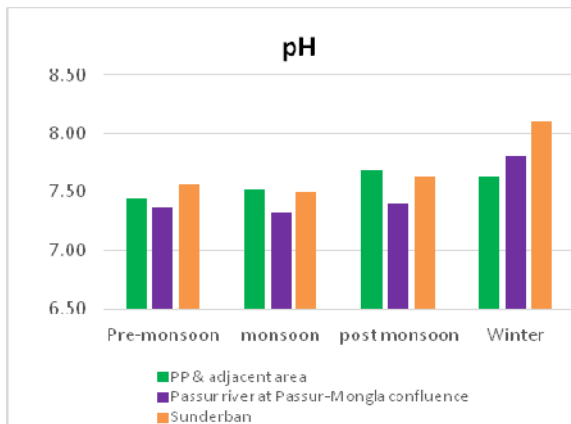
79. Among all the monitored locations DO concentrations are found to be ranged between 5.6 mg/L to 6.9 mg/L. The maximum concentration is found at Hiron point in Sundarbans while the lowest amount is recorded at Passur river at Passur-Mongla confluence It may be mentioned that the Maximum concentrations are observed during monsoon and post monsoon than the other seasons. These higher values of DO in the upstream stations could be due to DO enriched inland freshwater input through the river. Seasonal variations of DO at the monitoring sites of Passur-Sibsa RS are shown in **Figure: 2.6**; all the observed dataset are attached in **Table B.4** of **Appendix- IV**.

### (e) Biochemical Oxygen Demand (BOD<sub>5</sub>)

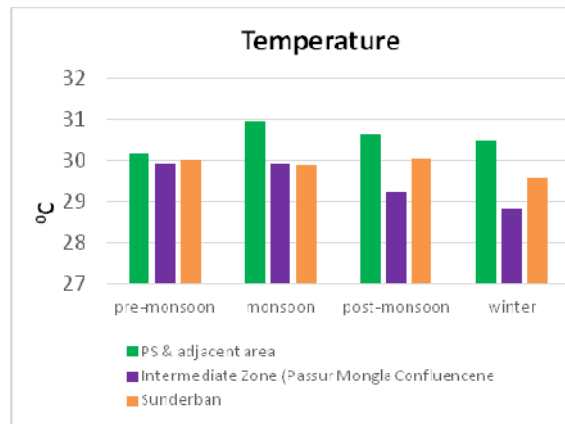
80. The BOD<sub>5</sub> values ranged from 2.3 to 3.4 mg/L. Maximum value of BOD<sub>5</sub> is found at Passur river at Passur-Mongla confluence while the lowest (2.3 mg/L) value is observed at Akram Point in SUNDarbans. However all the values are found to be within the standard limit as stated in the ECR' 1997 and in IFC standard.

81. It is also evident from the figure that the highest average value has been recorded in Passur-Mongla confluence during monsoon season because of the river receives huge amount of organic load and agricultural runoff from the adjacent areas. Thus, BOD<sub>5</sub> has been found higher during summer season than monsoon and the least during winter. The water temperature normally goes down in winter season than those of pre-monsoon, monsoon and post monsoon seasons, which in turn decreases the bacterial and microbial activities and contributes a low level of BOD<sub>5</sub>.

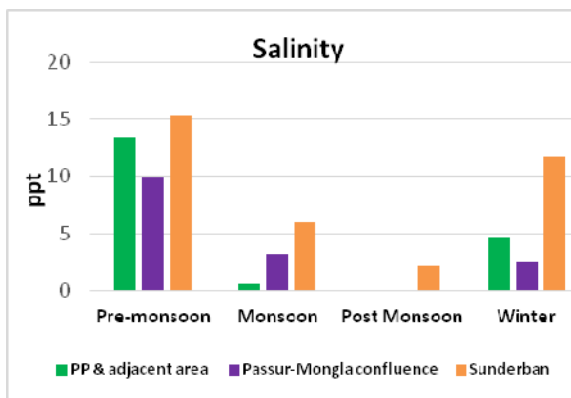
82. The measured BOD<sub>5</sub> values at different monitoring locations during the monitoring of Passur-Sibsa RS are presented in **Figure: 2.7** and all the observed dataset are attached in **Table B.5** of **Appendix- IV**.



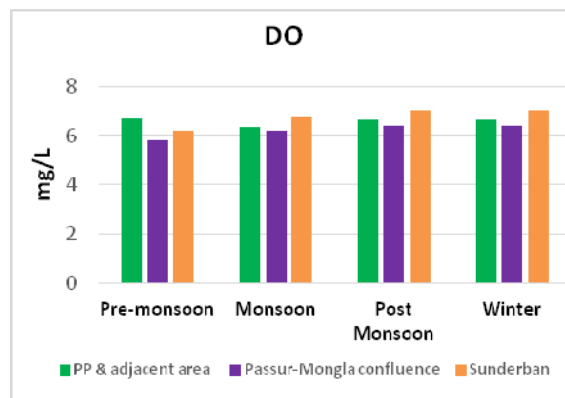
**Figure 2.3: Variations in average pH values in sampling spots for the consecutive seasons**



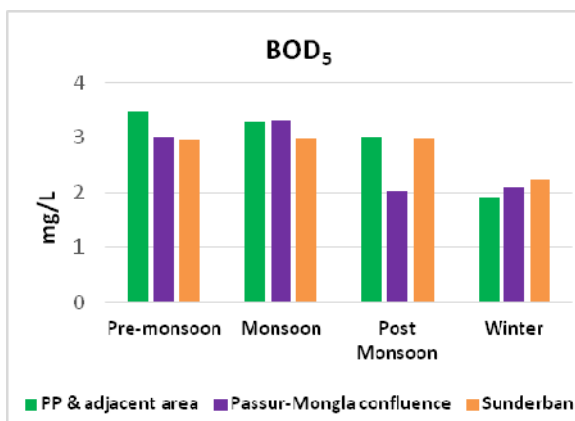
**Figure 2.4: Variations in average temperature values in sampling spots for the consecutive seasons**



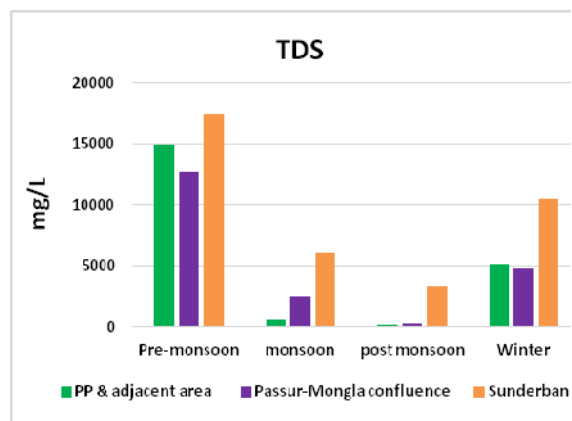
**Figure 2.5: Variations in average salinity values in sampling spots for the consecutive seasons**



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



**Figure 2.7: Variations in average BOD<sub>5</sub> values in sampling spots for the consecutive seasons**



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

### **Laboratory tested parameters**

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

83. The observed values of TDS vary from 112 mg/L to 7330 mg/L which shows a little proximity to that of the previously obtained data of the same season of 2014 and in 2015. The lowest value is found in Middle of Passur River at 100m u/s of North West corner from the Project boundary while the highest value is observed at Akram point in Sundarbans. This may be due to the sea water and the erosion-accretion process of the river.

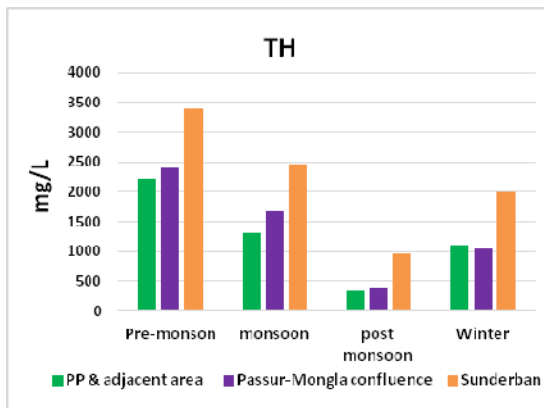
84. In most of the observed locations, the TDS concentrations seem to be lower in monsoon and post monsoon period and higher in pre-monsoon and winter season. A Significant spatial variation is found, which could be due to the sea water and the erosion-accretion process of the river. Sediment load in Passur River is relatively higher as it is located in the south western part of Bangladesh. TDS mainly indicates the presence of various kinds of minerals like ammonia, nitrite, 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*).

85. The highest and lowest concentration of Total Hardness are found 205 mg/L and 1750 mg/L and observed at Middle of Passur River at 100m u/s of North West corner from the Project boundary and in Passur River at Akram point in Sundarbans respectively. During the rainy season, the hardness in all monitoring stations in Passur River are found to be lower whereas it is 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*).

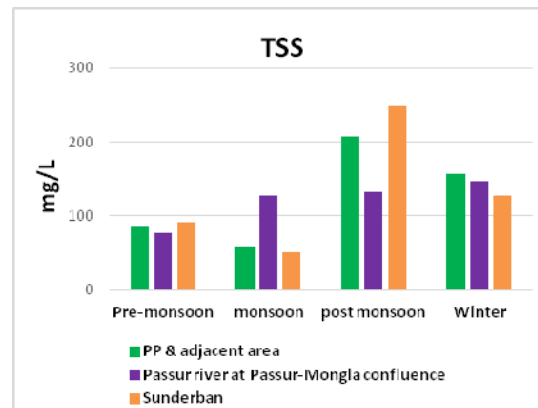
86. TSS includes solid materials of organic and inorganic in origins which are suspended in water. In Passur and Sibsa Rivers system the suspended matters generally contain sand, clay, silt and loam. However, during the 10<sup>th</sup> monitoring period the TSS concentrations vary from 16 mg/L to 61 mg/L among the monitoring locations. The highest value is found at Left Bank of Passur River at 100m u/s of North West corner from the Project boundary while the lowest value is found in Passur river at Akram point of Sunderbans. TSS values in every spots are found to be within the standard limit (150 mg/L) suggested for Bangladesh (ECR, 1997) inland fresh water and the monitored values are found to be lowest in this pre-monsoon season comparing to the other values recorded in the previous season of the monitoring year.

87. The values are found to be relatively higher in pre-monsoon season than those of monsoon. During dry season (pre-monsoon and winter season) the TSS value increases, probably due to less freshwater 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.

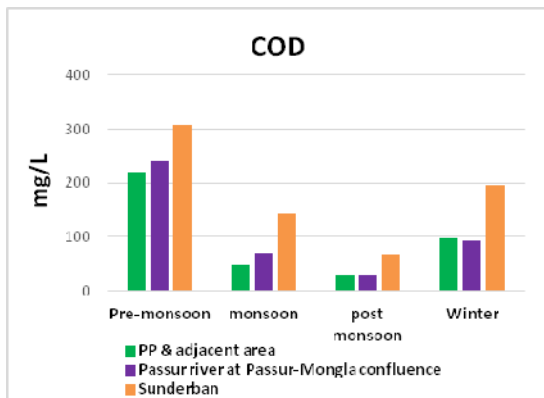
88. The TDS, TH and TSS of Passur River in pre-monsoon, monsoon, post-monsoon and winter seasons at different monitoring locations are presented in **Figure: 2.8, 2.9 and 2.10** respectively and all the observed dataset are attached in **Table B.8, B.9 and B.10** respectively of **Appendix- IV**.



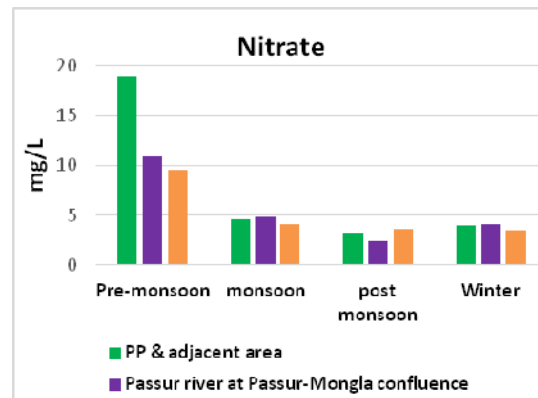
**Figure 2.9: Variations in average TH values in sampling spots for the consecutive seasons**



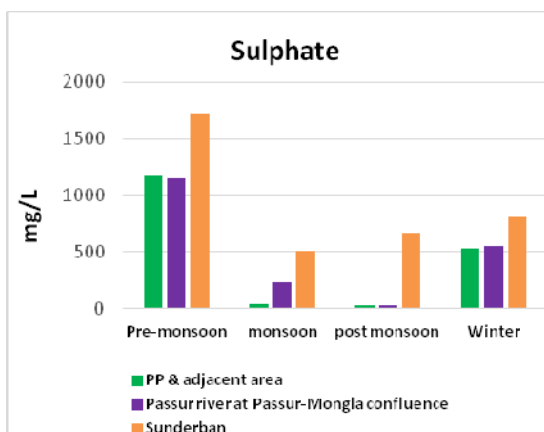
**Figure 2.10: Variations in average TSS values in sampling spots for the consecutive seasons**



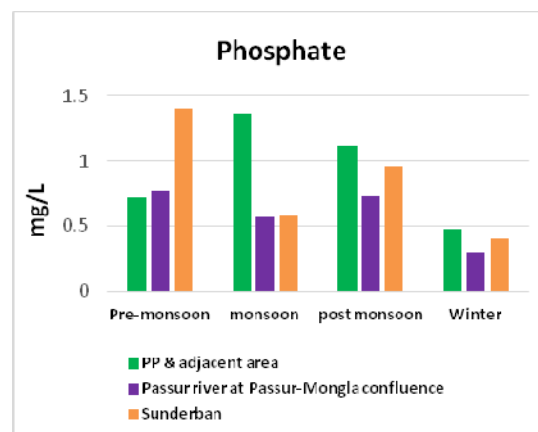
**Figure 2.11: Variations in average COD values in sampling spots for the consecutive seasons**



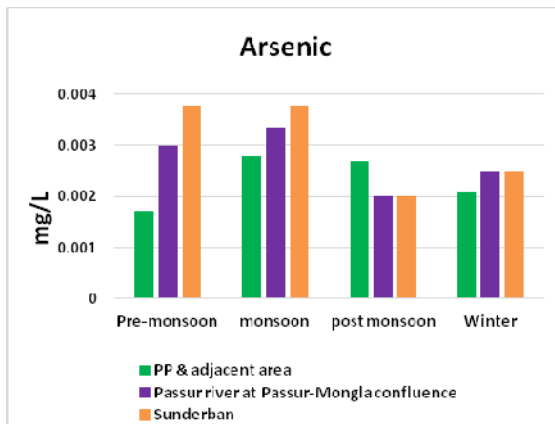
**Figure 2.12: Variations in average Nitrate values in sampling spots for the consecutive seasons**



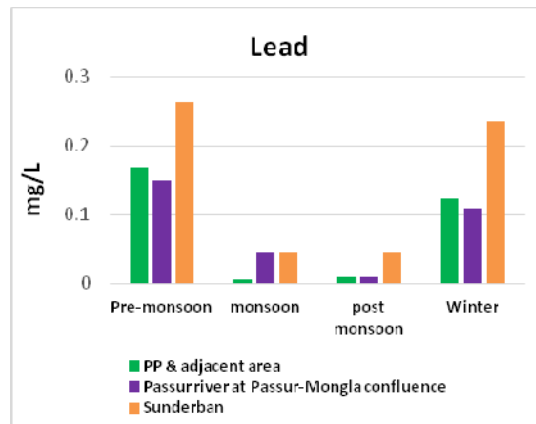
**Figure 2.13: Variations in average Sulphate values in sampling spots for the consecutive seasons**



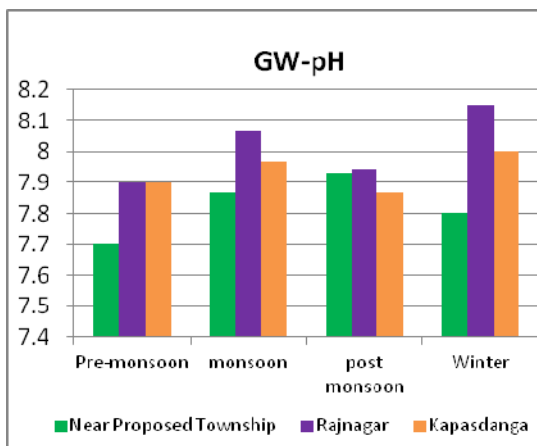
**Figure 2.14: Variations in average Phosphate values in sampling spots for the consecutive seasons**



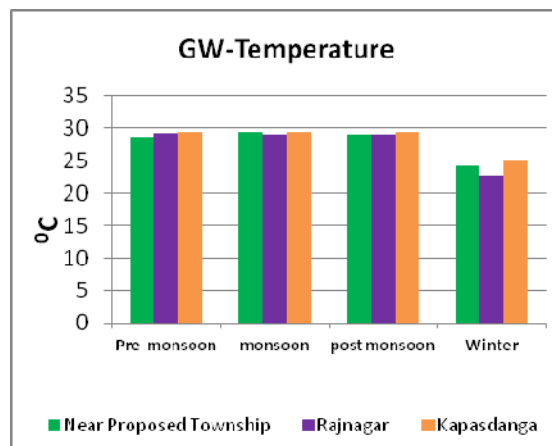
**Figure 2.15: Variations in average Arsenic values in sampling spots for the consecutive seasons**



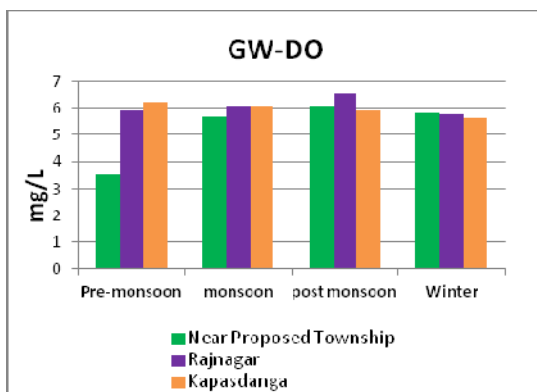
**Figure 2.16: Variations in average Pb values in sampling spots for the consecutive seasons**



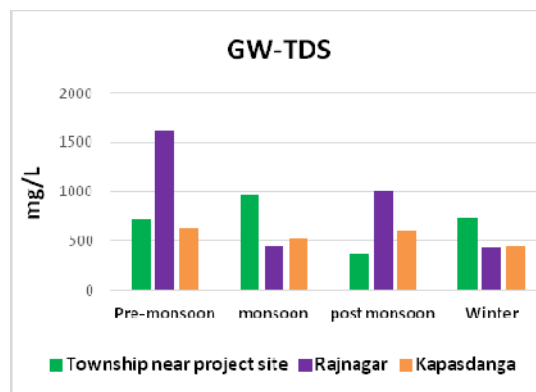
**Figure 2.17: Variations in average G-pH values in sampling spots for the consecutive seasons**



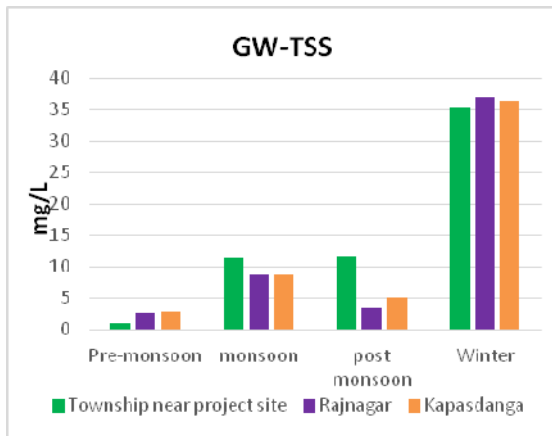
**Figure 2.18: Variations in average G-Temperature values in sampling spots for the consecutive seasons**



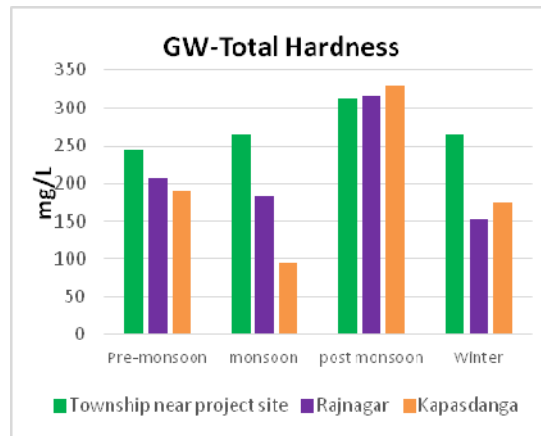
**Figure 2.19: Variations in average G-DO values in sampling spots for the consecutive seasons**



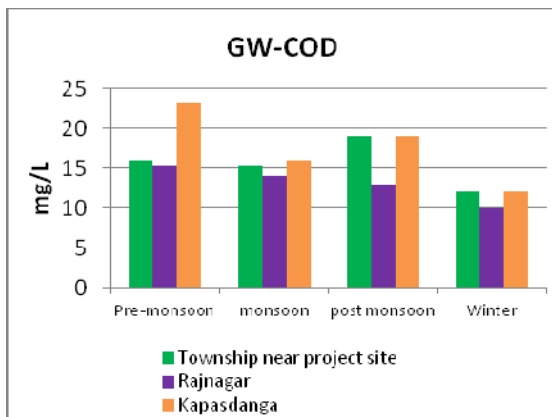
**Figure 2.20: Variations in average G-TDS values in sampling spots for the consecutive seasons**



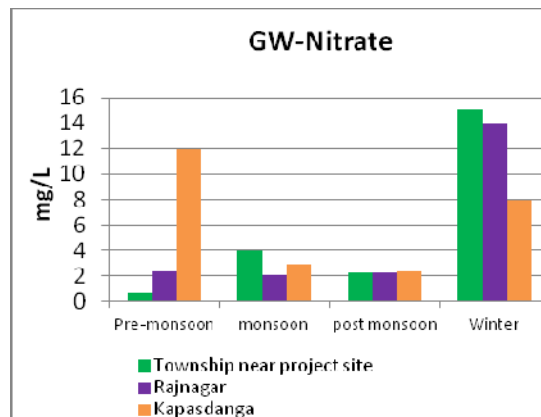
**Figure 2.21: Variations in average G-TSS values in sampling spots for the consecutive seasons**



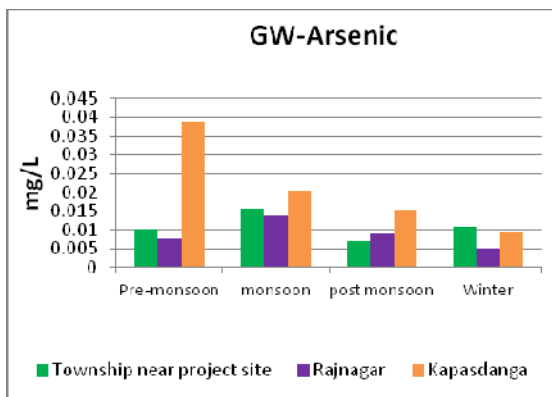
**Figure 2.22: Variations in average G-TH values in sampling spots for the consecutive seasons**



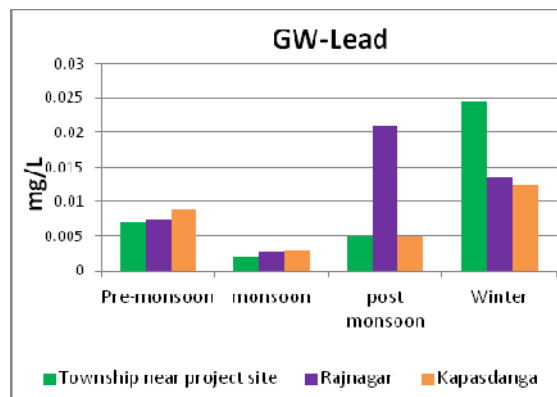
**Figure 2.23: Variations in average G-COD values in sampling spots for the consecutive seasons**



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



**Figure 2.25: Variations in average G-Arsenic values in sampling spots for the consecutive seasons**



**Figure 2.26: Variations in average G-Lead values in sampling spots for the consecutive seasons**

### (b) Chemical Oxygen Demand

89. COD is an indicator of organic pollution, which is caused by the inflow of domestic, livestock and industrial waste that contains elevated levels of organic pollutants (Ayati, 2003). Generally, COD found higher in Passur-Sibsa RS as it has been recorded to receive high amount of organic matter from the Sundarbans forest area and from Sundarbans adjacent community.

90. The observed values of COD vary from 8 mg/L to 30 mg/L in the last monitoring period among all the spots. The highest amount was found in Maidara River near proposed township area and may be due to the dumping of household wastes from the nearby area. While the lowest are recorded in Passur river at Akram point of Sundarbans. However, high values of COD indicate high levels of organic pollution in the river water (Sivasubramaniam, 1999). Moreover, a large scale industrial activity is taking place along the left bank of Passur River from Chalna to Harbaria, which might also contribute to the high concentration of COD.

91. The COD concentrations of pre-monsoon and winter seasons (dry) are found higher than monsoon and post-monsoon seasons. In monsoon, higher discharge diluted the COD load in the river which in turn reduces COD concentration in post monsoon. The observed dataset are shown in **Figure: 2.11** and all the observed dataset are attached in **Table B.6 of Appendix- IV**.

### (c) Nitrate, Sulphate and Phosphate

92. Among the monitoring locations, the nitrate values vary from 2.7 mg/L to 6.2 mg/L. The maximum value of nitrate (6.2 mg/L) is recorded in Middle of Passur River at 100m u/s of North West corner from the Project boundary. This may be due to the excessive agricultural runoff from the nearby areas and chemical bilge water from numerous ships and fishing boats. While on the other hand the lowest value (2.7 mg/L) is recorded at Middle Passur River at Project site-Jetty. The results obtained from all the monitoring locations from 10<sup>th</sup> monitoring period are found within the standard concentration stated in ECR'1997. . However, the highest values are found in pre-monsoon season of 1<sup>st</sup> quarter of 2<sup>nd</sup> year, which may be due to the higher amount of surface and groundwater runoff, dissolution of nitrogen-rich geological deposits, and biological degradation of organic matter (Spencer, 1975; Kinne, 1984; Gleick, 1993; Wetzel, 2001; Rabalais, 2002).

93. Naturally,  $\text{SO}_4^{2-}$  concentration is higher in sea water as well as in river in coastal region due to the tidal behavior of the respective water bodies. The monitored dataset reveals this general fact i.e., the  $\text{SO}_4^{2-}$  concentration of Passur-Sibsa RS increases in the direction of upstream to downstream. The highest value (620 mg/L) of sulphate is found in Akram point while the lowest is found in Middle of Passur River at 100m u/s of North West corner from the Project boundary (10mg/L. However, all the observed dataset of Sulphate ( $\text{SO}_4^{2-}$ ) found within the standard limit (400 mg/L) specified in ECR, 1997. Comparatively lower concentration of  $\text{SO}_4^{2-}$  in monsoon and post monsoon seasons could be due to the dilution effect of upstream fresh water.

94. In the 10<sup>th</sup> monitoring phase, the values of  $\text{PO}_4^{2-}$  (0.47-2.31 mg/L) are found relatively similar to that of the results pre-monsoon period in the previous years. The highest value observed in pre-monsoon period of 2014 and could be due to the discharge of bilge water from numerous ships and fishing boats, agricultural and industrial runoff. However, all the observed values are found to be within the standard limit (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 (Senthilkumar et al., 2002; Rajasegar, 2003) but agricultural fields as

fertilizers and phosphates used in households as detergents can be other sources of inorganic phosphates during the season (**Tiwari and Nair, 1993**).

95. The observed  $\text{NO}_3^{2-}$ ,  $\text{SO}_4^{2-}$  and  $\text{PO}_4^{2-}$  concentrations at different monitoring locations of five consecutive monitoring periods are presented in **Figure: 2.12, 2.13** and in **2.14** and all the observed dataset are attached in **Table B.11, B.12 and B.13** respectively of **Appendix- IV**.

#### (d) Heavy Metals

96. The observed dataset of Arsenic (As) concentrations demonstrated conformity among all the spots which vary from 0.001 mg/L to 0.005 mg/L. The minimum value is found in Passur River at Akram Point and the highest value is Right Bank of Passur River at 100m u/s of North West corner from the Project boundary and in Maidara River of the South East corner of the project at Ichamoti-Maidara confluence. In pre-monsoon season subsurface flow from groundwater to river might increase the concentration of As (Arsenic) in the river water. In monsoon, lower concentration of As is recorded. It might be due the dilution effect in river water caused by surface runoff.

97. Heavy metal (Pb) dissolved in water is very harmful to aquatic organisms; due to bioaccumulation, it increases in body tissue of organisms (**Rompas, 2010**). It is also evident that organic fertilizer, which comes from lime and compost fertilizers, can contain heavy metal, e.g., NPK fertilizer (phosphate fertilizers containing Pyromorphite-  $\text{Pb}_5(\text{PO}_4)^3$ ) (**Zhu et. al., 2004**) which may results in higher amount of Pb concentration in river water in winter season. During the last monitoring period, the lowest concentration of Pb (0.006 mg/L) was found in Middle of Passur River at South West corner from the Project boundary and the highest value (0.142 mg/L) was found in Passur River at Akram point of Sunderbans. This may be due to the dumping of bilge water from large ships which were seen anchored in the site.

98. The values of Hg (Mercury) revealed a continuous consistency among all the spots in all the seasons. The values never exceeded 0.0020 mg/L. All observed data found to be within the Bangladesh standard limit set by the environmental Conservation rule, 1997, Bangladesh.

99. The observed As, 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 attached in **Table B.14, B.15 and B.16** respectively of **Appendix- IV**.

#### (e) Oil and Grease

100. In order to measure the concentration of oil and grease in Passur River, samples have been taken from four locations during low tide from the surface layer. The analysis has been conducted through standard testing method of APHA. The concentration of oil and grease are presented in **Table-B.7** of **Appendix-IV**.

101. During pre-monsoon, monsoon and post monsoon periods, the concentration of oil and grease has been found negligible and all of the monitoring results are fully in conformity with the Standard of ECR 1997. Passur and Sibsa river system were found contained high concentration of oil and grease in winter period in 2014, which may be due to accidental oil spill occurred on the 9th December, 2014. An amount of 350,000 liters (Philips, 2014) of furnace oil has been spilled in the river which spread over a 350 km<sup>2</sup> area (Welle, 2014).

102. During the last monitoring period, the concentrations of oil and grease varied from 5 mg/L to 13.5 mg/L and are found to be within the standard limits for inland surface water, 10 mg/L (ECR, 1997) in all the spots except in Mongla-Passur Confluence. Maximum



concentration was found in Passur River at Mongla-Passur Confluence and the lowest value found in Left Bank of Passur River at South West corner from the Project boundary during the monitoring period. This higher concentration may be due to oil spillage and other organic residues discharges 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 in the site.

103. Status of the Groundwater quality

#### ***In-situ tested parameters***

##### **a) pH and Temperature**

104. The values of groundwater pH and temperature at observed locations are found fully complied with the drinking water quality standards as specified in ECR, 1997. The pH values of 11th monitoring program are found varied from 7.9 to 8.4 while temperature is found to be between 27°C and 28°C (**Table 5.15**). The recorded pH values are always found slightly alkaline in all the spots in all the season. No significant difference and negative health effect have been observed by the monitoring team. Similarly, no significant variation has been recorded in groundwater temperature over the monitoring period. In addition, larger seasonal variations, related to warming of or cooling at the surface are common, and ranges in the order of 5 to 10 degrees.

105. Both the results of pH and Temperature are found more or less consistent with all the previously obtained data. The seven 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**

##### **b) Salinity and Dissolved Oxygen**

106. Salinity is a common parameter in order to determine the ground water quality for drinking and irrigation purpose. However, groundwater is found to have 0 ppt of salinity in all the consecutive monitoring seasons.

107. The observed values of dissolved oxygen are ranged in between 5.8 mg/L and 6.3 mg/L and found in Rajnagar and in township area respectively among all the observed data are found within the BD standard (6.0 mg/L) set by ECR, 1997. Higher DO values makes water tastier but cause corrosion to the supply pipe.

108. Eight (8) consecutive 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**

109. During the 10th monitoring period TDS values are found within the standard limit (1000 mg/L). Though the Highest value (1000 mg/L) is recorded in Township area which does not exceed significantly while the lowest value (408 mg/L) is recorded in Rajnagar. The TDS concentration is found to be within than the BD standard (ECR, 1997) found in the last monitoring period.

110. Total Suspended Solids (TSS), also known as non-filterable residue, are those solids (minerals and organic material) that remain trapped on a 1.2 µm filter (U.S.EPA, 1998). Among all the monitoring season the values are found much higher in monsoon season which could be due to the runoff from industrial, urban or agricultural areas. In all the monitoring locations the concentration found varied in between 4 mg/L to 5 mg/L which

presents an ideal condition and fully in conformity with the BD drinking water standards (ECR, 1997).

111. TH concentrations of the three monitored spots vary from 28 mg/l to 320 mg/l. The maximum value is found in Township area near project site while the lowest value was found in Karpashdanga. The monitored values are found to be within the standard limit (200-500 mg/L) set by the ECR 1997. However, no incidents of weathering of  $\text{Ca}^{2+}$  bearing minerals or excessive application of lime is found during the monitoring period which could cause TH. Groundwater TDS, TSS and TH value of ten (10) consecutive monitoring periods in all the monitoring period are presented in **Figure 2.20**, **Figure 2.21** and **Figure 2.22** and all the observed dataset are attached in **table B.19** and **B.20** of **Appendix- IV**.

#### **(b) Chemical Oxygen Demand**

112. The Bangladesh standard for COD in drinking water is 4.0 mg/L. However, all the monitored data from the tube wells found to be within the standard limit. COD concentrations found higher in township area while the lowest value was recorded in the Rajnagar area. Such COD value is likely from anthropogenic sources such as percolation from landfill leachates and/ or industrial effluents.

113. The analyzed results are found to be lower than those of the previously monitored results. The COD concentrations of all the monitoring locations are presented in **Figure: 2.23** and all the observed dataset are attached in **Table B.21** of **Appendix- IV**.

#### **(c) Nitrate, Sulphate and Phosphate**

114. Nitrate values are found to be varied from 3.3 mg/L to 3.8 mg/L and also found within the standard limit (10 mg/L) as specified in ECR, 1997. However, Maximum values are observed in winter season in 4th monitoring program (i.e. 1st year 4th quarter). Again the value is found higher in pre-monsoon in Rajnagar which might be due to the excessive fertilizer use in the nearby agricultural field. However the observed values showed close conformity among all the monitoring locations in the last monitoring period.

115.  $\text{SO}_4^{2-}$  and  $\text{PO}_4^{2-}$  concentrations monitoring of Passur-Sibsa RS have been included in this study since 2nd monitoring report (i.e. 1<sup>st</sup> year 2<sup>nd</sup> quarter). Sulphate concentrations are found same (1 mg/L) in all the monitoring locations. On the other hand, the values of  $\text{PO}_4^{2-}$  are within the standard limit (6 mg/L) and ranged between 0.17 mg/L to 0.31 mg/L. Among all the monitoring period the recorded data are found maximum in the post-monsoon period. The vavisit in the post-monsoon in the lues have never been higher than the Bangladesh drinking water quality standard. The observed ground water  $\text{NO}_3^-$ ,  $\text{SO}_4^{2-}$  and  $\text{PO}_4^{2-}$  concentrations are presented in **Figure 2.24** and all the observed dataset are attached in **Table B.22** of **Appendix- IV**.

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

116. As per Bangladesh Standard (ECR, 1997), the maximum acceptable concentration of Arsenic in groundwater is 0.05 mg/L. Among all the monitoring locations, the As concentration ranged between 0.005 and 0.018 mg/L which is completely within the BD permissible standard limit (ECR, 1997). The maximum value was found in rajnagar and the lowest value was recorded in Karpashdanga. However, it can be concluded that the ground water sources are considered as suitable for the drinking purpose.

117. The Pb and Hg concentrations are detected and the values remained much lower than the detectable limit specified in ECR 1997. The concentration of Pb is found higher in pre-monsoon and post-monsoon in Rajnagar and Kapasdanga respectively. In the 10th monitoring period the values of Pb concentration have ranged between 0.002 mg/L and

0.004 mg/L, while Hg concentration for that period is very much negligible (<0.00015 mg/L). Therefore, it reveals that the monitored tube well is found suitable for drinking purposes.

118. The observed values of As, Pb and Hg in all the monitored locations are presented in **Figure 2.25** and **2.26** and all the observed dataset are attached in **Table B.23** of **Appendix-IV**.

## **2.4 Land Resources**

### **2.4.1 Methodology**

#### **Monitoring Indicators**

119. Monitoring of the selected indicators is very crucial for land resources monitoring in the study area. Land use, soil fertility/nutrient status, soil contamination with heavy metals and soil physical quality are the major monitoring indicators for land resources. During the operation phase of power plant, it is assumed that ash may be deposited on the surrounding agriculture land.

#### **Sampling Frequency**

120. Dry season, soil samples was collected in April, 2016 and wet season, soil samples was collected in October 2016.

#### **Location**

121. Five mauzas within the 10 Km radius of the power plant were selected for monitoring of plot use, soil fertility/nutrient status, soil contamination with heavy metals. The selected mauzas are Baranpara (E: 89°30'59.1", N: 22°37'57.0") of Batiagahata 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") 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 the table C.1 of Annex-IV and **Map 2.4**.

### **2.4.2 Process of soil samples collection**

#### **Plot selection**

122. Monitoring plot has been selected before initiation of monitoring through group discussion, especially with the plot owners and specific experts such as Upazila Agriculture Officer Batiaghata, Dacope, Rampal and Mongla of Khulna and Bagerhat districts and Senior Scientific Officer of Soil Resource Development Institute (SRDI), Khulna Office. All the selected areas are medium high (F<sub>1</sub>) land, which is normally flooded to the depth of 30-90 cm continuously for more than two weeks to few months during the flood season. Main emphasis is given to potential locations of dry/wet deposition of ash, SO<sub>x</sub> and NO<sub>x</sub> to be emitted from the Plant.

#### **Soil samples collection**

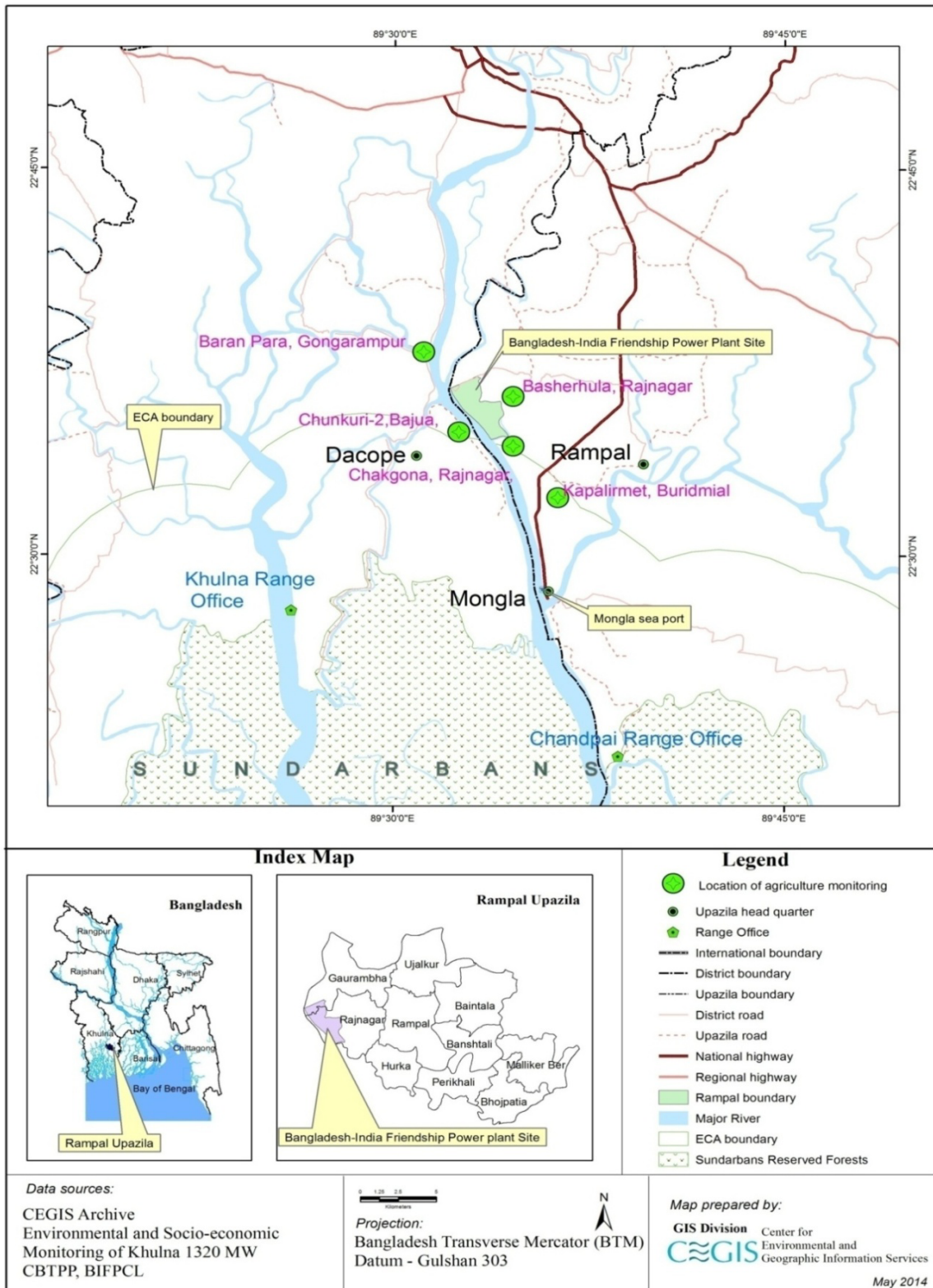
123. Soil sample were collected from five locations in three depths (0-15 cm, 15-30 cm and 30-45 cm) inside the monitoring area in the month of October, 2016. Some basic indicators are selected to evaluate the base condition of adjacent area of Rampal power plant. Besides, continuous monitoring of that area gives an opportunity to observe the seasonal change of the indicators of that specific locality. The indicators are soil reaction (pH), salinity (EC), Organic matter (OM), base cations-Ca, Mg, K and Na, macro nutrient status (N, P and S), status of micro nutrients (B, Fe, Mn and Zn) and presence of heavy metals (Pb and Cd).

***Laboratory analysis***

124. Collected soil samples have been handed over to the SRDI, Dhaka for laboratory analysis. Results presented in final monitoring report after obtaining from SRDI.

***2.4.3 Status of Land Resources***

125. The result will be presented in the 3<sup>rd</sup> year final monitoring report after obtaining from SRDI. All the monitoring results have been appended in the **Table E-1, E-2 and E-3** of **Appendix IV**.



Map 2.4: Land Resource Monitoring Locations



### 3 Biological Environment

126. Biological resources include all living organism within an ecosystem which interact with one another as well as with the physical environment. The biological resources around the project site were categorized into three major groups and monitored quarterly with the aim to establish baseline conditions to compare with the probable impact of proposed project in place. These groups include fisheries resources, ecological resources and Sundarbans Reserve Forest (SRF).

#### 3.1 Fisheries Resources

127. Fisheries resources have been monitored quarterly in a year. Monitoring of all four quarters of 2014-15 and of 2015-16 and first and second quarter of 2016-17 have been completed and reported earlier. This chapter contains the outcome of this 3rd quarter monitoring of 2016-17 along with the comparisons with the earlier nine quarters.

##### *Location of Monitoring Sites*

128. The monitoring activities are being carried out at ten pre-selected locations of which seven (7) are capture fish habitat and three (3) are shrimp/fish farm. The capture sampling sites have been selected based on the fishing availability of upstream, middle stream and downstream of Passur River system. Shrimp/fish farms have been selected based on the direct impacted area of Plant site. The sampling sites are detailed in Table 3.1.

**Table 3.1: The Sampling Locations for monitoring of Fisheries Resources**

| Site | Capture Habitat Location | Culture Habitat Location   |
|------|--------------------------|----------------------------|
| A    | Akram Point              | Bhekatkhali Khal, Rajnagar |
| B    | Haldikhali               | Kapasdanga-Muralia         |
| C    | Harbaria                 | Chunkuri-2                 |
| D    | Chandpai                 |                            |
| E    | Mongla Port              |                            |
| F    | Maidara                  |                            |
| G    | Chalna Point, Batiaghata |                            |

##### *Selection of Parameters*

129. In the fisheries monitoring, five major components had been selected according to TOR, such as, fish habitat status, fish migration, fish diversity, shrimp/fish farm practices and fish production. Fish habitat status has been monitored through investigating habitat suitability index in view of habitat classification based on length frequencies of different fish species and sensitivity of fish diversity and survival success of different life stages of fish to abiotic factors (water quality, bed material, hydrological condition, morphological aspects and biotic factors (food cover). Fish migration status has been monitored through assessing migratory fish species diversity, migration pattern, migration purpose, period and extent of migration etc. Species evenness, species richness and community structure have been investigated for monitoring fish diversity. Shrimp/fish farm practice has been monitored by



viewing stocking pattern, growth rate and mortality rate. Fish production monitoring has been divided into capture and shrimp/fish farm production.

### **3.1.1 Methodology**

#### ***Fish Habitat Status***

130. Fish habitat status has been monitored through determination of Habitat Suitability Index (HSI) 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 has been analyzed by calculating Eclidean 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***

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

#### ***Fish Diversity***

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

133. For monitoring shrimp/fish farm, three farms within the direct impact zone of the proposed Power Plant have been 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 have been surveyed intensively.

#### ***Fish Production***

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



Map 3.1: Fisheries Resources Monitoring Locations

### 3.1.2 Status of monitoring

135. Followed by the first and second quarter monitoring of the third year, third quarter monitoring has been conducted during the period of 4 to 12 October, 2016.

#### **Fish Habitat Status**

136. 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**

137. Habitat classification is 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 collected from literature. Linkage distance is then calculated with the similarity in distribution. The entire stretch of the Passur River System consists of three major behavioral habitats. The sampling sites have been classified (shown in the **Figure 3.1**) on the basis of abundance of different life stages of fish species in those habitats.

138. During 1<sup>st</sup> monitoring (April, 2014) fish habitat had been 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 – i) grazing ground, ii) spawning and nursery ground have been identified. However, during third quarter monitoring in the month of October 2014 the similarity of size group distribution of fish species among the habitats has been found to be shifted to some extent. In fourth monitoring phase in the month of January 2015 three habitats – i) grazing ground, ii) grazing and breeding ground; and iii) spawning, nursery and grazing ground have been identified. During the 1<sup>st</sup> quarter (April, 2015) of the second year three habitats – i) grazing ground, ii) nursery ground; and iii) spawning and nursery have been identified. During the 2<sup>nd</sup> quarter monitoring of 2<sup>nd</sup> year (October, 2015) two habitats have been identified as: i) grazing and breeding ground and ii) spawning and nursery ground. During the 3<sup>rd</sup> quarter monitoring of 2<sup>nd</sup> year (October, 2015) such three habitats as i) grazing ground, ii) nursery ground and iii) growing and feeding have been identified. During the 4<sup>th</sup> quarter monitoring of 2<sup>nd</sup> year (January, 2015) two major habitats – i) nursery and feeding ground and ii) feeding and growing ground have been identified. During the 1<sup>st</sup> quarter monitoring of 3<sup>rd</sup> year (April, 2016) two major habitats – i) spawning and nursery ground and ii) feeding and growing ground have been identified. During the 2<sup>nd</sup> quarter monitoring of 3<sup>rd</sup> year (July, 2016) two major habitats – i) nursery ground and ii) feeding and breeding ground have been identified.

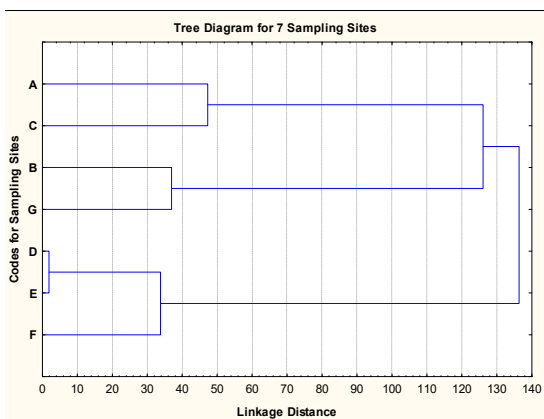
139. During the 3<sup>rd</sup> quarter monitoring of 3<sup>rd</sup> year (October, 2016) two major habitats – i) Breeding and spawning ground, mainly for Hilsha and Poma; and ii) feeding and grazing ground have been identified as shown in the **Figure-3.2**.

##### **Nursery Ground:**

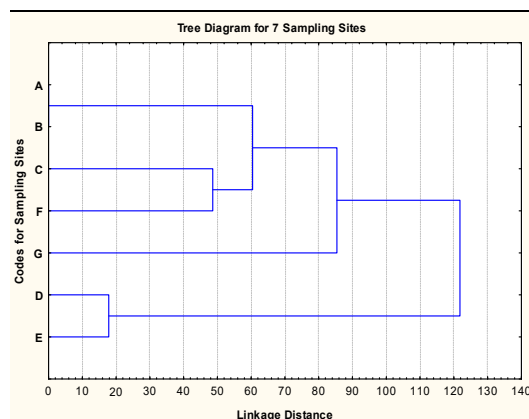
140. Among the sampling sites, Akram Point (A) and Haldikhali khal were identified as the breeding and spawning ground for abundance of brood fish.

##### **Feeding and Growing Ground:**

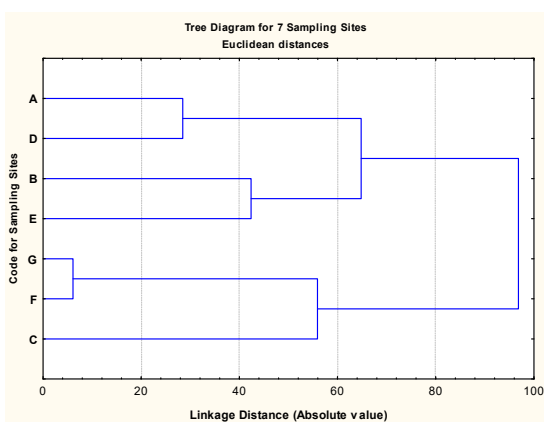
141. Among the sampling sites, mainly the Harbaria khal (C) and Sheola khal at Chandpai (D) were identified as the feeding and grazing ground. Moreover, Maidara-Passur confluence (F), Mongla Point (E) and Chalna Point (G) respectively were similar to C and D sampling sites. These habitats were classified as the feeding and grazing ground.



