Environmental Impact Assessment (Draft)

Draft as of 16 May 2014

Bangladesh: Flood and Riverbank Erosion Risk Management Investment Program

Prepared by the Bangladesh Water Development Board for the Asian Development Bank. This is an updated version of the draft originally posted in February 2014 and the second draft posted in April 2014, available on http://www.adb.org/projects/44167-013/documents.

CURRENCY EQUIVALENTS

(as of 18 February 2014)

Currency unit	–	taka (Tk)
Tk1.00	=	$77.62500
$1.00	=	Tk0.012882

ABBREVIATIONS

ADB	–	Asian Development Bank
BWDB	–	Bangladesh Water Development Board
DDM	–	Department of Disaster Management
DPP	–	development project proforma/proposal
GOB	–	Government of Bangladesh
MFF	–	multitranche financing facility
NGO	–	nongovernment organization
O&M	–	operation and maintenance
PMO	–	project management office

GLOSSARY

Char	–	tentatively emerged islands in rivers
Upazila	–	administrative unit under a district
Union	–	administrative unit under a upazila

NOTES

(i) The fiscal year (FY) of the Government of Bangladesh ends on 30 June. "FY" before a calendar year denotes the year in which the fiscal year ends, e.g., FY2013 ends on 30 June 2013.

(ii) In this report, "$" refers to US dollars

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Abbreviations and Acronyms

ADB	Asian Development Bank
AIFRERMIP	Assam Integrated Flood and Riverbank Erosion Risk Management Investment Program
BBA	Bangladesh Bridge Authority
BBS	Bangladesh Bureau of Statistics
BCCSAP	Bangladesh Climate Change Strategy and Action Plan
BDT	Bangladesh Taka
BMD	Bangladesh Meteorology Department
BWDB	Bangladesh Water Development Board
CC	Pre-cast concrete
CEGIS	Centre for Environment and Geographical Information Systems
CEMP	Contractor's environmental management plan
CIA	Cumulative impact assessment
DAE	Department of Agricultural Extension
DDM	Department of Disaster Management
DOE	Department of Environment
DOF	Department of Fisheries
EAP	Environmental action plan
EARF	Environmental assessment review framework
ECA	Environment Conservation Act
ECAs	Ecologically critical area
EIA	Environmental impact statement
EOP	Environment-on-project
EMP	Environmental management plan
F0	Area flooded to a maximum of 0-30 cm, either (i) MPO land type, remains flooded for three days or more to this depth in the 1:2 year return flood event; or (ii) hydrologic model area, instantaneously flooded to this depth in the modeled event (any return period)
F1	Area flooded 30-90 cm maximum (see F0)
F2	Area flooded 90-180 cm maximum (see F0)

F3	Area flooded 180-300 cm maximum (see F0)
F4	MPO land type, over 300 cm maximum 3-day flood depth, 1:2 event
FAO	Food Agriculture Organization
FAP	Flood Action Plan
FRERMIP	Flood and Riverbank Erosion Risk Management Investment Program
FW	Future-with-project
FWO	Future-without-project
GRC	Grievance Redress Committee
GPA	Guidelines for Project Assessment
IEE	Initial environmental examination
IFC	International Finance Corporation
ISPMC	Institutional Strengthening and Project Management Consultant
IUCN	International Union for Conservation of Nature
JMREMP	Jamuna Meghna River Erosion Mitigation Project
JVT	Joint Verification Team
MFF	Multi-tranche financing facility
MPO	Master Planning Organization
NGO	Non-governmental organization
NWRD	National Water Resources Database
PC	Public consultation
PMBP	Padma Multipurpose Bridge Project
PMO	Project Management Office
PPTA	Project preparation technical assistance
PWD	Public Works Department (denotes survey datum)
RCC	Reinforced cast concrete
SRDI	Soils Resources Development Institute
UNEP	United Nations Environment Programme
WARPO	Water Resources Planning Organization

Glossary

Bengali terms and place names

Aman	Rice planted in Kharif and harvested in Rabi
Aus	Rice planted and harvested in Kharif
Beel	Seasonal or perennial water body located in low-lying area of the floodplain
Boro	Rice planted in Rabi and harvested in Kharif
Brahmaputra, Jamuna, Ganges, Padma	In northwestern Bangladesh, the Brahmaputra changes name to Jamuna at its confluence with the much smaller Teesta. Further downstream, the Jamuna and Ganges flow together to create the Padma. Flood and Riverbank Erosion Risk Management Investment Program (FRERMIP) covers 60 km of the Jamuna, 20 km of the Ganges, and the entire 100 km of the Padma.
Jhupri	With reference to housing, construction of mud walls, earth floor, thatch or CI sheetroof.
Kutcha	With reference to housing, construction of wood, bamboo, and other local materials
Khal	Channel
Kharif	Monsoon season; in Bangladesh, generally Mar-Oct
Kum	Deep areas of water bodies eg river scours, used by fish as shelter areas
Mauza	Jurisdictional unit without administrative offices, upazila subunit
Pukka	With reference to housing, construction entirely of concrete, cement, and iron.
Rabi	Winter season; in Bangladesh, generally Nov-Feb
Upazila	Administrative unit, district subunit

English terms

Flood land type classification	*Definition 1:* The flood land types (F0 to F4) defined by Master Plan Organization classify agricultural land in terms of the normal flooding characteristics that drive farmer choice of rice variety for a particular location: by *three-day duration* flood depth in the *1:2 year return period* flood event.[1] Land that remains flooded for three days or more to a maximum depth of 0-30 cm is classified F0 "flood free." Land that floods 30-90 cm is classified F1, 90-180 cm F2, 180-300 cm F3, and over 300 cm F4. Within a given area, the F0-F4 values *do not* vary from year to year. They *can* however change in response to interventions that modify flood hydrology eg. flood embankments, drainage enhancements. *Definition 2:* The land type designators F0-F4 are used by Bangladesh flood

[1]Master Plan Organization (MPO). 1987. "Agricultural Production System". Technical Report No. 14.Dhaka.

modellers to refer to the amount of land that floods *instantaneously* to the requisite depth interval in a numerical model of a *flood event of any return period.* In this formulation (which is conceptually different from and fundamentally incompatible with MPO's), the F0-F4 areas vary with return period; and, for the 1:2 year classification, the modeling classification, relative to the MPO values, may be biased towards deeper flooding given that it uses a less stringent flood duration criterion (instantaneous rather than three-day).

Revetment Generally, retaining wall or facing of masonry or other material, supporting or protecting a rampart, wall, embankment, etc. Specifically in this context, erosion-resistant materials placed directly on a streambank to protect the bank from erosion.

Executive Summary

Introduction

This report presents the findings of an Environmental Impact Assessment (EIA) carried out under the ADB project preparation technical assistance (PPTA) *Main River Flood and Bank Erosion Risk Management Program* (PPTA No. 8054 BAN). This EIA assesses the three Subprojects proposed for inclusion in Tranche 1 of ADB the Flood and Riverbank Erosion Risk Management Investment Program (FRERMIP, Project No. 44167-013). FRERMIP is a proposed Asian Development Bank (ADB)-funded multi-tranche financing facility (MFF)[2] with the Bangladesh Water Development Board (BWDB) as the Executing Agency and the Department of Disaster Management (DDM) as Implementing Agency for community-based flood risk management measures.

Program outputs will (i) strengthen the flood and riverbank erosion management system, and (ii) establish, at priority erosion sites, sustainable, integrated non-structural and structural risk management measures. The MFF would provide a loaned amount of approximately US$250 million in three tranches beginning in mid-2014 and concluding in mid-2023. The initial Tranche-1 receives external financing of US$ 75 million for total project cost of US$ 104 million.

Tranche 1 meets criteria for GOB environment category Red, and has been classified ADB environment category A. Environmental safeguards required by GOB and ADB for Tranche 1 are addressed by this EIA. The required environmental safeguards for Tranches 2 and 3 are set forth in a separate Environmental Assessment and Review Framework (EARF) document.

Critical Facts

The Context - FRERMIP

FRERMIP aims to sustain incomes and livelihoods of people living along selected reaches of Jamuna, Ganges, and Padma Rivers by enhancing resilience to flooding and to riverbank erosion through a mix of structural and non-structural measures. After initially protecting critically eroding riverbanks at priority areas, the program plans to move to more systematic riverbank stabilization, potentially leading towards river-reach stabilization during later tranches. The stabilization approach will make use of the currently ongoing consolidation of the river morphology developing towards a more accentuated channel pattern similar to the one observed in the 1970s, before the dramatic widening (from the 1970s to 2000s) took place. In parallel existing, degraded or eroded embankment lines, such as the Brahmaputra Right Embankment will be restored and extended to arrive at reliable flood protection for the large population living on the floodplain along the main rivers. The community-based flood risk management component aims to increase resilience and preparedness of the population for the residucal risk, for example if existing embankments unexpectedly breach.

[2] The MFF FRERMIP consists of three individual loans for three individual, however systematically developing phases (called tranches in ADB's terminology) of interventions at three priority sites along the lower Jamuna and upper Padma Rivers. The cascading loans are packaged into a Program with a duration of 9 years, while the three tranches (phases) overlap and are scheduled for typically 4-years duration. Each tranche or loan is called Project with interventions at different Sub-project sites.

FRERMIP as whole aims to reduce the flood risk at three priority subprojects by providing new and rehabilitated embankments, leaving distributaries open, along selected reaches of the Jamuna and Padma Rivers. To protect these embankments, river banks will be progressively stabilized, starting at critically eroding reaches. Over time, and in conjunction with other government programs this approach may lead to a general river stabilization with less channels potentially having some similarity to the river system before the passing of the sediment wave of the Great Assam Earthquake. In parallel to this study, Government investigates other river restoration alternatives[3]. Siting of physical works for FRERMIP will be planned using an innovative dynamic methodology that responds to evolving river behaviour ("adaptive approach").

The anticipated benefits are considerable: (i) reduced loss of agricultural and other land to river erosion, (ii) reduced flood damage to agriculture (etc) and (iii) increased agricultural production on less-flooded agricultural land.

The Assessed Project

The assessed Project is the proposed Tranche 1 of the MFF. Tranche 1 consists of three Subprojects: Jamuna Right Bank 1 (JRB-1), Jamuna Left Bank 2 (JLB-2), and Padma Left Bank 1 (PLB-1). JLB-2 and PLB-1 physical works consist of riverbank-erosion protection works along critically eroding areas. JRB-1 consists of very limited riverbank-erosion protection works in support of existing works and the restoration of degraded and eroded flood embankments, specifically a section of the Brahmaputra Right Embankment. Flood embankments will also be rehabilitated behind the JLB-2 and PLB-1 erosion protection works, but not until Tranche 2. These embankments do not meet ADB criteria for "associated facilities" of Tranche 1 and therefore are not included in this EIA analysis.

Significant Findings

JRB-1 Flood Embankment Potential Impacts

JRB-1 includes for a new/restored (10 km section of Brahmaputra Right Embankment destroyed in the mid-1990s) and rehabilitated flood embankments. The embankment will reduce flood depth and duration so as to reduce flood damage to crops and infrastructure, and to induce greater economic investment and productivity in floodplain agriculture and other activities by reducing flood risk.Currently, JRB-1 seasonally flooded land (i.e. within the proposed flood-protected area) consists of 12,000 ha that is flooded to 120-360 cm (F3 land type) and 4,000 ha that is deeply flooded to >360 cm (F4 land type). Of this, JRB-1 will transform about 40 per cent (6,600 ha) to flood-free conditions (F0 land type, 0-30 cm). Another 10 per cent (1900 ha) will be converted to moderately-flooded conditions (F1 and F2 land types, 30-120 cm). These hydrologic changes within the proposed JRB-1 flood-protected area have numerous potential secondary impacts. Intended beneficial impacts are significantly reduced flood damage to agriculture and infrastructure; increased cultivated area and cropping intensity; and the resulting increases in agriculture / aquaculture production.

Several negative impacts may occur without mitigation measures. Floodplain aquatic (wetland) habitats will be degraded or extirpated due to reduced flooded area, depth, and duration (mentioned above); reduced hydrologic connectivity; and physiochemical / water quality changes.

[3] The feasibility study of Capital Dredging and Sustainable River Management in Bangladesh currently investigates one single and and one multiple-channel option for Jamuna and Padma as first step towards the development of a river stabilization plan. The final report is expected in early 2014. Building on the Capital Dredging study and the initial morphological assessment of potential future channel patterns conducted as part of this feasibility study, the FRERMIP will conduct a comprehensive river stabilization plan to identify potential stabilization solutions, to be implemented in an adaptive and phased manner, with minimal impacts on the river and char environment.

This in turn will adversely affect floodplain-dependent openwater fish species migration, population levels, and catch levels, as well as wetland biodiversity, services, and products more generally. These impacts can in turn adversely affect the nutrition, health, and economic status of poor people. The embankment can impede cross-drainage resulting in drainage congestion, adversely affecting agriculture within the protected area, and block the movement of migrating fish.

The assessed status of fish migration in the study area is moderate to poor. The restored embankment forsees regulator rehabilitation and a number of additional regulators, allowing for all-year round flow in internal rivers and khals, such as the Hurashagar including certain limited flooding in places where distributaries branch off the main river. In addition, the more concentrated fish migration route through tributaries and distributaries (Hurashagar/Baral and Karatoya will be left unregulated.

Flood-control-led expansion of high-yielding varieties (HYVs) may increase utilization of ground water and surface water for irrigation, and may increase fertilizer and pesticide usage, that in turn may adversely affect water quality and availability for other uses or at other locations. Newly flood-free lands may have less than optimal residual moisture for winter agriculture, compromising yields or causing high irrigation water consumption and costs in these areas. The sandy subsoil strata have generally high permeability, which reduces the risk of general groundwater depletion. In addition the embankment is left open to the Karatoya River during Tranche-1, which allows for periodic flooding.

Provision of embankment flood protection typically stimulates accelerated investment in the protected area. This project-induced investment has obvious economic benefits but paradoxically it also has less obvious costs: over time, an increasing amount of infrastructure, and potentially an increasing number of lives, come to be located in lower-lying areas compared to the without-project situation. Embankments can greatly reduce but not entirely eliminate the flood risk to such areas, as embankments can fail for various operational, hydrologic, hydraulic, and geotechnical reasons. Best-practice flood damage reduction assessment methodologies take this phenomenon into account, such as planned under the community-based flood risk management component that addresses the residual risk and increases resilience and preparedness.

JRB-1, JLB-2, and PLB-1 Riverbank Protection Works Potential Impacts

The Brahmaputra System (including the braided Brahmaputra in Assam and the Jamuna in Bangladesh as well as the Padma and Lower Meghna) is a dynamic system that is characterized by continuous, unpredictable changes. In addition, the system was strongly influenced by the passing sediment wave triggered by the 1950 Great Assam Earthquake. The river belt has developed from a more stable single or double channel pattern in the late 1960s to a vastly expanded braided belt with numerous main, medium, and minor channels in the early 2000. The reach downstream of Bangabandhu (Jamuna) Bridge still exhibited a largely single channel characteristic in the early 1970s, being 6 km wide. By 2000 the width exceeded 11 km. During this period of expansion densely populated fertile floodplain land converted into mostly low lying sand bars and chars. This process has changed the river environment, characterized by one or two pronounced deep channels to a multitude of shallower channels, many falling dry during the dry season.

More recently the Brahmaputra exhibits much less lateral erosion and slowly turns back to a more stable, natural channel pattern. This development has triggered Government’s initiative to study different options for “river restoration” supporting the natural process of consolidation and regaining some of the lost, densely populated floodplain land.

The environmental consequences of the transformation of the river environment from few deep channels into a vastly expanded, shallow braided belt were not systematically studied. Therefore its environmental impact is non-quantifiable and in addition it is superimposed by dramatic population growth (from around 70 million to 150 million) with increasingly intensifying land use on the flood plains but also systematic river use, e.g. fishing with floating nets during the dry season.

Riverbank protection works at the three subproject sites has the purpose of protecting the existing floodplain habitat from continuous and systematic erosion. While the protection at the JRB-1 extends existing 10km long protection by 1km, new, several kilometer long riverbank protection at JLB-2 and PLB-1 is designed to protect valuable infrastructure and land from imminent erosion.

Riverbank protection works has numerous primary intended *direct* beneficial impacts. Along the erosion-protected sections, they reduce the risk that erosion of agricultural land will destroy livelihoods, impoverish vulnerable families, and result in displaces lacking options other than squatting on public lands or migrating to the Dhaka slums. Another intended direct benefit along erosion-protected sections is reduced risk of erosion damage to existing infrastructure (roads, settlements, etc), including flood embankment breaches.

An additional *indirect* or *conditional* benefit of erosion protection and channel stabilization works is achieved when such works are located in front of an existing or prospective flood embankment: stabilization of the impacts of that embankment. In particular, erosion protection works secure (decreases risks to) the economic benefits of embankment flood protection, thereby making them available to justify the costs of the erosion protection and embankment physical works construction, rehabilitation, and maintenance. This erosion protection impact is deemed indirect or conditional because its valence and magnitude is entirely dependent on, and can be evaluated only with reference to, the valence and magnitude of the impacts of the associated flood protection embankment.

River changes associated with Tranch 1 riverbank protection work were assessed through a specific morphology study carried out as part of this PPTA. The morphology study concludes that the initial (Tranche-1) riverbank protection works has little impact on the overall morphology of the Jamuna, including the immediate downstream areas. In all cases the work invites deeper channels along the protected bank but with expected little impact on downstream areas.

The morphology study also assessed the relevance of the built protection work on future potential channel options, part of larger-scale river stabilization plans. The non-symetric Jamuna Bridge has substantially changed the lower part of the Jamuna River, creating a large attached char at the right bank from the western bridge abutment to about Enayetpur, and resulted in a single channel in this reach, which is expected to remain stable without riverbank protection at both sides. Downstream, the river exhibits two channels, enclosing a large char. The initial morphological assessment indicates that this currently existing channel pattern is likely the most desirable for the future, meaning that the overall natural river pattern will not be altered by the proposed interventions nor being in conflict with likely future stabilization options, rendering the present work redundant. The same holds true for the situation in the upper Padma River, where the two-channel solution appears to be the best in the long run, also meaning that the existing conditions would not be altered and the riverbank protection would support the currently existing natural river pattern.

First studies on the interaction of riverbank protection works with the environment have been conducted in 2007 and 2011[4]. The JMREMP, 2007 study found that there were more fish species and higher population numbers at protected banks, as opposed to unprotected banks. The size of the fish depends on the size of the voids in the protection, which means that large voids in concrete

[4] JMREMP; 2007. Bank Protection and Fisheries at JMREMP two Sub-projects. Dr. Munir Ahmed, Special Report 24, May. CEGIS, 2011: Final Report on Environment Impact Assessment (EIA) for Use of Sand-filled Geob-Bags Under Water; earlier the JMREMP design include an EIA and obtained environmental clearance from Government before starting the construction of geotextile bag revetments.

blocks tend to attrackt larger fish, specifically carnivores, but fewer numbers, while geobags, having more but smaller voids, attract smaller fish in larger numbers. CEGIS, 2011 identified overall positive impacts of geotextile bag revetements on water resources, fisheries, the algae community, the ecosystem and the socio-economy. Important findings are that there is no change in water quality, the terrestrial habitat is protected, and the scocio-economic conditions are improved for the local population, including employment opportunities during construction, health and sanitation conditions, fishing opportunities, and especially the situation of women. Geotextile bag revetments might change the composition of fish species, alter the habitat of the benthic community, as well as cause local shifting of the migratory routes of the dolphins[5] during construction. However, these effects are reversible and the constructed revetments do not impact on the free movement of dolphins and the benthic habitat is quickly restored over geobag revetments. With respect to the overall use of the recommended riverbank protection technology, CEGIS 2011 concludes: "*Considering all environmental, social and technical consequences of the geobag use under water, it might be concluded that compared with CC block use alone, geo-bag use under water with CC block used above water is more environmentally sustainable, socially acceptable, technically feasible and economically cost effective if the quality requirements and design requirements are assured and monitored."*

Dolphins utilizing riverine habitats potentially affected by Tranche 1 are part of a trans-boundary (Bangladesh-India) population. Most international migration of Dolphins occurs within peri-border areas as short-range tributary-to-mainstem trips, but longer-range movements of individuals between the Tranche 1 influence area and India cannot be ruled out. Localized stable and deeper channels in front of Tranche-1 protective works are more attractive for dolphins as they provide preferred migration routes. First studies indicate that the proposed riverbank protection increases the amount of small fish, the main food for dolphins. The construction season lies outside of the migration season of the dolphins (during the rising and falling of flood waters) and does not overlap much with the surfacing time of the juvenile and neonate dolphins in the morning and afternoon-evening hours.

Land Acquisition, Resettlement, and Construction Impacts

The land acquisition and resettlement required by the implementation of physical works will be managed through the Resettlement Plan process.

Routine impacts of construction-phase activitieswill be managed through the inclusion of standard environmental safeguard clauses in construction contract bidding packages, Contractor's Environmental Management Plans (CEMPs) and BWDB construction supervision.

Stakeholder Comments and Concerns

Two rounds of public consultation were undertaken during preparation of this EIA. The first presented the proposed project and EIA terms of reference to stakeholders for their review and suggestions, and the second presentedthe draft EIA results to stakeholders for their comments. Stakeholder concerns are of at most moderate significant, and are resolvable through continued dialogue and accommodation during design and implementation.

Recommended Actions

Overview

[5] Dolphins normally chose the thalweg, i.e. the deeper part of the river for migration

Mitigation of the aforementioned impacts is complex and challenging. It will not result in all residual impacts being reduced to insignificance, but it will reduce them to levels considered acceptable under the circumstances. To the extent possible, impacts will be mitigated through measures purpose-designed to the impact and setting. Many mitigation measures have been aggressively mainstreamed into the engineering designs, which also incorporate significant impact avoidance features e.g. leaving distributaries open and embankment vegetation and/or afforestation.

Recognizing potential cumulative effects when moving from emergency type riverbank protection during an initial tranche towards more systematic river stabilization in the priority reaches during following tranches, the first tranche will incorporate a comprehensive river stabilization study to develop and assess potential future stabilization options as well as impacts and mitigation measures. In addition, this study accounts for the potential cumulative and trans-boundary impacts from potential other programs and projects by covering the whole Brahmaputra System from the upstream areas at Kurigram in Bangladesh to the Bay of Bengal.

Environmental Management Plan

The Environmental Management Plan (EMP) sets for the mitigation and monitoring to be undertaken. Four mitigation packages address:

- *Construction-phase impacts.* Management will be through the inclusion of standard environmental safeguard clauses in construction contract bidding packages, Contractor's Environmental Management Plans (CEMPs) and BWDB construction supervision.

- *Impacts on critical habitats and trans-boundary/internationally migrating/threatened species:* The proposed mitigation measures are modelled after the ongoing Wetland Biodiversity Rehabilitation Project of GIZ /Department of Fisheries/BWDB, currently under implementation in areas of Pabna adjacent to the JRB-1 project area..

- *Impacts on openwater fish biodiversity and production.* Measures to mitigate these impacts (i) include openwater fisheries-related measures and (ii) expansion of aquaculture, particularly in areas benefitting from Project-led reductions in flood and erosion risk.

- *Land acquisition and resettlement impacts.* Management measures are documented in Final Report, Annex J1 Resettlement Framework, and Annex J2, Resettlement Plan for Tranche 1.

The EMP will be implemented by the Project Management Unit supported by an Institutional Strengthening and Project Management Consultant (ISPMC) team that will include an environment specialist, as well as an implementing NGO and a separately hired specialist environmental management organization outlinng the establishment of a biodiversity sanctuary in line with gradually increasing river stabilization during the program. Implementation of EMP mitigation and monitoring activities will be scheduled to ensure that each type of safeguards measure is in place and operating effectively by the time each corresponding impact (construction- or implementation-phase) is triggered.

Future Mitiagtion Measures – Preparing for Tranche-2 and 3

While the tranche-1 project consists of limited riverbank protection measures and the restoration/rehabiliation of an eroded/degraded embankment, future tranches plan to extend these measures. The limited and isolated riverbank protection measures of Tanche-1 do not change the existing channel pattern, as established by the morphological study. However, follow-on tranches, part of the total program, could do so when existing, initial work gets extended over greater length of some ten kilometers. As such, the proposed Tranche-1 combines construction measures with very limited morphological impact with two extensive studies on (i) potential ways towards larger river-reach stabilization and (ii) the establishment of a river sanctuary.

Potential alternative river-reach stabilization alternatives, impacts, and mitigation measures will be assessed during Tranche-1 through several systematic studies. During the first two years of Tranche-1 a systematic river stabilization study will be conducted. The river stabilization study will build on the ongoing natural development towards a more consolidated channel pattern. Alternative solutions will be developed how to support this channel pattern towards a more systematic stabilization of the lives on the floodplain. Social and environmental consideratiosn will form an integral part of the study in order to determine the impacts of different stabilization options, but also collect missing data and broaden the understanding about critical social and environmental parameters. The study results are alternative solutions for river-reach stabilization that accounts for the multitude of different drivers, outline least-impact solutions, identify the optimimal alternative, and design the following tranche work.

Starting from there, the feasibility study for tranche-1, continaing environmental assessment, will be supplanted by by a specialist sanctuary study that details the requirements for a river sanctuary in response to negative impacts from river stabilization. The sanctuary study is part of the Tranche-1 design and scheduled for implementation during year-3 and 4. It will specifically address impacts on critical habitats and trans-boundary/internationally migrating/threatened species, following (i) the Padma Bridge Project terms of reference for biodiversity baseline studies and monitoring, and a biodiversity sanctuary; and (ii) India's recently-promulgated Dolphin conservation action plan, as well as (iii) assessing migratory bird impacts. It will also attempt to develop measures that enhance the river biodiversity, specifically providing sheltered aquatic habitats.

The EIA for Tranche-2, part of the feasibility study, continues to aggressively mainstream environmental aspects into the project design. In addition, the EIA will follow a parallel approach by building on the river stabiliuzation plan and the sancturary study, to (i) address remaining uncertainties associated with the database on the impacts of riverbank protection on the river habitat, while (ii) continuing to reduce the imminent erosion risk to the livelihoods of a large number of mostly poor people on the floodplain.

Design- and Implementation-Phase Public Consultation

Stakeholder consultation will continue during subproject design and implementation to provide information to stakeholders about the project and to receive their input and concerns.Meetings will include in particular households and persons affected by resettlement (AHs and APs) and other adverse environmental and social impacts. At these meetings, information about designs, impacts, and mitigation and monitoring measures, including specific resettlement entitlements, will be disclosed verbally and in Bangla-language information handouts.

Grievance Redress Mechanism

At each Tranche 1 subproject location, a local Grievance Redress Committee (GRC) will be set up during the design stage and continue in operation through the implementation phase. Each GRC will consist of a BWDB representative, the concerned Union Parishad chairperson(s), and a representative of resettlement-affected persons for subprojects with resettlement. GRCs will resolve grievances within one month of receipt. Aggrieved personsare free to access the country's legal system regardless of GRC involvement. In addition, a Joint Verification Team (JVT) is responsible to address complaints related to the land acquisition process.

Reporting and Monitoring

Environmental monitoring reports will be issued for bi-annually disclosure on ADB's website. The environmental monitoring reports will also be incorporated into the December and July version of the quarterly progress report, which is at the beginning and end of every construction season. Environmental monitoring reports will be prepared by the Project Management Office, under the direction of the nominated environmental officer with the help of the consulting team's environmental specialist.

Monitoring will be undertaken for timely detection of conditions requiring remedial measures; to provide information on mitigation and institutional strengthening progress; and to assess compliance with required safeguards. Overall implementation progress including EMP implementation will be reviewed during periodic review missions involving ADB, the Implementing Agency, the Executing Agency, and the Implementation Consultant.

1. Introduction

1.1 Overview

1. The project area of the Flood and Riverbank Erosion Risk Management Investment Program (FRERMIP)comprises about 2,44,000 ha of which approximately 13 percent are occupied by rivers and a very minor percentage (approximately 0.6 percent) is occupied by other water bodies. The hydrology of the area is dominated by the three major rivers, the Jamuna, the Ganges and the Padma.

2. FRERMIPis an Asian Development Bank (ADB) multi-tranche financing facility (MFF) being prepared in partnership with the Government of Bangladesh (GOB). It aims to sustain incomes and livelihoods of people living along the three main rivers of Bangladesh – the Jamuna, the Ganges, and the Padma – by enhancing resilience to flood and riverbank erosion. Project outputs will (i) strengthen the flood and riverbank erosion management system, and (ii) establish, at priority erosion sites, sustainable, integrated non-structural and structural risk management measures. The MFF would provide a maximum loaned amount of approximately US$250 million over a nine-year period in three tranches of USD60 million, USD100 million, and USD90 million respectively.

3. This report presents the findings of an Environmental Impact Assessment (EIA) of the three Subprojects proposed for inclusion in Tranche 1: Jamuna Right Bank (JRB) 1, Jamuna Left Bank (JLB) 2, and Padma Left Bank (PLB) 1.

4. A companion document, the Environmental Assessment and Review Framework (EARF) sets forth (i) the safeguards procedures to be followed during subsequent MFF tranches, (ii) safeguards-related criteria to be considered in the selection of subprojects for subsequent tranches, and, with regard to Executing Agency safeguards capacity, (iii) an assessment and recommendations for appropriate institutional strengthening.

5. The EIA and EARF were prepared as part of the Tranche 1 feasibility studies under the ADB project preparation technical assistance project *Main River Flood and Bank Erosion Risk Management Program*(PPTA No. 8054 BAN).

1.2 Objectives

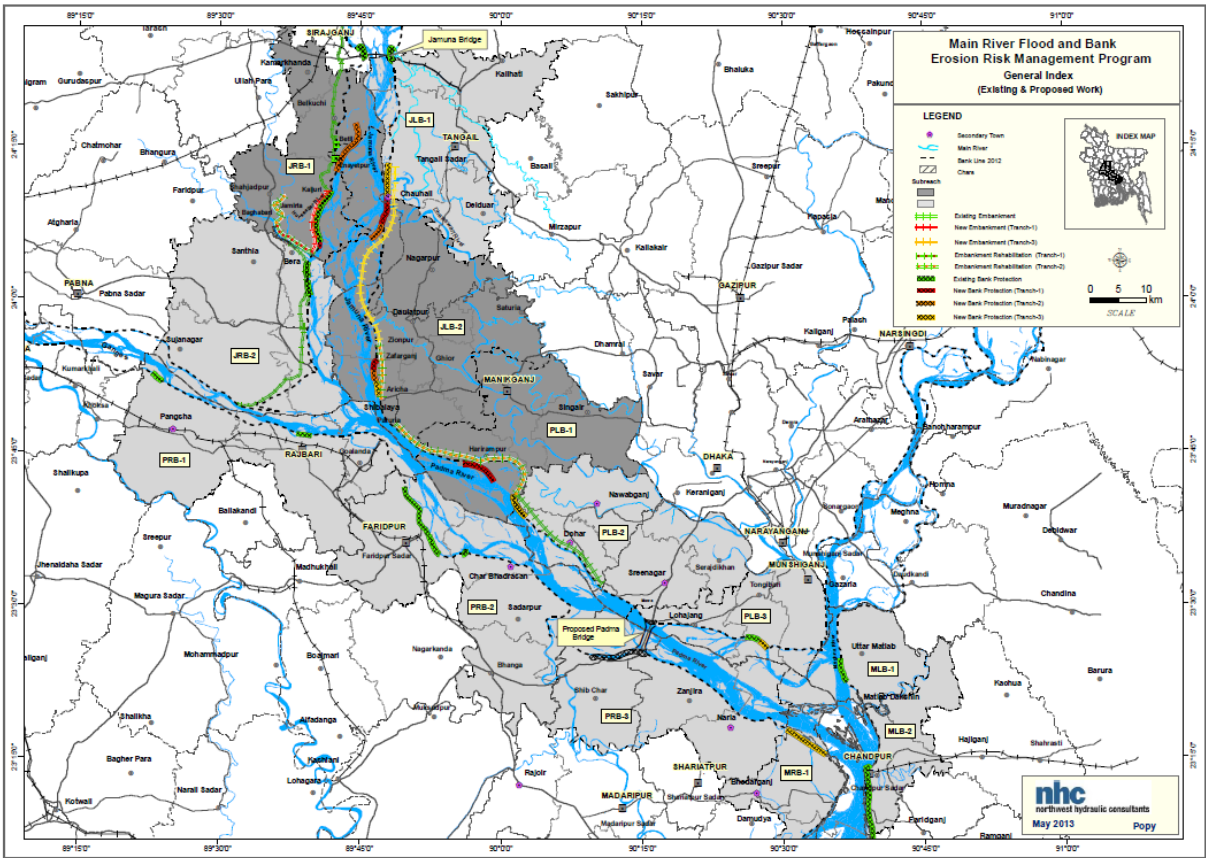
6. The main river flood and bank erosion risk management program (FFERMIP) is the follow-on project of the Jamuna-Meghna River Erosion Mitigation Project (JMREMP). It aims to sustain incomes and livelihoods of people living along the three main rivers of Bangladesh through establishing integrated non-structural and structural risk management measures at priority erosion sites and addressing their sustainability.

1.3 Project area

7. The project area of the proposed investment encompasses the river reach of the Jamuna River from below the Jamuna Bridge and the proposed Ganges Barrage site to Chandpuron the Lower Meghna. The Jamuna and Ganges river courses downstream of these two major river works are somewhat independent of upstream river developments.

8. These upstream areas are expected to be included in the Ganges Barrage project and the World Bank-supported Riverbank Improvement Project (RBIP). The project area covers a total population of 10.5 million in 40 upazilas and 431 unions, with an average population density of nearly 1,600 persons per km² of floodplain land.

9. The EIA/SIA studies have addressed the impacts of proposed interventions on three sub-reaches selected by feasibility study and possible inclusion in MRP tranche 1. These sub-reaches were selected from 13 sub-reaches into which the MRP area was divided based on discussions among BWDB, ADB, and the PPTA consultant. Sub-reaches are divided at upazila boundaries, most of which follow main river tributaries and distributaries and have not changed since 1961, facilitating the calculation of long-term trends from upazila-wise datasets. Eachsub-reach covers three to four upazilas and has a population of approximately 1 million. Six sub-reaches were selected for pre-feasibility level investigation using a multi-criteria assessment approach, and three – JRB-1, JLB-2, and PLB-1 – were retained for feasibility study.



Map1.1: Location of Project area

1.4 EIA Team members

10. International Consultant

Sara Bennett, PhD, International Environmental Specialist

11. CEGIS Team-

1. Mr. Mujibul Huq, Environmental Adviser, CEGIS
2. Dr. Anil Chandra Aich, Soil and Agriculture Specialist, CEGIS
3. Dr. Dilruba Ahmed, Senior Sociologist, CEGIS
4. Mr. Ashok Kumar Das, Senior Fisheries Biologist, CEGIS
5. Mr. Kazi Kamrull Hassan, Senior Water Resources Planner, CEGIS
6. Mr. Amanat Ullah, Senior Ecologist, CEGIS
7. Mr. Fahad Khan Khadim, Junior Water Resources Engineer, CEGIS
8. Mr. Roland Nathan Mondol, Junior Fisheries Biologist
9. Mr. Mobashir Bin Ansari, Junior Sociologist

10. Mr. Saifuddin Mahmud, Junior Sociologist
11. Mr. Zahid Hasan Dhali, Junior Agriculturist

1.5 Report Format

12. This EIA report has the following 10 (ten) chapters:

Chapter 1: Background, study area, objectives, scope of work in addition to presenting the list of the multi-disciplinary EIA study team members.

Chapter 2: The policy, legal and administrative framework.

Chapter 3: Approach and Methodology followed for conducting the EIA study.

Chapter 4: Description of the project including the present status of the infrastructure and the proposed interventions.

Chapter 5: Environmental and Social baseline condition in respect of meteorology, seismicity, water resources, land resources, agriculture, livestock, ecological resources and socio-economic condition.

Chapter 6 Public consultation and disclosure

Chapter 7: Important environmental and social components likely to be impacted by the proposed rehabilitation plan.

Chapter 8: Assessment of the impacts of the proposed rehabilitation plan on the environmental and social components pertaining to water resources, land resources, agriculture, livestock, ecological resources and socio-economic condition.

Chapter 9: Environmental Management Plan

Chapter 10: Conclusion and recommendations.

2. Policy, Legal and Administrative Framework

2.1 Introduction

13. This Chapter summarizes the policies, laws, regulations, guidelines, and international environmental agreements to which Bangladesh is a party that are relevant to this environmental assessment, including all environmental safeguards and environmental management guidance relevant to the assessed project.

2.1.1 Environmental Protection Policies and Legislation

a. National Conservation Strategy (1992)

14. National Conservation Strategy (NCS) was drafted in late 1991 and submitted to the Government in early 1992. This was approved in principle. However the final approval of the document is yet to be made by the government.

b. National Environmental Policy (1992)

15. Bangladesh National Environmental Policy of 1992 sets out the basic framework for environmental action, together with a set of broad sectoral action guidelines. The Environment Policy provides the broader framework of sustainable development in the country. It also states that all major undertakings, which will have a bearing on the environment, (including setting up of an industrial establishment) must undertake an Initial Environmental Examination (IEE) and Environmental Impact assessment (EIA) before they initiate the project. The Environment Policy delineates the Department of Environment (DoE) as the approving agency for all such IEE/EIA's to be undertaken in the country.

c. National Environmental Management Action Plan (NEMAP) (1995)

16. The National Environmental Management Action Plan (NEMAP) is a wide ranging and multi-faceted plan, which builds on and extends the statements set out in the National Environmental Policy. NEMAP was developed to address issues and management requirements for the period 1995 to 2005 and set out the framework within which the recommendations of the National Conservation Strategy are to be implemented.

17. NEMAP has the following broad objectives:

- Identification of key environmental issues affecting Bangladesh;
- Identification of actions necessary to halt or reduce rate of environmental degradation;
- Improvement of the natural and built environment;
- Conservation of habitats and biodiversity;
- Promotion of sustainable development; and
- Improvement in the quality of life of the people.

d. Bangladesh Climate Change Strategy and Action Plan (BCCSAP) 2009

18. The Bangladesh Climate Change Strategy and Action Plan 2009 is built on the following six pillars:

(i) Food security, social protection and health to ensure that the poorest and most vulnerable in society, including women and children, are protected from climate change and that all programs focus on the needs of this group for food security, safe housing, employment and access to basic services including health;

(ii) Comprehensive disaster management to further strengthen the country's already proven disaster management system to deal with increasingly frequent and severe natural calamities;

(iii) Infrastructure to ensure that existing assets are well maintained and fit-for-purpose and that urgently needed infrastructure is put in place to deal with the likely impact of climate change;

(iv) Research and knowledge management to predict the likely scale and timing of climate change impacts on different sectors of the economy and socio-economic groups, to underpin future investment strategies and to ensure that Bangladesh is networked with the latest global thinking on science and best practices of climate change management;

(v) Mitigation and low carbon development to ensure low carbon development options and implement these as the country's economy grows over the coming decades and the demand for energy increases; and

(vi) Capacity building and institutional strengthening to enhance the capacity of government ministries and agency, civil society and the private sector to meet the challenges of climate change and mainstream them as part of development action.[6]

2.1.2 Environmental Conservation Act (1995) and Amendments

ECA '95

19. The Bangladesh Environment Conservation Act of 1995 (ECA '95), with its 2000 and 2002 amendments (see below), is currently the main legislation for environment protection in Bangladesh. The Act addresses environment conservation, environmental standards development and environment pollution control and abatement. It replaced the earlier Environment Pollution Control Ordinance of 1977, now repealed.

20. The main objectives of ECA '95 are (i) conservation and improvement of the environment; and (ii) control and mitigation of pollution of the environment.

21. The main strategies of ECA '95 can be summarized as:

- Declaration of ecologically critical areas and restriction on the operations and processes, which can or cannot be carried out/initiated in the ecologically critical areas;
- Regulations in respect of vehicles emitting smoke harmful for the environment;
- Environmental clearance;
- Regulation of the industries and other development activities' discharge permits;
- Promulgation of standards for quality of air, water, noise and soil for different areas for different purposes;
- Promulgation of a standard limit for discharging and emitting waste; and
- Formulation and declaration of environmental guidelines.

22. ECA (1995) requires environmental clearance from DoE of industrial units and projects. Under Section 12 of the Act, "no industrial unit or project shall be established or undertaken without obtaining environmental clearance from the Director General in the manner prescribed by the Rules." The Act requires project proponents to obtain Environmental Clearance from the Director General (DG) DoE prior to construction.

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[6] Government of Bangladesh. 2008. "Bangladesh Climate Change Strategy and Action Plan." http://www.moef.gov.bd/climate_change_strategy2009.pdf

23. A schedule attached to the Environment Conservation Rules 1997 categorizes projects as Green, Orange A, Orange B, and Red, and identifies for each category the level of environmental impact assessment required and other clearance application procedures and information.

24. An appeal procedure is available for proponents who fail to obtain clearance. Failure to comply with any part of this Act may result in punishment to a maximum of three years imprisonment or a maximum fine of BDT 300,000 or both. The Department of Environment (DOE) executes the Act under the leadership of the DG.[7]

ECA Amendment 2000

25. This amendment focuses on (i) ascertaining responsibility for compensation in cases of damage to ecosystems, (ii) increased provision of punitive measures, both fines and imprisonment, and (iii) fixing authority on cognizance of offences.

ECA Amendment 2002

26. This amendment sets forth: (i) restrictions on polluting automobiles; (ii) restrictions on the sale and production of environmentally harmful items like polythene bags; (iii) assistance from law enforcement agencies for environmental actions; (iv) punitive measures; (v) authority for trials of environmental cases.

ECA Amendment 2010

27. This amendment of the Act deals with: (i) declaration of ecologically critical areas (ECAs); (ii) prohibition of harmful work and processes from being begun or continued in such areas; (iii) management systems for ECAs; (iv) restriction of hill cutting and razing; (v) restriction of hazardous waste production, import, collection, transportation, etc; (vi) prohibition of pollution created by ship breaking or cutting; (vii) prohibition of infilling of demarcated wetlands and waterbodies; (viii) determination of responsibility for compensation in cases of ecosystem damage; and (ix) restrictions on various industries and projects in various locations.

Environment Court Act (2010)

28. The Environmental Court Act (2010) provides for the establishment of an environment courts and amends the prevailing act to accelerate punishment of environment-related crime. This act defines: the jurisdiction of the environment court; the penalty for violating the court's order; the trial procedure in the special magistrate's court; the appeal and investigation procedures; and it gives the environment court authority to enter, search, and inspect.

Environmental Conservation Rules (1997)

29. These were the first Rules promulgated under the Environmental Conservation Act of 1995. These Rules defined categories of industries and projects and the types of environmental assessments each requires. There have been three amendments to these Rules, in February and August 2002, and in April 2003.

30. Among other things, the Rules set forth (i) National Environmental Quality Standards for ambient air, various types of water, industrial effluent, emission, noise, vehicular exhaust etc.;

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[7] Government of Bangladesh. 1995. "The Bangladesh Environment Conservation Act, Act No. 1 of 1995" http://www.moef.gov.bd/html/laws/env_law/153-166.pdf

(ii) the requirement for and procedures to obtain environmental clearance; and (iii) the requirement for IEE/EIAs for the various categories of industries and projects.[8]

EIA Guidelines for Industries (1997)

31. The EIA Guidelines for Industries (1997) sets forth lEE and EIA requirements for various industrial sectors and activities.

Environmental Clearance Procedure for Red Category Projects

32. Figure 4.2 shows the application procedure for obtaining site / environmental clearance. To obtain an environmental clearance certificate for category Red projects (the category of the Project documented here), the following documents and materials must be submitted with the application to DoE:

- Project feasibility report, where applicable
- Environmental impact assessment report
- Environmental management plan
- No Objection Certificate from relevant local authority (where applicable)
- Other necessary information, where applicable

2.1.3 Water Policies, Plans,and Legislation

a) National Water Policy (1999)

33. The National Water Policy, 1999, aims to ensure efficient and equitable management of water resources; proper harnessing and development of surface and ground water; availability of water to all concerned; and institutional capacity building for water resource management. It also addresses issues such as river basin management; water rights and allocation; public and private investment; water supply / sanitation; and water needs for agriculture, industry, fisheries, wildlife, navigation, recreation, environment, preservation of wetlands, etc. It does not address issues like consequences of trans-boundary water disputes and watershed management.

34. Specifically with regard to river flooding and erosion, it states that through its responsible agencies Government will:

(i) Develop early warning and flood-proofing systems; designate flood risk zones;

(ii) Take appropriate measures to provide desired levels of protection for life, property, vital infrastructure, agriculture and wetlands guided by these principles:

(a) Highest priority is providing full flood protection to economical important regions (eg metropolitan areas, sea and air ports, export processing zones);

(b) A reasonable degree of flood protection will be gradually provided to other critical areas (district / upazila towns, important commercial centers and historic places);

(c) in other areas (except those protected by existing flood control infrastructure), people will be motivated to develop flood proofing measures (eg raised platforms for homesteads, market places, educational institutions, community centers) and adjust cropping patterns to suit the flood regime;

[8]Government of Bangladesh. 1997. Environment Conservation Rules, 1997, as Amended 2002 and 2003. http://www.doe-bd.org/2nd_part/179-226.pdf

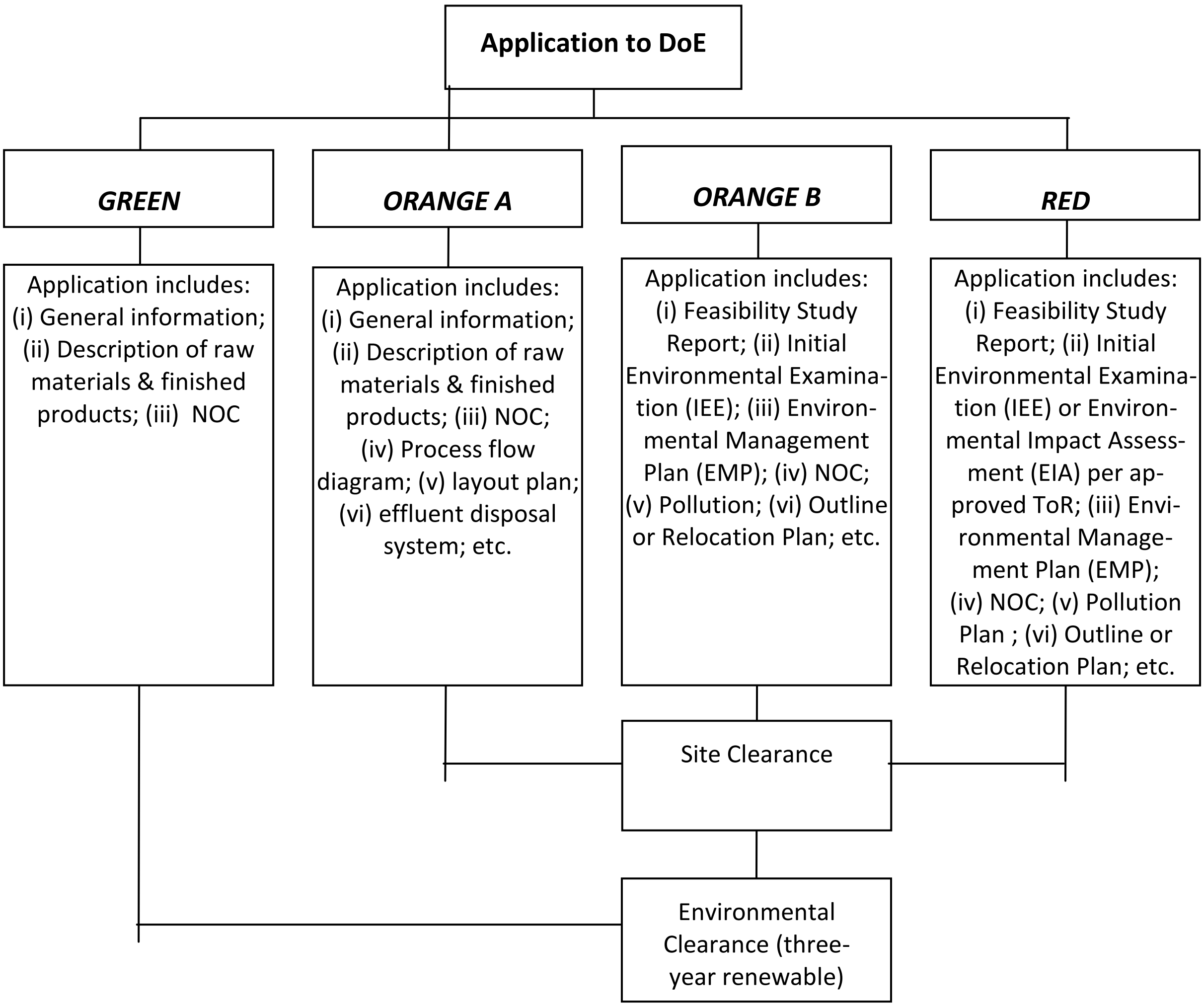

Figure 2.1: Application Procedure For Obtaining Site and Environmental Clearance

(d) All future national and regional highway, railway, and public building / facility new construction and reconstruction will be above the highest recorded flood level;

(e) All road and railway embankment plans will provide for unimpeded drainage;

(iii) Survey and investigate riverbank erosion problems, develop and implement river training and erosion control master plans that preserve scarce land and prevent landlessness and pauperization; and

(iv) Plan and implement coastal and river char land reclamation schemes.[9]

b) National Water Management Plan (2001, approved 2004)

35. The National Water Management Plan (NWMP) operationalizes the directives of the NWP. It is a “framework plan within which line agencies and other organizations are expected to plan and implement their own activities in a coordinated manner” in three phases – two of them now in the past (2000-5, 2006-10) and the third a perspective plan for 2011-25. Plan implementation was to be updated every five years but as of this writing has not been. NWMP has three central objectives, to be given equal importance: (i) rational management and wise use of water; (ii) quality of life

[9]Ministry of Water Resources. 1999. “National Water Policy”. Government of Bangladesh, p. 6-7.

improved by equitable, safe, reliable access to water for production, health, and hygiene; (iii) sufficient, timely, clean water for multi-purpose use and for preservation of aquatic ecosystems. With regard to the main rivers, NWMP articulates the main aims as ensuring comprehensive structural and non-structural development and management for multipurpose use; integrating the needs of all users through comprehensive planning of river systems by the responsible agencies and working towards international river basin planning (p. 9). Several national programmes of main rivers studies and research (p. 17), and twelve main rivers projects (p. 27), are identified.[10]

c) Guidelines for Environmental Assessment of Water Management (Flood Control, Drainage and Irrigation) Projects (approved 2003, published 2005)

36. The 2005/2003 guidelines are an update of 1992 guidelines issued by Flood Plan Coordination Organisation (FPCO) to govern assessment of Flood Action Plan (FAP) projects and programmes. The document sets out the framework for environmental assessment of flood control, drainage, and irrigation projects in Bangladesh; it aims both to educate and to guide project planning. It primarily addresses project planning (project identification, pre-feasibility, feasibility), but does include information on the preparation of management recommendations for later project stages (design, construction, operation, monitoring, decommissioning). The guidelines emphasize the need for wider knowledge of measures and procedures such as EIA to prevent future environmental damage, in light of the "widespread and serious environmental damage done in the past by physical interventions affecting the water sector (largely before formal assessment procedures were developed)." The stated purpose is "not to prevent development, but to ensure that it proceeds with due regard for the environment."[11]

d) National Policy for Safe Water Supply and Sanitation (1998)

37. The National Drinking Water Supply and Sanitation Policy (1998) goal is accessibility to all of water and sanitation services within the shortest possible time at a price that is affordable to all. The Policy will be achieved through strategies formulated at various levels in consultation with the Ministry of Planning. Policy objectives are (i) to improve the standard of public health and (ii) to ensure an improved environment. Policies for rural and urban areas are presented separately as they differ in institutional aspects, content, and magnitude.

e) National Policy for Arsenic Mitigation (2004)

38. The National Policy for Arsenic Mitigation (2004) provides a guideline for mitigating the effect of arsenic on people and environment in a realistic and sustainable way. It supplements the National Water Policy (1998) and the National Policy for Safe Water Supply and Sanitation (1998) in fulfilling national goals related to poverty alleviation, public health, and food security.

39. The Policy states that access to safe water for drinking and cooking shall be ensured through implementation of alternative water supply options in all arsenic-affected areas. Arsenic mitigation activities under the Policy will focus on public awareness, alternative arsenic safe water supply, diagnoses and management of patients and capacity building. The national arsenic programme is to encourage and promote research and development on the impact of arsenic on water supplies, health, food, and agriculture.[12]

f) Inland Water Transport Authority Ordinance (1958)

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[10] Water Resources Planning Organization (WARPO). 2001. "National Water Management Plan". Ministry of Water Resources, Government of Bangladesh.http://www.warpo.gov.bd/nwmp.html

[11] Water Resources Planning Organization. 2005. "Guidelines for Environmental Assessment of Water Management (Flood Control, Drainage and Irrigation) Projects". Dhaka, Bangladesh: National Water Management Plan Project, Ministry of Water Resources, Government of the People's Republic of Bangladesh.

[12] Government of Bangladesh. 2004. "National Policy for Arsenic Mitigation". Department of Public Health Engineering (DPHE).http://www.dphe.gov.bd/pdf/National-Policy-for-Arsenic-Mitigation-2004.pdf

40. This ordinance sets up an authority for the development, maintenance and control of inland water transport and certain inland navigable waterways. The authority is mandated to perform functions including carrying out river conservancy work; river training for navigation purposes and aiding navigation; drawing up dredging program requirements and priorities for efficient navigable waterway maintenance, reviving dead or dying rivers, channels, and canals, and development of new navigation waterways.[13]

2.1.4 Wildlife, Fisheries, Forestry, and Biodiversity Policies and Legislation

a) Bangladesh Wildlife (Protection and Safety) Act 2012

41. The Act:

- Protects 1,307 species of plants and animals, including 32 species of amphibian, 154 species of reptile, 113 species of mammal, 52 species of fish, 32 species of coral, 137 species of mollusk, 22 species of crustacean, 24 species of insect, six species of rodent, 41 species of plant and 13 species of orchid. Of these, eight amphibian, 58 reptile, 41 bird, and 40 mammal species are listed as endangered in the IUCN Red Data Book (2000).
- Mandates one to three years imprisonment, a fine of BDT 50,000 to 200,000, or both, for wildlife poaching, capturing, trapping, and trading, and for the purchase ofwild animals, parts of wild animals, trophies, meat or other products without licence.
- Mandates two to seven years imprisonment and BDT 100,000 to 1 million fine or both, for killing an elephant or tiger; and 12 years plus BDT 1.5 million for repeat offenders.
- Mandates five years imprisonment and BDT 200,000 fine for killing a cheetah, clouded cheetah, gibbon, sambar deer, crocodile, gavial, whale, and dolphin.
- Mandates two years imprisonment and BDT 200,000 fine for killing a wild bird or migratory bird.
- Empowers the Government to create an eco-park, safari park, botanical garden, or breeding ground on any state-owned forest land, land or water-body.
- Mandates two years imprisonment for farming, woodcutting, burning, and construction on such reserves.[14]

b) Bangladesh Wildlife (Preservation) Order (1973) and Act (1974)

42. The Bangladesh Wildlife Preservation (Amendment) Act 1974 regulates the hunting, killing, capture, trade and export of wild life and wild life products. It designates a list of protected species and game animals. It empowers the Government to declare areas as game reserves, wildlife sanctuaries, and national parks to protect the country's wildlife and provides the following legal definitions:

- *Game reserve*is defined as an area declared by Government wherein the capture of wild animals is unlawful, to protect wildlife and increase the population of important species;
- *National park*is defined as an area declared by Government comprising a comparatively large area of outstanding scenic and natural beauty with the primary objective of protection and preservation of scenery, flora, and fauna in their natural state, to which access for public recreation and education, and for scientific research, may be allowed;

[13]Government of Bangladesh. 1958. "Inland Water Transport Authority Ordinance." http://bdlaws.minlaw.gov.bd/pdf/282___.pdf
[14]Government of Bangladesh. 2012. "Wild Life (Protection and Safety) Act 2012 [in Bangla]." http://www.bforest.gov.bd/images/test/wildlife%20act.pdf

- *Wildlife sanctuary*is defined as an area declared by Government that is closed to hunting, shooting, or trapping of wild animals as an undisturbed breeding ground, primarily for the purpose of protecting all natural resources, including wildlife vegetation, soil, and water.

43. The Act allows Government to relax any or all specified prohibitions for scientific purposes, for aesthetic enjoyment, or betterment of scenery.[15]

c) Protection and Conservation of Fish Act (1950)

44. This Act provides power to the government to:

- Make and apply rules to protect fisheries.
- Prohibit or regulate erection and use of fixed engines; and construction of temporary or permanentweirs, dams, bunds, embankments and other structures.
- Prohibit the destruction of fish by explosives, guns, and bows in inland or coastal areas.
- Prohibit the destruction of fish by poisoning, pollution, or effluents.
- Prescribe the seasons during which fishing is allowed.
- Prohibit fishing during spawning periods.
- Specify officials having authority to detect breaches of this Act.[16]

d) East-Bengal Protection and Fish Conservation Act (1950) and Amendments

45. The East-Bengal Protection and Fish Conservation Act (1950), as amended by the Protection and Conservation of Fish (Amendment) Ordinance (1982) and the Protection and Conservation of Fish (Amendment) Act (1995), provides for the protection and conservation of fish in inland waters of Bangladesh. These instruments define a relatively non-specific framework that simply provides a means for Government to introduce rules to protect inland waters not in private ownership. Among other things, they sanction rule-making regarding destruction of, or any attempt to destroy, fish by poisoning of water or depletion of fisheries by pollution, industrial effluent, or otherwise.

e) Protection and Conservation of Fish Rules (1985)

46. These Rules are in line with the overall objectives of the Fisheries Act and its amendments. Section 5 of the Rules states that, "No person shall destroy or make any attempt to destroy any fish by explosives, gun, bow and arrow in inland waters or within coastal waters". Section 6 states, "No person shall destroy or make any attempt to destroy any fish by poisoning of water or the depletion of fisheries by pollution, by trade effluents or otherwise in inland waters."

f) National Forest Policy (1994)

47. The National Forestry Policy (1994) is a revision of the National Forest Policy (1977) in light of the National Forestry Master Plan. The major targets of the Policy are to conserve existing forest areas; bring approximately 20 per cent of the country's land area under the afforestation program; and increase reserve forest land by 10 per cent by the year 2015, through coordinated efforts of Government and non-governmental agencies, and active participation of the people.

48. The need of amendments of the existing forestry sector related laws and adoption of new laws for sectoral activities have been recognized as important conditions for achieving the policy

[15]Government of Bangladesh. "Bangladesh Wild Life (Preservation) Order (1973)."
http://bdlaws.minlaw.gov.bd/print_sections_all.php?id=452
[16]Government of Bangladesh. 1950. "Protection and Conservation of Fish Act, 1950."
http://bdlaws.minlaw.gov.bd/pdf/233___.pdf

goals and objectives. The Forest Policy also recognizes the importance of fulfilling the responsibilities and commitments under international multilateral environmental agreements.

g) Biodiversity Conservation Strategy and Action Plan 2004

49. The Biodiversity Conservation Strategy and Action Plan 2004 (BCSAP) is a wide-ranging multi-faceted plan closely related to the National Environment Policy. BCSAP has the following broad objectives:

- Identification of key environmental issues affecting Bangladesh;
- Identification of actions necessary to halt or reduce the rate of environmental degradation;
- Improvement of the natural and built environment;
- Conservation of habitats and biodiversity;
- Promotion of sustainable development; and
- Improvement in the quality of life of the people.

2.1.5 Agriculture and Land Use Policies and Legislation

a) National Agriculture Policy (1999)

50. The goal of the National Agriculture Policy (1999) is to facilitate and accelerate technological transformation with a view to achieving self-sufficiency in food production and improving the nutritional status of the population. The overall objective of the Policy is to achieve food self-sufficiency through increasing production of all crops including cereals and a dependable food security system for all. It aims to ensure, inter-alia, a sustainable agricultural production system; preservation and development of land productivity; and preservation of crop diversity. The Policy also aims to develop a contingency management system to combat natural disasters. The Policy provides for upazila-level programs to address soil erosion in Madhupur Tract, Barind Tract, and the piedmont area.

b) New Agricultural Extension Policy (1996)

51. The goal of the New Agricultural Extension Policy 1996is to encourage national agricultural extension system agencies and partners to provide efficient and effective services that complement and reinforce each other, to increase the efficiency and productivity of Bangladeshagriculture. To achieve this goal, the Policy includes the following key components: (i) extension support to all categories of farmer; (ii) efficient extension services; (iii) decentralization; (iv) demand-led extension; (v) working with groups of all kinds; (vi) strengthened extension-research linkage; (vii) training of extension personnel; (viii) appropriate extension methodology; (ix) integrated extension support to farmers; (x) coordinated extension activities; and (xi) integrated environmental support.

52. The broad objective of the Policy is to facilitate and accelerate technological transformation with a view to achieving food self-sufficiency and improving the nutritional status of the population. The long-term objective is to ensure sustainable agricultural development maintaining the ecological balance in the natural environment.

53. The National Task Force responsible for preparation of this Policy has also been charged with development of an Implementation Strategy that will establish: (i) clear definitions of the roles for the various extension agencies; (ii) effective mechanisms for collaboration and information exchange among extension agencies and among farmers; (iii) effective mechanisms for the supply, management, and monitoring of resources to support the extension agency activities; (iv) mechanisms to provide extension agents at all levels with skills and training appropriate to their job requirements; (v) effective linkages to support three-way information flow between farmers, extension agents, and research institute staff.

c) National Land Use Policy (2001)

54. The Land-Use Policy aims to ensure land use in harmony with the natural environment. The Policy introduced a zoning system to ensure the best use of land in different parts of the country taking into account local geological differences, to rationalize the currently unplanned expansion of residential, industrial, and commercial construction.

2.1.6 Environmental Quality Standards

55. Environmental quality standards relevant to the Project, for air quality, noise, and sewage discharge, are provided in Tables 2.1, 2.2, and 2.3.

Table 2.1: Bangladesh Standards for Ambient Air Quality

No.	Area	Suspended Particulate Matter	Sulfur Dixide	Carbon Dioxide	Nitrogen Oxides
		(mg/m^3)			
Ka	Industrial and mixed	500	120	5000	100
Kha	Commercial and mixed	400	100	5000	100
Ga	Residential and rural	200	80	2000	80
Gha	Sensitive	100	30	1000	30

Source: Schedule-2, Rule 12, Environment Conservation Rules of 1997 (Page 3123, Bangladesh Gazette, 28 August 1997. Translated from Bengali.

Notes:
1. Sensitive area includes national monuments, health resorts, hospitals, archaeological sites, educational institutions
2. Any industrial unit located not at a designated industrial area will not discharge such pollutants, which may contribute to exceed the ambient air quality above in the surrounding areas of category 'Ga' and 'Gha'.
3. Suspended particulate matters mean airborne particles of diameter of 10 micron or less.

Table 2.2: Bangladesh Standards for Noise

No.	Area Category	Standard Values (dBA)	
		Day	Night
Ka	Silent Zone	45	35
Kha	Residential area	50	40
Ga	Mixed area (basically residential and together used for commercial and industrial purposes)	60	50
Gha	Commercial area	70	60
Umma	Industrial area	75	70

Source: Schedule 4, Rule-12, Environment Conservation Rules, 1997 (Page 3127, Bangladesh Gazette, 28 August 1997, trans. from original Bengali).

Notes:
1. Daytime is reckoned as the time between 6 am. to 9 pm.
2. Nighttime is reckoned as the time between 9 pm to 6 am.
3. Silent zones are areas up to a radius of 100 m around hospitals, educational institutes, and Government-declared special establishments. Use of vehicular horns, other signals, and loudspeakers are prohibited in silent zones.

Table 2.3: Bangladesh Standards for Sewage Discharge

Parameters	Unit	Values
BOD	mg/L	40
Nitrate	mg/L	06-Sep
Phosphate	mg/L	25
Suspended Solid (SS)	mg/L	100
Temperature	^{o}C	30
Coliforms	number/100ml	1000

Source: Schedule-8, Rule-I3, Environment Conservation Rules, 1997. (Page 3131, Bangladesh Gazette, 28 August 199, trans. from Bengali].

Notes:

These standards are applicable for discharge into surface and inland water bodies.
Chlorination is to be done before final discharge.

2.2 Project-Relevant International Environmental Agreements In Force In Bangladesh

56. Of the international environmental agreements to which Bangladesh is a party,[17] those potentially relevant to the Project are:

(i) Convention on Wetlands of International Importance (also known as the Ramsar Convention, 1971; Bangladesh 1992) – promotes conservation and wise use of all wetlands
(ii) Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES Convention, 1975, Bangladesh 1981) – aims to ensure that international trade in specimens of wild animals and plants does not threaten their survival
(iii) Convention on Biological Diversity (1993, Bangladesh 1994) – addresses three objectives (a) sustainable use of biological diversity components, (b) fair and equitable sharing of genetic resources utilization benefits
(iv) Convention on the Conservation of Migratory Species of Wild Animals (also known as CMS or Bonn Convention) (1983; Bangladesh 2005) – addresses conservation of terrestrial, marine, and avian migratory species throughout their ranges, including conservation of migratory species habitats

57. These instruments document the GOB commitment to biodiversity conservation generally, at all levels (global-national-regional-local and ecosystem-habitat-species), and specifically to the provisions of these particular agreements.

2.2.1 ADB Safeguards: Policy and Guidelines/Guidance Documents

58. At the time of this report, current versions of Project-relevant ADB safeguards policy and guidelines/guidance documents included:

59. Environment and Social

2009a. Safeguard *Policy Statement*.
2010. *Multi-Tranche Financing Facility, Section D14/BP, Operations Manual*
2011a. *Complaint Handling in Development Projects - Grievance Mechanisms: A Critical Component of Project Management*
2011b. *Complaint Handling in Development Projects - Building Capacity for Grievance Redress Mechanisms*
2012a. *Guidelines for Climate Proofing Investment in Agriculture, Rural Development, and Food Security*

[17] Department of Environment.n.d. "Multilateral Environmental Agreements in Force in Bangladesh".Government of Bangladesh.http://www.doe-bd.org/agreement.html

60. Environment

2003a. *Environmental Assessment Guidelines*
2012b. *Environment Safeguards, A Good Practice Sourcebook—Draft Working Document*.

61. Social

2003b. *[Policy on] Gender and Development*
2006. *Gender Checklist: Agriculture*
2009b. *Project Gender Action Plans*, *Lessons for Achieving Gender Equality and Poverty Reduction Results*. Briefing Note
2012c. *Involuntary Resettlement Safeguards, A Planning and Implementation Good Practice Sourcebook – Draft Working Document.*
2012d. *Indigenous Peoples Safeguards, A Planning and Implementation Good Practice Sourcebook - Draft Working Document.*
2012e. *Handbook on Poverty and Social Analysis A Working Document*.

2012f. *Guidelines for Gender Mainstreaming Categories of ADB Projects.*

3. Approach and Methodology

62. This Chapter presents the detailed approach and procedure employed to conduct the EIA study. Also described in the Chapter are data sources and methodology of data collection, processing and impact assessment.

3.1 Overall Approach

63. The EIA study for the projectinterventions under**Tranch 1** has been carried out following the DoE and WARPO guidelines for water resources project. The overall approach of the study is shown in **Figure 3.1** below.

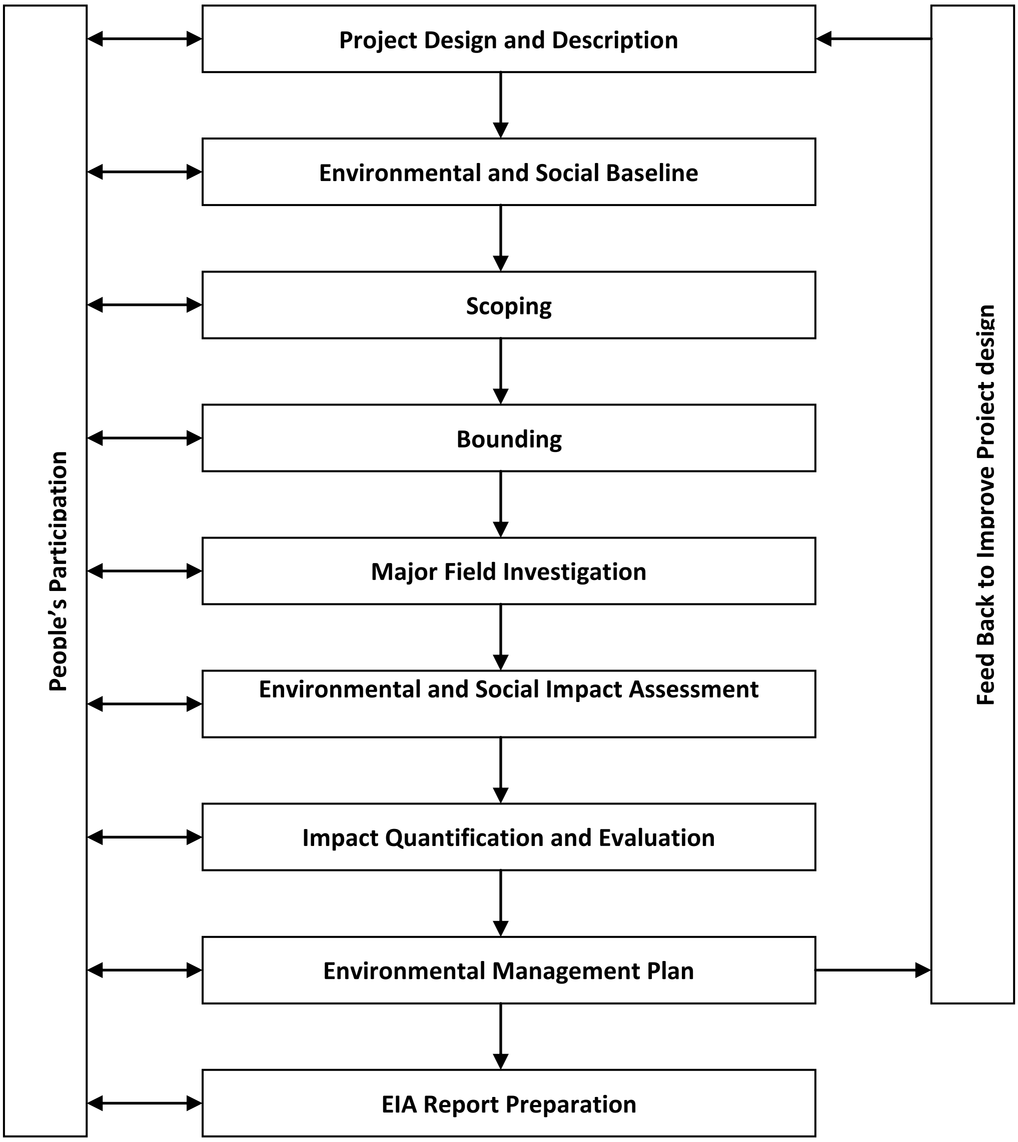

Figure 3.3-1: Overall approach of the EIA study

3.2 Methodology

64. The step-wise detail methodology followed for the EIA study is briefly described below.

3.2.1 Project design and description

65. Interventions proposed for **Tranch 1** was the basis of this EIA study. Initial information and specifications of the proposed interventions was obtained from the Main Consultant (MC). This was followed by development of base map using the images and data available with CEGIS in GIS data layers. Thereafter EIA study team met the concerned Executive Engineer of BWDB from whom detailed and specific information was collected and marked in the base map. The EIA study team also observed, to the extent possible, the present condition of the existing infrastructure during the field visit. Opinion of the local people on the performance of the existing infrastructure and their perception about the proposed interventions were also obtained.

3.2.2 Baseline data collection and analysis

66. Baseline data collection was conducted as a pre-requisite for EIA study. The baseline condition of the project area was drawn according to information collected from secondary and primary data sources through literature review, field investigations and consultation with different stakeholders. The baseline condition was established in respect of water resources, land resources, agriculture, livestock, fisheries, ecosystems and socio-economic conditions including identification of problems in respect of the proposed project site and adjoining area.

a) Water resources

67. Water resource data under the heading river hydrology, river morphology, ground water availability, drainage pattern, ground and surface water quality and water use were collected from secondary sources and primary observation by the professional of the multi-disciplinary team members backed up by feedback from the local people during field visit for baseline preparation and impact assessment in this study. Major river systems were identified for hydrological and morphological investigation through historical and current data collection and analysis. Specific areas or points of interest were selected for collecting data on special hydrological and morphological events such as river-khal-beel network, water availability, drainage pattern, water quality (surface and ground water), flash flood, risk of erosion or sedimentation etc.

68. Field visits were made to the study area and primary data on water resources components were collected through discussion with stakeholders. A checklist was used to obtain the information on different resources. Local knowledgeable persons and community representatives were also interviewed. During the field visits, the multidisciplinary EIA team members made professional observations pertaining to their individual areas of expertise. The impact of the project were assessed by analyzing collected data, community knowledge analysis and professional justification of water resource managers. The management plan for water resources components was incorporated to assess impact risk and water resources status using stakeholders' requirement and experts judgment.

69. The specific data on different events of water resources were gathered and analyzed using the methodology presented in the following table.

Parameter	Data Sources	Methodology

Parameter	Data Sources	Methodology
Surface Water hydrology		
Dry and wet season water level and discharge	BWDB	Mean monthly water level was collected from BWDB database
Drainage system	CEGIS	Data was gathered through image analysis and physical observations were used for ground truthing
River hydro-morphology		
Sedimentation	CEGIS	Data was collected through satellite image, secondary sources and physical observations.
Flooding	SRDI, CEGIS	Land type based on different inundation depth was collected from SRDI and verified in field
Ground water hydrology		
Water table	BWDB and field investigation	Data was collected from source organizations at different locations in the total study and project area.
Water quality and use		
Surface and ground water quality.	BWDB, DPHE and field investigation	Water quality was analyzed on the basis of data from BWDB and verified at field level through physical observation as well as in consultation with local people.
Surface and ground water use (availability)	Local community and authority	Sources and different sector of water use was identified from field investigation and local authority

70. Meteorological data such as rainfall, evapo-transpiration, temperature, sunshine hours, humidity and wind speed were collected and analyzed for assessing local climate that are directly related to water resources of the study area. Meteorological data for selected stations was collected from the National Water Resources Database (NWRD) of WARPO, which contains long time series of temporal data showing daily values for meteorological stations maintained by the Bangladesh Meteorological Department (BMD).

71. The general geological features and the seismicity of the project and its surrounding areas were collected from available secondary literature and Geological Survey of Bangladesh. The topographical data was collected from Geological Survey of Bangladesh and National Water Resources database (NWRD) of Water Resources Planning organization (WARPO).

b) Land Resources

72. The Agro-ecological Region of the proposed study area has been identified using secondary sources (FAO/UNDP). The land use, land type, soil texture data have also been collected from Upazila Land and Soil Resources Utilization Guide (Upazila Nirdeshika) of Soil Resource Development Institute (SRDI). The secondary data of these parameters have been verified at field level through

physical observations as well as in consultation with the local people and officials of the Department of Agriculture Extension (DAE) during field visit.

c) Agriculture Resources

73. Data on agricultural resources included farming practices, crop production, constraints, existing cropping patterns, crop variety, crop yield, crop damage and agricultural inputs were used. Agriculture data were collected from primary sources through extensive field survey by developing questionnaire and in consultation with local people and concerned agricultural officials. Agricultural resources data were also collected from secondary sources from Upazila Agriculture Extension office (DAE). Crop production was determined using the formula: Total crop production = damage free area × normal yield + damaged area × damaged yield. The crop damage (production loss) was calculated using the formula: Crop production loss = Total cropped area ×normal yield-(damaged area ×damaged yield+ damage free area × normal yield). The crop damage data were collected from the field for last three years.

d) Livestock Resources

74. Present status of livestock (Cow/Bullock, Buffalo, Goat and Sheep and poultry (Duck and Chicken) in the study area have been evaluated at field level survey in consultation with the local people through PRA, RRA and KII. Livestock resources data were also collected from secondary sources from Upazila Livestock office.

e) Fisheries Resources

75. **Data collection methods:** The fisheries data were collected for the EIA study by considering the seasonal variance of dry and wet seasons. Prior to going for data collection, a checklist/ questionnaire were developed. The checklist included all kinds of information which should be looked into in the context of existing and potential structures of the project. A combination of survey techniques was used for data collection. The survey techniques included sampling site selection, data collection, data analysis and reporting. The sequential interpretations of the methodological approach were as follows:

76. **Sampling Site Selection:** Existing and proposed intervention wise sites were selected for data collection. Sampling sites varied depending on the proposed intervention sites. During site selection concentration was given on the intervened area and non-intervened area to find the difference between them in terms of fisheries impact.

77. **Data Collection:** Data were collected in multiple ways which can be broadly classified into two classes, for instance, (i) primary data collection and (ii) secondary data collection. Primary data were collected from the fishermen community, fisher households and local key informants and secondary data were collected from Upazila Fisheries Offices during field visits.

78. **Habitat Identification:** Fish habitat classification was done based on physical existence and were categorized into capture and culture fish habitats. The capture fish habitats included river, khal, floodplain, burrow pit and beel. The culture fish habitats included homestead culture fish pond, commercial fish farm etc.

79. **Capture & Culture Fish habitats:** Capture fish habitat assessment was done through fishing Effort Survey (FES), Frame Survey (FS), micro scale Catch Assessment Survey (CAS), habitat based species diversity & composition, identification of species of conservation significance, identification of potential fish habitat prescribing to restore for fish conservation, fish migration survey, habitat identification for fish conservation. Culture fish habitat assessment was done through homestead culture fish pond survey and commercial fish farm survey.

80. **Associated Information:** Information on post harvest activities, forward and backward linkages, fisher livelihood information, fisheries management issues, potential fish recruitment, fish infrastructure and fisher vulnerability, etc. were also collected.

81. **Secondary Data Collection:** Relevant secondary data were collected from the Upazila Fisheries Office (UFO) from their annual report and from various literature/study.

82. **Data Analysis and Output:** Fish production for individual habitats were obtained through a series of calculation procedures using the collected information of FES, FS, CAS and Habitat area. Aggregating the fish production from all habitat types, total fish production of the study area were estimated basin wise and then holistically. Secondary information that was collected from the UFOs and literatures were blended with primary data in production estimation.

f) Ecology

83. Information on bio-ecological zones and their characteristics has been collected from the publication of International Union for Conservation of Nature (IUCN). The ecological component of the EIA study focused on terrestrial and riverine ecology including flora, birds, reptiles, amphibians, mammals, and migratory birds. The field activities included collecting ecosystem and habitat information, sensitive habitat identification, identifying ecological changes and potential ecological impact. The landuse information on different ecosystem was generated through analysis of the recent satellite image. Field investigation methods included physical observation; transect walk, habitat survey and consultation with local people. Field visits were carried out in delineating the ecological baseline condition. Public consultation was carried out through FGD and Key Informants Interview methods. Inventory of common flora and fauna was developed based on field survey and data base of IUCN.

g) Socio-economic Resources

84. The socio-economic baseline information including the study area, demographic information, occupation and employment, literacy rate, drinking water, sanitation, electricity facilities etc. were collected form secondary sources, i.e. BBS, 2011 and other relevant literatures included data obtained from BWDB. The income expenditure, land ownership pattern, self assessed poverty status, migration, social overhead capitals and quality of life, disasters, conflicts of the study area, information on NGOs, cultural and heritage features of the project area were collected mainly from primary sources through PRA and FGDs and public consultations.

85. The steps taken for collecting socio-economic data were as follows:

a) Data was collected from BBS, 2011 and reviewed relevant literatures from BWDB;

b) Reconnaissance field visit and discussion with BWDB officials and local stakeholders for primary data collection;

c) PRA /RRA, FGDs, KII for primary data collection

d) Institutional Survey (IS) for primary data collection in district and Upazila level offices which included DC office, LGED office, Civil Surgeon office, Social Service office etc.

3.2.3 Scoping

86. A scoping process was followed for selecting Important Environmental and Social Components (IESCs) which are likely to be impacted by the proposed interventions under **Tranch 1**. Scoping was done in two stages. Individual professionals of EIA study team made a preliminary list of the components pertaining to their disciplines, which could be impacted by the project. The second

stage included village scoping sessions where stakeholder perceptions were obtained about those environmental and social components. Professional judgment of the EIA team members as well as the stakeholder opinion obtained in the scoping sessions was considered in selecting the IESCs.

3.2.4 Bounding

87. Area likely to be impacted by the project interventions under Tranch 1 was delineated in consultation with the BWDB in addition to feed back received from the local people during baseline consultation.The processed RS tools were used for this purpose but there were some error due to unavailability of high resolution images of the proposed project area in CEGIS archive. The entire area influenced by existing sub-projects and the proposed projects were considered as the potential area to be impacted.

3.2.5 Major Field Investigation

88. The EIA study team members collected intensive data on possible impact of the project after procuring the project plan. Intensive data on the IESCs were collected from the field during major field investigation stage. In this case, information on the IESCs were gathered through a mixed method including RRA, PRA and KII using checklists for water resources, land resources, agriculture, livestock, fisheries, ecosystem and socio-economic components. Intensive consultation with the local people was carried out in each case for securing people's participation. The multidisciplinary EIA study team members also made professional observations and justification during the field visits. This time the concentration was on the historical status and public responses for the IESCs and the possible condition of the same against the proposed interventions.

3.2.6 Impact Assessment

89. Environmental and social impacts of the proposed interventions in the project on the IESCs have been assessed through several sets of activities. Impacts are caused as a result of interaction of specific project activities with the existing environmental settings. The impacts of proposed interventions were estimated on the basis of difference between the future-without-project (FWOP) condition and the future-with-project (FWIP) condition. The future-without-project (FWOP) conditions were generated through trend analysis and consultation with the local people. This reflected conditions of IESCs in the absence of the proposed interventions. Changes expected to be brought about due to the proposed interventions were assessed to generate the future-with-project (FWIP) condition. Comparison and projection methods were used for impact prediction. This included both positive and negative impacts which were considered in the preparation of the environmental management plan.

90. The sequence of assessment of environmental and social impact was asfollows:

i) Changes in the status of the IESCs pertaining to water resources;

ii) Changes in the status of the IESCs pertaining to land resources, agriculture, livestock and poultry;

iii) Changes in the status of the IESCs pertaining to fisheries;

iv) Changes in the status of the IESCs pertaining to ecological resources; and

v) Changes in the status of the IESCs pertaining to socio-economic condition.

3.2.7 Impact Evaluation

91. At this stage, attempts were made to quantify the impacts of the proposed interventions on the IESCs. But it was not possible to quantify all impacts, especially the impacts on some of the environmental and social components. In those cases, qualitative impacts were assessed and scores were assigned with (+) sign for positive impacts and (-) sign for negative impacts. The magnitude of both positive and negative impacts was indicated in a scale of 1 to 10 on extent, magnitude, reversibility, duration and sustainability considerations.

3.2.8 Preparation of Environmental Management and Monitoring Plan

92. An environmental management plan (EMP) for the proposed project was prepared comprising the mitigation/ enhancement measures with institutional responsibilities, environmental monitoring plan, training and capacity building plan, and reporting and documentation protocols.

3.2.9 EIA Report Preparation

93. At the end of the process, the present report was prepared incorporating all the findings of the EIA study.

4. Project Description

4.1 Introduction

94. The Project assessed by this EIA is Tranche 1 of the FRERMIP MFF. Section 4.2 immediately following describes the FRERMIP programme as the Project context and Section 04.3 describes the Project, Tranche 1.

4.2 Project Context: The FRERMIP Programme

4.2.1 FRERMIP Background and Objectives

95. Almost all of Bangladesh is floodplain delta at the confluence of three very large rivers. An integral part of the livelihoods of poor people is coping with water-related disasters – floods, drought, riverbank erosion caused by dynamic river channel shifting, cyclones, and tidal surges. All cause significant hardship.

Thus flood and riverbank erosion risk management can play a significant role in poverty reduction and economic growth. Riverbank erosionannually affects about 100,000 individuals who lose homestead, lands, agricultural crops, and displacement. Many erosion displacees relocate to insecure, marginal environments such as riverine fringe land, char land (river islands), and urban slums. Flooding, while integral to agriculture in the delta, causes displacement and economic losses, especially when high flooding occurs (approximately >1:10 return period).

96. FRERMIP aims to modify the flood season hydrology of a very large area of floodplain by providing new and rehabilitated embankments, leaving distributaries open, along selected reaches of the Padma / Jamuna River. To protect these embankments, river banks will be progressively stabilized, starting at critically eroding reaches. Over time, and in conjunction with other government programs this approach may lead to a general river stabilization with less channels potentially having some similarity to the river system before the passing of the sediment wave of the Great Assam Earthquake. In parallel to this study, Government will investigate other river restoration alternatives[18]. Siting of physical works for FRERMIP will be planned using an innovative dynamic methodology that responds to evolving river behaviour (“adaptive approach”). The anticipated benefits are considerable: (i) reduced loss of agricultural and other land to river erosion, (ii) reduced flood damage to agriculture (etc), and (iii) increased agricultural production on less-flooded agricultural land. Previous failures in river embankements have been due to erosion of river banks. Therefore, the present approach includes river bank protection followed by embankment construction.

97. FRERMIP will build upon the riverbank protection methods developed in the Jamuna Meghna River Erosion Mitigation Project (JMREMP) to other river reaches. A morphological study will be undertaken in Tranches 2 and 3 to improve prediction of long-term morphological trends. This will support a shift from the currently approach of ad hoc, piecemeal protection of actively eroding damaged sites, to proactive siting of protection at sites expected to erode in the near future.

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[18] The feasibility study of Capital Dredging and Sustainable River Management in Bangladesh currently investigates one single and and one multiple-channel option for Jamuna and Padma as first step towards the development of a river stabilization plan. The final report is expected in early 2014. Building on the Capital Dredging study and the initial morphological assessment of potential future channel patterns conducted as part of this feasibility study, the FRERMIP will conduct a comprehensive river stabilization plan to identify potential stabilization solutions, to be implemented in an adaptive and phased manner, with minimal impacts on the river and char environment.

98. Behind FRERMIP riverbank protection works where river erosion risk – the main cause of embankment failure on the major rivers – has been reduced, FRERMIP will invest in new and rehabilitated embankment works, leaving major distributaries open, to mitigate flood levels during greater return period flood events while still allowing lower levels of beneficial flooding to occur.

99. The structural components of riverbank protection and embankments are accompined by non-structural components. These address institutional issues, on knowledgebase and planning level, and directly assist local communities in the sub-project areas in improving their preparedness to flood and erosion disaster. The latter will be implemented through DDM under a community-based flood risk management program covering around ome million people in the three subproject areas.

4.2.2 FRERMIP Location and Area

100. The FRERMIP area encompasses the Jamuna River reach starting below the Jamuna Bridge and the proposed Ganges Barrage site, down to Chandpuron the Lower Meghna. Downstream of the Jamuna Bridge and the Barrage site, theJamuna and Ganges river courses are somewhat independent of upstream river developments. The FRERMIP area covers 9,300 km³ with a total population of 10.5 million (2011 census) in 40 upazilas and 431 unions, with an average population density of nearly 1,600 persons per km² of floodplain land.

101. Map 1 shows the locations of proposed interventions during Tranches 1, 2, and 3. Red is used for Tranche 1 interventions, orange for Tranche 2, and yellow for Tranche 3. Map 4-2 provides a more detailed map of the proposed Tranche 1 interventions.

4.2.3 FRERMIP Implementation Schedule

102. Figure 4.1 shows the FRERMIP schedule for all three tranches.

4.3 Project –Tranche 1

4.3.1 Proposed Interventions

103. Proposed interventions under Tranche 1 fall into four categories: (i) riverbank protection, (ii) new and rehabilitated road/flood embankments, (iii) drainage sluices and (iv) afforestation.

a) Riverbank Protection

104. Figure 4.2 shows a representative cross-section of riverbank protection works. Construction of riverbank protection typically involves the following activities. Labor sheds are constructed and stocked with construction materials (sand, cement, wood, shuttering materials etc.). Sanitation facilities for work crews are constructed. River bank slopes are developed with earth. Pre-cast concrete (CC) blocks are cast or manufactured. Geo-textile bags are placed onto the slope below water and CC blocks are placed onto the slope above water. Launching aprons are prepared at the toe of the underwater protection and geobags and are dumped, usually in a 15m wide strip in front of the toe. Embankment slopes and crests are turfed as needed.

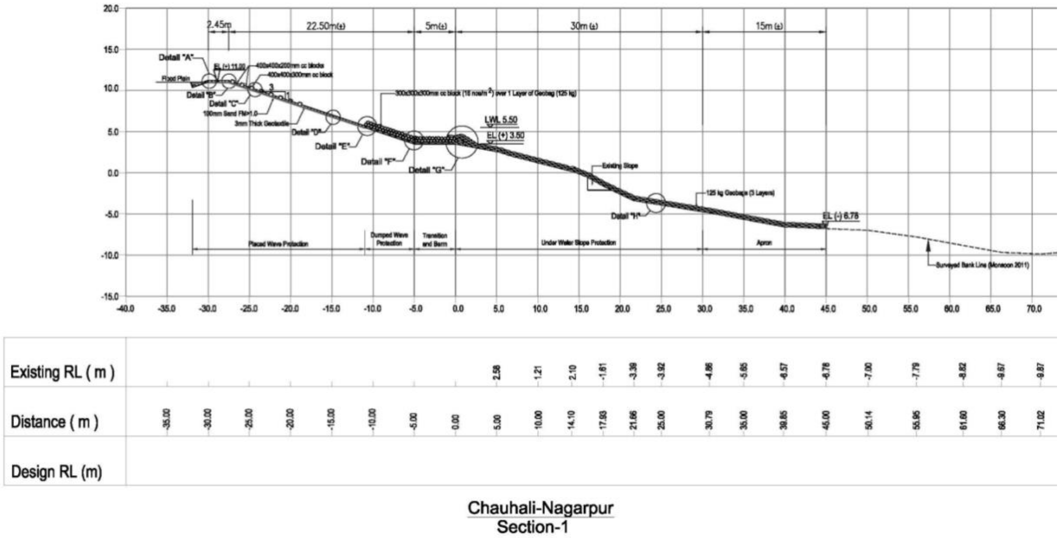
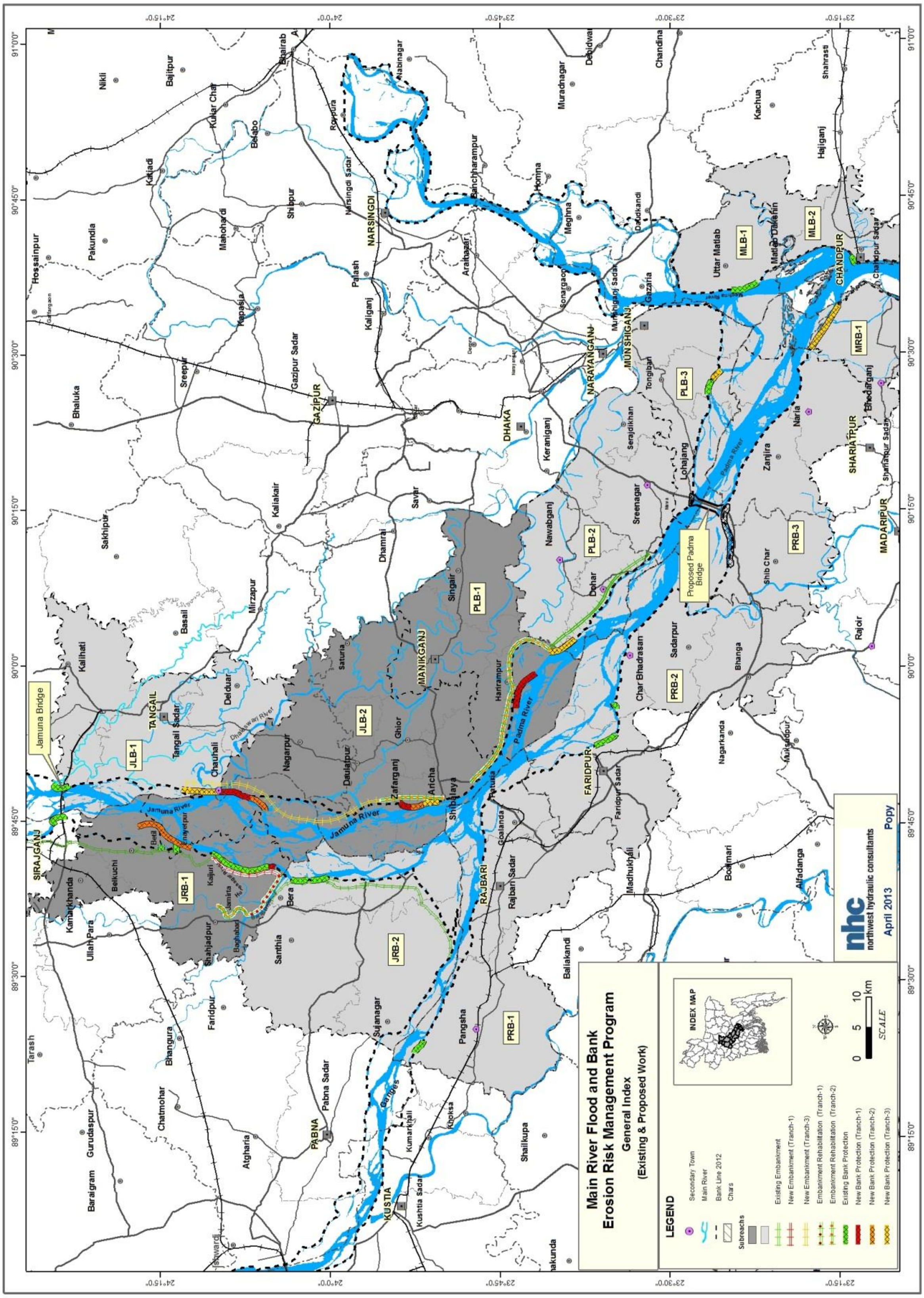
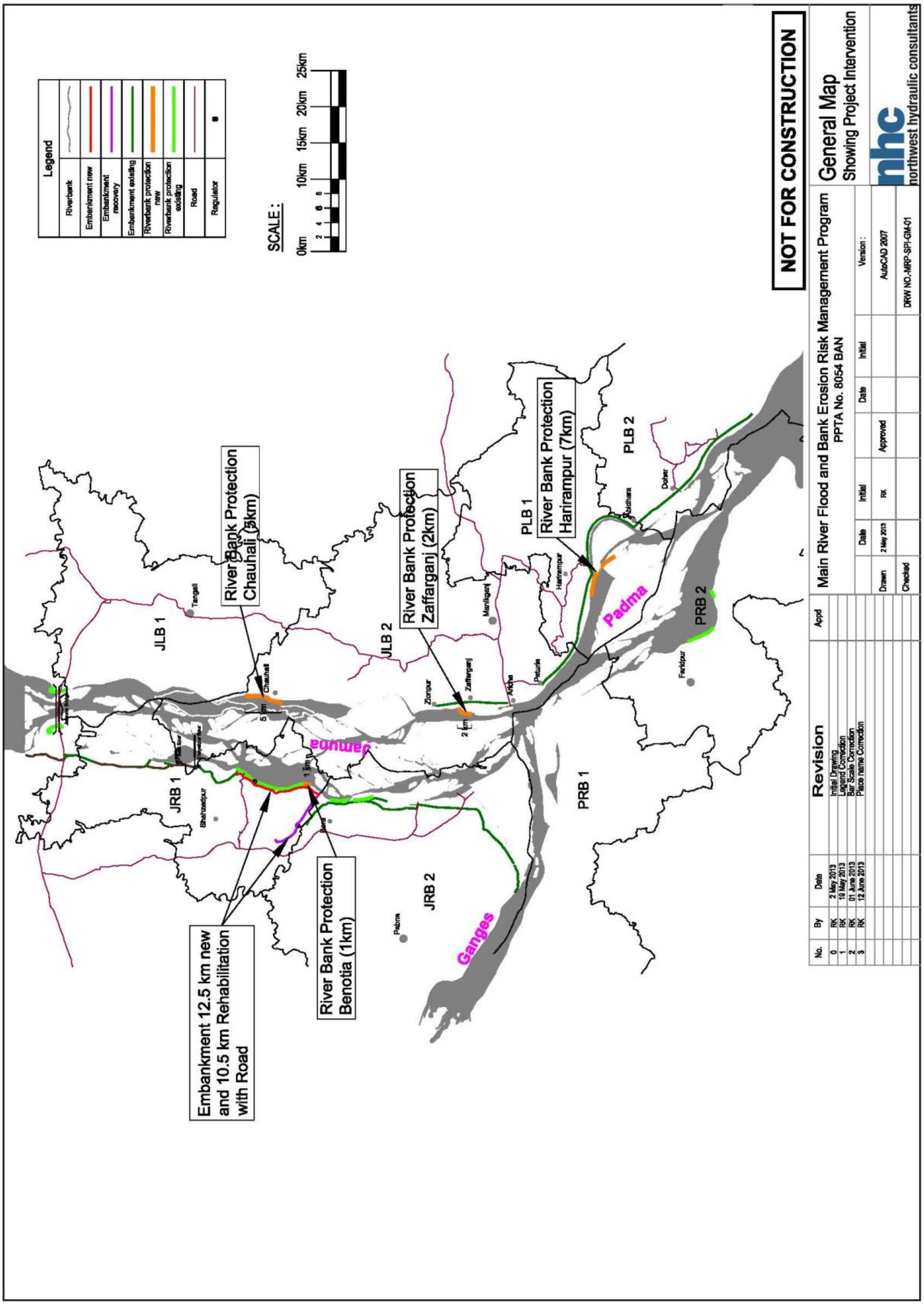


Figure 4-1: Riverbank Protection, Representative Cross-Section



Map 4.1: Proposed Interventions Color-Coded by Tranche



Map 4-2: Proposed Tranche 1 Interventions

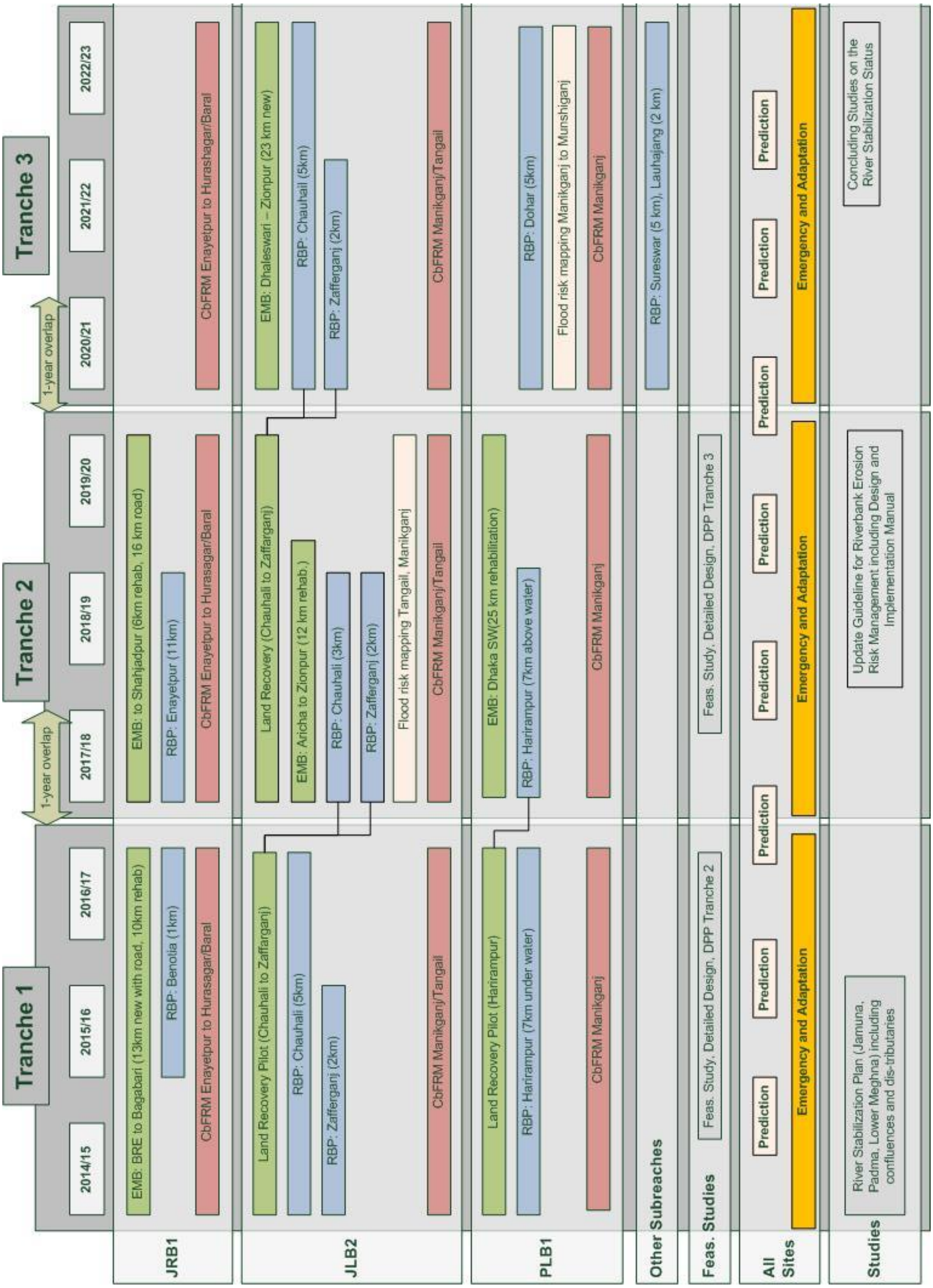
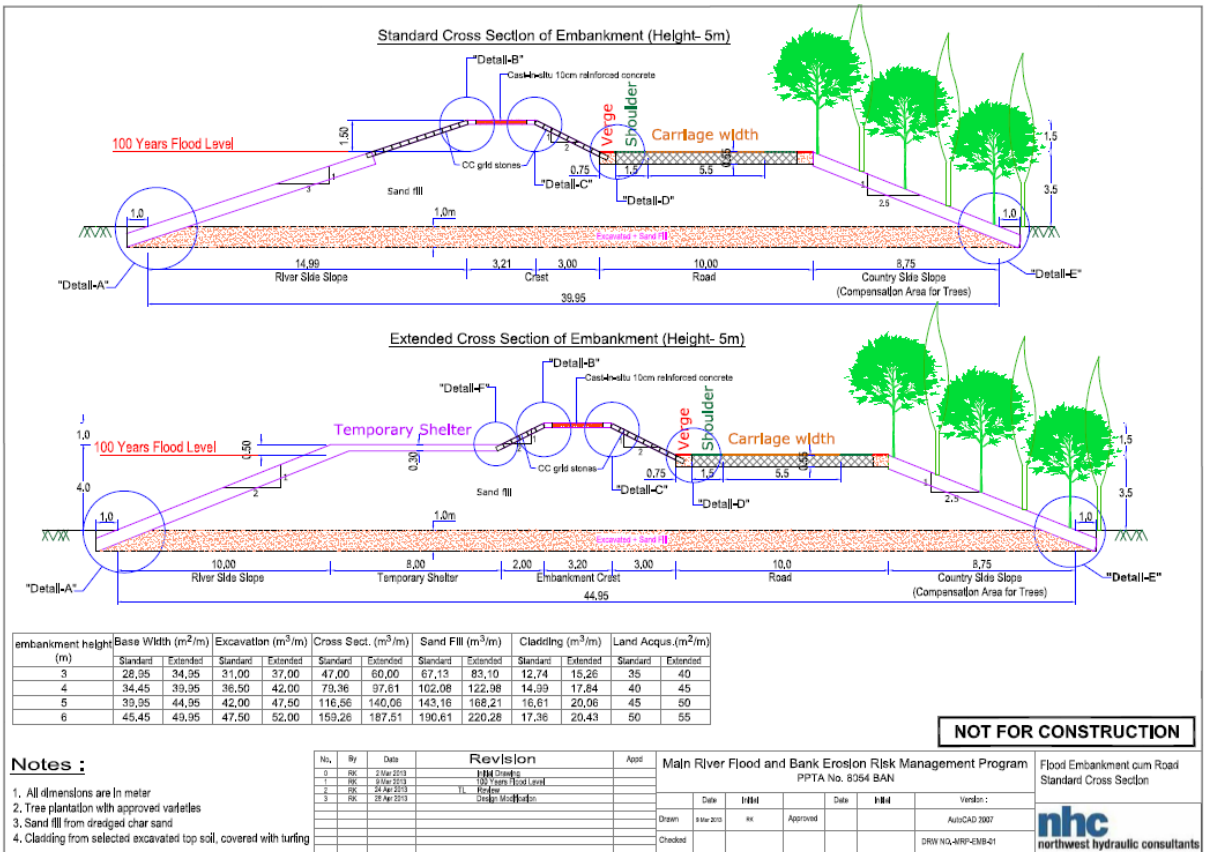


Figure 4.1: Construction Schedule

b) Embankments

105. Figure 4.3 shows a representative embankment cross section. Embankment construction typically involves the following activities. Labor sheds are constructed and stocked. Sanitation facilities for work crews are constructed. Under the supervision of the engineer in charge, the embankment alignment is marked out per engineering designs. As required by resettlement plans, resettlement activities are undertaken in the embankment footprint such that inhabitants are relocated and structures emptied out, such that they are no longer in use and can be dismantled and removed. Surface vegetation is cleared away. Construction tools are brought to the site and the final design is validated. Sand required for fill is pumped from the adjacent river by dredger, and clay required for surfacing is excavated from the embankment alignment. To achieve the desired rehabilitated or new embankment section, dredged sand is dumped and then compacted, sloped, and shaped in layers. When the design section has been reached, the embankment is surfaced with excavated clay and the embankment slope is turfed, watered and fertilized to establish a layer of biological protection from runoff surface erosion. The crest is paved for road access to the area. Later wave protection will be applied in critical zones on the riverside slope.



embankment height (m)	Base Width (m²/m)		Excavation (m³/m)		Cross Sect. (m³/m)		Sand Fill (m³/m)		Cladding (m³/m)		Land Acqus.(m²/m)	
	Standard	Extended	Standard	Extended	Standard	Extended	Standard	Extended	Standard	Extended	Standard	Extended
3	28,95	34,95	31,00	37,00	47,00	60,00	67,13	83,10	12,74	15,26	35	40
4	34,45	39,95	36,50	42,00	79,36	97,61	102,08	122,98	14,99	17,84	40	45
5	39,95	44,95	42,00	47,50	116,56	140,06	143,16	168,21	16,61	20,06	45	50
6	45,45	49,95	47,50	52,00	159,26	187,51	190,61	220,28	17,36	20,43	50	55

Figure 4.3: Embankment, Representative Cross-Section

c) Drainage Sluices

106. Pre-construction activities include labor shed construction and stocking with construction supplies; assembly of construction equipment and tools; construction of sanitation facilities; and construction site preparation (implementation of required resettlement actions and removal of structures and surface vegetation). To allow the construction site to be dewatered while maintaining the natural flow of water around it, ring bundhs and diversion channels are constructed. Foundation construction involves excavation and CC and reinforced cast concrete (RCC) works. Construction of

above-ground works involves cutting, bending and binding of rods, and casting and placement of CC blocks. Approach roads are constructed; gates and hoisting devices fitted, and gates painted. Per design, the sluice intake and outfall are constructed and CC blocks or geobags placed upstream and downstream for riverbed and -slope protection.

d) Afforestation

107. Figure 4.3 shows a representative cross section of an afforested embankment. Afforestation and/or vegetation may be conducted on the country-side (land-side) slopes and toe of the embankment, as part of livelihood support for local communities including project affected persons. Species for afforestation and/or vegetation will be selected based on preference of local communities, in due consultation with BWDB and other relevant government agencies, to ensure that the species are suitable for livelihood support, and for protecting embankment surface from erosion by drainage from the crest and the road. Afforestation activities include establishing a temporary nursery to ensure seedling availability and plantation of appropriate species seedlings at species-appropriate intervals.

