Government of The People's Republic of Bangladesh

Ministry of Water Resources

Bangladesh Water Development Board

Environmental Impact Assessment (EIA) (Draft)

Volume II (Annexes)

River Bank Improvement Program (RBIP)

January 2015

Contents

Annex A. Study Methodology

Citation in the main text (Volume I): **Section 1.4**.

The present EIA has been prepared following the standard methodology consisting of the steps listed below.

- Review of the program details and meeting/discussions with the design team
- Review of the policy and regulatory requirements
- Reconnaissance field visit and initial scoping and screening
- Collecting and analysis of baseline environmental and social data with the help of secondary literature review and field data collection
- Consultations with the stakeholders including beneficiary/affected communities
- Impact assessment
- Preparing environmental management plan
- Compilation of the present EIA.

These steps are discussed in the following sections.

A. 1. Review of the Program Details

At the outset of the study, detailed meetings were held with the main consultants (design team) in order to understand the project, its key components, the overall time schedule, and other relevant details. During these meetings, discussions were held regarding the need of close coordination among the various teams including the design team, social safeguard team, and the EIA team. It was agreed that the three teams will make efforts to hold fortnightly if not weekly meetings to ensure close coordination as well as sharing of information among the teams. Subsequent to this, all the necessary reports, documents, and maps were obtained from the design team. The EIA team reviewed these documents and held additional meetings with the design team to seek clarifications and further information on various aspects of the project.

A meeting was also held with the WB's environment specialists to discuss the understanding of the project, depth and breadth of the environment assessment, and the overall study schedule.

Initial scoping of the EIA study was also carried out at this stage and plans were made for the reconnaissance site visit.

A. 2. Reconnaissance Field Visit

A reconnaissance field visit was organized from 13 to 16 July to have a first-hand idea about the project, its components and its probable impacts on the local environment and community. Mr. Mohammad Omar Khalid, independent environment specialist was accompanied by Dr. Istiak Sobhan, EMP specialist and Md. Sunil Boron Debroy, Hydrologist and two field staff of IUCN. From the main consultant team, Mr. Habibur Rahman, Deputy Team Leader led the team in the field. During the reconnaissance visit, the team also visited 13 proposed resettlement sites for an initial environmental screening. Some photographs showing the project area are presented in **Figure A.1** below.

(a)

(b)

(c)

(d)

Figure A.1: Present condition of project site (a) Baliaghugri existing embankment, Changacha union of Sirajganj (b); Pukuria Bhanderbari existing embankment in Goshaibari, Dhunat, Bogra; (c) Per Debdanga Fishpass, Sariakandi Bogra; (d) Erosion of Brahmaputra river bank in Kurigram Sadar

A. 3. Inception Report

Subsequent to the reconnaissance field visit, the Inception Report was prepared that included detailed methodologies particularly for the field data collection. The table of content of the Inception Report is given below.

A. 4. Project Influence Area/Study Area

As an outcome of the initial scoping and the reconnaissance field visit discussed above, the project area off influence was determined, as described below.

The influence area of the project has been derived considering areas that are likely to be directly or indirectly affected by the RBIP construction and operation, including but not limited to: the extent the project would have an impact on the floodplain areas, lateral fish migration, hydrological network and road network, and the project footprints. The following criteria have been considered to define the influence area:

- Floodplain area: The extent of flood plain area that will be protected from the floods by the flood embankments (BRE) has been primarily considered as the project influence area. This area has been derived based on the latest satellite maps and GOB topographic maps through digital elevation model (DEM).
- Flood Inundation: The extent of flood inundation caused by breaches of BRE. Satellite maps were analyzed for August-September, 2014 to understand the extent of flooding from breaches and internal rivers like the Dharla, Dudhkumar, Teesta, Karotoya, Bengal, Ichamati and Hurasagar.
- Connectivity: The area is crisscrossed with a network of khals which carry flood waters from Jamuna to the internal rivers on the western side of the project area. The inundation area of the internal rivers was also considered during delineation

of influence area. On the other hand, all these rivers are interconnected by numerous khals, tributaries and distributaries forming a hydrological network in the entire north west region. For example, Mahananda, Punorbhaba which are major rivers of the north west region, are connected to the Atrai-Karatoya-Bengali system which drains to the lower Jamuna through the Hurasagar/Baral in the south east corner of the region.

- Lateral Fish Migration: Some fish species of Jamuna, such as major carps undergo lateral migration from Jamuna to floodplains for spawning. The migratory routes have been affected by the BRE and the proposed interventions also have a potential to impact these lateral migratory routes. The extent of lateral migration from Jamuna to floodplains is included in the project influence area. The other type of fish migration in Jamuna is longitudinal migration between upstream and downstream (e.g. hilsa migration from sea to Jamuna). Since the BRE and proposed interventions will not have any impacts on the longitudinal migratory routes, these areas are not included in the project influence area.
- Road network: Road network and other flow barrier structures have been considered. The western boundary of the influence area is thus the Dhaka-Bogra highway which impedes flood waters to flow westward. The southern boundary is defined as Jamuna bridge since it will be connected with the project road.
- Significant Habitats (Eco-dynamic area): There are many significant ecological habitats in the project area especially in the chars. The project will not have any impact on the chars. However, the nearest chars were also considered to be a part of the influence area.
- Movement of inhabitants – resource harvest, communication, livelihoods.
- Project footprints: Areas that are directly fall under foot prints of the projects, ancillary facilities, temporary construction areas and worker camp sites, borrow areas, access roads to the project facilities for transport of material, etc.; areas that will be affected by the emissions from construction and by operation of traffic; etc.

The Project influence area is shown in **Figure A.2** (next page).

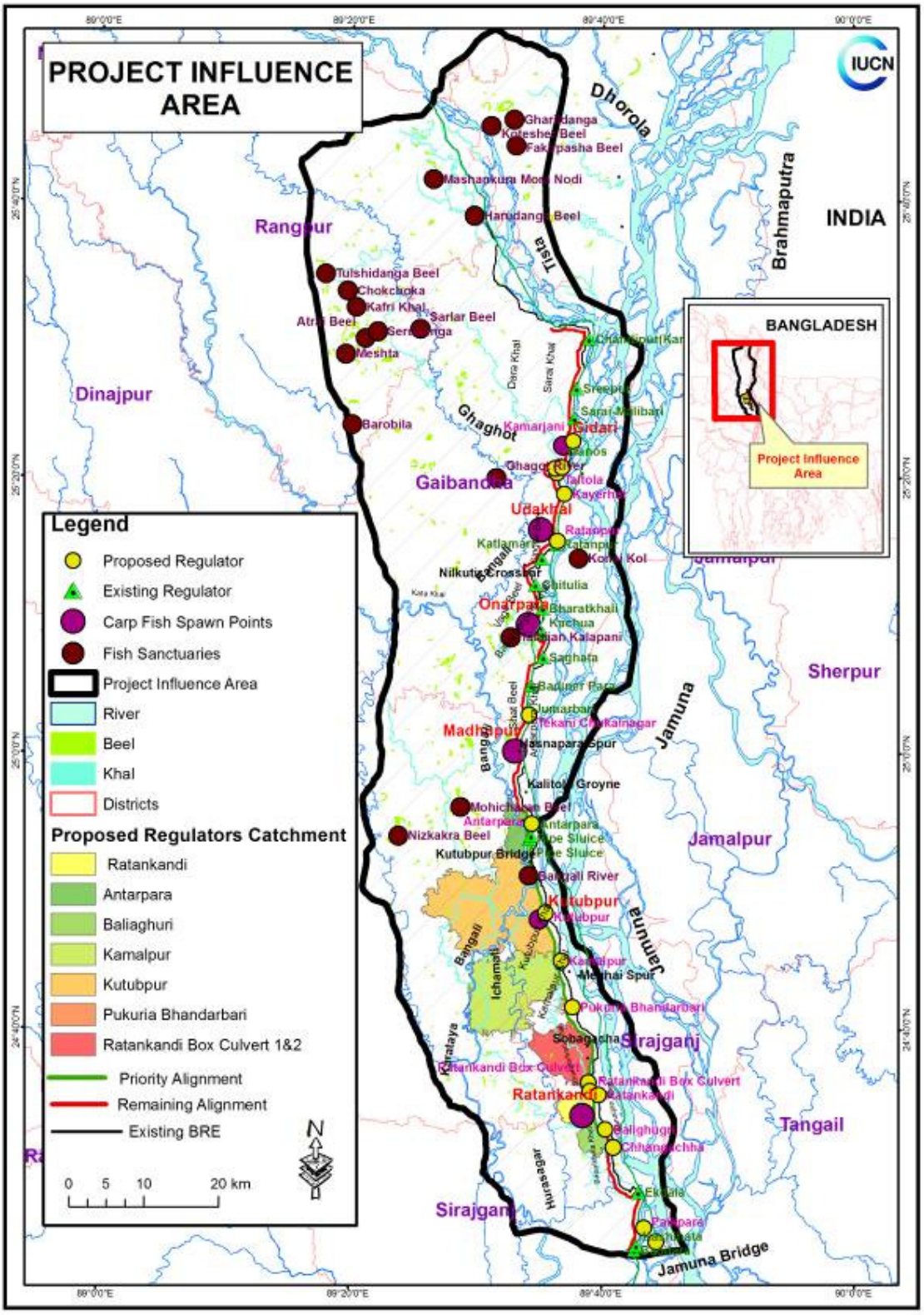


Figure A.2: Project Influence Area

A. 5. General Approach for Baseline Data Collection

The baseline condition of the project area has been formulated on the basis of the information collected from secondary and primary data sources through literature review, field investigations and consultations with different stakeholders. The baseline has been established in respect of air quality, noise, river morphology, surface and ground water quality, settlements, agriculture, livestock, fisheries, forestry, ecology, terrestrial and aquatic flora and fauna, socio-economic and institutional condition. Primary data on water resources, air quality, noise, agriculture, livestock, fisheries, forestry, ecology, and terrestrial as well as aquatic flora and fauna has been collected by conducting an intensive field survey. Additional data and information has been collected through rapid rural appraisals (RRA), participatory rural appraisals (PRA), focus group discussions (FGD) and key informant interviews (KII).

Maps prepared by using GIS and Remote Sensing have been used in collection and development of baseline database. In this regard IUCN team coordinated with main consultant and their associates, such as CEGIS. The RS based GIS maps have been prepared and used in designing the traverse line surveys carried out the field work along the traverse lines. The field teams used appropriate survey instruments, e.g. checklists and semi-structured formats to record the information on different resources.

Secondary Literature review

All relevant secondary information was collected to describe the baseline of the environmental and ecological setup.

A. 6. Field Investigations

Field surveys have primarily been conducted by the field investigators with biology, fisheries and engineering background. They have been guided, monitored and supported by the senior specialists in the EIA team. The field team has collected field data using structured questionnaires in addition to FGD, PRA and KII.

The team has walked through the entire length of the RBIP[1] (182 km) and collected data from the proposed alignment of the embankment cum road and the nearest river channel from the right bank. The field investigations were carried out during September and October 2014. The field observations are included at the end of the Annex**.**

Soil Quality

To establish the baseline soil quality in the project area and to monitor future impacts, soil samples were collected near the proposed construction areas of the embankment and bank protection works. Seven sites are identified for soil sampling in a way to cover overall project area with adequate distribution. These locations Balighurghuri, Changacha union of Sirajganj, Pukuria Vandarbari and Anterpara of Bogra and analyzed various parameters such as pH, texture, total phosphorus, total Nitrogen, Total Potassium, Total Sulfur and Pesticide residue for quality. Locations of the sampling sites are shown in **Figure A.3**.

Air Quality

Ambient air quality has been measured in seven locations close to the proposed embankment alignment. The sampling sites are selected in a way to cover major towns where there is relatively high traffic and the areas dominated by agricultural lands where relatively there is no pollution sources. Two samples each in Sirajganj, Bogra and

[1] Length of total RBIP (including priority embankment and future embankment)

Kurigram districts. Air quality parameters proposed in national air quality standards are considered for sampling. Locations for the field data collection points are provided in **Figure A.3**.

Ambient Noise

Noise data has been collected from seven sites as the same location of air quality measurement. At each site, noise data has been recorded for two times-day and night. Locations for the field data collection points are provided in **Figure A.3**.

Water Resources

Surface Water. Data was collected on the general pattern of surface water distribution and major drainage patterns, including rivers, small waterways, *beels*, khals and flooded areas. FGD and public consultations were done at all sites to collect primary information and anecdotal data. In particular, the following information was collected from both primary data (Field Investigation) and secondary data:

- Drainage System (natural and artificial) and their distribution
- Seasonal changes in water level
- Seasonal changes in drainage
- Extent, periods of occurrence and causes of water logging
- Effects of existing infrastructure (roads, canals, building) on drainage
- Extent of interconnection
- River erosion
- River stages and discharges for standard return periods
- Water availability for irrigation

Secondary data was also collected on the hydrological cycle within the overall watershed encompassing the study area, giving mean, maximum and minimum discharges and water levels for all major (lotic) flowing water bodies including main rivers. Data on canal sources and also for lentic (standing) water bodies like *beels* were collected from field investigation. Information was also gathered on hydrological problems in study area are including; flooding (Flash floods and other types), water logging and inadequate drainage.

To understand the river water quality, historical record of water quality has been collected from the Department of Environment (DoE) at Teesta bridge, Jamuna bridge, downstream of Jamuna bridge near Jamuna Fertilizer Plant, and Nandina. Data of both dry and winter season has been collected.

During the field investigations, water samples were collected from surface water resources (rivers, beels) considering the connectivity of khals and location of proposed regulator. The parameters considered for water quality are: dissolved oxygen, biological oxygen demand, total dissolved solids, electrical conductivity, pH and temperature. Locations of these sampling sites are shown in **Figure A.3**. Details of sampling methods and results are given later in the Annex.

Ground water. Groundwater is the primary source of drinking in the project area. Ground water samples were collected from two tube wells, which are located upstream and downstream of the priority area. The groundwater samples have been tested against

drinking water standards (pH, chloride, iron, bicarbonate and total dissolved solids). Locations of groundwater sampling sites are shown in **Figure A.3.**

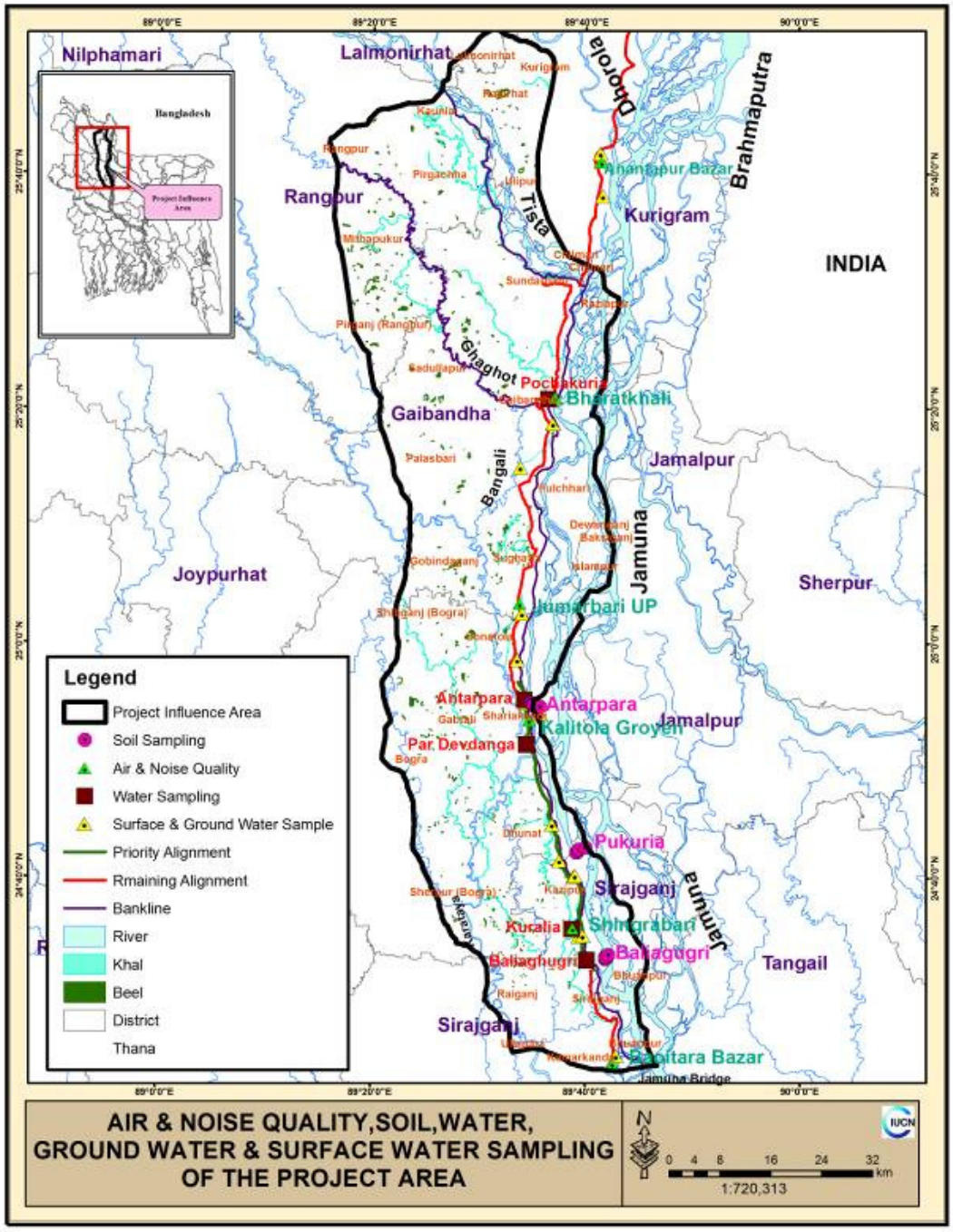


Figure A.3: Sites for Assessment of Air quality and Noise and sampling of Water and Soil

Ecology

Ecologically Sensitive Ecosystem. During the study, all sensitive ecosystems have been identified along the embankment alignment and into the river and nearby *charlands* (river islands or shoals). GPS locations have been collected for all ecologically important locations. All sensitive ecosystems have been mapped for the entire Area of Influence of the project. Questionnaires and data collection sheets for ecological field survey are provided in later in the Annex.

Terrestrial Environment. For development the baseline information of the terrestrial environment the following parameters have been collected by the field team:

- Terrestrial flora
  - General vegetation pattern on the site
  - Nearby homestead vegetation including major tree species according to their canopy cover (estimation of canopy cover percentage)
  - Information on plantation or orchards (if any)
  - Cropland and woodland (if any) and their landuse
  - Roadside vegetation
  - Grassland (if any in the vicinity) composition and their importance for wildlife especially avifauna
  - Fallow land (if any) why fallow and landuse and importance
  - Utilization
  - Wetland vegetation
  - Recent trends (whether increasing or decreasing, key prevailing threats)
- Terrestrial fauna
  - Terrestrial wildlife species and their importance and status
  - Identification of important wildlife habitats and their movement/migration pattern (especially for the wildlife that depends on the river for drinking and fishing, e.g. fishing cat)
  - Recent trends (whether increasing or decreasing, key prevailing threats)
- Biodiversity including terrestrial Species diversity
- Homestead vegetation

Aquatic Environment

The following data was collected on the wetlands and types of aquatic habitat in the project's Area of Influence:

- Aquatic flora
  - Ecology and plant community
  - Abundance and distribution
  - Growing period
  - Recent trends (whether increasing or decreasing, key prevailing threats)

- Utilization
- Recent trends (whether increasing or decreasing, key prevailing threats)

- Aquatic fauna
- Aquatic wildlife species and their importance and status
- Identification of their habitats, breeding and migration patterns in the project area
- Wetland birds
- Recent trends (whether increasing or decreasing, key prevailing threats)
- Impact on aquatic wildlife from the project activity including short and long term impacts (impact from changed landuse, noise, human presence)
- Utilization
- Recent trends (whether increasing or decreasing, key prevailing threats)

- Biodiversity (including aquatic Species diversity and recent trends.

Floral Survey

Baseline scenario of floral species has been prepared with special emphasis on endangered and protected species. Classification of satellite images and reconnaissance field visit has been made to assess the various vegetation types / ecosystems present within the direct impact area and charlands near the project site. The major ecosystems found from the images have been visited and a species assessment has been made. Standardized transects were established in order to assess species composition and vegetation structure. Also, recent trends have been determined on the basis of field data, interviews, and literature review.

Charland Survey

Data collection on charlands (river islands) included Remote Sensing image analysis, vegetation and wildlife survey. Also, recent trends will be determined on the basis of field data, interviews, and literature review.

Faunal Survey

Mammals have been assessed on an opportunistic basis by all of the teams. The small mammals (eg, like Small Indian Mongoose, Short-nosed fruit bat) are easily observed during walk over surveys. Interviews have also been held with known “hunters” in the area to assess the presence of game species.

For the assessment of amphibian and reptile species diversity in the study area line transects and opportunistic surveys have been used. Amphibian transects were selected focusing on croplands, stagnant water, running water and bushy areas as typical habitats. Additional interviews have been conducted with local people using photographs of amphibians and reptiles to determine the presence of species. The surveys were carried out during both day (5:30am-6:30am) and night (6pm-9pm) times by the following methods.

Gangetic Dolphin. Line transects survey were carried out to determine the population size of the Dolphin in the project sites. The length of line transects was 1km and during survey team used a boat with a speed of 2 km. Surveys were conducted between 9.30 am and 11.30 am. Two observers scanned the water surface for the sign or dolphin, whereas

a third observer took notes by direct counting the species. All sightings were noted with GPS coordinates.

Gharial (*Gavialis gangeticus*), also known as the gavial, and the fish-eating crocodile, is a crocodilian of the family Gavialidae, native to the Indian Subcontinent. Although, the species is no longer have a viable population in the Jamuna river but it is still regarded as the most suitable habitat for this species. In last few years several juvenile has been captured by the fishermen. Anecdotal information was collected during interviews with the community about the presence and sighting of gharial. The probable habitats were also identified during the field investigations.

Birds including Migratory Birds. Birds have been assessed during walk-over surveys. Identification was done by both visual and vocal characteristics with added support from photographic evidence. The bird inventory has been linked to the vegetation / ecosystem types identified during the floristic survey. Interviews with the local villagers were held to find out the presence of migratory birds during winters. Further information on the migratory bird has been obtained through literature review.

Fish and Fisheries Resources

A fish and fisheries survey was carried out in the project influence area of the proposed RBIP to prepare a fisheries baseline of the study area and also to identify the important fishery components those need to be taken care of. At the initial stage the study, a baseline survey was conducted. The methodologies used are - direct field data collection and sighting, public consultation, secondary data analysis, focal points interview, market survey, fish catch assessment survey, application of remote sensing and GIS tools and extensive literature review. A logically designed fish catch assessment survey was carried out to identify fish biodiversity of the project study area. The survey conducted in 50km priority area was more intensive than that of the remaining 132km of the RBIP. The survey was conducted from 25 Aug to 15 Sep 2014 during the high flow season. A total of 33 FGD, 10 Catch Assessment Survey (of different gears), transect walk and in-situ observations were carried out during this period. Locations of FGDs and consultations carried out to collect baseline ecological data are presented in **Figure A.4**.

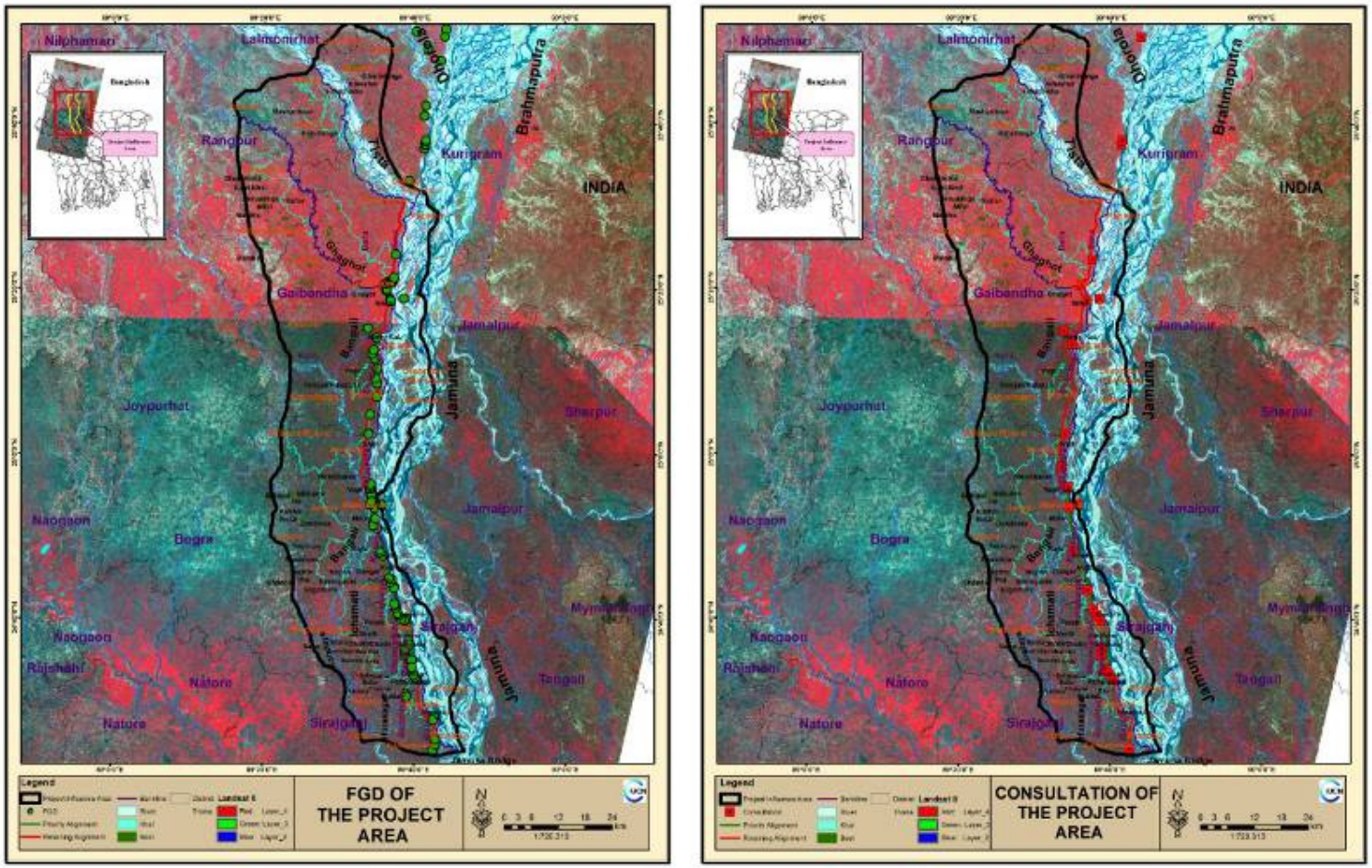


Figure A.4: Locations of FGDs and Consultations

Fisheries Survey

Survey methodology was selected on the basis of the reconnaissance survey outcome and various subsequent discussions held within the EIA team. Initial desk analysis was carried out to assess fish biodiversity and fisheries resource status. The survey was designed to fill up the knowledge gaps of the identified major fisheries resources. The key parameters of the survey are provided in the **Table A.1**.

Table A.1: Fish Survey Details

Parameters	Method	Sampling Site	Sampling Schedule
Species richness, Identification of pre-dominant indicator species those sensitive to the different constructions, Species composition, Biology of the indicator species, Fish production, Habitat analysis, Migration route/season, Breeding and feeding ground, Limnology, Fishing effort, Fishing Season	Catch assessment survey using different gears of fishermen, interview, FGD, market chain analysis, fishermen livelihood analysis, Area of conservation demarcation/GPS coordinating, Biodiversity analysis	Project Influence Area (1 Km buffer area from embankment location)	Year 2014: Aug-Sep

Site selection. Sampling sites were selected for each of the indicators by considering the characteristics of the sub-habitat types of the Jamuna river system, associated environmental factors, major fisheries characteristic, local knowledge, past and present scenarios, time and resource constraints. The study locations were selected after field visits and detail corresponding with the stakeholders of the project. Specific spots identified considering sampling strategies as per selected method. GPS readings were taken for each sampling spot. However, probable locations of the catch assessment survey were selected after a reconnaissance visit in the project area. In total, 20 sites along the 5 river cross sections at the distance interval of 10 km along the river and interval of 0.5 km across the river carried out within the **project influence area along the 50 Km of the Jamuna Right Bank for which EIA is being conducted** (**Figure A.5**). In addition, catch assessment was carried out in another 5 locations of the connected canals of the right bank which are identified by local community as potential fish shelter grounds. Beside, a questionnaire survey was also carried out in different fishing village and among the associated stakeholders to collect the necessary fisheries information. The frequency for the remaining area was much lesser at an interval of 25 km along the proposed alignment of the embankment. The catch assessment survey also carried out for beels and khals.

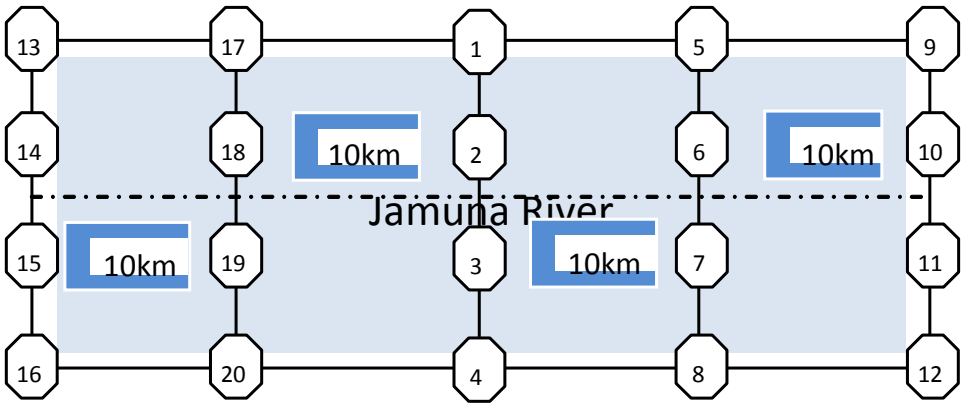


Figure A.5: Sampling Locations

Sampling materials. Specific depth and sampling time was recorded along with special information on weather condition e.g. sunny or rainy day. Local fishing gears and boats were used for catch assessment survey. Sampling times were recorded accordingly. Sorting, counting and identification of fishes were carried out in situ. Identification of the fish species has done by following standard literatures and FAO web tools for fish identification e.g. www.fishbase.org. Photographs of the identified fishes were collected giving unique code to identify at the later stage. Fish catch composition, total length, body weight, age, sex, were also collected in situ. A catch assessment survey sheet was used to record the collected data for each sample (provided at the end of the Annex). Different field equipment was used for sorting, identification and determination of the necessary measurements of captured fishes. Market survey was also carried out to compare the fish catch composition. FGD, market chain analysis and fishermen livelihood analysis has also been initiated this time using a checklist. Area of conservation significance i.e. fish breeding grounds were demarcated using GPS machine.