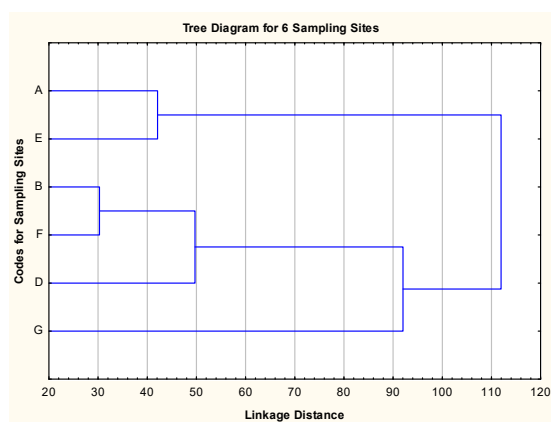
**1<sup>st</sup> Monitoring, April, 2014**



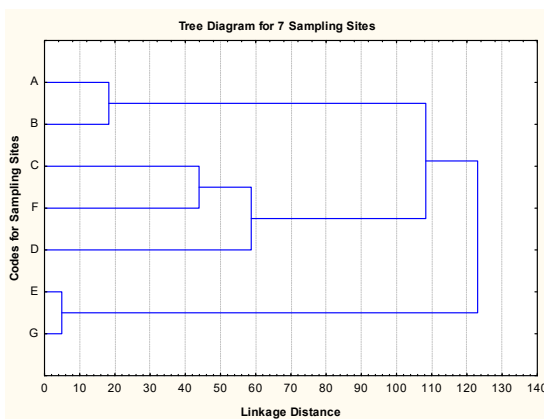
**2<sup>nd</sup> Monitoring, July 2014**



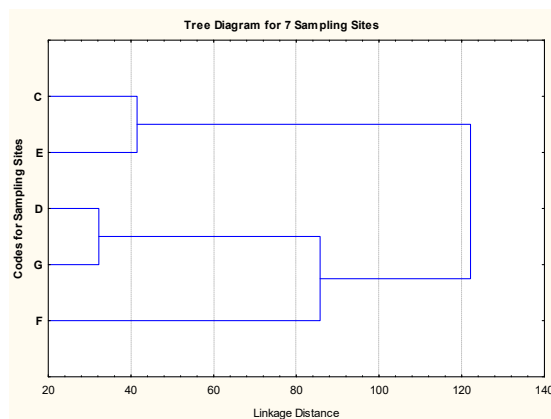
**3<sup>rd</sup> Monitoring, October, 2014**



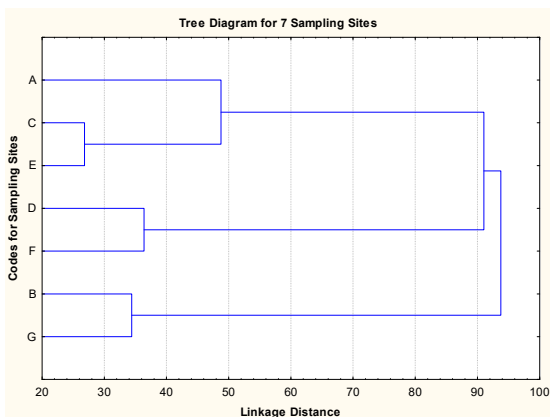
**4<sup>th</sup> Monitoring, January 2015**



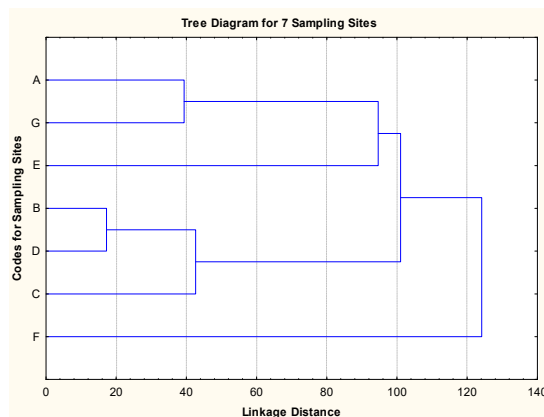
**5<sup>th</sup> Monitoring, April, 2015**



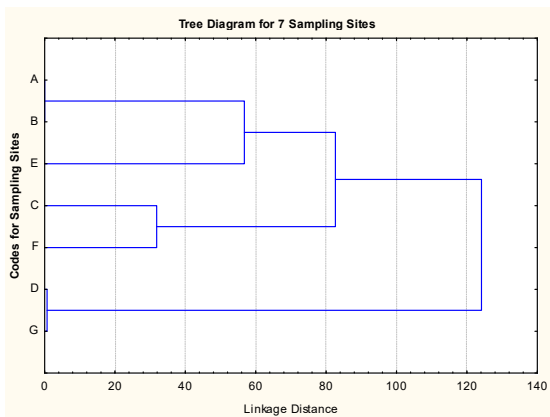
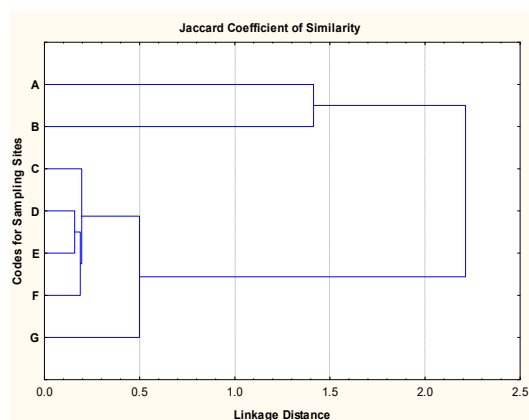
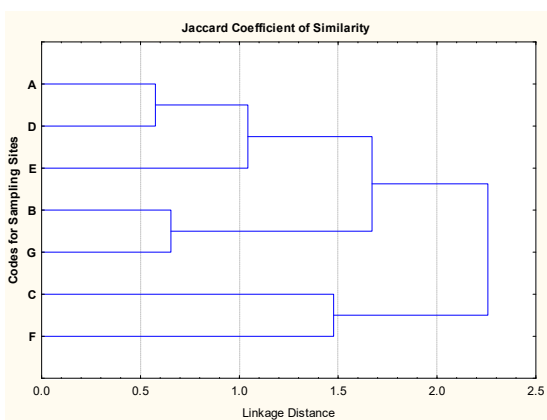
**6<sup>th</sup> Monitoring, August, 2015**



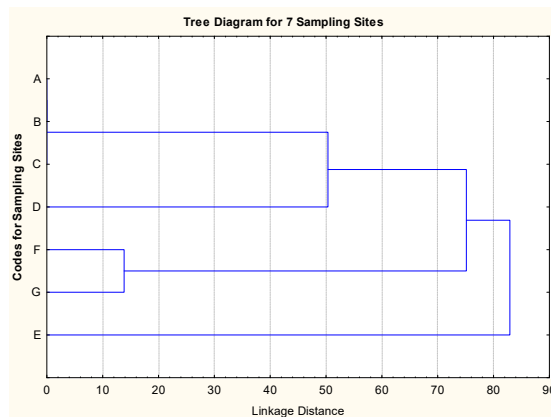
7<sup>th</sup> Monitoring, October, 2015



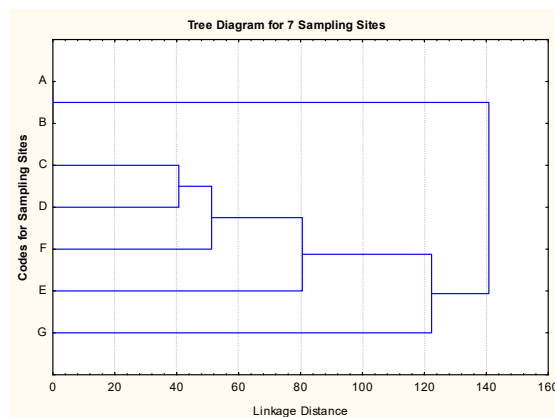
8<sup>th</sup> Monitoring, January, 2016



9<sup>th</sup> Monitoring, April, 2016



10<sup>th</sup> Monitoring, July, 2016

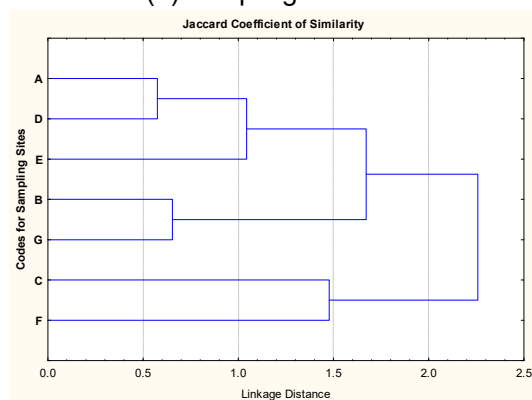


### 11<sup>th</sup> Monitoring, October, 2016

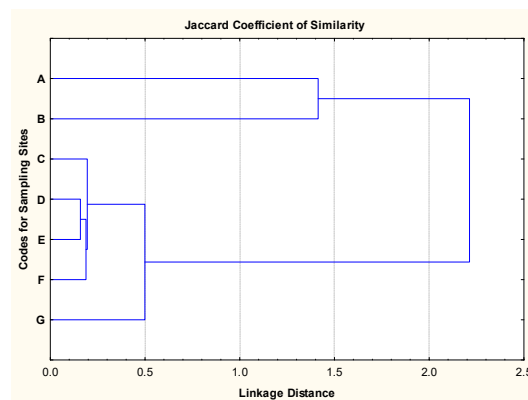
(Note: Life stage is identified through length measurement of the fish individuals)

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

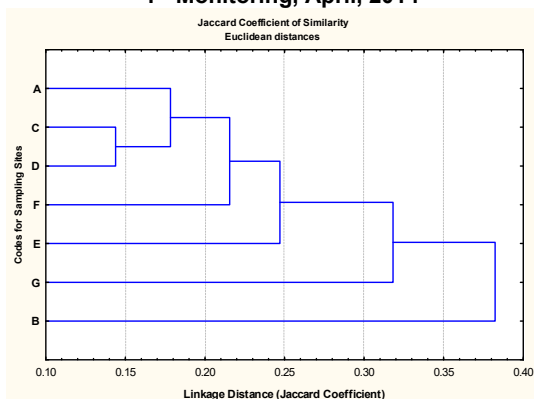
142. The dendrogram analyses the distances among the JI (Jaccard Coefficient Index) indices which are opposite to the JI values. It has been found that the length-wise distribution relationship varies not only with four quarter but also with year to year. In the third quarter of the third monitoring year, the JI value between C and D sampling sites is the highest (**Figure 3.2**) which indicates the maximum similarity in species occurrence between these two sites out of seven (7) sampling sites.



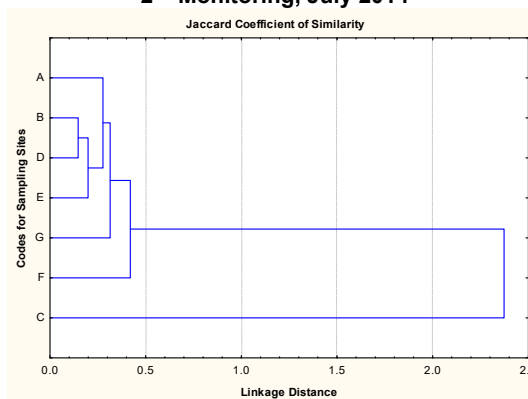
### 1<sup>st</sup> Monitoring, April, 2014



### 2<sup>nd</sup> Monitoring, July 2014

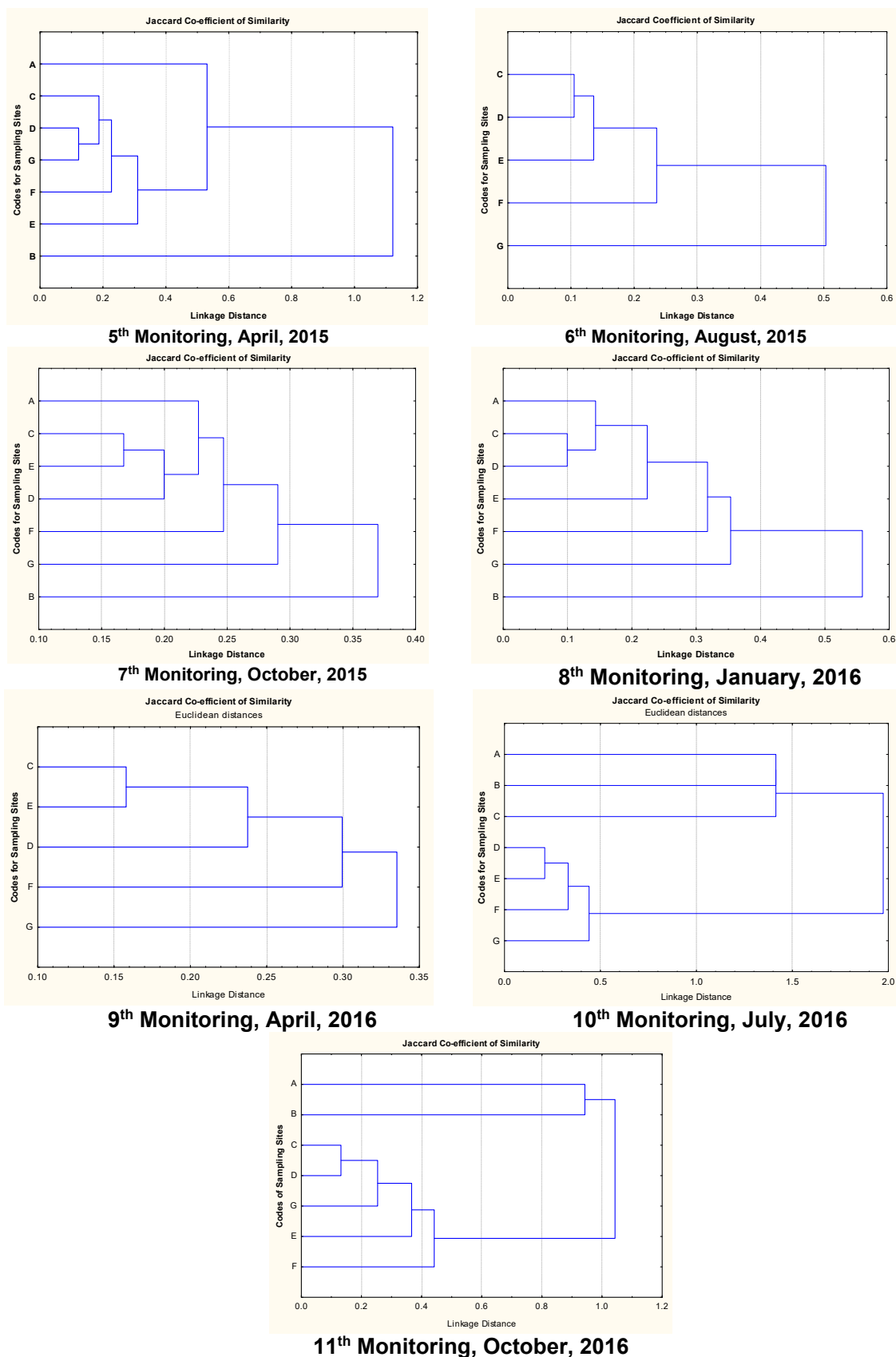


### 3<sup>rd</sup> Monitoring, October, 2014



### 4<sup>th</sup> Monitoring, January 2015





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



**(b) Habitat Suitability Index (HSI)**

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

144. In the first year of monitoring, Sheola khal at Chandpai has been found as the most suitable habitat for fish species among Passur River System. Sheola khal has also been identified as the most suitable which is 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            |                 |
| B              | Haldikhali               | 0.408            | 0.54            |                 |
| C              | Harbaria                 | 0.226            | 0.64            |                 |
| D              | Chandpai                 | 0.520            | 0.72            |                 |
| E              | Mongla Port              | 0.321            | 0.43            |                 |
| F              | Maidara                  | 0.224            | 0.25            |                 |
| G              | Botiaghata, Chalna Point | 0.218            | 0.32            |                 |

\*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**

145. In the third quarter monitoring of third year (2016-17), species evenness varies among the sampling sites. Highest Shannon-Weiner index has been found at Maidara (0.90) indicating most evenly distributed fish species. On the contrary, lowest evenness was found at Akram Point and Haldikhali (0) because only one fish species (Hilsha) has been predominantly occurred in this survey shown in the (**Table 3.3**).

**Table 3.3: Site Wise Species Diversity using Shannon-Weiner Index**

| Site | Species No                       |                                 |                               |                              |                               |                               |                               |                               |                    |                     |                     |                     | Shannon-Weiner Index* |                    |                    |                    |                    |                    |                    |                    |                    |                     |                     |                     |      |      |      |      |      |      |      |      |  |
|------|----------------------------------|---------------------------------|-------------------------------|------------------------------|-------------------------------|-------------------------------|-------------------------------|-------------------------------|--------------------|---------------------|---------------------|---------------------|-----------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|---------------------|---------------------|---------------------|------|------|------|------|------|------|------|------|--|
|      | 1 <sup>st</sup> QM (April, 2014) | 2 <sup>nd</sup> QM (July, 2014) | 3 <sup>rd</sup> QM (Oct 2014) | 4 <sup>th</sup> QM(Jan 2015) | 5 <sup>th</sup> QM (Apr 2015) | 6 <sup>th</sup> QM (Aug 2015) | 7 <sup>th</sup> QM (Oct 2015) | 8 <sup>th</sup> QM (Jan 2016) | 9 <sup>th</sup> QM | 10 <sup>th</sup> QM | 11 <sup>th</sup> QM | 12 <sup>th</sup> QM | 1 <sup>st</sup> QM    | 2 <sup>nd</sup> QM | 3 <sup>rd</sup> QM | 4 <sup>th</sup> QM | 5 <sup>th</sup> QM | 6 <sup>th</sup> QM | 7 <sup>th</sup> QM | 8 <sup>th</sup> QM | 9 <sup>th</sup> QM | 10 <sup>th</sup> QM | 11 <sup>th</sup> QM | 12 <sup>th</sup> QM |      |      |      |      |      |      |      |      |  |
| A    | 3                                | 3                               | 0                             | 1                            | 3                             | 7                             | 3                             | -                             | 10                 | 15                  | 0                   | 0                   |                       | 0                  | 4                  | 9                  | 0                  | 0                  | 7                  | 3                  | 0                  | 5                   | 7                   | 0.96                | -    | 0.55 | 0.44 | 0    | 0    | 0    |      |      |  |
| B    | 1                                | 2                               | 0                             | 2                            | 4                             | 1                             | 4                             | 0                             | -                  | 11                  | 3                   | 0                   | 0                     |                    | 0                  | 8                  | 5                  | 0                  | 0                  | 5                  | 7                  | 0                   | 3                   | 9                   | 0.00 | -    | 0.56 | 0.58 | 0    | 0    | 0    |      |  |
| C    | 2                                | 1                               | 2                             | 9                            | 0                             | 11                            | 26                            | 18                            | 24                 | 17                  | 0                   |                     |                       | 0                  | 2                  | 9                  | 0.77               | 0                  | 4                  | 0                  | 0                  | 0                   | 0                   | 0.78                | 0.59 | 0.54 | 0.67 | 0.57 | 0    | 0.60 |      |      |  |
| D    | 1                                | 2                               | 2                             | 2                            | 1                             | 5                             | 2                             | 6                             | 27                 | 24                  | 20                  | 25                  | 8                     | 19                 |                    | 0                  | 3                  | 1                  | 0.78               | 0                  | 7                  | 3                   | 0                   | 5                   | 1    | 0.65 | 0.72 | 0.51 | 0.71 | 0.61 | 0.55 | 0.58 |  |

| Site | Species No                       |                                 |                               |                               |                               |                               |                               |                               |                    |                     |                     |                     | Shannon-Weiner Index* |                    |                    |                    |                    |                    |                    |                    |                    |                     |                     |                     |
|------|----------------------------------|---------------------------------|-------------------------------|-------------------------------|-------------------------------|-------------------------------|-------------------------------|-------------------------------|--------------------|---------------------|---------------------|---------------------|-----------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|---------------------|---------------------|---------------------|
|      | 1 <sup>st</sup> QM (April, 2014) | 2 <sup>nd</sup> QM (July, 2014) | 3 <sup>rd</sup> QM (Oct 2014) | 4 <sup>th</sup> QM (Jan 2015) | 5 <sup>th</sup> QM (Apr 2015) | 6 <sup>th</sup> QM (Aug 2015) | 7 <sup>th</sup> QM (Oct 2015) | 8 <sup>th</sup> QM (Jan 2016) | 9 <sup>th</sup> QM | 10 <sup>th</sup> QM | 11 <sup>th</sup> QM | 12 <sup>th</sup> QM | 1 <sup>st</sup> QM    | 2 <sup>nd</sup> QM | 3 <sup>rd</sup> QM | 4 <sup>th</sup> QM | 5 <sup>th</sup> QM | 6 <sup>th</sup> QM | 7 <sup>th</sup> QM | 8 <sup>th</sup> QM | 9 <sup>th</sup> QM | 10 <sup>th</sup> QM | 11 <sup>th</sup> QM | 12 <sup>th</sup> QM |
| E    | 7                                | 13                              | 10                            | 11                            | 6                             | 16                            | 9                             | 9                             | 15                 | 12                  |                     |                     | 0.38                  | 0.60               | 0.76               | 0.77               | 0.15               | 0.73               | 0.85               | 0.41               | 0.66               | 0.50                | 0.71                |                     |
| F    | 3                                | 13                              | 6                             | 4                             | 10                            | 8                             | 14                            | 6                             | 7                  | 5                   |                     |                     | 0.82                  | 0.77               | 0.54               | 0.60               | 0.67               | 0.39               | 0.77               | 0.65               | 0.75               | 0.68                | 0.90                |                     |
| G    | 6                                | 3                               | 5                             | 7                             | 18                            | 3                             | 8                             | 6                             | 6                  | 4                   |                     |                     | 0.68                  | 0.82               | 0.72               | 0.66               | 0.18               | 0.95               | 0.72               | 0.81               | 0.58               | 0.87                | 0.24                |                     |

\*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)

### b) Fish Species Richness (FSR)

146. Fish species richness has been identified through Simpson's **Index<sup>1</sup>**. Considerable difference is noticed in the fish species richness (FSR) in different habitat classes (**Table 3.4** and **Figure-3.3**).

147. In this monitoring phase, the sampling sites vary with species richness. Maximum FSR is obtained in Harbaria (n=4), Sheola Khal at Chandpai, Mongla Point and Maidara (n=3), while very low FSR is recorded at Chalna Point, Akram Point and Haldikhali (n=1). Different scenarios of richness have been found in this quarter in comparison to the previous monitoring years. Among habitats in upstream portions of the Passur river, Mongla Port has been home to a rich assemblage of Poma, Gulsha Tengra and Tapsi; Maidara River at Baro Durgapur was of Hilsha, Horina Chingri and Passa; and Chalna Point has been of Khorsula. Among the habitats in down stream portions, Chandpai has been rich in Chaka Chingri, Katali Chingri and Gulsha Tengra; Harbaria has been in Goda Chingri, Katali Chingri, Motka Chingri and Aswene Bele.

**Table 3.4: Site wise Rich Species Number**

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

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



**Rupchanda in 1<sup>st</sup> Quarter of 1<sup>st</sup> Year**



**Chela in 2<sup>nd</sup> Quarter of 1<sup>st</sup> Year**



Phesa, Chela, Hilsa, Gagla Tengra



Harina Chingri

**Fish Species at 3<sup>rd</sup> Quarter Monitoring of 1<sup>st</sup> Year 2014-15**



Amadi Chela



Banspata

**Fish Species in Upstream of Passur River at 4<sup>th</sup> Quarter Monitoring of 1<sup>st</sup> Year 2014-15**



Adult Poma in Chalna Point



Fry of Bagda at Chalna Point





Meth and Gagra Tengra  
Fish species found in 1<sup>st</sup> quarter of the second monitoring year (2015-16)



Gagra Tengra



Mutkure and Paissa



Khorsula



Menu



Vetki

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



Gulsha Tengra, Bele, Aswine Bele and Paissa



Gangania



Telcupa



Golda



Kain Magur



A Mix of Culture and Capture Fishes

**Fish species found in 3<sup>rd</sup> quarter of the second monitoring year (2015-16)**



Tau Paissa



Bele



Horina Chingri



Gulsha and Gagra Tengra





Jaba



Female Gulsha Tengra



Fry Fishes



Chata Bele

**Fish species found in 4<sup>th</sup> quarter of the second monitoring year (2015-16)**



Kain Magur



Banspata, Vetki, Koidda and Poma



Miscellaneous Fish Species



Hilsha



Tapse  
Fish species found in 3<sup>rd</sup> quarter of the third monitoring year (2016-17)

Photo 3.1: Length-wise distribution of fish species

(FSR is identified through Simpson's Index)

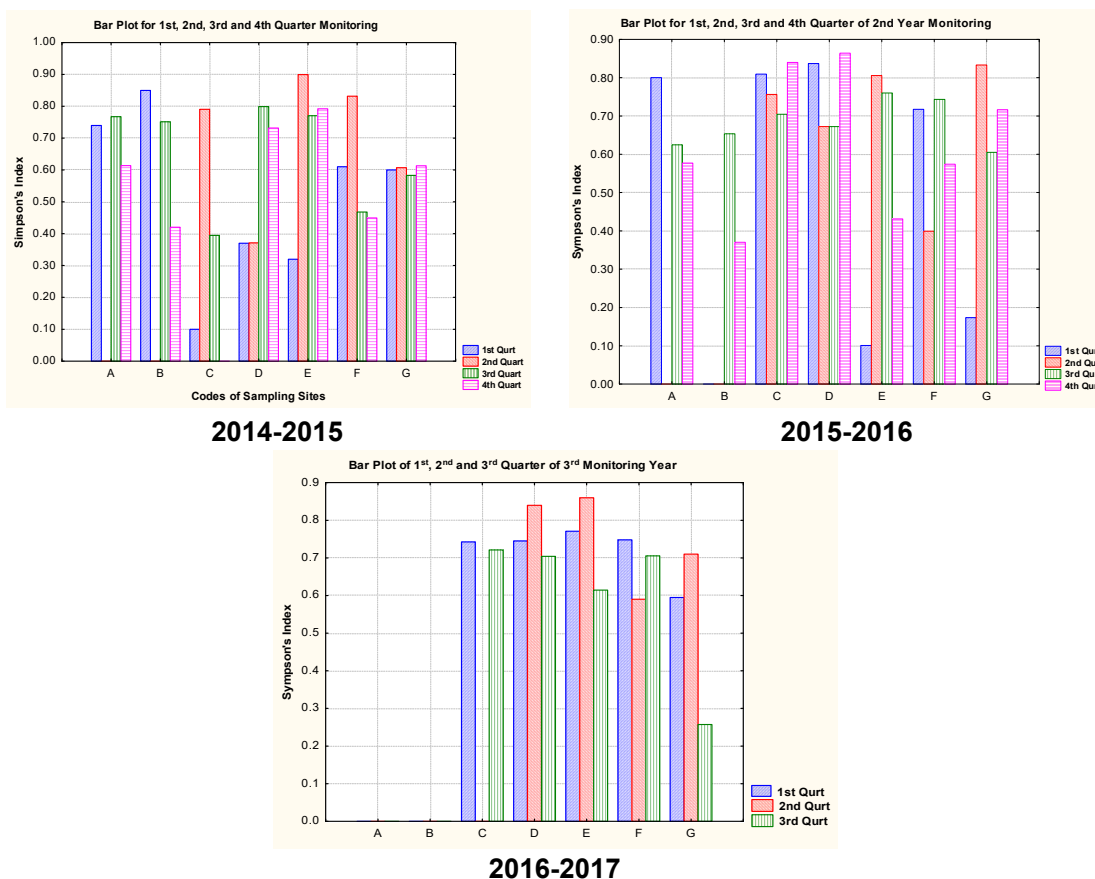


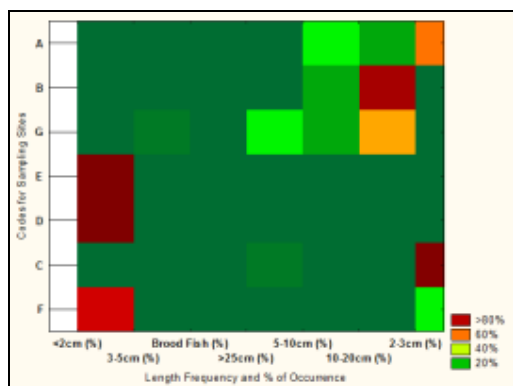
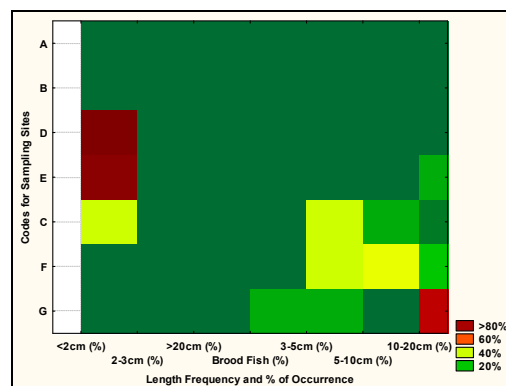
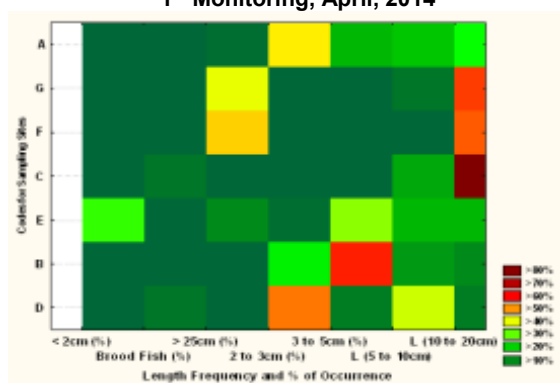
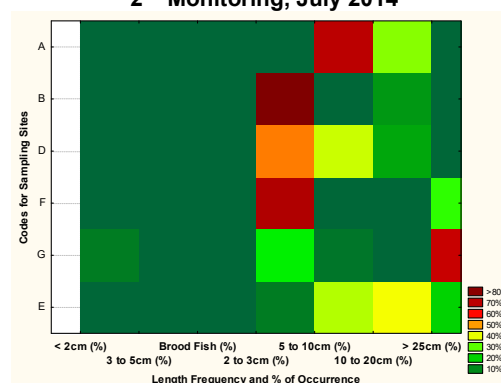
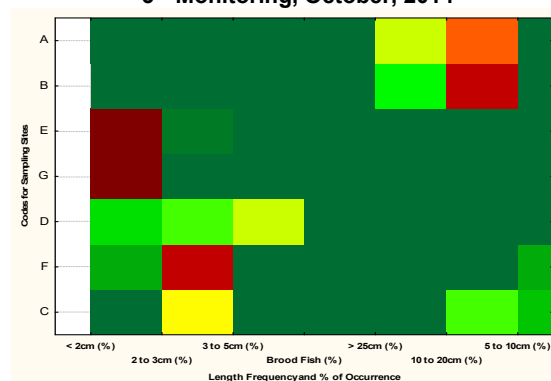
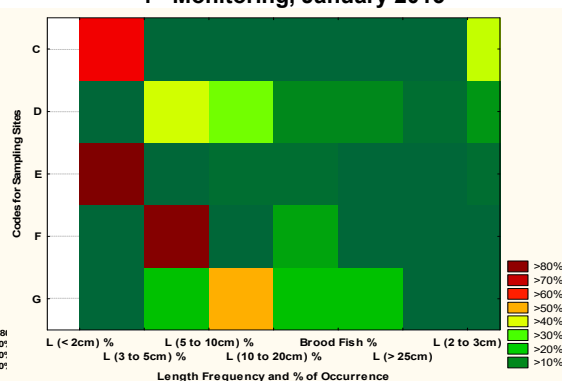
Figure 3.3: Site-wise fish species richness (FSR) in the Passur River System.

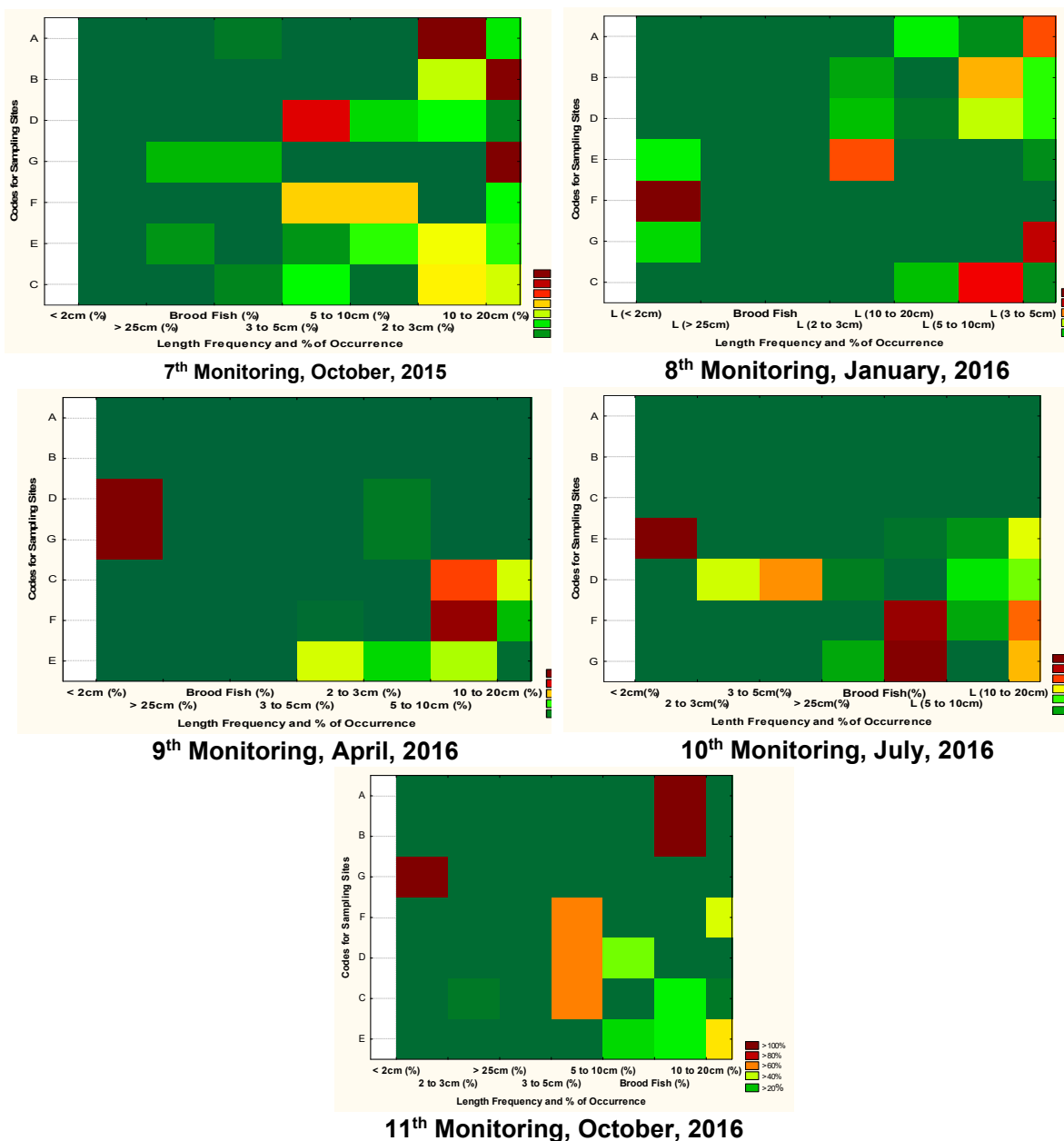
### c) Fish Community Structure

148. Fish community structure has been analyzed through counting the length-wise fish individuals (**Photo 3.1**). The following Table D.2 and D.3 of **Appendix IV** and **Figure 3.4** for third quarter of third monitoring year shows that fry and juveniles for fin fish were more widely



distributed among the middle and upper stretches of the Passur River. Among these Khorsula and Hilsha fishes were widely distributed among the sampling sites. Moreover, fry fish of Khorsula and Khas Chela were found at Chaina Point. Moreover, brood female fishes of Hilsha and Poma have highly observed at Akram Point, Haldikhali and Harbaria sampling sites in this quarter.

1<sup>st</sup> Monitoring, April, 20142<sup>nd</sup> Monitoring, July 20143<sup>rd</sup> Monitoring, October, 20144<sup>th</sup> Monitoring, January 20155<sup>th</sup> Monitoring, April, 20156<sup>th</sup> Monitoring, August, 2015

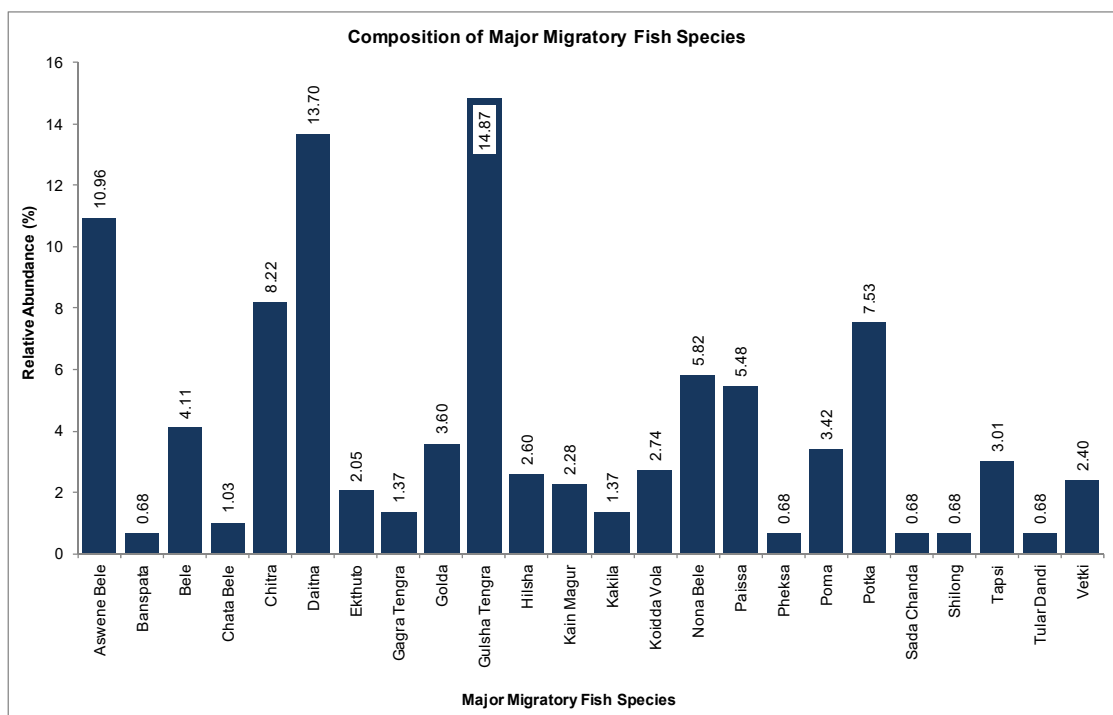


**Figure 3.4: Habitat Distribution of Different Life Stages of Fish Species**

### **Fish Migration**

#### **(a) Migratory Species Diversity**

149. Migratory species have been identified by analyzing the common species available in the regular catch from the sampling sites. Fish species like Gulsha Tengra attains the maximum abundance among the migratory fish species observed in third quarter of third monitoring year. The relative abundance of the migratory Fish species is give below in the Figure 3.5.

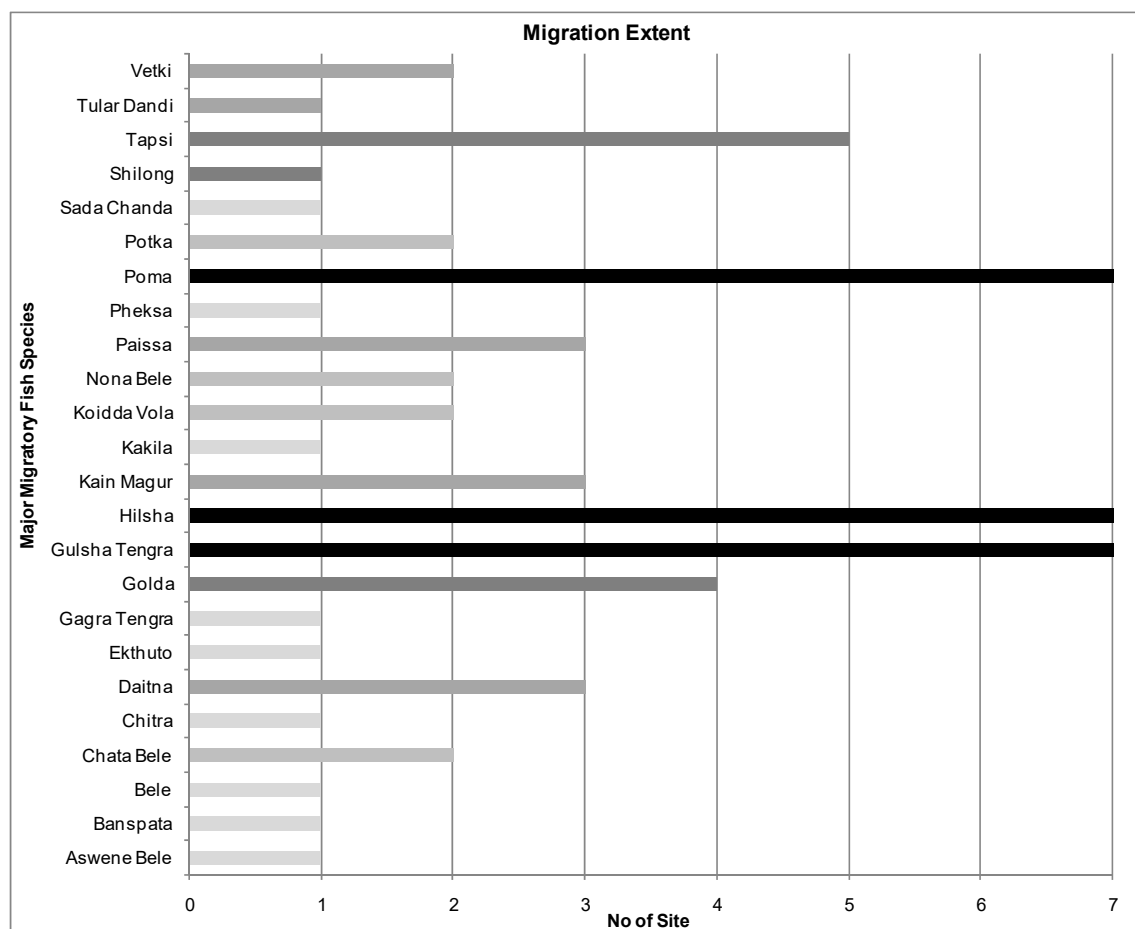


**Figure 3.5: Relative abundance of major migratory fish species in sampling sites**

**(b) Migration Extent, Time and Purpose**

150. Major fish species showed interesting pattern in distribution for exploiting different purposes mentioned in the following table all along the sampling sites. Three (3) fish species were found common in most of the sites. These species, also, Hilsha, Poma and Gulsha Tengra, have been observed indicating long range of distribution (Table D.4 of Appendix IV).

151. It is interpreted from the findings that in the month of October Hilsha fish use the middle and Lower reaches of the Passur River mainly for breeding and spawning purpose. Upper reach is used for feeding and growing.



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

### ***Shrimp/Fish Farm***

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

### ***Stocking Pattern***

153. It was reported by the farmers of the shrimp farms that availability of wild seed (PL) has been declining over the years. For this reason, one of the farm collect Bagda fry from both the wild (Passur) and hatchery (Namira and Sonar Gaor at Chalna) and another farm of Chunkuri-2 collected Bagda seed directly from Passur river. Highest stocking rate has been found in Gher at Chunkuri-2, while lowest in Gher at Kapasdanga.

### ***Shrimp/Fish Growth Rate and Mortality***

154. During the third quarter of third monitoring year, highest growth rate has been observed at farm in Kapashdanga and highest mortality rate (60%) at farms in Chunkuri-2 (Table 3.5).

**Table 3.5: Growth Rate and Mortality of Fish/Shrimp**

| Gher No. | 1 <sup>st</sup> QM (Apr 2014) |               | 2 <sup>nd</sup> QM (Jul 2014) |               | 3 <sup>rd</sup> QM (Oct 2014) |               | 4 <sup>th</sup> QM (Jan 2015) |               | 5 <sup>th</sup> QM (Apr 2015) |               | 6 <sup>th</sup> QM (Aug 2015) |               | 7 <sup>th</sup> QM (Oct 2015) |               | 8 <sup>th</sup> QM (Jan 2016) |               | 9 <sup>th</sup> QM   |               | 10 <sup>th</sup> QM  |               | 11 <sup>th</sup> QM  |               | 12 <sup>th</sup> 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 (%) |
| 1        | 0.3                           | 15-20         | 0.2                           | 40            | 0.25                          | 50            | -                             | -             | -                             | 30            | 0.18                          | 25            | 0.20                          | 60            | -                             | -             | -                    | -             | 0.2                  | 20            | 0.20                 | 60            |                      |               |
| 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            |                      |               |
| 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            |                      |               |

Source: CEGIS Field Survey, 2014 &amp; 2015

### Fish Production

#### (a) Capture Fish Production

155. In third quarter monitoring of the third year, the highest productivity has been found in Sheola khal at Chandpai (Table 3.6). The lowest productivity has been found in the Chalna Point. All the fry fishes are not considered as catch.

156. The present study observed that Chhandi Jal, mainly used for Hilsha catch, is frequently used to catch fish. The highest catch susceptibility has been found in case of Charpata Jal (17.5 kg/haul) (Table 3.6). The following table also expresses that Chhandi Jal is most frequently used in all upper reaches in Passur River System. Charpata Jal is commonly used in middle reach and Vola Jal in upper reach of the Passur River. Moreover, the highest total catch is observed in Sheola khal at Chandpai and lowest in the Chalna Point in this monitoring phase (Table-3.7).

**Table 3.6: 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  | Chhandi Jal    | 1                  | 1          | 10               | 10      |
| B      | Haldikhali   | Haldikhali Khal | Chhandi Jal    | 1                  | 1          | 4                | 4       |
| C      | Harbaria     | Harbaria Khal   | Chhandi Jal    | 14                 | 1          | 3                | 0       |
| D      | Chandpai     | Sheola Khal     | Charpata Jal   | 12.33              | 1          | 17.5             | 17.5    |
|        |              |                 | Mui Jal        | 1                  | 20         | 1.5              | 0.075   |
| E      | Mongla Point | Passur River    | Vola Jal       | 6                  | 1          | 5                | 5       |
|        |              |                 | Chhandi Jal    | 6                  | 1          | 0.2              | 0.2     |
| F      | Maidara      | Maidara River   | Chhandi Jal    | 1                  | 1          | 0.45             | 0.45    |
|        |              |                 | Mui Jal        | 1                  | 5          | 0.5              | 0.1     |
| G      | Chalna Point | Passur River    | Net Jal        | 6                  | 1          | 0                | 0       |
|        |              |                 | Vola Jal       | 6                  | 1          | 0.25             | 0.25    |

Source: Catch assessment survey, CEGIS (2015)

**Table 3.7: Total Catch in the Sampling Sites**

| Sampling Site | Total Catch (kg)                 |                                 |                               |                               |                               |                               |                               |                               |                    |                     |                     |                     |
|---------------|----------------------------------|---------------------------------|-------------------------------|-------------------------------|-------------------------------|-------------------------------|-------------------------------|-------------------------------|--------------------|---------------------|---------------------|---------------------|
|               | 1 <sup>st</sup> QM (April, 2014) | 2 <sup>nd</sup> QM (July, 2014) | 3 <sup>rd</sup> QM (Oct 2014) | 4 <sup>th</sup> QM (Jan 2015) | 5 <sup>th</sup> QM (Apr 2015) | 6 <sup>th</sup> QM (Aug 2015) | 7 <sup>th</sup> QM (Oct 2015) | 8 <sup>th</sup> QM (Jan 2016) | 9 <sup>th</sup> QM | 10 <sup>th</sup> QM | 11 <sup>th</sup> QM | 12 <sup>th</sup> QM |
| A             | 28*                              | 0                               | 3                             | 28.7                          | 6                             | -                             | 20                            | 276.2                         | 0                  | 0                   | 10                  |                     |
| B             | 65                               | 0                               | 1                             | 3.3                           | 0                             | -                             | 10                            | 12.8                          | 0                  | 0                   | 4                   |                     |
| C             | 1,559                            | 0.5                             | 8                             | 8.7                           | 1.05                          | 0.33                          | 19.5                          | 173.6                         | 2.75               | 0                   | 2.63                |                     |
| D             | **                               | 12                              | 3                             | 30.0                          | 10.5                          | 5.08                          | 10.75                         | 189                           | 0.00               | 11.8                | 17.5                |                     |
| E             | **                               | 0.6                             | 5                             | 0                             | 0.5                           | 0.40                          | 0.6                           | 7.8                           | 5.00               | 7.5                 | 2.6                 |                     |
| F             | **                               | 1.2                             | 13                            | 3.7                           | 1.5                           | 0.70                          | 0.8                           | 0                             | 1.50               | 0.77                | 0.46                |                     |
| G             | **                               | 1.6                             | 4                             | 0.7                           | 2.9                           | 0.83                          | 0.825                         | 70                            | 1.00               | 0.78                | 0.13                |                     |

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

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

**(b) Culture Fish Production**

157. The present study on shrimp/fish farm in the first quarter monitoring of 3rd year phase showed that the highest fish production has been found in the Gher of Kapasdanga and lowest in Chunkuri-2 (**Table D.5 in Appendix IV**).



**Photo 3.2: Fishing gears and crafts use in fishing at sampling sites**



## 3.2 Ecosystem Monitoring

### 3.2.1 *Monitoring of Ecosystem and Biodiversity*

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

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

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

161. Lichens often grow on trees and shrubs, absorbing nutrients from the atmosphere. Because lichens are very sensitive to air pollution, particularly to sulfur dioxide, fluoride, and ammonia, their presence or absence is an indicator of homestead forest health. The acidity of a tree's bark can also affect lichen abundance. Presence of lichen coverage on homestead trees would be a bio indicator for monitoring air quality standard of the study area.

162. Bird is important class in terrestrial faunal community that is sensitive to their habitat condition. Changes of environmental parameters, landuse and vegetation composition directly impact on bird's habitat of a locality. Broadly, two types of bird are found in an area; local and migratory. To observe local bird habitat suitability, number of bird nest and nesting bird species can be a good indicator. Numbers of wetlands where migratory birds come yearly have also been considered to observing migratory bird habitat suitability.

163. Monitoring butterfly is an important means of measuring change in the environment as well as state habitats for biodiversity. Insects are by far the most species rich group of animals, representing major portions of terrestrial biodiversity. Contrary to most other groups of insects, butterflies are well visible and mostly sensitive to changes of environmental parameters.

164. Dolphin is an ecological indicator which indicates water quality as well as aquatic habitat suitability of an aquatic system. This aquatic mammal is still present all the river systems of the study area. Any changes of water quality and river bed siltation may change dolphin occurrence in a river system. So, dolphin occurrence is needed to monitor.

#### ***Rationales for selection of indicators***

165. 4 homesteads have been selected for monitoring terrestrial ecosystem's indicators of the study area. Locations of the homesteads have been selected considering wind direction and spatial distribution from the project boundary. All the selected locations for terrestrial ecosystem monitoring is at northern sites as maximum time of the wind rose south to north direction and anticipated impacts will be take part according to this area. Beside this, Sundarban Reserve Forest is located sum of 14 km south from the project and various

indicators of different locations of this forest is also observing for forest health monitoring. So, no site has been selected at south site of the proposed project.

### ***Terrestrial ecosystem***

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

#### ***a. Vegetation canopy status***

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

#### ***Species representation in different canopy layers of homestead vegetation***

168. Cocos nucifera occupied top canopy of all the studied homestead vegetation. Phoenix sylvestris is prevalent as second top layer followed by Excochordia agallocha. Most of the fruit yielding trees like Manilkara zapota, Mangifera indica possess upper bole of canopy layer. Lower bole are occupied by small fruit yielding trees like Psidium guajava, Musa sp. Very few grass species and undergrowth vegetation were followed at studied homesteads.

#### ***Estimated Canopy cover in homestead vegetation of sampling sites***

169. Canopy status of Vegetation have been improved from the last monitoring period (Jun 2016) in 3 monitoring sites. This have been caused for more foliage growth of tree in rainy season. Comparing with same monitoring time in October 2015, it has also appeared in upward trend in all locations. Canopy coverage of the studied homesteads has been represented in following table.

**Table 3.8: Vegetation Canopy Cover in different studied homesteads**

| Location   | % of canopy Coverage                |                                     |                                     |                                     |                                     |                                     |                                     |                                     |                                      |                                      |
|------------|-------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|--------------------------------------|--------------------------------------|
|            | 1 <sup>st</sup> QM<br>(Apr<br>2014) | 2 <sup>nd</sup> QM<br>(Jun<br>2014) | 3 <sup>rd</sup> QM<br>(Oct<br>2014) | 4 <sup>th</sup> QM<br>(Jan<br>2015) | 5 <sup>th</sup> QM<br>(Apr<br>2015) | 6 <sup>th</sup> QM<br>(Aug<br>2015) | 7 <sup>th</sup> QM<br>(Oct<br>2015) | 8 <sup>th</sup> QM<br>(Jan<br>2016) | 10 <sup>th</sup> QM<br>(Jul<br>2016) | 11 <sup>th</sup> QM<br>(Oct<br>2016) |
| Rajnagar   | NS                                  | 19                                  | 19                                  | 17                                  | 20                                  | 20                                  | 20                                  | 20                                  | 21                                   | 23                                   |
| Borni      | NS                                  | 26                                  | 18                                  | 18                                  | 12                                  | 14                                  | 20                                  | 20                                  | 25                                   | 25                                   |
| Kalekarber | NS                                  | 20                                  | 24                                  | 25                                  | 23                                  | 24                                  | 24                                  | 22                                  | 24                                   | 26                                   |
| Chalkghona | NS                                  | 13                                  | 24                                  | 22                                  | 17                                  | 21                                  | 21                                  | 20                                  | 21                                   | 27                                   |

Note: NS = Not Surveyed

#### ***b. Lichen cover***

170. Alive lichen cover on different tree trunks have been followed more or less same in Rajnagar Kalekarber and Chalkghona monitoring sites from the previous quarter in July 2016. In Borni, the coverage assessed lower than previous. There is no known cause in favor of this result. In Borni and Kalekarber sites, alive lichen cover on tree barks have been observed less than previous year monitoring in October, 2015. This may be happened due

to starting early rain of this season, growing lichen early on the tree trunks and end of life cycle and not regenerate again. Following table refers average percentage of lichen coverage of the studied locations.

**Table 3.9: Lichen Coverage on different tree barks at studied homestead vegetation**

| Location   | % of Lichen Coverage             |                                  |                                  |                                  |                                  |                                  |                                   |                                   |
|------------|----------------------------------|----------------------------------|----------------------------------|----------------------------------|----------------------------------|----------------------------------|-----------------------------------|-----------------------------------|
|            | 1 <sup>st</sup> QM<br>(Apr 2014) | 2 <sup>nd</sup> QM<br>(Jun 2014) | 3 <sup>rd</sup> QM<br>(Oct 2014) | 5 <sup>th</sup> QM<br>(Apr 2015) | 7 <sup>th</sup> QM<br>(Oct 2015) | 8 <sup>th</sup> QM<br>(Jan 2016) | 10 <sup>th</sup> QM<br>(Jul 2016) | 11 <sup>th</sup> QM<br>(Oct 2016) |
| Raj Nagar  | NS                               | 5.1                              | 2.5                              | 1.4                              | 2.6                              | 1.5                              | 2.1                               | 2.4                               |
| Borni      | NS                               | 7.8                              | 3.1                              | 2.4                              | 4.8                              | 3.1                              | 2.1                               | 1.1                               |
| Kalekarber | NS                               | 4.3                              | 3.2                              | 1.0                              | 2.1                              | 1.6                              | 0.7                               | 0.6                               |
| Chalkghona | NS                               | 2.1                              | 2.6                              | 1.6                              | 3.1                              | 2.5                              | 3.7                               | 3.0                               |

Note: NS = Not Surveyed



**Photo 3.3: Alive Lichens on *Excoecaria agallocha* (Left) and *Areca catechu* ( Right) barks at Borni site**

### **c. Bird Habitat**

#### **Local birds and their nesting behavior**

171. The study area supports numerous local bird species. Most of which, dwell in homestead vegetation. Existence of vast shrimp farms as well as canals and rivers also favor good number of water dependent bird species in this area. Most of the birds are nesting on tall trees of homesteads. Coconut (*Cocos nucifera*) and Gewa (*Excoecaria agallocha*) followed top priority for nesting. Small bird like Tailor bird, prefer small bushy shrubs. Although, birds do not follow any local boundaries, a clear conception on available bird species have been gathered through discussions with studied homestead owners as well as physical observation,

#### **Bird species and number of Bird nests in sampling sites**

172. No bird nest was observed from any site of the monitoring location during this monitoring period.

**d. Butterfly occurrence**

173. Altogether, 32 butterfly species have been recorded from studied sites during last different monitoring tiers. Of which Common crow, Common Emigrant, Common Rose, Small Grass yellow, Peacock Pansy etc are followed most of the homesteads in most of the monitoring season. Abundance of butterfly is fluctuates according to seasonal variations.

174. A total of 7 butterflies species have been recorded from all the monitoring sites. Small Grass Yellow (*Eurema smilax*) is the most common species from all the locations. Number of butterfly species record is also same to previous monitoring quarter.



**Photo 3.4: Common Palmfly (*Elymnias hypermnestra*) and Blue Tiger (*Tirumala limniace*) are observed during the study**

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

| Common Name             | Scientific Name          | Time and locations for Occurrence of Butterfly species |    |   |   |          |    |    |   |          |   |   |   |          |    |   |    |          |   |   |   |          |   |   |   |          |   |   |   |          |    |   |   |
|-------------------------|--------------------------|--|----|---|---|----------|----|----|---|----------|---|---|---|----------|----|---|----|----------|---|---|---|----------|---|---|---|----------|---|---|---|----------|----|---|---|
|                         |                          | Jun 2014   |    |   |   | Oct 2014 |    |    |   | Jan 2015 |   |   |   | Apr 2015 |    |   |    | Aug 2015 |   |   |   | Oct 2015 |   |   |   | Jan 2016 |   |   |   | Oct 2016 |    |   |   |
|                         |                          | R  | B  | K | C | R        | B  | K  | C | R        | B | K | C | R        | B  | K | C  | R        | B | K | C | R        | B | K | C | R        | B | K | C | R        | B  | K | C |
| Three spot Grass Yellow | <i>Eurema blanda</i>     |  |    |   |   | *        | ** |    | * |          |   |   |   |          |    |   |    |          |   |   |   |          |   |   |   |          |   |   |   |          |    |   |   |
| Peacock pansy           | <i>Junonia almana</i>    |  |    |   |   |          | ** |    |   |          |   |   |   | *        |    |   |    |          |   |   |   | ***      |   | * |   | *        |   |   |   | **       |    |   |   |
| Rice Swift              | <i>Borbo cinnara</i>     |  |    |   |   | **       | *  | ** |   |          |   | * |   |          |    |   |    |          |   |   |   |          |   |   |   |          |   |   |   |          |    |   |   |
| Small Grass-yellow      | <i>Eurema smilax</i>     |  | ** |   |   |          |    |    |   |          | * |   |   | *        | ** |   | ** | **       | * |   |   |          |   |   | * | **       | * | * |   | **       | ** | * |   |
| Spotted Pea-blue        | <i>Euchrysops cnejus</i> |  |    |   |   |          |    |    |   |          |   |   |   |          |    |   |    |          |   |   |   |          |   |   |   |          |   |   |   |          |    |   |   |
| Swamp Tiger             | <i>Danaus affinis</i>    |  |    |   |   |          |    |    |   |          |   | * |   |          | *  |   |    |          |   |   |   |          |   |   |   |          |   |   |   |          |    |   |   |
| Common Red Eye          | <i>Matapa aria</i>       |  |    |   |   |          |    |    |   |          |   |   |   |          |    |   |    |          |   |   |   | *        |   |   | * |          |   |   |   |          |    |   |   |

Source: CEGIS Monitoring (2014-2016)

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

Butterfly occurrence: \* = Low, \*\* = Moderate, \*\*\* = High



### ***Aquatic Ecosystem Monitoring***

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

#### ***a. Monitoring Locations***

176. 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 (Maidara Sailtakhal and Ichamoti) exists as internal river system. Hence, status of benthos, planktons and aquatic mammals (Dolphin) in different locations of the study area has been monitored.