4.3.2 Project Implementation Arrangements

108. Appendix 5 documents the project implementation arrangements. BWDB is the executing agency, while DDM is the implementing agency for the community-based flood risk management component.As for all development projects, an inter-ministerial steering committee will review and discuss the project in annual meetings. A Panel of Experts will provide guidance related to river morphology, flood risk management, institutional development, regional/local capacity development, and other issues emerging during implementation.

109. A Project Management Office (PMO) integrated into BWDB administration will be set up, headed by a Project Director who will be a senior Superintending Engineer or an Additional Chief Engineer (with powers similar to the zonal Chief Engineer), supported by two Superintending Engineers. The PMO might be converted to proposed office of the Chief Engineer River Management and River Management Wing, once these posts are approved and staffed. The River Management Wing will be responsible for national river management activities such as char reclamation and materials procurement and strategic stockpiling, and for implementing works through existing zonal divisions (whose staff levels will be increased) that already construct embankments and revetments. In addition to the PMO in Dhaka, sub-project management offices (SMO) will be established in the divisional offices located in the project sites areas of Koitola, Tangail, and Manikgonj. In addition to the Project Director and the two superintendent engineers, the PMO will be staffed with four executive engineers, four sub-divisional engineers and one assistant engineer. All PMO staff will work full time on the project. One of the executive engineers will be responsible for environmental management, and will work with consultants to monitor and supervise activities in the project sites. Each SMO will be headed by an executive engineer who will be supported by a sub-divisional engineer, an assistant engineer, and three sub-assistant engineers. In the SMO, the sub-divisional engineer will be responsible for day to day management of environmental concerns.

110. BWDB is responsible for large-scale flood management and river erosion interventions, including the environmental aspects of their planning, assessment, and management, but it has very limited environmental staff in the Chief Planning office and no environmental- unit. Environmental management will be entrusted to executive engineer level PMO staff, supported by consultants. The PMO assures that environmental management will form part of construction contracts and regular monitoring of construction activities will be conducted. In addition future interventions will be studied at multiple levels to minimize negative impacts. A river stabilization study, and land recovery piloting, will assess potential river stabilization alternatives and their impacts, inter alia, on the

environment. In addition, successive tranches will be designed through full feasibility studies, complying with ADB safeguard standard.

111. An Institutional Strengthening and Project Management Consultant (ISPMC) will provide consultancy and NGO services to support project implementation in a variety of ways, including the services of a specialist organization to conduct environmental assessment, planning and management to support the PMO in environmental monitoring; and, in Tranches 2 and 3, to assist PMO to design and develop a new Environmental Monitoring and Management Unit.

112. The core components of this work relevant to Tranche 1 design and implementation include:

- Institutional support and project management (capacity development in river training, modern embankment construction, river surveying, and data management and evaluation; large-area flood hazard and risk mapping for larger areas; management information system development; construction management of large contracts; construction quality assurance / quality control); preparation of a river stabilization plan during the first two years of Tranche 1 for the Brahmaputra-Jamuna-Padma-Lower Meghna from the Bangladesh-India border to the estuary; and pilot activities to recover “lost” floodplain.
- Preparation and supervision by resettlement NGO of Resettlement Plan implementation at the three Tranche 1subprojects, supervised by an independent monitor.
- Implementation by a disaster management-experienced NGO of community-based flood risk management.
- Provision of specialist and NGO services required to implement Environmental Management Plan mitigation, monitoring, public consultation, and other activities. An environmental specialist will be included in the ISPMC team.
- Support to BWDB in the planning and initial staff training of a BWDB environmental monitoring and management unit under FRERMIP.

113. Additional details regarding the financing and potential scope of work of the advisory support are provided in Section 15.3.3, Advisory Support, of the Final Report, Main Volume.

4.3.3 Implementation Schedule

114. The scheduled start and end dates of Tranche 1 are 1 July 2014 and 30 June 2018. Tranche 2 is scheduled to start 1 July 2017 (Figure 4.1).

4.3.4 Tranche 1 Subprojects

115. Tranche 1 consists of three subprojects: Jamuna Right Bank 1 (Details in Annex 7), Jamuna Left Bank 2 (Detaisl in Annex 8) and Padma Right Bank 1 (Details in Annex 9). Table 4.1 through Table 4.4 summarizes key information for Tranche 1 interventions.

Table 4.1: Tranche 1Embankment Rehabilitation (along a tributary)

No.	Location	Length (km)	Design Crest Width (m)	Design Crest RL (m +PWD)	Side Slope
1	Verakhola along Hurashagar River	6.5	16.2 (section with different top elevation)	15.6	R/S 1V:3H C/S 1V:2.5H
2	From Hurashagar River to Korotoa bank	4	16.2 (section with different top elevation)	15.6	R/S 1V:3H C/S 1V:2.5H

Source: Final Report, Main Volume, 2013

Table 4.2: Tranche 1 New Embankment Construction (along the main river)

No.	Location	Length (km)	Design Crest Width (m)	Design Crest RL (m +PWD)	Side Slope
1	Kaizuri to Benotia	10.5	16.2 (section with different top elevation)	15.6	R/S 1V:3H C/S 1V:2.5H
2	Benotia to the start of Hurashagar/Baral river	2	26.2 (section with different top elevation, includes temporary settlement)	15.6	R/S 1V:3H C/S 1V:2.5H

Source: Final Report, Main Volume, 2013

Table 4.3: Tranche 1Riverbank Protection

No.	Location	Length (km)	Design Crest Width(m)	Design Crest RL (m +PWD)
1	Benotia	2	-8	1V:3H Above LWL 1V:2H Below LWL
2	Chouhali	5	-2	1V:3H Above LWL 1V:2H Below LWL
3	Zaffarganj	2	-4.5	1V:3H Above LWL 1V:2H Below LWL
4	Harirampur	7	-8	1V:2H Above LWL 1V:2H Below LWL (temporary protection above LWL)

Source: Final Report, Main Volume, 2013

Table 4.4: Tranche 1 Drainage Sluices

No.	Location	Khal Name	Catchment Area (ha)	Vent Size and Number
1	not set	not set	870	1 vent - 1.5m x 1.8m
2	not set	not set	3600	4 vent- 1.5m x 1.8m
3	not set	not set	5700	6 vent- 1.5m x 1.8m
Rehabilitation of 2 existing 4 vent regulators				

Source: Final Report, Main Volume, 2013

4.3.5 Associated Facility Analysis

116. The JLB-2 and PLB-1 flood embankments of Tranche 2 were evaluated for inclusion in this impact analysis as “associated facilities” of Tranche 1 (ADB, 2009, p. 31). Associated facilities are those “not funded as part of the Project… [i] whose viability and existence depend exclusively on the Project, and [ii] whose goods or services are essential for successful Project operation.”

117. The Tranche 2 JLB-2 and PLB-1 embankments do meet condition (i) but not condition (ii). With regard to condition (i), their viability and existence depends partially on the riverbank erosion protection constructed in Tranche 1 (the Project) (ie they also depend on additional erosion protection constructed in Tranches-2 and 3. Without it, they would not be built (viability) and if they were, they would be at risk of erosion damage or destruction (existence).

118. With regard to condition (ii), the embankments are not essential to the successful operation of the erosion protection. In the case of JLB-2, the Tranche 2 embankment flood damage benefits (ie

the "goods and services" of the flood embankment) do however substantially cross-subsidize the cost of the Tranche 1 JLB-2 erosion protection works.[19]

4.3.6 Labor Requirement, Construction Materials, and Equipment

119. Table 4.5 to Table 4.8 provide estimates of labor requirements, construction materials, and equipment for embankment re-sectioning, new / retired embankment construction, river bank protection construction, and drainage sluice construction respectively.

[19] The economic analysis presented in Sec. 18 of the Final Report, Main Volume (version dated 21 July 2013) includes costs and benefits of all tranches, broken out by subreach. For JLB-2, 66 per cent of the benefits derive from reduced flood damage, while 67 per cent of the costs derive from erosion protection works. For PLB-1, 72 per cent of the benefits derive from reduced erosion, and 77 per cent of the costs derive from the erosion protection.

Table 4.5: Embankment Re-Sectioning Details

Chainage and Placenames *(Para, Village/Mouza)*	Length (km)	Design Crest		Side Slope	Soil Volume Required (m^3)	Borrow Pits – Placenames, Area (ha), Existing Land Use	Skilled and Unskilled Labour Required (person-day)	Earthworks Labour Shed Location	Soil Conveyance Method(s)
		Width (m)	Elevation (m)						
Location 1Verakhola along Hurashagar river (JRB-1)	6.5	3.2+3+10 = 16.2 m (sections have different top elevation	15.60 m PWD	R/S 1V:3H C/S 1V:2.5H	Sandy soil 465,000 m^3 Clay soil 86,000 m^3	Construction soil will be dredged from river bed	*Construction* Skilled: 2,200 Unskilled: 40,000 *Annual O&M* Skilled: 110 Unskilled: 2000	Temporary, in the alignment	Sand pumped from dredger Excavator for clay collection from existing embankment
Location 2: From Hurashagar river to Korotoa bank (JRB-1)	4				Sandy soil 321,900 m^3 Clay soil 55,460 m^3		*Construction* Skilled: 1500 Unskilled 27,000 *Annual O&M* Skilled: 100 / year Unskilled: 1350 / year	Temporary, in the alignment	

Notes:

1. Skilled and un-skilled labour person-days required are calculated taking into account expected mechanization eg country made dredger and earth moving and compacting equipment.

2. Annual O&M labor for embankment resectioning and construction of new / retired embankments has been estimated at five per cent of total construction labour (see above). Additionally (not shown above), every ten years thereafter a major repair may be necessary; the estimated labour requirement is 20 to 30 per cent of total construction labour.

Table 4.6: New / Retired Embankment Construction Details

Chainage and Placenames (Para, Village/Mouza)	Length (km)	Land Ownership and Land Use Along Alignment	Design Crest width (m)	Design Crest R/L (m)	Side Slope	Soil Volume Required (m3))	Borrow Pits – Placenames, Area (ha), Existing Land Use	Skilled and Unskilled Labour Required (person-day)	Earthworks Labour Shed Location	Soil Conveyance Method(s)
Location 1: Kaizuri-to	10.5	Per LARP	3.2+3+10 =	15.60 m	R/S 1V:3H	Sandy soil	Construction sand	Construction:	Temporary,	Sand pumped

Benotia (JRB-1)			16.2 m (section with different top Elevation)	PWD	C/S 1V:2.5H	1,236,585 m3 Clay soil 174,405 m3	will be dredged from riverbed Clay is taken from topsoil removed from embankment alignment prior to construction (not all topsoil is clay; sand is used for embankment core; Any unsuitable (non-sand, non-clay) materials eg peat is disposed per Engineer in Charge instruction	Skilled: 5600 Unskilled: 105,000 Annual O&M Skilled: 380 Unskilled: 5200	in the alignment	from dredger Excavator for clay collection from embankment
Location 2: Benotia to the start of Harashagar/Baral River (JRB-1)	2.0		8+2+3.2+3+10 = 26.2 m (section with different top Elevation, includes temp settlement)			Sandy soil 282,540 m3 Clay soil 40,120 m3		Construction: Skilled: 1200 Unskilled 22,000 Annual O&M Skilled: 60 Unskilled: 1100		

Notes:

1. Skilled and un-skilled labour person-days requiredare calculated taking into account expected mechanization eg country made dredger and earth moving and compacting equipment.

2. **Annual O&M labor for embankment resectioning and construction of new / retired embankments has been estimated at five per cent of total construction labour (see above). Additionally (not shown above), every ten years thereafter a major repair may be necessary; the estimated labour requirement is 20 to 30 per cent of total construction labour.**

Table 4.7: River Bank Protection Construction Details

Chainage and Placenames *(Para, Village/Mouza)*	Length (km)	Design Bed R/L (m)	Side Slope	Soil Volume Required (m^3)	Soil Collection Locations	Concrete Blocks (number and size)	Geobags and Geotextile Filters	Skilled and Unskilled Labour Required (person-day)	Earthworks Labour Shed Location	Soil Conveyance Method(s)
Benotia (JRB-1)	2.0	-8.0 m PWD	1V:3H above LWL 1V:2H below	0.204 Mm^3	Bank slope from -2.00 to +9m PWD a 5.0m berm at the lowest level	*Construction* 86,000 nos 40x40x30cm 197,000 nos 40x40x20cm 500,000 nos	*Construction* 0.838M nos geobag-125 kg Geotextile filter- 74,000 sqm *Annual O&M*	*Construction* Skilled: 29000 nos Unskilled: 170,000 nos *Annual O&M*	Temporary rented locations	Carried by dump truck and excavator

Chainage and Placenames *(Para, Village/Mouza)*	Length (km)	Design Bed R/L (m)	Side Slope	Soil Volume Required (m^3)	Soil Collection Locations	Concrete Blocks (number and size)	Geobags and Geotextile Filters	Skilled and Unskilled Labour Required (person-day)	Earthworks Labour Shed Location	Soil Conveyance Method(s)
			LWL			30x30x30cm *Annual O&M* [no blocks needed]	16,500 nos geobag-125 kg	Skilled: 550 Unskilled: 3500		
Chouhali (JLB-2)	5.0	-2.0m PWD		0.540 Mm^3	Bank slope from +3.00 to +10.5m PWD a 5.0m berm at the lowest level	*Construction* 215,000 nos 40x40x30cm 493,000 nos 40x40x20cm 1,255,000 nos 30x30x30cm *Annual O&M* [no blocks needed]	*Construction* 1.914M nos geobag-125 kg 0.114M nos geobags-250 kg Geotextile filter- 0.185M sqm *Annual O&M* 35,000 nos geobag -125kg	*Construction* Skilled: 72,000 Unskilled: 428,000 *Annual O&M* Skilled: 1400 Unskilled: 8500		
Zaffarganj (JLB-2)	2.0	-4.5m PWD		0.256 Mm^3	Bank slope from +1.00 to +10.0m PWD a 5.0m berm at the lowest level	*Construction* 80,000 nos 40x40x30cm 185,000 nos 40x40x20cm 505,000 nos 30x30x30cm *Annual O&M* [no blocks needed]	*Construction* 0.760M nos geobag-125 kg 60,000 nos geobags-250 kg Geotextile filter- 70,000 sqm *Annual O&M* 15,000 nos geobag-125kg 1200 nos geobag-250kg	*Construction* Skilled: 29,000 nos Unskilled: 170,000 nos *Annual O&M* Skilled: 600 Unskilled: 3,500		
Harirampur (PLB-1)	7.0	-8.00 m PWD	1V:2H Above LWL 1V:2H Below LWL	602,000 m^3	Bank slope from +0.00 to +8.5m PWD	*Construction* Char area therefore geobags will be used above LWL (ie temporary solution is appropriate here)	*Construction* 2M nos geobag-125 kg 1.5M nos geobag-250 kg Geotextile filter- 0.151M sqm *Annual O&M*	*Construction* Skilled: 86,000 nos Unskilled: 525,000 nos *Annual O&M* Skilled:-1700		

Chainage and Placenames *(Para, Village/Mouza)*	Length (km)	Design Bed R/L (m)	Side Slope	Soil Volume Required (m^3)	Soil Collection Locations	Concrete Blocks (number and size)	Geobags and Geotextile Filters	Skilled and Unskilled Labour Required (person-day)	Earthworks Labour Shed Location	Soil Conveyance Method(s)
						Annual O&M [no blocks needed]	40,000 nos geobag-125kg 30,000 nos geobag-250kg	Unskilled: 10,500		

Notes:

1. Skilled and un-skilled labour person-days requiredare calculated taking into account expected construction methodologes.

2. Annual O&M labor for riverbank protection has been estimated at two per cent of total construction labour (see above). Unlike embankments, additional major repairs are not necessary.

Table 4.8: Drainage Sluice Construction Details

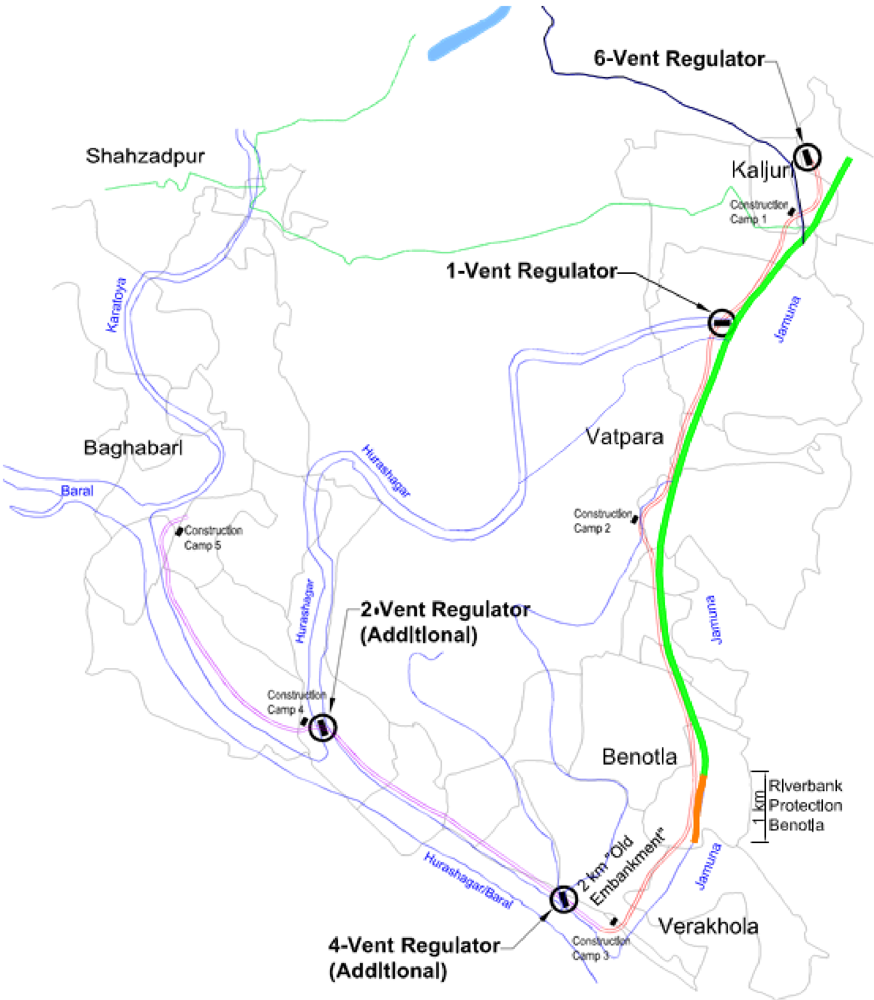
Chainage and Placenames *(Para, Village/Mouza)*	Identifying Landmark (name of mosque, school etc)	Khal Name	Catchment area (ha)	Vents (number and size)	Construction Materials (type, number, conveyance)	Number of skilled/ unskilled labour (man-day)	Location of Labour Sheds and Construction Camps
Gudhibari (JRB-1) 467619E; 671008N	NA	NA	870 ha	New 1 vent- 1.5mx1.8m	Cement: 140 tonne Sand: 230 m^3 Stone chips: 440 m^3 MS Rod: 79.00 tonne	*Construction* Skilled: 1700 Unskilled: 5800 *Annual O&M* Skilled: 17 Unskilled: 60	On rented land for two construction seasons
Gala (JRB-1) 465114E; 662557N	NA	NA	3600 ha	Existing 4 vent, adding 4 vents- 1.5mx1.8m	Cement: 270 tonne Sand: 430 m^3 Stone chips: 830 m^3 MSRod: 178.00 tonne	*Construction* Skilled: 2600 Unskilled: 9300 *Annual O&M* Skilled-26 Unskilled-95	
Lochna (JRB-1) 461392E; 665068N	NA	NA	3600 ha	Existing 4 vent, adding 2 vents- 1.5mx1.8m	Cement: 270 tonne Sand: 430 m^3 Stone chips: 830 m^3 MSRod: 178.00 tonne	*Construction* Skilled: 2600 Unskilled: 9300 *Annual O&M* Skilled-26 Unskilled-95	
Kaijuri, Gopalpur (new; JRB-1) 468742E; 673594N	NA	NA	5700 ha	New 6 vent- 1.5mx1.8m	Cement: 340 tonne Sand: 530 m^3 Stone chips: 1100 m^3 MSRod: 230.00 tonne	*Construction* Skilled: 3,100 Unskilled: 11,500 *Annual O&M* Skilled-31 Unskilled-115	

Notes:

1. NA – not applicable.
2. Skilled and un-skilled labour person-days required are calculated taking into account expected mechanization eg country made dredger and earth moving and compacting equipment.
3. Annual O&M labor for riverbank protection has been estimated as one per cent of total construction labour (see above). Additionally (not shown above), every ten years thereafter a major repair may be necessary; the estimated labour requirement is 20 to 30 per cent of total construction labour.

4.3.7 Camps

120. At each construction area (group of proximate construction sites), a camp to house project laborers will be constructed. The contractor will select camp locations after consultation with the local union parishad chairperson(s) and local residents. Camp locations are subject to the approval of the Engineer in Charge. Map 4.3shows the proposed locations of JRB-1 infrastructure and labor camps for embankment work crews. Riverbank protection does not require construction of camps as mostly local laborers are employed.



Map 4.3: JRB-1 Proposed Camp and Infrastructure Locations

4.3.8 Transportation of Materials

121. During implementation, trucks and inland vessels will carry heavy equipment and construction materials, including aggregates, cement, steel reinforcement, and sluice gate equipment, from various domestic locations to construction stock yards. Large quantities of earth will also be moved to construction stock yards by mechanical equipment such as excavators, pay loaders, dump trucks, trolleys, and to a lesser extent by manual labor. Materials will then be transported to individual work sites by trucks, smaller carts, non-motorized vans, and other smaller vehicles. The main construction material is sand. It will be mined locally in river areas approved by the designated engineer and transported by inland water vessels to construction stock yards and construction sites.

5. Environmental and Social Baseline

122. The environmental and social baseline condition in the study areahas been characterized using both primary and secondary data. Primary data were collected by the EIA field team during visits to the study area, through rapid rural appraisal (RRA), focus group discussions (FGD), key informant interviews (KII) and public consultations. Secondary data sources included:

- Bangladesh Bureau of Statistics (BBS)
- Bangladesh Water Development Board (BWDB)
- National Water Resources Database (NWRD)
- Water Resources Planning Organization (WARPO)
- Soils Resources Development Institute (SRDI)
- Bangladesh Meteorology Department (BMD)
- Department of Agricultural Extension (DAE)
- Department of Fisheries (DOF)
- International Union for Conservation of Nature (IUCN).

5.1 Physical Environment

5.1.1 Climate

a) Seasonality

123. Bangladesh has a sub-tropical monsoon-dominated climate. Seasons progress from a hot and dry pre-monsoon season March to May, to a rainy south-west monsoon season June to October, through a cool dry winter November to February. During the pre-monsoon, violent thunderstorms (referred to as “northwesters”) are common. During the rainy season, tropical depressions move inland from the Bay of Bengal. During the pre- and post-monsoon periods (March-May and October-December), cyclones can occur, sometimes generating very large storm surges that cause significant flood damage to the coastal area.

b) Meteorology Stations

124. Data used here is from two stations near the study area (Faridpur and Tangail) of Bangladesh Meteorological Division (BMD).

c) Rainfall

125. Mean annual rainfall in the project area is approximately 1800 mm/year (FAP-3, 1992).Figure 5.1 shows the 1959-2008 rainfall record from Faridpur station**.** Significant rainfall occurs from June to October, and little or no rainfall from November to February. The maximum recorded monthly rainfall was 831 mm in September 1986.

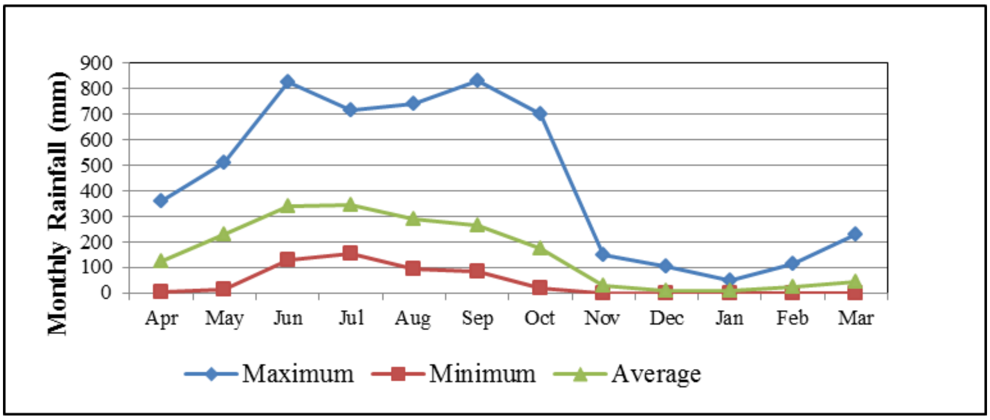


Figure 5.1: Monthly rainfall of the study area

d) Temperature

126. Figure 5.2 shows average monthly temperatures 1948-2010 at Faridpur and 1987-2010 at Tangail. These range from 18.2 to 28.9°C in Faridpur and 17.6°C-29.2°C in Tangail, with higher values (>27.4°C) from April to October, and lower values from November to March.

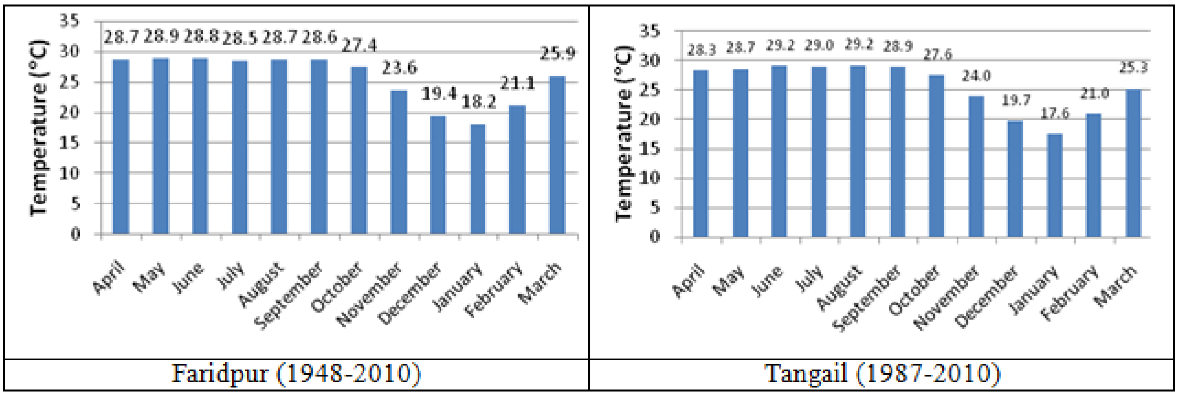


Figure 5.2: Monthly temperature of the study area

e) Humidity

127. Figure 5.3 shows average monthly humidity 1948-2010 at Faridpur and 1987-2010 at Tangail. These range from 71 to 87 per cent in Faridpur and 70 to 86 in Tangail, with lower values (< 81 per cent) from November to May and higher values from June to October.

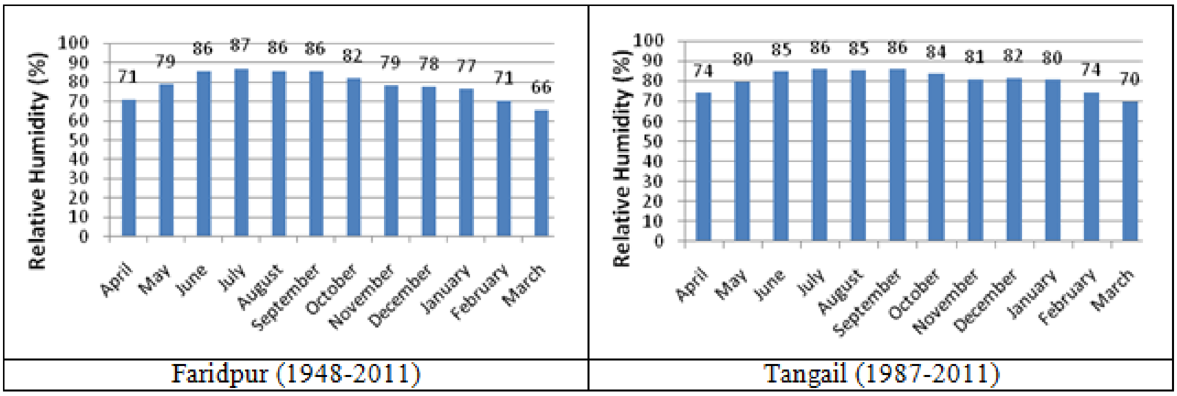


Figure 5.3: Relative humidity of the study area

f) Evaporation

128. Figure 5.4 shows average monthly evaporation 1987-2010 at Faridpur. Values range from 1.82 to 5.10 mm per day, with lower values (≤3.34 mm per day) July through February, and higher values from March through June.

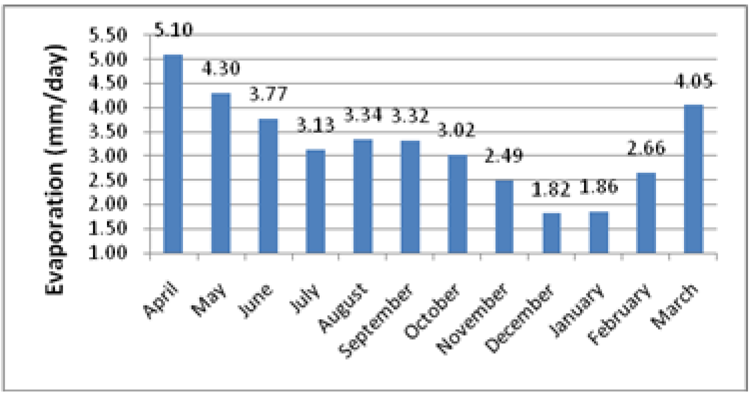


Figure 5.4: Evaporation of the study area

g) Wind Speed

129. Figure **Error! Reference source not found.**5.5 shows the average monthly wind speed 1948-2010 at Faridpur and 1987-2010 at Tangail. The highest value occurred in May (208 km/day in Faridpur) and the lowest in January (97 km/day in Tangail).

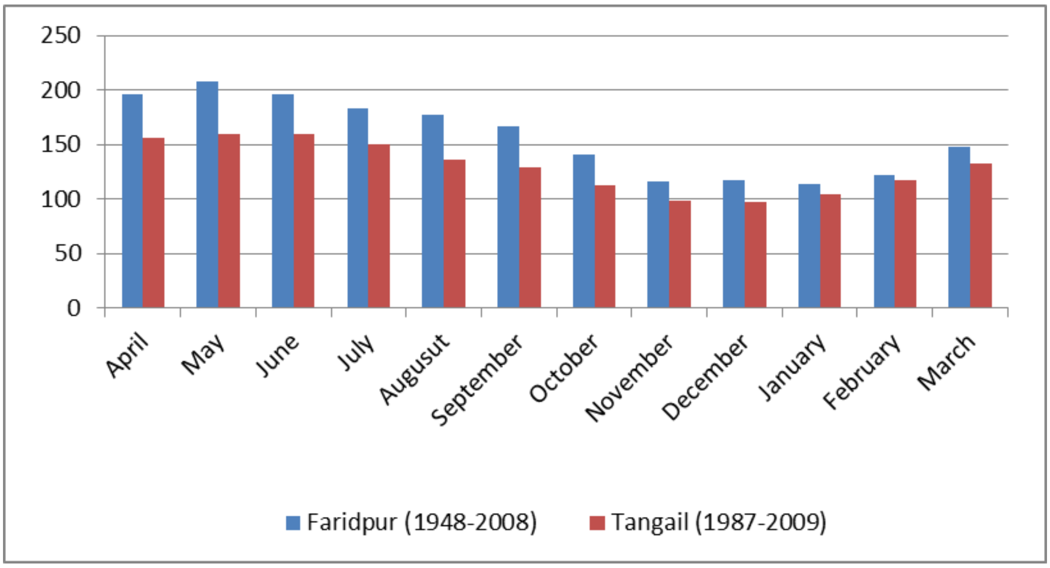


Figure 5.5: Windspeed of the study area

h) Sunshine Hours per Day

130. Figure 5.6 shows the average monthly sunshine hour per day data 1985-2008 at Faridpur and 1987-2008 at Tangail. The highest value occurred in April (8.1 hours per day in Faridpur) and the minimum in July (4.0 hours per day in Tangail).

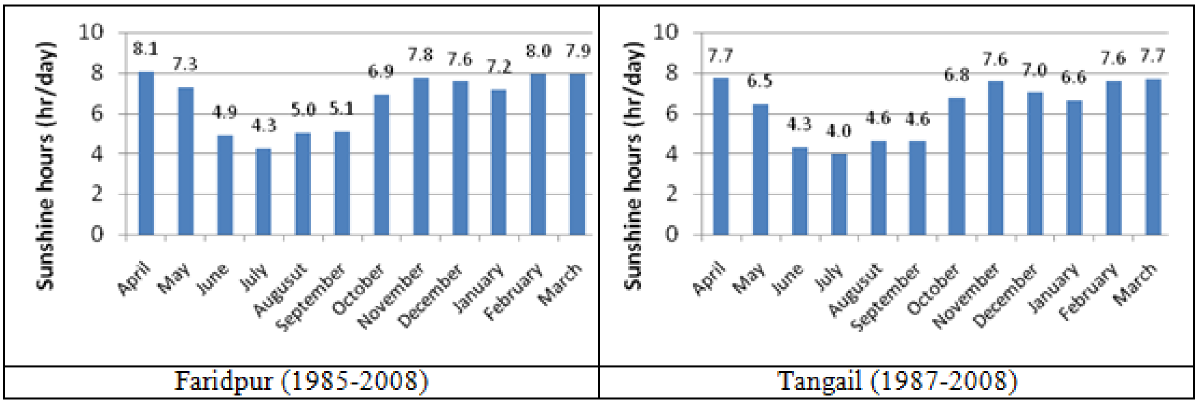


Figure 5.6: Sunshine hours per day

5.1.2 Stratigraphy and Seismicity

131. **Map 5.1** shows the ten tectonic units of Bangladesh. The study area lies mostly in the Faridpur trough. A small part of the study area in the northwestlies in the Calcutta-Mymensingh hinge. Map 5.1 shows the three seismic zones of Bangladesh. The study area falls in Zone-II. The Bask (BSC) coefficient for this zone is 0.05, which corresponds to medium earthquake vulnerability.

5.1.3 Topography

132. Map 5.2 shows study area topography as rendered by a digital elevation model. The topography of the study area is low and flat and affected by river flooding annually during the monsoon season. Land elevation varies from 0.39 to 1.39 m above mean sea level (AMSL). The average land level is 0.81 m AMSL. The area slopes gently downward from north to south. The higher northern portion (Khamarkhanda, Belkuchi, parts of Sirajganj, etc) and the lower southern portion (JLB-2 areas near Singair and Shibalaya in Manikganj district) have average land elevations of 1.15 m and 0.54 m AMSL respectively.

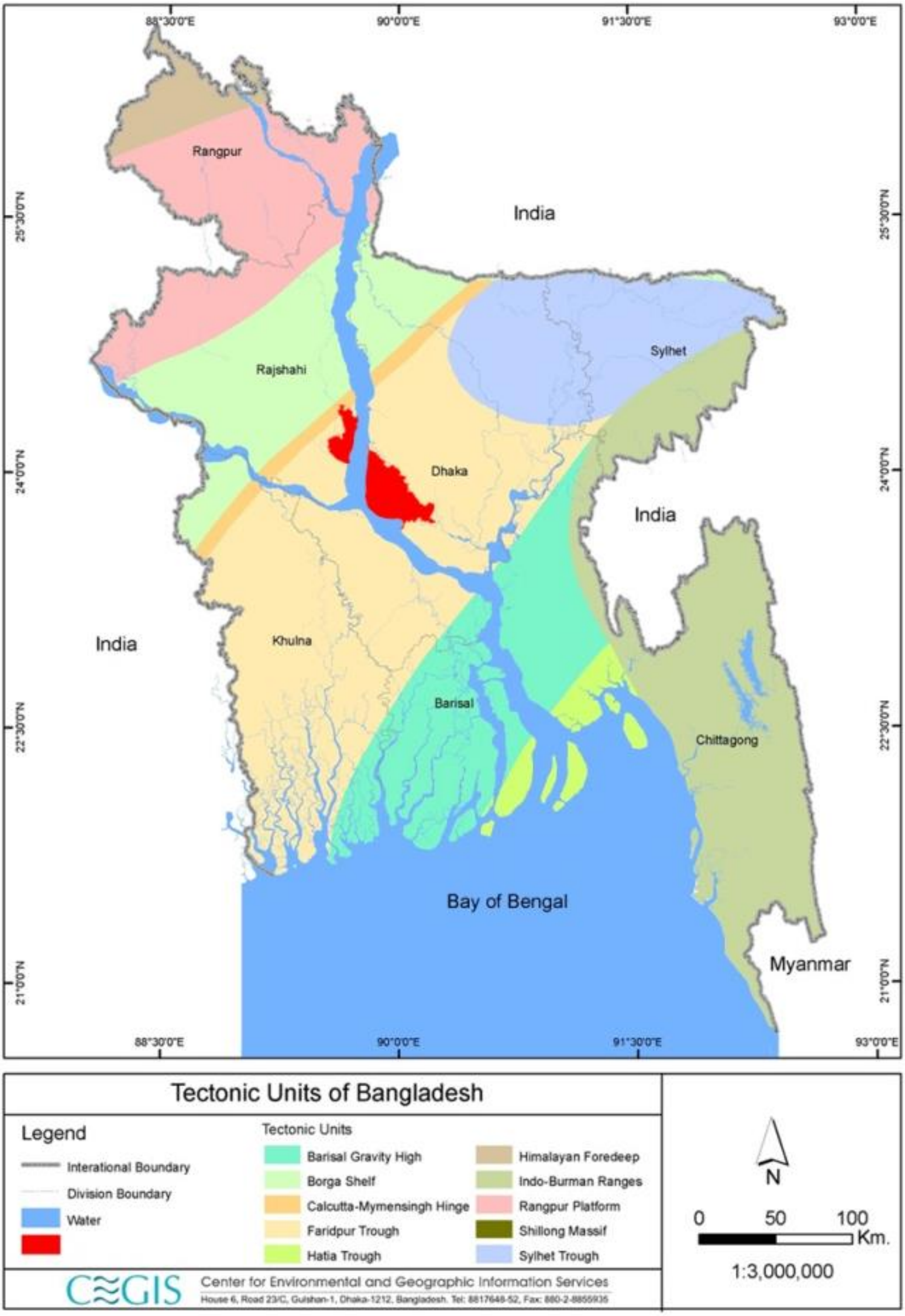
5.2 Water Resources

5.2.1 River System

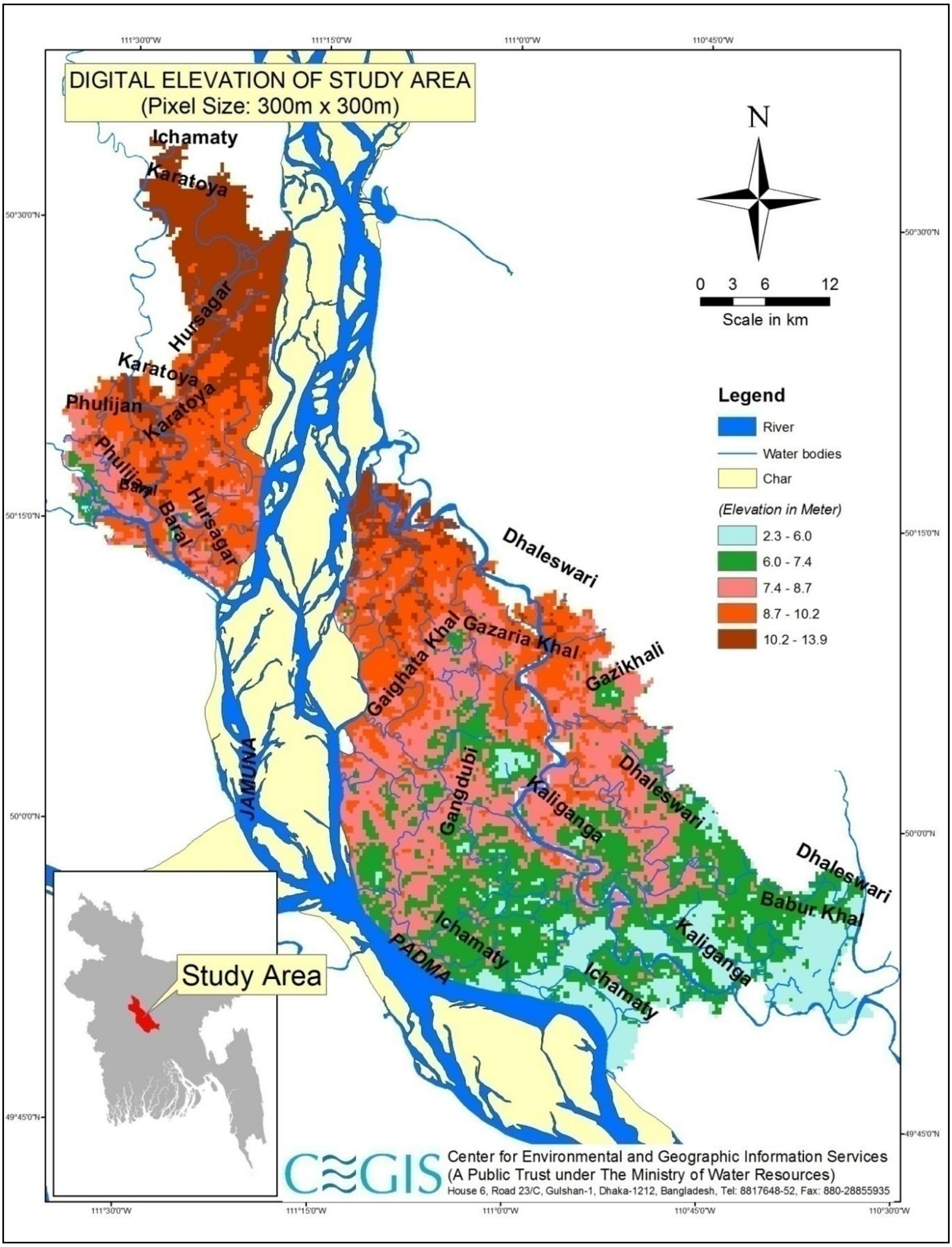
133. The study area (three sub-projects) comprises about 244,000 ha of which approximately 13 % are occupied by rivers and a very minor percentage (approximately 0.6 per cent) is occupied by other water bodies. The hydrology of the area is dominated by the three major rivers, the Jamuna, Ganges and the Padma into which they flow.

134. The Jamuna River is the 240 km-long lower reach of the Brahmaputra River from the India-Bangladesh border to the confluence with the Ganges. The Jamuna has an annual average discharge of around 20,000 m^3/s at Bahadurabad Transit. The flow varies from a low of 8000 m^3/s to a maximum of 100,000 m^3/s. Bankfull discharge is around 48,000 m^3/s. The river typically peaks in July-August. The average width is 11.8 km, the average floodwater slope of the river is 7.5 cm/km and the average median size of bed material at Bahadurabad is 0.20 mm.

135. The Ganges/Padma (above its confluence with the Jamuna) has a long-term mean flow of about 12,000 m^3/s or about 60 per cent of the Jamuna. Flood discharges reach80,000 m^3/s. The Ganges/Padma typically peaks later than the Jamuna in August-September.The Ganges/Padma has the lowest water yield, particularly in the dry season, with flows dropping below 650 m^3/s.



Map 5.1: Location of Study area in the Tectonnnnnnic units of Bangladesh



Map 5.2: Topography of the Study area

136. The Padma (below its confluence with the Jamuna) drains the combined Ganges/Padma-Jamuna. It is approximately 120 km long. The reach-averaged width of the river is 10.3 km but varies from 2.5 km to 20 km. The average median size of the bed material at Mawa is 0.12 mm. It has an average discharge at Mawa of around 30,000 m^3/s. Discharge varies from a minimum of 10,000 m^3/s up to 120,000 m^3/s. Substantial overland flow occurs along the Padma to the southern coastal area, and as such counters salinity intrusion, but this also leads to reduced in-channel discharges

downstream. The Padma is weakly tidal during the dry season. At the downstream end of the project area, the Padma joins the Meghna River near Chandpur.

137. Table 5.1 and Table 5.2 show the seasonal and mean discharge values of the Jamuna and Padma rivers from 1981 to 2006 at two stations, Bahadurabad transit and Baruria transit (BWDB, 2006). The Jamuna maximum is about 50,000 m^3/s (July) while the Padma maximum is about 70,000 m^3/s (September-October).

Table 5.1: Seasonal Discharge of Jamuna and Padma

Season	Jamuna River (Bahadurabad Transit)	Padma River (Baruria Transit)
m^3/s		
Dry (December-February)	9610	7330
Pre-Monsoon (March-May)	12700	9630
Monsoon (June-September)	35710	43250
Post-Monsoon (October-November)	25500	20660

Table 5.2: Mean Discharge (1981- 2006) of Jamuna and Padma

Season	Jamuna River (Bahadurabad Transit)	Padma River (Baruria Transit)
m^3/s		
Dry (December-February)	6080	7650
Pre-Monsoon (March-May)	10360	10920
Monsoon (June-September)	41020	60030
Post-Monsoon (October-November)	20100	29910

Source: BWDB

138. Main river water levels and discharges are not strongly related to local precipitation, since the vast majority of river runoff is generated outside the country. The most severe floods occur when the Jamuna and Ganges Rivers peak together such as in 1988.

139. The tributaries of these major rivers inside the study area are Hurasagar, Dhaleswari, Kaliganga, Baral, Gohala, and Ichamati Rivers. The Ichamati is the only Padma tributary passing through the study area; the other tributaries connect directly to the Jamuna.

140. Some small water bodies (*Kadaibadla Beel, Pandaha Beel, Khalsir Beel, Nalai Beel, Bharua Beel, Gharilpur Beel* etc.) are found inside the study area. Most are connected to the tributary channels during monsoon.

5.2.2 Surface Water Levels and Quality

141. Surface water data records for water level, water quality, and discharge of the two major rivers were collected from several BWDB stations covering various time intervals. The following sections provide a discussion of surface water characteristics in the study area.

142. **Water levels.** Secondary data on water levels were collected for the Jamuna and Padma rivers fromthe BWDB stations at Sirajganj and Aricha. The data collected on water levels (2009) are shown below in Table 5.3. The table shows that in monsoon the average surface water levels of Jamuna and Padma riversremain about 11.73m PWD and 7.28m PWD, respectively. In the dry season, the Padma Riverbecomes extremely shallow but the JamunaRiver remains deep enough. Table 5.4 shows the average values of water levels of the two major rivers in different seasons (1991 to 2009).

Table 5.3: Water levels of Jamuna and Padma

Season	Jamuna River (Sirajganj station)	Padma River (Aricha Station)
m+PWD		
Dry(December-February)	6.84	2.85
Pre-Monsoon(March-May)	7.75	3.35
Monsoon (June-September)	11.73	7.28
Post-Monsoon (October-November)	5.5	5.80

Source: Bangladesh Water Development Board

Table 5.4: Jamuna and Padma Rivers Mean Water Levels(1991-2009)

Season	Jamuna River (Sirajganj station)	Padma River (Aricha Station)
m+PWD		
Dry (December-February)	7.60	3.23
Pre-Monsoon (March-May)	8.50	3.73
Monsoon (June-September)	12.55	8.19
Post-Monsoon (October-November)	10.32	6.22

Source: Bangladesh Water Development Board

143. **Water quality.** Sevensurface water quality parameters were collected from two BWDB stations at Bahadurabad and Aricha. The values of the parameters and their standard values set by the DoE are shown in Table 5.5andTable 5.6 respectively.

Table 5.5: Surface Water Quality of Jamuna and Padma

Station Name	River	Month	Temp (°C)	pH	DO (mg/l)	TDS (mg/l)	EC (µS/cm)	Fe (mg/l)	Cl (mg/l)
Bahadurabad Transit	Jamuna	January	29	7.8	8.29	22	66	0.02	11
		February	30	7.8	8.29	23	65	0	11
		Marh	32	7.8	8.29	21	66	0.02	10
		April	28	7.8	8.28	21	64	0.02	10
		May	28	7.7	8.26	21	65	0.01	11
		June	27	7.6	8.21	21	65	0	11
Aricha	Padma	January	28	7.3	8.16	24	69.2	0.2	12
		February	30	7.3	8.12	24	69.2	0.2	12
		Marh	30	7.3	8.16	25	69.2	0.2	10
		April	30	7.3	8.16	23	69.2	0.2	10
		May	27	7.3	8.1	22	69.2	0.2	10
		June	28	7.3	8.1	23	69.2	0.2	12

Source: Bangladesh Water Development Board

Table 5.6: Bangladesh Water Quality Standard

Water quality parameters	Standard value	Suitable for
pH	7.0-8.5	Irrigation
	6.7-9.5	Fishing
DO (mg/l)	4.0-6.0	Fishing
	5.0	Irrigation
Nitrate (mg/l)	0.01-2.0	Irrigation
	2.5-10.0	Fishing
Phosphate (mg/l)	0.01-2.0	Irrigation
	1.5-10.0	Fishing
Chlorine (mg/l)	22.0	Irrigation
	22.0	Fishing
Temperature (oC)	20-30	Irrigation
	20-30	Fishing

Source: Bangladesh Water Development Board

(i) Ground Water

144. Groundwater level data are analyzed using data of three BDWB observation wellsin three districts (Sirajganj, Manikganj and Tangail) of the study area. Figure 5.7 showsvariations of mean ground water level. The Tangail average ground water level is slightly lower than those of the other two districts. Manikganj and Tangail average ground water levels were similar during the observation periods, whereas at Sirajganj station a drop in ground water table (up to 6 meters) was observed in 1997 and 2001.

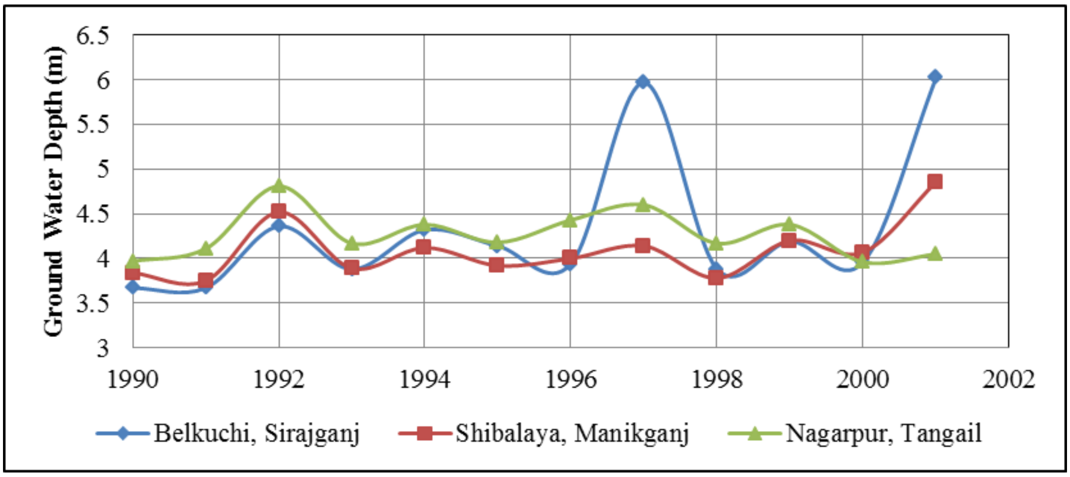


Figure 5.7: Mean Ground Water Levels, Sirajgang, Manikganj, and Tangail (1990-2001)

145. Table 10 under Annex 1 shows the ground water table (GWT) at ten year intervals at the three aforementioned locations. Values are shown for both the dry (April) and wet (September) period. In the dry season, increased use of ground water by local people lowers the GWT. During monsoon, surface water recharges the ground water and GWT rises upward. In 2000 compared to 1990, dry season GWThad dropped whereas wet season GWT had risen.

5.2.3 Water Resources Functions

146. The people of the study area not only depend on the existence of the surrounding water resources system, but also its adequate functioning. The assessment of the water resources functions is helpful to investigate the scenarios of different types of water use, as well as the consequences of natural flow phenomenon.

(a) Irrigation

147. The net cultivable area (NCA) for Tranche 1is approximately 184,200 ha, comprised of 51 per cent clay and 49 per cent loam soil. The water required to irrigate the entire NCA is approximately 2.8 Bm^3 for a single season of Boro rice planted in the Rabi winter season (generally Nov-Feb) and harvested in the Kharif monsoon season (generally Mar-Oct). Water to irrigate the NCA for Aus (rice planted and harvested in Kharif)and for Aman (rice planted in Kharif and harvested in Rabi) would be 0.55 Bm^3 each. Therefore around 3.9 Bm^3 water would be required for irrigating the entire 184,200 ha NCA. However, of this area, only 55 per cent area is irrigable. Table 5.7shows the proportion of irrigable areas and water consumed by these areas annually (Minor Irrigation Project, 2010). Approximately 2.15 Bm^3 of water is annually available for irrigation from different surface and ground water sources and around 1.75 bm^3 of water would be further required to provide irrigation in the entire NCA (Table).

Table 5.7: Irrigable Areas and Water Consumption

Irrigation methods used	Area (ha)	Percentage of NCA	Annual Water Requirements
Ground Water			
STW	94,840	51.15	2.0
DTW	6120	3.3	0.1
Surface Water			
LLP	1,020	0.55	0.05
Total Irrigated area	101,980	55	2.15 $Bm^3$of water is available for irrigation and another 1.75 Bm^3 of water is required to bring the remaining 45 per cent non-irrigated area into irrigation coverage
Total non-irrigated area	82,220	45	

Source: Minor irrigation Project, 2010

(b) Flood Management

148. Due to the flat topography of Bangladesh, just a small increase in water level above the river bank causes full-scale inundation. Figure 5.8 shows a relation between the flooded areas (Mha) and the total volume (Bm^3) of river water. During monsoon the Jamuna and Padma rivers attain their peak discharges which consequently lead to higher flooding as well as drainage congestion during the period.

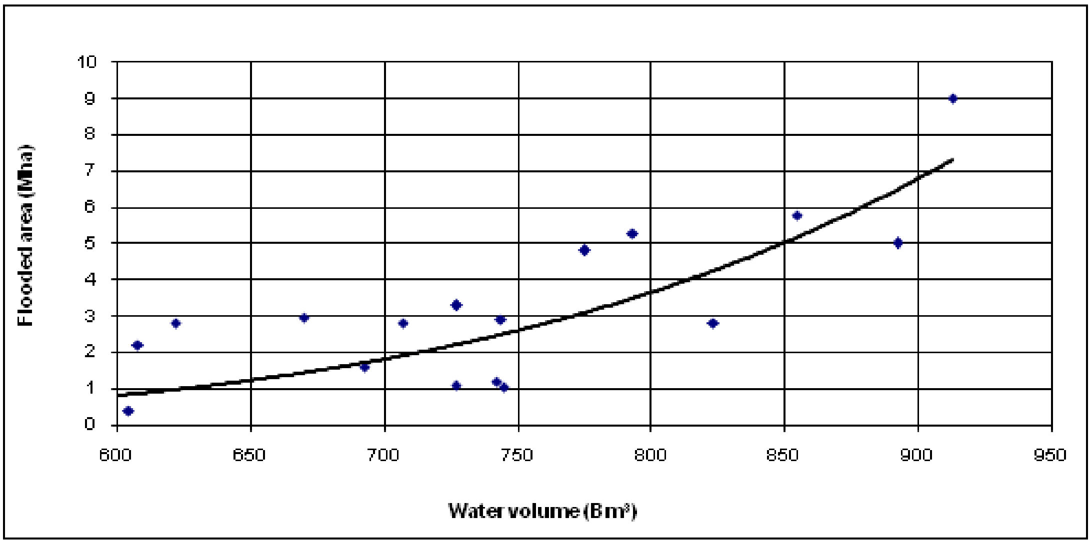


Figure 5.8: Flooded Area Vs Water Volume (1972-1993)

149. The occurrence of flood is indicated when the water level of the river exceeds its danger level. The danger level of the Padma at Mawa is 6.0 m PWD and the Jamuna at Bahadurabad is 19.5m PWD. The probability of flood in a year for the Padma is about 60 per cent and for the Jamuna is about 75 per cent. The average duration of flood is about 23 days in the Padma basin and about 14 days in the Jamuna basin. The durations of the floods previously affecting the Padma and Jamuna basins are given inTable 5.8.

Table 5.8: Flood Duration, Padma and Brahmaputra/Jamuna Basins

Padma Basin		Brahmaputra/Jamuna Basin	
Year	**Flood duration (days)**	**Year**	**Flood duration (days)**
1998	65	1998	63
1987	52	1974	44
2003	39	1970	26
1971	35	1984	24
1969	33	1977	22
1995	30	1973, 1980, 2007	21

Source: Flood Shelter Report, IWFM and BRAC

150. Table 5.9 and Table 5.10 show the frequency analyses of the annual maximum water levels of the Jamuna and Padma rivers (Flood Shelter Report, IWFM and BRAC). The tables explain the differences in water levels due to change in return periods. It is seen from the tables that the difference between the highest flood and the 20year flood is about 23 cm at Bahadurabad and 38 cm at Mawa.

Table 5.9: Flood Level Frequency Analysis, Jamuna at Bahadurabad

Probability distribution function	**Water level for the specified return period**(m PWD)					**Highest observed floods,** m+PWD (year)
	5 year	*10 year*	*20 year*	*50 year*	*100 year*	
Normal	20.11	20.29	20.44	20.6	20.72	20.61 (1988) 20.40 (2007) 20.37 (1998)
Log Normal	20.11	20.29	20.45	20.62	20.74	
Log Pearson Type III	20.11	20.26	20.38	20.5	20.58	
Gumbel	20.06	20.3	20.53	20.83	21.05	

Source: Flood Shelter Report, IWFM and BRAC

Table 5.10: Flood Level Frequency Analysis, Padma at Mawa

Probability distribution function	**Water level for the specified return period**(m PWD)					**Highest observed floods,** m+PWD (year)
	5 year	*10 year*		*5 year*	*10 year*	
Normal	6.5	6.67	6.81	6.97	7.08	7.14 (1998) 7.07 (1988) 6.84 (2004)
Log Normal	6.49	6.67	6.82	7.0	7.12	
Log Pearson Type III	6.5	6.64	6.76	6.88	6.95	
Gumbel	6.45	6.68	6.9	7.18	7.39	

Source: IWFM and BRAC Flood Shelter Report.

151. The severe land erosion along the river banks and char lands of the study area cause continuous siltation in a number of major tributary rivers (Karatowa, Baleswari, Baral, Hurasagar, Ichamati etc rivers) of the Padma and the Jamuna. This eventually reduces the depths of these rivers and during the dry periods these rivers become extremely shallow. As a result, water logging problems arise during the dry periods at a few locations (Ghashpukuria, Ghashkauliya, Bagutia etc villages under Chauhali and Daulatpur upazilas). The condition of drainage inside the area is poor. In the study area, drainage channels are not well developed. A significant portion of the entire study area suffers from drainage congestion problems during the wet period. As the major tributary

channels are becoming shallow because of heavy siltation, such rivers and water bodies do not provide the effective drainage needed during monsoon. Also due to the backwater effects of the two major rivers, drainage congestion problems occur. About 12.5 per cent of the total study area (some areas near JRB1 and PLB1 interventions at Belkuchi, Shahjadpur, Harirampur, Manikganj etc.) undergoes moderate drainage. The drainage of areas near the JLB2 intervention (Nagarpur, Saturia, Shibalaya etc locations) is poor.

(c) Morphology

152. The morphology of the two major rivers adjacent to the study area has enormous impacts on the lives and livelihood of the local people. During the last few decades the lower reach of the Jamuna River changed its plan form from a single threaded meandering river to a complicated braided river. The location of the confluence of the Hurasagar River shifted several kilometers upstream during the last 40 years and became fixed at the present position about two decades back. Channel development and abandonment, movement of bars, islands and bank lines is very common in this river. The Padma, on the other hand is a meandering river and less dynamic.

(d) Erosion

153. Riverbank erosion is the most important natural cause of landlessness and forced resettlement of people in the study area. During 1973 to 2012, erosion and accretion along the Jamuna River was 87,363 ha and 16,479 ha respectively (net erosion was about 70,884 ha). In 2011, net erosion was about 1,999ha of which 250 ha were settlements. The eroded lands also included about 1,867 m of district road, 958 m of upazila road and 3019 m of rural road.

154. During the last four decades (1973 to 2011), erosion and accretion along the Padma River was 41,323 ha and 9,134 ha respectively (the net erosion was about 32,189 ha). The rate of widening of the Padma River was 160 m/year in the 1980s, which increased to 230 m/year in the 1990s. Recently, the rate of widening has reduced to 130 m/year. In 2011, about 679 ha of land were eroded, of which settlements were about 60 ha. On the other hand, 54 m of district road, 22 m of upazila road and 1294 m of rural road were eroded in that year. In the study area, about 360 ha of land were eroded in 2011 which included about 27 ha of settlements, 41m district road, 39m upazila road and 407m rural roads.

(e) Char Formation

155. Char lands refer to mid-channel islands that periodically emerge from the riverbed as a result of accretion (Elahi, Ahmed, and Mafizuddin 1991). The residents of chars and mainland adjacent to main rivers are extremely vulnerable to erosion and flooding as it can destroy their crops and home-steads, render land unproductive, and destroy livestock. In the Jamuna floodplains, about 50 per cent people live in the island and attached chars whereas in the Padma char areas, the number is about 27 per cent (Bangladesh Flood Action Plan, 1993).

156. The study area comprises about 29,000 ha (about 12 per cent of the study area) of chars. About 90 per cent of these areas are used for different purposes (ie agriculture, settlement etc) by the local people. The remaining 10 per cent areas are not used by the local people because of its temporary existence. In the Jamuna River, about 85 per cent reduction in flow takes place during dry period. The mean depth of Jamuna River recorded near the Sirajganj Sadar reduces by approximately 39.5 per cent. About 87 per cent reduction in flow takes place in the Padma River from monsoon to dry period. The average depth of the river reduces by approximately 60 per cent (from 8.19 m during monsoon to 3.23 meters in the dry season). This significant reduction of dry season flow eventually increases the char lands during the dry season.

157. Char lands are formed mainly because of the low flow in the rivers in the dry season. Also the erosion along the sides of the Jamuna and Padma rivers result in the siltation of inside the rivers, which results in the formation of Char lands.

5.3 Land Resources

5.3.1 Agro-Ecological Regions

158. Bangladesh has a wide range of environmental conditions. Environmental diversity occurs not only at national and regional levels, it also occurs at upazila and village levels. Besides considerable year to year variability in moisture, the temperature and flood regimes create major problems for planning program on environment and agricultural research, extension and development activities.

159. Thirty agro-ecological regions and 88 sub-regions have been identified by adding successive layers of information on the physical environment which are relevant for land use and assessing agricultural potential (Map 5.3).These layers are: (i) physiography (land forms and parent materials); Soils and their characteristics; (ii) depth and duration of seasonal flooding; (iii) length of the rain-fed kharif and rabi growing periods; Length of the pre-kharif period of unreliable rainfall; (iv) length of the cool winter period and frequency of occurrence of extremely low temperature (below 0.40^{o}C); (v) winter temperature and (vi) frequency of occurrence of extremely high (> 400^{o}C) summer temperature.

160. The study area comprises of the following five agro-ecological regions:

- (i) Karatoya-Bangali Floodplain (AEZ-4);
- (ii) Active Brahmaputra-Jamuna Flood plain (AEZ-7);
- (iii) Young Brahmaputra and Jamuna Floodplain (AEZ 8);
- (iv) Active Ganges Floodplain (AEZ-10); and
- (v) Low Ganges River Floodplain (AEZ-12).

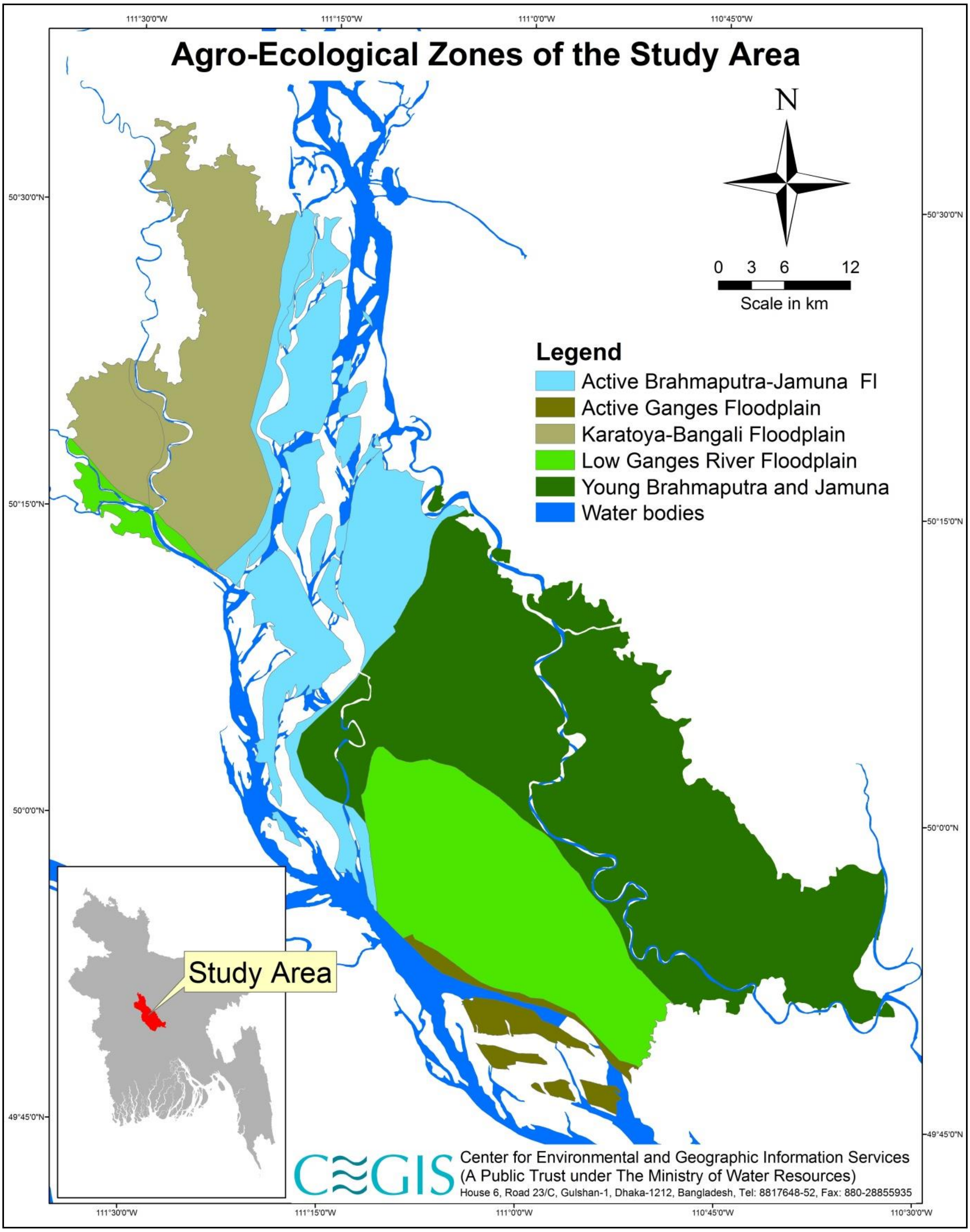
161. The distribution of agro-ecological regions in the study area is presented in **Error! Reference source not found.**5.11. Characteristics of study area agro-ecological regions are presented below.

Table 5.11: Agro-Ecological Zones

Agro-ecological Region	AEZ Area Within Study Area	
	(ha)	(per cent)
Active Brahmaputra-Jamuna	43,977	18
Active Ganges Floodplain	7,329	3
Karatoya-Bangali Floodplain	43,977	18
Low Ganges River Floodplain	46,420	19
Young Brahmaputra and Jamuna	102,613	42
Total	**244,316**	**100**

Karatoya-Bangali Floodplain Region (AEZ-4)

162. The floodplain apparently comprises of a mixture of Tista and Brahmaputra sediments. Most areas have smooth, broad, floodplain ridges and almost level basins. The soils are grey silt loams and silty clay loams on ridges and grey or dark grey clays in basins. Five general soil types occur in the region of which, Non-calcareous Grey Floodplain and Non-calcareous Dark Floodplain soils predominate. They are moderately acidic throughout. Organic matter content is low in ridge soils and moderate in basins. General fertility is medium. Some physico-chemical properties of soils of Karatoya-Bangali Floodplain Region are presented in Table 5.12.



Map 5.3: Agroecological Region of the Study Area

Table 5.12: Soil Characteristics, Karatoya-Bangali Floodplain Region

Major land type	Soil pH	Soil OM	Nutrients status								
			N	*P*	*K*	*S*	*Ca*	*Mg*	*Zn*	*B*	*Mo*
High land (23 per cent)	4.7-7.8	L	VL-L	L-M	L	L-M	Opt	Opt	L-M	L-M	Opt
Med highland (44 per cent)	5.4-7.9	L	VL-L	L-M	L	L-M	Opt	Opt	L-M	L-M	Opt
Med lowland (14 per cent)	6.2-7.7	L	VL-L	L-M	L	L-M	Opt	Opt	L-M	L-M	Opt

Source: BARC Fertilizer Recommendation Guide-2005.
Notes: OM=Organic matter; VL=Very low; L=Low; M=Medium; Opt=Optimum; H=High; VH=Very high.

Active Brahmaputra-Jamuna Flood plain Region (AEZ-7)

163. This subunit, which underlies agro-ecological region 7, comprises young, stratified, alluvial land within and adjoining the shifting channels of the Brahmaputra and Jumna Rivers, the Old Brahmaputra River and the Dhaleswari-Kaliganga River. The land formation (char) are liable to change shape each year as river banks are eroded,new alluvium is deposited within and alongside channels and older deposits are buried by layers of new alluvium. The relief varies from smooth to irregular, with differences in elevation of 2-3 meters or more between adjoining ridges and depressions. The depth of flooding varies from shallow to deep on different sites and the maximum depth may vary by a meter or more from year to year. The area is occupied by sandy and silty alluvium rich in minerals with slightly alkaline in reaction. The Brahmaputra sediments are greyer in color than the Ganges sediments. Six general soil types occupy the area of which only Non-calcareous Alluvium predominates. Organic matter content is low and fertility status low to medium. Some physico-chemical properties of soils of Active Brahmaputra-Jamuna Flood plain Region is presented in Table 5.13.

Table 5.13: Soil Characteristics, Active Brahmaputra-Jamuna Floodplain

Major land type	Soil pH	Soil OM	Nutrients status								
			N	*P*	*K*	*S*	*Ca*	*Mg*	*Zn*	*B*	*Mo*
Medium highland (37 per cent)	5.7-8.2	L	L	L-M	L-M	L-M	L-M	L-M	L-M	L-M	M
Medium lowland(20 per cent)	6.0-8.2	L	L	L-M	L-M	L-M	L-M	L-M	L-M	L-M	M

Source: BARC Fertilizer Recommendation Guide-2005.
Notes: OM=Organic matter; VL=Very low; L=Low; M=Medium; Opt=Optimum; H=High; VH=Very high.

Young Brahmaputra and Jamuna Floodplain Region (AEZ 8)

164. The region comprises of the area of Brahmaputra sediments. It has a complex relief of broad and narrow ridges, inter-ridge depressions, partially in filled cut-off channels and basins. This area is occupied by permeable silt loam to silty clay loam soils on the ridges and impermeable clays in the basins; neutral to slightly acid in reaction. General Soil Types include predominantly Grey Floodplain soils. Organic matter content is low in ridges and moderate in basins. Soils are deficient in N, P and S but the status of K and Zn is medium. Some physiochemical properties ofsoils of Young Brahmaputra and Jamuna Floodplain are presented inTable 5.14.

Table5.14: Soil Characteristics, Young Brahmaputra and Jamuna Floodplain

Major land type	Soil pH	Soil OM	Nutrients status								
			N	*P*	*K*	*S*	*Ca*	*Mg*	*Zn*	*B*	*Mo*
High land (18 per cent)	5.6-7.5	VL-L	VL-L	L	M	L	M	M	L-M	L-M	M
Med highland (42 per cent)	5.4-7.5	VL-L	VL-L	L	M	L	M	M	L-M	L-M	M
Med lowland (19 per cent)	5.4-7.5	L	L	L	M	L	M	M	L-M	L-M	M

Source: BARC Fertilizer Recommendation Guide-2005.

Notes: OM=Organic matter; VL=Very low; L=Low; M=Medium; Opt=Optimum; H=High; VH=Very high

Active Ganges Floodplain Region (AEZ-10)

165. The agro-ecological regions of Active Ganges Floodplain comprises of young, stratified, alluvium land within and adjoining the shifting channels of the Ganges River and its two main distributaries, the Gorai- Madhumati and Arial khan. The alluvial formations (chars) are liable to change shape each year as river bank are eroded, new alluvium are deposited within and along channels and older deposits are buried by layers of new alluvium. The relief varies from smooth to irregular, with 2-3 meters or more difference in elevation between the adjacent ridges and depressions. Seasonal flooding varies from shallow to deep on different sites and may vary in depth by more than a meter between years. The area has complex mixtures of calcareous sandy, silty and clayey alluvium. The general soil types predominately include Calcareous Alluvium and Calcareous Brown Floodplain soils, which are low in organic matter and mildly alkaline in reaction. The fertility status generally is medium. Physiochemical properties of soils of Active Ganges Floodplain Regionare presented inTable 5.15.

Table5.15: Soil Characteristics, Active Ganges Floodplain Region

Major land type	Soil pH	Soil OM	Nutrients status								
			N	*P*	*K*	*S*	*Ca*	*Mg*	*Zn*	*B*	*Mo*
High land (12 per cent)	7.1-8.1	L	L	L-M	M	L-M	H	H	L	M	M
Med highland (33 per cent)	7.1-8.1	L	L	L-M	M	L-M	H	H	L	M	M
Med lowland (18 per cent)	7.1-8.1	L	L	L-M	M	L-M	H	H	L	M	M

Source: BARC Fertilizer Recommendation Guide-2005.

Notes: OM=Organic matter; VL=Very low; L=Low; M=Medium; Opt=Optimum; H=High; VH=Very high.

Low Ganges River Floodplain (AEZ-12)

166. This region comprises of the north-eastern, eastern and south-eastern parts of the Ganges Meander Floodplain which are lower lying than the western part. The ridges are mainly shallowly flooded, but basins become moderately deeply or deeply flooded in the rainy season.

167. The soils of the Low Ganges River Floodplains are silt loams and silty clay loams on the ridges and silty clay loams to heavy clays on lower sites.General soil types predominately include Calcareous Dark Grey, Grey and Calcareous Brown Floodplain soils. Organic matter content is low in ridges and moderate in the basins. Soils are calcareous in nature having neutral to slightly alkaline in reaction. General fertility level is medium. Some physiochemical properties of soils of Low Ganges River Floodplainare presented inTable 5.16.

Table 5.16: Soil Characteristics, Low Ganges River Floodplain

Major land type	Soil pH	Soil OM	Nutrients status								
			N	*P*	*K*	*S*	*Ca*	*Mg*	*Zn*	*B*	*Mo*
High land (13 per cent)	6.8-8.2	L	VL-L	VL-L	M-Opt	L-M	Opt-H	Opt-H	L-M	M-Opt	Opt
Medium highland (29 per cent)	6.2-8.3	L-M	VL-M	VL-M	M-Opt	L-M	Opt-H	Opt-H	L-M	M-Opt	Opt
Medium lowland (31 per cent)	6.0-8.3	L-M	L	L	M-Opt	L-M	Opt-H	Opt-H	L-M	M-Opt	Opt
Lowland (14 per cent)	6.0-7.7	M	L	L	M-Opt	L-M	Opt-H	Opt-H	L-M	M-Opt	Opt

Source: Fertilizer Recommendation Guide-2005, BARC

Notes: OM=Organic matter; VL=Very low; L=Low; M=Medium; Opt=Optimum=High; VH=Very high

5.3.2 Land use

168. The total study area is about 244,316ha of which about 184,200 ha is net cultivable area (NCA). Settlements and water bodies constitute about 11 per cent and 13 per cent respectively of the total area of the project. The settlements and river constitute about 23 per cent and 8 per cent respectively of the total area. Details of land use of the study area are presented in Table 5.17.

Table 5.17: Land Use of the Study Area

Land use	Area (ha)	Per cent of total area
Total Area	244,316	-
NCA	184,200	75
Settlements	27,764	11
Rivers & Water Bodies	32,352	13
Total	244,316	100

Sources: CEGIS estimation from SOLARIS.

5.3.3 Land type

169. Land type classifications are based on depth of inundation on agriculture land during monsoon season due to normal flooding. There are five land type classes: high land (0-30 cm), medium highland (30 - 90 cm), medium lowland, (90 -180 cm), low land (180 - 300 cm), and very lowland (>300 cm). The percentages of land type of high land, medium highland, medium lowland, lowland and very lowland are about 4, 37, 37, 21 and 0.3 respectively of the NCA. Detailed land type is presented in Table 5.18.

Table 5.18: Land Types of the Study Area

Land type	**Area** (ha)	Per cent of NCA
Highland	8,153	4
Medium Highland	68,045	37
Medium Lowland	68,023	37
Lowland	39,376	21
Very Lowland	605	0.3
Total	**184,200**	**100**

Sources: CEGIS estimation from SOLARIS.

5.3.4 Soil Texture

170. Soil texture is the relative proportions of sand, silt and clay. It is very important for agriculture crop production. The percentages of texture of surface soil of the study areas are about 7, 44, 39, 6 and 4 per cent for clay, clay loam, loam, sand, sandy loam respectively of the NCA. Data on soil texture is presented in Table 5.19.

Table 5.19: Soil Texture, 0-15 cm Depth

Texture	Area(ha)	Percentage of NCA
Clay	13,157	7
Clay Loam	80,193	44
Loam	72,511	39
Sand	11,389	6
Sandy Loam	6,950	4
Total	**184,200**	**100**

Sources: CEGIS estimation from SOLARIS.

5.3.5 Available Soil Moisture

171. The available soil moisture is very important for the cultivation of Rabi crops. The high (72.9%) and medium level (26.9%) of available soil moisture has been observed in the study area. The distribution of available soil moisture is presented in Table5.20.

Table 5.20: Soil Moisture of the Study area

Soil Moisture	Area	Per cent of NCA
High	134,373	72.9
Medium	49,485	26.9
Low	342	0.2
Total	184,200	100.0

Source: CEGIS estimation from SOLARIS.

5.3.6 Drainage Characteristics

172. Drainage plays a vital role in the management of soil in the study area. As per the SRDI, the drainage characteristics have been divided into six classes from the agriculture point of view. Detailed drainage characteristics along with area of the project are presented in Table 5.21.

173. Most of the area (83%) of the NCA is under imperfectly drained condition. The rest (17 per cent) is under poorly drained condition. The dominance of imperfectly drained soil of the study area indicates that the removal of water in rainy/ monsoon season is the main constraint for growing dry land crops in the study area.

Table 5.21: Drainage Characteristics of the Study Area

Drainage classes	Drainage characteristics	Area (ha)	Percent ofNCA
Imperfectly Drained	Water drained from soil badly or slowly. This soil often remains wet in rainy season due to rainfall. In normal situation, water does not stand on land more than 15 days at a stretch. In rainy season, groundwater stands within 1 metre at least for some time.	31,314	17
Poorly Drained	The soil remains under water from 15 days to 7/8 months. Water is drained from the soil slowly. In most cases, the land remains wet/water logged for a considerable period of time after the rainy season.	152,886	83
Total		**184,200**	**100**

Source: CEGIS estimation from SOLARIS (NWRD).

5.4 Agriculture Resources

5.4.1 Farming Practices

174. Farming practices in the study area are largely controlled by physical, biological, climatological and socioeconomic factors. Agricultural crops are grown by cropping seasons. There are two distinct cropping seasons in a year. They are Kharif and Rabi seasons. The Kharif season starts from March and ends in October while the Rabi season starts from November and ends in February. Based on crop adaptability and crop culture, the Kharif season has been further sub-divided into Kharif-1 (March-June) and Kharif-II (July-October) season.

175. Kharif-I is characterized by high temperature, low humidity, high evaporation, high solar radiation and uncertainty of rainfall of low alternating dry and wet spells. In this season, mainly Aus rice, Jute and Vegetables are grown. The Kharif-II season is characterized by high rainfalls, lower temperatures, high humidity, low solar radiation and high floods that recede towards the end of the season. Rice is the predominant crop grown during this season due to the submergence of soil. Excessive soil moisture also restricts other crops suitable for a high temperature regime. Local transplanted Aman (LT Aman) and High Yielding Varieties of Transplanted Aman (HYV Aman) rice are grown in Kharif-II season in the study area.

176. The Rabi season starts from November and ends in February. During this season, crops are favored with high solar radiation, low humidity and temperature, but inadequate soil moisture due to very low or no rainfall depresses crop yield throughout the season. Wide ranges of crops can be grown in this season. Major crops grown in this season in the study area are HYV Boro (Photo 5.1), Pulses, Spices, Mustard (Photo 5.2), Potato and Vegetables. However, there are occasional overlaps such that Kharif-II season crops (Aman rice) are harvested in Rabi season and Rabi season crop (Maize, Potato and vegetables) are harvested in Kharif-I season and Jute is harvested in Kharif-II season.

Photo 5.1: Boro Seedbed

Photo 5.2: Mustard

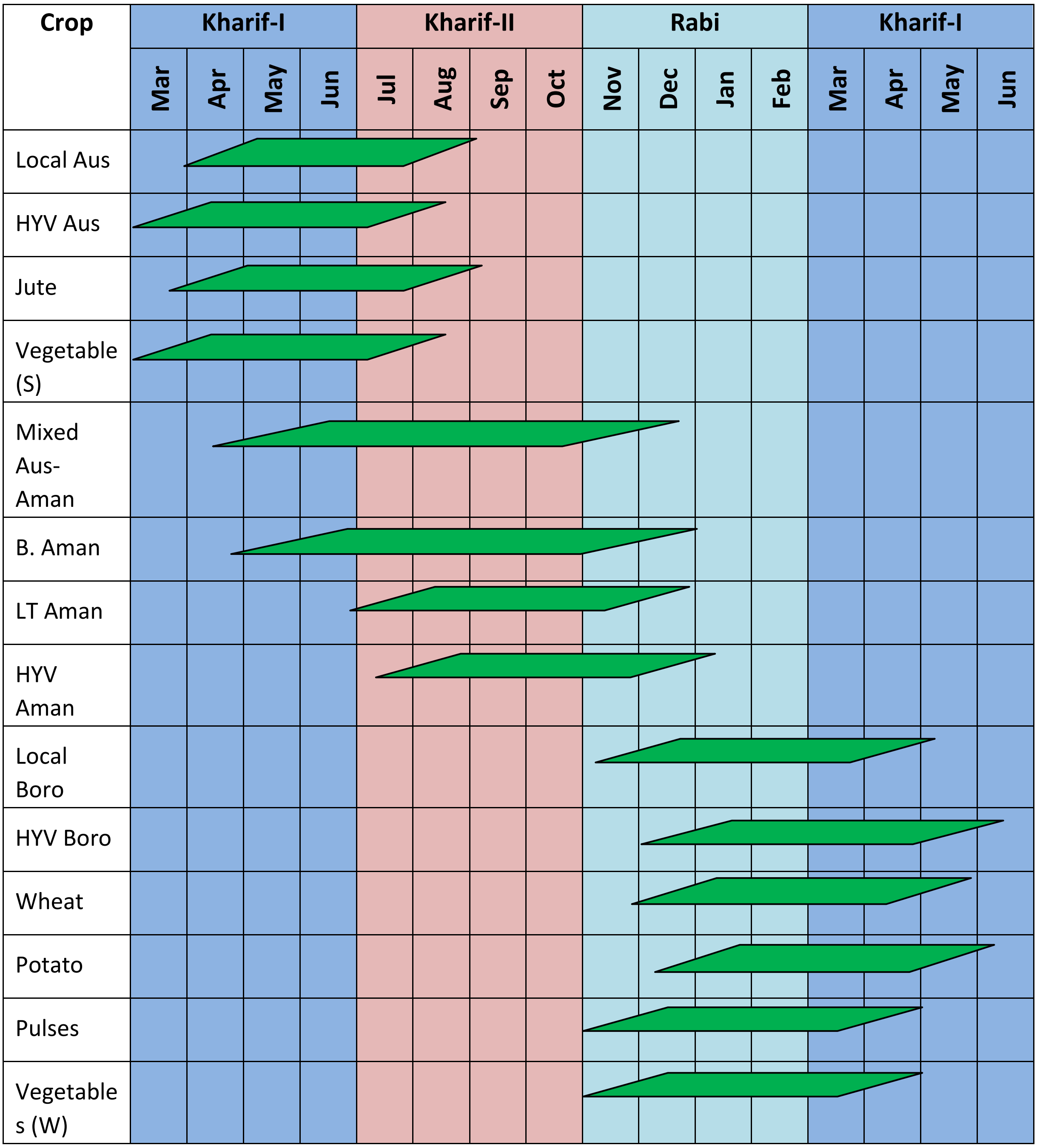
5.4.2 Crop Production Constraints

177. The main constraints that are found in the study area are erosion of river, drainage congestion, siltation of different internal river and drainage khals, scarcity of irrigation water in Boro season etc. Siltation of different internal Khals caused drainage congestion which affected transplantation of HYV Aman crops. Jute, Vegetables and Maskalai are also affected. Scarcity of irrigation water affect Boro cultivation and river bank erosion cause loss of fertile agriculture lands.

5.4.3 Crop Calendar, Crop Pattern andCropping Intensity

178. Figure 5.9 shows the crop calendar.

Figure 5.9: Crop Calendar



179. Cropping pattern, defined as the sequence of crops grown in Kharif-I, Kharif-II and Rabi crops in a plot of land in any one year, varies with flood timing, land type, and soil fertility.

180. Cropping patterns practiced on land types in the study area are presented in Table 5.22, which shows 24 major cropping patterns on five land types. Dominant high land cropping patterns are HYV Aus-Fallow-Mustard and Jute-Fallow-Lentil. Dominant medium high land cropping patterns in the include Fallow-HYV Aman-HYV Boro, HYV Aus-HYV Aman-Onion, Jute-HYV Aman-HYV Boro, Jute-Fallow-Mustard, Fallow-LT Aman-Wheat and local Aus-HYV Aman. Dominant medium low

landcropping patterns are B. Aman-HYV Boro, LT Aman and Fallow-Fallow-HYV Boro. Dominant cropping on low land and very low land respectively are single-cropped HYV Boro and Local Boro.

Table 5.22: Cropping Pattern by Land Type

Land type	Kharif-I (March-June)	Khartif-II (July-Oct)	Rabi (Nov-Feb)	Area (ha)	Per cent of NCA
High Land	Vegetables	Vegetables	Vegetables	1150	0.7
	Maize	Fallow	Potato	1,500	0.8
	HYV Aus	Fallow	Mustard	3,853	2.1
	Jute	Fallow	Lentil	1,650	0.9
	Sub-total:			*8,153*	*4.43*
Medium High Land	Fallow	HYV Aman	HYV Boro	13,625	7.4
	HYV Aus	HYV Aman	Onion	7,173	3.9
	Maize	HYV Aman	HYV Boro	1,608	0.9
	Fallow	HYV Aman	Ground nut	2,873	1.6
	Dhaincha	HYV Aman	HYV Boro	4,229	2.3
	Sesame	Fallow	Mustard	4,650	2.5
	Jute	HYV Aman	HYV Boro	8,770	4.8
	Jute	Fallow	Mustard	5,912	3.2
	Fallow	Local T Aman	Wheat	7,040	3.8
	Local Aus	HYV Aman	HYV Boro	8,080	4.4
	Maize	Fallow	HYV Boro	4,085	2.2
	Sub-total:			*68,044*	*36.9*
Medium Low Land	B. Aman	B. Aman	HYV Boro	15,000	8.1
	B.Aman	B.Aman	Black gram	8,341	4.5
	Mixed Aus+ B.Aman	B. Aman	Kheshari	8,540	4.6
	B. Aman	B. Aman	Kheshari	6,500	3.5
	Fallow	Local T. Aman	HYV Boro	11,321	6.1
	Fallow	Fallow	HYV Boro	12,931	7.0
	Fallow	Local T. Aman	Garlic	5,390	2.9
	Sub-total:			*68,023*	*36.9*
Low Land	Fallow	Fallow	HYV Boro	39,375	21.4
	Sub-total:			*39,375*	*21.4*
Very Low Land	Fallow	Fallow	Local Boro	605	0.3
	Sub-total:			*605*	*0.3*
Total:				***184,200***	***100.00***

Source: CEGIS field survey, 2013, plus secondary data from Upazila Agricultural Offices of the study area.

5.4.4 Cropped Area

181. Detailed areas of crops are shown in Table 5.23 which exhibits that total cropped area is 335,099 ha of which 240,052 ha is under rice crop cultivation. Therefore, about 72 per cent of the total cropped area in the study area is under rice crop and the rest (28.3 per cent) is covered with non-rice crops. Pulses and Jutes are the major among the non-rice crops which occupied about 26.3 per cent and 17.1per cent of the total cropped area respectively. The other non-rice crops covered

56.6 per cent of the total cropped area which include spices, oilseeds, wheat, potato and vegetables crops.

Table 5.23: Crop Production

No.	Crop	Area (ha)	Damage-Free			Damaged			Total Production (tons)
			Area (Ha)	Yield (t/ha)	Production (Tons)	Area (Ha)	Yield (t/ha)	Production (Tons)	
1	Local Aus	8,080	6,060	1.4*	8,526	2,020	0.7*	1,353	9,880
2	HYV Aus	11,026	7,718	1.7*	10,860	3,308	1.2*	2,216	12,213
3	Jute	16,332	13,066	2.4	18,383	3,266	1.5*	2,188	19,737
4	Maize	7,193	7,193	6.5	10,121	-	-	-	11,474
5	Vegetables	3,450	2,588	14	3,641	863	8	578	4,994
6	Sesame	4,650	4,650	0.95	6,543	-	-	-	7,896
Kharif-1 Total:		**50,731**	**41,274**		**58,073**	**9,457**		**6,336**	**59,426**
7	Mixed Aus-Aman	8,540	8,540	0.80*	12,016	-	-	-	12,016
8	B. Aman	29,841	19,397	0.85*	27,291	10,444	0.7*	7,697	28,644
9	HYV Aman	39,185	23,511	2.1*	33,080	15,674	1.3*	11,552	34,433
10	Local Aman	23,751	17,813	1.3*	25,063	5,938	0.8*	4376	26,417
Kharif-2 Total:		**101,317**	**69,261**		**97,450**	**32,056**		**23,625**	**98,803**
11	HYV Boro	119,024	101,170	4.0*	142,347	17,854	2*	35,886	143,700
12	Local Boro	605	605	1.9*	851	-	-		851
13	Wheat	7,040	7,040	2.4	9,905	-	-		9,905
14	Potato	1,500	1,500	15	2,111	-	-		2,111
15	Mustard	14,415	14,415	0.96	20,282	-	-		20,282
16	Pulses	25,031	25,031	1	35,219	-	-		35,219
17	Spices	12,563	12,563	4.6	17,676	-	-		17,676
18	Ground nut	2,873	2,873	1.5	4,042	-	-		4,042
Rabi Total:		**183,051**	**165,197**		**232,433**	**17,845**		**35,886**	**233,786**
Cropped Area		335,099	275,733			59,358			
NCA		184,200							
Cropping Intensity		**182 per cent**							

Source: CEGIS field survey, 2013, plus secondary data from Upazila Agricultural Offices of the study area.

182. From the Table 5.23 it is calculated thatamong the rice crops, Aus covers 11.5 per cent, Aman covers 38.7 per cent and Boro covers 49.8 per cent of the cropped area. About 70.5 per cent of the area is occupied by high yielding varieties and rest of the area is covered by local varieties of rice crop. Among the non-rice crop, Pulses cover about 25,031 ha; Jute 16,332 ha; Mustard 14,415 and spices 12,563 ha. About 3,450 ha of the total cropped areas are used for both summer and winter vegetable cultivation.

5.4.5 Crop Production

183. Crop production data, presented inTable 5.23, indicates that the major agricultural production of the study area comes from the rice crops. In the study area, the annual total rice production stands at about 268,154 metric tons. There is a production loss in rice production in the study which is calculated as 63,080 MT. Among the rice crops, Boro is contributing about 54 per cent (144,551 MT) followed by T. Aman 33 per cent (89,494 MT), T Aus 8 per cent (22,093 MT) and Mixed Aus-Aman 4 per cent (12,016 MT) of the total rice production. Different types of non-rice crops are grown in about 95,047 ha land and production is about 1,33,336 MT. The non-rice crops are Pulses

(about 35,219 MT), Spices (about 17,676MT), Jute (about 19,737MT), Mustard (about 20,282 MT), Vegetables (about 4,994MT) and Potato (about 2,111 MT).

5.4.6 Crop Damage

184. Table 5.23 also articulates the crop damage area and damaged yield in the study area. During the field survey, it was found that major crop damaging factors are heavy rainfall, floods, river erosion, drainage congestion and hailstorm during monsoon period; irrigation water scarcity and drought during dry season and pest infestation throughout the year. Boro crop of the study area suffered due to non-availability of surface water and lowering of ground water table during the flowering stage. For this reason, about 15 per cent of Boro crop area suffered damage annually and yield of this crop was reduced by about 24 per cent to 26 per cent. Aus crop was damaged due to heavy rainfall during the month of June and July at harvesting period of this crop. Jute also suffers during their sowing period when the distribution of rainfall is uneven. Farmers try to meet up the demand of water with the help of irrigation water. But their attempts fail due to non-availability of surface water due to siltation of the khals/rivers. About 35 per cent area of Aman crop was affected by flood, river erosion and drainage congestion during the months of August and September. Early drought also delay transplanting and harvesting of crop which affect the growing of Rabi crops after Aman rice. This crop also faces maximum drought stress during panicle initiation to the maturity stage. Crop production loss has been calculated using the formula: Crop production loss = Total cropped area × normal yield - (damaged area ×damaged yield+ damage-free area × normal yield).

5.4.7 Agricultural Inputs

185. Fertilizers and pesticides are used for all crop cultivated in the study area (Table 5.24). However, the rate of use of fertilizer per hectare varies considerably from farmer to farmer depending on soil fertility, cropping pattern and financial ability. The major fertilizers used in this area are Urea, TSP, MoP and Gypsum. Urea is widely used for potato (300-350 kg/ha), vegetables (200-300 kg/ha) HYV Boro (200-250 kg/ha) crop while less fertilizer is used in pulses (20-50 kg/ha), jute (60-100 kg/ha) and B. Aman (60-100 kg/ha). The use of pesticides depends on the degree of pest infestation. The major insects as reported by the farmers are stem borer, gal midge, leaf roller, rice bug, rice hispa, brown plant hopper and caterpillar for rice crop. Different types of fungus damages the Rabi crops. Local farmers reported that they are using different types of pesticides and fungicides to prevent pest infestation in croplands. Mainly pesticides are used in liquid form. Diazinon (Raison-60EC), Carbofuran (Brifer-5G), Sipermethrin (Siperin-10EC), Fipronil (Regent-3G), Melathion (Sifanon-57EC) are the main pesticides available in the study area. The most use of pesticide is for cultivating vegetables, farmers use 700ml/ha liquid pesticides in 2-3 times for the cultivated period, while less pesticides are used (0-1 times with 700ml/ha) for HYV Aus, local aman, wheat, pulse and jute. Details of fertilizer and pesticides application of the study area is presented in Table 5.24.

5.4.8 Minor Irrigation

186. Table 5.25 shows that in the study area about 55% of the cultivable areas are irrigated. Ground water irrigation coverage is about 99% of total irrigation coverage in the dry season. Mainly shallow tube-wells (STW) are used for lifting ground water for irrigation. The remaining 1 % is irrigated by low-lift pumpsand traditional methods that lift surface water from rivers, canals, and beels (Photo 5.3).

Table 5.24: Fertilizer and Pesticides

Crop name	Fertilizer (Kg/ha)				Pesticides		
	Urea	TSP	MP	Gypsum	No. of Appli.	Liq. (ml/ha)	Gran. (Kg/ha)
Local Aus	100-140	-	-	-	-	-	-
HYV Aus	100-140	40-60	0-40	0-40	0-1	700	7-8
HYV Aman	120-180	60-80	20-40	0-40	1-2	700	7-8
Local Aman	100-140	40-60	20-40	0-40	0-1	700	7-8
B. Aman	60-100	0-40	-	-	-	-	-
HYV Boro	200-250	100-120	80-100	50-100	1-2	700	7-8
Wheat	180-220	60-80	40-50	40-60	0-1	700	7-8
Pulses	20-50	40-50	20-40	-	0-1	700	7-8
Oilseeds	100-180	40-60	30-40	30-40	0-1	700	7-8
Spices	200-250	120-160	100-150	60-100	0-2	700	7-8
Potato	300-350	100-150	150-200	20-40	1-2	700	8-10
Vegetables (W)	200-300	100-200	100-200	-	2-3	700	8-10
Vegetables (S)	200-300	100-200	100-200	-	2-3	700	8-10
Jute	60-100	30-40	30-40	0-50	0-1	700	7-8

Source: CEGIS field survey, 2013, plus Irrigation statistics secondary data from study area Upazila Agricultural Offices.

Photo 5.3: Surfacewater-Irrigated Agricultural Field

Table 5.25: Minor Irrigation

Mode of Irrigation Equipment	Number	Irrigated Area (ha)
Deep Tube Well	283	6,094
Shallow Tube Well	47,705	94,530
Low Lift Pumps	108	1360
Total	48,096	101,984 (55.4 per cent)

Source: BADC Minor Irrigation Survey Report, 2009-10.

5.5 Livestock and Poultry

187. Livestock and poultry play a significant role in the agro-based economy of Bangladesh. Table 5.26 shows estimates livestock and poultry numbers in the study area. Livestock constitute an important part of the wealth in the study area, providing draft power, leather, meat, milk, and cow dung for fuel and fertilizer. Many individuals earn their livelihood through work associated with raising cattle and poultry. Draught power for tilling the land, the use of cow dung as manure and fuel, and animal power for transportation, a ready source of capital and meat, milk and eggs for human consumption make up the demand of the local area. In addition, hides and skins, bones,

feathers, etc, help in earning money. Livestock resources also play an important role in the sustenance of landless people.

Table 5.26: Livestock and Poultry

Live stock/Poultry	Number of Livestock/Poultry
Cattle/cow	974,817
Buffalo	1,563
Goat	290,967
Sheep	89,843
Horse	2,438
Chicken	2,876,480
Duck	524,564
Pigeon	93,580

Source: Upazila Livestock Offices and Census of Agriculture.

5.5.1 Livestock and Poultry Health

188. The health of an animal is a major concern in the study area. Health issues include infection by bacteria, virus, mycoplasma, or parasite. Disease outbreaks cause considerable economic loss in livestock farming. A bacterial or viral disease normally kills an animal, whereas parasites are mainly associated with debility and loss of production. Major bacterial diseases include *peste des petits ruminants* (PPR), foot and mouth disease (FMD), anthrax, badla (black quarter), diarrohea, pneumonia, and parasitic diseases such as worm infestation. In addition, a number of arthropods, including flies, ticks and mites, have economic importance mainly due to their role in pathogen transmission. Major poultry diseases are duck plague, paralysis, Newcastle, fowl pox and dysentery etc. Infectious disease is most prevalent in the rainy season between Septembers to October months, though most diseases continue at lower levels throughout the year.

5.5.2 Constraints of Livestock and Poultry Rearing

189. Livestock owners face problems due to shrinking and degrading pastures, coupled with fodder shortages due to dried up grazing land, during the December-April period. In Kharif-II season, almost all higher lands remain under crops and lower-lying areas are flooded. Grazing area shortages throughout the year aggravate the livestock feeding problem. Household poultry survives by scavenging and though generally no feed supplements are provided, kitchen waste can be a significant food source. Feed prices in the study area are high.

190. Another constraint of livestock and poultry production in the study area is a lack of veterinary health services, veterinary support services, quality production inputs, veterinary extension services and cooperation between private and public sectors dealing with prevention, diagnosis, treatment, and control of disease. Upazila Livestock Office capacity is limited.

191. Additional factors constraining livestock in the study area include low levels of knowledge of local people, frequent natural hazards, slaughtering of young cattle during religious festivals, and unplanned slaughtering of cattle for meat throughout the year.

5.6 Fisheries

192. Fisheries resources of the study area are diversified with different fresh water fish habitats. Open water fish habitat consists of seasonal and perennial rivers, *khals, beels*, and floodplain. The major rivers Jamuna and Padma and *beels*account for most of the fish production in the area. *Khals*act as major arteries of fish migration between habitats and playa vital role in maintaining species richness and fisheries productivity. Photo 5.4 and Photo 5.5 show the open water fish habitats of the study area.

Photo 5.4: Openwater Fish Habitat

Photo 5.5: Openwater Fish Habitat

193. Fish biodiversity is relatively rich, however, it is decreasing due to indiscriminate fishing, obstruction of migration routes (especially in the dry season), discharge of industrial waste, poor fisheries management, siltation, oil spills, insecticide contamination, and loss of critical habitats to siltation and bank erosion. Indiscriminate fishing practices include capture of brood-fish especially during the over-wintering period and use of *current jal* to catch juvenile fish (local name jatka), especially *hilsa*, and dewatering of *beels* for irrigation or fishing.

194. Aquaculture is also present in the study area. Two types are practiced, traditional and semi-intensive,

5.6.1 Open Water Fish Habitat

195. **Habitat Classification.**Fish habitats of the study area are classified into river, khal, seasonal beel. The Jamuna and Padma contain water year round. The other water bodies present in the study area are beel, floodplain, fish pond,khaland seasonal *beels*.

196. **Habitat Distribution.**Map 5.4shows a map of fish habitats of the study areaupazilas (seven in Manikganj, one in Tangail, and four in Sirajganj districts). Capture fisheries habitats with an area of 92,740 ha include rivers, *khals*, perennial and seasonal *beels* and floodplain. Table 5.27 shows the area of fish habitat categories. In the dry season, average river water depth is 4 to 7 m which is adequate for fish habitation. In deep areas(*kum*), both large and small riverine fishes take shelter when river water levels drop. Deep areasplay a vital role in fish propagation. The major problems in these riverine fish habitats are siltation and erosion.