Fishing gears and traps. Set gill net, Drift gill net, Clap net, Cast net, Seine net and Lift net were used for sampling from different habitats of the study area. Range of the mesh sizes of the gears used were 0.4 inch to 2.5 inch. Length of gears was from 10m to 200m. Fishing depth was 1 to 6 meters. Besides, different types of locally made fishing traps were used for fishing the SIS (Small Indigenous Species) e.g. Dury, Chi, and Vaer.

Fishing craft. Fishing crafts those used for sampling were e.g. Kosha, Dingi, Chandi and Karki. Average length of the crafts was around 8-9 m.

Haul duration. Duration of fishing (haul) were different depend on the gears and crafts. However, average duration per haul was considered as 30 min.

Assessment techniques. The specific methodologies to collect fisheries data and information on the selected parameters and associated analysis are described below.

Catch assessment survey. Fish catch assessment survey is considered as a successful method which reflects the divergence of all the important fishery components. Catch assessment survey carried out through field sampling from the Jamuna River and its connected canals of the study area. Appropriate number of fish catch samples was collected from some pre-selected sites. Samples collected by using local available fishing gears for a specific duration to get the catch effort (catch/ haul) data. Catch composition, abundance of individual species, fish species diversity, total production and production rate assessed for each specific habitat. Fish migration channels demarcated by consulting with the local fishermen and historical catch location data analysis of the Jamuna River.

Breeding ground demarcation. Breeding ground demarcated using GPS machine by collecting the information from the local fishermen. Fry collectors interviewed to assess the overall status of breeding grounds.

Market survey. Local market surveys carried out to collect fish catch composition data. These data used to validate the field sampling catch composition and species diversity estimation through catch assessment survey. Market chain analysis will be carried out to identify the status of the fish fry collection and trading at different sites.

Key Informant interviews and focal group discussions. Selected key persons of the study area were interviewed to the get real scenario of changes in fisheries and to collect information on the fisheries resources and fishermen status. KII results were used to validate the field sampling data more authentically. In addition, several FGD conducted at different fishing villages of the both banks and Chars (River Island) using a checklist.

Socio-economic Aspects

Data was collected on present demographic and socio-economic status, educational and cultural properties of the area, area vulnerabilities and development activities. Demographic and socio-economic status refers to a wide variety of parameters. This study particularly refers to population, community structures, employment and labor market, income and expenditure patterns of households, public health, education, vulnerabilities, values and customs. Most of the data was obtained from the social safeguard team in addition to the secondary resources.

Soil and Agriculture Resources

The production related data including soil resources were collected through secondary and primary sources. The secondary sources included: a) review and collection of data and documents available with other research teams of the RBIP like design, socio-economic; b) data and documents collected from the related organizations like DAE, BADC from the project area. The primary data were collected through: a) FGD (Focused Group Discussion), b) KII (Key Informant Interview), d) in-depth interview with potential farmers.

Review of Documents (Desk Review): Existing relevant documents available with the concerned organizations such as BWDB, DAE, BADC, BARI, and BRRI were collected and reviewed for having an initial idea and understanding of the crops and cropping of the areas. As part of project review, the environmental team attended workshop on RBIP organized by BWDB using national and international consultants.

Reconnaissance Field Visit cum Rapid Appraisal: After completion of the desk review, the consultant made a reconnaissance field visit to the embankment sites to further understand of the existing socio-economic conditions to identify the potential location for organizing the FGDs. The visiting team members made a Rapid Appraisal/Assessment on crop production scenarios through discussions with key stakeholders (BWDB staff, Local NGO officials, officials of Government service departments like DAE, BRRI, BARI, DLS, DoF pesticide/fertilizer Dealers, farmers) both at group and individual levels.

Focus Group Discussions (FGDs): Numbers of FGDs, one in each Upazila (11 total) were carried out using semi structured checklists outlined on the basis of the issues relevant to study objective and scope. The numbers of participants in each FGD were 10-15 farmers.

Key Informant interview (KII): During the field study numbers of open-ended KIIs were also conducted with representative stakeholders especially with the field staff of DAE using semi-structured checklist.

A. 7. Consultations

In accordance with the WB requirements, consultations have been carried out during the scoping/screening stage where the EIA ToR has been shared with the stakeholders. The second round of consultations will be carried out after compiling the draft EIA report. The VECs for the cumulative impact assessment and IESC for the overall impact assessment have been selected as a result and outcome of these consultations.

For consultations, various modes have been used including FDGs, KIIs, and workshops at district and upazilla levels. Consultations have been held with the local government institutions and community representatives, knowledgeable persons e.g. teachers, journalists and political leaders, and the affected community. The feedback has been useful in understanding the concerns and priorities of the stakeholders particularly the communities, assessing the potential impacts of the project, identifying the appropriate mitigation measures to address these impacts, and finalizing the EIA report.

A. 8. Impact Assessment Methodology

The significance of potential impacts was assessed using the risk assessment methodology that considers impact magnitude and sensitivity of receptors, described below.

Impact Magnitude

The potential impacts of the project have been categorized as major, moderate, minor or nominal based on consideration of the parameters such as: i) duration of the impact; ii) spatial extent of the impact; iii) reversibility; iv) likelihood; and v) legal standards and established professional criteria. These magnitude categories are defined in **Table A.2**.

Table A.2: Parameters for Determining Magnitude

Parameter	Major	Medium	Minor	Nominal
Duration of potential impact	Long term (more than 35 years)	Medium Term Lifespan of the project (5 to 15 years)	Limited to construction period	Temporary with no detectable potential impact
Spatial extent of the potential impact	Widespread far beyond project boundaries	Beyond immediate project components, site boundaries or local area	Within project boundary	Specific location within project component or site boundaries with no detectable potential impact
Reversibility of potential impacts	Potential impact is effectively permanent, requiring considerable intervention to return to baseline	Baseline requires a year or so with some interventions to return to baseline	Baseline returns naturally or with limited intervention within a few months	Baseline remains constant
Legal standards and	Breaches national standards and or	Complies with limits given in	Meets minimum national standard	Not applicable

Parameter	Major	Medium	Minor	Nominal
established professional criteria	international guidelines/obligations	national standards but breaches international lender guidelines in one or more parameters	limits or international guidelines	
Likelihood of potential impacts occurring	Occurs under typical operating or construction conditions (Certain)	Occurs under worst case (negative impact) or best case (positive impact) operating conditions (Likely)	Occurs under abnormal, exceptional or emergency conditions (occasional)	Unlikely to occur

Sensitivity of Receptor

The sensitivity of a receptor has been determined based on review of the population (including proximity / numbers / vulnerability) and presence of features on the site or the surrounding area. Each detailed assessment has defined sensitivity in relation to the topic. Criteria for determining receptor sensitivity of the Project's potential impacts are outlined in **Table A.3**.

Table A.3: Criteria for Determining Sensitivity

Sensitivity Determination	Definition
Very Severe	Vulnerable receptor with little or no capacity to absorb proposed changes or minimal opportunities for mitigation.
Severe	Vulnerable receptor with little or no capacity to absorb proposed changes or limited opportunities for mitigation.
Mild	Vulnerable receptor with some capacity to absorb proposed changes or moderate opportunities for mitigation
Low	Vulnerable receptor with good capacity to absorb proposed changes or/and good opportunities for mitigation

Assigning Significance

Following the determination of impact magnitude and sensitivity of the receiving environment or potential receptors, the significance of each potential impact has been established using the impact significance matrix shown below in **Table A.4**.

Table A.4: Significance of Impact Criteria

	Sensitivity of Receptors			
Magnitude of Impact	**Very Severe**	**Severe**	**Mild**	**Low**
Major	Critical	High	Moderate	Minimal
Medium	High	High	Moderate	Minimal
Minor	Moderate	Moderate	Low	Minimal
Nominal	Minimal	Minimal	Minimal	Minimal

Air Quality and Noise Measurement Spots

River Bank Improvement Program (RBIP)

Environmental Study

Priority Zone (50 km)

Place	Upazila/Union	District
1.Sariakandi HP	Sariakandi	Bogra
2.Singrabari	Kajipur	Sirajganj
3.Ratankandi	Ratankandi	Sirajganj

Reaming Zone

1. Baoitara	Saidabad	Sirajganj
2.Jumarbari	Gaibandha Sadar	Gaibandha
3.Bharatkhali	Saghatta	Gaibandha
4.Anantapur	Ulipur	Kurigram

Survey Sheets for Ecological Study

River Bank Improvement Program
Environmental Study

Focused Group Discussion (Ecological Survey)

SL. No.	Date:	Time:
Vill:	Mouza:	Union:
P.S.:	District:	No. of Participant:
GPS:		Photo:

Trees

Species Name	Use	Species Name	Use	Species Name	Use

Shrubs & Herbs

Species Name	Use	Species Name	Use	Species Name	Use

Wildlife

Species Name	Hunting/Poaching	Species Name	Hunting/Poaching	Species Name	Hunting/Poaching

Use : 1=food; 2=timber; 3=fuel; 4=medicinal; 5=fiber/thatching; 6=others
Hunting/Poaching: Y=Yes, N=No

Ecological Survey

Plot No.:	Date:	Time:
Vill:	Mouza:	Union:
P.S.:	District:	
GPS:		Photo:

Landform Pattern
Landform Element

ALP= Alluvial Plain FLO=Floodplain

100=Plain	101=Sandy Plain	102=Limestone Plain
103=Drainage Depression	104=Stream Channel	105=Flood out
106= Lake	107= Swamp	

Crop cover

0= Nil	1= 1-25%	2= <50%	3= 51%-100%

Crop characteristics

Surface Soil Texture

Sand	Loamy Sand	Clayey Sand
Sandy loam	Clay loam	Silty loam
Loam	Sandy Clay Loam	Silty Clay Loam
Peat	Clay	

Wild Animal Composition

Species Name	Microhabitat	Niche

Floral Species composition

Species Name	Adult		Juvenile	Comments
	Total	Avg. Height	Total	

Canopy Coverage

Wet land information

Types	Month (Wet)	Month (Dry)	Types	Month (Wet)	Month (Dry)
Permanent canal			Seasonal canal		
Permanent lakes			Seasonal/intermittent lakes		
Seasonal/intermittent ponds			Irrigated land and irrigation channels		
Riverine floodplains			Permanent pond		

GPS Location of Sensitive Receptor

Environmental Receptor	N	E
Hospital		
College		
School		
Madrasa		
Mosque		
Graveyard		
Prayer Place		

Questionnaire for homestead vegetation survey

HHH Name:			Village:		
Sample No.		GPS Reading:	N:	E:	Date:
Homestead size (Decimal):			% of homestead covered with woods:		

Species Name	Total Number		Avg. Height (m) of Adult	Utilization	*Economic Value (Tk.)*		Ecological value	Flood susceptibility	% of total Coverage of species
	Adult	*Juvenile*			*Annual*	*Harvest Value*			

[1] Utilization : 1=food; 2=timber; 3=fuel; 4=medicinal; 5=fiber/thatching; 6=others
[1] Ecological value : 1=for wildlife; 2= for avi-fauna; 3=for micro ecosystem
[1] Flood susceptibility : 1=highly susceptible; 2=susceptible; 3=resistant

Questionnaire for homestead wildlife survey

HHH Name:				Village:			
Sample No.		GPS Reading:	N:	E:		Date:	
Homestead size (Decimal):				% of homestead covered with woods:			

Species name	Habitat[1]	Food habit[2]	Breeding time (month)	Status[3]	Migration status[4]

[1] Habitat : 1=homestead forest; 2=flood plain; 3=wetland; 4=river
[2] Food habit : 1=herbivore; 2=carnivore; 3=both
[3] Status : 1=very common; 2=common ; 3=rare; 4-very rare
[4] Migration status : 1=local; 2=local migratory; 3=migratory

Fisheries Catch Assessment Survey Sheets

Field Researcher: *Habitat Name:* *Survey date:*

Annex 1

Fisheries Catch Assessment Survey Sheet

Baseline Survey of the Jamuna RBIP Project

IUCN Bangladesh Country Office

Date:	Sample no.	Location:	GPS Reading: N	E

Time	Riverbank distance	Meteorological setting @time of sampling	Gear Description	Craft Description	Duration of Haul	Total no. of haul/sample
		Sunshine:	Name & Type:	Name:		
		Part of day:	Mesh:	Length:		
		Wind speed:	Materials:	Fishermen no.:		
		Flow (m/s):	Length:	Made of:		
		Lunar date:	Depth of fishing:	Mechanized/non-mechanized:		
		Water quality:	Target species:	Type of boat (Commercial/non-commercial):		

Catch composition		Species list	Abundance (Count)	Total Length (L∞) S: 1-10	Body weight (gm) S: 1-10	Specimen Details					Catch (Kg/haul)	Tot catch (kg)
Fish	%					Photo ID	Morphology	Egg	Age	Sex		

Additional Comment/Constraints:	Research Assistant:	Signature:

Signature:

Field Researcher: *Habitat Name:* *Survey date:*

Annex 2: Fisheries Baseline Checklist

Vill: **Mouza:** **Union:** **Upazila:** **District:** **BWDB Circle:** **BWDB Division:**

Background Water bodies: *Name: Alphabetic, Area: in Ha/% of area/Ana, Length: in km, Depth/Inundation depth: in Meter, Flood Duration: in Months, Production: metric ton*

Problem/Issue	Fishing Effort	Habitat Type	Water Quality	Avg. Production	Production Trend (+/-) and Reason	List of Gears	% of gears	List of Habitat Name	Present					Past (15-20 yrs back)				
									Area	Length	Width	Depth	Duration	Area	Length	Width	Depth	Duration
Capture Fisheries: 1. 2. 3.	a. Total No. of fisher HHs: b. %/No. of CFHHs:	River																
Culture Fisheries: 4. 5. 6.	c. %/No. of SFHHS: d. No. of Days spend annually in fishing by CFHHs: SFHHs:	Beel (Leased/non leased)																
Indiscriminate Fishing Activities: 7. 8. 9.	e. Hrs/Day spend in fishing by CFHHs: SFHHs:	Khal																
		Floodplain																
		Mangrove area																
		Fish pond																
		Baor																
		Ghers																

Signature:

Field Researcher: ***Habitat Name:*** ***Survey date:***

Fish Migration				Fish Biodiversity		Species List					Species Composition				
						River	Khal	Beel	Pond	Other	Group	River	Khal	Beel	Pond
Previous Migration Status				Fish diversity status (Poor/Moderate/Rich) /%							Major carp				
											Exotic carp				
											Other carp				
											Catfish				
											Snakehead				
Present Obstacle to fish migration:	1. 2. 3.			Reasons of increase or decrease	1. 2. 3. 4. 5.						Live fish				
											Other fish				
											Shrimp/prawn				
											Hilsa/Bombay duck/Indian salmon				
											Pomfret				
Important breeding, feeding and over wintering ground											Jew fish				
											Sea cat fish				
											Shark/Skates/ Rays				
											Rui				
											Catla				
Horizontal Migration pattern	Species: 1. 2. 3. 4. 5.	Season (Months):	Routes:	Significant areas	1. 2. 3.						Mrigal				
											Koi				
											Sarputi				
											Large shrimp				
											Small shrimp				
Vertical Migration Pattern	Species: 1. 2. 3. 4. 5.	Season (Months):	Habitats :	Species of Conservation Significance	Rare:						Silver carp				
											Carpio				
											Grass carp				
											Tengera				
					Unavailable:						Chapila				
											Others				

Signature:

Field Researcher: *Habitat Name:* *Survey date:*

Post Harvest Activities		Fishermen Lifestyle	
Fish edible quality:		Socio-economic Status of subsistence level fishermen:	
Source of pollution in each habitat:		Socio-economic Status of Commercial fishermen:	
Seasonal vulnerability:		Other conflict (with muscle men/ agriculture/ other sector/laws):	
Ice factory (Number, location and name):		Fishermen community structure (Traditional/Caste/Religion)	
Landing center, whole sale market, other district markets, etc.:		Traditional fishermen vulnerability (Occupation change/others):	
Storage facility (number, location and name):		Existing Fisheries Management	
Fish market (Number, location and name):		Fishermen Community Based Organizations (FCBOs):	
Marketing problems:		WMOs activity:	
Fish diseases (Name, Host species, Season, Syndrome, Reason, etc.):		Fishing right on existing fish habitats (Deprived/Ltd. access/Full access):	
Other backward and forward linkages (Number, location and name):		Leasing system:	
Transport facility (Mode of fish transportation, cost, other involvements)		Enforcement of fisheries regulation (Weak/strong):	
Dry fish industries (Number, location and name):		Department of Fisheries (DoF) activity:	
Others information:		NGOs activities:	

Note: 1. Major Carp - Rui, Catla, Mrigal, 2. Exotic Carp - Silver Carp, Common Carp, Mirror Carp, Grass Carp, 3. Other Carp - Ghania, Kalbasu, Kalia, 4. Cat Fish - Rita, Boal, Pangas, Silon, Aor, Bacha, 5. Snake Head - Shol, Gazar, Taki, 6. Live Fish - Koi, Singhi, Magur, 7. Other Fish - Includes all other fishes except those mentioned above.
Marine: Hilsa/Illish, Bombay Duck (*Harpoodon nehereus*), Indian Salmon (*Polydactylus indicus*), Pomfret (*Rup_Hail_Foli Chanda*), Jew Fish (*Poa, Lambu, Kalakatina* etc.), Sea Cat Fish (*Tachysurus spp.*), Sharks, Skates & Rays, Other Marine Fish.

Beels: Rui (Labeo rohita), Catla (Catla catla), Mrigal (Cirrhinus mrigala), Kalbasu (Labeo calbasu), Gonia (Labeo gonius), Boal (Wallago attu), Air (Mystus aor / Mystus seenghala), Shol/Gazar (Channa spp.), Chital/Phali (Notopterus chitala / N. notopterus), Koi (Anabas testudineus), Singi/Magur (Heteropneustes fossilis /Clarias batrachus), Sarpunti (Puntius sarana), Large Shrimp (Macrobrachium rosenbergii /M. malcomsonii), Small Shrimp, Silver Carp (Hypophthalmichthys molitrix), Carpio (Cyprinus carpio), Grass Crap (Ctenopharyngodon idellus), Pabda (Ompok pabda), Punti (Puntius spp.), Tengra (Mystus spp.), Baim (Mastacembelus spp.), Chapila (Gudusia chapra), Others.

Pond: Rui (Labeo rohita), Catla (Catla catla), Mrigal (Cirrhinus mrigala), Kalbasu (Labeo calbasu), Mixed Carp, Silver Carp (Hypophthalmichthys molotrix), Grass Carp(Ctenopharyngodon idellus), Mirror Carp (Cyprinus carpio var. specularis), Tilapia (Oreochromis mossambicus / O. niloticus), Shrimp, Aor (Mystus aor / Mystus seenghala), Boal (Wallago attu), Shol/Gazar & Taki (Channa spp.), Chital/Phali (Notopterus chitala / N. notopterus), Koi (Anabas testudineus), Singi/Magur (Heteropneustes fossilis / Clarias batrachus), Sarpunti (Puntius sarana), Thai Sarpunti (Puntius goniconotus), Punti (Puntius spp.), Others.

Signature:

Annex B. Terms of Reference of EIA Study

Citation in the main text (Volume I): **Section 1.4**.

1. Background

Bangladesh is mainly comprised of the fertile alluvial floodplains and the delta of the Ganges-Brahmaputra-Meghna river system (Brahmaputra south through Bangladesh, named as the Jamuna). These three rivers combine within the country to form the world's third largest river, the Lower Meghna, which drains into the Bay of Bengal via a constantly changing network of estuaries and tidal creeks. Bangladesh is one of the most vulnerable countries to natural disasters, mainly by upstream river floods during monsoon season and coastal cyclones from the Bay of Bengal. Floods are of recurring phenomena in Bangladesh, and in each year about 22 percent of the country is inundated. Major floods occur when upland flood flows of the three rivers converging to Bangladesh coincide and combine with the heavy monsoon rainfall. It is also difficult to regulate these flood flows as over 90 percent of their river catchments areas are outside the Bangladesh.

Brahmaputra is the largest of the three rivers with highest erosion and bank movements. Prior to the construction of Brahmaputra Right Embankment (BRE), over bank spills along the 220 km stretch of the right bank of the Brahmaputra River used to cause flooding on an area of about 240,000 ha. In early 1960s, the BRE was built to protect from this flooding problem and to foster agricultural growth in the protected area. The original BRE had a setback of about 1.5 km from the Brahmaputra's right bank and it was allowed to have bank erosion life of 25-30 year span. In the 1970s the embankment started to fall under sporadic erosion attacks. During 1980s, the frequency of the BRE breaches by erosion increased rapidly as longer sections came within the range of rapidly eroding river bends which could cause bank-line erosion rates of several hundred meters per year in early stages of bend formation. To prevent flooding, these breaches were typically closed by local BRE retirements at about 200 meter set-backs. As a result of this minimal set-back distance the BRE has been retired several times in many places and at present perhaps only 50 KM of the original BRE has remained in place. Currently, many long stretches of the BRE are very close to the river-bank line. Hence when embankment is breached at many places it is often left open as closing of such breaching is becoming impossible. Consequently, security of area protected by the BRE has been seriously threatened and large areas of land and cities with large population like Sirajganj are exposed to flooding.

Under Flood Action Program a Master Plan was prepared in 1993 (River Training Studies of the Brahmaputra River, 1993) for improving the performance of BRE that preparing a revamping program to be implemented over a period of 30 years with identified priority investments in phasing. Based on these studies several hard points were identified and river bank protection revetments were constructed at Sirajganj, Sariakandi, Mathurapar and Kalitola and the embankment sections were improved. These protection works have performed very well in keeping the BRE anchored without much ongoing maintenance. The proposed consulting services are for the Environmental Assessment for the revamping plan for BRE (220 KM) starting from Nagarbari to the upstream point of BRE via Sirajganj Kazipur.

The main focus of the BRE rehabilitation work is on its length alongside the Brahmaputra/ Jamuna River from Bangabandhu (Jamuna) Bridge to the Teesta River (Appendix A). The task needs to consider inclusion of the flood protection embankment of the Kurigram Irrigation Project alongside the Brahmaputra River. The priority works will cover the approximately 50-kilometre long priority reach from Sailabari to Hasnapara. This reach has the highest historic erosion rates.

The project may also include the option of a toll road (highway) associated with the flood embankment. The project's physical works will include:

- River bank protection on portions of the western(right) bank;
- Embankment upgrading, reconstruction and realignment , including adding drainage/control
- structures (regulators);
- A new road on the embankment, along with a new bridge crossing of the Teesta.

The project may also provide livelihood and resettlement support to the displaced people. Based on the field reconnaissance and the preliminary morphological assessment, the project works has been divided into two phases:

Reach	**Length (km)**	**Phase**
Jamuna Bridge to Sailabari	19	Remaining
Sailabari to Hasnapara	50	Priority
Hasnapara to Belka	77	Remaining
Upstream of Teesta River	36	Remaining
Total	182	

The proposed project will be financed by IDA with GoB contribution and the project has to comply with the policies and legislative requirement of the World Bank and the GoB. Proper environmental management will require ensuring that the project would be environmentally sound and sustainable, and thus decision making will take place. It is envisaged that the detail Environment Impact Assessment (EIA) along with Environmental Management Plan (EMP) needs to be developed for priority phase. The borrower is responsible for carrying out these activities. The project is expected to be classified as Category 'A' project in accordance Bank's policy. BWDB intends to hire a consulting firm (the Consultant) to carry out these environment activities of the proposed project at the preparation stage to ensure that the proposed infrastructure takes environmental concerns into account.

2. Objective

The objective of the assignment is to carry out the tasks related to environmental aspects in light of the TOR. These include preparation of the **Environmental Impact Assessment** (including EMP) of the priority phase (Sailabari to Hasnapara).

3. Scope of Services

Carry out an overall Environmental Assessment (EA) and prepare Environmental Management Plan (EMP) for the project area covered under the feasibility study. For the area covered under the detailed designs conduct detail Environmental Impact Assessment and prepare full Environmental Management Plan (EMP). EIA, and EMP would be prepared according to the World Bank Guidelines and Operational Policies and the GoB procedures. The Consultant shall familiarize themselves with the project details and components as well as the Consultant shall interact with other preparation consultants (i.e, design consultant, social consultant etc) to determine best way of conduction environment activities and fits into overall project preparation/project cycle. Consultant shall appropriately plan the timing of the deliverables.

The major activities to be carried out will include, but not limited to the following.

3.1 Environmental Impact Assessment of Priority Phase (Document owned by the Implementing Agency and Requirement of GoB and World Bank)

3.1.1 Study Area and Likely Major Impacts.

i. Specify the boundaries of the study area for the assessment (project influence area): river basin/catchments, upstream land use, the drainage area and patterns, irrigation and other development scheme(s) – current and proposed, watersheds, access to sensitive/remote areas such as parks/ reserves/forests/agriculture land, elements of transport development program in the area.

3.1.2 Describe the proposed project.

ii. Provide information on the following: location of all project-related development sites and general layout and extent of facilities at project-related development sites; flow diagrams of facilities/operations; design basis, size, capacity; pre-construction activities; construction activities (land clearing, land grading, worker camps, if any), schedule, staffing and support, facilities and services; operation and maintenance activities (water management, monitoring of flows and groundwater, etc), staffing and support, facilities and services; management of risks, including health and safety; life expectancy for major components. Components may include any or all of the following: embankment, structural control measures; river channel modifications, dikes and levees; overflow basins; floodways and drainage and nonstructural measures (eg, zoning, floodplain regulations, building and sanitary ordinances and regulation of land use in basin/watershed areas), road route(s), types, ROWs, adjustments to alignments, including earthworks; repair/replacement of bridges; widening and stabilization of embankments; improvements to drainage and service ducts; sources of materials used during proposed road works; generation of wastes and their disposal expected volume of use and traffic impacts; necessary rehabilitation activities resettlement, land acquisition and temporary re-routing of traffic, safety features; staffing and accommodation of employees, including site clearance, scheduling of project activities; road paving and road signs and markings; operation and maintenance activities (eg, clearing of ditches, prevention of erosion, especially at culverts).

iii. Provide maps at appropriate scales to illustrate the general setting of project-related development sites, as well as surrounding areas likely to be environmentally affected. These maps shall include topographic contours, as available, as well as locations of major surface waters, roads, villages/towns, parks and reserves, and political boundaries. Also provide, as available, maps to illustrate existing land uses.

3.1.3 Description of the Environment

iv. Assemble and evaluate and baseline data on the environmental characteristics of the study area, including river basin/watershed, site of embankment, inundation, floodplain and biological features (habitats and rare species, fisheries), floodplain (recession) agriculture. Include information on any changes anticipated before the project commences.

(a). Physical environment: geology, topography, soils, climate, surface and ground water hydrology, annual peak discharge, ambient air quality; recurrence intervals of various peak discharges and peak stages of various discharges), erosion and sediment loading, existing/projected pollution discharges and receiving water quality; instances of flooding, siltation/erosion;

(b) Biological environment: ecology: flora and fauna, including rare or endangered species; sensitive natural habitats, including parks and reserves; potential vectors for disease; exotics and aquatic weeds; application of pesticides and fertilizers (current and projected as agriculture production is expected to be increased);

(c) Socio-cultural environment: land use (including current crops and cropping patterns - terracing or contour planting, population in the floodplain, etc.); fisheries and farm/industrial outputs and inputs; transportation; land tenure and land titling; present water supply and water uses (including current distribution of water resources); control over allocation of resource use rights; water-related human health problems; cultural sites, present and projected population; present land use/ownership; planned development activities; community structure; present and projected employment by industrial category; distribution of income, goods and services; recreation; public health; cultural properties; indigenous peoples, customs and aspirations; significant natural, cultural or historic sites, etc. Presence of HIV/AIDS and other sexually transmitted diseases;

(d) If resettlement sites and livelihood options are considered to support, find the physical, biological and socio economic conditions of the area;

v. Provide chainage wise information along the two sides of the project intervention and identify any critical aspect which needs special consideration during design, construction and operation.

3.1.4 Determination of the Potential Impacts of and Impacts on the Proposed Project.

vi. This analysis will require in depth interpretation. In this analysis, distinguish between significant positive and negative impacts, direct and indirect impacts, and immediate and long-term impacts. Identify impacts that are unavoidable or irreversible. Wherever possible, describe impacts quantitatively, in terms of environmental costs and benefits. Assign economic values when feasible. Characterize the extent and quality of available data, explaining significant information deficiencies and any uncertainties associated with predictions of impact. Compare the impact with the baseline. Provide TORs for studies to obtain the missing information. Special attention should be given to:

(a). Effects of the flood control embankment: direct environmental impacts of the embankment construction; effects on fisheries resources (creation of a reservoir fisheries, loss of downstream fisheries); effects on water quantity and quality; effects on floodplain ecology and estuarine, river hydrology, if applicable;

(b). Effects of flood control structures, intervention of river training structure and measures (e.g., channelization measures, floodways (high flow diversions or spillways), overflow basins, disposal of dredging spoils) on: aquatic ecology, particularly fish resources; hydrology, including groundwater recharge and exclusion of water from certain areas that may impact the hydrology and associated wildlife and agriculture; water quality; plant and animal ecology of the floodplain (habitat and species); and,

(c). Socio-economic impacts on populations in inundation area and downstream (floodplain dwellers, urban population, etc.) through: land use changes; impacts on water-related economic activities (e.g., fisheries, flood plain agriculture, transportation, etc.); health effects (e.g., increased incidence of water-borne and water related diseases). Additionally for road construction, consider loss of agricultural and residual lands; destruction of properties; loss of livelihood or other social disruption; relocation of infrastructures; unplanned settlements; noise; threat to cultural and historical sites or artifacts; demographic changes; potential for HIV/AIDS and other sexually-transmitted diseases. Also identify the impact due to resettlement and new livelihood options.

(d) Impact from road construction: Impact on air quality: air pollution from asphalt

plants; dust; noise from construction, equipment and blasting; impact on land resources: crossing of rivers, streams, canals and ravines, loss of habitat; foreclosure of other land uses; landslides; erosion; roadside litter; impact on hydrology: crossing of rivers, streams, canals and ravines; foreclosure of other land uses; landslides; erosion; modifications to natural drainage patterns and groundwater elevation; flash flooding; road side litter; impact on water quality: river/stream and lake sedimentation; use of pesticides; fuel and oil spills; water pollution from spills or accumulated contaminants on road surfaces; impact on biological environment: land clearance and loss of habitat; impacts on biodiversity caused by facilitation of access to and spontaneous settlements in natural areas; impacts on wetland management; control of hunting and poaching/wood-cutting

vii. Conduct model study on the water flow, geomorphology and water quality due to project intervention and predict the impact on ecology and socio economic activities after ten years.

viii. Identify the impact of the project intervention during lean period (seasonal variation) (impact on navigability, water variability).

ix. Determine the cumulative impact of the road construction and river bank improvement for the entire project area. Identify any steps to be taken to reduce the impact of the construction of remaining tasks on the current project.