#### ***b. Dolphin Occurrence***

##### ***Dolphin migration route in study area***

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

##### ***Dolphin occurrence in Passur River***

178. Occurrence of dolphin have been monitored by 29 km boat transect Passur and Maidara River surround the project area from the confluence point of Passur-Chunkuri River at Chalna Bazar to Mungla river at Mongla. A total of 11 Ganges River Dolphins were recorded at different locations of the surveyed transect. Of which, 6 dolphins have been recorded only within 1 km River area of Maidara River. All of which are followed in diving Position. High wavy condition in Passur River during the transect survey was a barrier to monitor the dolphins in this season. Detail survey result is presented in following map (**Map 3.2**).

179. Another survey have been conducted in 8 km length of the Dhangmari Khal Dolphin sanctuary from Dhangmari-Passur confluence point to Gagramari Forest Camp. Most of the dolphins were centered at confluence point of Ghagramari-Dhangmari Khal. A total of 11 dolphin individuals have been recorded with an average encounter rate of 1.37/km/hr. Dolphin occurrence points of Dhangmari Khal have been presented in Map 3.3 below. Dolphin have also been recorded in Harbaria and Koromjal site.

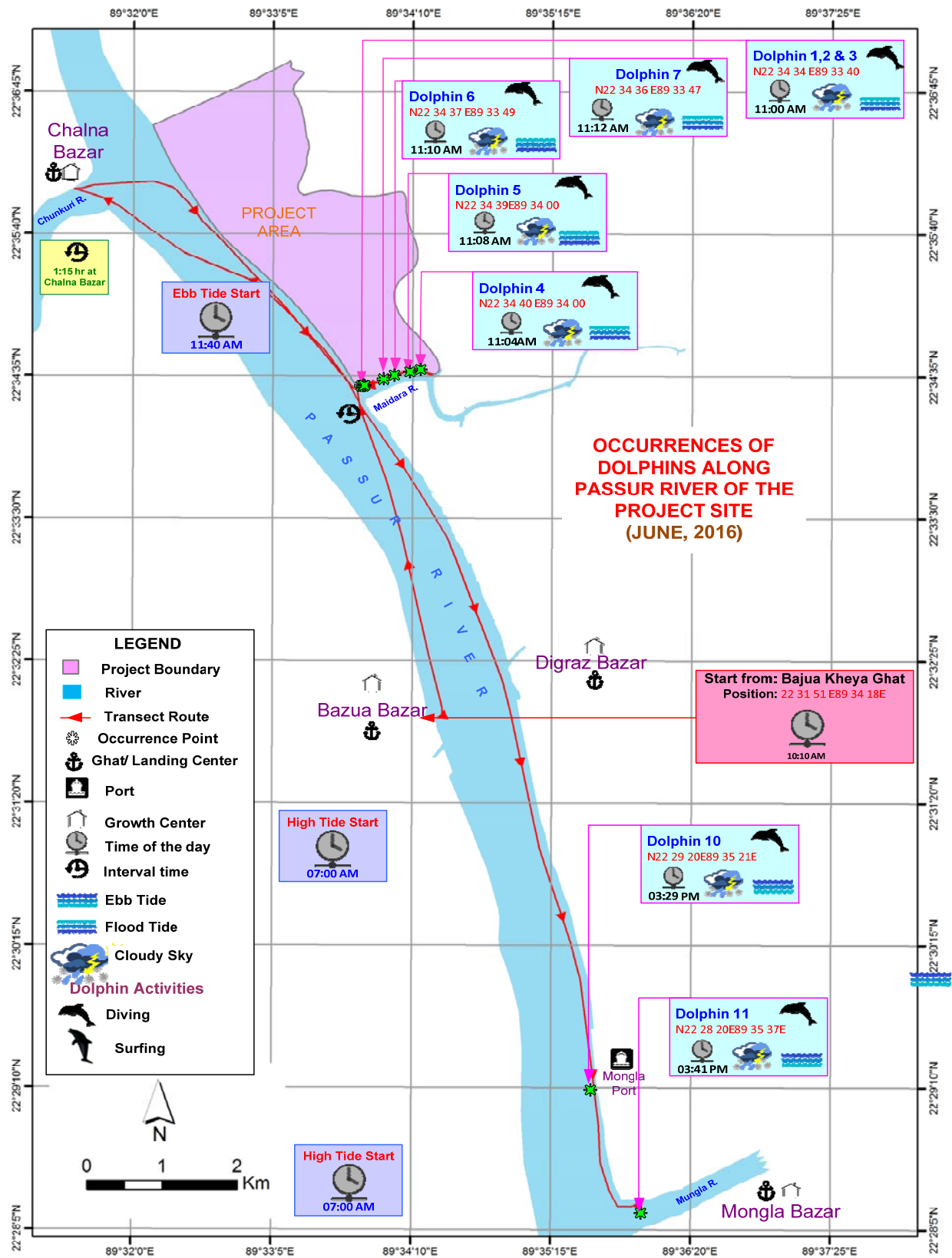
Bangladesh's government declared the three new wildlife sanctuaries at Sundarbans in Jan. 29, 2012 establishing them in part to protect freshwater dolphins in the Sundarbans, the world's largest mangrove ecosystem. The sanctuaries will serve for the survival of the last two species of freshwater dolphins in Asia: the Ganges River dolphin and the Irrawaddy dolphin.



Table 3.10: Dolphin observation Datasheet

| Location of River systems         | Occurrence Status                |    |                                  |   |                                  |   |                                  |   |                                  |   |                                  |    |                                  |    |                                  |    |                                   |    |                                   |    |
|-----------------------------------|----------------------------------|----|----------------------------------|---|----------------------------------|---|----------------------------------|---|----------------------------------|---|----------------------------------|----|----------------------------------|----|----------------------------------|----|-----------------------------------|----|-----------------------------------|----|
|                                   | 1 <sup>st</sup> QM<br>(Apr 2014) |    | 2 <sup>nd</sup> QM<br>(Jun 2014) |   | 3 <sup>rd</sup> QM<br>(Oct 2014) |   | 4 <sup>th</sup> QM<br>(Jan 2015) |   | 5 <sup>th</sup> QM<br>(Apr 2015) |   | 6 <sup>th</sup> QM<br>(Aug 2015) |    | 7 <sup>th</sup> QM<br>(Oct 2015) |    | 7 <sup>th</sup> QM<br>(Oct 2015) |    | 10 <sup>th</sup> QM<br>(Jul 2016) |    | 11 <sup>th</sup> QM<br>(Oct 2016) |    |
|                                   | F                                | T  | N                                | T | F                                | T | N                                | T | F                                | T | N                                | T  | F                                | T  | N                                | T  | F                                 | T  | N                                 | T  |
| Passur River<br>Near Project Site | Y                                | Y  | Y                                | Y | Y                                | Y | Y                                | Y | Y                                | Y | Y                                | Y  | Y                                | Y  | Y                                | Y  | Y                                 | Y  | Y                                 | Y  |
| Karamjal                          | NS                               | NS | NS                               | N | NS                               | Y | Y                                | Y | N                                | N | NS                               | Y  | NS                               | Y  | Y                                | N  | Y                                 | NS | Y                                 | Y  |
| Harbaria                          | NS                               | NS | NS                               | N | NS                               | Y | Y                                | N | N                                | N | N                                | N  | Y                                | NS | Y                                | N  | Y                                 | Y  | Y                                 | NS |
| Akram Point                       | NS                               | NS | NS                               | N | NS                               | N | NS                               | Y | Y                                | Y | NS                               | NS | N                                | Y  | Y                                | NS | NS                                | NS | N                                 | N  |
| Moidara River                     | Y                                | N  | N                                | N | Y                                | Y | Y                                | N | Y                                | N | Y                                | N  | NS                               | Y  | N                                | Y  | Y                                 | NS | NS                                | Y  |

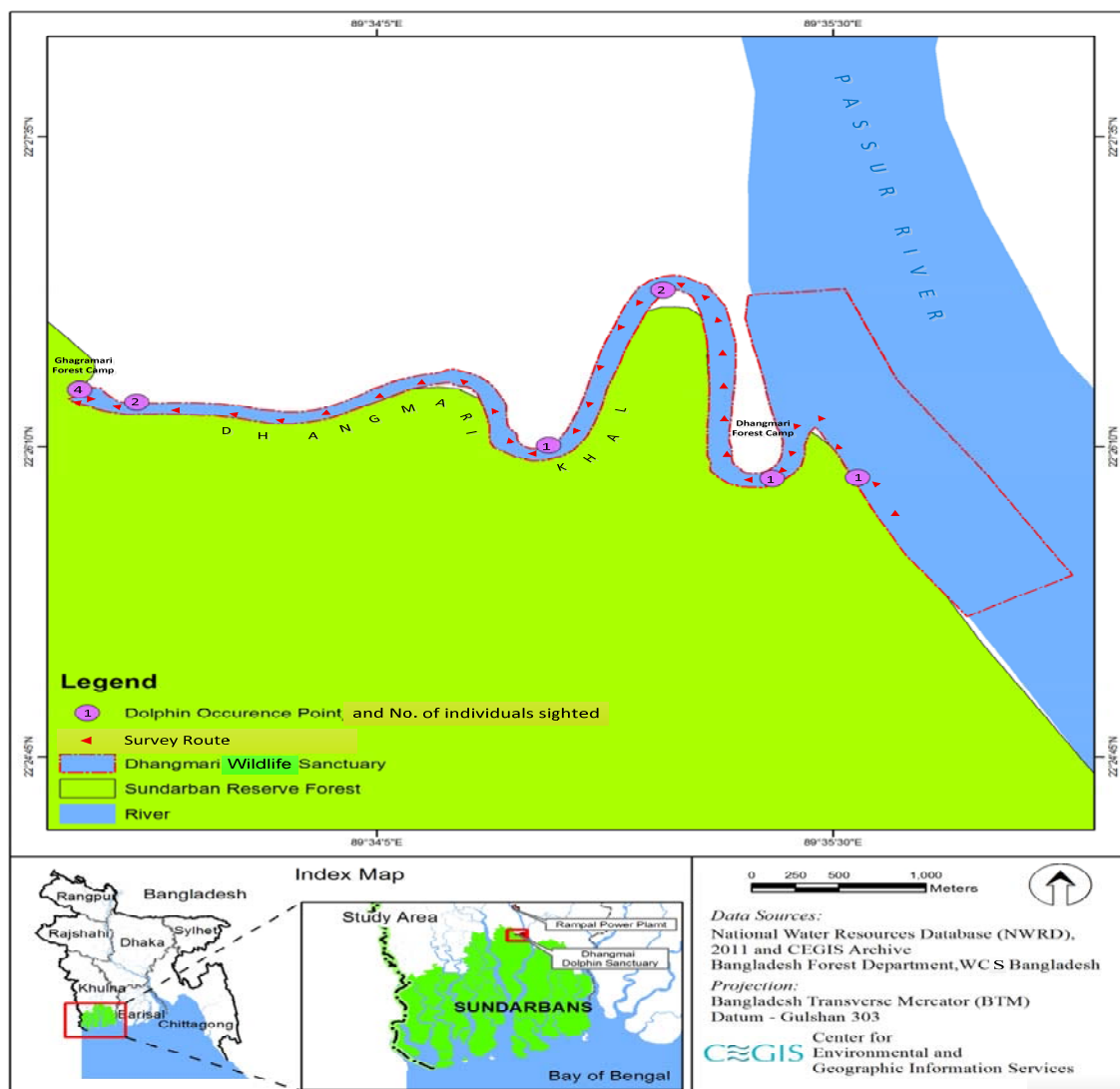
Note: FT=Flood Tide, NT=Neap Tide, NS=Not Surveyed, Occurrence Status: Y = Occurred, N = Not occurred



Map 3.2: Dolphin Occurrence in Passur River near Project Site



Photo 3.5: One of surveyed Ganges River dolphin found at Dhangmari khal



Map 3.3: Dolphin Occurrence in Dhangmari Khal

### 3.3 Sundarbans Forest Health

180. CEGIS team is periodically monitoring Sundarbans 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, eleven (11) surveys have been conducted at five locations, namely Sutarkhali, Karamjal, Harbaria, Akram point and Hiron point. The overall monitoring indicators observed in eleven monitoring schedules broadly include 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 Second Year Fourth Quarter*

181. Monitoring frequency for different indicators has been determined considering efficiency in time, cost and applicability. The indicators observed in this tier are as follows:

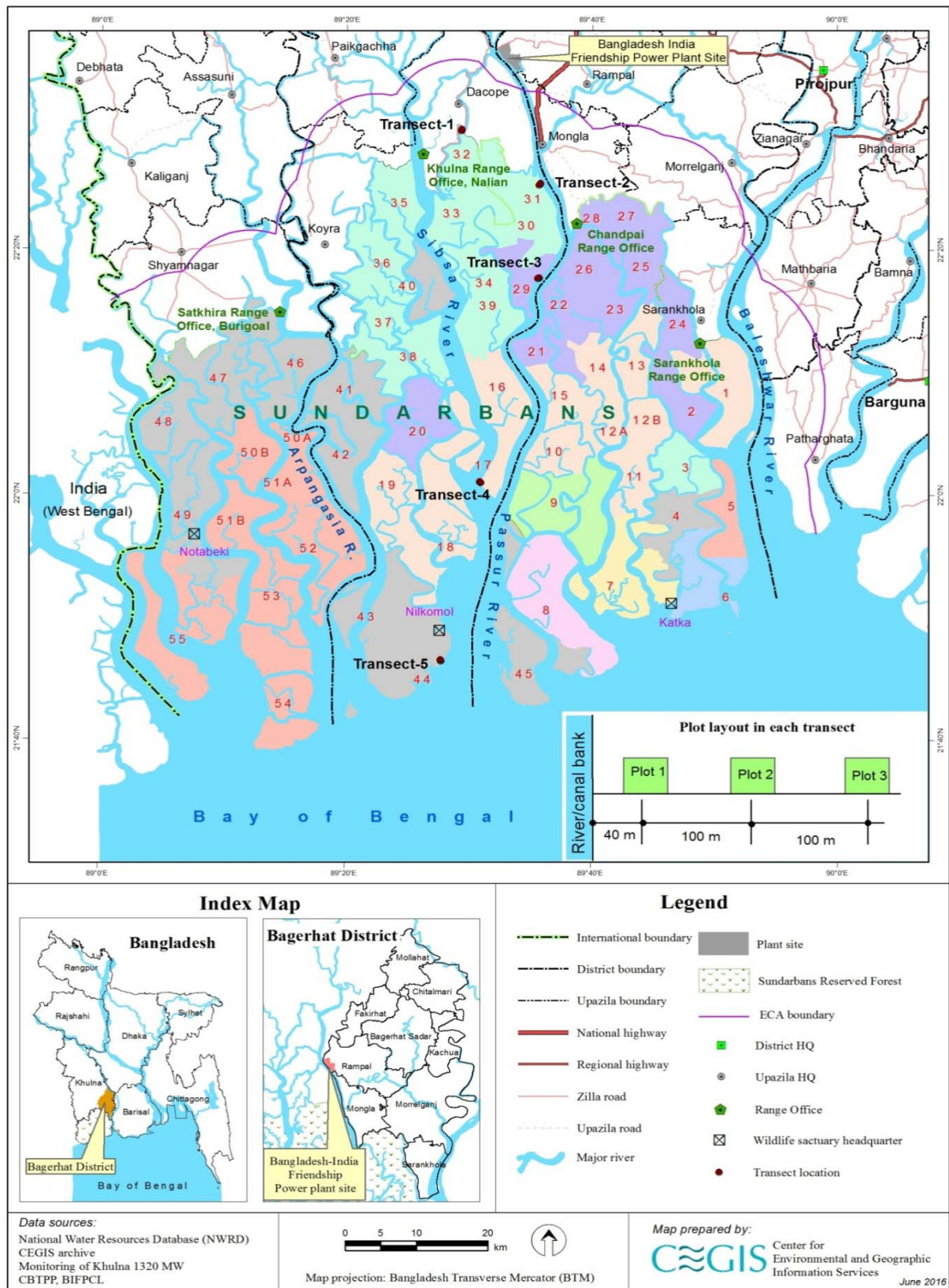
- Seedling Regeneration
- Pneumatophores
- Crab hole density
- Canopy cover
- Leaf Area Index
- Lichen Coverage

##### *Forest Health Monitoring Location*

182. To set up permanent sample plots five sites have been selected on the basis of the survey conducted from April 3 to April 6, 2014 (**Map 3.4**). Among those, four sites are along the Passur River at Karamjal, Harbaria, Akram point and Hiron point, and the fifth one is near Sutarkhali forest office. The sites have been selected considering the distance from the proposed Project site, coal transportation route, protection of the permanent sample plots, and vegetation types.

##### *Sampling Design of Permanent Sample Plots (PSPs)*

183. In each site, a transect line has been laid out perpendicular to river or canal bank. Along the transect line three circular nested subplots of 12.62 m radius have been laid out at 100 m intervals in order to capture the maximum tree species (**Figure 3.7**). Because of the variation in species composition in SRF, observation plots have been laid out from the coast, river or canal side to landward zone (forest proper side). The location of the first subplot is 40 m away from ecotone (riverside) to inner ward of forest in order to save the subplot from river bank erosion. Each subplot is again subdivided into four quadrates for the ease of data detection and recording (**Figure 3.8**).



Map 3.4: Location Map of Sundarbans Forest Health Monitoring Plots (PSPs)



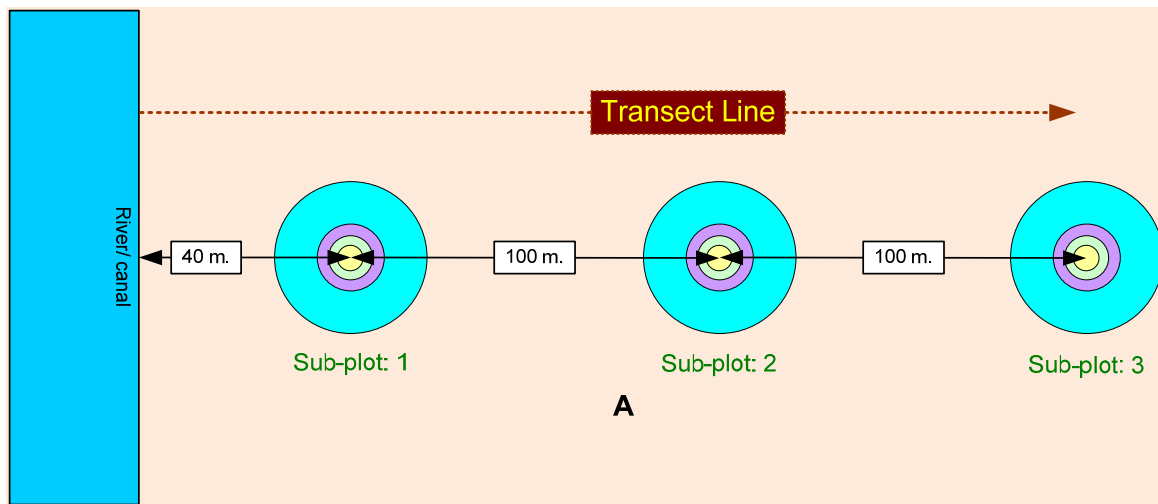


Figure 3.7: Layout of the subplots and transect line perpendicular from ecotone (river or canal bank)

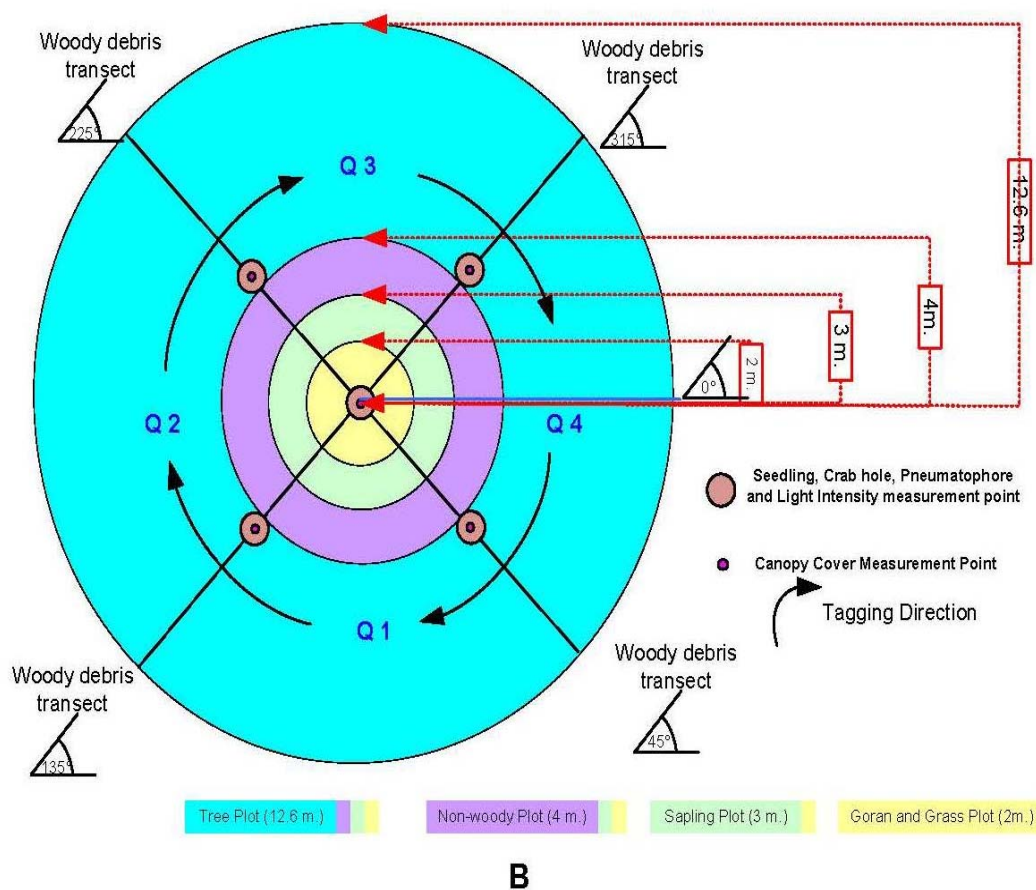


Figure 3.8: Layout of the survey activities in each subplot

## Forest Health Survey

### (a) Trees

184. The tag number of trees ( $DBH \geq 5\text{cm}$  and lean angle greater than  $45^\circ$ ) is monitored and rewritten if any new tree is found within 12.62 m radius circle of the Permanent Sample Plot (PSP). In the same monitoring period a map showing the location of all trees (tag number) is developed to ease the next data collection (**Photo 3.6**). The tree height and diameter are also taken by the surveyor (**Photo 3.7 & Photo 3.8**).



**Photo 3.6: Team Member recording and cross checking data in the field sheet**



**Photo 3.7: Team member measuring height of trees in the subplot**



**Photo 3.8: Surveyor measuring the DBH of trees in the subplot**

### (b) Sapling and seedling

185. Saplings ( $DBH < 5\text{ cm}$  and height 1.37 m) and seedlings (height  $< 1.37\text{ m}$ ) have been assessed within 3m and 2m radius circle, respectively in each PSP. Seedlings have been counted species wise, and their status of living have also been recorded (**Photo 3.9**). For saplings, species name and DBH have been recorded along with the living status (**Photo 3.10**).





**Photo 3.9: Team member counting the seedlings in the subplot**



**Photo 3.10: Surveyor measuring the DBH of saplings in the subplot**

### **(c) Pneumatophores**

186. The total number of living pneumatophores has been recorded within a circular area of 1 m radius centring each of the five points of all the subplots. The first point has been laid out in the centre of each subplot and other four have been in the midpoint of the four woody debris transects that are facing at 45°, 135°, 225° and 315° (**Photo 3.11**).

### **(d) Crab hole**

187. 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 have been counted within an area of 1 m radius circle in each subplot's centre and in the midpoint of four woody debris transect (**Photo 3.12**).



**Photo 3.11: Team member counting pneumatophore on forest floor**



**Photo 3.12: Counting of crab holes on forest floor**

### (e) Canopy Cover

188. Percentage (%) of canopy cover has been estimated by a spherical densiometer, a gridded convex mirror that provides a simple and inexpensive approach of measuring canopy cover. The densiometer has been held at a distance of 30–40 cm from the body and at an elbow height so that head is not visible in the mirror (**Photo 3.13**). After levelling the instrument using the level bubble, the dots, which are not occupied by canopy, are systematically counted. In each subplot, the meter readings have been taken at five points facing north, south, east, and west direction including the centre point of the subplot. The canopy cover has been calculated by taking the average of these five readings.

### (f) Leaf Area Index

189. 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 (**Photo 3.14**). In this monitoring report, LAI is calculated as follows:

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

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



**Photo 3.13: Team member taking canopy cover using Densiometer**



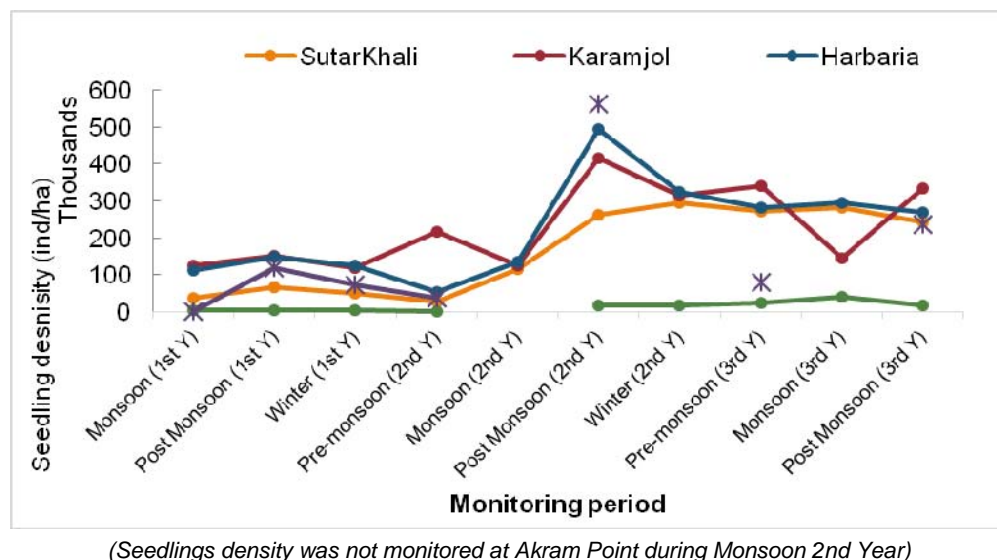
**Photo 3.14: Team member taking light intensity using Lux Meter**

### 3.3.2 Status of monitoring of SRF Health

#### Seedling

190. From last eleven monitoring, it is found that number of seedlings per hectare is increasing almost all the monitoring locations except Akram point (**Figure 3.3.3**). The graph has also shown that higher number of seedlings is being found during monsoon to post-monsoon period whereas the number decreases during winter to pre-monsoon period. The recruitment of new seedlings depends on regeneration and survival rate. These two indicators also depend on canopy cover, soil chemistry (pH, salinity, organic matter etc.). Seedlings usually die at an early stage in natural forest due to competition for nutrients as well as light intensity. 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. In this relation, seedlings are usually found more after the rainy season (monsoon to post monsoon) than in other seasons. However, the monitoring result of this period has shown comparatively higher number of seedlings at Hiron point than pre-monsoon. This may be due to higher light intensity as huge illicit feeling of trees is seen, which has created large open space. It is to be noted that seedling density at Hiron point during monsoon 2<sup>nd</sup> and 3<sup>rd</sup> year, winter 2<sup>nd</sup> year and at Akram point during monsoon 2<sup>nd</sup> year was not monitored.

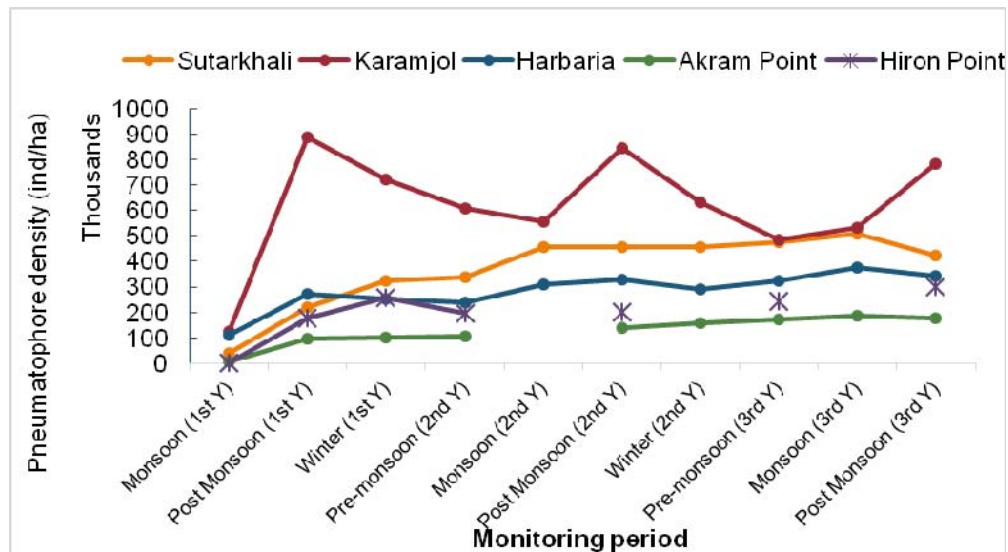


**Figure 3.9: Mean ( $\pm 95\%CI$ ) seedlings density among the quarterly surveys in five PSPs**

### ***Pneumatophores***

191. Like seedlings, pneumatophores density also changes due to seasonal variability (Figure 3.10). Pneumatophores usually dry up and die during dry season. Hence, the number of pneumatophores per hectare is found comparatively higher in post-monsoon period. However, among five monitoring sites, the mean pneumatophores density is found lower in Akram point due to floristic composition. From the species composition inventory, it is found that this monitoring site is mainly dominated by Gewa (*Exoecaria agallocha*) species. On the contrary, Karamjal is mainly dominated by Baen (*Avicennia officinalis*) tree and it has numerous tender pneumatophores considering to others. The number of pneumatophores may also vary due to the elevation of the forest floor from the mean sea level (MSL). The major function of pneumatophores is to exchange gas into the atmosphere during tidal inundation. Hence, the highly elevated plot with less effect of inundation may have lesser number of pneumatophores. It is to be noted that pneumatophore density at Hiron point during monsoon 2<sup>nd</sup> and 3<sup>rd</sup> year, winter 2<sup>nd</sup> year and at Akram point during monsoon 2<sup>nd</sup> year was not monitored.



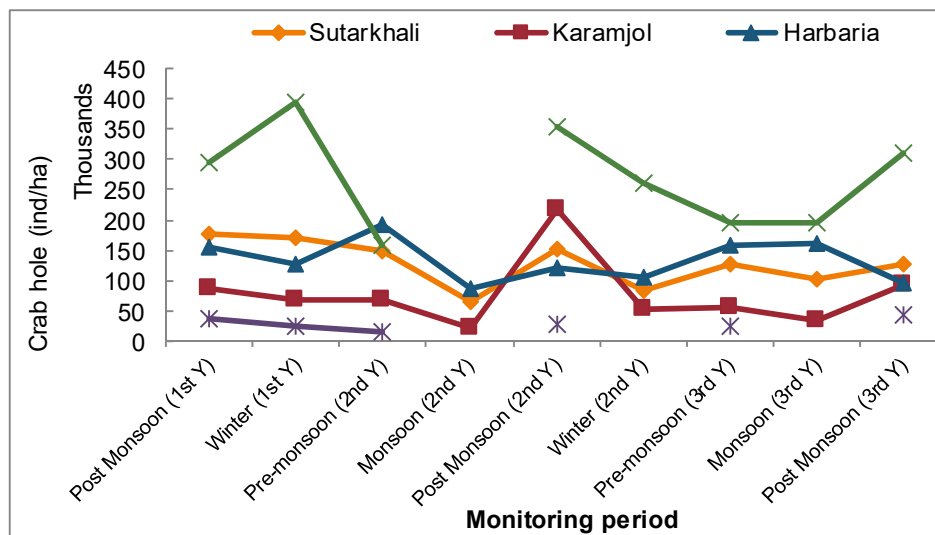


(Pneumatophores density was not monitored at Akram Point during Monsoon 2nd Year)

**Figure 3.10: Mean Pneumatophores Density among the quarterly surveys in four PSPs**

#### Crab hole

192. The crab hole density, the indicator of availability of crab in a site, has been found the highest at Akram point among the five monitoring sites (**Figure 3.11**). This may be due to sandy forest floor at Akram point because they love to drag hole on that particular habitat. From figure, it is difficult to predict the relationship of crab hole with seasonal variability. This may be due to the nature of mangrove (evergreen forest) forest floor. Although mangroves are marshy land, there are differences in terms of area in dry period (winter) and wet period (monsoon) which shows some influences on crab hole abundance. It is to be noted that crab hole density at Hiron point during monsoon 2nd and 3rd year, winter 2nd year and at Akram point during monsoon 2nd year was not monitored.

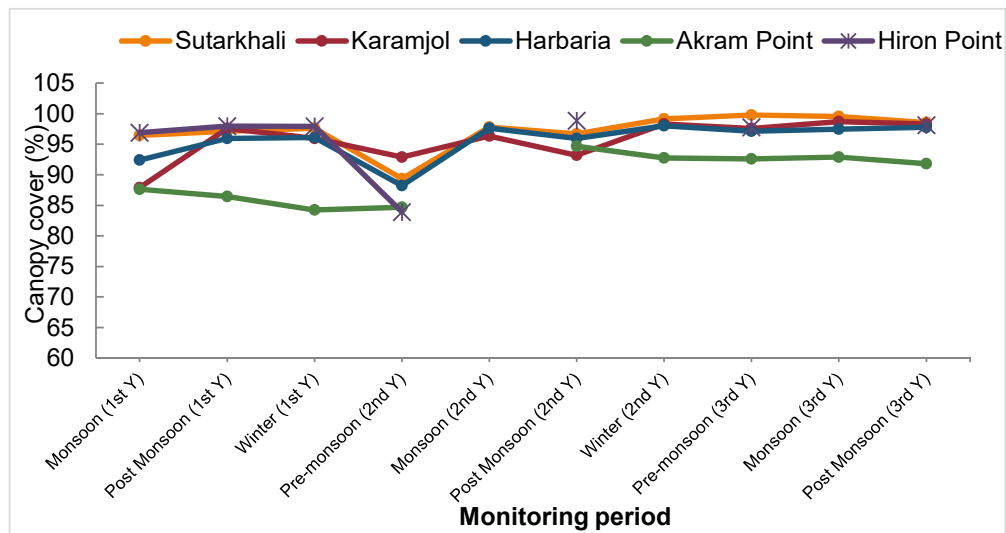


(Crab hole density was not monitored at Akram Point during Monsoon 2nd Year)

**Figure 3.11: Mean crab hole density among the quarterly surveys in five PSPs**

### Canopy cover

193. In the monitoring plots, the canopy cover percentages have not varied significantly. From the first year to second year pre-monsoon, the highest canopy cover percentages are observed during monsoon to post monsoon which started decreasing during winter and is found the lowest in pre-monsoon period. However, from monsoon second year to monsoon third year, it is found that the canopy cover percentages are similar among the monitoring sites (**Figure 3.12**). Since greater than 60% of the canopy coverage in a site is treated as healthy, all the locations of the monitoring sites are in good shape. It is to be noted that canopy cover at Hiron point during monsoon 2<sup>nd</sup> and 3<sup>rd</sup> year, winter 2<sup>nd</sup> year and at Akram point during monsoon 2<sup>nd</sup> year was not monitored.

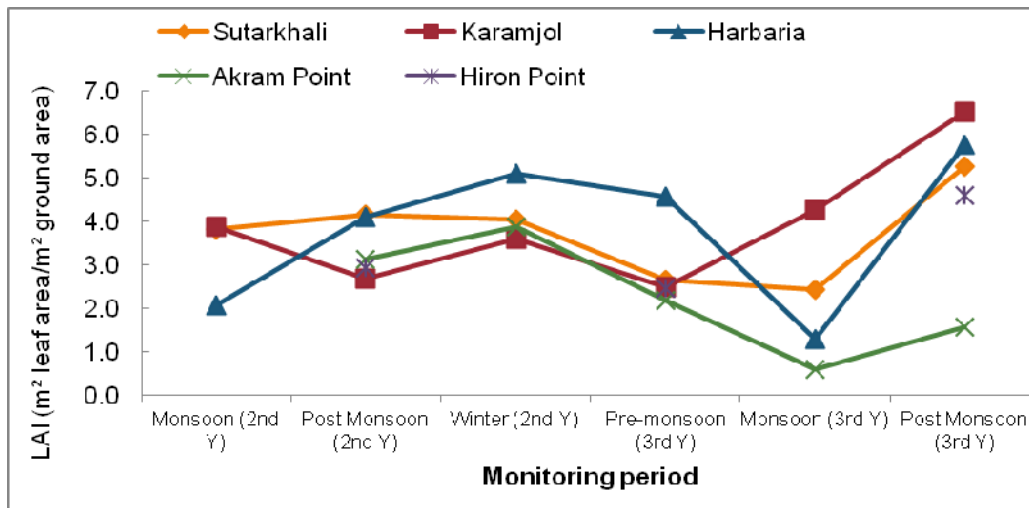


(Canopy cover was not monitored at Akram Point during Monsoon 2nd Year)

**Figure 3.12: Mean canopy cover (%) among the quarterly surveys in five PSPs**

### Leaf Area Index (LAI)

194. The LAI influences daily rate of net canopy photosynthesis which results in exchange of atmospheric CO<sub>2</sub>. The minimum the ratio of under canopy to open canopy light intensity value indicates the maximum the LAI. Hence, the maximum the net canopy photosynthesis. From Figure 3.3.7, it is found that the LAI has increased in all monitoring locations from previous results. This is a sign of good health of forest. However, at Akram point like other indicators the LAI is much lower due to high under canopy light intensity. It is to be noted that LAI at Hiron point during monsoon 2<sup>nd</sup> and 3<sup>rd</sup> year, winter 2<sup>nd</sup> year and at Akram point during monsoon 2<sup>nd</sup> year was not monitored.



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

**Figure 3.13: Leaf Area Index ( $\text{m}^2$  leaf area /  $\text{m}^2$  ground area) among the quarterly surveys in four PSPs**

### 3.3.3 Findings

195. From the last eleven monitoring, it can be predicted in terms of seedling density, pneumatophore, crab hole, canopy cover and leaf area index ( $\text{m}^2$  leaf area/ $\text{m}^2$  ground area) that the forest condition is showing positive changes periodically, although there has some seasonal effect. However, based on above indicators it is found that the health condition at Akram point is worse. This is due to the physiographic location of this plot, which is facing high environmental stress. The Akram point is situated at the confluence of Shibsa to Passur River. Therefore, during tidal inflow the forest floor carry large amount of soil sediment than other locations are being monitored under this study. Here, the forest is experiencing retrogradation process where the climax species are started decaying. Hence, this area is sensitive in terms of disturbance. It is to be noted here that the potential anchorage point for coal transshipment of the proposed power plant project is situated in the periphery of this area. So, there is a possibility of disturbance into the ecosystem on natural succession. Therefore, the monitoring 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 delineate as control site to compare any potential impact due to coal transportation and transshipment along the Passur River.

## 4 Social Environment

### 4.1 Socio-economic Condition and Social Safeguard

196. Objective of this section is to investigate the change (either improvement or deterioration) in identified socio-economic indicators/parameters with reference to the previous monitoring results and constitutes this phase of monitoring report (which is based on the field visit information collected from 7th to 12th October, 2016). The socio-economic status changes gradually over time and as such the frequency of this assessment is planned as twice in a year as successive six months regular interval. Socio-economic monitoring report of this phase is prepared considering the changes from April 2016 to September 2016.

197.

#### 4.1.1 Methodology

198. The important and project associated indicators are identified for monitoring and changes on those parameters/indicators only were examined in this phase with reference to its earlier condition. The monitoring methodologies adopted in this study was similar to the previous study (conducted in April, 2016) such as Focus Group Discussion (FGD) and informal discussions.

199. Total 4 FGDs and 5 informal discussions were conducted both in Project site and adjacent areas. One FGD was conducted in Foyla bazaar comprising of resettled people and the remaining three were conducted in Baradurgapur, Kapasdanga and Barni mouzas comprising of affected land owners and local inhabitants. Out of five (5) informal discussions, one was with Project Management and the rest four (4) in Rajnagar, Pankhali and Bajua mouzas with local inhabitants (**Map 4.1**).

200. For both FGDs and informal discussion a checklist with the compliance of “Performance Standards on Environmental and Social Sustainability” by International Finance Corporation (IFC) was followed.

#### 4.1.2 Exploration of Monitoring Parameters

##### **Compensation**

201. As per the rule of Bangladesh Government, people do not have legal documents of land will not be eligible for expected compensation or other administrative supports. The lessees are also not eligible to get compensation or any types of assistance, however in some cases they have been compensated or assisted as per the guideline of Donor agencies. Local people of the study area are expecting the involvement and persuasion of LGIs/Project authority to resolve land related compensation issues as soon as possible.

202. During this field visit, an issue was raised by the affected people regarding the acquired land which are still unused. BPDB acquired altogether 1834 acres of land and BIFPCL get the ownership of 914 acres of land only for the construction of the power plant. It has also been noted during the field visit that before acquiring, the land were sparsely populated and used for fish farming. But the remaining areas were as fallow as like the current state and after acquisition, the stakeholders were not allowed to do any types of activities within the land. However, the land losers have tried to communicate with the respective authority but did not receive any support or response from them. Therefore, they



urges for support from BIFPCL to help them for communicating with the authority so that they can use the unused land before starting the development works which may somehow help them to restore their livelihood for a certain period.

### ***Resettlement/Rehabilitation***

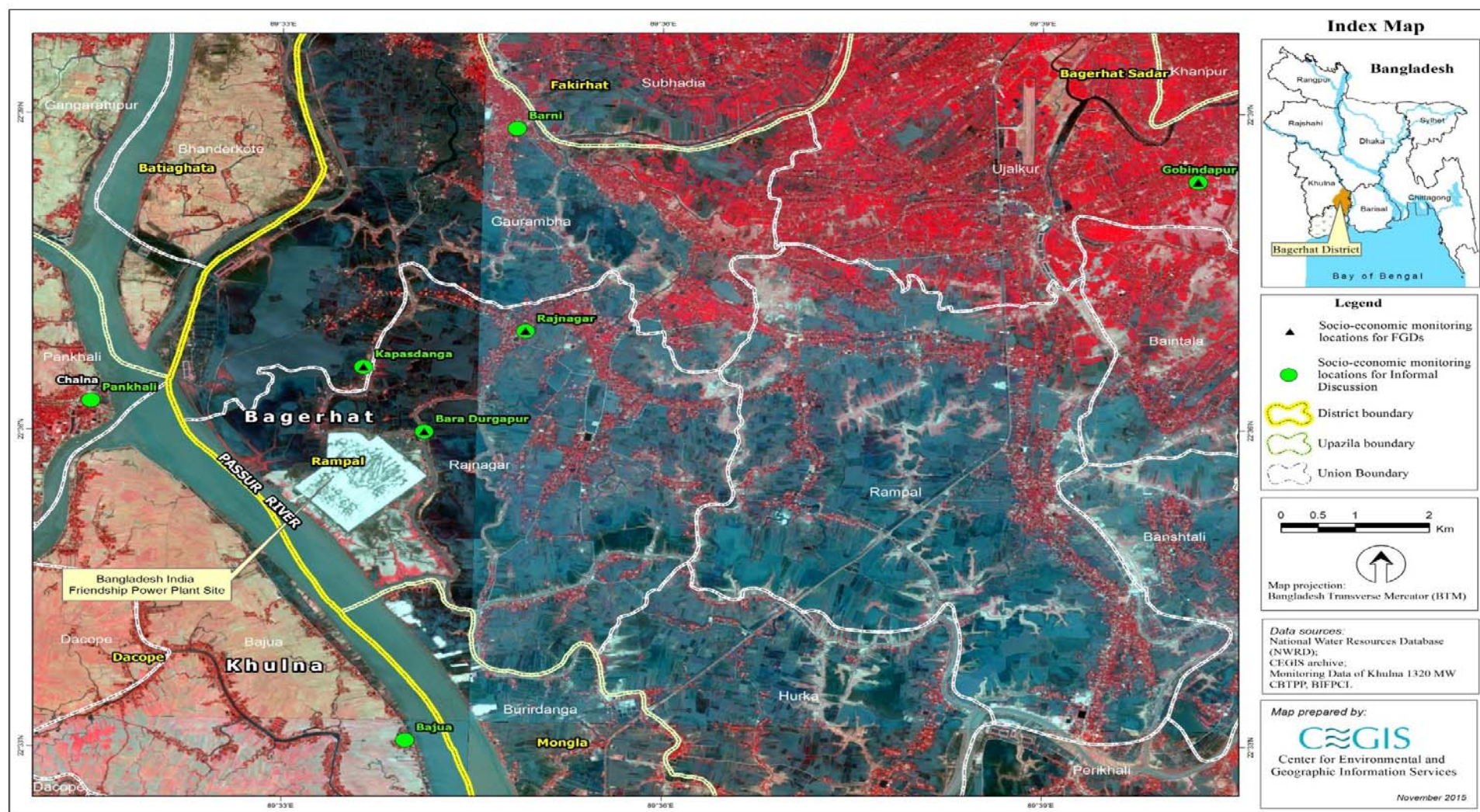
203. From the beginning of the monitoring, total 18 homestead who do not have any legal rights over the acquired land and who were residing as informal settlers in the acquired land have been resettled at Foyla Cluster Village without sufficient livelihood options. However, it observed in this field visit that 8 allottees already left the cluster village due to lack of income generating options and scant social benefits. The existing resettled people are somehow trying to cope with the surrounding features of that cluster village.

204. The list of the people indirectly affected by the Project has been collected for Bagerhat DC office. BPDB already appointed a social consultant for validating the status of those households and for preparing Labor Recruitment Plan (LRP) for them, which is under going. Following that LRP, labors will be recruited in construction and post-construction phases from those affected households.

205. In terms of rehabilitation issue, the resettled population urged to the project authority to get them involve in Project related activities which is suitable for them. As the resettled site is far from the Project site, accommodation facilities in the labor shed at the Project site or transport allowance would be helpful for sustaining their economic development.

206. For income restoration purposes, Project authority have conducted two trainings programs to develop technical skill of project affected people so that they can easily compete in contemporary challenging occupations. There were two types of training (sewing and computer literacy) which were started on 12th July 2016. Duration of sewing training was 2 months and computer literacy for 3 months. After successfully completion of the trainings, certificates were provided among the participants.

207. Total 10 female participants took part in sewing training and 20 participants (both male and female) took part in computer literacy. The local people opined that these trainings are helpful for the affected people for restoring their income while participant of sewing trainings demanded sewing machine from the project authority. The project affected people claimed that, local influential persons made the participants list of trainings where the actual affectees were not prioritized. However, BIFPCL authority informed the monitoring team that, the participant list is provided by the local administration.



Map 4.1: Socio-Economic Environment Monitoring Location





### ***Project Related Employment Generation***

208. The project authority is willing to recruit local labors according to their area of expertise. But, local people are rarely found to have related technical expertise that is why they are mainly engaged in laboring activity. Generally, contractors prefer to choose technical/skilled labors from his periphery for ensuring better understanding about the works. However, at present hardly any construction activities are going on in the Project area.

209. The present construction works (those are mostly in technical types) were supervised by contractual contractors and hence a negligible scope of local people was found to be involved in these activities. However, few numbers of local unskilled labors were involved in non-technical laboring activities according to the requirement of works. The Project proponent is expecting to employ a large number of manpower assuring engagement of all the locals soon, as the EPC contractor is about to set in for a full-fledged construction activity of the Power Plant.

### ***Labor and Working conditions***

210. At present the activity of pre-construction phase is running on and the main activities of construction phase will be started after initiating the works of the EPC contractor. At present labors recruitment and dismissal process remain same as earlier phase. In terms of skilled labour recruitment, the liability is fully goes upon the contractors and in most of the cases contractors recruit their known skilled labors with whom they have working from years. It can create better understanding between the contractors and his skilled labors; and labors always showed their dedication upon the contractors and constructing works as well. However, in non- technical activities the contractors recruited the local labors according to their availability and adroitness.

211. Capacity of three hundred working labors are found in the existing labor sheds those are made by locally available thatching materials e.g., Golpata, Bamboo and Tin. However, at present, a few labors were using those temporary labor sheds because no major works have been done over last few months at the Project site as the works of pre-construction phase is almost over. A vast number of labors will be recruited during construction phase. It is expected that, the EPC contractor will provide suitable and better accommodation facilities with suitable sanitary convenience, illumination, cleanliness, drinking water facility, eating facility and medical facilities etc as per specification of EPC contract.



**Photo 4.1: Labor Sheds at the Project area**



**Photo 4.2: Project area connecting under construction LGED Road**

212. Numbers of toilets including pucca, porta cabin type and RCC ring type have been found at the Project site which were constructed for ensuring better sanitation facilities for

labors and workers. Water treatment plant was installed in the Project site for supplying drinking and cooking water however a cistern was prepared for meeting up the demand of water for bathing and other domestic activities. Before establishment of that treatment plant drinking water for the labors and officers was supplied from the deep tubewell installed within the premises.

213. As the land of the Project site is developed by sand, so blowing of sand in heavy wind was major concern for health hazard issue of the laborers and the surrounding community as well. This dust may cause respiratory and skin diseases. To mitigate this problem project authority has already made the boundary wall and planted a number of trees. Moreover, the inside area of power plant became grassy which is helpful to protect dust from the sandy land. Therefore, the risk of blowing sand has been met up in many extents. The Project management informed that they can initiate more measures to control blowing of dust in the Project area, if required.

214. It has been observed that the labor and their working conditions have been gradually improving since early 2014. A prayer room is situated within the compound for the laborers and some labor sheds are modified than that was at the beginning. The project authority stated that the living condition of labour is improving gradually and it is expected that during the construction phase, EPC contractor will provide all facilities to its workers as per contract provisions in the EPC contract document.



**Photo 4.3: Mosque at Labor Shed area**



**Photo 4.4: Water Treatment Plant in the Project area**



**Photo 4.5: Toilet at Labor Shed area**



**Photo 4.6: Cistern at Labor Shed area for domestic use**

### ***Community Health Safety and Security***

215. People opined that problem of dust, generated from the Project area is mitigated in many extents. The boundary wall of the project surroundings might play an important role to reduce dust flow in the project surroundings and subsequent rain from last few years might help to be stable the developed land. During field visit, it found that the land in the Project area became grassy which might also help to reduce the flow of dust from the sandy land. Moreover, the project authority had planned for tree plantation in the project area at the beginning of land development phase and following it they have already planted 14,000 (fruit, wooden and medicinal) trees. These trees will be helpful for environmental balancing and to ensure health safety and security in the Project and study area. For ensuring safety and security, watch towers have also been constructed to the surroundings of the project boundary. Grievance redressal mechanism is under finalization by the management.



**Photo 4.7: Boundary wall in Project surroundings**

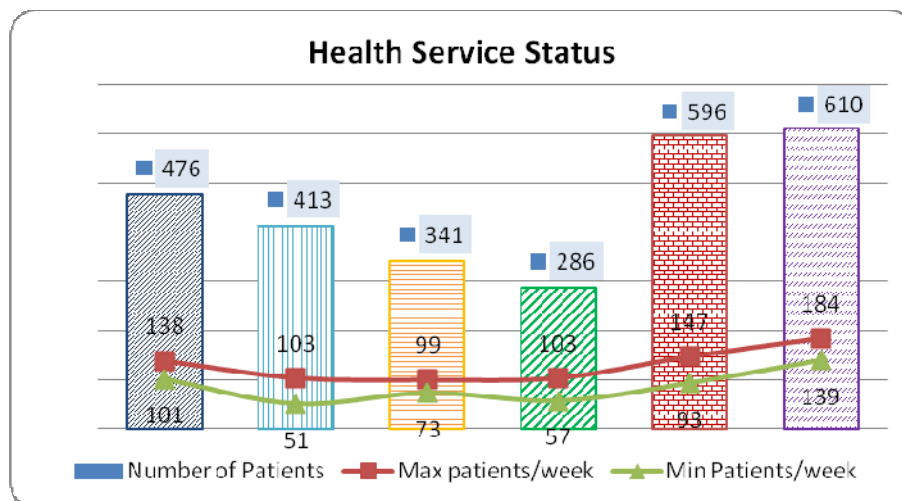


**Photo 4.8: Grassy Land in the Project area**

### ***Activities under Corporate Social Responsibilities***

216. Free medical service is being continued and getting familiar to local people. The coverage area of this service is growing day by day. This free service is provided in the Project site on every Tuesday from 10:00 am up to the last service recipient. This service has been provided from a separate compartment in the project site with an equipped institutional arrangement. It found 2 shelves for keeping medicines and instruments, a separate check-up room for keeping privacy, a bed with oxygen support and 3 supporting staffs etc in this medical compartment. A record book was also found to maintain some details of the patients. In addition, a new medical unit will also start functioning in nearly constructed pre-fabricated office cum residence complex.





Source: Field visit to Medical Center at Project area, CEGIS, 2016

**Figure 4.1: Record of health service recipients under CSR program**

217. From the record it was found that 2,722 people had received health services in the last six months (from April 2016 to September 2016). The highest recipients were in September-2016 and the lowest was in July-2016 (Figure: 4.1). The above figure also showed the maximum and minimum recipients/week on monthly basis.

218. In the middle months of the figure showed minimum number of participants. The line on number of minimum recipients is fluctuated more compared to that of maximum recipients (**Figure: 4.1**). The paramedical said that due to influence of seasonal variation while the circumstances were not in favour to come for receiving treatment in the project site the number of patients was decreased. From May-2016 to July-2016 the road communication facilities of the study area was disrupted due to heavy rain that is why number of patients found minimum during these months.

219. Among the recipients, female are still dominated in number compared to male and this gap is increasing day by day. Female recipient stated that they are getting conscious about health and treatment; and they get quality service for their critical diseases from project site's medical camp. On the other hand, male of the study area claimed that medicine providing facilities are becoming inadequate in present days compared to that of in previous time.

220. Overall the local people and the service recipients are satisfied for having such opportunity. They opined that the coverage of this facility will be explored more after completing the construction of under constructed main road which will easier the access for the recipients to the project site.



**Photo 4.9: Consultation at Barni**



**Photo 4.10: Consultation at Kapasdanga**



**Photo 4.11: Consultation at Rajnagar**



**Photo 4.12: Consultation at Bara Durgapur**



## 5 Environmental Compliance

### 5.1 Introduction

221. The Project is now at the end of site development stage. The land development activities of the Project area for the first phase are completed. Project site especially the first phase is encircled by boundary wall and slope protection works. The construction of prefabricated building, RO water treatment plant, bridges of the approach road have been completed. The Power Plant approach road starting from Khulna Mongla Road is at the finishing stage; land leveling, other infrastructures, tree plantation activities etc. have been progressing. However, there are some environmental compliance measures as suggested in the environmental management plan should be at place during this pre-construction stage.

222. The environmental compliance monitoring that includes monitoring of EMP implementation is 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; Labor and Working Condition; Community Health, Safety and Security; Biodiversity and Sustainable Management of Living Natural Resources.