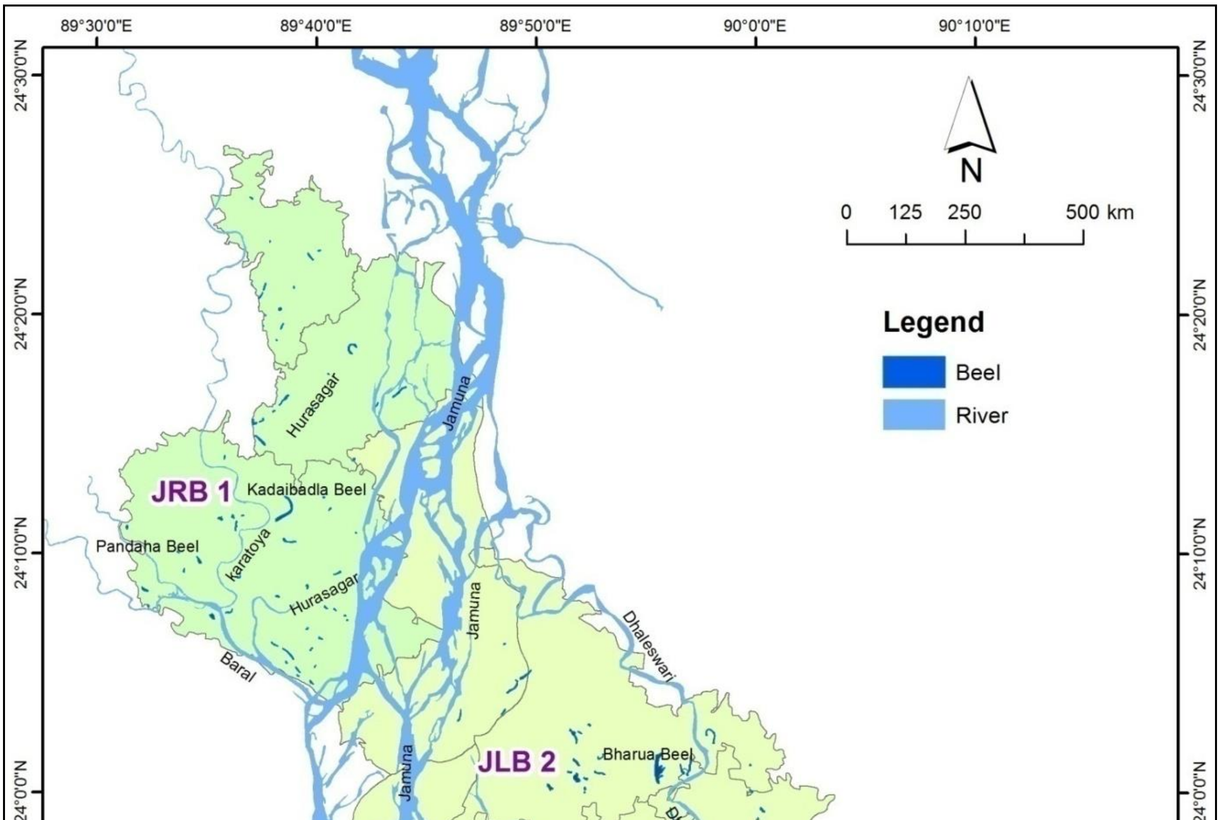
Table 5.27: Fish Habitat

Sl. No.	Habitat Category	Habitat Type	Area (ha)
1	Capture	River	30,783
		Khal	312
		Beel	1,258
		Kol	605
		Floodplain	59,782
		Sub total:	92,740
2	Culture	Fish pond	1,235
		Sub total:	1,235
		Total:	**93,975**

Source: CEGIS field Survey, 2013

Culture fisheries

197. Aquaculture is moderate in this study area. Different types of fish culture system are adopted by the local people, like monoculture and poly-culture in small ditches and ponds. Improved pond cultures are not found in the study area due to flooding. The estimated pond area is 1,235 ha. Both perennial and seasonal ponds are found.



Map 5.4: Fish Habitat area in the study area

5.6.2 Fish Production

198. Table 5.28 show fish production for each habitat type. As these illustrate, most fish production is from the capture fishery and rest coming from the culture fishery. Estimated total annual fish production is about 21,659 MT.

Table 5.28: Fish Production by Habitat

Sl. No.	Habitat Category	Habitat Type	Total production (MT)
1	Capture	River	4,617
		Khal	47
		Beel	722
		Kol (Semi closed water body)	871
		Floodplain	11,956
		Sub total:	18,213
2	Culture	Fish pond	3,446
		Sub total:	3,446
		Total:	**21,659**

Source: Field observation, FRSS 2010-11.

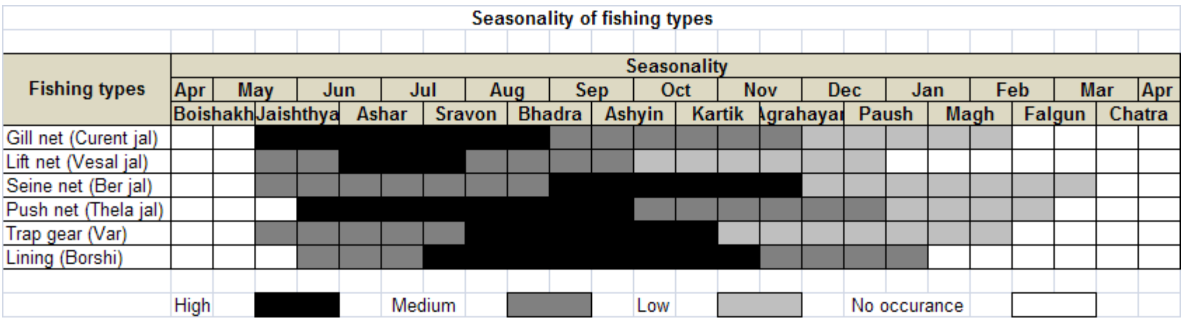
Fishing Effort

199. **Fisher number**. Two types of fishers found in the study area are commercial and subsistence fishers. But no part-time fishers have been recorded. The number of commercial fisher household is 6,983 which constitute 89 per cent of the total fishers. Maximum commercial fishers have been recorded in Daulatpur (22 per cent) and Horirumpur (49 per cent) of Manikganj district. Subsistence fishers have been found as 11 per centof total fishers. Diversified fishing community structure has been found in this study area. In Nagarpur Upazila of Tangail district, *hindu* community covers about 84 per cent and in some villages like *Dhamshar, Madhupur, Ulail, Mulkandi, Daulatpur Sadar, Binodpur, Charakholsi, Boinna, Bishnopur, Shamganj* of Daulatpur Upazila of Manikganj district is about 100 per cent. However, about 90 per cent of the fishers come from the Muslim community in total. They usually catch fish in the nearby *beels*, floodplains, rivers and *khals* using country boat and *dingi* boats particularly during wet season.

200. **Fishing season.**Fishing in floodplain, *beel*, river and *khals* starts in May and continue up to November except river. The seasonality of major fishing is furnished in theTable 5.29.

201. **Fishing crafts and location.**Country fishing boats are widely used to catch the fish in the study area. The fishers catch the fish in Jamuna, Karotoa, Ichamati, Baral, Dhalai, Sonai, Hura-sagar (old part of Jamuna river) and Dhaleshwary rivers round the year. However, fishing in seasonal beel and floodplain are done in monsoon only. The subsistence fishers catch the fish in same water bodies in the study area both in monsoon and dry season.

Table 5.29: Seasonality of Fishing Types



202. **Fishing gears.**Different types of nets/gears are used for fishing in the study area. These are: (i) *currant jal* used to catch *baim, tengra, punti, baila*, etc; (ii) *kona jal*used to catch *rui, catla, baim,*

tengra and small fishes, fry and fingerlings; (iii) *jhaki jal*used to catch *baila, punti, tengra, gulsha, shole, taki,* etc; (iv) *thela jal* used to catch *gura chingri, baila, punti, tengra*; (v) *dharmo jal* used to catch *gura chingri, baila, punti, tengra* etc. and (vi) *Berjal* used to catch small and big fish. Fish spears mostly target *shol, magur, gozar, boal*, etc. Only 25 to 30% of fishers have fishing boats and around 80% fishers have fishing gears/nets. The other fishing practices in the area are through lining (*Borshi*), spear (*koch*), trap (polo, bamboo traps, *chotka and dori*), *hajari borshi* (a lot of serial spear at one baseline) and *katha* fishing (*nim* fishing). These gears are used to catch *boal, rui, katla, air, punti, common carp, tilapia, shole, taki* etcin both the capture and culture fisheries.

5.6.3 Fish Migration

203. Overall status of fish migration in the study area is moderate to poor. The river Jamuna and Padma acts as main fish migration route between *beel* and adjacent *beel* and floodplain. The Jamuna river is connected with the other four rivers named Karotoa, Ichamati, Baral, Dhalai, Sonai, Hura-sagar (old part of Jamuna river) and Dhaleshwary which internally connect Sirajganj, Tangail and Manikganj district in the study area. Moreover, during pre-monsoon and monsoon period (availability of water in khal) *Shameshpur khal, Banigati Khal, Balorampur Khal,* etc *for Sirajganj district, Shureshwary Khal, Baro Khal, East Dhadra Vikon Khal* etc for Tangail district as well as *Tutium Dhamshar Khal, Kholshi-Kumuria Khal, Mandatta Khal* etc for the Manikganj district maintain the major arteries of the fish migration. These khals carry waters from the above mentioned river to both the perennial and seasonal beel.Fish migration usually occurs during pre-monsoon to some extent and largely during peak monsoon. Reportedly, feeding and spawning migration of riverine and beel resident fish species occur through open khals and channels between beels and rivers and over bank spill during the period of late May to August. During this period such fish species as *tengra, punti, chela, baim, gutum, taki, koi etc*migrate through khals to beels and floodplain each year. Seasonal water bodies such as *Kholsi beel, Kumuria beel, Shampur kum beel* etc are used as feeding and nursing ground by most of the open water fishes. Many fish species migrate horizontally to these water bodies as part of their life cycle. Nevertheless, aggradations of external rivers and internal khals of the study area due to siltation and water regulatory structures on the khals cause the reduction of the length of successive migratory routes.

204. Some of the fishes throughout their life cycle have no dependence on the floodplain. But some of the fishes are found more dependent on floodplain to complete their life cycle. Table 5.30 lists migratory fish species (species that migrate between river and floodplain). Table 5.31 lists the khal locations and their connections to other water bodies in the study area. Table 5.32 lists beel sanctuaries in the study area.

Table 5.30: Migratory Fish Species

No.	Scientific Name	Local Name
1	Labio rohita	Rui
2	Catla catla	Catla
3	Cirrhinus mrigala	Mrigal /Mirka
4	Cirrhinus reba	Raik
5	Labeo bata	Bata
6	Labeo boga	Bhangan
7	Labeo calbasu	Kalbaus
8	Labeo gonius	Ghonia
9	Aorichthyes aor	Ayre
10	Aoichthyes seenghala	Guzzi ayre
11	Mystus blekeeri	Golsha Tengra
12	Mystus cavasius	Kabashi Tengra
13	Chela laubuca	Kash khaira
14	Securicula gora	Ghora chela
15	Salmostoma bacaila	Katari chela

No.	Scientific Name	Local Name
16	Salmostoma phulo	Fulchela
17	Gudusia chapra	Chapila
18	Eutropiichthyes vacha	Bacha
19	Pseudeutropius atherinoides	Batasi
20	Ompok bimaculatus	Kani Pabda
21	Ompok Pabo	Pabda
22	Ompok pabda	Modhu pabda
23	Wallagu attu	Boal
24	Notopterus chitila	Chital

Source: FAP 17, Supporting Volume No. 10.

Table 5.31: Khal Locations and Connections

Name of District	Name of Upazila	Source River	Connecting Khal	Connecting Water Bodies (Beel / River / Floodplain).
Sirajganj	Belchuchi	Jamuna	Balorampur Khal	Chondi beel
		Hura-Sagor (Old part of Jamuna)	Shameshpur khal	Floodplain
			Banigati Khal	Kamarullahpara beel
			Khashnamoki Khal	
			Kamarullahpara Khal	
	Shahjadpur	Baral	-	Kadaibadla beel
		Sonai	-	Charkai beel
		Bag-Jamuna Nageswary	Barabil Khal	-
		Bag-Jamuna Nageswary	Barabil Khal	Pandaho beel
		Karotoa	Potazia Khal	Pranonathpur beel
			Madla Khal	-
		Dholail	-	Shaildar beel
	Kamarkhand	Hura-Sagor (Old part of Jamuna)	Shampur Khal	Nandinamadhu beel
			Chaubari khal	Dashsika beel
			Balorampur Khal	Pakuria beel
Tangail	Nagarpur	Dhaleshwary	Shureshwary Khal	Shonshi beel
			Baro Khal	Mailjani Rag beel
			Nardohi Khal	Autpara beel
		Jamuna	East Dhadra Vikon Khal	Alokdia beel
				Kustia beel
				Bara Pasha beel
			West Dhadra Vikon Khal	Bonogram beel
Manikganj	Daulatpur	Jamuna	Tutium Dhamshar Khal	Mixes with Kaliganga river
			Kholshi-Kumuria Khal	Kholsi beel
				Kumuria beel
		Old Dhaleshwary	Jeonpur Laotara Khal	Kholsi beel
			Mandatta Khal	Bahora Mola beel
				Dharer beel
			Dhamsar Kakna Khal	Dhala Pukur beel
		Dhaleshwary	-	Nilua beel
				Niraligala beel
				Pasthobi beel
				Ulail beel
				Nimaikhali beel
				Shampur kum beel
	Ghior	Old Dhaleshwary	-	Choto Niluar beel
				Char Ghior Mollar beel

Name of District	Name of Upazila	Source River	Connecting Khal	Connecting Water Bodies (Beel / River / Floodplain).
		Jamuna	-	Char Bailjuri Jala beel
				Char Bailjuri beel

Table 5.32: Beel Sanctuaries

Name of District	Name of Upazila	Nos. of Sanctuary	Name of Beel Sanctuary
Sirajganj	Belkuchi	2	Kamarullapara
			Saratoil-1
			Saratoil-2
	Shahjadpur	1	Potajia beel
	Kamarkhand	1	Kutirchar beel
Tangail	Nagarpur	2	Shonshi beel
			Bara Pasha beel
Manikganj	Daulatpur	3	Bahora Mola beel
			Dhala Pukur beel
			Nilua beel

Source: Upazila fisheries offices.

5.6.4 Fish Species Suitable for Fish Pass/Friendly Structures in Jamuna Catchment

205. **Swimming characteristics of fishes**. For fish pass/friendly structure planning, the speed and endurance of migratory fish was examined. Three aspects of swimming speeds, which vary with fish species, can be defined:

- Cruising speed: one that can be maintained for long period of time (hours);
- Sustained speed: one that can be maintained for minutes; and
- Darting speed: a single effort, not sustainable (estimated maximum duration, 10 seconds).

206. Table 5.33, Table 5.34 and Table 5.35 provide information on fish characteristics relevant to establishing fish pass/ fish-friendly structures, for a number of fish species of importance in the study area.

Table 5.33: Fish Pass/Fish Friendly Structure: Large Non-Carp Fish Species

Group	Species	Type	Minimum Size			Maximum Size (cm)		
			TL	**Vc**	**Vm**	**TL**	**Vc**	**Vm**
			(cm)	(cm/s)		(cm)	(cm/s)	
Large Catfish	Boal	B	48	35	70	115	85	170
	Air	B	43	30	60	85	65	130
	Baghir	B	80	60	120	180	135	270
	Rita	B	33	25	50	55	40	80
Knifefish	Chital	P	43	150	300	100	350	700
Herring	Ilish	P	28	100	200	45	160	320
Spiny Eel	Baim	B	38	30	60	80	60	120

Notes: TL total length, Vc cruising velocity, maximum (burst) velocity, B- benthic species, P – Pelagic Species
Source: FAP 6.

Table 5.34: Fish Pass/Fish Friendly Structure: Barbs and Catfish

Group	Species	Type	Minimum Size*	Maximum Size**

			TL	Vc	Vm	TL	Vc	Vm
			(cm)	(cm/s)		(cm)	(cm/s)	
Small Barbs	Puti	P	3.5	10	20	10	35	70
	Mola	P	4.5	15	30	9	30	60
	Chela	P	5.5	20	40	15	55	110
Small Catfish	Bacha	P	17	60	120	25	90	180
	Garua	P	16	55	110	25	90	180
	Baspata	P	7.5	25	50	10	35	70
	Batashi	P	5.5	20	40	7	25	50
	Tengra	P	9	5	10	15	10	20
	Gulsha	B	11	10	20	18	15	30

Notes: P- Pelagic Species, B- benthis species
Source: FAP 6.

Table 5.35: Fish Pass/Fish Friendly Structure: Other Small Fish Species

Group	Species	Type	Minimum Size*			Maximum Size**		
			TL	Vc	Vm	TL	Vc	Vm
			(cm)	(cm/s)		(cm)	(cm/s)	
Loach	Rani	B	7.5	5	10	12	10	20
Spiny Eel	Shile Baim	B	14	10	20	25	20	40
	Tara Baim	B	14	10	20	28	20	40
Needlefish	Kaikka	P	18	65	130	25	90	180
Sardine	Chapila	P	11	40	80	15	55	110

Notes; P- Pelagic Species, B- Benthic Species
Source: FAP 6.

5.6.5 Fish Biodiversity

207. The area, which includes reaches of the Jamuna and Padma Rivers, is rich in fish biodiversity; 120 fish species are recorded as available in the area.[20] A fish species list is presented in Table 5.36.

Table5.36: Fish Species of the Study area

Scientific Name	Local Name	Habitat		
		Beel and floodplain	River and khal	Pond
Hilisha ilisha	Ilish	A	P (River)	A
Pangasius pangasius	Pungus	A	P (River)	A
Glossogobius giuris	Baila	P	P	A
Puntius sophore	Jatputi	P	P	A
Prawn sp.	Chingri	P	P	A
Macrognathus aral	Tara baim	P	P	A
Mastacembelus armatus	Sal baim	P	P	A
Anabas testudineus	Koi	P	A	A
Heteropneutes fossilis	Shing	P	A	A
Channa panchtatus	Taki	P	A	A
Nandus nandus	Veda	P	A	A
Mystus vitatus	Tengra	P	P	P
Notopterus notopteus	Foli	P	A	A
Hypophthalmichthys molitrix	Silver Carp	A	A	P
Aristichthys nobilis	Bighead Carp	A	A	P
Ctenopharyngodon idella	Grass Carp	A	A	P
Catla catla	Catla	P	P	P
Labeo rohita	Rui	P	P	P

[20] 1995. Flood Action Plan 17, Supporting Volume 10.

Scientific Name	Local Name	Habitat		
		Beel and floodplain	River and khal	Pond
Labeo bata	Bata	P	P	P
Cirrhinus mrigela	Mrigel	P	P	P
Ciprinus carpio	Carfu	A	A	P
Labeo calbasu	Kalibaus	P	P	P
Oreochromis mossambicus	Tilapia	A	A	P
Oreochromis niloticus	Nilotica	A	A	P
Clarias batrachus	Magur	P	A	A
Channa striatus	Shol	P	P	A
Gudusia chapra	Chapila	P	P	A
Amblypharingodon mola	Mola	P	P	A
Wallago attu	Boal	P	P	A
Ompak pabda	Pabda	P	P	A
Mystus bleekri	Gulsha Tengra	P	P	A
Aorichthys aor	Ayre	P	P	A
Lepidosephalus guntia	Gutum	P	P	A
Macrognathus aculatus	Guchi baim	P	P	A
Rasbora daniconius	Darkina	P	P	A
Xenentodon cancila	Kakhila	P	P	A
Colisa fasciata	Khalisa	P	P	A
Corica soborna	Kaski	P	P	A
Puntius gonionotus	Thai Sarpunti	A	A	P

Notes; P- Pelagic Species, B- Benthic Species. A- absent

208. Fish biodiversity and abundance has been declining. Causes include water quality degradation including non-point source agricultural pollution (agrochemicals and pesticides) and point-source industrial pollution (from garmentfactories and other industries, especially in Sirajganj district). Other causes are obstruction to fish migratory routes, silting in and obstruction of internal khals, silting in of floodplain wetland fish habitats and shrinkage of spawning and feeding grounds.

5.6.6 Species of Conservation Significance

209. Fish species which are locally unavailable for last 10-15 years or have become rare as reported by the local fishers and concerned elderly people are given in the followingTable 5.37.

Table 5.37: Fish Species of Conservation Significance

Scientific name	Local name	Local Status	
		Rare	Unavailable
Puntius sarana	Deshi Sarputi	√	
Ompak pabda	Pabda		√
Lepidosephalus guntia	Gutum		√
Notopterus chitila	Chital	√	
Mastacembelus armatus	Sal baim	√	
Labeo bata	Bata		

Source: Upazila fisheries offices.

5.6.7 Area of Conservation Significance

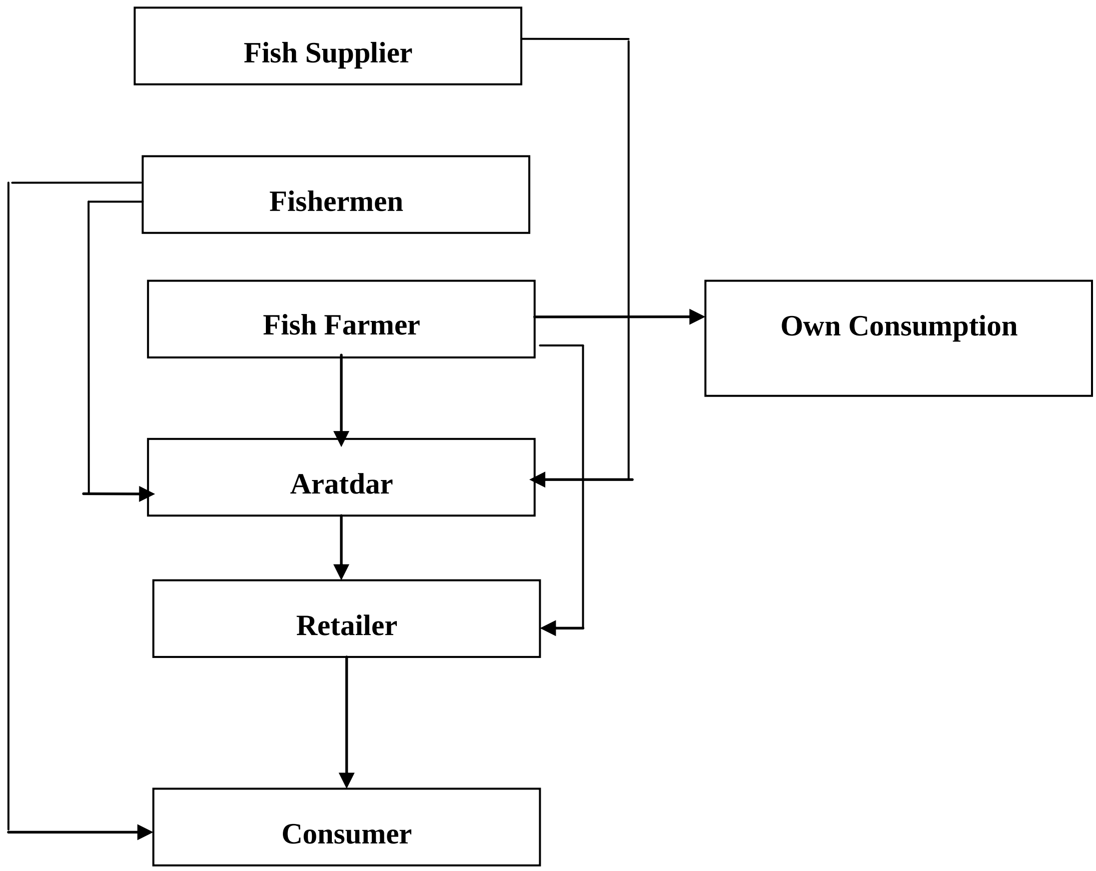
210. The water bodies in the study area are used as feeding and spawning ground of most of the open water fishes. Both perennial and seasonal beel are present in the study area. The deep portion of the *beel* can be conserved for fisheries propagation in the area. Department of fisheries (DoF) has declared fish sanctuaries in the area. They have made first a boundary around the selected water

bodies using bamboo or concrete pillar and net. Then they have made some block at the bottom of water bodies for fishes' shelter. DoF and local people jointly manage these *beels* so that nobody can catch fish or disturb these fish species. In monsoon period when the water level rise up to 2m for all the beel area then the local people are allowed to catch fish in the beel except the sanctuary area. There are 10*beel* sanctuaries present in the study area.

5.6.8 Fish Marketing and Post-Harvest Facilities

211. Fish edible quality is in good condition for human intake.But the use of agrochemicals and pesticides is deteriorating the fish edible quality and causing fish diseases especially in dry season. Some of the frequently observed diseases are tail and fin rot disease and cotton fungus. The local fishermen sell bulk of their fishes either directly to the local fish market (bazaars at Baghabari, Rautara, Bantiar,Betil etc. in Sirajganj District; Nagarpur, Dupuria, Vadra,Sabadpur in Tangail District; and Jhitka, Nayarhat,Andharmanik,Balra in Manikganj district). There are fifteen ice factories in the study area mainly located near whole sale markets. A few fish landing centers with poor structure have been found in this study area. Frequently occurred river bank erosion is the main cause of this status. There are no storage facilities. Transportation facility at root level is on foot, rickshaw and CNG auto rickshaw. Fish marketing channel is shown in Figure 5.10.

Figure 5.10: Fish Marketing Channels



5.6.9 Fisher's Lifestyle

212. Average daily income of commercial fishers isBDT 300-350 in monsoon period (May to November). Income level of commercial fisher is decreasing day by day. Consequently, they are changing their occupation. Most of the fishers are living in Horirampur Upazila. This upazila covers vast part of the study area. The fishers are also vulnerable to the musclemen who convert open

water fish habitats into culture fishery. Some of the fishers are involved with fish trading, fry trading and some are working as labor in fish farm especially in dry season.

5.6.10 Fisheries Management

213. Fisher based community association has been found in Shahjadpur of Sirajganj, Nagarpur of Tangail and Daulatpur in Manikganj District in the study area. Fishing right on existing fish habitats is limited. Upazila Fisheries office conducts technical training on fish culture for fish farmers and some activities such as awareness meeting, nursery management, linkage development among the fish traders in future. Enforcement of fisheries regulation is also weak.

5.7 Ecological Resources

5.7.1 Bioecological Zones - Introduction

The study area comprises five different bioecological zones of the country (Nishat *at el*, 2002): (i) Teesta floodplain, (ii) Major rivers, (iii) Brahmaputra–Jamuna floodplain, (iv) Chalan Beeland (v) Ganges floodplain.

(a)Teesta Floodplain

214. The Teesta floodplain bio-ecological zone is spread over Nilphamari, Lalmonirhat, Rangpur, Kurigram, Gaibandha, Bogra and Naogaon district. The Teesta River has occupied and later abandoned several channels during the last few thousand years. These are now occupied by the Mahananda, Punarnava, Atrai, Choto Jamuna, Kortoya and Ghagat Rivers.

215. Prior to clearance for agriculture, this zone was heavily forested, and it is still fairly wooded. Many valuable indigenous timber species are found here: Sal (*Shorea robusta*), Banyan tree (*Ficus bengalensis*), and Aswatha (*Ficus religiosa*). Fruit-bearing indigenous tree species are also found here:Mango (*Mangifera indica*), Guava (*Psidium guajava*), Sharifa (*Anona squamosa*), Tamarind (*Tamarindus indica*), Jackfruit (*Artocarpus heterophyllus*), Nut (*Terminalia catappa*), and Date Palm (*Phoenix sylvestris*), etc (Bari, 1979).

216. Early records show that tigers, leopards, buffaloes, deer, monkeys, wild boars, etcwere common in this zone until the end of the 19th century, but gradually were extirpated due to loss of habitat. Squirrels, rats, mice, shrews, jackals, foxes, frogs, and toads are still widely distributed in this zone. Commonly-found reptile species include the Bengal monitor (*Varanus bengalensis*), other lizards, snakes, freshwater tortoises and turtles and different species of poisonous and non-poisonous snakes. Among the bird species, the common peafowl (*Pavo cristatus*), once common in this zone, has now completely disappeared. Many other birds once common and widely distributed are generally less plentiful now. Most of the common bird species of Bangladesh is still found in this zone (Bari, 1979).

(a) Major Rivers

217. Bangladesh consists mainly of riverine and deltaic deposits of three large and extremely dynamic rivers entering the country: the Brahmaputra, the Ganges and the Meghna rivers. Newly accreted land, if it does not erode quickly, is initially colonized by grass, particularly catkin grass (Saccharum spontaneum, for example). Dense growth of catkin grass can accelerate silt deposition on chars. The Jamuna River yields the highest amount of char lands. Many of the species' natural distribution, migration and storage primarily continue via these rivers into other wetland ecosystems (GoB-IUCN, 1992). A diverse range of waterfowls are directly or ecologically dependent on these rivers and their associated ecosystems. However, it is quite alarming that with the exception of a few species of turtles, all other river biodiversity is threatened with extinction.

(b) Brahmaputra–Jamuna Floodplain

218. The Brahmaputra-Jamuna floodplain comprises the active channel of the Brahmaputra River and the adjoining areas of the young floodplain lands formed since about 1780, when the river shifted to its present course (ie the Jamuna River) to the south of Dewanganj in Jamalpur district. The main river course is strongly braided and consists of several interconnecting channels.This floodplain possesses a unique variety of plants, medicinal herbs, fruit yielding trees, many jungle shrubs, creepers and climbers, flowering trees etc, many of which yield valuable products. Bushes of reeds and canes are also found here. The faunal diversity in this zone is also rich. The most common poisonous snake in this area is the Banded krait (*Bungarus fascinatus)*, which could easily be identified by its broad black and yellow bands. In mammalian species, bats, several species of monkeys, pangolins, and raptorial birds are found.

(c) Chalan Beel

219. Chalan Beel, the center of which is located some 10km north of the JRB-1 area astride the Dhaka-Rajshahi highway in Ullapara upazila, Rajshahi Division, is an extensive low land area at the lower Atrai basin. It consists of a series of beels connected to one another by various channels to form more or less a continuous water body during the rainy season. The beel area expands into a vast water body. The Jamuna remains flooded during the monsoon with dense aquatic vegetation. However it dries up in the winter leaving only patches of water holes in the central part of this zone.

220. Significant species diversity of Chalan Beel is as follows. At present amphibian fauna in the *beel*include seven species of frogs and one species of toad. A total of 34 species of reptiles are found in this zone of which ten are turtles and tortoise, nine are lizards and the remaining 15 include various snake species. Of the turtles and tortoise, the Asiatic Soft-shell Turtle and three-keeled land tortoise are globally threatened. A total of 195 bird species from 51 families are recorded in this zone of which 140 are resident and 55 are migratory. Similarly a total of 27 species of mammals from 12 families are recorded in the beel.Of them, the smooth-coated otter is vulnerable in Bangladesh.

221. The common tree species in this area are Barun *Crataeva nurvala*, Aswatha *Ficus religiosa*, Aum *Mangifera indica*, and Hijol *Barringtonia acutangula*. The banks of the *beels* are vegetated with dense stands of Kash *Saccharum spontaneum*, Paddo *Nelumbo nucifera*, Nol *Arundo donax*, Dhol Kalmi *Ipomoea fistulosa*, Shimul *Bombax ceiba* and Date palm *Phoenix sylvestri*).

222. The northern palm squirrel, smooth-coated otter, fishing cat, cotton-pigmy-goose, small buttonquail, purple swamp hen, three-stripe roof turtle, painted roofed turtle, common krait are common wildlife species in this zone.

(d) Ganges Floodplain

223. The Ganges floodplain basically consists of the active floodplains of the Ganges River and the adjoining meandering floodplains. It is mostly situated in the districts of Rajshahi, Pabna, Jessore, Kushtia, Faridpur, Shariatpur and Barisal. The adjoining meander floodplains mainly comprise a smooth landscape of ridges, basins and old channels. A noteworthy aspect here is that the Gangetic alluvium is readily distinguishable from the old Brahmaputra, Jamuna and Meghna sediments by its high lime content. Beside this the relief is locally irregular alongside the present and former river courses, especially in the west, comprising a rapidly alternating series of linear low ridges and depressions. The Ganges and Jamuna channel is constantly shifting within its active floodplain, eroding and depositing large areas of new charlands in each flooding season. But it is less braided than those of the Brahmaputra-Jamuna. Interestingly enough, both plants and animals move and adapt with the pattern of flooding (Brammer, 1996).

224. Significant species diversity of the Ganges Floodplainis as follows. This floodplain is characterised by mixed vegetation. The presence of lot of stagnant water bodies and channels, rivers and tributaries in this zone support a habitat of rich biodiversity to some extent. In the beels and

other water bodies, free-floating aquatic vegetation is prominent. The dominant floral types are Panimorich *Polygonum orientale*, Jhanji *Hydrilla verticillata*, Helencha *Alternanthera philoxeroides*, Topapana *Pistia strateote*), Chechra *Schenoplectus articulatus*, Shada shapla *Nymphaea nouchali*, Keshordam *Ludwigia adscendense*, Kolmi *Ipomoea aquatica*, Dhol kolmi *I. fistulosa*, Hijal *Barringtonia acutangula*, Tentul *Tamarindus indica*, Biash *Salix tetrasperma*, etc.Moreover, grasses are abundant in the Ganges Floodplain and begin to grow as soon as the floodwater begins to recede.The Hunuman Langur, Five-Striped Palm Squirrel, Smooth-Coated Otter, Refuse-Tailed Hare, Water Cock, Bank Myna, Asian Paradise Flycatcher, River Tern, Yellow Monitor, Common Vine Snake, Painted-Roofed Turtle, Balloon Frog, etc, occur in this zone.

225. Nearly all the major groups of oriental birds are represented in this zone by one or more species. In addition, a large number of migratory birds are found here during the winter. Besides, different species of freshwater tortoises and turtles are also found in the rivers and ponds, most of which are a popular delicacy among non-Muslims. The amphibian species found in this zone include a few species of toads, frogs and tree frogs.

5.7.2 Terrestrial Habitats and Flora

226. Terrestrial habitats of the study area can be categorized under the following divisions:
(i) settlement/ homestead vegetation (ii) cropland vegetation, (iii) river-bank vegetation, (iv) social forest, and (v) roadside vegetation. Species lists of terrestrial flora and cropland vegetation are provided in Annex 1 (Table1 and Table).

227. **Settlement/ homestead vegetation**. Settlement/ homestead vegetation is a man-made plantation cultivated in the yard adjacent to the house. This type of vegetation has been practiced by community traditionally for financial and mundane needs.The Narikel *Cocos nucifera*, Aam *Mangifera Spp*., Supari *Areca catechu*, Bansh *Bambusa Spp*), Akashmoni *Acacia auricauliformes*, Bot *Ficus bengalensis* etc were observed frequently during the field survey. Chatim and Swarna Lata are present but less common.

228. **Cropland vegetation**. Cropland vegetation is found on the periphery of cultivated lands as weeds that grow and expand through self-propagation. Dominant weed species are Shyama Ghash, Durba Ghash, Badali ghash, Chawla ghas etc.

229. **Riverbank vegetation**. Riverbank vegetation consists primarily of small to large trees. The large species are Pitali *Trewia nudiflora*, Pakur *Ficus religiosa*, Neem *Azadirachta indica*, Shimul Tula *Bombax ceiba*, Kul etc. The small to medium-sized species are Bhat *Cleodendrum viscosum*, Chon, Dhol Kolmi, Dumur *Ficus hispida*, Bhadi *Lannea coromandelica*, Khejur *Phoenix sylvestris*, etc. Among grasses, Durba and Chawla are common.

230. **Social forest.** Social forests in this study area are found on small areas of fallow lands, croplandperiphery, and in the vicinity of settlements and graveyards. Social forestry species are Akashmoni(*Acacia auricauliformes*, Bansh *Bambusa Spp*., Mehogany *Swietenia mahogany* etc.

231. **Roadside vegetation**. Roadside vegetation consists of a variety of floral species, some wild and some planted. Roadside vegetation is planted in some locations with the concept of public-private partnership to protect roads from erosion. The Ghora Neem *Melia azadirachta*, Pakor *Ficus religiosa*, Akashmoni *Acacia auricauliformes,* Sisu *Dalbergia siso*mo, Pitali *Trewia nudiflora*, Bamboo *Bambusa Spp.*, Khejur *Phoenix sylvestris*, Bon Begun *Solanu nigrum*, Kachu, etc are common. Less common floral species are Dumur *Ficus hispida*, Debdaru *Polyalthia longifolia*, Pakor *Ficus religiosa*, etc.

232. **Urban Area**. Urban and built up areas have a low density of vegetations. Because of serious disturbance due to urbanization and dense road network with heavy traffic load, the wildlife population and floral condition and distribution are poor. But still some small mammals, reptiles, and birds were sighted during the field survey.

5.7.3 Seasonal and Perennial Wetland Habitats and Flora

233. **Overview**. Wetland habitats of the study area include charland, swamp, and grassland. Annex 1: Table 3 provides a species list of wetland vegetation.

234. **Charland**.Charland occupies significant part of the study area. The Jamuna and Padma Riversare constantly shifting within their active floodplains, eroding and depositing large areas of new charlands each flood season. New charlands exhibit considerable plant succession such that the char vegetation observed in a given area depends on the time since char formation. At species level, Shon *Crotolaria retusa*,Nol*Phragmites karka* and Kaisa are the first colonizers, whereas Mutha *Cyperus sp*, Kolmi *Ipomoea sp*, Binna *Vetiveria zizanioides,* Durba *Cynodon sp* etc, are the second level successor. At the terminal succession, some bushy plant species such as Dholkolmi *Ipomoea fistulosa* appear.

235. **Swamps**. Chalan Beel area is favorable for a good growth of wetland trees like Hizal *Barringtoniaacutangula* and Barun etc.

236. **Grassland**.Grassland species include Binna *Vetiveria zizanioides* and Durba Gash *Cynodon dactylon*.

5.7.4 Terrestrial Fauna

237. **Overview**. Among the terrestrial fauna, groups of animals present in the area include birds (Annex 1: Table 4), mammals (Annex 1: Table 5), amphibians (Annex 1: Table 6), and reptiles (Annex 1: Table 7).

238. **Amphibians**. Amphibians are found in terrestrial and aquatic environments. Very common terrestrial species observed during the survey were Indian Common Toad *Bufo melanostictus* and Indian Bullfrog *Hoplobatrachus trigerinus*. The rests were Common Tree Frog *Polypedates maculates* which inhabits in association with human settlement and periphery of the village forest and Balloon Frog *Uperodon globulosus* habituated both in burrows and forest patches and agricultural land. These are considered rare species within the study area.

239. **Reptiles**. House Gecko *Hemidactylus flaviviridis*, Common Garden Lizard *Calotes versicolor*, Yellow Monitor *Veranus flavescens* and Banded Krait *Bungarus fasciatus*, were observed during the field survey. King Cobra *Ophiophagus hannah* and Indian Cobra *Naja naja* were reported to be found within the site. Among reptiles Yellow Monitor *Veranus flavescens* is categorized as endangered (EN) by IUCN-Bangladesh (2000).

240. **Terrestrial birds – residents and short-range migrants**. Terrestrial birds that occupy or visit terrestrial habitats in the study area are Asian Pied Starling *Sturnus contra*, Common Myna *Acridotheres tristis*, Red-Vented Bulbul *Pycnonotus cafer*, Spotted Dove *Streptopelia chinensis*, Black Drongo *Dicrurus macrocercus*, Pompadour Green Pigeon *Treron pompadora*, Blue Rock Pigeon *Columba livia*, Oriental Magpie Robin *Copsychus saularis* and Brahminy Kite *Haliastur indus*. These were very common throughout the study area. Some rarely seen terrestrial birds were Eurasian Hoopoe *Upupa epops* and Red-Whiskered Bulbul *Pycnonotus jocosus*. Only the Eurasian Hoopoe *Upupa epops* is considered to be nationally uncommon resident bird.

241. **Terrestiral birds – long-range migratory species.**Bangladesh is on the Central Asian Flyway between the Palaearctic and the Indian subcontinent (Map 5.5). Migratory birds that move along the

Central Asian Flyway utilize the Brahmaputra-Jamuna-Padma-Ganges char and other habitats potentially affected by Tranch 1.[21]

242. **Mammals**. The situation of mammals in Bangladesh country is saddening, especially that of the large mammals which have gone extinctsince the 1970s due to habitat shortage,foodscarcity and hunting pressures. Mammmal species still present are Field Rat *Mus booduga*, Jungle Cat *Felis chaus*, Asiatic Jackal *Canis aureus*, Common Mongoose *Herpestes edwardsi*, Malayan Giant Squirrel *Ratufa bicolor*, Indian Flying Fox *Pteropus giganteus* and Greater Short-Nosed Fruit Bat*(Cynopterus sphinx*. The Asiatic Jackal *Canis aureus* is nationally categorized as Vulnerable(VU) by IUCN-Bangladesh.

5.7.5 Aquatic Ecosystems

243. The hydrological cycle regulates ecosystem function by providing varying water levels and flows that create diverse aquatic habitats to be utilized by aquatic biota. In this area, aquatic ecosystems include a range of riverine, floodplain, and pond habitats that become maximally interconnected in the monsoon season.

244. Wetlands (rivers, khals, ponds, and beels) are classified as seasonal and perennial. Seasonal wetlands usually remain inundated for four to five months. Seasonal wetland occupies the lower croplands and provides refuge and shelter for many aquatic flora and fauna. In addition, wetlands serve as the grazing ground for fish and other aquatic fauna. Perennial wetlands hold water throughout the year.

(a) Aquatic Flora

245. Aquatic floraispresent in both seasonal and perennial water bodies. The submerged species are Fodder *Hydrilla verticillata*, *Vallisnaria spirali, Aponogeton Sp*. and Gechu. The free-floating species mentionable here are Kachuripana *Eichhornia crassipes*, Kutipana *Azolla* Sp., and Khudipana *Lemna perpusilla*. Of the rooted floating species, Keshordam *Jussicea repens* and Shapla *Nymphae nouchali* are common especially in perennial and seasonal beel.

(b) Aquatic Fauna: South Asian River (Gangetic) Dolphin

246. The South Asian River (Gangetic) Dolphin *Platanista gangeticagangetica* is native to the Ganges and Brahmaputra rivers in Bangladesh and India (Map 5.5).

247. During January-September 2011, a Dolphin survey was carried out in the Padma, Jamuna, and Hurashagar-Baral Rivers of Pabna district.[22] Seventy-four transects (including upstream and downstream) were made over 79 km of river reach by mechanized boats to estimate abundance and habitat use. The dolphin population of the studied area was found to vary from 58 during early monsoon and to 103 during late monsoon. The mean dolphin population was 19.67 (one dolphin per 1.72 km) in the Padma and one per 0.69 km in the Jamuna. Adults accounted for 65 per cent and juveniles for 35 per cent of observed individuals. Dolphin concentrations were found in 22 river locations and found in every count in three scours (Bangla *kum)*: Mohanganj *kum* of Jamuna-Hurashagar River, Nazirganj ferry ghat *kum* of Padma River, and Nagarbari *kum* of Jamuna River. Dolphins were slightly more abundant during the low water Jan-Apr period (one per 1 km) than in the monsoon high water Jun-Jul period (one per 1.06 km). The local community in particular fishers were involved in river dolphin conservation.

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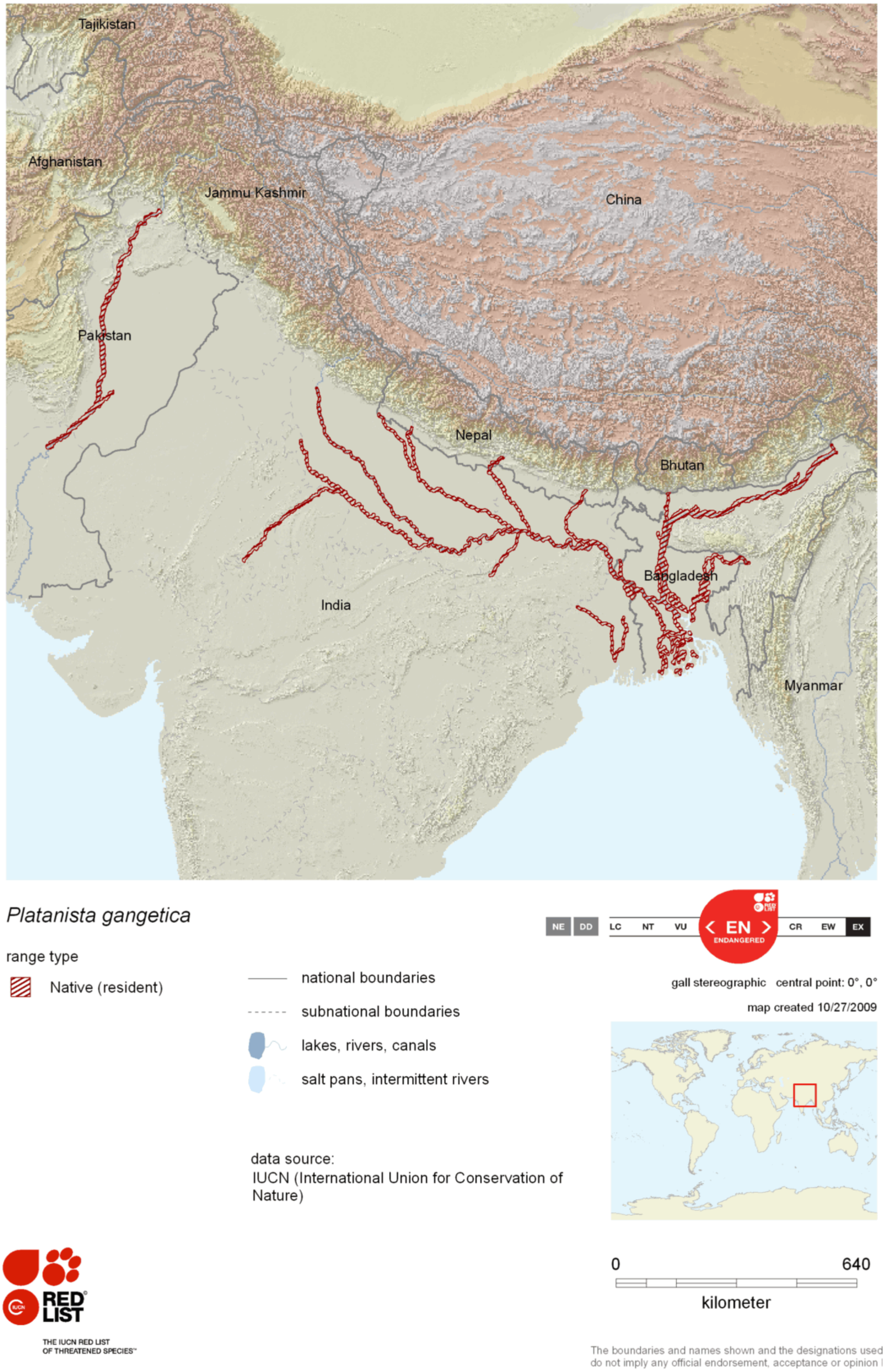
[21]Ministry of Environment and Forest. 2002. "Country Paper of Bangladesh." Seventh Meeting of the Conference of Parties of Convention on the Conservation of Migratory Species of Wild Animals. Bonn, Germany: Government of Bangladesh. http://www.cms.int/bodies/COP/cop7/proceedings/pdf/national_reports/national_report_bangladesh.pdf

[22]Rashid, S.M.A., Abdul Wahab Akonda, and Bashir Ahmed. 2012. "Occurrences of South Asian River Dolphin (Platanista Gangetica) in the Padma and Jamuna Rivers, Pabna." In Book of Abstracts, 130. Dhaka: Bangladesh Fisheries Research Forum. http://bfrf.org/bookofabstracts/BFRF%205th%20Fisheries%20Conference%20and%20Research%20Fair%202012%20-%20Book%20of%20Abstracts.pdf.



Map 5.5: Map - Range, South Asian River (Gangetic) Dolphin

248. Dolphins utilizing riverine habitats potentially affected by Tranche 1 are part of a transboundary (Bangladesh-India) population that may include individuals who

migrateinternationally between Bangladesh and India.Most international movement of Dolphins occurs within peri-border areas as short-range tributary-to-mainstem trips, but longer-range migrations of individuals between the Tranche 1 influence area and India cannot be ruled out.

249. South Asian River (Gangetic) Dolphin is on the IUCN Red List as Endangered. It is listed in Appendices I and IIof the Convention on the Conservation of Migratory Species of Wild Animals (CMS). CMS Appendix I listed species are deemed in danger of extinction throughout all or a significant proportion of their range and meriting from CMS Parties (Bangladesh is a signatory) strict protection, conservation or restorationof habitats, mitigation of migration obstacles, and control of other threats to survival. Appendix II listed species have an unfavourable conservation status or would benefit significantly from international co-operation organised by tailored agreements. It is also listed in Appendix I of the Convention on International Trade in Endangered Species (CITES) as a species in which international trade is probihited. Specific Threats to dolphins are summarized in Annex 2.

5.7.6 Other Aquatic Fauna

250. Among amphibians, Skipper Frog (*Euphlyctis cyanophlyctis*) and Indian Pond Frog (*Euphlyctis hexadactylus*) are frequently observed. Both species prefer to live in ponds, ditches, stagnant rainwater and paddy-fields. The latter species is categorized as Endangered (EN) by the IUCN-Bangladesh (2000).

251. The aquatic reptiles are frequent in this area. The Red-crowned Roofed Turtle (*Batagur kachuga*) and Smooth Water-snake (*Enhydris enhydris*) are present.

252. The diversity of aquatic birdsdepends on the area and quality of aquatic habitat. The aquatic habitat in this area is large and holds water year-round except seasonal water bodies. Thus, aquatic fauna are not dominant compared to terrestrial ecosystem. The Little Egret (*Egretta garzetta*), Indian Pond Heron (*Ardeola grayii)*, Little Cormorant (*Phalacrocorax niger*), Pied Kingfisher (*Ceryle rudis)*, White-throated Kingfisher (*Halcyon smyrnensis),* Asian Open-bill (*Anastomus oscitans*) and White-breasted Waterhen (*Amaurornis phoenicurus)* are common throughout the study area. Some of area especially char lands are used as a shelter place for migratory birds.

5.7.7 Aquatic Ecosystem Services

253. The flood plain and wetland ecosystem of the study area play an important role in the purification of water quality of the area, fertilization of the agricultural land, recreation and fodder for livestock and food sources for community. Flood cycle and its associated ecosystem purify the water quality deteriorated by several waste discharging or other ways.

5.7.8 Threats to Aquatic Ecosystems

254. In the study area, river erosion and siltation is occurring every year. Consequently, threats on surrounding aquatic ecosystem and its biodiversity are increasing. Some of the aquatic plant species being rare have become extinct due to erosion and siltation. Due to this process habitat quality is deteriorating day by day. Population of flora and fauna is disrupted.

5.8 Socioeconomic Condition

5.8.1 Area and Location

255. Socio-economic information is presented for the study area upazilas – twelve upazilas of Sirajganj, Tangail and Manikganj districts (Table 5.38).

Table 5.38: Administrative Units of Bangladesh

Divisions	Districts	Upazillas
Rajshahi	Sirajganj	Kamarkhanda
		Belkuchi
		Chauhali
		Shahjadpur
Dhaka	Manikganj	Ghior
		Shibalaya
		Manikganj sadar
		Singair
		Saturia
		Harirampur
		Daulatpur
	Tangail	Nagarpur

Source: Spatial GIS Analysis, CEGIS 2012.

5.8.2 Demography

256. Table 5.39 presents key demographic data of the study area. The study area population is 2.89 million (BBS Census Report, 2011). This includes 1.42 million males and 1,47 million females in 661,000 households having an average household size of 4.37 persons. Population density is about 1200 persons km^2.

Table 5.39: Demographic Information

Households	Population			Size of Household
	Total	**Male**	**Female**	
661,136	2,893,578	1,424,675	1,468,903	4.37
		49.24 per cent	50.76 per cent	

Source: BBS Population Census 2011.

257. Table 5.40shows age group composition of the area. About 34 per cent of the population is under 15 years of age; 57 per cent is between 15 and 59; and 9 per cent is over 60 years of age, for an approximate dependency ratio of 75.

Table 5.40: Age Distribution

Age Range (Years)	0-4	5-9	10-14	15-19	20-24	25-29	30-49	50-59	60-64	65+
Percentage of Population	10	13	11	8	8	9	25	7	3	6

Source: BBS Population Census 2011.

258. Most people live in dwellings owned by their household (Figure 5.11).[23] The exception is Manikganj sadar upazila which is more urbanized, where most dwellers live in dwellings owned by others.

[23]BBS distinguishes tenancy status of dwelling units into three classes such as- i) Owner: Dwelling unit found occupied and used by household owning it; ii) Rented: Dwelling unit found occupied and used under arrangement of contractually rented; and iii) Rent free: Dwelling unit found occupied and used without rent.

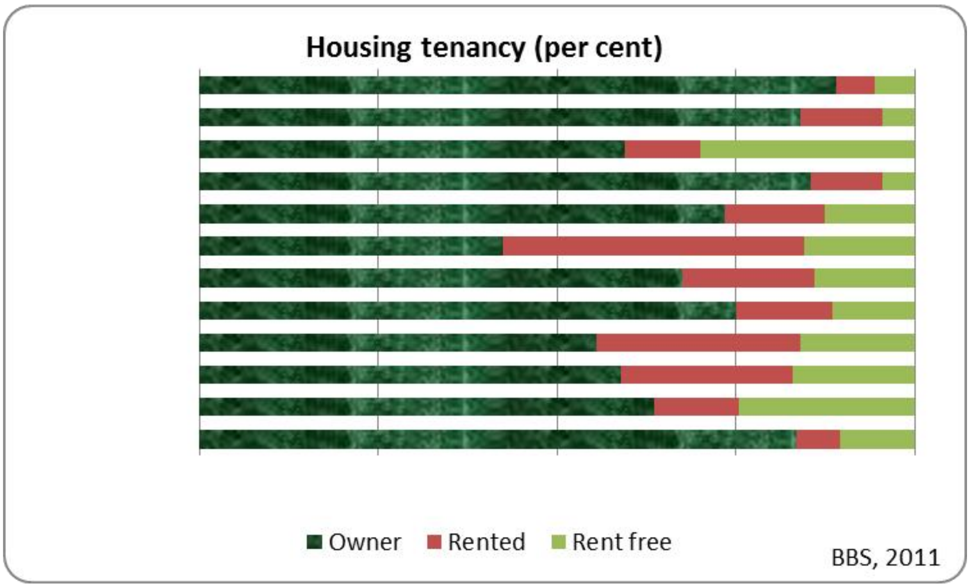


Figure 5.11: Housing Tenancy

5.8.3 Livelihood

(a) Occupation

259. Agriculture is the main occupation of 76 percent of households. About 16 percent of the population works in the service sector; and the remaining 8 percent works in the industrial sector(Table 5.41**Error! Reference source not found.** and Photo5.6)

260. Male and female are equally engaged in livelihood activities. However, participation of female member is nominal in comparison to male participation. In the study area only 2 per cent female members are working whereas 98 per cent male members are engaged in income generating activities.

Table 5.41: Primary Occupation

Upazilas	Agriculture (per cent)		Industry (per cent)		Service (per cent)	
	Male	Female	Male	Female	Male	Female
Kamarkhanda	55.98	0.59	18.40	3.68	19.47	1.88
Belkuchi	32.31	0.69	46.23	4.48	14.33	1.96
Chauhali	75.08	2.00	11.59	0.57	8.10	2.65
Shahjadpur	58.72	1.41	24.33	1.39	12.61	1.54
Ghior	78.42	1.67	5.58	0.80	11.78	1.75
Shibalaya	74.89	1.67	2.90	0.60	17.50	2.44
Manikganj sadar	62.99	1.39	5.82	1.81	23.91	4.07
Singair	79.09	1.37	5.85	0.86	11.49	1.33
Saturia	75.60	1.66	6.73	1.43	12.47	2.10
Harirampur	81.00	2.55	3.24	0.21	11.03	1.97
Daulatpur	90.29	3.20	2.75	0.23	3.19	0.33
Nagarpur	79.82	1.46	5.67	0.47	11.17	1.40

Source: BBS Population Census 2011.

Photo 5.6: Livelihoods

Photo 5.6.1: Jhupri House **Photo 5.6.2: Kutcha House**

Photo 5.6.3: Semi-Pukka House **Photo 5.6.4: Pukka House**

(b) Employment

261. Figure 5.12shows the employment status of people in the study area. About 40 per cent of total population is employed, 47 per cent is engaged in household work, only below than one per cent is looking for work and about 13 per cent of total population is not working (it includes children and physically challenged population).

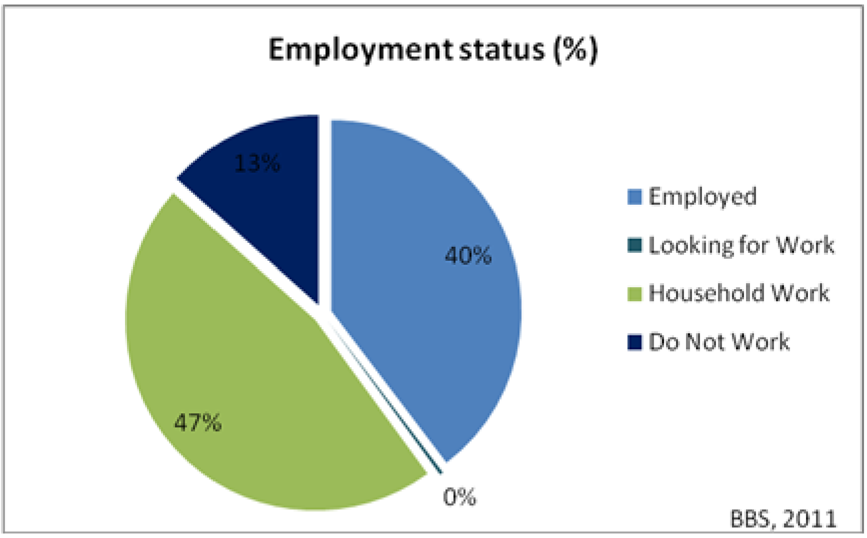


Figure 5.12: Employment Status

262. Table 5.42 shows the distribution of employment status by male and female in the study area. It is found that only four per cent female members are employed whereas 34 per cent male members are employed in the study area.

Table 5.42: Employment

Upazilas	Employed (per cent)		Looking for Work (per cent)		Household Work (per cent)		Do Not Work (per cent)	
	Male	Female	Male	Female	Male	Female	Male	Female
Kamarkhanda	38.82	2.54	0.16	0.05	0.30	45.09	5.88	7.16
Belkuchi	38.67	2.97	0.14	0.08	0.29	41.16	7.77	8.93
Chauhali	39.27	2.16	0.34	0.10	0.35	47.59	5.16	5.01
Shahjadpur	39.58	1.80	0.20	0.10	0.45	43.30	6.55	8.02
Ghior	36.53	1.61	0.17	0.07	1.04	49.01	4.56	7.00
Shibalaya	37.50	1.85	0.23	0.06	0.52	47.26	5.33	7.25
Manikganj sadar	35.81	2.81	0.17	0.05	0.45	46.63	5.97	8.12
Singair	37.43	1.38	0.29	0.07	0.66	46.09	6.28	7.80
Saturia	37.65	2.06	0.21	0.10	0.39	49.42	4.04	6.13
Harirampur	36.81	1.83	0.17	0.11	0.78	46.93	5.73	7.66
Daulatpur	35.49	1.39	0.22	0.08	0.88	49.82	5.34	6.77
Nagarpur	35.84	1.24	0.25	0.08	0.54	49.59	5.54	6.92

Source: BBS Population Census 2011.

5.8.4 Quality of Life

(a) Housing

263. In the study area, overall housing condition is not satisfactory. On an average, only three per cent houses are pukka (made of bricks and mortar) whereas 88 per cent are *kutcha* (made of wood/bamboo, and other local materials; Figure 5.13). Photo 5.6.3, show examples of these housing. Statistics shows that *kutcha* households are dominant in whole of the study area. It can be

concluded that the people living in the study area belong to extremely poor category in term of housing type.[24]

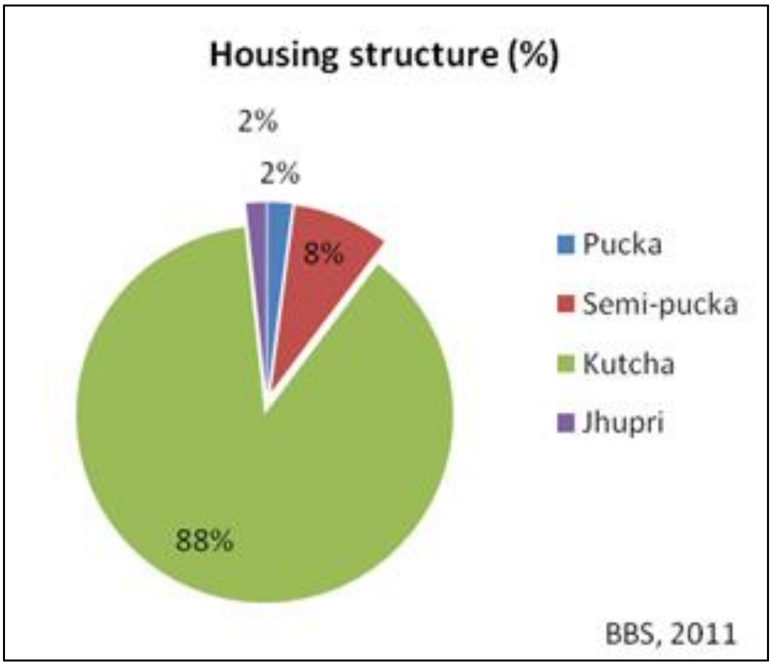


Figure 5-1.13: Distibution of Housing Types

(b) Drinking Water

264. The overall status of drinking water in the area is satisfactory. Tube-well coverage is quite good in some upazilas eg Belikuchi, Ghior, Nagarpur, Shibalaya and Harirampur. But in other area, people collect water from biologically unsafe sources such as ponds (with or without pond sand filter) and rivers. Of all households, 96 per centuse tube-well water and the rest other sources (Figure 5.14).

265. Sanitation facilities are unsatisfactory in the study area. Prevalence of the various types of sanitation facilities in the study area is shown in Figure 5.15which shows a typical arrangement.[25] Only 18 per cent of study area households use hygienic (water-sealed) facilities; 58 per cent use non-water-sealed facilities, 23 per cent use non-sanitary facilities; and one per cent lacks access to sanitation facilities.

[24]BBS distinguishes housing structures into four classes such as- i) Jhupri: House which consist mud walls of 1.5 to 3.0 ft thickness, which carry the roof load. Earthen floor, thatch or CI sheets are used as roofing materials. . There is no monolithic joint between the wall and the roof. ii) Kutcha: Walls: Organic materials like jute stick, catkin grass, straw, and bamboo mats. Split are bamboo framing. In some areas wall are made by earth. Foundation: Earthen plinth with bamboo or timber posts. Roof: Thatch-rice or wheat or maize straw, and catkin grass, with split bamboo framing; iii) Semi-pucka: Walls: Bamboo mats, CI sheet, Timber or bamboo framing. In some areas wall are made by earth, sometimes part or full brick. Foundation: Earthen plinth; Brick perimeter wall with earth infill; Brick and concrete also use. Roof: CI sheet with timber or bamboo framing; and iv) Pucka: House which is made by fully concrete, cement, and iron.

[25]BBS defined four types of sanitary facilities: (i) Sanitary water-sealed, pit latrine with a water barrier to prevent odors and insect, rodent, etc infestation; (ii) Sanitary not water-sealed, latrine with slab or other secure cover or polyethylene flap over the drop hole to prevent infestation; and (iii) non-sanitary (kutcha):latrine, a frame or platform extending over earth or water; an open pit latrine without squat platform or slab; and (iv) no facilities, defecation in bushes, fields, or other outdoor location.

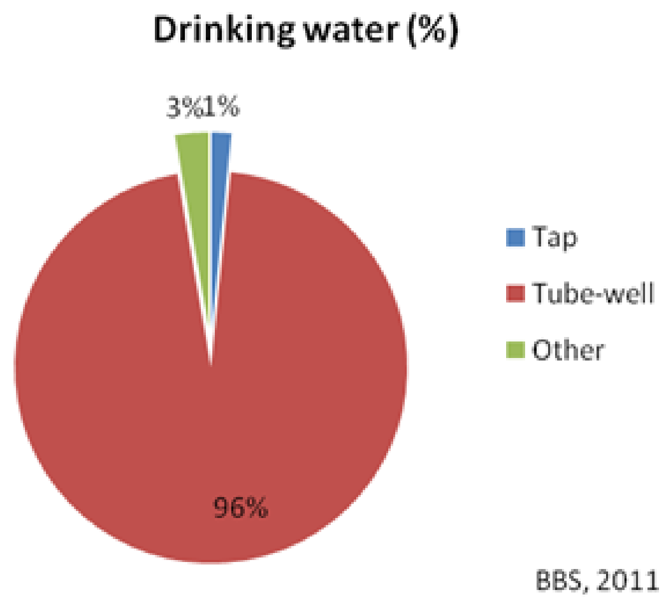


Figure 5.14: Drinking Water Sources

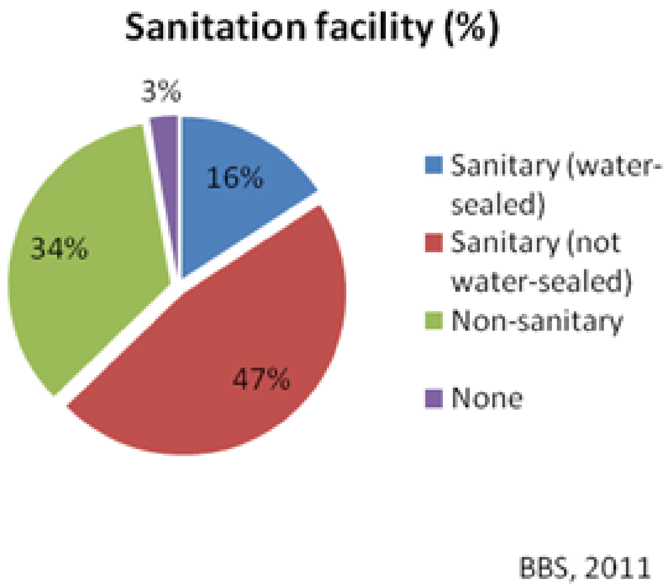


Figure 5.15: Sanitation

(c) Disease Incidence Ranking

266. According to local people's report, the diseaseswith highest incidence in the area ranked from highest to lowest are diarrhoea, influenza, heart disease, hypertension, gastric illness, asthma, skin disease, hepatitis, chicken pox, and arsenicosis (CEGIS fieldwork, 2012).

(d) Health Services and Facilities

267. It is found that in the study area, trained medical doctors are accessed by about 20 % of households; paramedic/diploma practitioners by 30 % and untrained ("quack") practitioners by 40 %. All types of medical treatment are inaccessible to the remaining 10 per centdue to

impoverishment and communication problems (Figure 5.16). Local people's report that they are very dissatisfied with the very poor quality of available health services and facilities.

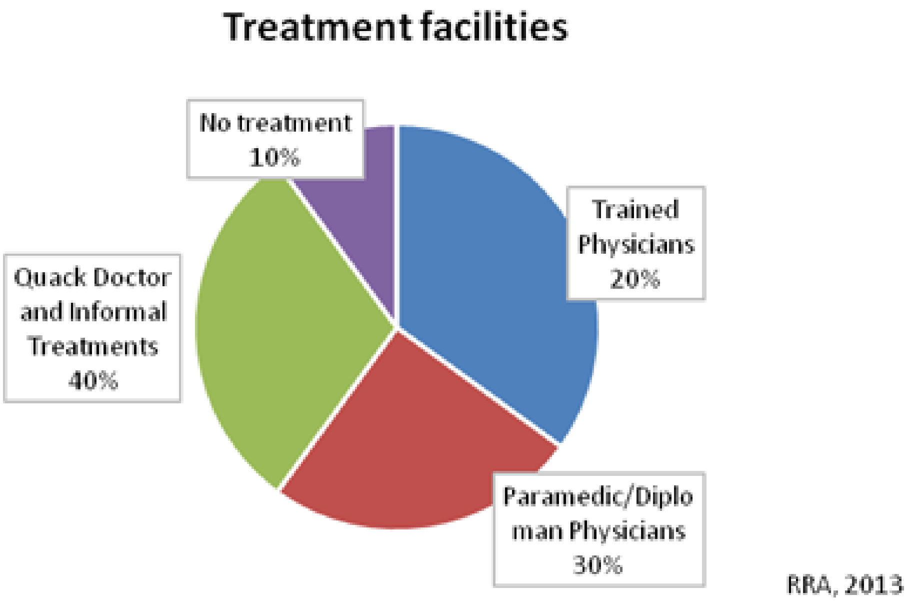


Figure 5.16: Medical Treatment

5.8.5 Education

268. In the study area literacy rate is quite satisfactory in terms of national average. Manikganj sadar has the highest literacy rate (56%) and is followed by Ghior (55%) upazilas (Table 5.43). However, the tendency to be educated is now growing among the local people. People show their interest in education. They send their children to the institutions in due time and try to continue with their education.

Table5.43: Literacy Rates

Upazilas	Literacy Rate (per cent)		
	Total/Both	Male	Female
Kamarkhanda	46	49	44
Belkuchi	46	48	43
Chauhali	37	41	33
Shahjadpur	38	42	35
Ghior	55	58	51
Shibalaya	53	57	49
Manikganj sadar	56	59	53
Singair	46	48	44
Saturia	47	52	43
Harirampur	48	50	47
Daulatpur	35	40	30
Nagarpur	43	46	40

Source: BBS Population Census 2011.

5.8.6 Electricity

269. According to secondary census data, electrification in the study area is available to only 48 %of households (Figure 5.17). In contrast, the RRA found that local people reported about 80% coverage of national grid connection; in addition, some households receive electricity from solar and other

sources. In consequence, the use of modern technology and access to information and entertainment is high.

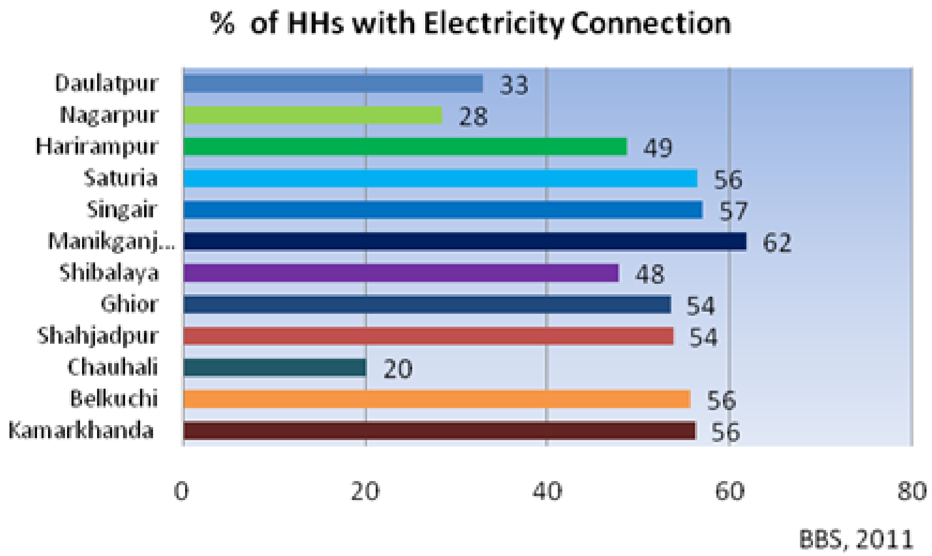


Figure 5.17: Household Access to Electricity

5.8.7 Poverty and Safety Nets

(a) Landownership Pattern

270. The landownership pattern is correlated with poverty incidence in the area. The RRA found that about 30 %of households are absolute or landless and the remaining 70 % have land for mainly agriculture use and also for settlement and commercial uses (see Table 5.44).

Table 5.44: Landownership

Land Holding Categories	Distribution of Household (per cent)
Absolute Landless (0 decimal)	20
Functional Landless (up to 49 decimal)	10
Marginal (50-100 decimal)	40
Small (101-249 decimal)	20
Medium (250-749 decimal)	7
Large (more than 750 decimal)	3

Source: CEGIS fieldwork 2013.

271. In the study area the Agricultural Census conducted by BBS in 2008 has found that most of the land is held in small holdings. BBS classifies land holdings into three broad categories: (i) small, 0.05 to 2.49 acre cultivated land; (ii) medium 2.50 to 7.49 acres; and (iii) large, 7.50 acres and above. In the upazilas of the project area, small holdings comprise between 78 and 93% of agricultural area, medium holdings comprise between 10 and 20%, whereas large holdings comprise far less, between 0.5 and 2% (see Figure 5.18).

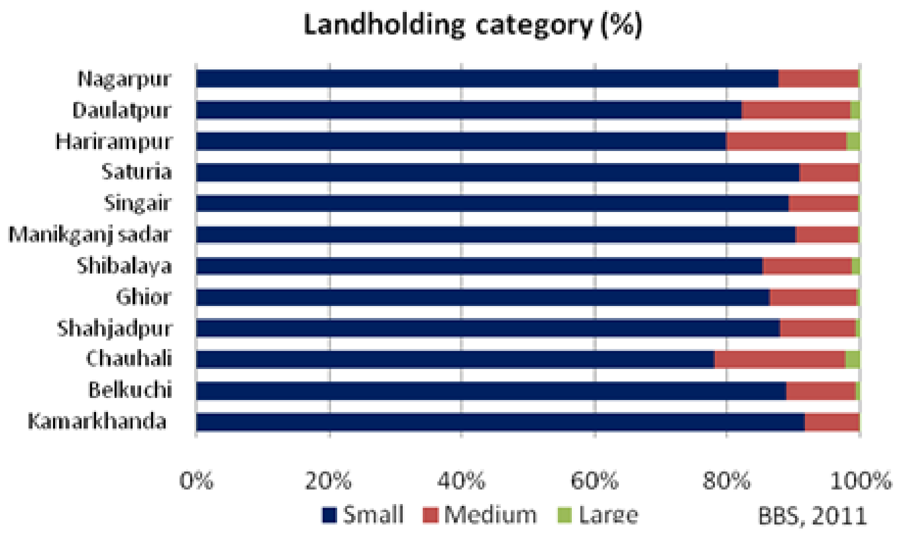


Figure 5.18: Landholding

(b) Income Poverty

272. Income poverty is measured through self-assessment in the study area. In this process, respondents were asked to assess the overall condition of people living in the study area. Their responses are assigned to three categories: deficit, balance or break-even and surplus.

273. Local people assessed that on an average about 50%of the local population are in a balance or break-even position, meaning that their economic activities are subsistence-oriented, 35% people are in deficit, meaning they must borrow all year long to finance consumption and 15 %, mainly large land ownersand businessmen, are in a surplus position (Figure 5.19). Thus in the study area consumption is higher than income which perpetuates poverty intergenerationally.

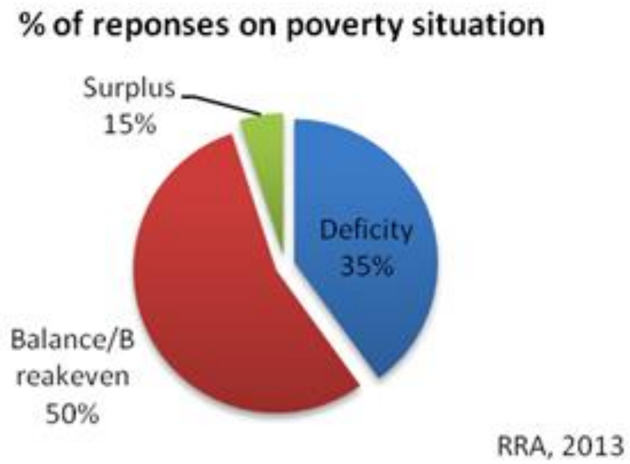


Figure 5.19: Self-Assessed Poverty Status

(c) Income and Expenditure

274. Household income and expenditure are key indicatorsof socio-economic status. In the study area, monthly household income and expenditure vary from BDT 5000 to 20,000. About 75% of

households hire out agricultural labor. The wage rate varies between BDT 150 to 350 per day. A few in-migrating laborers stay in the area for a year, returninghome at the end of the year with all their income. Women's participation in the agricultural sector is negligible (Table 5.45). Field findings show that most income comes from three sectors ie agriculture, small business and remittance, and that household consumption and housing account for most expenditure.

Table 5.45: Annual Income and Expenditure Level

Range (BDT/month)	Expenditure	Income
Less than 1,000	-	2
1,000 - 2,000	5	3
2,000 – 5,000	35	30
5,000 - 9,000	42	40
9,000 - 20,000	15	20
More than 20,000	3	5

Source: CEGIS fieldwork 2013.

5.8.8 Natural Disasters

275. The local inhabitants of the study area have identified river erosion, drought, and floods as the major hazards in the area. Details about the disasters and their affects in the area are presented in Table 5.46.

Table 5.46: Effects of Recent Natural Disasters

Disaster	Frequency	Affected Area (per cent)	Affected House Holds (per cent)	Crop Damaged (per cent)	Major Damaged Crop
River erosion	Every year	50	100	90	Rice
Drought	2007, 2009, 2011	50	40	30	Rice
Floods	1998, 2005 , 2009	60	100	90	Rice

Source: CEGIS fieldwork 2012.

5.8.9 Social Safety Nets and Poverty Reduction Measures

276. The major social safety nets and poverty reduction programs initiated in the area include the Vulnerable Group Development, Food/Taka for Work (F/TFW), Food for Education/Cash for Education, Rural Maintenance Program (RMP), Old Age Allowance, Freedom Fighter Allowance and Integrated Poverty Reduction Program. These programs have created food security as well as social safety nets among the targeted poor households and vulnerable communities (Table 5.47).

Table 5.47: Social Safety Net Programs

Social Safety Net Programs	Households/Communities Served (per cent)
Vulnerable Group Development (VGD)	6
Food/Taka For Work (F/TFW) of PIO	4
Food for Education/Cash for Education	10
Rural Maintenance Programme (RMP)	6
Old Age Allowance	5
Freedom Fighter Allowance	3
Integrated Poverty Reduction Program of BRDB	6

Source: CEGIS fieldwork 2013.

277. A number of local, national, and international NGOs work in the study area. Their main activities are micro credit programs among the rural poor and landless women/men. The major NGOs working in the area include BRAC (Bangladesh Rural Advancement Centre), ASA (Association for Social Advancement), TMSS (Thengamara Mohila Sobuj Songho), Manob Mukti Sangstha (MMS),Proshika, Muslim Aid UK, CARE and Karitas (Table .48). These NGOs are serving with micro

credit while BRAC, ASA, and Uttaran are working for non-formal education, Health, human rights, water and sanitation, gender and children development programs. About 40 per cent of households are found to benefit from NGO interventions.

Table 5.48: NGOs Programs

NGO	Type of Programs							
	Credit	Education	Water and Sanitation	Health	Human Rrights	Gender	Children	Disaster
BRAC	✓	✓	✓	✓	✓	✓	✓	-
ASA	✓	✓	-	-	✓	✓	-	-
TMSS	✓	✓	✓	-	✓	-	✓	-
Manob Mukti Sangstha	✓	-	-	-	-	-	-	-
CARE	✓	✓	✓	-	✓	✓	-	-
UK Muslim Aid	-	✓	✓	✓	✓	-	-	✓
Karitas	-	-	-	-	-	-	-	✓

Source: CEGIS fieldwork 2013.

5.8.10 Transportation

(a) Road way

278. Overall about 1011 km of roads exist in the 12 upazilas of the area, of which: 65 km roads are national: 200 km are FRA (connecting road from upazila to district); 253 km are FRB (connecting road from union to upazila); and 493km are R1 (regional road within the districts). Table 5.49presents data on the road network in the study area.

Table5.49: Road Network

Upazilas	N	FRA	FRB	R1
Daulatpur	-	6	22	33
Ghior	8	13	13	34
Harirampur	-	13	27	28
Manikganj Sadar	10	19	28	58
Saturia	3	12	8	52
Shibalaya	18	12	9	56
Singair	-	19	41	56
Belkuchi	-	25	9	43
Chauhali	-	2	23	2
Kamarkhanda	8	22	14	17
Shahjadpur	17	27	22	62
Nagarpur	-	30	37	53
Total	**65**	**200**	**253**	**493**

Source: NWRD database 2013.

(b) Waterways

279. Waterways are the most important means of communication in the area. Navigation routes in the study area include: 390 km of routes less than 25 m wide; 170km of routes25 to 50 m wide; 126 km that are 50 to 100 m wide and 207 km above100 m wide (see Table 5.50). The area has one ferry ghat, two inland river ports, and two pilot stationswithin the study area. Waterwaysare gradually decreasing in size due to siltation.

Table 5.50: Navigation Routes

Upazilas	Below 25m	25m - 50m	50m - 100m	Above 100m
Daulatpur	30	9	15	6
Ghior	24	25	15	8
Harirampur	12	37	4	11
Manikganj Sadar	14	8	41	34
Saturia	7	23	11	16
Shibalaya	25	20	0	10
Singair	48	12	29	15
Belkuchi	7	17	0	7
Chauhali	32	5	0	13
Kamarkhanda	22	10	2	4
Shahjadpur	82	3	0	60
Nagarpur	86	1	8	24
Total	**390**	**170**	**126**	**207**

Source: NWRD database 2013.

5.8.11 Educational Institutions

280. The area has 914 primary and secondary schools, 48 colleges, and 92 *madrasas* (religious schools; Table 5.51). Some area students go to Rajshahi and Dhaka for secondary education. Educational institutions are mostly concentrated in larger settlements, although primary schools are distributed equally in all unions of the area.

Table 5.51: Academic Institutions

Upazilla	School	College	Madrasha
Kamarkhanda	125	7	15
Belkuchi	173	6	11
Chauhali	134	7	23
Shahjadpur	264	15	30
Ghior	102	5	3
Harirampur	98	3	2
Daulatpur	18	5	8

Source: CEGIS fieldwork 2013.

5.8.12 Population Migration

281. Seasonal labor migration is common throughout the study area. Permanent in- and out-migration is negligible.

282. Area residents tend to out-migrate to Dhaka, Tangail, Sylhet and Rajshahi, for better livelihood (60 per cent). These out-migrants are both male and female and from both excluded/impoverished and privileged backgrounds.

283. A significant number of labourer sliving in the area (20 per cent) are in-migrantswho came seeking subsistence wages (Table 5.52). Most of these in-migrants are male, aged 15 to 47 and from socially excluded and economically impoverished backgrounds.

Table 5.52: Labor Migration

Type of	Out Migration	In Migration

Migration	Destination	Per cent of population	Origin	Per cent of population
Seasonal labor migration	Dhaka, Tangail, Narayangong, Slyet, Rajshahi, Manikgonj	60	Rajshahi, Pabna, Rangpur, Natore, Gaibandha, Bogra etc	20 (during harvesting period)
Permanent household migration	-	-	-	-

Source: RRA 2012.

5.8.13 Gender and Women

284. Restrictions on women's mobility, male-female discrepancies in wages, mortality, health, nutrition, and education are some of the key gender issues in the study area. Women have little role in decision-making in the family and community. The RRA found that area women and girls face social and economic discrimination within the family and the community. Figure 5.20shows the scope of decision-making by women in the study area.

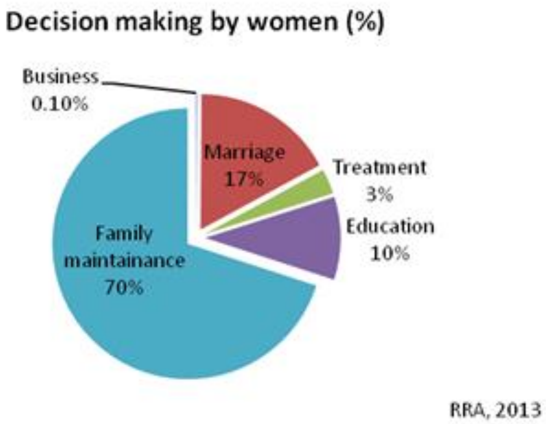


Figure 5.20: Decision-Making By Women

285. Women mobility in the area is mostly localized except for travel to obtain medical treatment, fetch water, engage in farming activities, and visit relatives.

286. Growing consciousness among local people, health services provided by the public and other healthcenters and NGO programs have each contributed to recent decreasesin higher mortality rates for women. About 15 per cent women are living with good health condition and the rest are suffering from various diseases such as low blood pressure and premature delivery. About 20 per cent women are getting proper nutrition and about 10 per cent have access to the health centers, which are around 15 km away on average from their residence.

287. As shown in Figure 5.21**Error! Reference source not found.**, women's literacy in the study area has been increasing gradually, to 58 per cent, while school attendance of males and females is now almost equal.

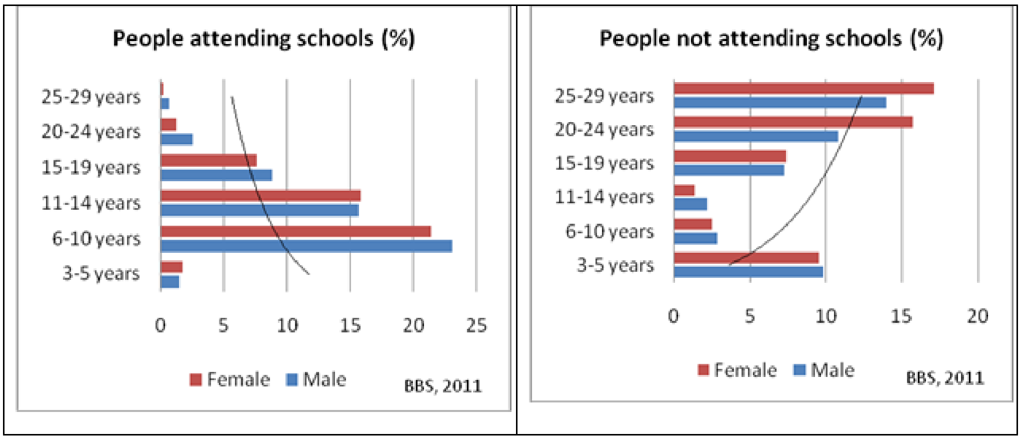


Figure 5.21: School Enrollment

5.8.14 Vulnerable Communities

288. In the study area, three types of people could be considered as vulnerable. These are: (i) marginal farmers having less than BDT 5000 monthly income; (ii) fishermen; and (iii) women-headed households. Even though most land owners cultivate their own land, sharecropping-in land is an important source of income for vulnerable households. Fishing in the open water bodies is another significant income source for these households.

5.8.15 Common Property Socio-Cultural Places and Resources

289. The common property socio-cultural places and resources of the area include mosques, graveyards, temples, cremation grounds, playgrounds, *eidgahs* (places for offering Eid prayers) and the BWDB embankment. Local people frequently use theseplaces for religious, social, and cultural gatherings.

6. Public Consultation and Disclosure

6.1 Disclosure, Consultation, and Participation during Project Preparation

290. Two rounds of stakeholder engagement were undertaken during project preparation. A first round of public consultation meetings (PCM) was carried out as part of this study. The objectives of this round of consultation were (i) disclosure of project information to stakeholders, (ii) consultation with the public on issues to include in the assessment, and (iii) participation of stakeholders in the formulating the set of VESCs to be assessed for project impacts.

291. A second round of PCMs was be undertaken when this environmental assessment report became available in draft form, with three objectives: **(i)** disclosure of the draft report contents, including the proposed GRM and EMP; (ii) consultation with stakeholders on the results of the assessment; and (iii) discussion of stakeholder participation in environmental management activities during construction and implementation.

6.2 Stakeholder Comments and Concerns

6.2.1 First Round

292. During the environmental assessment process a first round of public consultation meetings was held in four locations (Map 6.1) to present the location to stakeholders and document their concerns. The records of this round are presented in Annex 3.

293. The purpose, time, and location of the first-round meetings were disseminated to stakeholders by sending hard-copy letters in Bengali to all relevant upazila-level officials in the meeting catchment. These letters included the request to circulate the information to other stakeholders. Meetings were also publicized to stakeholders during all field work including focus group discussions, with FGD attendees being asked to contact other stakeholders. The means of secondary and tertiary notification was almost exclusively by cell phone voice calls.

294. Judging from meeting attendance, notification appeared to have been effective – now that "everyone" in Bangladesh has access to a cell phone – in reaching a large number and all types of stakeholders. The only stakeholder type noted to be seriously underrepresented in the public meetings was women. This was addressed by having separate women-only focus group discussions about the project and the environmental impacts.

295. There was a high degree of unanimity among stakeholders. Stakeholders, even some who would be resettled by construction, expressed strong support for the project to be implemented as quickly as possible to solve their severe and urgent erosion and flooding problems. No reservations were expressed regarding potential adverse impacts.

296. An issue identified by CEGIS meeting facilitators is that some stakeholders are unhappy that their area (which is suffering from flooding and/or erosion) is notcovered by Tranche 1, and they do not understand why areas other than theirs have been selected for priority intervention. This highlights a potential risk to the dynamic siting approach, which is supposed to determine intervention locations on the basis of morphologic/hydrologic modeling, but may be vulnerable to local stakeholder pressure. Another potential risk is of increased social conflict between protected/unprotected communities or between unprotected communities and project proponents, contractors, laborers, etc. These risks will be addressed through the implementation-phase public consultation program, which can include dissemination of information on how siting decisions are made, and the GRM.

Map 6.1: First Round Public Consultation Meeting Locations

6.2.2 Second Round

297. A second round of public consultation meetings was conducted to present the draft EIA results to stakeholders for their comments. The EIA reports and Bengali presentations were disclosed to the public on 2nd to 9th July, 2013 in four meetings, held at Shahjadpur (JRB-1), Shibalay and Chouhali (JLB-2), and Harirampur (PLB-1) of Manikganj and Sirajganj districts. The records of this round are presented in Annex 4.

298. The main meeting objectives were to present the findings of the final draft EIA report and receive feedback from local stakeholders who attended the meetings. Stakeholders including persons affected by Tranche 1 expressed their views in favor of the Project and their support for early implementation to protect them from natural flood and erosion disasters. CEGIS consultants shared the Tranche 1 feasibility and EIA process and results first with BWDB officials and Upazila Parishad Chairpersons (UZPC), Upazila Nirbahi Officers (UNOs), and Project Implementation Officers (PIOs) of polder areas. In turn, these individuals assisted in identifying and inviting union-level public representatives and key persons by phone to the consultation meetings.

299. Not surprisingly, given the higher level of information provided to meeting participants about the subprojects and their potential impacts, participants expressed more substantive concerns about the when, where, what and how of subproject interventions.

6.3 Summary of Concerns, All Meetings

300. **Conditions identified as important for success of subprojects**. (i) Participants emphasized the need to ensure that construction work is of high quality. (ii) Almost all participants stated that erosion will destroy areas currently under attack and subproject designswill have to be changed unless construction of erosion works begins this year (2013). To allow this construction to start in 2013, they requested that contingency funds be arranged now. (iii) Participants are concerned that development projects initiated by the ruling party will lose priority if/when the opposition party is in power. Participants strongly urge a 2013 construction start avoid future problems.

301. **Dredging.**River dredging has not been included in subprojectdesigns. Participants stated that embankmentswill not control flooding or erosion withoutit, and therefore it should be incorporatedin the project. Some participants suggested capital dredging from Jamuna Bridge to Brahmankanda of Horirampur Upazia under Manikgonj District. Participants also suggested that fisheries habitat could restored through dredging of internal channels in the Tranche 1area.

302. **Pollution.** Stakeholders were advised that the construction phase would cause temporary air pollution and noise. Almost all stakeholders present consented to accept these impacts during construction.

303. **Flood protection plans**. Participants expressed concerned about the effectiveness of the subprojects in controlling flooding. They stated that flood protection plans should be developed based on an assessment of water levels. Proposed interventions should be designed to provide protection from the highest monsoon water levels.

6.4 Additional Concerns from Specific Meetings

304. **Shibalay, Manikganj (JLB-2 area).** The upazila areas most affected by erosion are Zafargonj and Bachamara. Local MP Mr. A.B.M Anwerul Haq stated that over last five years, more than 9000 affluent households of Zafargonj area were forced by erosion to leave the area and now live in difficult circumstances in Dhaka city. Participants recommend that construction should start from November in the dry season. The northern part of Zafargonj Bazar is very much threatened by erosion this year. To protect this area,participants suggested seeking preparatory fundsfrom Asian Development Bank (ABD) and Water Development Board. River bank protection from Kaijuri to Baghabari is also essential this year as these areas are vulnerable. Participants believe permanent protection works are required in the Padma and Jamuna Rivers as temporary erosion protection works are not viable there. A reservoir to hold water for rice cultivation and fish culture should be added to the subproject.

305. **Shahjadpur, Sirajganj (JRB-1)**. Co-ordination among involved departments should be ensured during subproject implementation. Eroding locations should be properly identified and protection

works provided there. Participants requested adding construction of a water reservoir to the project, to hold water for rice cultivation and aquaculture, and immediate repair of the existing upazila embankment and revetment.

306. **Chouhali, Sirajganj (JLB-2)**. The area of Chouhali upazila most vulnerable to erosion is the upazila sadar, where 40 to 50 per cent of the area has already eroded away. BWDB has been using sandbags in attempt to control the erosion, but these have been ineffective given the intensity of the erosive attack. Participants stated that sandbag revetments are ineffective in the Jamuna due to its erosion intensity. Most participants stated that capital dredging should be undertaken from the Jamuna Bridge to Aricha. River dredging is required to ensure the survival of any future embankment works.An embankment built in this upazila at a cost of BDT 38 crore was already destroyed by erosion. A flow divider should be incorporated in the project design. Participants expressed frustration that the subproject design does not reflect the concerns and suggestions of local people, even though these have been expressed repeatedly in meetings with the Project Implementation Officer (PIO).

307. **Harirampur, Manikganj (PLB-1)**. The 5 km riverbank protection proposed in this upazila should be extended an additional 2 km up to Dhulsura. Bahadurpur union should be included with the project. Participants were concerned about the successful implementation of the project. They think that projects initiated by the ruling party will have lower priority if and when the opposition is in power. Participants hope the subprojectwill be implemented in 2013, and agreed to make whatever sacrifices would be required to expedite this. Participants stated that the priority should be to protect Harirampur before providing protection to Manikgonj town. Priority work should start as soon as possible. A quality control committee should be struck to ensure quality construction work. Local stakeholders should be involved in regular embankment maintenance.

6.5 Incorporation of Concerns in Project and Mitigation Designs

308. Some concerns relate to known issues that have been and are being attended to (eg quick start of construction, construction quality control); where prevailing funding, capacity, and other constraints obviate technical solutions, this will be communicated to stakeholders during subsequent consultation activities. Other concerns relate to participants' perceptions of technical issues (eg role of dredging in flood and erosion control and fish habitat restoration; flow divider) that may or may not accord with engineering analyses and understandings. Addressing these concerns first requires a technical assessment of the feasibility of modifying designs per stakeholders' wishes/suggestions; where feasible, appropriate modifications can be made. Addressing concerns without ready technical solution likely will involve an ongoing conversation between planners/designers and stakeholders, in which information about analytical tools and results in appropriate forms is provided to stakeholders and stakeholders are provided with opportunities to share their local knowledge and observations with planners/designers, especially where it contrasts with technical understandings. Currently detailed designs are underway and public continue to be consulted.

6.6 Implementation-Phase Stakeholder Disclosure, Consultation and Participation

309. Stakeholder engagement will continue during implementation facilitated by an NGO engaged for this purpose. Selected parts of this EIA, specifically related to impacts, mitigation measures and stakeholders' views, will be translated and made available to the public at different local levels, suitably the locations of the consultation meetings. On a larger scale this EIA will be published on ADB's webpage as part of the project documents.

6.7 Grievance Redress Mechanism

310. At each Tranche 1 subproject location, a local Grievance Redress Committee(GRC) will be set up during the design stage and operate throughout the implementation phase. Each GRC will consist of a BWDB representative (Executive Engineer (Field) or equivalent) as the chair, a BWDB Sub Assistant Engineer as member-secretary, and as members the concerned UnionParishad chairperson(s) and for subprojects with resettlement, a representative of resettlement-affected persons.

311. GRCswill review and resolve grievances within one month of receipt and maintain written records of complaints received, actions taken, and meeting minutes with dated photos. Aggrieved personsare free to access the country's legal system at any stage regardless of GRC involvement. In addition, a Joint Verification Team (JVT) is responsible to assess complaints related to the land acquisition process.[26]but also related to the environment, including the use of natural resources, such as fish associated with sluice gate operation or the use of embankment slopes based on long-term lease agreements[27].

6.8 Reporting and Monitoring

312. Environmental monitoring reports will be issued bi-annually disclosure on ADB's website. The environmental monitoring reports will also be incorporated into the December and July version of the quarterly progress report, which is at the beginning and end of every construction season. Environmental monitoring reports will be prepared by the Project Management Office, under the direction of the nominated environmental officer with the help of the consulting team's environmental specialist.

313. Monitoring will be undertaken for timely detection of conditions requiring remedial measures; to provide information on mitigation and institutional strengthening progress; and to assess compliance with required safeguards. Overall implementation progress including EMP implementation will be reviewed during periodic review missions involving ADB, the Implementing Agency, the Executing Agency, and the Implementation Consultant.

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[26] Annex J1, Resettlement Framework, version dated 2 Aug 2013.

[27] Long term lease agreements will be worked out after identification of stakeholder groups, associated with community disaster management units and taking into account vulnerable groups (such as hard core poor families, women-headed households) identified during the implementation of the resettlement process.

7. Important Environmental and Social Components

7.1 Introduction

314. The environmental and social components likely to be impacted by the project interventions are called important environmental and social components (IESC). IESCs were formulated through a two-stage scoping process. In the first stage, IESCs were identified by the experts of the EIA/SIA team in a multi-disciplinary scoping process. In the second stage, local scoping sessions were held in which local communities reviewed and validated the EIA/SIA team IESCs, and, as needed, identified additional IESCs they believed could be impacted by the proposed interventions.

315. The IESCs for water, land, agriculture, fisheries, ecosystem and socio-economic conditions that were formulated for this study, and their selection rationale, are described below.

7.2 Water Resources

7.2.1 Erosion and Accretion

316. Every year, bank line erosion in the study area grasps huge amount of lands damaging valuable assets and infrastructures. On the other hand, continuous accretion in the rivers reduces the navigability. In the dry period, the shallow rivers are silted up with chars and theavailable surface water can hardly meet the demand of local people. The interventions of will have significant effects in the morphological changes (i.e. erosion and accretion) of the area. The bank revetment works are likely to affect the river erosion/ accretion scenario, whereas the process of guided siltation (proposed in JLB-2 sub-reach) may affect the net accretion inside the Jamuna River. Considering these issues, erosion and accretion have been selected as an IESC.

7.2.2 Flooding

317. The study area is highly vulnerable to regular flooding during monsoon. Due to flat topography and geographic location of the area, small rise in water levels causes full scale inundation. Floods cause immense sufferings to the local people by damaging valuable assets and infrastructures, causing bank erosion, disrupting communication system etc. Interventions such as construction and re-sectioning of embankments are likely to cause significant impacts in the flood occurrence, extent and duration. Therefore, flooding was selected as an IESC.

7.2.3 Drainage Congestion

318. The major internal tributaries of the area are becoming shallow due to continuous siltation and hence do not provide effective drainage needed during monsoon. This leads to drainage congestion problems which eventually cause water logging and inundation in some parts of the area. The proposed bank revetment works and provision of regulators are likely to affect the drainage situation of the water bodies inside the area to some extent. Considering this phenomenon, drainage congestion was selected as another IESC.

7.2.4 Water Logging

319. In the wet season, some parts of the study area suffer from temporary water logging problems. However, there is no permanent water logging condition in the dry period. The construction and re-sectioning of embankments is likely to increase water level which may create

water logging on a permanent basis. Provision of regulators is likely to resist the occurrence of water logging, but in places where regulators would not be placed, water logging problems might arise. Moreover, no intervention has been proposed to re-excavate some of the shallow rivers and lakes which might affect the water logging scenario. Considering all these possibilities, water logging was selected as an IESC.

7.2.5 Water Availability and Water Use

320. Availability of water for agricultural and other uses is selected as anIESC. In the dry season, ground water as well as surface water is used to some extent for irrigation and domestic purposes while in the wet season, surface water is used predominantly. The availability of water for different uses therefore is a valued component for the lives and livelihood of local people. The interventions proposed in the study area would affect the local people's access to surface water and its use on multipurpose.

7.2.6 Navigation

321. Navigation through the major and internal rivers is an important phenomenon in the study area. It is important for the socio economic aspects, ecological balance and the different uses of water. The provision of interventions may affect the navigation status of the rivers. As such, navigation was considered as anIESC.

7.2.7 Surface Water Quality

322. Surface water quality is another IESC for the project. It is important for the environmental sustainability. Better quality of surface water would ensure improved use of water for domestic, irrigation and drinking purposes. The proposed interventions are likely to impact the quality of surface water. The bank revetment works would impact the siltation rates and overall quality of rivers. The construction and re-sectioning of embankments would also affect the quality of surface water during the construction phase.

7.3 Land Resources

7.3.1 Land Type

323. Land type depends on the depth of inundation on cultivated land during the wet season. Area under different land types was selected as an IESC.

7.3.2 Sand Carpeting

324. Sand carpeting or casting on agricultural land takes place through overtopping of embankment during high flood levels in the river. Area of agricultural land affected by sand casting was selected as anIESC.

7.3.3 Land Loss

325. Land loss through river bank erosion is a major problem in the study area. The proposed bank protection is expected to check such loss of agricultural land. Temporary loss of agricultural land is likely to take place during the pre-construction phase if labor sheds are constructed and/or construction materials are stored on agricultural land. Agricultural land may also be lost if dredged spoil/re-excavated soils are disposed on agricultural land. Permanent and temporary loss of agricultural land was selected as IESCs.

7.4 Agriculture

7.4.1 Cropping pattern and intensity

326. Changes in area under different land types are expected to bring in changes in cropping patterns. Increase in area under higher land type (F_0/F_1) would create scope of multiple cropping leading to increased cropping intensity.

7.4.2 Crop production

327. Agricultural crop production is expected to increase through river bank protection and changes in area under different land types. This is expected to be achieved through increased cropping pattern, reduction in crop damage, increased area under high yielding varieties of rice with increased provision of both primary and supplemental irrigation and overall adoption of improved crop management practices.

7.4.3 Crop damage

328. Crops are presently damaged in the study area due to flood, drainage congestion, and drought. Changes in crop damage would be reflected in aerial extent as well as increased yield per hectare contributing to increase in crop production.

7.4.4 Irrigated Area& Irrigation Water Availability

329. Irrigation supports greater and more reliable agricultural productivity. Surface water and ground water are used for irrigation use.

7.5 Fisheries

7.5.1 Fish Habitat

330. Any change of land types due to the proposed interventions might modify the quality and quantity of fish habitat. The project possesses some pockets and floodplain that goes under water in wet season and thus contribute towards the development of fisheries resources. The proposed interventions will modify the fish habitats in the study area. In this context, fish habitat was considered as anIESC in this study.

7.5.2 Riverine Fish Habitats

331. Continues sedimentation of river bed, establishment of different types of structures such as cross fish pata, katha/komor, shrimp gher on the river slope, agriculture practice by building mud bunds, housing and other engineering construction by encroaching the river causes the river habitat unsuitable for fish migration as well as fish production. The proposed interventions may modify the riverine fish habitats in the study area. Considering these aspects, riverine fish habitat was taken as an IESC for this study.

7.5.3 Beel and Khal Fish Habitats

332. Some of the riverine fishes migrate towards the beels through khal for breeding purpose and propagation. Beels are the breeding and feeding grounds of the indigenous species of fishes and play a vital role in stock recruitment. The khals are silted up due to closure, construction of water regulating structures, mud bund etc. Besides these beels are silted up rapidly and the indigenous

species of fishes might disappear from the area. The proposed interventions will modify the fish habitats in the study area In this context, beel and khal fish habitats are considered as IESC.

7.5.4 Floodplain Fish Habitat

333. The floodplain fisheries may be impacted due to the construction of embankment of the study area if the connecting khals/ canals are not restored properly.

7.5.5 Fish Migration

334. Fish migration is considered important for maintaining fish bio-diversity and production.

7.5.6 Fish Species Diversity

335. Fish biodiversity is an indicator of aquatic ecosystem health and has implications for income and nutrition of poor people.

7.5.7 Capture and Culture Fish Production

336. Fish production that comes from different open water sources may be reduced due to loss of habitat with reduction in water area. Besides this the unfavorable environment in terms of reduced dissolved oxygen (DO) and pH level and water temperature could also change the fish production. Therefore, capture fish production was considered as an IEC for this study.