3.1.5 Analysis of Alternatives to the Proposed Project.

x. Describe alternatives that were examined in the course of developing the proposed project and identify other alternatives that would achieve the same objectives. The concept of alternatives extends to siting and design of new alignments, rehabilitation techniques, choice of hydrological structures, and phasing, and operating and maintenance procedures, resettlement sites and livelihood support. Compare alternatives in terms of potential environmental impacts, capital and operating costs (including mitigation measures and their monitoring), and institutional, training, and monitoring requirements. To the extent possible, quantify the costs and benefits of each alternative, incorporating the estimated costs of any associated mitigating measures.

xi. Based on the above analysis identify and propose the best engineering design parameters to ensure minimal environment impacts due to the project.

xii. Closely work with the design consultants that those parameters are incorporated in the design.

3.1.6 Development of an Environmental Management Plan (EMP)

xiii. Identify key mitigation and enhancement approaches and prepare the impact specific mitigation measures. Estimate the impacts and costs of the mitigation measures and of the institutional and training requirements to implement them. If appropriate, assess compensation to affected parties for impacts that cannot be mitigated. Prepare an EMP, including proposed work programs, budget estimates, schedules, staffing and training requirements, and other necessary support services to implement the mitigating measures, monitoring, etc. Include measures for emergency response to accidental events (e.g. entry of raw sewage or toxic wastes into rivers, streams, etc).

xiv. Prepare a detailed plan to monitor the implementation of mitigating measures and the impacts of the project during rehabilitation and operation (eg, emission and ambient levels of pollutants where these may be detrimental to human health, soil erosion, changes in the

floodplain). Include in the plan an estimate of capital and operating costs and a description of other inputs (such as training and institutional strengthening) needed to implement the plan. Include a regular schedule of monitoring the quality of surface and ground waters to ensure that mitigation measures are effective. Provide guidance for reporting and enforcement and conducting environmental audits.

xv. Estimate the costing of EMP, ECoP and provide necessary clauses for incorporating in the bid document.

xvi. Review the responsibilities and capability of institutions at local, provincial/regional, and national levels and recommend steps to strengthen or expand them so that the EMP may be effectively implemented. The recommendations may extend to new laws and regulations, new agencies or agency functions, inter-sectoral arrangements, management procedures and training, staffing, operation and maintenance training, budgeting and financial support.

xvii. An outline of the contents of the EMP to be included in the project's Operational Manual should be provided along with environmental/social protection clauses for contracts and specifications**.**

3.1.7 Assist in Inter-Agency Coordination and Public/NGO Participation.

xviii. The Consultant will assist the government in coordinating the EIA with relevant agencies and the government will consult with affected groups likely to be affected by the proposed project and with local NGOs on the environmental and social aspects of the proposed project. These groups should be consulted when a draft EIA is available (a summary of the EIA will be available prior to the meeting). The draft EIA should also be available in a public place accessible to affected groups and local NGOs being consulted. The consultation workshops will be held locally, regionally and nationally.

Relevant materials will be provided to affected groups in a timely manner prior to consultation and in a form and language that is understandable and accessible to the groups being consulted. The Consultant should maintain a record of the public consultation (written and video and pictorial proof) and the records should indicate: means other than consultations) eg, surveys) used to seek the views of affected stakeholders; the date and location of the consultation meetings, a list of the attendees and their affiliation and contact address; and, summary minutes.

3.1.8 Institutional responsibility

xix. Define the roles and responsibilities of officials, staff, consultants and contractors of BWDB on environmental management;

xx. Describe in details who will (a) implement the environmental mitigation activities (b) carrying out environmental monitoring; (c) supervise environmental mitigation and monitoring; (d) design, implement and apply the environmental management information system (EMIS); and (e) prepare quarterly progress report on environmental management;

xxi. Finalize the draft EIA incorporating the comment from the consultation;

xxii. Translate and finalize the EIA in Bengali.

4. Consulting Team composition and qualifications

i. The studies outlined require interdisciplinary analysis with specialized sector knowledge (i.e., water resource and hydrology/embankment). The general skills required of the Environmental Safeguard team are: environmental management planning, civil/river /embankment engineer(s), with particular experience in dredging projects, river training and embankment construction and water-based transport; aquatic biologist depending upon the predicted impacts, land use planner, sociologist, archaeologist and communications / stakeholder engagement. The consulting team must be able to demonstrate appropriate skill mix and depth of experience to cover all areas of the proposed analysis, including incorporation of other specialized skill sets where required. The consulting team shall be led by a Team Leader with at least 10 years of experience leading EIA studies, including prior international experience on similar types of water resource projects, and prior experience as either team leader or deputy team leader on at least 3 previous major infrastructure EIAs for World Bank funded projects.

5. Schedule/Duration of the study

The study period shall be of **6 (six)** months from the date of commencement of the study.

6. Reports

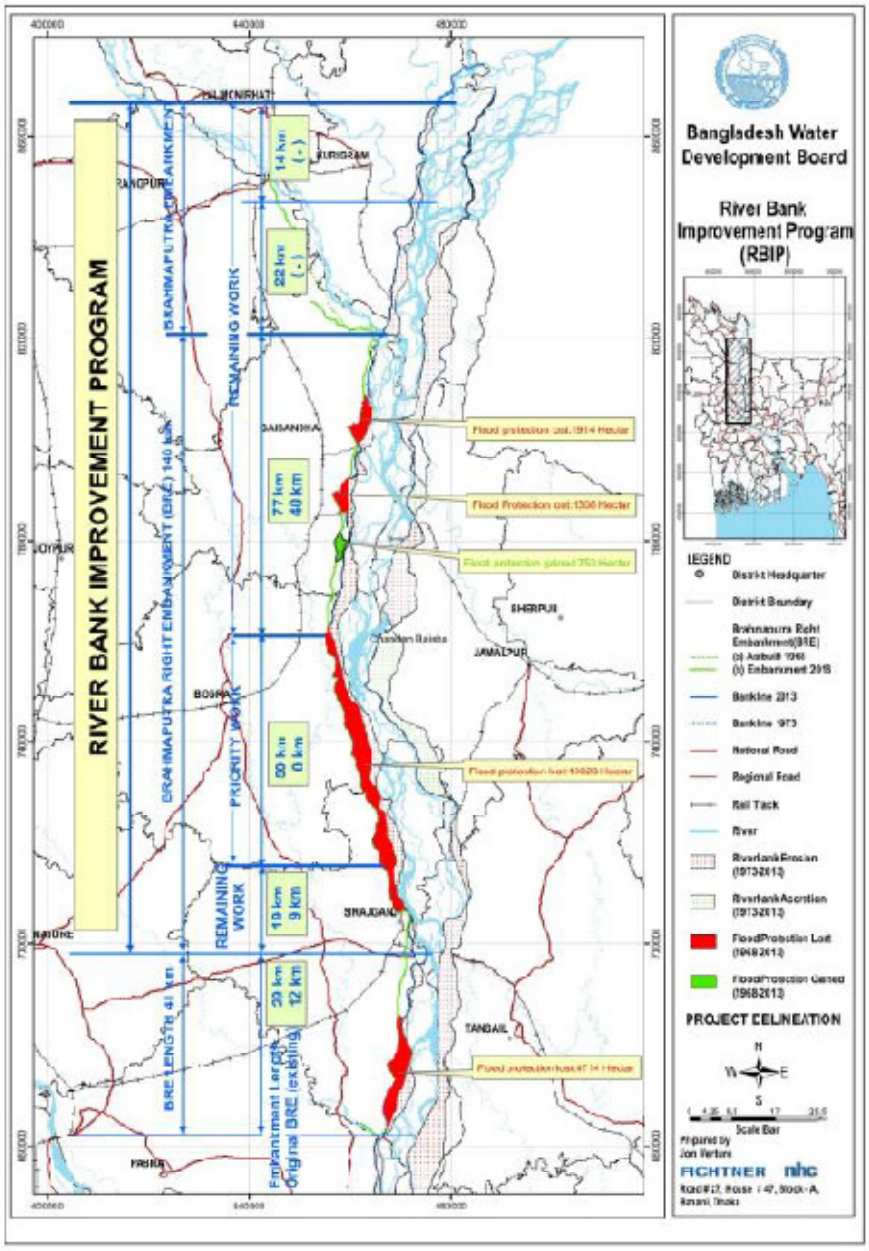
After commencement of the study the submission of the reports shall be both in **hard (3 copies) and soft copy** as follows:

- Draft Environmental Impact Assessment---submitted at the end of 4th month of signing the contract
- Final Environmental Management Framework--submitted at the end of 3rd month of signing the contract.
- Final Environmental Impact Assessment---submitted at the end of 5th month of signing the contract
- Bengali Translation of the Environmental Management Framework--submitted at the end of 5th month of signing the contract.
- Bengali Translation of the Environmental Impact Assessment--submitted at the end of 6th month of signing the contract.

8. Reporting

The consultant will report to the Project Director, River Bank Improvement Project, Bangladesh Water Development Board (BWDB).

Appendix A: Location of Priority (Phase I) and Remaining (Phase II) Project Location



Appendix B: Structure of EIA Report

The Consultant is required to prepare an EIA report that is concise and limited to significant environmental issues. The main text should focus on findings, conclusions and recommended actions, supported by summaries of the data collected and citations for any references used in interpreting those data. Detailed or uninterrupted data are not appropriate in the main text and should be presented in appendices or a separate volume. Unpublished documents used in the assessment may not be readily available and should also be assembled in an appendix. Organize the environmental assessment report according to the outline below.

The report should be prepared as per the following key contents:

1. Executive Summary (ES): The Executive Summary should mirror the report both in form and content and should be about 10 percent in length of the report. The significant findings and recommended actions should be clearly discussed in the ES.
2. Introduction: This section will include (i) purpose of the report and (ii) extent of the environmental study.
3. Policy, Legal and Administrative Framework: This section will describe relevant environmental policies, rules and administrative procedures that need to be followed for the proposed project. The relevant international environmental agreements to which Bangladesh is a party should also be discussed.
4. Project design and Description: This section will provide a brief but clear picture about (i) type of project; (ii) category of project; (iii) need for project; (iv) location (use maps showing general location, specific location, and project site); (v) size or magnitude of operation;(vi)Project influence area (vii) proposed schedule for implementation. The proposed project should be described with reasonable details so that the EIA report can be read as a standalone document without reference to other project documents.
5. Analysis of Alternatives: Systematic comparison for feasible alternatives to the proposed project site, technology, design, and operation--including the "without project" situation--in terms of their potential environmental impacts should be done. The feasibility of mitigating these impacts; their capital and recurrent costs; their suitability under local conditions; and their institutional, training, and monitoring requirements have to be provided. For each of the alternatives, the quantification of the environmental impacts to the extent possible, and economic values where feasible should be given. The basis for selecting the particular project design proposed and justification for recommended emission levels and approaches to pollution prevention and abatement have to be provided.
6. Environmental Baseline: *This section will provide sufficient information on the existing environmental baseline resources in the area affected by the project, including the following:*

   (i) Physical Resources: (e.g. atmosphere, air quality and climate), topography and soils, surface water & groundwater, geology/seismology)

   (ii) Water Resources: (e.g. hydrology, surface water and groundwater system, sedimentation, tidal influence, etc.)

   (iii) Land and Agriculture resources: (e.g. land type, land use, cropping pattern, crop production, etc.)

   (iv) Fisheries resources: (e.g. fisheries diversity, fish production, etc.)

   (v) Ecology: (e.g. ecosystems, wildlife, forests, rare or endangered species, protected areas, coastal resources, etc.)

   (vi) Socio-economic condition:(e.g. population and communities (e.g. numbers, locations, composition, employment), health facilities, education facilities, socio-economic conditions (e.g. community structure, family structure, social wellbeing), physical or cultural heritage, current use of lands and resources for traditional purposes by indigenous peoples, structures or sites that are of historical, archaeological, paleontological, or architectural significance, economic development (e.g. industries, infrastructure facilities, transportation, power sources and transmission, mineral development, and tourism facilities, etc.).

To assess the dimensions of the study area, the relevant physical, biological, and socioeconomic conditions before the project commencement should be discussed. The relevant data related to the issues have to be collected and reported.

7. Climate Change issues: *Climate change aspects in global, regional and local perspectives and the likely impacts on the Project area and its surroundings should be briefly discussed in this section.*

8. Significant Environmental Impacts: This chapter will need careful interpretation. Significant environmental and social impacts due to project location, and related to project design, construction, and operations phase should be discussed in detail in this section. The prediction and assessment of the project's likely positive and negative impacts, in quantitative terms to the extent possible should be made. The mitigation measures and any residual negative impacts that cannot be mitigated should be identified. The opportunities for environmental enhancement should also be explored. Estimates should be done on the extent and quality of available data, key data gaps, and uncertainties associated with predictions; and the topics that do not require further attention should be specified. Considering the impact the project has to be classified into Categories of A, B or C as per OP 4.01.

9. Cumulative and Induced Impacts: Cumulative impacts of the proposed Project and other projects as well as induced impacts should be provided in this section.

10. Design Parameters: This section should present the parameters which should be considered in the design for minimizing the environmental impact.

11. Environmental Management Plan: The environmental management plan (ESMP) will include mitigation and enhancement plan, compensation and contingency plan as well as monitoring plan including institutional arrangement for implementation of the EMP. The EMP should also include tentative cost of implementation of the plan. Guideline for preparation of EMP is included below.

12. Stakeholder Consultation and Disclosure: The proceeding of the consultations done as per OP4.01 has to be included in this section of the EIA report. It is to be noted that during the EIA process for all WB Category A and B projects, the proponents have to consults project-affected groups and local nongovernmental organizations (NGOs) about the project's environmental aspects and take their views into account. The proponents' initiates such consultations as early as possible. For Category A projects, the proponents consult these groups at least twice: (a) shortly after environmental screening and before the terms of reference for the EIA is finalized; and (b) once a draft EIA report is prepared. In addition, the proponent must consult with such groups throughout project implementation as necessary to address EIA-related issues that affect them.

13. Disclosure: For meaningful consultations between the borrower and project-affected groups and local NGOs on all Category A and B projects proposed for WB financing, the proponents must provide relevant material in a timely manner prior to consultation and in a form and language (i.e. Bangla) that are understandable and accessible to the groups being consulted. The disclosure details done as per OP 4.01 should be provided in this section.

14. Grievance Mechanism**:** A mechanism should be outlined to ensure that the project sponsor maintains appropriate external channels for communicating with and receiving feedback, questions, and complaints from local stakeholders, as well as internal

procedures for following up and resolving any complaints or grievances in a timely manner. The mechanism should include more than one channel for receiving communications and grievances (for example, a hotline, a public information office, boxes to receive written complaints or queries, etc. – depending on local preferences, literacy levels, etc.), as well as indicating requirements, responsibilities and budget for documenting, processing, and resolving issues that arise, including providing feedback to complainant(s) regarding the resolution. The existence of the grievance mechanism must be fully and proactively disclosed to the public.

15. Discussions and Conclusions**:** The essential issues in the EIA report should be summarily discussed and the conclusions are to be included in this section.
16. **References:** References should be provided to written materials both published and unpublished, used in study preparation.

- Annexes:
  - ✓ List of Environmental Assessment Preparers
  - ✓ Record of interagency and consultation meetings, including consultations for obtaining the informed views of the affected people and local nongovernmental organizations (NGOs). The record specifies any means other than consultations (e.g., surveys) that were used to obtain the views of affected groups and local NGOs
  - ✓ Data and Unpublished Reference Documents

Guideline for Preparing Environment Management Plan

Environmental Management Plan (EMP)

The Consultant is required to develop an Environmental Management Plan (EMP) consisting of a set of feasible and cost-effective mitigation measures and monitoring and institutional plan to prevent or reduce significant negative impacts to acceptable levels. This will include measures for emergency response to accidental events (e.g., fires, explosions), as appropriate. The Consultant will provide an estimation of the impacts and costs of the mitigation measures, and of the institutional and training requirements to implement them. In particular this would include:

Environmental Mitigation & Enhancement Measures: Recommend feasible and cost-effective measures to prevent or reduce significant negative impacts to acceptable levels. Apart from mitigation of the potential adverse impacts on the environmental components, the EMP shall identify opportunities that exist for the enhancement of the environmental quality along the surrounding area. Residual impacts from the environmental measures shall also be clearly identified. The EMP shall include detailed specification, bill of quantities, execution drawings and contracting procedures for execution of the environmental mitigation and enhancement measures suggested, separate for pre-construction, construction and operation periods. In addition, the EMP shall include good practice guides related to construction and upkeep of plant and machinery. Responsibilities for execution and supervision of each of the mitigation and enhancement measures shall be specified in the EMP. A plan for continued consultation to be conducted during implementation stage of the project shall also be appended.

Capacity Building & Training: The EMPs shall describe the implementation arrangement needed for the project, especially the capacity building proposals including the staffing of the environment unit (as and when recommended) adequate to implement the environmental mitigation and enhancement measures. For each staff position recommended to be created, detailed job responsibilities shall be defined. Equipment and resources required for the environment unit shall be specified, and bill of quantities prepared. A training plan and schedule shall be prepared specifying the target groups for individual training programs, the content and

mode of training. Training plans shall normally be made for the client agency (including the environmental unit), the supervision consultants and the contractors.

Supervision & Monitoring: Environmental monitoring plan will be an integral part of an EMP, which outlines the specific information to be collected for ensuring the environmental quality at different stages of project implementation. The parameters and their frequency of monitoring should be provided along with cost of the monitoring plan and institutional arrangements for conducting monitoring. Reporting formats should be provided along with a clear arrangement for reporting and talk corrective action. The EMP shall list all mandatory government clearance conditions, and the status of procuring clearances. Additionally, the EMPs shall include as separate attachments, if applicable, Natural Habitat Plan and/or Cultural Properties Plan to satisfy the requirements of the World Bank safeguard policies.

Annex C. Location and Specification of Different Fish Habitats and Chars

Citation in the main text (Volume I): **Section 6.5.3.3**.

Sirajganj Sadar Upazila

Water body type	Country side (Name/ No.)	River side (Name/No.)	Specification
River		Jamuna	
	Ichhamoti		
Beel/ Wetlands	Aminpur beel		0.80 ha
	Joynagar beel		20 ha
	Charkhada		0.80 ha
	Chatiantolir beel		13.36 ha
	Ghuria beel		6.68 ha
	CNB Beel		2.67 ha
Khal/Canal	Kothir Pinjira		
	WAPDA Khal		
	Doi Vanger khal		
	Balia ghugri khal		
	Perpachil khal		
	Bahuka khal		
Kole (Embayment)		Simla	2.97 ha
		Mothiar kul - achthakuri	3.34 ha
	Balutia- Moshamara		334.01 ha
Pond	52 nos.	10 nos.	3.51 ha

	Name of Char	Location (From proposed Baliaghugri regulator)
1	Simla	4 km east
2	Kharoya	6 km east
3	Khas para	7 km north-east
4	Par Simla	3 km north-east
5	Noya para	5 km north-east

	Name of Char	Location (From proposed Baliaghugri regulator)
6	Dumber char	2 km north east
7	Jhumkal char	7 km north

Kazipur Upazila, Sirajganj

Water body type	Country side (Name/No.)	River side (Name/No.)	Specification
River		Jamuna	
Beel/ Wetlands	Paikartoli beel		500 ha
	Chalita danga beel		300 ha
	Vhut baria beel		240 ha
	Kachihara beel		1000 ha
	Pagol kandi beel		500 ha
Khal/Canal	Halot khal		37.5 ha
	Meghai khad		2 km long (15.36 ha)
Pond	70 nos.	18 nos.	4.99 ha

Dhunat upazila, Bogra

Water body type	Country side (Name/No.)	River side (Name/No.)	Specification
River	Manos river		8.75 ha
Beel/ Wetlands		Jagiar beel/ Vander bari	10 ha
	Bera danger beel		200 ha
	Houra khali beel		112.5 ha
Khal/Canal	Madhob Danga		8 ha
	Shimul bari khal		12 ha
Kole (lagoon)		Pukuria	8.02 ha
		Sariakandi	0.67 ha
		Shamol bari	1.07 ha
		Baniajan	0.67 ha
		Adhanagar	0.67 ha
		Boishakhi	5.34 ha

Water body type	Country side (Name/No.)	River side (Name/No.)	Specification
		Chunia para	40.08 ha
Pond	59	40	5.61 ha

	Name of Char	Location
1	Maiz bari	3 km east From proposed Pukuria- Vanderbari regulator
2	Vanger bari	2 km east From proposed Pukuria- Vanderbari regulator
3	New Sariakandi	3 km north-east From proposed Pukuria- Vanderbari regulator
4	Pukuria	East to proposed Pukuria- Vanderbari regulator
5	Boroikandi	East to proposed Pukuria Vanderbari regulator
6	Baniajan	East to proposed Pukuria Vanderbari regulator
7	Koiya gari	East to proposed Pukuria Vanderbari regulator
8	Atai	East to proposed Pukuria Vanderbari regulator
9	Sohora	East to proposed Pukuria Vanderbari regulator
10	Boishaki	1 km east from Shimul baria spur
11	Adhanagor	1 km East from Shamol bari spur
12	Fuljhur	2 km southeast from Shamol bari spur
13	Mollik para	3 km southeast from Shamol bari spur
14	Shree pur	3 km southeast from Shamol bari spur
15	Agura Maizbari	4 km southeast from Shamol bari spur
16	Dhakuria	5 km southeast from Shamol bari spur
17	Boyan char	3 km east from Chuniapara regulator
18	Majhira	4 km east from Chuniapara
19	Shanbandha	5 km east from Chuniapara
20	Promitibari	6 km north from Chuniapara
21	Noi khola	6 km north from Chuniapara

Sariakandi Upazila, Bogra

Water body type	Country side (Name/No.)	River side (Name/No.)	Specifications
River		Jamuna	
		Bangali	
Beel/ Wetlands	Dauli beel		1 km long (50 ha)
	Vakir beel		60 ha
	Bera beel		100 ha
	Dikdar beel		2 km N- W from Hasnapara , 30
	Dighol kandi beel		40.08 ha
	Satbilla beel		293.93 ha (5 km long)
	Kalaihata beel		26.72 ha
	Burungir beel		20 ha
	Gojariar beel		60 ha
Khal/ Canal	Kata khal		1 km long (3.50 ha)
		Kuripara canal	derived from Jamuna and directed to Shalukar char , 4 ha
		Shalukar canal	derived from Jamuna and directed to Shalukar char,5.25 ha
		Char bati canal	derived from Jamuna and directed to Shalukar char, 5 ha
Kole (lagoon)	Antarpara kole		East to Antarpara regulator (4.01 ha)
	Nich Kola		0.75 km north from Hasnapara (8.01 ha)
	Khurda boloi		0.5 km east- from Hasnapara (6.68 ha)
	Maiz bari		5952.02 ha
	Taltola		66.80 ha
	Kazlar kole		10.69 ha
	Gobindapur		7 ha
	Nolcia		5.5 ha
	Beragram		10 ha
	Holdia		14 ha
Pond	75 nos.	20 nos.	5.38 ha

	Name of Char	Location/ Feature
1	Kuripara	East to proposed Antarpara regulator
2	Khapur para	East to proposed Antarpara regulator
3	Antarpara	East to proposed Antarpara regulator
4	Kazla	East to proposed Antarpara regulator
5	Ghager char	East to proposed Antarpara regulator
6	Diga para	1 km northeast from Hasnapara
7	Chokorthinatha	3 km northeast from Hasnapara
8	Konnobari	4 km northeast from Hasnapara
9	Kormoja	2 km north from Hasnapara
10	Housherpur	1.5 km north from Hasnapara
11	Sujatpur	3 km north from Hasnapara
12	Bauliapara	4 km north from Hasnapara
13	Banupur	2 km east from Hasnapara
14	Dhorbon	1 km southeast from Hasnapara
15	Pakuria char	West to Shalukar char
16	Jamtoil	West to Shalukar char
17	Manik	North to Shalukar char
18	Nobboi	Northeast to Shalukar char
19	Barabajbari	East to Shalukar char
20	Indurmara	South to Shalukar char
21	Hasnapara	Southeast to Shalukar char
22	Dakat mara	Southeast to Shalukar char
23	Chanpara	Southeast to Shalukar char
24	Gobindapur	7 km northeast from Kundupara
25	Nolcia	4 km northeast from Kundupara
26	Fazilpur	6 km east from Kundupara
27	Joyantirpara	4 km east from Kundupara

Sonatola Upazila, Bogra

Water body type	Country side (Name/No.)	River side (Name/No.)	Specification
Beel/ Wetlands	Saluka beel		13.36 ha, perennial, average water depth= 15 feet
Pond	16	2	0.87 ha

	Name of Char	Location/ Feature
1	Khabilla	5 km southeast from Pakulla, Bogra
2	Boro vanga	10 km East from Pakulla
3	Shollia	8 km southeast from Pakulla
4	Auchar	10 km southeast from Pakulla
5	Patil char	11 km southeast from Pakulla

Shaghata Upazila, Gaibandha

Water body type	Country side (Name/No.)	River side (Name/No.)	Specification
River		Jamuna	
Beel/ Wetlands	Kharkhara		0.5 km west from Saghata sluice gate,5 ha, Seasonal, water depth 8 feet
	Charagata		1.5 km west from Saghata sluice gate, 6 ha, Perennial, water depth 20 feet
	Ghoridaho		3 km west from Saghata sluice gate,3 ha, Perennial, water depth 15 feet
	Kachur beel		West to Kachuar regulator, 2.01 ha, perennial, culture
	Beel bosta		0.5 km south from Kachuar regulator, 2 ha, perennial, culture
	Vagir beel		0.81 ha, southeast of Nilkhuthi village , Bhorot khali union , Shaghata, Gaibandha
	Napiter beel		0.81 ha
Kole (Seasonal water body)		Hatbari	5 km east from Saghata sluice gate, 4 ha
		Pansi para	5 km north from Saghata sluice gate, 10 ha

Water body type	Country side (Name/No.)	River side (Name/No.)	Specification
		Shaghata	1 km east from Saghata sluice gate, 14 ha
		Kachuar kole	300 m west from Saghata sluice gate,50 ha, Perennial, water depth (R=25 feet, D=12 feet
		Bashhata	657,0.40 ha
		Shatilla	657,2.67 ha
Pond	40 nos.	6 nos.	2.79 ha

	Name of Char	Location / Feature
1	Hatbari	3 km east from Saghata sluice gate
2	Delabari	6 km east from Saghata sluice gate
3	Jamira	8 km east from Saghata sluice gate
4	Batoner char	1 km east from 657
5	Shatilar char	2 km east from 657

Fulchari Upazila, Gaibandha

Water body type	Country side (Name/No.)	River side (Name/No.)	Specification
		Brahmaputra	
River	Ghaghot	Ghaghot	
	Alai	Alai	
Beel/ Wetlands	Singrai beel		N-E to Catlamari sluice gate, 80.16 ha, Perennial, water depth(R= 15 feet, D= 5 feet)
	Gauchulki beel		N-W to Catlamari sluice gate, 20.16 ha, Seasonal, water depth(R= 7 feet, D= 0 feet)
	Khathuria beel		N-E to Ratanpur sluice gate, 26.72 ha, Perennial, water depth (R= 15 feet, D= 7.5feet)
	Kabilpur beel		4 km S from proposed Kanchipara regulator,30 ha

Water body type	Country side (Name/No.)	River side (Name/No.)	Specification
	Gun bhuri		5.5 km S from proposed Kanchipara regulator
	Ratanpur beel		5.5 km S from proposed Kanchipara regulator
Canal		Gopaldoba	6.01 ha, 1 km east from Catlamari regulator(2v)
Kole (Seasonal water body)		Khazjani Kole	0.5 km E from Hardanga Char, 26.73 ha, Perennial, water depth (R=30 feet, D=15 feet
		Coach khali kole	1.5 km N from Hardanga Char, 13.36 ha, Perennial, water depth (R=25.5 feet, D=7.5 feet
Pond	55 nos.	12 nos.	3.53 ha

	Name of Char	Location / Feature
1	Khatia mari	6 km S-E from proposed kanchipara regulator
2	Haro danga	3 km S from proposed kanchipara regulator
3	Satar danga	1.5 km E-N from proposed kanchipara regulator
4	Kauya para	3 km E from proposed kanchipara regulator
5	Kuch khali	1 km E from proposed kanchipara regulator
6	Jora bari	1.5 km E-S from proposed kanchipara regulator
7	Kabilpur	1.5 km E-S from proposed kanchipara regulator
8	Fazlur pur	3 km E-S from proposed kanchipara regulator
9	Kalosona	6 km S from proposed kanchipara regulator
10	Chomohan	4 km S from proposed kanchipara regulator
11	Krishnomoni	4.5 km S from proposed kanchipara regulator
12	Zira bari	10 km E from proposed kanchipara regulator
13	Khazjani	1.5 km E from Hardanga Char
14	Kauyabada	5 km E-N from Hardanga Char
15	Rahamatpur	4 km E-N from Hardanga Char
16	Satarkandi char	5 km E from Hardanga Char

Sadar, Gaibandha

Water body type	Country side (Name/No.)	River side (Name/No.)	Specification
River	Ghaghot		
	Manos River		
		Brahmaputra	
Floodplain/ Wetlands	Vela goa beel		0.25 km W from Baguria point ,two parts divided by WAPDA badh, 9.35 ha, Seasonal, water depth(R= 15 feet)
	Pakhimara beel		Adjacent to existing 8 vent regulator,1002.02 ha, Seasonal, Water depth =7 feet
	Puiya gara beel		Adjacent to proposed taltola regulator,240.49 ha, seasonal , water depth = 6 feet
	Purbo Baroboldia beel		Adjacent to(N-W) Proposed Kamarjani regulator, 280.57ha, Perennial , Average water depth = 7.5 feet
	Gidari beel		2.5 km S-W from Proposed Kamarjani regulator, 400.81ha, Perennial , Average water depth = 9 feet
Canal	Kamarjani khal		Along the WAPDA badh
		Dara/Canal	Brahmaputra to WAPDA badh
Kole (Seasonal water body)		Uttar gidari kole	10 km N from Hardanga Baguria point, 1.07 ha, Perennial, water depth (R=30 feet, D=10.5 feet
		Gorain kole	1.20 ha, Perennial, water depth (R=30 feet, D=12 feet
		Kalaibari	8 km E-S from first grown of Anarar chora,5.34 ha, Perennial, water depth (R=30 feet, D=12 feet, Fish culture practiced
		Khazjani	10 km E-S from first grown of Anarar chora, 3.34 ha, Perennial, water depth (R=25 feet, D=10 feet, Fish culture practiced
		Gidari	2 km N-W from first grown of Anarar chora,6.68 ha, perennial, water depth (R=22.5 feet, D=7.5 feet
		Khana bari	4 km northeast from proposed Kamarjani regulator, 9.35ha, Perennial , Average

Water body type	Country side (Name/No.)	River side (Name/No.)	Specification
			water depth = 12 feet
		Kamarjani	2 km E from Proposed Kamarjani regulator, 3.34 ha, Perennial , Average water depth = 10 feet
		Koraibari	2 km E-N from Proposed Kamarjani regulator, 8.02 ha, Perennial , Average water depth = 11 feet
		Matikhola	7 km S- E from Proposed Kamarjani regulator, 66.80 ha, Perennial , Average water depth = 12 feet
Pond	244 nos.	17 nos.	13.74 ha