223. The aim of the checklists is to check the diligence of measures 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 summary of the 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  | Recommended Action   | Compliance Status |
|-------|---|--|---|--|-------------------|
| 1     | Generation of Noise within the BIFPCL's Plant premises                        | <ul style="list-style-type: none"> <li>Conduct noise survey around and inside the site boundary</li> <li>Reducing Noise and Vibrations to country's ambient standards, and also occupational health and safety standards</li> <li>Introducing vehicle speed limit and speed limit monitoring system</li> <li>Green plantation around the Project boundary</li> <li>Switching off/ throttling down of machines/equipment/ generators which are not in use</li> </ul>      | <ul style="list-style-type: none"> <li>CEGIS is carrying out noise survey in ambient environment under environmental monitoring study.</li> <li>BFD has initiated green plantation as a depository work of BIFPCL</li> <li>Switching off/throttling down of machines/equipment/ generators which are passing idle period</li> </ul>   | <ul style="list-style-type: none"> <li>Create awareness among the labour for using noise muffler at construction site.</li> <li>Stop working of the heavy noise generating equipment operators (e.g. stone/brick crusher) during 6:00 pm-8:00 am.</li> <li>Supply sufficient ear plugs for the labours at the construction site.</li> </ul>  | Being Complied    |
| 2     | Dust Generation from land development activities and other construction works | <ul style="list-style-type: none"> <li>Conducting dust monitoring and visual inspection around the site boundary</li> <li>No use of earthen and undeveloped roads by vehicles related to the Project use</li> <li>Installation of water spraying system to control fugitive dusts</li> <li>Introducing vehicle speed limit and speed limit monitoring system</li> <li>If yes, do they monitor vehicle speed regularly?</li> <li>Construction of boundary wall</li> </ul> | <ul style="list-style-type: none"> <li>CEGIS is quarterly monitoring the dust generated from land development activities and other construction works.</li> <li>Construction of boundary wall for the main Plant is completed.</li> <li>Preparing the road alignment for construction of paved road</li> <li>Post monsoon season is responsible for not to emit the dust particles from the land development areas</li> </ul> | <ul style="list-style-type: none"> <li>The project authority should include vehicular sprinkler for using during the winter onward.</li> <li>Demarcate traffic way and enforce that all the vehicles are using the demarcated ways only.</li> <li>Spray water along the road and road side to suppress dust generation.</li> <li>Clearing the bushes just before starting the construction works.</li> </ul> | Being Complied    |

| SI no | Potential Impacts             | EMP measures as proposed in the EIA  | Actual condition/ Measures already Implemented   | Recommended Action   | Compliance Status            |
|-------|-------------------------------|--|--|--|------------------------------|
| 3     | Water Quality                 | <ul style="list-style-type: none"> <li>Fencing the construction site</li> <li>Arrangement of runoff drainage for reducing any water logging</li> <li>Location of backfilling stockpile in safe area and protected from wind and rain action</li> <li>No storing of backfilling materials/spoil stored on river bank/slope</li> <li>No disposal of waste and waste water to river or canal.</li> </ul>                          | <ul style="list-style-type: none"> <li>Construction of boundary wall for the main Plant</li> <li>Rainfall runoff discharge to nearby river through temporary drainage network at some places</li> <li>Onsite sanitation facilities has been developed at the labour sheds as well as the working places</li> </ul>   | <ul style="list-style-type: none"> <li>Stockpile of construction material should be placed at a safe distance from drainage network;</li> <li>The solid kitchen waste should be disposed off on designated places.</li> </ul>  | Being Complied               |
| 4     | Waste Management System       | <ul style="list-style-type: none"> <li>Provision of onsite waste management system</li> </ul>  | <ul style="list-style-type: none"> <li>Conventional way of waste collection and disposal system at Plant office and kitchen</li> <li>Kitchen waste was recorded scattered around the labor colony.</li> </ul>  | <ul style="list-style-type: none"> <li>Sufficient waste disposal bin/s with labelling should be installed at labour shed, and working area before starting of the main construction works.</li> <li>Proper training should be given to the labours for waste management</li> </ul>                                     | Being complied               |
| 5     | Compensation and Resettlement | <ul style="list-style-type: none"> <li>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</li> <li>Resettlement of the PAPs</li> <li>Cash for compensation of land (CCL) before resettlement</li> <li>formal agreement with the affected people</li> </ul> | <ul style="list-style-type: none"> <li>Compensation has been given to the rightful owners of the land as per the laws of Bangladesh e.g., Acquisition and Requisition of Immovable Property Ordinance, 1982</li> <li>Compensation made by local DC office</li> <li>Local DC office facilitates unauthorized occupants of the acquired land to get home in</li> </ul> | <ul style="list-style-type: none"> <li>Initiatives should be taken for resettlement of the people who do not own the land but have been dependent on it for their livelihoods;</li> <li>To meet the international standard and guideline of the funding agencies, necessary measures have to be undertaken.</li> </ul> | In the process of Compliance |



| SI no | Potential Impacts               | EMP measures as proposed in the EIA  | Actual condition/ Measures already Implemented   | Recommended Action  | Compliance Status            |
|-------|---------------------------------|--|--|---|------------------------------|
|       |                                 | <p>prior to migration/resettlement</p> <ul style="list-style-type: none"> <li>• Sufficient standing crop compensation</li> <li>• Compensation for movable structures?</li> <li>• Retention of salvageable materials?</li> <li>• Compensation for loss of trading income?</li> <li>• one time moving assistance</li> <li>• grant to cover loss of regular wage income</li> <li>• Has a resettlement plan been developed which includes compensation, restoration, livelihood, living standards etc. based on proper socio economic studies?</li> <li>• Human provide/ take extra care/caution for the disadvantaged/ vulnerable group/s (i.e. women, children, ethnic minorities, indigenous people etc.)</li> <li>• Provision of monitoring the compensation and resettlement process</li> </ul> | <p>the Government's shelter homes or cluster villages</p> <ul style="list-style-type: none"> <li>• BIFPCL gives priority to affected people in Project related employment</li> <li>• List of 136 people indirectly affected was given by the DC office, Bagerhat.</li> <li>• Consultant has been appointed by BPDB for preparation of Livelihood Restoration plan (LRP).</li> <li>• LRP is under preparation.</li> </ul> | <ul style="list-style-type: none"> <li>• The proponent should take initiatives to engage the PAPs during construction stages according to their skills and capabilities.</li> </ul>   |                              |
| 6     | Livelihood and living condition | <ul style="list-style-type: none"> <li>• 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?</li> <li>• Has the company developed any policy which prioritizes the local labourers in employment opportunities?</li> <li>• Is there any possibility that large vehicle</li> </ul>   | <ul style="list-style-type: none"> <li>• Recruited a social officer who is responsible for maintaining social liaison;</li> <li>• Engagement of Human Resources consultant for preparing HR policies, Labour recruitment Policies, Manpower set up etc.;</li> </ul>  | <ul style="list-style-type: none"> <li>• Monitoring the status regularly</li> <li>• Awareness program and grievance redress mechanism should be adopted in formal way</li> <li>• Accidental log sheet or injury log book should be</li> </ul> | In the process of Compliance |

| SI no | Potential Impacts                    | EMP measures as proposed in the EIA  | Actual condition/ Measures already Implemented  | Recommended Action  | Compliance Status                                       |
|-------|--------------------------------------|--|---|---|---|
|       |                                      | <p>related to the Project will cause traffic induced disturbance/s to the local dwellers?</p> <ul style="list-style-type: none"> <li>If yes, are there any mitigation steps taken to decrease the disturbance/s?</li> <li>Has the road network been developed after the Project being proposed and during the construction phase?</li> <li>Are there separate water and sanitation facilities for the construction workers in the Project area?</li> </ul> | <ul style="list-style-type: none"> <li>At present around 120 labours are working directly or indirectly employed for this project</li> <li>Provision of first aid is present;</li> <li>Medical unit capable of dealing emergency situation like injury, accident, etc. already set up.</li> </ul> | <p>put into display</p> <ul style="list-style-type: none"> <li>Improve the sanitary facilities for the labours who are employed directly or indirectly for this project related activities.</li> <li>Training to the Bouali or Mauali of Sundarbans as future labor force</li> </ul>          |   |
| 7     | Green House Gas Controlling Measures | <ul style="list-style-type: none"> <li>Use of efficient generator in the construction activities;</li> <li>Regular maintenance of vehicles, generator and machinery in accordance with manufacturer's specifications;</li> <li>Use of approved pollution control devices fitted in the equipment and machineries;</li> <li>Switching off and throttling down the machines/equipment/generators which are not in use.</li> </ul>                            | <ul style="list-style-type: none"> <li>Informing the bidders for EPC of main Plants about measures to be followed;</li> <li>Making IFC guidelines, EIA approval of DoE, and EMP of the EIA, etc. as a part of the bid document.</li> </ul>  | <ul style="list-style-type: none"> <li>Prepare checklist on equipment and their condition owned by the contractors;</li> <li>GHG inventory checklist might be mandatory for the EPC contractors.</li> <li>Use low GHG emission machineries and CDM during main Plant construction.</li> </ul> | To be complied during construction and operation stage. |

Table 5.2: Monitoring of Labor and Working Condition

| SI no | Potential Impacts  | EMP measures as proposed in the EIA  | Actual measures already Implemented  | Recommended Action   | Compliance Status           |
|-------|--|--|--|--|-----------------------------|
| 1     | Working Conditions and Management of Worker Relationship | <ul style="list-style-type: none"> <li>Preparation of Human Resources Policies and Procedures for Direct workers;</li> <li>Defined Working condition and Terms of Employment for direct worker;</li> <li>Sustainably equivalent terms and condition for migrant workers;</li> <li>Compliance to national law of forming workers' organization;</li> <li>No discrimination and equal opportunity for all;</li> <li>Measures for diminishing past discrimination;</li> <li>Grievance Redress Mechanism.</li> </ul> | <ul style="list-style-type: none"> <li>Engaged HR consultant to prepare relevant policies;</li> <li>Preparing to recruit Environment, Occupation and Health Safety Expert;</li> <li>No discrimination has been recorded.</li> <li>Women are recorded as worker in this project</li> <li>ERP and ESMS are in Dhaka office.</li> </ul> | <ul style="list-style-type: none"> <li>The proposed EMP measures should be addressed in the HR policies;</li> <li>Follow the nation labour law 2006 and guideline of ILO.</li> <li>Local workers would be given priority for non-technical jobs.</li> <li>Formal mechanism of grievance redress should be established.</li> <li>Motivational and training works should be introduced regularly.</li> </ul> | Compliance action initiated |
| 2     | Protecting Workforce                                     | <ul style="list-style-type: none"> <li>The client will not employ children in any manner that is economically exploitative, or is likely to be hazardous or to interfere with the child's education, or to be harmful to the child health or physical, mental, spiritual, moral, or social development.</li> <li>No Forced Labour</li> </ul>   | <ul style="list-style-type: none"> <li>Ensured no child labour employment</li> <li>Ensured no forced labour</li> <li>First Aid support to the labours during any accident</li> </ul> <p>(Immediate first aid medical treatment has given to about 48</p>   | <ul style="list-style-type: none"> <li>The HR policy should cover child labour policy and Labour Law 2006 and all other amendments;</li> <li>Proper documentation of contract with the worker is required, which includes working hour, wage, and benefit and emphasise to recruit the local labours</li> </ul>  | Compliance action initiated |

| SI no | Potential Impacts | EMP measures as proposed in the EIA  | Actual measures already Implemented  | Recommended Action  | Compliance Status |
|-------|-------------------|--|--|---|-------------------|
|       |                   |  | numbers of labour accidents.)  | <ul style="list-style-type: none"> <li>BIFPCL should pay the bill for any accidental event of the workers.</li> </ul>   |                   |
| 3     | Safety at site    | <ul style="list-style-type: none"> <li>Installation/Construction of Safety Fence around the Project area;</li> <li>Use of Personnel Protective Equipment's (i.e. safety suit, safety goggles, ear plug, safety shoes, gloves, dust mask, etc.);</li> <li>Safety trainings for workers (i.e. fire control, working at height, working in heat, first aid etc.);</li> <li>Practice of Tool box meeting, safety talks</li> <li>Safe Storage of Hazardous Chemicals (e.g. fuel, flammable chemical, toxic chemicals, etc.);</li> <li>Maintaining Material Safety Data Sheet (MSDS);</li> <li>Provision of Health care facilities such as doctor, hospital etc. available at/nearby the plant construction site;</li> <li>Availability of First Aid at work place;</li> <li>Preparation and Follow of Emergency Response Plan;</li> <li>Adequate fire precautions in place (e. g.,</li> </ul> | <ul style="list-style-type: none"> <li>Construction of boundary wall;</li> <li>Encouraged labour and Project personnel to use appropriate PPEs;</li> <li>Safety Policy of DoE and IFC, Safety measures proposed in EIA report have been incorporated in the bid document of main Plant to aware the potential bidders;</li> <li>Included the EHS plan in the tender documents for the EPC contractor.</li> <li>Preparation of emergency response plan in association with the EPC contractor.</li> <li>Safety manual has been prepared.</li> <li>EPC contractor submitted the site specific SHE plan.</li> <li>At present the project site is in pre-construction stage. In this monsoon period only some</li> </ul> | <ul style="list-style-type: none"> <li>Appointment of site specific EHS Officer of proponent and also contractors/sub-contractors is urgently required before EPC contractor take over the site.</li> <li>Signboard must be kept into proper places.</li> <li>Use of local language and picture so that the worker could aware.</li> <li>5 minute awareness speech would be deliberated to the workers at every morning</li> <li>All electric distribution lines at project site required to be fixed as safe and tidy</li> <li>Emergency contact number, personnel's, equipment and facilities should be developed before starting of the work of EPC contractor.</li> </ul> | Being complied    |

| SI no | Potential Impacts                        | EMP measures as proposed in the EIA   | Actual measures already Implemented  | Recommended Action  | Compliance Status   |
|-------|--|---|--|---|---|
|       |  | fire extinguishers, escape routes etc.);<br><ul style="list-style-type: none"> <li>Documentation and reporting of occupational accidents, diseases, and incidents;</li> <li>Policies and procedures for managing and monitoring the performance of third party employers in relation to OHS.</li> </ul> | finishing works are going on<br><ul style="list-style-type: none"> <li>Fire safety mock drill is being conducted at some regular intervals.</li> </ul>   |   |   |
| 4     | Occupational Health and Safety Procedure | <ul style="list-style-type: none"> <li>Provision of complete EHS division in the Human Resources Planning/Organogram</li> <li>Preparation of Safety Policy to be adopted during Plant operation</li> </ul>  | <ul style="list-style-type: none"> <li>Engagement of HR consultant to develop HR policy and Organogram;</li> <li>Medical aid, fire extinguisher, PPE are provided;</li> <li>Worker's shed and sanitation facilities have been developed at construction site;</li> <li>Onsite medical facilities have been continuing.</li> <li>EPC contractor already prepared the site specific Environmental Health &amp; Safety plan which is under finalization.</li> </ul> | <ul style="list-style-type: none"> <li>Develop a complete EHS division in the HR Management;</li> <li>Regular training, awareness, motivational and mock drill should be arranged at this pre-construction phase;</li> <li>OHS procedure should also be followed by all workers including the labor from sub-contractors. Appointment of EHS Officer is recommended to expedite the EHS and OHS plan/procedure at project site</li> <li>Insurance system may be introduced</li> </ul> | EHS & OHS policy in line with World Bank standard formulated and Health and Safety manual prepared. |

| SI no | Potential Impacts  | EMP measures as proposed in the EIA   | Actual measures already Implemented  | Recommended Action   | Compliance Status |
|-------|--------------------|---|--|--|-------------------|
| 5     | Workers Well Being | <ul style="list-style-type: none"> <li>Provision of Welfare facilities for Worker/Labor such as, timely bonuses, salaries, sick leaves, vacations etc.;</li> <li>Routine medical check-up and emergency medical care for the sick and injured;</li> <li>Appointment of a leader amongst the labor group, who will look into workers' well-being.</li> </ul> | <ul style="list-style-type: none"> <li>Engagement of HR consultant to develop HR policy and Organogram;</li> <li>Health care &amp; information, canteen, restrooms, accommodation, water supply are facilitated by the proponents.</li> <li>Register has been developed for receiving the grievance of the worker</li> </ul> | <ul style="list-style-type: none"> <li>The workers well-being should be protected in the HR policy</li> <li>Freedom of Association, Rights &amp; scope of bargaining and tripartite consultation should be open for the workers.</li> </ul> <p>Development and formal procedure for grievance redress mechanisms</p> | Being Complied    |

Table 5.3: Monitoring of Community Health, Safety and Security

| SI no | Potential Impacts  | Proposed EMP  | Actual measures already Implemented  | Recommended Action  | Compliance Status |
|-------|--|---|--|---|-------------------|
| 1     | Disturbance to nearby community due to dust from newly developed land and Noise from construction activities | <ul style="list-style-type: none"> <li>Construction of boundary wall around the Project area;</li> <li>Installation of water spraying system to control dusts;</li> <li>Conducting dust monitoring and visual inspection around the site boundary;</li> <li>Adoption of Noise management plan.</li> </ul> | <ul style="list-style-type: none"> <li>Construction of boundary wall around the Project area already completed;</li> <li>No dust control systems were recorded but monsoon season and bushy grass limited dust emission in the land development areas</li> <li>Grievance redressal mechanism is under finalization.</li> </ul> | <ul style="list-style-type: none"> <li>Regular communication with the local community</li> <li>Prepare a register for receiving any grievance from the community</li> <li>Low noise generating vehicles and equipment should be used by the EPC contractor</li> </ul> | Being complied    |
| 2     | Grievance of local   | <ul style="list-style-type: none"> <li>Availability and operation of Grievance</li> </ul>   | <ul style="list-style-type: none"> <li>A Social officer has been</li> </ul>  | <ul style="list-style-type: none"> <li>Grievance Redress</li> </ul>   | Being             |



| SI no | Potential Impacts                  | Proposed EMP   | Actual measures already Implemented  | Recommended Action  | Compliance Status  |
|-------|------------------------------------|--|--|---|--|
|       | people                             | Redress Mechanism;<br><ul style="list-style-type: none"> <li>Maintaining open communication channel with the local community.</li> </ul>   | recruited to maintain close relation with nearby community;<br><ul style="list-style-type: none"> <li>Regular monitoring has been conducted to identify the grievance of the nearby communities ;</li> <li>National level stakeholder consultation has been conducted.</li> </ul>  | Mechanism is to be finalized early;<br><ul style="list-style-type: none"> <li>Establish a system to receive the grievance, and to take appropriate measures to redress it;</li> <li>Regular local level consultation is necessary for impact monitoring as well as updating the local communities</li> </ul>  | complied   |
| 3     | Risk of breaching Community Safety | <ul style="list-style-type: none"> <li>Construction of boundary wall/safety fence around the Project area;</li> <li>Practicing Risk Assessment and Evaluation Process;</li> <li>Practicing safe management for hazardous materials which may pose threat to the community;</li> <li>Availability and operation of Emergency Response Plan;</li> <li>Maintaining open communication channel with the local community;</li> <li>Training and instruction to the security personnel about their behaviour and communication with the local people;</li> <li>Aware the security personnel about the</li> </ul> | <ul style="list-style-type: none"> <li>Construction of boundary wall around the Project area;</li> <li>Incorporating safety policies to be followed in the bid documents for the appointment of EPC contractors;</li> <li>Preparing a safety checklist to be followed during selection of construction contractors;</li> <li>Maintaining a good communication with local community;</li> <li>Negotiation with local DC office and Bangladesh Ansar and VDP (who are responsible for security).</li> <li>The project proponent has</li> </ul> | <ul style="list-style-type: none"> <li>Assign responsibility of enforcing and monitoring safety procedure to an officer</li> <li>Aware labours and all employees about the safety procedure and health check-up.</li> <li>The EPC contractors should prepare site specific ESMPs;</li> <li>Arrange a safety training program for Project personnel and labours;</li> <li>Training and instruction to the security personnel about their behaviour and communication with the local people;</li> </ul> | BIFPCL agrees to comply all the measures during construction stage |

| SI no | Potential Impacts        | Proposed EMP   | Actual measures already Implemented   | Recommended Action   | Compliance Status                          |
|-------|--------------------------|--|---|--|--|
|       |                          | right of the community people.   | engaged the local governments and communities for improving their livelihood status   | <ul style="list-style-type: none"> <li>Aware the security personnel about safeguarding environment and community.</li> </ul>   |  |
| 4     | Community Health Risk    | <ul style="list-style-type: none"> <li>Provision of providing health service facilities to community if the Project poses any health risk like sexually transmitted disease, contract disease, vector-borne diseases;</li> <li>Implement all pollution mitigation measures to ensure safeguarding to community.</li> </ul> | <ul style="list-style-type: none"> <li>Established a medical unit (consisting medical officer, medical assistant, office assistant) at Plant site;</li> <li>Arranging weekly health service program (medical consultation and free medicine) for the local community;</li> <li>Provided health services to around 1206 people from August 2016 to September, 2016.</li> </ul> | <ul style="list-style-type: none"> <li>The proponent should train the migrated labour regarding the local culture and customs</li> <li>Health check-up must be done to the migrant labours</li> <li>The proponent may arrange consultation meeting with the local communities</li> <li>The proponent may introduce the business development services (BDS) support to the local communities as CSR activities</li> </ul> | Being Complied                             |
| 5     | Youth Employment (Local) | <ul style="list-style-type: none"> <li>Providing training/awareness program for the local youth to let them aware about the required qualification to get involved in the Project related activities</li> </ul>  | <ul style="list-style-type: none"> <li>Informal sitting with the community</li> <li>Regular training workshop on tailoring and computer has been organized by the proponents</li> <li>The proponents have already taken few initiatives to encourage local students</li> </ul>  | <ul style="list-style-type: none"> <li>Initiate awareness program for the local youth to let them aware about the required qualification to get involved in the Project related activities;</li> <li>Assign job responsibilities based on skills and previous experience.</li> </ul>   | Will be complied during construction stage |

| SI no | Potential Impacts                                | Proposed EMP  | Actual measures already Implemented  | Recommended Action   | Compliance Status |
|-------|--|---|--|--|-------------------|
|       |  |   | through awarding them.   |  |                   |
| 6     | Public Communication, Consultation and Awareness | <ul style="list-style-type: none"> <li>• Arranging public communication/consultation meeting;</li> <li>• Sharing of Project information with local people;</li> <li>• Organizing environmental and social awareness programs/meetings.</li> </ul> | <ul style="list-style-type: none"> <li>• Informal sitting with the community;</li> <li>• Display Project related information on a display board at Project site;</li> <li>• Regular public consultation meetings are taken places at different level;</li> <li>• Advertisement of this power plant was broadcasted</li> <li>• Publishing Project related discussion/article in different print media.</li> </ul> | • Continue the dissemination workshop in Dhaka and Khulna to aware the community, civil society, environmentalists about the environmental safeguarding measures considered in basic design. | Being Complied    |

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

| SI no | Potential Impacts  | EMP measures as proposed in the EIA   | Actual condition/ Measures already Implemented   | Recommended Action   | Compliance Status                              |
|-------|--|---|--|--|--|
| 1     | Runoff (contain mostly sediment load) from newly developed land falls into nearby river and channel would cause deterioration of | <ul style="list-style-type: none"> <li>• Installation of proper runoff drains;</li> <li>• Use of sediment fences, traps and basins for trapping the sediment, if required.</li> </ul> | <ul style="list-style-type: none"> <li>• Temporary installation of runoff drains;</li> <li>• Construction of sediment traps is mentioned in the Bid documents to instruct the bidders;</li> <li>• Develop temporary drainage network inside the Project boundary.</li> </ul> | <ul style="list-style-type: none"> <li>• The proponent has to ensure a good drainage system in before commencing the construction works by the EPC contractor.</li> <li>• The proponent needs to monitor that connectivity of the free flow of Maidara River.</li> </ul> | Will be complied during the construction stage |

| SI no | Potential Impacts  | EMP measures as proposed in the EIA  | Actual condition/ Measures already Implemented   | Recommended Action   | Compliance Status |
|-------|--|--|--|--|-------------------|
|       | aquatic ecosystem.   |  | <ul style="list-style-type: none"> <li>The connectivity of Maidara River is being maintained.</li> </ul>   |  |                   |
| 2     | Disturbance to nearby ecosystem due to different construction activities | <ul style="list-style-type: none"> <li>No cutting/ felling of trees along the river bank;</li> <li>Implementation of onsite waste and air quality management plan;</li> <li>Limiting soil extraction activities within the defined area;</li> <li>Limiting the vegetation clearance and base stripping process within the Project boundary;</li> <li>Safety fence around the construction site;</li> <li>Limiting the use of night light;</li> <li>Using shade (directed downwards) around the outdoor lights;</li> <li>Provision of cut-off time to switch off unnecessary lights at night;</li> <li>Initiate Green plantation;</li> <li>No plantation of non-native species;</li> <li>Retaining top soil for future habitat</li> </ul> | <ul style="list-style-type: none"> <li>No cutting/ felling of trees occurred along the river bank;</li> <li>Limiting soil extraction activities within the defined area;</li> <li>Limiting the vegetation clearance and base stripping process within the Project boundary;</li> <li>Construction of Boundary wall;</li> <li>Installation of few numbers of night light;</li> <li>Provision of cut-off time to switch off unnecessary lights at night;</li> <li>Selection of local plant species for green plantation;</li> <li>No degradation of the habitat out site the power plant area</li> </ul> | <ul style="list-style-type: none"> <li>Using of light shade (directed downwards) around the outdoor lights;</li> <li>Regular monitoring of the trees planted around the Project site.</li> <li>Bird sheds can be developed at the green belt areas or on the bank slope.</li> <li>Eco-friendly development must be incorporated during the construction activities.</li> <li>The pollution prevention technologies should be introduced before the commencement of this project</li> </ul> | Being Complied    |

| SI no | Potential Impacts                                     | EMP measures as proposed in the EIA  | Actual condition/ Measures already Implemented  | Recommended Action   | Compliance Status |
|-------|---|--|---|--|-------------------|
|       |   | <p>restoration;</p> <ul style="list-style-type: none"> <li>No degradation of critical habitat?</li> </ul>  |   |  |                   |
| 3     | Disturbance to river, inter-tidal areas and wet lands | <ul style="list-style-type: none"> <li>No encroachment of inter-tidal flood plain area;</li> <li>No disturbance to Dolphin community;</li> <li>Monitoring of Ecosystem Health and Monitoring of Sundarbans Forest Health;</li> <li>If required, embankment should be constructed considering a setback distance from river/canal bank;</li> <li>Slope protection work along the Maidara River should be completed on an urgent basis before rainy season come, and;</li> <li>BIFPCL may take initiatives of excavating of silted reach of Maidara river near proposed township area to facilitate proper functioning of River for maintaining tidal flow dynamics</li> </ul> | <ul style="list-style-type: none"> <li>Monitoring of forest health and ecosystem health in Sundarbans and around the Project site are being carried out by CEGIS;</li> <li>Maintaining significant setback distance from Passur river to the Project site;</li> <li>Completion of slope protection work;</li> <li>Revising the drawing of embankment/slope protection works along the Maidara River keeping necessary setback distance from Maidara River.</li> <li>The stream flow of Maidara River near access road has been opened.</li> </ul> | <ul style="list-style-type: none"> <li>BIFPCL may take initiatives to excavate the silted reach of Maidara River near proposed township area to facilitate proper functioning of the River for maintaining tidal flow dynamics.</li> <li>Proponent may have taken the initiatives in policy level for not to development the adjacent wetland area of MSTPP into industrial or commercial area.</li> </ul> | Being Complied    |

## 5.2 Compliance to 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   | <b><i>BPDB will comply with the condition prior to initiation of any expansion or extension</i></b> |
| 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 is to obtain consent from DoE.  | <b><i>To be Complied as and when required</i></b>   |
| 3     | Project Proponent may undertake activities for land development and infrastructural development of the Project.   | BIFPCL has started land and infrastructure development activities.   | <b><i>Complied</i></b>  |
| 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.                             | BIFPCL will open L/C after finalizing the EPC contractor.  | <b><i>To be Complied</i></b>  |
| 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. | At present the Plant is in preliminary stage. BIFPCL engaged CEGIS for monitoring pre-construction and construction activities for examining environmental impacts. No damaging impact on the environment or natural resources impact has been reported yet. All necessary measures have already been incorporated in the technical specification of main plant EPC package as per DoE stipulations. Pollution control measures have widely been covered in technical specification like effluent treatment plant, ESP, FGD etc. | <b><i>Complied at present and will be complied at Construction and Operation phase</i></b>          |
| 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. At present preliminary site preparation (pre-construction) activities are going on. Mitigation measures appropriate at this stage have been taken. Proper and adequate mitigation measures have widely been covered in Technical Specification. MP prepared & monitoring is being done for pre-construction period.   | <b><i>Complied at present and will be complied at Construction and Operation phase</i></b>          |
| 7     | Any heritage sight, ecologically critical area, and other environmentally, religious and archaeologically sensitive places  | There is no religious, archaeological place in and around the site. The pre-construction activities has been carried out ensuring safeguarding to  | <b><i>Complied at present and will be complied at</i></b>   |



| Sl no | Condition of DoE  | Compliance  | Remarks                   |
|-------|---|---|---------------------------|
|       | shall be kept protected during Project construction phase.  | Sundarbans and ECA  | <b>Construction phase</b> |
| 8     | Environment friendly construction and development practices shall be followed that minimize loss of habitats and fish breeding, feeding & nursery sites.  | The pre-construction activity is being carried out keeping all the mitigation measures in order.  | <b>Being Complied</b>     |
| 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 Project site and the present activities are limited to day time only. BIFPCL is keeping close communication with local people to receive the grievance.   | <b>Being Complied</b>     |
| 10    | Proper and adequate sanitation facilities shall be ensured in labor camps throughout the proposed Project period.   | At present the Plant is in preliminary site preparation (pre-construction) phase. Adequate sanitation facilities have been provided for this 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 work for Main Plant construction work starts.               | <b>Being Complied</b>     |
| 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. Provisions in line with this condition have been included Clause no 14.11 of SCC and in Health & Safety Manual.  | <b>Being Complied</b>     |
| 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.   | At present the Plant is in preliminary site preparation (pre-construction) phase. No solid waste is burnt. 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)  | <b>Being Complied</b>     |
| 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.  | Pre-construction activities are being taken up with adequate on-site precautionary measures and safety measures to safeguard flora and fauna. Safety manual prepared and it is part of EPC contract document.   | <b>Being Complied</b>     |
| 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 Plant is in preliminary site preparation (pre-construction) phase. BIFPCL has appointed a paramedical staff and visiting Doctor is also made available for regular health checkup of the workers. Villagers of surrounding areas also availing the health facilities. Emergency response plan shall be strictly implemented and kept operative/ functioning on a continuous basis. | <b>Being Complied</b>     |

| 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.   | Water is sprayed in the area around the premises of site office to control dust. A boundary wall around the Plant has been constructed to control dust within the project boundary.   | <b>Being Complied</b>  |
| 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 bank and other natural water bodies.   | <b>Being Complied</b>  |
| 17    | Adequate considerations should be given to facilitate drainage system for runoff water from rain/tidal surge.  | Run off drainage are being constructed as required at this stage. Adequate drainage shall be ensured during construction and operation phase of the Plant.  | <b>Being Complied</b>  |
| 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.  | <b>Being Complied</b>  |
| 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. | <b>Complied</b>  |
| 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).   | <b>Compliance action initiated</b>   |
| 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).   | <b>Compliance action initiated</b>   |
| 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.  | <b>Compliance action initiated</b>   |
| 23    | 100% utilization of fly ash and bottom ash should be planned and implemented throughout the operation of the Plant. There should only be a provision of small ash dyke that will not exceed 25 (twenty five) acres of land to store residual ash.                    | 100% utilization of fly ash has been planned and shall be implemented throughout the operation of the plant. Only 25 acres area has been allocated to store residual ash. EOI has been received in this regards from nearby Cement Plants.  | <b>Complied at present and Will be Complied throughout Operation phase</b> |

| Sl no | Condition of DoE   | Compliance  | Remarks   |
|-------|--|---|---|
| 24    | Integrated dry ash handling, loading, unloading and transportation system should be established.   | Integrated dry ash handling, loading, unloading and transportation system will be established. Provisions in line with this has been included in Technical Specification of main plant EPC contract package (Section V, Chapter B4).  | <b>Compliance action initiated</b>  |
| 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).   | <b>Compliance action initiated</b>  |
| 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).  | <b>Compliance action initiated</b>  |
| 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.  | <b>Compliance action initiated</b>  |
| 28    | Resettlement plan should be properly implemented and people should be adequately compensated.  | -do-  | <b>Compliance action initiated</b>  |
| 29    | Construction material should be properly disposed off after construction work is over.   | At present the Plant is in preliminary site preparation (pre-construction) phase. Construction wastes are being reused at this stage. Solid Waste Management system has been prepared keeping the provisions in line with this (Section-V, B12, Part 9 of Technical Specification). | <b>Complied at present and Will be Complied during and after Construction Phase</b> |
| 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. From then on, each quarterly monitoring report has been submitted regularly, based on study conducted for that period, to be shared with DoE, which are available at BIFPCL web page also.                  | <b>Being Complied</b>   |
| 31    | All activities (pre-construction, construction and post-construction stage) should be implemented according to EMP clearly listed in the EIA report.                                     | BIFPCL has adopted all of the EMP applicable at this stage. CEGIS, as an environmental consultant of BIFPCL is monitoring implementation of EMP. BIFPCL is taking all possible actions based on EMP monitoring report.  | <b>Being Complied</b>   |
| 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 | CEGIS, as an independent monitoring body has been engaged by BIFPCL as environmental consultant since February 2014. From then on, CEGIS has been conducting the monitoring programs quarterly and producing monitoring   | <b>Being Complied</b>   |

| Sl no | Condition of DoE   | Compliance   | Remarks                            |
|-------|--|--|------------------------------------|
|       | 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.   | 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.  |                                    |
| 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.   | <b>Being Complied</b>              |
| 34    | Air, water, soil, biological and social data should be monitored regularly with a network monitoring system with a view to assess the natural quality of the Sundarbans and other fragile ecosystem and report of monitoring results should be submitted to Bagerhat District Office, Khulna Divisional Office and Headquarters of the Department of Environment simultaneously. | The network monitoring system will be installed as a part of the project construction for online monitoring when the Plant will be in operation.<br>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).   | <b>Compliance action initiated</b> |
| 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 ( <a href="http://www.bifpcl.com">www.bifpcl.com</a> ). CEGIS is regularly carrying out public consultation. The progress of the monitoring is regularly discussed in monthly Project implementation monitoring meeting in presence of PGCB, LGED, Bangladesh Army, BPDB, CEGIS, etc. The same is being reviewed by the Project Steering Committee, Chaired by the Secretary, Power Division, MoPEMR, and Government of Bangladesh. | <b>Being Complied</b>              |
| 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.<br>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).  | <b>Compliance action initiated</b> |
| 37    | Management Information System (MIS) are to be developed for this coal based Power Plant. The scope of MIS services will obviously include representing the real time monitored data especially environmental parameters displaying at Bagerhat District Office, Khulna Divisional Office and   | The MIS will be prepared before commissioning of the Plant. The consultant for developing MIS will be engaged at least one year earlier. Specification for elaborate MIS system is already included in EPC contract document. Technical Specification like DDCMIS, DDOS, PADO System, HART system, Plant MMS, Information  | <b>Compliance action initiated</b> |

| Sl no | Condition of DoE  | Compliance  | Remarks   |
|-------|---|---|---|
|       | 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.  | management security system etc. have been included.   |   |
| 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.   | <b>Ready to comply</b>  |
| 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.   | <b>Complied at this stage and will be complied during operation phase</b> |
| 40    | Conduct stakeholder meetings on regular basis for better performance of the Project as a whole.   | At present the Plant is in pre-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 carrying out consultation with local people. The progress / review of the project is regularly discussed in monthly project implementation monitoring meeting in presence of PGCB, LGED, Bangladesh Army, BPDB, CEGIS, etc. The same is being reviewed by the project steering committee, chaired by the Secretary, Power Division. | <b>Being Complied</b>   |
| 41    | Additional Environmental baseline data to be collected as suggested in the EIA report and conveyed to DoE and other concern authorities.  | In February 2014, CEGIS has been engaged for preparing Detail 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.   | <b>Being Complied</b>   |
| 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 by DoE which is regularly monitored by CEGIS.   | <b>Being Complied</b>   |
| 43    | The Project authority shall submit a detail work plan with time schedule of development activities at least 7 (seven) days ahead of the work commences in the field to the Bagerhat District Office, Khulna Divisional Office and Headquarters of the Department of Environment simultaneously. | At present the Plant is in preliminary site preparation (pre-construction) phase. BIFPCL shall submit detail work plan seven (7) days before the start of Main Plant Works.   | <b>Agreed to Comply</b>   |
| 44    | Environmental Monitoring Reports  | Environmental Monitoring Reports as per   | <b>being</b>  |

| Sl no | Condition of DoE  | Compliance   | Remarks  |
|-------|---|--|--|
|       | 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.  | 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.   | <b>complied</b>  |
| 45    | The following records must be kept in respect if any samples required to be collected for the purpose of environmental monitoring activities:<br>(a) the date(s) on which the sample was taken;<br>(b) the time(s) at which the sample was collected;<br>(c) the point at which the sample was taken; and<br>(d) the name of the person who collected the sample.   | The Monitoring report of CEGIS keeps all the records as suggested.   | <b>Being Complied</b>  |
| 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.  | <b>Being Complied</b>  |
| 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<br>a) Nature of incident (oil spill, fire, accident. Collision, land slide, etc.)<br>b) Personnel affected (injured, missing, fatalities, etc.)<br>c) Emergency support available and its location (standby transport, medical facilities, etc.)<br>d) Weather conditions<br>e) Current operations (abandoning the site, fire fighting, etc.) | So far no such emergency has occurred. Emergency Reporting/ Emergency response plan have been prepared. Health and safety management manual have been prepared and it is a part of technical specification. BIFPCL would establish a proper mechanism for recording such incident as suggested, when main plant construction activities start.   | <b>Compliance action initiated and Will be complied as and when required</b> |
| 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 of 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 CEGIS is monitoring EMP. | <b>Will be complied as and when required</b>                                 |



| Sl no | Condition of DoE   | Compliance  | Remarks                                       |
|-------|--|---|---|
| 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 been happened. BIFPCL would establish a proper mechanism for recording such incident as suggested. CEGIS has been engaged to record such incident during pre-construction and construction period   | <b>Will be complied as and when required</b>  |
| 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 would arise, BIFPCL would seek for appropriate permission as suggested   | <b>Will be Complied as and when necessary</b> |
| 51    | Re-vegetation and re-plantation under green belt activities shall be undertaken in consultation with the Forest Department according to those mentioned in the EIA report.   | An MoU signed with Forest Dept., Bangladesh on 24.02.2015 for implementation of Afforestation Programme.<br>Initial target is planting of 2 lac saplings in 3 years. By this time, they have already planted about 7500 nos. of saplings of different species. In this quarter they have again planted 1057 numbers local varieties plant.  | <b>Being Complied</b>                         |
| 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.   | <b>Being Complied</b>                         |
| 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 is being conducted by M/s CEGIS as per approved ToR of DoE. Inception Report for the said study has been submitted to BIFPCL. | <b>Being Complied</b>                         |
| 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.  | <b>Being complied</b>                         |
| 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 cooperation to DoE  | <b>Being Complied</b>                         |
| 56    | Violation of any of the above  | Noted by BIFPCL   | -   |

| Sl no | Condition of DoE   | Compliance   | Remarks  |
|-------|--|--|--|
|       | conditions shall render this approval void.  |  |  |
| 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 pre-construction phase. The functional technical specification of the main Plant includes 275 Meter high Chimney, Effluent Treatment Plant (ETP), Waste Water Treatment Plant (WWTP), Settling Pond, Desalinization Plant, API, Oil Water Separator, High Efficiency Electro Static Precipitator (ESP), 'closed-loop' Flue Gas Desulfurization (FGD), Low NOx Burner, online air and water quality monitoring systematic for preventing pollution. All these stipulations have been included in the technical specification of Main Plant EPC contract package. | <b>Compliance action initiated and will be complied before starting operation of the Project</b> |
| 59    | This EIA Approval has been issued with the approval of the appropriate authority.  | BPDB and BIFPCL are thankful to DoE.   | -  |



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## Appendix I: Checklist of Monitoring Environmental Compliances

**Table A: Checklist of Monitoring for ESMP Implementation (During Pre-Construction and Land Development)**

| Sl no | Potential Impacts   | Proposed EMP  | Actual Implementation | Recommended Action | Compliance Status |
|-------|---|---|-----------------------|--------------------|-------------------|
| 1     | Generation of Noise within the BIFPCL's Plant premises                        | <ul style="list-style-type: none"> <li>Conduct noise survey around and inside the site boundary</li> <li>Reducing Noise and Vibrations to country's ambient standards, and occupational health and safety standards</li> <li>Introducing vehicle speed limit and speed limit monitoring system</li> <li>Green Plantation around the Project boundary</li> <li>Switching off/ throttling down of machines/equipment's/generators which are not in use</li> </ul> |                       |                    |                   |
| 2     | Dust Generation from Land development activities and other construction works | <ul style="list-style-type: none"> <li>Conducting dust monitoring and visual inspection around the site boundary</li> <li>No use of earthen and undeveloped roads by vehicles related to the Project use</li> <li>Installation of water spraying system to control fugitive dusts</li> <li>Introducing vehicle speed limit and speed limit monitoring system</li> <li>If yes, do they monitor vehicle speed regularly?</li> </ul>                               |                       |                    |                   |
| 3     | Water Quality   | <ul style="list-style-type: none"> <li>Fencing the construction site by drum sheet or Tarja of any other fencing</li> <li>Arrangement of runoff drainage for reducing any water logging</li> <li>Location of backfilling stockpile in safe area and protected from wind and rain action</li> <li>No storing of backfilling materials/spoil stored on river bank/slope</li> <li>No disposal of waste and waste water to river or canal.</li> </ul>               |                       |                    |                   |

| Sl no | Potential Impacts             | Proposed EMP  | Actual Implementation | Recommended Action | Compliance Status |
|-------|-------------------------------|---|-----------------------|--------------------|-------------------|
| 4     | Waste Management System       | <ul style="list-style-type: none"> <li>Provision of onsite waste management system</li> </ul>   |                       |                    |                   |
| 5     | Compensation and Resettlement | <ul style="list-style-type: none"> <li>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</li> <li>Resettlement of the PAPs</li> <li>cash for compensation of land (CCL) before resettlement</li> <li>formal agreement with the affected people prior to migration/resettlement</li> <li>Sufficient standing crop compensation</li> <li>Compensation for shift able structures?</li> <li>Retention of salvageable materials?</li> <li>Compensation for loss of trading income?</li> <li>one time moving assistance</li> <li>grant to cover loss of regular wage income</li> <li>Has a resettlement plan been developed which includes compensation, restoration, livelihood, living standards etc. based on proper socio economic studies?</li> <li>Provide/take extra care/caution for the disadvantaged/vulnerable group(s) (i.e. women, children, ethnic minorities, indigenous people etc.)</li> <li>Provision of monitoring the compensation and resettlement process</li> </ul> |                       |                    |                   |
| 6     | Livelihood and living         | <ul style="list-style-type: none"> <li>Does the Project pose any threat to the livelihood/living standards of the local people?</li> <li>If yes, are adequate steps taken to reduce the impacts?</li> <li>Has the company developed any policy which prioritizes the local labourers in employment opportunities?</li> <li>Is there any possibility that large vehicle related to the Project will cause traffic induced disturbance/s to the local dwellers?</li> </ul>  |                       |                    |                   |

| SI no | Potential Impacts                    | Proposed EMP  | Actual Implementation | Recommended Action | Compliance Status |
|-------|--------------------------------------|---|-----------------------|--------------------|-------------------|
|       |                                      | <ul style="list-style-type: none"> <li>• If yes, are there any mitigative steps taken to decrease the disturbance/s?</li> <li>• Has the road network been developed after the Project being proposed and during the construction phase?</li> <li>• Are there separate water and sanitation facilities for the construction workers in the Project area?</li> </ul>  |                       |                    |                   |
| 7     | Green House Gas Controlling Measures | <ul style="list-style-type: none"> <li>• Use of efficient generator in the construction activities</li> <li>• Regular maintenance of vehicles, generator and machinery in accordance with manufacturer's specifications</li> <li>• Use of approved pollution control devices fitted in the equipment's and machineries</li> <li>• Switching off and throttling down the machines/equipment's/generators which are not in use</li> </ul> |                       |                    |                   |

**Table B: Checklist of Monitoring ESMP Implementation (During Pre-Construction and Land Development)**  
**(Labor and Working Condition)**

| Basic Data |                      |        |
|------------|----------------------|--------|
| SI 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 | <ul style="list-style-type: none"> <li>• Preparation of Human Resources Policies and Procedures for Direct workers</li> <li>• Defined Working condition and Terms of Employment for direct worker</li> <li>• Sustainably equivalent terms and condition for migrant workers</li> <li>• Compliance to national law of forming workers' organization</li> <li>• No discrimination and equal opportunity for all</li> <li>• Measures for diminishing past discrimination</li> <li>• Grievance Mechanism</li> </ul>   |                       |                    |                   |
|       | Protecting Workforce                                     | <ul style="list-style-type: none"> <li>• 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.</li> <li>• No Force Labor</li> </ul>  |                       |                    |                   |
|       | Safety at site   | <ul style="list-style-type: none"> <li>• Installation/Construction of Safety Fence around the Project area</li> <li>• Use of Personnel Protective Equipment (i.e. safety suit, safety goggles, ear plug, safety shoes, gloves, dust mask, etc.)</li> <li>• Safety trainings for workers (i.e. fire control, working at height, working in heat, first aid etc.)</li> <li>• Practice of Tool box meeting, safety talks,</li> <li>• Safe Storage of Hazardous Chemicals (e.g. fuel, flammable chemical, toxic chemicals, etc.)</li> <li>• Maintaining Material Safety Data Sheet (MSDS)</li> <li>• Provision of Health care facilities such as doctor, hospital etc available at/nearby the plant construction site</li> <li>• Availability of First Aid at work place</li> </ul> |                       |                    |                   |

| Sl no | Potential Impacts                        | Proposed EMP   | Actual Implementation | Recommended Action | Compliance Status |
|-------|--|--|-----------------------|--------------------|-------------------|
|       |  | <ul style="list-style-type: none"> <li>• Preparation and Follow of Emergency Response Plan</li> <li>• Adequate fire precautions in place (for example, fire extinguishers, escape routes etc.)</li> <li>• Documentation and reporting of occupational accidents, diseases, and incidents</li> <li>• Policies and procedures for managing and monitoring the performance of third party employers in relation to OHS</li> </ul> |                       |                    |                   |
|       | Occupational Health and Safety Procedure | <ul style="list-style-type: none"> <li>• Provision of complete EHS division in the Human Resources Planning/Organogram</li> <li>• Preparation of Safety Policy to be adopted during plant operation</li> </ul>   |                       |                    |                   |
|       | Worker's Well Being                      | <ul style="list-style-type: none"> <li>• Establishment Grievance Mechanisms</li> <li>• Ensuring fair treatment, non-discrimination and equal opportunity</li> <li>• Compliance of Project's labor policy with the national labor law</li> <li>• No Child Labor</li> <li>• No incident of forced labor</li> <li>• Provision of Welfare facilities for Worker/Labor</li> </ul>   |                       |                    |                   |



**Table C: Checklist of Monitoring ESMP Implementation (During Pre-Construction and Land Development)**  
**(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 | <ul style="list-style-type: none"> <li>• Construction of boundary wall around the Project are</li> <li>• Installation of water spraying system to control dusts</li> <li>• Conducting dust monitoring and visual inspection around the site boundary</li> <li>• Adoption of Noise management plan</li> </ul>  |                       |                    |                   |
| 2     | Grievance of local people  | <ul style="list-style-type: none"> <li>• Availability and operation of Grievance Redress Mechanism</li> <li>• Maintaining open communication channel with the local community</li> </ul>  |                       |                    |                   |
| 3     | Risk of breaching Community Safety   | <ul style="list-style-type: none"> <li>• Construction of boundary wall/safety fence around the Project area</li> <li>• Practicing Risk Assessment and Evaluation Process</li> <li>• Practicing safe management for hazardous materials which may pose threat to the community</li> <li>• Availability and operation of Emergency Response Plan</li> <li>• Maintaining open communication channel with the local community</li> <li>• Training and instruction to the security personnel about their behaviour and communication with the local people</li> <li>• Aware the security personnel about the right of the</li> </ul> |                       |                    |                   |

(Continued)

| Sl no | Potential Impacts                                | Proposed EMP   | Actual Implementation | Recommended Action | Compliance Status |
|-------|--|--|-----------------------|--------------------|-------------------|
|       |  | community people   |                       |                    |                   |
|       | Community Health Risk                            | <ul style="list-style-type: none"> <li>• Provision of providing health service facilities to community if the Project possess any health risk like sexually transmitted disease, communicable disease, vector-borne diseases</li> <li>• Implement all pollution mitigation measures to ensure safeguarding to community</li> </ul> |                       |                    |                   |
|       | Youth Employment                                 | <ul style="list-style-type: none"> <li>• Providing training/awareness program for the local youth to let them aware about the required qualification to get involved in the Project related activities</li> </ul>  |                       |                    |                   |
|       | Public Communication, Consultation and Awareness | <ul style="list-style-type: none"> <li>• Arranging public communication/consultation meeting</li> <li>• Sharing of Project information with local people</li> <li>• Organizing environmental and social awareness programs/meetings</li> </ul>   |                       |                    |                   |

**Table D: Checklist of Monitoring ESMP Implementation (During Pre-Construction and Land Development)**  
**(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. | <ul style="list-style-type: none"> <li>• Installation of proper run on/runoff drains</li> <li>• Use of sediment fences, traps and basins for trapping the sediment, if required</li> </ul>   |                       |                    |                   |
| 2     | Disturbance to nearby ecosystem due to different construction activities                             | <ul style="list-style-type: none"> <li>• No cutting/ felling of trees along the river bank</li> <li>• Implementation of on-site waste and air quality management plan</li> <li>• Limiting soil extraction activities limited within the defined area</li> <li>• Limiting the vegetation clearance and base stripping process within the Project boundary</li> <li>• Safety fence around the construction site</li> <li>• Limiting the use of night light</li> <li>• Using shade (directed downwards) around the outdoor lights</li> <li>• Provision of cut-off time to switch off unnecessary lights at night</li> <li>• Initiate Green plantation</li> <li>• No plantation of non-native species</li> <li>• Retaining top soil for future habitat restoration</li> <li>• No degradation of critical habitat?</li> </ul> |                       |                    |                   |
| 3     | Occupation of river, inter-tidal areas and wetlands  | <ul style="list-style-type: none"> <li>• No encroachment of inter-tidal flood plain area</li> <li>• No disturbance to Dolphin community</li> <li>• Monitoring of Ecosystem Health and Monitoring of Sundarbans Forest Health</li> </ul>  |                       |                    |                   |

| Sl no | Potential Impacts | Proposed EMP   | Actual Implementation | Recommended Action | Compliance Status |
|-------|-------------------|--|-----------------------|--------------------|-------------------|
|       |                   | <ul style="list-style-type: none"><li>• If required, embankment should be constructed considering a setback distance from river/canal bank</li><li>• Slope protection work along the Maidara River should be completed on an urgent basis before rainy season come and</li><li>• 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</li></ul> |                       |                    |                   |



## Appendix II: Photo Album

### Environmental Monitoring of Khulna 2×660 MW Power Plant for 3<sup>rd</sup> Quarter of 3<sup>rd</sup> Year (October, 2016)



**The Monitoring Team**



**Professional is Estimating Tree height**



**Professional is collecting forest soil sample**





**Taking Tree DBH at Koromjal**



**Taking Sapling Diameter at Harbaria**



**Conducting air quality monitoring**



**Counting pneumatophore**



**Fisheries catch assessment at Passur River near project site and sibsha river in Akram point**







**Plant site to babur bari road construction is under progress**



**Bridge construction is under progress**



**Consultants are inspecting toilets of local labor shed**



**Inside of the local labor sahde**



**Water storage tank in the site**



**Development of boundary wall is almost compleated**



The monitoring team is examining the fire extinguisher

## Appendix III: Terms of References (ToR)

As per ECA 1995 and ECR 1997, the proposed Project “1320MW coal based thermal Power Plant at Rampal, Khulna” falls under red category; needs proper monitoring and documenting of environmental and socio-economic parameters.

Accordingly, the EIA study of the proposed plant has already been conducted. The EIA of the proposed Power Plant briefly describes the monitoring plan. The ToR has been prepared for engaging Engineering, environmental and social Contractor for monitoring the environmental and socio-economic parameters during pre-construction and construction phases along with the engineering consideration of the site development and construction of the Project so that the monitoring plan suggested in the EIA is properly followed and satisfies the requirement of ECR 1997 and ECR 2005.

The monitoring works has been divided in to two major components:

**Work A:** Monitoring of Engineering activities of site development and others.

**Work B:** Monitoring of Social and Environmental parameters for updating the baseline and Implementation of the Project.

**Work A:** The main objective of this component is to monitoring the engineering activities of site development and others during pre-construction and construction phase for installation of the Power Plant.

The specific objectives of the monitoring program are:

- To establish baseline environmental conditions;
- To detect adverse environmental impacts for river dredging and land filling activities for site development;
- 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.

Landfill monitoring is an interactive process of incorporating the findings of the site investigation, the environmental impact assessment, environmental monitoring results, risk assessment and the conclusions reached in the investigations.

**Work B:** The main objective of this component is to monitor the environmental parameters and implementation of environmental management plan during pre-construction and construction phase for installation of the Power Plant. The specific objectives of the monitoring program are:

- Update baseline data as per monitoring schedule and location.
- Monitor and provide the environmental parameters during pre construction activities.
- Provide technical assistance to the client for implementation of the EMP at different sector of construction activities.
- Monitor the environmental aspects during construction of the Project.

- 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.
- Render any other related services as and when requested.

The scope of the services can be specified as bellows:

| Monitoring Parameter     | Indicators  |
|--------------------------|---|
| Socio-economy            | Livelihood and Occupation                               |
|                          | Income and expenditure                                  |
|                          | Displacement and Migration                              |
|                          | Cultural and heritage                                   |
|                          | Health and sanitation                                   |
|                          | Risks and accidental assessment                         |
|                          | Transportation and communication                        |
|                          | Public and private Infrastructure development           |
| Ecology and Biodiversity | Bio-indicator Assessment                                |
|                          | Movement of indigenous/ native species                  |
|                          | Envision of exotic species and regime dominance         |
|                          | Species composition (Flora and Fauna)                   |
|                          | Assessment the services of dependent ecosystem          |
| Agriculture              | Land use and canopy coverage                            |
|                          | Soil quality (Salinity, pH, OM,)                        |
|                          | Cropping pattern and crop intensities                   |
|                          | Irrigation and crop production                          |
|                          | Farmers survey result                                   |
| Fisheries                | Fish diversity and specification                        |
|                          | Fish production and availability                        |
|                          | Fisher survey result                                    |
| Noise level              | Sound level at the sensitive zone                       |
| Water resources          | DO, BOD, COD, Salinity , TDS, TS, pH, Hg, Pb            |
|                          | Total Hardness, Hg, NO <sub>3</sub> and PO <sub>4</sub> |
|                          | River Morphology,                                       |
|                          | Tidal inundation  |
|                          | Drainage Network  |
|                          | Erosion and Accretion                                   |
|                          | Ground water quality                                    |
| Air quality              | SOx   |
|                          | NOx   |
|                          | SPM (PM <sub>10</sub> and PM <sub>2.5</sub> )           |
|                          | CO  |



## Reporting Requirements

As it is proposed to carry out the monitoring program for three (3) years, the schedule of deliverables has to be re-scheduled. The proposed deliverables are scheduled below

- An Inception Report shall be submitted within 30 (thirty) days from the commencement of the assignment
- Submission of 1<sup>st</sup> quarterly monitoring report at the end of three (3) months from the date of signing contract;
- Submission of 2<sup>nd</sup> quarterly monitoring report at the end of six (6) months from the date of signing contract;
- Submission of 3<sup>rd</sup> quarterly monitoring report at the end of nine (9) months from the date of signing contract;
- Submission of Annual (1<sup>st</sup>) monitoring report at the end of one (1) year from the date of signing contract;
- Submission of 5<sup>th</sup> quarterly monitoring report at the end of fifteen (15) months from the date of signing contract;
- Submission of 6<sup>th</sup> quarterly monitoring report at the end of eighteen (18) months from the date of signing contract;
- Submission of 7<sup>th</sup> quarterly monitoring report at the end of twenty one (21) months from the date of signing contract;
- Submission of Annual (2<sup>nd</sup>) monitoring report at the end of twenty four (24) months from the date of signing contract;
- Submission of 9<sup>th</sup> quarterly monitoring report at the end of twenty seven (27) months from the date of signing contract;
- *Submission of 10<sup>th</sup> quarterly monitoring report at the end of thirty (30) months from the date of signing contract;*
- **Submission of 11<sup>th</sup> quarterly monitoring report at the end of thirty three (33) months from the date of signing contract;**
- Submission of Annual (3<sup>rd</sup>) monitoring report at the end of thirty three months from the date of signing contract;
- All report shall be submitted to BIFPCL in (five) hard copies and soft copy on CD.