7.6 Ecological Resources

7.6.1 Terrestrial Ecosystem

337. Terrestrial ecosystem provides habitat for all the terrestrial plants. Several indicators such as biodiversity, species richness and habitat suitability can be used to assess the physical condition of the ecosystem. Therefore, assessing the population dynamics of local plants and wildlife communities including terrestrial birds can measure the health of terrestrial ecosystem as well as its population. Physical settings of the existing ecosystem may be changed e.g. terrestrial’s communities due to bank protection of river. So the terrestrial ecosystem was considered as one of the IEC.

7.6.2 Aquatic Ecosystem

338. Aquatic ecosystems provide support not only to aquatic inhabitants but also supply the vital ingredients to terrestrial ecosystems. Unlike terrestrial ecosystems, any impact on aquatic system is generally not confined to local area, it also cover the surrounding areas. Change in flow regime of water in the study area will change the habitat suitability for resident plants, aquatic birds and wildlife, niche etc. That is why aquatic ecosystem is considered as an IEC of this project.

7.6.3 Floral Composition and Diversity

339. Composition and floral diversity of khal, beel, homestead and crop field vegetations are sensitive to hydro-morphological condition of its habitats. The impact of the proposed bank protection activities would change the hydro-morphological condition of river and would change the floral composition and diversity both on terrestrial and aquatic in the study area. Hence, the floral composition and diversity was considered anIESC.

7.6.4 Faunal Composition and Diversity

340. Developing of bank protection activities might have impacts on faunal composition and diversity both on terrestrial and aquatic faunas. This IEC was selected to identify and evaluate the potential impacts on terrestrial and aquatic fauna for this project.

7.7 Socio-Economic Condition

7.7.1 Land Acquisition

341. Land will have to be acquired for implementation of the bank protection work. So, land acquisition was selected as anIESC for the proposed erosion protection activity.

7.7.2 Income Generation

342. Project interventions could increase employment opportunities in agriculture and fishery sectors as well as in the field of non-agricultural trades. Therefore, income generation was selected as anIESC.

7.7.3 Communications

343. One of the objective of bank protection work is to save embankments from river erosion and the outcome of the project will protect this embankment from erosion and the road over the right embankment which is a major road for communication in that area and will not be affected further because of erosion and will serve the communication purpose of the local people. Therefore, communication was selected as an IESC.

7.7.4 Poverty

344. People can cultivate the agricultural lands by the side of the river and thus the production will be increased. Food securities of the local people will be ensured by producing more crops in the protected agricultural lands. Thus, poverty was selected as anIESC.

8. Impact Assessment and Mitigation Measures

8.1 Categorization and Quantification

345. The Important Environmental Components (IECs) for the project have been selected and validated in Chapter 7. Following the analyses of all the secondary information available, major field investigation were conducted in May 2013, by a multidisciplinary team of experts from CEGIS. The information collected from that field visit was analyzed in order to assess and evaluate the impacts of each previously selected IEC. This chapter contains the details on impact assessment and evaluation for the implementation of the project.

346. The impact assessment concentrates on the Tranche-1 project but also prepares for aspects that will be addressed during later tranches, as part of the whole program[28]. Impacts distinguish between the impacts of restoring the eroded Brahmaputra Right Embankment at the JRB-1 subproject and building riverbank protection at critically eroding locations at all three sub-project sites. This work could provide the foundation for more systematic riverbank stabilization work covering river reaches of several ten kilometers in length. The stabilization of first river reaches can be expected to have larger impacts than the limited riverbank protection planned under Tranche-1. Consequently, tranche-1 incorporates investigations into suitable stabilization solutions, minimizing potential impacts of larger scale river stabilization, and suggesting appropriate mitigation measures for successive tranches. Expected impacts (from literature) and mitigation measueres associated with the 9-year program are summarized at the end of this chapter.

347. An attempt has been made to evaluate the impacts with and without mitigation measures by assigning numerical scores. The scores have been assigned using expert level judgments of the study team. The impacts and mitigation measures distinguish pre-construction, construction, and post construction phases and are detailed for the following five resource categories:

- Physical and Water Resources
- Land Resources
- Agriculture Resources
- Fisheries Resources
- Ecological Resources
- Socio-economic Resources

348. The level of impact has been assessed as follows:

Negative Impact (-); Positive Impact (+);

No impact (0);
Low Impact (1-3);
Medium Impact (4-6);
High Impact 7-8;
Very High Impact (9-10).

[28] The program, in ADB's terminology consists of three individual loans, referred to as Tranche-1, Tranche-2 and Tranche-3. Each tranche is an individual project, with work at different subproject sites, covering the three priority subprojects JRB-1, JLB-2, and PLB-1, but not being limited to them.

349. Fish production estimates are based on the following figures:

Habitat Category	Habitat Type	Production rate kg/Ha	Total Production
Capture	River	150	Area x Production rate
	Khal	151	
	Beel	574	
	Kol	1440	
	Floodplain	200	
Culture	Fish pond	2790	

(Source: Fisheries Statistical Year Book of Bangladesh 2010-2011,Department of Fisheries, Ministry of Fisheries and Livestock).

350. Annual Crop production has been calculated as follows:
Baseline Situation:

Sl. No.	Crop	Area (ha)	Damage-free			Damaged			Total production (Tons)
			Area (Ha)	Yield (t/ha)	Production (Tons)	Area (Ha)	Yield (t/ha)	Production (Tons)	
1	Local Aus	8,080	6,060	1.4*	8,526	2,020	0.7*	1,353	9,880
2	HYV Aus	11,026	7,718	1.7*	10,860	3,308	1.2*	2,216	12,213
3	Jute	16,332	13,066	2.4	18,383	3,266	1.5*	2,188	19,737
4	Maize	7,193	7,193	6.5	10,121	-	-	-	11,474
5	Vegetables	3,450	2,588	14	3,641	863	8	578	4,994
6	Sesame	4,650	4,650	0.95	6,543	-	-	-	7,896
Kharif-1 Total:		***50,731***	**41,274**		**58,073**	**9,457**		**6,336**	**59,426**
7	Mixed Aus-Aman	8,540	8,540	0.80*	12,016	-	-	-	12,016
8	B. Aman	29,841	19,397	0.85*	27,291	10,444	0.7*	7,697	28,644
9	HYV Aman	39,185	23,511	2.1*	33,080	15,674	1.3*	11,552	34,433
10	Local Aman	23,751	17,813	1.3*	25,063	5,938	0.8*	4376	26,417
Kharif-2 Total:		***101,317***	**69,261**		**97,450**	**32,056**		**23,625**	**98,803**
11	HYV Boro	119,024	101,170	4.0*	142,347	17,854	2*	35,886	143,700
12	Local Boro	605	605	1.9*	851	-	-		851
13	Wheat	7,040	7,040	2.4	9,905	-	-		9,905
14	Potato	1,500	1,500	15	2,111	-	-		2,111
15	Mustard	14,415	14,415	0.96	20,282	-	-		20,282
16	Pulses	25,031	25,031	1	35,219	-	-		35,219
17	Spices	12,563	12,563	4.6	17,676	-	-		17,676
18	Ground nut	2,873	2,873	1.5	4,042	-	-		4,042
Rabi Total:		***183,051***	**165,197**		**232,433**	**17,845**		**35,886**	**233,786**
Total Cropped Area		**335,099**	**275,733**			**59,358**			

Souce: CEGIS field information and consultation with DAE;*Indicates cleaned rice

"Without Project" Situation (WOP) at the end of the project (5 years from now)

Sl. No.	Crop	Area (ha)	Damage-free			Damaged			Total production (Tons)
			Area (Ha)	Yield (t/ha)	Production (Tons)	Area (Ha)	Yield (t/ha)	Production (Tons)	
1	Local Aus	7,478	4,487	1.2	5,384	2,991	0.65	1,944	7,328
2	HYV Aus	10,197	5,608	1.5	8,413	4,589	1	4,589	13,001
3	Jute	15,126	8,319	2.2	18,302	6,806	1.2	8,168	26,470
4	Maize	6,628	6,590	6	39,540	-	-	-	-
5	Vegetables	3,569	2,141	12	25,696	1428	8	11421	37,117
6	Sesame	4,249	4,225	0.85	3,591	-	-	-	-
	Kharif-1 Total:	***47,246***	**31,370**		**100,926**	**15,814**		**26,121**	**83,916**
7	Mixed Aus-Aman	7,818	7,818	0.75	5,864	-	-	-	5,380
8	B. Aman	27,362	17,785	0.75	13,339	9,577	0.65	6,225	19,564
9	HYV Aman	34,840	19,162	2	38,324	15,678	1.1	17,246	55,569
10	Local Aman	21,754	14,140	1.1	15,554	7,614	0.75	5,710	21,264
	Kharif-2 Total:	***91,773***	**58,905**		**73,080**	**32,868**		**29,181**	**101,777**
11	HYV Boro	109,788	82,341	3.8	312,895	27,447	1.5	41,170	354,065
12	Local Boro	510	507	1.7	862	-	-	-	862
13	Wheat	6,458	6,422	2.2	14,128	-	-	-	14,128
14	Potato	1,360	1,352	12	16,224	-	-	-	16,224
15	Mustard	13,256	13,181	0.9	11,863	-	-	-	11,863
16	Pulses	22,943	22,813	0.95	21,672	-	-	-	21,672
17	Spices	11,557	11,491	4.2	48,262	-	-	-	48,262
18	Ground nut	2,719	2,704	1.4	3,786	-	-	-	3,786
	Rabi Total:	***168,590***	**140,811**		**429,692**	**27,291**		**40,937**	**470,862**
Total Cropped Area		**307,610**	**231,086**		**603,698**	**75,973**		**96,239**	**699,938**

Souce : CEGIS field information and consultation with DAE;*Indicates cleaned rice

With Project Situation (WIP)- at project completion (5 years from now)

Sl. No.	Crop	Area (ha)	Damage-free			Damaged			Total production (Tons)
			Area (Ha)	Yield (t/ha)	Production (Tons)	Area (Ha)	Yield (t/ha)	Production (Tons)	
1	Local Aus	10,666	10,133	1.5	15,199	533	0.95	507	15,706
2	HYV Aus	14,554	13,826	1.8	24,887	728	1.4	1,019	25,906
3	Jute	21,558	20,480	2.5	51,200	1,078	1.8	1,940	53,140
4	Maize	9,495	9,495	6.8	64,566	-	-	-	-
5	Vegetables	1,518	1,442	15	21,632	76	10	759	22,391
6	Sesame	6,138	6,138	1	6,138	-	-	-	-
	Kharif-1 Total:	***63,929***	**61,514**		**183,622**	**2,415**		**4,225**	**117,143**
7	Mixed Aus-Aman	6,543	6,543	0.95	6,216	-	-	-	6,216
8	B. Aman	24,427	23,206	0.9	20,885	1,221	0.8	977	21,862
9	HYV Aman	61,192	58,132	2.2	127,891	3,060	1.4	4,283	132,175
10	Local Aman	22,097	20,992	1.4	29,389	1,105	0.9	994	30,383
	Kharif-2 Total:	***114,259***	**108,873**		**184,381**	**5,386**		**6,255**	**190,636**
11	HYV Boro	112,171	106,562	4.1	436,906	5,609	2.2	12,339	449,245
12	Local Boro	605	605	2	1,210	-	-	-	1210
13	Wheat	9,293	9,293	2.5	23,233	-	-	-	23,233
14	Potato	1,980	1,980	18	35,640	-	-	-	35,640
15	Mustard	19,028	19,028	1	19,028	-	-	-	19,028
16	Pulses	20,092	20,092	1.2	24,110	-	-	-	24,110
17	Spices	13,598	13,598	4.8	65,270	-	-	-	65,270
18	Ground nut	3,792	3,792	1.8	6,826	-	-	-	6,826
	Rabi Total:	***180,559***	**174,950**		**612,223**	**5,609**		**12,339**	**624,562**
Total Cropped Area		**358,747**	**345,338**		**980,226**	**13,409**		**22,818**	**1,003,045**

Souce: CEGIS field information and consultation with DAE;*Indicates cleaned rice

351. Mitigation measures are included in the following tables to allow the direct comparison of the scoring of impacts and after mitigation measures for the five resource categories. Mitigation measures for future potential impacts will be worked out during subsequent studies, as outlined at the end of this chapter.

8.2 Climate Change

352. Climate change is believed to impacts on the river and floodplains in two ways: (i) the discharges in the rivers will increase, which potentially means higher river instability and increased flooding, and (ii) the sea level rise will result in flatter river slopes, potentially leading to more flooding and substantial river adjustment processes. Based on modeling results for A1F1 scenario , discharges in the main rivers are expected to increase between 6 and 15% for moderate and average flood events by 2040 (see main reports, section 2.4 and IWM, 2008). The increase in discharge might be offset by increased water storage for hydro-power generation. Overall there is a risk that

inundation depths will increase for the without project scenario. The second potential climate change impact on the sea level is not expected to influence the program area within the design life (30-years). River adjustment processes related to an increase in sea levels work upstream over decades or centuries and do not have a direct impact.

353. The program addresses climate change in several ways: Increases in discharge only result in small increases in water levels in the rivers, first due to the vast expanse of the river system and secondly because alluvial rivers can cope with increased discharges by adusting their bed within a short time (refer for example to the Padma Bridge Study). . Higher flow velocities could potentially lead to increased scouring and deeper channels . The embankments are setback from the river bank. Furthermore, embankment designs (See figure 4.3 for typical cross section) follow best international practice providing road access along the top of the embankment and the opportunity to raise embankments later in response to climate change requirements within the typical construction width applied in Bangladesh. This means that design levels for embankment do not need to be raised (also given the large freeboard). The riverbank protection is built in an adaptive manner which allows adjustments in terms of river depth and location as and when required.

8.3 Physical and Water Resources

8.3.1 Construction Phase

Jamuna Right Bank 1						
Activity: Construction of labor shed, stock yard and construction camp, mobilization of labor, materials, equipment and other machineries, construction of CC blocks at site.						
Air quality	- Possible locations of labor shed (Dombarla, Locha, Dorta Mehi, Jagtala, Gopalpur mauzas); stock yard (to be selected by the Engineer in Charge) and site of CC block construction (Benotia Mauza). - Road side places used for transportation of materials (Kaijuri-shahjadpur road and the rural roads from Hat panchil to barnia mauzas and from Nagardala to Shelachapri mauzas).	Air quality is good as no dust is generated at present.	Minor impact may occur from the small amount of dust generated due to movement of vehicles, construction materials and machineries; construction of labor shed and stock yard; preparation of CC block at site.	-2	- Construction materials should be covered with thick materials (i.e. polythene) during transportation. - Water to be sprinkled to control the generation and spreading of dust; as and where required.	-1
Noise	- Possible locations of labor shed (Dombarla, Locha, Dorta Mehi, Jagtala, Gopalpur mauzas), stock yard (to be selected by the Engineer in Charge), site of CC block construction (Benotia Mauza). - Road side places through which construction materials would be transported (Kaijuri-shahjadpur road and the rural roads from Hat panchil to barnia mauzas and Nagardala to Shelachapri mauzas).	Sound is within tolerable limit, No significant source of noise found.	Low impacts caused due to noise generation for mobilization of construction materials and construction of labor shed, stockyard and CC blocks.	-2	- Noise levels due to vehicular movement are to be kept within permissible limit. - Construction camps, labor shed, and sites for CC blocks construction are to be located far away from settlements	-1

<table>
<tr><th>IEC</th><th>Location</th><th>Baseline condition</th><th>Impacts</th><th>Magnitude of Impact*</th><th>Mitigation Measure</th><th>Magnitude with EMP*</th></tr>
<tr><td colspan="7">Jamuna Left Bank-2 (JLB-2)</td></tr>
<tr><td colspan="7">Activity: Construction of labor shed with water and sanitation facilities, garbage disposal system, construction of stock yard and construction camp, labor and material/equipment mobilization</td></tr>
<tr><td>Air quality</td><td>- Possible locations of labor camps (Char Jajuria and Khashkaulia mauzas at Chauhali and Char Raghunathpur at Jafarganj).
- Location of stock yard (to be selected by the Engineer In Charge).
- Location of CC blocks construction (Khashkaulia mauza at Chauhali and Raghunathpur mauza at Jafarganj).</td><td>Air quality is good. No dust is generated at present.</td><td>Small amount of dust would be generated during movement of vehicles, construction materials and machineries; construction of labor shed and CC block.</td><td>-2</td><td>- Construction materials to be covered with thick materials i.e. polythene during transportation.
- Water to be sprinkled to control the generation and spreading of dust; as and where needed.</td><td>-1</td></tr>
<tr><td>Noise</td><td>- Possible locations of labor shed (Char Jajuria and Khashkaulia mauzas at Chauhali and Char Raghunathpur at Jafarganj).
- Location of stock yard (to be selected by the Engineer In Charge).
- Location of CC blocks construction (Khashkaulia mauza at Chauhali and Raghunathpur mauza at Jafarganj).
- Roadside locations to be used during material transportation (Char Jajuria, Khashkaulia mauzas at Chauhali and Raghunathpur and Paila mauzas at Jafarganj)</td><td>Sound is within tolerable limit, No significant source of noise found.</td><td>Low impacts caused due to noise generation due to mobilization of construction materials and construction of labor shed, stockyard and CC blocks. There is a high school and an upazilla office at the construction site of Chauhali and one primary school at Jafarganj which would face minor impacts due to noise generation.</td><td>-2</td><td>- Noise levels due to vehicular movement are to be kept within permissible limit.
- Construction camps, labor shed, and sites for CC blocks construction are to be located far away from settlements, school, offices.</td><td>-1</td></tr>
</table>

IEC	Location	Baseline condition	Impacts	Magnitude of Impact*	Mitigation Measure	Magnitude with EMP*
Padma Left Bank-1 (PLB-1)						
Activity: Construction of labor shed with water and sanitation facilities, garbage disposal system, construction of stock yard and construction camp, labor and materials/equipment mobilization						
Air quality	- Possible locations of labor camps (Ramkrishnapur and Andarmanik mauzas) - Location of stock yard (to be selected by the Engineer In Charge), - Location of CC block construction (Andarmanik mauza) - Roadside locations to be used in carrying construction materials (Harirampur-Rathora road; Andarmanik and Ramkrishnapur mauzas)	Air quality is good. No dust is generated at present.	Small amount of dust generation during movement of vehicles, construction materials and machineries, construction of labor shed and CC blocks.	-2	- Construction materials to be covered with thick materials i.e. polythene during transportation - Water to be sprinkled to control the generation and spreading of dust; as and where needed	-1
Activity: Construction of labor shed and construction camp; labor and materials/equipment mobilization						
Noise	- Possible locations of labor camps (Ramkrishnapur and Andarmanik mauzas) - Location of stock yard (to be selected by the Engineer In Charge), - Location of CC block construction (Andarmanik mauza) - Roadside locations to be used in carrying construction materials (Harirampur-Rathora road; Andarmanik and Ramkrishnapur mauzas)	Noise level is within permissible standard	Minor impact would be generated due to the construction of CC block, labor shed, stock yard and mobilization of materials.	-2	- Noise levels are to be kept within permissible standard	-1

8.3.2 Construction Phase

IEC	Location	Baseline condition	Impacts	Magnitude of impact*	Mitigation Measure	Magnitude with EMP*
Jamuna Left Bank-1 (JLB-1)						
Activity: Excavation of earth materials from the location of embankment; dredging of soil from the Jamuna River; dumping of earthen materials on the embankment; embankment surface lavelling and compaction through mechanical equipment; movement of vehicles for carrying materials.						
Air quality	- Places adjacent to the Jamuna River bank where the new embankment would be constructed (from Hat Panchil to Benotia mauzas). - Places adjacent to the existing embankment of the Baral river (from Verakhola to Dambarla mauzas). - At Benotia where the bank protection works is to be carried out. - Road side places through which transportation of construction materials would be carried out (Kaijuri-shahjadpur road and rural roads from Hat panchil to barnia mauzas and Nagardala to Shelachapri mauzas).	Air quality is good.	Minor amount of dust may be generated during excavating and dumping of earth materials, surface leveling with dumping machine and vehicular movements.	-3	Water to be sprinkled on regular intervals, as and where required.	-2
Noise	- Road side places for transportation of construction materials (Kaijuri-shahjadpur road and rural roads from Hat panchil to barnia mauzas and Nagardala to Shelachapri mauzas). - Location of embankment (from Kaijuri to Karatoya offtake)	Sound is within tolerable limit, No significant source of noise found.	Low impacts would be caused during excavation and dredging of soil and vehicular movements.	-2	- Noise levels due to vehicular movement, excavation and dredging activities are to be kept within permissible limit.	-1
Activity: Dredging of earth materials from the Jamuna Rivers; placing of geo-bags and CC blocks on the river banks; construction of sluices, disposal of waste generated from the labor shed.						
Surface	- Jamuna River (from Hat Panchil to Benotia	Aesthetic	The surface water quality might	-4	- Dredged spoil should be	-1

IEC	Location	Baseline condition	Impacts	Magnitude of impact*	Mitigation Measure	Magnitude with EMP*
water quality	mauzas) and Baral River (from Verakhola to Dambarla mauzas). - Possible locations of construction of drainage sluices	quality of river water is good.	be affected due to the disposal of waste generated from the labor shed into the river. Additionally, minor quantity of sediments would be generated in the rivers during dredging of soil from river bed, which would temporarily hamper the aesthetic quality of river water.		carefully dealt with. - Proper waste disposal system is to be implemented. - Dredging sites will be selected such as it does not cause erosion downstream , will exclude spawning areas, and dredging will be conducted during dry season.	
Activity: Rehabilitation of embankment						
Drainage congestion	- Hurasagar river	Drainage characteristics are good at present	Low impact may occur due to the rehabilitation of embankment blocking the Hurasagar offtake. The river has two mouths at present, meeting the Baral river and blocking any one of these might stress the drainage characteristics of the other.	-2	- Constructing a sluice at one of the two channel mouths. (Currently there is a sluice at one of the two mouths of Hurasagar river, which will be rehabilitated and extended, another sluice will be built at the Jamuna.).	-1

IEC	Location	Baseline condition	Impacts	Magnitude of impact*	Mitigation Measure	Magnitude with EMP*
Jamuna Left Bank-2 (JLB-2)						
Activity: Movement of vehicles for carrying earth materials						
Air quality	Places along the left bank of the Jamuna river where bank protection works would be carried out (Char janjira, Khasdalai, Atapara, Khash kaulia mauzas at Chauhali upazilla and Char	Air quality is good	Small amount of dust generated due to movement of vehicles and construction materials.	-2	Water to be sprinkled on the roads at regular intervals.	-1

IEC	Location	Baseline condition	Impacts	Magnitude of impact*	Mitigation Measure	Magnitude with EMP*
	pailadhusar, Raghunathpur, Banghabari and Paila mauzas at Jafarganj of Shibalaya upazilla)					
Activity: Waste disposal, generated from the labor shed						
Surface water quality	Possible locations of labor shed (Char Janjira and Khashkaulia mauzas at Chauhali and Char raghunathpur at Jafarganj).	Aesthetic quality of water is good	Impacts can be generated due to improper disposal system which may eventually contaminate the water of Jamuna River.	-4	Proper waste disposal system, not interfering with the Jamuna river flow.	-1

IEC	Location	Baseline condition	Impacts	Magnitude of impact*	Mitigation Measure	Magnitude with EMP*
Padma Left Bank-1(PLB-1)						
Activity: Movement of vehicles for carrying earth materials; placing of geo-bags; temporary slope pitching with geobags						
Air quality	Places along the left bank of the Padma river, where bank protection works would be carried out (Ram krishnapur, Andarmanik and Boyra mauzas of Harirampur upazilla).	Air quality is good.	Minor amount of dust generation during placing and dumping of Geo-bags; temporary slope preparation and geobag laying, and movement of vehicles and construction materials.	-2	Water to be sprinkled as and where needed.	-1
Activity: Waste disposal from the labor sheds.						
Surface water quality	- Possible locations of labor camps (Ramkrishnapur and Andarmanik mauzas)	Aesthetic quality of water is good	Impacts can be generated due to improper disposal system which may eventually contaminate the water of Padma River.	-4	Proper waste disposal system, not interfering with the padma river flow.	-1

8.3.3 Post-Construction Phase

IEC	Location	Baseline condition	FWOP	FWIP	Impacts	Magnitude of impact*	Mitigation Measure	Magnitude with EMP*
Jamuna Left Bank-1 (JLB-1)								
Erosion	Location adjacent	Severe erosion at	Erosion along the	Bank erosion will be	Savings in	+6	N/A	N/A

IEC	Location	Baseline condition	FWOP	FWIP	Impacts	Magnitude of impact*	Mitigation Measure	Magnitude with EMP*
	to the bank protection work (Benotia mauza)	Benotia mauza, along the right bank of Jamuna River. Each year, approximately 200 hectars of land are eroded by the Jamuna river, at and near Benotia mauza	bank of Jamuna river will continue to propagate inside Shahjadpur. Without the project, in ten years, approximately 2,000 hectors of land would be eroded.	protected; roads and other valuable infrastructures, agricultural lands and settlements would be saved from erosion.	agricultural lands and settlements would take place. Roadway communication will be established along the Jamuna river.			
Drainage congestion	Karatoya and Hurasagar rivers, which drain out water from the sub reach to the Baral and Jamuna rivers.	The entire sub-reach is of high topography, with elevations ranging from 8 to 10 meters. As such, water drain out quickly from the area after of rainfall.	The area will be free from drainage congestion problems.	Drainage congestion problems might occur as water may be entrapped in the area due to the construction of new embankment.	Low impact may be generated as the conveyance capacity of internal rivers and lakes will be stressed, resulting in drainage congestion problems.	-1	Provision of sluices at the mouth of Hurasagar river, and places where required.	0
Flood	Entire sub reach (especially near the location of embankment works i.e. from Hat Panchil to Benotia mauzas and from Verakhola to Dambarla mauzas).	The area is susceptible to regular flooding. The existing values of Reduced Level (RL) near the river banks are within 6 to 8 meters and the same in the entire sub reach is around 8-10 meters. Regular flood level is around 8-9 meters and each year, around 80-90% of the entire sub reach area gets inundated. Average duration of flood is 30-45 days.	Regular damage due to flood will keep affecting the socio-economic status of the local people. The farmers would not be able to practice Aman cropping in the wet season. Regular monsoon flooding will affect the communication system as well.	Flooding would be reduced near the banks by a considerable margin. The tranche 1 of the project only entails embankment rehabilitation works from Verakhola to the Karatoya offtake (Dambarla mauza). However there is no embankment at present from the Nagardala-Ratankandi bridge to the Karatoya offtake (there used to be an embankment which has	The improvement in regular flooding would be around 30% in the entire sub-reach. This would lead to a better control in both irrigation and social status of the people in the subreach.	+5	N/A	N/A

IEC	Location	Baseline condition	FWOP	FWIP	Impacts	Magnitude of impact*	Mitigation Measure	Magnitude with EMP*
				been eroded in the flood of 1998). This embankment breach covers a total length of 7 kilometers through which significant water would enter during flood. However, the new embankment along the Jamuna right bank and embankment rehabilitation along the Baral river would result in around 30% improvement of flooding whereas almost 80-90% improvement would have been achieved if the embankment rehabilitation works at ratankandi (in tranche-2) would be carried out in tranche-1				
Water Availability and Use	Agricultural lands near the possible location of regulators and sluices.	Due to regular flooding in monsoon, farmers cannot practice monsoon cropping in their fields.	Farmers will not be able to undergo Aman cropping in future; this would result in increased socio-economic losses.	Farmers would have a better control on surface water and as such, they can use water for irrigation during monsoon.	The socio-economic status of the farmers would be enhanced due their increased chances of practicing Aman crops	+3	N/A	N/Asian Development BankAsian Development Bank

**No impact (0); Negative Impact (-); Positive Impact (+); Low Impact (1-3); Medium Impact (4-6); High Impact 7-8; Very High Impact (9-10).*

IEC	Location	Baseline condition	FWOP	FWIP	Impacts	Magnitude of impact*	Mitigation Measure	Magnitude with EMP*

IEC	Location	Baseline condition	FWOP	FWIP	Impacts	Magnitude of impact*	Mitigation Measure	Magnitude with EMP*
Jamuna Left Bank-2 (JLB-2)								
Erosion	- From Atapara to Khash kaulia mauzas at Chauhali upazila - From Gangadia to the end of Paila mauzas at Jafarganj of Shibalaya upazila	Severe erosion at both Chauhali and Shibalaya upazilas, at the left bank of Jamuna River. Each year, approximately 1400 hectors of land in total are eroded in these locations (1000 ha at Chauhali and 400 ha at Shibalaya)	Erosion along the bank of Jamuna river will continue to propagate inside the sub reach, destroying various places under both Chauhali and Shibalaya upazilas. In a period of ten years, around 14,000 hectors of land would be eroded in the entire sub reach if no protective works are carried out immediately. Loss of livelihoods, assets and infrastructures would occur.	River banks will be protected. Roads and other infrastructures, agricultural lands and settlements would be saved from erosion.	Massive impact to the livelihood of the local people. Due to the bank protection works at Chauhali and Jafarganj, huge amount of agricultural lands and settlements will be saved. Communication facilities will be re-established over the left bank of Jamuna river.	+8	N/A	N/A

**No impact (0); Negative Impact (-); Positive Impact (+); Low Impact (1-3); Medium Impact (4-6); High Impact 7-8; Very High Impact (9-10).*

IEC	Location	Baseline condition	FWOP	FWIP	Impacts	Magnitude of impact*	Mitigation Measure	Magnitude with EMP*
Padma Left Bank-1 (PLB-1)								
Erosion	Ram krishnapur, Andarmanik and Boyra mauzas of Harirampur upazilla	Harirampur upazilla undergoes erosion /accretion features every year. Generally, in every each year around 300 ha of lands are eroded.	Erosion along the left bank of Padma river will continue to through the Harirampur upazilla. In about ten years' time, around 3,000 hectors of land would be eroded if the project is not implemented. Huge amount of agricultural lands, settlements, roads will be	River bank erosion protection would save existing roads and other assets/ infrastructures; agricultural lands and settlements would also be saved from erosion.	Huge impacts in the impacted area. River Bank protection work at Harirampur will save agricultural lands and settlements. Communication system will be enhanced. The economic status of livelihood would improve.	+7	N/A	N/A

IEC	Location	Baseline condition	FWOP	FWIP	Impacts	Magnitude of impact*	Mitigation Measure	Magnitude with EMP*
			eroded.					
Flood	Ram krishnapur, Andarmanik and Boyra mauzas of Harirampur upazilla.	The area undergoes regular monsoon flooding as the area is relatively low, with average RLs near the river banks ranging between 2-4 meters. Around 20-30% of the area gets inundated each year for 1~2 months.	Regular flooding will affect the socio-economic status of local people as the farmers would be unable to cultivate Aman in monsoon. The communication system of the area will aggravate as well.	The risk of embankment breaches would be reduced to some extent near the left bank of the Padma river at Harirampur.	Minor impact in flooding. The improvement in regular flooding would be around 5%.	+3	N/A	N/A

**No impact (0); Negative Impact (-); Positive Impact (+); Low Impact (1-3); Medium Impact (4-6); High Impact 7-8; Very High Impact (9-10).*

8.4 Land Resources

8.4.1 Pre-Construction Phase

IEC	Location	Baseline condition	Impacts	Magnitude of impact*	Mitigation Measure	Magnitude with EMP*
Jamuna Right Bank-1 (JRB-1)						
Activity	***Construction of labor sheds, stocking yard with CC block preparation yard for Embankment Rehabilitation activities***					
Land loss	Location-1: Dombaria (Baghabari towards Shahzadpur-6.5km)	About 1.04 ha of land	About 1.04 ha of existing embankment area would be used temporarily	0	• Construction of labor sheds and stocking yard in existing embankment so that the agri. land would not be lost. • Constructing materials of the protective works should be stored in such a manner that the agriculture lands and standing crops would not be damaged. • Area for executing construction activities, storage of construction materials, labor sheds, and other project related activities should be optimized with the purpose of minimum disruption to cultivable lands and standing crops. • The contractor should ensure that no vehicular movements would	+1
	Location-2: Lochha (Shahzahdpur-Korotoa bank-	About 1.08 ha of land	About 1.08 ha of existing embankment area would be used temporarily	0		+1

IEC	Location	Baseline condition	Impacts	Magnitude of impact*	Mitigation Measure	Magnitude with EMP*
	4.0km)				take place inside cultivation fields. • The contractor should maintain liaison with communities (WMOs) for better performance.	
	Sub-total	**2.12 ha**				
Activity	***Construction of labor shed and stocking yard for construction of new embankment activities***					
Land loss	Location-1: Gopalpur (Kaizuri-Hura sagar offtake-10.5km)	About 1.02 ha of land	About 1.02 ha of agricultural land would be lost temporarily	-1	• Construction of labor sheds and stocking yard preferably is constructed in khas/fallow land. • Constructing materials of the new embankment should be stored in such a manner that the agriculture lands and standing crops would not be damaged. • Area for executing construction activities, storage of construction materials, labor sheds and other project related activities should be optimized with the purpose of minimum disruption to cultivable lands and standing crops. • In cases where the disruption to farming becomes unavoidable, adequate cash compensation should be provided to the land owners. /share croppers. • Exact amount of compensation should be determined based on the amount of land temporarily going out of cultivation. • The rate should be decided on the basis of the crop usually grown on the pieces of land. • The contractor should ensure that no vehicular movements would take place inside cultivation fields. • The contractor should maintain liaison with communities (WMOs) for better performance.	+1
	Location-2: Jagtala Kaizuri-Benotia-2.0km)	About 1.04 ha of land	About 1.04 ha of agricultural land would be lost temporarily	-1		+1
	Location-3: Doriamehi (Hura sagar – Baghabari-6.0km)	About 1.0 ha of land	About 1.0 ha of agricultural land would be lost temporarily	-1		+1
	Sub total	**3.06 ha**				
Activity	***Construction of labor sheds, stocking yard and CC block preparation yard for Bank Protective activities***					
Land loss	Location-1: (Benotia-2.0km)	About 1.0 ha of land	About 1.0 ha of agricultural land would be lost temporarily	-1	• Construction of labor sheds and stocking yard preferably be done in khas/fallow land. • Constructing materials of the protective works should be stored in such a manner that the agriculture lands and standing crops would not be damaged. • Area for executing construction activities, storage of construction materials, labor sheds, and other project related activities should	+1

IEC	Location	Baseline condition	Impacts	Magnitude of impact*	Mitigation Measure	Magnitude with EMP*
					be optimized with the purpose of minimum disruption to cultivable lands and standing crops. • In cases where the disruption to farming becomes unavoidable, adequate cash compensation should be provided to the land owners. /share croppers. • Exact amount of compensation should be determined based on the amount of land temporarily going out of cultivation. • The rate should be decided on the basis of the crop usually grown on the pieces of land. • The contractor should ensure that no vehicular movements would take place inside cultivation fields and would maintain liaison with communities (WMOs) for better performance.	
	Sub total	**1.0ha**				
Jamuna Left Bank (JLB-2)						
Activity	***Construction of labor sheds, stocking yard and CC block preparation yard for Bank Protective activities***					
Land loss	Location-2: (Chauhali-5.0km)	About 1.02ha of land	About 1.02 ha of agricultural land would be lost temporarily.	-1	• Construction of labor sheds and stocking yard preferably is made in khas/fallow lands. • Constructing materials of the protective works should be stored in such a manner that the agriculture lands and standing crops would not be damaged. • Area for executing construction activities, storage of construction materials, labor sheds, and other project related activities should be optimized with the purpose of minimum disruption to cultivable lands and standing crops. • The contractor should ensure that no vehicular movements would take place inside cultivation fields. • The contractor should maintain liaison with communities (WMOs) for better performance.	+1
	Location-3: (Bachamara-2.0km)	About 1.01 ha of land	About 1.01 ha of agricultural land would be lost temporarily.	-1		+1
	Sub total	**2.03ha**				
Padma Left Bank (PLB-1)						
Activity	***Construction of labor sheds and bag-filling yard for Bank Protective activities***					
	Location-4: (Harirampur-	About 1.04 ha of land	About 1.04 ha of char land/ agricultural land	-1	• Construction of labor sheds and stocking yard preferably is made in khas/fallow lands.	+1

IEC	Location	Baseline condition	Impacts	Magnitude of impact*	Mitigation Measure	Magnitude with EMP*
	7.0km)		would be lost temporarily.		• Constructing materials of the protective works should be stored in such a manner that the agriculture lands and standing crops would not be damaged. • Area for executing construction activities, storage of construction materials, labor sheds, and other project related activities should be optimized with the purpose of minimum disruption to cultivable lands and standing crops. • The contractor should ensure that no vehicular movements would take place inside cultivation fields. • The contractor should maintain liaison with communities (WMOs) for better performance.	
	Sub total	**1.04ha**				
Jamuna Right Bank (JRB-1)						
Activity	***Construction of labor sheds and stocking yard for construction of drainage sluices activities***					
Land loss	Location-1: (Not fix up)	About 0.05ha of land	About 0.05 ha of agricultural land would be lost temporarily	-1	• Construction of labor sheds and stocking yard preferably is made in khas/fallow lands. • Constructing materials of the protective works should be stored in such a manner that the agriculture lands and standing crops would not be damaged. • Area for executing construction activities, storage of construction materials, labor sheds, and other project related activities should be optimized with the purpose of minimum disruption to cultivable lands and standing crops. • The contractor should ensure that no vehicular movements would take place inside cultivation fields. • The contractor should maintain liaison with communities (WMOs) for better performance.	+1
	Location-2: (Not fix up)	About 0.08ha of land	About 0.08ha of agricultural land would be lost temporarily	-1		+1
	Location-3: (Not fix up)	About 0.08ha of land	About 0.08ha of agricultural land would be lost temporarily	-1		+1
	Sub total	**0.21ha**				
	Grand total	**9.46 ha**				

8.4.2 Construction Phase

IEC	Location	Baseline condition	Impacts	Magnitude of impact*	Mitigation Measure	Magnitude with EMP*
Jamuna Right Bank-1						
Activity	***Collection and disposal of constructing materials for Embankment rehabilitation activities***					
Land loss	Location-3: Doriamehi (Hura sagar-Baghabari-6.0km)	About 0.6ha	About 0.6ha of agricultural land would be lost permanently	0	Top soil (0-15cm) should be managed properly for conserve the soil fertility. The filling /disposal materials should be collected preferably from river bed using sand pumped from dredger and excavator and clay collection from existing embankment.	+1
	Location-2: Lochha (Shahzahdpur-Korotoa bank-4.0km)	About 0.4ha of land		0	Area for executing construction and other project related activities should be optimized with the purpose of minimum disruption to cultivable lands and standing crops. Disposal of spoil/ constructing materials for bank rehabilitation work should preferably be place on existing embankment so that the new area might not be affected for growing crops. In cases where the disruption to farming becomes unavoidable, adequate cash compensation should be provided to the land owners. /share croppers. Exact amount of compensation should be determined based on the amount of land temporarily going out of cultivation. The rate should be decided on the basis of the crop usuallygrown on the pieces of land.	+1
	Sub total	**1.0 ha**				
Activity	***Collection and disposal of earth materials for construction of new embankment activities***					
Land loss	Location-1: Gopalpur (Kaizuri-Hura sagar offtake-10.5km)	About 1.05ha	About 1.05ha of agricultural land would be lost permanently.	-1	Top soil (0-15cm) should be managed properly for conserve the soil fertility. The filling /disposal materials should be collected preferably from river bed using sand pumped from dredger and excavator and clay collection from existing embankment.	+1
	Location-2: Jagtala	About 0.2ha	About 0.2ha of agricultural land would	-1	Area for executing construction and other project related activities	+1

IEC	Location	Baseline condition	Impacts	Magnitude of impact*	Mitigation Measure	Magnitude with EMP*
	Kaizuri-Benotia-2.0km)		be lost permanently		should be optimized with the purpose of minimum disruption to cultivable lands and standing crops. Disposal of spoil/ constructing materials for bank rehabilitation work should preferably be place on existing embankment so that the new area might not be affected for growing crops. In cases where the disruption to farming becomes unavoidable, adequate cash compensation should be provided to the land owners. /share croppers. Exact amount of compensation should be determined based on the amount of land temporarily going out of cultivation. The rate should be decided on the basis of the crop usually grown on the pieces of land.	
	Sub total	**1.25ha**				
Activity	***Collection and disposal of construction materials for bank protection activities***					
Land loss	Location-1: (Benotia-2.0km)	About 0.2ha of land	About 0.20 ha of land would be lost.	-1	Top soil (0-15cm) should be managed properly for conserve the soil fertility. The filling /disposal materials should be carried by dump truck and excavator for loading and unloading. Precautionary measure should be taken so that the dumping materials would not be spreading on agricultural land during carrying. Area for executing construction and other project related activities should be optimized with the purpose of minimum disruption to cultivable lands and standing crops. Disposal of spoil/ constructing materials for bank protective work should preferably be place on existing embankment so that the new area might not be affected for growing crops. In cases where the disruption to farming becomes unavoidable, adequate cash compensation should be provided to the land owners. /share croppers. Exact amount of compensation should be determined based on the amount of land temporarily going out of cultivation. The rate should be decided on the basis of the crop usually grown on the pieces of land.	+1

IEC	Location	Baseline condition	Impacts	Magnitude of impact*	Mitigation Measure	Magnitude with EMP*
	Sub total	**0.2ha**				
Jamuna Left Bank(JLB-2)						
Activity	***Collection and disposal of construction materials for bank protection activities***					
Land loss	Location-2: (Chauhali-5.0km)	About 0.5ha of land	About 0.5ha of land would be lost.	-1	Top soil (0-15cm) should be managed properly for conserve the soil fertility. The filling /disposal materials should be carried by dump truck and excavator for loading and unloading. Precautionary measure should be taken so that the dumping materials would not be spreading on agricultural land during carrying. Area for executing construction and other project related activities should be optimized with the purpose of minimum disruption to cultivable lands and standing crops. Disposal of spoil/ constructing materials for bank protective work should preferably be place on existing embankment so that the new area might not be affected for growing crops. In cases where the disruption to farming becomes unavoidable, adequate cash compensation should be provided to the land owners. /share croppers. Exact amount of compensation should be determined based on the amount of land temporarily going out of cultivation. The rate should be decided on the basis of the crop usually grown on the pieces of land.	+1
	Location-3: (Bachamara-2.0km)	About 0.2ha of land	About 0.2ha of land would be lost.	-1		+1
	Sub total	**0.7ha**				
Padma Left Bank(PLB-1)						
Activity	***Collection and disposal of Bank protection activities***					
Land loss	Location-4: (Harirampur-7.0km)	About 0.7ha of land	About 0.7ha of land would be lost for temporary protection.	-1	Top soil (0-15cm) should be managed properly for conserve the soil fertility. The filling /disposal materials should be carried by dump truck and excavator for loading and unloading. Precautionary measure should be taken so that the dumping materials would not be spreading on agricultural land during carrying. Area for executing construction and other project related activities should be optimized with the purpose of minimum disruption to	+1

IEC	Location	Baseline condition	Impacts	Magnitude of impact*	Mitigation Measure	Magnitude with EMP*
					cultivable lands and standing crops. Disposal of spoil/ constructing materials for bank protective work should preferably be place on existing embankment so that the new area might not be affected for growing crops. In cases where the disruption to farming becomes unavoidable, adequate cash compensation should be provided to the land owners. /share croppers. Exact amount of compensation should be determined based on the amount of land temporarily going out of cultivation. The rate should be decided on the basis of the crop usually grown on the pieces of land.	
	Sub total	**0.7ha**				
Jamuna Right Bank(JRB-1)						
Activity	***Disposal of dumping spoil for construction of drainage sluices***					
Land loss	Location-1: (Hurashagar outfall)	About 0.01ha of land	About 0.01ha of land would be lost	-1	The top soil (0-15cm) should be managed properly for conserving the soil fertility. Area for executing construction activities and other project related activities should be optimized with the purpose of minimum disruption to cultivable lands and standing crops. Disposal of spoil/ constructing materials for construction of drainage sluice should preferably be place on non agricultural land so that the new area might not be affected for growing crops. In cases where the disruption to farming becomes unavoidable, adequate cash compensation should be provided to the land owners. /share croppers. Exact amount of compensation should be determined based on the amount of land temporarily going out of cultivation. The rate should be decided on the basis of the crop usually grown on the pieces of land.	+1
	Location-2: (Hurashagar inlet)	About 0.02ha of land	About 0.02ha of land would be lost	-1		+1
	Location-3: (widening of existing sluice gate)	About 0.02ha of land	About 0.02ha of land would be lost.	-1		+1
	Sub total	**0.05ha**				
	Grand total	**4.55ha**				
Land type change	Entire project area	Presently, land type	Land type might change due to the activities of	-2	The sequence of work (rehabilitation of embankment, construction of new embankment, bank protective work and	+2

IEC	Location	Baseline condition	Impacts	Magnitude of impact*	Mitigation Measure	Magnitude with EMP*
		status is about: Highland - 4.4%; Medium Highland - 36.9%; Medium Lowland- 36.9%, Lowland- 21.4%, Very low land- 0.3%.	rehabilitation of embankment, construction of new embankment, bank protective work and construction of drainage sluices. If proper measures would not be taken, there is a possibility of increase of drainage congestion.		construction of regulators/sluices) in the water channels would be carefully planned to avoid disruption of drainage system. Alternate bundh (embankment) should be prepared for the protection of intrusion of flood water. Sufficient Low Lift Pumps should be made available for removal of excess /rain water. The activities should be done in dry season as far as possible. The contractor would ensure no negative impacts on crop cultivation in monsoon season. The contractor would maintain liaison with communities of WMOs.	

8.4.3 Post-Construction Phase (Loss of land from erosion)

IEC	Location	Baseline	FWOP	FWIP	Impacts	Magnitude of impact*	Mitigation Measure	Magnitude with EMP*
Land use	Entire project areas (for all locations)	Present land use is about: (i) Single crop area:28.7% (ii) Double crop area:49.8% and (iii) Triple cropped area:21.5% Present NCA=184,200ha.	Land use would be about: (i)Single crop area:26.3% (ii)Double crop area:43.5% and (iii)Triple cropped area:30.2%	Land use would be about: (i)Single crop area:22.5% (ii)Double crop area:32.4% and (iii)Triple cropped area: 45.1%.	Minimize River bank erosion, so that, (a)About 30% of the NCA might be impacted positively in JRB-1, (Kaizuri and Bachamara area). (b)About 5% of the NCA (3% of the NCA in Chauhali and Nagarpur area and 2% of the NCA in Jafarganj-Bachamara area) might be impacted in JLB-2 area.	+2	• Thecommunity organizations should be formed and strengthening through orientation on embankment management, smooth functioning of regulators, improve of the drainage system of the project, integrated water management, on farm development etc.	+4

IEC	Location	Baseline	FWOP	FWIP	Impacts	Magnitude of impact*	Mitigation Measure	Magnitude with EMP*
			NCA would decrease to 169,950 ha.	NCA would remain as baseline.	(c) About 5% of the NCA might be impacted positively in PLB-1, Harirampur area.			
Land type	Entire project areas (for all locations)	Highland -4.4%, Medium Highland - 36.9%, Medium Lowland-36.9%, Lowland-21.4%, and Very low land-0.3%.	Highland-4.5%, Medium Highland - 37.0%, Medium Lowland-36.8%, Lowland-21.4%, and Very low land-0.3%.	Highland-5.8%; Medium Highland - 48.8%; Medium Lowland-28.3%, Lowland-16.8%, and Very low land-0.3%	Land type would be improved especially in JRB-1 area.	+2	Thecommunity organizations should be formed and strengthening through orientation on embankment management, smooth functioning of regulators, improve of the drainage system of the project, integrated water management, on farm development etc.	+4
Sand carpeting	Entire project area(all locations)	Presently sand carpeting affects (i) JRB-1 area, about 5%, (ii) JLB-2 area, about 3% and (iii) PLB-1 area ,about 1% of the NCA in concerned area	Sand carpeting would continue	Sand carpeting area would be minimized	Minimize sand carpeting for the rehabilitation of proposed interventions.	+4	• Formation of WMOs, strengthening through imparting training need to be done. • Involvement of community organizations in project activities (maintenance of embankment, functioning of regulators, etc) would improve the project situation. • Land of sand carpeting area might bring under cultivation through removal of coarse sand from field, incorporation of	+6

IEC	Location	Baseline	FWOP	FWIP	Impacts	Magnitude of impact*	Mitigation Measure	Magnitude with EMP*
							organic manure in the land, practicing of green manure, crop diversification through leguminous crops etc.	

No impact (0); Negative Impact (-); Positive Impact (+); Low Impact (1-3); Medium Impact (4-6); High Impact 7-8; Very High Impact (9-10).

N.B: The project area is an erosion prone area. If the project is not implemented, there would be negative impact on agricultural land by river erosion gradually. According to local people, erosion of JRB-1, JLB-2 and PLB-1 areas, river bank erosion is increasing gradually for the last 10 (ten) years. But the intensity of erosion has been found higher in last 3 (three) years. It is estimated that an average of about 1,900 ha of lands are being eroded every year. On the other hand, the accretion of land (char) is being created in both right and left bank of the river. It is assumed from previous experiences that, if the project is not be implemented, about 19,000 ha of fertile agricultural land might be lost after 10(ten) years from the present base year. In the study area about 75% land is under cultivation over total area. Therefore about 14,250 ha cultivable land would be lost. So, about (184200- 14,250) = 1, 69, 950 ha land might be considered as net cultivable area (NCA) under the FWOP condition in 2023.

8.5 Agriculture Resources

8.5.1 Pre-Construction Phase

354. There would be no impact during pre-construction phase

8.5.2 Construction Phase

IEC	Location	Baseline condition	Impacts	Magnitude of impact*	Mitigation Measure	Magnitude with EMP*
Jamuna Right Bank(JRB-1),Jamuna Left Bank(JLB-2) and Padma Left Bank(PLB-1)						
Activity->	*Construction of labor sheds, stocking yard for Bank rehabilitation, construction of new embankment, bank protection and construction of drainage sluices and disposal of spoils activities*					
Loss of crop Production	(i) Dombaria (ii) Lochha (iii) Gopalpur (iv) Jagtala (v) Doria mehi	Total expected crop land loss is about 9.24 ha. for: (a)Construction of labor sheds and	Expected crop production loss would be about 27.9 metric ton (Rice-23.1metric ton and Ground nut 4.8 metric	-2	• Top soil (0-15cm) should be managed properly to conserve the soil fertility. • Construction of labor sheds and stocking yard/ disposal spoils for rehabilitation of embankment, construction of new	+1

IEC	Location	Baseline condition	Impacts	Magnitude of impact*	Mitigation Measure	Magnitude with EMP*
	(vi)Benotia (vii)Chauhali (viii)Bachamara (ix) Harirampu (x)Location-1(Yet to be fixed) (xi)Location-2 (Yet to be fixed) (xii)Location-3 (Yet to be fixed)	stocking yard: 7.34 ha (b)Disposal of spoils for new embankment: 1.90 ha.	ton) for: (a) Loss of rice 18.35metric ton for construction of labor sheds and stocking yard: (b) Loss of rice 4.75 metric ton and ground nut 4.8 metric ton for disposal of spoils.		embankment, bank protective work and construction of drainage sluices should be placed in non-agricultural land as far as possible. • In cases where the disruption to farming becomes unavoidable, adequate cash compensation should be provided to the land owners. /share croppers. • Exact amount of compensation should be determined based on the amount of land temporarily going out of cultivation. • The rate should be decided on the basis of the crop usually grown on the pieces of land.	
Disrupt drainage system	Entire project area	River and khals silted up	It is expected that the drainage congested area might increase during the implementation of rehabilitation of embankment, construction of new embankment, bank protection and construction of drainage sluice activities.	-2	• The sequence of work during construction of drainage sluices in the water channels would be carefully planned to avoid disruption of drainage. • During construction period contractor should construct a by pass canal to avoid disruption of drainage. • The contractor would ensure no negative impacts on crop cultivation in monsoon season. • The contractor would maintain liaison with communityorganizations.	+2
Disrupt irrigation facilities	Entire project area	Presently, surface water irrigated area is about 1% of the study area	Irrigation facilities might be disrupted due to construction of embankment and	-2	• The sequence of work during construction of embankment and drainage sluices in the water channels would be carefully planned to avoid disruption of irrigation.	+2

IEC	Location	Baseline condition	Impacts	Magnitude of impact*	Mitigation Measure	Magnitude with EMP*
			drainage sluices.		• During construction period contractor should construct a by pass canal to ensure irrigation in dry season. • The contractor would ensure no negative impacts on crop cultivation in monsoon season. • The contractor would maintain liaison with communityorganizations.	

N.B: *****_The area of labor sheds for (i) rehabilitation of embankment /disposal of rehabilitation of embankment, and (ii) disposal of bank protection activities have not been considered as the activities would continue in existing embankment_.

8.5.3 Post-Construction Phase (JRB-1)

IEC	Location	Baseline condition	FWOP	FWIP	Impacts	Magnitude of impact*	Mitigation Measure	Magnitude with EMP*
Cropping intensity	Entire project area	Cropping intensity is about 182%	Cropping intensity would be about 181%	Cropping intensity would be about 195%	The cropping intensity would be increased by about 14% under FWIP over FWOP.	+4	-	+4
Crop Production	Entire project area	Rice production is about 202,886 metric tons	Rice production would be about 400753 metric tons	Rice production would be about 662,584 metric tons	Additional rice production would be about 204,948 metric tons	+7	-	+7
Expansion of irrigated area	Entire project area	Irrigated area is about 55% of which ground water irrigation is 54% and 1% is under surface water.	Would more or less same	It is expected that irrigated area would be increased to 70% in dry season (ground water 60% and surface water 10%).	Additional irrigated area would be increased 15 % (ground water 16% and surface water 9%).	+6	-	+6

**No impact (0); Negative Impact (-); Positive Impact (+); Low Impact (1-3); Medium Impact (4-6); High Impact 7-8; Very High Impact (9-10).*

8.6 Fisheries Resources

8.6.1 Pre-Construction Phase

355. There will be no impact in the pre-construction phase.

8.6.2 Construction Phase

IEC	Location	Baseline condition	Impacts	Magnitude of impact*	Mitigation Measure	Magnitude with EMP*
Jamuna Right Bank – 1(Embankment Rehabilitation)						
ivity: Dumping of earthen materials on the embankment						
Fish habitat	6.5 km of the Verakhola towards start of Hurashagar river (Char Andharmanik)	The proposed location generally contains vegetation covers (Chon, Nol, Kaisa, Mutha, Binna, Durba etc.). Fish and prawn species (major carps, i.e., rui, catla, mrigel etc., big and small catfishes, Golda, gura chingri etc.) use this habitat as spawning, grazing and refuge grounds during the inundation of habitat in the monsoon flood season (June to September).	Temporary damage would occur in the seasonal fish habitat of 10.5 km long right bank of the Boral river due to either clearance of vegetation cover or draped by the filling earth during earth work for the fish species of marginal vegetation feeder.	-1	Vegetation clearance should be done as low as possible only covering the footprint of the embankment.	-1
	4km from the starting point of Hurashagar (Char Andharmanik) to Korotoa bank			-1		-1
Fish biodiversity	Same as above	Riverine species diversity is rich with more than 100 species	Riverine fish species i. e. major carp species, grass carp and other herbivorous species, eel (*baim*), big and small cat fish (*boal, ayr, magur*), might shift from the project area	-1		-1
				-1		-1
Fish production	Same as above	Fish production from the proposed portion of the Jamuna river is 16.5 MT	Capture fish production would temporarily be declined by 3.3 MT within the project area.	-1		-1
		Fish production from the proposed portion of the Jamuna river is 10 MT	Capture fish production would temporarily be declined by 2 MT within the project area.	-1		

IEC	Location	Baseline condition	Impacts	Magnitude of impact*	Mitigation Measure	Magnitude with EMP*
Activity: Collection of earth materials from Jamuna Riverl through dredging						
Fish habitat	Same as above	More than 10 deep pools or locally called dor/duars are located at 20-40m far from the right river bank. These areas play an important role for hilsa production. Moreover, other larger fish species, i.e., boal, ayr, baghayr, rui, catla etc. use these habitat particularly during the dry season (December-March)	- Water quality (stream flow, temperature, pH, turbidity, DO, hardness etc.) of that portion of the Boral river will temporarily be changed which would change the behavior of riverine fish species (both the juveniles and adults). - Feeding habitat for the demersal (boal, ayr) and benthopelagic (baim) fish species would be damaged. - Deep pools (dor/duars) would temporarily be damaged.	-2 -1	1. Dredging will have to done during the dry season. 2. Proper protective device (silt fence) will have to take to protect the deep pools (dor/duars).	-1 -1
Fish migration	Same as above	1. Lateral migration occurs through flooding water. 2. Larvae and juveniles migrate from the river to the adjacent beels (Kadaibadla beel, Nuar beel, Mathavanga beel, Merpahnir beel, Kumirpecha beel, Moakholar beel etc) for feeding and growth during the dry season (December to March)	Both the Longitudinal (hilsa) and lateral migration for fish will be temporarily disturbed.		Dry season (December-March) is proposed for dredging.	
Fish biodiversity	Same as above	Riverine species diversity is rich with more than 100 species	Riverine fish species i. e. hilsa, major carp species, eel (*baim*), big and small cat fish (*boal, ayr, magur*), etc. might shift from the project area	-5	1. Dredging will have to be done during the dry season. 2. Proper protective device (silt fence) will have to be taken to protect the deep pools (dor/duars).	-3
Fish production	Same as above	Fish production from the proposed portion of the Jamuna river is 16.5 MT	Capture fish production would temporarily be declined by 3.3 MT within the project area.	-1		-4
		Fish production from the proposed portion of the Jamuna river is 10 MT	Capture fish production would temporarily be declined by 2 MT within the project area.	-1		

IEC	Location	Baseline condition	Impacts	Magnitude of impact*	Mitigation Measure	Magnitude with EMP*
Activity: Construction of sluice gate						
Fish Migration	Not fixed up	- There is good connectivity between the Baral khal to Hurashagar which flows over the Mohakholar Beel and Kumir pecha Beel. - The water of Baral khal goes to the Nuar Beel, Mathavanga Beel, Merpahnir Beel, Kossailkar Beel and Gobindapur Beel through the Verakhola khal	Fish migration would be hindered	-3	1. Fish friendly structure with suitable water depth, water velocity etc. should be maintained. 2. Gates should be operated with the knowledge of fish migration behavior with suitable season	-1
Fish biodiversity			Fish biodiversity would slightly be reduced, because they can enter the mentioned beel through another migration route.	-2	Same as above	-1
Fish production			Production would slightly be lowered	-2	Same as above	-1
New Embankment Construction						
ivity: Collection of earth materials from the location of embankment through excavator, pay loader, head load , dump truck and trolley						
Fish habitat	10.5 km of the Jamuna river bank from Hat Pachil Bazar, Kaizuri to Benotia Hat/Bazar	The proposed location generally contains vegetation covers (Chon, Nol, Kaisa, Mutha, Kolmi, Binna, Durba etc.). Fish and prawn species (major carps, i.e., rui, catla, mrigel etc., big and small catfishes, Golda, gura chingri etc.) use this habitat as spawning, grazing and refuge grounds during the inundation of habitat in the monsoon flood season (June to September).	Temporary damage would occur in the seasonal fish habitat due to either clearance of vegetation cover or draped by the filling earth during earth work for the fish species of marginal vegetation feeder.	-1	The area of vegetation clearance should be minimized	-1
	2 km from Benotia Hat/Bazar to the start of Baral Khal, Verakola Hat			-1		-1

IEC	Location	Baseline condition	Impacts	Magnitude of impact*	Mitigation Measure	Magnitude with EMP*
Fish migration	Same as above	Fish migration occurs through flooding water during the monsoon flood season (June to September)	Lateral migration for fish will be temporarily disturbed.	-2	Same as above	-1
Fish biodiversity	Same as above	Riverine species diversity is rich with more than 100 species	Riverine fish species i. e. major carp species, grass carp and other herbivorous species, eel (*baim*), big and small cat fish (*boal, ayr, magur*), might shift from the project area	-1 -1	Same as above	-1 -1
Fish production	Same as above	Fish production from the proposed portion of the Jamuna river is 26.62 MT	Capture fish production would temporarily be declined by 13.3 MT within the project area. In opposite, culture fisheries practice would be increased.	-3	Same as above	-1
		Fish production from the proposed portion of the Jamuna river is 10 MT	Capture fish production would temporarily be declined by 2 MT within the project area.	-1		
vity: Collection of earth materials from Jamuna river through dredging						
Fish habitat	Same as above	More than 10 deep pools or locally called dor/duars are located at 20-40m far from the right river bank. These areas play an important role for hilsa production. Moreover, other larger fish species, i.e., boal, ayr, baghayr, rui, catla etc. use these habitat particularly during the dry season (December-March)	1. Water quality (stream flow, temperature, pH, turbidity, DO, hardness etc.) of that portion of the Boral river will be temporarily changed which would change the behavior of riverine fish species (both the juveniles and adults). 2. Feeding habitat for the demersal (boal, ayr) and benthopelagic (baim) fish species would be damaged. 3. Deep pools (dor/duars) would temporarily be damaged.	-2 -1	1. Dredging will have to done during the dry season. 2. Proper protective device (silt fence) will have to take to protect the deep pools (dor/duars).	-1 -1
Fish migration	Same as above	1. Lateral migration occurs through flooding water. 2. Larvae and juveniles migrate from the river to the adjacent beels (Kadaibadla beel, Nuar beel, Mathavanga beel, Merpahnir beel, Kumirpecha beel,	Both the Longitudinal (hilsa) and lateral migration for fish will be temporarily disturbed.		Dry season (December-March) is proposed for dredging.	

IEC	Location	Baseline condition	Impacts	Magnitude of impact*	Mitigation Measure	Magnitude with EMP*
		Moakholar beel etc) for feeding and growth during the dry season (December to March)				
Fish biodiversity	Same as above	Riverine species diversity is rich with more than 100 species	Riverine fish species i. e. hilsa, major carp species, eel (*baim*), big and small cat fish (*boal, ayr, magur*), etc. might shift from the project area	-5	1. Dredging will have to done during the dry season. 2. Proper protective device will have to be taken to protect the deep pools (dor/duars).	-3
Fish production	Same as above	Fish production from the proposed portion of the Jamuna river is 26.62 MT	Capture fish production would temporarily decline by 13.3 MT within the project area. Culture fisheries practice would be increased. Net fish production would increase by 25 MT	+3	Same as above	-1
		Fish production from the proposed portion of the Jamuna river is 10 MT	Capture fish production would temporarily be declined by 2 MT within the project area. Culture fisheries practice would be slightly increased.	-1		-1
Activity: Construction of sluice gate						
Fish Migration	Not fixed up	1. There is goodl connectivity between the Baral khal to Hurashagar which flows over the Mohakholar Beel and Kumir pecha Beel. 2. The water of Baral khal goes to the Nuar Beel, Mathavanga Beel, Merpahnir Beel, Kossailkar Beel and Gobindapur Beel through the Verakhola khal	Fish migration would be hindered	-3	1. Fish friendly structure with suitable water depth, water velocity etc. should be maintained. 2. Gates should be operated with the knowledge of fish migration behavior with suitable	-1

IEC	Location	Baseline condition	Impacts	Magnitude of impact*	Mitigation Measure	Magnitude with EMP*
					season	
Fish biodiversity			Fish biodiversity would slightly be reduced, because they can enter the mentioned beel through another migration route.	-2	Same as above	-1
Fish production			Production would slightly be lowered	-2	Same as above	-1
Riverbank Protection Work						
Activity: Embankment slope pitching and turfing						
Fish habitat	2 km from Benotia Hat/Bazar toward the start of Baral river.	proposed location generally contains vegetation covers (Chon, Nol, Kaisa, Mutha, Kolmi, Binna, Durba etc.). Fish and prawn species (major carps, i.e., rui, catla, mrigel etc., big and small catfishes, Golda, gura chingri etc.) use this habitat as spawning, grazing and refuge grounds during the inundation of habitat in the monsoon flood season (June to Sept.).	Temporary damage would occur in the seasonal fish habitat due to either clearance of vegetation cover or draped by the filling earth during earth work for the fish species of marginal vegetation feeder.	0	Vegetation clearance should be done as low as possible	-1
Fish biodiversity		Riverine species diversity is rich with more than 100 species	Riverine fish species i. e. major carp species, grass carp and other herbivorous species, eel (*baim*), big and small cat fish (*boal, ayr, magur*), might shift from the project area	-1		-1
Fish production		Fish production from the proposed portion of the Boral river is 10 MT	Capture fish production would temporarily be declined by 2 MT within the project area.	-1		-1
vity: Placing and dumping of C.C. blocks as per design						
Fish biodiversity	2 km from Benotia Hat/Bazar to the start of Baral Khal	Riverine species diversity is rich with more than 100 species	Riverine fish species i. e. hilsa, major carp species, eel (*baim*), big and small cat fish (*boal, ayr, magur*), etc. might shift from the project area. Potential impact on surface feeder fish species due to chemicals, oil and grease lubricants.	-5	1. Sloping will have to done during the dry season. 2. Proper protective device will have to take to protect the deep pools (dor/duars). 3. Ensure careful refueling of	-3

IEC	Location	Baseline condition	Impacts	Magnitude of impact*	Mitigation Measure	Magnitude with EMP*
					vehicles and careful handling during any changes in parts of vehicles. Ensure concrete mixing does not happen at the river embankments	
Fish production		Fish production from the proposed portion of the Jamuna river is 10 MT	Capture fish production would temporarily decline by 2 MT within the project area. Culture fisheries practice would be slightly increased.	-1		
Jamuna Left Bank – 2 (Riverbank Protection Work)						
vity: Riverbank protection slope pitching with concrete blocks (above low water level)						
Fish habitat	5 km of the Jamuna Left bank from Chauhali Sadar to Atpara	1. During the pre-monsoon (April-early June) period small to larger fish species (boal, ayr, baghayr, pangas, taki, magur, baim, gura chingri etc.) go against the higher water current nearby the river bank for their breeding. 2. Cultured practice of high-valued fish species (tilapia, pangas and major carps) in cultured pond and baropit is happened near the river bank which is highly vulnerable to river bank erosion.	Boropit would be lost somewhat near the river bank at Chauhali sadar (East and North Khaskaulia	-1	Not applicable	-1
	2 km of the Jamuna Left bank from Jaffarganj to Bachamara		Not applicable	0		0
Fish biodiversity	Same as above	Riverine species diversity is moderate to rich with more than 60 species	Not applicable	0		0
Fish production	Same as above	Fish production from the proposed portion of the Jamuna river is 591.5 MT	Capture and culture fish production would be the same as the base.	0	Proper training to increase the culture practice of high-valued fish	0

IEC	Location	Baseline condition	Impacts	Magnitude of impact*	Mitigation Measure	Magnitude with EMP*
					species	
		Fish production from the proposed portion of the Jamuna river is 236.6 MT	Culture fish production would temporarily be declined by 47.32 MT within the project area.	-1		-1
Padma Left Bank -1 (Riverbank Protection Work)						
ivity: Riverbank protection temporary slope pitching with geobags above low water level						
Fish habitat	7 km of the Padma Left Bank at Harirampur	1. The proposed location generally contains vegetation covers (Chon, Nol, Kaisa, Mutha, Kolmi, Binna, Durba etc.). Fish and prawn species (major carps, i.e., rui, catla, mrigel etc., big and small catfishes, Golda, gura chingri etc.) use this habitat as spawning, grazing and refuge grounds during the inundation of habitat in the monsoon flood season (June to September). 2. There is a major spawning ground of major carps (rui, catla, mrigel etc.) at Andharmanik Ghat of Bayra Union.	- Temporary damage would occur in the seasonal fish habitat due to clearance of vegetation cover for the fish species of marginal vegetation feeder. - Spawning ground would be lost	-4	egetation clearance should be done as low as possible pawning season to be avoided during the earthwork and earth filling. (Spawning season is generally from June to September and construction will take place from November to April)	-2
Fish migration		Major carps migrated toward the spawning ground (created before the 7 years) through the flooding water and Padma river channel.	Migration route would be disturbed	-3	Construction with take place during the dry season	0
Fish biodiversity		Riverine species diversity is rich with more than 100 species	Riverine fish species i. e. major carp species, grass carp and other herbivorous species, eel (*baim*), big and small cat fish (*boal, ayr, magur*), might shift from the project area	-2		-2
Fish production		Fish production from the proposed portion of the Padma river is 1,183 MT	Capture fish production would temporarily be declined by 592 MT within the project area.	-1		-1

8.6.3 Post-Construction Phase

IEC	Location	Baseline condition	FWOP	FWIP	Impacts	Magnitude of impact*	Mitigation Measure	Magnitude with EMP*
Jamuna Right Bank – 1 (Embankment Rehabilitation)								
Fish habitat	6.5 km of the Verakhola towards start of Hurashagar river	Fish habitat area is 4322.5 ha Capture: 4322.5 ha Culture: 0 ha	Fish habitat area in FWOP would be 4429 ha Capture: 4429 ha (Capture area would increase since floodplain area would increase for ongoing siltation through spill over channel)	Fish habitat area in FWIP would be slightly reduced to 107.7 ha Capture: 97.7 ha (Capture area would decrease by 5814.8 ha because of embankment construction and ring bundh construction on floodplain area) Culture: 10 ha (Culture area would be increased since flood induced risk would be minimized)	Estimated net loss to fish habitat area would be 4321.3 ha	-10	1. Aquatic trees and herbs should be planted on the slope of the bank. 2. Proper protective device will have to be taken to protect the deep pools (dor/duars). 3. Use of surface water during the breeding period should be stopped. 4. Culture fisheries should be developed 5. Perennial beels should be developed	-6
	4km from the starting point of Hurashagar to Korotoa bank	Fish habitat area is 1660 ha Capture: 1660 ha Culture: 0 ha	Fish habitat area in FWOP would be 1729 ha Capture: 1729 ha (Capture area would increase since floodplain area would increase for ongoing siltation through spill over channel)	Fish habitat area in FWIP would be 70 ha Capture: 69 ha (Capture area would decrease by 1591 ha because of embankment construction and ring bundh construction on floodplain area) Culture: 1 ha (Culture area would be increased since flood induced risk would be minimized)	Estimated net loss to fish habitat area would be 1659 ha	-4		-2

IEC	Location	Baseline condition	FWOP	FWIP	Impacts	Magnitude of impact*	Mitigation Measure	Magnitude with EMP*
							under a biodiversity program	
Fish migration	Same as above	Fish migration is in good condition	Fish migration would increased due to the increase of floodplain area	Fish migration would be obstructed along the floodplain because of embankment rehabilitation	Degraded fish migration	-5	Sluice gates operated by communities following the GIZ approach at Pabna	-3
Fish biodiversity	Same as above	Riverine species diversity is rich with more than 100 species	Fish diversity would remain same as base condition or increased slightly	The present structure (species composition, population size per species etc.) of the fish community particularly SIS would decline in the following way: Floodplain migration will be declined ↓ Habitat area will be declined ↓ Population size (number of individuals) of source habitat (rivers) will be declined ↓ Increase of Vulnerability to Natural calamities ↓ Increase of Demographic calamities ↓ Decrease of Fish biodiversity	Capture fish species diversity would be moderate to low	-2	1. Proper protective device will have to be taken to protect the deep pools (dor/duars). 2. Use of surface water during the breeding period should be stopped. 3. Culture fisheries should be developed 4. Perennial beels should be developed	-2

IEC	Location	Baseline condition	FWOP	FWIP	Impacts	Magnitude of impact*	Mitigation Measure	Magnitude with EMP*
				High-valued culture fish species (Major carps, minor carps, Tilapia, Pangas, Thai koi etc.) would be increased			under a biodiversity program 5. Proper training to increase the culture practice of high-valued fish species	
	Same as above	Same as above	Same as above	Same as above	Capture fish species diversity would be moderate to low	-2		-
Fish production	Same as above	Production: 1216 MT Capture: 1216 MT Culture: 0 MT	Fish production in FWOP would be 1229 MT Capture: 1229 MT (Fish production would be declined because of capture fish habitat quality would deteriorate) Culture: 0 MT (Culture fish production would decline due to flood induced risk; fish farmers would feel discourage to culture fish commercially)	Fish production in FWIP would be 49.5 MT Capture: 16.5 MT (Fish production would decrease because of migration obstacle along the floodplain through the bank protection work. All fish cannot migrate through high velocity water. During monsoon riverine fish species laterally migrate to floodplain and other capture habitat for food and spawning. Fish migration would totally be lost because of proposed intervention. Culture: 33 MT (Culture fish production would increase due to minimizing river bank erosion and flood induced risk)	Estimated net loss to fish production: 1179.5 MT	-5		-3
	Same as above	Production: 464 MT Capture: 464	Fish production in FWOP would be 476 MT	Fish production in FWIP would be 15 MT Capture: 12 MT (Fish production	Estimated net loss to fish production: 461	-9		-5

IEC	Location	Baseline condition	FWOP	FWIP	Impacts	Magnitude of impact*	Mitigation Measure	Magnitude with EMP*
		MT Culture: 0 MT	Capture: 476 MT (Fish production would be declined because of capture fish habitat quality would deteriorate) Culture: 0 MT (Culture fish production would decline due to flood induced risk; fish farmers would feel discourage to culture fish commercially)	would decrease because of migration obstacle along the floodplain and huge flow of water through the regulator during wet season. All fish can not migrate through high velocity water. During monsoon riverine fish species laterally migrate to floodplain and other capture habitat for food and spawning. Fish would not migrate freely because of proposed intervention. Culture: 3 MT (Culture fish production would increase due to minimizing flood induced risk)	MT			
New Embankment Construction								
Fish habitat	10.5 km of the Jamuna river bank from Hat Pachil Bazar, Kaizuri to Benotia Hat/Bazar	Fish habitat area is 11183 ha Capture: 11183 ha Culture: 0 ha	Fish habitat area in FWOP would be 11206 ha Capture: 11206 ha (Capture area would increase since floodplain area would increase for ongoing siltation through spill over channel)	Fish habitat area in FWIP would be reduced to 167.5 ha Capture: 157.5 ha (Capture area would decrease by 11025 ha because of embankment construction and ring bundh construction on floodplain area) Culture: 10 ha (Culture area would be increased since flood induced risk would be minimized)	Estimated net loss to fish habitat area would be 11038.5 ha	-9	1. Aquatic trees and herbs should be planted on the slope of the bank. 2. Proper protective device will have to take to protect the deep pools (dor/duars). 3. Use of	-6
	2 km from Benotia Hat/Bazar to	Fish habitat area is 460 ha Capture: 460	Fish habitat area in FWOP would be 469 ha	Fish habitat area in FWIP would be 61 ha Capture: 60 ha	Estimated net loss to fish habitat area	-5		-4

IEC	Location	Baseline condition	FWOP	FWIP	Impacts	Magnitude of impact*	Mitigation Measure	Magnitude with EMP*
	the start of Baral Khal, Verakola Hat	ha Culture: 0 ha	Capture: 469 ha (Capture area would increase since floodplain area would increase for ongoing siltation through spill over channel)	(Capture area would decrease by 400 ha because of embankment construction and ring bundh construction on floodplain area) Culture: 1 ha (Culture area would be increased since flood induced risk would be minimized)	would be 409 ha		surface water during the breeding period should be stopped.	
Fish migration	Same as above	Same as the above scenario	Fish migration would increase due to the increase of floodplain area	Fish migration would be obstructed along the floodplain because of embankment rehabilitation	Degraded fish migration	-5	operation of regulators during migration periods	-5
	Same as above		Fish migration would increased due to the increase of floodplain area	Fish migration would be obstructed along the floodplain because of embankment rehabilitation	Degraded fish migration	-5	Not applicable	-5
Fish biodiversity	Same as above	Same as the above scenario	Fish diversity would remain same as base condition or increased slightly	The present structure (species composition, population size per species etc.) of the fish community particularly SIS would decline in the following way: Floodplain migration will be declined ↓ Habitat area will be declined ↓ Population size (number of individuals) of source habitat	Capture fish species diversity would be moderate to low	-2	Not applicable	-2

IEC	Location	Baseline condition	FWOP	FWIP	Impacts	Magnitude of impact*	Mitigation Measure	Magnitude with EMP*
				(rivers) will be declined ↓ Increase of Vulnerability to Natural calamities ↓ Increase of Demographic calamities ↓ Decrease of Fish biodiversity High-valued culture fish species (Major carps, minor carps, Tilapia, Pangas, Thai koi etc.) would be increased				
	Same as above	Same as the above scenario	Fish diversity would remain same as base condition or increased slightly	Same as above	Capture fish species diversity would be moderate to low	-2	Not applicable	-
Fish production	Same as above	Production: 890 MT Capture: 890 MT Culture: 0 MT	Fish production in FWOP would be 894 MT Capture: 1094 MT (Fish production would be declined because of capture fish habitat quality would deteriorate) Culture: 0 MT (Culture fish production would decline due to flood	Fish production in FWIP would be 861 MT Capture: 828 MT (Fish production would decrease because of migration obstacle along the floodplain and huge flow of water through the regulator during wet season. All fish cannot migrate through high velocity water. During monsoon riverine fish species laterally migrate to floodplain and other capture	Estimated net loss to fish production: 33 MT	-5	Proper training to increase the culture practice of high-valued fish species Sluice gate construction and joint operation with communities	-3

IEC	Location	Baseline condition	FWOP	FWIP	Impacts	Magnitude of impact*	Mitigation Measure	Magnitude with EMP*
			induced risk; fish farmers would feel discourage to culture fish commercially)	habitat for food and spawning. Fish would not migrate freely because of proposed intervention. Culture: 33 MT (Culture fish production would increase due to minimizing flood induced risk)			following the GIZ approach at Pabna district	
	Same as above	Production: 78 MT Capture: 78MT Culture: 0 MT	Fish production in FWOP would be 79 MT Capture: 79 MT (Fish production would be declined because of capture fish habitat quality would deteriorate) Culture: 0 MT (Culture fish production would decline due to flood induced risk; fish farmers would feel discourage to culture fish commercially)	Fish production in FWIP would be 13 MT Capture: 10 MT (Fish production would decrease because of migration obstacle along the floodplain and huge flow of water through the regulator during wet season. All fish can not migrate through high velocity water. During monsoon riverine fish species laterally migrate to floodplain and other capture habitat for food and spawning. Fish would not migrate freely because of proposed intervention. Culture: 3 MT (Culture fish production would increase due to minimizing flood induced risk)	Estimated net loss to fish production: 66 MT	-6	Not applicable Sluice gate construction and joint operation with communities following the GIZ approach at Pabna district	-6
Jamuna Right Bank – 1 (Bank Protection Work)								
Fish habitat	2 km from Benotia Hat/Bazar to the start of Baral Khal	Fish habitat area is 60 ha Capture: 60 ha Culture: 0 ha	Fish habitat area in FWOP would be 69 ha Capture: 69 ha (Capture area would increase since	Fish habitat area in FWIP would be 58 ha Capture: 57 ha (Capture area would decrease by 12 ha because of embankment	Estimated net loss to fish habitat area would be 1 ha	-2	1. Aquatic trees and herbs should be planted on the slope of	-1

IEC	Location	Baseline condition	FWOP	FWIP	Impacts	Magnitude of impact*	Mitigation Measure	Magnitude with EMP*
			floodplain area would increase for ongoing siltation through spill over channel)	construction and ring bundh construction on floodplain area) Culture: 1 ha (Culture area would be increased since flood induced risk would be minimized)			the bank. 2. Proper protective device (declaration of Sanctuary) will have to take to protect the deep pools (dor/duars). 3. Use of surface water during the breeding period should be stopped.	
Fish migration		Same as the above scenario	Fish migration would increased due to the increase of floodplain area	Fish migration would be obstructed along the floodplain because of embankment rehabilitation	Degraded fish migration	-4	Not applicable Sluice gate construction and joint operation with communities following the GIZ approach at Pabna district	-4
Fish biodiversity		Same as the above scenario	Fish diversity would remain same as base condition or increased slightly	Same as above	Capture fish species diversity would be moderate to low	-2	Not applicable Sluice gate construction and joint	-2

IEC	Location	Baseline condition	FWOP	FWIP	Impacts	Magnitude of impact*	Mitigation Measure	Magnitude with EMP*
							operation with communities following the GIZ approach at Pabna district	
Fish production		Production: 10 MT Capture: 10 MT Culture: 0 MT	Fish production in FWOP would be 12 MT Capture: 12 MT (Fish production would be declined because of capture fish habitat quality would deteriorate) Culture: 0 MT (Culture fish production would decline due to flood induced risk; fish farmers would feel discourage to culture fish commercially)	Fish production in FWIP would be 13 MT Capture: 10 MT (Fish production would decrease because of migration obstacle along the floodplain and huge flow of water through the regulator during wet season. All fish can not migrate through high velocity water. During monsoon riverine fish species laterally migrate to floodplain and other capture habitat for food and spawning. Fish would not migrate freely because of proposed intervention. Culture: 3 MT (Culture fish production would increase due to minimizing flood induced risk)	Estimated net gain to fish production: 1 MT	+1	Not applicable Sluice gate construction and joint operation with communities following the GIZ approach at Pabna district	+1
Jamuna Left Bank – 2 (Bank Protection Work)								
Fish habitat	5 km of the Jamuna Left bank from Chauhali Sadar to Atpara	Fish habitat area is 3511.4 ha Capture: 3500 ha	Fish habitat area in FWOP would be 4900 ha Capture: 4900 ha (Capture area would	Fish habitat area in FWIP would be slightly reduced to 3511.4 ha Capture: 3500 ha (Capture area would be the same as the base condition)	Estimated net loss to fish habitat area would be 1388.6 ha	-3	1. Aquatic trees and herbs should be planted on the slope of	-1

IEC	Location	Baseline condition	FWOP	FWIP	Impacts	Magnitude of impact*	Mitigation Measure	Magnitude with EMP*
		Culture: 11.4 ha	increase due to the river bank erosion by 40%) Culture: 0 ha. (Due to the river bank erosion)	Culture: 11.4 ha (Culture area would be the same since erosion induced risk would be minimized)			the bank. 2. Proper protective device (i.e., declaration of Sanctuary) will have to take to protect the deep pools (dor/duars). 3. Use of surface water during the breeding period should be stopped.	
	2 km of the Jamuna Left bank from Jaffarganj to Bachamara	Fish habitat area is 1400 ha Capture: 1400 ha Culture: 0 ha	Fish habitat area in FWOP would be 1960 ha Capture: 1960 ha (Capture area would increase due to the river bank erosion by 40%)	Fish habitat area in FWIP would be 1410 ha Capture: 1400 ha (Capture area would be the same as the base condition) Culture: 10 ha (Culture area would be increased since flood induced risk would be minimized)	Estimated net loss to fish habitat area would be 550 ha	-3		-1
Fish migration	Same as above	Have no significant migratory routes	Would be developed	Would be blocked	Migration would be hindered permanently	-1	sluice gates would provide limited migration opportunity	-1
	Same as above	Same as above	Same as above	Same as above	Same as above	Same as above	Same as above	Same as above
Fish biodiversity	Same as above	Riverine species diversity is moderate to rich with more than 60 species	Would be the same as the base condition	Would be the same as the base condition	Fish biodiversity would be reduced	-1	Same as above	-1

IEC	Location	Baseline condition	FWOP	FWIP	Impacts	Magnitude of impact*	Mitigation Measure	Magnitude with EMP*
	Same as above	Same as the above scenario	Same as above	Same as above	Same as above	Same as above	Same as above	Same as above
Fish production	Same as above	Production: 591.5 MT Capture: 575 MT Culture: 37.5 MT	Fish production in FWOP would be 591.5 MT Capture: 575 MT (Fish production would be the same as the base condition) Culture: 37.5 MT (Fish production would be the same as the base condition	Fish production in FWIP would be 591.5 MT Capture: 575 MT (Fish production would be the same as the base condition) Culture: 37.5 MT (Fish production would be the same as the base condition	Not applicable	Not applicable	Proper training to increase the culture practice of high-valued fish species Not applicable	+2
	Same as above	Production: 236.6 MT Capture: 236.6 MT Culture: 0 MT	Fish production in FWOP would be 284 MT Capture: 284 MT (Fish production would be increased at 20%)) Culture: 0 MT (Culture fish production would be same)	Fish production in FWIP would be 285 MT Capture: 236.6 MT (Due to the reduction of erosion induced risk). Culture: 48 MT (Culture fish production would increase due to minimizing flood induced risk)	Estimated net gain to fish production: 1 MT	+1		+3
Padma Left Bank – 1(Bank Protection Work)								
Fish habitat	7 km of the Padma Left Bank at Harirampur	Fish habitat area is 7,111 ha Capture: 7000 ha Culture: 111 ha	Fish habitat area is 7811 ha Capture: 7700 ha (Due to river bank erosion) Culture: 111 Spawning ground would be lost	Fish habitat area is 7133 ha Capture: 7000 ha Culture: 133 ha (Due to the increased erosion induced risk)	Estimated net loss to fish habitat: 678 ha.	-6	1. Vegetation clearance should be done as low as possible Proper protective	-2

IEC	Location	Baseline condition	FWOP	FWIP	Impacts	Magnitude of impact*	Mitigation Measure	Magnitude with EMP*
Fish migration		Major carps migrate toward the spawning ground (created before 7 years) through the flooding water and Padma river channel.	Major carps migrated toward the spawning ground (created before the 7 years) through the flooding water and Padma river channel.	Migration route would be disturbed	Migration route would be disturbed	-2	device will have to take to protect the deep pools (dor/duars).	-1
Fish biodiversity		Same as above scenario	Riverine species diversity is rich with more than 100 species	Riverine fish species i. e. hilsa, major carp species, eel (baim), big and small cat fish (boal, ayr, magur), etc. might shift from the project area	Riverine fish species i. e. hilsa, major carp species, eel (baim), big and small cat fish (boal, ayr, magur), etc. might shift from the project area	-5		-3
Fish production		Production: 1548 MT Capture: 1183 MT Culture: 365 MT	Production: 1666 MT Capture: 1301 MT Culture: 365 MT	Production: 1620 MT Capture: 1183 MT Culture: 437 MT	Estimated net loss to fish production: 46 MT	-5		-3

** No impact (0); Negative Impact (-); Positive Impact (+); Low Impact (1-3); Medium Impact (4-6); High Impact (7-8); Very High Impact (9-10).*

8.7 Ecological Resources

8.7.1 Pre-Construction Phase

356. There will be no impact in the pre-construction phase.

8.7.2 Construction Phase

IEC	Location	Baseline condition	Impacts	Magnitude of impact*	Mitigation Measure	Magnitude with EMP
Jamuna Right Bank – 1(Embankment Rehabilitation)						
Activity: Rehabilitation of embankment						
Terrestrial Ecosystem Aquatic ecosystem. Floral composition and diversity. Faunal composition and diversity.	6.5 km of the Verakhola towards start of Hurashagar river (Char Andharmanik). 4km from the starting point of Hurashagar (Char Andharmanik) to Korotoa bank .	Dense vegetations like trees, shrubs and herbs are present besides the River bank. Trees are used as nesting and breeding places. Plantation action should be implemented.	Shrubs and herbs and other vegetation of bank slopes will be damaged. Feeding and resting ground will be damaged completely. After 2-3 year the situation will same as base situation.	- 4	Do not cut the big trees Do not clean the additional area. Do not dump large volume of excavated soil on bottom of the aforesaid trees. Different species of sapling should the planted. Use the area as less as possible.	+2
Construction of New Embankment						
Activity: Collection of earth materials and construction of new embankment						
Terrestrial Ecosystem Aquatic Ecosystem. Floral composition and diversity	10.5 km of the Jamuna river bank from Hat Pachil Bazar, Kaijuri to Benotia Hat/Bazar 2 km from Benotia Hat/Bazar to the start of	River banks holds dense vegetations like trees, shrubs and herbs etc.	Shrubs and herbs and vegetation of bank slopes will be damaged by excavated soil dumping. Less damage of trees of	-3	Use the area as required. Do not dump large volume of excavated soil on	+2

IEC	Location	Baseline condition	Impacts	Magnitude of impact*	Mitigation Measure	Magnitude with EMP
Faunal Composition and diversity	Baral Khal, Verakola Hat		bank slope. Aquatic flora as well as zooplankton and phytoplankton will be destroyed After 2-3 year the situation will return as base situation.		bottom of the aforesaid trees.	
Bank Protection Work of Jamuna Right Bank-1, Jamuna Left Bank – 2, Padma Left Bank – 1						
Activity: Slope protection activities						
Terrestrial ecosystem Aquatic ecosystem. Floral composition and diversity Faunal composition and diversity	2 km from Benotia Hat/Bazar to the start of Baral Khal, Verakola Hat. 5 km of the Jamuna Left bank from Chauhali Sadar to Atpara. 2 km of the Jamuna Left bank from Jaffarganj to Bachamara 7 km of the Padma Left Bank at Harirampur.	River bank holds dense vegetations like trees, shrubs and herbs. Faunal diversity is moderate in this region Homestead and roadside vegetations like fruit bearing and timber trees, shrubs and herbs are located beyond the 2-10 m far from the river bank.	Vegetation of river banks will temporarily be damage and disturbed. Aquatic fauna i.e., little egret, Indian pond heron etc. would not exist near the river bank.	-2	Do not dump the large volume of excavated soil on bottom of the aforesaid trees. Bot, Pakur, Shimul and other big trees are suggested to be protected Plantation of different species of saplings should be implemented along the country side slope of the embankment	+2
Activity: Plantation Activities						
Terrestrial ecosystem. Aquatic ecosystem. Floral composition	6.5 km of the Verakhola towards start of Hurashagar river (Char Andharmanik) 4km from the starting point	River bank holds dense vegetations like trees, shrubs and herbs. Faunal diversity is	Vegetation of river banks will temporarily be damage and disturbed. Some trees will lose due to	-3	About 50,000 species of different, sapling e.g. timber, fruit	+5

IEC	Location	Baseline condition	Impacts	Magnitude of impact*	Mitigation Measure	Magnitude with EMP
and diversity Faunal Composition and diversity	of Hurashagar (Char Andharmanik) to Korotoa river bank. 10.5 km of the Jamuna river bank from Hat Pachil Bazar, Koijuri to Benotia Hat/Bazar 2 km from Benotia Hat/Bazar to the start of Baral Khal, Verakola Hat.	moderate in this region Homestead and roadside vegetations like fruit bearing and timber trees are present	implementation of proposed intervention.		and water tolerance trees should the planted. Cut the trees as less as possible.	

**No impact (0); Negative Impact (-); Positive Impact (+); Low Impact (1-3); Medium Impact (4-6); High Impact 7-8; Very High Impact (9-10).*

8.7.3 Post-Construction Phase

IEC	Location	Baseline condition	FWOP	FWIP	Impacts	Magnitude of impact*	Mitigation Measure	Magnitude with EMP
Jamuna Right Bank – 1 (Embankment Rehabilitation)								
Terrestrial ecosystem Aquatic ecosystem. Floral composition and diversity. Faunal composition and diversity	10.5 km from Verakhola toward the Korotoa bank at Mohakhola	River bank holds dense vegetations like trees, shrubs and herbs. Faunal diversity is moderate in this region Homestead and roadside vegetations like fruit bearing and timber trees are present.	Vulnerable due to bank erosion and flooding. Will be more vulnerable e.g. bank mayna due to flooding and bank erosion. Wildlife population will be same as baseline	Bank erosion will be protected Vegetation will be protected but less in quantity. Vegetation will be improved and healthy. Faunal composition will improve	Protection of homestead, roadside and social forest habitat will improve bio-diversity. Vegetation coverage of the project area will improve. Faunal composition and diversity would be improve simultaneously	+3	Plantation of different species of saplings should be implemented	+5

IEC	Location	Baseline condition	FWOP	FWIP	Impacts	Magnitude of impact*	Mitigation Measure	Magnitude with EMP
				simultaneously				
Jamuna Right Bank – 1 (Construction of New Embankment)								
Terrestrial ecosystem Aquatic ecosystem. Floral composition and diversity. Faunal composition and diversity	12.5 km of the Jamuna river bank from Hat Pachil Bazar, Kaizuri toward the Korotoa bank at Mohakhola.	Vegetation of embankment moderate. Faunal composition is moderate to rich.	Vulnerable due to bank erosion and flooding. Will be more vulnerable e.g. bank mayna due to flooding and bank erosion. Wildlife population will be same as baseline	Habitat protection from river erosion and flood. Vegetation will be improved and healthy. Faunal composition will improve simultaneously.	Protection of homestead, roadside and social forest habitat that will improve faunal diversity.	+2	Plantation of different species of saplings should be implemented.	+4
Bank Protection Work of Jamuna Right Bank -1, Jamuna Left Bank – 2, Padma Left Bank – 1								
Activity: Slope protection activities								
Terrestrial ecosystem Aquatic ecosystem. Floral composition and diversity Faunal composition and diversity.	2 km from Benotia Hat/Bazar to the start of Baral Khal, Verakola Hat. 5 km of the Jamuna Left bank from Chauhali Sadar to Atpara. 2 km of the Jamuna Left	Vegetation of embankment moderate. Faunal composition is poor to moderate. Homestead habitat moderate. Roadside vegetation moderate, but vulnerable due to flood.	Vulnerable due to bank erosion and flooding. Will be more vulnerable e.g. bank mayna due to flooding and bank erosion. Wildlife population will be same as baseline	Habitat protection from river erosion and flood. Vegetation will be improved and healthy. Faunal composition will improve simultaneously.	Protection of homestead, roadside and social forest habitat will improve bio-diversity	+3	Plantation action should be implemented	+3

IEC	Location	Baseline condition	FWOP	FWIP	Impacts	Magnitude of impact*	Mitigation Measure	Magnitude with EMP
	bank from Jaffarganj to Bachamara 7 km of the Padma Left Bank at Harirampur							
Activity: Plantation Activities (JRB-1)								
Terrestrial ecosystem Aquatic ecosystem. Floral composition and diversity. Faunal composition and diversity	6.5 km of the Verakhola towards start of Hurashagar river (Char Andharmanik) 4km from the starting point of Hurashagar (Char Andharmanik) to Korotoa bank. 10.5 km of the Jamuna river bank from Hat Pachil Bazar, Kaijuri to Benotia Hat/Bazar	River bank holds dense vegetations like trees, shrubs and herbs. Faunal diversity is moderate in this region Homestead and roadside vegetations like fruit bearing and timber trees are present.	River bank will erroted and destroyed the homestead and road side plantation in the area.	Protection of river bank will protect the trees that will maintain the ecological balance.	Vegetation of river banks will temporarily be damage and disturbed. Some trees will lose due to implementation of proposed intervention.	-3	Plantation of different species of saplings should be implemented.	+5

IEC	Location	Baseline condition	FWOP	FWIP	Impacts	Magnitude of impact*	Mitigation Measure	Magnitude with EMP
	2 km from Benotia Hat/Bazar to the start of Baral Khal, Verakola Hat.							

**No impact (0); Negative Impact (-); Positive Impact (+); Low Impact (1-3);Medium Impact (4-6); High Impact 7-8;Very High Impact (9-10).*

8.8 Socio-economic

8.8.1 Pre-Construction Phase

IEC	Location	Baseline	Impacts	Magnitude of impact*	Mitigation Measure	Magnitude with EMP*
Jamuna Right Bank-1(JRB-1)						
Activity->	Construction of labor shed with proper water and sanitation facilities, garbage disposal system, construction of stock yard and construction camp, mobilization of labor, materials, equipment and other machineries; preparing CC blocks at site.					
Resettlement	10.5 km of the Jamuna river bank from Hat Pachil Bazar, Kaizuri to Benotia Hat/Bazar 2 km from Benotia Hat/Bazar to the start of Baral Khal, Verakola Hat These villages/ mauzas are: Ratankandi	About more than 2500 HHs are living near embankment area for last 20 years and those who are living on embankment, mostly they are migrated from outside of these area.	About 1130 HHs in the different locations of project area will be displaced.	-1	Proper land compensation, PAPs should be ensured for displaced peopled of project area (refer to the resettlement plan)	0

IEC	Location	Baseline	Impacts	Magnitude of impact*	Mitigation Measure	Magnitude with EMP*
	Selachapri Dumbaria Alokdia Nundao					
Gender Issues	The whole project study area i.e. Ratankandi Mohakhola Sontosha Kashipur Dholai Marma Binotia	Women are mainly engaged in household level works and their involvement in outside of the home is now growing.	Labor mobilization may create disturbance for the local women.	-2	The labor mobilization activities should be strictly followed up by project authority.	-1
Public Health		About 40 percent people tend to receive health service from quack and 30 percent from paramedic/ diploma physicians and 20 percent from trained physicians. But it is noteworthy that about 10 percent do not receive treatment facility due to their impoverishment and communication problems	Because of having limited access to toilet and unhygienic environment, huge gathering of labors can create disturbance to health.	-1	Proper health and sanitation system should be ensured for labors.	0

** No impact (0); Negative Impact (-); Positive Impact (+); Low Impact (1-3); Medium Impact (4-6); High Impact (7-8); Very High Impact (9-10).*

IEC	Location	Baseline	Impacts	Magnitude of impact*	Mitigation Measure	Magnitude with EMP*
Jamuna Left Bank-2 (JLB-2)						
Activity->	Construction of labor shed with water and sanitation facilities, garbage disposal system, construction of stock yard and construction camp, labor and material/ equipment mobilization					
Resettlement	5 km of the Jamuna	About more than 2000 HHs are	About 534 HHs in the	-2	Proper land	-1

IEC	Location	Baseline	Impacts	Magnitude of impact*	Mitigation Measure	Magnitude with EMP*
Jamuna Left Bank-2 (JLB-2)						
	Left bank from Chauhali Sadar to Atpara 2 km of the Jamuna Left bank from Jaffarganj to Bachamara These villages/ mauzas are: Andharmanik Beda khola Mohakhola Kashipur Ata para Noya Para Dholai Kaulia Marma	living near embankment area for last 20 years and those who are living on embankment, mostly they are migrated from outside of these area.	different locations of project area will be displaced.		compensation, PAPs should be ensured for displaced peopled of project area	
Employment	Possible locations of labor camps (Char Janjira and Khashkaulia mauzas). Location of stock yard (to be selected by the Engineer In Charge). Location of CC blocks construction (at Khashkaulia mauza).	About 40 percent of total population is employed, 47 percent is engaged in household work, only less than one percent is looking for work and about 13 percent of total population is not working (it includes children and physically challenged population).	A temporary employment opportunity will be created for local labors during labor shed construction.	+1	-	0
Gender Issues	The whole study area	Women are mainly engage in	Labor mobilization	-2	The labor mobilization	-1

IEC	Location	Baseline	Impacts	Magnitude of impact*	Mitigation Measure	Magnitude with EMP*
			Jamuna Left Bank-2 (JLB-2)			
	i.e. Andharmanik Beda khola Mohakhola Kashipur Ata para Noya Para Dholai Kaulia Marma	household level works and their involvement in outside of the home is now growing.	may create disturbance for the local women.		activities should strictly follow up by project authority.	
Public Health		About 40 percent people tend to receive health service from quack and 30 percent from paramedic/diploma physicians and 20 percent from trained physicians. But it is noteworthy that about 10 percent cannot receive treatment facility due to their impoverishment and communication problems	Because of having limited access to toilet and unhygienic environment, huge gathering of labors can create disturbance to health.	-1	Proper health and sanitation system should be ensured for labors.	0

** No impact (0); Negative Impact (-); Positive Impact (+); Low Impact (1-3); Medium Impact (4-6); High Impact (7-8); Very High Impact (9-10).*

IEC	Location	Baseline	Impacts	Magnitude of impact*	Mitigation Measure	Magnitude with EMP*
			Padma Left Bank-1(PLB-1)			
Activity->	Construction of labor shed with water and sanitation facilities, garbage disposal system, construction of stock yard and construction camp, labor and materials/equipment mobilization					
Resettlement	Possible locations of labor camps (Ramkrishnapur and Andarmanik mauzas) Location of stock yard (to be selected by the Engineer In Charge), Location of CC block construction	About more than 2000 HHs are living near embankment area for last 20 years and those who are living on embankment, mostly they are migrated from outside of these area.	Due to temporary slope protection no displacement will take place but some construction disturbance might take place	-2	Construction disturbance should be minimized	-1

IEC	Location	Baseline	Impacts	Magnitude of impact*	Mitigation Measure	Magnitude with EMP*
Padma Left Bank-1(PLB-1)						
	(Andarmanik mauza) These villages are: Jaghannathpur Boxor Andharmanik Bholabaj Boyra					
Gender Issues	The whole project study area i.e. Jaghannathpur Boxor Andharmanik Bholabaj Boyra	Women are mainly engage in household level works and their involvement in outside of the home is now growing.	Labor mobilization may create disturbance for the local women.	-2	The labor mobilization activities should strictly follow up by project authority.	-1
Public Health		About 40 percent people tend to receive health service from quack and 30 percent from paramedic/diploma physicians and 20 percent from trained physicians. But it is noteworthy that about 10 percent cannot receive treatment facility due to their impoverishment and communication problems	Because of having limited access to toilet and unhygienic environment, huge gathering of labors can create disturbance to health.	-1	Proper health and sanitation system should be ensured for labors.	0

** No impact (0); Negative Impact (-); Positive Impact (+); Low Impact (1-3); Medium Impact (4-6); High Impact (7-8); Very High Impact (9-10).*

8.8.2 Construction Phase

IEC	Location	Baseline condition	Impacts	Magnitude of impact*	Mitigation Measure	Magnitude with EMP*

IEC	Location	Baseline condition	Impacts	Magnitude of impact*	Mitigation Measure	Magnitude with EMP*
Jamuna Right Bank-1(JRB-1)						
Activity->	Excavation of earth materials from the location of embankment; dredging of soil from the Jamuna and Baral rivers; dumping of earthen materials on the embankment; embankment surface labeling through dumping machine; movement of vehicles for carrying earth materials.					
Employment	Places adjacent to the Jamuna River bank where the new embankment would be constructed (from Hat Panchil to Benotia mauzas). Places adjacent to the existing embankment of the Baral river (from Verakhola to Dambarla mauzas). At Benotia where the bank protection works is to be carried out.	About 40 percent of total population is employed, 47 percent is engaged in household work, only below than one percent is looking for work and about 13 percent of total population is not working (it includes children and physically challenged population)	A temporary employment may be created for laborer during bailing out activities.	+1	-	0
Income generation		In the study area it is found that most of the income and expenditure are varying from 5,000 Tk. to 20,000 Tk. /month. About 75% of total household hire labor for agricultural production. The wage rate varies between 350 Tk. to 150 Tk. /day.	The additional income source may bring betterment of family happiness in the project area	+1	-	0
Labor migration	Labor would be internally in-migrated from adjacent upazilas/ districts.	People from the project area tend to migrate to Dhaka, Tangail, Sylhet and Rajshahi for better livelihood (60%) while a significant number of labor (20%) migrate to the project area with a view to subsisting the economy.	The in-migrated people may take part in construction work and this will bring opportunities for them also.	+2	-	0
Activity->	Dredging of earth materials from the Jamuna rivers; placing of geo-bags and CC blocks on the river banks; construction of sluices.					