	Name of Char	Location / Feature
1	Raidas bari	2 km N from Baguria point
2	Faliar gob	3 km E from Baguria point
3	Kalai bari	4 km E from Baguria point
4	Khas jani	5 km E from Baguria point
5	Patdiara	6 km E from Baguria point
6	Kundarpara	7 km E from Baguria point
7	Batkamari	9 km E from Baguria point
8	Fazlur pur	3 km E-S from proposed kanchipara regulator
9	Kalosona	6 km S from proposed kanchipara regulator
10	Chomohan	4 km S from proposed kanchipara regulator
11	Krishnomoni	4.5 km S from proposed kanchipara regulator
12	Zira bari	10 km E from proposed kanchipara regulator
13	Khazjani	1.5 km E from Hardanga Char
14	Kauyabada	5 km E-N from Hardanga Char
15	Rahamatpur	4 km E-N from Hardanga Char
16	Satarkandi char	5 km E from Hardanga Char
17	Folar cock	3 km E- N from Anarar chora
18	Sayedpur	5 km E- N from Anarar chora

	Name of Char	Location / Feature
19.	Satarkangi	10 km E from Anarar chora
20	Khazjani	10 km E- N from Anarar chora
21	Kalaibari	7 km E from Anarar chora
22	Aijaz bari	2 km E from Anarar chora
23	Khamarjani	6 km E from Proposed Kamarjani regulator
24	Karaibari	5 km E-S from Proposed Kamarjani regulator
25	Batkamari	9 km E-S from Proposed Kamarjani regulator
26	Kandolpara	25 km E-S from Proposed Kamarjani regulator
27	Kolmu	18 km E-S from Proposed Kamarjani regulator
28	Puran char	8 km E-N from Proposed Kamarjani regulator
29	Sidhai	25 km E from Proposed Kamarjani regulator

Chilmari Upazila, Kurigram

Water body type	Country side (Name/No.)	River side (Name/No.)	Specification
River	Sorai river	Sorai river	Brahmaputra to Shreepur
Beel/ Wetlands	Chang mari beel		713, Seasonal, water depth(R= 9 feet)
	Nakhali beel		713 ,Seasonal, water depth(R= 7 feet)
	Baharer beel		3 km N from Horichiri ghat (12 vent) regulator, 80.16ha, Perennial , Average water depth = 10 feet,
	Hasar dala beel		5 km N from Horichiri ghat (12 vent) regulator, Seasonal , Average water depth = 7 feet
	Mohisalar beel		N to Horichiri ghat (12 vent) regulator,, 13.36ha, Seasonal , Average water depth =

Water body type	Country side (Name/No.)	River side (Name/No.)	Specification
			8 feet
	Magurar beel		1 km N from kachkol (10 vent) regulator,160.32 ha, Seasonal Average water depth = 7 feet
	Shol dukri		2 km W from Kachkole regulator,120.24 ha
	Kodal daho beel		2.5 km N from Kachkole regulator
	Kalir pati		4 km W from Kachkole regulator
	Rajar ghat		4 km W from Kachkole regulator
	Ranigonj (Domer hat)		6km W from Kachkole regulator
	Khaye ghat		7 km W from Kachkole regulator
	Hagritola beel		80.16 ha
	Koyar beel		601.21 ha
Khal/Canal	Gidari canal		20 km long (28 ha)
	Antarpur canal		8 km long (12 ha)
Kole (Lagoon)		Agabor kole	E to Horichori ghat regulator, 2.67 ha, Perennial, Average water depth= 12 feet
		Horipur-1	2 km S to Horichori ghat regulator, Seasonal, Average water depth= 8 feet
		Horipur-2	3 km W to Horichori ghat regulator, Perennial, Average water depth= 10 feet
		Hasher beel kole	4.01 ha, Seasonal, water depth = 15 feet
		Bahattor kole	5 km E from kachkol (10 vent) regulator, 20.04 ha, Perennial, Average water depth = 30 feet
		Haser vita kole	3 km E from kachkol (10 vent) regulator, Perennial, 3.21 ha, average water depth = 18 feet
		Kachkole	0.5 km s from simultola/Magurar regulator, Perennial, average water depth=15 feet
		Kolapani	1.5 km E from Simultola/Magurar regulator, Perennial, 1.34 ha, average water depth= 9 feet

Water body type	Country side (Name/No.)	River side (Name/No.)	Specification
		Badhdhara	5 km E from Simultola/Magurar regulator , Perennial, 4.01 ha, Average water depth= 15 feet
		Uttarowari	5 km E-N from Simultola/Magurar regulator , Perennial
		Bongram	100.20 ha, perennial, Average water depth=30 ha

	Name of Char	Location / Feature
1	Gorghoti char	2 km E from Shimultola regulator
2	Chutarmari	20 km S from Shimultola regulator
3	Bagdhara badh	8 km S from Shimultola regulator
4	Nauer char	8 km S from Shimultola regulator
5	Boro vitar char	7 km W-S from 728
6	Bongram char	8 km E-N from 728
7	Damar char	1 km S-W from Horichorighat regulator
8	Char horipur	3 km S-W from Horichorighat regulator
9	Nil char	8 km S-W from Horichorighat regulator

Ulipur, Kurigram

Water body type	Country side (Name/No.)	River side (Name/No.)	Specification
River		Brahmaputra	
		Sorai	
Beel/ Wetlands	Anantapur beel		7 km W from proposed Anantapur regulator, perennial
	Paglir kuri		4 km W-S from proposed Anantapur regulator, perennial
	Nayantapur		8 km W-N from proposed Anantapur regulator, perennial
	Chirokhaoya dola		4 km S from proposed Anantapur regulator, perennial
	Malchar par		7 km S from proposed Anantapur regulator, perennial

Water body type	Country side (Name/No.)	River side (Name/No.)	Specification
	Kosulla		Adjacent to regulator, 1.5 km long, 500 m wide, Seasonal (3 month), water depth=9.5 feet
	Singramari		1 km N-W from regulator, seasonal (4 month), water depth=10.5 feet
	Kossa		3 km N-W from regulator, seasonal (5 months),15 feet
	Darki mari beel		1.5 km N from regulator, 4 km long, 3 km wide, perennial, water depth=14 feet
	Chokchoka beel		5 km N from regulator, 5 km long, 4 km wide, perennial
Kole (Lagoon)		Jolanger kuthi	2 km E from ...,48.09 ha,
		Anatapur kole	100 m E from Anantapur regulator , 320.65 ha, Perennial, Average water depth=30 feet
		Kolakata	4 km E-N from Anantapur regulator , 480.97 ha, Perennial, Average water depth=30 feet
		Gujimari	2 km E from Anantapur regulator , 40.08 ha, Perennial, Average water depth=30 feet
Pond	38 nos.	13 nos.	2.68 ha

	Name of Char	Location / Feature
1	Anantapur char	100 m E from Anantapur regulator
2	Gujimari	1 km E from Anantapur regulator
3	Uttar gujimari	2 km N from Anantapur regulator
4	Dakkhin gujimari	km S from Anantapur regulator
5	Sukherbati	25 km S from Anantapur regulator
6	Char Bagua	20 km S from Anantapur regulator
7	Parar char	7 km east from Balaijan regulator
8	Kaziar char	8 km E from Anantapur regulator
9	Durga pur	14 km E from Anantapur regulator

Sadar, Kurigram

Water body type	Country side (Name/No.)	River side (Name/No.)	Specification
River		Brahmaputra	
		Dhudkumar	
Beel/ Wetlands	Ponchasar beel		0.75 km W from Aragikodomtola regulator ,2.40 ha, Perennial, water depth=10 feet, fish culture practiced
	Jobber munsher beel		1 km W from Aragiodomtola regulator, Perennial, water depth=10.5 feet
	Amluddi hazir beel		2 km W from Aragikodom regulator, water depth=12 feet
	Kazol daho		2 km W from 743 regulator
	Dubba churi		2.5 km N-W from 743 regulator
	Gagla beel		1 km W from Existing Tangormarir patar regulator,40.08 ha, perennial, average water depth=9 feet
	Sarisui beel		1.5 km N from Existing Tangormarir patar regulator,60.12 ha, perennial, average water depth=16 feet
	Dolarpar beel		1.5 km N-W from Existing Tangormarir patar regulator,80.16 ha, seasonal, average water depth=8 feet
	Sonalir khuthi beel		1.5 km W from Existing Tangormarir patar regulator,10.69 ha, Seasonal, average water depth=10 feet
	Hodir beel		3 km W-N from Existing Tangormarir patar regulator,20.04 ha,Perennial, average water depth=15 feet
	Koi ghuri		4.5 km N-W from Tangormarir patar regulator
	Duba churi		7 km S-W from Tangormarir patar regulator, 8.02 ha, water depth=5 feet
	kazol daho		9 km S-W from Tangormarir patar regulator, 13.36 ha, seasonal, water depth= 6 feet
	Pachgaciar chora		5 km W from Tangormarir patar regulator,80.16ha, perennial, water

Water body type	Country side (Name/No.)	River side (Name/No.)	Specification
			depth=20 feet
	Misti parar beel		1 km N-W from Tangormarir patar regulator,2 ha, perennial, water depth = 10 feet
Khal/Canal	Girai nodi/Khal		1 km west from khama Rasulpur,4.8 ha,4 km long
Kole (Lagoon)		Gobindopur	2 km E from Aragikodomtola regulator,80.16 ha, perennial, Water depth=15 feet
		Perbotti pur	3 km E from Aragikodomtola regulator,140.28 ha, perennial, Water depth=18 feet
		Vushakuthi	2 ha, perennial, Water depth=10 feet
		Sarkerpara vanga	0.5 km N from Tangormarir patar regulator,40.08 ha, perennial, Water depth=14 feet
		Prothom alo kole	2 km E-S from Tangormarir patar regulator, 12.04 ha
		Bangar dola kole	1.5 km E-N from Tangormarir patar regulator, 10.69 ha
		Kath giri kole	2.5 km N from Tangormarir patar regulator , 10.69 ha
		Pocha kata kole	5 km N from Tangormarir patar regulator , 9.35 ha
		Shantiar kole	2.5 km E from Tangormarir patar regulator , 13.36 ha
		Rolakata kole	4 km E-N from Tangormarir patar regulator , 9.35 ha
		Narayanpur kole	8 km E from Tangormarir patar regulator , 133.60 ha, perennial
		Astoasi kole	7 km E-N from Tangormarir patar regulator , 13.36 ha, perennial
		Jhumkar kole	6 km E from Tangormarir patar regulator ,12.02 ha
Pond	47 nos.	3 nos.	2.43 ha

	Name of Char	Location / Feature
1	Prothom alo	2 km E-S from Tangormarir patar regulator, 12.04 ha
2	Bangar dola	1.5 km E-N from Tangormarir patar regulator, 10.69 ha
3	Kath giri	2.5 km N from Tangormarir patar regulator , 10.69 ha
4	Pocha kata	5 km N from Tangormarir patar regulator , 9.35 ha
5	Shantiar	2.5 km E from Tangormarir patar regulator , 13.36 ha
6	Rolakata	4 km E-N from Tangormarir patar regulator , 9.35 ha
7	Narayanpur	8 km E from Tangormarir patar regulator , 133.60 ha, perennial
8	Astoasi	7 km E-N from Tangormarir patar regulator , 13.36 ha, perennial
9	Jhumkar	6 km E from Tangormarir patar regulator ,12.02 ha
10	Raulia char	Adjacent and E to Tangormarir patar regulator
11	Char Rasulpur	1.5 km E from Tangormarir patar regulator
12	Majher char	3 km E from Tangormarir patar regulator
13	Catlar char	1.5 km E-N from Tangormarir patar regulator
14	Fakirere char	2 km E-N from Tangormarir patar regulator
15	Kathgirir char	2.5 km N from Tangormarir patar regulator
16	Motherganj char	4 km N from Tangormarir patar regulator
17	Barobisha	3 km E-N from Tangormarir patar regulator
18	Khaser char	3.5 kmE-S from Tangormarir patar regulator
19.	Balduba	3 km E-S from Tangormarir patar regulator
20	Porar char	4.5 km E-S from Tangormarir patar regulator
21	Mirgamari char	6 km W from Tangormarir patar regulator

Annex D. Tree Plantation Plan

Citation in the main text (Volume I): **Section 9.4.1.4.**

This plantation raising program provides the following details:

- Species to be used for establishing the plantation.
- Seedlings availability.
- Spacing and planting technique.
- Rotation to be used.
- Cost estimates of establishing tree plantation per unit area.
- Plantation management or maintenance.
- Yield prediction.
- Participant involvement mechanism.

The site at which this plantation will be raised is the country side slope of embankment cum road. The slope is 33%. The aspect will be mostly eastern. This plantation will be something like the "strip plantation" that is raised by the Forest Department. The plantation raising modality should preferably be a "Participatory Approach". The required details in this connection are being described below.

1. Species that may be used for establishing the plantation

It is better to decide about the species through discussions with the participants. But in this sort of discussions technical support will be essential from the authority. In this case, since the land in question is owned by the Bangladesh Water Development Board (BWDB), this agency will require to play the role of "authority". It is generally expected that the local people will prefer to plant 'Eucalyptus' species, since they have a bias towards this species. The local people for various reasons prefer this species over others. In this connection, it has to be borne in mind that the government has an embargo in planting eucalyptus species. BWDB being an autonomous semi government agency, it will be better to avoid planting eucalyptus. The species that are commonly used in case of trip plantations include:

	Local name	Biological name	Some special features in connection with its use in road side or strip plantations
	Akashmoni	*Acacia auricoliformis*	Fast growing medium quality timber but looks like teak.
	Chattian	*Alstonia scholaris*	Fast growing match-wood, nice & strong smelling flowers.
	Kodom	*Anthocephealous kadamba*	Good match wood, fast growing, good looking flowers,
	Hijol	*Barringtonia acutangula*	A fresh water wetland species, branches produce "Khata" for open water fishing.

	Local name	Biological name	Some special features in connection with its use in road side or strip plantations
	Tal	*Borasus flabellifer*	Fibrous rooted slow growing long living plant, can with stand strong wind thrusts, juice and fruits fetches high price.
	Toon	*Cedrela toona*	Good timber, light weight, used in making rickshaw body, boat, etc.
	Chikrassia	*Chickrassia tabularis*	Faster growing, good timber species
	Narikal	*Cocos nucifera*	Fibrous rooted medium growing plant, can withstand strong wind thrusts, fruits green or ripe fetches high price.
	Kala Jam	*Eugenia spp / Syzygium cumini*	Good construction timber, fruits are highly priced.
	Puti jam	*Eugenia spp.*	Good and durable construction wood yielding tree.
	Gamar	*Gmelina arborea*	Wood is "A grade" timber, fast growing, high priced.
	Ghora Neem	*Melia azadericta*	Fast growing but soft, snaps off during strong wind,
	Neem	*Melia indica*	Possess good medicinal values, durable wood, used in musical instrument making (especially *tobla*)
	Khajoor	*Phoenix sylvestris*	Fibrous rooted medium growing plant, can withstand strong wind thrusts, juice used to make “gur” & fetches high price, long living tree.
	Amloki	*Phyllaenthus embellica*	Timber value is poor but it is a medicinal plant, fruits fetches high price, attract birds.
	Koroj	*Pongamia pinnata*	Fast growing, grow in wet areas, seeds yield oil, medium quality wood.
	Payaara	*Psidium guajava*	Timber is not good but the fruits fetches high price.
	Rain tree	*Samanea saman*	Large crown, occupy lots of space, drips are harmful to road pavements.
	Barapatar mehagony	*Swietenia macrophyla*	Slightly faster growing, very often affected by stem borer, produces good timber,
	Chotopatar Mehagony	*Swietenia mehagoni*	Slow growing, affected by stem borer, very good timber species.
	Tetool	*Tamarindus indica*	High caloric wood, heavy, slow growing, high water shed values, and fruits are highly priced.
	Arjun	*Termienalia arjuna*	Medicinal plant, medium quality wood, bark fetches high price, fruits attract deer.
	Hartaki	*Terminalia chebula*	Medicinal plant, medium quality wood, fruits fetches high price & attract deer.

	Local name	Biological name	Some special features in connection with its use in road side or strip plantations
	Harbarooi		Medicinal plant, wood quality poor, fruit fetches high price.

It is better to keep the number of species under a manageable number. The number species to be used should not exceed 10. In view of the above discussions, the following species may be used but this must be shared with the local communities so that they are 'on board' and own the selection of species.

	Local name	Biological name	Remarks
	Akashmoni	*Acacia auricoliformis*	Maximum 20%, to be felled in 8th year
	Barapatar mehagony	*Swietenia macrophyla*	To be felled in 12th year
	Chikrassia	*Chickrassia tabularis*	To be felled in 10th year
	Gamar	*Gmelina arborea*	To be felled in 8th year
	Neem	*Melia indica / Azadirachta indica*	To be felled in 10th year
	Toon	*Cedrela toona*	To be felled in 12th year
	Khajoor	*Phoenix sylvestris*	Never to be felled (may be replaced by another fruit or fresh water wetland species, including *Syzygium cumini, Phyllaenthus embellica,* etc. at the death of the tree*).*
	Narikal	*Cocos nucifera*	
	Tal	*Borasus flabellifer*	
	Hijol	*Barringtonia acutangula*	
	Payaara	*Psidium guajava*	To be planted on the (1+6+2.95=) 9.95 Meter wide strip, between the road and the river, at 4 X 4 Meter spacing.

2. Seedlings availability

Since the planting program will not continue for years, the seedlings may be procured from sources such as Forest Department Nurseries or Private Nurseries. It is expected that the quality of the seedlings from FD nurseries will be better. One will have to decide about the year in which these will be planted on the given site. For better success, at least 3.5 feet tall seedlings in 10" x 6" poly-bags, of about 1.5 years of age, are to be used. Under such situation orders may be placed officially (formally) with the nearby forest nursery at least 3 years ahead of the stipulated planting year, stating the number required species wise, with a tentative date of delivery solicited. The seedlings should never be transported from the nurseries to planting site, using tractor tailor, Niassimon, etc. The best mode of transporting seedlings is either by 'head load' or 'boat'. However the seedlings may be transported by slow moving smooth running pick-ups (to avoid jerks).

3. Spacing and planting technique

After the selection of planting site the following tasks need to be undertaken sequentially:

- The planting site is to be surveyed, maps prepared, plantation journal initiated and history of the planting site is recorded in the plantation journal. The names of the participants are to be recorded in the plantation journal for future reference.
- The planting site has to be cleared of unwanted bushes if any. The small vegetation such as grasses etc. should not be disturbed to avoid soil erosion of the embankment slopes. The bushes while being cleared should not be uprooted rather should be cut at ground level. The site should be cleared and made ready for planting without disturbing the soil and grass like vegetation on the ground.
- Stacking at the desired spacing of 2m x 2m should be done.
- All of these activities should be accomplished before April 1 i.e. before the first monsoon shower (by second week of April).

At every planting point (at the stacking point) pits are to be dug. The size of the pit should be 1ft by 1ft and the depth has to be 1.5 ft. The top half of the soil has to be put on the upper side (uphill) of the pit while the bottom half of the soil be put on one side (say on North) of the pit, but not on the down slope (downhill) side. This pit making work should be completed by the first week of April. *The pits after being dug should be left open for about 15 days.*

Planting activities are to be started after 15 days of pit-making. Compost @ 3 Kg is to be put in each pit. Before planting the seedlings, the top soil from the up-slope side of the pit is to be placed at the bottom and the bottom soil from the side of the pit is be placed on the top, so that the soil get turned over. Compost and all the soil in the pit are to be mixed properly, pulverized, all roots and foreign materials removed, so that 'seedling planting bed' looks nice, clean and ready. One seedling has to be planted in each 'seedling planting bed' so prepared. After 15 days of planting the seedling 70 to 75 grams of NPK (1:2:2) fertilizer should be applied in each pit. The fertilizers once mixed, must be used within 6 hours of mixing. Another dose of urea @ 25 gm per pit is to be applied after 2 months of planting.

Each and every operation must be recorded in the plantation journal, stating the duration of the operation with starting and ending dates, labor used, the then weather conditions, etc. for future use.

A word of caution: While planting the seedlings, the first thing to be identified is the locations of underground drainage pipes and planting of seedlings right on the top of that has to be meticulously avoided.

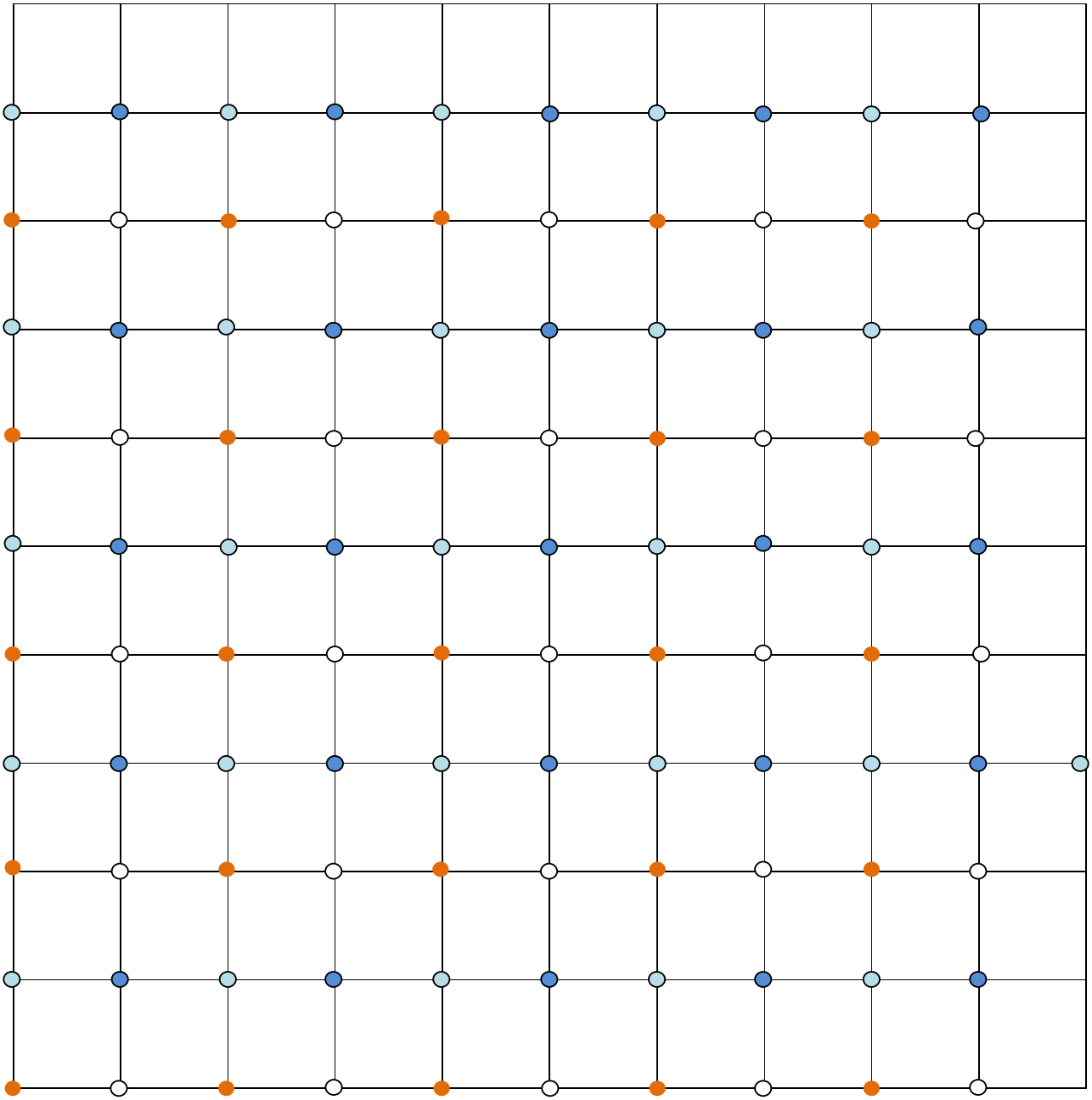
A schematic diagram of planting layout is as under (next page):

- One hectare = 10,000 Sq M Spacing 2 M x 2 M
- 3 Fruit spp. in 4 positions. The sequence will be "Narikal", "Khajoor", "Tal", "Khajoor" "Narikal", "Khajoor", "Tal", "Khajoor" & so on at 4M x 4M = 625 plants per Ha
- 6 Tree spp. = (2500 – 625) = 1875 plants per Hectare
- 1875/3 = 625 plants (of each tree species) to be felled at 8th, 10th and 12th year
- Design for 20M x 20M (= 0.04 ha) area

Legend:

●	Fruit tree ("Narikal", "Khajoor", "Tal", "Khajoor")	4M x 4M = 625 plants per Ha
○	Tree spp to be felled at 8th year	625 tree species such as Akashmoni & Gamar to be felled at 8th year
○	Tree spp to be felled at 10th year	625 tree species such as Chikrassi & Toon to be felled at 10th year
●	Tree spp to be felled at 12th year	625 tree species such as Neem & Mehagony to be felled at 12th year

20M x 20M Plot Showing 2M x 2M Grid



4. Rotation to be used

In case of these plantations, the planting will be initiated with about 10 species. Two of these species (Akashmoni & Gamar) the fastest growing ones will be felled (cut and extracted) in 8th year. Another two species namely Toon & Chikrassia, medium growing species will be felled in 10th year. The other two tree species namely Barapatar mehagony and Neem will be felled in 12th year. The other 3 fruit species (Narikal, Khajoor, Tal and Khajoor, at 4 positions) will continue to grow as long as they live at 4M x 4M spacing and yield fruits and juices for the participants. Thus there will be 4 types of rotations.

- 8 year rotation for tree species, Akashmoni & Gamar.
- 10 year rotation for species, Toon & Chikrassia.
- 12 year rotation for species, Barapatar mehagony and Neem.
- Life-long for fruit species, Narikal, Khajoor, Tal and Khajoor.

After 12 years, these plantations will virtually become orchards.

5. Cost estimates of establishing tree plantation per unit area

The cost of establishing one hectare of plantation including its maintenance to its final stage is calculated here under.

Plantation in one hectare - Planting of 2500 seedlings

	Item of works	Number of Labor required	Cost of Labor per day	Cost of Labor	Material Required& Rate in BDT	Cost of Material
	Cutting of bushes to be done by participants but they will get the wages.	3	450	1350		
	Layout by participants. They will get the wages.	2	450	900	Jute rope, no nylon rope. LS	100
	Inter cropping. Participants to do this on wages.	2	450	900	Arhar seeds 6 Kg @ of Taka 200/Kg	1200
	Procure stacks carry to planting site fix them at 2M x 2M spacing, including fastening of sapling with the stack. Participants to be involved on wages.	3	450	1350	Price of 2750 (10% more to cover wastages) Stack @ of Taka 4/stack & Shootly etc. complete.	11000
	Pit making, keeping the pits open for about 2 weeks. 2500 pits are required per hectare. Each MD will make 75 pits. This has to be done by the participants on wages.	34	450	15300		
	Price of 2875 (15% more to cover wastages) seedlings in 10"x6"				Price of each seedling @ of Taka	34500

	Item of works	Number of Labor required	Cost of Labor per day	Cost of Labor	Material Required& Rate in BDT	Cost of Material
	poly bags, including transportation.				12 each	
	Procure compost or decomposed cow-dung, carry these to planting site. Put back the soil in the pit, apply 3 Kg of compost / decomposed cow dung in each pit, pulverize the soil, mix it with compost / cow dung, remove all debris, root pieces (especially the roots of sun grasses), plant the seedlings by taking off the poly-bags carefully. Participants need to do this but on payment of wages.	20	450	9000	Price of 8250 Kg (10% more to cover wastages) of compost of decomposed cow dung @ Taka 4/Kg.	33000
	Weeding and cleaning immediately after planting. To be done by participants but on wages.	5				
	Application of fertilizers (N:P:K::1:2:2 ; 75 gm/pit) after 15 days of planting. Participants will do this but on payments.	10	450	4500	Price of 207 Kg (2500*0.075*1.1; 10% more to cover wastages) of fertilizer @ of Taka 40/Kg	8280
	Application of nitrogenous fertilizers (Urea 25 gm/pit) after two months of planting to be done by the participants but on wages. Fertilizer required (2500*0.025*1.1 =) 68.75 Kg including 10% wastages.	10	450	4500	Price of 68.75 Kg of fertilizer (Urea) @ Taka 40/Kg.	2750
	First year maintenance, 3-4 weeding and mulching	50	450	22500		
	Second year maintenance, 2-3 weeding, cleaning & vacancy filling. Price of 2500*0.1=250 @ BDT 12 each = 3000	40	450	18000	Price of 250 seedlings @ BDT 12 each	3000
	Third year maintenance, 1 - 2 weeding and pruning of tree spp. Only. The pruned branches will go to the participants	30	450	13500		
	Fourth year maintenance, climber cutting & cleaning.	20	450	9000		
	Fifth year maintenance, pruning of tree spp only not fruit tree. The pruned branches will go to the participants.	10	450	4500		

	Item of works	Number of Labor required	Cost of Labor per day	Cost of Labor	Material Required& Rate in BDT	Cost of Material
	Fixing of a plantation Board (may be RCC board).	2	450	900	LS per hectare	1000
	Miscellaneous					
	TOTAL	241		**106200**		**94830**
	Total cost per hectare including maintenance in BDT					**201030**

The total cost for establishing one hectare of plantation till its final stage is BDT 201,030.00 say 2.02 lakh. At the final stage i.e. after 12 years of raising the plantation it will become an orchard and the participants will keep on getting the benefits continuously.

Cost for raising Hijol and Payaara plantation:

Cost for raising Hijol (*Barringtonia acutangula)* plantation per Km	**20,000 Taka/Km**
Cost for raising Payaara (*Psidium guajava)* plantation per Hectare.	**62,500 Taka/Ha**

6. Plantation management or maintenance. (maintenance costs have been included in the plantation establishment costs)

Ideally the following maintenance program should be followed.

- Intercropping by agricultural crop, especially of leguminous species may be done during first 1 & half year.
- First year: three to four weeding and cleaning with vacancy filling & mulching.
- Second year: two to three weeding and cleaning with vacancy filling.
- Third year: One to two weeding. Pruning (first) lower 1/3rd of the bole of all TREE spp. Fruit species should not be pruned.
- Fourth year: Climber cutting and cleaning, etc.
- Fifth year: Pruning (second) lower 2/3rd of the bole of all TREE spp. Fruit species should not be pruned.

Hijol (B*arringtonia acutangula*) Plantation

Besides the establishment of the above stated plantation on the slope of the embankment, at the toe, along the village side a 2.5 Meter strip of land, that may remain inundated during monsoon, for about 3 to 6 months, shall have to be planted. This strip has to be planted with a fresh water wet land species. Thus a fresh water wet land species, which is likely to be attractive to the participants, has been identified. This could be Hijol

(Barringtonia acutangula) for this given site. One row of Hijol (Barringtonia acutangula) will be planted at a spacing of 4 meter, in this 2.5 meter wide strip. In every km, 250 such species will be planted. The cost of establishing such Hijol plantation will be about Taka 80 per plant. Thus the cost per km for raising Hijol plantation will be about Taka 20,000.00.