## 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, Jul 2015 | 7th QM, Oct 2015 | 8 QM, Jan 2016 | 9th QM, Apr 2016 | 10th QM, Jul 2016 | 11th QM, Oct 2016 | 12th QM, Jan 2017 | Bangladesh (DoE) Standard ( ECR 2005) | IFC/WB Standard          |
|---------------------------|-------------------|--|------------------|------------------|------------------|------------------|------------------|------------------|----------------|------------------|-------------------|-------------------|-------------------|---------------------------------------|--------------------------|
| Weather                   |                   | Sunny  | Rainy/ Cloudy    | Sunny            | Sunny            | Sunny            | Rainy/ Cloudy    | Sunny to Rainy   | Sunny          | Sunny            | Rainy/ Cloudy     | Rainy/ Cloudy     |                   |                                       |                          |
| Wind Direction            |                   | SE   | SE               | SE               | NW               | SE to NW         | SW to NE         | SW to NE         | NW to SE       | SSE to NN W      | SW to NE          | SE                |                   |                                       |                          |
|                           |                   | Concentrations are in $\mu\text{g}/\text{m}^3$ |                  |                  |                  |                  |                  |                  |                |                  |                   |                   |                   |                                       |                          |
| SW Corner of the PP area  | PM <sub>2.5</sub> | 33   | 37               | 25               | 33               | 47               | 25               | 22               | 34             | 19               | 5                 | 9                 |                   | 65 <sup>24hr</sup> (100)              | 25 <sup>24hr</sup> (39)  |
|                           | PM <sub>10</sub>  | 78   | 77               | 53               | 79               | 83               | 35               | 52               | 135            | 117              | 32                | 22                |                   | 150 <sup>24hr</sup> (233)             | 50 <sup>24hr</sup> (78)  |
|                           | SPM               | 207  | 239              | 190              | 200              | 177              | 42               | 91               | 175            | 332              | 51                | 53                |                   | (200)                                 | NF                       |
|                           | SO <sub>2</sub>   | 21   | 24               | 19               | 23               | 15               | 52               | 35               | 14             | 18               | 9                 | 8                 |                   | 365 <sup>24hr</sup> (455)             | 125 <sup>24hr</sup> (80) |
|                           | NO <sub>x</sub>   | 26   | 29               | 27               | 31               | 29               | 35               | 29               | 18             | 18               | 12                | 10                |                   | 100 <sup>Annual</sup> (405)           | 200 <sup>1hr</sup> (162) |
|                           | CO                | 120  | 188              | 140              | 190              | 144              | 146              | 88               | 74             | 57               | 35                | 119               |                   | (10000)                               | NF                       |
|                           | O <sub>3</sub>    | 27   | 26               | 19               | 22               | 26               | 12               | 5                | 4              | 1                | 1                 | 1                 |                   | (157)                                 | (100)                    |
| Proposed Township area of | PM <sub>2.5</sub> | 39   | 48               | 48               | 39               | 34               | 18               | 17               | 35             | 25               | 3                 | 8                 |                   | 65 <sup>24hr</sup> (100)              | 25 <sup>24hr</sup> (39)  |

| 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, Jul 2015 | 7th QM, Oct 2015 | 8 QM, Jan 2016 | 9th QM, Apr 2016 | 10th QM, Jul 2016 | 11th QM, Oct 2016 | 12th QM, Jan 2017 | Bangladesh (DoE) Standard (ECR 2005) | IFC/WB Standard          |
|--------------------------|-------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|----------------|------------------|-------------------|-------------------|-------------------|--------------------------------------|--------------------------|
|                          | PM <sub>10</sub>  | 89               | 90               | 74               | 102              | 97               | 31               | 48               | 116            | 44               | 11                | 11                |                   | 150 <sup>24hr</sup> (233)            | 50 <sup>24hr</sup> (78)  |
|                          | SPM               | 217              | 263              | 217              | 274              | 266              | 47               | 79               | 192            | 187              | 27                | 23                |                   | (200)                                | NF                       |
|                          | SO <sub>2</sub>   | 19               | 28               | 22               | 21               | 22               | 58               | 27               | 13             | 11               | 4                 | 6                 |                   | 365 <sup>24hr</sup> (455)            | 125 <sup>24hr</sup> (80) |
|                          | NO <sub>x</sub>   | 29               | 39               | 27               | 26               | 24               | 46               | 25               | 16             | 22               | 6                 | 8                 |                   | 100 <sup>Annual</sup> (405)          | 200 <sup>1hr</sup> (162) |
|                          | CO                | 165              | 210              | 230              | 164              | 136              | 127              | 102              | 77             | 22               | 31                | 108               |                   | (10000)                              | NF                       |
|                          | O <sub>3</sub>    | 33               | 26               | 26               | 23               | 21               | 16               | 1                | 1              | 1                | 0                 | 0                 |                   | (157)                                | (100)                    |
| NW Corner of the PP area | PM <sub>2.5</sub> | 37               | 44               | 19               | 42               | 59               | 28               | 19               | 24             | 11               | 3                 | 10                |                   | 65 <sup>24hr</sup> (100)             | 25 <sup>24hr</sup> (39)  |
|                          | PM <sub>10</sub>  | 67               | 78               | 56               | 98               | 91               | 96               | 29               | 125            | 29               | 24                | 14                |                   | 150 <sup>24hr</sup> (233)            | 50 <sup>24hr</sup> (78)  |
|                          | SPM               | 234              | 217              | 157              | 310              | 244              | 321              | 66               | 187            | 115              | 31                | 35                |                   | (200)                                | NF                       |
|                          | SO <sub>2</sub>   | 19               | 22               | 18               | 27               | 21               | 56               | 32               | 13             | 17               | 4                 | 8                 |                   | 365 <sup>24hr</sup> (455)            | 125 <sup>24hr</sup> (80) |
|                          | NO <sub>x</sub>   | 23               | 28               | 22               | 32               | 39               | 43               | 21               | 18             | 16               | 5                 | 11                |                   | 100 <sup>Annual</sup> (405)          | 200 <sup>1hr</sup> (162) |
|                          | CO                | 110              | 178              | 110              | 210              | 140              | 133              | 87               | 77             | 38               | 47                | 127               |                   | (10000)                              | NF                       |
|                          | O <sub>3</sub>    | 25               | 19               | 17               | 36               | 44               | 11               | 8                | 2              | 0                | 1                 | 1                 |                   | (157)                                | (100)                    |
| Barni, Gaurambha         | PM <sub>2.5</sub> | 39               | 47               | 57               | 39               | 41               | 34               | 11               | 29             | 23               | 9                 | 10                |                   | 65 <sup>24hr</sup> (100)             | 25 <sup>24hr</sup> (39)  |
|                          | PM <sub>10</sub>  | 103              | 122              | 67               | 97               | 82               | 65               | 26               | 97             | 82               | 45                | 13                |                   | 150 <sup>24hr</sup> (233)            | 50 <sup>24hr</sup> (78)  |
|                          | SPM               | 233              | 244              | 183              | 277              | 236              | 79               | 112              | 176            | 268              | 69                | 30                |                   | (200)                                | NF                       |
|                          | SO <sub>2</sub>   | 21               | 23               | 17               | 22               | 25               | 41               | 31               | 16             | 20               | 10                | 7                 |                   | 365 <sup>24hr</sup> (455)            | 125 <sup>24hr</sup> (80) |
|                          | NO <sub>x</sub>   | 25               | 28               | 22               | 26               | 27               | 44               | 32               | 21             | 16               | 12                | 9                 |                   | 100 <sup>Annual</sup> (405)          | 200 <sup>1hr</sup> (162) |
|                          | CO                | 175              | 210              | 190              | 150              | 196              | 96               | 96               | 81             | 73               | 41                | 98                |                   | (10000)                              | NF                       |
|                          | O <sub>3</sub>    | 26               | 29               | 22               | 19               | 15               | 9                | 6                | 4              | 0                | 0                 | 3                 |                   | (157)                                | (100)                    |
| Chunkuri-2,              | PM <sub>2.5</sub> | 35               | 39               | 46               | 37               | 33               | 35               | 28               | 31             | 25               | 7                 | 5                 |                   | 65 <sup>24hr</sup> (100)             | 25 <sup>24hr</sup> (39)  |

| 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, Jul 2015 | 7th QM, Oct 2015 | 8 QM, Jan 2016 | 9th QM, Apr 2016 | 10th QM, Jul 2016 | 11th QM, Oct 2016 | 12th QM, Jan 2017 | Bangladesh (DoE) Standard (ECR 2005) | IFC/WB Standard          |
|-------------------------|-------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|----------------|------------------|-------------------|-------------------|-------------------|--------------------------------------|--------------------------|
|                         | PM <sub>10</sub>  | 77               | 86               | 69               | 68               | 61               | 109              | 49               | 98             | 60               | 23                | 20                |                   | 150 <sup>24hr</sup> (233)            | 50 <sup>24hr</sup> (78)  |
|                         | SPM               | 117              | 113              | 162              | 183              | 188              | 175              | 94               | 167            | 167              | 31                | 48                |                   | (200)                                | NF                       |
|                         | SO <sub>2</sub>   | 19               | 24               | 21               | 18               | 11               | 55               | 33               | 21             | 13               | 7                 | 9                 |                   | 365 <sup>24hr</sup> (455)            | 125 <sup>24hr</sup> (80) |
|                         | NO <sub>x</sub>   | 23               | 26               | 27               | 24               | 18               | 49               | 23               | 16             | 25               | 10                | 8                 |                   | 100 <sup>Annual</sup> (405)          | 200 <sup>1hr</sup> (162) |
|                         | CO                | 190              | 205              | 170              | 170              | 33               | 133              | 75               | 70             | 33               | 38                | 79                |                   | (10000)                              | NF                       |
|                         | O <sub>3</sub>    | 27               | 24               | 18               | 22               | 41               | 21               | 2                | 1              | 1                | 0                 | 2                 |                   | (157)                                | (100)                    |
| Pankhali, Dacope        | PM <sub>2.5</sub> | 47               | 49               | 57               | 41               | 39               | 34               | 25               | 47             | 15               | 8                 | 10                |                   | 65 <sup>24hr</sup> (100)             | 25 <sup>24hr</sup> (39)  |
|                         | PM <sub>10</sub>  | 119              | 127              | 139              | 101              | 105              | 144              | 62               | 128            | 46               | 42                | 18                |                   | 150 <sup>24hr</sup> (233)            | 50 <sup>24hr</sup> (78)  |
|                         | SPM               | 297              | 266              | 254              | 208              | 299              | 339              | 183              | 198            | 114              | 78                | 34                |                   | (200)                                | NF                       |
|                         | SO <sub>2</sub>   | 28               | 31               | 31               | 24               | 30               | 58               | 36               | 18             | 9                | 8                 | 8                 |                   | 365 <sup>24hr</sup> (455)            | 125 <sup>24hr</sup> (80) |
|                         | NO <sub>x</sub>   | 41               | 39               | 36               | 26               | 27               | 47               | 23               | 15             | 19               | 9                 | 9                 |                   | 100 <sup>Annual</sup> (405)          | 200 <sup>1hr</sup> (162) |
|                         | CO                | 230              | 217              | 250              | 188              | 177              | 125              | 105              | 101            | 55               | 29                | 112               |                   | (10000)                              | NF                       |
|                         | O <sub>3</sub>    | 49               | 38               | 36               | 27               | 11               | 13               | 5                | 2              | 2                | 0                 | 0                 |                   | (157)                                | (100)                    |
| Mongla Port area        | PM <sub>2.5</sub> | 47               | 55               | 39               | 41               | 26               | 33               | 19               | 34             | 21               | 9                 | 11                |                   | 65 <sup>24hr</sup> (100)             | 25 <sup>24hr</sup> (39)  |

| 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, Jul 2015 | 7th QM, Oct 2015 | 8 QM, Jan 2016 | 9th QM, Apr 2016 | 10th QM, Jul 2016 | 11th QM, Oct 2016 | 12th QM, Jan 2017 | Bangladesh (DoE) Standard ( ECR 2005) | IFC/WB Standard          |
|-------------------------|-------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|----------------|------------------|-------------------|-------------------|-------------------|---------------------------------------|--------------------------|
|                         | PM <sub>10</sub>  | 139              | 174              | 77               | 82               | 35               | 52               | 33               | 132            | 45               | 29                | 15                |                   | 150 <sup>24hr</sup> (233)             | 50 <sup>24hr</sup> (78)  |
|                         | SPM               | 288              | 303              | 197              | 217              | 214              | 118              | 65               | 189            | 144              | 50                | 6                 |                   | (200)                                 | NF                       |
|                         | SO <sub>2</sub>   | 27               | 28               | 26               | 24               | 14               | 45               | 36               | 16             | 10               | 8                 | 7                 |                   | 365 <sup>24hr</sup> (455)             | 125 <sup>24hr</sup> (80) |
|                         | NO <sub>x</sub>   | 44               | 39               | 33               | 27               | 17               | 40               | 20               | 13             | 14               | 10                | 8                 |                   | 100 <sup>Annual</sup> (405)           | 200 <sup>1hr</sup> (162) |
|                         | CO                | 230              | 320              | 220              | 211              | 24               | 110              | 84               | 71             | 29               | 31                | 97                |                   | (10000)                               | NF                       |
|                         | O <sub>3</sub>    | 57               | 52               | 37               | 26               | 09               | 15               | 8                | 3              | 1                | 2                 | 1                 |                   | (157)                                 | (100)                    |
| Harbaria, Sundarbans    | PM <sub>2.5</sub> | 19               | 22               | 33               | 27               | 24               | 27               | 24               | 26             | 13               | 6                 | 10                |                   | 65 <sup>24hr</sup> (100)              | 25 <sup>24hr</sup> (39)  |
|                         | PM <sub>10</sub>  | 41               | 39               | 59               | 56               | 49               | 42               | 50               | 82             | 42               | 20                | 14                |                   | 150 <sup>24hr</sup> (233)             | 50 <sup>24hr</sup> (78)  |
|                         | SPM               | 111              | 117              | 129              | 139              | 109              | 70               | 73               | 159            | 91               | 43                | 44                |                   | (200)                                 | NF                       |
|                         | SO <sub>2</sub>   | 9                | 10               | 14               | 12               | 16               | 51               | 34               | 15             | 11               | 6                 | 7                 |                   | 365 <sup>24hr</sup> (455)             | 125 <sup>24hr</sup> (80) |
|                         | NO <sub>x</sub>   | 19               | 22               | 27               | 18               | 22               | 34               | 22               | 14             | 16               | 8                 | 10                |                   | 100 <sup>Annual</sup> (405)           | 200 <sup>1hr</sup> (162) |
|                         | CO                | 65               | 58               | 70               | 64               | 56               | 112              | 81               | 62             | 47               | 32                | 110               |                   | (10000)                               | NF                       |
|                         | O <sub>3</sub>    | 13               | 12               | 13               | 11               | 14               | 12               | 4                | 2              | 2                | 0                 | 1                 |                   | (157)                                 | (100)                    |
| Akram Point,            | PM <sub>2.5</sub> | 17               | 19               | 23               | 18               | 49               | -                | 25               | 18             | 9                | 4                 | 4                 |                   | 65 <sup>24hr</sup> (100)              | 25 <sup>24hr</sup> (39)  |

| 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, Jul 2015 | 7th QM, Oct 2015 | 8 QM, Jan 2016 | 9th QM, Apr 2016 | 10th QM, Jul 2016 | 11th QM, Oct 2016 | 12th QM, Jan 2017 | Bangladesh (DoE) Standard (ECR 2005) | IFC/WB Standard          |
|-----------------------------------|-------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|----------------|------------------|-------------------|-------------------|-------------------|--------------------------------------|--------------------------|
|                                   | PM <sub>10</sub>  | 39               | 44               | 32               | 39               | 77               | -                | 32               | 77             | 31               | 15                | 14                |                   | 150 <sup>24hr</sup> (233)            | 50 <sup>24hr</sup> (78)  |
|                                   | SPM               | 114              | 133              | 97               | 88               | 102              | -                | 51               | 128            | 46               | 23                | 27                |                   | (200)                                | NF                       |
|                                   | SO <sub>2</sub>   | 7                | 9                | 12               | 13               | 21               | -                | 27               | 14             | 9                | 4                 | 6                 |                   | 365 <sup>24hr</sup> (455)            | 125 <sup>24hr</sup> (80) |
|                                   | NO <sub>x</sub>   | 17               | 19               | 22               | 17               | 27               | -                | 19               | 15             | 10               | 5                 | 6                 |                   | 100 <sup>Annual</sup> (405)          | 200 <sup>1hr</sup> (162) |
|                                   | CO                | 49               | 60               | 50               | 46               | 163              | -                | 92               | 64             | 21               | 37                | 101               |                   | (10000)                              | NF                       |
|                                   | O <sub>3</sub>    | 11               | 14               | 9                | 10               | 27               | -                | 8                | 1              | 0                | 0                 | 2                 |                   | (157)                                | (100)                    |
| Hiron Point, Sundarbans           | PM <sub>2.5</sub> | 15               | 23               | 19               | 17               | 28               | -                | 27               | -              | 17               | -                 | 9                 |                   | 65 <sup>24hr</sup> (100)             | 25 <sup>24hr</sup> (39)  |
|                                   | PM <sub>10</sub>  | 44               | 38               | 34               | 41               | 60               | -                | 45               | -              | 40               | -                 | 14                |                   | 150 <sup>24hr</sup> (233)            | 50 <sup>24hr</sup> (78)  |
|                                   | SPM               | 101              | 119              | 107              | 97               | 110              | -                | 88               | -              | 132              | -                 | 26                |                   | (200)                                | NF                       |
|                                   | SO <sub>2</sub>   | 8                | 7                | 13               | 14               | 15               | -                | 28               | -              | 15               | -                 | 9                 |                   | 365 <sup>24hr</sup> (455)            | 125 <sup>24hr</sup> (80) |
|                                   | NO <sub>x</sub>   | 18               | 18               | 19               | 22               | 20               | -                | 23               | -              | 19               | -                 | 9                 |                   | 100 <sup>Annual</sup> (405)          | 200 <sup>1hr</sup> (162) |
|                                   | CO                | 52               | 62               | 65               | 60               | 60               | -                | 93               | -              | 40               | -                 | 121               |                   | (10000)                              | NF                       |
|                                   | O <sub>3</sub>    | 14               | 13               | 11               | 9                | 23               | -                | 2                | -              | 0                | -                 | 0                 |                   | (157)                                | (100)                    |
| Khulna City, near Khulna Air Port | PM <sub>2.5</sub> | 54               | 39               | 52               | 42               | 55               | 46               | 19               | 35             | 11               | 16                | 9                 |                   | 65 <sup>24hr</sup> (100)             | 25 <sup>24hr</sup> (39)  |



| 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, Jul 2015 | 7th QM, Oct 2015 | 8 QM, Jan 2016 | 9th QM, Apr 2016 | 10th QM, Jul 2016 | 11th QM, Oct 2016 | 12th QM, Jan 2017 | Bangladesh (DoE) Standard ( ECR 2005) | IFC/WB Standard          |
|-------------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|----------------|------------------|-------------------|-------------------|-------------------|---------------------------------------|--------------------------|
|                         | PM <sub>10</sub> | 139              | 117              | 91               | 84               | 75               | 89               | 49               | 112            | 69               | 68                | 24                |                   | 150 <sup>24hr</sup> (233)             | 50 <sup>24hr</sup> (78)  |
|                         | SPM              | 301              | 287              | 239              | 219              | 222              | 181              | 101              | 181            | 112              | 107               | 64                |                   | (200)                                 | NF                       |
|                         | SO <sub>2</sub>  | 33               | 29               | 33               | 28               | 31               | 59               | 28               | 16             | 11               | 10                | 10                |                   | 365 <sup>24hr</sup> (455)             | 125 <sup>24hr</sup> (80) |
|                         | NO <sub>x</sub>  | 49               | 41               | 39               | 36               | 33               | 38               | 26               | 16             | 15               | 15                | 14                |                   | 100 <sup>Annual</sup> (405)           | 200 <sup>1hr</sup> (162) |
|                         | CO               | 330              | 370              | 330              | 296              | 101              | 89               | 94               | 98             | 68               | 36                | 104               |                   | (10000)                               | NF                       |
|                         | O <sub>3</sub>   | 59               | 67               | 57               | 39               | 21               | 7                | 4                | 2              | 1                | 0                 | 2                 |                   | (157)                                 | (100)                    |

Note(s):

- Concentrations are in  $\mu\text{g}/\text{m}^3$  ;
- DoE- Department of Environment, NF – Not found;
- Fine Particulate Matter (PM<sub>2.5</sub>), Respirable Dust Content (PM<sub>10</sub>), Suspended Particulate Matter (SPM), Oxides of Nitrogen (NO<sub>x</sub>). Sulfur dioxide (SO<sub>2</sub>), Carbone Monoxide (CO) & Ozone (O<sub>3</sub>);
- 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.
- Standards presented in parenthesis are 8 hourly standard converted using standard formula.

**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   | ✓               | ✗                              | ✗                  | ✗           | ✓            | ✓                          | ✓                         | ✗                            | ✗               | ✗                | ✗                         | ✗                 | ✗                     | ✗                             | ✗                                 | ✗                          | ✗  | ✗                    | ✗                   | ✗                   | ✓                         | ✗                | ✓                             | ✓                   |
|                                  | SOx  | ✗               | ✗                              | ✗                  | ✗           | ✓            | ✓                          | ✓                         | ✗                            | ✗               | ✗                | ✗                         | ✗                 | ✗                     | ✗                             | ✗                                 | ✗                          | ✗  | ✗                    | ✗                   | ✗                   | ✗                         | ✗                | ✗                             | ✓                   |
|                                  | NOx  | ✗               | ✗                              | ✗                  | ✗           | ✓            | ✓                          | ✓                         | ✗                            | ✗               | ✗                | ✗                         | ✗                 | ✗                     | ✗                             | ✗                                 | ✗                          | ✗  | ✗                    | ✗                   | ✗                   | ✗                         | ✗                | ✗                             | ✓                   |
|                                  | GHGs | ✗               | ✗                              | ✗                  | ✗           | ✓            | ✓                          | ✓                         | ✗                            | ✗               | ✗                | ✗                         | ✗                 | ✗                     | ✗                             | ✗                                 | ✗                          | ✗  | ✗                    | ✗                   | ✗                   | ✗                         | ✗                | ✗                             | ✓                   |
| Proposed Township area of the PP | PM   | ✓               | ✗                              | ✗                  | ✗           | ✓            | ✓                          | ✓                         | ✗                            | ✗               | ✗                | ✗                         | ✗                 | ✗                     | ✗                             | ✗                                 | ✗                          | ✗  | ✗                    | ✗                   | ✗                   | ✓                         | ✗                | ✗                             | ✓                   |
|                                  | SOx  | ✗               | ✗                              | ✗                  | ✗           | ✓            | ✓                          | ✓                         | ✗                            | ✗               | ✗                | ✗                         | ✗                 | ✗                     | ✗                             | ✗                                 | ✗                          | ✗  | ✗                    | ✗                   | ✗                   | ✗                         | ✗                | ✗                             | ✓                   |
|                                  | NOx  | ✗               | ✗                              | ✗                  | ✗           | ✓            | ✓                          | ✓                         | ✗                            | ✗               | ✗                | ✗                         | ✗                 | ✗                     | ✗                             | ✗                                 | ✗                          | ✗  | ✗                    | ✗                   | ✗                   | ✗                         | ✗                | ✗                             | ✓                   |
|                                  | GHGs | ✗               | ✗                              | ✗                  | ✗           | ✓            | ✓                          | ✓                         | ✗                            | ✗               | ✗                | ✗                         | ✗                 | ✗                     | ✗                             | ✗                                 | ✗                          | ✗  | ✗                    | ✗                   | ✗                   | ✗                         | ✗                | ✗                             | ✓                   |
| NW Corner of the PP area         | PM   | ✗               | ✗                              | ✗                  | ✗           | ✓            | ✓                          | ✓                         | ✗                            | ✗               | ✗                | ✗                         | ✗                 | ✗                     | ✗                             | ✗                                 | ✗                          | ✗  | ✗                    | ✗                   | ✗                   | ✓                         | ✗                | ✗                             | ✓                   |
|                                  | SOx  | ✗               | ✗                              | ✗                  | ✗           | ✓            | ✓                          | ✓                         | ✗                            | ✗               | ✗                | ✗                         | ✗                 | ✗                     | ✗                             | ✗                                 | ✗                          | ✗  | ✗                    | ✗                   | ✗                   | ✗                         | ✗                | ✗                             | ✓                   |
|                                  | NOx  | ✗               | ✗                              | ✗                  | ✗           | ✓            | ✓                          | ✓                         | ✗                            | ✗               | ✗                | ✗                         | ✗                 | ✗                     | ✗                             | ✗                                 | ✗                          | ✗  | ✗                    | ✗                   | ✗                   | ✗                         | ✗                | ✗                             | ✓                   |
|                                  | GHGs | ✗               | ✗                              | ✗                  | ✗           | ✓            | ✓                          | ✓                         | ✗                            | ✗               | ✗                | ✗                         | ✗                 | ✗                     | ✗                             | ✗                                 | ✗                          | ✗  | ✗                    | ✗                   | ✗                   | ✗                         | ✗                | ✗                             | ✓                   |
| Barni, Gaurambha                 | PM   | ✗               | ✗                              | ✗                  | ✗           | ✓            | ✗                          | ✗                         | ✗                            | ✗               | ✗                | ✗                         | ✗                 | ✗                     | ✗                             | ✗                                 | ✗                          | ✗  | ✗                    | ✗                   | ✗                   | ✗                         | ✗                | ✓                             | ✓                   |

Legend ✗ Absence of source or no emission, ✓ Presence of source, emission of pollutant

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

Legend X Absence of source or no emission, ✓ Presence of source, emission of pollutant

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

| SI | Sampling Locations  | pH Values |      |     |     |          |      |      |     |                      |      |     |         | BD Standard |
|----|---|-----------|------|-----|-----|----------|------|------|-----|----------------------|------|-----|---------|-------------|
|    |   | 1st year  |      |     |     | 2nd Year |      |      |     | 3 <sup>rd</sup> year |      |     |         |             |
|    |   | Apr       | July | Oct | Jan | Apr      | July | Oct  | Jan | Apr                  | July | Oct |         |             |
|    |   | 1QM       | 2QM  | 3QM | 4QM | 1QM      | 2QM  | 3QM  | 4QM | 1QM                  | 2QM  | 3QM |         |             |
| 1  | Left Bank of Passur River at 100m u/s of North West corner from the Project boundary  | 7.2       | 7.0  | 8.1 | 7.9 | 7.6      | 7.8  | 7.6  | 7.1 | 7.5                  | 7.27 | 6.9 | 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   |         |             |
| 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 |         |             |
| 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 |         |             |
| 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   |         |             |
| 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 |         |             |
| 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  | 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 |         |             |
| 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 |         |             |
| 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 |         |             |
| 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 |         |             |
| 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 |         |             |
| 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 |         |             |
| 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 |         |             |
| 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                  |      | 7.6 |         |             |

Source: CEGIS Field Survey- April, July and October 2014 and January, April, July and October 2015, January and April 2016

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

| SI | Sampling Locations  | Temperature (°C) |            |            |            |            |            |            |            |            |            |            |                | BD | Standard |
|----|---|------------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|----------------|----|----------|
|    |   | 1st Year         |            |            |            | 2nd Year   |            |            |            | 3rd year   |            |            |                |    |          |
|    |   | Apr<br>1QM       | Jul<br>2QM | Oct<br>3QM | Jan<br>4QM | Apr<br>1QM | Jul<br>2QM | Oct<br>3QM | Jan<br>4QM | Apr<br>1QM | Jul<br>2QM | Oct<br>3QM |                |    |          |
| 1  | Left Bank of Passur River at 100m u/s of North West corner from the Project boundary  | 31               | 33         | 31         | 19         | 30         | 31.8       | 31.2       | 22.0       | 31.2       | 29.6       | 30.1       | 20°C -<br>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       |                |    |          |
| 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       |                |    |          |
| 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       |                |    |          |
| 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       |                |    |          |
| 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       |                |    |          |
| 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       |                |    |          |
| 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       |                |    |          |
| 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       |                |    |          |
| 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       |                |    |          |
| 11 | Maidara river near proposed township area   | 30               | 32         | 27         | 20         | 30         | 31.6       | 31.2       | 23.0       | 30.6       | 30.7       | 31.2       |                |    |          |
| 12 | Passur river at Passur-Ghasiakhali confluence   | 29               | 30         | 32         | 19         | 30         | 29.8       | 30.7       | 21         | 31.3       | 30.7       | 30.38      |                |    |          |
| 13 | Passur river at Harbaria of Sundarbans  | 30               | 30         | 27         | 22         | 30         | 29.0       | 30.8       | 22.0       | 31.5       | 30.9       | 29.9       |                |    |          |
| 14 | Passur river at Akram point of Sundarbans   | 29               | 29         | 30         | 21         | 30         | NS         | 30.2       | 21.0       | 30.8       | 30.4       | 30.4       |                |    |          |
| 15 | Passur river at Hiron point of Sundarbans   | 29               | 30         | 29         | 21         | 30         | NS         | 30.4       | NS         | 31.4       |            | 31.3       |                |    |          |

Source: CEGIS Field Survey- April, July and October 2014 and January, April, July and October 2015, January and April 2016

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)       |        |     |        |                      |        |     |        |                      |        |     |
|----|---|----------------------|--------|-----|--------|----------------------|--------|-----|--------|----------------------|--------|-----|
|    |   | 1 <sup>st</sup> Year |        |     |        | 2 <sup>nd</sup> Year |        |     |        | 3 <sup>rd</sup> year |        |     |
|    |   | Apr                  | Jul    | Oct | Jan    | Apr                  | Jul    | Oct | Jan    | Apr                  | Jul    | Oct |
|    |   | 1st QM               | 2nd QM | 3QM | 4th QM | 1st QM               | 2nd QM | 3QM | 4th QM | 1st QM               | 2nd QM | 3QM |
| 1  | Left Bank of Passur River at 100m u/s of North West corner from the Project boundary  | 11.5                 | 2.5    | 0.0 | 4.5    | 13                   | 0      | 0   | 4.1    | 8                    | 0      | 0   |
| 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  | 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   |
| 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   |
| 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   |
| 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   |
| 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   |
| 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   |
| 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   |
| 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   |
| 11 | Maidara river near proposed township area   | 9.0                  | 4.5    | 0.0 | 4.5    | 9                    | 0      | 0   | 2.5    | 6.3                  | 0      | 0   |
| 12 | Passur river at Passur-Ghasiakhali confluence   | 10.0                 | 9.5    | 0.0 | 5.0    | 14                   | 0      | 0   | 4.8    | 6                    | 0      | 0   |
| 13 | Passur river at Harbaria of Sundarbans  | 12.0                 | 10.0   | 0.0 | 6.0    | 15                   | 0      | 0   | 5.3    | 8.9                  | 0      | 0   |
| 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   |
| 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 |

Source: CEGIS Field Survey- April, July and October 2014 and January, April, July and October 2015, January and April 2016

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 |     |     |  |             |
|    |   | Apr                    | Jul | Oct | Jan | Apr      | Jul | Oct | Jan | Apr      | Jul | Oct |  |             |
|    |   | 1QM                    | 2QM | 3QM | 4QM | 1QM      | 2QM | 3QM | 4QM | 1QM      | 2QM | 3QM |  |             |
| 1  | Left Bank of Passur River at 100m u/s of North West corner from the Project boundary  | 5.9                    | 6.1 | 5.6 | 5.5 | 6.2      | 5.3 | 6.8 | 5.1 | 7.1      | 6.2 | 6   | 5 or more<br>(standard for<br>sustaining<br>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 |  |             |
| 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   |  |             |
| 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 |  |             |
| 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 |  |             |
| 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 |  |             |
| 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 |  |             |
| 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   |  |             |
| 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   |  |             |
| 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 |  |             |
| 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 |  |             |
| 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 |  |             |
| 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 |  |             |
| 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 |  |             |
| 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 |  |             |

Source: CEGIS Field Survey- April, July and October 2014 and January, April, July and October 2015, January and April 2016

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<sub>5</sub> of Passur River Water

| S<br>L | Sampling Location   | Biochemical Oxygen Demand (mg/L) |         |         |         |          |         |         |         |                      |         |         |  | BD<br>Standard |
|--------|---|----------------------------------|---------|---------|---------|----------|---------|---------|---------|----------------------|---------|---------|--|----------------|
|        |   | 1st Year                         |         |         |         | 2nd Year |         |         |         | 3 <sup>rd</sup> year |         |         |  |                |
|        |   | Apr                              | Jul     | Oct     | Jan     | Apr      | Jul     | Oct     | Jan     | Apr                  | Jul     | Oct     |  |                |
|        |   | 1Q<br>M                          | 2Q<br>M | 3Q<br>M | 4Q<br>M | 1Q<br>M  | 2Q<br>M | 3Q<br>M | 4Q<br>M | 1Q<br>M              | 2Q<br>M | 3Q<br>M |  |                |
| 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     | 6 or less (for<br>sustaining<br>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     |  |                |
| 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     |  |                |
| 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     |  |                |
| 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     |  |                |
| 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     |  |                |
| 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     |  |                |
| 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     |  |                |
| 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     |  |                |
| 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     |  |                |
| 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     |  |                |
| 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     |  |                |
| 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     |  |                |
| 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     |  |                |
| 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     |  |                |

Source: CEGIS Field Survey- April, July and October 2014 and January, April, July and October 2015, January and April 2016

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

Table B.6: COD of Passur River System

| Sl | Sampling Locations  | COD (mg/L) |            |            |            |            |             |            |            |                      |             |
|----|---|------------|------------|------------|------------|------------|-------------|------------|------------|----------------------|-------------|
|    |   | 1st Year   |            |            |            | 2nd year   |             |            |            | 3 <sup>rd</sup> year |             |
|    |   | Apr<br>1QM | Jul<br>2QM | Oct<br>3QM | Jan<br>4QM | Apr<br>1QM | July<br>2QM | Oct<br>3QM | Jan<br>4QM | Apr<br>1QM           | July<br>2QM |
| 1  | Left Bank of Passur River at 100m u/s of North West corner from the Project boundary  | 288        | 24         | 6          | 128        | 87         | 42          | 32         | 124        | 220                  | 8           |
| 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           |
| 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           |
| 4  | Left Bank of Passur River at Project site-Jetty                                       | 376        | 28         | 18         | 84         | 102        | 26          | 36         | 100        | 280                  | 8           |
| 5  | Middle Passur River at Project site-Jetty   | 400        | 60         | 14         | 116        | 110        | 21          | 36         | 108        | 240                  | 12          |
| 6  | Right Bank of Passur River at Project site-Jetty                                      | 364        | 496        | 18         | 108        | 88         | 24          | 40         | 80         | 260                  | 8           |
| 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  | Middle of Passur River at South West corner from the Project boundary                 | 400        | 40         | 22         | 16         | 18         | 25          | 28         | 100        | 180                  | 8           |
| 9  | Right Bank of Passur River at South West corner from the Project boundary             | 408        | 120        | 10         | 100        | 106        | 25          | 48         | 124        | 200                  | 12          |
| 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           |
| 11 | Maidara river near proposed township area   | 284        | 96         | 26         | 84         | 94         | 36          | 42         | 108        | 210                  | 30          |
| 12 | Passur river at Passur - Ghasiakhali confluence                                       | 408        | 172        | 14         | 96         | 92         | 30          | 46         | 88         | 220                  | 12          |
| 13 | Passur river at Harbaria of Sundarbans  | 372        | 216        | 14         | 96         | 102        | 26          | 36         | 100        | 140                  | 16          |
| 14 | Passur river at Akram point of Sundarbans   | 536        | 520        | 54         | 316        | 302        | NS          | 84         | 96         | 156                  | 4           |
| 15 | Passur river at Hiron point of Sundarbans   | 540        | 416        | 122        | 472        | 470        | NS          | 96         |            | 160                  |             |

Source: CEGIS Field Survey- April, July and October 2014 and January, April, July and October 2015, January 2016

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

| SI | Sampling Locations   | Oil and Grease (mg/L) |     |     |     |                      |      |      |     |                      |      | ECR, 1997 (mg/L)* | IFC, 2007 (mg/L) |
|----|--|-----------------------|-----|-----|-----|----------------------|------|------|-----|----------------------|------|-------------------|------------------|
|    |  | 1 <sup>st</sup> Year  |     |     |     | 2 <sup>nd</sup> year |      |      |     | 3 <sup>rd</sup> year |      |                   |                  |
|    |  | Apr                   | Jul | Oct | Jan | Apr                  | Jul  | Oct  | Jan | Apr                  | Jul  |                   |                  |
|    |  | 1QM                   | 2QM | 3QM | 4QM | 1QM                  | 2QM  | 3QM  | 4QM | 1QM                  | 2QM  |                   |                  |
| 1  | Left Bank of Passur River at South West corner from the Project boundary | <5                    | <5  | <5  | >15 | 16.9                 | 9    | <5   | 39  | 61                   | 5    | 10                | 10               |
| 2  | Passur-Ghasiakhali Confluence  | <5                    | <5  | <5  | >15 | 13                   | 7.63 | 9.87 | 21  | 30.3                 | 13.5 |                   |                  |
| 3  | Passur river at Harbaria of Sundarbans                                   | <5                    | 6.3 | <5  | >20 | 39.1                 | 10.1 | <5   | 14  | 26                   | 5.73 |                   |                  |
| 4  | Passur river at Hiron point of Sundarbans                                | <5                    | <5  | <5  | >20 | <5                   | NS   | 10.8 | ND  | 31                   | 5.87 |                   |                  |
| 5  | Akram Point of Sundarbans  | <5                    | <5  | <5  | >20 | <5                   | NS   | 9.73 | 36  | 82                   |      |                   |                  |

Source: CEGIS Field Survey- April, July and October 2014 and January, April, July and October 2015, January 2016

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)           |       |      |       |                      |      |      |       |                      |      |
|----|---|----------------------|-------|------|-------|----------------------|------|------|-------|----------------------|------|
|    |   | 1 <sup>st</sup> Year |       |      |       | 2 <sup>nd</sup> year |      |      |       | 3 <sup>rd</sup> year |      |
|    |   | Apr                  | Jul   | Oct  | Jan   | Apr                  | Jul  | Oct  | Jan   | Apr                  | Jul  |
|    |   | 1QM                  | 2QM   | 3QM  | 4QM   | 1QM                  | 2QM  | 3QM  | 4QM   | 1QM                  | 2QM  |
| 1  | Left Bank of Passur River at 100m u/s of North West corner from the Project boundary  | 13060                | 251   | 176  | 4360  | 14400                | 937  | 158  | 5570  | 13400                | 179  |
| 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  |
| 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  |
| 4  | Left Bank of Passur River at Project site-Jetty                                       | 13190                | 445   | 169  | 4750  | 14600                | 175  | 172  | 5720  | 12830                | 162  |
| 5  | Middle Passur River at Project site-Jetty   | 13330                | 353   | 156  | 4920  | 14500                | 132  | 162  | 5850  | 13100                | 185  |
| 6  | Right Bank of Passur River at Project site-Jetty                                      | 13380                | 402   | 152  | 4870  | 14200                | 156  | 160  | 5480  | 13460                | 143  |
| 7  | Left Bank of Passur River at South West corner from the Project boundary              | 13180                | 655   | 162  | 5040  | 14500                | 336  | 192  | 5650  | 12820                | 205  |
| 8  | Middle of Passur River at South West corner from the Project boundary                 | 13390                | 587   | 153  | 5050  | 14600                | 158  | 164  | 5740  | 12960                | 195  |
| 9  | Right Bank of Passur River at South West corner from the Project boundary             | 13240                | 916   | 154  | 5130  | 14250                | 160  | 164  | 5650  | 13590                | 140  |
| 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  |
| 11 | Maidara river near proposed Township area   | 10970                | 2510  | 257  | 4390  | 13900                | 355  | 176  | 4420  | 11700                | 5170 |
| 12 | Passur river at Passur - Mongla confluence  | 12800                | 6410  | 209  | 5130  | 14050                | 298  | 227  | 4540  | 11330                | 893  |
| 13 | Passur river at Harbaria of Sundarbans  | 12280                | 9360  | 285  | 4780  | 13900                | 683  | 205  | 4940  | 13580                | 1321 |
| 14 | Passur river at Akram point of Sundarbans   | 21500                | 15960 | 3400 | 12350 | 13600                |      | 4220 | 13330 | 20720                | 7330 |
| 15 | Passur river at Hiron point of Sundarbans   | 21500                | 14050 | 5720 | 17900 | 25300                |      | 5830 |       | 25500                |      |

Source: CEGIS Field Survey- April, July and October 2014 and January, April, July and October 2015, January 2016

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)            |      |      |      |                      |     |      |      |                      |      |
|----|---|----------------------|------|------|------|----------------------|-----|------|------|----------------------|------|
|    |   | 1 <sup>st</sup> Year |      |      |      | 2 <sup>nd</sup> year |     |      |      | 3 <sup>rd</sup> year |      |
|    |   | Apr                  | Jul  | Oct  | Jan  | Apr                  | Jul | Oct  | Jan  | Apr                  | Jul  |
|    |   | 1QM                  | 2QM  | 3QM  | 4QM  | 1QM                  | 2QM | 3QM  | 4QM  | 1QM                  | 2QM  |
| 1  | Left Bank of Passur River at 100m u/s of North West corner from the Project boundary  | 2900                 | 250  | 216  | 930  | 3000                 | 245 | 250  | 1270 | 3130                 | 240  |
| 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  |
| 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  |
| 4  | Left Bank of Passur River at Project site-Jetty                                       | 2550                 | 175  | 390  | 940  | 3450                 | 118 | 365  | 1220 | 3010                 | 220  |
| 5  | Middle Passur River at Project site-Jetty   | 2600                 | 275  | 340  | 990  | 3250                 | 103 | 355  | 1300 | 3070                 | 232  |
| 6  | Right Bank of Passur River at Project site-Jetty                                      | 2625                 | 350  | 355  | 970  | 3200                 | 105 | 350  | 1260 | 3100                 | 218  |
| 7  | Left Bank of Passur River at South West corner from the Project boundary              | 2550                 | 325  | 330  | 1045 | 3600                 | 153 | 345  | 1370 | 3060                 | 235  |
| 8  | Middle of Passur River at South West corner from the Project boundary                 | 2800                 | 350  | 345  | 1125 | 3670                 | 105 | 390  | 1340 | 3130                 | 242  |
| 9  | Right Bank of Passur River at South West corner from the Project boundary             | 2500                 | 475  | 325  | 975  | 3540                 | 165 | 445  | 1270 | 3110                 | 224  |
| 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  |
| 11 | Maidara river near proposed township area   | 2400                 | 725  | 330  | 970  | 3190                 | 130 | 340  | 1075 | 3080                 | 875  |
| 12 | Passur river at Passur - Mongla confluence  | 3150                 | 1400 | 377  | 1000 | 3210                 | 135 | 410  | 1090 | 3060                 | 405  |
| 13 | Passur river at Harbaria of Sundarbans  | 2625                 | 2150 | 345  | 970  | 3080                 | 200 | 430  | 1100 | 3050                 | 415  |
| 14 | Passur river at Akram point of Sundarbans   | 4500                 | 3625 | 980  | 2380 | 3420                 | NS  | 1090 | 2850 | 4520                 | 1750 |
| 15 | Passur river at Hiron point of Sundarbans   | 4850                 | 3050 | 1440 | 2690 | 3640                 | NS  | 1460 | NS   | 5050                 |      |

Source: CEGIS Field Survey- April, July and October 2014 and January, April, July and October 2015, January 2016

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)           |     |     |     |                      |     |     |     |                      |     |
|----|---|----------------------|-----|-----|-----|----------------------|-----|-----|-----|----------------------|-----|
|    |   | 1 <sup>st</sup> Year |     |     |     | 2 <sup>nd</sup> year |     |     |     | 3 <sup>rd</sup> year |     |
|    |   | Apr                  | Jul | Oct | Jan | Apr                  | Jul | Oct | Jan | Apr                  | Jul |
|    |   | 1QM                  | 2QM | 3QM | 4QM | 1QM                  | 2QM | 3QM | 4QM | 1QM                  | 2QM |
| 1  | Left Bank of Passur River at 100m u/s of North West corner from the Project boundary  | 598                  | 126 | 234 | 180 | 160                  | 26  | 76  | 14  | 8                    | 61  |
| 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  |
| 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  |
| 4  | Left Bank of Passur River at Project site-Jetty                                       | 54                   | 99  | 227 | 450 | 160                  | 30  | 92  | 17  | 10                   | 62  |
| 5  | Middle Passur River at Project site-Jetty   | 60                   | 100 | 232 | 250 | 165                  | 27  | 85  | 18  | 8                    | 45  |
| 6  | Right Bank of Passur River at Project site-Jetty                                      | 55                   | 105 | 186 | 200 | 155                  | 40  | 97  | 22  | 7                    | 49  |
| 7  | Left Bank of Passur River at South West corner from the Project boundary              | 24                   | 116 | 185 | 300 | 150                  | 32  | 104 | 20  | 12                   | 51  |
| 8  | Middle of Passur River at South West corner from the Project boundary                 | 27                   | 112 | 536 | 530 | 147                  | 40  | 90  | 7   | 10                   | 43  |
| 9  | Right Bank of Passur River at South West corner from the Project boundary             | 67                   | 37  | 459 | 450 | 155                  | 44  | 82  | 18  | 11                   | 39  |
| 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  |
| 11 | Maidara river near proposed township area   | 9                    | 24  | 389 | 206 | 160                  | 28  | 92  | 10  | 6                    | 11  |
| 12 | Passur river at Passur - Mongla confluence  | 50                   | 310 | 203 | 280 | 165                  | 24  | 60  | 15  | 13                   | 47  |
| 13 | Passur river at Harbaria of Sundarbans  | 65                   | 90  | 869 | 400 | 160                  | 42  | 74  | 22  | 18                   | 31  |
| 14 | Passur river at Akram point of Sundarbans   | 115                  | 99  | 28  | 103 | 150                  | NS  | 110 | 16  | 23                   | 16  |
| 15 | Passur river at Hiron point of Sundarbans   | 91                   | 72  | 267 | 200 | 180                  | NS  | 144 |     | 15                   |     |

Source: CEGIS Field Survey- April, July and October 2014 and January, April, July and October 2015, January 2016

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

Table B.11: NO<sub>3</sub><sup>2-</sup> concentration of Passur River System

| SI | Sampling Locations  | NO <sub>3</sub> <sup>2-</sup> (mg/L) |      |      |     |                      |      |      |     |                      |     |
|----|---|--------------------------------------|------|------|-----|----------------------|------|------|-----|----------------------|-----|
|    |   | 1 <sup>st</sup> Year                 |      |      |     | 2 <sup>nd</sup> year |      |      |     | 3 <sup>rd</sup> year |     |
|    |   | Apr                                  | Jul  | Oct  | Jan | Apr                  | Jul  | Oct  | Jan | Apr                  | Jul |
|    |   | 1QM                                  | 2QM  | 3QM  | 4QM | 1QM                  | 2QM  | 3QM  | 4QM | 1QM                  | 2QM |
| 1  | Left Bank of Passur River at 100m u/s of North West corner from the Project boundary  | 0.9                                  | 2.89 | 0.32 | 3   | 33                   | 9.1  | 4    | 6.3 | 3                    | 3.9 |
| 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 |
| 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 |
| 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 |
| 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 |
| 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 |
| 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 |
| 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 |
| 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 |
| 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 |
| 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 |
| 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 |
| 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 |
| 14 | Passur river at Akram point of Sundarbans   | 2.7                                  | 3.32 | 0.59 | 1.5 | 25                   |      | 3.2  | 4.9 | 2.9                  | 5.4 |
| 15 | Passur river at Hiron point of Sundarbans   | 0.8                                  | 2.84 | 0.4  | 2   | 28                   |      | 11.5 |     | 3.5                  |     |

Source: CEGIS Field Survey- April, July and October 2014 and January, April, July and October 2015, January 2016

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

Table B.12: SO<sub>4</sub><sup>2-</sup> concentration of Passur River System

| SI | Sampling Locations  | SO <sub>4</sub> <sup>2-</sup> (mg/L) |      |      |      |                      |     |     |     |                      |     |
|----|---|--------------------------------------|------|------|------|----------------------|-----|-----|-----|----------------------|-----|
|    |   | 1 <sup>st</sup> Year                 |      |      |      | 2 <sup>nd</sup> year |     |     |     | 3 <sup>rd</sup> year |     |
|    |   | Apr                                  | Jul  | Oct  | Jan  | Apr                  | Jul | Oct | Jan | Apr                  | Jul |
|    |   | 1QM                                  | 2QM  | 3QM  | 4QM  | 1QM                  | 2QM | 3QM | 4QM | 1QM                  | 2QM |
| 1  | Left Bank of Passur River at 100m u/s of North West corner from the Project boundary  | 1840                                 | 20   | 26   | 580  | 1360                 | 67  | 7   | 570 | 1080                 | 18  |
| 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  | 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  | Left Bank of Passur River at Project site-Jetty                                       | 1360                                 | 45   | 33   | 550  | 1240                 | 26  | 10  | 550 | 1060                 | 15  |
| 5  | Middle Passur River at Project site-Jetty   | 1040                                 | 32   | 30   | 520  | 1120                 | 6   | 8   | 580 | 980                  | 17  |
| 6  | Right Bank of Passur River at Project site-Jetty                                      | 1320                                 | 20   | 27   | 540  | 820                  | 8   | 9   | 565 | 1100                 | 14  |
| 7  | Left Bank of Passur River at South West corner from the Project boundary              | 1640                                 | 60   | 40   | 630  | 880                  | 9   | 12  | 640 | 1060                 | 15  |
| 8  | Middle of Passur River at South West corner from the Project boundary                 | 1520                                 | 40   | 35   | 560  | 1180                 | 19  | 8   | 560 | 1020                 | 18  |
| 9  | Right Bank of Passur River at South West corner from the Project boundary             | 1280                                 | 80   | 64   | 620  | 900                  | 12  | 6   | 550 | 1080                 | 12  |
| 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  |
| 11 | Maidara river near proposed township area   | 1320                                 | 210  | 63   | 460  | 840                  | 27  | 9   | 480 | 1020                 | 480 |
| 12 | Passur river at Passur - Mongla confluence  | 1360                                 | 620  | 44   | 630  | 980                  | 39  | 13  | 482 | 1100                 | 42  |
| 13 | Passur river at Harbaria of Sundarbans  | 1560                                 | 860  | 69   | 590  | 900                  | 51  | 7   | 500 | 1080                 | 60  |
| 14 | Passur river at Akram point of Sundarbans   | 2600                                 | 1400 | 1390 | 850  | 1540                 |     | 84  | 760 | 1650                 | 620 |
| 15 | Passur river at Hiron point of Sundarbans   | 2080                                 | 1160 | 2360 | 1500 | 1920                 |     | 97  |     | 2100                 |     |

Source: CEGIS Field Survey- April, July and October 2014 and January, April, July and October 2015, January 2016

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

Table B.13: PO<sub>4</sub><sup>2-</sup> concentration of Passur River System

| SI | Sampling Locations  | PO <sub>4</sub> <sup>2-</sup> (mg/L) |      |      |      |                      |      |      |       |                      |       |
|----|---|--------------------------------------|------|------|------|----------------------|------|------|-------|----------------------|-------|
|    |   | 1 <sup>st</sup> Year                 |      |      |      | 2 <sup>nd</sup> year |      |      |       | 3 <sup>rd</sup> year |       |
|    |   | Apr                                  | Jul  | Oct  | Jan  | Apr                  | Jul  | Oct  | Jan   | Apr                  | Jul   |
|    |   | 1QM                                  | 2QM  | 3QM  | 4QM  | 1QM                  | 2QM  | 3QM  | 4QM   | 1QM                  | 2QM   |
| 1  | Left Bank of Passur River at 100m u/s of North West corner from the Project boundary  | 0.52                                 | 2.23 | 0.67 | 0.32 | 0.86                 | 10   | 1.27 | 0.269 | 0.22                 | 1.14  |
| 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  |
| 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  | 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  |
| 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  |
| 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  |
| 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  |
| 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  |
| 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 |
| 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  |
| 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     |
| 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  |
| 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  |
| 14 | Passur river at Akram point of Sundarbans   | 1.3                                  | 0.29 | 0.8  | 0.42 | 0.61                 |      | 0.43 | 0.357 | 0.26                 | 0.47  |
| 15 | Passur river at Hiron point of Sundarbans   | 7.51                                 | 0.29 | 1.09 | 0.44 | 0.47                 |      | 0.45 |       | 0.36                 |       |

Source: CEGIS Field Survey- April, July and October 2014 and January, April, July and October 2015, January 2016

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

| SI | Sampling Locations  | As (mg/L)            |       |       |       |                      |       |       |       |                      |       |
|----|---|----------------------|-------|-------|-------|----------------------|-------|-------|-------|----------------------|-------|
|    |   | 1 <sup>st</sup> Year |       |       |       | 2 <sup>nd</sup> year |       |       |       | 3 <sup>rd</sup> year |       |
|    |   | Apr                  | Jul   | Oct   | Jan   | Apr                  | Jul   | Oct   | Jan   | Apr                  | Jul   |
|    |   | 1QM                  | 2QM   | 3QM   | 4QM   | 1QM                  | 2QM   | 3QM   | 4QM   | 1QM                  | 2QM   |
| 1  | Left Bank of Passur River at 100m u/s of North West corner from the Project boundary  | 0.002                | 0.003 | 0.004 | 0.003 | 0.002                | 0.002 | 0.001 | 0.001 | 0.001                | 0.002 |
| 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 |
| 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 |
| 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 |
| 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 |
| 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 |
| 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 |
| 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 |
| 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 |
| 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 |
| 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 |
| 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 |
| 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 |
| 14 | Passur river at Akram point of Sundarbans   | 0.004                | 0.002 | 0.002 | 0.003 | 0.002                |       | 0.001 | 0.002 | 0.006                | 0.001 |
| 15 | Passur river at Hiron point of Sundarbans   | 0.003                | 0.002 | 0.003 | 0.002 | 0.002                |       | 0.001 |       | 0.004                |       |

Source: CEGIS Field Survey- April, July and October 2014 and January, April, July and October 2015, January 2016