IEC	Location	Baseline condition	Impacts	Magnitude of impact*	Mitigation Measure	Magnitude with EMP*
Employment	Jamuna River (from Hat Panchil to Benotia mauzas). Baral River (from Verakhola to Dambarla mauzas). Other possible locations of construction of drainage sluices.	About 40 percent of total population is employed, 47 percent is engaged in household work, only below than one percent is looking for work and about 13 percent of total population is not working. About 75% of total household hire labor for agricultural production.	A temporary employment opportunity will be created for many labors.	+1	-	0
Income generation		About 55% of people earn 5000tk-20,000tk per month and also being unemployed for days in a year and they keen on to involve in alternative works.	A small number of low earned people will enhance their income with this additional income source.	+1	-	0

** No impact (0); Negative Impact (-); Positive Impact (+); Low Impact (1-3); Medium Impact (4-6); High Impact (7-8); Very High Impact (9-10).*

IEC	Location	Baseline condition	Impacts	Magnitude of impact*	Mitigation Measure	Magnitude with EMP*
Jamuna Left Bank-2(JLB-2)						
Activity->	Movement of vehicles for carrying earth materials					
Employment	Places along the left bank of the Jamuna river where bank protection works would be carried out (Char janjira, Khasdalai, Atapara, Khash kaulia mauzas at Chauhali upazilla and Char	About 40 percent of total population is employed, 47 percent is engaged in household work, only below than one percent is looking for work and about 13 percent of total population is not working (it includes children and physically challenged	A temporary employment will be created for many labors during bailing out activities.	+1	-	+1

IEC	Location	Baseline condition	Impacts	Magnitude of impact*	Mitigation Measure	Magnitude with EMP*
	pailadhusar, Raghunathpur, Banghabari and Paila mauzas at Jafarganj of Sirajganj upazilla)	population).				
Income generation		Approximately over 55% of people earn 20000tk-5000tk per month also being unemployed for many days in a year and they are keen on to involve in alternative works.	A small number of low earned people will enhance their income with this additional income source.	+1	-	+1
Labor migration	Labor would be internally in-migrated from adjacent upazilas/ districts.	Overall 20% of labors are in-migrated in the study area.	Opportunities for in-migrant labors could be ensured during earthwork activities.	+2	-	+2
Public Health	The whole project study area i.e. Andharmanik Beda khola Mohakhola Kashipur Ata para Noya Para Dholai Kaulia	About 40 percent people tend to receive health service from quack and 30 percent from paramedic/diploma physicians and 20 percent from trained physicians. But it is noteworthy that about 10 percent cannot receive treatment facility due to their impoverishment and communication problems	Because of having limited access to toilet and unhygienic environment, huge gathering of labors can create disturbance to health.	-1	Proper health and sanitation system should be ensured for labors.	-1

** No impact (0); Negative Impact (-); Positive Impact (+); Low Impact (1-3); Medium Impact (4-6); High Impact (7-8); Very High Impact (9-10).*

IEC	Location	Baseline condition	Impacts	Magnitude of impact*	Mitigation Measure	Magnitude with EMP*
Padma Left Bank-1(PLB-1)						

IEC	Location	Baseline condition	Impacts	Magnitude of impact*	Mitigation Measure	Magnitude with EMP*
Activity->	Movement of vehicles for carrying earth materials					
Employment	Places along the left bank of the Padma River, where bank protection works would be carried out (Ram krishnapur, Andarmanik and Boyra mauzas of Harirampurupazilla).	About 40 percent of total population is employed, 47 percent is engaged in household work, only less than one percent is looking for work and about 13 percent of total population is not working. About 75% of total household hire labor for agricultural production.	Temporary employment opportunities will be created for labors during bailing out activities.	+1	-	-
Income generation		About 55% of people can earn 20000tk-5000tk per month, they are unemployed for many days in a year and keen on to involve in alternative works.	A small number of low earned people will enhance their income with this additional income source.	+1	-	-
Labor migration	Labor would be internally in-migrated from adjacent upazilas/districts.	Overall 20% of labors are in-migrated in the study area.	Opportunities of in-migrant labors could be created during earthwork activities.	+2	-	-

** No impact (0); Negative Impact (-); Positive Impact (+); Low Impact (1-3); Medium Impact (4-6); High Impact (7-8); Very High Impact (9-10).*

8.8.3 Post-Construction Phase

IEC	Location	Baseline	FWOP	FWIP	Impacts	Magnitude of impact*	Mitigation Measure	Magnitude with EMP*
Jamuna Right Bank-1(JRB-1)								

IEC	Location	Baseline	FWOP	FWIP	Impacts	Magnitude of impact*	Mitigation Measure	Magnitude with EMP*
Jamuna Right Bank-1(JRB-1)								
Communication	Possible locations for communication in project area - Hat Panchil - Benotia - Verakhola - Dambarla	Embankment cum road is locally used for communication and some light vehicle as well.	Embankment cum road could wipe out for last 10 years. In near future, main road of Hat Panchil to Benotia would be affected.	Communication facilities will be improved both in local and upazila level.	Road communication may be improved which convey better economy by expanding business option.	+3	-	0
Employment	- Ratankandi - Selachapri - Dumbaria - Alokdia - Nundao	About 40 percent of total population is employed, 47 percent is engaged in household work, only below than one percent is looking for work and about 13 percent of total population is not working. About 75% of total household hire labor for agricultural production.	Temporary employment will be created for many labors during labor shed construction.	More employment opportunities will be created for farmers and fishers of the project area.	In future, a number of employment opportunities may be generated in culture fish and agriculture sector.	+4	-	0
Income generation		Approximately over 55% of people earn 20000tk-5000tk	A small number of low earned people will	People income will increase in future by creating more	Income will be increased for all classes i.e. labor to businessmen.	+4	-	0

IEC	Location	Baseline	FWOP	FWIP	Impacts	Magnitude of impact*	Mitigation Measure	Magnitude with EMP*
Jamuna Right Bank-1(JRB-1)								
		per month, are unemployed for many days in a year and keen on to involve in alternative works.	enhance their income with this additional income source.	work options.				
Communities settle on embankments		None	Not applicable as without project there will be no embankment.	Potential for families to settle on embankments during times of flood events when they have lost	The embankments lose the purpose it is designed for.	+2	Design includes Platforms on the base of the embankments to provided temporary shelter to potential victims of floods. However, with flood protection measures it is expected that the number affected will be less	0

** No impact (0); Negative Impact (-); Positive Impact (+); Low Impact (1-3); Medium Impact (4-6); High Impact (7-8); Very High Impact (9-10).*

IEC	Location	Baseline	FWOP	FWIP	Impacts	Magnitude of impact*	Mitigation Measure	Magnitude with EMP*
Jamuna Left Bank-2(JLB-2)								
Protection of municipal area including	Chouhali bazaar and adjacent villages	Damages of municipal areas due to erosion	Municipal area including markets and	Protective work will protect the municipal area	Municipal area, markets and homesteads will	+6	N/A	N/A

IEC	Location	Baseline	FWOP	FWIP	Impacts	Magnitude of impact*	Mitigation Measure	Magnitude with EMP*
markets and homesteads	Jafarganj bazaar and adjacent village		homesteads will certainly be eroded	including markets and homestead	be protected and business will be run properly. Government office, and educational and religious institutions will be protected			
Employment	Char janjira Khasdalai Khash kaulia Pailadhusar Raghunathpur Paila	About 40 percent of total population is employed, 47 percent is engaged in household work, only below than one percent is looking for work and about 13 percent of total population is not working. About 75% of total household hire labor for agricultural production.	A temporary employment will be created for many labors during labor shed construction.	More employment opportunities may be created for farmers and fishers of the project area.	In future, a number of employment opportunities may be generated in culture fish and agriculture sector.	+4	-	+4
Income		Approximately	A small number	People income	Income will be	+4	-	0

IEC	Location	Baseline	FWOP	FWIP	Impacts	Magnitude of impact*	Mitigation Measure	Magnitude with EMP*
generation		over 55% of people earn 20000tk-5000tk per month, are unemployed for many days in a year and keen on to involve in alternative works.	of low earned people will enhance their income with this additional income source.	will increase in future by creating more work options.	increased for all classes i.e. labor to businessmen.			

** No impact (0); Negative Impact (-); Positive Impact (+); Low Impact (1-3); Medium Impact (4-6); High Impact (7-8); Very High Impact (9-10).*

IEC	Location	Baseline	FWOP	FWIP	Impacts	Magnitude of impact*	Mitigation Measure	Magnitude with EMP*
Padma Left Bank-1(PLB-1)								
Communication	The possible locations for communication system are: Jaghannathpur Boxor Andharmanik Bholabaj Boyra	Bank protection cum road is locally used for communication and some light vehicle as well.	Bank protection cum road wiped out recently. In near future, main road of Alfadanga to Faridpur would be affected.	Communication facilities will be protected at its current levelboth in local and upazila level.	Road communication will remain the same	+3	-	0
Protection of municipal area including	Ramkrishnapur bazaar and adjacent other	Damages of municipal areas due to erosion	Municipal area including	Protective work will protect the municipal area	Municipal area, markets and homesteads will	+6	N/A	0

IEC	Location	Baseline	FWOP	FWIP	Impacts	Magnitude of impact*	Mitigation Measure	Magnitude with EMP*
markets and homesteads	villages Andharmanik bazaar and adjacent other village		markets and homesteads will certainly be eroded	including markets and homestead	be protected and business will be run properly. Government office, and educational and religious institutions will be protected			
Employment	The possible locations for employment opportunities in future are: Jaghannathpur Boxor Andharmanik Bholabaj Boyra	A number of labor, man powers are unemployed in many days in a year and 6% of skilled worker are permanently out-migrated. Also, 23% of seasonal out migrants daily out-migrated for employment.	A temporary employment will be created for many labors during labor shed construction.	More employment opportunities will be created in agriculture and fisheries field.	In future, a number of employments will generate in fish culture and agriculture activities.	+4	-	0
Income generation		Over 55% of people earn 20000tk-5000tk per month, are	A small number of low earned people will	People income will increase in future by creating more	Income will be increased for all classes i.e. labor to businessmen.	+4	-	0

IEC	Location	Baseline	FWOP	FWIP	Impacts	Magnitude of impact*	Mitigation Measure	Magnitude with EMP*
		unemployed for many days in a year and keen on to involve in alternative works.	enhance their income with this additional income source.	work options.				

** No impact (0); Negative Impact (-); Positive Impact (+); Low Impact (1-3); Medium Impact (4-6); High Impact (7-8); Very High Impact (9-10).*

8.9 Summary of anticipated environmental Impacts and Mitigation Measures

8.9.1 JRB-1 Flood Embankment Potential Impacts

357. The reconstructed Brahmaputra Right Embankment[29] along the Jamuna and rehabilitated flood embankment works along the Hurashagar/Baral included in JRB-1 could have adverse impacts on the floodplain water resources. Residual adverse impacts from the JRB-1 embankment are a possibility, and contribute to the rationale for the classification of Tranche 1 as ADB environmental category A.

358. The primary and intended impact of the JRB-1 flood embankments is to reduce flood damage to crops and infrastructure, and to induce greater economic investment and productivity in floodplain agriculture and other activities by reducing flood risk. Figure 8.1 shows the modeled effect of the JRB-1 embankment works on water levels behind the embankment (the difference between with-project and without-project water levels) for 2003 river flood levels which approximate the 1:2 year return period flood.

359. The land type changes induced by the embankment are shown inTable 8.1, Figure 8.2, and Figure 8.3. Currently, JRB-1 seasonally flooded land (ie within the proposed flood-protected area) consists of 12,000 ha that is flooded to 120-360 cm (F3 land type) and 4,000 ha that is deeply flooded to >360 cm (F4 land type). Of this, JRB-1 will transform about 40 per cent (6,600 ha) to flood-free conditions (F0 land type, 0-30 cm). Another 10 per cent (1900 ha) will be converted to moderately-flooded conditions (F1 and F2 land types, 30-120 cm). These hydrologic changes within the proposed JRB-1 flood-protected area have numerous potential secondary impacts. Intended beneficial impacts are significantly reduced flood damage to agriculture and infrastructure; increased cultivated area and cropping intensity and the resulting increases in agriculture / aquaculture production.

Table 8.1: JRB-1 Impacts on Land Type

Pre and Post Project Change (post-pre)	F0 0-30 cm	F1 30-90 cm	F2 90-120 cm	F3 120-360 cm	F4 >360 cm	Total
(ha)						
Pre	12673	117	2313	12024	3825	30952
Post	19315	1116	3177	5319	2178	31105
Change	6642	999	864	-6705	-1647	153
% change	52%	854%	37%	-56%	-43%	0%

Notes: Land type areas are taken from the flood modelling of the area enclosed by the embankments, for the 2003 flood event, adjusted to reflect RADARSAT flood extent information. 2003 was chosen to approximate the average moderate *bonna* 1:2 flood event.

Source: Tables 5-3 and 5-4, Final Report, Annex D – Flood Modelling (revision 13 dated 21 June).

[29] This embankment eroded from 1996 onwards after having protected the Hurashagar Flood Control and Drainage Project. The embankment was not rebuilt and progressive erosion lead to a more than 10km wide gap. Since 2009, the JMREMP project protected 10km of riverbank from erosion allowing the reconstruction of the embankment.

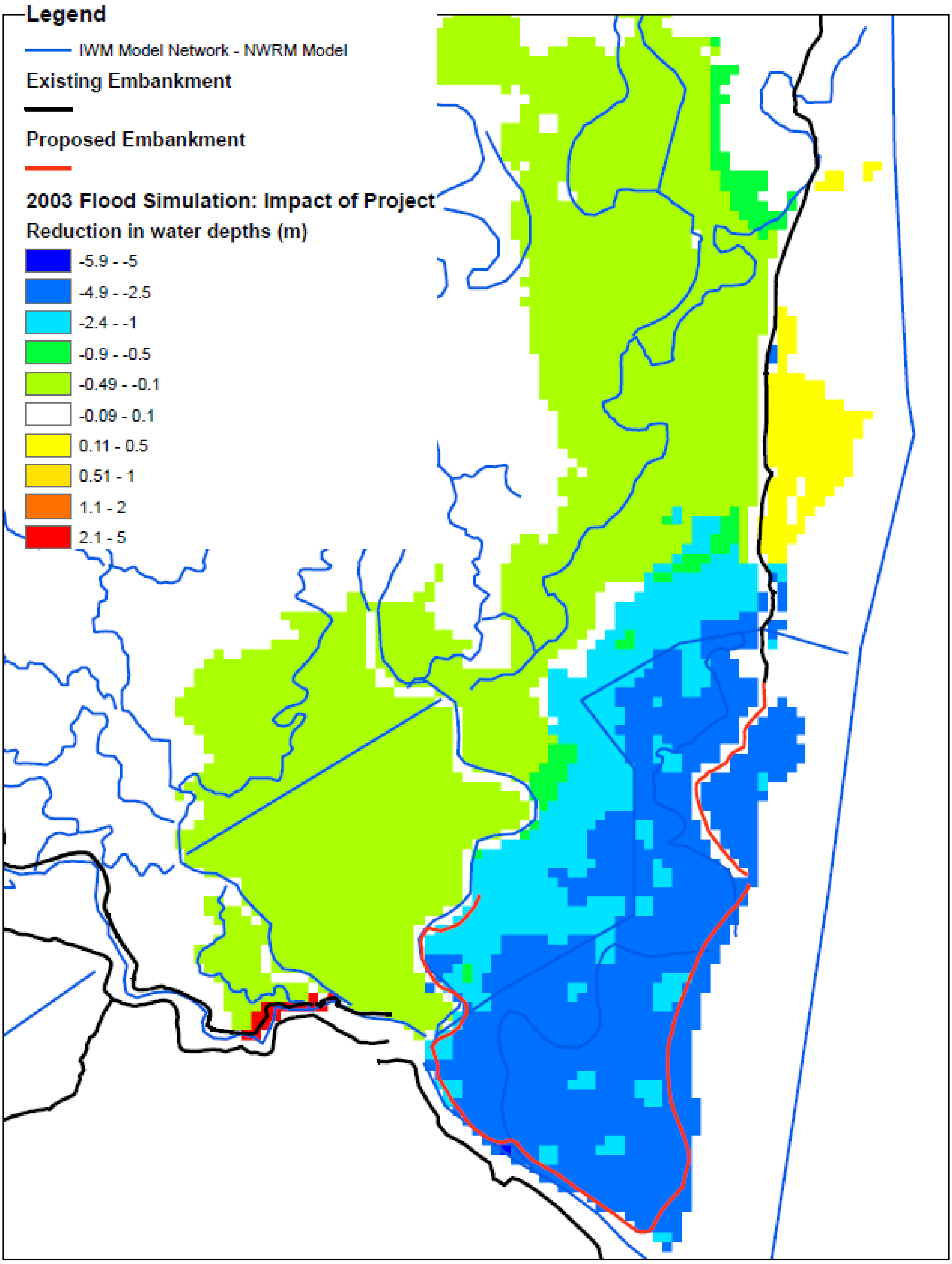

Figure 8.1: Effect of JRB-1 on Water Levels, 2003 Flood Condition

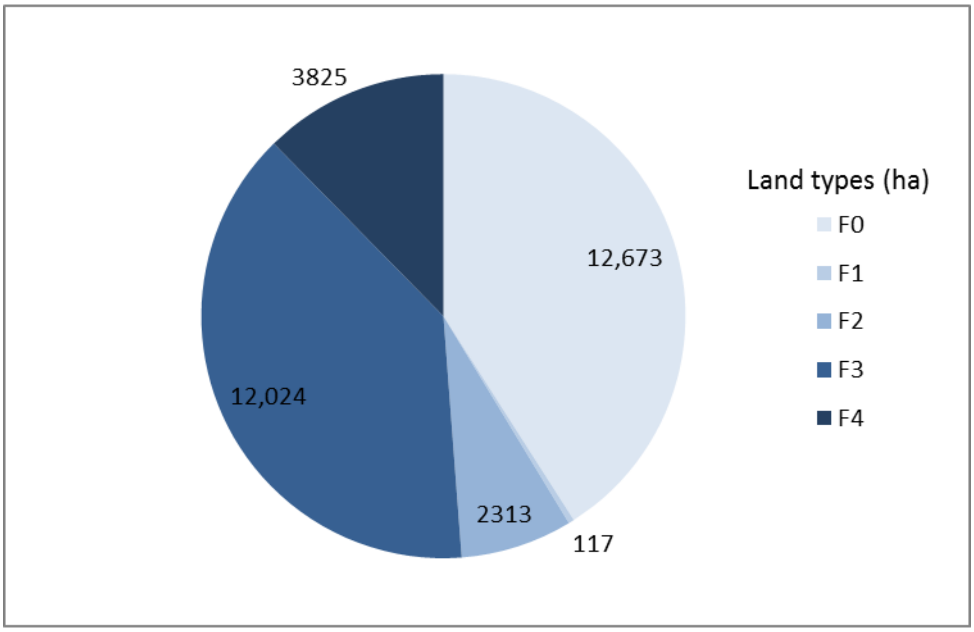

Figure 8.2: JRB-1 Land Type Areas, Pre-Project

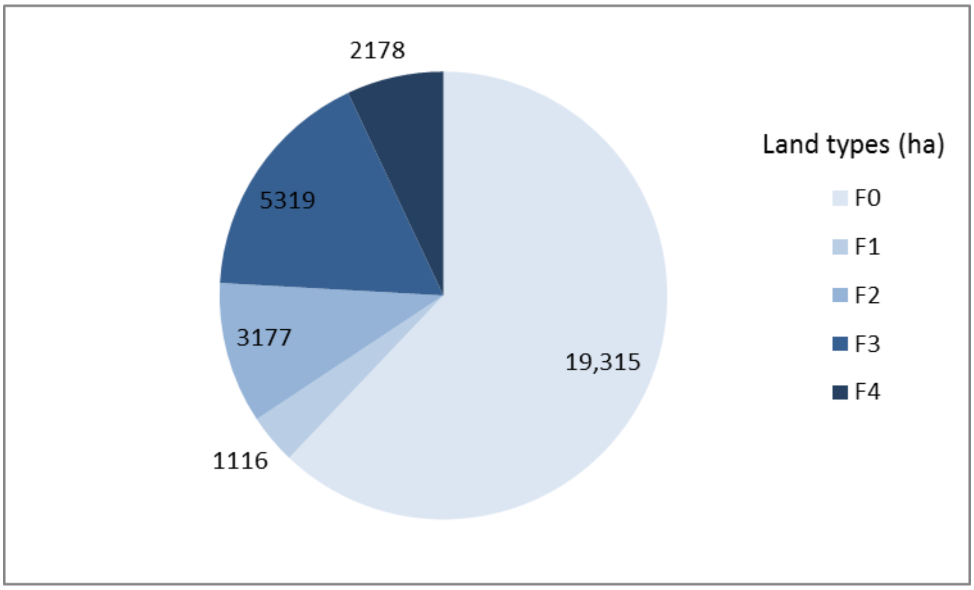

Figure 8.3: JRB-1 Land Type Areas, Post-Project

360. Potential adverse impacts of the hydrologic and land type changes described above are diverse. *Floodplain aquatic (wetland) habitats will be degraded or extirpated* due to reduced flooded area, depth, and duration (mentioned above); reduced hydrologic connectivity; and physiochemical / water quality changes. This in turn will *adversely affect floodplain-dependent openwater fish* species migration, population levels, and catch levels[30], as well as *wetland biodiversity*, services, and products more generally. Wetland products (mostly fish and aquatic plants) in Bangladesh have been documented to be worth as much as US$650/ha.[31] This production

[30]The project team estimates the loss of 15.3MT in capture fish production (see Chapter 8)

[31]Thompson, Paul M. (2008). Conserving and Restoring the Benefits from Bangladesh Wetlands. Presented at the 12th Biennial Conference of the International Association for the Study of Commons - Governing Shared Resources: Connecting

will be lost where more deeply-flooded F3-F4 land is converted to F0-F2 higher land types. However, the loss of open water fisheries will be compensated by the increase in culture fisheries, resulting in a net gain in fish production. The embankment can *impede cross-drainage* (drainage congestion), adversely affecting agriculture within the protected area, and blocking the movement of migrating fish. A number of sluice gates will reduce the risk of drainage congestion and allow some cross movement of fish during the migration season.

361. The loss of floodplain fisheries will be further mitigated through a program enhancing wetland biodiversity and aquaculture (please refer Annex 14). The program will be implemented through a specialist NGO and supervised through the Department of Fishereis (DOF). Vulnerable groups, specifically the poor, project affected people, and women will be given preference in these activities.The overall status of fish migration in the study area is moderate to poor (refer to chapter 5.6.3) while the project design includes a number of additional sluice gates/regulators (refer to table 4.4). Both facts and in addition the positive effect of the existing geobag revetment on small fish somewhat reduce the impact of the embankment construction on migratory fish or carnivorous fish species depending on them. The more concentrated migration route through the Hurashagar/Baral tributary is not blocked.

362. Flood-control-led expansion of high-yielding varieties (HYVs) may *increase utilization of ground water and surface water for irrigation* and may *increase fertilizer and pesticide usage* that in turn may adversely affect water quality and availability for other uses or at other locations. Newly flood-free lands may have less than optimal residual moisture for winter agriculture, compromising yields or causing high irrigation water consumption and costs in these areas. Given the close vicinity to the Jamuna on one side and its tributaries Hurashagar/Baral and Karakoya combined with generally permeable, sandy soil sub-strata, there are little risk of depleting the groundwater table significantly. In order to reduce the amount of fertilizer and pesticides integrated crop and pest management measures, part of the program of the Department of Agricultural Extension (DAE) will be encouraged.

363. Provision of embankment flood protection typically stimulates accelerated investment in the protected area. This *project-induced investment* has obvious economic benefits but paradoxically it also has less obvious costs: over time, an increasing amount of infrastructure and potentially an increasing number of lives, come to be *located in lower-lying areas* compared to the without-project situation.[32] Embankments can greatly reduce but not entirely eliminate the flood risk to such areas, as embankments can fail for various operational, hydrologic, hydraulic, and geotechnical reasons.[33]

364. Best-practice flood damage reduction assessment methodologies address the residual risk of embankment failures[34]. The feasibility level designs studied different special risks, such as earthquake, pore over-pressure due to repid draw-down at the end of the flood season, and the risk of seepage. The embankment width and side slopes were designed to withstand the loads to be expected. As such the feasibility level design of the embankments accounts for technical regulations in effect in Bangladesh and common engineering practice world-wide and assures that the embankments do not fail for the design loads. In addition, an extensive community-based flood risk management program addresses the residual risk in developing volunteer groups that support enhanced awareness and preparedness to the flood risk.

Local Experience to Global Challenges, University of Gloucestershire, UK. http://iasc2008.glos.ac.uk/conference%20papers/papers/T/Thompson_220701.pdf

[32] Whipple, William. 1969. "Optimizing Investment in Flood Control and Floodplain Zoning." Water Resources Research 5 (4) (August): 761–766. doi:10.1029/WR005i004p00761.

[33] National Research Council. 2000. *Risk Analysis and Uncertainty in Flood Damage Reduction Studies*. Washington DC: Committee on Risk-Based Analysis for Flood Damage Reduction, Water Science and Technology Board. National Academies Press. http://www.nap.edu/catalog.php?record_id=9971, p. 51.

[34] Mori, Koichiro, and Charles Perrings. 2012. "Optimal Management of the Flood Risks of Floodplain Development." Science of The Total Environment 431 (August): 109–121. doi:10.1016/j.scitotenv.2012.04.076.

8.9.2 JRB-1, JLB-2, and PLB-1 Riverbank Protection Works Potential Impacts

365. Riverbank protection works at the three subproject sites has the purpose of protecting the existing floodplain habitat from constinuous and systematic erosion. The Jamuna has widened by around 4km from 1973 to 2013 mostly as a consequence of the sediment wave triggered by the Great Assam Earthquake in August 1950. This sediment wave has changed the river environment, characterized by one or two pronounced deep channels to a multitude of shallower channels, many falling dry during the dry season.

366. Specific changes associated with Tranch 1 riverbank protection work were assessed through a specific morphology study carried out as part of this feasibility study. The morphology study concludes that the initial (Tranche-1) riverbank protection works has little impact on the overall morphology of the Jamuna, including the immediate downstream areas and are found to be minor in terms of morphological impact. In all cases the riverbank protection work encourages deeper channels along the protected bank but with expected little impact on downstream areas.

367. The morphology study also assessed future potential channel options to assess if the riverbank protection conflicts with the natural established channel pattern currently observed. The non-symetric Jamuna Bridge has substantially changed the lower part of the river, creating a large attached char at the right bank from the western bridge abutment to about Enayetpur, and resulted in a single channel in this reach, which is expected to remain stable without riverbank protection at both sides. Downstream, the river exhibits two channels, enclosing a large char. The initial morphological assessment indicates that this currently existing channel pattern is likely the most desirable for the future, meaning that the overall natural river pattern will not be altered by the proposed interventions. The same holds true for the situation in the upper Padma River, where the two-channel solution appears to be the best in the long run, also meaning that the existing conditions would not be altered and the riverbank protection would support the currently existing natural river pattern.

368. The consequence of the transformation of the river environment on the habitat was not systematically studied. Not much is know about the impact on the biodiversity of the conversion of a river characterized by few deep channels to a multitude of shallow channels. Furthermore, this development is superimposed by dramatic population growth (from around 70million to 150 million) with increasingly intensifying land use on the flood plains but also systematic fishing in the rivers using floating nets in the main ones. Fish specialists indicate that the total fish population has decreased over time.

369. First attempst have been made to assess the impact of riverbank protection on fish[35]. The JMREMP, 2007 study found that there were more fish species and higher population numbers at protected banks, as opposed to unprotected banks. The size of the fish depends on the size of the voids in the protection, which means that large voids in concrete blocks tend to attrackt larger fish, specifically carnivores, however in fewer numbers; while geobag revetments attract smaller fish in larger numbers. CEGIS, 2011 identified overall positive impacts of geotextile bag revetements on water resources, fisheries, the algae community, the ecosystem and the socio-economy. Important findings are that there is no change in water quality, the terrestrial habitat is protected, and the scocio-economic conditions are improved for the local population, providing employment opportunities during construction, health and sanitation conditions, fishing opportunities, and especially improving the situation of mostly home-bound women. Geotextile bag revetments might change the composition of fish species, alter the habitat of the bethic community, as well as cause local shifting of the migratory routes of the dolphins[36] during construction. However, these effects

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[35] JMREMP; 2007. Bank Protection and Fisheries at JMREMP two Sub-projects. Dr. Munir Ahmed, Special Report 24, May. CEGIS, 2011: Final Report on Environment Impact Assessment (EIA) for Use of Sand-filled Geob-Bags Under Water

[36] Dolphins normally chose the thalweg, i.e. the deeper part of the river for migration

are reversible and the constructed revetments do not impact on thefree movement of dolphins and the benthic habitat is quickly restored over geobag revetments.

370. With respect to the overall use of the recommended riverbank protection technology, CEGIS 2011 concludes: *Considering all environmental, social and technical consequences of the geobag use under water, it might be concluded that compared with CC block use alone, geo-bag use under water with CC block used above water is more environmentally sustainable, socially acceptable, technically feasible and economically cost effective if the quality requirements and design requirements are assured and monitored.*

371. Overall the proposed Tranche-1 riverbank protection of limited length has no siginificant negative impacts on the river but the potential to enhance the biodiversity in places. Locally more stable and deeper channels, as encouraged by riverbank protection, support fish populations. The deeper channels provide a better refugium especially during systematic fishing with floating nets, are more attractive for dolphins which depend on the deeper channels also for migration. The construction season lies outside of the migration season of the dolphins (during the rising and falling of flood waters) and does not overlap much with the surfacing time of the juvenile and neonate dolphins in the morning and afternoon-evening hours. Benthos communities are known to settle on geotextile bags and apart from the disturbance during the dry season construction, when benthos are not active, the inert geobag revetments do not have significant negative impacts on the river. The Program proposes to establish supporting enhancement measures during later tranches by placing navigation buoyage alongside protected riverbanks, which would discourage systematic, wide-scale fishing with floating nets, and to study sanctuary / protected area options.

8.10 Cumulative Impacts

372. Significant cumulative impacts arise (i) if multiple interventions (plus possibly ongoing natural processes) with small impacts affect the same area or system during a particular time period; or (ii) if the (small) instantaneous impacts of one or more interventions persist in a particular area or system over a long period of time (possibly in parallel with ongoing natural processes having similar or related impacts).

373. With regard to (i) above, in the Brahmaputra-Jamuna-Padma channel / floodplain system, there are multiple major riverbank erosion protection, and flood embankment, projects that completed and in the pipeline. These include, in addition to Tranche 1, the completed ADB Jamuna-Meghna River Erosion Management Project; the river engineering and water management works of the Jamuna Bridge Project; the World Bank-funded River Bank Improvement Project (RBIP) that is expected to commence shortly; and), and FRM Tranches 2 and 3. The impacts and influence zones of these projects potentially overlap (cumulate) in space, time, and effects.

374. With regard to (ii) above, river confinement within embankments, and channel stabilization to a fixed channel configuration, both persistently shift water and sediment away from the floodplain. Over longer-term time scales – decades or centuries,– their effects can accumulate.

375. In particular, floodplain land levels may gradually become lower (*land subsidence*), in areas where the thick delta sediment wedge compacts plus tectonic subsidence proceeds more rapidly than new sediment is deposited at the land surface. *Channel bed levels may gradually increase* and *channels may fill in*, in reaches where confined flood waters deposit sediment in-channel, that in unembanked conditions would have been deposited on the floodplain. Eventually, *channels can become perched above the floodplain*, *increasing the risks of flooding, drainage congestion, embankment failure, and, ultimately, channel avulsion*.[37,38] These *adverse impacts can be*

[37] Goodbred, Steven L, and Steven A Kuehl. 1998. "Floodplain Processes in the Bengal Basin and the Storage of Ganges–Brahmaputra River Sediment: An Accretion Study Using 137Cs and 210Pb Geochronology." Sedimentary Geology 121 (3-4) (November): 239–258. doi:10.1016/S0037-0738(98)00082-7.

exacerbated if they occur *in parallel with climate changes such as increased local or catchment rainfall,* or *rising sea level* for areas where this affects local drainage.

376. Another potential *cumulative and intended* impact of an ongoing program of riverbank erosion protection works *is to control the river widening* process. The Brahmaputra-Jamuna-Padma Rivers widened significantly during the period 1950-2000. The cause of this widening is now believed to have been the passage of the 1950 Assam earthquake sediment wave. This sediment wave is thought to have passed, leaving the channel wider than necessary to convey future flows[39]. The progressive channel narrowing would be achieved as a cumulative impact of multiple river engineering interventions over time that promote land accretion and channel simplification. On the other hand, riverbank protection structures with significant lengths after multiple interventions may triger new erosion on downstream riverbanks. Such downstream impacts by tranche-1 intervention with limited length of bank protections is unlikely to be significant.

377. During Tranche 1 a long term river morphological/stabilization study will be carried out, where impacts of all planned and ongoing projects will be assessed. Environmental assessments to be conducted for Tranches 2 and 3, which will build on the findings of this river morphological/stabilization study, will look at the long-term cumulative impacts of the entire MFF on open water fish species, flood plain aquatic habitats, and wetlands. Regular survey and monitoring of post-construction behaviours of riverbanks and bathymetry around the new bank protection structures are built into the project design. Resuts of surveys and monitoring will also be incorporated in the long-term stabilization study and project design of Tranches 2 and 3. Additional studies to be conducted are listed in paragraph 380.

8.10 Future Mitigation Measures

378. While the tranche-1 project consists of limited riverbank protection measures and the restoration/rehabiliation of an eroded/degraded embankment, future tranches plan to extend these measures. The limited and isolated riverbank protection measures of Tanche-1 do not change the existing channel pattern, as established by the morphololgical study. However, follow on tranches, part of the total program, could do so when existing, initial work gets extended over greater length of some ten kilometers. As such, the proposed Tranche-1 combines construction measures with very limited morphological impact with two extensive studies on (i) potential ways towards larger river-reach stabilization and (ii) the establishment of a river sanctuary.

379. Potential alternative river-reach stabilization alternatives with impacts and mitigation measures will be assessed during Tranche-1 through several systematic studies. During the first two years of Tranche-1 a systematic river stabilization study will be conducted. The river stabilization study will build on the ongoing natural development towards a more consolidated channel pattern. Alternative solutions will be developed how to support this channel pattern towards a more systematic stabilization of the lives on the floodplain. Social and environmental consideratiosn will form an integral part of the study in order to determine the impacts of different stabilization options, but also collect missing data and broaden the understanding about critical social and environmental parameters. The study results are alternative solutions for river-reach stabilization

[38] Pickering, Jennifer L. 2013. "Late Quaternary Sedimentary Record of Holocene Channel Avulsions of The Brahmaputra River In The Upper Bengal Delta Plain". Master thesis, Tennesee USA: Vanderbilt University
[39] Sarker, Maminul Haque, and Colin R. Thorne. 2006. "Morphological Response of the Brahmaputra–Padma–Lower Meghna River System to the Assam Earthquake of 1950." In Braided Rivers, edited by Gregory H. Sambrook Smith, James L. Best, Charlie S. Bristow, and Geoff E. Petts, 289–310. Oxford, UK: Blackwell Publishing Ltd. doi:10.1002/9781444304374.ch14.

that accounts for the multitude of different drivers, outline least-impact solutions, identify the optimimal alternative, and design the following tranche work.

380. Starting from there, the feasibility study for tranche-1, continaing environmental assessment, will be supplanted by by a specialist sanctuary study that details the requirements for a river sanctuary in response to negative impacts from river stabilization. The outline ToR and time frame for implementation is provided in Annex 12. The sanctuary study is part of the Tranche-1 design and scheduled for implementation during year-3 and 4. It will specifically address impacts on critical habitats and trans-boundary/internationally migrating/threatened species, following (i) the Padma Bridge Project terms of reference for biodiversity baseline studies and monitoring, and a biodiversity sanctuary; and (ii) India's recently-promulgated Dolphin conservation action plan, as well as (iii) assessing migratory bird impacts.

381. Building on the outcome (recommended approach) of the river stabilization study, a river sanctuary study is part of the Tranche-1 design, to be conducted in year 3 and 4 by a specialist firm/NGO. This study will plan a river sanctuary that mitigates all identified negative impacts of river stabilization and additionally attempts to enhance the river biodiversity, specifically providing sheltered aquatic habitats. In addition to this study, the program design for Tranche-2 already contains an element of enhancing the aquatic environment along protected banks

382. The environmental assessment for Tranche-2, part of the feasibility study continues the aggressively mainstreamed environmental aspects into the project design. In addition, the EIA will follow a parallel approach to (i) address remaining uncertainties associated with the database on the impacts of riverbank protection on the river habitat including migratory species, while (ii) continuing to reduce the imminent erosion risk to the livelihoods of a large number of mostly poor people on the floodplain.

9. Analysis of Alternatives

383. The three sub-reaches selected for FRERMIP physical works– JRB-1, JLB-2, and PLB-1 – were chosen from 13 sub-reaches into which the FRERMIP project area was divided based on discussions among BWDB, ADB, and the PPTA consultant. These 13 were evaluated using a multi-criteria assessment approach taking into consideration three primary criteria (riverbank erosion, flooding, and poverty) and several secondary criteria (related to planning, design, cost-benefit, and safeguards issues) (refer to Annex 10). Of the six sub-reaches scoring highest[40], three were screened out due to a lack of active erosion and/or conflicts with other immediately planned interventions.

384. While riverbank protection was placed according to immediate needs especially for growth centers ("something to defend"), embankment construction considered alternatives especially for the areas JLB-2 and PLB-1. BWDB contemplates the establishment of two polders (ring-embankments) covering large parts o JLB-2 and PLB-1 with very long ring embankment lines. These were compared to the solution of an embankment only along the riverbanks of the main rivers, reducing the length of the embankments and as such minimizing the footprint and related land acquisition and resettlement. In addition, open distributaries would allow all-year-round water flow to the area, which specifically enhances the dry season water management[41].

[40] The highest ranking sites scored between 300 and 370 points, while the lower ranking sites ranged between 200 and 260 points.
[41] Annex D of the feasibility study, "River and Charland Morphology and River Engineering" provides more background.

10. Environmental Management Plan

385. In the previous chapter, the possible impacts for each selected Important Environmental Component (IEC) have been assessed and evaluated. In addition to that, a number of mitigation measures have been mentioned for the negative impacts only. This chapter depicts a detail elaboration of the Environmental Management Plan (EMP) suggested by the study team. The EMP entails mitigation measures for the negative impacts, enhancement measures for the positive impacts, compensation for the non-mitigated impacts and contingency measures for the accidental events that might occur.

386. The EMP has been organized per site and distinguishing pre-construction, construction, and post-construction phase, to facilitate the monitoring process.

387. Impacts and mitigation measures broadly cover the three topics: (i) construction, (ii) biodiversity and (iii) aquaculture. Most construction related impacts are mitigated by contractors during construction. Issues pertaining to biodiversity and aquaculture, especially related to the construction of the embankment at JRB-1 will be implemented through a specialist NGO, following the principles established by the biodiversity program of GIZ at Pabna, now extended to Sirajganj, and as part of the livelihood program of the resettlement plan. In addition, aquaculature will be supported to compensate for the loss of openwater fisheries on the floodplain after the construction of the embankment at JRB-1. Aquaculture has a strong relevance for the poor and is part of the livelihood component of the resettlement plan, which is a separate compensation mechanism.

388. In addition to mitigating direct impacts of the tranche-1 work, a specialist firm/NGO will be retained to study the establishment of a river sanctuary, in accordance with future (Tranche-2 and Tranche-3) stabilization plans, looking beyond the localized Tranche-1 measures and aiming at identifying and mitigating any impacts from larger scale river-reach stabilization during Tranche-2 and Tranche-3.

10.1

10.2 Subproject JRB-1

10.2.1 Pre-Construction Phase

IEC	Location	Impacts	Magnitude of impact	Mitigation/ Enhancement/ Compensation/ Contingency	Magnitude with EMP	EMP Cost (Lac Tk)	Responsible Agency
Activity: Construction of labor shed, stock yard and construction camp, mobilization of labor, materials, equipment and other machineries, construction of CC blocks at site.							
Air quality	- Possible locations of labor shed (Dombarla, Locha, Dorta Mehi, Jagtala, Gopalpur mauzas); stock yard (to be selected by the Engineer in Charge) and site of CC block construction (Benotia Mauza). - Road side places used for transportation of materials (Kaijuri-shahjadpur road and the rural roads from Hat panchil to barnia mauzas and from Nagardala to Shelachapri mauzas).	Minor impact may occur from the small amount of dust generated due to movement of vehicles, construction materials and machineries; construction of labor shed and stock yard; preparation of CC block at site.	-2	Mitigation: - Construction materials should be covered with thick materials (i.e. polythene) during transportation to resist the generation of dust. - Water to be sprinkled to control the generation and spreading of dust; as and where required.	-1	1	Implementation: Contractor Monitoring: Nominated Engineer (SMO, BWDB)
Noise	- Possible locations of labor shed (Dombarla, Locha, Dorta Mehi, Jagtala, Gopalpur mauzas), stock yard (to be selected by the Engineer in Charge), site of CC block construction (Benotia Mauza).	Low impacts caused due to noise generation for mobilization of construction materials and construction of labor shed, stockyard and CC blocks.	-2	Mitigation: - Noise levels due to vehicular movement are to be kept within permissible limit. - Construction camps, labor shed, and sites for CC block construction are to be located	-1	N/A	Implementation: Contractor Monitoring: Nominated Engineer (SMO, BWDB)

IEC	Location	Impacts	Magnitude of impact	Mitigation/ Enhancement/ Compensation/ Contingency	Magnitude with EMP	EMP Cost (Lac Tk)	Responsible Agency
	- Road side places through which construction materials would be transported (Kaijuri-shahjadpur road and the rural roads from Hat panchil to barnia mauzas and Nagardala to Shelachapri mauzas).			far away from settlements.			

Land Resources

IEC	Location	Impacts	Magnitude of impact	Mitigation/ Enhancement/ Compensation/ Contingency	Magnitude with EMP	EMP Cost (Lac Tk)	Responsible Agency
Activity	***Construction of labor sheds, stocking yard with CC block preparation yard for Embankment Rehabilitation activities***						
Land loss	Location-1: Dombaria (Baghabari towards Shahzadpur-6.5km)	Possibility of loss of 1.04 ha land for existing embankment	0	• Construction activities should be carried out as per design. • Labor shed should preferably be constructed on fallow or khas land. • Landowners affected by the construction of labor shed and placement of filling materials on agriculture land should be noticed ahead of time so that the area might not be affected for growing crops. • Labor sheds, and other project related activities should be optimized with the purpose of minimum disruption to cultivable lands and standing crops. • Adequate cash compensation should be provided to the land owners /share croppers. • The compensation should be determined based on the amount of land temporarily going out of cultivation.	+1	No cost involvement of cost for land due to activities in existing embankment	Implementation: Contractor Monitoring: Nominated Engineer (SMO, BWDB)
	Location-2: Lochha (Shahzahdpur-Korotoa bank-4.0km)	Possibility of Loss of 1.08 ha existing embankment land	0		+1		Implementation: Contractor Monitoring: Nominated Engineer (SMO, BWDB)
					Sub-Total	**00**	

IEC	Location	Impacts	Magnitude of impact	Mitigation/ Enhancement/ Compensation/ Contingency	Magnitude with EMP	EMP Cost (Lac Tk)	Responsible Agency
Activity	***Construction of labor sheds, stocking yard for construction of new embankment activities***						
Land loss	Location-1: Gopalpur (Kaizuri-Hura sagar offtake-10.5km)	Possibility of 1.02 ha of agricultural land would be lost temporarily	-1	• Construction activities should be carried out as per design. • Labor shed and stocking yard should preferably be constructed on fallow or khas land. • Landowners affected by the construction of labor shed and placement of filling materials on agriculture land should be noticed ahead of time so that the area might not be affected for growing crops. • Labor sheds and other project related activities should be optimized with the purpose of minimum disruption to cultivable lands and standing crops. • Adequate cash compensation should be provided to the land owners /share croppers. • The compensation should be determined based on the amount of land temporarily going out of cultivation.	+2	0.38 (for compensation)	Implementation: Contractor Compensation payment: BWDB Monitoring: Nominated Engineer (SMO, BWDB)
	Location-2: Jagtala Kaizuri-Benotia-2.0km)	Possibility of 1.04 ha of agricultural land would be lost temporarily	-1		+2	0.39 (for compensation)	Implementation: Contractor Compensation payment: BWDB Monitoring: Nominated Engineer (SMO, BWDB)
	Location-3: Doriamehi (Hura sagar – Baghabari-6.0km)	Possibility of 1.0 ha of agricultural land would be lost temporarily	-1		+2	0.37 (for compensation)	Implementation: Contractor Compensation payment: BWDB Monitoring: Nominated Engineer (SMO, BWDB)
					Sub total	**1.14**	
Activity	***Construction of labor sheds and stocking yard for Bank Protective activities***						
Land loss	Location-1: (Benotia-2.0km)	Possibility of 1.0 ha of agricultural land would be lost temporarily	-1	• Construction activities should be carried out as per design. • Labor shed and stocking yard should preferably be constructed on fallow or khas land. • Landowners affected by the construction of labor shed and placement of filling materials on	+2	0.37 (for compensation)	Implementation: Contractor Compensation payment: BWDB Monitoring:

IEC	Location	Impacts	Magnitude of impact	Mitigation/ Enhancement/ Compensation/ Contingency	Magnitude with EMP	EMP Cost (Lac Tk)	Responsible Agency
				agriculture land should be noticed ahead of time so that the area might not be affected for growing crops. • Labor sheds, and other project related activities should be optimized with the purpose of minimum disruption to cultivable lands and standing crops. • Adequate cash compensation should be provided to the land owners /share croppers. • The compensation should be determined based on the amount of land temporarily going out of cultivation.			Nominated Engineer (SMO, BWDB)
					Sub total	**0.37**	
Activity	***Construction of labor sheds and stocking yard for construction of drainage sluices activities***						
Land loss	Location-1 (Hurashagar outfall)	Possibility of 0.05 ha of agricultural land would be lost temporarily	-1	• Construction activities should be carried out as per design. • Labor shed and stocking yard should preferably be constructed on fallow or khas land. • Landowners affected by the construction of labor shed and placement of filling materials on agriculture land should be noticed ahead of time so that the area might not be affected for growing crops. • Labor sheds, and other project related activities should be optimized with the purpose of minimum disruption to cultivable lands and standing crops. • Adequate cash compensation should be provided to the land owners /share croppers. • The compensation should be determined based on the amount of land temporarily going out of cultivation.	+2	0.01 (for compensation)	Implementation: Contractor Compensation payment: BWDB Monitoring: Nominated Engineer (SMO, BWDB)
	(ii)Location-2(Hurashagar intake)	Possibility of 0.08ha of agricultural land would be lost temporarily	-1		+2	0.03 (for compensation)	Implementation: Contractor Compensation payment: BWDB Monitoring: Nominated Engineer (SMO, BWDB)
	(iii)Location-3(at existing sluices)	Possibility of 0.08ha of	-1		+2	0.03 (for	Implementation: Contractor

IEC	Location	Impacts	Magnitude of impact	Mitigation/ Enhancement/ Compensation/ Contingency	Magnitude with EMP	EMP Cost (Lac Tk)	Responsible Agency
		agricultural land would be lost temporarily				compensation)	Moni Compensation payment: BWDB toring: Nominated Engineer (SMO, BWDB)
					Sub total	**0.07**	
					Grand total	**2.72**	

Agricultural Resources

389. There would be no impact during the pre-construction phase

Fisheries Resources

390. There would be no impact during the pre-construction phase.

Ecological Resources

391. There will be no impact duriing the pre-construction phase.

Socio-economic

IEC	Location	Impacts	Magnitude of impact*	Mitigation/ Enhancement/ Compensation/ Contingency	Magnitude with EMP*	EMP Cost (in Lac Tk)	Responsible Agency
Activity->	Construction of labor shed with proper water and sanitation facilities, garbage disposal system, construction of stock yard and construction camp, mobilization of labor, materials, equipment and other machineries; preparing CC blocks at site.						
Resettlement	10.5 km of the Jamuna river bank from Hat Pachil Bazar, Kaizuri to Benotia Hat/Bazar 2 km from Benotia Hat/Bazar to the start of Baral Khal, Verakola Hat	About 1130 HHs in the different locations of project area will be displaced.	-1	Proper land compensation, PAPs should be ensured for displaced peopled of project area as per resettlement plan	0	Will be estimated from RAP report	Implementation: Deputy Commissioner, specialist NGO Monitoring:

IEC	Location	Impacts	Magnitude of impact*	Mitigation/ Enhancement/ Compensation/ Contingency	Magnitude with EMP*	EMP Cost (in Lac Tk)	Responsible Agency
	These villages/mauzas are:Ratankandi, Selachapri Dumbaria, Alokdia, Nundao,						PMO
Gender Issues	The whole study area i.e. Ratankandi Mohakhola Sontosha Kashipur Dholai Marma Binotia	Labor mobilization may create disturbance for the local women.	-2	The labor mobilization activities should be strictly followed up by project authority.	-	N/A	Implementation: Contractor Monitoring: Nominated Engineer (SMO, BWDB)
Public Health		Because of having limited access to toilet, unhygienic environment due huge gathering of labors can create disturbance to health.	-1	Labor shed should establish near to bazaar areas and also ring slab water-sealed sanitary latrines should be established in each shed.	0	N/A	Implementation: Contractor Monitoring: Nominated Engineer (SMO, BWDB)

10.2.2 Construction Phase

Water Resources

IEC	Location	Impacts	Magnitude of impact	Mitigation/ Enhancement/ Compensation/ Contingency	Magnitude with EMP	EMP Cost (Lac Tk)	Responsible Agency
Activity: Excavation of earth materials from the location of embankment; dredging of soil from the Jamuna and Baral rivers; dumping of earthen materials on the embankment; embankment surface labeling through dumping machine; movement of vehicles for carrying materials.							

IEC	Location	Impacts	Magnitude of impact	Mitigation/ Enhancement/ Compensation/ Contingency	Magnitude with EMP	EMP Cost (Lac Tk)	Responsible Agency
Air quality	- Places adjacent to the Jamuna River bank where the new embankment would be constructed (from Hat Panchil to Benotia mauzas). - Places adjacent to the existing embankment of the Baral river (from Verakhola to Dambarla mauzas). - At Benotia where the bank protection works is to be carried out. - Road side places through which transportation of construction materials would be carried out (Kaijuri-shahjadpur road and rural roads from Hat panchil to barnia mauzas and Nagardala to Shelachapri mauzas).	Minor amount of dust may be generated during excavating and dumping of earth materials, surface labeling with dumping machine and vehicular movements.	-3	Mitigation: Water to be sprinkled on regular intervals, as and where required.	-2	N/A	Implementation: Contractor Monitoring: Nominated Engineer (SMO, BWDB)
Activity: Excavation of earth materials from the location of embankment; dredging of soil from the Jamuna River; movement of vehicles for carrying earth materials.							
Noise	- Road side places for transportation of construction materials (Kaijuri-shahjadpur road and rural roads from Hat panchil to barnia mauzas	Low impacts would be caused during excavation and dredging of soiland vehicular movements.	-2	Mitigation: Noise levels due to vehicular movement, excavation and dredging activities are to be kept within permissible limit.	-1	N/A	Implementation: Contractor Monitoring: Nominated Engineer (SMO, BWDB)

IEC	Location	Impacts	Magnitude of impact	Mitigation/ Enhancement/ Compensation/ Contingency	Magnitude with EMP	EMP Cost (Lac Tk)	Responsible Agency
	and Nagardala to Shelachapri mauzas). - Location of embankment (from Kaijuri to Karatoya offtake)						
Activity: Dredging of earth materials from the Jamuna River; placing of geo-bags and CC blocks on the river banks; construction of sluices, disposal of waste generated from the labor shed.							
Surface water quality	- Jamuna river (from Hat Panchil to Benotia mauzas) and Baral river (from Verakhola to Dambarla mauzas). - Possible locations within the embankment for construction of the drainage sluices	The surface water quality might be affected due to the disposal of waste generated from the labor shed into the river. Additionally, minor quantity of sediments would be generated in the rivers during dredging of soil from river bed, which would temporarily hamper the aesthetic quality of river water.	-4	<u>Mitigation:</u> - The dredging locations should be selected so that dredge spoil would be minimized, and will not cause erosion downstream. - Proper waste disposal system is to be implemented.	-1		Implementation: Contractor Monitoring: Nominated Engineer (SMO, BWDB)
Activity: Rehabilitation of embankment							
Drainage congestion	- Hurasagar river	Low impact may occur due to the rehabilitation of embankment temporarily blocking the Hurasagar offtake. The river has two mouths at present, meeting the Baral river and blocking any one of these might stress the drainage characteristics of the other.	-2	- Constructing a sluice at one of the two channel mouths. (Currently there is a sluice at one of the two mouths of Hurasagar river, which will be rehabilitated and extended while another one will be constructed at the channel mouth at the Jamuna riverbank).	-1	200 (included in construction costs)	Implementation: Contractor Monitoring: Nominated Engineer (SMO, BWDB)

Land Resources

IEC	Location	Impact	Magnitude of impact	Mitigation/ Enhancement/ Compensation/ Contingency	Magnitude with EMP	EMP Cost (Lac Tk)	Responsible Agency
Activity	***Collection and disposal of constructing materials for Embankment rehabilitation activities***						
Land loss	Location-1: Dombaria (Baghabari towards Shahzadpur-6.5km)	About 0.65ha of land	-1	• Top soil (0-15cm) will be removed and stored securely away from drainage lines and erosion prone areas for future use in revegetation and surfacing. • Area for executing construction activities and other project related activities should be optimized with the purpose of minimum disruption to cultivable lands and standing crops • The filling materials should be collected from khas/fallow land /river. • Disposal of spoil/ constructing materials should preferably be stored on fallow or khas land so that the area might not be affected for growing crops. • Compensation will be paid for any crop damage. • The contractor will avoid cultivation fields during construction. • The contractor will avoid agricultural land for material borrowing and material stockpiling. • The contractor will ensure that no vehicular movements take place inside cultivation fields. • The contractor will ensure that no material is dumped inside cultivation fields. • The contractor will maintain liaison with communities	+1	No cost involvement of cost for land due to activities in existing embankment	Implementation: Contractor Monitoring: Nominated Engineer (SMO, BWDB)
	Location-2: Lochha (Shahzahdpur-Korotoa bank-4.0km)	About 0.4 ha of land	-1		+1	No cost involvement of cost for land due to activities in existing embankment	Implementation: Contractor Monitoring: Nominated Engineer (SMO, BWDB)
					Sub total	**00**	
Activity	***Collection and disposal of earth materials for construction of new embankment activities***						
Land loss	Location-1: Gopalpur (Kaizuri-Hura sagar offtake-	1.05ha of agricultural land would be lost	-1	• Top soil (0-15cm) will be removed and stored securely away from drainage lines and erosion prone areas for future use in	+2	39.38 (for compensation)	Implementation: Contractor Compensation

IEC	Location	Impact	Magnitude of impact	Mitigation/ Enhancement/ Compensation/ Contingency	Magnitude with EMP	EMP Cost (Lac Tk)	Responsible Agency
	10.5km)	permanently		revegetation and surfacing. • . • Area for executing construction activities and other project related activities should be optimized with the purpose of minimum disruption to cultivable lands and standing crops • The filling materials should be collected from khas/fallow land /river. • Disposal of spoil/ constructing materials should preferably be stored on fallow or khas land so that the area might not be affected for growing crops. • Compensation will be paid for any crop damage. • The contractor will avoid cultivation fields during construction. • The contractor will avoid agricultural land for material borrowing, material stockpiling, and labor camps. • The contractor will ensure that no vehicular movements take place inside cultivation fields. • The contractor will ensure that no material is dumped inside cultivation fields.			payment: BWDB Monitoring: Nominated Engineer (SMO, BWDB)
	Location-2: Jagtala Kaizuri-Benotia-2.0km)	0.2ha of agricultural land would be lost permanently	-1		+2	7.50 (for compensation	Implementation: Contractor Compensation payment: BWDB Monitoring: Nominated Engineer (SMO, BWDB)
	Location-3: Doriamehi (Hura sagar – Baghabari-6.0km)	0.6ha of agricultural land would be lost permanently	-1		+2	22.5 (for compensation)	Implementation: Contractor Compensation payment: BWDB Monitoring: Nominated Engineer (SMO, BWDB)
					Sub total	**69.38**	
Activity	***Collection and disposal of construction materials for bank protection activities***						
Land loss	Location-1: (Benotia-2.0km)	0.2ha of land would be lost	-1	• Top soil (0-15cm) will be removed and stored securely away from drainage lines and erosion prone areas for future use in	+2	No cost involvement of cost for land due	Implementation: Contractor

IEC	Location	Impact	Magnitude of impact	Mitigation/ Enhancement/ Compensation/ Contingency	Magnitude with EMP	EMP Cost (Lac Tk)	Responsible Agency
		permanently		revegetation and surfacing. • . • Area for executing construction activities and other project related activities should be optimized with the purpose of minimum disruption to cultivable lands and standing crops • The filling materials should be collected from khas/fallow land /river. • Disposal of spoil/ constructing materials should preferably be stored on fallow or khas land so that the area might not be affected for growing crops. • Compensation will be paid for any crop damage. • The contractor will avoid cultivation fields during construction. • The contractor will avoid agricultural land for material borrowing and material stockpiling. • The contractor will ensure that no vehicular movements take place inside cultivation fields. • The contractor will ensure that no material is dumped inside cultivation fields.		to activities in existing embankment	Monitoring: Nominated Engineer (SMO, BWDB)
					Sub total	**00**	
Activity	***Disposal of dumping spoil for construction of drainage sluices***						
Land loss	Location-1: (Hurashagar outfall)	0.01ha of agricultural land would be lost permanently	-1	• Top soil (0-15cm) will be removed and stored securely away from drainage lines and erosion prone areas for future use in revegetation and surfacing. • . • Area for executing construction activities and other project related activities should be optimized with the purpose of minimum disruption to cultivable lands and standing crops	+2	0.37 (for compensation**)**	Implementation: Contractor Compensation payment: BWDB Monitoring: Nominated Engineer

IEC	Location	Impact	Magnitude of impact	Mitigation/ Enhancement/ Compensation/ Contingency	Magnitude with EMP	EMP Cost (Lac Tk)	Responsible Agency
				• The filling materials for backfill should be collected from khas/fallow land /river. • Disposal of spoil/ constructing materials should preferably be stored on fallow or khas land so that the area might not be affected for growing crops. • Compensation will be paid for any crop damage. • The contractor will avoid cultivation fields during construction. • The contractor will avoid agricultural land for material borrowing and material stockpiling. • The contractor will ensure that no vehicular movements take place inside cultivation fields. • The contractor will ensure that no material is dumped inside cultivation fields.			(SMO, BWDB)
	Location-2: (Hurashagar inlet)	0.02ha of agricultural land would be lost permanently	-1		+2	0.75 (for compensation)	Implementation: Contractor Compensation payment: BWDB Monitoring: Nominated Engineer (SMO, BWDB)
	Location-3: (at existing sluice gates)	0.02ha of agricultural land would be lost permanently	-1		+2	0.75 (for compensation)	Implementation: Contractor Compensation payment: BWDB Monitoring: Nominated Engineer (SMO, BWDB)
					Sub total	**1.87**	
Land type change	Entire study area	Drainage congested area would be increased due to rehabilitation of embankment,	-2	• The sequence of work during construction of regulators in the water channels would be carefully planned to avoid disruption of drainage system. • The contractor would ensure that there would be no negative impacts on crop cultivation in monsoon season. • The contractor would maintain liaison with community organizations .	+2		Implementation: Contractor Monitoring: Nominated Engineer (SMO, BWDB)

IEC	Location	Impact	Magnitude of impact	Mitigation/ Enhancement/ Compensation/ Contingency	Magnitude with EMP	EMP Cost (Lac Tk)	Responsible Agency
		construction of new embankment, bank protective work and drainage sluice. So that land type would be changed.					
					Sub total	**1.50**	

Agricultural Resources

IEC	Location	Impact	Magnitude of impact	Mitigation/ Enhancement/ Compensation/ Contingency	Magnitude with EMP	EMP Cost (Lac Tk)	Responsible Agency
Activity	***Construction of labor sheds, stocking yard for Bank rehabilitation, construction of new embankment, bank protection and construction of drainage sluices and disposal of spoils activities***						
Crop production loss	i) Dombaria (ii) Lochha (iii) Gopalpur (iv) Jagtala (v) Doria mehi (vi)Benotia (vii)Chauhali (viii)Bachamara (ix) Harirampu (x)Location-1(Not fix up) (xi)Location-2(Not fix up) (xii)Location-3(Not fix up)	Loss of crop production is expected to be about 27.9 metric ton for Construction of labor sheds and stocking yard for bank rehabilitation, construction of new embankment, bank protection and construction	-1	• In cases where the disruption to farming becomes unavoidable, adequate cash compensation should be provided to the land owners. /share croppers. • Exact amount of compensation should be determined based on the amount of land temporarily going out of cultivation. • The rate should be decided on the basis of the one crop usually grown on the pieces of land. • Constructing materials • like sand, cement, construction of labor sheds, concrete, block, etc. should be placed in non-agricultural land as far as possible. These materials should not be placed in standing crops.	+3	9.33 (for compensation)	Implementation: Contractor Compensation payment: BWDB Monitoring: Nominated Engineer (SMO, BWDB)

IEC	Location	Impact	Magnitude of impact	Mitigation/ Enhancement/ Compensation/ Contingency	Magnitude with EMP	EMP Cost (Lac Tk)	Responsible Agency
		of drainage sluices and disposal of spoils activities					
					Sub-Total	***9.33***	
Community Organizations	All locations of regulators	Positive impact	+2	• The community organizations should be formed prior to implementation of the project. • The community organizations should be given orientation to protect their standing crops from river bank protection work, spoil soils, on farm water management, LCS, EMG etc.	+4	2.50 (for formation of community organization)	Implementation: specialist NGOs Monitoring: PMO / DDM / DAE
					Sub Total	***2.50***	

Fisheries Resources

IEC	Location	Impacts	Magnitude of impact*	Mitigation/ Enhancement/ Compensation/ Contingency	Magnitude with EMP*	EMP Cost (Lac Tk/Yr) *	Responsible Agency
(Re-habilitation of Embankment							
Activity: Dumping of earthen materials on the embankment							
Fish habitat	6.5 km of the Verakhola towards start of Hurashagar river (Char Andharmanik)	Temporary damage would occur in the seasonal fish habitat of 10.5 km long right bank of the Boral river due to either clearance of vegetation cover or draped by the filling earth during earth work for the fish species of marginal vegetation feeder.	-2	Vegetation clearance should be done as low as possible	-1		Implementation: Contractor Monitoring: Nominated Engineer (SMO, BWDB) in coordination with Department
	4km from the starting point of Hurashagar (Char Andharmanik) to Korotoa bank		-2		-1		

IEC	Location	Impacts	Magnitude of impact*	Mitigation/ Enhancement/ Compensation/ Contingency	Magnitude with EMP*	EMP Cost (Lac Tk/Yr) *	Responsible Agency
Fish biodiversity	Same as above	Riverine fish species i. e. major carp species, grass carp and other herbivorous species, eel (baim), big and small cat fish (boal, ayr, magur), might shift from the project area	-2		-1		of Fisheries
	Same as above		-2		-1		
Fish production	Same as above	Capture fish production would temporarily be declined by 3.3 MT within the project area.	-2		-1		
	Same as above	Capture fish production would temporarily be declined by 2 MT within the project area.	-2				
Activity: Collection of earth materials from river/khal through dredging							
Fish habitat	Same as above	Water quality (stream flow, temperature, pH, turbidity, DO, hardness etc.) of that portion of the Boral river will temporarily be changed which would change the behavior of riverine fish species (both the juveniles and adults). Feeding habitat for the demersal (boal, ayr) and benthopelagic (baim) fish species would be damaged. Deep pools (dor/duars) would temporarily be damaged.	-2	1. Dredging will have to done during the dry season. 2. Proper protective device (construction of silt fences) will have to take to protect the deep pools (dor/duars).	-1		Implementation: Contractor Monitoring: Nominated Engineer (SMO, BWDB) in coordination with Department of Fisheries
	Same as above		-2		-1		
Fish migration	Same as above	Both the Longitudinal (hilsa) and lateral migration for fish will temporarily be disturbed.	-2	Dry season (December-March) is proposed for dredging.	-1	Not applicable	Implementation: Contractor Monitoring: Nominated Engineer (SMO, BWDB)
	Same as above		-2		-1		

IEC	Location	Impacts	Magnitude of impact*	Mitigation/ Enhancement/ Compensation/ Contingency	Magnitude with EMP*	EMP Cost (Lac Tk/Yr) *	Responsible Agency
							in coordination with Department of Fisheries
Fish biodiversity	Same as above	Riverine fish species i. e. hilsa, major carp species, eel (baim), big and small cat fish (boal, ayr, magur), etc. might shift from the project area	-5	1. Dredging will have to done during the dry season. 2. Proper protective device will have to take to protect the deep pools (dor/duars).	-3	Not applic able	Implementati on: Contractor Monitoring: Nominated Engineer (SMO, BWDB) in coordination with Department of Fisheries
	Same as above		-5		-3		
Fish production	Same as above	Capture fish production would temporarily be declined by 3.3 MT within the project area.	-5	Same as above	-3	Not applic able	Implementati on: Contractor Monitoring: Nominated Engineer (SMO, BWDB) in coordination with Department of Fisheries
	Same as above	Capture fish production would temporarily be declined by 2 MT within the project area.	-5		-3		
Construction of New Embankment							

IEC	Location	Impacts	Magnitude of impact*	Mitigation/ Enhancement/ Compensation/ Contingency	Magnitude with EMP*	EMP Cost (Lac Tk/Yr) *	Responsible Agency
Activity: Collection of earth materials from the location of embankment through excavator, pay loader, head load , dump truck and trolley							
Fish habitat	10.5 km of the Jamuna river bank from Hat Pachil Bazar, Kaizuri to Benotia Hat/Bazar	Temporary damage would occur in the seasonal fish habitat due to either clearance of vegetation cover or draped by the filling earth during earth work for the fish species of marginal vegetation feeder.	-2	Vegetation clearance should be done as low as possible	-1		Implementation: Contractor Monitoring: Nominated Engineer (SMO, BWDB) in coordination with Department of Fisheries
	2 km from Benotia Hat/ Bazar to the start of Baral Khal, Verakola Hat		-2		-1		
Fish migration	Same as above	Lateral migration for fish will temporarily be disturbed.	-2		-2	Not applicable	Implementation: Contractor Monitoring: Nominated Engineer (SMO, BWDB) in coordination with Department of Fisheries
	Same as above	Same as above	-2		-2		
Fish biodiversity	Same as above	Riverine fish species i. e. major carp species, grass carp and other herbivorous species, eel (baim), big and small cat fish (boal, ayr, magur), might shift from the project area	-2		-1		Implementation: Contractor Monitoring: Nominated Engineer (SMO, BWDB)
	Same as above		-2		-1		

IEC	Location	Impacts	Magnitude of impact*	Mitigation/ Enhancement/ Compensation/ Contingency	Magnitude with EMP*	EMP Cost (Lac Tk/Yr) *	Responsible Agency
							in coordination with Department of Fisheries
Fish production	Same as above	Capture fish production would temporarily be declined by 13.3 MT within the project area. However, culture fisheries practice would be increased.	-3		-1		Implementation: Contractor Monitoring: Nominated Engineer (SMO, BWDB) in coordination with Department of Fisheries
	Same as above	Capture fish production would temporarily be declined by 2 MT within the project area.	-3		-1		
Activity: Collection of earth materials from river/khal through dredging							
Fish habitat	Same as above	Water quality (stream flow, temperature, pH, turbidity, DO, hardness etc.) of that portion of the Boral river will temporarily be changed which would change the behavior of riverine fish species (both the juveniles and adults). Feeding habitat for the demersal (boal, ayr) and benthopelagic (baim) fish species would be damaged. - Deep pools (dor/duars) would temporarily be damaged.	-2	1. Dredging will have to done during the dry season. 2. Proper protective device (silt fence) will have to take to protect the deep pools (dor/duars).	-1	0.5 (for protective devices)	Implementation: Contractor Monitoring: Nominated Engineer (SMO, BWDB) in coordination with Department of Fisheries
	Same as above		-2		-1		

IEC	Location	Impacts	Magnitude of impact*	Mitigation/ Enhancement/ Compensation/ Contingency	Magnitude with EMP*	EMP Cost (Lac Tk/Yr) *	Responsible Agency
Fish migration	Same as above	Both the Longitudinal (hilsa) and lateral migration for fish will temporarily be disturbed.	-5	Dry season (December-March) is proposed for dredging.	-3	Not applic able	Implementati on: Contractor Monitoring: Nominated Engineer (SMO, BWDB) in coordination with Department of Fisheries
	Same as above		-5		-3		
Fish biodiversity	Same as above	Riverine fish species i. e. hilsa, major carp species, eel (baim), big and small cat fish (boal, ayr, magur), etc. might shift from the project area	-5	1. Dredging will have to done during the dry season. 2. Proper protective device (silt fence)will have to be taken to protect the deep pools (dor/duars).	-3	0.5 (for prote ctive devic es)	Implementati on: Contractor Monitoring: Nominated Engineer (SMO, BWDB) in coordination with Department of Fisheries
	Same as above		-5		-3		
Fish production	Same as above	Capture fish production would temporarily be declined by 13.3 MT within the project area. In opposite, culture fisheries practice would be increased. Net fish production would be increased by 25 MT	-5	1. Dredging will have to done during the dry season. 2. Proper protective device (silt fence) will have to be taken to	-3	1.0 (for prote ctive devic es)	Implementati on: Contractor Monitoring: Nominated Engineer

IEC	Location	Impacts	Magnitude of impact*	Mitigation/ Enhancement/ Compensation/ Contingency	Magnitude with EMP*	EMP Cost (Lac Tk/Yr) *	Responsible Agency
	Same as above	Capture fish production would temporarily be declined by 2 MT within the project area. Culture fisheries practice would be slightly increased.	-5	protect the deep pools (dor/duars).	-3		(SMO, BWDB) in coordination with Department of Fisheries
Riverbank Protection Work							
Activity: Embankment slope pitching and turfing							
Fish habitat	1km from Benotia Hat/Bazar toward the start of Baral river.	Temporary damage would occur in the seasonal fish habitat due to either clearance of vegetation cover or draped by the filling earth during earth work for the fish species of marginal vegetation feeder.	-1	Vegetation clearance should be done as low as possible	-1		Implementation: Contractor Monitoring: Nominated Engineer (SMO, BWDB) in coordination with Department of Fisheries
Fish biodiversity		Riverine fish species i. e. major carp species, grass carp and other herbivorous species, eel (baim), big and small cat fish (boal, ayr, magur), might shift from the project area	-1		-1		
Fish production		Capture fish production would temporarily be declined by 2 MT within the project area.	-1		-1		
Fish production		Capture fish production would temporarily be declined by 2 MT within the project area. Culture fisheries practice would be slightly increased.	-1				
Activity: Placing and dumping of C.C. blocks as per design							

IEC	Location	Impacts	Magnitude of impact*	Mitigation/ Enhancement/ Compensation/ Contingency	Magnitude with EMP*	EMP Cost (Lac Tk/Yr) *	Responsible Agency
Fish biodiversity	1 km from Benotia Hat/Bazar to the start of Baral Khal	Riverine fish species i. e. hilsa, major carp species, eel (baim), big and small cat fish (boal, ayr, magur), etc. might shift from the project area. Potential impact on surface feeder fish species due to oil and grease lubricants	-5	1. Dredging will have to done during the dry season. 2. Proper protective device (silt fence) will have to take to protect the deep pools (dor/duars). 3. . Ensure careful refueling of vehicles and careful handling during any changes in parts of vehicles. Ensure concrete mixing does not happen at the river embankments	-3		Implementation: Contractor Monitoring: Nominated Engineer (SMO, BWDB) in coordination with Department of Fisheries

Ecological Resources

IEC	Location	Impacts	Magnitude of impact*	Mitigation/Enhancement/Compensation/Contingency	Magnitude with EMP	EMP Cost (Lac Tk.)	Responsible Agency
Embankment Re-habilitation							
Activity: Collection of earth materials and construction of embankment							
Terrestrial ecosystem Aquatic ecosystem. Floral	6.5 km of the Verakhola towards start of Hurashagar River (Char Andharmanik)	Shrubs and herbs of bank slopes will be damaged by excavated soil dumping. Vegetation damage via	-5	Do not dump large volume of excavated soil on bottom of the existing trees. Observation of national and international days	+3	2.0 (for awareness activities and	Implementation: Contractor Monitoring : Nominated

IEC	Location	Impacts	Magnitude of impact*	Mitigation/Enhancement/Compensation/Contingency	Magnitude with EMP	EMP Cost (Lac Tk.)	Responsible Agency
composition and diversity. Faunal composition and diversity	4km from the starting point of Hurashagar (Char Andharmanik) to Korotoa River bank.	dumping a high volume of excavated soil on the river banks		Awareness development activities should be conducted by the committee or nature club to protect the saplings.		purchase of saplings)	Engineer (SMO, BWDB)
Construction of New Embankment							
Activity: Collection of earth for construction of embankment							
Terrestrial ecosystem Aquatic ecosystem. Floral composition and diversity. Faunal composition and diversity.	10.5 km of the Jamuna river bank from Hat Pachil Bazar, Kaizuri to Benotia Hat/ Bazar 2 km from Benotia Hat/Bazar to the start of Baral Khal, Verakola Hat.	Aquatic flora as well as zooplankton and phytoplankton will destroy. Shrubs and herbs of bank slopes will be damaged.	-3	Do not collect the soil from the fertile land and do not dump the soil.	-1	-	Implementation: Contractor Monitoring: Nominated Engineer (SMO, BWDB)
Riverbank Protection Work							
Activity: Slope protection							
Terrestrial ecosystem Aquatic ecosystem. Floral composition and diversity. Faunal composition and diversity	2 km from Benotia Hat/ Bazar to the start of Baral Khal, Verakola Hat. 5 km of the Jamuna Left bank from Chauhali Sadar to Atpara. 2 km of the Jamuna Left bank from Jaffarganj to Bachamara	Vegetation of river banks and some aquatic flora will reduce. Wildlife population like terrestrial birds and palm squirrels will be disturbed.	-5	Awareness development activities should be conducted by the committee or nature club to protect the saplings.	+7	-	Implementation: specialist NGOs Monitoring: PMO /

IEC	Location	Impacts	Magnitude of impact*	Mitigation/Enhancement/Compensation/Contingency	Magnitude with EMP	EMP Cost (Lac Tk.)	Responsible Agency
	7 km of the Padma Left Bank at Harirampur						
Activity: Plantation at JRB-1							
Terrestrial ecosystem Aquatic ecosystem. Floral composition and diversity. Faunal composition and diversity.	6.5 km of the Verakhola towards start of Hurashagar river (Char Andharmanik) 4km from the starting point of Hurashagar (Char Andharmanik) to Korotoa bank. 10.5 km of the Jamuna river bank from Hat Pachil Bazar, Kaijuri to Benotia Hat/Bazar 2 km from Benotia Hat/Bazar to the start of Baral Khal, Verakola Hat.	Vegetation of river bank will damage.	-5	• Plantation of 50,000 saplings. (Bot, Pakur, Shimul, Jam, Pitali, Khajur, Tal and water tolerance fruit and timber are suggested for plantation). • Do not dump large volume of excavated soil on bottom of the present trees. • Awareness development on natural resources. • Observation of national and international days. • Nature club or Local committee should be formed to protect the saplings. • Awareness development activities should be conducted by the committee or nature club.	+5	50.0 (Sapling-25 Tk. Stick-20Tk Fertilizer - 15 Plantation-10Tk. Guarding - 30tk/year).	Implementation: specialist NGOs Monitoring: PMO

Socio-economic

IEC	Location	Impacts	Magnitude of impact*	Mitigation/ Enhancement/ Compensation/ Contingency	Magnitude with EMP*	EMP Cost (in Lac Tk)	Responsible Agency
Jamuna Right Bank-1(JRB-1)							
Activity->	Excavation of earth materials from the location of embankment; dredging of soil from the Jamuna and Baral rivers; dumping of earthen materials on the embankment; embankment surface labeling through dumping machine; movement of vehicles for carrying earth materials.						
Employment	Places adjacent to the Jamuna River bank where the new embankment would be constructed (from Hat Panchil to Benotia mauzas). Places adjacent to the existing embankment of the Baral river (from Verakhola to Dambarla mauzas). At Benotia where the bank protection works is to be carried out.	A temporary employment will be created for labors during bailing out activities.	+1	Ensure employment for local people for both technical and non-technical works. If possible, 60% labor should be recruited from locale.	N/A	N/A	Implementation: Contractor Monitoring: Nominated Engineer (SMO, BWDB)
Labor migration	Labor would be internally in-migrated from adjacent upazilas/districts.	The in-migrated people can take part in construction work and this will bring opportunities for them also.	+2	A number of labors should be recruited to prompt the work.	N/A	N/A	Implementation: Contractor Monitoring: Nominated Engineer (SMO, BWDB)
Activity->	Dredging of earth materials from the Jamuna and Baral rivers; filling placing of geo-bags and casting and placing of CC blocks on the river banks; construction of sluices.						

IEC	Location	Impacts	Magnitude of impact*	Mitigation/ Enhancement/ Compensation/ Contingency	Magnitude with EMP*	EMP Cost (in Lac Tk)	Responsible Agency
Employment	Jamuna River (from Hat Panchil to Benotia mauzas). Baral River (from Verakhola to Dambarla mauzas). Other possible locations of construction of drainage sluices.	Temporary employment opportunity will be created for many labors.	+1	Ensure employment for local people for both technical and non-technical works. If possible, 60% labor should be recruited from locale.	N/A	N/A	Implementation : Contractor Monitoring: Nominated Engineer (SMO, BWDB)

10.2.3 Post-construction Phase

Water Resources

IEC	Location	Impact	Magnitude of impact	Mitigation/ Enhancement/ Compensation/ Contingency	Magnitude with EMP	EMP Cost (Lac Tk)	Responsible Agency
Erosion	Location adjacent to the bank protection work (Benotia mauza)	Agricultural lands and settlements wil be saved from erosion. Roadway communication will be established along the Jamuna river.	+6	<u>Enhancement</u>: - Implementing Katkin and other small scale plantation along the slope of protective works - Providing fencing, biological protection (bamboo, other trees) at the country side of protective works to ensure soil stability	+7	15 (for fencing and planting)	Implementation: Community organizations Monitoring: Department of Forestry, BWDB Field Division

IEC	Location	Impact	Magnitude of impact	Mitigation/ Enhancement/ Compensation/ Contingency	Magnitude with EMP	EMP Cost (Lac Tk)	Responsible Agency
Drainage congestion	Karatoya and Hurasagar rivers, which drain out water from the sub reach to the Baral and Jamuna rivers.	Low impact may be generated as the conveyance capacity of internal rivers and lakes will be stressed, resulting in drainage congestion problems.	-1	<u>Mitigation:</u> Operationof sluices at the mouth of Hurasagar river, and places where required.	0	N/A	Implementation: Joint committee Monitoring: DoF, DAE, BWDB Field Division
Flood	Entire sub reach (especially near the location of embankment works i.e. from Hat Panchil to Benotia mauzas and from Verakhola to Dambarla mauzas).	Significant impact in flooding. The improvement in regular flooding would be around 30% in the entire sub-reach. This would lead to a better control in both irrigation and social status of the people in the subreach.	+5	<u>Enhancement:</u> - Forwarding the rehabilitated embankment an additional seven kilometers upto the Nagardala-Ratankandi bridge along the karatoya river to ensure better flood protection - Providing vegetative cover along the slope of the embankments and afforestation works in the countryside of the embankment	+8	2,000 (included in construction costs)	Implementation: PMO BWDB when planning Tranche-2, Monitoring: BWDB, DOE Implementation: Community organizations Monitoring Department of Forestry, Field Division, BWDB
Water Availability and Use	Agricultural lands near the possible location of regulators and sluices.	The socio-economic status of the farmers would be enhanced due their increased chances of practicing Aman crops	+3	<u>Enhancement:</u> Providing inlets through embankments to allow farmers in using river water in irrigation	+5	1 (part of designs and construction costs)	Implementation: Joint committee Monitoring: DAE, DoF, BWDB Field Division

**No impact (0); Negative Impact (-); Positive Impact (+); Low Impact (1-3); Medium Impact (4-6); High Impact 7-8;Very High Impact (9-10).*

Land Resources

IEC	Location	Impact	Magnitude of impact	Mitigation/ Enhancement/ Compensation/ Contingency	Magnitude with EMP	EMP Cost (Lac Tk)	Responsible Agency
Land type change	Entire project area	Minimize River bank erosion, drainage congestion/water logging, flooding, siltation etc to 1,84,200 ha of agricultural land.	+2	• Formation of community organizations, strengthening through imparting training need to be done. • Involvement of community organizations in project activities (maintenance of embankment, functioning of regulators, etc) would improve the project situation. • Crop rotation with leguminous crops, application of more organic materials, organic manure, and green manuring and soil management should be practiced to improve soil fertility in the project area. • Crop diversification with multi-crops might improve environmental condition of the soil.	+4	3.50 (formation and training of community organizations)	Implementation: specialist NGOs Monitoring: PMO / DDM / DAE
Sand carpeting	Entire study area	Sand carpeting minimized due to proposed interventions.	+4	• Formation of community organizations, strengthening through imparting training need to be done. • Involvement of community organizationsin project activities (maintenance of embankment, functioning of regulators, etc) would improve the project situation. • Land of sand carpeting area might bring under cultivation through removal of coarse sand from field, incorporation of organic manure in the land, practicing of green manure, crop diversification through leguminous crops etc.	+6	3.5 (formation and training of community organizations)	Implementation: specialist NGOs Monitoring: PMO / DDM / DAE
					Sub-Total	***7.00***	
					Grand Total	***82.47***	

**No impact (0); Negative Impact (-); Positive Impact (+); Low Impact (1-3); Medium Impact (4-6); High Impact 7-8;Very High Impact (9-10)*

Agricultural Resources

IEC	Location	Impact	Magnitude of impact	Mitigation/ Enhancement/ Compensation/ Contingency	Magnitude with EMP	EMP Cost (Lac Tk)	Responsible Agency
Crop production	Entire project area(All locations)	Additional rice production would be about 148,065 metric tons	+3	• Organic manure should be applied for the increase of soil fertility; • Farmers group should have close contact with DAE for adaptation of various measures of IPM/ICM; • Irrigation should be provided in optimum level with minimum conveyance loss; • Involvement of Community organizationsin project activities would enhance crop production.	+6		Implementation: specialist NGOs Monitoring: PMO / DDM / DAE
Improved irrigation facilities	Entire project area(All locations)	Additional surface water irrigated area would be increased by about 75 ha due to re-excavation of khals.	+3	• Farmers expand surface irrigation during rabi and boro season • communityorganizations get training in irrigation management	+4	3.50 (training)	Implementation: Community organizations Monitoring: DAE

Fisheries Resources

IEC	Location	Impacts	Magnitude of impact*	Mitigation/ Enhancement/ Compensation/ Contingency	Magnitude with EMP*	EMP Cost (Lac Tk/Yr)*	Responsible Agency
Re-habilitation of Embanment							

IEC	Location	Impacts	Magnitude of impact*	Mitigation/ Enhancement/ Compensation/ Contingency	Magnitude with EMP*	EMP Cost (Lac Tk/Yr)*	Responsible Agency
Fish habitat	6.5 km of the Verakhola towards start of Hurashagar river	Estimated net loss to fish habitat area would be 4321.3 ha	-7	1. Aquatic trees and herbs should be planted on the slope of the bank. 2. Proper protective device will have to take to protect the deep pools (dor/duars). 3. Use of surface water during the breeding period should be stopped. 4. Culture fisheries should be developed 5. Perennial beels should be developed under sanctuary program 6. Some flood water from the river should be allowed during normal or low floods (through sluice gates)	-4	0.5 (planting of trees and herbs, development of culture fishery ponds and construction of protective devices)	Implementation: specialist NGOs, community organizations Monitoring: PMO in coordination with Department of Fisheries
	4km from the starting point of Hurashagar to Korotoa bank	Estimated net loss to fish habitat area would be 1659 ha	-4		-2		
Fish migration	6.5 km of the Verakhola towards start of Hurashagar river	Degraded fish migration	-5	Operation of sluice gates	-3	Not applicable	Implementation: joint management committees, Monitoring: Department of Fisheries (DoF)
	4km from the starting point of Hurashagar to Korotoa bank	Degraded fish migration	-5	Operation of sluice gates	-3		
Fish biodiversity	6.5 km of the Verakhola towards start of Hurashagar	Capture fish species diversity would be moderate to low	-2	1. Proper protective device) will have to take to protect the deep pools (dor/duars).	-2	0.5 (for protective	Implementation: specialist NGOs, community

IEC	Location	Impacts	Magnitude of impact*	Mitigation/ Enhancement/ Compensation/ Contingency	Magnitude with EMP*	EMP Cost (Lac Tk/Yr)*	Responsible Agency
	river			2. Use of surface water during the breeding period should be stopped. 3. Culture fisheries should be developed 4. Perennial beels should be developed under biodiversityprogram 5. Proper training to increase the culture practice of high-valued fish species		devices, development of culture fisheries and training programs)	organizations Monitoring: PMO / Department of Fisheries (DoF)
	4km from the starting point of Hurashagar to Korotoa bank	Capture fish species diversity would be moderate to low	-2		-		
Fish production	6.5 km of the Verakhola towards start of Hurashagar river	Estimated net loss to fish production: 1179.5 MT	-7		-5	1	Implementation: specialist NGOs, community organizations Monitoring: PMO / Department of Fisheries (DoF)
	4km from the starting point of Hurashagar to Korotoa bank	Estimated net loss to fish production: 461 MT	-6		-4		
Construction of New Embankment							
Fish habitat	10.5 km of the Jamuna river bank from Hat Pachil Bazar, Kaizuri to Benotia Hat/Bazar	Estimated net loss to fish habitat area would be 11038.5 ha	-9	1. Aquatic trees and herbs should be planted on the slope of the bank. 2. Proper protective device will have to take to protect the deep pools (dor/duars). 3. Use of surface water during the breeding period should be stopped.	-6	0.5 (for protective devices, and planting of aquatic trees and herbs)	Implementation: specialist NGOs Monitoring: PMO / Department of Fisheries (DoF)
	2 km from Benotia Hat/Bazar to the start of Baral Khal, Verakola Hat	Estimated net loss to fish habitat area would be 409 ha	-9		-6		
Fish migration	10.5 km of the Jamuna river bank from Hat Pachil Bazar, Kaizuri to Benotia Hat/Bazar	Degraded fish migration	-5	Operation of sluice gates	-5	Not applicable	Implementation: joint management committees, Monitoring:

IEC	Location	Impacts	Magnitude of impact*	Mitigation/ Enhancement/ Compensation/ Contingency	Magnitude with EMP*	EMP Cost (Lac Tk/Yr)*	Responsible Agency
	2 km from Benotia Hat/Bazar to the start of Baral Khal, Verakola Hat	Degraded fish migration	-5		-5		Department of Fisheries (DoF)
Fish biodiversity	10.5 km of the Jamuna river bank from Hat Pachil Bazar, Kaizuri to Benotia Hat/Bazar	Capture fish species diversity would be moderate to low	-2	Aquaculture program including reexcavation of khals and borrow pits, developing fish ponds, and operation of sluice gates during the flood season	-2		Implementation: community organizations, joint management committees Monitoring: Department of Fisheries (DoF)
	2 km from Benotia Hat/Bazar to the start of Baral Khal, Verakola Hat	Capture fish species diversity would be moderate to low	-2		-		
Fish production	10.5 km of the Jamuna river bank from Hat Pachil Bazar, Kaizuri to Benotia Hat/Bazar	Estimated net loss to fish production: 99 MT	+3	Proper training to increase the culture practice of high-valued fish species	+4	1 (for training)	Implementation: specialist NGOs Monitoring: PMO / Department of Fisheries (DoF)
	2 km from Benotia Hat/Bazar to the start of Baral Khal, Verakola Hat	Estimated net gain to fish production: 1 MT	+1	Not applicable	+1		
Riverbank Protection Work							
Fish habitat	2 km from Benotia Hat/Bazar to the start of Baral Khal	Estimated net loss to fish habitat area would be 1 ha	-2	1. Aquatic trees and herbs should be planted on the slope of the bank. 2. Proper protective device (i.e., declaration of Sanctuary) will	-2	0.5 (for aquatic plants and protective devices)	Implementation: specialist NGOs, community organizations Monitoring: PMO /

IEC	Location	Impacts	Magnitude of impact*	Mitigation/ Enhancement/ Compensation/ Contingency	Magnitude with EMP*	EMP Cost (Lac Tk/Yr)*	Responsible Agency
				have to take to protect the deep pools (dor/duars). 3. Use of surface water during the breeding period should be stopped.			Department of Fisheries (DoF)
Fish migration		Degraded fish migration	-5	Not applicable	-5	Not applicable	Not applicable
Fish biodiversity		Capture fish species diversity would be moderate to low	-2	Not applicable	-	Same as above	Not applicable
Fish production		Estimated net gain to fish production: 1 MT	+1	Not applicable	+1	1	Not applicable

Ecological Resources

IEC	Location	Impacts	Magnitude of impact*	Mitigation/Enhancement/Compensation/Contingency	Magnitude with EMP	EMP Cost (Lac Tk.)	Respons-ible Agency
Embankment Rehabilitation							
Terrestrial ecosystem Aquatic ecosystem. Floral composition and	10.5 km from Verakhola toward the Korotoa bank at Mohakhola	Protection of homestead, roadside and social forest habitat. Vegetation coverage of the project area will improve	+3	Do not dump large volume of excavated soil on bottom of the present trees. Observation of national and international days Awareness development activities should be conducted by the committee or nature club to protect the saplings.	+5	-	Implementation: specialist NGOs, community organizations Monitoring: PMO / Department of Forestry

IEC	Location	Impacts	Magnitude of impact*	Mitigation/Enhancement/Compensation/Contingency	Magnitude with EMP	EMP Cost (Lac Tk.)	Respons-ible Agency
diversity. Faunal composition and diversity		Faunal composition and diversity would be deteriorated					
Construction of New Embankment							
Terrestrial ecosystem Aquatic ecosystem. Floral composition and diversity Faunal composition and diversity	12.5 km of the Jamuna river bank from Hat Pachil Bazar, Kaizuri toward the Korotoa bank at Mohakhola	Protection of homestead, roadside and social forest habitat will improve bio-diversity Vegetation coverage of the project area will improve Faunal composition and diversity would be deteriorated	+2	Observation of national and international days Awareness development activities should be conducted by the committee or nature club to protect the saplings.	+3	Mention above	Implementation: specialist NGOs, community organizations Monitoring: PMO / Department of Forestry
Riverbank Protection Work							
Activity- Slope Protection Activities							

IEC	Location	Impacts	Magnitude of impact*	Mitigation/Enhancement/Compensation/Contingency	Magnitude with EMP	EMP Cost (Lac Tk.)	Respons-ible Agency
Terrestrial ecosystem Aquatic ecosystem. Floral composition and diversity. Faunal composition and	2 km from Benotia Hat/ Bazar to the start of Baral Khal, Verakola Hat.	Protection of homestead, roadside and social forest habitat will improve bio-diversity Vegetation coverage of the project area will improve Faunal composition and diversity would be deteriorated	+2	Awareness development activities should be conducted by the committee or nature club to protect the planted saplings.	5	-	Implementation: specialist NGOs, community organizations Monitoring: PMO / Department of Forestry

**No impact (0); Negative Impact (-); Positive Impact (+); Low Impact (1-3); Medium Impact (4-6); High Impact 7-8; Very High Impact (9-10).*

Socio-economic

IEC	Location	FWOP	FWIP	Impacts	Magnitude of impact*	Mitigation/ Enhancement/ Compensation/ Contingency	Magnitude with EMP*	EMP Cost (in Lac Tk)	Responsible Agency
Jamuna Right Bank-1(JRB-1)									
Communication	Possible locations for communication in project area Hat Panchil Benotia Verakhola	Embankment cum road wiped out for last 10 years. In near future, main road of	Communication facilities will be improved both in local and upazila level.	Road communication will be improved which convey better economy by	+3	Not applicable	N/A	N/A	Not applicable

IEC	Location	FWOP	FWIP	Impacts	Magnitude of impact*	Mitigation/ Enhancement/ Compensation/ Contingency	Magnitude with EMP*	EMP Cost (in Lac Tk)	Responsible Agency
	Dambarla	Hat Panchil to Benotia would be affected.		expanding business option.					
Employment	Ratankandi Selachapri Dumbaria Alokdia Nundao	Temporary employment will be created for many labors during labor shed construction	More employment opportunities will be created for farmers and fishers of the project area.	In future, a number of employments will generate in fish culture and agriculture activities.	+2	Ensure/arrange training from DAE and DOF for local labors.	N/A	N/A	Implementation: specialist NGOs Monitoring: PMO
Income generation		A small number of low earned people will enhance their income with this additional income source.	People income will increase in future by creating more work options.	Income will be increased for all classes i.e. labor to businessmen.	+4	Implement a livelihood program for vulnerable groups directly affected by the construction	N/A	N/A	Implementation: specialist NGOs Monitoring: PMO

10.3 Subproject JLB-2

10.3.1 Pre-Construction Phase

Water Resources

IEC	Location	Impacts	Magnitude of impact	Mitigation/ Enhancement/ Compensation/ Contingency	Magnitude with EMP	EMP Cost (Lac Tk)	Responsible Agency
Activity: Construction of labor shed with water and sanitation facilities, garbage disposal system, construction of stock yard and construction camp, labor and material/equipment mobilization							
Air quality	- Possible locations of labor camps (Char Jajuria and Khashkaulia mauzas at Chauhali and Char raghunathpur at Jafarganj). - Location of stock yard (to be selected by the Engineer In Charge). - Location of CC blocks construction (Khashkaulia mauza at Chauhali and raghunathpur amauza at Jafarganj).	Small amount of dust would be generated during movement of vehicles, construction materials and machineries; construction of labor shed and CC block.	-2	Mitigation: - Construction materials to be covered with thick materials i.e. polythene during transportation. - Water to be sprinkled to control the generation and spreading of dust; as and where needed.	-1	N/A	Implementation: Contractor Monitoring: Nominated Engineer (SMO, BWDB)
Noise	- Possible locations of labor shed (Char Jajuria and Khashkaulia mauzas at Chauhali and Char raghunathpur at Jafarganj). - Location of stock yard (to be selected by the Engineer In Charge).	Low impacts caused due to noise generation due to mobilization of construction materials and construction of labor shed, stockyard and CC blocks. There is a high school and an upazilla office at the construction site of Chauhali and one primary school at Jafarganj which would face minor impacts due to noise	-2	Mitigation: - Noise levels due to vehicular movement are to be kept within permissible limit. - Construction camps, labor shed, and sites for CC blocks construction are to be located	-1	N/A	Implementation: Contractor Monitoring: Nominated Engineer (SMO, BWDB)

IEC	Location	Impacts	Magnitude of impact	Mitigation/ Enhancement/ Compensation/ Contingency	Magnitude with EMP	EMP Cost (Lac Tk)	Responsible Agency
	- Location of CC blocks construction (Khashkaulia mauza at Chauhali and raghunathpur amauza at Jafarganj). - Roadside locations to be used during material transportation (Char jajuria, khashkaulia mauzas at Chauhali and raghunathpur and paila mauzas at Jafarganj)	generation.		far away from settlements, school, offices.			