Payaara (*Psidium guajava*) Plantation

This Payaara (Psidium guajava) plantation will be established on the 9.95 Meter wide strip between the road and the river. The Payaara (Psidium guajava) plantation will be raised at 4 Meter by 4 Meter spacing. In every hectare 625 seedlings will be planted. The cost per hectare, for raising Payaara will be about Taka 62,500.00.

7. Yield prediction.

This prediction of yields is for a hectare. A total of 2500 seedlings will be planted over an area of one hectare. The following shows the assumptions used and yields predicted.

Yield Predictions

Plantation Types	Assumptions	No of plants survived per Ha	Fuel-wood production in 3rd yr per Ha in Kg	Fuel-wood production in 5th yr per Ha in Kg	Final yield in 8th, 10th & 12th year, in Cu. M. per Ha	Total final yield in Taka at 8th, 10th and 12 year per Ha	Fruit trees. Annual yield in Taka from 7th, 8th and 12th year per Ha.	Remarks
Acacia auricoliformis (Akashmoni) final felling at 8th yr.	Planted **312 seedlings** in one Ha	250	125	250	13.75	110375		
	Survival rate **80%**							
	1st pruning in 3rd year, each plant will yield **0.5 Kg** of fuel-wood. Price of each KG of fuel-wood will be **Taka 1**							
	2nd pruning in 5th year. Each plant will yield **1 Kg** of fuel-wood. Price of each KG of fuel-wood will be **Taka 1**							
	Final felling in 8th year. Each plant will yield **0.055 CuM** of wood. Price of each Cu. M. wood on an average will be about **Taka 8000**							
Gmelina arborea (Gamar) final felling at 8th year.	Planted **313 seedlings** in one Ha	219	109.5	219	10.95	82453.5		
	Survival rate **70%**							
	1st pruning in 3rd year, each plant will yield **0.5 Kg** of fuel-wood. Price of each Kg of fuel-wood will be **Taka 1**							
	2nd pruning in 5th year. Each plant will yield **1 Kg** of fuel-wood. Price of							

Plantation Types	Assumptions	No of plants survived per Ha	Fuel-wood production in 3rd yr per Ha in Kg	Fuel-wood production in 5th yr per Ha in Kg	Final yield in 8th, 10th & 12th year, in Cu. M. per Ha	Total final yield in Taka at 8th, 10th and 12 year per Ha	Fruit trees. Annual yield in Taka from 7th, 8th and 12th year per Ha.	Remarks
	each Kg of fuelwood will be **Taka 1**							
	Final felling in 8th year. Each plant will yield **0.05 CuM** of wood. Price of each Cu. M. of wood will be about **Taka 7500**							
Chickrassia tabularis (Chikrassia) final felling at 10th year	Planted **312 seedlings** in one Ha	218	65.4	152.6	13.08	65618		
	Survival rate **70%**							
	1st pruning in 3rd year, each plant will yield **0.3 Kg** of fuel-wood. Price of each Kg of fuel-wood will be **Taka 1**							
	2nd pruning in 5th year. Each plant will yield **0.7 Kg** of fuel-wood. Price of each KG of fuel-wood will be **Taka 1**							
	Final felling in **10th year**. Each plant will yield **0.06 CuM** of wood. Each Cu. M. of wood will fetch **Taka 5000**.							
Cedrela toona (Toon) final felling at 10th year	Planted **313 seedlings** in one Ha	219	65.7	153.3	13.14	92199		
	Survival rate **70%**							
	1st pruning in 3rd year, each plant will							

Plantation Types	Assumptions	No of plants survived per Ha	Fuel-wood production in 3rd yr per Ha in Kg	Fuel-wood production in 5th yr per Ha in Kg	Final yield in 8th, 10th & 12th year, in Cu. M. per Ha	Total final yield in Taka at 8th, 10th and 12 year per Ha	Fruit trees. Annual yield in Taka from 7th, 8th and 12th year per Ha.	Remarks
	yield **0.3 Kg** of fuel-wood. Price of each Kg of fuel-wood will be **Taka 1**.							
	2nd pruning in 5th year. Each plant will yield **0.7 Kg** of fuel-wood. Price of each Kg of fuel-wood will be **Taka 1**.							
	Final felling in 10th year. Each plant will yield **0.06 CuM** of wood. Price of each Cu. M. of wood will be **Taka 7000**.							
Swietenia macrophyla (Mehagony) final felling at 12th year	Planted **312 seedlings** in one Ha	188	56.4	75.2	13.16	105411.6		
	Survival rate **60%**							
	1st pruning in 3rd year, each plant will yield **0.3 Kg** of fuel-wood. Price of each Kg of fuel-wood will be **Taka 1**.							
	2nd pruning in 5th year. Each plant will yield **0.4 Kg** of fuel-wood. Price of each Kg of fuel-wood will be **Taka 1**.							
	Final felling in 10th year. Each plant will yield **0.07 CuM** of wood. Price of each Cu. M. wood will be **Taka 8000**.							
Melia indica (Neem)	Planted **313 seedlings** in one Ha	188	75.2	94	9.4	65969.2		

Plantation Types	Assumptions	No of plants survived per Ha	Fuel-wood production in 3rd yr per Ha in Kg	Fuel-wood production in 5th yr per Ha in Kg	Final yield in 8th, 10th & 12th year, in Cu. M. per Ha	Total final yield in Taka at 8th, 10th and 12 year per Ha	Fruit trees. Annual yield in Taka from 7th, 8th and 12th year per Ha.	Remarks
final felling at 12th year.								
	Survival rate **60%**							
	1st pruning in 3rd year, each plant will yield **0.4 Kg** of fuel-wood. Price of each Kg of fuel-wood will be **Taka 1**.							
	2nd pruning in 5th year. Each plant will yield **0.5 Kg** of fuel-wood. Price of each Kg of fuel-wood will be **Taka 1**.							
	Final felling in 10th year. Each plant will yield **0.05 CuM** of wood. Price of each Cu. M. will be about **Taka 7000**.							
Phoenix sylvestris (Khajoor) Juice production starts in 7th year	Planted 312 **seedlings** in one Ha	218					741200	From **7th year** annual yield in Taka
	Survival rate **70%**							
	Juice extraction will start from **7th yea**r. Yearly yield **200 Kg per plant**							
	200 Kg of juice will produce **20 Kg of gur**. Excluding gur production costs, each Kg of gur will fetch **Taka 170**.							

Plantation Types	Assumptions	No of plants survived per Ha	Fuel-wood production in 3rd yr per Ha in Kg	Fuel-wood production in 5th yr per Ha in Kg	Final yield in 8th, 10th & 12th year, in Cu. M. per Ha	Total final yield in Taka at 8th, 10th and 12 year per Ha	Fruit trees. Annual yield in Taka from 7th, 8th and 12th year per Ha.	Remarks
Cocos nucifera (Narikal) fruit production starts in 7th year	Planted **157 seedlings** in one Ha	126					252000	From **7th year** annual yield in Taka
	From **7th yr** annually **200 fruits** will be available. Price of each fruit will be about **Taka 10**.							
Borasus flabellifer (Tal) Juice or fruit production starts in 12th year	Planted 156 seedlings in one Ha	109					218000	From 12th year annual yield in Taka
	Survival rate **70%**							
	From **12th yr** annually **100 Kg of juice** will be available, which will produce **10 Kg of gur**. Price of each Kg of gur excluding processing cost will be about **Taka 200**.							
Psidium guajava Payaara Plantation	Planted **625 seedlings per hectare**	438					525,600	From 4**th year** annual yield in Taka per Ha
	Survival rate **70%**							
	From **4th year** each tree will produce about **40 Kg** of fruits which will fetch a price of **Taka 30 per Kg**.							

Plantation Types	Assumptions	No of plants survived per Ha	Fuel-wood production in 3rd yr per Ha in Kg	Fuel-wood production in 5th yr per Ha in Kg	Final yield in 8th, 10th & 12th year, in Cu. M. per Ha	Total final yield in Taka at 8th, 10th and 12 year per Ha	Fruit trees. Annual yield in Taka from 7th, 8th and 12th year per Ha.	Remarks
Barringtonia acutangula Hijol Plantation	Planted **250 seedlings per Km**	175					17500	From 7**th year** annual yield in Taka per Km
	Survival rate **70%**							
	From 7**th year** each tree will produce about 2 Khata, each will fetch a price of **Taka 50**							

Yield Predictions	
Descriptions	**Taka**
Total yield per Ha in Taka from the TREE CROPS during first 12 years	**522,026**
Annual yield/Ha from 7th year in Taka from Khajoor & Narikal	**993,200**
Annual yield/Ha from 12th year in Taka from Tal	**218,000**
Annual yield/Ha from 4th year in Taka from Payaara	**525,600**
Annual yield/Km from 7th year in Taka from Hijol	**17,500**

8. Participant involvement mechanism.

In case of Bangladesh, sustainability of project benefits (outputs), after the completion of the project very often get jeopardized, since none rightly shoulders the responsibility to take care of the plantations established under a project. The plantations, being a biological entity, will need to be taken care of on a routine basis for years after years. It is thus essential to associate some personnel with these plantations, so that they have some sort of ownerships and they take care of these plantations for years to come. Under such situation the best possible methods known till date, is to involve the local people as "participants" under a 'social forestry' context. The involvement of participants directly revolves around the tangible benefits that they can get from these plantations.

The yields from these plantations will be mostly as under.

1. Pruned branches in 3rd and 5th year of raising the plantation from forest tree species such as

- Acacia auricoliformis (Akashmoni)
- Gmelina arborea (Gamar)
- Chickrassia tabularis (Chikrassia)
- Cedrela toona (Toon)
- Swietenia macrophyla (Mahogany)
- Melia indica / Azadirachta indica (Neem)

2. Final yield of wood (timber, poles and some branches) forest tree species such as

- *Acacia* auricoliformis (Akashmoni) (after 8 years of planting)
- *Gmelina arborea* (Gamar) (after 8 years of planting)
- *Chickrassia tabularis* (Chikrassia) (after 10 years of planting)
- *Cedrela toona* (Toon) (after 10 years of planting)
- *Swietenia macrophyla* (Mahogany) (after 12 years of planting)
- *Melia indica / Azadirachta indica* (Neem) (after 12 years of planting)

3. Fruits from *Psidium guajava* (payaara)
4. Khatas from *Barringtonia acutangula* (Hijol)
5. Juices and fruits from:

- Phoenix sylvestris (Khajoor)
- Cocos nucifera (Narikal)
- Borasus flabellifer (Tal)

From 12th year of plantation establishment, these plantations will get transformed to orchards. The juice (from Khajur and Tal) and fruits (from Narikal and Tatool) will be continuously produced.

The participant selection process should be such so that sincere and effective personnel are indentified as "participants". In this connection the following guidelines may be used for the selection of participants.

Participant selection guidelines:

Under the present day context the protection of natural resources, especially tree resources have become a serious problem. Till date the general answer to solve this problem is 'Social Forestry' wherein the participants will be involved and they will actively protect these resources and in lieu of that they will share the benefits under agreements, with the land owning agency (in this case BWDB). These participants or the community will play the conspicuous role in protecting these plantations. The Social Forestry Rules 2010 (given in annexure 01), that the FD is using as such, though not binding for the BWDB to follow, can be of some use under this given context.

The criteria laid in the social forestry rules for selecting participants is to go for the poor and ultra poor people of the society. Because of the prevailing low living standards of the people in general, many of the people are eligible to be participants according to the criteria laid down in the 'Social Forestry Rules 2010'. Though the criteria set in the rules are fine, the interferences by the influential personnel especially by the political people are very heavy and can hardly be mitigated. To avoid any underhand deal and to avoid external pressure, especially from political people, the participants may be selected through an open forum, in presence of the personnel from all concerned. This may be more transparent and acceptable to the members of the public.

The squatters, displaced due to land acquisition, river bank erosion, etc. should be given the priority while selecting participants for this program. Besides these while selecting participants, the people having privately owned lands adjoining the BWDB lands should also be taken into consideration. They have homesteads, agricultural lands, ponds, small wetlands, etc. in their privately owned lands adjoining the BWDB lands. These private land owners are very important towards the sustainability of the plantations that will be established under this given program. In some cases their role may be very vital as well. Under this situation all possible attempts must be lunched to let them be parties for the protection of these plantations. These people in some form or the other should be incorporated as participants' associates, if not as actual participants, in this program and at the same time, necessary safe guard measures need to be incorporated, so that their involvements benefit the plantations established and ensure sustainability.

The following steps may be taken to select participants.

- The participants should be selected at least 6 months ahead of the initiation of the plantation activities.
- The concerned authorized personnel (may be the Executive Engineer) will prepare the work plan by January, for the participatory plantations to be undertaken during the financial year (where the plantation works will start in April next).
- This program of participatory afforestation should be announced among the nearby communities (hats and bazaars) by January.
- An application form has to be developed by the concerned authority, which will be used as the application form by the probable applicants. This form must be available to all concerned, free of costs by January.
- A public announcement has to be made through loud speakers in the local areas, especially in the local markets and *haats*, about the invitation of applications in prescribed format, for probable social forestry participants, elucidating the criteria

and selection process, by January-February. This announcement has to be given by the local authority (may be the Executive Engineer).

- The last date of receiving application may be March 15th.
- On receipt of the applications, the facts and information given in the applications may be verified by the locally, as best as possible, with assistance from the local Union Parishad by last week of March.
- One public meeting may be day long, will be arranged for every Union to finalize the participants for all plantations to be under taken within the jurisdiction of the given Union by the first week of April.
- The date and venue of such public meeting has to be well announced through loud speakers, in the given locality including the local *haats* and *bazars*. All the applicants from the given union will be requested to remain present in this meeting. This has to be done by the concerned local authority (may be the local Executive Engineer).
- The following personnel must be present in the above said public meeting.
    - The local Union Parishad (UP) chairman must be present in the meeting. He will also preside in the meeting.
    - The concerned local BWDB official may be an the Assistant Engineer of BWDB.
    - One BWDB official as representative of the concerned Executive Engineer.
    - Local UP members. (Three to four of them may be selected locally as signatories. While selecting such ward members, preference will be given to those nearby the plantation site).
    - Local elites. (Two of them will be locally nominated to function as signatories).
- The local BWDB official concerned will arrange all of these.
- All of these above mentioned 10 personnel will be the signatories in the final list of participants selected in the meeting.
- The UP chairman and the other 9 signatories may be given a small remuneration from the project funds.
- The final selection will be done in this meeting publicly. The local BWDB official may do the required home works in this connection. The final list of participants selected, plantation wise, has to be endorsed by the above mentioned 9 personnel by putting their signatures.
- The concerned local BWDB official will take the signatures of the participants on the agreement forms (the agreement form that the FD is using at present may be used by making small changes as required) at the closer of the meeting. The UP chairman will be the witness in each of these agreements.
- The final list will be announced in this public meeting. The name and the required details will be sent to the concerned BWDB authority (may be the Executive Engineer) to process the agreements. The agreements must be ready for delivery to the incumbents within 2 weeks from the date of this public meeting.

- A list of the selected participants, plantation wise will be sent to the concerned UNOs and DCs for their information.

This project will have budget allocations to provide remunerations to all the signatories, BWDB staff working on this issue and for the costs for holding meetings etc.

Benefit sharing mechanism

Once the participants are selected and finalized, plantation wise, they will be involved in the plantation establishment activities.

An agreement has got to be signed between the participant group and the BWDB. For every 5 hectare of plantation, a group of 10 participants will be identified. One agreement will be signed between each such group (of 10 participants) and the BWDB.

Benefit sharing arrangement will be as under:

The participant group (of 10) will get receive the following benefits:

- All the produce or yield of intercropped crop.
- The entire yield (branches etc.) from the first and second pruning of the trees.
- At the time of final felling of the trees at 8^{th}, 10^{th} and 12^{th} year of the plantation; 75% of the total yield (or produce). Out of the rest, 20% will go to the BWDB, as their revenue or over head, 5% will go to the management committee.
- 75% of the entire yield (juices & fruits) from the fruit trees as they come under production. Out of the rest, 20% will go to the BWDB, as their revenue or over head, 5% will go to the management committee.

The participants will have the responsibilities to

- Protect the plantations,
- Maintain the plantation,
- All the participants (100 in number for this 50 hectare plantation) will constitute (may be through election, selection or nomination) a 5 member (Chairman 1, General secretary 1, Treasurer 1 and Members 2) Management Committee to oversee, ensure proper management and sustainability of the plantation established. The management committee will run the show by formulating by laws etc. including the management of the fund that will go to them.
- In association with the BWDB the management committee will lunch awareness programs, training programs, AIG programs etc. in future.

Annex E. ToR for Consulting Services for Preparation of Biodiversity Management Plan and Implementation of RBIP Monitoring Program

Citation in main text (Volume I): **Section 9.4.1.4**.

Background

The lower Brahmaputra, named Jamuna in Bangladesh is one of largest rivers in the World. Following its avulsion (change of course) into the present day Jamuna River during the late 17th century, it has been constantly migrating westward and additionally widened by 50% from 8 to 12 km since the 1970s. These morphological changes have led to the loss of about 88,000 ha of floodplain from 1973 to 2014, affecting the ecology and livelihood of the floodplain dwellers by displacing hundreds and thousands of people. In addition to unpredictable riverbank erosion, floods are the other major natural hazard. While typically 20% of the country is flooded during the annual monsoon, severe floods have inundated up to two thirds of the country.

The Government of Bangladesh through Bangladesh Water Development Board (BWDB) is preparing the River Bank Improvement Program (RBIP) to reconstruct the existing degraded embankment and secure it against riverbank erosion along 137 km length from the Teesta River to the Jamuna Bridge. The program will be designed and implemented in three phases. A 50 km long priority reach between Simla and Hasnapara will be protected in Phase 1. Phase 2 covers the remaining 87 km while Phase 3 focuses on and the construction of a highway on the countryside of the new flood embankment. The entire program will be implemented over a period of 10 years.

Objectives

The proposed RBIP program is located in an area of high biological diversity in which many important and endangered aquatic species are present. The Jamuna, its floodplains and stabilized chars are home to a wide variety of terrestrial and aquatic birds and is an important area for migrating birds (winter visitors). The program footprints due to construction of river training works and flood embankments, highway and associated developments are affected to affect the aquatic and floodplain habitat. Historically also the biodiversity of the Jamuna is under threat from natural morphological process and floods. The RBIP program has taken an approach to address the impacts associated with natural processes and also with the project activities by development of sanctuaries for protection of biodiversity. Development of such conservation areas is expected to restore the riverine ecology and biodiversity conservation and create highly needed reproduction, nursing and feeding areas for aquatic biota.

Baseline data has been collected along the right bank of the Jamuna during detailed design stage of Phase 1 of the program. However, a detailed and more comprehensive ecological baseline data needs to be collected along the entire reach of the Jamuna including its floodplains on both sides considering cumulative development in the region.

The other objective of this study is to conduct impact monitoring for fish catches and populations and biodiversity of fish, birds, dolphins, herpeto-fauna, and wetland trees following consistent methodologies so as to enable the project to assess key performance indicators.

Detailed Scope of the Study

Component 1: Baseline Studies

Detailed ecological studies will be carried out, during implementation of Phase 1, both within the Jamuna river boundaries and on the floodplains alongside both river banks to broaden the existing baseline data. The study will cover all aspects of aquatic and terrestrial ecology.

The data to be collected for terrestrial ecosystem are: natural vegetation in the floodplains and chars, riparian vegetation, wetland vegetation, recent trends in natural vegetation and threats, homestead vegetation, Terrestrial fauna; terrestrial wildlife species and their importance and status; identification of important wildlife habitats and their movement/migration pattern (especially for the wildlife that depends on the river for drinking and fishing, e.g. fishing cat); Recent trends (whether increasing or decreasing, key prevailing threats); and biodiversity including terrestrial Species diversity.

The data to be collected aquatic ecosystem are: ecology and plant community; abundance and distribution; growing period; recent trends (whether increasing or decreasing, key prevailing threats); aquatic fauna; aquatic wildlife species and their importance and status; identification of their habitats, breeding and migration patterns; wetland birds and recent trends; impact on aquatic wildlife from the project activity including short and long term impacts (impact from changed landuse, noise, human presence), utilization and recent trends (whether increasing or decreasing, key prevailing threats); and biodiversity (including aquatic Species diversity and recent trends.

Based on enhanced baseline data, the study will review the mitigation measures proposed for identified impacts, and update the mitigation measures and prepare additional management plans.

Component 2: Identification and Development of Conservation Areas

The EIA of Phase 1 has identified six potential sites of fish conservation and two locations of dolphin conservation in the priority area. The proposed study will confirm these locations and identify additional locations of conservation significance (in the river, and or chars/shoals or the floodplains) and prepare detailed conservation plans. These plans will be implemented during Phase 2. The sites will be identified for entire reach of the Jamuna river. The sites are to be identified in consultation with local community and relevant stakeholders. Detailed management plans will be prepared for each of the conservation areas.

The study will also prepare necessary implementation plans, construction drawings, bidding documents if any construction activities are required to implement the conservation plans. The consulting team is also responsible for supervision of the implementation activities and operation and management for conservation areas for first two years. These conservation areas will be handed over to the local community or relevant government departments for future maintenance. The study will also assess the possibility of developing ecotourism to generate revenue for the maintenance of the conservation areas and develop necessary plans to implement these plans.

Component 4: Capacity Building in Biodiversity

The study will prepare and implement capacity building programs for the BWDB implementation staff, construction workers, local community and relevant government

agencies for conservation and promotion of biodiversity in the program area. A capacity building plan will be submitted for approval of BWDB for its approval.

Component 4: Monitoring during construction and post construction

The impact monitoring will be carried out through assessing the impact monitoring of representative intervention and control sites in the working areas of both project phases – with the sites having already been covered by baseline, through to the end of project. Improvement or change of biodiversity due to the project interventions such as revetments, embankment, road construction and others will be ultimately determined comparing the present and past status of biodiversity in the area. The detailed methodology for monitoring program is given in Appendix 1.

Selection of the biodiversity monitoring sites by category and indicator groups to be monitored

Category		Water body Type	Birds	Fish catch	Herpeto-fauna	Vegetation	Dolphins
Location	**Intervention**						
Potential impact area	Main interventions (revetment, embankment, road)	Jamuna River/Chars	Y	Y	Y	Y	Y
		Beel/flood plain	Y	Y	Y	Y	
		Canal/linking river		Y	Y		
	Other interventions (Regulators, culverts, fish passes, markets, ramps, crossings, etc.)	Beel/flood plain	Y	Y	Y	Y	
		Canal/linking river		Y	Y	Y	
		Jamuna river/chars	Y	Y	Y	Y	Y
	Cumulative impact area	Left bank	Y	Y	Y	Y	Y
		Down stream	Y	Y			
		Up stream	Y	Y			
		Country side	Y		Y	Y	
Control area	No project interventions	Beel/flood plain	Y	Y	Y	Y	
		Chars	Y	Y	Y	Y	Y
		Jamuna River	Y	Y	Y		Y

Time frame

The baseline study will be carried out over a period of one after covering all seasons. The development of conservation areas will be carried out in the second year. The monitoring will be carried out during the entire construction period and for two years after the construction period. Detailed terms of reference for the consultant input will be developed by PMU during initial stages of project implementation.

Appendix 1 (of Annex E)

Proposed Methodology for monitoring of Fish catches and diversity

For impact monitoring of RBIP intervention on "Fish Catch and Species Diversity" Catch Assessment Study will be undertaken in the RBIP intervened and controlled water bodies. Baseline data on Catch, fishing effort and species diversity of those water bodies are available. CPUE (Catch per Unit of Effort) of different fishing gears (Fishing Unit), total number of fishing units in operation and the number of species in the catch and their intensity/relative abundance of different species in the catch (to be determined by Shanon Index) will be the measurable indicators of the project interventions on fish catches species diversity.

CPUE:

CPUE is generally defined as quantity of fish caught by a defined fishing unit of a particular type of fishing gear during a defined type period (An hour or a day etc.).

Fishing Unit:

Fishing unit is a fishing enterprise, which coincide with the 'fishing economic unit consisting of the fishing craft (if used), fishing gear and fishers (Bazigos, 1974). The fishing unit/economic units will be also considered under two categories: (i) the usual fishing unit (UFU), composed of the boat, fishing gear and the fishers necessary to carry out the fishing operation; and (ii) a minor fishing unit, composed of fishing gears and fishers (without a fishing boat).

Fisher/fisherman

Anybody operating a gear will be considered as a fisherman and each of the gear will be considered as a single fishing unit.

Catch assessment survey

Catch assessment including gear survey will be performed in each of the intervention and control sites at 10 (ten) days interval on sampling basis by following methods:

- Fishing Effort Survey (FES) and Catch Assessment Survey (CAS) will be conducted on the sampling day for 24 hours from 6 a.m. to 6 a.m. on the next day in two shifts (1) Day shift and (2) night shift. Anybody operating a gear will be considered as a fisherman and each of the gear will be considered as a single fishing unit. Day catch will be monitored and recorded by all time observation, while the night catch will be observed and recorded in the following morning in the fishing ground or landing centre.
- All different types of fishing gear/fishing unit will be studied on sampling basis selected randomly, with fishers interviewed on each sampling day and data on the gear type, its length, width and mesh size, mode of operation, duration of fishing per day will be collected and recorded. Name of fisher. Number of fish and weight (gram) of the catch will be recorded by using a single pan balance.
- On the sampling day all different types (categories) of fishing gears/efforts (fishing unit) in operation on that day in specified area (part or entire water body) will be surveyed/counted and recorded as per Form-1. Then from each category of fishing gear (fishing unit), sample fishing unit selected at random will be studied

for catch and effort data as per Form-2. Number of Katha (Brush shelter) under fishing (if any) and their catch will be recorded separately by species for inclusion in the catch of the water body. If the observed catch is in large quantity, then a sample of the observed catch will be taken randomly and species-wise number and weight of the fishes in the sample will be recorded as per Form-2. Number of sampling fishing unit to be studied will be selected on the following principals:

	Total no. of fishing units of a particular type in operation on sampling day	**No. of fishing units to be studied for each type of gear in operation**
1	1 – 3 nos.	All fishing units in operation
2	4 – 10 nos.	3 fishing units
3	11–30 Nos.	4 -5 fishing units
4	31 and above	10% of the total units with minimum 5 units.

The data will be analyzed statistically by using SPSS method for estimating CPUE, species-wise catch on monthly, quarterly and finally yearly basis. CPUE will be estimated based on the weight of fish caught during a fishing day (Catch per day per fishing unit).

Fish species diversity will be obtained from the species-wise catch data by number and weight.

Form 1

IMPACT MONITORING – CATCH ASSESSMENT (RBIP)

Format for Fishing Effort Survey (Gear Survey)

Biologist : Location:

Date : Upazila:

Site No.: District:

Site :

Habitat: Beel/River/F. Plain/Chars/Other specify

Sl. No.	Gear Type (Name)	Observed Number and Time					Comments
		With Boat (√)	Without Boat (√)	Katha fishing (√)	Fishing period		
					Start time	End time	
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							

Form - 2

CATCH ASSESSMENT FORMAT

Impact Monitoring of RBIP

Fish Catch Assessment Form

Day/Night Catch

Site: ________________________________ Habitat: ☐

Date ☐☐☐☐☐☐ (Code: River-1, Canal-2, Beel-3, Floodplain-4, Char-5)

1. **Information about Gear and Fishermen type**

1.1 Gear: 1.2 No. of Gear: 1.3 Length (m): ☐☐☐☐☐

1.4 Width (m): ☐☐ 1.5 Diameter (m): ☐☐☐☐ 1.6 Mesh size (cm) ☐☐

1.7 Craft/boat: Boat/Donga

1.8 Fishers type: Professional/full time/part-time/subsistence

1.9 No. of person (Fishers): Male _____ Female _____ Total ______

1.10 Name of the Fisher(Head): __________ 1.11 Villages: ____________________

1.12 Total number of this type of gear operated today: ☐

2. **Fishing time**

2.1 Fishing began at: ☐☐☐☐ 2.3 Time spent for present catch ☐☐☐☐

2.2 Time of observation: ☐☐☐☐ 2.4 Observed catch (weight gm) ☐☐☐☐

2.5 Expected to end at: ☐☐☐☐ 2.6 Expected fishing hour: ☐☐☐☐

3. **Species, number and weight (gm) of observed catch:**

(a) Species composition from total observed catch or sample (code): ☐ (code: Total catch=5, sample=6)

(b) Weight of sample of observed catch: ☐☐☐☐

Species (Code)	Number	Weight	Species (Code)	Number	Weight
☐☐☐	☐☐☐	☐☐☐☐☐	☐☐☐	☐☐☐	☐☐☐☐☐
☐☐☐	☐☐☐	☐☐☐☐☐	☐☐☐	☐☐☐	☐☐☐☐☐
☐☐☐	☐☐☐	☐☐☐☐☐	☐☐☐	☐☐☐	☐☐☐☐☐
☐☐☐	☐☐☐	☐☐☐☐☐	☐☐☐	☐☐☐	☐☐☐☐☐
☐☐☐	☐☐☐	☐☐☐☐☐	☐☐☐	☐☐☐	☐☐☐☐☐
☐☐☐	☐☐☐	☐☐☐☐☐	☐☐☐	☐☐☐	☐☐☐☐☐
☐☐☐	☐☐☐	☐☐☐☐☐	☐☐☐	☐☐☐	☐☐☐☐☐
☐☐☐	☐☐☐	☐☐☐☐☐	☐☐☐	☐☐☐	☐☐☐☐☐

4. **Fishing rights (code):** ☐ ☐

Name of Enumerator: _____

Fishing right Code, License-7, Permit-8, Leases-9, Free-10

List of Fishes (Species Code)	
Carp Species	41. Ranga Chanda,
1. Rui	42. Gol Chanda,
2. Catla	43. Lamba Chanda
3. Mrigel	44. Tepa, Potka
4. Kalibaus	45. Pabda,
5. Ghonia	46. Madu pabda,
6. Common carp (Carpio)	47. Kani pabda
7. Mirror Carp	48. Gutum,
Snake Head	49. Gora gutom/Guchi Gutom
8. Soal	50. Naftani
9. Gojar	51. Chela,
10. Taki, Cheng Taki	52. Chep chela,
11. Telo Taki	53. Nerkeli chela
	54. Moa
Live Fish/ Cat fish/Featherback	55. Sar punti(Desi)
12 Koi	56. Tin Choka
13 Sing	57. Rani
14. Magur	58. Tatkini,Bata
15 .Boal	59. Chapila/Mamoli chapila
16. Air	60 Kuchia
17 Baghair	61. Senia (Eusufi)
18. Chital	62. Bacha
19. Foli	63. Hilsa (Jatka)
20. Rita	64 Baspata
	65. Kazuli
Small Fishes	66. Chaka/Gangina
21. Jat punti,	67. Dela

22. Tit punti,	68. Kachki
23. Jhili punti,	69. Shilong
24. Futani Punti	70. Ghaura
25. Khalisa	71. Peali
26. Tengra,	72. Poa
27. Bujuri Tengra	73. Batasi
28. Icha,/Gura Icha/Chingri	74. Tapasi
29. Galda Chingri	75. Chewa
30. Kaikla	76. Anju
31. Guchi Baim	77. Baicha
32. Tara Baim	78. Kanpona
33. Sal Baim	79. Mola
34. Bele,	80. Meni/Bedi/Roina
35. Gugri Bila	
36. Darkina	
37. Khalisa,	
38. Chuna Khalisa,	
39. Lal khalisa	
40. Chanda,	

Methodology for monitoring of Dolphins

The following major activities will be carried out for monitoring of dolphins:

- Survey and monitoring of dolphin population
- This project aims to thorough survey dolphin population at specified transact line along the Jamuna river at regular interval. The preliminary information will come from the baseline monitoring reports and consultation with the experts involved with the baseline study. It will help to design the survey. A three man team will be formed for the survey. A medium to large-sized engine boat will be used for counting of dolphins in the rivers. The survey team will visit dolphin transact line and spotted the dolphin population. Usually three observers used to participate in dolphin count: one stationed on left-side of the boat, one in front and the third one on right side of the boat. Sometimes, four observers participated in the dolphin count. On each side (left or right) of the boat, the observers/counters covered particularly during monsoon, 500 meters open eye. The survey will be conducted in two periods – one in monsoon (August-October) and the other in dry season (January-February) in each year. So, one survey in monsoon (August – October) and two survey in dry seasons (Jan-Feb and Jan-Feb) will be conducted.