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

| SI | Sampling Locations  | Pb (mg/L)            |       |            |       |                      |        |       |       |                      |       |
|----|---|----------------------|-------|------------|-------|----------------------|--------|-------|-------|----------------------|-------|
|    |   | 1 <sup>st</sup> Year |       |            |       | 2 <sup>nd</sup> year |        |       |       | 3 <sup>rd</sup> year |       |
|    |   | Apr                  | Jul   | Oct        | Jan   | Apr                  | Jul    | Oct   | Jan   | Apr                  | Jul   |
|    |   | 1QM                  | 2QM   | 3QM        | 4QM   | 1QM                  | 2QM    | 3QM   | 4QM   | 1QM                  | 2QM   |
| 1  | Left Bank of Passur River at 100m u/s of North West corner from the Project boundary  | 0.053                | 0.004 | 0.002      | 0.104 | 0.098                | 0.0059 | 0.007 | 0.168 | 0.203                | 0.01  |
| 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 |
| 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 |
| 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 |
| 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 |
| 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  |
| 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 |
| 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 |
| 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 |
| 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 |
| 11 | Maidara river near proposed township area   | 0.048                | 0.004 | <0.00<br>2 | 0.133 | 0.14                 | 0.002  | 0.008 | 0.067 | 0.275                | 0.015 |
| 12 | Passur river at Passur - Mongla confluence  | 0.05                 | 0.032 | <0.00<br>2 | 0.141 | 0.14                 | 0.002  | 0.009 | 0.078 | 0.258                | 0.098 |
| 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  |
| 14 | Passur river at Akram point of Sundarbans   | 0.194                | 0.071 | 0.032      | 0.309 | 0.297                |        | 0.084 | 0.302 | 0.359                | 0.142 |
| 15 | Passur river at Hiron point of Sundarbans   | 0.224                | 0.05  | 0.07       | 0.309 | 0.291                |        | 0.073 |       | 0.607                |       |

Source: CEGIS Field Survey- April, July and October 2014 and January, April, July and October 2015, January 2016

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)            |              |              |              |                      |              |              |              |                      |              |
|----|---|----------------------|--------------|--------------|--------------|----------------------|--------------|--------------|--------------|----------------------|--------------|
|    |   | 1 <sup>st</sup> Year |              |              |              | 2 <sup>nd</sup> year |              |              |              | 3 <sup>rd</sup> year |              |
|    |   | Apr                  | Jul          | Oct          | Jan          | Apr                  | Jul          | Oct          | Jan          | Apr                  | Jul          |
|    |   | 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  | <<br>0.00015         | <<br>0.00015 | <<br>0.00015 | <<br>0.00015 | <<br>0.00015         | <<br>0.00015 | <<br>0.00015 | <<br>0.00015 | <<br>0.00015         | <<br>0.00015 |
| 2  | Middle Passur River at 100m u/s of North West corner from the Project boundary        | <<br>0.00015         | <<br>0.00015 | <<br>0.00015 | <<br>0.00015 | <<br>0.00015         | <<br>0.00015 | <<br>0.00015 | <<br>0.00016 | <<br>0.00015         | <<br>0.00015 |
| 3  | Right Bank of Passur River at 100m u/s of North West corner from the Project boundary | <<br>0.00015         | <<br>0.00015 | <<br>0.00015 | <<br>0.00015 | <<br>0.00015         | <<br>0.00015 | <<br>0.00015 | <<br>0.00017 | <<br>0.00015         | <<br>0.00015 |
| 4  | Left Bank of Passur River at Project site-Jetty                                       | <<br>0.00015         | <<br>0.00015 | <<br>0.00015 | <<br>0.00015 | <<br>0.00015         | <<br>0.00015 | <<br>0.00015 | <<br>0.00018 | <<br>0.00015         | <<br>0.00015 |
| 5  | Middle Passur River at Project site-Jetty   | <<br>0.00015         | <<br>0.00015 | <<br>0.00015 | <<br>0.00015 | <<br>0.00015         | <<br>0.00015 | <<br>0.00015 | <<br>0.00019 | <<br>0.00015         | <<br>0.00015 |
| 6  | Right Bank of Passur River at Project site-Jetty                                      | <<br>0.00015         | <<br>0.00015 | <<br>0.00015 | <<br>0.00015 | <<br>0.00015         | <<br>0.00015 | <<br>0.00015 | <<br>0.00020 | <<br>0.00015         | <<br>0.00015 |
| 7  | Left Bank of Passur River at South West corner from the Project boundary              | <<br>0.00015         | <<br>0.00015 | <<br>0.00015 | <<br>0.00015 | <<br>0.00015         | <<br>0.00015 | <<br>0.00015 | <<br>0.00021 | <<br>0.00015         | <<br>0.00015 |
| 8  | Middle of Passur River at South West corner from the Project boundary                 | <<br>0.00015         | <<br>0.00015 | <<br>0.00015 | <<br>0.00015 | <<br>0.00015         | <<br>0.00015 | <<br>0.00015 | <<br>0.00022 | <<br>0.00015         | <<br>0.00015 |
| 9  | Right Bank of Passur River at South West corner from the Project boundary             | <<br>0.00015         | <<br>0.00015 | <<br>0.00015 | <<br>0.00015 | <<br>0.00015         | <<br>0.00015 | <<br>0.00015 | <<br>0.00023 | <<br>0.00015         | <<br>0.00015 |
| 10 | Maidara river of the South East corner of the project at Ichamoti-Maidara confluence  | <<br>0.00015         | <<br>0.00015 | <<br>0.00015 | <<br>0.00015 | <<br>0.00015         | <<br>0.00015 | <<br>0.00015 | <<br>0.00024 | <<br>0.00015         | <<br>0.00015 |
| 11 | Maidara river near proposed township area   | <<br>0.00015         | <<br>0.00015 | <<br>0.00015 | <<br>0.00015 | <<br>0.00015         | <<br>0.00015 | <<br>0.00015 | <<br>0.00025 | <<br>0.00015         | <<br>0.00015 |
| 12 | Passur river at Passur - Mongla confluence  | <<br>0.00015         | <<br>0.00015 | <<br>0.00015 | <<br>0.00015 | <<br>0.00015         | <<br>0.00015 | <<br>0.00015 | <<br>0.00027 | <<br>0.00015         | <<br>0.00015 |
| 13 | Passur river at Harbaria of Sundarbans  | <<br>0.00015         | <<br>0.00015 | <<br>0.00015 | <<br>0.00015 | <<br>0.00015         | <<br>0.00015 | <<br>0.00015 | <<br>0.00029 | <<br>0.00015         | <<br>0.00015 |
| 14 | Passur river at Akram point of Sundarbans   | <<br>0.00015         | <<br>0.00015 | <<br>0.00015 | <<br>0.00015 | <<br>0.00015         | <<br>0.00015 | <<br>0.00015 | <<br>0.00030 | <<br>0.00015         | <<br>0.00015 |
| 15 | Passur river at Hiron point of Sundarbans   | <<br>0.00015         | NS           | <<br>0.00015 | <<br>0.00015 | <<br>0.00015         | <<br>0.00015 | NS           | NS           | <<br>0.00015         | NS           |

Source: CEGIS Field Survey- April, July and October 2014 and January, April, July and October 2015, January 2016

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**

| SI | Locations              | Tube Well Type    | pH value             |     |     |     |                      |     |      |     |                      |     |     |
|----|------------------------|-------------------|----------------------|-----|-----|-----|----------------------|-----|------|-----|----------------------|-----|-----|
|    |                        |                   | 1 <sup>st</sup> Year |     |     |     | 2 <sup>nd</sup> year |     |      |     | 3 <sup>rd</sup> year |     |     |
|    |                        |                   | Apr                  | Jul | Oct | Jan | Apr                  | Jul | Oct  | Jan | Apr                  | Jul | Oct |
|    |                        |                   | 1QM                  | 2QM | 3QM | 4QM | 1QM                  | 2QM | 3QM  | 4QM | 1QM                  | 2QM | 3QM |
| 1  | Near Proposed Township | Deep (>600 ft)    | 7.6                  | 7.7 | 7.9 | 8   | TC                   | 8.1 | 7.49 | 7.6 | 7.8                  | 7.8 | 8.4 |
| 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 |
| 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 |
| 4  | Kalekharber            | Shallow (<250 ft) | 6.3                  | 6.5 | NF  | NF  | NF                   | NF  | NF   | NF  | ND                   |     |     |

| Locations              | Tube Well Type    | Temperature (°C)     |      |     |      |                      |     |      |     |                      |      |      |
|------------------------|-------------------|----------------------|------|-----|------|----------------------|-----|------|-----|----------------------|------|------|
|                        |                   | 1 <sup>st</sup> Year |      |     |      | 2 <sup>nd</sup> year |     |      |     | 3 <sup>rd</sup> year |      |      |
|                        |                   | Apr                  | Jul  | Oct | Jan  | Apr                  | Jul | Oct  | Jan | Apr                  | Jul  | Oct  |
|                        |                   | 1QM                  | 2QM  | 3QM | 4QM  | 1QM                  | 2QM | 3QM  | 4QM | 1QM                  | 2QM  | 3QM  |
| Near Proposed Township | Deep (>600 ft)    | 27.3                 | 28.5 | 26  | 24.5 | TC                   | 31  | 30   | 24  | 29.8                 | 28.6 | 29.1 |
| Rajnagar               | Deep (>600 ft)    | 29.6                 | 29.9 | 28  | 22.5 | 28.6                 | 28  | 27.8 | 23  | 29.6                 | 29.1 | 30.4 |
| Kapasdanga             | Deep (>600 ft)    | 29.2                 | 28.9 | 28  | 25.1 | 28.8                 | 30  | 28.7 | 25  | 30.1                 | 29.4 | 29.8 |
| Kalekharber            | Shallow (<250 ft) | 27.5                 | 28.7 | NF  | NF   | NF                   | NF  | NF   | NF  | ND                   | NF   | NF   |

Source: CEGIS Field Survey- April, July and October 2014 and January, April, July and October 2015, January and April 2016

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

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

Table B.18: Salinity and DO in Groundwater

| SI | Locations              | Tube Well Type    | Salinity (ppt)       |     |      |      |                      |      |      |      |                      |     |     |  |
|----|------------------------|-------------------|----------------------|-----|------|------|----------------------|------|------|------|----------------------|-----|-----|--|
|    |                        |                   | 1 <sup>st</sup> Year |     |      |      | 2 <sup>nd</sup> year |      |      |      | 3 <sup>rd</sup> year |     |     |  |
|    |                        |                   | Apr                  | Jul | Oct  | Jan  | Apr                  | Jul  | Oct  | Jan  | Apr                  | Jul | Oct |  |
|    |                        |                   | 1QM                  | 2QM | 3QM  | 4QM  | 1QM                  | 2QM  | 3QM  | 4QM  | 1QM                  | 2QM | 3QM |  |
| 1  | Near Proposed Township | Deep (>600 ft)    | 0                    | 0   | 0    | 1    | TC                   | 0    | 0    | 0    | 0                    | 0   | 0   |  |
| 2  | Rajnagar               | Deep (>600 ft)    | 0                    | 0   | 0    | 0    | 0                    | 0    | 0    | 0    | 0                    | 0   | 0   |  |
| 3  | Kalekharber            | Shallow (<250 ft) | 0                    | 0   | NF** | NF** | NF**                 | NF** | NF** | NF** |                      | 0   | 0   |  |
| 4  | Kapasdanga             | Deep (>600 ft)    | 0                    | 0   | 0    | 0    | 0                    | 0    | 0    | 0    | 0                    | 0   | 0   |  |

| SI | Locations              | Tube Well Type    | DO (mg/L)            |     |      |      |                      |      |      |      |                      |      |      |  |
|----|------------------------|-------------------|----------------------|-----|------|------|----------------------|------|------|------|----------------------|------|------|--|
|    |                        |                   | 1 <sup>st</sup> Year |     |      |      | 2 <sup>nd</sup> year |      |      |      | 3 <sup>rd</sup> year |      |      |  |
|    |                        |                   | Apr                  | Jul | Oct  | Jan  | Apr                  | Jul  | Oct  | Jan  | Apr                  | Jul  | Oct  |  |
|    |                        |                   | 1QM                  | 2QM | 3QM  | 4QM  | 1QM                  | 2QM  | 3QM  | 4QM  | 1QM                  | 2QM  | 3QM  |  |
| 1  | Near Proposed Township | Deep (>600 ft)    | 4.4                  | 5.2 | 6.5  | 6.7  | TC                   | 6    | 5.4  | 4.9  | 6.1                  | 5.8  | 6.3  |  |
| 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  |  |
| 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  | Kalekharber            | Shallow (<250 ft) | 4.4                  | 6   | NF** | NF** | NF                   | NF** | NF** | NF** | NF**                 | NF** | NF** |  |

Source: CEGIS Field Survey- April, July and October 2014 and January, April, July and October 2015, January and April 2016

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

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

Table B.19: TDS and TSS concentrations in Groundwater

| SL | Locations                  | Type of tube wells | TDS (mg/L)           |     |     |      |                      |     |      |     |                      |      |
|----|----------------------------|--------------------|----------------------|-----|-----|------|----------------------|-----|------|-----|----------------------|------|
|    |                            |                    | 1 <sup>st</sup> Year |     |     |      | 2 <sup>nd</sup> year |     |      |     | 3 <sup>rd</sup> year |      |
|    |                            |                    | Apr                  | Jul | Oct | Jan  | Apr                  | Jul | Oct  | Jan | Apr                  | Jul  |
|    |                            |                    | 1QM                  | 2QM | 3QM | 4QM  | 1QM                  | 2QM | 3QM  | 4QM | 1QM                  | 2QM  |
| 1  | Township near project site | Deep (>600 ft)     | 1113                 | 999 | -   | 1021 | NO                   | 881 | 377  | 447 | 1025                 | 1000 |
| 2  | Rajnagar                   | Deep (>600 ft)     | 4090                 | 371 | -   | 378  | 390                  | 574 | 1007 | 491 | 384                  | 408  |
| 3  | Kapasdanga                 | Deep (>600 ft)     | 643                  | 635 | -   | 600  | 600                  | 328 | 611  | 284 | 645                  | 607  |
| 4  | Kalekharber                | Shallow (<250 ft)  | 1055                 | 970 | -   | NF   | D                    | D   | NF   | NF  | NF                   |      |

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

Source: CEGIS Field Survey- April, July and October 2014 and January, April, July and October 2015, January 2016

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**

| SI No | Locations                  | Type of tubewell  | TH (mg/L)* |     |     |     |          |     |     |     |                      |     | BD standard* |
|-------|----------------------------|-------------------|------------|-----|-----|-----|----------|-----|-----|-----|----------------------|-----|--------------|
|       |                            |                   | 1st Year   |     |     |     | 2nd year |     |     |     | 3 <sup>rd</sup> year |     |              |
|       |                            |                   | Apr        | Jul | Oct | Jan | Apr      | Jul | Oct | Jan | Apr                  | Jul |              |
|       |                            |                   | 1QM        | 2QM | 3QM | 4QM | 1QM      | 2QM | 3QM | 4QM | 1QM                  | 2QM |              |
| 1     | Township near project site | Deep (>600 ft)    | 425        | 250 | 300 | 235 | NO       | 225 | 325 | 295 | 305                  | 320 | 200-500 mg/L |
| 2     | Rajnagar                   | Deep (>600 ft)    | 220        | 175 | 180 | 110 | 138      | 125 | 450 | 195 | 263                  | 248 |              |
| 3     | Kalekarber                 | Shallow (<250 ft) | 780        | 450 | NF  | NF  | NF       | NF  | NF  | NF  |                      | 28  |              |
| 4     | Kapasdanga                 | Deep (>600 ft)    | 190        | 140 | 180 | 125 | 216      | 115 | 480 | 225 | 163                  |     |              |

Source: CEGIS Field Survey- April, July and October 2014 and January, April, July and October 2015, January 2016

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

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

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

| SI | Locations                  | Tubewell Type     | COD (mg/L) |     |     |     |          |     |     |     |          |     | BD standard* |
|----|----------------------------|-------------------|------------|-----|-----|-----|----------|-----|-----|-----|----------|-----|--------------|
|    |                            |                   | 1st Year   |     |     |     | 2nd year |     |     |     | 3rd year |     |              |
|    |                            |                   | Apr        | Jul | Oct | Jan | Apr      | Jul | Oct | Jan | Apr      | Jul |              |
|    |                            |                   | 1QM        | 2QM | 3QM | 4QM | 1QM      | 2QM | 3QM | 4QM | 1QM      | 2QM |              |
| 1  | Township near project site | Deep (>600 ft)    | 32         | 32  | 34  | 20  | NO       | 12  | 4   | 4   | 4        | 4   | 4.0 mg/L     |
| 2  | Rajnagar                   | Deep (>600 ft)    | 28         | 28  | 18  | 16  | 14       | 10  | 8   | 4   | 4        | 4   |              |
| 3  | Kalekarber                 | Shallow (<250 ft) | 32         | 36  | NF  | NF  | NF       | NF  | NF  | NF  | NF       |     |              |
| 4  | Kapasdanga                 | Deep (>600 ft)    | 48         | 32  | 34  | 20  | 18       | 14  | 4   | 4   | 4        | 2   |              |

Source: CEGIS Field Survey- April, July and October 2014 and January, April, July and October 2015, January 2016

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<sub>3</sub><sup>-</sup>, SO<sub>4</sub><sup>2-</sup> and PO<sub>4</sub><sup>3-</sup> Concentrations in Ground Water

| SI | Locations                  | Type of tube well | NO <sub>3</sub> <sup>2-</sup> (mg/L)<br>*BD Standard (10 mg/L) |      |       |     |                      |     |     |     |                      | SO <sub>4</sub> <sup>2-</sup> (mg/L)<br>*BD Standard (400 mg/L) |                      |     |     |     |                      |     |     |     | PO <sub>4</sub> <sup>2-</sup> (mg/L)<br>*BD Standard (6.0 mg/L) |     |                      |     |     |      |                      |      |      |      |                      |      |      |
|----|----------------------------|-------------------|--|------|-------|-----|----------------------|-----|-----|-----|----------------------|---|----------------------|-----|-----|-----|----------------------|-----|-----|-----|---|-----|----------------------|-----|-----|------|----------------------|------|------|------|----------------------|------|------|
|    |                            |                   | 1 <sup>st</sup> Year   |      |       |     | 2 <sup>nd</sup> year |     |     |     | 3 <sup>rd</sup> year |   | 1 <sup>st</sup> Year |     |     |     | 2 <sup>nd</sup> year |     |     |     | 3 <sup>rd</sup> year  |     | 1 <sup>st</sup> Year |     |     |      | 2 <sup>nd</sup> year |      |      |      | 3 <sup>rd</sup> year |      |      |
|    |                            |                   | Apr  | Jul  | Oct   | Jan | Apr                  | Jul | Oct | Jan | Apr                  | Jul   | Apr                  | Jul | Oct | Jan | Apr                  | Jul | Oct | Jan | Apr   | Jul | Apr                  | Jul | Oct | Jan  | Apr                  | Jul  | Oct  | Jan  | Apr                  | Jul  |      |
|    |                            |                   | 1QM  | 2QM  | 3QM   | 4QM | 1QM                  | 2QM | 3QM | 4QM | 1QM                  | 2QM   | 1QM                  | 2QM | 3QM | 4QM | 1QM                  | 2QM | 3QM | 4QM | 1QM   | 2QM | 3QM                  | 4QM | 1QM | 2QM  | 3QM                  | 4QM  | 1QM  | 2QM  | 3QM                  | 4QM  |      |
| 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   | -                    | -   | 3   | -   | -                    | -   | -   | 1   | 5   | 1   | 1                    | -   | 2.2 | -    | 0.74                 | NO   | 1.4  | 0.31 | 0.267                | 1.08 | 0.17 |
| 2  | Rajnagar                   | Deep (>600 ft)    | 0.60   | 0.68 | 0.31  | 26  | -                    | 2.2 | 4.2 | 1.9 | 2.3                  | 3.3   | -                    | -   | 2   | -   | -                    | -   | -   | 2   | 6   | 2   | 1                    | -   | 2.5 | -    | 0.44                 | 1.98 | 1.6  | 0.27 | 0.179                | 1.53 | 0.29 |
| 3  | Kalekarber                 | Shallow (<250 ft) | 0.40   | 0.56 | NF    | NF  | -                    | -   | NF  | NF  | -                    | 3.7   | -                    | 3   | NF  | -   | -                    | -   | -   | -   | NF  | 1   | -                    | 1.2 | NF  | NF   | NF                   | -    | NF   | NF   | -                    | 0.31 |      |
| 4  | Kapasdan ga                | Deep (>600 ft)    | 0.80   | 0.40 | 0.80  | 13  | -                    | 4.7 | 3.8 | 2.8 | 1.9                  | -   | -                    | 10  | -   | -   | -                    | -   | -   | 2   | 2   | 8   | -                    | 6.2 | -   | 0.48 | 4.54                 | 4.1  | 0.48 | 0.17 | 3.26                 | -    |      |

Source: CEGIS Field Survey- April, July and October 2014 and January, April, July and October 2015, January 2016

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

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

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

| SI | Locations                  | As (mg/L)<br>*BD Standard<br>(0.05 mg/L) |       |       |       |                      |       |       |                      |                      |       | Pb (mg/L)<br>*BD Standard<br>(0.05 mg/L) |        |                      |       |       |                      |                      |       |       |       | Hg (mg/L)<br>*BD Standard<br>(0.001 mg/L) |          |         |                      |        |         |          |          |          |        |
|----|----------------------------|--|-------|-------|-------|----------------------|-------|-------|----------------------|----------------------|-------|--|--------|----------------------|-------|-------|----------------------|----------------------|-------|-------|-------|---|----------|---------|----------------------|--------|---------|----------|----------|----------|--------|
|    |                            | 1 <sup>st</sup> Year                     |       |       |       | 2 <sup>nd</sup> year |       |       | 3 <sup>rd</sup> year | 1 <sup>st</sup> Year |       |  |        | 2 <sup>nd</sup> year |       |       | 3 <sup>rd</sup> year | 1 <sup>st</sup> Year |       |       |       | 2 <sup>nd</sup> year                      |          |         | 3 <sup>rd</sup> year |        |         |          |          |          |        |
|    |                            | Apr                                      | Jul   | Oct   | Jan   | Apr                  | Jul   | Oct   | Jan                  | Apr                  | Jul   | Oct                                      | Jan    | Apr                  | Jul   | Oct   | Jan                  | Apr                  | Jul   | Oct   | Jan   | Apr                                       | Jul      | Oct     | Jan                  | Apr    | Jul     | Oct      | Jan      | Apr      | Jul    |
|    |                            | 1QM                                      | 2QM   | 3QM   | 4QM   | 1QM                  | 2QM   | 3QM   | 4QM                  | 1QM                  | 2QM   | 1QM                                      | 2QM    | 3QM                  | 4QM   | 1QM   | 2QM                  | 3QM                  | 4QM   | 1QM   | 2QM   | 3QM                                       | 4QM      | 1QM     | 2QM                  | 3QM    | 4QM     | 1QM      | 2QM      | 1QM      | 2QM    |
| 1  | Township near project site | 0.013                                    | 0.020 | 0.012 | 0.014 | NO                   | 0.015 | 0.002 | 0.008                | 0.018                | 0.012 | 0.002                                    | <0.002 | 0.004                | 0.023 | NO    | 0.002                | 0.006                | 0.026 | 0.019 | 0.002 | <0.00015                                  | <0.00015 | <0.0005 | <0.0005              | NO     | 0.00015 | <0.00015 | <0.00015 | <0.00015 |        |
| 2  | Rajnagar                   | 0.006                                    | 0.009 | 0.006 | 0.008 | 0.01                 | 0.014 | 0.012 | 0.002                | 0.007                | 0.018 | <0.002                                   | <0.002 | <0.002               | 0.016 | 0.013 | 0.0027               | 0.021                | 0.011 | 0.007 | 0.002 | <0.000                                    | <0.000   | <0.000  | <0.000               | <0.000 | 0.0001  | <0.000   | <0.000   | <0.000   | <0.000 |
| 3  | Kalekarber                 | 0.376                                    | 0.407 | NF    | NF    | D                    | D     | NF    | NF                   |                      |       | 0.002                                    | 0.008  | NF                   | NF    | D     | D                    | NF                   | NF    |       |       | <0.0001                                   | <0.0001  | NF      | NF                   | NF     | NF      | NF       | NF       |          |        |
| 4  | Kapasdanga                 | 0.036                                    | 0.033 | 0.020 | 0.017 | 0.034                | 0.024 | 0.011 | 0.002                | 0.047                | 0.005 | <0.002                                   | 0.004  | <0.002               | 0.013 | 0.017 | 0.002                | 0.005                | 0.012 | 0.008 | 0.002 | <0.000                                    | <0.000   | <0.000  | <0.000               | <0.000 | 0.0001  | <0.000   | <0.000   | <0.000   | <0.000 |

Source: CEGIS Field Survey- April, July and October 2014 and January, April, July and October 2015, January 2016

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)

| SI No | Location                             | QM1 (Noise Level in dB (A))<br>Mar-14 |                |                 |              | QM2 (Noise Level in dB (A))<br>Jul-14 |                |                 |              | QM3 (Noise Level in dB (A))<br>Oct-14 |                |                 |              | QM4 (Noise Level in dB (A))<br>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 |      |
| 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)

| SI No | Location                             | QM1 (Noise Level in dB (A))<br>Apr-15 |                |                 |              | QM2 (Noise Level in dB (A))<br>Jul-15 |                |                 |              | QM3 (Noise Level in dB (A))<br>Oct-15 |                |                 |              | QM4 (Noise Level in dB (A))<br>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 |      |
| 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              | -            | 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              | -            | 54.44                                 | 37.69          | NM              | 46.06        | -                                     | -              | -               | -            | 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)

| SI No | Location                             | QM1 (Noise Level in dB (A))<br>Apr-16 |                |                 |              | QM2 (Noise Level in dB (A))<br>Jul-16 |                |                 |              | QM3 (Noise Level in dB (A))<br>Oct-16 |                |                 |              | QM4 (Noise Level in dB (A))<br>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 |      |
| 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         | -                                     | -              | -               | -            | 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         | -                                     | -              | -               | -            | 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         | -                                     | -              | -               | -            | 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         | -                                     | -              | -               | -            | 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         | -                                     | -              | -               | -            | 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         | -                                     | -              | -               | -            | 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         | -                                     | -              | -               | -            | 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         | -                                     | -              | -               | -            | 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         | -                                     | -              | -               | -            | 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         | -                                     | -              | -               | -            | 45   |
| 11    | Hiron Point, Sundarbans              | 48.53                                 | 37.69          | NM              | 43.11        | -                                     | -              | -               | -            | 46.1                                  | 42.08          | 41.9            | 44.0         | -                                     | -              | -               | -            | 45   |

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

## (C) Fisheries resources monitoring data

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

| Life Requirements          | Variable SI. | 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 SI. | Habitat Variables         |
|----------------------------------|--------------|---------------------------|
|                                  | V2           | Zooplankton (%)           |
|                                  | V3           | Turbidity                 |
|                                  | V4           | TDS                       |
|                                  | V5           | Surface water temperature |
|                                  | V6           | Dissolved Oxygen (DO)     |
|                                  | V7           | pH                        |
|                                  | V8           | Salinity                  |
| Food (C <sub>F</sub> )           | V1           | Phytoplankton (%)         |
|                                  | V2           | Zooplankton (%)           |
| Water Quality (C <sub>WQ</sub> ) | V3           | Turbidity                 |
|                                  | V4           | TDS                       |
|                                  | V5           | Surface water temperature |
|                                  | V6           | Dissolved Oxygen (DO)     |
|                                  | V7           | pH                        |
|                                  | V8           | Salinity                  |
| Reproduction (C <sub>R</sub> )   | 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* | 1 <sup>st</sup> QM         | 2 <sup>nd</sup> QM | 3 <sup>rd</sup> QM | 4 <sup>th</sup> QM | 5 <sup>th</sup> QM | 6 <sup>th</sup> QM | 7 <sup>th</sup> QM | 8 <sup>th</sup> QM | 9 <sup>th</sup> QM | 10 <sup>th</sup> QM | 11 <sup>th</sup> QM | 12 <sup>th</sup> QM |
|-------------|-----------------------------|---------------|----------------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|---------------------|---------------------|---------------------|
|             |                             |               | ‘-’ = No; ‘+’ = Occurrence |                    |                    |                    |                    |                    |                    |                    |                    |                     |                     |                     |
| Amadi Chela | <i>Chela sp.</i>            | DD            | -                          | -                  | +                  | +                  | +                  | -                  | +                  | +                  | -                  | +                   | -                   |                     |
| Hilsa       | <i>Tenualosa ilisha</i>     | NO            | -                          | -                  | +                  | -                  | -                  | +                  | +                  | -                  | -                  | -                   | +                   |                     |
| Sagor Baim  | <i>Anguilla bengalensis</i> |               | +                          | -                  | -                  | -                  | -                  | -                  | -                  | -                  | -                  | -                   | -                   |                     |

| Local Name        | Scientific Name                      | Local Status* | 1 <sup>st</sup> QM         | 2 <sup>nd</sup> QM | 3 <sup>rd</sup> QM | 4 <sup>th</sup> QM | 5 <sup>th</sup> QM | 6 <sup>th</sup> QM | 7 <sup>th</sup> QM | 8 <sup>th</sup> QM | 9 <sup>th</sup> QM | 10 <sup>th</sup> QM | 11 <sup>th</sup> QM | 12 <sup>th</sup> QM |
|-------------------|--------------------------------------|---------------|----------------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|---------------------|---------------------|---------------------|
|                   |                                      |               | ‘-’ = No; ‘+’ = Occurrence |                    |                    |                    |                    |                    |                    |                    |                    |                     |                     |                     |
| Baim              | <i>Pisodonophis cancrivorus</i>      | NT            | -                          | -                  | -                  | -                  | -                  | +                  | -                  | -                  | -                  | -                   | -                   |                     |
| Bacha             | <i>Eutropiichthys vacha</i>          | CR            | +                          | -                  | -                  | -                  | -                  | -                  | -                  | -                  | -                  | -                   | -                   |                     |
| Bagda Chingri     | <i>Penaeus monodon</i>               | DD            | +                          | +                  | +                  | +                  | +                  | +                  | +                  | +                  | +                  | +                   | -                   |                     |
| Banspata          | <i>Brachypleura novae-zeelandiae</i> | NO            | +                          | +                  | +                  | +                  | -                  | +                  | +                  | +                  | +                  | +                   | +                   |                     |
| Kukurjib          | <i>Cynoglossus lingua</i>            | NO            | +                          | -                  | -                  | -                  | -                  | -                  | -                  | +                  | +                  | -                   | -                   |                     |
| Bele              | <i>Glossogobius giuris</i>           | NO            | +                          | +                  | +                  | +                  | +                  | +                  | +                  | +                  | +                  | +                   | +                   |                     |
| Aswine Bele       |                                      | NO            | -                          | -                  | -                  | -                  | -                  | -                  | +                  | +                  | +                  | -                   | +                   |                     |
| Bairagi           | <i>Coilia dussumieri</i>             | NO            | +                          | +                  | +                  | +                  | +                  | +                  | -                  | +                  | -                  | +                   | -                   |                     |
| Boishakhi Chingri |                                      | NO            | -                          | +                  | -                  | -                  | +                  | +                  | +                  | +                  | +                  | -                   | -                   |                     |
| Chammu Chingri    | <i>Metapenaeus brevicornis</i>       | DD            | +                          | +                  | +                  | -                  | +                  | +                  | +                  | +                  | +                  | -                   | +                   |                     |
| Chaka Chingri     | <i>Penaeus indicus</i>               | DD            | +                          | +                  | -                  | +                  | +                  | +                  | +                  | +                  | +                  | +                   | +                   |                     |
| Ghora Chela       | <i>Securicula gora</i>               | -             | +                          | -                  | -                  | -                  | -                  | -                  | -                  | -                  | -                  | -                   | -                   |                     |
| Chanda Chela      |                                      |               | -                          | +                  | +                  | -                  | -                  | -                  | -                  | -                  | +                  | -                   | -                   |                     |
| Chitra            |                                      |               | +                          | -                  | -                  | +                  | +                  | +                  | -                  | +                  | +                  | +                   | +                   |                     |
| Khayra Chela      |                                      |               | -                          | +                  | -                  | -                  | -                  | -                  | +                  | -                  | +                  | -                   | -                   |                     |
| Sada Chewa        | <i>Trepachen vagina</i>              | NO            | +                          | -                  | +                  | -                  | -                  | +                  | -                  | -                  | -                  | -                   | -                   |                     |
| Lal Chewa         | <i>Odontamblyopus rubicundus</i>     | NO            | +                          | +                  | +                  | +                  | +                  | +                  | +                  | +                  | +                  | +                   | -                   |                     |
| Chhuri            | <i>Trichiurus muticus</i>            | NO            | +                          | -                  | +                  | -                  | -                  | -                  | -                  | -                  | -                  | -                   | -                   |                     |
| Sagor Chela       | <i>Megalops cyprinoids</i>           | NO            | +                          | -                  | -                  | -                  | -                  | -                  | -                  | -                  | -                  | -                   | -                   |                     |
| Purabi Chela      | <i>Thryssa purava</i>                | NO            | +                          | -                  | -                  | -                  | -                  | -                  | -                  | -                  | -                  | -                   | -                   |                     |

| Local Name     | Scientific Name                       | Local Status* | 1 <sup>st</sup> QM         | 2 <sup>nd</sup> QM | 3 <sup>rd</sup> QM | 4 <sup>th</sup> QM | 5 <sup>th</sup> QM | 6 <sup>th</sup> QM | 7 <sup>th</sup> QM | 8 <sup>th</sup> QM | 9 <sup>th</sup> QM | 10 <sup>th</sup> QM | 11 <sup>th</sup> QM | 12 <sup>th</sup> QM |
|----------------|---------------------------------------|---------------|----------------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|---------------------|---------------------|---------------------|
|                |                                       |               | ‘-’ = No; ‘+’ = Occurrence |                    |                    |                    |                    |                    |                    |                    |                    |                     |                     |                     |
| Kabashi Tengra | <i>Mystus cavasius</i>                | DD            | +                          | -                  | -                  | -                  | -                  | -                  | -                  | -                  | -                  | -                   | -                   |                     |
| Gagra Tengra   |                                       | DD            | -                          | +                  | +                  | -                  | +                  | -                  | +                  | -                  | +                  | -                   | +                   |                     |
| Gulsha Tengra  | <i>Mystus bleekery</i>                | DD            | +                          | +                  | -                  | +                  | -                  | +                  | +                  | +                  | +                  | +                   | +                   |                     |
| Harina Chingri | <i>Metapenaeus ensis</i>              | DD            | +                          | +                  | +                  | +                  | +                  | +                  | +                  | +                  | +                  | +                   | +                   |                     |
| Ekthuto        | <i>Hyporhamphus limbatus</i>          | NO            | +                          | -                  | +                  | +                  | -                  | -                  | -                  | +                  | +                  | -                   | +                   |                     |
| Kakila         | <i>Xenentodon cancila</i>             | NO            | +                          | -                  | -                  | -                  | -                  | -                  | -                  | -                  | -                  | -                   | +                   |                     |
| Chapila        | <i>Gudusia chapra</i>                 | NO            | +                          | +                  | -                  | -                  | -                  | -                  | -                  | -                  | -                  | -                   | -                   |                     |
| Kuchia         | <i>Monopterusuchia</i>                | DD            | +                          | +                  | -                  | +                  | +                  | +                  | +                  | +                  | +                  | +                   | +                   |                     |
| Kain Magur     |                                       | EN            | -                          | +                  | +                  | +                  | +                  | +                  | +                  | +                  | +                  | +                   | +                   |                     |
| Loitta         | <i>Harpodon nehereus</i>              | NO            | +                          | +                  | +                  | -                  | +                  | -                  | -                  | -                  | +                  | -                   | -                   |                     |
| Motka Chingri  | <i>Macrobrachium villosimanusless</i> | DD            | +                          | +                  | +                  | +                  | +                  | +                  | +                  | +                  | +                  | +                   | +                   |                     |
| Mud Crab       | <i>Scylla serrata</i>                 | NO            | +                          | -                  | +                  | +                  | +                  | +                  | +                  | +                  | +                  | +                   | +                   |                     |
| Tular Dandi    | <i>Sillaginopsis panijus</i>          | NO            | +                          | -                  | +                  | -                  | +                  | -                  | +                  | -                  | -                  | -                   | +                   |                     |
| Paيرا Chanda   | <i>Scatophagus argus</i>              | DD            | +                          | -                  | -                  | -                  | -                  | -                  | -                  | -                  | -                  | -                   | -                   |                     |
| Paissa         | <i>Liza parsia</i>                    | NO            | +                          | +                  | +                  | +                  | +                  | +                  | +                  | +                  | +                  | +                   | +                   |                     |
| Pangas         | <i>Pangasius pangasius</i>            | CR            | +                          | -                  | +                  | -                  | -                  | -                  | -                  | +                  | -                  | +                   | -                   |                     |
| Tak Chanda     | <i>Leiognathus equulus</i>            | NO            | +                          | -                  | -                  | -                  | -                  | -                  | +                  | -                  | -                  | -                   | -                   |                     |
| Phessa         | <i>Setipinna phasa</i>                | NO            | +                          | +                  | +                  | +                  | +                  | +                  | +                  | +                  | +                  | +                   | +                   |                     |
| Teli Phessa    | -                                     | -             | -                          | -                  | +                  | -                  | -                  | -                  | -                  | -                  | -                  | -                   | -                   |                     |
| Poma           | <i>Poma poma</i>                      | NO            | +                          | +                  | +                  | +                  | +                  | +                  | +                  | +                  | +                  | +                   | +                   |                     |

| Local Name | Scientific Name                    | Local Status* | 1 <sup>st</sup> QM         | 2 <sup>nd</sup> QM | 3 <sup>rd</sup> QM | 4 <sup>th</sup> QM | 5 <sup>th</sup> QM | 6 <sup>th</sup> QM | 7 <sup>th</sup> QM | 8 <sup>th</sup> QM | 9 <sup>th</sup> QM | 10 <sup>th</sup> QM | 11 <sup>th</sup> QM | 12 <sup>th</sup> QM |
|------------|------------------------------------|---------------|----------------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|---------------------|---------------------|---------------------|
|            |                                    |               | ‘-’ = No; ‘+’ = Occurrence |                    |                    |                    |                    |                    |                    |                    |                    |                     |                     |                     |
| Potka      | <i>Chelonodon patoca</i>           | NO            | +                          | +                  | -                  | +                  | +                  | +                  | -                  | +                  | +                  | +                   | +                   |                     |
| Shilong    | <i>Silonia silondia</i>            | EN            | +                          | -                  | +                  | -                  | -                  | -                  | -                  | -                  | -                  | -                   | +                   |                     |
| Tailla     | <i>Eleutheronema tetradactylum</i> | -             | +                          | -                  | -                  | -                  | -                  | -                  | -                  | -                  | -                  | -                   | -                   |                     |
| Tapse      | <i>Polynemus paradiseus</i>        | -             | +                          | +                  | +                  | -                  | -                  | +                  | +                  | +                  | -                  | +                   | +                   |                     |
| Datina     |                                    |               | -                          | -                  | -                  | +                  | -                  | -                  | -                  | +                  | +                  | -                   | +                   |                     |
| Jaba       |                                    |               | -                          | -                  | -                  | +                  | -                  | -                  | +                  | +                  | -                  | -                   | -                   |                     |
| Shole      | <i>Channa striatus</i>             |               | -                          | -                  | -                  | +                  | -                  | -                  | -                  | +                  | -                  | -                   | -                   |                     |
| Magur      | <i>Clarias batrachus</i>           |               | -                          | -                  | -                  | +                  | -                  | -                  | -                  | +                  | -                  | -                   | -                   |                     |
| Koi        | <i>Anabas testudineus</i>          |               | -                          | -                  | -                  | +                  | -                  | -                  | -                  | +                  | -                  | -                   | -                   |                     |
| Vetki      |                                    |               | -                          | -                  | -                  | +                  | +                  | +                  | +                  | +                  | +                  | +                   | +                   |                     |
| Gangania   |                                    |               | -                          | -                  | -                  | +                  | +                  | -                  | +                  | -                  | -                  | -                   | +                   |                     |

\*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   | Harbaria | 0.00      | 0.00         | 0.00         | 18.75         | 81.25          | 0.00       | 0.00       |
| Banspata      | Harbaria | 0.00      | 0.00         | 0.00         | 0.00          | 0.00           | 100.00     | 0.00       |
| Bele          | Chandpai | 0.00      | 0.00         | 0.00         | 100.00        | 0.00           | 0.00       | 0.00       |
| Chaka Chingri | Chandpai | 0.00      | 0.00         | 0.00         | 100.00        | 0.00           | 0.00       | 0.00       |
| Chali Chingri | Chandpai | 0.00      | 0.00         | 100.00       | 0.00          | 0.00           | 0.00       | 0.00       |
| Chami Chingri | Harbaria | 0.00      | 100.00       | 0.00         | 0.00          | 0.00           | 0.00       | 0.00       |
| Chata Bele    | Chandpai | 0.00      | 0.00         | 0.00         | 0.00          | 33.33          | 66.67      | 0.00       |
| Chitra        | Chandpai | 0.00      | 100.00       | 0.00         | 0.00          | 0.00           | 0.00       | 0.00       |

| 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 |
|----------------|--------------|-----------|--------------|--------------|---------------|----------------|------------|------------|
| Daitna         | Chandpai     | 0.00      | 0.00         | 0.00         | 100.00        | 0.00           | 0.00       | 0.00       |
| Ekthuto        | Harbaria     | 0.00      | 0.00         | 0.00         | 0.00          | 100.00         | 0.00       | 0.00       |
| Gagra Tengra   | Harbaria     | 0.00      | 0.00         | 0.00         | 0.00          | 100.00         | 0.00       | 0.00       |
| Gangania       | Chandpai     | 0.00      | 0.00         | 0.00         | 100.00        | 0.00           | 0.00       | 0.00       |
| Goda Chingri   | Harbaria     | 0.00      | 0.00         | 100.00       | 0.00          | 0.00           | 0.00       | 0.00       |
| Golda          | Chandpai     | 0.00      | 0.00         | 0.00         | 0.00          | 68.42          | 31.58      | 0.00       |
|                | Harbaria     | 0.00      | 0.00         | 0.00         | 100.00        | 0.00           | 0.00       | 0.00       |
| Gulsha Tengra  | Chalna Point | 0.00      | 0.00         | 0.00         | 100.00        | 0.00           | 0.00       | 0.00       |
|                | Chandpai     | 0.00      | 0.00         | 0.00         | 100.00        | 0.00           | 0.00       | 0.00       |
|                | Maidara      | 0.00      | 0.00         | 100.00       | 0.00          | 0.00           | 0.00       | 0.00       |
|                | Mongla Point | 0.00      | 0.00         | 0.00         | 100.00        | 0.00           | 0.00       | 0.00       |
| Hilsha         | Akram Point  | 0.00      | 0.00         | 0.00         | 0.00          | 0.00           | 0.00       | 100.00     |
|                | Haldikhali   | 0.00      | 0.00         | 0.00         | 0.00          | 0.00           | 0.00       | 100.00     |
|                | Harbaria     | 0.00      | 0.00         | 0.00         | 0.00          | 0.00           | 0.00       | 100.00     |
|                | Maidara      | 0.00      | 0.00         | 0.00         | 0.00          | 100.00         | 0.00       | 0.00       |
|                | Mongla Point | 0.00      | 0.00         | 0.00         | 0.00          | 0.00           | 0.00       | 100.00     |
| Horina         | Maidara      | 0.00      | 0.00         | 100.00       | 0.00          | 0.00           | 0.00       | 0.00       |
| Horina Chingri | Harbaria     | 0.00      | 100.00       | 0.00         | 0.00          | 0.00           | 0.00       | 0.00       |
| Kain Magur     | Chandpai     | 0.00      | 0.00         | 0.00         | 0.00          | 0.00           | 100.00     | 0.00       |
|                | Harbaria     | 0.00      | 0.00         | 0.00         | 28.57         | 71.43          | 0.00       | 0.00       |
| Kakila         | Harbaria     | 0.00      | 0.00         | 0.00         | 0.00          | 100.00         | 0.00       | 0.00       |
| Kash Chela     | Chalna Point | 100.00    | 0.00         | 0.00         | 0.00          | 0.00           | 0.00       | 0.00       |
| Katali Chingri | Chandpai     | 0.00      | 0.00         | 100.00       | 0.00          | 0.00           | 0.00       | 0.00       |
|                | Harbaria     | 0.00      | 0.00         | 0.00         | 0.00          | 0.00           | 0.00       | 100.00     |
| Khorsula       | Chalna Point | 100.00    | 0.00         | 0.00         | 0.00          | 0.00           | 0.00       | 0.00       |
| Koidda Vola    | Chandpai     | 0.00      | 0.00         | 0.00         | 100.00        | 0.00           | 0.00       | 0.00       |
|                | Harbaria     | 0.00      | 0.00         | 0.00         | 0.00          | 100.00         | 0.00       | 0.00       |
| Kuchia         | Chandpai     | 0.00      | 0.00         | 0.00         | 0.00          | 0.00           | 100.00     | 0.00       |

| 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 |
|---------------|--------------|-----------|--------------|--------------|---------------|----------------|------------|------------|
| Motka Chingri | Harbaria     | 0.00      | 0.00         | 100.00       | 0.00          | 0.00           | 0.00       | 0.00       |
| Moukatali     | Harbaria     | 0.00      | 0.00         | 0.00         | 75.00         | 0.00           | 0.00       | 25.00      |
| Nona Bele     | Chandpai     | 0.00      | 0.00         | 0.00         | 0.00          | 100.00         | 0.00       | 0.00       |
|               | Harbaria     | 0.00      | 100.00       | 0.00         | 0.00          | 0.00           | 0.00       | 0.00       |
| Paissa        | Chandpai     | 0.00      | 0.00         | 0.00         | 100.00        | 0.00           | 0.00       | 0.00       |
|               | Harbaria     | 0.00      | 0.00         | 55.56        | 33.33         | 11.11          | 0.00       | 0.00       |
|               | Maidara      | 0.00      | 0.00         | 100.00       | 0.00          | 0.00           | 0.00       | 0.00       |
| Pheksha       | Mongla Point | 0.00      | 0.00         | 0.00         | 0.00          | 100.00         | 0.00       | 0.00       |
| Poma          | Chalna Point | 0.00      | 0.00         | 0.00         | 12.50         | 75.00          | 12.50      | 0.00       |
|               | Chandpai     | 0.00      | 0.00         | 0.00         | 0.00          | 40.00          | 0.00       | 60.00      |
|               | Harbaria     | 0.00      | 0.00         | 0.00         | 0.00          | 50.00          | 0.00       | 50.00      |
|               | Mongla Point | 0.00      | 0.00         | 0.00         | 0.00          | 61.54          | 0.00       | 38.46      |
| Potka         | Chandpai     | 0.00      | 0.00         | 9.09         | 90.91         | 0.00           | 0.00       | 0.00       |
| Sada Chanda   | Harbaria     | 0.00      | 100.00       | 0.00         | 0.00          | 0.00           | 0.00       | 0.00       |
| Shilong       | Chalna Point | 0.00      | 0.00         | 0.00         | 0.00          | 0.00           | 100.00     | 0.00       |
| Tapsi         | Chalna Point | 0.00      | 0.00         | 0.00         | 0.00          | 100.00         | 0.00       | 0.00       |
|               | Chandpai     | 0.00      | 0.00         | 0.00         | 100.00        | 0.00           | 0.00       | 0.00       |
|               | Mongla Point | 0.00      | 0.00         | 0.00         | 0.00          | 100.00         | 0.00       | 0.00       |
| Tular Dandi   | Chalna Point | 0.00      | 0.00         | 0.00         | 0.00          | 0.00           | 100.00     | 0.00       |
| Vetki         | Chandpai     | 0.00      | 0.00         | 0.00         | 0.00          | 0.00           | 100.00     | 0.00       |
|               | Harbaria     | 0.00      | 0.00         | 0.00         | 0.00          | 0.00           | 100.00     | 0.00       |