Land Resources

IEC	Location	Impacts	Magnitude of impact	Mitigation/ Enhancement/ Compensation/ Contingency	Magnitude with EMP	EMP Cost (Lac Tk)	Responsible Agency
Activity	***Construction of labor sheds and stocking yard for Bank Protective activities***						
Land loss	Location-2: (Chauhali-5.0km)	Possibility of 1.02 ha of agricultural land would be lost temporarily	-1	• Construction activities should be carried out as per design. • Labor shed and stocking yard should preferably be constructed on fallow or khas land. • Landowners affected by the construction of labor shed and placement of filling materials on agriculture land should be noticed ahead of time so that the area might not be affected for growing crops. • Labor sheds, and other project related activities should be optimized with the purpose of minimum disruption to cultivable lands and standing crops.	+2	0.38 (compensation)	Implementation: Contractor Compensation payment: BWDB Monitoring: Nominated Engineer (SMO, BWDB)
	Location-3: (Bachamara-2.0km)	Possibility of 1.01 ha of agricultural land would be lost temporarily	-1		+2	0.37 (compensation)	Implementation: Contractor Compensation payment: BWDB

IEC	Location	Impacts	Magnitude of impact	Mitigation/ Enhancement/ Compensation/ Contingency	Magnitude with EMP	EMP Cost (Lac Tk)	Responsible Agency
				• Adequate cash compensation should be provided to the land owners /share croppers. • The compensation should be determined based on the amount of land temporarily going out of cultivation.			Monitoring: Nominated Engineer (SMO, BWDB)
					Sub total	**0.75**	

Agricultural Resources

392. There would be no impact during the pre-construction phase

Fisheries Resources

393. There will be no impact during the pre-construction phase.

Ecological Resources

394. There will be no impact duriing the pre-construction phase.

Socio-economic

IEC	Location	Impacts	Magnitude of impact*	Mitigation/ Enhancement/ Compensation/ Contingency	Magnitude with EMP*	EMP Cost (in Lac Tk)	Responsible Agency
Activity->	Construction of labor shed with water and sanitation facilities, garbage disposal system, construction of stock yard and construction camp, labor and material/equipment mobilization						
Resettlement	5 km of the Jamuna Left bank from Chauhali Sadar to	About 534 HHs in the different locations of project area will be	-2	Proper land compensation to the PAPs, displaced	0	Will be estimated from RAP	Implementation: Deputy Commissioner,

IEC	Location	Impacts	Magnitude of impact*	Mitigation/ Enhancement/ Compensation/ Contingency	Magnitude with EMP*	EMP Cost (in Lac Tk)	Responsible Agency
	Atpara 2 km of the Jamuna Left bank from Jaffarganj to Bachamara These villages/mauzas are: Andharmanik Beda khola Mohakhola Kashipur Ata para Noya Para Dholai Kaulia Marma	displaced.		peopled of project area should be re-settled.		report	specialist NGO Monitoring: PMO
Employment	Possible locations of labor camps (Char Janjira and Khashkaulia mauzas). Location of stock yard (to be selected by the Engineer in Charge). Location of CC blocks construction (at Khashkaulia mauza).	A temporary employment opportunity will be created for local labors during labor shed construction.	+1	Recruit at least 60% of labors from locale for construction work.	N/A	N/A	Implementation: Contractor Monitoring: Nominated Engineer (SMO, BWDB)
Gender Issues	The whole study area i.e. Andharmanik	Labor mobilization may create disturbance for the local women.	-2	The labor mobilization activities should strictly follow up by project	-1	N/A	Implementation: Contractor Monitoring:

IEC	Location	Impacts	Magnitude of impact*	Mitigation/ Enhancement/ Compensation/ Contingency	Magnitude with EMP*	EMP Cost (in Lac Tk)	Responsible Agency
	Beda khola Mohakhola Kashipur			authority.			Nominated Engineer (SMO, BWDB)
Public Health	Ata para Noya Para Dholai Kaulia Marma	Because of having limited access to toilet, unhygienic environment and huge gathering of labors can create disturbance to health.	-1	Proper health and sanitation system should be ensured for labors.	0	N/A	Implementation: Contractor Monitoring: Nominated Engineer (SMO, BWDB)

10.3.2 Construction Phase

Water Resources

IEC	Location	Impacts	Magnitude of impact	Mitigation/ Enhancement/ Compensation/ Contingency	Magnitude with EMP	EMP Cost (Lac Tk)	Responsible Agency
Activity: Movement of vehicles for carrying earth materials							
Air quality	Places along the left bank of the Jamuna river where bank protection works would be carried out (Char janjira, Khasdalai, Atapara, Khash kaulia mauzas at Chauhali upazilla and Char pailadhusar, Raghunathpur, Banghabari and Paila mauzas at Jafarganj of Shibalaya upazilla)	Small amount of dust generated due to movement of vehicles and construction materials.	-2	Mitigation: Water to be sprinkled on the roads at regular intervals.	-1	N/A	Implementation: Contractor Monitoring: Nominated Engineer (SMO, BWDB)
Activity: Waste disposal, generated from the labor shed							

IEC	Location	Impacts	Magnitude of impact	Mitigation/ Enhancement/ Compensation/ Contingency	Magnitude with EMP	EMP Cost (Lac Tk)	Responsible Agency
Surface water quality	Possible locations of labor shed (Char Janjira and Khashkaulia mauzas at Chauhali and Char raghunathpur at Jafarganj).	Impacts can be generated due to improper disposal system which may eventually contaminate the water of Jamuna River.	-4	Mitigation: Proper waste disposal system, not interfering with the Jamuna river flow.	-1	N/A	Implementation: Contractor Monitoring: Nominated Engineer (SMO, BWDB)

Land Resources

IEC	Location	Impact	Magnitude of impact	Mitigation/ Enhancement/ Compensation/ Contingency	Magnitude with EMP	EMP Cost (Lac Tk)	Responsible Agency
Activity	***Collection and disposal of construction materials for bank protection activities***						
Land loss	Location-2: (Chauhali-5.0km)	About 0.5ha of land would be lost permanently	-1	• Top soil (0-15cm will be removed and stored securely away from drainage lines and erosion prone areas for future use in revegetation and surfacing. • . • Area for executing construction activities and other project related activities should be optimized with the purpose of minimum disruption to cultivable lands and standing crops • The filling materials should be collected from khas/fallow land /river. • Disposal of spoil/ constructing materials should preferably be stored on fallow or khas land so that the area might not be affected for growing crops. • Compensation will be paid for any crop damage. • The contractor will avoid cultivation fields	+2	No cost involvement of cost for land due to activities in existing embankment	Implementation: Contractor Monitoring: Nominated Engineer (SMO, BWDB)
	Location-3: (Bachamara-2.0km)	About 0.2ha of land would be lost permanently	-1		+2		Implementation: Contractor Monitoring: Nominated Engineer (SMO, BWDB)

IEC	Location	Impact	Magnitude of impact	Mitigation/ Enhancement/ Compensation/ Contingency	Magnitude with EMP	EMP Cost (Lac Tk)	Responsible Agency
				during construction. • The contractor will avoid agricultural land for material borrowing and material stockpiling. • The contractor will ensure that no vehicular movements take place inside cultivation fields. • The contractor will ensure that no material is dumped inside cultivation fields.			
					Sub total	**00**	

Agricultural Resources

IEC	Location	Impact	Magnitude of impact	Mitigation/ Enhancement/ Compensation/ Contingency	Magnitude with EMP	EMP Cost (Lac Tk)	Responsible Agency
Activity	***Construction of labor sheds, stocking yard for Bank rehabilitation, construction of new embankment, bank protection and construction of drainage sluices and disposal of spoils activities***						
Crop production loss	i) Dombaria (ii) Lochha (iii) Gopalpur (iv) Jagtala (v) Doria mehi (vi)Benotia (vii)Chauhali (viii)Bachamara (ix) Harirampu (x)Location-1(Not fix up) (xi)Location-2(Not fix up) (xii)Location-3(Not fix up)	Loss of crop production is expected to be about 27.9 metric ton for Construction of labor sheds and stocking yard for bank rehabilitation, construction of new embankment, bank protection and construction of drainage sluices and disposal of spoils activities	-1	• In cases where the disruption to farming becomes unavoidable, adequate cash compensation should be provided to the land owners. /share croppers. • Exact amount of compensation should be determined based on the amount of land temporarily going out of cultivation. • The rate should be decided on the basis of the one crop usually grown on the pieces of land. • Constructing materials • like sand, cement, construction of labor sheds, concrete, block, etc. should be placed in non-agricultural land as far as possible. These materials should not be placed in standing crops.	+3	9.33 (compensation)	Implementation: Contractor Compensation payment: BWDB Monitoring: Nominated Engineer (SMO, BWDB)

IEC	Location	Impact	Magnitude of impact	Mitigation/ Enhancement/ Compensation/ Contingency	Magnitude with EMP	EMP Cost (Lac Tk)	Responsible Agency
					Sub-Total	***9.33***	
Community Organizations	All locations of regulators	Positive impact	+2	• The community organizations should be formed prior to implementation of the project. • The community organizations should be given orientation to protect their standing crops from river bank protection work, spoil soils, on farm water management, LCS, EMG etc.	+4	2.50 (for formation and training of community organizations)	Implementation: specialist NGOs Monitoring: PMO / DDM / DAE
					Sub Total	***2.50***	

Fisheries Resources

IEC	Location	Impacts	Magnitude of impact*	Mitigation/ Enhancement/ Compensation/ Contingency	Magnitude with EMP*	EMP Cost (Lac Tk/Yr) *	Responsible Agency
Activity: Riverbankslope protection with concrete blocks and geobags (under water)							
Fish habitat	5 km of the Jamuna Left bank from Chauhali Sadar to Atpara	Borrowpit would be lost near the river bank at Chauhali sadar (East and North Khaskaulia)	-1	Not applicable	-1	Not applicable	Not applicable
	2 km of the Jamuna Left bank from Jaffarganj to Bachamara	Capture and culture fish production would be the same as the base.	0		0		
Fish biodiversity	Same as above	Capture and culture fish production would be the same as the base.	0		0		
	Same as above		0		0		
Fish production	Same as above	Capture and culture fish production would be the same as the base.	0	Proper training to increase the culture practice of high-valued fish species	+2	0.5	Implementation: specialist fisheries NGOs
	Same as above	Culture fish production would be increased by 47.32 MT MT within the project area.	+5		+6		

IEC	Location	Impacts	Magnitude of impact*	Mitigation/ Enhancement/ Compensation/ Contingency	Magnitude with EMP*	EMP Cost (Lac Tk/Yr) *	Responsible Agency
							Monitoring: PMO in coordination with Department of Fisheries
Activity: Placing and dumping of C.C. blocks above low water as per design							
Fish biodiversity	5 km of the Jamuna Left bank from Chauhali Sadar to Atpara	No Impact	0	Not applicable	0	Not applicable	Not applicable
	2 km of the Jamuna Left bank from Jaffarganj to Bachamara	Cat fish (boal, ayr, magur, etc.) might shift from the project area	-3	Proper protective device will have to be taken to protect the deep pools (dor/duars).	-2	0.2	Implementation: Contractor Monitoring: Nominated Engineer (SMO, BWDB) in coordination with Department of Fisheries
Fish production	Same as above	Capture and culture fish production would be the same as the base.	0	Proper training to increase the culture practice of high-valued fish species	+1	1	Implementation: specialist NGOs Monitoring: PMO in coordination
	Same as above	Culture fish production would be increased by 47.32 MT MT within the project area.	+5		+5		

IEC	Location	Impacts	Magnitude of impact*	Mitigation/ Enhancement/ Compensation/ Contingency	Magnitude with EMP*	EMP Cost (Lac Tk/Yr) *	Responsible Agency
							with Department of Fisheries

Ecological Resources

IEC	Location	Impacts	Magnitude of impact*	Mitigation/Enhancement/Compensation/Contingency	Magnitude with EMP	EMP Cost (Lac Tk.)	Responsible Agency
Activity: Slope protection							
Terrestrial ecosystem Aquatic ecosystem. Floral composition and diversity. Faunal composition and diversity	5 km of the Jamuna Left bank from Chauhali Sadar to Atpara. 2 km of the Jamuna Left bank from Jaffarganj to Bachamara	Vegetation of river banks and some aquatic flora will reduce. Wildlife population like terrestrial birds and palm squirrels will be disturbed.	-5	Awareness development activities should be conducted by the committee or nature club to protect the saplings.	+7	-	Implementation: specialist NGOs Monitoring: PMO /

Socio-economic

IEC	Location	Impacts	Magnitude of impact*	Mitigation/ Enhancement/ Compensation/ Contingency	Magnitude with EMP*	EMP Cost (in Lac Tk)	Responsible Agency
Activity->	Filling placing of geo-bags and casting and placing of CC blocks on the river banks						
Employment	Places along the left bank of	A temporary	+1	Recruit at least	N/A	N/A	Implementation:

IEC	Location	Impacts	Magnitude of impact*	Mitigation/ Enhancement/ Compensation/ Contingency	Magnitude with EMP*	EMP Cost (in Lac Tk)	Responsible Agency
	the Jamuna river where bank protection works would be carried out (Char janjira, Khasdalai, Atapara, Khash kaulia mauzas at Chauhali upazilla and Char pailadhusar, Raghunathpur, Banghabari and Paila mauzas at Jafarganj of Sirajganj upazilla)	employment will be created for many labors during bailing out activities.		60% of labors from locale for construction work.			Contractor Monitoring: Nominated Engineer (SMO, BWDB)
Labor migration	Labor would be internally in-migrated from adjacent upazilas/districts.	Opportunities for in-migrant labors could be ensured during earthwork activities.	+2	A number of labors should be recruited to prompt the work.	N/A	N/A	Implementation: Contractor Monitoring: Nominated Engineer (SMO, BWDB)
Public and Occupational Health	The whole project study area i.e.Andharmanik, Beda khola, Mohakhola, Kashipur Ata para, Noya Para, Dholai Kaulia Work sites	Because of having limited access to toilet, unhygienic environment and huge gathering of labors can create disturbance to health. Accidents during construction activities	-1	Proper health and sanitation system should be ensured for labors. Safety measures, first aid provisions, and arrangements for medical evacuation and attention	-1	N/A	Implementation: Contractor Monitoring: Nominated Engineer (SMO, BWDB)

10.3.3 Post-construction Phase

Water Resources

IEC	Location	Impact	Magnitude of impact	Mitigation/ Enhancement/ Compensation/ Contingency	Magnitude with EMP	EMP Cost (Lac Tk)	Responsible Agency
Erosion	- From Atapara to Khash kaulia mauzas at Chauhali upazilla - From Gangadia to the end of Paila mauzas at Jafarganj of Shibalaya upazilla	Massive impact to the livelihood of the local people. Due to the bank protection works at Chauhali and Jafarganj, huge amount of agricultural lands and settlements will be saved. Communication facilities will be re-established over the left bank of Jamuna river.	+8	Enhancement: - Implementing Katkin and other small scale plantation along the slope of protective works - Providing bamboo protection at the country side of protective works to increase soil strength.	+9	N/A	Implementation: Community organizations Monitoring: Department of Forestry, BWDB Field Division

**No impact (0); Negative Impact (-); Positive Impact (+); Low Impact (1-3); Medium Impact (4-6); High Impact 7-8;Very High Impact (9-10).*

Land Resources

395. There will be no impact during the post-construction phase.

Agricultural Resources

396. There will be no impact during the post-construction phase.

Fisheries Resources

IEC	Location	Impacts	Magnitude of impact*	Mitigation/ Enhancement/ Compensation/ Contingency	Magnitude with EMP*	EMP Cost (Lac Tk/Yr)*	Responsible Agency
Fish habitat	5 km of the Jamuna Left bank from Chauhali Sadar to Atpara	Estimated net loss to fish habitat area would be 1388.6 ha	-3	1. Aquatic trees and herbs should be planted on the slope of the bank. 2. Proper protective device (i.e., declaration of Sanctuary) will have to take to protect the deep pools (dor/duars). 3. Use of surface water during the breeding period should be stopped.	-1	1	Implementation: specialist NGOs, community organizations Monitoring: PMO / Department of Fisheries (DoF)
	2 km of the Jamuna Left bank from Jaffarganj to Bachamara	Estimated net loss to fish habitat area would be 550 ha	-3		-1		
Fish biodiversity	5 km of the Jamuna Left bank from Chauhali Sadar to Atpara	Capture and culture fish production would be the same as the base.	0	Not applicable	0	-	Not applicable
	2 km of the Jamuna Left bank from Jaffarganj to Bachamara	Same as above	0	Same as above	0		

Fish production	5 km of the Jamuna Left bank from Chauhali Sadar to Atpara	Capture and culture fish production would be the same as the base.	0	Proper training to increase the culture practice of high-valued fish species Not applicable	+2	0.5	Implementation: specialist NGOs Monitoring: PMO / Department of Fisheries (DoF)
	2 km of the Jamuna Left bank from Jaffarganj to Bachamara	**Estimated net gain to fish production: 1 MT**	**+1**		**+3**		

** No impact (0); Negative Impact (-); Positive Impact (+); Low Impact (1-3); Medium Impact (4-6); High Impact (7-8); Very High Impact (9-10).*

Ecological Resources

397. There will be no impact during the post-construction phase.

Socio-economic

IEC	Location	FWOP	FWIP	Impacts	Magnitude of impact*	Mitigation/ Enhancement/ Compensation/ Contingency	Magnitude with EMP*	EMP Cost (in Lac Tk)	Responsible Agency
Jamuna Left Bank-2 (JLB-2)									
Communication	Possible locations for communication in project area Char janjira Khasdalai Khash kaulia	Embankment cum road could be wiped out. In near future, road of Char janjira,	Communication facilities will be improved both in local and upazila level.	Road communication will be improved which convey better economy by	+3	Plan upgrading of embankment with road during next tranches	N/A	N/A	Implementation: PMO, Monitoring: ADB

IEC	Location	FWOP	FWIP	Impacts	Magnitude of impact*	Mitigation/ Enhancement/ Compensation/ Contingency	Magnitude with EMP*	EMP Cost (in Lac Tk)	Responsible Agency
	Pailadhusar Raghunathpur Paila	Khasdalai, Atapara, Khash kaulia mauzas at Chauhali upazilla and Char pailadhusar, Raghunathpur, Banghabari and Paila mauzas at Jafarganj of Sirajganj upazilla would be affected.		expanding business option.					
Protection of municipal area including markets and homesteads	Chouhali bazaar and adjacent villages Jafarganj bazaar and adjacent village	Municipal area including markets and homesteads will certainly be eroded	Protective work will protect the municipal area including markets and homestead	Municipal area, markets and homesteads will be protected and business will be run properly. Government office, and educational and religious	+6	Extend protection where necessary during next tranches	N/A	N/A	Implementation: PMO, Monitoring: ADB

IEC	Location	FWOP	FWIP	Impacts	Magnitude of impact*	Mitigation/ Enhancement/ Compensation/ Contingency	Magnitude with EMP*	EMP Cost (in Lac Tk)	Responsible Agency
				institutions will be protected					
Employment	Char janjira Khasdalai Khash kaulia Pailadhusar Raghunathpur Paila	A temporary employment will be created for many labors during labor shed construction.	More employment opportunities will be created for farmers and fishers of the project area.	In future, a number of employments will generate in fish culture and agriculture activities.	+4	Ensure/arrange training from DAE and DOF for local labors.	N/A	N/A	Implementation: specialist NGOs Monitoring: PMO
Income generation		A small number of low earned people will enhance their income with this additional income source.	People income will increase in future by creating more work options.	Income will be increased for all classes i.e. labor to businessmen.	+4	Implement a livelihood program for vulnerable groups directly affected by the construction	N/A	N/A	Implementation: specialist NGOs Monitoring: PMO

10.4 Subproject PLB-1

10.4.1 Pre-Construction Phase

Water Resources

IEC	Location	Impacts	Magnitude of impact	Mitigation/ Enhancement/ Compensation/ Contingency	Magnitude with EMP	EMP Cost (Lac Tk)	Responsible Agency
Activity: Construction of labor shed with water and sanitation facilities, garbage disposal system, construction of stock yard and construction camp, labor and materials/equipment mobilization							
Air quality	- Possible locations of labor camps (Ramkrishnapur and Andarmanik mauzas) - Location of stock yard (to be selected by the Engineer In Charge), - Location of CC block construction (Andarmanik mauza) - Roadside locations to be used in carrying construction materials (Harirampur-Rathora road; Andarmanik and Ramkrishnapur mauzas)	Small amount of dust generation during movement of vehicles, construction materials and machineries, construction of labor shed and CC blocks.	-2	<u>Mitigation:</u> - Construction materials to be covered with thick materials i.e. polythene during transportation - Water to be sprinkled to control the generation and spreading of dust; as and where needed	-1	N/A	Implementation: Contractor Monitoring: Nominated Engineer (SMO, BWDB)
Activity: Construction of labor shed and construction camp; labor and materials/equipment mobilization							
Noise	- Possible locations of labor camps (Ramkrishnapur and Andarmanik mauzas) - Location of stock yard (to be selected by the Engineer In Charge), - Location of CC block construction (Andarmanik mauza) - Roadside locations to be used in carrying construction materials (harirampur-rathora road; andarmanik and ramkrishnapur mauzas)	Minor impact would be generated due to the construction of CC block, labor shed, stock yard and mobilization of materials.	-2	- Noise levels are to be kept within permissible standard	-1	N/A	Implementation: Contractor Compensation payment: BWDB Monitoring: Nominated Engineer (SMO, BWDB)

Land Resources

IEC	Location	Impacts	Magnitude of impact	Mitigation/ Enhancement/ Compensation/ Contingency	Magnitude with EMP	EMP Cost (Lac Tk)	Responsible Agency
Activity	***Construction of labor sheds and stocking yard for Bank Protective activities***						
Land loss	Location-4: (Harirampur-7.0km)	Possibility of 1.04ha agricultural land would be lost temporarily lost	-1	• Construction activities should be carried out as per design. • Labor shed and stocking yard should preferably be constructed on fallow or khas land. • Landowners affected by the construction of labor shed and placement of filling materials on agriculture land should be noticed ahead of time so that the area might not be affected for growing crops. • Labor sheds, and other project related activities should be optimized with the purpose of minimum disruption to cultivable lands and standing crops. • Adequate cash compensationshould be provided to the land owners /share croppers. • The compensation should be determined based on the amount of land temporarily going out of cultivation.	+2	0.39 (compensation)	Implementation: Contractor Monitoring: Nominated Engineer (SMO, BWDB)
					Sub total	**0.39**	

Agricultural Resources

398. There would be no impact during the pre-construction phase

Fisheries Resources

399. There will be no impact during the pre-construction phase.

Ecological Resources

400. There will be no impact duriing the pre-construction phase.

Socio-economic

IEC	Location	Impacts	Magnitude of impact*	Mitigation/ Enhancement/ Compensation/ Contingency	Magnitude with EMP*	EMP Cost (in Lac Tk)	Responsible Agency
Activity->	Construction of labor shed with water and sanitation facilities, garbage disposal system, construction of stock yard and construction camp, labor and materials/equipment mobilization						
Resettlement	Possible locations of labor camps (Ramkrishnapur and Andarmanik mauzas) Location of stock yard (to be selected by the Engineer In Charge), Location of CC block construction (Andarmanik mauza). These villages are: Jaghannathpur, Boxor, Andharmanik, Bholabaj, Boyra	About 596 HHs in the different locations of project area will be displaced.	-2	Proper land compensation, PAPs should be ensured for displaced peopled of project area	-1	Will be estimated from RAP report	Implementation: Deputy Commissioner, specialist NGO Monitoring: PMO
Gender Issues	The whole study area ,i.e. Jaghannathpur,Boxor Andharmanik, Bholabaj, Boyra	Labor mobilization may create disturbance for the local women.	-2	The labor mobilization activities should strictly follow up by project authority.	-1	N/A	Implementation: Contractor Monitoring: Nominated Engineer (SMO, BWDB)
Public Health		Because of having limited access to toilet, unhygienic environment due	-1	Proper health and sanitation system should be ensured for labors.	0	N/A	Implementation: Contractor Monitoring:

IEC	Location	Impacts	Magnitude of impact*	Mitigation/ Enhancement/ Compensation/ Contingency	Magnitude with EMP*	EMP Cost (in Lac Tk)	Responsible Agency
		huge gathering of labors can create disturbance to health.					Nominated Engineer (SMO, BWDB)

10.4.2 Construction Phase

Water Resources

IEC	Location	Impacts	Magnitude of impact	Mitigation/ Enhancement/ Compensation/ Contingency	Magnitude with EMP	EMP Cost (Lac Tk)	Responsible Agency
Activity: Placing of geo-bags							
Air quality	Places along the left bank of the Padma river, where bank protection works would be carried out (Ramkrishnapur, Andarmanik and Boyra mauzas of Harirampurupazilla).	Minor amount of dust generation during placing and dumping of CC blocks, Geo-bags; slope preparation and pitching, construction of sluices and movement of vehicles and construction materials.	-2	Mitigation: Water to be sprinkled as and where needed.	-1	N/A	Implementation: Contractor Monitoring: Nominated Engineer (SMO, BWDB)
Activity: Waste disposal from the labor sheds.							
Surface water quality	- Possible locations of labor camps (Ramkrishnapur and Andarmanik mauzas)	Impacts can be generated due to improper disposal system which may eventually contaminate the water of Padma River.	-4	Proper waste disposal system, not interfering with the Padma River flow.	-1	N/A	Implementation: Contractor Monitoring: Nominated Engineer (SMO, BWDB)

Land Resources

IEC	Location	Impact	Magnitude of impact	Mitigation/ Enhancement/ Compensation/ Contingency	Magnitude with EMP	EMP Cost (Lac Tk)	Responsible Agency
Activity	***Collection and disposal of construction materials for rbank protection activities***						
Land loss	Location-4: (Harirampur-7.0km)	0.7ha of land would be lost permanently	-1	• Top soil (0-15cm) will be removed and stored securely away from drainage lines and erosion prone areas for future use in revegetation and surfacing. • . • Area for executing construction activities and other project related activities should be optimized with the purpose of minimum disruption to cultivable lands and standing crops • The filling materials should be collected from khas/fallow land /river. • Disposal of spoil/ constructing materials should preferably be stored on fallow or khas land so that the area might not be affected for growing crops. • Compensation will be paid for any crop damage. • The contractor will avoid cultivation fields during construction. • The contractor will avoid agricultural land for material borrowing and material stockpiling. • The contractor will ensure that no vehicular movements take place inside cultivation fields. • The contractor will ensure that no material is dumped inside cultivation fields	+2	No cost involvement of cost for land due to activities in existing embankment	Implementation: Contractor Monitoring: Nominated Engineer (SMO, BWDB)
					Sub total	**00**	

Agricultural Resources

IEC	Location	Impact	Magnitude of impact	Mitigation/ Enhancement/ Compensation/ Contingency	Magnitude with EMP	EMP Cost (Lac Tk)	Responsible Agency
Activity	***Construction of labor sheds, stocking yard for Bank rehabilitation, construction of new embankment, bank protection and construction of drainage sluices and disposal of spoils activities***						
Crop production loss	i) Dombaria (ii) Lochha (iii) Gopalpur (iv) Jagtala (v) Doria mehi (vi)Benotia (vii)Chauhali (viii)Bachamara (ix) Harirampu (x)Location-1(Not fix up) (xi)Location-2(Not fix up) (xii)Location-3(Not fix up)	Loss of crop production is expected to be about 27.9 metric ton for Construction of labor sheds and stocking yard for bank rehabilitation, construction of new embankment, bank protection and construction of drainage sluices and disposal of spoils activities	-1	• In cases where the disruption to farming becomes unavoidable, adequate cash compensation should be provided to the land owners. /share croppers. • Exact amount of compensation should be determined based on the amount of land temporarily going out of cultivation. • The rate should be decided on the basis of the one crop usually grown on the pieces of land. • Constructing materials • like sand, cement, construction of labor sheds, concrete, block, etc. should be placed in non-agricultural land as far as possible. These materials should not be placed in standing crops.	+3	9.33 (compensation)	Implementation: Contractor Monitoring: Nominated Engineer (SMO, BWDB)
					Sub-Total	***9.33***	
Community Organizations	All locations of regulators	Positive impact	+2	• The community organizations should be formed prior to implementation of the project. • The community organizations should be given orientation to protect their standing crops from river bank protection work, spoil soils, on farm water management, LCS, EMG etc.	+4	2.50 (formation and training of community organizations)	Implementation: specialist NGOs Monitoring: PMO / DDM / DAE
					Sub Total	***2.50***	

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Fisheries Resources

IEC	Location	Impacts	Magnitude of impact*	Mitigation/ Enhancement/ Compensation/ Contingency	Magnitude with EMP*	EMP Cost (Lac Tk/Yr) *	Responsible Agency
Fish habitat	7 km of the Padma Left Bank at Harirampur	Temporary damage would occur in the seasonal fish habitat due to either clearance of vegetation cover or draped by the filling earth during earth work for the fish species of marginal vegetation feeder. Spawning ground would be lost	-6	1. Vegetation clearance should be done as low as possible 2. There should be nowork on spawning grounds during the spawning season	-2		Implementation: Contractor Monitoring: Nominated Engineer (SMO, BWDB) in coordination with Department of Fisheries
Fish migration		Migration route would be disturbed	-6		-2		
Fish biodiversity		Riverine fish species i. e. major carp species, grass carp and other herbivorous species, eel (baim), big and small cat fish (boal, ayr, magur), might shift from the project area	-6		-2		
Fish production		Capture fish production would temporarily be declined by 592 MT within the project area.	-1		-1		

Ecological Resources

IEC	Location	Impacts	Magnitude of impact*	Mitigation/Enhancement/Compensation/Contingency	Magnitude with EMP	EMP Cost (Lac Tk.)	Responsible Agency
Activity: Slope protection							
Terrestrial ecosystem Aquatic ecosystem. Floral composition and diversity. Faunal composition and diversity	7 km of the Padma Left Bank at Harirampur	Vegetation of river banks and some aquatic flora will reduce. Wildlife population like terrestrial birds and palm squirrels will be disturbed.	-5	Awareness development activities should be conducted by the committee or nature club to protect the saplings.	+7	-	Implementation: specialist NGOs Monitoring: PMO /

Socio-economic

IEC	Location	Impacts	Magnitude of impact*	Mitigation/ Enhancement/ Compensation/ Contingency	Magnitude with EMP*	EMP Cost (in Lac Tk)	Responsible Agency
Pdma Left Bank-1 (PLB-1)							
Activity->	filling placing of geo-bags on the river banks						
Employment	Places along the left bank of the Padma River, where bank protection works would be carried out (Ram krishnapur, Andarmanik and Boyra mauzas of Harirampurupazilla).	Temporary employment opportunities will be created for labors during bailing out activities.	+1	Recruit at least 60% of labors from locale for construction work.	N/A	N/A	Implementation: Contractor Monitoring: Nominated Engineer (SMO, BWDB)
Labor	Labor would be internally in-	Opportunities of in-	+2	A number of labors	N/A	N/A	Implementation:

IEC	Location	Impacts	Magnitude of impact*	Mitigation/ Enhancement/ Compensation/ Contingency	Magnitude with EMP*	EMP Cost (in Lac Tk)	Responsible Agency
migration	migrated from adjacent upazilas/districts.	migrant labors could be created during earthwork activities.		should be recruited to prompt the work.			Contractor Monitoring: Nominated Engineer (SMO, BWDB)
Public and Occupational Health	Places along the left bank of the Padma River, where bank protection works would be carried out (Ram krishnapur, Andarmanik and Boyra mauzas of Harirampurupazilla). Work sites	Because of having limited access to toilet, unhygienic environment and huge gathering of labors can create disturbance to health. Accidents during construction activities	-1	Proper health and sanitation system should be ensured for labors. Safety measures, first aid provisions, and arrangements for medical evacuation and attention	-1	N/A	Implementation: Contractor Monitoring: Nominated Engineer (SMO, BWDB)

10.4.3 Post-construction Phase

Water Resources

IEC	Location	Impact	Magnitude of impact	Mitigation/ Enhancement/ Compensation/ Contingency	Magnitude with EMP	EMP Cost (Lac Tk)	Responsible Agency

IEC	Location	Impact	Magnitude of impact	Mitigation/ Enhancement/ Compensation/ Contingency	Magnitude with EMP	EMP Cost (Lac Tk)	Responsible Agency
Erosion	Ram krishnapur, Andarmanik and Boyra mauzas of Harirampur upazilla	Huge impacts in the impacted area. River Bank protection work at Harirampur will save agricultural lands and settlements. Communication system will be enhanced. The economic status of livelihood would improve.	+7	Enhancement: - Implementing Katkin and other small scale plantation along the slope of protective works. - Providing biological protection at the country side of protective works to ensure soil stability.	+8	N/A	Implementation: Community organizations Monitoring: Department of Forestry, BWDB Field Division

No impact (0); Negative Impact (-); Positive Impact (+); Low Impact (1-3); Medium Impact (4-6); High Impact 7-8; Very High Impact (9-10).

Land Resources

401. There will be no impact during the post-construction phase.

Agricultural Resources

402. There will be no impact during the post-construction phase.

Fisheries Resources

IEC	Location	Impacts	Magnitude of impact*	Mitigation/ Enhancement/ Compensation/ Contingency	Magnitude with EMP*	EMP Cost (Lac Tk/Yr)*	Responsible Agency
Fish habitat	7 km of the Padma Left Bank at Harirampur	Estimated net loss to fish habitat: 678 ha.	-6	1. Vegetation clearance should be done as low as possible	-2		Implementation: specialist NGOs

IEC	Location	Impacts	Magnitude of impact*	Mitigation/ Enhancement/ Compensation/ Contingency	Magnitude with EMP*	EMP Cost (Lac Tk/Yr)*	Responsible Agency
				Spawning season should be avoided during the earthwork and earth filling Dredging will have to done during the dry season. Proper protective device will have to take to protect the deep pools (dor/duars).			Monitoring: PMO / Department of Fisheries (DoF)
Fish migration		Migration route would be disturbed	-2		-1		Implementation: specialist NGOs Monitoring: PMO / DoF
Fish biodiversity		Riverine fish species i. e. hilsa, major carp species, eel (baim), big and small cat fish (boal, ayr, magur), etc. might shift from the project area	-5		-3		Implementation: specialist NGOs Monitoring: PMO / Department of Fisheries (DoF)
Fish production		Estimated net loss to fish production: 46 MT	-5		-3		

** No impact (0); Negative Impact (-); Positive Impact (+); Low Impact (1-3); Medium Impact (4-6); High Impact (7-8); Very High Impact (9-10).*

Ecological Resources

403. There will be no impact during the post-construction phase.

Socio-economic

IEC	Location	FWOP	FWIP	Impacts	Magnitude of impact*	Mitigation Measure	Magnitude with EMP*	EMP Cost (in Lac Tk)	Responsible Agency
Padma Left Bank-1 (PLB-1)									
Communication	The possible locations for communication system are: Jaghannathpur Boxor Andharmanik Bholabaj Boyra	Bank protection cum road wiped out recently. In near future, main road of Alfadanga to Faridpur would be affected.	Communication facilities will be improved both in local and upazila level.	Road communication will be improved which convey better economy by expanding business option.	+3	Plan upgrading of embankment with road during next tranches	N/A	N/A	Implementation: PMO, Monitoring: ADB
Protection of municipal area including markets and homesteads	Ramkrishnapur bazaar and adjacent other villages Andharmanik bazaar and adjacent other village	Municipal area including markets and homesteads will certainly be eroded	Protective work will protect the municipal area including markets and homestead	Municipal area, markets and homesteads will be protected and business will be run properly. Government office, and educational and religious institutions will be protected	+6	Extend protection where necessary during next tranches	N/A	N/A	Implementation: PMO, Monitoring: ADB

IEC	Location	FWOP	FWIP	Impacts	Magnitude of impact*	Mitigation Measure	Magnitude with EMP*	EMP Cost (in Lac Tk)	Responsible Agency
Employment	The possible locations for employment opportunities in future are: Jaghannathpur Boxor Andharmanik Bholabaj Boyra	Temporary employment will be created for many labors during labor shed construction.	More employment opportunities will be created in agriculture and fisheries field.	In future, a number of employments will generate in fish culture and agriculture activities.	+4	Ensure/arrange training from DAE and DOF for local labors.	N/A	N/A	Implementation: specialist NGOs Monitoring: PMO
Income generation		A small number of low earned people will enhance their income with this additional income source.	People income will increase in future by creating more work options.	Income will be increased for all classes i.e. labor to businessmen.	+4	Implement a livelihood program for vulnerable groups directly affected by the construction	N/A	N/A	Implementation: specialist NGOs Monitoring: PMO

10.5 Monitoring Plan

10.5.1 Monitoring schedule for Pre-construction Phase

404. In this phase, no implementation monitoring plan is needed for checking EMP implementation works. The below provides an non-exhaustive example how the EMP could be monitored, which needs to be expanded to the site specific conditions.

10.5.2 Monitoring schedule for construction Phase

	Bangladesh Water Development Board	
	Integrated Flood and Riverbank Erosion Management	
	Investment Program	

EMP IMPLEMENTATION

Book No. ________________ Monitoring Report No.__________

Date:_____________________ Time:_______________________

Contract:____

Contractor:____

Work Sites (s):____

Sample checklist:

A	DAILY EHS CHECKLIST	Yes	No	Score Yes=+5 No=-5	A	DAILY EHS CHECKLIST	Yes	No	Score Yes=+5 No=-5
1	Correct Disposal of Construction Solid Waste				15	Dispensary working, Doctor present			
2	Correct Disposal of Liquid Waste				16	Ambulance Functional			
3	Vehicles and dredger With No Smoke or Noise				17	No Loss to Flora or Fauna (Specially Tree)			
4	Vehicles Within Speed Limit				18	Re-excavation work			
5	No Pollution from construction site				19	Placement of dredging spoil			
6	No Oil/Diesel Spills on Land or Water				20	Top-soil protection system from embankment area			
7	No Social Issue Created				21	Placement of Top Soil			
8	Any Threat Caused				22	Plantation			

A	DAILY EHS CHECKLIST	Yes	No	Score Yes=+5 No=-5	A	DAILY EHS CHECKLIST	Yes	No	Score Yes=+5 No=-5
	to Riverine area					system			
9	Water Sprinkled on embankment				23	Presence of Child Labour			
10	No embankment and bank Soil Erosion				24	Labour camp location & management in order			
11	Safety dress, helmet and field boots used				25	Drinking water and sanitation facilities for labour			
12	Health precautions taken				26	No Burning of wood in camp			
13	Placement of C.C blocks				27	Women wage			
14	Turfing materials								

B. EXPLANATION (of any of above points)	Total Scores = _______%

C. NON COMPLIANCE:

Non Compliance # Period Description	Class
	1. Minor: Under One Month (Contractor alerted)
	2. Moderate: Over One Month but under Two Months (Contractor warned)
	3. Major: About Two Months (Contractor's local bill withheld by RE* till compliance)
	4. Critical: Over Three Months (Contractor's overall bill withheld by RE and PM* till compliance)

D. CIRCULATION

1) DG, DOE, 2) DG, BWDB, 4) EE, Local BWDB Office

Field EHS* Monitor of Consultant (Full Name & Signature) *EHS- Environment Health & Safety *RE – Resident Engineer *ES – Environmental Supervisor of Consultants.	Field EHS Expert of Contractor (Full Name & Signature)

10.5.3 Monitoring schedule for Post-construction Phase

405. A monitoring plan has been prepared to be carried out during the post-construction phase of the project. The monitoring plan has been prepared considering a number of environmental indicators related to the project interventions. The methods of carrying out the monitoring plan as well as the desired schedule of monitoring have also been recommended.

(a) Water Resources

Indicator	Method	Location	Frequency	Monitoring Cost (Lac Tk per year)*	Responsible Agency
Physical condition(***crest level, crest width, and slope***) of the new and rehabilitated embankments	To check whether any breaching or physical failures have occurred in the new and rehabilitated embankments	At places along the embankment, preferably at Kaijuri, Verakhola and Hurasagar offtake.	Twice in a year (pre and post monsoon)	1	BWDB
Technical performance of the drainage sluices	To examine the functionality of drainage sluices	At the locations of sluices (in every sub reach)	Once in a year (post monsoon)	0.5	BWDB
Physical condition of the river bank protection works	To check if the CC blocks and Geo-bags are in place	Locations where bank protection works have been carried out (Benotia, Chauhali, Jafarganj and Harirampur)	Twice in a year (pre and post monsoon)	1	BWDB
River planform	Checking the diversion phenomenon, conveyance characteristics and plan forms of a number of rivers	Karatoya offtake (JRB-1), Ichamaty offtake (PLB-1), Kata khal at Andarmanik (PlB-1)	Once in a year (post monsoon)	1	BWDB
			Sub-total	**3.50**	

(b) Land and Agriculture Resources

Indicator	Method	Location	Frequency	Monitoring Cost (Lac Tk)*	Responsible Agency
Crop yield	The Water Management Organizations	All Upazilas within the project area namely-	The appropriate time for	3.0	DAE, BWDB with involvemen

Indicator	Method	Location	Frequency	Monitoring Cost (Lac Tk)*	Responsible Agency
	(WMOs) should be involved for monitoring the crop area and yield level of the crops. Focus Group Discussion (FGD) should be followed and also individual discussion has to be followed.	Balkuchi kamarkhanda, Shahjadpur, Nagarpur, Daulatpur, Saturia, Ghior, Manikganj sadar, Singair, Sibalaya, Harirampur and Chauhali	monitoring yield would be harvesting time for each crop season.		t of beneficiaries (WMOs).
Crop damage	The community organizations should be involved for monitoring the damage of the crops.	All Upazilas within the project area namely- Balkuchi kamarkhanda, Shahjadpur, Nagarpur, Daulatpur, Saturia, Ghior, Manikganj sadar, Singair, Sibalaya, Harirampur and Chauhali	The appropriate time for monitoring damage would be harvest time of each crop.	3.0	BWDB, DAE and Community organizations
Irrigation Expansion	The Water Management Organizations (WMOs) should be involved for monitoring the activity related to the expansion of irrigated area.	All Upazilas within the project area namely- Balkuchi kamarkhanda, Shahjadpur, Nagarpur, Daulatpur, Saturia, Ghior, Manikganj sadar, Singair, Sibalaya, Harirampur and Chauhali	Three times in dry season (mainly Boro crops).	3.0	DAE, BWDB with involvement of beneficiaries (WMOs).
			Sub-total	**9.0**	

(c) **Fisheries Resources**

Indicator	Method	Location	Frequency	Monitoring Cost (Lac Tk/Yr)*	Responsible Agency
Fish habitat status	Habitat observation	Seven locations beside the Baral river bank: 6.5 km of the Verakhola towards start of Hurashagar river 4km from the starting point of Hurashagar to Korotoa bank 10.5 km from Hat Pachil Bazar, Kaizuri to Benotia Hat/Bazar 2 km from Benotia Hat/Bazar to the start of Baral Khal, Verakola Hat 5 km of the Jamuna Left bank from Chauhali Sadar to Atpara 2 km of the Jamuna Left bank from Jaffarganj to Bachamara 7 km of the Padma Left Bank at Harirampur, Andharmanik Ghat	Two times per year. (Will continue for 5 years) Baseline will need to be conducted during pre-constructio n phase.	1.25	DoF
Fish migration	Catch monitoring, RRA and FGD	Four locations: The mouth of Baral river to Hurashagar connectivity near sluice gates at Char Andharmanik near the end point of embankment at the mouth of Baral vs karotoa connectivity Baral river to Karotoa and Baral to Hurashagor Major carp migration route at Andharmanik Ghat of Bayra Union for spawning	Two month e.g. May and June, per year. (Will continue for 2 years after completion of project activities).	1.0	DoF
Fish species and fish productio n	Catch monitoring and Fish Market Survey	Entire study area	Once per month in each location for 2 year after completion of	1.0	DoF

Indicator	Method	Location	Frequency	Monitoring Cost (Lac Tk/Yr)*	Responsible Agency
			proposed activities.		
Pond fish culture	Interviewing fish farmers and Fish Market Survey	Selected ponds	One time per month (Will continue 5 years)	1.25	DoF
Public awareness	Observation of wetland based national and international days, e.g. Fish week. Environment day, wetland day etc.	In the study area	Selected schedule (Will continue 2 year)	2.0	DoF, Community based Fisheries Management Organizations (CBFMOs) and Community based Organizations (CBOs) and other nature clubs.
			Sub-total	**5.00**	

(d) Ecological resources

Indicator	Method	Location	Frequency	Cost (Lac Tk.)	Responsible Agency
Survival rate of planted saplings	Observation and counting	Locations are below: • 6.5 km of the Verakhola towards start of Hurashagar river • 4km from the starting point of Hurashagar to Korotoa river bank • 10.5 km from Hat Pachil Bazar, Kaizuri to Benotia Hat/Bazar • 2 km from Benotia Hat/Bazar to the start of Baral Khal, Verakola Hat • 5 km of the Jamuna Left bank from Chauhali Sadar to Atpara • 2 km of the Jamuna Left bank from Jaffarganj to Bachamara	For the first three years (by the recruited guard)	Mention above	BWDB in coordination with local group

Indicator	Method	Location	Frequency	Cost (Lac Tk.)	Responsible Agency
		• 7 km of the Padma Left Bank at Harirampur, Andharmanik Ghat			

(e) **Socio-economic**

Indicator	Method	Location	Frequency	Monitoring Cost (Lac Tk)*	Responsible Agency
Roadway communication Income generation Protection of municipal area including markets and homesteads	RRA	**JRB-1** Hat Panchil, Benotia Verakhola,Dambarla **JLB-2** Char janjira, Khasdalai Khash kaulia,Pailadhusar Raghunathpur, Paila **PLB-1** Jaghannathpur, Boxor Andharmanik, Bholabaj Boyra	Once	3	BWDB/consultant and contractor
			Sub-total	**3.0**	

11. Conclusion and Recommendations

11.1 Conclusion

406. The program has a number of inbuilt mechanisms to reduce environmental impacts. Many mitigation measures have been aggressively mainstreamed into program planning and engineering designs. The flexibility of a phased MFF approach supports minimization and mitigation of potential negative impacts in a gradual manner. Works will start in Tranche-1 with protection of critically eroding riverbanks and the reconstruction of the destroyed Brahmaputra Right Embankment, while conducting extensive studies on future impacts of river stabilization and associated embankment works, including piloting new measures. During Tranche-2 first measures for larger scale river stabilization are planned, designed based on the Tranche-1 study outcomes and supported by environmental monitoring and mitigation measures. This approach will be carried forward and adapted in Tranche-3.

407. With respect to flood mitigation and river stabilization, the program considers the following detailed approach:

(i) The program as a whole aims to reduce the flood risk at three priority sub-projects (JRB-1, JLB-2, and PLB-1) by providing new/rehabilitated embankments in all tranches. The program intends to mitigate negative impacts at the planning and designlevel, and through additional compensation measures. Planning and design account for: (a) leaving key distributariesopen to limited flood flowsto support the continued deposition of fertile sediments as well as flood season navigation, (b) designing the offtakes of the distributaries as part of the river stabilization work, in order to improve dry season flows, (c) providing embankments with sluice gates specifically for local drainage[42], and (d) designing embankments in accordance to international practice to reduce the risk of failure. Mitigation measures address: (e) loss in floodplain biodiversity, and (f) open water fisheries. At community-level, flood risk management training will be provided to the flood affected population in order to raise the awareness to the residual risk after strengthening the existing flood embankment lines.

(ii) To protect the flood embankments, river banks will be progressively stabilized through riverbank protection, starting in Tranche-1 at critically eroding reaches on an emergency basis. Over time, this approach may lead to general river stabilization. To avoid transforming the geomorphology of the Padma/Jamuna in an unprecedented manner, for example if a single-channel solution is implemented, as studied in the Capital Dredging and Sustainable River Management Project, (a) a multi-disciplinary river stabilization study[43] covering the whole Brahmaputra system from the Indian boarder will be conducted, supported by (b) piloting stabilization measures, focussing on bio-engineering techniques or “building with nature”; (c)siting of physical works will be planned over the three tranches using an innovative dynamic methodology that responds to evolving river behavior. Mitigation of potentially negative impacts of the

[42]As it is not possible to locate sluice gates for later tranches, cost have been reflected in the embankment kilometer cost.
[43]encompassing potential future river morphologies including the response of the system to man-made impacts on global (e.g. climate change), basin (e.g. sediment wave) and local (e.g stabilization) scale, plus socio-economic and environmental impacts of potential stabilization scenarios on floodplain and char habitants and biodiversity.

planned river stabilization will be based on (d) a river sanctuary study covering river- and floodplain land and conducted in tranche-1 potentially followed by implementation of a sanctuary in a suitable river reach.

11.2 Recommendations

408. Mitigation of embankment and revetment operation-phase impacts described in chapter 8 – on aquatic habitats including charlands and their biodiversity including fisheries, and on people who depend on them – will be implemented in three work packages:

- Aquaculture expansion (from Tranche-1).
- Wetland biodiversity mitigation and rehabilitation (from Tranche-1).
- Sanctuary (studied under Tranche-1, implemented from Tranche-2).

409. The anticipated environmental impacts of Tranch 1 are expected to be acceptable under the circumstances if the mitigation measures set forth in the EMP under Chapter 9 are implemented.

410. Tranch 1 can proceed without further environmental study. This EIA is the Project environmental assessment report.

Annex 1: List of Tables

Table 1: Species Lists – Terrestrial Flora

Terrestrial Flora				
Scientific Name	**Local name**	**Habit**	**Importance**	**Status**
Acacia nilotica	Babla	Tree	Ornamental	Common
Aegle marmelos	Bel	Tree	Medicinal,Fruits	Common
Adhatoda zeylanica	Bashak	Shrub	Medicinal	Rare
Aeschynomene aspera	Shola	Shrub	Fuel	Rare
Albiazia odoratissima	Shrish	Tree	Timber	Common
Albizia richardiana	Gagon serish	Tree	Firewood, timber, Avenue	Common
Abroma augusta	Ulatkambal	Shrub	Medicinal	Rare
Acacia moniliformis	Akashmoni	Tree	Note known	Common
Acalypha indica	Muktajhuri	Shrub	Medicinal	Common
Achyranthes aspera	Apang	Herb	Medicinal	Common
Adenanthera	Rakton	Tree	Firewood	Rare
Alostonia macrophylla	Chatim	Tree	Ornamental	Common
Alstonia scholaris	Shatim/Shatian	Tree	Timber	Rare
Amaarthus spinosa	Katanatea	Herb	Medicinal	Common
Anthocephalus chinensis	Kadam	Tree	Timber and fuelwood	Common
Aphanamixis polystachya	Pitraj	Tree	Timber	Rare
Areca catechu	Supari	Tree	Fruit and Timber	VC
Artocarpus heterophyllus	Kanthal	Tree	Timber, Fruits	Common
Artocarpus lakoocha	Deoa	Tree	Fruits	Rare
Averrhoa carambola	Kamranga	Tree	Fruits	Common
Azadirachta indica	Nim	Tree	Timber and medicine	Common
Bambusa sp	Bash	Woody Herb	Furniture	Common
Barringtonia acutangula	Hijal	Shrub	Fuelwood	Common
Bauhinia sp.	Kanson	Tree	Ornamental	Rare
Bombax ceiba	Shimul	Tree	Cotton and Fuelwood	Common
Borassus flabellifera	Tal	Tree	Timber	Common
Calamus tenuis	Bet	Shrub	Thatching	Common
Calophyllum inophyllum	Sultan Chapa/Punnag	Tree	Ornamental	Rare
Calotropis gigantea	Akand	Shrub	Medicinal	Common
Calotropis procera	Akand	Shrub	Medicinal	Common
Carica papaya	Papay	Shrub	Fruit	Common
Carissa carandas	Karamcha	Shrub	Fruit	Common
Cassia fistula	Sonalu	Tree	Ornamental	Common
Cassia alata	Dardmardon	Shrub	Medicinal	Common
Cassia occidentalis	Barahalkasunda	Shrub	Fuelwood	Common
Centella asitica	Thankuni	Herb	Medicinal and Vegetables	Common
Cestrum nocturnum	Hasnahena	Shrub	Ornamental	Rare
Citrus grandis	Jambura	Tree	Fruits	Common
Clerodendrum viscosum	Bhat	Shrub	Medicinal	Common
Cocos nucifera	Narikel	Tree	Fruit and Fuelwood	V.Common
Crataeva nurvala	Baroon	Tree	Fuel wood	Common
Cuscuta australis	Swarnalata	Herb	Medicinal	Common
Cynodon dactylone	Durba Gash	Herb	Medicinal	Common

Terrestrial Flora				
Scientific Name	**Local name**	**Habit**	**Importance**	**Status**
Dalbergia sissoo	Sisso	Tree	Timber	Common
Datura metel	Dhutura	Shrub	Medicinal	Rare
Delonix regia	Krichnochura	Tree	Ornamental	Common
Dillenia indica	Chalta	Tree	Fruit	Common
Diospyros discolor	Bilatigab	Tree	Fruit	Common
Diospyros perigrina	Deshigab	Tree	Fruit and Timber	Rare
E. ovalifolia	Tali Mander	Tree	Firewood	Common
Eichornia crassipes	Kachuripana	Herb	Fertilizer	Common
Enhydra fluctuins	Halencha	Herb	Vegetable	Common
Erythrina ovalifolia	Talimandar	Tree	Fuelwood	Common
Erythrina variegata	Mander	Tree	Firewood, Ornamental	Common
Excoecaria agallocha	Gheoa	Tree	Fuel wood	Common
Ficus hispida	Dumur	Tree	Fuel wood	Common
Ficus benghalensis	Bot	Tree	Fuel wood	Common
Ficus hispida	Dumur	Shrub	Fruit and Fuelwood	VC
Ficus religiosa	Assawath	Tree	Fuel wood	Common
Gardenia jesminoides	Ghandhoraj	Shrub	Flower	Common
Heletropium indicum	Hatisuri	Herb	Medicinal	Common
Hoya parasitica	Parghaca	Climber	Medicinal	Common
Ipomea fistulosa	Dhol Kalmi	Shrub	Fuel	Common
Leucauna laucocephalata	Ipil ipil	Tree	Timber	Common
Litchi chinensis	Lichu	Tree	Fruit	Common
Musa sapientum	Kacha kala	Herb	Vegetable	Common
Mangifera indica	Aum	Tree	Fruit and Timber	Common
Marsilea quadrifolia	Susnishak	Herb	Medicinal	Common
Mimosa pudica	Lajjaboti	Shrub	Medicinal	Common
Moringa oleifera	Sajna	Tree	Vegetable	Common
Muntinga calabura	China chari	Tree	Ornamental	Very Rare
Musa paradisiaca var. sapientum	Kala	Shrub	Fruit	Common
Musa paradisiaca var. sapientum	Kala	Shrub	Fruit	Common
Nerium odorum	Karobi	Shrub	Medicinal	Common
Nicotiana plumbaginifolia	Bantamak	Herb	Wild	Common
Nyctanthes arbortristris	Safali	Herb	Ornamental	Common
Nymphea nouchli	Sapla	Herb	Medicinal, Vegetable	Common
Ocimum americanum	Tulshi	Herb	Medicine	Common
Oryza sativa	Dhan	Herb	Food	Common
Phoenix paludosa	Hental	Tree	Wildlife	Common
Phoneix sylvestris	Khejur	Tree	Fruit and Fuel wood	Common
Pistia strateotes	Topapana	Herb	-	Common
Pithecolobium dulce	Dakshnia Babul	Tree	Ornamental, Avunue	Common
Polyalthia longifolia	Debdaru	Tree	Ornamental	Common
Psidium guajava	Peyara	Shrub	Fruit	Common
Raulwolfia serpentina	Sarpagandha	Shrub	Medicinal	Rare
Ricinus communis	Reri	Shrub	Oil	Common
Sesbania grandiflora	Bakphul	Shrub	Medicinal	Rare
Sesbania rostrata	Dhaincha	Herb	Fuel / Fertilizer	Common
Spondias dulcis	Amra	Tree	Fruit	Common
Streblus asper	Sheora	Shrub	Fuel wood	Common

Terrestrial Flora				
Scientific Name	**Local name**	**Habit**	**Importance**	**Status**
Swietenia mahagoni	Mahogoni	Tree	Timber, Medicinal	VC
Tamarindus indica	Tetul	Tree	Fruit	Common
Tectona grandis	Segun	Tree	Timber	Common
Terminalia arjuna	Arjun	Tree	Timber and Medicinal	Common
Terminalia bellirica	Bhorae	Tree	Medicinal	Rare
Terminalia catappa	Katbadam	Tree	Fruit	Common
Trewia nudiflora	Pitali/Latim	Tree	Timber and fuel wood	Common
Typha angustata	Hogla	Herb	Domestic use	Common
Zizyphus mauritiana	Baroi	Tree	Fruit	Common

Table2: Species Lists - Cropfield Vegetation

Cropfield Vegetation				
Scientific Name	Local name	Habit	Importance	Status
Acalypha indica	Muktajhuri	Herb	Medicinal	C
Achyranthes aspera	Apang	Herb	Medicinal	C
Alternanthera sessilis	Sachishak	Herb	Vegetable	VC
Amaranthus spinosus	Kata note	Herb	Vegetable	VC
Calotropis gigantea	Akand	Shrub	Medicinal	C
Calotropis procera	Akand	Shrub	Medicinal	C
Carissa carandas	Karamcha	Shrub	Fruits	R
Cotula hemispherica	Kancha ghash	Herb	Domestic food	C
Crotolaria retusa	Ban-san	Herb	Medicinal	VC
Cuscuta australis	Swarnalata	Herb	Medicinal	C
Cynodon dactylon	Durba	Herb	Medicinal	VC
Dentella repens	Hachuti	Herb	Medicinal	C
Marsilea quadrifolia	Susnishak	Herb	Vegetable	C
Nicotiana plumbaginifolia	Bantamak	Herb	Wild	C
Nyctanthes arbortristris	Sefali	Herb	Ornamental	C
Rhynchospora rufescens	Shimbhatraji	Herb	Medicinal	VC
Rorippa indica	Bansarisha	Herb	Medicinal	C
Sesbania rostrata	Dhaincha	Herb	Fuel/Fertilizer	VC

C – Common, VC – Very Common, R - Rare

Table 3: Species Lists - Wetland Vegetation

Wetland Vegetation				
Scientific Name	Local name	Habit	Importance	Status
Alternanthera philoxiroides	Helencha	Herb	Medicinal	VC
Aponogeton natans	Ghentu	Herb	Medicinal	C
Azolla pinnata	Kutipana	Herb	Fish food	C
Ceratophyllum desmersum	Jhangi	Herb	-	C
Colocasia esculenta	Kachu	Herb	Medicinal	C
Cyperus sp.	Mutha	Herb	Domestic food	VC
Cheratopteris sp	Fern	Herb	-	C
Eichhornia crassipes	Kochuripana	Herb	Fertilizer	VC
Enhydra fluctuans	Helencha	Herb	Vegetable	VC
Ipomoea aquatica	Kalmi sak	Herb	Vegetable	VC
Lemna perpusilla	Khudipana	Herb	-	C
Limnophila sessiliflora	Bijatighas	Herb	Domestic food	C

Wetland Vegetation				
Scientific Name	Local name	Habit	Importance	Status
Ludwigia abscendens	Keshordam	Herb	Medicinal	C
Ludwigia hyssopifolia	Keshordam	Herb	Medicinal	VC
Mersilea quadrifoliata	Susnisak	Herb	Vegetable	VC
Nachamendra alternifolia	Kaisha	Herb	Domestic food	C
Nymphaea nouchali	Shapla	Herb	Vegetable	VC
Nymphaea stellata	Nilshapla	Herb	Vegetable	R
Phragmites karka	Nol Khagra	Herb	Fuel	VC
Pistia stratiotes	Topapana	Herb	-	VC
Polygonum barbatum	Bishkatali	Herb	Medicinal	C
Salvina cucullata	Kuripana	Herb	-	C
Scirpus juncoides	Chasra	Herb	Fuel	C
Spirodela polyrhiza	Khudipana	Herb	-	C
Trapa natans	Singra	Herb	Fruit	R
Vetiveria zizanioides	Binna	Herb	Domestic use	C
Wolffia microscopica	Guripana	Herb	-	C

C – Common, VC – Very Common, R - Rare

Table 4: Species Lists - Birds

Birds			
Scientific Name	**English Name**	**Local Name**	**Local Status**
Tyto alba	Barn Owl	Lokkhi Pecha	UR
Eudynamys scolopaceus	Asian Koel	Ashio Kalakokil	CR
Sturnus ginginianus	Bank Myna	Gaang Shalik	UR
Dicrurus macrocercus	Black Drongo	Kala Fingey	CR
Milvus migrans	Black Kite	Bhubon Chil	CR
Metopidius indicus	Bronze-winged Jacana	Dol Pipi	UR
Ketupa zeylonensis	Brown Fish Owl	Khoira Mechopecha	UR
Ixobrychus cinnamomeus	Cinnamon Bittern	Khoira Bogla	UR
Artamus fuscus	Ashy Wood swallow	Metey Bonbabil	CR
Anastomus oscitans	Asian Open bill	Ashio Shamkhol	CR
Terpsiphone paradisi	Asian Paradise-flycatcher	Ashio Shabulbuli	UR
Anser indicus	Bar-headed Goose	Dagi Rajhash	UWV
Ploceus philippinus	Baya Weaver	Deshi babui	CR
Ciconia nigra	Black Strock	Kala Manikjor	WV
Sterna acuticauda	Black-bellied Tern	Kalapet Panchil	UR
Nycticorax nycticorax	Black-crowned Night Heron	Kalamatha Nishibok	CR
Lonchura malacca	Black-headed Munia	Kalamatha Munia	UR
Oriolus xanthornus	Black-hooded Oriole	Kalamatha Benebou	CR
Haliastur Indus	Brahminy Kite	Shonkho Chil	CR
Lanius cristatus	Brown Shrike	Khoira Latora	CWV
Larus brunnicephalus	Brown-headed Gull	Khoiramatha Gangchil	CWV
Bubulcus ibis	Cattle Egret	Go Boga	CR
Motacilla citreola	Citrine Wagtail	Sitrin Khonjon	CWV
Acrocephalus stentoreus	Clamorous Reed Warbler	Bachal Nolfutki	CWV

Birds			
Scientific Name	**English Name**	**Local Name**	**Local Status**
Sarkidiornis melanotos	Comb Duck	Nakta Hash	RWV
Larus ridibundus	Common Black-headed Gull	Kalamatha Gangchil	CWV
Dinopium javanense	Common Golden back	Pati Kaththokra	CR
Numenius nebularia	Common Greenshank	Pati Shobujpa	CWV
Hierococcyx varius	Common Hawk-Cuckoo	Pati Chokhgelo	CR
Aegithina tiphia	Common Iora	Pati Fatikjal	CR
Alcedo atthis	Common Kingfisher	Pati Machranga	CR
LC Acridotheres tristis	Common Myna	Bhat Shalik	CR
Columba livia	Common Pigeon	Gola Paira	CR
Atthya ferina	Common Pochard	Pati Bhutihash	CWV
Tringa tetanus	Common Redshank	Pati Lalpa	CWV
Actitis hypoleucos	Common Sandpiper	Pati Batan	CWV
Tadorna tadorna	Common Shelduck	Pati Chokachoki	CWV
Gallinago gallinago	Common Snipe	Pati Chega	CWV
Orthotomus sutorius	Common Tailorbird	Pati Tuntuni	CR
Megalaima haemacephala	Coppersmith Barbet	Shekra Boshonto	CR
Nettapas coromandelianus	Cotton Pygmy Goose	Dhola Balihash	UR
Phylloscopus fuscatus	Dusky Warbler	Kalchey Futki	CWV
Upupa epops	Eurasian Hoopoe	Pati Hoodhood	UR
Zoothera torquatus	Eurasian Stone Chat	Pati Shilafidda	CWV
Anas crecca	Eurasian Teal	Pati Tilihash	CWV
Dendrocygna bicolor	Fulvous Whistling Duck	Raj Shorali	CWV
Anas querquedula	Garganey	Giria Hash	CWV
Prinia gracilis	Graceful Prinia	Shundori Prinia	RR (DD)
Larus brunnicephalus	Great Black-headed Gull	Palasi Gangchil	CWV
Phalacrocorax carbo	Great Cormorant	Boro Pankouri	CWV
Casmerodius albus	Great Egret	Boro Boga	CR
Parus major	Great Tit	Boro Tit	CR
Centropus sinensis	Greater Coucal	Boro Kubo	CR
Chrysocolaptes lucidus	Greater Golden back	Boro Kaththokra	CR
Charadrius leschenaultii	Greater Sand Plover	Boro Dhuljiria	CWV
Merops orientalis	Green Bee-eater	Shobuj Shuichora	CR
Numenius ochropus	Green Sandpiper	Shobuj Batan	UWV
Phaeniocophaeus tristis	Green-billed Malkoha	Shobujthot Malkoa	CR
Ardea cinerea	Grey Heron	Dhupni Bok	CR
Charadrius squatarola	Grey Plover	Metey Jiria	CWV
Motacilla cinerea	Grey Wagtail	Metey Khonjon	UWV
Dendrocopos canicapillus	Grey-cappedPygmy Woodpecker	Metetoopi Batkurali	UR
Ichthyophaga ichthyaetus	Grey-headed Fish Eagle	Metematha Kura-eegol	UR
Gelochelidon nilotica	Gull-billed Tern	Kalathot Panchil	CR
Corvus splendens	House Crow	Pati Kak	CR
Passer domesticus	House Sparrow	Pati Chorui	CR
Phalacrocorax fuscicollis	Indian Cormorant	Deshi Pankouri	V
Cuculus micropterus	Indian Cuckoo	Bokotakou Kokil	CR
Ardeola grayii	Indian Pond Heron	Deshi Kanibok	CR

Birds			
Scientific Name	**English Name**	**Local Name**	**Local Status**
Coracias benghalensis	Indian Roller	Bangla Nilkanto	CR
Lonchura malabarica	Indian Silver bill	Deshi Chandithot	UR
Anas poecilorhyncha	Indian Spot-billed Duck	Metey Hash	UR
Turdoides striatus	Jungle Babbler	Bon Satarey	CR
Acridotheres fuscus	Jungle Myna	Jhuti Shalik	CR
Corvus macrorhynchos	Large-billed Crow	Dar Kak	CR
Caprimulgus macrurus	Large-tailed Nightjar	Lenja Ratchora	CR
Centropus bengalensis	Lesser Coucal	Bangla Kubo	CR
Dinopium benghalense	Lesser Golden back	Bangla Kaththokra	CR
Charadrius mongolus	Lesser Sand Plover	Soto Dhuljiria	CWV
Dendrocygna javanica	Lesser Whistling Duck	Pati Shorali	CR
Megalaima lineata	Lineated Barbet	Dagi Boshonto	CR
Phalacrocorax niger	Little Cormorant	Choto Pankouri	CR
Egretta garzetta	Little Egret	Choto Boga	CR
Charadrius dubius	Little Ringed Plover	Choto Nothjiria	CR & CWV
Arachnothera longirostra	Little Spider hunter	Choto Makormar	CR
Calidris minuta	Little Stint	Choto Chapakhi	CWV
Buteo rufinus	Long -Legged Buzzard	Lombapa Tishabaj	RWV
Lanius schach	Long-tailed Shrike	Lenja Latora	CR
Tringa stagnatilis	Marsh Sandpiper	Bil Batan	UWV
Anas acuta	Northern Pintail	Utturey Lenjahash	CWV
Anthus hodgsoni	Olive-backed Pipit	Jolpaipith Tulika	CWV
Copsychus saularis	Oriental Magpie-Robin	Udoi Doel	CR
Alauda gulgula	Oriental Skylark	Udoi Ovrobhorot	CR
Zosterops palpebrosus	Oriental White-eye	Udoi Dholachokh	CR
Pluvialis fulva	Pacific Golden Plover	Proshanto Shonajiria	CWV
Anthus rufulus	Paddy field Pipit	Dhani Tulika	CR
Alauda erythrorhynchos	Pale-billed Flowerpecker	Metethot Fuljhuri	CR
Ceryle rudis	Pied Kingfisher	Pakra Machranga	CR
Sturnus contra	Pied Myna	Ashio Pakrashalik	CR
Gallinago stenura	Pin-tailed Snipe	Lenja Chega	CWV
Parus inornata	Plain Prinia	Nirol Prina	CR
Leptocoma zeylonica	Purple-rumped Sunbird	Begunikomor Moutushi	CR
Streptopelia tranquebarica	Red Turtle Dove	Lal Konthighughu	CR
Pycnonotus cafer	Red-vented Bulbul	Bangla Bulbul	CR
Vanellus indicus	Red-wattled Lapwing	Hot Titi	UR
Anthus richardi	Richard's Pipit	Richarder Tulika	CWV
Vanellus duvaucelii	River Lapwing	Nodi Titi	UR
Sterna aurantia	River Tern	Nodia Panchil	UWV
Psittacula krameri	Rose-ringed Parakeet	Modna Tia	CR
Anthus roseatus	Rosy Pipit	Golapi Tulika	CWV
Tadorna ferruginea	Ruddy Shelduck	Khoira Chokachoki	CWV
Dendrocitta vagabunda	Rufous Treepie	Khoira Harichacha	CR
Celeus brachyurus	Rufous Woodpecker	Khoira Khathkurali	CR
Lonchura punctulata	Scaly-breasted Munia	Butibook Munia	CR
Asio flammeus	Short-eared-Owl	Chotokan Pecha	RWV

Birds			
Scientific Name	**English Name**	**Local Name**	**Local Status**
Pericrocotus cinnamomeus	Small Minivet	Choto Saheli	CR
	Small Pratincole	Soto Babubatan	
Streptopelia chinensis	Spotted Dove	Tila Ghughu	CR
Athene brama	Spotted Owlet	Khuruley Kutipecha	CR
Pelargopsis capensis	Stork-billed Kingfisher		UR
Ploceus manyar	Streak Weaver	Dagi Babui	RR(DD)
Picus xanthopygaeus	Streak-throated Woodpecker	Dagigola Kathkurali	UR
Turdoides earlei	Striated Babbler	Dagi Satarey	UR
Megalurus palustris	Striated Grassbird	Dagi Ghashpakhi	CR
Butorides striata	Striated Heron	Khude Bok	CR
Gallicrex cinerea	Water cock	Deshi Kora	UR
Motacilla flava	Western Yellow Wagtail	Holdey Khonjon	CWV
Chlidonias hybrida	Whiskered Tern	Julphi Panchil	CR/WV
Motacilla alba	White Wagtail	Dhola Khonjon	CWV
Amaurornis phoenicurus	White-breasted Water hen	Dholabook Dahuk	UR
Motacilla madaraspatensis	White-browed Wagtail	Dholavru Khonjon	UR
Rhipidura albicollis	White-throated Fantail	Dholagola Chatighurani	CR
Halcyon smyrnensis	White-throated Kingfisher	Dholagola Machranga	CR
Numenius glareola	Wood Sandpiper	Bon Batan	CWV
Egretta intermedia	Yellow-billed Egret	Majhla Boga	CR
Treron phoenicopterus	Yellow-footed Green Pigeon	Holdepa Horial	CR
Cisticola juncidis	Zitting Cisticola	Bhomra Soton	CR
Alcdo hercules	Blyth's Kingfisher	Machranga	RR
Halcyon coromandra	Ruddy Kingfisher	Lal Machranga	RR
Heliopais personata	Masked Finfoot	Giolo Hansh	RR
Rynchops albicolis	Indian Skimmer	Panikata	RR
Haliaeetus leucogaster	White-bellied sea Eagle	Sindhu Eagle	RR
Platalea leucorodia	Eurasian Spoonbill	Kodali Bok	RR
Leptoptilos javanicus	Lesser Adjutant	Modontak	RR
Myctria leucocephala	Painted Stork	Rangila bok	RR

Local Status: CR-Common Resident; UR-Uncommon Resident; CWV- Common Winter Visitor; UWV-Uncommon Winter Visitor; RR-Rare Residant; DD-Data Deficient; WV-Winter Vagrant; RWV-Rare Winter Visitor

Table 5: Species List - Mammals

Mammals				
English name	**Local Name**	**Scientific Name**	**IUCN status**	**Local status**
Asian House Shrew	Chika/Chucho	*Suncus murinus*	NO	CR
Asian Palm Civet	Gandhogakul	*Paradoxurus hermaphroditus*	VU	CR
Asiatic Brush-tailed Porcopine	Sajaru	*Atherurus macrourus*	EN	RR
Asiatic Long tail Climbing Mouse	Gecho Indur	*Vandeleuria oleracea*	DD	CR
Bengal Fox	Pati Shial/Shial	*Vulpes bengalensis*	VU	CR
Common Tree Shrew	Gecho Chucho	*Tupaia glis*	DD	RR
Estern House Mouse	Nenti indur	*Mus musculus*	NO	CR

Mammals				
English name	**Local Name**	**Scientific Name**	**IUCN status**	**Local status**
Eurasian Otter	Ud Biral	*Lutta lutra*	EN	UR
Eurasian Wild Boar	Buno Shukar	*Sus scrofa*	NO	CR
Finless Porpoise	Shishu	*Neophocaenoides phocaenoides*	EN	UR
Fishing Cat	Mecho Biral/Baghailla	*Felis viverrina*	EN	UR
Ganges River Dolphin	Shishu / Shushuk	*Platanista gangetica*	EN	CR
Golden Jackal	Sial	*Canis aureus*	VU	CR
Greater Bandicot Rat	Dhari indur	*Bandicota indica*	NO	CR
Greater False Vampire Bat	Badur	*Megaderma lyra*	NO	CR
Greater Short-nosed fruit Bat	Kola badur	*Cynopterus sphinx*	DD	CR
House Rart	Indur	*Rattus rattus*	NO	CR
Indian crested Porcupine	Shojaru	*Hystrix indica*	EN	UR
Indian Flying Fox	Baro Badur	*Pteropus giganteus*	NO	CR
Indian Hare	Khargosh	*Lepus nigricolis*	EN	UR
Indian Pipistrelle	Chamchika/ Cham Badur	*Pipistrellus coromandra*	NO	CR
Irrawaddy Dolphin	Mohonar Shushuk	*Oracaela brevirostris*	CR	CR
Jungle Cat	Ban Biral	*Felis chaus*	EN	RR
Large- Indian Civet	Baro Baghdash	*Viverra zibetha*	EN	CR
Lesser Bandicot -rat	Baro indur	*Bandicota bengalensis*	NO	CR
Little Indian Field Mouse	Metho indur	*Mus booduga*	NO	CR
Northern palm Squirrel	Khatbirali	*Funambulus pennantii*	NO	CR
Oriental Small- Clawed Otter	Bhodor/ Ud Biral	*Amblonyx cinereus*	EN	CR
Rofous-tailed Hair	Khorgosh	*Lepus nigricolis*	EN	RR
Small- Indian Civet	Choto Bagdash	*Viverricula indica*	VU	CR
Small- Indian Mongoose	Benji, Nakul	*Herpestes auropunctatus*	NO	CR
Smooth -Coated Otter	Ud Biral	*Lutrogale perspicillata*	EN	RR

Local Status: CR – Common Resident, C – Common, UR – Uncommon Resident, RR – Rare Resident, V – Vagrant, WV – Winter Visitor; UWV – Uncommon Winter Visitor. *IUCN Status code*: CR – Critically Endangered, EN - Endangered, VU – Vulnerable, NO – Not Threatend

Table 6: Species Lists - Amphibians

Amphibians				
English name	**Local Name**	**Scientific Name**	**IUCN status**	**Local status**
Asian Brown Tree Frog	Gecho Bang	*Polypedates leucomystax*	NO	CR
Cricket Frog	Jhijhi Bang	*Limnonectes limnoccharis*	NO	CR
Green Frog	Sabuj Bang	*Euphlyctis hexadactylus*	VU	UR
Indian Bull Frog	Sona bang	*Hoplobactrachus tigerinus*	NO	CR
Indian Tree Frog	Gecho Bang	*Polypedates maculatus*	NO	UR
Large Tree Frog	Baro Gecho Bang	*Rhacophorus maximus*	VU	UR
Leaping Frog	Pana bang	*Hylarana tytleri*	NO	UR
Ornate Microhylid	Cheena Bang	*Microhyla ornata*	VU	CR
Southern Cricket Frog	Jhijhi Bang	*Fejervarya syhadrensis*	NO	CR
Two-striped Grass Frog	Kaad Bang	*Sylvirana taipehensis*	EN	RR

CR – Critically Endangered, EN - Endangered, VU – Vulnerable, NO – Not Threatened

Table7: Species Lists - Reptiles

Reptiles				
English name	**Local Name**	**Scientific Name**	**IUCN Status**	**Local Status**
Bengal Monitor	Ghuy Shap	*Varanus bengalensis*	VU	CR
Brooks House Gecko	Tiktiki	*Hemidactylus brookii*	NO	CR
Brown Roofed Turtle	Baro Kori Kasim	*Pangshura smithii*	EN	UR
Checkered Keelback	Dhora Shap	*Xenochropis piscator*	NO	CR
Common Garden Lizard	Roktochosha	*Calotes versicolor*	NO	CR
Common House Gecko	Tiktiki	*Hemidactylus frenatus*	NO	CR
Common Krait	Kal-keutey Shap	*Bungarus caeruleus*	EN	UR
Common River Terrpain	Boro Kasim	*Batagur baska*	CR	RR
Common Smooth Water Snake	Painna Shap	*Enhydris enhydris*	NO	CR
Common Vine Snake	Laodoga Shap	*Ahaetulla nasuta*	VU	UR
Common Wolf Snake	Gharginni Shap	*Lycodon aulicus*	VU	CR
Crowned River Turtle	Kali Kasim	*Hardella thurjii*	EN	UR
Estuarine Crocodile	Lonapanir Kumir	*Crocodylus porosus*	CR	UR
Ganges softshell Turtle	Khalua Kasim	*Aspideteres gangeticus*	EN	UR
Gharial	Ghorial/Baishal	*Gavialis gangeticus*	CR	UR
Indian Rat Snake	Daraj Shap	*Ptyas mucosus*	VU	CR
Indian Roofed Turtle	Kori/Hali Kasim	*Pangshura tectum*	-	CR
Jerdon's Blind Snake	Dumukh Shap	*Typhlops jerdoni*	-	CR
Keeled Grass skink	Anjoni	*Mabuya carinata*	-	CR
Median Roofed Turtle		*Pangshura tentoria*	EN	UR
Monocled Cobra	Gokhra Shap	*Naja kaouthia*	VU	RR
Narrow-headed Softshell Turtle	Sim Kasim	*Chitra indica*	CR	UR
Olive Keelback	Maita Shap	*Atretium schistosum*	-	CR
Olive Ridley Turtle	Jalpaironga Samudrik Kasim	*Lepidochelys olivacea*	EN	CR
Peacock-marked Softshell Turtle	Dhum Kasim	*Aspideteres hurma*	EN	CR
Pond tortoise	Kalo Kasim	*Melanochelys trijuga*	EN	UR
Red Crowned Roofed Turtle	Kori Kasim	*Kachuga kachuga*	EN	UR
Spectacled Cobra	Khoiya Gokhra Shap	*Naja naja*	EN	CR
Spotted Flapshell Turtle	Patapori	*Lissemys punctata*	VU	UR
Spotted Litter skink	Anzoni	*Sphenomorphus maculatus*		CR
Spotted Pond Turtle	Mogom Kasim	*Geoclemys hamiltonii*	EN	UR
Three- Striped Roofe Turtle	Dhoor Kasim	*Kachuga dhongoca*	CR	UR
Tokay Gecko	Takkhak	*Gekko gecko*	VU	CR
Yellow Monitor	Sona Guy	*Varanus flavescens*	EN	RR
Yellow-bellied House Gecko	Tiktiki	*Hemidactylus flaviviridis*	-	CR
Ring Lizard	Ram Godi	*Varanus salvator*	EN	
Paintet Bronzedback tree Snake	Gecho	*Dendrelaphis pictus*	VU	

CR – Critically Endangered, EN - Endangered, VU – Vulnerable, NO – Not Threatened

Table6: Species Lists – Fish (Jamuna River March 1993 – February 1994)

Table - List of Riverine fish Species

Sl.	Local name of fish	Scientific name of Fishes
1	Bali chata	*Nemaceheilus botia*
2	Gharpoia	*Somileptes gongota*
3	Kachki	*Corica soborna*
4	Phasa	*Setipinna phasa*
5	Nuna baila	*Brachygobius nunus*
6	Chiring	*Apocryptes bato*
7	Ghaura	*Clupisoma garua*
8	Baghair	*Bagarius bagarius*
9	Kajuli	*Ailia coila*
10	Magur	*Amblyceps mangois*
11	Rita	*Rita rita*
12	Gang tengra	*Gagata youssoufi*
13	Gang tengra	*Gagata nangra*
14	Sisor	*Sisor rhabdophorus*
15	Kauwa/Cenia	*Gagata cenia*
16	Ilish	*Tenulosa ilisha*
17	Gang Magur	*Plotosus canius*
18	Koi Puti	*Anodontostoma chacunda*
19	Khorsula	*Sicamugil cascasia*
20	Piali	*Aspidoparia morar*
21	Kalabata	*Crossocheilus latius*
22	Rani	*Botia dario*
23	Khorsula	*Rhinomugil corsula*
24	Shilong	*Silong silondia*
25	Kutakanti	*Hara hara*
26	Poa	*Pama pama*
27	Shangus	*Himantura sp.*

Table - List of Migratory Fish Species		
1	Catla	*Catla catla*
2	Kalibaus	*Labeo calbasu*
3	Rui	*Labeo rohita*
4	Mrigal	*Cirrhinus mrigala*
5	Bata	*Labeo bata*
6	Raik	*Cirrhinus reba*
7	Chital	*Notopterus chittala*
8	Ayre	*Aorichthys aor*
9	Guzza ayre	*Aorichthys seengala*
10	Golsha tengra	*Mystus bleekeri*
11	Kabashi tengra	*Mystus cabasius*
12	Bacha	*Eutropiichthys vacha*
13	Batashi	*Pseudeutroplus atheridonoide*
14	Boal	*Wallago attu*
15	Kani pabda	*Ompok pabda*
16	Modhu pabda	*Ompok bimaculatus*
17	Pabda	*Ompok pabo*
18	Katari	*Salmostoma bacaila*

19	Fulchela	*Salmostoma phulo*
20	Ghora chela	*Securicula gora*
21	Chapila	*Gudusia chapra*
22	Kash khaira	*Chela laubuca*

Table - List of Floodplain Resident Fishes		
1	Baro baim	*Mastacembalus armatus*
2	Guchi baim	*Macrognathus pancalus*
3	Tara baim	*Macrognathus aculatus*
4	Lal Chanda	*Chand a ranga*
5	Nama chanda	*Chanda nama*
6	Chanda	*Chanda baculis*
7	Shing	*Heteropneus. fossilies*
8	Magur	*Clarias batrachus*
9	Shol	*Channa striatus*
10	Taki	*Channa puncalus*
11	Gojar	*Channa marulius*
12	Tit puti	*Puntius ticto*
12	Puti	*Puntius sophore*
14	Deshi Sarputi	*Puntius sarana*
15	Phutani puti	*Puntius phutunio*
16	Gilli puti	*Puntius gelius*
17	Kanchon puti	*Puntius conconius*
18	Kanpona	*Aplocheilus panchax*
19	Gutum	*Lepidocephalus guntea*
20	Chep chala	*Chela cachius*
21	Baila	*Glossogobius giurus*
22	Napit Koi	*Badis badis*
23	Darkina	*Rasbora daniconius*
24	Chebli	*Danio devario*
25	Anju	*Brachydanio rerio*
26	Mola	*Amblyphayngodon mola*
27	Keti	*Osteobrama cotio cotio*
28	Kaikla	*Xenentodon cancila*
29	Soto Kholisa	*Colisa sota*
30	Lal kholisa	*Colisa lalius*
31	Kholisa	*Colisa fasciatus*
32	Tengra	*Mystus vittatus*
33	Bajari tengra	*Mystus tengara*
34	Potka	*Tetradon cutcutia*

Total number of fish species in the Jamuna River, **March 1993 – February 1994**

Sl.	Habitat Preference	Number
1	Riverine	27
2	Migratory	22
3	Floodplain Resident	34
	Total	83

Source - FAP 17, Fisheries Studies and Pilot Project, FINAL REPORT (Draft) JUNE 1994, Supporting Volume No. 10, FISHERIES STUDY, THE JAMUNA AND PADMA RIVERS.

- After FAP 17 Study no intensive survey has conducted on fish in Jamuna River. Further study in required.
- But after this study some fish species like Deshi Sarputi , Rita, Pabda, Gojar are almost absent in the fish catch in Jamuna River.

Table 9: Embankment and Dredging Projects Affecting River Cetaceans in Bangladesh

Project	River and location	Purpose	Technical and Hydrological Specifications	Status	Summary of dolphin occurrence and potential or realized impacts
Embankments					
Bank Protection and River Training Pilot Projects (FAP 21/22)	Right bank of Jamuna River near Kamarjani and left bank of Jamuna River near Bahadurabad	Prototype works to investigate whether river training is feasible or desirable.	Three embankments on right bank. Eight slope revetments on right and left banks.	Embankments recently constructed. Slope revetments currently in construction.	Dolphins observed in the area during surveys in April 1996. Project will reduce hydraulic complexity and eliminate spawning habitat for floodplain-dependent fish.
Brahmaputra Right Embankment (BRE)	Jamuna River near Serajgonj, Rajshahi	Protection of Serajgonj and adjacent floodplain.	Embankment length 220km. Over half the length of the embankment has been eroded.	Completion date unknown.	Dolphins observed in the area during surveys in October 1995 and in April 1996. The embankment has reduced hydraulic complexity and eliminated spawning habitat for floodplain-dependent fish.
Brahmaputra River Bank Priority Works (BPW)	Jamuna River near Serajgonj, Rajshahi	Protection of Serajgonj from migration of Jamuna River	Two hard points linking the existing realigned BRE with low earth embankments.	Advanced stages of planning	Dolphins observed in the area during surveys in October 1995 and in April 1996. Additional impacts beyond the effects of the existing BRE are unknown.
Jamuna Bridge Project Embankments	Jamuna River slightly upstream of Serajgonj, Rajshahi	Protection of bridge foundation from erosive flooding.	Paired embankments upstream and a hard point/guide bund on the right bank down-stream. Embankment on left bank will be linked to BPW.	Completed in 1998	Dolphins observed in the area during surveys in October 1995 and in April 1996. Project will reduce hydraulic complexity and eliminate spawning habitat for floodplain-dependent fish.
Jamalpur Priority Project (FAP 3.1)	Divergence of Jamuna and Old Brahmaputra rivers near Jamalpur	Flood control and drainage	82km embankment along left bank of the Jamuna river and a 43km embankment along the right bank of the Old Brahmaputra River.	Detailed engineering study in progress.	Dolphins observed in the area during surveys in April 1996. Project will reduce hydraulic complexity and eliminate spawning habitat for floodplain-dependent fish.
Dredging					
Jamuna Bridge Project Dedging	Jamuna River upstream of Serajgonj, Rajshahi	Facilitate construction of bridge	?	Dredging believed to have been completed after bridge commissioned in 1998	Dolphins observed in the area during surveys in October 1995 and in April 1996. Potential problem with increased turbidity during dredging operations and increased sedimentation downstream.
Kalni-Kushiyara River Improvement Project	Kushiyara River between Asmiriganj and Katkhal, Chittagong	Facilitate passage of water in the Kushiyara River during the monsoon season.	Dredging at three sites extending for 0.25-1.0 km each. If successful, 10 additional sites will be dredged in the 50km stretch of river between Markuli and Mudha.	Advanced stages of planning	Dolphins observed in the area during surveys in October 1995. Potential problem with increased turbidity during dredging. Project could potentially benefit dolphins by increasing counter-current habitat.

Source: Brian D. Smith, Ravindra K. Sinha, Zhou Kaiya, A. Aleem Chaudhry, Liu Renjun, Wang Ding, Benazir Ahmed, A.K.M. Aminul Haque, R.S.L. Mohan, and Kumar Sapkota. 2000. "Register of Water Development Projects Affecting River Cetaceans in Asia." In *Biology and Conservation of Freshwater Cetaceans in Asia*, edited by Randall R. Reeves, Brian D. Smith, and Toshio Kasuya. Occasional Paper 23. IUCN Species Survival Commission. http://data.iucn.org/dbtw-wpd/edocs/ssc-op-023.pdf.

Table 10: Ground Water Depth

Well ID	Location	Groundwater Depth (m)					
		1980		1990		2000	
		April	September	April	September	April	September
8811001	Shrenagar village, Belkuchithana, Sirajganj	6.78	2.83	4.51	1.70	5.84	1.42
5678012	Uthali village, Shibalayathana, Manikganj	6.31	1.39	5.91	1.89	7.07	0.90
9376032	Bhalkutia village, Nagarpurthana, Tangail	6.46	1.64	5.51	1.94	6.31	1.52

Source: BWDB.

Annex 2: Dolphin Threats

1.1 Threats

Dolphins have been very adversely affected by human use of the river systems in the sub-continent. Entanglement in fishing nets can cause significant damage to local population numbers. Some individuals are still taken each year and their oil and meat used as a liniment, as an aphrodisiac and as bait for catfish. Irrigation has lowered water levels throughout the ranges. Poisoning of the water supply from industrial and agricultural chemicals may have also contributed to population decline. Perhaps the most significant issue is the building of more than 50 dams along many rivers, causing the segregation of populations and a narrowed gene pool in which dolphins can breed.

This species is considered to be particularly threatened by overfishing (incidental by-catch, direct exploitation, resource depletion), and high industrial and agricultural pollutant loads may also have a severe impact on dolphin immune competence and fertility. The immediate danger for the resident population of dolphin in the haor basin is the decrease in river depth due to sedimentation.

1.2 Threats from Other Human Activities

1.2.1 Use of Dolphin Products

Dolphin oil is used by people in Bangladesh as a liniment, claimed to be effective for treating rheumatism, burns, and nervous disorders, and a tonic for treating impotence and asthma. It is noted that pregnant women sometimes drink the oil in the belief that it will ensure a healthy baby and that the oil is mixed with banana leaves and fed to cows to fatten them before being taken to market. Pelletier and described a factory in Chandpur used for processing dolphin oil. Recent survey recorded that the dolphin oil is used as mosquito repellant. On the bank of river Kushyiara near Kawadighi Haor, people are using oil of dolphin as mosquito repellant for the cattle and buffalo. They used to rub the oil over the body of cow and buffalo.

1.2.2 Fisheries Bycatch

Cetaceans worldwide are threatened from incidental mortality in gillnets. According to local fishermen, incidental catch in monofilament gill nets, called *current jals,* is their primary source of dolphin products. It is difficult to determine if the catch of dolphins in nets is deliberate or accidental, especially since dolphin products are highly valued and nets are often deployed for multispecies catch (Reeves and others 1993). Although *current jals* with a stretched mesh size of below 4.5 cm are prohibited in Bangladesh, their use is increasing throughout the country. We were told by fishermen that dolphins are sometimes caught in *jam jals.* These rectangular nets have an 8- to 10-cm mesh size and are used to catch large broodstock in river *duars.*

1.2.3 Directed Catch

Local villagers appeared to be unaware that hunting dolphins is prohibited under the laws of Bangladesh. In villages along the Kalni-Kushiyara river, a small group of fishermen from a Hindu minority caste in the Bhawol (Sylhet District) come every year during December or January to hunt dolphins in major *duars.* They hunt dolphins at night with long iron-tipped harpoons made from bamboo.

1.2.4 Overexploitation of Fisheries

The Rivers of Bangladesh sustain one of the most productive freshwater fisheries in the world. Significant declines in carp and catfish production suggest that exploitation may be exceeding sustainable yields. Major factors cited for declines are the use of small mesh gillnets (*current jals* and *kona ber jals*) in tributaries and harvesting large fish in *duars* during their breeding season. The strong correlation between the distribution of river dolphins and large fish species and the reported decline of these fishes may indicate a potential problem in maintaining an adequate food base to support dolphins.

1.2.5 Pollution

The main sources of water pollution in Bangladesh are leather, paper and pulp, fertilizer, pharmaceutical, sugar, jute, textile, and petrochemical industries, which generally discharge untreated wastes directly into rivers. The widespread use of fertilizers and pesticides for ‘‘green revolution’’ rice crops also creates serious water-quality problems. Recent studies of the biodegradation capacity and residue patterns of organochlorines in dolphins inhabiting the Ganges river in India indicate that, similar to marine cetaceans, *P. gangetica* is unable to metabolize these chemicals. The high concentrations of heavy metals (Fe, Mn, Zn, Cu, Pb, Mi, and Cd) found in the tissues of one neonatal male dolphin and one slightly larger immature male dolphin suggest considerable transfer of these contaminants across the fetal membrane and through milk (Reeves and others 1993). The lack of systematic monitoring of pollutant levels in Bangladesh.

Scientists believe that eddy countercurrents, called *duars* in Bengali (or *koom* or *khari* in larger rivers), are essential to the survival of river dolphins and to the productivity of riverine biota. A recent fisheries study in the northeast region of Bangladesh supports the idea of a linkage between dolphin occurrence and *duars.* The same study also found that *duars* are essential overwintering habitat for *boromaach* (commercially important fishes including major carp, catfish, and other large migratory species). During surveys in the Kushiyara River, all sightings of dolphins were located within the eddy boundaries of obvious *duars.* Larger *duars,* created by sharp meanders and convergent or divergent channels, contained a greater number of dolphins than smaller *duars,* created by gentle meanders. River channels in the Kushiyara River are a few hundred meters wide and are generally contained within well-defined banks. The aggregate nature of river dolphin distribution can also be used to the dolphins’ advantage by allowing conservation strategies to focus on areas that already require judicious stewardship for protecting vital fishery resources. The concentration of dolphins in limited and circumscribed areas makes them particularly vulnerable to habitat disturbance from water development, direct exploitation, accidental entanglement in fishing nets, and local sources of pollution.

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Annex 3: Public Consultation Meeting, First Round

A. Overview of Meetings

Four first-round meetings were conducted at Chowhali, Harirampur, and Shahjadpur and Shibalaya, attended by 247 participants. Locations, dates, numbers and types of participants, and meeting photos are provided in Tables A8.1 and A8.2, and Photos A8.1 to A8.4.

B. Stakeholder Concerns and Meeting Documentation

Summaries of stakeholder concerns expressed in each meeting are provided in Tables A8.3 to A8.6. Copies of the meeting sign-in sheets and Bengali questionnaire are shown in Photos A8.5 to A8.9.

Table A3.1:

District	Upazila	Union	Meeting venue	Meeting date	Time
Sirajganj	Chauhali	Sadar	UP conference room	12/03/2013	11 am
Sirajganj	Harirampur	Sadar	UP conference room	26/02/2013	10 am
Manikganj	Shahjadpur	Sadar	UP conference room	27/02/2013	10:30 am
Sirajganj	Shibalaya	Sadar	UP conference room	17/04/2013	02:00 pm

Table A3.2: Public Consultation Meeting Participant Details

Meeting venue	Type of Participants	No. of participants
Chauhali Upazila conference room	Primary and secondary stakeholders	30
Harirampur Upazila conference room	Primary stakeholders	57
Shahjadpur Upazila conference room	"	26
Shibalaya Upazila conference room	"	44

Photo A3.1: PCM at Chouhali

Photo A3.2: PCM at Harirampur

Photo A3.3: PCM at Shahjadpur

Photo A3.4: PCM at Shibalya

Table A3.3: First-Round Meeting Summary, Chouhali Upazila Complex, Sirajgonj

Project/Subproject: **Integrated Flood and Riverbank Erosion Management Investment Program**
Meeting date: 12.03.2013
Place: Chouhali Upazila Complex, Sirajgonj
Attending: **Proponents:** BWDB, NHC, ADB **Stakeholders:** • ***Primary:*** farmers, fishermen, local business community as well as the households to be displaced, women groups, and caretakers of community properties. • ***Secondary:*** those who may not be directly affected but have interests that could contribute to the study, play a role in implementation at some stage, or affect decision making on Project aspects. In this Project NGOs, concerned government departments, and line agencies are considered. **Reported by**:Manju Ara, Jr. Professional, CEGIS
Issues, questions, responses, comments - People's perception, opinion and attitude
1.1 Main problems due to erosion and flooding: - Flooding and eroding of homesteads - Accommodation problems for livestock - Land erosion in river side areas - Spreading of water-borne diseases and resulting health hazards - Problems in crop cultivation - Students cannot go to the educational institutions - Siltation Problem in the Jamuna River - Communication and transportation problems - Problems in various rural infrastructures (educational institutions, religious institutions etc.) - Reduce employment opportunities for river erosion **1.2 Peoples' responses to the FRERMIP project:** - People are very much positive to the implementation of this projects. Additionally, they added the following suggestions: - Ensure the use of Geo-bag and CC-Block in protective work - Requirements of embankment

- Construction of new embankment along the river bank

1.3 Impacts of the project

- People opined that this project must bring immense socio-economic benefits for them
- Save Chowhali upazila complex and different govt. office
- Prevent River erosion and protect house hold, livestock etc.

1.4 Impacts on Charlands

- Increase density in Muradpur Char for relocation
- Erosion of Charlands if construction cross dam or river

Resettlement/ Relocation issues

2.1. Impact of land acquisition on different group of people

- Loss of homesteads
- Damages of agricultural land
- Increases the number of landless of people
- loss of market facilities
- Some of peoples have no land or not able to purchase land and they take shelter others home stated

2.2. Relocation of houses and other establishments

- Landless people will be rehabilitated
- People will be economically benefited
- Price of adjacent land might be increased
- Relocation should be ensured through the consultation with local allied persons

2.3. Choice of relocation site, availability of land and its current price

There is availability of land for relocation. The current price of land 1000 0BDT for cultivable land and 30,000 BDT for homesteads land.

People suggested that in compensation process, prices should be fixed by the consultation with the local people rather than the average price of sub-registered office.

2.4. Present community social services the affected areas and relocated areas

Presently, there is inadequacy of social services both in the affected and relocated area

2.5. Will this situation be improved or deteriorated after relocation?

The present situation must be improved if the concerned authority manage it effectively and relocate them in desired locations

2.6. Present level of access to market centers and towns/future level of access to market centers and towns after relocation

At present, access level of local people to markets and towns is low. But, it will be improved if the project is implemented.

2.7. What are the patterns of transport and communication in the affected area/relocated area?

Rickshaw, Nosiman, tempo, boat, CNG, Horse cab, cycle are the main transportation in the affected and relocated area. But, overall transportation and communication facilities are not good.

2.8. What are the patterns for utilizing cultural and religious facilities? Will it generate conflicts in the host community?

There exists homogeneous religious and cultural scenario both in the affected and relocated area.

So, there is no possibility any sort of social conflict.

2.9. What types of conflicts may arise due to relocation/resettlement?

There is no possibility of social conflict. In spite of this, local allied persons should be involved in the process of relocation the affected people.

Compensation issues

3.1. ADB and GoB policies on involuntary resettlement

Local people do not know the policies on involuntary resettlement of ADB and GoB

3.2. Discussion on entitlements, compensation rates, income restoration, and grievance redress mechanism

- Compensation should be given on the basis current price land rather than traditional policy
- Ensuring compensated money to the actually affected people

3.3. People's preference on mode of compensation payment and their previous experience

In case of compensation they prefer money rather land as they feel freedom of choice

3.4. Cut-off date for listing affected properties

Income restoration and generation

4.1. What are the current income generating activities of APs?

- Agriculture
- Fish culture
- Livestock rearing
- Small entrepreneurship
- Employed
- Business Etc.

4.2. Are there possibilities for continuing employment in the project area? Which type of occupation?

- It is possible to continue the current occupation in the project area

4.3. What types of income-generating activities are available at relocation sites? and to be generated?

- Agriculture
- Fish culture/capture
- Livestock rearing
- Small entrepreneurship
- Employed
- Business Etc.

4.4. How does relocation of households affect the current market situation (job opportunities, competition, land price and market price situation)

- Labour availability will be increased. There is a chance to be more labor than less work
- Land price will be increased
- Social neighborhood will increased

4.5. How many people can be absorbed?

About 75 to 80 percent people can be absorbed

4.6. Does this require training for skill development and IGA?

- Livestock roaring training
- Swinging training

- Health training
- Fish culture training
- Agricultural training
- Skill development training is highly needed for the local people. In addition, training should be given on disaster risk reduction
4.7. How many people need to be trained and for what occupation?
- About 70% people need to be trained up. *Training sectors:*
    - Fish culture
    - Farming
    - Livestock and poultry

Social Development Support
5.1. Name of NGOs prevailing in the relocation site - Proshika, BRAC, ASA, Manob Mukti Sangstha, BDPC Etc. **5.2. Willingness of NGOs to support the APs for savings and income generation programs, providing capital support for income restoration and poverty reduction.** - Various NGOs show greater interest to support the affected people through poverty reduction activities **5.3. Social safeguard and safety nets** - At present the coverage of social safety net is quiet good
Outcome (s)
- All livelihood sectors are affected by erosion and flood - They demanded immediate bank protection - They show willingness to be relocated in purpose of protective work - There is no social conflict regarding relocation - Prior consultation with local allied persons is highly required before starting work - Income and employment will be generated - Compensation should be given in money considering the current market price - Lifestyle of the local people will be improved
Special Attention
- Requirements of new embankment and protect work

Table A8.4: First-Round Meeting Summary, Harirampur Upazila Complex, Manikganj

Project/Subproject:**Integrated Flood and Riverbank Erosion Management Investment Program**
Meeting date: **26 /02/ 2013**
Place: **Harirampur Upazila Complex, Manikganj**
Attending: **<u>Proponents:</u>** BWDB, NHC, ADB **<u>Stakeholders:</u>** • ***Primary:*** Farmers, fishers, local business community as well as the households to be displaced, women groups, and caretakers of community properties. • ***Secondary:*** Those who may not be directly affected but have interests that could contribute to the study, play a role in implementation at some stage, or affect decision making on Project

aspects. In this Project NGOs, concerned government departments, and line agencies are considered.

porte d by: Muhammad Shifuddin Mahmud, Professional, CEGIS

Issues, questions, responses, comments

People's perception, opinion and attitude

1.1 Main problems due to erosion and flooding:

- Flooding and eroding of homesteads
- Accommodation problems for livestock
- Scarcity of safe drinking water
- Sanitation problems
- Spreading of water-borne diseases and resulting health hazards
- Problems in crop cultivation
- Students cannot go to the educational institutions
- Problems in movements for population and livestock
- Destruction in fishery sector
- Communication and transportation problems
- Problems in various rural infrastructures (educational institutions, religious institutions etc.)

1.2 Peoples' responses to the FRERMIP project:

- People are very much positive to the implementation of this project. Additionally, they added the following suggestions:
- Ensure the use of Geo-bag in protective work
- Repairing of sluice gate at Kantapara
- Construction of new embankment at Dhulshura, Boyra and Lesraganj UP

1.3 Impacts of the project

- People opined that this project would bring immense socio-economic benefits for them

Resettlement/ Relocation issues

2.1. Impact of land acquisition on different group of people

- Loss of homesteads
- Damages of agricultural land
- Increases the number of landless of people

2.2. Relocation of houses and other establishments

- Landless people will be rehabilitated
- People will be economically benefited
- Price of adjacent land might be increased
- Relocation should be ensured through the consultation with local allied persons

2.3. Choice of relocation site, availability of land and its current price

- There is availability of land for relocation. The current price of land is 10,000 BDT for cultivable land and 30,000 BDT for homesteads land.
- People suggested that in compensation process, prices should be fixed in consultation with the local people instead of considering the average price of sub-registered office.

2.4. Present community social services the affected areas and relocated areas

- Presently, there is inadequacy of social services both in the affected and relocated area

2.5. Will this situation be improved or deteriorated after relocation?

- The present situation would improve if the concerned authority manage it effectively and relocate them in desired locations

2.6. Present level of access to market centers and towns/future level of access to market centers and towns after relocation

- At present, access level of local people to markets and towns is low. It will be improved if the project is implemented.

2.7. What are the patterns of transport and communication in the affected area/relocated area?

- Rickshaw, Nosiman, tempo are the main transportation in the affected and relocated area. But, overall transportation and communication facilities are not good.

2.8. What are the patterns for utilizing cultural and religious facilities? Will it generate conflicts in the host community?

- There exists homogeneous religious and cultural scenario both in the affected and relocated area. So, there is no possibility of any sort of social conflict.

2.9. What types of conflicts may arise due to relocation/resettlement?

- There is no possibility of social conflict. However, local allied persons should be involved in the process of relocation the affected people.

Compensation issues

3.1. ADB and GoB policies on involuntary resettlement

- Local people do not know the policies on involuntary resettlement of ADB and GoB

3.2. Discussion on entitlements, compensation rates, income restoration, and grievance redress mechanism

- Compensation should be given on the basis current price land rather than traditional policy
- Ensuring compensated money to the actually affected people

3.3. People's preference on mode of compensation payment and their previous experience

- In case of compensation they prefer money rather than land as they feel freedom of choice

3.4. Cut-off date for listing affected properties

Income restoration and generation

4.1. What are the current income generating activities of APs?

- Agriculture
- Fish culture/capture
- Livestock rearing
- Small entrepreneurship
- Employed
- Business
- Etc.

4.2. Are there possibilities for continuing employment in the project area? Which type of occupation?

- It is possible to continue the current occupation in the project area

4.3. What types of income-generating activities are available at relocation sites? and to be generated?

- Agriculture
- Fish culture/capture
- Livestock rearing
- Small entrepreneurship
- Employed
- Business
- Etc.

4.4. How does relocation of households affect the current market situation (job opportunities, competition, land price and market price situation)

- Labour availability will be increased. There is a chance to be more labor than less work
- Land price will increase

- Social neighbourhood will increase **4.5. How many people can be absorbed?** - About 70 to 75 percent people can be absorbed **4.6. Does this require training for skill development and IGA?** - Skill development training is highly needed for the local people. In addition, training should be given on disaster risk reduction **4.7. How many people need to be trained and for what occupation?** - About 70% people need to be trained up *Training sectors:* - Fish culture - Farming - Livestock and poultry
Social Development Support
5.1. Name of NGOs prevailing in the relocation site - Proshika, BRAC, Grammeen Bank, GKT, BARSIC, Bangladesh Red Crescent Society **5.2. Willingness of NGOs to support the APs for savings and income generation programs, providing capital support for income restoration and poverty reduction.** - Various NGOs showed greater interest to support the affected people through poverty reduction activities **5.3. Social safeguard and safety nets** - At present the coverage of social safety net is quiet good
Outcome (s)
- All livelihood sectors are affected by erosion and flood - They demanded immediate bank protection - They showed willingness to be relocated in purpose of protective work - There is no social conflict regarding relocation - Prior consultation with local allied persons is highly required before starting work - Income and employment will be generated - Compensation should be given in money considering the current market price - Lifestyle of the local people will be improved
Special Attention
In Dhulshura union 5 schools, 4 mosques, one orphanage, 2 Madrashas and Dhulshura bazaar as well as crop land, homesteads and roadways may be eroded during the next April-May (Boisakh, Bangla month), if the government do not take effective initiative immediately to protect this resources.

Table A8.5: First-Round Meeting Summary, Shibalaya Upazila Complex, Manikgonj

Project/Subproject:**Integrated Flood and Riverbank Erosion Management Investment Program**
Meeting date: **17/04/2013**
Place: **Shibalaya Upazila Complex, Manikgonj**
Attending: **Proponents:**

BWDB, NHC, ADB

Stakeholders:

- ***Primary:*** farmers, fishermen, local business community as well as the households to be displaced, women groups, and caretakers of community properties.
- ***Secondary:*** those who may not be directly affected but have interests that could contribute to the study, play a role in implementation at some stage, or affect decision making on Project aspects. In this Project NGOs, Member of Parliamentarian (MP), concerned government departments, and line agencies are considered.

ported by: Manju Ara, Jr. Professional, CEGIS

Issues, questions, responses, comments
People's perception, opinion and attitude

2.1. Main problems due to erosion and flooding:

- River erosion is main problem of Shibalaya Upazila.
- Flooding and eroding of homesteads, cultivable land, homestead, various institutions such as educational institutions, social and religious institutions as well as all immovable and material resources are evanescing to Jumana and PadmaRiver.
- Due to river erosion, communication system based on embankment has broken down. People cannot carry their goods as a result carrying cost and sufferings become no bounds. It keeps a negative impact on their economy.
- Land erosion in river side areas
- Accommodation problems for livestock
- Spreading of water-borne diseases and resulting health hazards
- Problems in crop cultivation
- Students cannot go to the educational institutions
- Communication and transportation problems
- Problems in various rural infrastructures (educational institutions, religious institutions etc.)
- Losing cultivable land and all resources, they have become unemployed
- Reduce employment opportunities for river erosion

2.2. Peoples' responses to the FRERMIP project:

- People are very much positive to the implementation of this project. Additionally, they added the following suggestions:
- Ensure the use of Geo-bag and CC-Block in protective work
- Construction of new embankment along the river bank

2.3. Impacts of the project

- Both positive and negative impact will be occurring after implementation of the FRERMIP project intervention.
- Positive impact like- agricultural land, crops, homes, hat-bazaar, school, social institutions will be protected from riverbank erosion.
- Negative impact- Agricultural land will reduce due to land acquisition. On the other hands, houses will be needed to shift or migrate.

2.4. Impacts on char lands

- The char area will be protected from river erosion by implementation of the intervention and positive impact will occur in char area. Char area will sustain, as well as more crops will produce.

Resettlement/ Relocation Issues

3.1. Impact of land acquisition on different group of people

- Impact will be occurring after Impact of land acquisition of the FRERMIP
- Agricultural land will reduce due to land acquisition.
- On the other hands, houses will be needed to shift or migrate.
- Increases the number of landless of people
- loss of market facilities
- Some of peoples have no land or not able to purchase land and they take shelter others home stated

3.2. Relocation of houses and other establishments

- There are severe economical effects on different professional due to migration of homes, school, and various social institution of this area
- Landless people will be rehabilitated
- People will be economically benefited
- Price of adjacent land might be increased
- Relocation should be ensured through the consultation with local allied persons

3.3. Choice of relocation site, availability of land and its current price

- There is availability of land for relocation. The local people prefer both side of Utholy-Aricha highway's space as rehabilitation. The price of land is almost BDT 50,000. Per decimal for homesteads land.
- People suggested that in compensation process, prices should be fixed by the consultation with the local people rather than the average price of sub-registered office.

3.4. Present community social services the affected areas and relocated areas

- There is no opportunity in river erosion area of Hat- Bazar as well as health and education services where relocation area has better facilities.
- Presently, there is inadequacy of social services both in the affected and relocated area.

3.5. Will this situation be improved or deteriorated after relocation?

- The present situation must be improved if the concerned authority manage it effectively and relocate them in desired locations

3.6. Present level of access to market centers and towns/future level of access to market centers and towns after relocation

- At present, access level of local people to markets and towns is low. But, it will be improved if the project is implemented.

3.7. What are the patterns of transport and communication in the affected area/relocated area?

- The dwellers normally use rickshaw, van, Auto van etc to go to nearest place such as hat, bazaar in village. On the other hand, in upzilla people use CNG, Auto van, Motor cycle etc. same kind of vehicles will be used. There are street facilities for communication. Overall transportation and communication facilities are not good.

3.8. What are the patterns for utilizing cultural and religious facilities? Will it generate conflicts in the host community?

- Simply socio-religious and cultural facilities are equally enjoyed by the local people and there is no major conflict about it. If it is needed due to project implementation, conflict might not be happened.

3.9. What types of conflicts may arise due to relocation/ resettlement?

- There is no possibility of social conflict. In spite of this, local allied persons should be involved in the process of relocation the affected people.

Compensation issues
4.1. ADB and GoB policies on involuntary resettlement - Local people do not know the policies on involuntary resettlement of ADB and GoB **4.2. Discussion on entitlements, compensation rates, income restoration, and grievance redress mechanism** - The local people have preferred to have compensation by Union Parishad or Bank. Some people believe that hard cash might create predicament. Sometimes landowner does get money. In that case, land can be provided as replace of land. - Compensation should be given on the basis current price land rather than traditional policy - Ensuring compensated money to the actually affected people **4.3. People's preference on mode of compensation payment and their previous experience** - In case of compensation they prefer money rather land as they feel freedom of choice **4.4. Cut-off date for listing affected properties**
Income restoration and generation
4.1. What are the current income generating activities of APs? - The main sources of income of this area are agriculture and handloom. But there are also have a little range of fisher men, business men, job holder and other professionals. **4.2. Are there possibilities for continuing employment in the project area? Which type of occupation?** - Many of them will bound to change their occupation due to changed environment and situation. However, being migrated if population, present income generating source could be sustained. **4.3. What types of income-generating activities are available at relocation sites? and to be generated?** - There are almost same in income generating source between affected area and project relocated area. Nevertheless, in project relocated area has predominance of handloom occupation. **4.4. How does relocation of households affect the current market situation (job opportunities, competition, land price and market price situation)** - Due to migration process, Abundance of labour force might be seen in newly relocated area, which might influence on local labour market. As a result, labour competition might increase and might lessen wage. - Labour availability will be increased. There is a chance to be more labor than less work - Land price will be increased - Social neighborhood will increased **4.5. How many people can be absorbed?** - Almost affected people could be people can be absorbed. **4.6. Does this require training for skill development and IGA?** - Livestock roaring training - Swinging training - Health training - Fish culture training - Agricultural training etc - Skill development training is highly needed for the local people. In addition, training should be given on disaster risk reduction **4.7. How many people need to be trained and for what occupation?** - By proper providing proper training, a great development of handloom will be brought

and will create more employment opportunities. Related with handloom should provide proper training and better opportunities by govt. and NGOs. Almost half of total people should be trained up.
Social Development Support
5.1. Name of NGOs prevailing in the relocation site - BRAC, CEDIA, Grameen Bank, ASA, Paribar Unnoyn Samajik Sangasta, Pard, ASEA - CODAC and many other NGOs are working in this area. **5.2. Willingness of NGOs to support the APs for savings and income generation programs, providing capital support for income restoration and poverty reduction.** - NGOs worker are working in Savings, Income generating activities, financial assistance in re-settlement of income and in eradicating poverty. NGOs could expand their activities if they get financial assistance. **5.3. Social safeguard and safety nets** - The opportunities of social safety net are moderate. They need adequate financial assistance is needed. They also need training related to awareness. Employment generating activities should be increased.
Outcome (s)
- All livelihood sectors are affected by erosion and flood - They demanded immediate bank protection - They show willingness to be relocated in purpose of protective work - There is no major social conflict regarding relocation - Prior consultation with local allied persons is highly required before starting work - Income and employment will be generated - Compensation should be given in money considering the current market price - Lifestyle of the local people will be improved
Special Attention
quirements of new embankment and protect work

Table A8.5: First-Round Meeting Summary, Shibalaya Upazila Complex, Manikgonj

Project/Subproject:**Integrated Flood and Riverbank Erosion Management Investment Program**
Meeting date: **27.02.2013**
Place: **Shahzadpur Upazila Complex, Sirajganj**
Attending: **<u>Proponents:</u>** BWDB, NHC, ADB **<u>Stakeholders:</u>** • ***Primary:*** Farmers, fishermen, local business community as well as the households to be displaced, women groups, and caretakers of community properties. • ***Secondary:*** Those who may not be directly affected but have interests that could contribute to the study, play a role in implementation at some stage, or affect decision making on Project

aspects. In this Project NGOs, concerned government departments, and line agencies are considered.

ported by: Mobasher Bin Ansari, Professional, CEGIS

Issues, questions, responses, comments:

1.1. People's perception, opinion and attitude

- Major problems relating to flood and riverbank erosion,
- Attitude of the people towards the project (FRERMIP) and its proper completion,
- Impact (positive and negative) of the project and mitigation measures against negative impact,
- Unanticipated Impacts on Charlands

1.2. Resettlement/ Relocation issues

- Impact of land acquisition on different group of people (farmer, fisherman, vulnerable people, and others),
- Relocation of houses and other establishments,
- Choice of relocation site, availability of land (agricultural, homestead, etc.) and its current price,
- Present community social services (eg health care, education) in the affected areas and relocated areas,
- Will this situation be improved or deteriorated after relocation?
- Present level of access to market centers and towns/future level of access to market centers and towns after relocation,
- What are the patterns of transport and communication in the affected area/relocated area?
- What are the patterns for utilizing cultural and religious facilities? Will it generate conflicts in the host community?
- What types of conflicts may arise due to relocation/resettlement?