- Identification of dolphin hotspots: The survey team will count dolphin population at hotspots area which are already been identified in the baseline study and they will also monitor the population status and threats of their habitat and food and feeding behavior. Furthermore the team will also search the newly dolphin hotspots which are not identified in and around the transact area.
- GIS mapping: All information will be transferred into GIS database and maps produced to make a comparison between the past and present distribution scenario and to evaluate the threats and habitat, movement, nesting sites, etc.,

Methodology for monitoring of Herpetofauna

Herpetofauna include Amphibia (frogs and toads) and Reptilia (turtles and tortoises, lizards, snakes and crocodilians). The RBIP include four major habitat categories :(1) wetlands/water bodies (beels, Rivers and ponds) (2) agricultural lands (iii) settlements/homesteads; and (iv) grass lands and char areas. So, both terrestrial and wetland habitats particularly broadcast aman rice plots (deepwater rice) and grasslands chars within RBIP location will be considered for the survey as specified in the baseline study. Best time for Herpetofauna survey is rainy season. However, for more specific study, the survey team will count species in two season (monsoon and dry).

The broad activities for the herpetological survey are as follows:

- Literature review
- Identifying the transact line or specific site within RBIP project location and traversing for direct sighting of species by the survey team
- Data collection of herpetofauna in two season (monsoon and dry). Survey will done by at early morning and night at selected transects
- Preservation and taking photograph of uncommon herpetofauna for identification
- Discussion with local community people, local snake charmers and other stakeholders for identification of uncommon herpetofauna
- Data analysis and GIS Mapping of the survey area and transact line

Methodology for monitoring of Birds and Water birds

The bird survey will be carried out through field survey by applying different survey methods namely strip transact sampling, point sampling, opportunistic survey, focus group discussion methods in the identified transact line and some other project site where baseline monitoring survey was done; the methods are described in brief:

- **Strip Transect Sampling:** Strip transect sampling (Buckland *et al.* 2001) was found most suitable to estimate the population density. In this method the observer(s) slowly walk on a relatively straight line through the study area and count the objects from both sides. The initial location of the object is always considered, because the object is might move away after watching the observer(s). If any object is sighted beyond the pre-decided observation-range, or if the object is coming from the back (in order to avoid duplication), the observation is not recorded. The survey is conducted in early morning and late afternoons when the

birds are most active. Transects are located in areas which are suitable in terms observation in each study site.

- **Opportunistic survey:** In opportunistic survey, any important or interesting observation/information is recorded at any time while in the field. This method is suitable for recording the occurrences, relative abundance and distribution of different species of birds and other birds.
- **Focus group discussion:** Focus Group Discussion will conducted in monitoring sites for gathering information on bird habitat condition, availability and seasonality of birds, migration of birds, etc.

Major Activities for bird monitoring:

- Preparation of detail work plan and methodologies through consultation with team members and experts and literature review.
- Bird survey in two season (post-monsoon (November) and dry (January)) in the identified transacts line. Two surveys in winter (Jan and Jan) and one survey in post monsoon (Nov) will be carried out.
- Data compilation and threats identification
- Comparison of the data with previous census data and impact the rationality
- Identification of the major hotspots of birds in the project sites

Wetland trees monitoring

Success of wetland tree plantation will be evaluated based survival percentage (i.e., plantation establishment) through sample survey where plantation has been established by the project. The monitoring will be done for two different types of plantations: (1) for the trees planted surrounding the water bodies (Table 1) and (2) for distributed seedlings among the household (Table 2) in the project site. The data will be collected twice a year (one before monsoon and another in dry season).

For evaluating tree plantations surrounding water bodies, initially baseline information of density (number of seedlings planted in a given area), diversity, average height and average collar diameter along the strips (if available) will be collected from the baseline reports and from project personnel. The present density, diversity, height and collar diameter will be collected through sample survey in the project sites by following simple random sampling procedure. The sampling intensity will be 10% (of the area) in the control sites and the intervened sites. For example, for canal plantation, the density will be measured per kilometer (Km) basis and the success and failure will be evaluated on the basis of survival percentage (the Table 1). On top of that, diversity, average height and average collar diameter will be calculated through sample survey.

For evaluating seedling distributed to the households, number of seedlings distributed per household will be collected from project reports and their survival percentage will be evaluated. The growth related data (height and collar dia) will be collected performance will be investigated through sample field survey by following simple random sampling with a sampling intensity of 10%.

Table 1: For monitoring trees and other vegetation surrounding water bodies

Items	Baseline		Impact study		Monitoring Success/Failure
	Control sites	Intervened sites	Control sites	Intervened sites	
Number of seedlings/Km (Density)	baseline report, project personnel	baseline report	Sample survey	Sample survey	Survival percentage 80% and above- successful plantation 60%-less than 80%- Moderate Below 60%- Poor
Diversity	baseline report, project personnel	baseline report	Sample survey	Sample survey	Higher diversity is desired
Average height (m)	baseline report, project personnel	baseline report	Sample survey	Sample survey	Growth performance
Average collar diameter (cm)	baseline report, project personnel	baseline report	Sample survey	Sample survey	Growth performance

Table 2: For monitoring trees distributed to the households

Items	Baseline (if available)	Impact study	Monitoring Success/Failure
Number of seedlings/household	baseline report, project personnel	Sample survey (10% sampling intensity)	Survival percentage 80% and above- successful plantation 60%-less than 80%- Moderate Below 60%- Poor
Average height (m)	baseline report, project personnel	Sample survey	Growth performance
Average collar diameter (cm)	baseline report, project personnel	Sample survey	Growth performance

Methodology for Participatory monitoring

Participatory biodiversity monitoring team will be formed and trained. The major activities to be carried out are as follows.

a. Development of participatory monitoring tools

- The monitoring methods and formats used for the monitoring of fish, birds, herpetofauna, trees and dolphins under this study will be customized for the members of the BMOs (Beel Monitoring Organization) who will undertake biodiversity monitoring of indicator species in future. The formats will be finalized through consultation with BMOs and pilot testing in the area.
- Matrix will be developed for all indicator faunal species showing the basic characteristics of the species in the project sites. The matrix will be used by the participatory monitoring team for identification of the indicator species during biodiversity monitoring survey. A sample of the matrix is shown below.

Name of the Indicator bird species	Food and habitat	Identification Characteristics	Status	Bird's Calling	Census time	Status without this species (red line)	
E-Purple Swamphen S-*Porphyrio porphyrio* L-Kalim/Kayem	-Resident bird of Bangladesh -Largely feed on aquatic vegetation insects,small fishes and larvae -Builds nests inside the reed of elevated land of the haor	Easily identifiable	-Once it was widely found in most of the wetlands of Bangladesh. -Hard to be seen anywhere except in the haor	Can be easily identified by its calling	All around the year	-Decreasing of this species indicates reducing the reeds of the haor -Not only Purple swamphen but also other birds, small mammals, frog, turtle/tortoise and fish will be reduced in numbers as it is suitable for their breeding	Photo

Fish			
Species	Food and habitat	Status without this species (red line)	
E- ***Rohi or Rohu*** **S-Labeo rohita** L-Rou	-Natural breeding center. -Rapidly growing -Survival of this fish is interlinked with the depth of water -Thousands of fishermen sustain their livelihoods by Rohu fishing.	-If this fish decreases in the Tanguar Haor area, Bangladesh's most prosperous breeding centre, the whole biodiversity of this area would be affected. - Living standards of the fishermen will decline - Protein crisis might occur	photo

Code: E- English name; S- Scientific name; L-Local name

For data collection, separate format will be developed for the participatory monitoring team. A sample of participatory biodiversity monitoring format, which are being used in Tanguar Haor, Sunamganj, is given as follows.

Bird's name	Number	Obtained marks
Purple Swamphen	**Census data:**	**Marks:…….**
Marking guidelines:0%=1,1-40%=2,41-60%=3,61-79%=4,80>=5		
Formula of result calculation:7000*100/10,000=70%=if 7,000 birds seen in one census, Marks=3		
Purple Swamphen= If 10,000 individuals are seen=100%= No management is required in case of scored more than 80% (5) marks If scored 4 management is going well If scored 3 management is required If scored 2 management is going down In case of not seen Red Line's causes are clear		

b. Capacity building of biodiversity monitoring team:

The interested members of BMOs having basic education skill will be selected for the biodiversity monitoring team. Several teams (each comprising of three educated local people interested in birds/nature conservation from villages/union) will be formed for the monitoring task. Local school teachers or even the students of schools and colleges could be considered for the team. The teams will be given training with field sessions so that they can collect, analyze/ interpret and present the biodiversity monitoring information.

Annex F. List of Khals and Beels with Recommended Improvements

Citation in main text (Volume I): **Section 9.4.1.6**.

Table 1: List of water bodies and enhancement measures needed to ensure functional connectivity between floodplain and the Jamuna river

	Name of the water body	Co-ordinate		Problem/Connectivity	Present situation of water flow	Mitigation / work needed
		Longitude	Latitude			
1	Bahuli Khal	89.66168	24.47354	Connectivity with Jamuna has been blocked by the BWDB embankment at Diarbari of Khoksha union, Kajipur Sirajganj	It is connected with Jamuna at Nolka	Have to be connected with the nearest canals that opened to the Jamuna river.
2	Bagdumur Khal	89.69330	24.39480	Connectivity with Jamuna has been blocked by the BWDB embankment	Dried up during dry season	Have to be connected with the nearest canals that opened to the Jamuna river.
3	Icamoti river	89.61576	24.48196	It is originated from Jamuna at Sariakandi , Bogra and falls into the Hurasagar at Baghabari, Pabna	Some parts of its dried up during dry season	Fish pass needs at this position
4	Bera daho	89.69330	24.39480	It is blessed with water from Jamuna, Sariakandi, Bogra and connected with Jamuna again at Baghabari, Pabna through Nolka river	Dried up during dry season	Re-excavation needed
5	Laxmi kola daho	89.55251	24.51404	It is blessed with water from Jamuna, Sariakandi, Bogra and connected with Jamuna again at Baghabari, Pabna through Nolka river		Re-excavation needed
6	Boilar beel			It is blessed with water from Jamuna, Sariakandi, Bogra	Rich in fish biodiversity and support livelihood to the surrounding people	Re-excavation needed
7	Fuljhor river	89.53297		It is blessed with water from Jamuna, Sariakandi, Bogra and connected with Jamuna again at Baghabari, Pabna through Nolka river		Re-excavation needed

	Name of the water body	Co-ordinate		Problem/Connectivity	Present situation of water flow	Mitigation / work needed
		Longitude	Latitude			
8	Degree para khal (Icamoti river)	89.67097	24.53584	Connectivity with Jamuna has been blocked by the BWDB embankment at Balighugri of Channgacha, sadar, Sirajganj Water start to flow from Balighugri of Channgacha, sadar, Sirajganj and it meets with Nolka river and finally falls into Jamuna again at Baghabari, Pabna	Dried up during dry season at different places	The proposed Balighugri Fish pass will facilitate water flow throughout the year. Re-excavation needed.
9	Degree para khal (Icamoti river)	89.67140	24.53576	Connectivity with Jamuna has been blocked by the BWDB embankment at Balighugri of Channgacha, sadar, Sirajganj Water start to flow from Balighugri of Channgacha, sadar, Sirajganj and it meets with Nolka river and finally falls into Jamuna again at Baghabari, Pabna	Dried up during dry season at different places	The proposed Balighugri Fish pass will facilitate water flow throughout the year. Re-excavation needed.
10	Degree para khal (Icamoti river)	89.67079	24.53590	Connectivity with Jamuna has been blocked by the BWDB embankment at Balighugri of Channgacha, sadar, Sirajganj Water start to flow from Balighugri of Channgacha, sadar, Sirajganj and it meets with Nolka river and finally falls into Jamuna again at Baghabari, Pabna	Dried up during dry season at different places	The proposed Balighugri Fish pass will facilitate water flow throughout the year. Re-excavation needed.
11	Aminpur beel	89.65938	24.54013	It is blessed with water from Icamoti river		The proposed Balighugri Fish pass will enrich its fish biodiversity and overall agricultural production. Re-excavation needed.
12	Dattabari Daho	89.63949	24.54805	Durind rainy season it gets water		The proposed Balighugri Fish

	Name of the water body	Co-ordinate		Problem/Connectivity	Present situation of water flow	Mitigation / work needed
		Longitude	Latitude			
				from Icamoti river and connected with Baghbati beel		pass will facilitate more water to it. Re-excavation needed.
13	Bahuka khal	89.65561	24.56011	Connectivity with Jamuna has been blocked by the BWDB embankment near Bahuka bazar of Ratankandi, sadar, Sirajganj Water start to flow from Bahuka bazar of Ratankandi , sadar, Sirajganj and it meets with Nolka river and finally falls into Jamuna again at Baghabari, Pabna The khal is divided into two branches in this point ; 1. One branch meet again with the degree para khal (Icamoti river) 2. The second part falls into the Jamuna at Baghabari , Pabna	Dried up during dry season at different places	If the wanted regulator is constructed water flow will be normal, Need to re-excavate.
14	Bahuka khal	89.65595	24.56020	Connectivity with Jamuna has been blocked by the BWDB embankment near Bahuka bazar of Ratankandi, sadar, Sirajganj Water start to flow from Bahuka bazar of Ratankandi , sadar, Sirajganj and it meets with Nolka river and finally falls into Jamuna again at Baghabari, Pabna The khal is divided into two branches in this point ; 1. One branch meet again with the degree para khal (Icamoti river) 2. The second part falls into the Jamuna at Baghabari , Pabna	Dried up during dry season at different places	If proposed regulator is constructed water flow will be normal.
15	Bahuka- Gojaria khal	89.65436	24.56743	Connectivity with Jamuna has been blocked by the BWDB embankment	Dried up during dry season at different places	If they wanted regulator is constructed water flow will be

	Name of the water body	Co-ordinate		Problem/Connectivity	Present situation of water flow	Mitigation / work needed
		Longitude	Latitude			
				near Chowdhury bari, Ratankandi, sadar, Sirajganj		normal Need re-excavation about 1.5 km from Chowdhurybari
16	Gojaria khal (Part of Bahuka khal)	89.64542	24.55981	Connectivity with Jamuna has been blocked by the BWDB embankment near Chowdhury bari, Ratankandi, sadar, Sirajganj	Dried up during dry season at different places	If the wanted regulator is constructed water flow will be normal
17	Soratol Khal	89.63643	24.56538	Connectivity with Jamuna has been blocked by the BWDB embankment at Suvogacha, Ratankandi, sadar, Sirajganj Get water from Banaijan khal and have connection with Icamoti river	Dried up during dry season at different places	The proposed Ratankandi culvert will facilitate water flow to it
18	Khamar gati khal	89.62269	24.55285	It gets water from Bahuka- Gojaria khal and meets with Icamoti river through Brammagacha	Dried up during dry season at different places	If proposed Bahuka regulator is constructed water flow will be normal
19	Bahuka- Gojaria khal	89.62292	24.54940		Water flow and depth quite well in this point	
20	Baghbati beel	89.61644	24.53864	It gets water from Bahuka- Gojaria khal and Icamoti river during rainy season	Perinnial beel	If proposed Bahuka regulator is constructed water flow will be normal
21	Baghbati beel	89.61102	24.53899			Re-excavation needed.
22	Icamoti river	89.60017	24.54520			Re-excavation needed.
23	Icamoti river	89.59996	24.54534			Re-excavation needed.
24	Icamoti river	89.59985	24.54542			Re-excavation needed.
25	Icamoti river	89.59874	24.54614			Re-excavation needed.
26	Icamoti river	89.61088	24.53813			Re-excavation needed.

	Name of the water body	Co-ordinate		Problem/Connectivity	Present situation of water flow	Mitigation / work needed
		Longitude	Latitude			
27	Baghbati beel	89.61063	24.53795			Re-excavation needed.
28	Baghbati beel	89.64029	24.52005			Re-excavation needed.
29	Dublai beel	89.63970	24.51554	It gets water from Icamoti river during rainy season	Rich in fish biodiversity and support livelihood to the surrounding people	Re-excavation needed.
30	Pata beel	89.64901	24.53479	It gets water from Icamoti river during rainy season	Rich in fish biodiversity and support livelihood to the surrounding people	Re-excavation needed.
31	Bandhob beel	89.65004	24.53060			Re-excavation needed.
32	Badaila beel	89.66149	24.50610	No existence	No existence	-
33	Chilgacha bridge	89.64003	24.58013	Get water from Banaijan khal and moves towards Soratol khal		Re-excavation needed.
34	Banaijan khal	89.64654	24.59599	Starting point of Banaijan Khal		Re-excavation needed.
35	Kurala Beel	89.64363	24.59636	No existence; converted into agriculture land		Re-excavation needed.
36	Patagram Khal (Baoikhola khal)	89.64182	24.60700			Re-excavation needed.
37	Dublai beel	89.64348	24.62118	Get water from Banaijan khal	Rich in fish biodiversity and support livelihood to the surrounding people	If proposed Bahuka regulator is constructed water flow will be normal
38	Hunahanthor beel	89.64160	24.60024	Get water from Banaijan khal		If proposed Bahuka regulator is constructed water flow will be normal
39	Paikertali Daho	89.64005	24.66932	Connectivity with Jamuna has been blocked by the BWDB embankment		Re-excavation needed.
40	Halot khal	89.63930	24.66793	Connectivity with Jamuna has been blocked by the BWDB embankment , connected with Banaijan khal		Re-excavation needed.

	Name of the water body	Co-ordinate		Problem/Connectivity	Present situation of water flow	Mitigation / work needed
		Longitude	Latitude			
41	Halot khal	89.63876	24.66695			Re-excavation needed.
42	Halot khal	89.63840	24.66523			Re-excavation needed.
43	Halot khal	89.63799	24.66519			Re-excavation needed.
44	Halot khal	89.63773	24.66519			Re-excavation needed.
45	Kunkunia Daho	89.63309	24.66938	Closed water body		Re-excavation needed.
46	Kunkunia Daho	89.63256	24.66942	Closed water body		Re-excavation needed.
47	Kunkunia Daho	89.63266	24.67018	Closed water body		Re-excavation needed.
48	Kunkunia Daho	89.63325	24.67039	Closed water body		Re-excavation needed.
49	Kunkunia Daho	89.63406	24.67013	Closed water body		Re-excavation needed.
50	Kunkunia Daho	89.63538	24.66955	Closed water body		Re-excavation needed.
51	Chalita Danga Daho	89.60832	24.66266	Closed water body		Re-excavation needed.
52	Paroli beel	89.60061	24.66002			Re-excavation needed.
53	Paroli beel	89.60047	24.66017			Re-excavation needed.
54	Paroli beel	89.60023	24.66034			Re-excavation needed.
55	Paroli beel	89.59675	24.65963			Re-excavation needed.
56	Paroli beel	89.59365	24.65883			Re-excavation needed.
57	Sonamukhi river	89.56406	24.65128			Re-excavation needed.
58	Paikpara kola	89.55166	24.66154	Connect with Icamoti river during rainy season		Re-excavation needed.
59	Chokibari khal	89.55060	24.65016			Re-excavation needed.
60	Chokibari khal	89.55059	24.64899			Re-excavation needed.
61	Chokibari khal	89.55098	24.64590			Re-excavation needed.
62	Sonamukhi river (Icamoti river)	89.55133	24.64374			Re-excavation needed.
63	Sholli beel	89.54406	24.64648	No connection with Jamuna and Icamoti River		Re-excavation needed.

	Name of the water body	Co-ordinate		Problem/Connectivity	Present situation of water flow	Mitigation / work needed
		Longitude	Latitude			
64	Icamoti river	89.55570	24.63639			Re-excavation needed.
65	Icamoti river	89.55935	24.62645			Re-excavation needed.
66	Chatla beel	89.56878	24.60757	Connected with Icamoti		Re-excavation needed.
67	Sonaidanga beel	89.58535	24.59346	Connected with Icamoti		Re-excavation needed.
68	Icamoti river	89.58594	24.60362			Re-excavation needed.
69	Icamoti river	89.59377	24.61765			Re-excavation needed.
70	Kachihara khal	89.59588	24.62603	Get water from Kachihara beel and fall into Icamoti during rainy season water	Dried up during dry season at different places	Re-excavation needed.
71	Kachihara khal	89.59881	24.62541			Re-excavation needed.
72	Kachihara khal	89.59941	24.62706			Re-excavation needed.
73	Kachihara khal	89.60216	24.62624			Re-excavation needed.
74	Aziz morar Daho	89.61810	24.62626	Connected with Dublai beel		Re-excavation needed.
75	Gandhail Daho	89.63000	24.60845			Re-excavation needed.
76	Gandhail Daho	89.63804	24.60125			Re-excavation needed.
77	Khokshabari daho	89.68393	24.47791			Re-excavation needed.
78	Khalifa potti Daho	89.68366	24.48085			Re-excavation needed.
79	Khalifa potti Daho	89.68349	24.48325			Re-excavation needed.
80	Khalifa potti Daho	89.67703	24.49436			Re-excavation needed.
81	Icamoti river	89.59623	24.54525			Re-excavation needed.
82	Koiccha beel	89.58709	24.54177	Once connected with Icamoti river		Re-excavation needed.
83	Kali bari beel	89.57187	24.53009	Connected with Brammagacha river		Re-excavation needed.
84	Chandpur daho	89.56605	24.52730	Connected with Jugi Daho		Re-excavation needed.
85	Jugi daho	89.55717	24.52691	Connected with Laxikhola Daho and Fuljhor river		Re-excavation needed.
86	Jugi daho	89.55634	24.52602			Re-excavation needed.
87	Laxmikhola Daho	89.55362	24.51917	Connected with B6 and B 7		Re-excavation needed.

	Name of the water body	Co-ordinate		Problem/Connectivity	Present situation of water flow	Mitigation / work needed
		Longitude	Latitude			
88	Taltola Khal	89.54434	24.52985	Connected with Nolka river		Re-excavation needed.
89	Bailar daho	89.55395	24.54366	Connected with Nolka river through Jugidaho		Re-excavation needed.
90	Sholir daho	89.56019	24.54623	Get water from Kutubpur, Sariakandi, Bogra		Re-excavation needed.
91	Mahishgari beel	89.56265	24.54375	Connected with Jamuna river		Re-excavation needed.
92	HurJapanna beel	500 m south from 902		get water from Jamuna and moves towards Nolka	500 m south from 902	Re-excavation needed.
93	Muchi daho	89.56610	24.56032	Connect with Sadir daho and Boga daho		Re-excavation needed.
94	Gobindapur danga	89.56467	24.56400	Closed		Re-excavation needed.
95	Sadir daho	89.55871	24.57404	Connected with Fuljhor river	all type of fishes are found here	Re-excavation needed.
96	Barobari dado	89.55066	24.59087	Connected with Sadir daho		Re-excavation needed.
97	Maizlani daho	89.54302	24.59458	Connected with Fuljhor river and Icamoti river		Re-excavation needed.
98	Satdaho beel	89.55683	24.60296	Connected with gopal nagor daho		Re-excavation needed.
99	Satdaho beel	89.55952	24.60139			Re-excavation needed.
100	Satdaho beel	89.56291	24.60199			Re-excavation needed.
101	Satdaho beel	89.56405	24.60365			Re-excavation needed.
102	Dakhir beel	89.56720	24.60855			Re-excavation needed.
103	Rudrabaria daho	89.52444	24.59469	Closed		Re-excavation needed.
104	Tangrakhali daho	89.50934	24.59763	Connected with Rudrabaria daho		Re-excavation needed.
105	Rudrabaria-Pirahati pond	89.52641	24.59951	Closed		Re-excavation needed.

	Name of the water body	Co-ordinate		Problem/Connectivity	Present situation of water flow	Mitigation / work needed
		Longitude	Latitude			
106	Baliadanga beel	89.52418	24.60518	Closed; once connected with Bau and Bangali river		Re-excavation needed.
107	Shitola beel	89.52383	24.61960	Connected with Vasha beel		Re-excavation needed.
108	Chandiar dara	89.52825	24.63966			Re-excavation needed.
109	Icamoti river	89.54726	24.68830			Re-excavation needed.
110	Icamoti river	89.55146	24.69253			Re-excavation needed.
111	Icamoti river	89.55509	24.69335			Re-excavation needed.
112	Borobila khal	89.58667	24.71617	Get water from Chitulia beel and then moves towards Manos and then fall into Bangali		Re-excavation needed.
113	Borobila khal	89.58919	24.72106			Re-excavation needed.
114	Manos river	89.57593	24.73605			Re-excavation needed.
115	Manos river	89.57550	24.73730			Re-excavation needed.
116	Choto Chikashi	89.57541	24.73853	Connected with Manos river		Re-excavation needed.
117	Chikashi khal	89.56906	24.73718	Connected with Jamuna river and Sonaimukhi khal		Re-excavation needed.
118	Sultanata pond	89.56254	24.73898	Closed; man made		Re-excavation needed.
119	Chikashi beel	89.56375	24.74285	Connected with Jamuna river		Re-excavation needed.
120	Chunipara khal	89.60487	24.74225	Connectivity with Jamuna has been blocked by the BWDB embankment , connected with Manos during rainy season		Re-excavation needed.
121		89.60570	24.75468			Re-excavation needed.

	Name of the water body	Co-ordinate		Problem/Connectivity	Present situation of water flow	Mitigation / work needed
		Longitude	Latitude			
122		89.60569	24.75825			Re-excavation needed.
123	Andhara beel	89.59713	24.76279	Get water from Jamuna river throughBari khal and meet with Bangali river after passing the Dander beel		Re-excavation needed.
124	Danger beel	89.59276	24.76321	Connected with Bangali	Pen culture	Re-excavation needed.
125		89.58337	24.78865		Pen culture	Re-excavation needed.
126	Burir beel	89.56433	24.79057	Connected with Bangali on 2 km south		Re-excavation needed.
127	Valukatola Mochra	89.55876	24.77841			Re-excavation needed.
128	Bilai chati beel	89.56951	24.75076	Connected with Jamuna		Re-excavation needed.
129	Harani beel	89.56729	24.75152	Connected with Jamuna		Re-excavation needed.
130	Bognali beel	89.56975	24.76222	Connected with Jamuna		Re-excavation needed.
131	Fish sanctuary on bangali river	89.53374	24.80312			Re-excavation needed.
132	Nayan beel	89.52835	24.76171	Get water when Bangali overflows		Re-excavation needed.
133	Ghoramara beel	89.52333	24.74808	Get water when Bangali overflows		Re-excavation needed.
134	Nander para khal	89.51768	24.75037			Re-excavation needed.
135	Nander para kola	89.51315	24.75345	Connected with Nander para beel		Re-excavation needed.
136	Uttar Kanto nagar beel	89.51281	24.74619	Connected with Nander para khal		Re-excavation needed.
137	Bangali branch	89.49290	24.75480			Re-excavation needed.
138	Bangali river	89.48886	24.75877			Re-excavation needed.

	Name of the water body	Co-ordinate		Problem/Connectivity	Present situation of water flow	Mitigation / work needed
		Longitude	Latitude			
	branch					
139		89.48516	24.76425			Re-excavation needed.
140	Chokivati Daho	89.47973	24.78126	Get water from Bangali river		Re-excavation needed.
141	Kharo khal	89.47749	24.77528	Get water from Jamuna river		Re-excavation needed.
142	Chander beel	89.45283	24.79038	Get water from kharo khal		Re-excavation needed.
143	Karotoya river	89.40497	24.74013			Re-excavation needed.
144	Bagomara beel	89.42257	24.73449	Get water from takur beel		Re-excavation needed.
145	Durga danga beel	89.42328	24.73920	Rain water	Fish culture is practised	Re-excavation needed.
146	Sonaidanga beel	89.43215	24.74156	Get water from Bangali river through Kashpata khal	Community based fisheries management	Re-excavation needed.
147	Satbeela	89.43452	24.74504	Get water from Bangali river through Kashpata khal	Fish culture is practised	Re-excavation needed.
148	Beel pui	89.43835	24.74597	Get water from Bangali river through Kashpata khal and Satbeela		Re-excavation needed.
149	Kachugari beel	89.44924	24.74556	Get water from Bangali river through Cholmari khal		Re-excavation needed.
150	Kashpathar khal	89.45717	24.75674			Re-excavation needed.
151	Kashpathar beel	89.45085	24.75305	Get water from Bangali river through Kashpata khal and Karotoya river via Madla canal		Re-excavation needed.
152	Bagtumari beel	89.44770	24.75289			Re-excavation needed.
153	Vhabra beel	89.44488	24.75544	Get water from Bangali river through Kashpata khal		Re-excavation needed.
154	Karotoya river	89.44739	24.62760			Re-excavation needed.

	Name of the water body	Co-ordinate		Problem/Connectivity	Present situation of water flow	Mitigation / work needed
		Longitude	Latitude			
155	Bangali	89.47812	24.61754			Re-excavation needed.
156	Bangali	89.46523	24.62604			Re-excavation needed.
157	Karotoya river meets with Bangali	89.47432	24.63037			Re-excavation needed.
158	Paddy field	89.46753	24.60966			Re-excavation needed.
159	Satra beel	89.46122	24.61151	Closed	Pen culture is practised	Re-excavation needed.
160	Sujabaz Daho	89.39687	24.80644	Connected with karotoya		Re-excavation needed.
161	Karotoya river	89.40605	24.80666			Re-excavation needed.
162	Dighar beel	89.44632	24.81971	Connected with Bangali		Re-excavation needed.
163	Pirir daho	89.45170	24.81626	Connected with Bangali		Re-excavation needed.
164	Dharma gacha Daho	89.45706	24.81232	Closed		Re-excavation needed.
165	Sonakanidoya daho	89.46321	24.81052	Get water from Branch of Bangali river/ Mohisaban khal		Re-excavation needed.
166	Branch of Bangali	89.46529	24.79370			Re-excavation needed.
167	Karotoya river	89.38919	24.82735			Re-excavation needed.
168	Angari beel	89.40704	24.84187	Get water from Karotoya		Re-excavation needed.
169	Karotoya	89.41679	24.84209			Re-excavation needed.
170	Karotoya	89.42217	24.84446			Re-excavation needed.
171	Karotoya	89.42276	24.84586			Re-excavation needed.
172	Dholir beel			Get water from Karotoya		Re-excavation needed.