Source: CEGIS field survey, 2015

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 Monitoring (April, 2014) | 2nd Monitoring (July, 2014) | 3rd Monitoring (Oct, 2014) | 4th Monitoring (Dec, 2014) | 5th Monitoring (April, 2015) | 6th Monitoring (July, 2015) | 7th Monitoring (Oct, 2015) | 8th Monitoring (Dec, 2015) | 9th Monitoring (April, 2016) | 10th Monitoring (July, 2016) | 11th Monitoring (Oct, 2016) | 12th Monitoring (Dec, 2016) |
| 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       | -                          | -                            | Breeding                     | Feeding and Growing         |                             |
|                        |                           | Adult                      | -                            | -                           | Feeding and Growing        | -                          | -                            | Feeding                     | Feeding                    | -                          | -                            | Breeding                     |                             |                             |
|                        | Harbaria                  | Juvenile and Age-1 adult   | Feeding and Growing          | Feeding and Growing         |                            | -                          | -                            | -                           | -                          | -                          | -                            | -                            | -                           |                             |
|                        |                           | Adult and Brood Fish       | -                            | -                           | Breeding and Spawning      | -                          | -                            | -                           | -                          | -                          | -                            | -                            | -                           |                             |
|                        | Chandpai                  | Juvenile                   | -                            | -                           | Feeding and Growing        | -                          | -                            | -                           | Feeding                    | -                          | -                            | -                            | Feeding                     |                             |
|                        | South-west of the Project | Age-1 adult                | Feeding and Growing          | Feeding and Growing         | Feeding and Growing        | -                          | -                            | Feeding                     | -                          | -                          | -                            | Feeding                      | -                           |                             |
|                        |                           | Brood Fish                 | -                            | -                           | -                          | -                          | -                            | Breeding and Spawning       | -                          | -                          | -                            | 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 Monitoring (April, 2014) | 2nd Monitoring (July, 2014) | 3rd Monitoring (Oct, 2014) | 4th Monitoring (Dec, 2014) | 5th Monitoring (April, 2015) | 6th Monitoring (July, 2015) | 7th Monitoring (Oct, 2015) | 8th Monitoring (Dec, 2015) | 9th Monitoring (April, 2016) | 10th Monitoring (July, 2016) | 11th Monitoring (Oct, 2016) | 12th Monitoring (Dec, 2016) |
|                        | 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                 | -                            | -                           | -                          | -                          | -                            | -                           | -                          | -                          | -                            | Feeding                      | -                           |                             |
|                        | Chalna Point              | Juvenile and Age-1 adult | Feeding and Growing          | -                           | -                          | -                          | Feeding and Growing          | -                           | -                          | -                          | -                            | -                            | -                           |                             |
|                        | Harbaria                  | Juvenile                 | Feeding and Growing          | -                           | -                          | -                          | -                            | Feeding                     | -                          | -                          | -                            | -                            | -                           |                             |
|                        | Mongla Point              | Fry                      | -                            | Nursing                     | -                          | Feeding                    | -                            | -                           | -                          | -                          | -                            | -                            | -                           |                             |
|                        |                           | Juvenile                 | -                            | -                           | -                          | -                          | -                            | -                           | -                          | Feeding                    | -                            | Feeding                      | -                           |                             |
|                        | South-west of the Project | Juvenile                 | -                            | Feeding and Growing         | -                          | -                          | -                            | -                           | -                          | -                          | -                            | -                            | -                           |                             |
| 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        | -                          | -                            | -                           | -                          | -                          | -                            | -                            | -                           |                             |

| Migratory Fish Species | Sampling Sites | Year Class*                   | Migration Purpose            |                              |                            |                            |                              |                             |                            |                            |                              |                              |                             |                             |
|------------------------|----------------|-------------------------------|------------------------------|------------------------------|----------------------------|----------------------------|------------------------------|-----------------------------|----------------------------|----------------------------|------------------------------|------------------------------|-----------------------------|-----------------------------|
|                        |                |                               | 1st Monitoring (April, 2014) | 2nd Monitoring (July, 2014)  | 3rd Monitoring (Oct, 2014) | 4th Monitoring (Dec, 2014) | 5th Monitoring (April, 2015) | 6th Monitoring (July, 2015) | 7th Monitoring (Oct, 2015) | 8th Monitoring (Dec, 2015) | 9th Monitoring (April, 2016) | 10th Monitoring (July, 2016) | 11th Monitoring (Oct, 2016) | 12th Monitoring (Dec, 2016) |
|                        | Akram Point    | Juvenile                      | Feeding and Growing          | -                            | -                          | -                          | Feeding and Growing          | -                           | -                          | -                          | -                            | -                            | -                           |                             |
|                        | Akram Point    | Age-1 adult                   | -                            | -                            | Feeding and Growing        | -                          | Feeding and Growing          | -                           | -                          | -                          | -                            | -                            | -                           |                             |
|                        | Chandpai       | Juvenile                      | Feeding and Growing          | -                            | -                          | -                          | -                            | -                           | -                          | -                          | -                            | -                            | -                           |                             |
|                        | Harbaria       | Fry, Juvenile and Age-1 adult | -                            | Nursing, Feeding and Growing | -                          | -                          | -                            | -                           | -                          | -                          | -                            | -                            | -                           |                             |
|                        | Chalna Point   | Age-1 adult                   | -                            | Feeding and Growing          | -                          | -                          | Feeding and Growing          | -                           | -                          | -                          | -                            | -                            | -                           |                             |
|                        |                | Fry                           | -                            | -                            | -                          | -                          | -                            | -                           | -                          | -                          | Nursing                      | -                            | -                           |                             |
| Poma                   | Haldikhali     | Juvenile                      | Feeding and Growing          | -                            | -                          | Feeding                    | -                            | -                           | -                          |                            | -                            | -                            | -                           |                             |

| Migratory Fish Species | Sampling Sites    | Year Class*                   | Migration Purpose            |                             |                               |                            |                              |                             |                            |                            |                              |                              |                             |                             |
|------------------------|-------------------|-------------------------------|------------------------------|-----------------------------|-------------------------------|----------------------------|------------------------------|-----------------------------|----------------------------|----------------------------|------------------------------|------------------------------|-----------------------------|-----------------------------|
|                        |                   |                               | 1st Monitoring (April, 2014) | 2nd Monitoring (July, 2014) | 3rd Monitoring (Oct, 2014)    | 4th Monitoring (Dec, 2014) | 5th Monitoring (April, 2015) | 6th Monitoring (July, 2015) | 7th Monitoring (Oct, 2015) | 8th Monitoring (Dec, 2015) | 9th Monitoring (April, 2016) | 10th Monitoring (July, 2016) | 11th Monitoring (Oct, 2016) | 12th Monitoring (Dec, 2016) |
|                        | 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                     | -                          | -                          | -                            | Feeding                      | -                           |                             |
|                        |                   | Juvenile                      | -                            | -                           | Feeding and Growing           | Feeding                    | Feeding and Growing          | -                           | Feeding and Growing        |                            | -                            |                              | Feeding and Growing         |                             |
|                        |                   | Adult                         | -                            | -                           | -                             | -                          | -                            | -                           | Feeding                    |                            | -                            |                              |                             |                             |
|                        |                   | Brood Fish                    | -                            | -                           | -                             | -                          | -                            | -                           | -                          |                            | -                            | -                            | Spawning                    |                             |
|                        | Haldikhali        | Fry and Juvenile              | -                            | -                           | Nursing                       | -                          | -                            | -                           | -                          | -                          | -                            | -                            | -                           |                             |
|                        | Harbaria          | Adult and Brood Fish          | -                            | -                           | Breeding and Spawning         | -                          | -                            | -                           | -                          | -                          | -                            | -                            | Feeding and Spawning        |                             |
|                        |                   | Adult                         | -                            | -                           | -                             | -                          | -                            | -                           | Feeding                    |                            | -                            | -                            | -                           |                             |
|                        |                   | Fry and Juvenile              |                              |                             |                               |                            |                              | Spawning and Nursery        | -                          | -                          | Feeding and Growing          | -                            | -                           |                             |
|                        | Mongla Point      | Fry, Juvenile and Age-1 adult | -                            | -                           | Spawning, Feeding and Growing | -                          | -                            | -                           | -                          | Nursing                    | -                            | -                            | -                           |                             |
|                        |                   | Juvenile                      | -                            | -                           | -                             | -                          | -                            | -                           | Feeding and Growing        |                            | -                            |                              | -                           |                             |
|                        |                   | Age-1 Adult                   | -                            | -                           | -                             | -                          | -                            | -                           | Feeding                    | Feeding                    | -                            | -                            | -                           |                             |
|                        |                   | Adult                         | -                            | -                           |                               | Feeding                    | -                            | Feeding                     | -                          | -                          | -                            | -                            | Feeding                     |                             |
|                        |                   | Brood Fish                    | -                            | -                           | -                             | -                          | -                            | -                           | -                          | -                          | -                            | -                            | Spawning                    |                             |
|                        | South-west of the | Adult                         | -                            | -                           | Feeding                       | Feeding                    | -                            | Feeding                     | -                          | -                          | -                            | Feeding                      |                             |                             |

| Migratory Fish Species | Sampling Sites | Year Class*                    | Migration Purpose            |                             |                            |                            |                              |                             |                            |                            |                              |                               |                               |                             |
|------------------------|----------------|--------------------------------|------------------------------|-----------------------------|----------------------------|----------------------------|------------------------------|-----------------------------|----------------------------|----------------------------|------------------------------|-------------------------------|-------------------------------|-----------------------------|
|                        |                |                                | 1st Monitoring (April, 2014) | 2nd Monitoring (July, 2014) | 3rd Monitoring (Oct, 2014) | 4th Monitoring (Dec, 2014) | 5th Monitoring (April, 2015) | 6th Monitoring (July, 2015) | 7th Monitoring (Oct, 2015) | 8th Monitoring (Dec, 2015) | 9th Monitoring (April, 2016) | 10th Monitoring (July, 2016)  | 11th Monitoring (Oct, 2016)   | 12th Monitoring (Dec, 2016) |
|                        | Project        |                                |                              |                             |                            |                            |                              |                             |                            |                            |                              |                               |                               |                             |
|                        | Chalna Point   | Juvenile, Adult and Brood Fish | Breeding and Spawning        | -                           | -                          | -                          | -                            | -                           | -                          | -                          | -                            | Spawning                      | Feeding, Growing and Spawning |                             |
|                        |                | Juvenile and Adult             | -                            | -                           | Feeding and Growing        | Feeding                    | Feeding and Growing          | -                           | Feeding and Growing        | -                          | -                            | -                             | -                             |                             |
|                        |                | Fry                            | -                            | -                           | -                          | -                          | -                            | -                           | -                          | -                          | Nursery                      | Feeding, Growing and Spawning | -                             |                             |
| Chhuri                 | Haldikhali     | Adult                          | Feeding                      | -                           | Feeding                    | -                          | -                            | -                           | -                          | -                          | -                            | -                             | -                             |                             |
|                        | Akram Point    |                                | Feeding                      | -                           | Feeding                    | -                          | -                            | -                           | -                          | -                          | -                            | -                             | -                             |                             |
| Chela                  | Haldikhali     | Adult                          | Feeding                      | -                           | Feeding                    | -                          | -                            | -                           | -                          | -                          | -                            | -                             | -                             |                             |
|                        | Akram Point    | Juvenile and Adult             | Feeding and Growing          | -                           | -                          | -                          | -                            | -                           | -                          | -                          | -                            | -                             | -                             |                             |
|                        | Harbaria       | Fry and Juvenile               | -                            | Feeding and Growing         | -                          | -                          | -                            | Nursery                     | -                          | -                          | -                            | -                             | -                             |                             |
|                        | Chandpai       |                                | -                            | -                           | -                          | -                          | -                            | -                           | -                          | Growing and Feeding        | Nursery                      | -                             | -                             |                             |
| Gang Tengra            | Haldikhali     | Adult                          | Feeding                      | -                           | Feeding                    | Feeding                    | -                            | -                           | -                          | -                          | -                            | -                             | -                             |                             |
|                        | Akram Point    | Adult                          | Feeding and Breeding         | -                           | -                          | Feeding                    | -                            | -                           | -                          | -                          | -                            | -                             | -                             |                             |
|                        | Harbaria       | Adult                          | -                            | -                           | Feeding                    | -                          | -                            | -                           | -                          | -                          | -                            | -                             | -                             |                             |
|                        | Chandpai       | Adult                          | -                            | -                           | Feeding                    | Feeding                    | -                            | -                           | -                          | -                          | -                            | -                             | -                             |                             |
| Gagra Tengra           | Chandpai       | Juvenile and Age-1 adult       | -                            | Feeding and Growing         | -                          | -                          | Feeding and Growing          | -                           | -                          | -                          | -                            | -                             | -                             |                             |

| Migratory Fish Species | Sampling Sites | Year Class*        | Migration Purpose            |                             |                            |                            |                              |                             |                            |                            |                              |                              |                             |                             |
|------------------------|----------------|--------------------|------------------------------|-----------------------------|----------------------------|----------------------------|------------------------------|-----------------------------|----------------------------|----------------------------|------------------------------|------------------------------|-----------------------------|-----------------------------|
|                        |                |                    | 1st Monitoring (April, 2014) | 2nd Monitoring (July, 2014) | 3rd Monitoring (Oct, 2014) | 4th Monitoring (Dec, 2014) | 5th Monitoring (April, 2015) | 6th Monitoring (July, 2015) | 7th Monitoring (Oct, 2015) | 8th Monitoring (Dec, 2015) | 9th Monitoring (April, 2016) | 10th Monitoring (July, 2016) | 11th Monitoring (Oct, 2016) | 12th Monitoring (Dec, 2016) |
|                        | Chalna Point   | Age-1 adult        | -                            | -                           | -                          | -                          | Feeding and Growing          | -                           | -                          | -                          | -                            | -                            | -                           |                             |
|                        | Mongla Point   | Age-1 adult        | -                            | Feeding and Growing         | -                          | -                          | -                            | -                           | -                          | -                          | -                            | -                            | -                           |                             |
|                        | Akram Point    | Juvenile and Adult | -                            | -                           | Feeding and Growing        | -                          | -                            | -                           | -                          | -                          | -                            | -                            | -                           |                             |
|                        |                | Adult              | -                            | -                           | -                          | -                          | -                            | -                           | Feeding                    | -                          | -                            | -                            | -                           |                             |
|                        | Haldikhali     | Juvenile           | -                            | -                           | -                          | -                          | -                            | -                           | Feeding and Growing        | -                          | -                            | -                            | -                           |                             |
|                        | Harbaria       | Adult              | -                            | -                           | Feeding                    | -                          | Feeding and Growing          | -                           | -                          | -                          | Feeding                      | -                            | Feeding                     |                             |
| Gulsha                 | Haldikhali     | Adult              | Feeding and                  | -                           | -                          | -                          | -                            | -                           | -                          | -                          | -                            | -                            | -                           |                             |

| Migratory Fish Species | Sampling Sites | Year Class*              | Migration Purpose            |                             |                            |                            |                              |                             |                            |                            |                              |                              |                             |                             |
|------------------------|----------------|--------------------------|------------------------------|-----------------------------|----------------------------|----------------------------|------------------------------|-----------------------------|----------------------------|----------------------------|------------------------------|------------------------------|-----------------------------|-----------------------------|
|                        |                |                          | 1st Monitoring (April, 2014) | 2nd Monitoring (July, 2014) | 3rd Monitoring (Oct, 2014) | 4th Monitoring (Dec, 2014) | 5th Monitoring (April, 2015) | 6th Monitoring (July, 2015) | 7th Monitoring (Oct, 2015) | 8th Monitoring (Dec, 2015) | 9th Monitoring (April, 2016) | 10th Monitoring (July, 2016) | 11th Monitoring (Oct, 2016) | 12th Monitoring (Dec, 2016) |
|                        | Akram Point    | Adult                    |                              | -                           | -                          | -                          | -                            | -                           | -                          | -                          | -                            | -                            | -                           |                             |
|                        | Chandpai       | Age-1 adult              | -                            | -                           | -                          | Feeding                    | -                            | Feeding                     | Feeding and Growing        | -                          | -                            | Feeding                      | -                           |                             |
|                        |                | Juvenile                 | -                            | -                           | -                          | -                          | -                            | -                           | Feeding and Growing        |                            | -                            | -                            | Feeding and Growing         |                             |
|                        | Mongla Point   | Age-1 adult              | -                            | Feeding and Growing         | -                          | Feeding and Growing        | -                            | Feeding and Growing         |                            | -                          | Feeding and Growing          | Feeding and Growing          | -                           |                             |
|                        |                | Juvenile                 | -                            | -                           | -                          | -                          | -                            | -                           | Feeding and Growing        |                            | -                            | -                            | Feeding and Growing         |                             |
|                        | Harbaria       | Juvenile                 | -                            | -                           | -                          | -                          | -                            | -                           | Feeding and Growing        |                            | -                            | -                            | 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         | -                           | -                          | -                          | -                            | -                           | -                          | -                          | -                            | -                            | -                           |                             |

| Migratory Fish Species | Sampling Sites | Year Class*        | Migration Purpose            |                             |                            |                            |                              |                             |                            |                            |                              |                              |                             |                             |
|------------------------|----------------|--------------------|------------------------------|-----------------------------|----------------------------|----------------------------|------------------------------|-----------------------------|----------------------------|----------------------------|------------------------------|------------------------------|-----------------------------|-----------------------------|
|                        |                |                    | 1st Monitoring (April, 2014) | 2nd Monitoring (July, 2014) | 3rd Monitoring (Oct, 2014) | 4th Monitoring (Dec, 2014) | 5th Monitoring (April, 2015) | 6th Monitoring (July, 2015) | 7th Monitoring (Oct, 2015) | 8th Monitoring (Dec, 2015) | 9th Monitoring (April, 2016) | 10th Monitoring (July, 2016) | 11th Monitoring (Oct, 2016) | 12th Monitoring (Dec, 2016) |
|                        | Chandpai       | Fry                | Spawning                     | Spawning and Nursing        | -                          | -                          | -                            | -                           | -                          | -                          | -                            | -                            | -                           |                             |
|                        |                | Juvenile           | -                            | -                           | -                          | -                          | -                            | -                           | -                          | Feeding and Growing        | -                            | -                            | -                           |                             |
|                        |                | Adult              | -                            | -                           | -                          | Feeding                    | -                            | -                           | -                          | -                          | -                            | 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 Monitoring (April, 2014) | 2nd Monitoring (July, 2014) | 3rd Monitoring (Oct, 2014) | 4th Monitoring (Dec, 2014) | 5th Monitoring (April, 2015) | 6th Monitoring (July, 2015) | 7th Monitoring (Oct, 2015) | 8th Monitoring (Dec, 2015) | 9th Monitoring (April, 2016) | 10th Monitoring (July, 2016) | 11th Monitoring (Oct, 2016) | 12th Monitoring (Dec, 2016) |
|                        | Chandpai                  | Fry and Juvenile   | Spawning                     | -                           | Feeding and Growing        | -                          | Nursing and Grazing          | Nursery                     | Feeding and Growing        | -                          | Nursing                      | -                            | -                           |                             |
|                        |                           | Adult              | -                            | -                           | -                          | Feeding                    | -                            | Feeding                     | -                          | Feeding                    | -                            | Feeding                      | -                           |                             |
|                        | Haldikhal                 | 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         | -                          | -                          | -                            | -                           | -                          | -                          | -                            | -                            | -                           |                             |
|                        |                           | Adult              | -                            | -                           | -                          | -                          | Feeding                      | -                           | -                          | -                          | -                            | -                            | -                           |                             |
|                        | Chalna Point              | Age-1 Juvenile     | -                            | -                           | -                          | -                          | -                            | -                           | -                          | -                          | Feeding and Growing          | -                            | -                           |                             |
| Bele                   | Akram                     | Adult              | Feeding                      | -                           | Feeding                    | Feeding                    | -                            | -                           | -                          | -                          | -                            | -                            | -                           |                             |

| Migratory Fish Species | Sampling Sites | Year Class*                    | Migration Purpose            |                             |                            |                            |                              |                             |                            |                            |                              |                              |                             |                             |
|------------------------|----------------|--------------------------------|------------------------------|-----------------------------|----------------------------|----------------------------|------------------------------|-----------------------------|----------------------------|----------------------------|------------------------------|------------------------------|-----------------------------|-----------------------------|
|                        |                |                                | 1st Monitoring (April, 2014) | 2nd Monitoring (July, 2014) | 3rd Monitoring (Oct, 2014) | 4th Monitoring (Dec, 2014) | 5th Monitoring (April, 2015) | 6th Monitoring (July, 2015) | 7th Monitoring (Oct, 2015) | 8th Monitoring (Dec, 2015) | 9th Monitoring (April, 2016) | 10th Monitoring (July, 2016) | 11th Monitoring (Oct, 2016) | 12th Monitoring (Dec, 2016) |
|                        |                | Juvenile                       | -                            | -                           | -                          | -                          | -                            | -                           | -                          | Feeding and Growing        | -                            | -                            | -                           |                             |
|                        | Haldikhal      | Juvenile-1, Juvenile and Adult | -                            | -                           | Nursing and Growing        | Feeding                    | -                            | -                           | -                          | -                          | -                            | -                            | -                           |                             |
|                        | Harbaria       | Juvenile and Adult             | -                            | -                           | Feeding and Growing        | -                          | Feeding and Growing          | Nursery and Feeding         | Feeding and Growing        | -                          | -                            | -                            | -                           |                             |
|                        | Chandpai       | Fry                            | Breeding and Spawning        | Nursing                     | -                          | -                          | Nursing                      | Nursery                     | -                          | -                          | Nursery                      | -                            | -                           |                             |
|                        | Chandpai       | Juvenile and Adult             | -                            | -                           | Feeding and Growing        | Feeding                    | -                            | Feeding                     | -                          | Feeding                    | -                            | Feeding                      | Feeding and Growing         |                             |
|                        | Harbaria       | Juvenile and Age-1 Adult       | -                            | -                           | -                          | -                          | -                            | -                           | Feeding and Growing        |                            |                              | -                            | -                           |                             |
|                        | Mongla Point   | Fry                            | Breeding and Spawning        | -                           | -                          | -                          | -                            | Nursery                     | -                          | -                          | -                            | Nursery                      | -                           |                             |
|                        | Mongla Point   | Fry, Juvenile-1 and Juvenile   |                              |                             | Nursing and Growing        | -                          | -                            | -                           | -                          | -                          | -                            | -                            | -                           |                             |
|                        | Mongla Point   | Juvenile and Adult             | -                            | -                           | -                          | Feeding                    | Feeding and Growing          | Feeding                     | Feeding and Growing        | -                          | -                            | Feeding                      | -                           |                             |
|                        | 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          | -                            | -                           |                             |

| Migratory Fish Species  | Sampling Sites            | Year Class* | Migration Purpose            |                             |                            |                            |                              |                             |                            |                            |                              |                              |                             |                             |
|-------------------------|---------------------------|-------------|------------------------------|-----------------------------|----------------------------|----------------------------|------------------------------|-----------------------------|----------------------------|----------------------------|------------------------------|------------------------------|-----------------------------|-----------------------------|
|                         |                           |             | 1st Monitoring (April, 2014) | 2nd Monitoring (July, 2014) | 3rd Monitoring (Oct, 2014) | 4th Monitoring (Dec, 2014) | 5th Monitoring (April, 2015) | 6th Monitoring (July, 2015) | 7th Monitoring (Oct, 2015) | 8th Monitoring (Dec, 2015) | 9th Monitoring (April, 2016) | 10th Monitoring (July, 2016) | 11th Monitoring (Oct, 2016) | 12th Monitoring (Dec, 2016) |
|                         |                           | Fry         | -                            | -                           | -                          | -                          | -                            | -                           | -                          | 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                      | -                           | -                          | -                          | -                            | -                           | -                          | -                          | -                            | -                            | -                           |                             |
| Phekssa                 | Akram                     | Adult       | Feeding                      | -                           | -                          | -                          | -                            | -                           | -                          | Feeding                    | -                            | -                            | -                           |                             |

| Migratory Fish Species | Sampling Sites | Year Class*        | Migration Purpose            |                             |                            |                            |                              |                             |                            |                            |                              |                              |                             |                             |
|------------------------|----------------|--------------------|------------------------------|-----------------------------|----------------------------|----------------------------|------------------------------|-----------------------------|----------------------------|----------------------------|------------------------------|------------------------------|-----------------------------|-----------------------------|
|                        |                |                    | 1st Monitoring (April, 2014) | 2nd Monitoring (July, 2014) | 3rd Monitoring (Oct, 2014) | 4th Monitoring (Dec, 2014) | 5th Monitoring (April, 2015) | 6th Monitoring (July, 2015) | 7th Monitoring (Oct, 2015) | 8th Monitoring (Dec, 2015) | 9th Monitoring (April, 2016) | 10th Monitoring (July, 2016) | 11th Monitoring (Oct, 2016) | 12th Monitoring (Dec, 2016) |
|                        |                | Juvenile           | -                            | -                           | Feeding and Growing        | -                          | -                            | -                           | -                          | -                          | -                            | -                            | -                           |                             |
|                        | Haldikhali     | Juvenile           | -                            | -                           | Feeding and Growing        | -                          | -                            | -                           | -                          | -                          | -                            | -                            | -                           |                             |
|                        | Haldikhali     | Adult              | -                            | -                           | -                          | Feeding                    | -                            | -                           | -                          | -                          | -                            | -                            | -                           |                             |
|                        | Harbaria       | Juvenile           | -                            | -                           | -                          | -                          | -                            | -                           | -                          | -                          | Feeding and Growing          | -                            | -                           |                             |
|                        | Chalna Point   | Juvenile and Adult | Feeding                      | Feeding and Growing         | -                          | -                          | -                            | -                           | Feeding and Growing        | -                          |                              | -                            | -                           |                             |
|                        | Chalna Point   | 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                     | -                          | -                          | -                            | Feeding                      | -                           |                             |
| Paissa                 | Akram Point    | Juvenile and Adult | Feeding                      | -                           | Feeding and Growing        | Feeding                    | -                            | -                           | -                          | Feeding and Growing        | -                            | -                            | -                           |                             |

| Migratory Fish Species | Sampling Sites | Year Class*                              | Migration Purpose            |                             |                            |                            |                              |                             |                               |                            |                              |                              |                             |                             |
|------------------------|----------------|--|------------------------------|-----------------------------|----------------------------|----------------------------|------------------------------|-----------------------------|-------------------------------|----------------------------|------------------------------|------------------------------|-----------------------------|-----------------------------|
|                        |                |  | 1st Monitoring (April, 2014) | 2nd Monitoring (July, 2014) | 3rd Monitoring (Oct, 2014) | 4th Monitoring (Dec, 2014) | 5th Monitoring (April, 2015) | 6th Monitoring (July, 2015) | 7th Monitoring (Oct, 2015)    | 8th Monitoring (Dec, 2015) | 9th Monitoring (April, 2016) | 10th Monitoring (July, 2016) | 11th Monitoring (Oct, 2016) | 12th Monitoring (Dec, 2016) |
|                        |                | Juvenile                                 | -                            | -                           | -                          | -                          | -                            | -                           | Feeding and Growing           |                            |                              | -                            | -                           |                             |
|                        | Haldikhalai    | Juvenile and Adult                       | Feeding                      | -                           | Feeding and Growing        | Feeding                    | -                            | -                           | -                             | -                          | -                            | -                            | -                           |                             |
|                        |                | Juvenile                                 | -                            | -                           | -                          | -                          | -                            | -                           | Feeding and Growing           | -                          | -                            | -                            | -                           |                             |
|                        | Harbaria       | Juvenile-1 and Juvenile                  | -                            | -                           | Feeding                    | -                          | Feeding and Growing          | -                           | Feeding and Growing           | -                          | -                            | -                            | -                           |                             |
|                        |                | Adult                                    | -                            | -                           | -                          | -                          | -                            | -                           | -                             | Feeding                    | -                            | -                            | -                           |                             |
|                        | Chandpai       | Fry                                      | Breeding and Spawning        | -                           | -                          | -                          | Nursing                      | -                           | -                             | -                          | Nursery                      | -                            | -                           |                             |
|                        | Chandpai       | Juvenile and Adult                       | -                            | -                           | Feeding and Growing        | -                          | -                            | Nursery and Feeding         | -                             | -                          | -                            | Feeding                      | Feeding and Growing         |                             |
|                        | Harbaria       | Juvenile                                 | -                            | -                           | -                          | -                          | -                            | -                           | Feeding and Growing           | -                          | -                            | -                            |                             |                             |
|                        | Mongla Point   | Fry                                      | Breeding and Spawning        | -                           | -                          | -                          | -                            | Nursery                     | -                             | -                          | Nursery                      | Nursery                      | -                           |                             |
|                        |                | Age-1 Juvenile                           | -                            | -                           | -                          | -                          | -                            | -                           | -Nursing, Feeding and Growing | -                          | Feeding and Growing          | -                            | -                           |                             |
|                        |                | Age-1 Adult                              | -                            | -                           | -                          | -                          | Feeding and Growing          | Feeding                     | -                             | -                          |                              | Feeding                      | -                           |                             |
|                        | Maidara        | Fry, Juvenile and Age-1 adult            | Breeding and Spawning        | Feeding and Growing         | -                          | -                          | Feeding and Growing          | -                           | -                             | -                          | Feeding and Growing          | -                            | -                           |                             |
|                        |                | Age-1 Juvenile, Juvenile and Age-1 Adult | -                            | -                           | -                          | -                          | -                            | -                           | Nursing, Feeding and Growing  | -                          |                              | -                            | Feeding and Growing         |                             |
|                        |                | Adult                                    | -                            | -                           | -                          | -                          | -                            | Feeding                     | -                             | -                          | -                            | Feeding                      | -                           |                             |

| Migratory Fish Species | Sampling Sites | Year Class*       | Migration Purpose            |                             |                            |                            |                              |                             |                            |                            |                              |                              |                             |                             |
|------------------------|----------------|-------------------|------------------------------|-----------------------------|----------------------------|----------------------------|------------------------------|-----------------------------|----------------------------|----------------------------|------------------------------|------------------------------|-----------------------------|-----------------------------|
|                        |                |                   | 1st Monitoring (April, 2014) | 2nd Monitoring (July, 2014) | 3rd Monitoring (Oct, 2014) | 4th Monitoring (Dec, 2014) | 5th Monitoring (April, 2015) | 6th Monitoring (July, 2015) | 7th Monitoring (Oct, 2015) | 8th Monitoring (Dec, 2015) | 9th Monitoring (April, 2016) | 10th Monitoring (July, 2016) | 11th Monitoring (Oct, 2016) | 12th Monitoring (Dec, 2016) |
| Banshpata              | Chandpai       | Juvenile          | Feeding                      | -                           | -                          | -                          | -                            | -                           | -                          | -                          | -                            | -                            | -                           |                             |
|                        |                | Adult             | -                            | -                           | -                          | Feeding                    | -                            | 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                     | -                          | -                          | -                            | -                           | -                          | -                          | -                            | -                            | -                           |                             |
|                        | Mongla Point   | Adult             | -                            | -                           | -                          | Feeding                    | -                            | -                           | -                          | -                          | Feeding                      | -                            | -                           |                             |
|                        | Maidara        | Adult             | -                            | -                           | Feeding                    | Feeding                    | -                            | Breeding and Spawning       | -                          | -                          | -                            | Feeding                      | -                           |                             |
| Hilsa                  | Chalna Point   | Adult             | -                            | -                           | Feeding                    | Feeding                    | -                            | -                           | -                          | -                          | -                            | -                            | -                           |                             |
|                        | Akram Point    | Brood Fish        | -                            | -                           | -                          | -                          | -                            | -                           | -                          | -                          | -                            | -                            | Breeding and Spawning       |                             |
|                        |                | Brood Fish        | -                            | -                           | -                          | -                          | -                            | -                           | -                          | -                          | -                            | -                            |                             |                             |
|                        | Haldikhali     | Juvenile          | -                            | -                           | Feeding and Growing        | -                          | -                            | -                           | -                          | -                          | -                            | -                            | -                           |                             |
|                        | Harbaria       | Brood Fish        | -                            | -                           | -                          | -                          | -                            | -                           | -                          | -                          | -                            | -                            | -                           |                             |

| Migratory Fish Species | Sampling Sites | Year Class*          | Migration Purpose            |                             |                            |                            |                              |                             |                            |                            |                              |                              |                             |                             |
|------------------------|----------------|----------------------|------------------------------|-----------------------------|----------------------------|----------------------------|------------------------------|-----------------------------|----------------------------|----------------------------|------------------------------|------------------------------|-----------------------------|-----------------------------|
|                        |                |                      | 1st Monitoring (April, 2014) | 2nd Monitoring (July, 2014) | 3rd Monitoring (Oct, 2014) | 4th Monitoring (Dec, 2014) | 5th Monitoring (April, 2015) | 6th Monitoring (July, 2015) | 7th Monitoring (Oct, 2015) | 8th Monitoring (Dec, 2015) | 9th Monitoring (April, 2016) | 10th Monitoring (July, 2016) | 11th Monitoring (Oct, 2016) | 12th Monitoring (Dec, 2016) |
|                        | 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                    | -                          | -                            | -                           | -                          | -                          | -                            | Feeding and Breeding         | -                           |                             |

Source: CEGIS Field Survey- April, July and October 2014 and January, April, July and October 2015, January and April 2016

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



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

| Sampling Site | Total Catch (ton)                |      |                                 |      |                    |     |                    |     |                    |     |                    |      |                    |     |                    |     |                    |     |                     |     |                     |     |                     |     |
|---------------|----------------------------------|------|---------------------------------|------|--------------------|-----|--------------------|-----|--------------------|-----|--------------------|------|--------------------|-----|--------------------|-----|--------------------|-----|---------------------|-----|---------------------|-----|---------------------|-----|
|               | 1 <sup>st</sup> QM (April, 2014) |      | 2 <sup>nd</sup> QM (July, 2014) |      | 3 <sup>rd</sup> QM |     | 4 <sup>th</sup> QM |     | 5 <sup>th</sup> QM |     | 6 <sup>th</sup> QM |      | 7 <sup>th</sup> QM |     | 8 <sup>th</sup> QM |     | 9 <sup>th</sup> QM |     | 10 <sup>th</sup> QM |     | 11 <sup>th</sup> QM |     | 12 <sup>th</sup> QM |     |
|               | Species                          | ton  | Species                         | ton  | Species            | ton | Species            | ton | Species            | ton | Species            | ton  | Species            | ton | Species            | ton | Species            | ton | Species             | ton | Species             | ton | Species             | ton |
| 1             | Bagda                            | 5    | Bagda                           | 6.42 | Bagda              | 4.8 | -                  | -   | Bagda              | -   | Bagda              | 1.6  | Bagda              | 2   | Catla              | 2   | -                  | 0   | Bagda               | 3   | Bagda               | 3   |                     |     |
|               | Vetki                            | 1.57 | Bele                            | 0    | Gusha Chingri      | -   | -                  | -   | Horina Chingri     | 1   | Horina Chingri     | 1    | Horina Chingri     | 3.2 | Glass Carp         | 0.1 | -                  | 0   | Horina Chingri      | 1   | Tengra              | 0.1 |                     |     |
|               | Bele                             | 0.98 | Cheng                           | 0    | Harina Chingri     | -   | -                  | -   | Tengra             | -   | Chali Chingri      | 0.5  | Gusha Chingri      | 0.8 | Horina Chingri     | 0.8 | -                  | 0   | Chali Chingri       | 0.3 | Horina Chingri      | 0.8 |                     |     |
|               | Harina Chingri                   | 0.78 | Bhangan                         | 0    | Rui (kg)           | -   | -                  | -   | Paissa             | -   | Paissa             | 0.25 | Paissa             | 24  | Minar Carp         | 0.1 | -                  | 0   | -                   | -   | Paissa              | 0.1 |                     |     |
|               | Chali Chingri                    | 0.11 | Chali Chingri                   | 0    | Catla (kg)         | -   | -                  | -   | Chela              | -   | Bele               | 0.25 | Vetki              | 0.2 | Nilotica           | 1.6 | -                  | 0   | -                   | -   | Vetki               | 2   |                     |     |
|               | Chaka Chingri                    | 0.08 | -                               | -    | -                  | -   | -                  | -   | Vetki              | -   | -                  | -    | Kailla             | 0.4 | Paissa             | 0.6 | -                  | 0   | -                   | -   | -                   | 0   |                     |     |
|               | -                                | -    | -                               | -    | -                  | -   | -                  | -   | -                  | -   | -                  | -    | Bele               | 0   | Rui                | 3   | -                  | 0   | -                   | -   | -                   | 0   |                     |     |
|               | -                                | -    | -                               | -    | -                  | -   | -                  | -   | -                  | -   | -                  | -    | Tilapia            | 0   | Vetki              | 0.8 | -                  | 0   | -                   | -   | -                   | 0   |                     |     |
|               | -                                | -    | -                               | -    | -                  | -   | -                  | -   | -                  | -   | -                  | -    | Catla              | 0   | -                  | 0   | -                  | 0   | -                   | -   | -                   | 0   |                     |     |
|               | -                                | -    | -                               | -    | -                  | -   | -                  | -   | -                  | -   | -                  | -    | Minar Carp         | 0   | -                  | 0   | -                  | 0   | -                   | -   | -                   | 0   |                     |     |
|               | -                                | -    | -                               | -    | -                  | -   | -                  | -   | -                  | -   | -                  | -    | Glass Carp         | 0   | -                  | 0   | -                  | 0   | -                   | -   | -                   | 0   |                     |     |
|               | -                                | -    | -                               | -    | -                  | -   | -                  | -   | -                  | -   | -                  | -    | Kakra              | 0.4 | -                  | 0   | -                  | 0   | -                   | -   | -                   | 0   |                     |     |
| Sub-total =   |                                  | 8.52 |                                 | 6.42 |                    | 4.8 | -                  | -   |                    | 1   |                    | 3.06 | -                  | 31  | -                  | 9   | -                  | 0   | -                   | 4.3 | -                   | 6   |                     |     |
| 2             | Bagda                            | 4    | Bagda                           | 1    | Bagda              | 7   | -                  | -   | Bagda              | -   | Bagda              | 1.67 | Bagda              | 0   | -                  | 0   | Bag                | 1   | Bag                 | 3,4 | Bag                 | 2   |                     |     |

| Sampling Site | Total Catch (ton)                |      |                                 |      |                    |     |                    |   |                    |   |                    |      |                    |      |                    |   |                    |      |                     |       |                     |      |                     |  |
|---------------|----------------------------------|------|---------------------------------|------|--------------------|-----|--------------------|---|--------------------|---|--------------------|------|--------------------|------|--------------------|---|--------------------|------|---------------------|-------|---------------------|------|---------------------|--|
|               | 1 <sup>st</sup> QM (April, 2014) |      | 2 <sup>nd</sup> QM (July, 2014) |      | 3 <sup>rd</sup> QM |     | 4 <sup>th</sup> QM |   | 5 <sup>th</sup> QM |   | 6 <sup>th</sup> QM |      | 7 <sup>th</sup> QM |      | 8 <sup>th</sup> QM |   | 9 <sup>th</sup> QM |      | 10 <sup>th</sup> QM |       | 11 <sup>th</sup> QM |      | 12 <sup>th</sup> QM |  |
|               |                                  |      |                                 |      |                    |     |                    |   |                    |   |                    |      |                    |      |                    |   | da                 |      | da                  |       | da                  |      |                     |  |
|               | Harina Chingri                   | 2    | Harina Chingri                  | 0.33 | Vetki              | 1   | -                  | - | -                  | - | Chali Chingri      | 0.30 | Horina Chingri     | 0    | -                  | 0 | Hori na            | 0.14 | Hori na             | 12    | Bel e               | 1.6  |                     |  |
|               | Chali Chingri                    | 0.18 | Chali Chingri                   | 0.08 | Paissa             | 10  | -                  | - | -                  | - | Horina Chingri     | 0.50 | Chali Chingri      | 0    | -                  | 0 | -                  | 0    | Cha li              | 10    | Cha li Chingri      | 4    |                     |  |
|               | -                                | -    | Golda Chingri                   | 0.01 | Phessa             | 2.4 | -                  | - | -                  | - | Bele               | 0.30 | Tilapia            | 0    | -                  | 0 | -                  | 0    | Tila pia            | 3.6   | Hori na Chingri     | 8    |                     |  |
|               | -                                | -    | Bele                            | 0.08 | Bhanga n           | 1.7 | -                  | - | -                  | - | Paissa             | 0.25 | Vetki              | 0    | -                  | 0 | -                  | 0    | Bel e               | 0.4   | Pais sa             | 0.28 |                     |  |
|               | -                                | -    | Tengra & Paissa                 | 0.04 | Golda Chingri      | 0.9 | -                  | - | -                  | - | -                  | -    | Tengra             | 0    | -                  | 0 | -                  | 0    | Pais sa             | 0.08  | Ten gra             | 0.8  |                     |  |
|               | -                                | -    | -                               |      | Gulsha Tengra      | 0.2 | -                  | - | -                  | - | -                  | -    | Paissa             | 0    | -                  | 0 | -                  | 0    | Ten gra             | 0.08  | Tila pia            | 8    |                     |  |
|               | -                                | -    | -                               | -    | -                  | -   | -                  | - | -                  | - | -                  | -    | -                  | -    | -                  | - | -                  | -    | -                   | -     | Vet ki              | 2.4  |                     |  |
| Sub-total =   |                                  | 6.00 |                                 | 2.00 |                    | 23  |                    | - | -                  | - |                    | 3.02 | -                  | 0    | -                  | 0 |                    | 1.14 | -                   | 29.56 | -                   | 9    |                     |  |
| 3             | Bagda                            | 1.38 | Bagda                           | 2.4  | Bagda              | 1.5 | -                  | - | Bagda              | - | Bagda              | 3.5  | Bagda              | 0.4  | -                  | 0 | Bag da             | 2    | Bag da              | 1.6   | Bag da              | 0.4  |                     |  |
|               | Harina Chingri                   | 0.34 | Harina Chingri                  | 0.34 | Paissa             | 10  | -                  | - | -                  | - | -                  | -    | Paissa             | 3.2  | -                  | 0 | -                  | 0    | Tila pia            | 2     | Hori na Chingri     | 0.35 |                     |  |
|               | Chali Chingri                    | 0.17 | Chali Chingri                   | 0.17 | Tengra             | 10  | -                  | - | -                  | - | -                  | -    | Vetki              | 0.4  | -                  | 0 | -                  | 0    | -                   | -     | Pais sa             | 0.06 |                     |  |
|               | -                                | -    | -                               | -    | Bele               | 20  | -                  | - | -                  | - | -                  | -    | Tilapia            | 0.06 | -                  | 0 | -                  | 0    | -                   | -     | Ten gra             | 0.4  |                     |  |
|               | -                                | -    | -                               | -    | Tilapia            | 22  | -                  | - | -                  | - | -                  | -    | Horina Chingri     | 0.35 | -                  | 0 | -                  | 0    | -                   | -     | Tila pia            | 3.2  |                     |  |
|               | -                                | -    | -                               | -    | Rui                | 28  | -                  | - | -                  | - | -                  | -    | Chali Chingri      | 0.6  | -                  | 0 | -                  | 0    | -                   | -     | -                   | 0    |                     |  |
|               | -                                | -    | -                               | -    | Vetki              | -   | -                  | - | -                  | - | -                  | -    | Chaka              | 0.1  | -                  | 0 | -                  | 0    | -                   | -     | -                   | 0    |                     |  |

| Sampling Site | Total Catch (ton)                |       |                                 |       |                    |       |                    |   |                    |   |                    |     |                    |       |                    |   |                    |      |                     |       |                     |    |                     |  |
|---------------|----------------------------------|-------|---------------------------------|-------|--------------------|-------|--------------------|---|--------------------|---|--------------------|-----|--------------------|-------|--------------------|---|--------------------|------|---------------------|-------|---------------------|----|---------------------|--|
|               | 1 <sup>st</sup> QM (April, 2014) |       | 2 <sup>nd</sup> QM (July, 2014) |       | 3 <sup>rd</sup> QM |       | 4 <sup>th</sup> QM |   | 5 <sup>th</sup> QM |   | 6 <sup>th</sup> QM |     | 7 <sup>th</sup> QM |       | 8 <sup>th</sup> QM |   | 9 <sup>th</sup> QM |      | 10 <sup>th</sup> QM |       | 11 <sup>th</sup> QM |    | 12 <sup>th</sup> QM |  |
|               |                                  |       |                                 |       |                    |       |                    |   |                    |   |                    |     | Chingri            |       |                    |   |                    |      |                     |       |                     |    |                     |  |
|               | -                                | -     | -                               | -     | Harina Chingri     | -     | -                  | - | -                  | - | -                  | -   | Tengra             | 0     | -                  | 0 | -                  | 0    | -                   | -     | -                   | 0  |                     |  |
|               | -                                | -     | -                               | -     | Chami Chingri      | -     | -                  | - | -                  | - | -                  | -   | Bele               | 0     | -                  | 0 | -                  | 0    | -                   | -     | -                   | 0  |                     |  |
|               | -                                | -     | -                               | -     | Catla              | 56    | -                  | - | -                  | - | -                  | -   | Tairel             | 0.06  | -                  | 0 | -                  | 0    | -                   | -     | -                   | 0  |                     |  |
|               | -                                | -     | -                               | -     | Mrigel             | 50    | -                  | - | -                  | - | -                  | -   | Bhangan            | 0     | -                  | 0 | -                  | 0    | -                   | -     | -                   | 0  |                     |  |
| Sub-total =   |                                  | 1.89  |                                 | 2.91  |                    | 197.5 | -                  | - | -                  | - | -                  | -   | -                  | 5.17  | -                  | 0 |                    | 2    | -                   | 3.6   | -                   | 4  |                     |  |
| Grand-total = |                                  | 17.00 |                                 | 11.33 |                    | 226.5 | -                  | - |                    | 1 |                    | 3.5 |                    | 36.17 | -                  | 0 |                    | 3.14 | -                   | 37.46 | -                   | 19 |                     |  |

Source: CEGIS Field Survey- April, July and October 2014 and January, April, July and October 2015, January and April 2016

## Land Resource Monitoring Data

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

| Plot No. | Location   | GPS                              | Distance from the plant location(km) | Plot size (ha) | Plot owner  |
|----------|--|----------------------------------|--------------------------------------|----------------|---|
| 1        | Mouza: Baran Para<br>Union:Gongarampur<br>Upazila-Batiaghata<br>District:Khulna            | E-89° 30'59.1"<br>N-22° 37'57.0" | About 3.5                            | About 0.4      | Name: Anil Krishna Roy<br>Father: Keshab Lal Roy  |
| 2        | Mouza:Chunkuri-2<br>Union:Bajua<br>Upazila:Dacope<br>District:Khulna                       | E-89° 32'20.0"<br>N-22° 34'51.0" | About 1.0                            | About 0.93     | Name: Md. Abul Sheikh<br>Father: Md. Jamir Sheikh                                       |
| 3        | Mouza:Kapalirmet<br>Buridmial<br>Union: Burirdanaga<br>Upazila:Mongla<br>District:Bagerhat | E-89° 36'8.8"<br>N-22° 32'18.9"  | About 5.5                            | About 0.14     | Name: Panesh Biswas<br>Father: Nishikanto Biswas  |
| 4        | Mouza: Chakgona<br>Union:Rajnagar<br>Upazila:Rampal<br>District:Bagerhat                   | E-89° 34'25.3"<br>N-22° 34'18.3" | About 1.0                            | About 0.28     | Name: Manoj Das<br>Father: Mahendra Nath Das  |
| 5        | Mouza: Basherhula<br>Union:Rajnagar<br>Upazila:Rampal<br>District: Bagerhat                | E-89° 34'25.0"<br>N-22° 36'14.0" | About 1.0                            | About 0.47     | Name: Amjad Hajra<br>Father: Chirman Ali Hajra<br>Share cropper: Md. Oliur Rahman Hajra |

Source: Field survey; 2014

## (D) Land Resource Monitoring Data

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

| Plot No. | Location   | GPS                              | Distance from the plant location(km) | Plot size (ha) | Plot owner  |
|----------|--|----------------------------------|--------------------------------------|----------------|---|
| 1        | Mouza: Baran Para<br>Union:Gongarampur<br>Upazila-Batiaghata<br>District:Khulna            | E-89° 30'59.1"<br>N-22° 37'57.0" | About 3.5                            | About 0.4      | Name: Anil Krishna Roy<br>Father: Keshab Lal Roy  |
| 2        | Mouza:Chunkuri-2<br>Union:Bajua<br>Upazila:Dacope<br>District:Khulna                       | E-89° 32'20.0"<br>N-22° 34'51.0" | About 1.0                            | About 0.93     | Name: Md. Abul Sheikh<br>Father: Md. Jamir Sheikh |
| 3        | Mouza:Kapalirmet<br>Buridmial<br>Union: Burirdanaga<br>Upazila:Mongla<br>District:Bagerhat | E-89° 36'8.8"<br>N-22° 32'18.9"  | About 5.5                            | About 0.14     | Name: Panesh Biswas<br>Father: Nishikanto Biswas  |
| 4        | Mouza: Chakgona<br>Union:Rajnagar<br>Upazila:Rampal<br>District:Bagerhat                   | E-89° 34'25.3"<br>N-22° 34'18.3" | About 1.0                            | About 0.28     | Name: Manoj Das<br>Father: Mahendra Nath Das      |

| Plot No. | Location  | GPS                              | Distance from the plant location(km) | Plot size (ha) | Plot owner  |
|----------|---|----------------------------------|--------------------------------------|----------------|---|
| 5        | Mouza: Basherhula<br>Union:Rajnagar<br>Upazila:Rampal<br>District: Bagerhat | E-89° 34'25.0"<br>N-22° 36'14.0" | About 1.0                            | About 0.47     | Name: Amjad Hajra<br>Father: Chirman Ali Hajra<br>Share cropper: Md. Oliur Rahman Hajra |

Source: Field survey; 2014

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

| SI .No. | Location   | Parameter                | 2013-2014             |                    |                         |            | 2014-2015             |                   |                         |                      | 2015-2016             |                      |                         |         |
|---------|------------|--------------------------|-----------------------|--------------------|-------------------------|------------|-----------------------|-------------------|-------------------------|----------------------|-----------------------|----------------------|-------------------------|---------|
|         |            |                          | Dry season<br>(April) | Remarks            | Wet season<br>(October) | Remarks    | Dry season<br>(April) | Remarks           | Wet season<br>(October) | Remarks              | Dry season<br>(March) | Remarks              | Wet season<br>(October) | Remarks |
| 1       | Baran para | Top soil(0-15cm)         |                       |                    |                         |            |                       |                   |                         |                      |                       |                      |                         |         |
|         |            | EC(ds/m)                 | 9.1                   | Moderately saline  | 1.8                     | Non saline | 10.01                 | Moderately saline | 2.54                    | Very slightly saline | 2.46                  | Very slightly saline |                         |         |
|         |            | pH                       | 4.2                   | Very strongly acid | 6.7                     | Neutral    | 7.6                   | Slightly alkaline | 6.9                     | Neutral              | 7.0                   | Neutral              |                         |         |
|         |            | OM (%)                   | 3.1                   | Medium             | 2.5                     | Medium     | 0.93                  | Very low          | 1.27                    | Low                  | 1.35                  | Low                  |                         |         |
|         |            | N (%)                    | 0.16                  | Low                | 0.12                    | Low        | 0.05                  | Very low          | 0.06                    | Very low             | 0.08                  | Very low             |                         |         |
|         |            | K (meq/100g)             | 1.00                  | Very high          | 0.59                    | Very high  | 1.61                  | Very high         | 0.57                    | Very high            | 0.69                  | Very high            |                         |         |
|         |            | Ca (meq/100g)            | 11.3                  | Very high          | 14.3                    | Very high  | 31.50                 | Very high         | 14.75                   | Very high            | 15.12                 | Very high            |                         |         |
|         |            | Mg (meq/100g)            | 10.7                  | Very high          | 8.6                     | Very high  | 6.00                  | Very high         | 2.06                    | Very high            | 2.58                  | Very high            |                         |         |
|         |            | Na(meq/100g)             | 5.50                  | *                  | 2.7                     | *          | 10.01                 | *                 | 4.76                    | *                    | 4.43                  | *                    |                         |         |
|         |            | P(µg/gm)                 | 2.7                   | Very low           | 14.3                    | Medium     | 8.19                  | Low               | 4.60                    | Very low             | 5.33                  | Low                  |                         |         |
|         |            | S(µg/gm)                 | 523.2                 | Very high          | 41.4                    | Very high  | 354.40                | Very high         | 210.0                   | Very high            | 212.18                | Very high            |                         |         |
|         |            | B(µg/gm)                 | 0.45                  | Medium             | 0.55                    | Very high  | 2.37                  | Very high         | 2.11                    | Very high            | 2.05                  | Very high            |                         |         |
|         |            | Fe(µg/gm)                | 150.3                 | Very high          | 258.6                   | Very high  | 49.72                 | Very high         | 78.25                   | Very high            | 42.96                 | Very high            |                         |         |
|         |            | Mn(µg/gm)                | 7.2                   | Very high          | 11.3                    | Very high  | 24.72                 | Very high         | 6.89                    | Very high            | 11.90                 | Very high            |                         |         |
|         |            | Zn(µg/gm)                | 1.4                   | Medium             | 1.2                     | Medium     | 1.88                  | High              | 2.47                    | Very high            | 1.82                  | High                 |                         |         |
|         |            | Lead(Pb) (µg/gm)         | 31.8                  | *                  | 33.7                    | *          | 32.21                 | *                 | 25.95                   | *                    | 24.23                 | *                    |                         |         |
|         |            | Cadmium (Cd)(µg/gm)      | 0                     | 0                  | 0                       | 0          | 2.39                  | *                 | 00                      | *                    | 00                    | *                    |                         |         |
|         |            | Chloride (Cl-) (µg/gm)   | 762.2                 | *                  | 0                       | 0          | 0                     | 0                 | 00                      | 0                    | 00                    |                      |                         |         |
|         |            | Subsurface soil(15-30cm) |                       |                    |                         |            |                       |                   |                         |                      |                       |                      |                         |         |

| SI .No. | Location | Parameter             | 2013-2014             |                    |                         |                 | 2014-2015             |                   |                         |                   | 2015-2016             |                      |                         |         |
|---------|----------|-----------------------|-----------------------|--------------------|-------------------------|-----------------|-----------------------|-------------------|-------------------------|-------------------|-----------------------|----------------------|-------------------------|---------|
|         |          |                       | Dry season<br>(April) | Remarks            | Wet season<br>(October) | Remarks         | Dry season<br>(April) | Remarks           | Wet season<br>(October) | Remarks           | Dry season<br>(March) | Remarks              | Wet season<br>(October) | Remarks |
|         |          | EC(ds/m)              | 8.4                   | Moderately saline  | 2.0                     | Non saline      | 7.90                  | Slightly saline   | 4.65                    | Slightly saline   | 2.23                  | Very slightly saline |                         |         |
|         |          | pH                    | 4.3                   | Very strongly acid | 6.9                     | Neutral         | 7.8                   | Slightly alkaline | 7.4                     | Slightly alkaline | 7.1                   | Neutral              |                         |         |
|         |          | OM (%)                | 2.9                   | Medium             | 2.2                     | Medium          | 1.46                  | Low               | 1.53                    | Low               | 1.67                  | Low                  |                         |         |
|         |          | N (%)                 | 0.15                  | Low                | 0.2                     | Medium          | 0.08                  | Very low          | 0.08                    | Very low          | 0.09                  | Very low             |                         |         |
|         |          | K (meq/100g)          | 1.0                   | Very high          | 0.61                    | Very high       | 1.46                  | Very high         | 0.59                    | Very high         | 0.58                  | Very high            |                         |         |
|         |          | Ca(meq/100g)          | 10.48                 | Very high          | 14.3                    | Very high       | 26.84                 | Very high         | 12.31                   | Very high         | 12.67                 | Very high            |                         |         |
|         |          | Mg(meq/100g)          | 8.8                   | Very high          | 8.2                     | Very high       | 5.30                  | Very high         | 2.15                    | Very high         | 2.10                  | Very high            |                         |         |
|         |          | Na(meq/100g)          | 5.00                  | *                  | 2.7                     | *               | 8.95                  | *                 | 6.32                    | *                 | 4.22                  | *                    |                         |         |
|         |          | P(µg/gm)              | 2.9                   | Very low           | 22.8                    | High            | 9.23                  | Low               | 4.65                    | Very low          | 4.74                  | Very low             |                         |         |
|         |          | S(µg/gm)              | 513.7                 | Very high          | 31.4                    | High            | 307.65                | Very high         | 221.0                   | Very high         | 210.06                | Very high            |                         |         |
|         |          | B(µg/gm)              | 0.36                  | Medium             | 0.49                    | Optimum         | 1.86                  | Very high         | 0.90                    | Very high         | 1.02                  | Very high            |                         |         |
|         |          | Fe(µg/gm)             | 39.1                  | Very high          | 60.9                    | Very high       | 26.60                 | Very high         | 29.27                   | Very high         | 22.53                 | Very high            |                         |         |
|         |          | Mn(µg/gm)             | 3.3                   | High               | 10.9                    | Very high       | 41.87                 | Very high         | 5.75                    | Very high         | 7.11                  | Very high            |                         |         |
|         |          | Zn(µg/gm)             | 1.5                   | Optimum            | 0.87                    | Low             | 1.56                  | Optimum           | 1.69                    | Optimum           | 1.31                  | Medium               |                         |         |
|         |          | Lead(Pb)(µg/gm)       | 31.8                  | *                  | 32.1                    | *               | 31.54                 | *                 | 22.56                   | *                 | 22.35                 | *                    |                         |         |
|         |          | Cadmium (Cd)(µg/gm)   | 0                     | 0                  | 0                       | 0               | 2.42                  | *                 | 00                      | *                 | 00                    | *                    |                         |         |
|         |          | Chloride (Cl-)(µg/gm) | 398.4                 | *                  | 0                       | 0               | 0                     | 0                 | 0                       | 0                 | 0                     |                      |                         |         |
|         |          | Substratum(30-45cm)   |                       |                    |                         |                 |                       |                   |                         |                   |                       |                      |                         |         |
|         |          | EC(ds/m)              | 9.6                   | Moderately saline  | 5.8                     | Slightly saline | 9.26                  | Moderately saline | 5.56                    | Slightly saline   | 4.32                  | Slightly saline      |                         |         |
|         |          | pH                    | 5.7                   | Slightly acid      | 6.9                     | Neutral         | 7.7                   | Slightly alkaline | 7.0                     | Neutral           | 7.0                   | Neutral              |                         |         |
|         |          | OM (%)                | 1.6                   | Low                | 1.1                     | Low             | 1.62                  | Low               | 1.48                    | Low               | 1.69                  | Low                  |                         |         |



| SI .No. | Location   | Parameter                | 2013-2014             |                   |                         |                 | 2014-2015             |                 |                         |                   | 2015-2016             |                 |                         |         |
|---------|------------|--------------------------|-----------------------|-------------------|-------------------------|-----------------|-----------------------|-----------------|-------------------------|-------------------|-----------------------|-----------------|-------------------------|---------|
|         |            |                          | Dry season<br>(April) | Remarks           | Wet season<br>(October) | Remarks         | Dry season<br>(April) | Remarks         | Wet season<br>(October) | Remarks           | Dry season<br>(March) | Remarks         | Wet season<br>(October) | Remarks |
|         |            | N (%)                    | 0.08                  | Very low          | 0.06                    | Very low        | 0.09                  | Very low        | 0.07                    | Very low          | 0.09                  | Very low        |                         |         |
|         |            | K (meq/100g)             | 1.0                   | Very high         | 0.6                     | Very high       | 2.00                  | Very high       | 0.60                    | Very high         | 0.51                  | Very high       |                         |         |
|         |            | Ca(meq/100g)             | 12.6                  | Very high         | 16.3                    | Very high       | 28.69                 | Very high       | 14.06                   | Very high         | 13.78                 | Very high       |                         |         |
|         |            | Mg(meq/100g)             | 15.9                  | Very high         | 8.8                     | Very high       | 5.57                  | Very high       | 2.71                    | Very high         | 3.03                  | Very high       |                         |         |
|         |            | Na(meq/100g)             | 6.00                  | *                 | 3.7                     | *               | 9.91                  | *               | 6.83                    | *                 | 5.51                  | *               |                         |         |
|         |            | P(µg/gm)                 | 2.00                  | Very low          | 13.3                    | Medium          | 8.24                  | Low             | 2.99                    | Very low          | 3.13                  | Very low        |                         |         |
|         |            | S(µg/gm)                 | 490.9                 | Very high         | 31.9                    | High            | 307.29                | Very high       | 262.0                   | Very high         | 279.37                | Very high       |                         |         |
|         |            | B(µg/gm)                 | 0.73                  | High              | 0.77                    | Very high       | 1.67                  | Very high       | 1.16                    | Very high         | 1.34                  | Very high       |                         |         |
|         |            | Fe(µg/gm)                | 51.3                  | Very high         | 113.9                   | Very high       | 33.91                 | Very high       | 73.87                   | Very high         | 52.21                 | Very high       |                         |         |
|         |            | Mn(µg/gm)                | 3.9                   | Very high         | 5.2                     | Very high       | 88.75                 | Very high       | 6.21                    | Very high         | 6.34                  | Very high       |                         |         |
|         |            | Zn(µg/gm)                | 1.6                   | Optimum           | 0.49                    | Low             | 1.74                  | Optimum         | 3.19                    | Very high         | 2.94                  | Very high       |                         |         |
|         |            | Lead(Pb)<br>(µg/gm)      | 37.8                  | *                 | 31.5                    | *               | 32.29                 | *               | 18.89                   | *                 | 19.18                 | *               |                         |         |
|         |            | Cadmium<br>(Cd)(µg/gm)   | 0                     | 0                 | 0                       | 0               | 2.17                  | *               | 00                      | *                 | 00                    | *               |                         |         |
|         |            | Chloride<br>(Cl-)(µg/gm) | 692.9                 | *                 | 0                       | 0               | 0                     | 0               | 0                       | 0                 | 0                     |                 |                         |         |
| 2       | Chunkuri-2 | Top soil (0-15cm)        |                       |                   |                         |                 |                       |                 |                         |                   |                       |                 |                         |         |
|         |            | EC(ds/m)                 | 11.2                  | Moderately saline | 5.6                     | Slightly saline | 13.05                 | Strongly saline | 8.20                    | Moderately saline | 6.92                  | Slightly saline |                         |         |
|         |            | pH                       | 6.1                   | Slightly acid     | 6.4                     | Slightly acid   | 5.9                   | Slightly acid   | 6.0                     | Slightly acid     | 6.3                   | Slightly acid   |                         |         |
|         |            | OM (%)                   | 2.1                   | Medium            | 1.2                     | Low             | 3.22                  | Medium          | 1.75                    | Low               | 1.98                  | Medium          |                         |         |
|         |            | N (%)                    | 0.11                  | Low               | 0.06                    | Very low        | 0.18                  | Low             | 0.09                    | Very low          | 0.11                  | Low             |                         |         |
|         |            | K (meq/100g)             | 1.5                   | Very high         | 1.14                    | Very high       | 2.97                  | Very high       | 0.79                    | Very high         | 0.86                  | Very high       |                         |         |
|         |            | Ca(meq/100g)             | 12.3                  | Very high         | 12.9                    | Very high       | 27.15                 | Very high       | 11.88                   | Very high         | 11.89                 | Very high       |                         |         |
|         |            | Mg(meq/100g)             | 9.8                   | Very high         | 8.9                     | Very high       | 6.33                  | Very high       | 2.50                    | Very high         | 2.47                  | Very high       |                         |         |
|         |            | Na(meq/100g)             | 8.5                   | *                 | 9.4                     | *               | 12.51                 | *               | 8.16                    | *                 | 7.11                  | *               |                         |         |
|         |            |                          |                       |                   |                         |                 |                       |                 |                         |                   |                       |                 |                         |         |