1.3. Compensation issues

- ADB and GoB policies on involuntary resettlement,
- Discussion on entitlements, compensation rates, income restoration, and grievance redress mechanism,
- People's preference on mode of compensation payment and their previous experience,
- Cut-off date for listing affected properties

1.4. Income restoration and generation

- What are the current income generating activities of APs?
- Are there possibilities for continuing employment in the project area? Which type of occupation?
- What types of income-generating activities are available at relocation sites? and to be generated?
- How does relocation of households affect the current market situation (job opportunities, competition, land price and market price situation)?
- How many people can be absorbed?
- Does this require training for skill development and IGA?
- How many people need to be trained and for what occupation?

1.5. Social Development Support

- Name of NGOs prevailing in the relocation site,
- Willingness of NGOs to support the APs for savings and income generation programs, providing capital support for income restoration and poverty reduction.
- Social safeguard and safety nets

Outcomes (s)
People's perception, opinion and attitude
2.1. Main problems due to erosion and flooding: - Flooding - river bank erosion - Damage of households and assets - Damage of bridge, culvert and livestock etc. **2.2. Peoples' responses to the FRERMIP project:** - Participants expressed positive attitude to the project implementation and demanded its early implementation adjacent villages of Padma River bank; **2.3. Impacts of the project** - People opined that this project must bring immense socio-economic benefits for them
Resettlement/ Relocation issues
3.1. Negative impact of land acquisition on different group of people - Bank erosion will increase due to unplanned river management program - Lack of permanent protection work will not be enough to save households and agricultural and in project area.
3.2. Positive impact of land acquisition on different group of people: - To save agricultural land, households, bridges and culvert from river bank erosion and flood. - Increase agricultural production - The stone base construction work from gravel layer will ensure its longevity. **3.3. Unanticipated Impacts on Charlands** - No unanticipated impacts will observe on Charlands people rather this activities will ensure more food production and safety for them. **3.4. Impact of land acquisition on different group of people (farmer, fisherman, vulnerable people, and others),** - The farmers and local people will lose their agricultural and homestead land due to land acquisition; - They demanded adequate compensation and other benefits for the loss of their assets and livelihood, as well as alternative place for relocation of their houses and business. **3.5. Relocation of houses and other establishments,** - Relocation of houses and other establishments will possible in new Charlands, **3.6. Choice of relocation site, availability of land (agricultural, homestead, etc.) and its current price,** - Government can decide best for relocation of site - There are available land for relocation - Current land price is now: - Agricultural land is 20,000BDT for each decimal. - Homestead land is 30,000BDT for each decimal. **3.7. Present community social services (eg health care, education) in the affected areas and relocated areas,** - The present health and education services in project area not satisfactory - Lack of health centres and schools in both project and relocated areas **3.8. Will this situation be improved or deteriorated after relocation?** - After relocation this situation may not improve as high but definitely improve after few years **3.9. Present level of access to market centers and towns/future level of access to market centers and towns after relocation,**

- At present access to market is not satisfactory.

3.10. What are the patterns of transport and communication in the affected area/relocated area?

- Modes of transportations in the project area are Rickshaw and van. Most of the people communicate through foot.

3.11. What are the patterns for utilizing cultural and religious facilities? Will it generate conflicts in the host community?

- People of these areas are practicing homogenous cultural practices for 100 of years. No social conflicts are exists in whole project area

3.12. What types of conflicts may arise due to relocation/resettlement?

- According to local people, no conflicts will happen due to relocation/resettlement. If any will rise, local power holder can solve this problem easily.

Compensation issues, income restoration and generation

4.1. ADB and GoB policies on involuntary resettlement

- Local people are totally unknown about ADB and GoB policies on involuntary resettlement issues.

4.2. Discussion on entitlements, compensation rates, income restoration, and grievance redress mechanism,

- Compensation should be paid to actual people who are affected by land acquisition.
- Land compensation should be given on the basis of present land price.

4.3. People's preference and previous experience on mode of compensation payment

- People's preferences on mode of compensation payment only through money.

4.4. Cut-off date for listing affected properties

- **N/A**

4.8. What are the current income generating activities of APs?

- Agricultural farming
- Fishing (culture/capture)
- Livestock rearing
- Small cottage/Handicraft
- Employed/service
- Small business

4.9. Are there possibilities for continuing employment in the project area? Which type of occupation?

- The mentions above occupations are possible for continuing in the project area.

4.10. What types of income-generating activities are available at relocation sites? And to be generated?

- Agricultural farming
- Fishing (culture/capture)
- Livestock rearing
- Small cottage/Handicraft
- Employed/service
- Small business

4.11. How does relocation of households affect the current market situation (job opportunities, competition, land price and market price situation)?

- Land price will be increased
- Development of agriculture
- Development of communication system
- Improvement of livestock rearing practice etc.

4.12. How many people can be absorbed?

- About 50 percent people can be absorbed

4.13. Does this require training for skill development and IGA?

- It is highly needed training programs on agriculture farming, livestock rearing and small cottage for the betterment of local people.

4.14. How many people need to be trained and for what occupation?

- People identified at least 80% of local are needed to trained up on these particular occupation as:
- Improve agricultural farming
- Fishing (culture/capture)
- Small cottage/handicraft etc.

Social Development Support

5.1. Name of NGOs prevailing in the relocation site

- BRAC, Grameen Bank, PPD, Manab Mukti, UNDP, ASA

5.2. Willingness of NGOs to support the APs for savings and income generation programs, providing capital support for income restoration and poverty reduction.

- These NGOs are interested to support the APS for savings and income generation programs, providing capital for income restoration and poverty reduction.

5.3. Social safeguard and safety nets

- At present, the social safeguard and safety nets activities in the project area are not good. Local people argued more initiatives should have taken by government in this regard such as:
- Old allowances
- Maternity allowances
- Widow allowances etc

Overall Findings

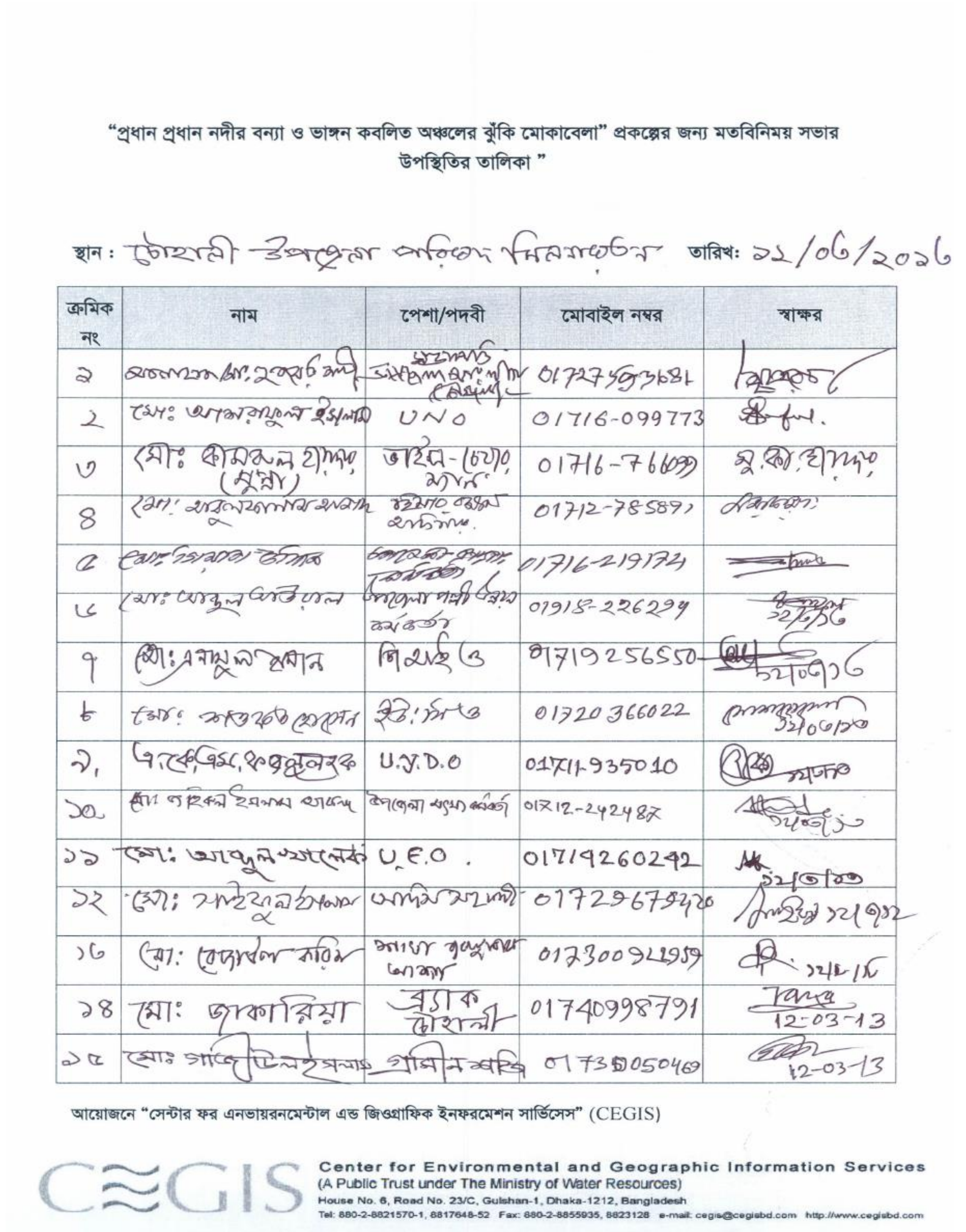
Overall:

- The local people desired for quick implementation of this project as they believe that the communication infrastructure and other facilities of the study area will be improved as well in the aftermath.
- The land owners stated that they want higher prices of land than anticipated but still they agreed that the project would change the socio-economical condition of the area as well as of the country.
- People demanded that the village cross road which run beside the river bank should be made as metalled road for the convenience of local people, contractor and the BWDB.

Specific:

- Participants expressed positive attitude to the project implementation and demanded its early implementation.
- Local people expect employment opportunities during and after project implementation;
- People suggested for the development of road communication network which in a sense would create income generating sources for the villagers;
- The compensation should be fixed in conformity with the market value of the land; and
- People strongly demanded a plan which will not affect the local development with an excuse of national development.

Photo A3.5: First Round Meeting Sign-in Sheet, Chauhali, Sirajganj



"প্রধান প্রধান নদীর বন্যা ও ভাঙ্গন কবলিত অঞ্চলের ঝুঁকি মোকাবেলা" প্রকল্পের জন্য মতবিনিময় সভার উপস্থিতির তালিকা "

স্থান : চ�ৌহালী উপজেলা পরিষদ মিলনায়তন তারিখ: ২১/০৬/২০১৬

ক্রমিক নং	নাম	পেশা/পদবী	মোবাইল নম্বর	স্বাক্ষর
১	[illegible]	[illegible]	01727563681	[illegible]
২	মো: আশরাফুল ইসলাম	UNO	01716-099773	[illegible]
৩	মো: কামরুল হাসান (সুমন)	[illegible]	01716-766099	[illegible]
৪	[illegible]	[illegible]	01712-785891	[illegible]
৫	[illegible]	[illegible]	01716-219172	[illegible]
৬	[illegible]	উপজেলা পল্লী উন্নয়ন কর্মকর্তা	01918-226229	[illegible]
৭	মো: এনামুল হক	[illegible]	01719256550	২১/০৬/১৬
৮	[illegible]	[illegible]	01720366022	২১/০৬/১৬
৯	এ.কে.এম. ফজলুল হক	U.Y.D.O	01711-935010	[illegible]
১০	[illegible]	উপজেলা মৎস্য কর্মকর্তা	01712-242487	[illegible]
১১	মো: আব্দুল [illegible]	U.E.O.	01719260242	২১/০৬/১৬
১২	মো: [illegible]	[illegible]	01729675420	[illegible]
১৩	মো: [illegible] করিম	[illegible]	01730094959	২১/৬/১৬
১৪	মো: জাকারিয়া	ব্র্যাক চৌহালী	01740998791	12-03-13
১৫	মো: [illegible]	গ্রামীণ ব্যাংক	01730050469	12-03-13

আয়োজনে "সেন্টার ফর এনভায়রনমেন্টাল এন্ড জিওগ্রাফিক ইনফরমেশন সার্ভিসেস" (CEGIS)

CEGIS Center for Environmental and Geographic Information Services
(A Public Trust under The Ministry of Water Resources)
House No. 6, Road No. 23/C, Gulshan-1, Dhaka-1212, Bangladesh
Tel: 880-2-8821570-1, 8817648-52 Fax: 880-2-8855935, 8823128 e-mail: cegis@cegisbd.com http://www.cegisbd.com

"প্রধান প্রধান নদীর বন্যা ও ভাঙ্গন কবলিত অঞ্চলের ঝুঁকি মোকাবেলা" প্রকল্পের জন্য মতবিনিময় সভার উপস্থিতির তালিকা "

স্থান : চৌহালী উপজেলা পরিষদ মিলনায়তন তারিখঃ ২২/০৬/২০১৬

ক্রমিক নং	নাম	পেশা/পদবী	মোবাইল নম্বর	স্বাক্ষর
০১	মোঃ [illegible] ইসলাম	চাকুরী	01712884965	[illegible]
০২	মোঃ সাইদুল ইসলাম	ইউ পি সদস্য	01729-320453	[illegible]
০৩	মোঃ [illegible]	ইউ পি	01749365461	[illegible]
০৪	মোঃ [illegible]	ইউ পি	0173180404[illegible]	[illegible]
০৫	মোঃ মোঃ রহমান	ইউ পি	01912660855	[illegible]
০৬	মোঃ [illegible]	ইউ, পি সদস্য	01765022165	[illegible]
০৭	" ইউসুফ আলী	" " মেম্বার	01719-616774	[illegible]
০৮	[illegible] বেগম	ইউপি সদস্য	01721078054	[illegible]
০৯	মোসাঃ [illegible]	ইউ, পি সদস্য	01725337030	[illegible]
১০	মোঃ [illegible]	[illegible]	01730935120	[illegible] ২২.৬.১৬
১১	মোঃ [illegible] রহমান	[illegible]	017111072664	[illegible] ২২/৬/১৬
১২	[illegible] ফিরোজ	কৃষক		ফিরোজ
	নবীর	কৃষক		নবীর
	মোঃ [illegible] উদ্দিন	কৃষি		মোঃ [illegible] উদ্দিন
	বাক্কার	কৃষি		বাক্কার

আয়োজনে "সেন্টার ফর এনভায়রনমেন্টাল এন্ড জিওগ্রাফিক ইনফরমেশন সার্ভিসেস" (CEGIS)

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Tel: 880-2-8821570-1, 8817648-52 Fax: 880-2-8855935, 8823128 e-mail: cegis@cegisbd.com http://www.cegisbd.com

Photo A3.6: First Round Meeting Sign-In Sheet, Harirampur, Sirajganj

"প্রধান প্রধান নদীর বন্যা ও ভাঙ্গন কবলিত অঞ্চলের ঝুঁকি মোকাবেলা" প্রকল্পের জন্য মতবিনিময় সভার উপস্থিতির তালিকা "

স্থান: হরিরামপুর উপজেলা পরিষদ মিলনায়তন তারিখ: ২৫/০২/২০১৬

ক্রমিক নং	নাম	পেশা/পদবী	মোবাইল নম্বর	স্বাক্ষর
১	মোঃ [illegible]	চেয়ারম্যান, উপজেলা	[illegible]	[illegible]
২	এম, এম, সাইদ হাসান	সহঃ উপজেলা [illegible]	[illegible]	[illegible]
৩	হারুন-অর-রশিদ	[illegible]	[illegible]	[illegible]
৪	[illegible]	চেয়ারম্যান [illegible]	[illegible]	[illegible]
৫	Md. Lutfar Rahman	U Agri officer	01938822567	[illegible]
৬	Md. Nazrul Islam Bhuiyan	UPa-Zila Engineer.	01715593154	[illegible]
৭	A.K.M. MIZANUR RAHMAN	U.L.O. Harirampur Manikganj	01716637536	[illegible]
৮	Abubakor Siddik	UEO(C)	01815814456	[illegible]
৯	Mohsinuzzaman Khan	SAE/PHE	01732681242	[illegible]
১০	Mursalima Begum	UWAO	01719615360	M Begum
১১	MD. JANNAT-UL-FERDOUSH	ULSO	01199-060326	[illegible] 26/02/13
১২	মোঃ [illegible]			[illegible]
১৩	মোঃ [illegible]	[illegible]	01925784316	[illegible]
১৪	[illegible]	[illegible]	[illegible]	[illegible]
১৫	মোঃ [illegible]		[illegible]	[illegible]

আয়োজনে "সেন্টার ফর এনভায়রনমেন্টাল এন্ড জিওগ্রাফিক ইনফরমেশন সার্ভিসেস" (CEGIS)

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স্থান : হরিরামপুর উপজেলা পরিষদ মিলনায়তন তারিখ: ২৬/০২/২০১৬

ক্রমিক নং	নাম	পেশা/পদবী	মোবাইল নম্বর	স্বাক্ষর
১৬	আমিনুল হক শাহ	শাখা ব্যবস্থাপক ব্র্যাক হরিরামপুর	০১৯২৫ ১১০৬১৫	
১৭	সাজ্জাদুর রহমান সাহেব	বার্তা সম্পাদক হরিরামপুর	01717353901	
১৮	রোমা জিয়াসমীন	শাখা ব্যবস্থাপক শক্তি ফাউন্ডেশন	01733076025	
১৯	মোঃ হাবিবুর খাঁন	UP সদস্য		মোঃ হাবিবুর
২০	হযরত আলী	UP সদস্য	01736621694	
২১	ওয়াজেদ	কৃষি কর্মী	০১৭ ২৬৮১৮১৯১১	ওয়াজেদ
২২	মো: মাহাবুবুর হোসেন	ছাত্র	01762562292	
২৩	মো: আবু সাঈদ	কৃষি	01795474158	PANIVOIYOLLD
২৪	শেখ হাবিবুর	উপজেলা সদস্য	01727603153	শেখ হাবিবুর
২৫	মো: হাবিবুর	ব্যবসা	01732365667	Habibur
২৬	মো: মাসুম মিয়া	ব্যবসা	01922000454	Masum
২৭	মো: রনি মোল্লা	ছাত্র	01963-848908	Roni
২৮	ডা: মোশারফ হোসেন	সহকারী উপজেলা কৃষি কর্মকর্তা	01712516628	
২৯	সুকুমার দে	উপ সহকারী প্রকৌশলী উপজেলা জনস্বাস্থ্য প্রকৌশল অধিদপ্তর	01715448580	
৩০	হরিদাস দাস	ইউ.পি সদস্য	01741181464	

আয়োজনে "সেন্টার ফর এনভায়রনমেন্টাল এন্ড জিওগ্রাফিক ইনফরমেশন সার্ভিসেস" (CEGIS)

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স্থান :

তারিখঃ

ক্রমিক নং	নাম	পেশা/পদবী	মোবাইল নম্বর	স্বাক্ষর
৩১	[illegible]	UNO	01752843866	[illegible]
৩২.	[illegible]	উপজেলা চেয়ারম্যান	01746148851	[illegible]
৩৩	[illegible]	ভাইস চেয়ারম্যান	01715867799	[illegible]
৩৪	[illegible]	[illegible]	01711-296066	[illegible]
৩৫	মোঃ [illegible]	[illegible]	01715833[illegible]	[illegible]
৩৬	[illegible]	Value chain Specialist	01712505755	[illegible]
৩৭	[illegible]	[illegible]	01912076342	[illegible]
৩৮	রোকিয়া বেগম	গৃহিণী মেম্বার	01720821359	রোকেয়া বেগম
৩৯	[illegible] বেগম	মেম্বার	01750213466	[illegible]
৪০	মো: বিল্লাল [illegible]	কৃষক	01712026985	[illegible]
৪১	রাজিয়া সুলতানা	মেম্বার	01731724142	রাজিয়া সুলতানা
৪২	মোঃ [illegible]	ব্যবসায়ী -	01740818357	[illegible]
৪৩	মোঃ সাজ্জাদ হোসেন	মৎস ব্যবসায়ী	01747251040	[illegible]
৪৪	[illegible]	ব্যবসায়ী	01710331156	[illegible]
৪৫	[illegible]	কৃষক -	0171921070	[illegible]

আয়োজনে "সেন্টার ফর এনভায়রনমেন্টাল এন্ড জিওগ্রাফিক ইনফরমেশন সার্ভিসেস" (CEGIS)

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স্থান :

তারিখ:

ক্রমিক নং	নাম	পেশা/পদবী	মোবাইল নম্বর	স্বাক্ষর
৪৬	মোঃ [illegible]	[illegible]	01732805172	[illegible]
৪৭	[illegible] হোসেন	ব্যবসা	01778183185	[illegible]
৪৮	মোঃ কাদের আলী	ব্যবসা	01715792537	কাদের আলী
৪৯	[illegible] খানম	চাকুরী	01775245777	[illegible]
৫০	মুহাম্মদ [illegible] মাহমুদ	Job	0171000 9233	[illegible]
৫১	মোঃ কামাল হোসেন	চেয়ারম্যান, রামকৃষ্ণপুর ইউপি	01711060719	[illegible]
৫২	[illegible] মোল্লা	[illegible]	01778904906	[illegible] মোল্লা
৫৩	[illegible]	[illegible]		[illegible]
৫৪	মোঃ [illegible]		01731548691	মোঃ [illegible]
৫৫.	[illegible]	[illegible]	01719210702	[illegible]
৫৬.	[illegible]	[illegible]	01768/8623	[illegible]
৫৭.	এম. এম. এ. [illegible]	উপজেলা প্রকল্প বাস্তবায়ন কর্মকর্তা	01734-747084	[illegible]

আয়োজনে "সেন্টার ফর এনভায়রনমেন্টাল এন্ড জিওগ্রাফিক ইনফরমেশন সার্ভিসেস" (CEGIS)

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Photo A3.7: First Round Meeting Sign-In Sheet, Shahjadpur, Sirajganj

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স্থান : শাহজাদপুর উপজেলা পরিষদ মিলনায়তন

তারিখ: ২৭.০২.১৬

ক্রমিক নং	নাম	পেশা/পদবী	মোবাইল নম্বর	স্বাক্ষর
	মো: রাসেল সাবরিন	উপজেলা নি. অফিসার	০১৭১৭৪৫৫৫৫৯	
	[illegible]	উপ: সহ: প্র:	01718367295	
	মো: [illegible]	উপজেলা পল্লী উন্নয়ন	০১৭১৮-২৪৩৫৭২	
	এ.কে.এম. সাইফুল ইসলাম	[illegible] UAS	01716243475	

আয়োজনে "সেন্টার ফর এনভায়রনমেন্টাল এন্ড জিওগ্রাফিক ইনফরমেশন সার্ভিসেস" (CEGIS)

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স্থান : শাহজাদপুর উপজেলা পরিষদ মিলনায়তন

তারিখ: ২৯.০২.১৬

ক্রমিক নং	নাম	পেশা/পদবী	মোবাইল নম্বর	স্বাক্ষর
০১	মো: হারুন অর রশিদ	চাকুরী ম্যানেজার UDPS	01197415814	29/2/16
০২	রঘুনাথ সরকার	চাকুরী	01722306757	
০৩	মোঃ আবু দাউদ	উ: সহ: প্রকৌ: জনস্বাস্থ্য প্রকৌ:	01715319039	29/2/16
০৪	[illegible] আলী	চাকুরী	01730187807	29/2/16
০৫	[illegible] বিশ্বাস	চাকুরী	01720526230	29/2/16
০৬	মো: আব্দুর রহমান	চাকুরী [illegible]	01917-965266	
০৭	[illegible] সাহা	চাকুরী লিগ্যাল অ্যাডভাইজার [illegible]	01727-023923	27.2.13
০৮	মোঃ আবু নঈম	শাখা ব্যবস্থাপক [illegible]	01730025453	29/2/16
০৯	মো: [illegible]	চেয়ারম্যান ২নং [illegible]	01712953351	29.2.16
১০	মো: খালিদুর রহমান	ইউ, পি ও	01719765995	29.2.16
১১	মোঃ আব্দুল কাদের	ইউ.এ.ও.	01710-865555	27.2.13
১২	মো: আব্দুল্লাহ [illegible]	ইউ.পি.ও BADC	01719-856207	29.2.13
১৩	[illegible]	U.S.O	01718-841866	29/02/16
১৪	এ.কে.এম [illegible] চৌধুরী	চেয়ারম্যান [illegible]	01712-554837	
১৫	মো: [illegible]	চেয়ারম্যান	02922922326	29/2/16

আয়োজনে “সেন্টার ফর এনভায়রনমেন্টাল এন্ড জিওগ্রাফিক ইনফরমেশন সার্ভিসেস” (CEGIS)

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স্থান : শাহজাদপুর উপজেলা পরিষদ মিলনায়তন তারিখ: ২৭.০২.১৬

ক্রমিক নং	নাম	পেশা/পদবী	মোবাইল নম্বর	স্বাক্ষর
	মোঃ [illegible]	চেয়ারম্যান	01710-609299	
	মোঃ আব্দুর [illegible]	[illegible]	01711-246258	
	রুকসানা জাহান কনিকা	CEP ব্র্যাক	01734168336	
	কে.এম, মামুনুর রহমান	খাদ্য পরিদর্শক	01190555776	
	মোঃ আখতারুজ্জামান	উপজেলা শিক্ষা অফিসার.	01712-635894	২৭/২/১৬
	মো. শাহজাহান আলি	উপজেলা [illegible] অফিসার	01714-723187	২৭/২/১৬
	মোঃ সাব্বির আহমেদ	উপজেলা নির্বাহী অফিসার	01710-609317	২৭/২/১৬

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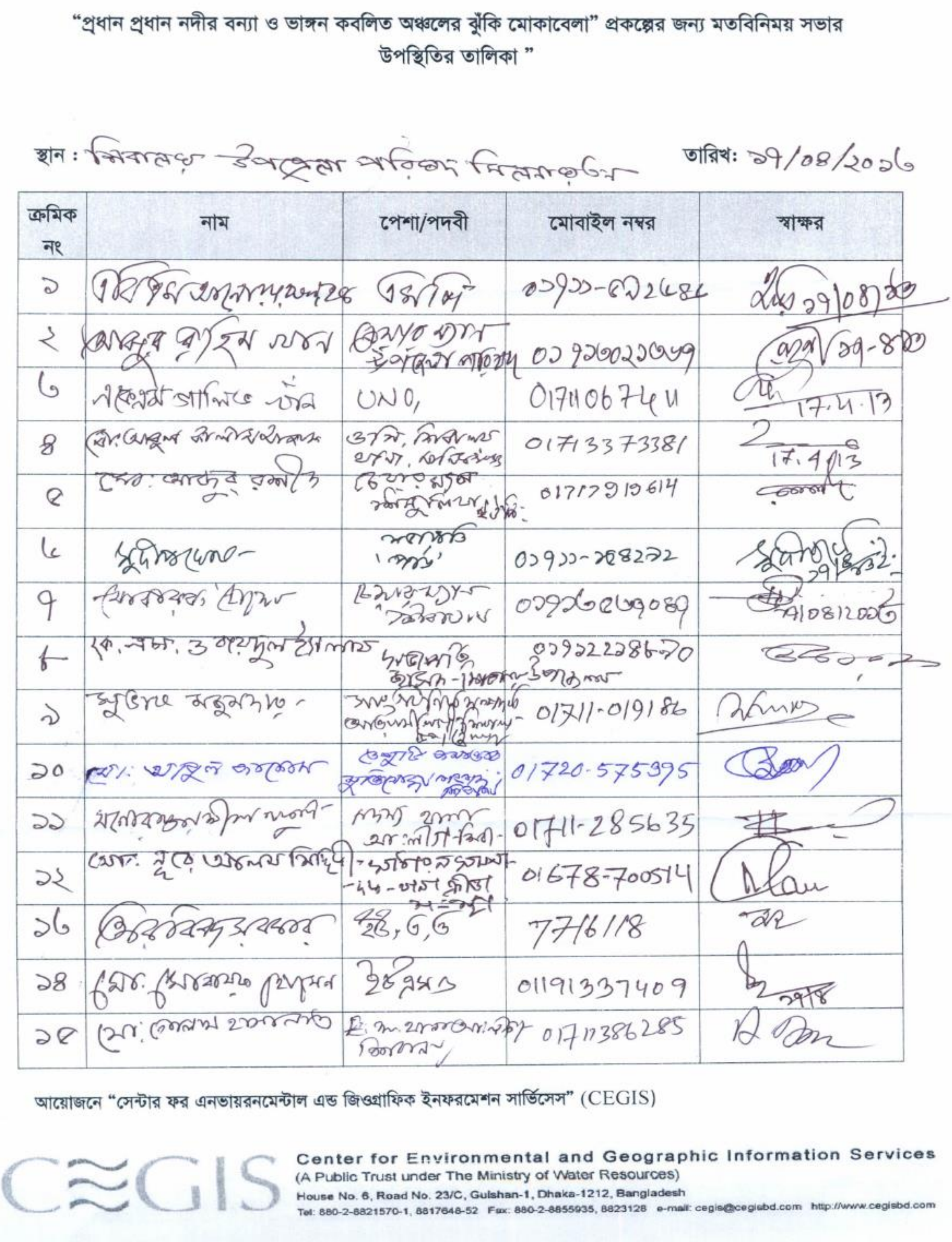
Photo A3.8: First Round Meeting Sign-In Sheet, Shibalaya, Manikganj



"প্রধান প্রধান নদীর বন্যা ও ভাঙ্গন কবলিত অঞ্চলের ঝুঁকি মোকাবেলা" প্রকল্পের জন্য মতবিনিময় সভার উপস্থিতির তালিকা "

স্থান : [illegible] তারিখ: ১৭/০৪/২০১৩

ক্রমিক নং	নাম	পেশা/পদবী	মোবাইল নম্বর	স্বাক্ষর
১	[illegible]	[illegible]	০১৭১১-৬০২৪৮৪	[illegible] ১৭/০৪/১৩
২	[illegible]	[illegible]	[illegible]	[illegible] ১৭-৪-১৩
৩	[illegible]	UNO,	01711067411	[illegible] 17.4.13
৪	[illegible]	[illegible]	01713373381	17.4.13
৫	[illegible]	[illegible]	01717910614	[illegible]
৬	[illegible]	[illegible]	০১৭১১-২০৮২৯২	[illegible]
৭	[illegible]	[illegible]	[illegible]	[illegible] 17/04/2013
৮	[illegible]	[illegible]	[illegible]	[illegible]
৯	[illegible]	[illegible]	01711-019186	[illegible]
১০	[illegible]	[illegible]	01720-575395	[illegible]
১১	[illegible]	[illegible]	01711-285635	[illegible]
১২	[illegible]	[illegible]	01678-700514	[illegible]
১৩	[illegible]	[illegible]	7716118	[illegible]
১৪	[illegible]	[illegible]	01191337409	[illegible]
১৫	[illegible]	[illegible]	01711386285	[illegible]

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স্থান : শিবালয় উপজেলা পরিষদ মিলনায়তন   তারিখঃ ১৭/০৪/২০১৬

ক্রমিক নং	নাম	পেশা/পদবী	মোবাইল নম্বর	স্বাক্ষর
১৬.	[illegible]	[illegible]	01780351251	[illegible]
১৭.	[illegible]	[illegible]	01718187480	[illegible]
১৮.	[illegible]	[illegible]	01711310557	[illegible]
১৯.	[illegible]	[illegible]	01713579299	[illegible]
২০.	মো: [illegible]	[illegible]	017352C651	[illegible]
২১	মো: আবুল বাশার সুমন	সম্পাদক [illegible]	01714-747038	[illegible]
২২	[illegible]	[illegible]	01712-152410	[illegible]
২৩	[illegible]	[illegible]	0171-1107079	[illegible]
২৪	[illegible]	[illegible]	01838104398	[illegible]
২৫	ডা: মো: মো: হালিম মোল্লা	UH & FPO	01712-544911	17.4.13
২৬	নাহিদ ফারজানা সিদ্দিকী	AC (L) [illegible]	01716986369	17.04.13
২৭	মো: [illegible]	[illegible]	01713-520478	[illegible]
২৮	[illegible]	[illegible]	01758438909	[illegible]
২৯	মো: [illegible]	[illegible]	0196 782362	[illegible]
৩০	মো: [illegible]	[illegible]	01714951316	[illegible]

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স্থান : শিবালয় উপজেলা পরিষদ মিলনায়তন তারিখ: ১৭/০৪/২০১৬

ক্রমিক নং	নাম	পেশা/পদবী	মোবাইল নম্বর	স্বাক্ষর
৩১.	মো: আব্দুল লতিফ	উপজেলা প্রকৌশলী	০১৭১১-১৮৪৩৪১	17.04.13
৩২.	মো: আব্দুল লতিফ	উ: প্র: ক: কর্ম	০১৪১১১৯১৮৯৩৯	১৭/০৪/১৬
৩৩.	রিক্তা বেগম	উপজেলা মহিলা বিষয়ক অফিসার	০১৮১৯৪৬৪৮৩৮৮	১৭/০৪/১৬
৩৪.	হাসিনা সুমন	উপজেলা শিক্ষা অফিসার	01711978085	১৭/৪/১৬
৩৫	হামিদা আহমেদ	উপজেলা পল্লী উন্নয়ন অফিসার	01714648980	১৭/৪/১৬
৩৬	আ.ত.ম. নুরুজ্জামান	উপজেলা জনস্বাস্থ্য ও ডিসিসিপি কর্মকর্তা	01776682081	১৭/৪/১৬
৩৭	মো: আব্দুস সবুর	দারিদ্র বিমোচন কর্মকর্তা	01766578115	১৭/৪/১৬
৩৮	মফিজুর রহমান	উপজেলা পরিবার পরিকল্পনা কর্মকর্তা	01712292993	১৭/৪/১৬
৩৯	মোসা: শামসুন্নাহার	উপজেলা সমবায় কর্মকর্তা	01761796 31	শামসুন্নাহার ১৭/৪/১৬
৪০	মোহাম্মদ খালেকুজ্জামান খান	সিনিয়র উপজেলা মৎস্য কর্মকর্তা	01712502213	১৭/৪/১৬
৪১	মো: মামুনুর হক	ব্র্যাক অফিস	01722845182	মামুন
৪২	আছমা আক্তার	শিক্ষক	—	আছমা আক্তার
৪৩	মো: আব্দুল্লাহ	পেশ ইমাম	01672626523	আব্দুল্লাহ
৪৪	সাজিদুল হক	ব্যবসায়ী	01935982456	সাজিদুল
৪৫				

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Photo A3.9: Questionnaire, Public Consultation Meeting

মত বিনিময় সভার আলোচ্য বিষয়

১। প্রকল্পের প্রভাব

১.১ নদী ভাঙ্গন ও বন্যা সম্পর্কিত প্রধান প্রধান সমস্যা কি কি?

১.২ এম,আর,পি প্রকল্প বাস্তবায়ন সম্পর্কে জনগণের অভিমত কি?

১.৩ এম,আর,পি প্রকল্পের সম্ভাব্য প্রভাব (ইতিবাচক নেতিবাচক) কি?

১.৪ নেতিবাচক প্রভাব প্রশমনে প্রয়োজনীয় পদক্ষেপ গুলো কি কি?

১.৫ প্রকল্প বাস্তবায়িত হলে চর অঞ্চলের ওপর প্রভাব পড়বে কি? পড়লে, তা কি ধরনের?

২। পুনর্বসতি/স্হানান্তর

২.১ জমি অধিগ্রহণের ফলে ঘর-বাড়ী ও অন্যান্য স্হাপনা সমূহের স্হানান্তরের প্রয়োজন হলে বিভিন্ন পেশাজীবী গোষ্ঠীর (কৃষক, জেলে, বিপদাপন্ন/ঝুঁকিগ্রস্ত) ওপর কি প্রভাব পড়তে পারে তা বর্ণনা করুন।

২.২ স্হানান্তরের জন্য আপনাদের পছন্দের স্হান কোনটি? যে স্হানে যেতে চান সেখানে পর্যাপ্ত জমি পাওয়া যাবে কি? সেখানে জমির (বসতবাড়ী, ভিটা, কৃষি ইত্যাদি) দাম কত?

২.৩ ক্ষতিগ্রস্ত এলাকায় এবং স্হানান্তরকৃত স্হানে বিদ্যমান সামাজিক সেবা সমূহ (যেমন: স্বাস্হ্য সেবা, শিক্ষা, ইত্যাদি) সম্পর্কে বলুন।

২.৪ স্হানান্তরকৃত স্হানে বিদ্যমান সামাজিক সেবা সমূহের উন্নতি বা অবনতি হবে কিনা।

২.৫ শহরে/বাজারে যাওয়ার জন্য বর্তমান স্হানের (ক্ষতিগ্রস্ত স্হানের) যাতায়াত ব্যবস্হা (সড়ক, ইত্যাদি) কেমন, কি ধরণের যানবাহন ব্যবহার করা হয় এবং স্হানান্তরকৃত স্হান থেকে শহরে/বাজারে যাওয়ার জন্য যাতায়াত ব্যবস্হা কেমন, কি ধরণের যানবাহন ব্যবহার করা হয়?

২.৬ বর্তমান স্হানের (ক্ষতিগ্রস্ত স্হানের) সাংস্কৃতিক সুযোগ সুবিধা, আচার আচরণ, প্রথা, কি এবং কেমন? আপনাদের আচার আচরণ, প্রথা স্হানান্তরকৃত স্হানে পূর্ব থেকে বসবাসরত জনগোষ্ঠীর সাথে কোন দ্বন্দ্ব/কলহ সৃষ্টির সম্ভাবনা আছে কি?

২.৭ দ্বন্দ্ব/কলহ হলে, তা কি ধরনের হতে পারে?

২.৮ ক্ষতিগ্রস্ত জনগণ কিভাবে ক্ষতিপূরণ পেতে চান তা বলুন।

৩ আয়-উপার্জনের পূন:সংস্হান:

৩.১ ক্ষতিগ্রস্ত জনগণের আয়ের উৎস সমূহ কি কি?

৩.২ স্হানান্তরিত হওয়ার পরেও বর্তমান স্হানে (ক্ষতিগ্রস্ত স্হানে) আয়ের উৎস সমূহ টিকিয়ে রাখা সম্ভব কিনা; যদি সম্ভব হয়, তাহলে সে উৎস সমূহ কি কি?

৩.৩ স্হানান্তরকৃত স্হানে আয়ের বর্তমান উৎস সমূহ কি কি?

৩.৪ স্হানান্তর বর্তমান বাজার ব্যবস্হাকে (যেমন: কর্ম সংস্হানের সম্ভাবনা এবং প্রতিযোগিতা, জমির দাম, ইত্যাদি) কি ভাবে প্রভাবিত করবে?

৩.৫ স্হানান্তরকৃত স্হানে কত সংখ্যক মানুষের কর্ম সংস্হান হতে পারে?

৩.৬ কর্ম সংস্হানের জন্য স্হানান্তরকৃত জনগোষ্ঠীর দক্ষতা অর্জনে প্রশিক্ষণের প্রয়োজন আছে কি?

৩.৭ কত লোকের প্রশিক্ষণ প্রয়োজন এবং কি কি পেশার প্রশিক্ষণ প্রয়োজন?

৪ সামাজিক উন্নয়ন সহায়তা:

৪.১ স্হানান্তরকৃত স্হানে বর্তমানে কোন কোন এনজিও কাজ করছে?

৪.২ ক্ষতিগ্রস্ত জনগণের সঞ্চয়, উপার্জন মূলক কর্মকান্ড, আয় পূন:সংস্হানে আর্থিক সহায়তা প্রদান এবং দারিদ্র নিরসনে বিদ্যমান এনজিও সমূহ আগ্রহী কিনা।

৪.৩ সামাজিক নিরাপত্তা বেষ্ঠনী সুযোগ সুবিধা কেমন?

Annex 4: Public Consultation Meeting, Second Round

A. Overview of Meetings

Four second-round meetings were conducted at Chowhali, Harirampur, and Shahjadpur and Shibalaya, attended by 157 participants. Locations, dates, numbers and types of participants, and meeting photos are provided in Tables A9.1 and A9.2, and Photos A9.1 to A9.4.

B. Stakeholder Concerns and Meeting Documentation

Summaries of stakeholder concerns expressed in the meetings are provided in Sections A9.C and A9.D. Copies of the meeting sign-in sheets are shown in Photos A9.5 to A9.8.

Table A4.1: Meeting Venues, First Round Public Consultation Meetings

District	Upazila	Union	Meeting venue	Meeting date	Time
Manikganj	Shibalay	Sadar	UZ conference room	02/07/2013	11:00 am
Sirajganj	Shahjadpur	Sadar	UZ conference room	04/07/2013	11:30 am
Sirajganj	Chouhali	Sadar	UZ conference room	07/07/2013	11:00 am
Manikganj	Harirampur	Sadar	UZ conference room	09/07/2013	11:00 am

Table A4.2: Public Consultation Meeting Participant Details

Meeting venue	Type of Participants	No. participants
Shibalaya (JLB-2)	BWDB staff, ADB consultants, Upazila Nirbahi Officer, teachers, UP Chairman, UP members (Male/Female), farmer, Fishermen, local notable persons, healthcare assistants, businessmen, traders, and NGO staff	69
Shahjadpur (JRB-1)	BWDB staff, PPTA consultants, UP Nirbahi Officer, teachers, UP Chairperson, UP members (male and female), farmer, fishermen, local notable persons, healthcare assistants, businessmen, traders, and NGO staff	37
Chouhali (JLB-2)	BWDB representatives, ADB consultants, Upazila Nirbahi Officer, teachers, UP Chairman, UP members (Male/Female), farmer, Fishermen, local notable persons, healthcare assistants, businessmen, traders, and NGO staff	56
Harirampur (PLB-1)	BWDB representatives, ADB consultants, Upazila Nirbahi Officer, teachers, UP Chairman, UP members (Male/Female), farmer, Fishermen, local notable persons, healthcare assistants, businessmen, traders, and NGO staff	85

Photo A4.1: PCM at Chouhali

Photo A4.2: PCM at Harirampur

Photo A4.3: PCM at Shahjadpur

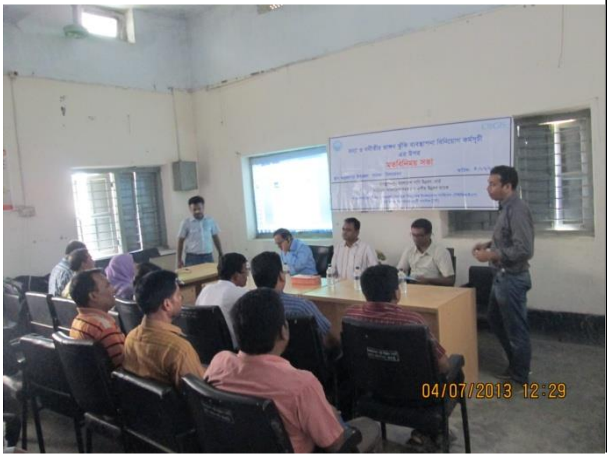


Photo A4.4: PCM at Shibalya (JLB-2 area)

C. Summary of Concerns, All Meetings

Erosion. Stakeholders were informed of average annual rates of land, homestead, and infrastructure loss to erosion in each subproject area, and that the proposed bank protection is expected to reduce these losses. Participants emphasized the need to ensure that construction work is of high quality.

Flooding. Stakeholders were informed that the proposed embankment will help to protect from flooding.Stakeholders stated that the embankment will not control flood without river dredging, and therefore dredging should be incorporatedin the project.

Land use. Stakeholders were advised that the project would induce significant changesin land type, land use, and increased food production.

Fish habitat. Stakeholders were informed that the project is expected to have negative impacts on fish and other aquatic fauna due to reduction of wetland by the proposed interventions. Local participants suggested restoring fisheries habitat through pilot dredging of channels in the Tranche 1area.

Pollution. Stakeholders were advised that the construction phase would cause temporary air pollution and noise. Almost all stakeholders present consented to accept these impacts during construction.

Resettlement. Participants were informed that, at the time of the meetings, 1726 households in Horirampur of Manikgonj and Chouhali of Sirajgonj district would require relocation to suitable alternate sites before the beginning of construction, per Tranche 1 resettlement plans.

Improved road transportation. Participants were informed thatflood embanbkments would be provided with appropriate road facilities.

Employment.Participants were informed that the subproject's reduction of the areas' vulnerability will improve conditions for trade and commerce. Project construction will provide temporary employment opportunities to local people.

Contingency funding to begin revetment construction this year (2013). Almost all participants mentionedlocaitons threatened by erosion, and that If the construction does not start for one year, erosion will proceed in this areas and the subproject designswill have to be changed. They requested contingency funds to be arranged now so that protection work can begin in 2013.

Addition of dredging to subproject designs. River dredging has not been included in subproject designs. Participants strongly recommended that it be added, as they believe flood and erosion control cannot be achieved in these areas without it. Some participants suggested capital dredging from Jamuna Bridge to Brahmankanda of Horirampur upazia under Manikgonj district.

Successful implementation. Participants are concerned that development projects initiated by the ruling party will lose priority if/when the opposition party is in power. Participants strongly urge a 2013 construction start avoid future problems.

Flood protection plans. Participants expressed concerned about the effectiveness of the subprojects in controlling flooding. They stated that flood protection plansshould be developed based on an assessment of water levels. Proposed interventions should be designed to provide protection from the highest monsoon water levels.

D. Notes of Specific Meetings

Shibalay, Manikganj (JLB-2 area)

The upazila areasmost affected by erosion are Zafargonj and Bachamara. Local MP Mr. A.B.M Anwerul Haq stated that over last five years, more than 9000 affluent households of Zafargonj area were forced by erosion to leave the area and now live in difficult circumstances in Dhaka city.

Participants recommend that construction should start from November in the dry season.

The northern part of Zafargonj Bazar is very much threatened by erosion this year. To protect this area,participants suggested seeking preparatory fundsfrom Asian Development Bank (ABD) and Water Development Board.

The subproject area needs access to contingency fundsfor emergency work.

Participants believe permanent protection works are required in the Padma and Jamuna Rivers as temporary erosion protection works are not viable there.

River dredging is essential to the success of the subproject and should be started in order to prevent erosion and flooding.

River bank protections from Koijuri to Baghabari are essential this year as these areas are vulnerable.

During construction, transparency should be ensured through BWDB monitoring of work quality.

A reservoir to hold water for rice cultivation and fish culture should be added to thesubproject.

Shahjadpur, Sirajganj

Co-ordination among involved departments should be ensured during subproject implementation.

Eroding locations should be properly identified and protection works provided there.

Participants requested adding construction of a water reservoir to the project, to hold water for rice cultivation and aquaculture and immediate repair of the existing upazila embankment and revetment.

Participants stated that a flood action plan was needed to improve flood proofing and response given the high flood levels in the subproject area.

Participants favor pilot dredging in area channels to increase fish production and maintain fish habitat.

Chouhali, Sirajganj

The area of Chouhali upazila most vulnerable to erosion is the upazila sadar, where 40 to 50 per cent of the area has already eroded away. BWDB has been using sandbags in attempt to control the erosion, but these have been ineffective given the intensity of the erosive attack. Participants stated that sandbag revetments are ineffective in the Jamuna due to its erosion intensity.

Participants urged BWDB to appeal to ADB to allocate preparatory funds for emergency work. Construction of riverbank protection works should commence in the dry season, otherwise adequate work quality will not be achieved.

Most participants stated that capital dredging should be undertaken from the Jamuna Bridge to Aricha. River dredging is required to ensure the survival of any future embankment works. An embankment built in this upazila at a cost of BDT 38 crore was already destroyed by erosion.

A flow divider should be incorporated in the project design.

Participants expressed frustration that the the subproject design does not reflect the concerns and suggestions of local people, even though these have been expressed repeatedly in meetings with the Project Implementation Officer (PIO).

Harirampur, Manikganj

The 5 km riverbank protection proposed in this upazila should be extended an additional 2 km up to Dhulsura. Bahadurpur union should be included with the project.

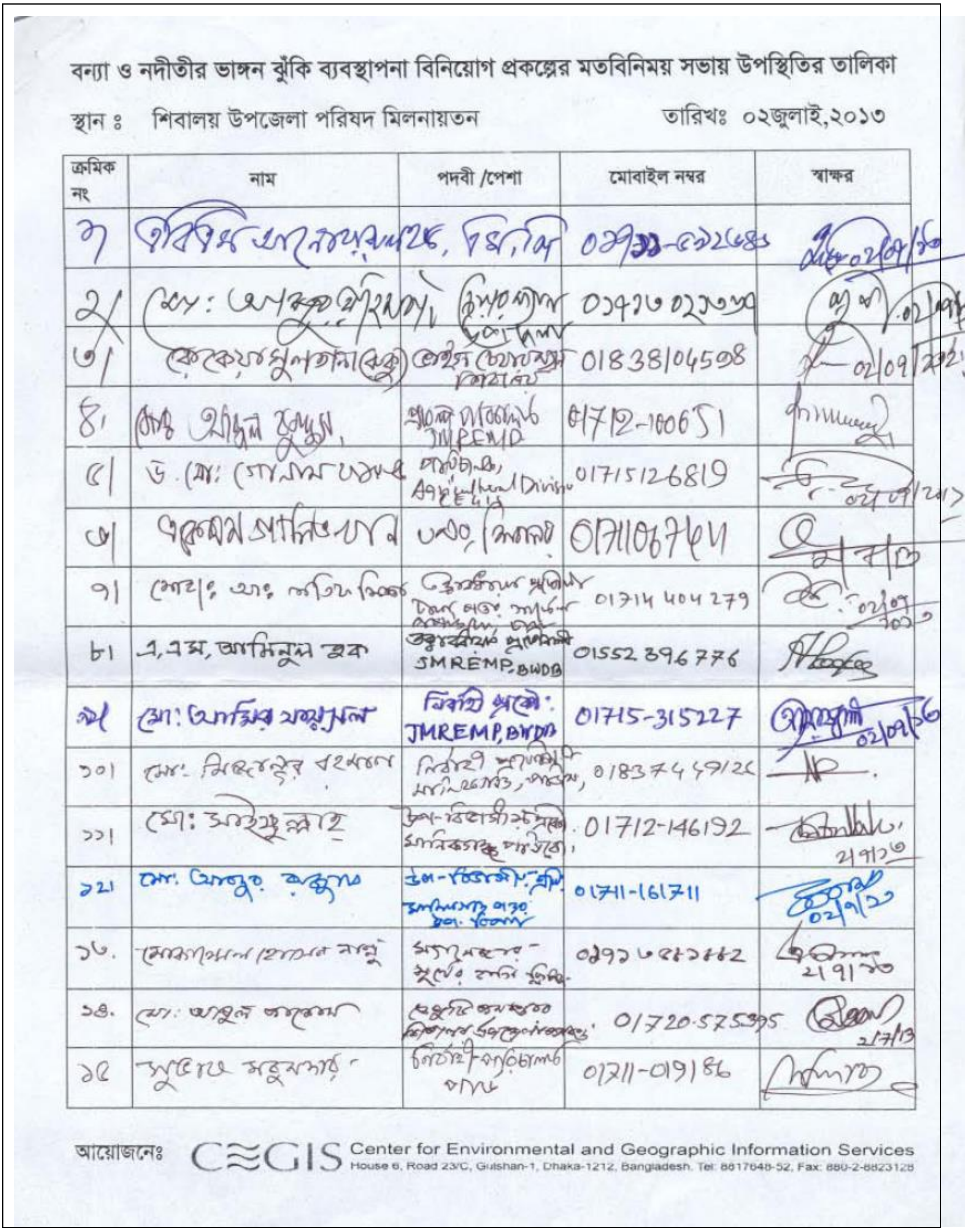
Participants were concerned about the successful implementation of the project. They think that projects initiated by the ruling party will have lower priority if and when the opposition is in power. Participants hope the subproject will be implemented in 2013 and agreed to make whatever sacrifices would be required to expedite this.

Participants stated that the priority should be to protect Harirampur before providing protection to Manikgonj town. Priority work should start as soon as possible.

A quality control committee should be struck to ensure quality construction work.

Local stakeholders should be involved in regular embankment maintenance.

Photo A4.5: Second Round Meeting Sign-in Sheet, Shibalaya, Manikganj



বন্যা ও নদীতীর ভাঙ্গন ঝুঁকি ব্যবস্থাপনা বিনিয়োগ প্রকল্পের মতবিনিময় সভায় উপস্থিতির তালিকা

স্থান ঃ শিবালয় উপজেলা পরিষদ মিলনায়তন তারিখঃ ০২জুলাই,২০১৩

ক্রমিক নং	নাম	পদবী /পেশা	মোবাইল নম্বর	স্বাক্ষর
১	[illegible]	[illegible]	[illegible]	[illegible]
২	[illegible]	[illegible]	[illegible]	[illegible]
৩	[illegible]	[illegible]	01838104598	[illegible]
৪	[illegible]	[illegible] JMREMP	01712-100651	[illegible]
৫	ড. মো: [illegible]	[illegible] Agricultural Division	01715126819	[illegible]
৬	[illegible]	[illegible]	[illegible]	[illegible]
৭	[illegible]	[illegible]	01714404279	[illegible]
৮	এ,এম, আমিনুল হক	[illegible] SMREMP, BWDB	01552396776	[illegible]
৯	মো: [illegible]	[illegible] JMREMP, BWDB	01715-315227	[illegible]
১০	মো: [illegible]	[illegible]	[illegible]	[illegible]
১১	মো: [illegible]	[illegible]	01712-146192	[illegible]
১২	মো: [illegible]	[illegible]	01711-161711	[illegible]
১৩.	[illegible]	[illegible]	[illegible]	[illegible]
১৪.	মো: [illegible]	[illegible]	01720-575395	[illegible]
১৫	[illegible]	[illegible]	01711-019186	[illegible]

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বন্যা ও নদীতীর ভাঙ্গন ঝুঁকি ব্যবস্থাপনা বিনিয়োগ প্রকল্পের মতবিনিময় সভায় উপস্থিতির তালিকা

স্থান : শিবালয় উপজেলা পরিষদ মিলনায়তন তারিখঃ ০২জুলাই,২০১৩

ক্রমিক নং	নাম	পদবী /পেশা	মোবাইল নম্বর	স্বাক্ষর
১৬	[illegible]	[illegible]	01758438909	[signature]
১৭	মো: [illegible]	[illegible]	01191337409	[signature]
১৮	রিজা বেগম	উপজেলা মহিলা বিষয়ক অফিসার	01819434386	[signature] 02/07/13
১৯	[illegible]	[illegible]	01718187480	[signature]
20	[illegible]	[illegible]	01720039694	[signature]
২১	রতন চন্দ্র [illegible]	উপজেলা [illegible]	01742083855	[signature]
২২	[illegible]	[illegible]	01776682081	[signature]
২৩	ডাঃ নুরজাহান বেগম	ভেটেরিনারি সার্জন, উপজেলা প্রাণিসম্পদ দপ্তর।	01717-926888	[signature] 02.07.13
24	মো: [illegible]	[illegible]	01717450431	[signature]
25	[illegible]	[illegible]	01721842054	[signature]
26	মো: [illegible]	[illegible]	01718888036	[signature]
27	[illegible]	"	01711386285	[signature]
28	মো: আব্দুল [illegible]	[illegible]	01741196939	[signature]
29	আনন্দ কুমার সরকার	উপজেলা [illegible]	01938879349	[signature]
30	[illegible]	[illegible]	01711-285635	[signature]

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বন্যা ও নদীতীর ভাঙ্গন ঝুঁকি ব্যবস্থাপনা বিনিয়োগ প্রকল্পের মতবিনিময় সভায় উপস্থিতির তালিকা

স্থান ঃ শিবালয় উপজেলা পরিষদ মিলনায়তন তারিখঃ ০২জুলাই,২০১৩

ক্রমিক নং	নাম	পদবী /পেশা	মোবাইল নম্বর	স্বাক্ষর
৩১	মোঃ আব্দুর রহমান	ব্যবসায়ী	01764014074	[illegible]
৩২	মোঃ আব্দুর [illegible]	চেয়ারম্যান [illegible]	01717919654	[illegible]
৩৩	কামরুন্নাহার	উপজেলা ভাইস চেয়ারম্যান	01711107079	[illegible]
৩৪	পারভীন সুলতানা	উপজেলা মাধ্যমিক শিক্ষা অফিসার	01711467888	[illegible]
৩৫	[illegible]	UFPO.	01712292993	[illegible]
৩৬	[illegible]	URDO	01714648980	[illegible]
৩৭	মোহাম্মদ কামরুজ্জামান	UCO.	01716179631	[illegible]
৩৮	মো: আ: [illegible]	[illegible]	01713-520478	[illegible]
৩৯	[illegible]	[illegible]	01714-203230	[illegible]
৪০	[illegible]	[illegible]	[illegible]	[illegible]
৪১	[illegible]	Zonal Co-ordinator	01715-622159	[illegible]
৪২	[illegible]	[illegible]	01713473214	[illegible]
৪৩	[illegible]	[illegible]	01711905860	[illegible]
৪৪	মো: [illegible]	[illegible]	01711977744	[illegible]
৪৫	মোঃ মাসুদ রানা	এস.ও	01722613299	[illegible]

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বন্যা ও নদীতীর ভাঙ্গন ঝুঁকি ব্যবস্থাপনা বিনিয়োগ প্রকল্পের মতবিনিময় সভায় উপস্থিতির তালিকা

স্থান ঃ শিবালয় উপজেলা পরিষদ মিলনায়তন তারিখঃ ০২জুলাই,২০১৩

ক্রমিক নং	নাম	পদবী /পেশা	মোবাইল নম্বর	স্বাক্ষর
৪৬	মো: [illegible]	ব্যবসা	01673468585	
৪৭	মো: লোকমান	কৃষি কাজ	০১৭৪৯৭৬৬৮৮২	লোকমান
৪৮	মো: [illegible]	ব্যবসায়ী	০১৭১৪২০৫৫০৪	
৪৯	আব্দুল [illegible]	[illegible]	০১৭১০১০০৮৪৪	
৫০	[illegible]	[illegible]	01730916980	
৫১	মো: [illegible]	সহকারী [illegible]	01712-014567	
৫২	শফিকুল ইসলাম	সাংবাদিক	01716210110	
৫৩	[illegible]	কৃষি	01835815691	
৫৪	মোবাশ্বের বিন আনসারী	চাকুরী	01718 244298	Mobashar
৫৫	মো: [illegible] হোসেন	[illegible]	0171138472[illegible]	
৫৬	মনজু আরা	Jr. Professional CEGIS		Monja Aru
৫৭	[illegible]	সদস্য (জেলা পরিষদ)	০১৭৩৪৮৬৩১০১১	
৫৮	মো: [illegible] রহমান	চাকুরী	-01716351379	
৫৯	মো: আহমেদ আলী	কৃষক		
৬০	মো: [illegible]	কৃষক		

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স্থান : শিবালয় উপজেলা পরিষদ মিলনায়তন তারিখঃ ০২জুলাই,২০১৩

ক্রমিক নং	নাম	পদবী /পেশা	মোবাইল নম্বর	স্বাক্ষর
৬১	মোহাম্মদ ইউনুস আলম	সাংগঠনিক [illegible]	01712754064	
৬২	[illegible]	ব্যবসায়ী	[illegible]	
৬৩	মো: আব্দুল মালেক	প্রকল্প [illegible] পরিচালক, [illegible]	01715438362	০২/০৭/১৩
৬৪	মীর আসাদ হোসেন	পরিচালক ESAA (এসা)	01718-027199	
৬৫	রতন কুমার দে	সহকারী প্রকৌশলী [illegible]	01717-176114	
৬৬	মো: আব্দুল লতিফ	উপজেলা [illegible] কর্মকর্তা	01711-184381	02.07.13
৬৭	মো: রহমান	[illegible]	01712-959836	2-7-13
৬৮	মো: আক্তারুজ্জামান খান	চেয়ারম্যান [illegible]	01713577299	
৬৯	মাহফুজুর রহমান	[illegible]	01736526651	

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Photo A4.6: Second Round Meeting Sign-in Sheet, Shahjadpur, Sirajganj

বন্যা ও নদীতীর ভাঙ্গন ঝুঁকি ব্যবস্থাপনা বিনিয়োগ প্রকল্পের মতবিনিময় সভায় উপস্থিতির তালিকা

স্থানঃ শাহজাদপুর উপজেলা পরিষদ মিলনায়তন তারিখঃ ০৪ জুলাই,২০১৩

ক্রমিক নং	নাম	পদবী/পেশা	মোবাইল নম্বর	স্বাক্ষর
১	মো: [illegible]	UNO	[illegible]	
২	[illegible]	MO	017164268[illegible]	
৩	[illegible]	উপজেলা মহিলা বিষয়ক কর্মকর্তা	01711280845	
৪	মোছা: [illegible]	UFPO	07822-68809	
৫	মো: [illegible]	উপজেলা শিক্ষা অফিসার	01712635894	
৬	মোঃ [illegible]	URDO	01718-241571	
৭	ডাঃ মোঃ আঃ হাই	ইউ.এল.ও	০১৭১১৫৭৮০৬৫	০৪.০৭.১৩
৮	মো: [illegible]	[illegible]	01714845317	৪.০৭.১৩
৯	মো: [illegible]	[illegible]	01711-247[illegible]	
১০	মো: [illegible]	UPO	01720497802	০৪.০৭.১৩
১১	মো: [illegible] রহমান	সহকারী ব্যবস্থাপক ব্র্যাক শাহজাদপুর	01730-547916	
১২	মো: [illegible]	[illegible]	01716632856	
১৩	মো: [illegible]	[illegible]	01710609299	
১৪	মো: [illegible]	[illegible]	01917965266	
১৫	মোঃ আব্দুল বাছেদ	খামার ম্যানেজার	০১৭৩০০[illegible]	০৪।০৭।১৩

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বন্যা ও নদীতীর ভাঙ্গন ঝুঁকি ব্যবস্থাপনা বিনিয়োগ প্রকল্পের মতবিনিময় সভায় উপস্থিতির তালিকা

স্থানঃ [illegible] উপজেলা পরিষদ মিলনায়তন তারিখঃ ০৪ জুলাই,২০১৩

ক্রমিক নং	নাম	পদবী/পেশা	মোবাইল নম্বর	স্বাক্ষর
০১	হালেছা	ইউপি সদস্য	০১৭৪৮৬৬০৮৪২১	[illegible]
০২	মো: রুপচাঁদ আলী	গ্রাম পুলিশ	০১৭২৫৫৫৩৪৪১১	[illegible]
০৩	মো: আজিবার	চাকুরী		[illegible]
০৪	মো: জালাল	কৃষক		[illegible]
০৫	মো: লিটন	ব্যবসায়ী		[illegible]
০৬	মো: সামসুল হক	সাধারণ সম্পাদক	০১৭২৯৬৭৪৮৯৩	[illegible]
০৭	মো: রফিকুল ইসলাম	ইউনিয়ন সমাজকর্মী	০১৭২৮৫৫৯২৭২	[illegible]

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বন্যা ও নদীতীর ভাঙ্গন ঝুঁকি ব্যবস্থাপনা বিনিয়োগ প্রকল্পের মতবিনিময় সভায় উপস্থিতির তালিকা

স্থানঃ আহ্‌ম্মদপুর উপজেলা পরিষদ মিলনায়তন তারিখঃ ০৪ জুলাই,২০১৩

ক্রমিক নং	নাম	পদবী/পেশা	মোবাইল নম্বর	স্বাক্ষর
১৬	মো: আবদুল মান্নান	কৃষক	01712[illegible]	[illegible]
১৭	মো: আব্দুল কাদের UAO	চাকুরী	01710-865555	[illegible]
১৮	মো: নজরুল ইসলাম	ইউপি সদস্য	01716884866	[illegible]
১৯	আবু তাহের	সমাজসেবক	01728-066898	[illegible]
২০	মো: জিয়াউর	ইউপি সদস্য	01720669[illegible]	[illegible]
২১	মো: শুকুর	সাংবাদিক	01839209025	Shilu
২২	মো: মোস্তফা —	ইউ,পি-সদস্য	01725-679157	[illegible]
২৩	মো: খলিলুর সরকার	সচিব ২নং ইউনিয়ন	01725-441898	[illegible]
২৪	মো: বেকার আলী	সচিব ৯নং ইউনিয়ন/up	01718-811511	Rakib
২৫	মো: আবুল হোসেন	সচিব ৮নং ইউনিয়ন	01718-087749	[illegible]
২৬	মো: রমজান আলী	সাংবাদিক	01730957387	[illegible]
২৭	এম.এম. আনোয়ারুল বারী	CA উপজেলা পরিষদ	01737-103906	আনোয়ার
২৮	মো: ইসমাইল আলী	ইউপি সদস্য	01721886392	ইসমাইল
২৯	মো: আমির হোসেন	ইউপি সদস্য	01728[illegible]	[illegible]
৩০	মো: [illegible] বিরবাহাদুর	ইউপি সদস্য	0171388[illegible]	[illegible]

Photo A4.7: Second Round Meeting Sign-in Sheet, Chouhali, Sirajganj

বন্যা ও নদীতীর ভাঙ্গন ঝুঁকি ব্যবস্থাপনা বিনিয়োগ প্রকল্পের মতবিনিময় সভায় উপস্থিতির তালিকা

স্থানঃ চৌহালী উপজেলা পরিষদ মিলনায়তন তারিখঃ ০৭ জুলাই,২০১৩

ক্রমিক নং	নাম	পদবী/পেশা	মোবাইল নম্বর	স্বাক্ষর
১।	মোহাম্মদ আবদুল্লাহ	UNO, চৌহালী	01718364050	
২।	[illegible]	চেয়ারম্যান	01711955433	
৩।	[illegible]	U.W.A.O	01927-313560	
৪।	মোহাম্মদ আব্দুল [illegible]	U.E.O.	01714260242	
৫।	মোঃ [illegible] হোসেন	[illegible]	01720366022	
৬।	মোঃ [illegible] হোসেন	[illegible] (Surveyor [illegible])	01711384729	
৭।	মোঃ [illegible] মিয়া	[illegible]	01712007617	
৮।	[illegible]	[illegible]	01822814764	
৯।	মোঃ [illegible]	UFO.	01712-242487	
১০।	নাসির আহমেদ	উপজেলা প্রকৌশলী (চৌহালী)	01712-231353	
১১।	মোঃ [illegible]	[illegible]	01718341804	
১২।	মোঃ [illegible]	[illegible]	01730955120	
১৩।	মোঃ [illegible]	[illegible]	০১৭১৮৭০৭৫৭৫	
১৪।	মোঃ [illegible]	[illegible]	01936974001	
১৫।	মোঃ [illegible] ইসলাম	উপ-[illegible] চৌহালী	01554631678	

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বন্যা ও নদীতীর ভাঙ্গন ঝুঁকি ব্যবস্থাপনা বিনিয়োগ প্রকল্পের মতবিনিময় সভায় উপস্থিতির তালিকা

স্থানঃ চৌহালী উপজেলা পরিষদ মিলনায়তন তারিখঃ ০৭ জুলাই,২০১৩

ক্রমিক নং	নাম	পদবী/পেশা	মোবাইল নম্বর	স্বাক্ষর
১৬	মো: হাই মিয়া	শিক্ষক	01746368629	[illegible]
১৭	মো: আব্দুর রহমান	শিক্ষক	01715-782942	[illegible]
১৮	মো: লুৎ: রহমান	শিক্ষক	01773096107	[illegible]
১৯	এস, এম, হাবিব	শিক্ষক	01735850323	[illegible]
২০	মো: সাইফুল ইসলাম	প্রভাষক	01727501799	[illegible]
২১	মো: মাসুম সিকদার	সমাজসেবক	01712-378364	[illegible]
২২	মো: ইদ্রিস আলী	শিক্ষক ও সমাজ সেবক	01718308665	[illegible]
২৩	মো: শহিদুর রহমান	পরিচালক [illegible]	01712-7206 91	[illegible]
২৪	মো: মিজানুর রহমান	চেয়ারম্যান [illegible]	01726-177649	[illegible] ৭/৭/১৩
২৫	মো: জাহাঙ্গীর আলম	মানব মুক্তি সংস্থা UDRRC	01740-652555	[illegible] ৭/৭/১৩
২৬	জীবন কুমার দে	উপজেলা [illegible] AUSEO	01716137630	[illegible] 07.07.13
২৭	মো: আবু মোসা মোল্যা	সিনিয়র শাখা ব্যবস্থাপক ব্যাংক	01730346476	[illegible] 07.7.13
২৮	মো: মো: আমান	সমাজ সেবক	01752581061	[illegible]
২৯	মো: ইমদাদুল হক	শিক্ষক	01964816758	[illegible]
৩০	মো: হাফিজুর রহমান	সচিব ৬নং [illegible] ইউপি	01799821527	[illegible]

বন্যা ও নদীতীর ভাঙ্গন ঝুঁকি ব্যবস্থাপনা বিনিয়োগ প্রকল্পের মতবিনিময় সভায় উপস্থিতির তালিকা

স্থানঃ চৌহালী উপজেলা পরিষদ মিলনায়তন তারিখঃ০৭ জুলাই,২০১৩

ক্রমিক নং	নাম	পদবী/পেশা	মোবাইল নম্বর	স্বাক্ষর
০১	Dr. M. Mahmudul [illegible]	ULO, Chowhali	01712-735878	[illegible]
০২	মোঃ আব্দুল্লাহ	উপজেলা কৃষি অফিসার	01710961398	[illegible]
০৩	মোঃ [illegible]	[illegible]	01711102664	[illegible]
০৪	মোঃ [illegible]	[illegible]	01717100585	[illegible]
০৫	[illegible]	[illegible]	01727593681	[illegible]
০৬	[illegible]	[illegible]	01771546195	[illegible]
০৭	[illegible]	[illegible]	01726201737	
০৮	নুর মোহাম্মদ চৌধুরী [illegible]	[illegible]	01712-720515	[illegible]
০৯	[illegible]	[illegible]	01718236455	[illegible]
১০	মোঃ [illegible]	[illegible]	01716-219179	[illegible]
১১	মোঃ [illegible]	[illegible]	01712062548	[illegible]
১২	মোঃ [illegible] আলী	[illegible]	01711-269016	[illegible]
১৩	মোঃ রফিকুল [illegible]	[illegible]	0173387910	[illegible]
১৪	মোঃ [illegible]	[illegible]	01724713857	[illegible] 7/7/13
১৫	মোঃ [illegible]	[illegible]	01721286404	[illegible] 7/7/13

বন্যা ও নদীতীর ভাঙ্গন ঝুঁকি ব্যবস্থাপনা বিনিয়োগ প্রকল্পের মতবিনিময় সভায় উপস্থিতির তালিকা

স্থানঃ চৌহালী উপজেলা পরিষদ মিলনায়তন তারিখঃ ০৭ জুলাই,২০১৩

ক্রমিক নং	নাম	পদবী/পেশা	মোবাইল নম্বর	স্বাক্ষর
৪৬	মোঃ আঃ ছাত্তার	কৃষি		ছাত্তার
৪৭	[illegible]	[illegible]		[illegible]
৪৮	মোঃ [illegible]	চাকুরী		[illegible]
৪৯	মোঃ [illegible] আলী	অবঃ [illegible]		[illegible]
৫০	মোবাশ্বেরা বিনতে আনসারী	Professional	01718 244298	Mobashe
৫১	মনজু আরা	Jr. Professional		Monju Ara
৫২	মোঃ [illegible] আলী [illegible]	[illegible]	01722-070219	[illegible]
৫৩	মোঃ [illegible]	[illegible]	01712-881696	[illegible]
৫৪	মোঃ আবুল কালাম	শিক্ষক	01712-024638	[illegible]
৫৫	মোঃ ইসমাইল হোসেন	[illegible]		[illegible]
৫৬	[illegible]	[illegible]		[illegible]

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Photo A4.8: Second Round Meeting Sign-in Sheet, Harirampur, Manikganj

বন্যা ও নদীতীর ভাঙ্গন ঝুঁকি ব্যবস্থাপনা বিনিয়োগ প্রকল্পের মতবিনিময় সভায় উপস্থিতির তালিকা

স্থানঃ হরিরামপুর উপজেলা পরিষদ মিলনায়তন তারিখঃ ৯ জুলাই,২০১৩

ক্রমিক নং	নাম	পদবী/পেশা	মোবাইল নম্বর	স্বাক্ষর
১	ড. মো: [illegible]	Director (Deputy Secretary) CEGIS	01715126819	[illegible]
2	[illegible]	UNO হরিরামপুর	01752843866	[illegible]
৩	[illegible], চেয়ারম্যান	উপজেলা চেয়ারম্যান	01744448851	[illegible]
8	[illegible]	Ex-M.P.	[illegible]	[illegible]
৫	মো: [illegible]	নির্বাহী প্রকৌশলী JMREMP, BWDB	01715315227	[illegible] 9/7/13
৬.	[illegible]	সাংবাদিক	01711-857395	[illegible]
৭।	[illegible]	[illegible]	[illegible]	[illegible] 9-7-13
৮।	মো: [illegible]	[illegible]	01712026925	[illegible] 9-7-13
৯।	মো: মাজহারুল হক	উপজেলা যুব উন্নয়ন কর্মকর্তা	01716-457940	[illegible]
১০।	[illegible]	উপজেলা [illegible]	01913011173	[illegible] 9/7/13
১১।	[illegible]	উপজেলা [illegible] কর্মকর্তা	01715615360	[illegible]
১২।	[illegible]	[illegible]	01741181464	[illegible]
১৩।	[illegible]	[illegible]	01724588482	[illegible]
১৪।	মো: [illegible]	[illegible]	01932331327	[illegible]
১৫।	[illegible]	[illegible]		[illegible]

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বন্যা ও নদীতীর ভাঙ্গন ঝুঁকি ব্যবস্থাপনা বিনিয়োগ প্রকল্পের মতবিনিময় সভায় উপস্থিতির তালিকা

স্থানঃ হরিরামপুর উপজেলা পরিষদ মিলনায়তন তারিখঃ ৯ জুলাই,২০১৩

ক্রমিক নং	নাম	পদবী/পেশা	মোবাইল নম্বর	স্বাক্ষর
১৬.	[illegible]	[illegible]	01713 [illegible]	[illegible]
১৭.	মো: মুস্তাফিজুর রহমান	উ: কৃষি অফিসার	01727705307	[illegible]
১৮.	[illegible]	কৃষি অফিসার	01723811651	[illegible]
১৯.	[illegible]	SAE/PHE	01732681242	[illegible]
২০.	[illegible]	[illegible]	01716657766	[illegible]
২১.	মো: [illegible] রহমান	[illegible]	01713565974, 01827300956	[illegible]
২২.	[illegible]	[illegible]	01715593154	[illegible] ৯/৭/০১৩
২৩.	[illegible]	[illegible]	01711-290066	[illegible]
২৪.	মো: [illegible]	[illegible]	01713-488225	[illegible]
২৫.	[illegible]	[illegible]	01712-[illegible]	[illegible]
২৬.	[illegible]	[illegible]	01720828 [illegible]	[illegible]
২৭	[illegible]	[illegible]	01717094607	[illegible]
২৮	[illegible]	[illegible]	01717228620	[illegible] ৯/৭/২০১৩
২৯.	মো: [illegible]	[illegible]	[illegible]	[illegible] ৯/৭/১৩
৩০	আবুল হাসেম খান চৌধুরী		0172117589 [illegible]	আবুল হাসেম

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বন্যা ও নদীতীর ভাঙ্গন ঝুঁকি ব্যবস্থাপনা বিনিয়োগ প্রকল্পের মতবিনিময় সভায় উপস্থিতির তালিকা

স্থানঃ হরিরামপুর উপজেলা পরিষদ মিলনায়তন তারিখঃ ৯ জুলাই,২০১৩

ক্রমিক নং	নাম	পদবী/পেশা	মোবাইল নম্বর	স্বাক্ষর
৩১।	মো: [illegible]	[illegible]	01925784316	[signature]
৩২।	[illegible]	ব্যবসা	01715120453	[signature]
৩৩।	[illegible]	[illegible]	01731548641	[signature]
৩৪।	আ: রাজ্জাক	গ্রামপুলিশ		[signature]
৩৫।	[illegible]	কৃষক		[signature]
৩৬।	মো: [illegible]	কৃষক		[signature]
৩৭।	মো: [illegible]	কৃষক		[signature]
৩৮।	মো: [illegible] হোসেন	উদ্যোক্তা [illegible]	01912062204	[signature]
৩৯।	মো: [illegible]	[illegible]	01729630902	[signature]
৪০।	মো: ইউনুচ মোল্লা	কৃষি	01714 92 8465	[signature]
৪১।	মো: [illegible]	[illegible]	01718630049	[signature]
৪২।	মীর মাহমুদ হাসান	ইউ.পি. সদস্য	01825555873	[signature]
৪৩।	[illegible]	ইউপি সদস্য	01731791795	[signature]
৪৪।	মো: [illegible]	মুক্তিযোদ্ধা	01719855412	[signature]
৪৫।	পিয়াস চৌধুরী	কৃষক	01716302442	[signature]

বন্যা ও নদীতীর ভাঙ্গন ঝুঁকি ব্যবস্থাপনা বিনিয়োগ প্রকল্পের মতবিনিময় সভায় উপস্থিতির তালিকা

স্থানঃ হরিরামপুর উপজেলা পরিষদ মিলনায়তন তারিখঃ ১ জুলাই,২০১৩

ক্রমিক নং	নাম	পদবী/পেশা	মোবাইল নম্বর	স্বাক্ষর
৪৬	[illegible]	[illegible]	01712276439	[illegible]
৪৭	[illegible]	[illegible]	01732708478	[illegible]
৪৮	[illegible]	বার্তিক Ass. P.O.	01717353901	[illegible]
৪৯	[illegible]	[illegible]	01735581028-	[illegible]
৫০	[illegible]	[illegible]	01776685652	[illegible]
৫১	[illegible]	[illegible]	01778192550	[illegible]
৫২	[illegible]	[illegible]	01727604153	[illegible]
৫৩	রোকেয়া বেগম	[illegible]	01720821359	রোকেয়া
৫৪	[illegible]	[illegible]	01781805149	[illegible]
৫৫	[illegible]	[illegible]	01731766392	[illegible]
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৬১	মোঃ আক্তার হোসেন	কৃষক	01718099520	মো: আক্তার হোসেন
৬২	রোকেয়া বেগম	সদস্য ইউপি	01720821359	রোকেয়া বেগম
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৬৬	আজেজ	কৃষক		মো: আজেজ
৬৭	মো: রুবেল মিয়া	চাকুরি	01[illegible]1596[illegible]53	রুবেল
৬৮	আসাদুল হোসেন	ব্যবসায়ী	01778183185	[illegible]

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ক্রমিক নং	নাম	পদবী/পেশা	মোবাইল নম্বর	স্বাক্ষর
৬৯	MD Kamal Hossain	J. S. A	01781 510164	Kamal
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	নাম	পেশা	মোবাইল	স্বাক্ষর
৮৪	শেখ মোবারক হুসাইন	সদস্য ৩নং ওয়ার্ড কমিটি ইউ. পিং	০১৭৭৪৮৭৪১৯২৯	[illegible] ২৭/৭/১৬
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Annex 5: Standard Construction Contract Environmental Safeguard Clauses

A. Environmental Protection and Control of Pollution

1. General

The Contractor shall observe and comply with all National Laws and Government Regulationspertaining to environmental protection, pollution control, waste management, and biodiversity protection.

In conducting his construction activities, the Contractor shall take all necessary precautions to minimise environmental disturbance to the project area and surroundings and to prevent the escape of polluting substances into streams, water courses, and ground water. The Contractor shall also utilise all necessary practicable methods and devices as are available to prevent and otherwise minimize atmospheric emissions or discharges of air contaminants.

Except where otherwise agreed or provided for by the Employer or expressly stipulated in Particular Specifications or Technical Specifications forming part of the Contract Documents, no separate payment will be made for complying with the provisions of this Clause and attendant sub-clauses; and all costs shall be deemed to be included in the prices for the Contractor’s mobilisation for construction, and the various rates and lump sum items for the works included in the priced Bill of Quantities.

2. Pollution of Water Courses and Streams

The emission of polluting liquids or other waste into drains, water courses or ground water shall not be permitted.

No concrete or cement washings from the works or drainage from the Contractor's concrete batching and mixing areas, asphalt (hot mix) plants or other manufacturing or production facilities shall be allowed to discharge into streams or drains without passing through an adequate system of settling ponds.

Storage of fuels, fuelling and maintenance of plant and vehicles, etc. shall take place only on sites and under conditions that that do not allow spilt fuels to be discharged to water bodies. Fuel storage and fuelling areas shall be equipped with adequate protective measures to confine and retain accidental spillages. No drainage from fuel store and plant maintenance depots shall be allowed to be discharged without passing through an adequate arrangement of oil traps and separators.

Washing of vehicles shall not be permitted in streams but only in specially designated and equipped areas.

Operations in quarries and borrow areas shall be carried out in such a way as to minimize any possible pollution from particulate matter entering the streams.

Adequate sanitary waste control facilities shall be provided in site offices and workers camps, and sewage waste shall be collected regularly and disposed in accordance with relevant environmental legislation.

The Contractor shall accordingly be responsible for the installation, operation and maintenance of a comprehensive drainage system to all areas of the Works. The system shall be constructed such that no discharges of oil, cement, silt or other liquid or solid waste matter can enter the streams and water courses at the site; and it shall have all necessary solid waste and sediment traps, settling ponds, oil separators, etc. required to ensure that pollution of streams watercourses and natural bodies of water does not occur. The Contractor shall be responsible for maintaining the system to the satisfaction of the Employer's Construction Supervisor and all costs of providing the system shall be deemed to be included in the various rates and lump sum items for the works included in the priced Bill of Quantities.

3. Air Pollution

The Contractor shall take all necessary steps to minimize air pollution resulting from his operations.

Except where stipulated in these Specifications for the disposal of natural vegetation and organic materials from clearing operations, the burning of waste materials for disposal, particularly oil and petroleum wastes, rubber, plastics and similar materials will not be permitted.

During the performance of the work required under the Contract or of any operations appurtenant thereto, whether on the Project Site or elsewhere, the Contractor shall take all steps necessary, and shall furnish all labor, equipment, materials and means, required to reduce dust nuisance from the Works, and to prevent dust originating from his operations from damaging crops, orchards, cultivated fields, and dwellings; or causing a nuisance to persons. The Contractor shall be held liable for any damage resulting from dust originating from his operations including on Government roads, rights-of-way or elsewhere.

The emission of dust into the atmosphere shall not be permitted during the manufacture, handling and storage and handling of cement and of concrete aggregates and the Contractor shall use such methods and equipment as are necessary for the prevention, or the collection and disposal, of dust during such operations. All truckloads of loose materials shall be covered during transportation

Concrete batching and mixing areas, asphalt (hot mix) plants, or other manufacturing or production facilities shall be sited at least 500m from the nearest habitation. Emission outlets shall be fitted with pollution control devices in compliance with relevant current Government of Bangladesh emission control legislation.

The cost of spraying water on haul roads, access roads, government roads, aggregate stockpiles, etc.; or of any other methods of reducing the formation of dust; and the cost of furnishing and applying materials to maintain the works areas, adjacent areas, and roads, in a dustless condition, shall be deemed to be included in the various rates and lump sum items for the works included in the priced Bill of Quantities.

4. Noise Pollution

The Contractor shall take all necessary precautions to minimize the amount of noise and vibrations coming from construction activities.

The Contractor shall ensure that all plant and equipment is properly maintained in good operating condition, and that noisy construction activities shall be effectively sound reduced by means of silencers, mufflers, acoustic linings or shields, acoustic sheds or screens or other means, to avoid disturbance to any nearby noise sensitive receivers. All plant and equipment shall comply with relevant Government of Bangladesh legislation covering sound emissions.

Quarry operations and blasting shall be undertaken so as to minimize blasting and disturbance during the night and, insofar as possible, noise, vibration and dust. Operation of trucks and heavy vehicles and machinery shall be restricted to the hours of 06:30 to 19:00.

All necessary measures shall be undertaken to protect schools, hospitals and other adjacent noise sensitive receptors, including the use of noise barriers.

5. Damage to Property, Crops, and Vegetation

The Contractor shall limit the movement of his employees and equipment within the project area and on adjacent land, including access routes approved by the Employer's Construction Supervisor, so as to minimize damage to natural vegetation, crops and property, and shall endeavor to avoid any damage to land.

The Contractor shall strictly ensure employees and equipment do not enter any sensitive environmental areas that are demarcated as "no-entry" zones.

The Contractor shall preserve existing trees, plants and other vegetation that are to remain within or adjacent to the Works and shall use every precaution necessary to prevent damage or injury thereto. Trees or shrubs shall only be felled or removed where such impinge directly on the permanent works or necessary temporary works areas; and where such is approved by the Employer's Construction Supervisor.

On completion of the Works all areas disturbed by the Contractor's construction activities shall be restored by the Contractor to their original condition, or as may be acceptable to the Employer.

The Contractor shall be responsible directly to the Employer for any excessive or unnecessary damage to crops or lands arising from his operations, whether within the project area, on lands adjacent thereto, or adjacent to approved access roads: and deductions will be made from the payment due to the Contractor to cover the cost of such excessive or unnecessary damage, as determined by the Employer.

B. Sanitation Facilities and Arsenic Safe Water Supplies

At each construction area, (i) an appropriate number of tubewells will be installed to supply water for construction and safe drinking water to laborers and the construction camps, and (ii) latrines with septic tanks will be provided. Tubewells will be tested for arsenic and marked accordingly (green/red for safe/unsafe).

C. Reporting

The Contractor shall maintain a record of all emissions and spills of liquid, solid and gaseous matter which occur at the site, whether into water courses, streams, on land, or into the air. This record shall be compiled daily and shall include details of date, time and nature of the event, along with details of the remedial and clean-up measures carried out. Copies of these records shall be given to the Employer monthly.

The Contractor shall also maintain a record of any complaints made by any Governmental or Community Organization or by the public, regarding his operations. This record shall contain the date and time of receipt of the complaint, the name and address of the complainant and the action taken to remedy the situation. Copies of these records shall be given to the Employer monthly.

D. Environmental Management Plan

The requirements of this clause and attendant sub-clauses on Environmental Protection and Pollution Control notwithstanding; the Contractor shall observe and comply with all relevant environmental protection and mitigation, monitoring and reporting requirements in the Environmental Management Plan (EMP) as stipulated in the Particular Specification. In the event of any conflict between the foregoing sub-clauses and the environmental protection and mitigation measures and pollution control requirements of the EMP, the EMP shall take precedence.

The Contractor shall prepare and submit to the Employer's Construction Supervisor a Construction Environmental Management and Monitoring Plan (CEMP) demonstrating the manner in which the Contractor will comply with the requirements of the foregoing sub-clauses on Environmental Protection and Pollution Control, the EMP, and any particular environmental mitigation measures as stipulated in the Particular Specifications or Technical Specifications forming part of the Contract Documents.

The CEMP shall be submitted within 15 working days of the Contractor receiving the Notice to Proceedwith the Works, and shall include a waste management plan detailing procedures for waste management for the site covering all solid, liquid and gaseous waste materials and emissions. The waste management plan shall include procedures for the collection and disposal of all waste materials in such a way as to ensure that no damage is caused to the environment. Training shall be provided to workers about the appropriate implementation of the CEMP and waste management plan measures.

Where stipulated in the Particular Specifications or Technical Specifications forming part of the Contract Documents, and provision has been made in the Bill of Quantities; payment for the implementation of the CEMP will be made in accordance with the Unit Rates, Lump Sum or Provisional Sum Items included in the Priced Bill of Quantities.

Annex 6: Project Implementation Arrangements

A. Steering and Guidance of Executing and Implementing Agencies

The program is suggested to be implemented under the lead of BWDB (executing agency) with close relationships to DDM (implementing agency). Other associated organizations are WARPO, LGED and BIWTA. The participating organizations require clearly defined procedures of when, where, and how to coordinate their activities. To this end BWDB has a number of Memoranda of Understanding (MoU) in place, which will be suitably updated for the purpose of the program during the first year of the program.

In line with government principles program activities are regularly reviewed and discussed through annual inter-ministerial steering committee meetings. Given the complexities of the program, a Panel of Experts is expected to provide guidance related to key questions:

(i) River morphology, engineering, and stabilization
(ii) Flood Risk Management at regional and community level
(iii) Institutional and capacity development at regional and community level

B. Integrated Program Management Office (PMO)

The PMO will be integrated into the administrative setup of BWDB and placed at a high level given the importance and relevance of the program. The key features are:

(i) Headed by an Additional Chief Engineer, similar in rank as the zonal Chief Engineers and supported by two Superintending Engineers
(ii) Initially identical and later closely associated with the CE River Management, once the post gets approved. This is a vital element to activate the new river management wing and to institutionalize the broad river stabilization approach.
(iii) Supported by an individual design office, exclusively dealing with river stabilization measures.
(iv) Conducting river management activities of larger national importance, such as procuring materials for works and strategic stockpiling for emergencies, and guiding char reclamation activities
(v) Implementing work through existing zonal division. These divisions already build embankments and riverbank protection, and will be strengthened in terms of staff during the implementation of the works.

Figure A3.1 depicts the program management principles agreed during discussion with the BWDB management, namely ADG and Chief Planning in early 2013.

C. Advisory Support

The program will be supported by consultants and NGOs at different level. This addresses the program management requirements of ADB and supports BWDB during the current period of staff shortage, specifically of junior staff. An Institutional Strengthening and Project Management Consultant (ISPMC) will provide the main support in a number of different areas. The advisory support scope of work includes the services of a specialist organization to conduct environmental assessment and planning. Additional details regarding the financing and potential scope of work of the advisory support are provided in Section 15 of the Final Report, Main Volume.

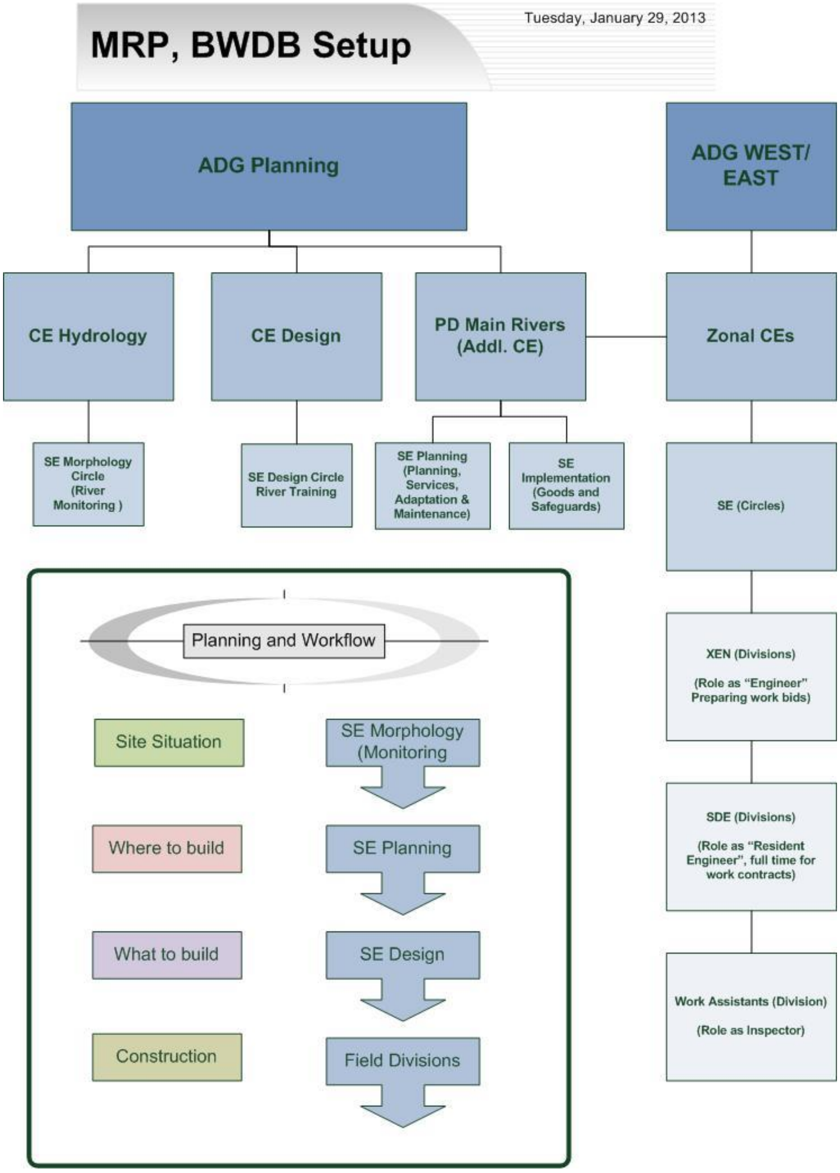
D. Management Information and Reporting

The program requires data management at different levels for different purposes:

(i) Baseline data for benefit assessment
(ii) Project management data for progress documentation
(iii) Asset information for BWDB operation, namely maintenance

A suitable MIS system for above three elements was outlined for AFRERMIP (Individual Consultants, 2012). Component (iii) has been developed further for the purpose of BWDB and forms part of the institutional report. The reporting requirements form also part of ADB's project implementation memorandum.

Figure A3.1 Organization chart for BWDB program management



Annex 7: Project Description, Jamuna Right Bank 1[44]

Project Name	ID	Upazilas (Unions)	Area	River Area	Population
Jamuna Right Bank 1	JRB1	3 (24)	582 km²	24 %	1,052,600

Bankline length	Average Erosion (1973-2010/2007-2012)	Flood extent (1998 / 2007)	Area Boro/Aman	Population Density (total/floodplain)
37 km	1.52 km / 0.13 km	69% / 56%	65% / 37%	1810/2370

A. Situation

The JRB-1 subreach extends from from Jamuna Bridge to Shahjadpur on the right bank of the Jamuna. The Jamuna Bridge guide bunds impose a straight channel downstream of the bridge for about 15 km along the left bank of the braided belt (Sarker et al. 2011). As a consequence, a stable attached char about 15 km long and 5 km wide has formed along the right bank, south of the western guide bund.

This straight channel bifurcates into a western and eastern branch at about Enayetpur. The eastern channel is presently dominant. While the location of this bifurcation appears to be quite stable, discharges vary in the two downstream channels. During the early 2000s, very little dry-season flow occurred along the right bank. Recently most dry season flow has occurred along this bank.

Historically, the western floodplain was protected by the Brahmaputra Right Embankment (BRE) as far as the Hurashagar/Baral River, which is upstream of the Pabna Integrated Rural Development Project (PIRDP). The last 10 km or so of the BRE, from Kaijuri to the Hurashagar/Baral outfall, part of the Hurashagar FCD Project embankment, eroded during the 1990s (Figure A7.1 and Figure A7.2). This erosion brought once-protected areas back to the natural cycle of flooding and erosion, accompanied by substantial deposition of sand along the riverbanks (sand casting). It rendered the Hurashagar FCD project completely inoperational (FAP 2).

Riverbank protection constructed in 2010 and 2011 from Kaijuri to Benotia stabilized the riverbank (Figure A7.3) and as such induced cluster settlements along the derelict BRE. It also stabilized the larger channel pattern and substantially reduced the dredging volume (Figure A7.4) required to maintain navigation access to the important Bagabari Port (see Annex D of January 2013 report).

B. Future Scenarios

During the 2012 dry season the Enayetpur area came under erosional attack. The existing riverbank protection (spur) in this area allowed the the Enayetpur spur to be eroded to the brink of collapse (Figure A7.5; note the absence of toe protection; Figure A7.6). Other infrastructure is at risk from

[44] Project descriptions were adapted from Final Report Annex A, 16 July 2013 version.

erosion at this location, notably the large Enayetpur hospital complex and the BRE which if breached will allow flooding of the adjacent area. The situation is comparable to that of PIRDP in the early 2000s, when the embankment was at risk of immediate erosion.

Future channel planforms downstream of the bifurcation at Enayetpur can consist of one or two channels. The initial morphological study for the lower Jamuna reach (Annex C, January Pre-Feasibility Report) indicates that the present two-channel system with one large char affords the most pragmatic future river stabilization approach.

C. Existing Works

BWDB has built two RCC spurs at Betil and Enayetpur, which were rehabilitated two times from ADB flood damage repair funds (after the 2004 and 2007 flood), but which are not stable for major river attack as experienced at this moment.

BWDB, under JMREMP, has built 10 km of riverbank protection from Kaijuri towards the Hurashagar River. Some of this work shows local geotechnical failure (slip circles) and is presently (dry season 2013) repaired at cost of 1.5 Crore.

Three LGED small scale projects are situated in this area.

D. Project Concept

This sub-project incorporates three BWDB priority projects: (i) riverbank protection along the right bank of the bifurcating channel from upstream of Enayetpur towards Kaijuri, (ii) riverbank protection upstream of the Hurasagar to close an existing gap, and (iii) reconstruction of the BRE and Hurashagar FCD embankment from Kaijuri to Shahjadpur

The Tranche 1 interventions are:

- Embankment reconstruction, of the BRE with road facilities for 12.5 km, and along the Hurashagar/Baral for 9.5 km
- 1 km of riverbank protection, from the existing protection downstream towards the Hurashagar/Baral
- Regulators for water management including rehabilitation of existing structures
- Immediate stabilization of the Enayetpur spur.

Tranche 1 will reinstate much of the flood protection afforded by the original BRE. Benefits will include reduction of overall flood levels, and in particular flood reductions in Hurashagar FCD (Figure A4.7 shows flood extent in 1987 when Hurashagar was still functioning vs in 1998 after the BRE breach had compromised it). The BRE reconstruction will complete the road connection along the Jamuna right bank, connecting the densely populated area along the bank with the Jamuna Bridge and with Shahjadpur via Kaijuri.

The Tranche 2 interventions are:

- Rehabilitation of the remaining 4 km of embankment from Bagabari to Shazadpur along the Kortoa River, and construction of a road from the Jamuna embankment to Bagabari and Shahjadpur
- About 11 km of priority riverbank protection from the upstream bifurcation towards Kaijuri to protect Enayetpur from erosion and flooding and to stabilize the off-take of the western Jamuna channel which is the main access to Bagabari Port.

- Potentially construction of the upstream riverbank protection will require excavation or dredging through some distance of low-lying charland. Excavated/dredged material created in this process can be used to fill in (create reclaimed land in) the bankline channel between Enayetpur and Betil.
- Existing riverbank protection may be adapted to greater river depth as needed.

The Tranche 2 benefits include:

- Rendering the Hurashagar FCD project fully operational with full flood benefits.
- Provising a road connection to Bagabari (via ferry) and Shahjadpur.
- Mitigation of Enayetpur area erosion risks, including the risk to Enayetpur hospital.

Optional work in this area, depending on morphological study, economic feasibility, and availability of funds, includes:

- Protection of char head for bifurcation stabilization (depending on morphological confirmation) so as to create an all-year-round navigable channel towards Jamuna Bridge.
- Future BRE construction over the attached char from Jamuna Bridge to Enayetpur. This has the potential to reclaim around 50 km² of land. Catkin plantation may be used to accelerate sedimentation and soil fertility.
- Construction of an additional 5 km of riverbank protection, and adaptation of the existing 10 km to the greater river depth expected for a more stable channel.

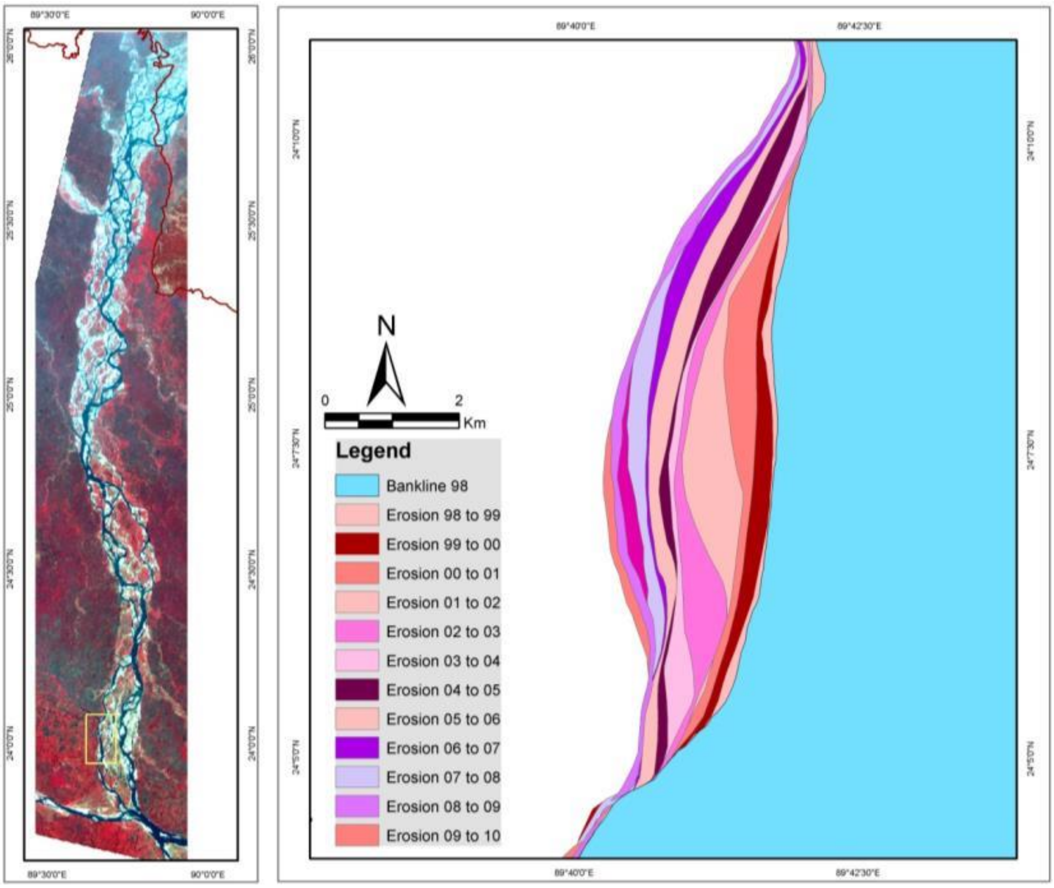
Intervention Elements	
List by type	***Description** (Location, dimensions or quantity)*
Infrastructure	**TRANCHE 1**
1.RBP	1 km at Benotia Adaptation and Enayetpur spur stabilization
2. EMB	23 km for reconstruction of BRE and Hurashagar FCD scheme
3. Other	4 new regulators with 11 vents in total (1*1 vent, 1*4 vent, 1*6 vent) and rehabilitation of 2 existing 4 vent regulators
Infrastructure	**TRANCHE 2**
1.RBP	11 km at Enayetpur for protection and stabilization of the bifurcation LS adaptation work to greater river depth
2. EMB	4 km along Kortoa river. 13 km of road construction from Jamuna to Shahzadpur.
3. Other	Buoys for navigation and fish protection along revetment work

Intended Benefits (+) and Potential Adverse Impacts (-)		
Type	***+ - ?***	***Description*** *(impacted location, activity or asset; timing, extent or magnitude)*

Intended Benefits (+) and Potential Adverse Impacts (-)		
Reduced flood damage	**+**	Whole area from (i) Rehabilitated embankments (BRE and Hurashagar FCD project) (ii) Securing BRE at the Enayetpur area
Reduced erosion	+	Whole bankline through stabilized river course
Navigation	+	More stable channel along protected bank with increased draught Dramatically reduced dredging cost
Land reclamation	+	Downstream part of Enayetpur char secured
Water Management	+	Improved conditions for HY aman and dry season irrigation after reconstruction of BRE
Communication	+	Improved access in case a dedicated national highway standar road is built along the embankment from Beira to Nagarbari and beyond
Land acquisition/loss	-	Associated with original BRE embankment – about 1 km^2 (20km*50m) floodplain land
Resettlement	-	To be confirmed
Fisheries	?	Geotextile bag revetments provide shelter, attached chars potential spawning ground, protection from floating nets Improved operation of regulators following GIZ biodiversity project (at Pabna)

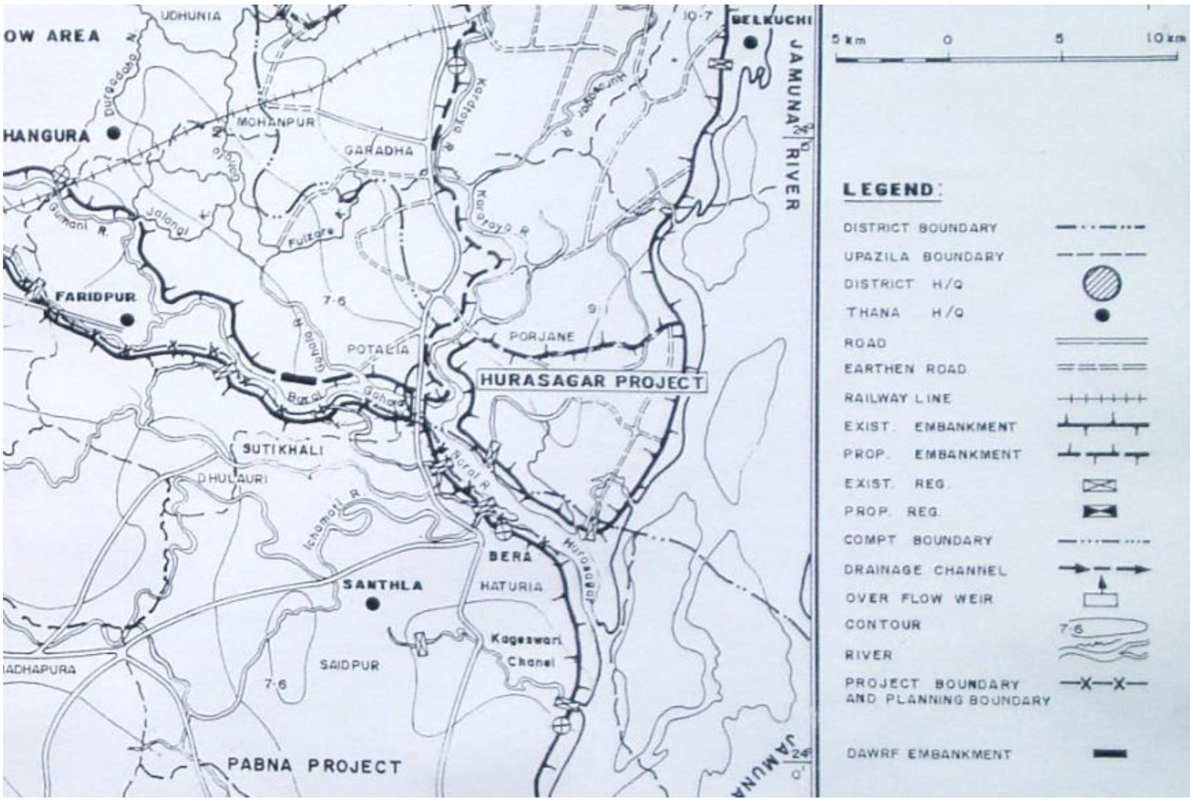
Supporting Studies	
Surveys	River surveys by BWDB and the PPTA team Flood plain surveys along the Hurashagar and Kaijuri to Shariatpur
Char-land Study	Investigation of deposition rates of the char opposite of the Hurashagar/Baral outfall and upstream between Enayetpur and Jamuna Bridge
River Modeling & Analytical Approach	1-D HEC RAS modeling of flow patterns to determine the minimum width of a single channel river solution
Flood Modeling	Scenario 1: restoration of Hurashagar FCD embankment from Kaijuri to Benatia along the Jamuna, Benotia to Bagabari along the Hurashagar/Baral, and Bagabari to Shahjadpur along the Karatoa River Scenario 2: loss of flood protection in the Enayetpur area due to erosion and breach of the embankment
EIA/SIA	Environmental baseline and impacts of above works
Resettlement	100% census and IOL, 20% SES for embankment and 2 km of riverbank protection

Figure A7.1: Jamuna Right Bank 1 – Bankline 1998-2010



Source: CEGIS. 2007. JMREMP Morphology Study.