	Name of the water body	Co-ordinate		Problem/Connectivity	Present situation of water flow	Mitigation / work needed
		Longitude	Latitude			
173	Dhondhonia beel	89.41430	24.86742	Get water from Karotoya and Bangali		Re-excavation needed.
174	Dhondhonia beel	89.41386	24.86840			Re-excavation needed.
175	Nolar beel	89.41061	24.86907	Get water from Karotoya		Re-excavation needed.
176	Kusar beel	89.42342	24.87745	Get water from Karotoya and Bangali via Dhondhonia beel		Re-excavation needed.
177	Upar danga beel	89.42840	24.86907	Get water from Karotoya and Bangali via Dhondhonia beel and Kusar beel		Re-excavation needed.
178	Nurail beel	89.39532	24.91359	Get water from Karotoya and Bangali		Re-excavation needed.
179	Nurail beel	89.39527	24.91603			Re-excavation needed.
180	Nurail beel	89.39503	24.91614			Re-excavation needed.
181	Marajan khal	89.41873	24.90452			Re-excavation needed.
182	Singar beel	89.42564	24.90241	Get water from Bangali River		Re-excavation needed.
183	Do beel	89.42564	24.90241	Get water from Bangali River	Merged with Singar beel	Re-excavation needed.
184	Hapania -Shaghat beel	89.44408	24.90150	Get water from Singer		Re-excavation needed.
185	Naruamala khal	89.45493	24.90198			Re-excavation needed.
186	Icamoti river	89.46289	24.90291			Re-excavation needed.
188	Gorar beel	0.5 km east-north from 1006				Re-excavation needed.
189	Nizkakza beel	89.48751	24.93151	Get water from Bangali River		Re-excavation needed.
191	Suk daho khal	89.51324	24.94915			Re-excavation needed.
192	Boira khal	89.53643	24.96608			Re-excavation needed.

	Name of the water body	Co-ordinate		Problem/Connectivity	Present situation of water flow	Mitigation / work needed
		Longitude	Latitude			
193	Suk daho beel	0.5 km north from 1010		Get water from Bangali River		Re-excavation needed.
194	Mahicharan beel	89.46846	24.91093			Re-excavation needed.
195	Branch of Icamoti	89.48320	24.87175			Re-excavation needed.
196	Branch of Icamoti	89.49667	24.86076			Re-excavation needed.
197	Branch of Icamoti	89.50040	24.85955			Re-excavation needed.
198	Branch of Icamoti	89.50349	24.85308			Re-excavation needed.
199	Branch of Icamoti	89.50686	24.85143			Re-excavation needed.
200	Bejora beel	89.39543	24.81822			Re-excavation needed.
201	Khaura jan beel	89.45013	24.79272			Re-excavation needed.
202	Khaura jan beel	89.45725	24.78784			Re-excavation needed.
203	Machbari beel	89.46482	24.78668			Re-excavation needed.
204	Sonaikhali khal	89.49549	24.77695	Meet with Bangali at 1.5 km south-west		Re-excavation needed.
205	Bangali	89.49316	24.75472			Re-excavation needed.
206	Nimgachi beel	89.50155	24.75198			Re-excavation needed.
207	Nimgachi khal	89.51022	24.75119	Meet with Bangali at 0.25 km north-west		Re-excavation needed.
208	Nander para khal	89.51787	24.75032			Re-excavation needed.
209	Chara gari Matchra	89.53926	24.77685			Re-excavation needed.
210	khal	89.55307	24.79847			Re-excavation needed.

	Name of the water body	Co-ordinate		Problem/Connectivity	Present situation of water flow	Mitigation / work needed
		Longitude	Latitude			
211	Kutubpur khal	89.58432	24.80751			Re-excavation needed.
212	Kutubpur khal	89.58185	24.80804			Re-excavation needed.
213	Branch of Bangali	89.56434	24.80184			Re-excavation needed.
214	Bangali river	89.56655	24.80478			Re-excavation needed.
215	Bangali and kutubpur meet point	89.56491	24.80923			Re-excavation needed.
216	Kazla beel	2 km north- east from 1042				Re-excavation needed.
217	Meet point of Kazla and kutubpur khal	89.56628	24.80983			Re-excavation needed.
218	Kholsha bari beel	89.57743	24.80746	Connected with Kutubpur khal during rainy season		Re-excavation needed.
219	Meet point of Manos river and kutubpur khal	89.58508	24.80691			Re-excavation needed.
220	Kutubpur - Manos beel	89.58766	24.81208	Merged with Manos river		Re-excavation needed.
221	Kutubpur - Manos beel	89.58769	24.81228	Merged with Manos river		Re-excavation needed.
222	Branch of Belai river	89.57469	24.86299			Re-excavation needed.
223	Bangali river	89.57147	24.86721			Re-excavation needed.
224	Molar beel	89.57145	24.87070	Closed		Re-excavation needed.
225	Deuli beel	89.57267	24.91768			Re-excavation needed.

	Name of the water body	Co-ordinate		Problem/Connectivity	Present situation of water flow	Mitigation / work needed
		Longitude	Latitude			
226	Vagir beel	89.55803	24.92871	Get water from Bangali and again meet with Bangali via Deuli beel and Taijur para khal		Re-excavation needed.
227	Taijur para khal	89.56252	24.92269			Re-excavation needed.
228	Taijur para khal	89.56242	24.91901			Re-excavation needed.
229	Meet point of Bangali and Taijur para khal	89.56255	24.91980			Re-excavation needed.
230	Bangali river	89.56763	24.89481			Re-excavation needed.
231	Manos river	89.58050	24.80426			Re-excavation needed.

Timing of fish migration:

15 March - Broodstock (berried fish) starts migration towards upstream

15 April to 30 May - Most of the matured broods complete either partial or full breeding i.e. eggs/spawn, so need connectivity with the adjacent floodplains to facilitate drifting downstream migration.

01 to 30 July - Most of the fingerlings enter into the floodplains. After that, only lately recruited spawn/eggs drifted down to the floodplain.

15 September to 30 October - Adults and young fishes migrate to the main river channel.

Criteria for fish migration:

A very little information on the swimming and migration pattern of the fish and shrimp species is available around. Considering all the limitation a detail study has carried out on the species life cycle and habitat, their migration pattern, responses to the water velocity, spawning season, seasonal occurrence and abundance, tidal condition, water depth, hydrological parameters, etc by IUCN in 2005 (Chowdhury, M.S.M., 2005).

Fish migration is most commonly brought about by a behavioral response to currents. However, the nature of this response can change during the life cycle of the species. The most fundamental change is between active upstream migration, usually undertaken by adults moving to their spawning grounds, and the passive or combined active/passive downstream migrations of juveniles. River discharge provides the essential directional cues to physiologically prepared fishes to move upstream, whilst also offering increased resistance to progress. Some fish tend to follow their migratory pathways against the resistance of the current in one of two ways. Pelagic and some near bottom dwelling species move near the surface of the water, Illumination and not the time of day is the principal criterion for movement, hence the fullness of the moon is important in determining the timing of migrations. Species which rely upon mainly tactile orientation, for many of the catfishes, move against the current close to the bottom or near the banks at night. The moon or other sources of light can inhibit migratory movement of these species.

The early floods are not only important for transporting carp hatchlings, but they also carry a large number of other species. The development and drift of other species, such as *Chanda spp.,* and *Glossogobius spp.* and species of prawn correspond to later peaks in river discharge in August and September. Early water flow in March-April from the upper regime also influences the downstream migration of the prawn brood.

Fish normally migrate at an intermediate cruising speed and only rarely at maximum speed. If water velocity in the main river channel exceeds their swimming ability, the fish will move closer to the bank where velocities are generally slower. The presence of turbulence or whirlpools tends to disorientate the fish. The swimming speeds of bottom fish tend to be rather lower than those of pelagic species, of the order of 0.5-1.0 times the body length sec^{-1} compared to 3-4 times the body length sec^{-1} for pelagic species. Nevertheless, the rate of progress upstream is often similar, since the bottom fish are moving in slower currents.

Water velocity is the main initial stimulus to upstream migration, and there are two indices which define the ability of the current to stimulate movement and the ability of the fish to respond. These are ***Threshold water Velocity (V_{thr}) the minimum water***

velocity which lead to an orientation reaction against the current (value remain between 1-30cm sec^{-1}) *and* ***Critical Velocity (V_{cr}) at which minimum water velocity fish begin to be carried away by the water flow.*** The V_{thr} and V_{cr} vary with size of fish and also according to the species or category of fish. Typically, bottom dwellers have critical velocities 2-3 times lower than those for species living in mid or upper level of the water column. For these species there is a tendency for threshold velocities to be high and critical velocities to be low. The reverse is true for pelagic species.

Fish are also generally attracted to faster currents: attracting velocities are frequently 0.6-0.8 m sec^{-1} of the V_{cr}. For a wide selection it could be 0.7-0.9 m sec^{-1} (Malevanchik and Nikonorov, 1984)i.e. 1.0 meter/sec. But maximum water velocity need to the orientation of the fish movement is generally remains within 0.3 meter sec^{-1} (approximately). *Critical velocity (V_{cr}) of current should be in between 0.6-0.8 meter sec^{-1} (approximately).* Minimum water depth will be required 0.8-1.0 meter in both side of the structure. Head difference should be maintained as 1-1.2 meter.

One final factor which is known to affect the performance and response of migratory fishes to water velocity is temperature. Maximum swimming speed affects both by temperature and length of the fish. The higher the temperature and length of the fish species the higher of current velocity and faster the swimming speed of the fish. **The hydrostatic pressure caused by head difference across water control structures may sometimes be sufficient to kill hatchlings and berried fish female.**

Effectivity of the fish migration through fish pass:

Effectivity of the fish pass structure depends on the timing for hatchlings migration and fish mortality rate. The figures given in the following table showed effectivity (%) of the proposed fish passes at different invert level (LWL of the Jamuna river at Jamuna Bridge):

Period	L.W.L of Jamuna at EGB Year (2000-09) (mPWD)	Flood Plain Level (mPWD)	Proposed Invert level (mPWD)	Depth of Canal from Flood Plain (m)	Percentage of Effectivity	Age of fish
Col 1	Col 2	Col 3	Col 4 (Col 2-1.0 to 1.2 m)	Col 5 (Col 3-Col 4)	Col 6	Col 7
01 Apr	5.90	11.00	4.90	6.10	0%	-
15 Apr	6.60	11.00	5.60	5.40	100%	Eggs/spawn
01 May	7.50	11.00	6.50	4.50	90%	Eggs/spawn
15 May	7.80	11.00	6.80	4.20	75%	Eggs/spawn
01 Jun	8.40	11.00	7.40	3.60	50%	Eggs/spawn
15 Jun	8.85	11.00	7.85	3.15	25%	Eggs/spawn
30 Jun	9.40	11.00	8.40	2.60	10%	Eggs/spawn
15 Sep	10.40	11.00	9.40	1.60	100%	Young/Adult
30 Sep	10.60	11.00	9.60	1.40	100%	Young/Adult
15 Oct	9.50	11.00	8.50	2.50	90%	Young/Adult

* Minimum water depth required in canal/khal 1-1.2 m with velocity <1m/sec.

Annex G. Emission Factors

Citation in main text (Volume I): **Section 9.4.3.2**.

Equipment to be used during construction and their emission factors

Equipment	Emission Factors (lb/hr)							
	ROG	CO	NO_X	SO_X	PM	CO_2	CH_4	N_2O
Concrete Mixer								
Concrete Static Mixer 0.25 M3	0.0075	0.0386	0.0475	0.0001	0.0023	6.3	0.0007	0.0003048
Concrete Vibrator	0.0075	0.0386	0.0475	0.0001	0.0023	6	0.0007	0.0003048
Concrete Batching Plant (Computerized)								
Batch/Mix RCC Plant 500 m3/hr	0.1525	0.5829	0.9172	0.0010	0.0851	83.1	0.0138	0.0061903
Asphalt Plant								
Capacity 20 Ton	0.1927	0.5215	0.4545	0.0006	0.0462	44.0	0.0174	0.0078241
Bull-Dozer								
Komatsu D-85	0.2545	0.7124	2.1985	0.0021	0.0942	183	0.0230	0.0103347
Bull-Dozer 90 HP	0.2209	0.8528	1.6304	0.0015	0.0945	129	0.0199	0.0089691
Bull-Dozer 120 HP	0.2209	0.8528	1.6304	0.0015	0.0945	129.5	0.0199	0.0089691
Bull-Dozer 200 HP	0.2545	0.7124	2.1985	0.0021	0.0942	183	0.0230	0.0103347
Front End Loader								
Front End Loader 1.5 M3	0.1045	0.4187	0.6404	0.0007	0.0576	58.9	0.0094	0.0042419
Front End Loader 2.5 M3	0.1312	0.6288	1.0135	0.0012	0.0583	106	0.0118	0.0053287
Front End Loader 3.00 M3	0.1330	0.3838	1.3129	0.0017	0.0462	149	0.0120	0.0054
Grader								
Road Roller								
Tandem Roller (10 Ton to 12 Ton)	0.0392	0.3801	0.2647	0.0007	0.0137	59.0	0.0035	0.0015925
Tandem Vibratory Roller 1.5 Ton	0.0392	0.3801	0.2647	0.0007	0.0137	59.0	0.0035	0.0015925
Dumpers/Trucks								
Truck Mercedes 10W (500 ft^3 (14.16 M^3) Capacity)	0.1533	0.7593	1.1072	0.0014	0.0666	125	0.0138	0.0062243
Dumper 10 Ton Capacity	0.1533	0.7593	1.1072	0.0014	0.0666	125	0.0138	0.0062243
Excavator (Chain Excavator)								
Hitachi 220	0.1183	0.5220	0.7300	0.0009	0.0657	73.6	0.0107	0.0048023
Hitachi 200	0.1183	0.5220	0.7300	0.0009	0.0657	73.6	0.0107	0.0048023
Power Generators								
150 KVA	0.0157	0.0698	0.1063	0.0002	0.0061	10.2	0.0014	0.0006363
250 KVA	0.0276	0.0951	0.1632	0.0002	0.0096	17.6	0.0025	0.0011217
Diesel Delivery Truck								
Diesel Delivery Truck with 100 mm (4 “) diameter Pump, 6000 Liters	0.034	0.3304	0.0336	0.0004	0.0036	44.094	0.0032	0.002
Diesel Delivery Truck with 100 mm (4") Diameter Pump, 10,000 Liters (Capacity)	0.034	0.3304	0.0336	0.0004	0.0036	44.094	0.0032	0.002
Bitumen Distributor Truck								
Capacity 2000 Ton	0.034	0.3304	0.0336	0.0004	0.0036	44.094	0.0032	0.002
Dewatering Pump								
Dewatering Pump with Delivery Pipe 4" Ø (Diesel)	0.0386	0.1051	0.1803	0.0002	0.0117	19.5	0.0035	0.0015671

Equipment	Emission Factors (lb/hr)							
	ROG	CO	NO_X	SO_X	PM	CO_2	CH_4	N_2O
Asphalt Recycling & Cold Milling Machine								
Asphalt Recycling Machine	0.0185	0.0632	0.1170	0.0002	0.0045	15.3	0.0017	0.0007518

Source: US South Coast Air Quality Management District - OFFROAD Model Mobile Source Emission Factors (http://www.aqmd.gov/home/regulations/ceqa/air-quality-analysis-handbook/off-road-mobile-source-emission-factors).

Annex H. Environmental Codes of Practice

Citation in main text (Volume I): **Section 9.4.3.2**.

ECoP 1: Waste Management

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
General Waste	Soil and water pollution from the improper management of wastes and excess materials from the construction sites.	The Contractor shall • Develop waste management plan for various specific waste streams (e.g., reusable waste, flammable waste, construction debris, food waste etc.) prior to commencing of construction and submit to CSC for approval. • Organize disposal of all wastes generated during construction in an environmentally acceptable manner. This will include consideration of the nature and location of disposal site, so as to cause less environmental impact. • Minimize the production of waste materials by 3R (Reduce, Recycle and Reuse) approach. • Segregate and reuse or recycle all the wastes, wherever practical. • Prohibit burning of solid waste • Collect and transport non-hazardous wastes to all the approved disposal sites. Vehicles transporting solid waste shall be covered with tarps or nets to prevent spilling waste along the route • Train and instruct all personnel in waste management practices and procedures as a component of the environmental induction process. • Provide refuse containers at each worksite. • Request suppliers to minimize packaging where practicable. • Place a high emphasis on good housekeeping practices. • Maintain all construction sites in a cleaner, tidy and safe condition and provide and maintain appropriate facilities as temporary storage of all wastes before transportation and final disposal.
Hazardous Waste	Health hazards and environmental impacts due to improper waste	The Contractor shall • Collect chemical wastes in 200 liter drums (or similar sealed container), appropriately labeled

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
	management practices	for safe transport to an approved chemical waste depot. • Store, transport and handle all chemicals avoiding potential environmental pollution. • Store all hazardous wastes appropriately in bunded areas away from water courses. • Make available Material Safety Data Sheets (MSDS) for hazardous materials on-site during construction. • Collect hydrocarbon wastes, including lube oils, for safe transport off-site for reuse, recycling, treatment or disposal at approved locations. • Construct concrete or other impermeable flooring to prevent seepage in case of spills

ECoP 2: Fuels and Hazardous Goods Management

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Fuels and hazardous goods.	Materials used in construction have a potential to be a source of contamination. Improper storage and handling of fuels, lubricants, chemicals and hazardous goods/materials on-site, and potential spills from these goods may harm the environment or health of construction workers.	The Contractor shall • Prepare spill control procedures and submit the plan for CSC approval. • Train the relevant construction personnel in handling of fuels and spill control procedures. • Store dangerous goods in bunded areas on a top of a sealed plastic sheet away from watercourses. • Refueling shall occur only within bunded areas. • Make available MSDS for chemicals and dangerous goods on-site. • Transport waste of dangerous goods, which cannot be recycled, to a designated disposal site approved by DoE. • Provide absorbent and containment material (e.g., absorbent matting) where hazardous material are used and stored and personnel trained in the correct use. • Provide protective clothing, safety boots, helmets, masks, gloves, goggles, to the construction personnel, appropriate to materials

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
		in use. • Make sure all containers, drums, and tanks that are used for storage are in good condition and are labeled with expiry date. Any container, drum, or tank that is dented, cracked, or rusted might eventually leak. Check for leakage regularly to identify potential problems before they occur. • Store hazardous materials above flood plain level. • Put containers and drums in temporary storages in clearly marked areas, where they will not be run over by vehicles or heavy machinery. The area shall preferably slope or drain to a safe collection area in the event of a spill. • Put containers and drums in permanent storage areas on an impermeable floor that slopes to a safe collection area in the event of a spill or leak. • Take all precautionary measures when handling and storing fuels and lubricants, avoiding environmental pollution. • Avoid the use of material with greater potential for contamination by substituting them with more environmentally friendly materials. • Return the gas cylinders to the supplier. However, if they are not empty prior to their return, they must be labeled with the name of the material they contained or contain, information on the supplier, cylinder serial number, pressure, their last hydrostatic test date, and any additional identification marking that may be considered necessary.

ECoP 3: Water Resources Management

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Hazardous Material and Waste	Water pollution from the storage, handling and disposal of hazardous materials and general construction	The Contractor shall • Follow the management guidelines proposed in ECPs 1 and 2. • Minimize the generation of sediment, oil and

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
	waste, and accidental spillage	grease, excess nutrients, organic matter, litter, debris and any form of waste (particularly petroleum and chemical wastes). These substances must not enter waterways, storm water systems or underground water tables
Discharge from construction sites	During construction both surface and groundwater quality may be deteriorated due to construction activities in the river, sewerages from construction sites and work camps. The construction works will modify groundcover and topography changing the surface water drainage patterns of the area including infiltration and storage of storm water. These changes in hydrological regime lead to increased rate of runoff, increase in sediment and contaminant loading, increased flooding, groundwater contamination, and effect habitat of fish and other aquatic biology.	The Contractor shall • Install temporary drainage works (channels and bunds) in areas required for sediment and erosion control and around storage areas for construction materials • Install temporary sediment basins, where appropriate, to capture sediment-laden run-off from site • Divert runoff from undisturbed areas around the construction site • Stockpile materials away from drainage lines • Prevent all solid and liquid wastes entering waterways by collecting solid waste, oils, chemicals, bitumen spray waste and wastewaters from brick, concrete and asphalt cutting where possible and transport to an approved waste disposal site or recycling depot • Wash out ready-mix concrete agitators and concrete handling equipment at washing facilities off site or into approved bunded areas on site. Ensure that tires of construction vehicles are cleaned in the washing bay (constructed at the entrance of the construction site) to remove the mud from the wheels. This shall be done in every exit of each construction vehicle to ensure the local roads are kept clean.
Soil Erosion and siltation	Soil erosion and dust from the material stockpiles will increase the sediment and contaminant loading of surface water bodies.	The Contractor shall • Stabilize the cleared areas not used for construction activities with vegetation or appropriate surface water treatments as soon as practicable following earthwork to minimize erosion • Ensure that roads used by construction vehicles are swept regularly to remove sediment. • Water the material stockpiles, access roads and bare soils on an as required basis to minimize dust. Increase the watering frequency during periods of high risk (e.g. high winds)

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Construction activities in water bodies	Construction works in the water bodies will increase sediment and contaminant loading, and effect habitat of fish and other aquatic biology.	The Contractor Shall • Dewater sites by pumping water to a sediment basin prior to release off site – do not pump directly off site • Monitor the water quality in the runoff from the site or areas affected by dredge plumes, and improve work practices as necessary • Protect water bodies from sediment loads by silt screen or bubble curtains or other barriers • Minimize the generation of sediment, oil and grease, excess nutrients, organic matter, litter, debris and any form of waste (particularly petroleum and chemical wastes). These substances must not enter waterways, storm water systems or underground water tables. • Use environment friendly and nontoxic slurry during construction of piles to discharge into the river. • Reduce infiltration of contaminated drainage through storm water management design • Do not discharge cement and water curing used for cement concrete directly into water courses and drainage inlets.
Drinking water	Groundwater at shallow depths is contaminated with arsenic and hence not suitable for drinking purposes.	The Contractor Shall • Pumping of groundwater shall be from deep aquifers of more than 300 m to supply arsenic free water. Safe and sustainable discharges are to be ascertained prior to selection of pumps. • Tube wells will be installed with due regard for the surface environment, protection of groundwater from surface contaminants, and protection of aquifer cross contamination • All tube wells, test holes, monitoring wells that are no longer in use or needed shall be properly decommissioned
	Depletion and pollution of groundwater resources	• Install monitoring wells both upstream and downstream areas near construction yards and construction camps to regularly monitor the water quality and water levels. • Protect groundwater supplies of adjacent lands

ECoP 4: Drainage Management

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Excavation and earth works, and construction yards	Lack of proper drainage for rainwater/liquid waste or wastewater owing to the construction activities harms environment in terms of water and soil contamination, and mosquito growth.	The Contractor shall • Prepare a program for prevent/avoid standing waters, which CSC will verify in advance and confirm during implementation • Provide alternative drainage for rainwater if the construction works/earth-fillings cut the established drainage line • Establish local drainage line with appropriate silt collector and silt screen for rainwater or wastewater connecting to the existing established drainage lines already there • Rehabilitate road drainage structures immediately if damaged by contractors' road transports. • Build new drainage lines as appropriate and required for wastewater from construction yards connecting to the available nearby recipient water bodies. Ensure wastewater quality conforms to the relevant standards provided by DoE, before it being discharged into the recipient water bodies. • Ensure the internal roads/hard surfaces in the construction yards/construction camps that generate has storm water drainage to accommodate high runoff during downpour and that there is no stagnant water in the area at the end of the downpour. • Construct wide drains instead of deep drains to avoid sand deposition in the drains that require frequent cleaning. • Provide appropriate silt collector and silt screen at the inlet and manholes and periodically clean the drainage system to avoid drainage congestion • Protect natural slopes of drainage channels to ensure adequate storm water drains. • Regularly inspect and maintain all drainage channels to assess and alleviate any drainage congestion problem. • Reduce infiltration of contaminated drainage through storm water management design
Ponding of water	Health hazards due to mosquito breeding	• Do not allow ponding of water especially near the waste storage areas and construction camps

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
		• Discard all the storage containers that are capable of storing of water, after use or store them in inverted position

ECoP 5: Soil Quality Management

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Filling of Sites with dredge spoils	Soil contamination will occur from drainage of dredged spoils	The Contractor shall • Ensure that dredged sand used for land filling shall be free of pollutants. Prior to filling, sand quality shall be tested to confirm whether soil is pollution free. Sediments shall be properly compacted. Top layer shall be the 0.5 m thick clay on the surface and boundary slopes along with grass. Side Slope of Filled Land of 1:2 shall be constructed by suitable soils with proper compaction as per design. Slope surface shall be covered by top soils/ cladding materials (0.5m thick) and grass turfing with suitable grass. • Leaching from the sediments shall be contained to seep into the subsoil or shall be discharged into settling lagoons before final disposal. • No sediment laden water in the adjacent lands near the construction sites, and/or wastewater of suspended materials excessive of 200mg/l from dredge spoil storage/use area in the adjacent agricultural lands.
Storage of hazardous and toxic chemicals	Spillage of hazardous and toxic chemicals will contaminate the soils	The Contractor shall • Strictly manage the wastes management plans proposed in ECP1 and storage of materials in ECP2 • Construct appropriate spill contaminant facilities for all fuel storage areas • Establish and maintain a hazardous materials register detailing the location and quantities of hazardous substances including the storage, use of disposals • Train personnel and implement safe work practices for minimizing the risk of spillage • Identify the cause of contamination, if it is reported, and contain the area of contamination.

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
		The impact may be contained by isolating the source or implementing controls around the affected site • Remediate the contaminated land using the most appropriate available method to achieve required commercial/industrial guideline validation results
Construction material stock piles	Erosion from construction material stockpiles may contaminate the soils	The Contractor shall • Protect the toe of all stockpiles, where erosion is likely to occur, with silt fences, straw bales or bunds

ECoP 6: Erosion and Sediment Control

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Clearing of construction sites	Cleared areas and slopes are susceptible for erosion of top soils, that affects the growth of vegetation which causes ecological imbalance.	• Reinstate and protect cleared areas as soon as possible. • Mulch to protect batter slopes before planting • Cover unused area of disturbed or exposed surfaces immediately with mulch/grass turfings/tree plantations
Construction activities and material stockpiles	The impact of soil erosion are (i) Increased run off and sedimentation causing a greater flood hazard to the downstream, (ii) destruction of aquatic environment in nearby lakes, streams, and reservoirs caused by erosion and/or deposition of sediment damaging the spawning grounds of fish, and (iii) destruction of vegetation by burying or gullying.	The Contractor shall • Locate stockpiles away from drainage lines • Protect the toe of all stockpiles, where erosion is likely to occur, with silt fences, straw bales or bunds • Remove debris from drainage paths and sediment control structures • Cover the loose sediments and water them if required • Divert natural runoff around construction areas prior to any site disturbance • Install protective measures on site prior to construction, for example, sediment traps • Control drainage through a site in protected channels or slope drains • Install 'cut off drains' on large cut/fill batter slopes to control water runoff speed and hence erosion

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
		• Observe the performance of drainage structures and erosion controls during rain and modify as required.

ECoP 7: Top Soil Management

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Land clearing and earth works	Earthworks will impact the fertile top soils that are enriched with nutrients required for plant growth or agricultural development.	The Contractor shall • Strip the top soil to a depth of 15 cm and store in stock piles of height not exceeding 2m. • Remove unwanted materials from top soil like grass, roots of trees and similar others. • The stockpiles will be done in slopes of 2:1 to reduce surface runoff and enhance percolation through the mass of stored soil. • Locate topsoil stockpiles in areas outside drainage lines and protect from erosion. • Construct diversion channels and silt fences around the topsoil stockpiles to prevent erosion and loss of topsoil. • Spread the topsoil to maintain the physico-chemical and biological activity of the soil. The stored top soil will be utilized for covering all disturbed area and along the proposed plantation sites • Prior to the re-spreading of topsoil, the ground surface will be ripped to assist the bunding of the soil layers, water penetration and revegetation
Transport	Vehicular movement outside ROW or temporary access roads will affect the soil fertility of the agricultural lands	• Limit equipment and vehicular movements to within the approved construction zone • Construct temporary access tracks to cross concentrated water flow lines at right angles • Plan construction access to make use, if possible, of the final road alignment • Use vehicle-cleaning devices, for example, ramps or wash down areas

ECoP 8: Topography and Landscaping

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Land clearing and earth works	Flood plains of the existing Project area will be affected by the construction of various project activities. Construction activities especially earthworks will change topography and disturb the natural rainwater/flood water drainage as well as will change the local landscape.	The Contractor shall • Ensure the topography of the final surface of all raised lands (construction yards, approach roads, access roads, bridge end facilities, etc.) are conducive to enhance natural draining of rainwater/flood water; • Keep the final or finished surface of all the raised lands free from any kind of depression that insists water logging • Undertake mitigation measures for erosion control/prevention by grass-turfing and tree plantation, where there is a possibility of rain-cut that will change the shape of topography. • Cover immediately the uncovered open surface that has no use of construction activities with grass-cover and tree plantation to prevent soil erosion and bring improved landscaping

ECoP 9: Sand Extraction

Project Activity/ Impact Source	**Environmental Impacts**	**Mitigation Measures/ Management Guidelines**
Sand extraction	Sand extraction can potentially impact the aquatic habitat, water quality, and key aquatic species and their food availability.	The Contractor shall: • not extract sand from the river bed in long continuous stretches; alternate patches of river bed will be left undisturbed to minimize the potentially negative impacts on the aquatic habitat. • not collect large quantities of sand from any single location • not excavate deeper than 3 m at any single location. • not carry out sand extraction near chars that have sensitive habitats • not carry out sand extraction during the night particularly near the chars • obtain approval from CSC before starting sand extraction from any location. • carry out sand extraction from sand bars to the

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
		extent possible. • maintain record of all sand extraction (quantities, location shown on map, timing, any sighting of key species) • provide silt fences, sediment barriers or other devices around the extraction areas to prevent migration of sediment rich water in to the river channels. • refuel of barges and boats with a proper care to avoid any spills. • make available spill kits and other absorbent material at refueling points on the barges. • properly collect, treat and dispose the bilge water from of barges, and boats. • regularly service all waterborne plant as per the manufacturer's guidelines and be inspected daily prior to operation. CSC will: • carry out survey of the area prior to sand extraction • identify any sensitive receptors/habitats (eg, turtle nesting area, birds colony) at or near the proposed sand extraction locations. • determine 'no-go' areas for sand extraction, based upon the above survey, • monitor the activity to ensure that the contractor complies with the conditions described earlier. • survey the area after sand extraction to identify any left over impacts.