| SI .No. | Location | Parameter                | 2013-2014             |                      |                         |                    | 2014-2015             |                      |                         |                 | 2015-2016             |                    |                         |         |
|---------|----------|--------------------------|-----------------------|----------------------|-------------------------|--------------------|-----------------------|----------------------|-------------------------|-----------------|-----------------------|--------------------|-------------------------|---------|
|         |          |                          | Dry season<br>(April) | Remarks              | Wet season<br>(October) | Remarks            | Dry season<br>(April) | Remarks              | Wet season<br>(October) | Remarks         | Dry season<br>(March) | Remarks            | Wet season<br>(October) | Remarks |
|         |          | P(µg/gm)                 | 2.7                   | Very low             | 12.8                    | Medium             | 8.34                  | Low                  | 6.89                    | Low             | 8.05                  | Low                |                         |         |
|         |          | S(µg/gm)                 | 401.9                 | Very high            | 16.9                    | Medium             | 673.58                | Very high            | 500.0                   | Very high       | 574.26                | Very high          |                         |         |
|         |          | B(µg/gm)                 | 0.57                  | Optimum              | 0.74                    | High               | 0.75                  | High                 | 1.52                    | Very high       | 1.88                  | Very high          |                         |         |
|         |          | Fe(µg/gm)                | 60.2                  | Very high            | 223.6                   | Very high          | 52.46                 | Very high            | 89.23                   | Very high       | 48.75                 | Very high          |                         |         |
|         |          | Mn(µg/gm)                | 5.3                   | Very high            | 12.8                    | Very high          | 74.59                 | Very high            | 7.05                    | Very high       | 7.44                  | Very high          |                         |         |
|         |          | Zn(µg/gm)                | 1.7                   | Medium               | 2.5                     | Very high          | 2.66                  | Very high            | 5.32                    | Very high       | 4.36                  | Very high          |                         |         |
|         |          | Lead(Pb)<br>(µg/gm)      | 0.00                  | *                    | 29.2                    | *                  | 31.34                 | *                    | 14.09                   | *               | 15.12                 | *                  |                         |         |
|         |          | Cadmium<br>(Cd)(µg/gm)   | 0                     | 0                    | 0                       | 0                  | 2.31                  | *                    | 00                      | *               | 00                    | *                  |                         |         |
|         |          | Chloride<br>(Cl-)(µg/gm) | 1957.6                | *                    | 0                       | 0                  | 0                     | 0                    | 0                       | 0               | 0                     |                    |                         |         |
|         |          | Subsurface soil(15-30cm) |                       |                      |                         |                    |                       |                      |                         |                 |                       |                    |                         |         |
|         |          | EC(ds/m)                 | 9.1                   | Moderately<br>saline | 5.6                     | Slightly<br>saline | 10.48                 | Moderately<br>saline | 6.97                    | Slightly saline | 5.74                  | Slightly<br>saline |                         |         |
|         |          | pH                       | 6.7                   | Neutral              | 6.4                     | Slightly<br>acid   | 6.4                   | Slightly acid        | 6.7                     | Neutral         | 7.00                  | Neutral            |                         |         |
|         |          | OM (%)                   | 1.8                   | Low                  | 0.95                    | Very low           | 3.08                  | High                 | 1.64                    | Low             | 1.66                  | Low                |                         |         |
|         |          | N (%)                    | 0.09                  | Very low             | 0.06                    | Very low           | 0.17                  | Low                  | 0.08                    | Very low        | 0.10                  | Low                |                         |         |
|         |          | K (meq/100g)             | 1.6                   | Very high            | 1.1                     | Very high          | 2.68                  | Very high            | 0.75                    | Very high       | 0.77                  | Very high          |                         |         |
|         |          | Ca(meq/100g)             | 12.6                  | Very high            | 13.8                    | Very high          | 26.29                 | Very high            | 15.65                   | Very high       | 16.44                 | Very high          |                         |         |
|         |          | Mg(meq/100g)             | 9.5                   | Very high            | 8.9                     | Very high          | 6.29                  | Very high            | 3.13                    | Medium          | 3.16                  | Very high          |                         |         |
|         |          | Na(meq/100g)             | 8.5                   | *                    | 9.9                     | Very high          | 10.61                 | *                    | 7.89                    | *               | 6.88                  | *                  |                         |         |
|         |          | P(µg/gm)                 | 2.7                   | Very low             | 18.4                    | Optimum            | 7.32                  | Low                  | 6.67                    | Low             | 5.77                  | Low                |                         |         |
|         |          | S(µg/gm)                 | 280.5                 | Very high            | 23.8                    | Optimum            | 487.29                | Very high            | 298.0                   | Very high       | 311.1<br>5            | Very high          |                         |         |
|         |          | B(µg/gm)                 | 1.1                   | Very high            | 1.7                     | Very high          | 0.92                  | Very high            | 1.44                    | Very high       | 1.37                  | Very high          |                         |         |
|         |          | Fe(µg/gm)                | 133.9                 | Very high            | 193.3                   | Very high          | 52.20                 | Very high            | 75.51                   | Very high       | 35.34                 | Very high          |                         |         |
|         |          | Mn(µg/gm)                | 2.8                   | Optimum              | 11.6                    | Very high          | 17.75                 | Very high            | 8.29                    | Very high       | 11.21                 | Very high          |                         |         |
|         |          | Zn(µg/gm)                | 0.99                  | Medium               | 1.4                     | Optimum            | 2.00                  | High                 | 1.71                    | Optimum         | 1.28                  | Medium             |                         |         |

| Sl .No. | Location          | Parameter             | 2013-2014          |                   |                      |                 | 2014-2015          |                   |                      |                 | 2015-2016          |                 |                      |         |
|---------|-------------------|-----------------------|--------------------|-------------------|----------------------|-----------------|--------------------|-------------------|----------------------|-----------------|--------------------|-----------------|----------------------|---------|
|         |                   |                       | Dry season (April) | Remarks           | Wet season (October) | Remarks         | Dry season (April) | Remarks           | Wet season (October) | Remarks         | Dry season (March) | Remarks         | Wet season (October) | Remarks |
|         | K a p a l i r e t | Lead(Pb)(µg/gm)       | 0.00               | *                 | 29.9                 | *               | 31.52              | *                 | 16.63                | *               | 17.07              | *               |                      |         |
|         |                   | Cadmium (Cd)(µg/gm)   | 0                  | 0                 | 0                    | 0               | 2.35               | *                 | 00                   | *               | 00                 | *               |                      |         |
|         |                   | Chloride (Cl-)(µg/gm) | 1,472.5            | *                 | 0                    | 0               | 0                  | 0                 | 0                    | 0               | 0                  |                 |                      |         |
|         |                   | Substratum(30-45cm)   |                    |                   |                      |                 |                    |                   |                      |                 |                    |                 |                      |         |
|         |                   | EC(ds/m)              | 10.1               | Moderately saline | 5.3                  | Slightly saline | 10.00              | Moderately saline | 6.91                 | Slightly saline | 6.59               | Slightly saline |                      |         |
|         |                   | pH                    | 6.6                | Neutral           | 6.2                  | Slightly acid   | 6.6                | Neutral           | 6.4                  | Slightly acid   | 6.2                | Slightly acid   |                      |         |
|         |                   | OM (%)                | 1.9                | Medium            | 1.4                  | Low             | 3.36               | High              | 1.53                 | Low             | 1.68               | Low             |                      |         |
|         |                   | N (%)                 | 0.09               | Low               | 0.08                 | Low             | 0.19               | Medium            | 0.08                 | Low             | 0.10               | Low             |                      |         |
|         |                   | K (meq/100g)          | 1.5                | Very high         | 1.2                  | Very high       | 2.60               | Very high         | 0.72                 | Very high       | 0.67               | Very high       |                      |         |
|         |                   | Ca(meq/100g)          | 13.7               | Very high         | 34.4                 | Very high       | 18.87              | Very high         | 13.16                | Very high       | 11.99              | Very high       |                      |         |
|         |                   | Mg(meq/100g)          | 11.8               | Very high         | 6.4                  | Very high       | 6.34               | Very high         | 3.08                 | Very high       | 3.12               | Very high       |                      |         |
|         |                   | Na(meq/100g)          | 8.5                | *                 | 9.3                  | *               | 10.92              | *                 | 7.69                 | *               | 6.98               | *               |                      |         |
|         |                   | P(µg/gm)              | 1.3                | Very low          | 19.5                 | Optimum         | 6.11               | Low               | 5.71                 | Low             | 7.70               | Low             |                      |         |
|         |                   | S(µg/gm)              | 320.4              | Very high         | 32.8                 | High            | 428.10             | Very high         | 262.0                | Very high       | 265.61             | Very high       |                      |         |
|         |                   | B(µg/gm)              | 1.14               | Very high         | 1.5                  | Very high       | 1.12               | Very high         | 1.36                 | Very high       | 1.28               | Very high       |                      |         |
|         |                   | Fe(µg/gm)             | 125.3              | Very high         | 175.5                | Very high       | 117.70             | Very high         | 91.20                | Very high       | 71.63              | Very high       |                      |         |
|         |                   | Mn(µg/gm)             | 2.7                | Optimum           | 12.2                 | High            | 46.08              | Very high         | 6.09                 | Very high       | 8.79               | Very high       |                      |         |
|         |                   | Zn(µg/gm)             | 1.8                | Optimum           | 0.5                  | Low             | 2.15               | High              | 2.83                 | Very high       | 2.09               | High            |                      |         |
|         |                   | Lead(Pb)(µg/gm)       | 31.3               | *                 | 29.7                 | *               | 32.46              | *                 | 14.10                | *               | 13.58              | *               |                      |         |
|         |                   | Cadmium (Cd)(µg/gm)   | 0                  | 0                 | 0                    | 0               | 2.12               | *                 | 00                   | *               | 00                 | *               |                      |         |
|         |                   | Chloride (Cl-)(µg/gm) | 1715.0             | *                 | 0                    | 0               | 0                  | 0                 | 0                    | 0               | 0                  |                 |                      |         |
|         |                   |                       | K a p a l i r e t  | Top soil(0-15cm)  |                      |                 |                    |                   |                      |                 |                    |                 |                      |         |

| SI .No. | Location | Parameter                | 2013-2014             |                   |                         |                   | 2014-2015             |                      |                         |                   | 2015-2016             |                   |                         |         |
|---------|----------|--------------------------|-----------------------|-------------------|-------------------------|-------------------|-----------------------|----------------------|-------------------------|-------------------|-----------------------|-------------------|-------------------------|---------|
|         |          |                          | Dry season<br>(April) | Remarks           | Wet season<br>(October) | Remarks           | Dry season<br>(April) | Remarks              | Wet season<br>(October) | Remarks           | Dry season<br>(March) | Remarks           | Wet season<br>(October) | Remarks |
| 3       |          | EC(ds/m)                 | 4.8                   | Slightly saline   | 8.5                     | Moderately saline | 3.89                  | Very slightly saline | 8.29                    | Moderately saline | 8.22                  | Moderately saline |                         |         |
|         |          | pH                       | 7.0                   | Neutral           | 7.6                     | Slightly alkaline | 6.2                   | Slightly acid        | 8.0                     | Slightly alkaline | 8.1                   | Slightly alkaline |                         |         |
|         |          | OM (%)                   | 3.0                   | Medium            | 1.5                     | Low               | 2.01                  | Medium               | 1.75                    | Low               | 2.03                  | Medium            |                         |         |
|         |          | N (%)                    | 0.2                   | Low               | 0.07                    | Very low          | 0.11                  | Low                  | 0.09                    | Very low          | 0.11                  | Low               |                         |         |
|         |          | K (meq/100g)             | 1.5                   | Very high         | 1.7                     | Very high         | 1.32                  | Very high            | 0.92                    | Very high         | 0.89                  | Very high         |                         |         |
|         |          | Ca(meq/100g)             | 18.2                  | Very high         | 19.9                    | Very high         | 27.04                 | Very high            | 10.77                   | Very high         | 11.09                 | Very high         |                         |         |
|         |          | Mg(meq/100g)             | 15.3                  | Very high         | 10.0                    | Very high         | 6.21                  | Very high            | 2.67                    | Very high         | 3.48                  | Very high         |                         |         |
|         |          | Na(meq/100g)             | 12.0                  | *                 | 11.9                    | *                 | 5.22                  | *                    | 7.77                    | *                 | 7.87                  | *                 |                         |         |
|         |          | P(µg/gm)                 | 3.2                   | Very low          | 7.3                     | Low               | 6.76                  | Very high            | 5.01                    | Very low          | 6.26                  | Low               |                         |         |
|         |          | S(µg/gm)                 | 545.2                 | Very high         | 20.8                    | Medium            | 216.69                | Very high            | 700.0                   | Very high         | 710.40                | Very high         |                         |         |
|         |          | B(µg/gm)                 | 1.2                   | Very high         | 1.3                     | Very high         | 0.95                  | Very high            | 1.69                    | Very high         | 2.03                  | Very high         |                         |         |
|         |          | Fe(µg/gm)                | 37.3                  | Very high         | 230.2                   | Very high         | 34.56                 | Very high            | 94.22                   | Very high         | 45.52                 | Very high         |                         |         |
|         |          | Mn(µg/gm)                | 3.8                   | Very high         | 6.6                     | Very high         | 10.26                 | Very high            | 7.28                    | Very high         | 6.05                  | Very high         |                         |         |
|         |          | Zn(µg/gm)                | 2.0                   | High              | 1.0                     | Low               | 1.64                  | Optimum              | 3.58                    | Very high         | 2.68                  | Very high         |                         |         |
|         |          | Lead(Pb)<br>(µg/gm)      | 12.5                  | *                 | 28.9                    | *                 | 47.12                 | *                    | 8.17                    | *                 | 6.89                  | *                 |                         |         |
|         |          | Cadmium<br>(Cd)(µg/gm)   | 0                     | 0                 | 0                       | 0                 | 2.86                  | *                    | 00                      | *                 | 00                    | *                 |                         |         |
|         |          | Chloride<br>(Cl-)(µg/gm) | 3741.9                | *                 | 0                       | 0                 | 0                     | 0                    | 0                       | 0                 | 0                     |                   |                         |         |
|         |          | Subsurface soil(15-30cm) |                       |                   |                         |                   |                       |                      |                         |                   |                       |                   |                         |         |
|         |          | EC(ds/m)                 | 11.1                  | Moderately saline | 6.3                     | Slightly saline   | 4.26                  | Slightly saline      | 7.43                    | Slightly saline   | 8.60                  | Moderately saline |                         |         |
|         |          | pH                       | 7.2                   | Neutral           | 7.9                     | Slightly alkaline | 6.3                   | Slightly acid        | 8.0                     | Slightly alkaline | 8.1                   | Slightly alkaline |                         |         |
|         |          | OM (%)                   | 2.6                   | Medium            | 1.3                     | Low               | 3.36                  | High                 | 1.69                    | Low               | 1.95                  | Medium            |                         |         |
|         |          | N (%)                    | 0.2                   | Low               | 0.06                    | Very low          | 0.19                  | Medium               | 0.08                    | Very low          | 0.10                  | Low               |                         |         |
|         |          | K (meq/100g)             | 1.5                   | Very high         | 1.6                     | Very high         | 1.13                  | Very high            | 0.98                    | Low               | 0.98                  | Very high         |                         |         |

| Sl .No. | Location | Parameter                 | 2013-2014             |                   |                         |                   | 2014-2015             |                      |                         |                   | 2015-2016             |                   |                         |         |
|---------|----------|---------------------------|-----------------------|-------------------|-------------------------|-------------------|-----------------------|----------------------|-------------------------|-------------------|-----------------------|-------------------|-------------------------|---------|
|         |          |                           | Dry season<br>(April) | Remarks           | Wet season<br>(October) | Remarks           | Dry season<br>(April) | Remarks              | Wet season<br>(October) | Remarks           | Dry season<br>(March) | Remarks           | Wet season<br>(October) | Remarks |
|         |          | Ca(meq/100g)              | 11.7                  | Very high         | 14.4                    | Very high         | 25.16                 | Very high            | 16.89                   | Very high         | 16.12                 | Very high         |                         |         |
|         |          | Mg(meq/100g)              | 7.1                   | Very high         | 9.9                     | Very high         | 6.22                  | Very high            | 3.94                    | Very high         | 3.88                  | Very high         |                         |         |
|         |          | Na(meq/100g)              | 8.5                   | *                 | 9.8                     | *                 | 5.45                  | *                    | 7.86                    | *                 | 7.89                  | *                 |                         |         |
|         |          | P(µg/gm)                  | 3.8                   | Very low          | 5.6                     | Low               | 5.29                  | Low                  | 5.52                    | Low               | 6.21                  | Low               |                         |         |
|         |          | S(µg/gm)                  | 341.4                 | Very high         | 52.1                    | Very high         | 236.58                | Very high            | 655.0                   | Very high         | 666.23                | Very high         |                         |         |
|         |          | B(µg/gm)                  | 0.86                  | Very high         | 1.6                     | Very high         | 0.21                  | Low                  | 1.93                    | Very high         | 2.11                  | Very high         |                         |         |
|         |          | Fe(µg/gm)                 | 140.2                 | Very high         | 249.0                   | Very high         | 30.03                 | Very high            | 93.15                   | Very high         | 73.04                 | Very high         |                         |         |
|         |          | Mn(µg/gm)                 | 3.7                   | High              | 5.9                     | Very high         | 11.23                 | Very high            | 6.95                    | Very high         | 8.16                  | Very high         |                         |         |
|         |          | Zn(µg/gm)                 | 0.94                  | Medium            | 0.5                     | Low               | 1.04                  | Medium               | 2.39                    | Very high         | 1.96                  | High              |                         |         |
|         |          | Lead(Pb)<br>(µg/gm)       | 0.00                  | *                 | 29.3                    | *                 | 33.66                 | *                    | 9.58                    | *                 | 10.03                 | *                 |                         |         |
|         |          | Cadmium<br>(Cd)(µg/gm)    | 0                     | 0                 | 0                       | 0                 | 2.18                  | *                    | 00                      | *                 | 00                    | *                 |                         |         |
|         |          | Chloride<br>(Cl-) (µg/gm) | 2217.4                | *                 | 0                       | 0                 | 0                     | 0                    | 0                       | 0                 | 0                     |                   |                         |         |
|         |          | Substratum(30-45cm)       |                       |                   |                         |                   |                       |                      |                         |                   |                       |                   |                         |         |
|         |          | EC(ds/m)                  | 10.8                  | Moderately saline | 7.5                     | Slightly saline   | 3.99                  | Very slightly saline | 7.06                    | Slightly saline   | 6.77                  | Slightly saline   |                         |         |
|         |          | pH                        | 7.3                   | Neutral           | 7.8                     | Slightly alkaline | 6.3                   | Slightly acid        | 7.9                     | Slightly alkaline | 7.9                   | Slightly alkaline |                         |         |
|         |          | OM (%)                    | 2.8                   | Medium            | 1.3                     | Low               | 4.03                  | High                 | 2.38                    | Medium            | 2.42                  | Medium            |                         |         |
|         |          | N (%)                     | 0.15                  | Low               | 0.06                    | Very low          | 0.23                  | Medium               | 0.12                    | Low               | 0.13                  | Low               |                         |         |
|         |          | K (meq/100g)              | 1.5                   | Very high         | 1.6                     | Very high         | 1.16                  | Very high            | 0.87                    | Very high         | 0.88                  | Very high         |                         |         |
|         |          | Ca(meq/100g)              | 12.9                  | Very high         | 15.4                    | Very high         | 27.13                 | Very high            | 17.20                   | Very high         | 16.88                 | Very high         |                         |         |
|         |          | Mg(meq/100g)              | 10.4                  | Very high         | 9.7                     | Very high         | 6.25                  | Very high            | 3.90                    | Very high         | 4.12                  | Very high         |                         |         |
|         |          | Na(meq/100g)              | 8.5                   | *                 | 9.6                     | *                 | 5.76                  | *                    | 7.27                    | *                 | 7.03                  | *                 |                         |         |
|         |          | P(µg/gm)                  | 3.4                   | Very low          | 5.8                     | Low               | 9.24                  | Optimum              | 3.65                    | Very low          | 3.81                  | Very low          |                         |         |

| Sl .No. | Location   | Parameter                 | 2013-2014             |                   |                         |                   | 2014-2015             |                 |                         |                   | 2015-2016             |                   |                         |         |
|---------|------------|---------------------------|-----------------------|-------------------|-------------------------|-------------------|-----------------------|-----------------|-------------------------|-------------------|-----------------------|-------------------|-------------------------|---------|
|         |            |                           | Dry season<br>(April) | Remarks           | Wet season<br>(October) | Remarks           | Dry season<br>(April) | Remarks         | Wet season<br>(October) | Remarks           | Dry season<br>(March) | Remarks           | Wet season<br>(October) | Remarks |
|         |            | S(µg/gm)                  | 345.1                 | Very high         | 5.6                     | Very low          | 231.67                | Very high       | 732.0                   | Very high         | 764.07                | Very high         |                         |         |
|         |            | B(µg/gm)                  | 1.4                   | Very high         | 1.1                     | Very high         | 1.55                  | Very high       | 1.83                    | Very high         | 1.56                  | Very high         |                         |         |
|         |            | Fe(µg/gm)                 | 120.3                 | Very high         | 247.8                   | Very high         | 33.82                 | Very high       | 87.26                   | Very high         | 38.64                 | Very high         |                         |         |
|         |            | Mn(µg/gm)                 | 2.9                   | Optimum           | 7.2                     | Very high         | 53.90                 | Very high       | 7.31                    | Very high         | 9.43                  | Very high         |                         |         |
|         |            | Zn(µg/gm)                 | 0.88                  | Low               | 0.79                    | Low               | 1.00                  | Medium          | 2.09                    | High              | 2.35                  | High              |                         |         |
|         |            | Lead(Pb)<br>(µg/gm)       | 0.00                  | *                 | 27.6                    | *                 | 34.37                 | *               | 7.88                    | *                 | 7.57                  | *                 |                         |         |
|         |            | Cadmium<br>(Cd)(µg/gm)    | 0                     | 0                 | 0                       | 0                 | 2.20                  | *               | 00                      | *                 | 00                    | *                 |                         |         |
|         |            | Chloride<br>(Cl-) (µg/gm) | 1801.6                | *                 | 0                       | 0                 | 0                     | 0               | 0                       | 0                 | 0                     |                   |                         |         |
| 4       | Chalkghona | Top soil(0-15cm)          |                       |                   |                         |                   |                       |                 |                         |                   |                       |                   |                         |         |
|         |            | EC(ds/m)                  | 11.5                  | Moderately saline | 7.2                     | Slightly saline   | 7.36                  | Slightly saline | 7.31                    | Slightly saline   | 7.67                  | Slightly saline   |                         |         |
|         |            | pH                        | 7.7                   | Slightly alkaline | 8.0                     | Slightly alkaline | 5.7                   | Slightly acid   | 8.5                     | Strongly alkaline | 8.6                   | Strongly alkaline |                         |         |
|         |            | OM (%)                    | 1.5                   | Low               | 1.5                     | Low               | 2.13                  | Medium          | 2.17                    | Medium            | 2.15                  | Medium            |                         |         |
|         |            | N (%)                     | 0.08                  | Low               | 0.08                    | Low               | 0.12                  | Low             | 0.11                    | Low               | 0.11                  | Low               |                         |         |
|         |            | K (meq/100g)              | 1.5                   | Very high         | 1.4                     | Very high         | 1.72                  | Very high       | 0.86                    | Very high         | 0.88                  | Very high         |                         |         |
|         |            | Ca(meq/100g)              | 22.2                  | Very high         | 14.3                    | Very high         | 18.79                 | Very high       | 14.58                   | Very high         | 15.31                 | Very high         |                         |         |
|         |            | Mg(meq/100g)              | 11.7                  | Very high         | 9.4                     | Very high         | 6.29                  | Very high       | 3.87                    | Very high         | 3.89                  | Very high         |                         |         |
|         |            | Na(meq/100g)              | 8.5                   | *                 | 8.4                     | *                 | 9.81                  | *               | 6.56                    | *                 | 6.33                  | *                 |                         |         |
|         |            | P(µg/gm)                  | 5.6                   | Very low          | 9.2                     | Low               | 4.11                  | Very low        | 10.88                   | Medium            | 11.26                 | Medium            |                         |         |
|         |            | S(µg/gm)                  | 444.2                 | Very high         | 4.1                     | Very low          | 440.19                | Very high       | 975.0                   | Very high         | 982.55                | Very high         |                         |         |
|         |            | B(µg/gm)                  | 0.98                  | Very high         | 1.2                     | Very high         | 0.85                  | Very high       | 1.65                    | Very low          | 1.88                  | Very high         |                         |         |
|         |            | Fe(µg/gm)                 | 55.3                  | Very high         | 189.0                   | Very high         | 41.14                 | Very high       | 68.05                   | Very high         | 43.62                 | Very high         |                         |         |
|         |            | Mn(µg/gm)                 | 4.3                   | High              | 16.4                    | Very high         | 32.04                 | Very high       | 7.23                    | Very high         | 8.34                  | Very high         |                         |         |
|         |            | Zn(µg/gm)                 | 0.76                  | Low               | 4.8                     | Very high         | 4.33                  | Very high       | 3.28                    | Very high         | 2.14                  | High              |                         |         |
|         |            | Lead                      | 0.00                  | *                 | 27.2                    | *                 | 30.99                 | *               | 14.94                   | *                 | 14.88                 | *                 |                         |         |

| Sl .No. | Location | Parameter                | 2013-2014             |                      |                         |                      | 2014-2015             |                 |                         |                      | 2015-2016             |                      |                         |         |
|---------|----------|--------------------------|-----------------------|----------------------|-------------------------|----------------------|-----------------------|-----------------|-------------------------|----------------------|-----------------------|----------------------|-------------------------|---------|
|         |          |                          | Dry season<br>(April) | Remarks              | Wet season<br>(October) | Remarks              | Dry season<br>(April) | Remarks         | Wet season<br>(October) | Remarks              | Dry season<br>(March) | Remarks              | Wet season<br>(October) | Remarks |
|         |          | (Pb) (µg/gm)             |                       |                      |                         |                      |                       |                 |                         |                      |                       |                      |                         |         |
|         |          | Cadmium<br>(Cd)(µg/gm)   | 0                     | 0                    | 0                       | 0                    | 2.38                  | *               | 00                      | *                    | 00                    | *                    |                         |         |
|         |          | Chloride<br>(Cl-)(µg/gm) | 1576.4                | *                    | 0                       | 0                    | 0                     | 0               | 0                       | 0                    | 0                     |                      |                         |         |
|         |          | Subsurface soil(15-30cm) |                       |                      |                         |                      |                       |                 |                         |                      |                       |                      |                         |         |
|         |          | EC(ds/m)                 | 11.3                  | Moderately<br>saline | 6.2                     | Slightly<br>saline   | 7.81                  | Slightly saline | 7.38                    | Slightly saline      | 7.02                  | Slightly<br>saline   |                         |         |
|         |          | pH                       | 7.7                   | Slightly<br>alkaline | 8.2                     | Slightly<br>alkaline | 5.9                   | Slightly acid   | 8.6                     | Strongly<br>alkaline | 8.5                   | Strongly<br>alkaline |                         |         |
|         |          | OM (%)                   | 2.6                   | Medium               | 1.3                     | Low                  | 1.88                  | Medium          | 1.90                    | Medium               | 1.88                  | Medium               |                         |         |
|         |          | N (%)                    | 0.13                  | Low                  | 0.07                    | Very low             | 0.10                  | Low             | 0.10                    | Low                  | 0.10                  | Low                  |                         |         |
|         |          | K (meq/100g)             | 1.5                   | Very high            | 1.1                     | Very high            | 1.54                  | Very high       | 0.81                    | Very high            | 0.84                  | Very high            |                         |         |
|         |          | Ca(meq/100g)             | 22.6                  | Very high            | 17.8                    | Very high            | 18.96                 | Very high       | 16.05                   | Very high            | 16.00                 | Very high            |                         |         |
|         |          | Mg(meq/100g)             | 16.3                  | Very high            | 8.3                     | Very high            | 6.30                  | Very high       | 4.25                    | Very high            | 4.33                  | Very high            |                         |         |
|         |          | Na(meq/100g)             | 8.5                   | *                    | 8.6                     | *                    | 9.23                  | *               | 6.93                    | *                    | 6.56                  | *                    |                         |         |
|         |          | P(µg/gm)                 | 13.6                  | Medium               | 9.4                     | Low                  | 3.23                  | Very low        | 9.23                    | Low                  | 8.27                  | Low                  |                         |         |
|         |          | S(µg/gm)                 | 415.6                 | Very high            | 47.7                    | Very high            | 393.37                | Very high       | 886.0                   | Very high            | 990.4<br>8            | Very high            |                         |         |
|         |          | B(µg/gm)                 | 0.66                  | High                 | 0.97                    | Very high            | 0.79                  | Very high       | 1.46                    | Very high            | 1.17                  | Very high            |                         |         |
|         |          | Fe(µg/gm)                | 124.1                 | Very high            | 172.7                   | Very high            | 25.52                 | Very high       | 77.47                   | Very high            | 55.06                 | Very high            |                         |         |
|         |          | Mn(µg/gm)                | 6.1                   | Very high            | 13.8                    | Very high            | 26.59                 | Very high       | 6.78                    | Very high            | 7.05                  | Very high            |                         |         |
|         |          | Zn(µg/gm)                | 1.1                   | Medium               | 3.2                     | Very high            | 1.09                  | Medium          | 3.37                    | Very high            | 2.73                  | Very high            |                         |         |
|         |          | Lead(Pb(µg/g<br>m)       | 6.3                   | *                    | 28.4                    | *                    | 30.81                 | *               | 11.83                   | *                    | 12.43                 | *                    |                         |         |
|         |          | Cadmium<br>(Cd)(µg/gm)   | 0                     | 0                    | 0                       | 0                    | 2.35                  | *               | 00                      | *                    | 00                    | *                    |                         |         |
|         |          | Chloride<br>(Cl-)(µg/gm) | 2113.5                | *                    | 0                       | 0                    | 0                     | 0               | 0                       | 0                    | 0                     |                      |                         |         |
|         |          | Substratum(30-45cm)      |                       |                      |                         |                      |                       |                 |                         |                      |                       |                      |                         |         |



| SI .No. | Location   | Parameter                | 2013-2014             |                   |                         |                   | 2014-2015             |                 |                         |                   | 2015-2016             |                   |                         |         |
|---------|------------|--------------------------|-----------------------|-------------------|-------------------------|-------------------|-----------------------|-----------------|-------------------------|-------------------|-----------------------|-------------------|-------------------------|---------|
|         |            |                          | Dry season<br>(April) | Remarks           | Wet season<br>(October) | Remarks           | Dry season<br>(April) | Remarks         | Wet season<br>(October) | Remarks           | Dry season<br>(March) | Remarks           | Wet season<br>(October) | Remarks |
|         |            | EC(ds/m)                 | 10.9                  | Moderately saline | 5.1                     | Slightly saline   | 7.14                  | Slightly saline | 7.12                    | Slightly saline   | 7.45                  | Slightly saline   |                         |         |
|         |            | pH                       | 7.5                   | Slightly alkaline | 8.2                     | Slightly alkaline | 6.0                   | Slightly acid   | 8.9                     | Strongly alkaline | 8.7                   | Strongly alkaline |                         |         |
|         |            | OM (%)                   | 1.7                   | Low               | 1.0                     | Very low          | 2.94                  | Medium          | 1.53                    | Low               | 1.57                  | Low               |                         |         |
|         |            | N (%)                    | 0.09                  | Very low          | 0.06                    | Very low          | 0.17                  | Low             | 0.08                    | Very low          | 0.09                  | Very low          |                         |         |
|         |            | K (meq/100g)             | 1.5                   | Very high         | 0.95                    | Very high         | 1.57                  | Very high       | 0.89                    | Very high         | 0.90                  | Very high         |                         |         |
|         |            | Ca(meq/100g)             | 13.9                  | Very high         | 14.4                    | Very high         | 19.10                 | Very high       | 15.95                   | Very high         | 16.25                 | Very high         |                         |         |
|         |            | Mg(meq/100g)             | 11.1                  | Very high         | 7.2                     | Very high         | 6.26                  | Very high       | 4.15                    | Very high         | 4.06                  | Very high         |                         |         |
|         |            | Na(meq/100g)             | 8.5                   | *                 | 6.7                     | *                 | 9.33                  | *               | 7.20                    | Very high         | 7.39                  | *                 |                         |         |
|         |            | P(µg/gm)                 | 4.1                   | Very low          | 9.5                     | Low               | 5.67                  | Low             | 11.26                   | Medium            | 12.33                 | Medium            |                         |         |
|         |            | S(µg/gm)                 | 334.6                 | Very high         | 8.3                     | Low               | 343.00                | Very high       | 465.0                   | Very high         | 543.04                | Very high         |                         |         |
|         |            | B(µg/gm)                 | 0.67                  | High              | 0.63                    | High              | 1.05                  | Very high       | 1.14                    | Very high         | 1.11                  | Very high         |                         |         |
|         |            | Fe(µg/gm)                | 75.3                  | Very high         | 160.0                   | Very high         | 29.70                 | Very high       | 90.55                   | Very high         | 67.84                 | Very high         |                         |         |
|         |            | Mn(µg/gm)                | 3.6                   | Very high         | 14.1                    | Very high         | 25.22                 | Very high       | 6.03                    | Very high         | 7.03                  | Very high         |                         |         |
|         |            | Zn(µg/gm)                | 1.7                   | Optimum           | 2.9                     | Very high         | 1.78                  |                 | 2.94                    | Very high         | 2.00                  | High              |                         |         |
|         |            | Lead(Pb)<br>(µg/gm)      | 6.3                   | *                 | 26.5                    | *                 | 32.23                 | *               | 15.50                   | *                 | 14.71                 | *                 |                         |         |
|         |            | Cadmium<br>(Cd)(µg/gm)   | 0                     | 0                 | 0                       | 0                 | 2.55                  | *               | 00                      | *                 | 00                    | *                 |                         |         |
|         |            | Chloride<br>(Cl-)(µg/gm) | 1715.0                | *                 | 0                       | 0                 | 0                     | 0               | 0                       | 0                 | 0                     |                   |                         |         |
| 5       | Basherhula | Top soil(0-15cm)         |                       |                   |                         |                   |                       |                 |                         |                   |                       |                   |                         |         |
|         |            | EC(ds/m)                 | 11.7                  | Moderately saline | 6.0                     | Slightly saline   | 7.14                  | Slightly saline | 5.58                    | Slightly saline   | 9.10                  | Moderately saline |                         |         |
|         |            | pH                       | 7.7                   | Slightly alkaline | 8.3                     | Slightly alkaline | 7.3                   | Neutral         | 8.7                     | Strongly alkaline | 8.8                   | Strongly alkaline |                         |         |
|         |            | OM (%)                   | 1.7                   | Low               | 1.2                     | Low               | 1.74                  | Low             | 1.59                    | Low               | 1.79                  | Medium            |                         |         |
|         |            | N (%)                    | 0.09                  | Low               | 0.06                    | Very low          | 0.10                  | Low             | 0.08                    | Very low          | 0.09                  | Very low          |                         |         |

| SI .No. | Location | Parameter                | 2013-2014             |                   |                         |                   | 2014-2015             |                   |                         |                   | 2015-2016             |                   |                         |         |
|---------|----------|--------------------------|-----------------------|-------------------|-------------------------|-------------------|-----------------------|-------------------|-------------------------|-------------------|-----------------------|-------------------|-------------------------|---------|
|         |          |                          | Dry season<br>(April) | Remarks           | Wet season<br>(October) | Remarks           | Dry season<br>(April) | Remarks           | Wet season<br>(October) | Remarks           | Dry season<br>(March) | Remarks           | Wet season<br>(October) | Remarks |
|         |          | K (meq/100g)             | 1.5                   | Very high         | 1.2                     | Very high         | 1.67                  | Very high         | 0.75                    | Very high         | 0.81                  | Very high         |                         |         |
|         |          | Ca(meq/100g)             | 23.6                  | Very high         | 31.4                    | Very high         | 25.26                 | Very high         | 15.11                   | Very high         | 16.53                 | Very high         |                         |         |
|         |          | Mg(meq/100g)             | 11.9                  | Very high         | 7.9                     | Very high         | 5.50                  | Very high         | 4.05                    | Very high         | 4.42                  | Very high         |                         |         |
|         |          | Na(meq/100g)             | 8.5                   | *                 | 8.1                     | *                 | 7.06                  | *                 | 6.32                    | *                 | 8.24                  | *                 |                         |         |
|         |          | P(µg/gm)                 | 4.5                   | Very low          | 7.4                     | Low               | 7.12                  | Low               | 5.92                    | Low               | 5.47                  | Low               |                         |         |
|         |          | S(µg/gm)                 | 272.3                 | Very high         | 21.8                    | Medium            | 454.19                | Very high         | 607.0                   | Very high         | 623.73                | Very high         |                         |         |
|         |          | B(µg/gm)                 | 0.94                  | Very high         | 1.1                     | Very high         | 1.00                  | Very high         | 1.19                    | Very high         | 1.32                  | Very high         |                         |         |
|         |          | Fe(µg/gm)                | 50.3                  | Very high         | 205.6                   | Very high         | 53.37                 | Very high         | 85.08                   | Very high         | 48.00                 | Very high         |                         |         |
|         |          | Mn(µg/gm)                | 3.4                   | High              | 5.9                     | Very high         | 49.22                 | Very high         | 6.50                    | Very high         | 5.22                  | Very high         |                         |         |
|         |          | Zn(µg/gm)                | 1.4                   | Medium            | 1.1                     | Medium            | 2.27                  | Very high         | 1.86                    | High              | 1.04                  | Medium            |                         |         |
|         |          | Lead(Pb(µg/g m)          | 18.8                  | *                 | 25.1                    | *                 | 30.55                 | *                 | 6.19                    | *                 | 5.77                  | *                 |                         |         |
|         |          | Cadmium (Cd)(µg/gm)      | 0                     | 0                 | 0                       | 0                 | 2.21                  | *                 | 00                      | *                 | 00                    | *                 |                         |         |
|         |          | Chloride (Cl-)(µg/gm)    | 2442.6                | *                 | 0                       | 0                 | 0                     | 0                 | 0                       |                   |                       |                   |                         |         |
|         |          | Subsurface soil(15-30cm) |                       |                   |                         |                   |                       |                   |                         |                   |                       |                   |                         |         |
|         |          | EC(ds/m)                 | 10.7                  | Moderately saline | 7.0                     | Slightly saline   | 7.44                  | Slightly saline   | 7.16                    | Slightly saline   | 6.29                  | Slightly saline   |                         |         |
|         |          | pH                       | 7.7                   | Slightly alkaline | 8.2                     | Slightly alkaline | 7.7                   | Slightly alkaline | 8.7                     | Strongly alkaline | 8.6                   | Strongly alkaline |                         |         |
|         |          | OM (%)                   | 1.5                   | Low               | 0.9                     | Low               | 2.01                  | Medium            | 1.43                    | Low               | 1.31                  | Low               |                         |         |
|         |          | N (%)                    | 0.08                  | Very low          | 0.05                    | Very low          | 0.11                  | Low               | 0.07                    | Very low          | 0.07                  | Very low          |                         |         |
|         |          | K (meq/100g)             | 1.0                   | Very high         | 1.2                     | Very high         | 2.20                  | Very high         | 0.76                    | Very high         | 0.77                  | Very high         |                         |         |
|         |          | Ca(meq/100g)             | 24.0                  | Very high         | 32.6                    | Very high         | 33.28                 | Very high         | 14.75                   | Very high         | 13.87                 | Very high         |                         |         |
|         |          | Mg(meq/100g )            | 11.7                  | Very high         | 8.4                     | Very high         | 6.10                  | Very high         | 3.76                    | Very high         | 3.69                  | Very high         |                         |         |
|         |          | Na(meq/100g)             | 7.0                   | *                 | 10.1                    | *                 | 8.66                  | *                 | 7.06                    | *                 | 6.93                  | *                 |                         |         |
|         |          | P(µg/gm)                 | 3.9                   | Very low          | 5.3                     | Low               | 8.19                  | Low               | 6.82                    | Low               | 7.03                  | Low               |                         |         |
|         |          | S(µg/gm)                 | 317.2                 | Very high         | 2.8                     | Very low          | 379.38                | Very high         | 627.0                   | Very high         | 652.28                | Very high         |                         |         |

| SI .No. | Location | Parameter                 | 2013-2014             |                      |                         |                      | 2014-2015             |                   |                         |                      | 2015-2016             |                      |                         |         |
|---------|----------|---------------------------|-----------------------|----------------------|-------------------------|----------------------|-----------------------|-------------------|-------------------------|----------------------|-----------------------|----------------------|-------------------------|---------|
|         |          |                           | Dry season<br>(April) | Remarks              | Wet season<br>(October) | Remarks              | Dry season<br>(April) | Remarks           | Wet season<br>(October) | Remarks              | Dry season<br>(March) | Remarks              | Wet season<br>(October) | Remarks |
|         |          | B(µg/gm)                  | 0.71                  | High                 | 1.0                     | Very high            | 1.38                  | Very high         | 1.31                    | Very high            | 1.08                  | Very high            |                         |         |
|         |          | Fe(µg/gm)                 | 121.4                 | Very high            | 307.0                   | Very high            | 53.18                 | Very high         | 83.13                   | Very high            | 50.12                 | Very high            |                         |         |
|         |          | Mn(µg/gm)                 | 3.9                   | Very high            | 15.5                    | Very high            | 45.34                 | Very high         | 5.98                    | Very high            | 5.62                  | Very high            |                         |         |
|         |          | Zn(µg/gm)                 | 1.8                   | Optimum              | 0.8                     | Low                  | 1.99                  | High              | 2.27                    | Optimum              | 2.34                  | Very high            |                         |         |
|         |          | Lead(Pb)<br>(µg/gm)       | 18.8                  | *                    | 23.7                    | *                    | 31.49                 | *                 | 16.35                   | *                    | 17.15                 | *                    |                         |         |
|         |          | Cadmium<br>(Cd)(µg/gm)    | 0                     | 0                    | 0                       | 0                    | 2.32                  | *                 | 00                      | *                    | 00                    | *                    |                         |         |
|         |          | Chloride<br>(Cl-) (µg/gm) | 1611.1                | *                    | 0                       | 0                    | 0                     | 0                 | 0                       | 0                    | 0                     |                      |                         |         |
|         |          | Substratum(30-45cm)       |                       |                      |                         |                      |                       |                   |                         |                      |                       |                      |                         |         |
|         |          | EC(ds/m)                  | 10.9                  | Moderately<br>saline | 6.3                     | Slightly<br>saline   | 6.68                  | Slightly saline   | 6.96                    | Slightly<br>saline   | 6.38                  | Slightly<br>saline   |                         |         |
|         |          | pH                        | 7.7                   | Slightly<br>alkaline | 8.2                     | Slightly<br>alkaline | 7.8                   | Slightly alkaline | 8.8                     | Strongly<br>alkaline | 8.7                   | Strongly<br>alkaline |                         |         |
|         |          | OM (%)                    | 1.5                   | Low                  | 1.0                     | Low                  | 2.81                  | Medium            | 2.17                    | Medium               | 2.18                  | Medium               |                         |         |
|         |          | N (%)                     | 0.08                  | Very low             | 0.06                    | Very low             | 0.16                  | Low               | 0.11                    | Low                  | 0.11                  | Low                  |                         |         |
|         |          | K (meq/100g)              | 1.5                   | Very high            | 1.2                     | Very high            | 2.20                  | Very high         | 0.86                    | Very high            | 0.85                  | Very high            |                         |         |
|         |          | Ca(meq/100g)              | 24.4                  | Very high            | 32.1                    | Very high            | 30.68                 | Very high         | 13.95                   | Very high            | 12.92                 | Very high            |                         |         |
|         |          | Mg(meq/100g)              | 12.9                  | Very high            | 8.3                     | Very high            | 6.11                  | Very high         | 3.80                    | Very high            | 4.01                  | Very high            |                         |         |
|         |          | Na(meq/100g)              | 7.5                   | *                    | 9.8                     | *                    | 8.76                  | *                 | 7.68                    | *                    | 7.01                  | *                    |                         |         |
|         |          | P(µg/gm)                  | 6.1                   | Low                  | 5.9                     | Low                  | 11.14                 | Medium            | 9.12                    | Low                  | 8.77                  | Low                  |                         |         |
|         |          | S(µg/gm)                  | 321.1                 | Very high            | 3.1                     | Very low             | 305.69                | Very high         | 182.0                   | Very high            | 230.62                | Very high            |                         |         |
|         |          | B(µg/gm)                  | 0.63                  | High                 | 0.85                    | Very high            | 2.95                  | Very high         | 1.40                    | Very high            | 1.54                  | Very high            |                         |         |
|         |          | Fe(µg/gm)                 | 77.3                  | Very high            | 162.4                   | Very high            | 42.36                 | Very high         | 66.29                   | Very high            | 39.40                 | Very high            |                         |         |
|         |          | Mn(µg/gm)                 | 3.2                   | High                 | 16.9                    | Very high            | 31.74                 | Very high         | 5.69                    | Very high            | 7.16                  | Very high            |                         |         |
|         |          | Zn(µg/gm)                 | 2.1                   | High                 | 2.7                     | Very high            | 1.62                  | Optimum           | 2.04                    | High                 | 1.46                  | Optimum              |                         |         |
|         |          | Lead(Pb)<br>(µg/gm)       | 25.00                 | *                    | 22.2                    | *                    | 31.54                 | *                 | 14.96                   | *                    | 16.02                 | *                    |                         |         |
|         |          | Cadmium                   | 0                     | 0                    | 0                       | 0                    | 2.44                  | *                 | 00                      | *                    | 00                    | *                    |                         |         |

**Table E.3: Different Concentrations of metals in the agricultural soil of the study area over three seasons in 2013-14, 2014-15 and 2015-16(dry season)**

[illegible]

| Q       | C       | σ | P       | N | Parameter                                |  |
|---------|---------|---|---------|---|--|--|
|         |         |   |         |   | Safe limit of India(mg/kg/<br>μg/gm/ppm) | Maximum Acceptable<br>Concentration of Agricultural soil in<br>Australia (mg/kg/μg/gm/ppm) |
| 3.0-6.0 | 250-500 |   | 300-600 |   |  |  |
| 5.0     | 100     |   | 300     |   |  |  |
| 14.7    | 14.7    |   | 1.75    |   | Mean(mg/kg/μg/gm/ppm)                    |  |
| 0       | 5.4     |   | 1.13    |   | SD                                       |  |
| 6.3     | 6.3     |   | 0.76    |   | Min(mg/kg/μg/gm/ppm)                     |  |
| 37.8    | 37.8    |   | 2.1     |   | Max(mg/kg/μg/gm/ppm)                     |  |
| 26.6    | 26.6    |   | 3.2     |   | Mean(mg/kg/μg/gm/ppm)                    |  |
| 0       | 2.3     |   | 1.5     |   | SD                                       |  |
| 22.2    | 22.2    |   | 0.49    |   | Min(mg/kg/μg/gm/ppm)                     |  |
| 33.7    | 33.7    |   | 4.8     |   | Max(mg/kg/μg/gm/ppm)                     |  |
| 30.8    | 30.8    |   | 3.9     |   | Mean(mg/kg/μg/gm/ppm)                    |  |
| 0.24    | 2.98    |   | 2.18    |   | SD                                       |  |
| 29.9    | 29.9    |   | 1.09    |   | Min(mg/kg/μg/gm/ppm)                     |  |
| 34.37   | 34.37   |   | 4.33    |   | Max(mg/kg/μg/gm/ppm)                     |  |
| 12.7    | 12.7    |   | 3.3     |   | Mean(mg/kg/μg/gm/ppm)                    |  |
| 0.6     | 5.4     |   | 2.5     |   | SD                                       |  |
| 7.88    | 7.88    |   | 1.69    |   | Min(mg/kg/μg/gm/ppm)                     |  |
| 25.95   | 25.95   |   | 5.32    |   | Max(mg/kg/μg/gm/ppm)                     |  |
| 12.7    | 12.7    |   | 3.3     |   | Mean(mg/kg/μg/gm/ppm)                    |  |
| 0.0     | 3.0     |   | 1.6     |   | SD                                       |  |
| 5.77    | 5.77    |   | 1.04    |   | Min(mg/kg/μg/gm/ppm)                     |  |
| 24.23   | 24.23   |   | 4.36    |   | Max(mg/kg/μg/gm/ppm)                     |  |
|         |         |   |         |   | Mean(mg/kg/μg/gm/ppm)                    |  |
|         |         |   |         |   | SD                                       |  |
|         |         |   |         |   | Min(mg/kg/μg/gm/ppm)                     |  |
|         |         |   |         |   | Max(mg/kg/μg/gm/ppm)                     |  |

Source: SRDI laboratory analysis (2016), Awashthi (2000) and Kabata-Pendias, A. and H.Pendias, (1992) \*Not specified

## Appendix V: Monitoring Data observed During EIA Study

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

| Date  | Sample location   | SPM ( $\mu\text{g}/\text{m}^3$ ) | SO <sub>x</sub> ( $\mu\text{g}/\text{m}^3$ ) | NO <sub>x</sub> ( $\mu\text{g}/\text{m}^3$ ) |
|---|---|----------------------------------|--|--|
| 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 <sup>-</sup> | T.Alkalinity | Turbidity | T S   | TDS   | SS   | DO   | BOD  | COD  | Salinity |
|----------|--------|-------|------|-------|-----------------|--------------|-----------|-------|-------|------|------|------|------|----------|
|          |        | °C    |      | µS/cm | mg/l            | mg/l         | NTU       | mg/l  | mg/l  | mg/l | mg/l | mg/l | mg/l | mg/l     |
| 1        | 7-Jan  | 27.4  | 7.74 | 3010  | 879             | 36           | 68.7      | 1565  | 1510  | 55   | 5.1  | 0.8  | 55   | 1.6      |
| 2        | 7-Jan  | 27.1  | 7.72 | 3020  | 878.8           | 36           | 68.5      | 1570  | 1510  | 60   | 5.1  | 0.8  | 55   | 1.6      |
| 3        | 7-Jan  | 27.8  | 7.71 | 3030  | 879             | 36           | 68.8      | 1565  | 1510  | 55   | 5.1  | 0.8  | 55   | 1.6      |
| 1        | 11-Feb | 29.8  | 7.66 | 4380  | 1262            | 36           | 182       | 2390  | 2180  | 210  | 4.7  | 1    | 76   | 2.3      |
| 2        | 11-Feb | 29.2  | 7.63 | 4380  | 1268            | 36           | 178       | 2390  | 2190  | 200  | 4.7  | 1    | 76   | 2.3      |
| 3        | 11-Feb | 29.1  | 7.65 | 4380  | 1263            | 36           | 179       | 2380  | 2180  | 200  | 4.7  | 1    | 76   | 2.3      |
| 1        | 9-Mar  | 32.6  | 7.56 | 11780 | 2944.4          | 38           | 176       | 6080  | 5890  | 190  | 4.7  | 1.2  | 76   | 6.7      |
| 2        | 9-Mar  | 32.6  | 7.57 | 11780 | 2945.2          | 38           | 178       | 6080  | 5890  | 190  | 4.7  | 1.2  | 76   | 6.7      |
| 3        | 9-Mar  | 32.1  | 7.55 | 11780 | 2946.4          | 38           | 177       | 6090  | 5890  | 200  | 4.7  | 1.2  | 76   | 6.7      |
| 1        | 17-Apr | 32.6  | 7.59 | 25300 | 8273            | 36           | 185.6     | 12950 | 12700 | 250  | 4.6  | 0.7  | 136  | 15.5     |
| 2        | 17-Apr | 32.6  | 7.59 | 25300 | 8273            | 36           | 186.2     | 12950 | 12700 | 250  | 4.6  | 0.7  | 138  | 15.5     |
| 3        | 17-Apr | 32.6  | 7.59 | 25300 | 8273            | 36           | 184.8     | 12950 | 12700 | 250  | 4.6  | 0.7  | 136  | 15.5     |
| 1        | 5-May  | 32.6  | 7.59 | 29200 | 9480            | 36           | 198.6     | 14900 | 14600 | 300  | 4.5  | 1.2  | 177  | 17.6     |
| 2        | 5-May  | 32.9  | 7.54 | 29200 | 9470            | 36           | 198.6     | 14900 | 14600 | 300  | 4.4  | 1.2  | 177  | 17.6     |
| 3        | 5-May  | 33.2  | 7.57 | 29200 | 9470            | 36           | 199.6     | 14900 | 14600 | 300  | 4.5  | 1.2  | 177  | 17.6     |
| 1        | 13-Jun | 31.6  | 7.69 | 18000 | 5820            | 36           | 112.6     | 9200  | 9000  | 200  | 4.7  | 1.1  | 97   | 10.8     |
| 2        | 13-Jun | 31.6  | 7.69 | 18000 | 5800            | 36           | 113.2     | 9200  | 9000  | 200  | 4.7  | 1.1  | 97   | 10.8     |
| 3        | 13-Jun | 31.6  | 7.69 | 18000 | 5810            | 36           | 112.4     | 9200  | 9000  | 200  | 4.7  | 1.1  | 97   | 10.8     |
| 1        | 1-Jul  | 31.6  | 7.69 | 440   | 32.6            | 36           | 76.6      | 285   | 220   | 65   | 5.2  | 0.8  | 26   | -        |
| 2        | 1-Jul  | 31.6  | 7.69 | 440   | 32.6            | 36           | 76.6      | 285   | 220   | 65   | 5.2  | 0.8  | 26   | -        |
| 3        | 1-Jul  | 31.6  | 7.69 | 440   | 32.6            | 36           | 76.6      | 285   | 220   | 65   | 5.2  | 0.8  | 26   | -        |
| 1        | 5-Aug  | 31.6  | 7.69 | 275   | 16.6            | 36           | 68.6      | 192   | 137   | 55   | 5.3  | 0.7  | 22   | -        |
| 2        | 5-Aug  | 31.6  | 7.69 | 275   | 16.6            | 36           | 68.6      | 192   | 137   | 55   | 5.3  | 0.7  | 22   | -        |
| 3        | 5-Aug  | 31.6  | 7.69 | 275   | 16.6            | 36           | 68.6      | 192   | 137   | 55   | 5.3  | 0.7  | 22   | -        |
| 1        | 8-Sep  | 31.6  | 7.74 | 270   | 15.6            | 36           | 65.6      | 180   | 135   | 45   | 5.5  | 0.7  | 22   | -        |
| 2        | 8-Sep  | 31.6  | 7.76 | 270   | 15.6            | 36           | 65.6      | 180   | 135   | 45   | 5.5  | 0.7  | 22   | -        |
| 3        | 8-Sep  | 31.6  | 7.74 | 270   | 15.6            | 36           | 65.6      | 180   | 135   | 45   | 5.5  | 0.7  | 22   | -        |
| 1        | 12-Oct | 30.6  | 7.79 | 290   | 26.6            | 36           | 62.6      | 192   | 145   | 47   | 5.6  | 0.7  | 22   | -        |
| 2        | 12-Oct | 30.6  | 7.78 | 290   | 26.6            | 36           | 62.6      | 192   | 145   | 47   | 5.6  | 0.7  | 22   | -        |
| 3        | 12-Oct | 30.6  | 7.78 | 290   | 25.6            | 36           | 62.6      | 192   | 145   | 47   | 5.6  | 0.7  | 22   | -        |
| 1        | 5-Nov  | 24.6  | 7.79 | 340   | 38.6            | 36           | 56.6      | 210   | 170   | 40   | 5.6  | 0.7  | 22   | -        |
| 2        | 5-Nov  | 26.6  | 7.79 | 340   | 38.6            | 36           | 56.6      | 210   | 170   | 40   | 5.6  | 0.7  | 22   | -        |
| 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  | 7.72 | 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