ECoP 10: Air Quality Management

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Construction vehicular traffic	Air quality can be adversely affected by vehicle exhaust emissions and combustion of fuels.	The Contractor shall • Fit vehicles with appropriate exhaust systems and emission control devices. Maintain these devices in good working condition. • Operate the vehicles in a fuel efficient manner • Cover haul vehicles carrying dusty materials moving outside the construction site

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
		• Impose speed limits on all vehicle movement at the worksite to reduce dust emissions • Control the movement of construction traffic • Water construction materials prior to loading and transport • Service all vehicles regularly to minimize emissions • Limit the idling time of vehicles not more than 2 minutes
Construction machinery	Air quality can be adversely affected by emissions from machinery and combustion of fuels.	The Contractor shall • Fit machinery with appropriate exhaust systems and emission control devices. Maintain these devices in good working condition in accordance with the specifications defined by their manufacturers to maximize combustion efficiency and minimize the contaminant emissions. Proof or maintenance register shall be required by the equipment suppliers and contractors/subcontractors • Focus special attention on containing the emissions from generators • Machinery causing excess pollution (e.g. visible smoke) will be banned from construction sites • Service all equipment regularly to minimize emissions • Provide filtering systems, duct collectors or humidification or other techniques (as applicable) to the concrete batching and mixing plant to control the particle emissions in all its stages, including unloading, collection, aggregate handling, cement dumping, circulation of trucks and machinery inside the installations
Construction activities	Dust generation from construction sites, material stockpiles and access roads is a nuisance in the environment and can be a health hazard.	• Water the material stockpiles, access roads and bare soils on an as required basis to minimize the potential for environmental nuisance due to dust. Increase the watering frequency during periods of high risk (e.g. high winds). Stored materials such as gravel and sand shall be covered and confined to avoid their being wind-drifted • Minimize the extent and period of exposure of

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
		the bare surfaces • Reschedule earthwork activities or vegetation clearing activities, where practical, if necessary to avoid during periods of high wind and if visible dust is blowing off-site • Restore disturbed areas as soon as practicable by vegetation/grass-turfing • Store the cement in silos and minimize the emissions from silos by equipping them with filters. • Establish adequate locations for storage, mixing and loading of construction materials, in a way that dust dispersion is prevented because of such operations • Crushing of rocky and aggregate materials shall be wet-crushed, or performed with particle emission control systems

ECoP 11: Noise and Vibration Management

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Construction vehicular traffic	Noise quality will be deteriorated due to vehicular traffic	The Contractor shall • Maintain all vehicles in order to keep it in good working order in accordance with manufactures maintenance procedures • Make sure all drivers will comply with the traffic codes concerning maximum speed limit, driving hours, etc. • Organize the loading and unloading of trucks, and handling operations for the purpose of minimizing construction noise on the work site
Construction machinery	Noise and vibration may have an impact on people, property, fauna, livestock and the natural environment.	The Contractor shall • Appropriately site all noise generating activities to avoid noise pollution to local residents • Use the quietest available plant and equipment • Modify equipment to reduce noise (for example, noise control kits, lining of truck trays or pipelines) • Maintain all equipment in order to keep it in

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
		good working order in accordance with manufactures maintenance procedures. Equipment suppliers and contractors shall present proof of maintenance register of their equipment. • Install acoustic enclosures around generators to reduce noise levels. • Fit high efficiency mufflers to appropriate construction equipment • Avoid the unnecessary use of alarms, horns and sirens
Construction activity	Noise and vibration may have an impact on people, property, fauna, livestock and the natural environment.	The Contractor shall • Notify adjacent landholders prior any typical noise events outside of daylight hours • Educate the operators of construction equipment on potential noise problems and the techniques to minimize noise emissions • Employ best available work practices on-site to minimize occupational noise levels • Install temporary noise control barriers where appropriate • Notify affected people if major noisy activities will be undertaken, e.g. pile driving • Plan activities on site and deliveries to and from site to minimize impact • Monitor and analyze noise and vibration results and adjust construction practices as required. • Avoid undertaking the noisiest activities, where possible, when working at night near the residential areas

ECoP 12: Protection of Flora

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Vegetation clearance	Local flora are important to provide shelters for the birds, offer fruits and/or timber/fire wood, protect soil erosion and overall keep the environment very	The Contractor shall • Reduce disturbance to surrounding vegetation • Use appropriate type and minimum size of machine to avoid disturbance to adjacent vegetations. • Get approval from supervision consultant for clearance of vegetation.

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
	friendly to human-living. As such damage to flora has wide range of adverse environmental impacts.	• Make selective and careful pruning of trees where possible to reduce need of tree removal. • Control noxious weeds by disposing of at designated dump site or burn on site. • Clear only the vegetation that needs to be cleared in accordance with the plans. These measures are applicable to both the construction areas as well as to any associated activities such as sites for stockpiles, disposal of fill and construction of diversion roads, etc. • Do not burn off cleared vegetation – where feasible, chip or mulch and reuse it for the rehabilitation of affected areas, temporary access tracks or landscaping. Mulch provides a seed source, can limit embankment erosion, retains soil moisture and nutrients, and encourages re-growth and protection from weeds. • Return topsoil and mulched vegetation (in areas of native vegetation) to approximately the same area of the roadside it came from. • Avoid work within the drip-line of trees to prevent damage to the tree roots and compacting the soil. • Minimize the length of time the ground is exposed or excavation left open by clearing and re-vegetate the area at the earliest practically possible. • Ensure excavation works occur progressively and re-vegetation done at the earliest • Provide adequate knowledge to the workers regarding nature protection and the need of avoid felling trees during construction • Supply appropriate fuel in the work caps to prevent fuel wood collection

ECoP 13: Protection of Fauna

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Construction activities	The location of construction activities	The Contractor shall • Limit the construction works within the

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
	can result in the loss of wild life habitat and habitat quality,.	designated sites allocated to the contractors • check the site for animals trapped in, or in danger from site works and use a qualified person to relocate the animal
	Impact on migratory birds, its habitat and its active nests	The Contractor shall • Not be permitted to destruct active nests or eggs of migratory birds • Minimize the tree removal during the bird breeding season. If works must be continued during the bird breeding season, a nest survey will be conducted by a qualified biologist prior to commence of works to identify and located active nests • Minimize the release of oil, oil wastes or any other substances harmful to migratory birds to any waters or any areas frequented by migratory birds.
Vegetation clearance	Clearance of vegetation may impact shelter, feeding and/or breeding and/or physical destruction and severing of habitat areas	The Contractor shall • Restrict the tree removal to the minimum required. • Retain tree hollows on site, or relocate hollows, where appropriate • Leave dead trees where possible as habitat for fauna • Fell the hollow bearing trees in a manner which reduces the potential for fauna mortality. Felled trees will be inspected after felling for fauna and if identified and readily accessible will be removed and relocated or rendered assistance if injured. After felling, hollow bearing trees will remain unmoved overnight to allow animals to move of their own volition.
Construction camps	Illegal poaching	• Provide adequate knowledge to the workers regarding protection of flora and fauna, and relevant government regulations and punishments for illegal poaching.

ECoP 14: Protection of Fisheries

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Construction activities in River	The main potential impacts to fisheries are hydrocarbon spills and leaks from riverine transport and disposal of wastes into the river	The Contractor shall • Ensure the riverine transports, vessels and ships are well maintained and do not have oil leakage to contaminate river water. • Contain oil immediately on river in case of accidental spillage from vessels and ships and in this regard, make an emergency oil spill containment plan to be supported with enough equipments, materials and human resources • Do not dump wastes, be it hazardous or non-hazardous into the nearby water bodies or in the river
Construction activities on the land	The main potential impacts to aquatic flora and fauna River are increased suspended solids from earthworks erosion, sanitary discharge from work camps, and hydrocarbon spills	The Contractor shall • follow mitigation measures proposed in ECoP 3 : Water Resources Management and EC4: Drainage Management
	Filling of ponds for site preparation will impact the fishes.	The Contractor shall • Inspect any area of a water body containing fish that is temporarily isolated for the presence of fish, and all fish shall be captured and released unharmed in adjacent fish habitat • Install and maintain fish screens etc. on any water intake with drawing water from any water body that contain fish

ECoP 15: Road Transport and Road Traffic Management

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Construction vehicular traffic	Increased traffic use of road by construction vehicles will affect the movement of normal road traffics and the safety of the road-users.	The Contractor shall • Prepare and submit a traffic management plan to the CSC for his approval at least 30 days before commencing work on any project component involved in traffic diversion and management. • Include in the traffic management plan to ensure uninterrupted traffic movement during construction: detailed drawings of traffic arrangements showing all detours, temporary

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines

		road, temporary bridges temporary diversions, necessary barricades, warning signs / lights, and road signs.
		• Provide signs at strategic locations of the roads complying with the schedules of signs contained in the Bangladesh Traffic Regulations.
		• Install and maintain a display board at each important road intersection on the roads to be used during construction, which shall clearly show the following information in Bangla:
		  • Location: chainage and village name
		  • Duration of construction period
		  • Period of proposed detour / alternative route
		  • Suggested detour route map
		  • Name and contact address/telephone number of the concerned personnel
		  • Name and contact address / telephone number of the Contractor
		  • Inconvenience is sincerely regretted.

	Accidents and spillage of fuels and chemicals	• Restrict truck deliveries, where practicable, to day time working hours. • Restrict the transport of oversize loads. • Operate road traffics/transport vehicles, if possible, to non-peak periods to minimize traffic disruptions. • Enforce on-site speed limit

ECoP 16: River Transport management

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Construction activities in River	The presence of construction and dredging barges, pipe lines and other construction activities in the river can cause hindrance and risks to the river traffic.	The Contractor shall • Not obstruct other normal riverine transport while doing riverine transport and works • Identify the channel to be followed clearly using navigation aids such as buoys, beacons, and lighting • Provide proper buoyage, navigation lights and markings for bridge and dredging works to guide the other normal riverine transport

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
		• Keep regular and close contacts with Bangladesh Inland Water Transport Authority (BIWTA) regarding their needs during construction of the project • Plan the river transport and transportation of large loads in coordination with BIWTA to avoid traffic congestions. • Provide signage for river traffic conforming to the BIWTA requirements • Position the dredge and pipeline in such a way that no disruption to the channel traffic will occur
	Accidents	The Contractor shall • Prepare an emergency plan for dealing with accidents causing accidental sinking of the vessels and ships • Ensure sufficient equipment and staffs available to execute the emergency plans • Provide appropriate lighting to barges and construction vessels.

ECoP 17: Construction Camp Management

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Siting and Location of construction camps	Campsites for construction workers are the important locations that have significant impacts such as health and safety hazards on local resources and infrastructure of nearby communities.	The Contractor shall • Locate the construction camps at areas which are acceptable from environmental, cultural or social point of view. • Consider the location of construction camps away from communities in order to avoid social conflict in using the natural resources such as water or to avoid the possible adverse impacts of the construction camps on the surrounding communities. • Submit to the CSC for approval a detailed layout plan for the development of the construction camp showing the relative locations of all temporary buildings and facilities that are to be constructed together with the location of site roads, fuel storage areas (for use in power supply generators), solid waste management and dumping locations, and drainage facilities, prior to the

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
		development of the construction camps. • Local authorities responsible for health, religious and security shall be duly informed on the set up of camp facilities so as to maintain effective surveillance over public health, social and security matters
Construction Camp Facilities	Lack of proper infrastructure facilities , such as housing, water supply and sanitation facilities will increase pressure on the local services and generate substandard living standards and health hazards.	Contractor shall provide the following facilities in the campsites • Adequate housing for all workers • Safe and reliable water supply. Water supply from deep tube wells of 300 m depth that meets the national standards • Hygienic sanitary facilities and sewerage system. The toilets and domestic waste water will be collected through a common sewerage. Provide separate latrines and bathing places for males and females with total isolation by wall or by location. The minimum number of toilet facilities required is one toilet for every ten persons. • Treatment facilities for sewerage of toilet and domestic wastes • Storm water drainage facilities. Both sides of roads are to be provided with shallow v drains to drain off storm water to a silt retention pond which shall be sized to provide a minimum of 20 minutes retention of storm water flow from the whole site. Channel all discharge from the silt retention pond to natural drainage via a grassed swale at least 20 meters in length with suitable longitudinal gradient. • Paved internal roads. Ensure with grass/vegetation coverage to be made of the use of top soil that there is no dust generation from the loose/exposed sandy surface. Pave the internal roads of at least haring-bond bricks to suppress dusts and to work against possible muddy surface during monsoon. • Provide child crèches for women working construction site. The crèche shall have facilities for dormitory, kitchen, indoor and outdoor play area. Schools shall be attached to these crèches so that children are not deprived of education whose mothers are construction workers • Provide in-house community/common

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
		entertainment facilities. dependence of local entertainment outlets by the construction camps to be discouraged/prohibited to the extent possible.
Disposal of waste	Management of wastes is crucial to minimize impacts on the environment	The Contractor shall • Ensure proper collection and disposal of solid wastes within the construction camps • Insist waste separation by source; organic wastes in one pot and inorganic wastes in another pot at household level. • Store inorganic wastes in a safe place within the household and clear organic wastes on daily basis to waste collector. Establish waste collection, transportation and disposal systems with the manpower and equipments/vehicles needed. • Dispose organic wastes in a designated safe place on daily basis. At the end of the day cover the organic wastes with a thin layer of sand so that flies, mosquitoes, dogs, cats, rats, are not attracted. One may dig a large hole to put organic wastes in it; take care to protect groundwater from contamination by leachate formed due to decomposition of wastes. Cover the bed of the pit with impervious layer of materials (clayey or thin concrete) to protect groundwater from contamination. • Locate the garbage pit/waste disposal site min 500 m away from the residence so that peoples are not disturbed with the odor likely to be produced from anaerobic decomposition of wastes at the waste dumping places. Encompass the waste dumping place by fencing and tree plantation to prevent children to enter and play with. • Do not establish site specific landfill sites. All solid waste will be collected and removed from the work camps and disposed in approval waste disposal sites.
Fuel supplies for cooking purposes	Illegal sourcing of fuel wood by construction workers will impact the natural flora and fauna	The Contractor shall • Provide fuel to the construction camps for their domestic purpose, in order to discourage them to use fuel wood or other biomass. • Made available alternative fuels like natural gas or kerosene on ration to the workforce to

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
		prevent them using biomass for cooking. • Conduct awareness campaigns to educate workers on preserving the protecting the biodiversity and wildlife of the project area, and relevant government regulations and punishments on wildlife protection.
Health and Hygiene	There will be a potential for diseases to be transmitted including malaria, exacerbated by inadequate health and safety practices. There will be an increased risk of work crews spreading sexually transmitted infections and HIV/AIDS.	The Contractor shall • Provide adequate health care facilities within construction sites. • Provide first aid facility round the clock. Maintain stock of medicines in the facility and appoint fulltime designated first aider or nurse. • Provide ambulance facility for the laborers during emergency to be transported to nearest hospitals. • Initial health screening of the laborers coming from outside areas • Train all construction workers in basic sanitation and health care issues and safety matters, and on the specific hazards of their work • Provide HIV awareness programming, including STI (sexually transmitted infections) and HIV information, education and communication for all workers on regular basis • Complement educational interventions with easy access to condoms at campsites as well as voluntary counseling and testing • Provide adequate drainage facilities throughout the camps to ensure that disease vectors such as stagnant water bodies and puddles do not form. Regular mosquito repellant sprays during monsoon. • Carryout short training sessions on best hygiene practices to be mandatorily participated by all workers. Place display boards at strategic locations within the camps containing messages on best hygienic practices
Safety	In adequate safety facilities to the construction camps may create security problems and fire hazards	The Contractor shall • Provide appropriate security personnel (police / home guard or private security guards) and enclosures to prevent unauthorized entry in to the camp area. • Maintain register to keep a track on a head count of persons present in the camp at any

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
		given time. • Encourage use of flameproof material for the construction of labor housing / site office. Also, ensure that these houses/rooms are of sound construction and capable of withstanding wind storms/cyclones. • Provide appropriate type of firefighting equipments suitable for the construction camps • Display emergency contact numbers clearly and prominently at strategic places in camps. • Communicate the roles and responsibilities of laborers in case of emergency in the monthly meetings with contractors.
Site Restoration	Restoration of the construction camps to original condition requires demolition of construction camps.	The Contractor shall • Dismantle and remove from the site all facilities established within the construction camp including the perimeter fence and lockable gates at the completion of the construction work. • Dismantle camps in phases and as the work gets decreased and not wait for the entire work to be completed • Give prior notice to the laborers before demolishing their camps/units • Maintain the noise levels within the national standards during demolition activities • Different contractors shall be hired to demolish different structures to promote recycling or reuse of demolished material. • Reuse the demolition debris to a maximum extent. Dispose remaining debris at the designated waste disposal site. • Handover the construction camps with all built facilities as it is if agreement between both parties (contactor and land-owner) has been made so. • Restore the site to its condition prior to commencement of the works or to an agreed condition with the landowner. • Not make false promises to the laborers for future employment in O&M of the project.

ECoP 18: Cultural and Religious Issues

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Construction activities near religious and cultural sites	Disturbance from construction works to the cultural and religious sites, and contractors lack of knowledge on cultural issues cause social disturbances.	The Contractor shall • Communicate to the public through community consultation and newspaper announcements regarding the scope and schedule of construction, as well as certain construction activities causing disruptions or access restriction. • Do not block access to cultural and religious sites, wherever possible • Restrict all construction activities within the foot prints of the construction sites. • Stop construction works that produce noise (particularly during prayer time) shall there be any mosque/religious/educational institutions close to the construction sites and users make objections. • Take special care and use appropriate equipment when working next to a cultural/religious institution. • Stop work immediately and notify the site manager if, during construction, an archaeological or burial site is discovered. It is an offence to recommence work in the vicinity of the site until approval to continue is given by the CSC/PMU. • Provide separate prayer facilities to the construction workers. • Show appropriate behavior with all construction workers especially women and elderly people • Allow the workers to participate in praying during construction time • Resolve cultural issues in consultation with local leaders and supervision consultants • Establish a mechanism that allows local people to raise grievances arising from the construction process. • Inform the local authorities responsible for health, religious and security duly informed before commencement of civil works so as to maintain effective surveillance over public health, social and security matters

ECoP 19: Worker Health and Safety

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Best practices	Construction works may pose health and safety risks to the construction workers and site visitors leading to severe injuries and deaths. The population in the proximity of the construction site and the construction workers will be exposed to a number of (i) biophysical health risk factors, (e.g. noise, dust, chemicals, construction material, solid waste, waste water, vector transmitted diseases etc), (ii) risk factors resulting from human behavior (e.g. STD, HIV etc) and (iii) road accidents from construction traffic.	The Contractor shall • Implement suitable safety standards for all workers and site visitors which shall not be less than those laid down on the international standards (e.g. International Labor Office guideline on 'Safety and Health in Construction; World Bank Group's 'Environmental Health and Safety Guidelines') and contractor's own national standards or statutory regulations, in addition to complying with the national standards of the Government of Bangladesh (e.g. `The Bangladesh Labor Code, 2006') • Provide the workers with a safe and healthy work environment, taking into account inherent risks in its particular construction activity and specific classes of hazards in the work areas, • Provide personal protection equipment (PPE) for workers, such as safety boots, helmets, masks, gloves, protective clothing, goggles, full-face eye shields, and ear protection. Maintain the PPE properly by cleaning dirty ones and replacing them with the damaged ones. • Safety procedures include provision of information, training and protective clothing to workers involved in hazardous operations and proper performance of their job • Appoint an environment, health and safety manager to look after the health and safety of the workers • Inform the local authorities responsible for health, religious and security duly informed before commencement of civil works and establishment of construction camps so as to maintain effective surveillance over public health, social and security matters
	Child and pregnant labor	The Contractor shall • not hire children of less than 14 years of age and pregnant women or women who delivered a child within 8 preceding weeks, in accordance with the Bangladesh Labor Code, 2006
Accidents	Lack of first aid facilities and health	• Provide health care facilities and first aid facilities are readily available. Appropriately

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
	care facilities in the immediate vicinity will aggravate the health conditions of the victims	equipped first-aid stations shall be easily accessible throughout the place of work • Document and report occupational accidents, diseases, and incidents. • Prevent accidents, injury, and disease arising from, associated with, or occurring in the course of work by minimizing, so far as reasonably practicable, the causes of hazards. In a manner consistent with good international industry practice. • Identify potential hazards to workers, particularly those that may be life-threatening and provide necessary preventive and protective measures. • Provide awareness to the construction drivers to strictly follow the driving rules • Provide adequate lighting in the construction area and along the roads
Construction Camps	Lack of proper infrastructure facilities, such as housing, water supply and sanitation facilities will increase pressure on the local services and generate substandard living standards and health hazards.	The Contractor shall provide the following facilities in the campsites to improve health and hygienic conditions as mentioned in ECoP 17 Construction Camp Management • Adequate ventilation facilities • Safe and reliable water supply. Water supply from deep tube wells that meets the national standards • Hygienic sanitary facilities and sewerage system. The toilets and domestic waste water will be collected through a common sewerage. • Treatment facilities for sewerage of toilet and domestic wastes • Storm water drainage facilities. • Recreational and social facilities • Safe storage facilities for petroleum and other chemicals in accordance with ECoP 2 • Solid waste collection and disposal system in accordance with ECP1. • Arrangement for trainings • Paved internal roads. • Security fence at least 2 m height. • Sick bay and first aid facilities
Water and sanitation facilities at the	Lack of Water sanitation facilities at construction sites cause	• The contractor shall provide portable toilets at the construction sites, if about 25 people are working the whole day for a month. Location

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
construction sites	inconvenience to the construction workers and affect their personal hygiene.	of portable facilities shall be at least 6 m away from storm drain system and surface waters. These portable toilets shall be cleaned once a day and all the sewerage shall be pumped from the collection tank once a day and shall be brought to the common septic tank for further treatment. • Contractor shall provide bottled drinking water facilities to the construction workers at all the construction sites.
Other ECPs	Potential risks on health and hygiene of construction workers and general public	The Contractor shall follow the following ECPs to reduce health risks to the construction workers and nearby community • ECoP 2: Fuels and Hazardous Goods Management • ECoP 4: Drainage Management • ECoP 10: Air Quality Management • ECoP 11: Noise and Vibration Management • ECoP 15: Road Transport and Road Traffic Management • ECoP 16: River Transport management
Trainings	Lack of awareness and basic knowledge in health care among the construction workforce, make them susceptible to potential diseases.	The Contractor shall • Train all construction workers in basic sanitation and health care issues (e.g., how to avoid malaria and transmission of sexually transmitted infections (STI) HIV/AIDS. • Train all construction workers in general health and safety matters, and on the specific hazards of their work Training shall consist of basic hazard awareness, site specific hazards, safe work practices, and emergency procedures for fire, evacuation, and natural disaster, as appropriate. • Commence the malaria, HIV/AIDS and STI education campaign before the start of the construction phase and complement it with by a strong condom marketing, increased access to condoms in the area as well as to voluntary counseling and testing. • Implement malaria, HIV/AIDS and STI education campaign targeting all workers hired, international and national, female and male, skilled, semi- and unskilled occupations, at the time of recruitment and thereafter pursued throughout the construction phase on

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
		ongoing and regular basis. This shall be complemented by easy access to condoms at the workplace as well as to voluntary counseling and testing.

Annex I. ToR for External Environmental Monitoring

Citation in the main text (Volume I): **Section 11.5.3**.

Background

The lower Brahmaputra, named Jamuna in Bangladesh is one of largest rivers in the World. Following its avulsion (change of course) into the present day Jamuna River during the late 17th century, it has been constantly migrating westward and additionally widened by 50% from 8 to 12 km since the 1970s. These morphological changes have led to the loss of about 88,000 ha of floodplain from 1973 to 2014, affecting the ecology and livelihood of the floodplain dwellers by displacing hundreds and thousands of people. In addition to unpredictable riverbank erosion, floods are the other major natural hazard. While typically 20% of the country is flooded during the annual monsoon, severe floods have inundated up to two thirds of the country.

The Government of Bangladesh through Bangladesh Water Development Board (BWDB) is preparing the River Bank Improvement Program (RBIP) to reconstruct the existing degraded embankment and secure it against riverbank erosion along 137 km length from the Teesta River to the Jamuna Bridge. The program will be designed and implemented in three phases. A 50 km long priority reach between Simla and Hasnapara will be protected in Phase 1. Phase 2 covers the remaining 87 km while Phase 3 focuses on and the construction of a highway on the countryside of the new flood embankment. The entire program will be implemented over a period of 10 years.

Objectives

A detailed ESMP has been prepared as part of the present EIA study. As one of the key elements of the ESMP, a three-tier monitoring program has been proposed comprising compliance monitoring, effects monitoring, and external monitoring. The main purpose of the monitoring program is to ensure that the various tasks detailed in the ESMP particularly the mitigation measures are implemented in an effective manner, and also to evaluate project's impacts on the key environment and social parameters.

The main purpose of the external monitoring – the third tier of the monitoring program - will be to ensure that all the key entities including EDSU, CSC, and contractors are effectively and adequately fulfilling their designated role for ESMP implementation, and that all the ESMP requirements are being implemented in a timely and effective manner. The primary objective for engaging an independent external monitor is to review the efficacy of ESMP implementation as well as internal monitoring, and conduct periodic third party monitoring and provide feedback to BWDB and WB on policy improvement and enhancement of implementation process. The External Monitoring Consultants (EMC) will review implementation process as per set procedures and tasks given in the ESMP and assess the achievement of overall environmental management objectives.

Scope of Work

The scope of work of the EMC will include the following specific tasks:

- To develop specific monitoring indicators, checklists, and questionnaires to undertake external monitoring (a preliminary list of monitoring indicators has been given in the ESMP) in consultation with BWDB and WB.

- To review and verify the implementation progress of various ESMP elements, particularly, mitigation plan, compliance and effects monitoring, environmental trainings, documentation, and grievance redress mechanism.
- To review and verify the functioning of the key entities – ESDU, CSC, and contractors - for environmental management.
- Identify the strengths and weaknesses of the design of ESMP and its implementation, and also the entities tasked to undertake various tasks detailed in the ESMP.
- Evaluate and assess the institutional arrangements established for the environmental management of the project. Evaluate and assess the effectiveness and appropriateness of the key personnel of ESDU, CSC, and contractors tasked to implement various aspects of the ESMP.
- Evaluate and assess the adequacy of the mitigation measures proposed in the Mitigation Plan in addressing the potentially negative impacts of the project activities and propose changes as appropriate.
- Review results of internal monitoring (compliance and effects monitoring) and verify its effectiveness through community consultations, spot checks, and field observations.
- Review the process and outcome of environmental trainings conducted by different project entities in line with the training program given in the ESMP.
- Review the process and outcome of the documentation and reporting being carried out by various project entities in line with the ESMP requirements.
- Identify, quantify, and qualify the types of ESMP-related conflicts and grievances reported and resolved and the consultation and participation procedures.
- Provide a summary of whether ESMP is being effectively implemented
- Describe any outstanding actions that are required to bring ESMP implementation in line with the GoB and WB requirements as stated in the EIA. Describe further mitigation measures and or corrective actions needed to ensure that the project remains environmentally and socially acceptable. Provide a timetable and define budget requirements for these supplementary mitigation measures / corrective actions.
- Describe any lessons learned that might be useful for environmental assessment and management of future projects.

Approach and Methodology

The general approach will include monitoring of ESMP implementation activities and to identify any environmental impacts actually caused by the project. The EMC will conduct quarterly field visits for external monitoring. During the field visits, the EMC will carry out meetings with the key project entities including PMU, ESDU, CSC, and contractors; review reports and record of ESMP implementation; conduct consultation meetings with key stakeholders particularly communities and local government officials; carry out field investigations including spot checks and visual observations, and identify need of any sampling and laboratory analysis.

The EMC will prepare checklists and questionnaires for the field investigations, comprising both qualitative and quantitative parameters. After each field visit, the EMC will prepare external monitoring report comprising field observations and findings, assessment of ESMP implementation, key gaps identified, conclusions, and recommendations for addressing the gaps.

Responsibility of BWDB

The BWDB through its PMU will ensure timely supply of background references, data and project options to the EMC. It will ensure uninterrupted access to work sites, relevant offices of the GOB and BWDB in particular. The EMC will participate in quarterly coordination meetings with the BWDB in presence of the CSC.

Recommendation based on the result of the external monitoring will be provided to BWDB to cover up the deficiencies identified by the EMC. BWDB will accept the recommendations of the EMC if they are within the scope of work and there is nothing incorrect in the report.

Responsibility of CSC

The CSC will provide appropriate protocol at site or at its Project Office for the field visit of the EMC. It will on behalf of BWDB ensure free access to work sites, impact areas and the database on ESMP implementation. The CSC will ensure timely intimation of its works planning as and when made or updated during the construction period and keep the EMC informed.

Team Composition of the EMC

The tasks of the key members of the EMC are given below.

Position/expertise	Qualification and experience
1. Team Leader/ ESMP Implementation Specialist	Masters in environment engineering or environmental science with 15 years working background in planning, implementation and monitoring of environmental management for large infrastructure projects. Experience in institutional capacity analysis, preparation and implementation of ESMPs, and knowledge of latest environmental safeguard policies of the international development financing institutions in Bangladesh are required.
2. Environment Specialist(s)	Masters in environment engineering or environmental science with 10 years working experience in environmental impact assessment including field surveys, stakeholder consultations, and analyzing environmental impacts to identify mitigation measures in compliance with environmental safeguard policies of the international development financing institutions and national legislations. Experience of preparing and implementing ESMP for externally financed projects is essential.
3. Ecologists	Masters in biological sciences with 15 years working experience in relevant fields. Thorough knowledge of ecological issues (natural vegetation, terrestrial as well as aquatic fauna, fish, and birds) and their implications for development projects; research and work experience relating to ecological issues; and knowledge of techniques for data collection and analysis.

4. Data Analyst	Graduate with working experience and knowledge of software, those are most commonly used in Bangladesh; demonstrated ability to design and implement automated MIS(s) for monitoring progress, comparing targets with achieved progress and the procedural steps.

Time Frame and Reporting

The EMC will be employed over a period of five years with intermittent inputs from the professional team to continue one year after completion of the RBIP implementation.

Quarterly and annual monitoring reports should be submitted to the BWDB with copies to the WB. An evaluation report at the end of the Project should be submitted to the BWDB and WB with critical analysis of the achievement of the programs and the environmental performance of RBIP.

The EMC will provide monitoring and evaluation report covering the following aspects:

- Field observations, results of any field investigations and or laboratory analysis
- Assessment of whether the ESMP is being implemented as planned and budgeted
- Assessment of the extent to which the specific ESMP objectives and the expected outcomes/results have been achieved and the factors affecting their achievement or non achievement
- Major areas of improvement and key risk factors
- Major lessons learnt and
- Recommendations.

Formats for collection and presentation of monitoring data will be designed in consultation with BWDB.

Budget and Logistics

The budget should include all expenses such as staff salary, office accommodation, training, computer/software, transport, field expenses and other logistics necessary for field activities, data collection, processing and analysis for monitoring and evaluation work. Additional expense claims whatsoever outside the proposed and negotiated budget will not be entertained. VAT, Income Tax and other charges admissible will be deducted at source as per GOB laws.