Figure A7.2: Jamuna Right Bank 1 Historic Area Map



Source: FAP 2 report.

Figure A7.3: Jamuna Right Bank 1 - Channel Variability, 2007-9 vs. 2010-12

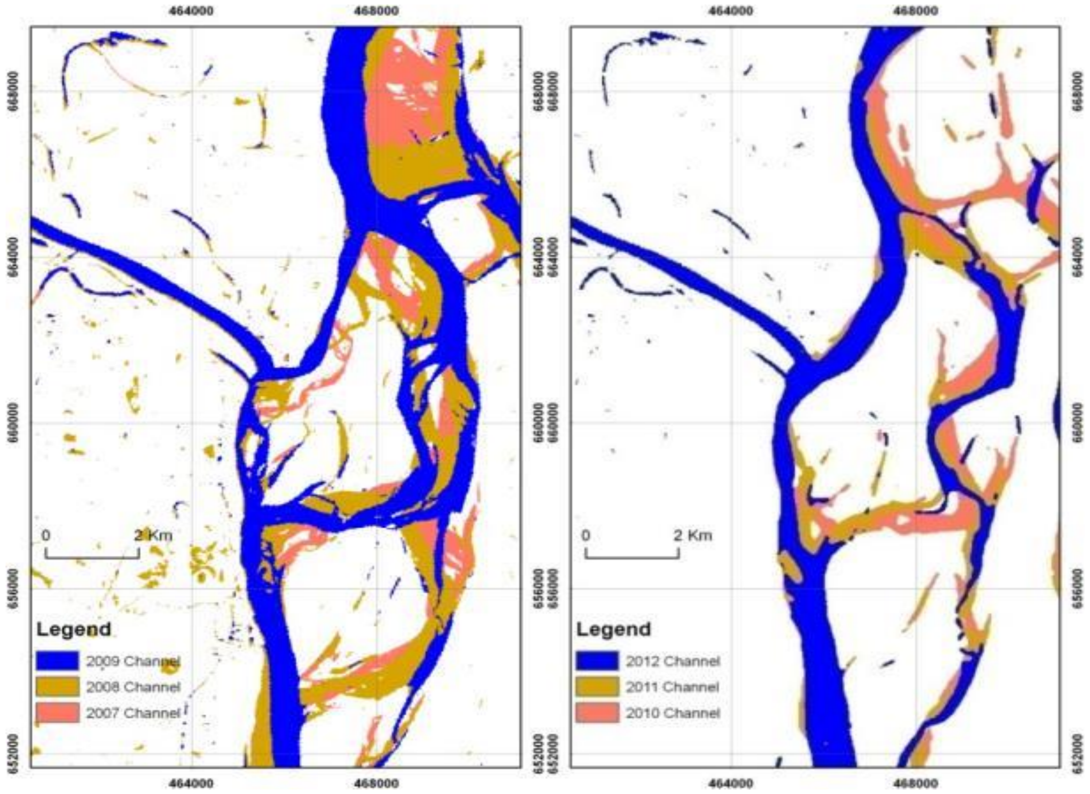


Figure A7.4: Jamuna Right Bank 1 – Dredging Volume, 2007-9 vs. 2010-12

(m^3)

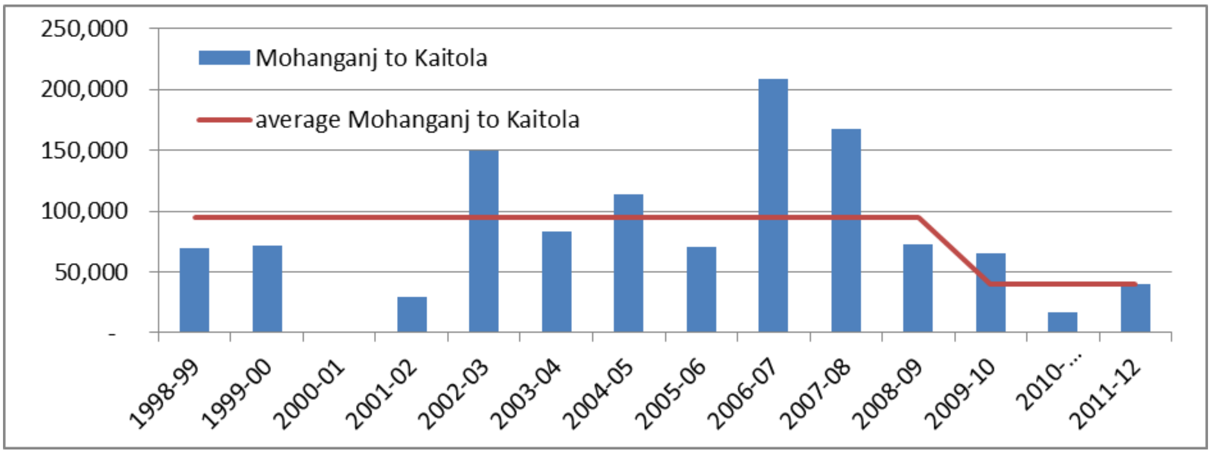
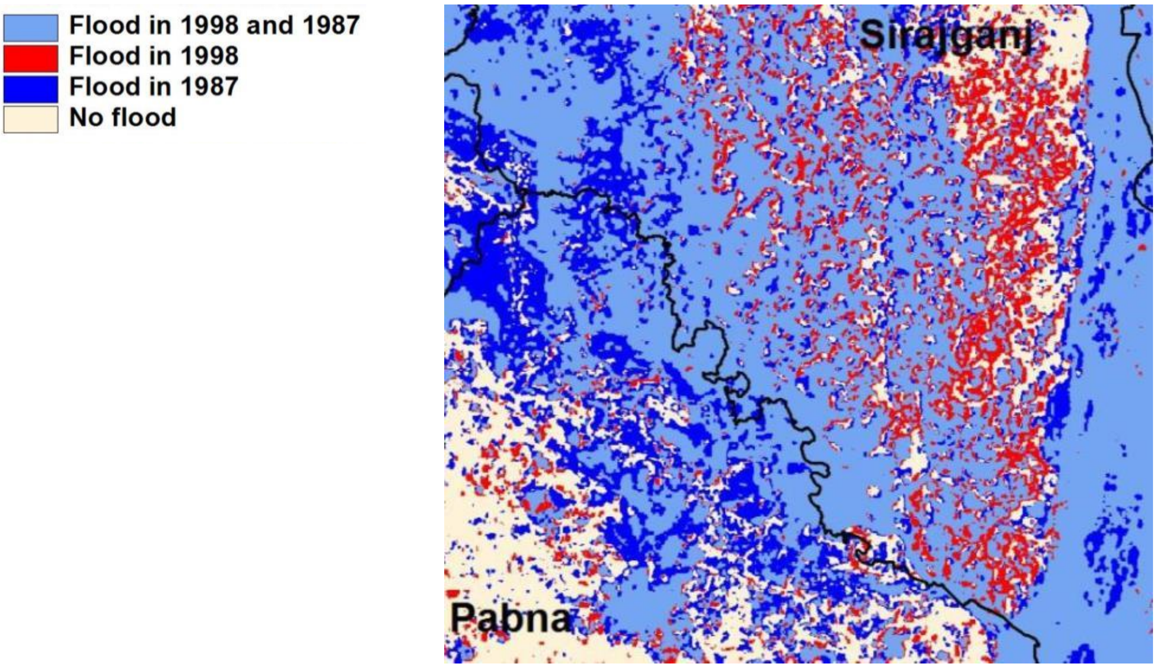


Figure A7.5: Enayetpur Spur Erosion Damage, Post-2012

Figure A7.6: Erosion Damage Upstream of Enayetpur, Post-2012

Figure A7.7: Hurushagar Flood Control Project Area – 1987 vs 1998 Flooding



Source: CEGIS.

Annex8: Project Description, Jamuna Left Bank 2

Jamuna Left Bank 2 – Aricha PRIORITY

Project Name	ID	Upazilas (Unions)	Area	River Area	Population
Jamuna Left Bank 2	JL2	6 (48)	1212 km²	31 %	1,104,800

Bankline length	Average Erosion (1973-2010/2007-2012)	Flood extent (1998 / 2007)	Area Boro/Aman	Population Density (total/floodplain)
56 km	2.59 km / 0.12 km	62% / 58%	32% / 44%	910/1340

Situation

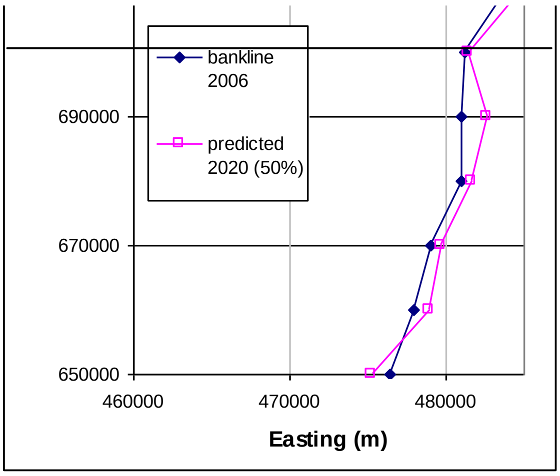
The east bank of the Jamuna is erosion prone since the construction of Jamuna Bridge (see JRB-1).

The presently dominant eastern Jamuna channel flows as meandering (dry-season) channel along the bank leaving a larger attached char of more than 10 km in length in the upstream part of the project, between Dhaleswari and Ghior Khal (old Dhaleswari) offtake. This eastern Jamuna channel erodes its riverbanks at Chauhali and Zafferganj since several years putting both growth centers at the risk of extinction. The upazilla Chauhali has lost most of its floodplain land and nowadays consists mostly of a river and char environment.

Apart from the main Dhaleswari river offtake, which consists of several offtake channels within an approximately 5 km bankline reachanother distributary exists notably the Ghior Khal near Daulatpur. Both are vital to provide water to the river system around Dhaka (see map in JLB-1)

The flood plain is lower and prone to excessive flooding during higher floods (see figure in JLB-1).

Future Scenarios



It can be expected that eastern and western Jamuna channel will be separated by a more stable char in future, however, it is not clear if either channel can break through the char to join the other channel.

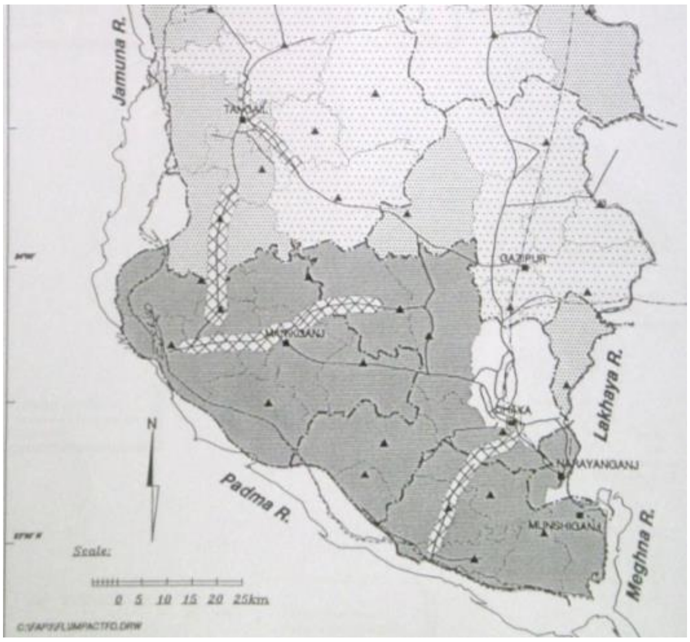
Both channels experienced alternating times of nearly no dry season flow with the eastern channel presently carrying the majority of the water. During the flood season, however the discharge appears to be much more evenly distributed. The dry season variability results from the changing bifurcation morphology upstream of the Dhaleswari and has implications on the dry season navigation.

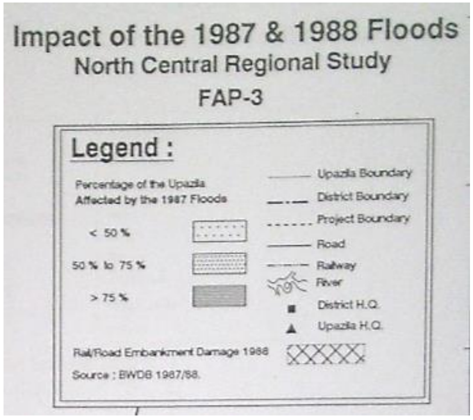
Given that little riverbank protection was built in this area, the future scenario without protective measures predicts quite substantial riverbank erosion the order of kilometers (see next figure from CEGIS, 2007).

Existing and Planned Works

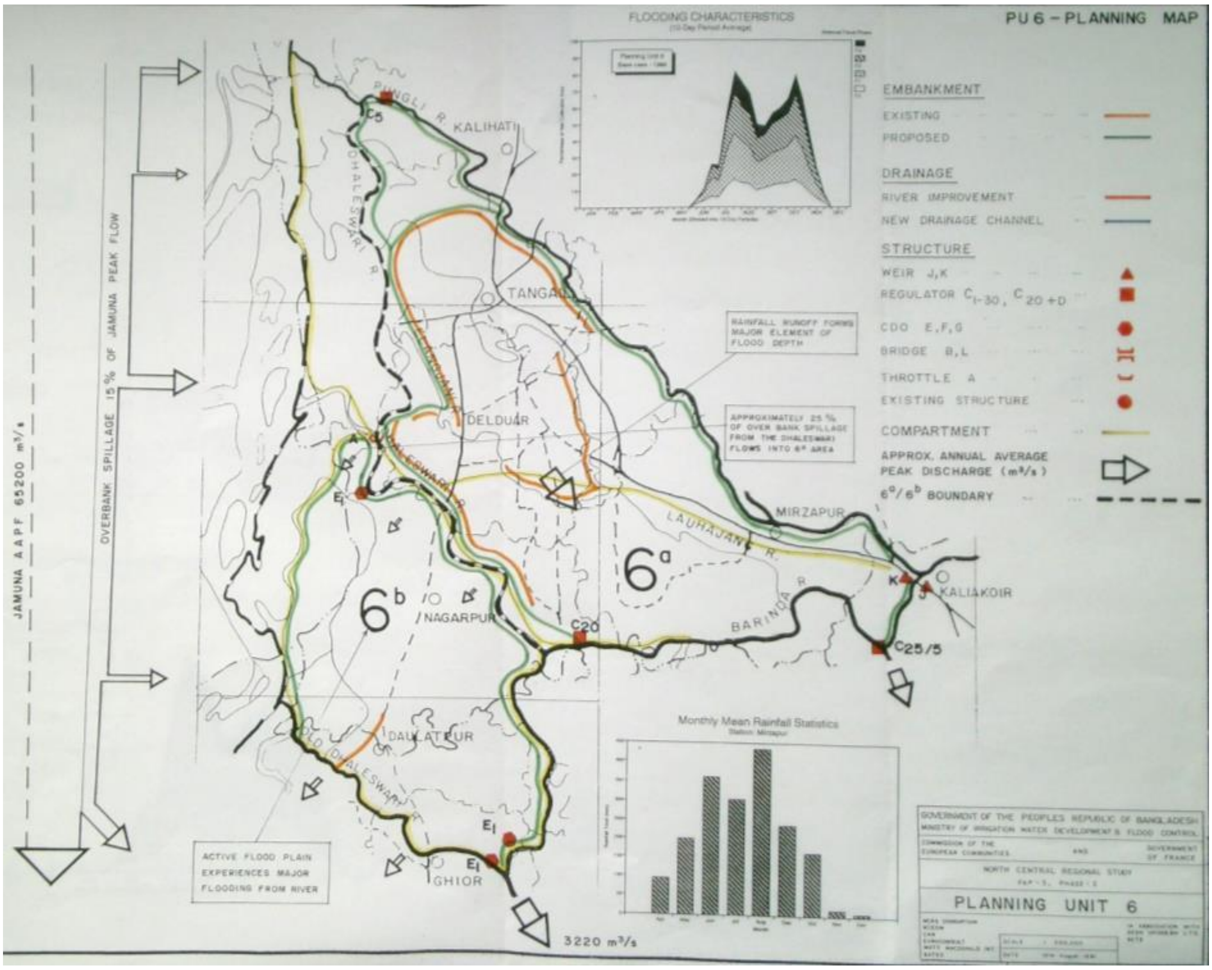
BWDB has provided 2 km of riverbank protection at Chauhali in 2011/12, which was largely destroyed during the 2012 flood.

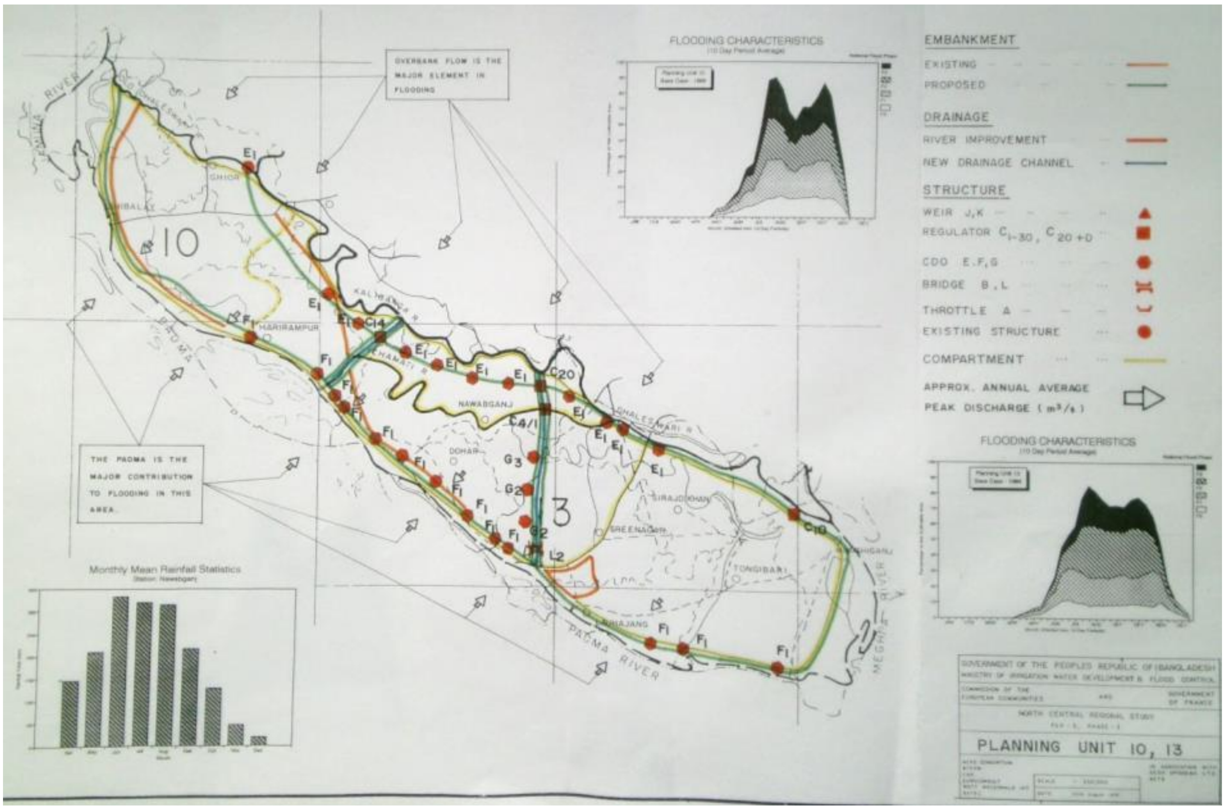
BWDB plans an about 35 km long embankment along the riverbank from the Dhaleswari (Nagarpur upazila) to Aricha for two FCD projects, namely the Nagarpur-Chauhali and the Jamuna-Padma left bank Project (shown in the following figures, from FAP-3 documents). These two projects go back to the FAP-3 planning in the early 1990s recognizing the vulnerability of the area to flooding and flood damages





figures from FAP-3 report





Three LGED small scale projects are situated in this area.

The areas at Chauhail and Zafferganj were identified by BWDB as priority areas for riverbank stabilization during the preparatory phase of this FRERMIP PPTA in 2011.

Project Concept

This subproject incorporates three BWDB priority projects: (i) riverbank protection along vulnerable reaches with a view to work towards river stabilization, (ii) strengthening of the existing 12 km long embankment from Aricha to Zionpur via Zaffarganj and extension to the Dhaleswari, (iii) provision of defined Dhaleswari and Ghior Khal offtake for dry and flood season flow including navigation. The central char is intended to be left unprotected to maintain natural river processes and to not disturb the established char societies. The project concept depends on further studies during Tranche 1.

Tranche 1

- Priority riverbank protection at Chauhali (about 5 km) and Zafferganj (about 2 km) to stabilize critically eroding reaches along the upazilla headquarters
- Pilot testing of guided, accelerated charland accretion of a suitable attached char through catkin plantation

Tranche 2

- Extension of existing riverbank protection in upstream and downstream direction
  Chauhali including Dhaleswari offtake (around 3km) with the purpose of stabilizing the attached char in that area
  Zafferganj area (2 km)
- Stabilization of attached char through guided, accelerated siltation (plantation of catkin as piloted in Bhuapur in the 1990s and other measures) with the purpose of reclaiming around 30km² of lost floodplain land
- Rehabilitation of 12 km of existing embankment

Tranche 3

- Extension of existing riverbank protection in upstream and downstream direction
  Chauhali including Dhaleswari offtake (around 5km) with the purpose of stabilizing the attached char in that area
  Zafferganj area (2 km)
- Optional offtake geometry of Dhaleswari likely distinguishing dry season and flood season offtake
- Offtake geometry at Ghior Khal
- Embankment rehabilitation and link embankment from Dhaleswari to Aricha (total length around 17km)
- Local placement of navigation buoys with combined navigation / fish protection purpose

Intervention Elements	
List by type	***Description** (Location, dimensions or quantity)*
Infrastructure	**TRANCHE 1**
1.RBP	Around 7 km initial left bank stabilization: 5km at and 2 km at Zaffarganj
2. Other	Pilot test of guided, accelerated charland siltation (catkin and supporting

Intervention Elements	
	measures)
Infrastructure	**TRANCHE 2**
1.RBP	Extension of existing protection Around 3 km at Chauhali, Around 2 km at Zaffarganj
2. EMB	Rehabilitation of 12 km of embankment from Aricha to Zionpur
3. Other	Guided accelerated siltation of charland Placement of buoys along the protected bank
Infrastructure	**TRANCHE 3**
1.RBP	Around 5 km at Chauhali, Around 2 km at Zaffarganj Adaptation and maintenance
2. EMB	offtake geometry for Dhaleswari offtake geometry for the Ghior Khal Around 23 km new embankment
3. Other	Regulators, Fish passes Placement of buoys along the protected bank

Intended Benefits (+) and Known Potential Adverse Impacts (-)		
Type	**+ - ?**	**Description** (impacted location, activity or asset; timing, extent or magnitude)
Reduced flood damage	**+**	Whole area
Reduced erosion	+	Whole bankline
Navigation	+	More stable channel along protected bank with increased draught
Land reclamation	+	30 km²
Water Management	+	Improved dry season flow in Dhaleswari for boro irrigation and cleaning the rivers around Dhaka
Communication	+	Improved access in case a dedicated national highway standard road is built along the embankment from Dhaleswari to Aricha and beyond
Land acquisition/loss	-	Associated with embankment – about 2 km² (40km*50m) floodplain land
Resettlement	-	To be confirmed

Fisheries	?	Geotextile bag revetments provide shelter, attached chars potential spawning ground, protection from floating nets Improved river fish diversity due to dry season flow in distributaries and protection from floating nets (buoys)

Supporting Studies	
Surveys	River surveys by BWDB and the PPTA team Flood plain surveys along the Hurashagar and Kaijuri to Shariatpur
Char-land Study	Investigation of deposition rates of the char opposite of the Hurashagar/Baral outfall and upstream between Enayetpur and Jamuna Bridge
River Flow Modeling & Analytical Approach	1-D HEC RAS modeling of flow patterns to determine the minimum width of a single channel river solution
Flood Modeling	Scenario 1: restoration of Hurashagar FCD embankment from Kaijuri to Benatia along the Jamuna, Benotia to Bagabari along the Hurashagar/Baral, and Bagabari to Shahjadpur along the Karatoa River Scenario 2: loss of flood protection in the Enayetpur area due to erosion and breach of the embankment
EIA/SIA	Environmental baseline and impacts of above works
Resettlement	100% census and IOL, 20% SES for embankment and 2 km of riverbank protection

Version change log (latest first)		
Change date	**Version created by change**	**Changes made + reasons for changes**
10 May 2013	5.0	Updated for final report - ko
1 March 2013	4.0	Expanded description – ko
3 Oct 2012	2.0	Full description entered – ko
25 Sep 2012	1.0	Initial version of project description – slb

Annex9: Project Description, Padma Left Bank 1

PadmaLeft Bank 1 –Paturia – Harirampur PRIORITY

Project Name	ID	Upazilas (Unions)	Area	River Area	Population
Padma Left Bank 1	PLB1	3 (35)	682 km²	22%	736,000

Bankline length	Average Erosion (1973-2009/2004-2009)	Flood extent (1998 / 2007)	Area Boro/Aman	Population Density (total/floodplain)
25 km	3.35 km / 0.03 km	62% / 46%	18% / 34%	1080/1400

Situation

The Padma starts as single channel after the confluence of Jamuna and Ganges. 10 km downstream of the confluence it bifurcates into two channels, carrying different percentages of its flow over time and enclosing an around 25 km long and up to 10 km wide char. Presently the southern channel is declining.

At the downstream boundary of this subproject reach, about 25 km downstream of the confluence, a more erosion resistant clay forms the northern (left) bank (marked in figure below). Upstream of this clay the Padma tends to erode substantial amounts of floodplains through outflanking channels, which periodically close (see following figure with bankline development). At this moment a historic, extreme meander loop is filled in and the river is flowing rather straight. The filled in area is around 30 km² (3000 ha) in size. The historic Dhaka Southwest Project embankment in this area is eroded and was not rebuild (also refer to JLB-2 maps from FAP 3). The char age map (1973-2009, Padma Bridge report) indicates that the anabranch between Harirampur and Faridpur is presently contracting in width with substantial areas along both banks recently silted in.

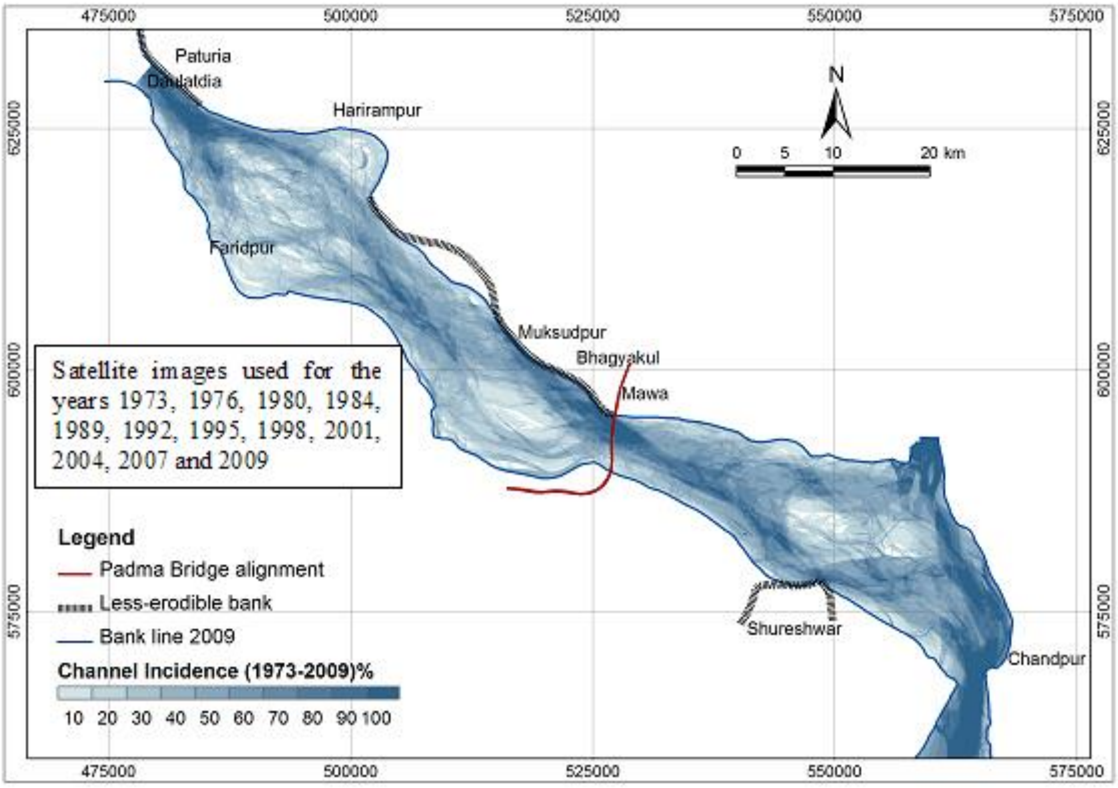
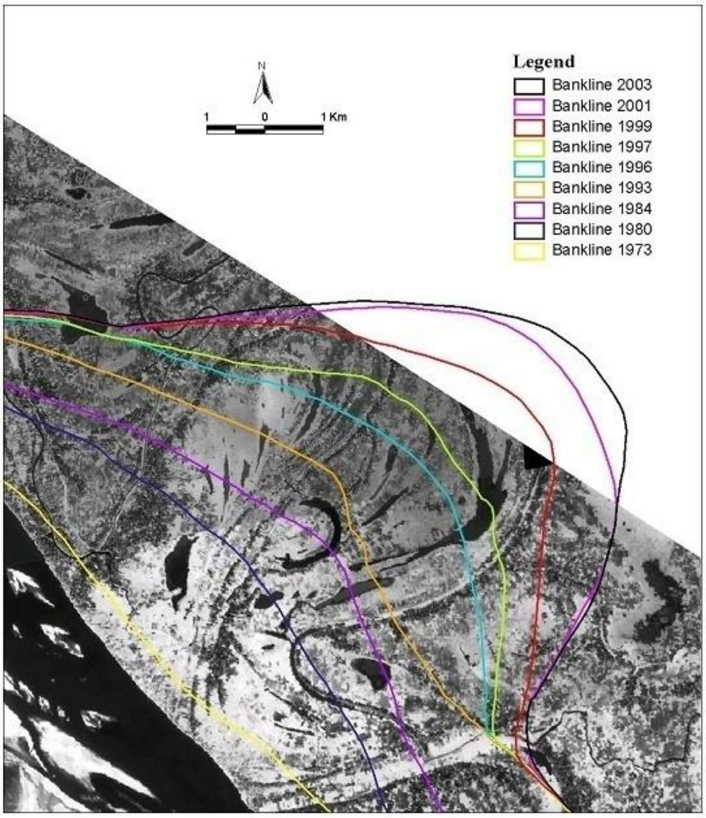
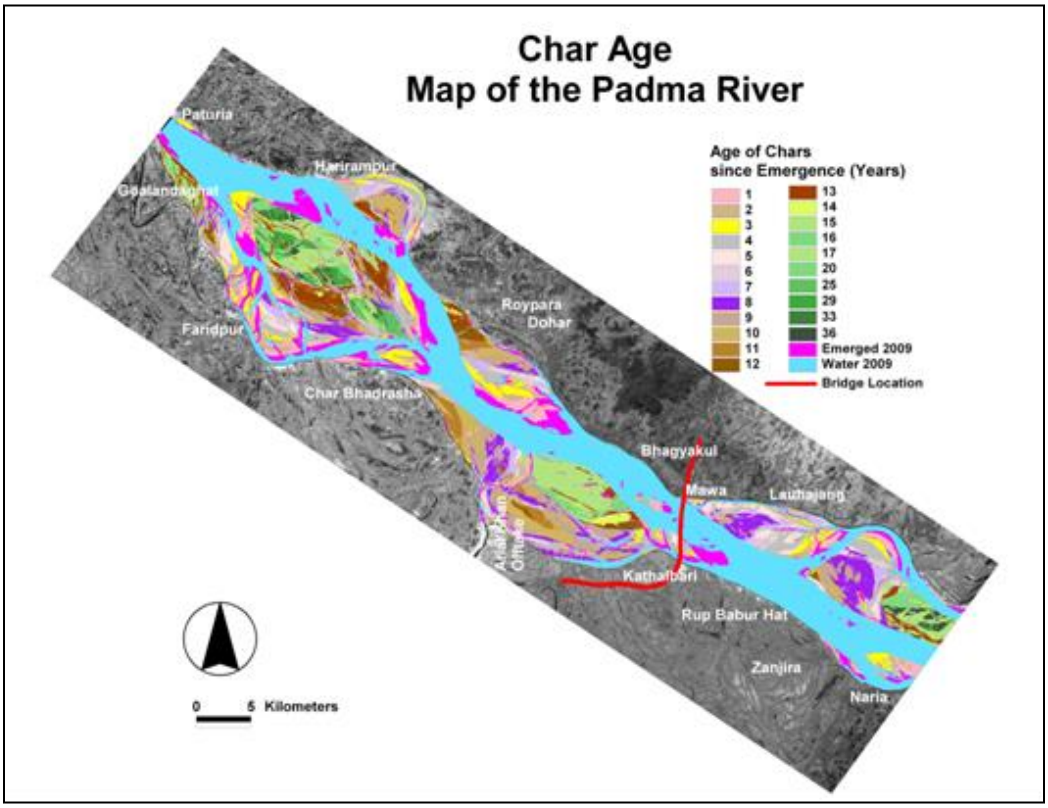


Figure from Padma Bridge design report



Erosion at Harirampur



Figures from Padma Bridge design report

Future Scenarios

Future channel planforms downstream of the bifurcation can consist of one or two channels. The initial morphological study for the upper Padma reach (Annex C, January 2013 PPTA report) indicates that the present two-channel system with one large char provides an overall acceptable solution and in terms of future river management (or stabilization) efforts the most pragmatic approach.

It is expected that the Padma exhibits the currently straighter alignment along the north bank near Harirampur and continues building the recently deposited land to greater height. The field trip in December confirmed that roughly the upstream half has reached substantial height, while the downstream part is still low lying.

BWDB pursues some plans of the Nagarpur-Chauhali and the Jamuna-Padma left bank Project in this area going back to the FAP 3 recommendations (also refer to JLB-2). This project basically addresses the flooding issue in this area, providing drainage facilities and improved irrigation opportunities in addition.

Existing Works

The Paturia ferry ghat is located at the upstream end of this subreach. For dry season ferry operation a navigation channel is dredged regularly.

Two LGED small scale projects are situated in this area.

Project Concept
This area incorporates two BWDB priority projects: (i) riverbank protection along the left bank upstream of Harirampur to protect the large meander bend from forming again, and (ii) reconstruction of the Dhaka Southwest Project embankment from Paturia to Harirampur. The PPTA recognizes the opportunity of reclaiming around 3000 ha of lost flood plain land due to the present favorable morphological situation. Tranche 1 • 7 km of riverbank protection at Harirampur covering the upstream of the old meander erosion, only geobag part • Pilot plantation of catkin for accelerated char growth Tranche 2 • 7 km of riverbank protection at Harirampur covering the upstream of the old meander erosion, only wave protection part • Reconstruction of the embankment from Paturia towards Mawa • Sluice gates for water management (including rehabilitation of existing sluice gates) Tranche 3 • About 5 km of riverbank protection in continuation of tranche 1 works • Sluice gates for water management (including rehabilitation of existing sluice gates)

Intervention Elements	
List by type	***Description** (Location, dimensions or quantity)*
Infrastructure	**TRANCHE - 1**
1.RBP	Around 7 km with temporary wave protection
2. EMB	none
3. Other	Pilot plantation of catkin and monitoring of vertical char growth (up to floodplain level)
1.	Buoys for navigation and fish protection along revetment work
Infrastructure	**TRANCHE –2**
1.RBP	Around 7 km of permanent wave protection
2. EMB	Around 17 km of rehabilitation with 8 km new embankment
3. Other	Plantation of catkin for vertical char growth (up to floodplain level)
Infrastructure	**TRANCHE – 3**
1.RBP	Around 5 km of riverbank protection
2. EMB	None
3. Other	Buoys for navigation and fish protection along revetment work

Intended Benefits (+) and Known Potential Adverse Impacts (-)		
Type	***+ - ?***	***Description*** *(impacted location, activity or asset; timing, extent or magnitude)*
Reduced flood damage	**+**	Whole area
Reduced erosion	+	Whole bankline
Navigation	+	More stable channel along protected bank with increased draught
Land reclamation	+	Potential flood protected area around30km²
Water Management	+	Improved conditions for dry season irrigation after reconstruction of embankment
Communication	+	Improved access in case a dedicated national highway standard road is built along the embankment from Aricha to Dohar and beyond
Land acquisition/loss	-	Associated with embankment strengthening– about 1 km² (20km*50m – assumption that existing land can be used)
Resettlement	-	To be confirmed
Fisheries	?	Geotextile bag revetments provide shelter, attached chars potential spawning ground Improved river fish diversity due to protection from floating nets (buoys)

Version change log *(latest first)*		
Change date	***Version created by change***	***Changes made + reasons for changes***
30 May 2013	5.0	Updated for final report - ko
1 Mar 2013	4.0	Expanded description – ko
6 Feb2013	3.0	Finalization with more detailed work layouts – ko
25 Sep 2012	1.0	Initial version of project description – slb

Annex 10: Selection of Subreaches

A. Multi-Criteria Assessment (MCA) of Tranche 1 Interventions

1. Approach and Key Criteria

MCA is an appropriate approach when comparing quantitative and qualitative data that are otherwise incomparable. This is especially true for prefeasibility level assessment, when not all data are quantified or quantifiable.

In this PPTA, an MCA is used to select the sub-reaches to be brought forward for feasibility assessment and potential inclusion in Tranche 1. The MCA is the first step to identify three suitable sub-reaches, to which, in a second step, a simplified economic feasibility analysis will be applied for confirmation of their suitability. The purpose is to arrive at two or three sub-reaches to be covered by Tranche 1 subprojects.

We have identified issues and criteria in two categories, means-ends and impacts (Table 0-1). Issues in the means-ends group are vulnerability and planning-engineering aspects, and relate to the identification of priority sites suitable for MRP interventions. Issues in the impact group are safeguards and cost-benefit, and relate to acceptability of the potential impacts of the interventions. Criteria were then identified for each issue, nine criteria in total, each of which can have up to three sub-criteria. In addition, we assess if the identified priority interventions conflict with other planned major interventions. An example would be the Padma Bridge construction, which impacts on two sub-reaches directly and has the potential to affect four sub-reaches downstream.

Each of the following subsections systematically describes each criterion. In order to be transparent, we follow the same structure throughout. Starting with a short justification of the criterion we provide details about how we classify the criterion and how we arrived at the values used for the classification. The latter is important as we are using primary, qualitative data, and quantitative data, based on a more general assessment of an overall situation. Finally, we conclude with detailed tables explaining each sub-criterion. When there are measured data, this contains ranking and definition of limits, while for qualtitative assessment detailed descriptions of the considerations leading to the ranking are provided for each sub-reach.

Table 0-1: Grouping of criteria

Broad Category	Main Issues	Criterion
Means and ends	Vulnerability	Riverbank erosion Flooding Social fabric
	Planning and engineering	Ease of engineering interventions Complements existing work/schemes Is consistent with predicted/expected future planform ("no regret")
Impacts	Safeguards	Social and environmental
	Cost and benefits	Cost deviation from average low-cost work Expected benefits for different sectors

1. Criteria

a) River bank erosion

JUSTIFICATION:

Riverbank erosion along the main rivers has resulted in substantial land losses in Bangladesh and impacts on the development of the floodplains bordering the main rivers.

DETAILS FOR EACH SUB-CRITERION:

Historic Riverbank Erosion

This sub-criterion is based on primary data. Riverbank erosion is expressed as erosion per km of bankline. It is the result of the total loss of land in one sub-reach divided by the length of riverbank in this sub-reach. The reference lines are the 1973 and the 2010 bankline.

Recent Riverbank Erosion

This sub-criterion follows the same process as for historic riverbank erosion, only for the period 2007 to 2012.

Future Riverbank Erosion

This sub-criterion cannot be based on primary data. Given the uncertainties the most likely scenario for the future around 10 - 15 years has been developed. The timeframe of 10 – 15 years is relevant as the PPTA prepares an MFF with around 10 years implementation period. Consequently, future developments are highly relevant for any interventions that target the reduction of river instability and maximization of reclamation of land lost during the erosion process of the last 30 years. The criteria selected were expected substantial erosion, coded "1", no substantial erosion or accretion, coded "0", and likely accretion, coded "-1".

DETAILED TABLES:

CATEGORY	SUB-CATEGORY	Unit	JRB1	JRB2	JLB1	JLB2	PLB1	PLB2	PLB3	PRB1	PRB2	PRB3	MRB1	MLB1	MLB2
Area		sq km	580.4	914.6	787.5	1,211.8	681.7	789.5	440.9	876.3	1,055.2	801.4	435.1	277.5	440.5
floodplain		ha	44,416.0	72,178.0	71,812.0	82,520.0	52,491.0	69,239.0	29,738.0	74,638.0	75,454.0	55,890.0	33,099.0	20,026.0	27,981.0
bank length		km	36.7	66.0	21.2	56.3	24.8	30.4	47.6	55.4	50.3	46.5	34.1	21.4	24.4
erosion	total (1973-2010)	ha	5,561.4	2,053.5	5,224.2	14,579.7	8,312.9	2,048.0	6,042.9	7,673.6	9,125.9	8,356.6	6,313.4	2,022.0	1,096.1
	recent (2007-2012)	ha	478.7	427.4	125.3	694.4	70.8	182.2	390.2	1,027.2	597.2	857.5	875.1	115.6	256.2

ABSOLUTE FIGURES

CATEGORY	SUB-CATEGORY	Unit	JRB1	JRB2	JLB1	JLB2	PLB1	PLB2	PLB3	PRB1	PRB2	PRB3	MRB1	MLB1	MLB2
erosion	total (1973-2010)	km/km	1.52	0.31	2.46	2.59	3.35	0.67	1.27	1.39	1.81	1.80	1.85	0.94	0.45
	recent (2007-2012)	km/km	0.13	0.06	0.06	0.12	0.03	0.06	0.08	0.19	0.12	0.18	0.26	0.05	0.11
	future (2012-2020)	+ / -	0	0	1	1	1	-1	1	1	1	1	1	0	0

RANK

erosion	total (1973-2010)		7	13	3	2	1	11	9	8	5	6	4	10	12
	recent (2007-2012)		4	9	11	5	13	10	8	2	6	3	1	12	7
	future (2012-2020)		9	9	1	1	1	13	1	1	1	1	1	9	9

a) Flooding

JUSTIFICATION:

Flooding is a major development impediment as it causes sporadic, unpredictable but substantial damages affecting the life on the floodplains in multiple negative ways.

DETAILS FOR EACH SUB-CRITERION:

Average Flood

This sub-criterion is based on primary data. The analysis of Radarsat flood season images allows the determination of areas in each sub-reach flooded during a flood with a 2-year return period, or an average flood. As such this sub-criterion reflects on the amount of land potentially taken from agriculture during normal flood years.

Mean Flood

Same as before this criterion is based on primary data, however for a higher return period. The range chosen lies between return periods of 5 to 15 years. This represents roughly the boundary between good flood and bad flood and could be considered to be the amount of flooded land that is accepted as an off-set of the beneficial fertilization of fields.

High Flood

Following along the same lines, as the other two sub-criteria, this flood represents areas flooded during some of the highest floods observed in Bangladesh during the recent past, namely 1998, 2004, and 2007. These were damaging floods and flooding to this extent is unwelcome.

DETAILED TABLES:

CATEGORY	SUB-CATEGORY	Unit	JRB1	JRB2	JLB1	JLB2	PLB1	PLB2	PLB3	PRB1	PRB2	PRB3	MRB1	MLB1	MLB2
Area		sq km	580.39	914.56	787.5	1211.82	681.68	789.46	440.87	876.27	1055.15	801.43	435.14	277.53	440.48
floodplain		ha	44,416	72,178	71,812	82,520	52,491	69,239	29,738	74,638	75,454	55,890	33,099	20,026	27,981
Total Area without River		ha	44,417	72,179	71,813	82,561	52,492	69,242	29,740	74,640	75,456	55,891	33,100	20,026	27,983
Flooded Area 1998		ha	31,946	33,138	45,807	60,399	32,617	42,054	8,860	25,829	38,738	31,054	21,683	7,396	6,522
approximate return period		year	20	40	20	40	40	40	40	40	40	40	40	40	40
1998		%	72%	46%	64%	73%	62%	61%	30%	35%	51%	56%	66%	37%	23%
Flooded Area 2000		ha	19,982	15,383	17,098	28,194	19,041	27,692	3,990	4,339	10,010	12,904	6,038	1,699	4,795
approximate return period		year	3	3	3	3	3	3	3	3	3	3	3	3	3
2000		%	45%	21%	24%	34%	36%	40%	13%	6%	13%	23%	18%	8%	17%
Flooded Area 2001		ha	20,175	10,583	1,627	1,652	1,692	8,682	1,533	1,692	4,028	2,653	523	732	2,349
approximate return period		year	2	2	2	2	2	2	2	2	2	2	2	2	2
2001		%	45%	15%	2%	2%	3%	13%	5%	2%	5%	5%	2%	4%	8%
Flooded Area 2002		ha	21,816	17,238	20,657	36,710	16,279	21,348	2,136	8,012	14,923	12,387	3,243	1,410	3,304
approximate return period		year	6	10	6	10	10	5	5	10	5	5	5	5	5
2002floode		%	49%	24%	29%	44%	31%	31%	7%	11%	20%	22%	10%	7%	12%
Flooded Area 2003		ha	21,065	16,125	9,969	27,250	12,202	20,229	2,080	7,189	9,313	13,215	2,564	1,627	2,579
approximate return period		year	7	6	7	6	6	6	6	6	6	6	5	5	5
2004		%	47%	22%	14%	33%	23%	29%	7%	10%	12%	24%	8%	8%	9%
Flooded Area 2004		ha	26,020	15,137	30,880	48,384	23,764	30,750	5,328	9,127	21,929	18,904	7,097	3,096	4,942
approximate return period		year	25	15	25	15	15	15	15	15	15	15	15	15	15
2004		%	59%	21%	43%	59%	45%	44%	18%	12%	29%	34%	21%	15%	18%
Flooded Area 2007		ha	24,652	23,761	29,579	48,145	23,926	30,370	3,650	11,642	22,688	20,487	5,110	1,326	4,759
approximate return period		year	30	30	30	30	30	30	30	30	30	30	30	30	30
2007		%	56%	33%	41%	58%	46%	44%	12%	16%	30%	37%	15%	7%	17%
average 2 year event			45%	18%	13%	18%	20%	26%	9%	4%	9%	14%	10%	6%	13%
moderate (5-15year)			48%	23%	21%	39%	27%	30%	9%	10%	16%	23%	10%	8%	11%
severe (>15yr)			62%	33%	49%	63%	51%	50%	20%	21%	37%	42%	34%	20%	19%
RANK															
flooding	% flooded 2-yr event		1	5	7	4	3	2	11	13	10	6	9	12	8
	% flooded 5-15-yr event		1	5	7	2	4	3	12	10	8	6	11	13	9
	% flooded >15-yr event		2	9	5	1	3	4	11	10	7	6	8	12	13

a) Social Fabric

JUSTIFICATION:

ADB's overarching goal is to fight poverty and consequently poverty incidence is an important criterion for any interventions. In addition, the envisaged MFF comes with some focus on the primary sector, not at last as agriculture provides the expected main benefits while employing still the majority of the Bangladeshi population.

DETAILS FOR EACH SUB-CRITERION:

Poverty Level

The poverty level is based on primary data from the earlier quoted (Chapter 3) BBS census. We are using the upper limit for the lower poverty line based on the cost of basic needs (upper poverty line). This reflects how many people are poor. The group of hard-core poor is included in this figure and a subset.

Dependency on the Primary Sector

The analysis is based on primary data from 2010 Household Income and Expenditure Survey (HIES). The reference unit is a dwelling unit. The primary sector dependency is expressed in three categories: agriculture/forestry/livestock, agricultural labor, fishery. The total number is expressed as percentage of the total number of dwelling units.

DETAILED TABLES:

CATEGORY	SUB-CATEGORY	Unit	JRB1	JRB2	JLB1	JLB2	PLB1	PLB2	PLB3	PRB1	PRB2	PRB3	MRB1	MLB1	MLB2
UPoverty		%	49% - 60%	49% - 60%	37% - 48%	37% - 48%	37% - 48%	37% - 48%	21% - 36%	37% - 48%	37% - 48%	21% - 36%	21% - 36%	21% - 36%	21% - 36%
Lpoverty		%	11% - 22%	23% - 32%	23% - 32%	23% - 32%	23% - 32%	23% - 32%	11% - 22%	23% - 32%	23% - 32%	11% - 22%	% or great	11% - 22%	11% - 22%
Total Dwelling Unit		no	177,316	159,245	209,784	218,324	144,721	183,163	132,133	153,375	180,137	146,039	140,190	57,543	124,381
Dwelling Unit of Agriculture/ Forestry/Livestock		no	35,319	55,643	53,760	81,967	40,967	31,471	23,393	51,558	54,475	48,051	51,060	15,089	15,411
Dwelling Unit of Agri labour		no	28,129	32,333	32,864	47,092	29,811	25,803	23,807	35,693	35,587	38,824	42,176	12,178	26,570
Dwelling Unit of FISHERY		no	1,783	2,645	3,064	3,804	3,123	3,712	2,340	2,172	2,117	1,997	3,506	1,741	5,487
U Poverty Level		%	60%	60%	48%	48%	48%	48%	36%	48%	48%	36%	36%	36%	36%
Dependency on Primary Sector (% total dwelling		%	37%	57%	43%	61%	51%	33%	37%	58%	51%	61%	69%	50%	38%
RANK															
poverty level			1	1	3	3	3	3	9	3	3	9	9	9	9
primary sector			12	5	9	2	7	13	11	4	6	3	1	8	10
CLASSIFICATION (POINTAGE)															
lower	upper boundary														
0.45	0.58		3	3	2	2	2	2	1	2	2	1	1	1	1
0.4	0.6		1	2	2	3	2	1	1	2	2	3	3	2	1

a) Ease of engineering

JUSTIFICATION:

Initial interventions need to be based on simple, straight forward engineering interventions for a number of reasons. Firstly, riverbank protection design can follow existing guidelines, while embankment design can be based on present best-practice, such as established in the International Levee Handbook (ILH, 2012). Secondly, easy implementation supports the quick initial success of a future program. Thirdly, initial implementation of riverbank protection does work during an emerging final planform and it is easier to accept some future adjustments to recently build low-cost work. Fourthly, the limited resources and time scale of a PPTA do not allow complicated design processes depending on costly, long supporting studies.

DETAILS FOR EACH SUB-CRITERION:

Riverbank Protection

Work in a sub-reach, contributing to large scale stabilization shall not depend on complicated engineering work. While long guiding geotextile bag revetments form the standard, offtake structures for distributaries are out of the ordinary. As example, the design for the Gorai offtake took multiple years and substantial resources. The ordinary construction receives one point, while out of the ordinary structures receive zero points.

Embankments

The standard is an embankment incorporating a road on the land side and a berm for temporary settlement towards the river. In addition, simple sluice gates for local drainage are considered. Complicated embankments would incorporate a number of offtakes or a large number of openings to let flow pass for example along the right bank of the Padma towards the coastal area. Points are awarded as above.

Other Difficult Structures

Difficult structures relate mostly to the offtake regulators which requires specific structural designs. The work associated with a specific intake geometry is considered under riverbank protection. No additional structures are awarded one point, whereas additional difficult structures do not get any points.

DETAILED TABLES:

	riverbank protection	embankment	other difficult structure	riverbank protection	embankment	other difficult structure
JRB1	y	y	y	normal conditions	Kaijuri to Bagabari, potential u/s char	regulator / fish pass
JRB2	n	n	y	confluence issues	reclamation at confluence on loose char soils	potential additional regulator / fish pass
JLB1	n	n	y	number of distributary offtake geometries	number of offtake geometries	offtake old Dhaleswari and Dhaleswari
JLB2	y	y	y	largely normal conditions	largely normal floodplain	offtake old Ichamutti
PLB1	y	y	n	normal conditions	normal conditions	no
PLB2	n	y	n	erosion resistant area, deep	existing road, higher - check	no
PLB3	n	y	n	stabilization of confluence	normal conditions	no
PRB1	n	y	n	Ganges barrage and confluence	normal conditions	no
PRB2	n	n	y	additional measures along long reclaimed bank,	around Faridpur, rest open for overland flow to south,	Arial Khan offtake
PRB3	n	n	y	response to Padma Bridge RTW with higher v	open for overland flow to south,	regulator / fish pass
MRB1	n	y	y	stabilization of confluence	open for overland flow to south,	regulator / fish pass
MLB1	y	y	y	conducive existing conditions	normal conditions	existing embankment
MLB2	n	y	y	Chandpur protection	normal conditions	regulator / fish pass

a) Complements existing work

JUSTIFICATION:
Completion of existing work means less efforts and higher potential rewards. This is the more true in economic terms, as existing work is treated as sunken cost, which do not reduce the economic feasibility.

Details for each Sub-criterion:

Riverbank Protection
Riverbank Protection of several kilometers in length is considered existing work. This could, for example, provide the backbone for reconstruction of embankments. In case there is existing work, one point is awarded, otherwise none.

Embankments

Existing embankments provide potentially higher benefits at lower cost, if riverbank protection should be required. Consequently, existing embankments are awarded one point, while the non-existence of embankments receives none.

DETAILED TABLES:

	riverbank protection	embankment	riverbank protection	embankment
JRB1	y	y	existing work at Kaijuri, 10 km	existing BRE
JRB2	y	y	existing work at Kaitola, 7 km	PIRDP ring embankment is complete
JLB1	n	n	no work, offtakes uncertain due to fund shortage	no embankment
JLB2	n	n	marginal work at Chauhali	no major embankment
PLB1	n	y	no work	Dhaka SW embankment
PLB2	y	y	natural protection	some existing road close to bankline
PLB3	n	n	marginal work at Munshiganj	no embankment
PRB1	y	n	existing work at Rajbari	no embankment
PRB2	n	n	existing work at Faridpur useless if land reclaimed	no embankment
PRB3	y	n	Padma Bridge 12 km revetment	no embankment
MRB1	n	n	no work	no embankment
MLB1	y	y	existing work at Eklashpur, 4.5 km	MDIP ring embankment complete
MLB2	y	n	existing work at Chandpur, about 1.5 km	no embankment

a) "No regret"

JUSTIFICATION:
Any work that does not match with a future planform results in a potential waste of funds.

DETAILS FOR EACH SUB-CRITERION:
The only sub criterion is the assessment if there is a potential wastage as work built during the next decade (under an MFF program) could risk not match with the future desired planform.

DETAILED TABLES:

	no regret	no regret
JRB1	y	existing straight channel and bifurcation to be maintained
JRB2	y	existing western bankline channel for navigation
JLB1	y	existing straight channel and bifurcation to be maintained
JLB2	y	existing eastern bankline channel dominant
PLB1	y	reclamation of land due to favourable planform
PLB2	n	potential char development alongside Mawa left bank
PLB3	n	downstream consequence of Padma Bridge uncertain
PRB1	n	unclear due to confluence
PRB2	n	river planform not yet developed for reclamation
PRB3	n	downstream consequence of Padma Bridge uncertain
MRB1	n	not clear with confluence
MLB1	y	bankline stable
MLB2	n	not clear with confluence

a) Safeguards

JUSTIFICATION:

Safeguards play an important role in the densely populated and highly exploited deltaic environment. Any major implications could stop interventions as planned. On a somewhat lower level, complicated interventions could require more time than available for PPTA preparation and as such also need to be avoided during the initial PPTA.

DETAILS FOR EACH SUB-CRITERION:

Land Acquisition and Resettlement

Land acquisition and resettlement in Bangladesh is complex due to the fractured small landholdings often with unclear land titles. This problem is unavoidable and required to be addressed for any construction work. We consider three levels of complexity, also depending on the extent of the work: low, medium, high, with points in descending order from 3 to 1. Normal resettlement involves a 50 m wide strip along the bankline and a 50 m wide strip for embankment construction. If the embankment length is limited to less than 20 km and runs through less populated areas, and if there is only limited riverbank protection the impact is low. Medium impact relates to longer embankments and/or riverbank protection. High impact relates to areas that require embankment works and riverbank protection, both of substantial length.

Environment

There are no environmental sensitive areas in the areas under consideration. Consequently, environmental aspects focus also on potential effects beyond the boundaries. This is especially true for the southern sub-reaches, with contribute substantial fresh water to the coastal area and as such restrict salinity intrusion.

DETAILED TABLES:

	land acquisition and resettlement	environment	land acquisition and resettlement	environment
JRB1	m	m	embankment and limited riverbank protection	existing embankment, char implications
JRB2	l	l	no embankment work, only limited riverbank protection	low impacts due to largely existing work
JLB1	h	h	both required	distributary effects
JLB2	h	m	both required	normal impacts
PLB1	m	m	full embankment but limited riverbank proteciton	normal impacts
PLB2	l	l	limited embankment work, no revetment	limited impacts as no riverbank protection
PLB3	h	m	both required	normal impacts
PRB1	h	m	both required	normal impacts
PRB2	h	h	both required	flow to south impacted
PRB3	h	h	both required	flow to south impacted
MRB1	h	h	both required	flow to south impacted
MLB1	l	l	existing work, minimal impacts	existing work, minimal impacts
MLB2	h	m	both required	normal impacts

a) Cost

JUSTIFICATION:

Individual tranches have only limited total budgets. This is required for not overloading the implementing agency but also from budgetary considerations of ADB’s pipeline.

DETAILS FOR EACH SUB-CRITERION:

Riverbank Protection

Addressing two or three sub-areas is potentially more beneficial for achieving the overall goal than putting all investment of one tranche into one area. For this reason high investment is less beneficial than lower investment. As such points are given for low, medium, and high investment in descending order, starting with three points for low.

Embankments

The same holds true for embankments.

DETAILED TABLES:

	riverbank protection	embankment	riverbank protection	embankment
JRB1	l	l	normal new revetment, 10 km already existing	normal new embankment, partly existing
JRB2	l	l	normal new revetment, 7 km already existing	existing embankment
JLB1	h	m	substantial offtake work	new embankment
JLB2	m	m	limited offtake work	new embankment
PLB1	m	m	normal new revetment	new embankment
PLB2	l	l	erosion resistant area	existing road can be converted to embankment
PLB3	h	m	higher requirement revet-ment d/s of Padma Bridge	new embankment
PRB1	m	m	normal new revetment	new embankment
PRB2	h	m	normal new revetment, but offtake of Arial Khan	new embankment
PRB3	h	h	higher requirement revet-ment d/s of Padma Bridge	new embankment with many openings
MRB1	h	h	deep confluence with high velocities and weak soils	new embankment with many openings
MLB1	l	l	existing work, no revetment	existing work, no embankment
MLB2	h	m	deep confluence with high velocities	new embankment

a) Benefits

JUSTIFICATION:

High benefits provide attractive investments.

Details for each Sub-criterion:

Directly

A main consideration is that work in already protected areas is less likely to achieve lower incremental benefits than work in previously unprotected areas. As such this sub-criterion filters the potential for new investment. Direct benefits largely focus on the primary sector. The classification is only yes or no gaining one point for yes and zero points for no.

Additional

Apart from primary sector benefits obvious additional benefits where visible were identified. Again points were given for yes and no.

DETAILED TABLES:

	directly	additional	directly	additional
JRB1	y	y	restoration of BRE	flow along west bank for navigation, reclamation of charland
JRB2	n	n	existing scheme	existing scheme
JLB1	n	y	higher area	dry season flow due to offtakes
JLB2	y	y	increased due to reduced flood losses and incremental agri increases	dry season flow due to offtakes, additional reclamation of charland
PLB1	y	y	increased due to reduced flood losses and incremental agri increases	reclamation of charland
PLB2	y	n	increased due to reduced flood losses and incremental agri increases	reclamation likely only after ten years
PLB3	y	n	increased due to reduced flood losses and incremental agri increases	none
PRB1	y	n	increased due to reduced flood losses and incremental agri increases	none
PRB2	y	n	improvement of Faridpur flood situation	none
PRB3	n	n	open floodplain, reduced benefits	none
MRB1	n	n	open floodplain, reduced benefits	none
MLB1	n	n	existing scheme	existing scheme
MLB2	y	n	increased due to reduced flood losses and incremental agri increases	none

1. MCA WEIGHTING AND SCOREBOARD

The MCA combines all above criteria, and applies weighing factors to each criterion. We applied weighing factors at two levels: (i) primary interest and (ii) evening out of the number of sub-criteria. Firstly, the three vulnerability criteria (riverbank erosion, flooding, social fabric) were set to obtain higher marks, in order to allow addressing these more urgent problems at higher priority. Secondly, we applied weighing factors, so that each group of sub-criteria (primary interest and others) obtains the same maximum marks. In combination this means that the vulnerability criteria get a maximum of 90 marks. If there are three classification groups, for example high, medium, low, the weighing factor applied was 10 (3 sub-criteria * 3 points * 10 weighing factor = 90), if there are two classification groups (for example yes - no) the weighing factor is 15 (3 sub-criteria * 2 points * 15 weighing factor = 90). For the second group, the same weighing factors apply, only with the goal to reach a maximum of 30 points. The result is presented in (Table 0-2).

A sensitivity run, setting all criteria equal, confirms the same selection as obtained by above method. Furthermore, a very similar result was obtained during an initial discussion with ADB, BWDB and members of the PPTA team in September, however with less refinement and quantification of sub-criteria.

Table 0-2: MCA scorecard

CATEGORY	SUB-CATEGORY	Unit	JRB1	JRB2	JLB1	JLB2	PLB1	PLB2	PLB3	PRB1	PRB2	PRB3	MRB1	MLB1	MLB2
EROSION	total (1973-2010)	km²	2	1	2	3	3	1	2	2	2	2	2	1	1
	recent (2007-2012)	km²	2	2	1	2	1	1	2	3	2	3	3	1	2
	future (2012-2020)	km²	2	2	3	3	3	1	3	3	3	3	3	2	2
	WEIGHT	10	60	50	60	80	70	30	70	80	70	80	80	40	50
FLOODING	average (2-year)	%	3	3	2	3	3	3	1	1	1	2	1	1	2
based on radarsat	mean (5-15 year)	%	3	2	2	3	2	3	1	1	2	2	1	1	1
images	high(>15 years)	%	3	2	3	3	3	3	1	1	2	2	2	1	1
	WEIGHT	10	90	70	70	90	80	90	30	30	50	60	40	30	40
SOCIAL FABRIC	poverty	%	3	3	2	2	2	2	1	2	2	1	1	1	1
	employment in agriculture	%	1	2	2	3	2	1	1	2	2	3	3	2	1
	WEIGHT	15	60	75	60	75	60	45	30	60	60	60	60	45	30
	Subtotal		***210***	***195***	***190***	***245***	***210***	***165***	***130***	***170***	***180***	***200***	***180***	***115***	***120***
ENGINEERING	riverbank protection first?	yes/no	1	0	0	1	1	0	0	0	0	0	0	1	0
INTERVENTION	existing embankment	yes/no	1	0	0	1	1	1	1	1	0	0	1	1	1
	complicated structures	yes/no	0	0	0	0	1	1	1	1	0	0	0	0	0
	WEIGHT	10	20	0	0	20	30	20	20	20	0	0	10	20	10
COMPLEMENTS	riverbank protection	yes/no	1	1	0	0	0	1	0	1	0	1	0	1	1
EXSITING SCHEME	embankment	yes/no	1	1	0	0	1	1	0	0	0	0	0	1	0
	WEIGHT	15	30	30	0	0	15	30	0	15	0	15	0	30	15
"NO REGRET"	consist. w future planform	yes/no	1	1	1	1	1	0	0	0	0	0	0	1	0
	WEIGHT	30	30	30	30	30	30	0	0	0	0	0	0	30	0
EXPECTED COST	riverbank protection (2.5M)	l/m/h	3	3	1	2	2	3	1	2	1	1	1	3	1
	embankment (0.5M)	l/m/h	3	3	2	2	2	3	2	2	2	1	1	3	2
	WEIGHT	5	30	30	15	20	20	30	15	20	15	10	10	30	15
SAFEGUARD	expected social impact	l/m/h	2	3	1	1	2	3	1	1	1	1	1	3	1
IMPLICATIONS	expected environm. impact	l/m/h	2	3	1	2	2	3	2	2	1	1	1	3	2
	WEIGHT	5	20	30	10	15	20	30	15	15	10	10	10	30	15
EXPECTED BENEFITS	primary sector (agriculture)	high/low	2	1	1	2	2	2	2	2	2	1	1	1	2
	other (land-river transport)	high/low	2	1	2	2	2	1	1	1	1	1	1	1	1
	WEIGHT	7.5	30	15	22.5	30	30	22.5	22.5	22.5	22.5	15	15	15	22.5
	Subtotal		***160***	***135***	***77.5***	***115***	***145***	***132.5***	***72.5***	***92.5***	***47.5***	***50***	***45***	***155***	***77.5***
GRAND TOTAL	**SUMMARY WEIGHT**	**107.5**	**370**	**330**	**237.5**	**330**	**325**	**297.5**	**202.5**	**262.5**	**257.5**	**250**	**255**	**330**	**197.5**
		Rank	1	2	11	2	5	6	12	7	8	10	9	2	13
			winner	winner		winner	winner	winner						winner	

In conclusion the MCA indicates the following sub-reaches for potential initial investments (Table 0-3):

Table 0-3: Sub-reaches suitable for potential investment

River	Sub-reach	Division
Jamuna	Jamuna Right Bank 1 and 2	North West
	Jamuna Left Bank 2	North Central
Padma	Padma Left Bank 1 and 2	
Meghna	Meghna Left Bank 1	South East

1. Final Selection

The final selection considers the relevance of the findings of the MCA. There are two main criteria to be considered: (i) overlap or conflict with existing or planned schemes, and (ii) "nothing to protect" during Tranche 1. With the focus of ongoing or planned investments, there are three sub-reaches that might be affected: (i) Rajbari where BWDB is building riverbank protection, and the Padma Bridge river training works planned at Mawa and Char Janajat. This means the PLB2 and PRB 2 sites will overlap with Padma Bridge river training works. "Nothing to protect" holds true for two of the winning sub-reaches: (i) JRB2, where there is little erosion at the PIRDP this moment and embankment set-back distances are quite large along unprotected banklines, and (ii) MLB1, where there is no erosion along the

MDIP. Notwithstanding the lack of urgent protection, both sub-reaches should be covered under contingency measures during the first tranche, as their high ranking indicates the vulnerability and potentially viable investments. While the JRB2 site will have a clear focus on riverbank protection in support of an existing embankment line, MLB1 will have a clear focus on strengthening the flood embankment, which regularly is affected by “boiling” or seepage indicating a structural weakness.

Considering the relevance of immediate interventions, the most attractive projects are listed in Table 0-4.

Table 0-4: Winning sub-reaches

<table>
<tr><th>River</th><th>Sub-reach</th><th>Division</th></tr>
<tr><td rowspan="2">Jamuna</td><td>JRB1</td><td>North West</td></tr>
<tr><td>JLB 2</td><td rowspan="2">North Central</td></tr>
<tr><td>Padma</td><td>PLB 1</td></tr>
</table>

Annex 11: DOE Approved Terms of Referrence

Government of the People's Republic of Bangladesh
Department of Environment
www.doe-bd.org
Head Office, E-16 Agargaon
Dhaka-1207

Memo No: DoE/Clearance/5215/2013/ 154 Date: 10 /07/2013

Subject: Terms of Reference for EIA of the Proposed Flood and Riverbank Erosion Risk Management Programme (FRERMP).

Ref: Your Application dated 06/05/2013.

With reference to the above, the undersigned is directed to convey the approval of the Terms of Reference (TOR) for Environmental Impact Assessment (EIA) of the proposed Flood and Riverbank Erosion Risk Management Programme (FRERMP).

I. The project authority shall submit a comprehensive Environmental Impact Assessment (EIA) considering the overall activity of the proposed Project in accordance with the TOR and time schedule submitted to the Department of Environment (DOE).
II. The EIA report should be prepared in accordance with following indicative outlines:

Executive Summary
1.0 Introduction
- 1.1 Background
- 1.2 Rationale of the Project
- 1.3 Objective of the Study
- 1.4 Scope of Study/Work
- 1.5 Approach and Methodology
- 1.6 The EIA Team
- 1.7 Structure of the Report/Report Format

2.0 Legal, Policy and Administrative Framework
- 2.1 Introduction
- 2.2 Relevant National Policies and Legislations
- 2.3 Compliance with DOE EIA Guidelines

3.0 Project Description
- 3.1 Introduction
- 3.2 Project Objective
- 3.3 Project Options
- 3.4 Interventions under Selected Options
- 3.5 Project Plan, Design, Standard, Specification, Quantification, etc.

4.0 Environmental and Social Baseline
- 4.1 Meteorology
  - 4.1.1 Temperature
  - 4.1.2 Humidity
  - 4.1.3 Rainfall
  - 4.1.4 Evaporation
  - 4.1.5 Wind Speed
  - 4.1.6 Sun Shine Hours
- 4.2 Water Resources
  - 4.2.1 Surface Water System
  - 4.2.2 Tropical Cyclones and Tidal Flooding
  - 4.2.3 Salinity
  - 4.2.4 Drainage Congestion and Water Logging
  - 4.2.5 Erosion and Sedimentation
  - 4.2.6 River Morphology
  - 4.2.7 Navigation
  - 4.2.8 Ground Water System

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4.3 Land Resources
- 4.3.1 Agroecological Regions
- 4.3.2 Land Types
- 4.3.3 Soil Texture
- 4.3.4 Land Use

4.4 Agriculture Resources
- 4.4.1 Farming Practice
- 4.4.2 Cropping Pattern and Intensity
- 4.4.3 Cropped Area
- 4.4.4 Crop Production
- 4.4.5 Crop Damage
- 4.4.6 Main Constraints of Crop Production

4.5 Livestock and Poultry
- 4.5.1 Feed and Fodder Shortage
- 4.5.2 Livestock/Poultry Diseases

4.6 Fisheries
- 4.6.1 Introduction
- 4.6.2 Problem and Issues
- 4.6.3 Habitat Description
- 4.6.4 Fish Production and Effort
- 4.6.5 Brakish Water and Pond Aquaculture
- 4.6.6 Fish Migration
- 4.6.7 Fish Biodiversity
- 4.6.8 Fisheries Management

4.7 Ecological Resources
- 4.7.1 Bio-ecological Zone
- 4.7.2 Common Flora and Fauna
- 4.7.3 Ecosystem Services and Function

4.8 Socio Economic Condition
- 4.8.1 Socio Economic Condition
- 4.8.2 Quality of Life Indicators
- 4.8.3 Income and Poverty
- 4.8.4 Gender and Women
- 4.8.5 Common Property Resources
- 4.8.6 Conflict of Interest and Law and Order Situation
- 4.8.7 Historical, Cultural and Archaeological Sites

4.9 Ecological Resources
- 4.9.1 Bio-ecological Zone
- 4.9.2 Common Flora and Fauna
- 4.9.3 Ecosystem Services and Function

5.0 Identification and Analysis of Key Environmental Issues (Analysis shall be presented with Scenarios, Maps, Graphics, etc. for the Case of Anticipated Impacts on Baseline)

5.1 Environmental Sensitivity Investigation
5.2 Environmental Asset
5.3 Environmental Hot Spots
5.4 Likely Beneficial Impacts
5.5 Community Recommendations
5.6 Alternate Analysis

6.0 Environmental and Social Impacts

6.1 Introduction

6.2 Impact on Water Resources
- 6.2.1 Pre-Construction Phase
- 6.2.2 Construction Phase
- 6.2.3 Post-Construction Phase

6.3 Impact on Land Resources
- 6.3.1 Pre-Construction Phase
- 6.3.2 Construction Phase
- 6.3.3 Post-Construction Phase

6.4 Impact on Agriculture Resources
 6.4.1 Pre-Construction Phase
 6.4.2 Construction Phase
 6.4.3 Post-Construction Phase
6.5 Impact on Fisheries
 6.5.1 Pre-Construction Phase
 6.5.2 Construction Phase
 6.5.3 Post-Construction Phase
6.6 Impact on Eco System
 6.6.1 Pre-Construction Phase
 6.6.2 Construction Phase
 6.6.3 Post-Construction Phase
6.7 Socio Economic Impact
 6.7.1 Pre-Construction Phase
 6.7.2 Construction Phase
 6.7.3 Post-Construction Phase

7.0 Public Consultation and Disclosure
 7.1 Introduction
 7.2 Objectives of Public Consultation and Disclosure Meeting
 7.3 Approach and Methodology of Public Consultation and Disclosure Meeting
 7.4 Public Consultation Meetings (PCMs)
 7.5 Public Disclosure Meetings (PDMs)

8.0 Environmental Management Plan and Monitoring Indicators
 8.1 Introduction
 8.2 Mitigation Plan
 8.3 Enhancement Plan
 8.4 Contingency Plan
 8.5 Compensation Plan
 8.6 Monitoring Plan
 8.7 Monitoring Indicators

9.0 Cost Estimation for Environmental Mitigation Measures and Monitoring

10.0 Conclusions and Recommendations

III. Without approval of EIA report by the Department of Environment, the project authority shall not be able to open L/C in favor of importable machineries.

IV. Without obtaining Environmental Clearance, the project authority shall not be able to start the physical activity of the project.

V. The project authority shall submit the EIA along with a filled-in application for Environmental Clearance in prescribed form, the applicable fee in a treasury Chalan, the no objection certificates (NOCs) from the local authority, NOCs from forest department (if it is required in case of cutting any forested plant, private or public) and NOC from other relevant agencies for operational activity etc. to the Head Office of DOE in Dhaka with a copy to the concerned Divisional Office of DOE.

10.07.2013

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Annex 12: Outline Terms of Reference of Services for Conducting Biodiversity Baseline and Preparing Monitoring Plan; Identifying Location of the Protected Sanctuary and Developing a Sanctuary Establishment Plan

A. Background

The Flood and Riverbank Erosion Risk Management Investment Program (FRERMIP) aims to sustain incomes and livelihoods of people living along selected reaches of Jamuna, Ganges, and Padma Rivers (Figure 1) by enhancing resilience to flooding and to riverbank erosion through a mix of structural and non-structural measures. FRERMIP will be implemented under a Multi-tranche Financing Facility (MFF) in three phases or tranches of three to four year duration each with one year overlap from 2014 until 2023. Tranche 1 of the MFF consisting of three Subprojects: Jamuna Right Bank 1 (JRB-1), Jamuna Left Bank 2 (JLB-2), and Padma Left Bank 1 (PLB-1).

The program includes structural measures, extensive non-structural activities, and institutional strengthening. A total of 50 km of riverbank protection, 53 km of embankment rehabilitation, and 36 km of embankment reconstruction or new construction are planned to be implemented through the Bangladesh Water Development Board (BWDB). In addition, more than one million people living in flood risk areas along the main rivers are expected to be supported by a community-based flood risk management program organized through the Department of Disaster Management (DDM). Institutional strengthening will largely focus on improving the knowledge base and planning tools for managing critical river reaches, particularly within the planned River Management Wing in BWDB.

After initially protecting critically eroding riverbanks at priority areas, the program plans to move to more systematic riverbank stabilization, potentially contributing towards future river-reach stabilization during later tranches. The stabilization approach will make use of the currently ongoing consolidation of the river morphology developing towards a more accentuated channel pattern similar to the one observed in the 1970s, before the dramatic widening (from the 1970s to 2000s) took place. In parallel existing, degraded or eroded embankment lines, such as the Brahmaputra Right Embankment will be restored and extended to arrive at reliable flood protection for the large population living on the floodplain along the main rivers. The community-based flood risk management component aims to increase resilience and preparedness of the population for the residual risk, for example if existing embankments unexpectedly breach.

The suggested investment program commences during the first Tranche with three priority reaches (subprojects) along the lower Jamuna and upper Padma Rivers, and later adds downstream areas including at the confluence of Padma and Upper Meghna Rivers. The riverbank protection approach builds on and extends technical principles established under the successful Jamuna-Meghna River Erosion Mitigation Project (JMREMP). Embankment designs follow best international practice providing access along the top of the embankment and the opportunity to raise embankments later in response to climate change requirements within the typical construction width applied in Bangladesh. Tranche-1 JLB-2 and PLB-1 physical works consist of riverbank-erosion protection works along critically eroding areas only. JRB-1 consists of very limited riverbank-erosion protection works in support of existing works and the restoration of degraded and eroded flood embankments, specifically a section of the Brahmaputra Right Embankment. Flood embankments will also be rehabilitated behind the JLB-2 and PLB-1 erosion protection works, but not until Tranche 2.

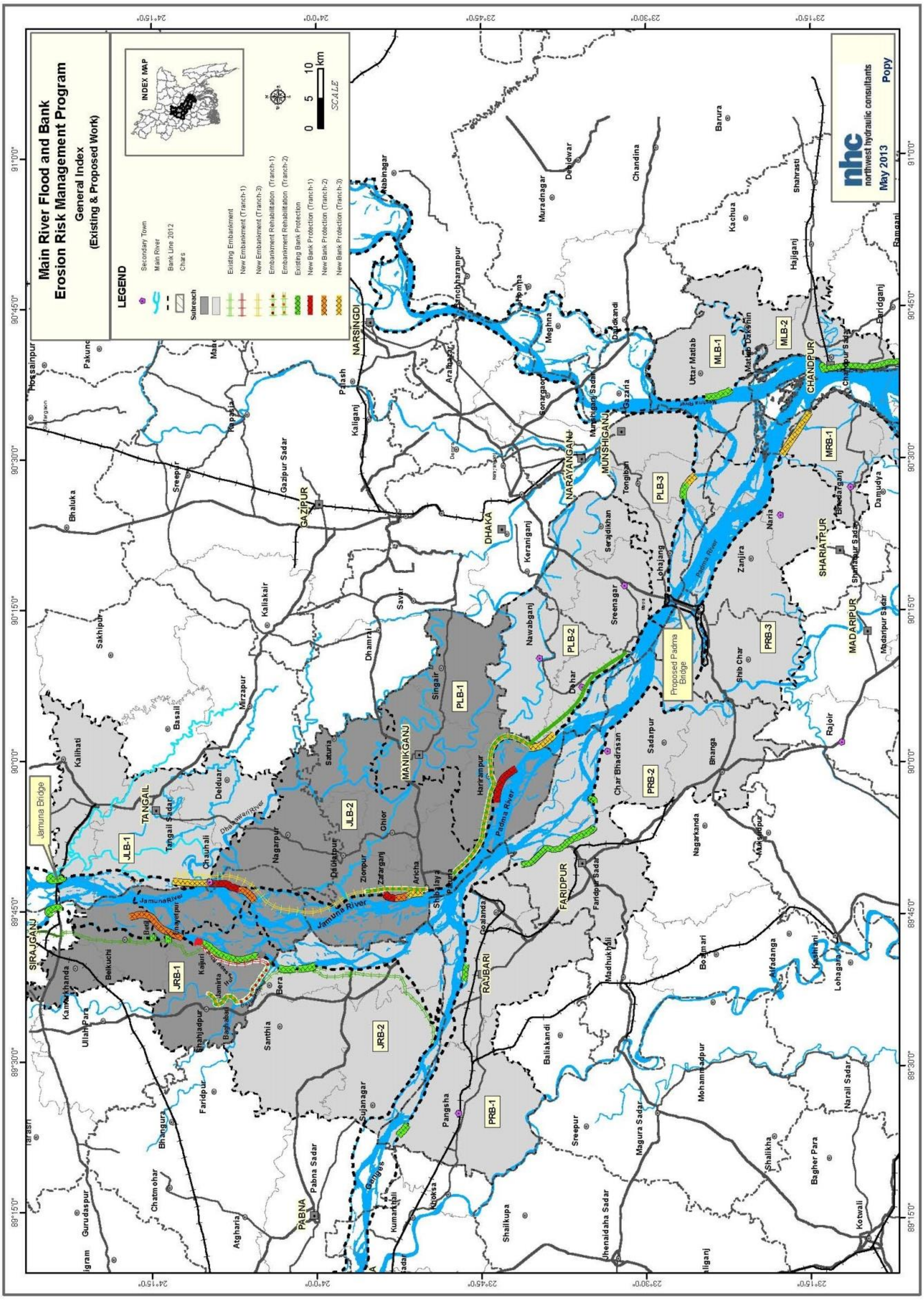


Figure 1 Project Area

In addition to a full EIA the preparatory study prepared an Environmental Assessment and Review Framework (EARF). The purpose of this EARF is to guide the preparation of future tranches of the ADB supported Flood and Riverbank Erosion Risk Management Investment Project (FRERMIP), prepared through Project Preparatory Technical Assistance (PPTA) 8054, Main River Flood and Bank Erosion Risk Management Program (MRP). Specific guidance is required as the Program intends to move from localized riverbank protection towards stabilization of first river reaches of the main rivers in central Bangladesh. This approach includes the restoration and expansion of existing flood risk mitigation infrastructure (flood embankments), leading to more reliable flood risk mitigation. To this end existing literature knowledge on issues pertaining to environmental safeguards, such as the river ecosystem, river floodplain interaction, and specifically fish, need to be expanded, in parallel to the study of the overall stabilization approach over the following tranches, alternative solutions, and their impacts. Future environmental assessment has to account for the dynamic river morphology that experienced dramatic changes over the last 40 years, which are still ongoing.

The anticipated benefits are considerable and include: (i) reduced loss of agricultural and other land with established infrastructure to prevent river erosion, (ii) reduced destruction of livelihood and impoverishment of families, (iii) gains in floodplain land from river stabilization, (iv) improved river navigation and trade, (v) reduced flood damage to agriculture, particularly Aus and Aman cropping, and (vi) increased agricultural production on less-flooded agricultural land.

While the anticipated program benefits are considerable, the program potentially negatively impacts both floodplain and river environment. Potential negative impacts may include the transformation of deeply flooded floodplain into less flooded areas leading to the degradation of floodplain aquatic (wetland) habitats, reduced hydrological connectivity, and physiochemical / water quality changes, which may adversely affect floodplain-dependent openwater fish species and wetland biodiversity. Increased agriculture may increase utilization of water resources for irrigation and increased fertilizer and pesticide use may impact on water quality. Erosion protection of the program may alter the river morphology along a river reach beyond the works, change the river appearance (e.g. the number of channels and islands, water depths, and velocity), and as a consequence change the river habitat. This may in turn have an impact on the biodiversity locally as well as for migrating or trans-boundary animal populations.

The program has a number of inbuilt mechanisms to reduce environmental impacts, and mitigation measures have been aggressively mainstreamed into program planning and engineering designs. The flexibility of a phased MFF approach supports minimization and mitigation of potential negative impacts in a gradual manner. Works will start in Tranche-1 with protection of critically eroding riverbanks and the reconstruction of the destroyed Brahmaputra Right Embankment, while conducting extensive studies on future impacts of river stabilization and associated embankment works, including piloting new measures. Specialist studies have been conducted for Tranche-1 interventions on morphology, floodplain hydrology, and environmental aspects. They support that the Tranche-1 impacts are more limited in nature and can be mitigated. During Tranche-2 first measures for river stabilization along the priority work reaches are planned and will be designed based on the Tranche-1 study outcomes and supported by environmental monitoring and mitigation measures. This approach will be carried forward and adapted in Tranche-3.

The Program includes several additional studies to develop a broader background understanding and develop an approach that optimizes different key drivers, ranging from morphological trends, future river use for navigation, safeguarding and enhancing the river ecosystem, and reducing social impacts.

Mitigation measures suggested for larger-scale river stabilization include:

(i) Development of stabilization alternatives and impacts through the River Stabilization Study during year 1 and 2 of Tranche-1

(ii) Establishment of a river sanctuary, building on the River Stabilization Study and an individual study to outline the sanctuary requirements during year 3 and 4 of Tranche-1,

(iii) Development of EIA studies for each subsequent tranche

(iv) Consideration of protected areas, supported by physical measures, such as navigation buoyage alongside protected riverbanks disallowing systematic fishing with floating nets.

Figure 2 depicts the system of studies and their interaction with environmental and social safeguards. In addition, “building-with-nature” measures will be piloted to assess ways closely mimicking or making use of natural processes to build attached char land faster into floodplain land.

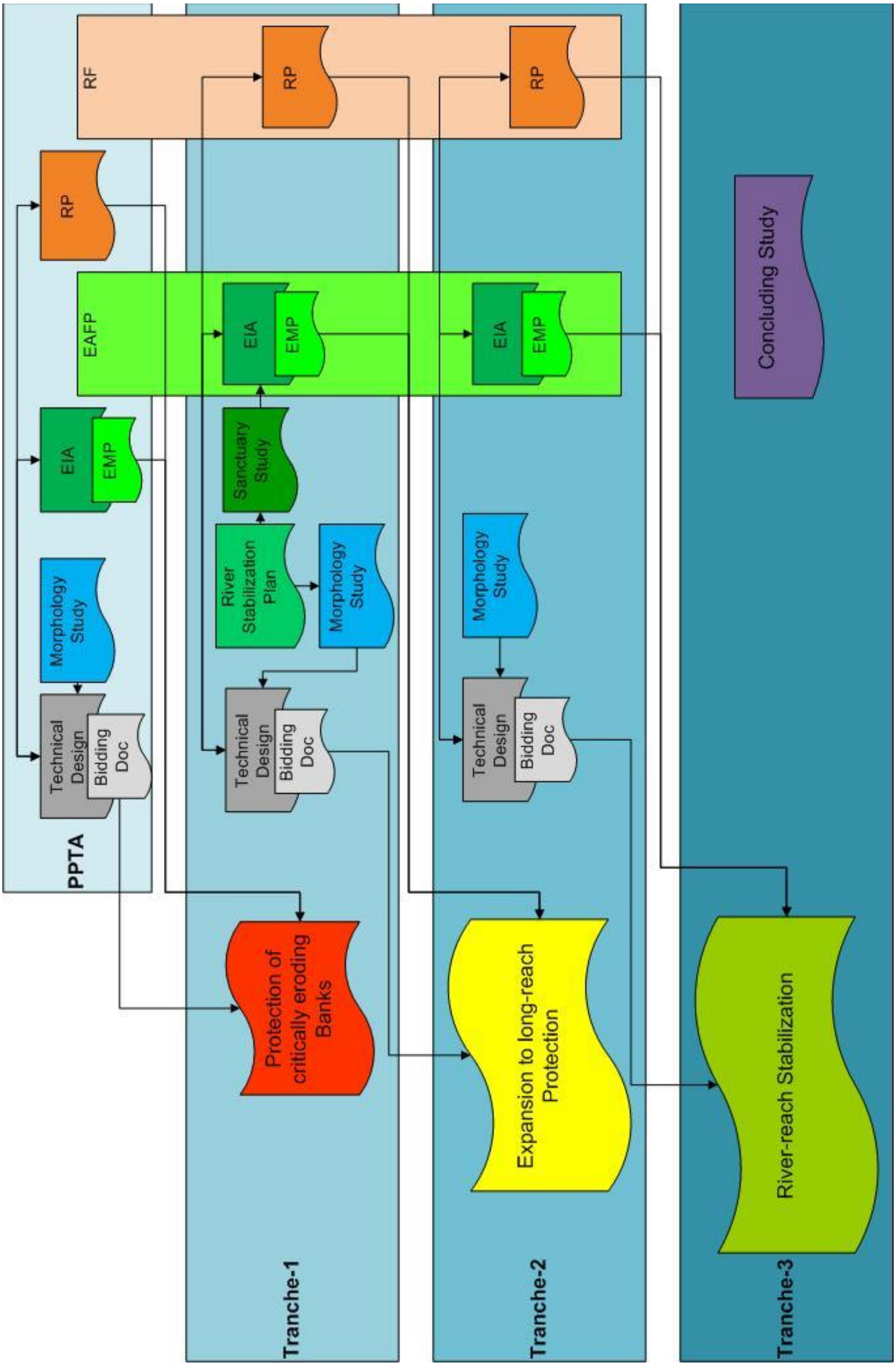


Figure 3. Flow chart for key design and construction elements throughout the three tranches

B. Objectives

Based on the outcome the River Stabilization Plan environmental measures for potential larger-scale river stabilization need to be investigated and suitable mitigation measures, such as a river sanctuary identified and detailed. This involves:

- Identification of monitoring indicators for all the flora and fauna components of the project site during pre-construction, construction and operational stages. Once these indicators are carefully selected, they would be the monitoring indicators/parameters that will be followed throughout the project life. Hence, considerable research and thought must be given to this aspect.
- Establish a comprehensive baseline for the biodiversity in project's influence areas.
- Develop an interactive biodiversity monitoring plan which covers all species specially critically endangered species, such as Dolphin (Platanista gangetica) and economically important species, such as Hilsa (Tenaulosa ilisha) a national flagship fish during the construction phase.
- Identify a suitable location for the sanctuary preferably within project impact area and develop a detailed plan for establishment of a protected sanctuary to compensate for project impacts and contribute to a long term conservation of aquatic and terrestrial habitat.

The outcome of this study which will be undertaken in Tranche 1 will form part of the EIA studies for future tranche-2 and -3 work.

C. Consulting Services

Consulting services are solicited from Firm/NGO/Research institute's experienced in setting ecological baseline , biodiversity monitoring , defining conservation status of species and their conservation strategy and restoration, establishment and management of protected Sanctuary area and proven international and national experience to provide necessary technical services for biodiversity monitoring and establishment of Sanctuary. The consulting team will include a mix of experts with experiences in biology of the various species and habitats. The interested Firm/NGO/Research institute should have experience in similar works and preferably working experience in Bangladesh.

Designation of Protected Status: Under the Sanctuary Establishment Plan the Firm/NGO/ Research institute's shall prepare all necessary documentation and procedures to be followed and support BWDB to develop a sanctuary suitable for later obtaining the legal status under the existing laws of Bangladesh and recognition as "protected ''. The core area of the protected sanctuary may be closed by legal means to unauthorized human encroachment, fishing, boating, or any other activity that significantly and adversely affect the habitat. The public may be allowed to enter selected areas including the buffer zones for guided visits in order to promote eco-tourism. In order to self-sustain the eco- tourism venture a business plan will be drawn up

Sanctuary Establishment Plan should include the detailed Management & Monitoring Plan for the Sanctuary. The plan should identify the responsible persons/ organizations and present a site-specific or/ and species- specific management /monitoring plan for the required inputs

D. Scope of Services

The Consultants of the Firm/NGO/Research Institute's shall familiarize with the River Stabilization Plan prepared during the Tranche-1 project, as well as the program preparatory documents (feasibility study 2013) and maintain close coordination with the Environment Unit of PMO. The scope of works is defined into two groups with following outputs.

E. Biodiversity Baseline and Biodiversity Monitoring Plan

Biodiversity baseline

- Prepare the Biodiversity Baseline which covers all species, specially critically endangered species and economically important species in the project impact areas based on;
- Identification of key monitoring indicators
- Analysis of the key environmental issues regarding the biodiversity and collect primary data on the aquatic and terrestrial biodiversity in every month through field sampling and observation
- Using social instruments for surveying to collect the opinion of the local people and their perception on the possible impacts of the bridge construction activities; special emphasis on Hilsa and Dolphin migration , resident and migratory birds , reeds and wildlife
- Observe and record the frequency , abundance, distribution and dislocation of indicator species of wildlife in the impact area of the project
- Conduct a study of the ecology and breeding habitats of biology of the migratory birds in the project area;
- Monitor the migration pattern and breading of Hilsa fish *Tenaulosa ilisha*;
- Monitor the migration pattern of Dolphin (Platanista gangetica), etc.

Biodiversity Monitoring Plan

- Prepare the Biodiversity Monitoring plan of all species which includes specially critically endangered or endangered species including Dolphin (Platanista gangetica) and economically important species including Hilsa (Tenaulosa ilisha) based on;
- Review the EAP documents of the Padma Bridge Project and all available literature on the Padma and its Char land ecology are essential for development of the Biodiversity Monitoring Plan and that will assist enable determination of project construction and operation effects on biod iversity and the success of associated mitigation measures
- Identify the project associated activities in the project impact area that will have a negative impact on to biodiversity and to recommend remedial measures where necessary for the protection of biodiversity
- Public Consultations: Carry out stakeholder 's analysis through public consultation meetings with local l level elites, public representatives, Department of Environment, respective department for wild life conservation , NGOs, representative of major professional groups (fishermen , agriculture farmers, etc.) and char land dwellers at the sites and consider the outcomes in preparing monitoring plan
- The Biodiversity Monitoring Plan shall include terrestrial and aquatic species including critically endangered/ endangered species and economically important species with appropriate monitor indicators based on the obtained baseline information during the pre-construction stage for monitoring the biodiversity during the construction stage and in operation stage of the project
- Submit a draft Biodiversity Monitoring Plan to BWDB for their review, comment and possible circulation to agency stakeholders and co-financiers
- Finalization of the Biodiversity Monitoring Plan according to the comments received
- Capacity building for the professionals of Environmental unit, Safeguard and Project relevant personnel through conducting trainings, workshop (national /international) regarding the protection and conservation of the biodiversity in the project area (focus on aquatic and terrestrial endangered species)., operate ion and maintenance of Sanctuary, etc.
- Awareness programs should be conducted through conducting meeting, workshop, pamphlet and communication materials on the biodiversity as an integral part to aware the public regarding the protection and conservation of the biodiversity

F. Identification of suitable location of the sanctuary and development of a Sanctuary Establishment Plan

<u>A Identify the location of the Sanctuary</u>

Identification of the suitable location for development of the protective Sanctuary though

- Field survey
- Three-five site (Char lands) will be studied and based on the alternative
- Following analysis the suitable location should be finalized .
- Public Consultations: Conduct public consultation meetings with charland dwellers, local level elites, public representatives of the Department of Forest, Department of Environment , respective department for wildlife conservation, NGOs , representative of major profess ional groups (fishermen , agriculture farmers, etc.) at the sites and consider outcomes in identify the suitable location of the Sanctuary.

The following criteria should be considered for the site selection;

- Location should be in the lower Jamuna downstream of Jamuna Bridge;
- Location should be relatively insensitive to river erosion; The Chars with reed lands with submerged areas surrounding the Char are generally suitable for such compensation measure due to their suitability for aquatic and bird habitat as well terrestrial habitats.
- Evaluate the location impacts of the protected sanctuary for the construction of main bridge, river training works or other related components at downstream erosion and /or accretion
- Proposed location should be raised to a height of I to (maximu m of) 3 m above the monsoon water and should have a number of water bodies or channels.
- Conduct consultations with local community and government organizations to agree on the project location
- Potential location site will be mapped and zoning on the existing revenue maps to enable BBA to identify land for acquisition purposes.

<u>B Sanctuary Establishment Plan</u>

The Sanctuary Establishment Plan should include detailed design of the Sanctuary as follows

- Site location should be reflected on the mouza maps for acquisition purposes.
- Demarcate into and design the proposed area as core and buffer zones.
- The core zone shall include the char and the river. A critical part of the design process will focus on the establishment of nursing and feeding areas for fish, crustaceans, turtles, cetaceans and dolphins, etc.
- Design of observation path(s) and observation hides in the protected area for tourism.
- Experience from fish sanctuaries developed in Hakaluki in 2008 by the DOE under 'Coastal and Wetland Biodiversity Management Project' and in Brahmaputra river by Bangladesh Agriculture University may be considered in designing the sanctuary.
- Stakeholder's analysis through Public Consultations should be considered at the sites and consider outcomes in planning the establishment of Sanctuary.
- Prepare Sanctuary Establishment Plan of the proposed protected area,
- including details on design.

G. Time Frame

The consulting service for the baseline monitoring and determine the suitable location of a Sanctuary including the development of Sanctuary Establishment Plan is for a total period of twelve (18) months. Thereafter the consultant shall provide revisions based on comments by Client and ADB.

H. Reporting Requirements/Deliverables

The Firm/NGO/Research lnstitute's will prepare and submit the following reports and deliverables during the course of the activities:

- Inception Report
- Draft Baseline Monitoring Survey Report
- Intermittent Progress Report (includes final baseline of biodiversity and identification of Sanctuary location etc.)
- Draft report on Biodiversity Monitoring Plan
- Final report on Biodiversity Monitoring plan
- Report on Protected Sanctuary; identified location, mapping, zoning, planning, designing Sanctuary Establishment Plan including Management / Monitoring Plan.

In addition the Firm/NGO/Research Institute's will conduct several Meetings/ Workshops;

- meeting on inception report
- meeting on draft baseline monitoring survey report
- meeting on draft biodiversity monitoring program and Stakeholders workshops. Under meetings/workshops and public consultation the Finn/NGO/Research lnstitute must also discuss with local communities, NGO's, DOE, respective department for wildlife conservation etc.

I. Staffing and Inputs

The Firm/N GO/R esearch lnstitute's wi ll be employed for a period of 18 month s with intermittent inputs from the professional team, to synchronize project activities. Expertise on biodiversity assessment, monitoring and planning for development of the protected sanctuary are the basic requirement for this consultancy services. The winning Firm/NGO/Research [nstitute's should apply its staff resources in the field of specialization and skills as shown below for undertaking the study as mentioned in the ToR.

SN	Profession/ Discipline	No	Man -month
International Professionals			
1	Ecologist/Team Leader	1	6
2	Protected Sanctuary Planner	1	4
National Professionals			
1	Botanist/Forest Specialist	1	12
2	Protected Sanctuary Planner	1	7
3	Fisheries Specialist	1	6
4	Hydrologist	1	2
5	Wild.life specialist	1	5
6	Ornithologist	1	5
7	RS/GIS Analyst	1	4

8	Civil Engineer	1	2
9	Eco-tourism development specialist	1	2
10	Field Researchers	2	12

J. Qualifications and Tasks of Staff

Qualifications and task to be performed by the key staff mentioned above are as follows: Position	Qualification	*Specific expertise relevant to assignment*
International Professional		
Ecologiest Team Leader	*Minimum Educational Qualification:* Master's degree (PhD is preferable) in Biological sciences or Natural Resources Management*Minimum Years of Experience:* 15 years	Preferably 10 years international experience as Team Projectt Manager in similars projects fundedby international development organizations/financiers like WB, ADB, JICA, IDB, UNDP, etc. More than ten (I0) years international experience in research, planning and implementation of protected areas/sanctuary. Proven record of biodiversity monitoring for large scale project. Demonstrated experience in the preparation of monitoring plan, sanctuary management, eco-tourism etc. Experience in preparing plan for setting of biodiversity baseline and monitoring plan of the ecological habitat. Experience in awareness raising activities and conducting relevant training program for protection and conservation of terrestrial and aquatic habitat.
Protected Area Specialist	*Minimum Educational Qualification:* : Master's degree (Ph.D is preferable) in Natural Resources Management or related field *Minimum Years of Experience:* 15 years	At least 8 years experience in similar projects funded by international development organizations/financiers like WB, ADB, JICA, IDB, UNDP Proven record of Planning and Designing of Sanctuary. Experience in preparation of monitoring and management plan of sanctuary and management of co-tourism etc.

Position	Qualification	*Specific Expertise and experience relevant to assignment*
National Professional		
Botanist/Forest Specialist	*Minimum Educational Qualification:* Master's	At least eight (8) years specific experience in similar field.

	degree (Ph.D is preferable) in Botany/Forestry Biological sciences, *Minimum Years of Experience:* l0 years	Experience in similar projects funded by international development organization s/financiers like WB, ADB, JICA, IDB, UNDP, etc. Experience in biodiversity baseline survey (terrestrial and aquatic habitat). Experience in preparation of biodiversity baseline and monitoring plan for protection and conservation of the plant habitat. Experience in managerial experience.
Protected Area Planner	*Minimum Educational Qualification:* Master 's degree (Ph.D is preferable) in Natural Resources Management or related field, *Minimum Years of Experience:* 10 years	Al least eight (8) years specific experience in similar fields. Experience in similar projects funded by international development organizations/financiers like WB, ADB, JICA, IDB, UNOP, etc. Experience in working on awareness programs. Experience in working on Planning and Designing of Sanctuary is preferable. Experience in awareness raising activities and conducting Training programs.
Fisheries Specialist	*Minimum EducationalQualification :* Master's degree in Fisheries/Zoology /Marine Science/Aquatic Resources Development *MinimumYears of Experience:* 10years	At least 5 years specific experience in similar fields. Experience in similar projects funded by international development organization s/financiers like WB, ADB, JICA, IDB, UNDP, etc. Experience in fisheries biodiversity baseline survey and its monitoring. Proven record for preparation of monitoring and management plan for fisheries. Experience in working on Hilsa catch assessment. breeding and migration pattern (migation of Dolphin is preferable).

Position	Qualification	*Specific Expertise and experience in project works relevant to assignment:*
Wildlife specialist	*Minimum Educational Qualification:* Master's degree in Zoology with specialization on wildlife *Minimum Years of Experience :* 10 years	Five (5) years specific experience in workig on wildlife and related field. Experience in preparing wildlife biodiversity baseline and monitoring.
Ornithologist	*Minimum Educational Qualification :* Master 's	Five (5) years specific experience in working on birdlife and similar fields.

	degree in Zoology with specialization on birdlife	Experience in working on birds biodiversity baseline and monitoring.
GIS/RS Analyst	*Minimum Educational Qualification:* B.Sc in GIS/RS/Urban and Rural Planning/ Geography/ Environmental science	Two (2) years specific experience in GIS mappings and analysis. Experience in mapping and zoning of areas and buffering of the sensitive areas.
Civil Engineer	*Minimum Educational Qualification :* 8.Sc 111 Civil Engineering *Minimum Years of Experience:* 10 years	Two (2) years specific experience in working on design and construction of the tourism site. Experience in working on green infrastructure designing and construction
Eco-tourism development specialist	*Minimum Educational Qualification :* Master 's degree in Social Science or other related fields, *Minimum Years of Experience:* 10 years	Two (2) years specific experience in working on eco-tourism development is preferable Expertise on designing and Planning eco- tourism site.
	Minimum Educational Qualification: Master's degree in Biological sciences	Two (2) years specific experience in survey works and biodiversity survey is preferable. Experience in field data analysis and reporting,

K. Implementation Arrangements

Consulting firm will directly report to the Project Director, BWDB. The BWDB will cooperate by supplying the hydro-morphological, meteorological, design, EIA and project feasibility study reports and other necessary data collected by other consultants of the project. Indicators of environmental monit oring should be decided in consultations with the P project personnel. The analysis as well as the writing of the reports would require constant interaction and feedback from concerned stakeholder's views, interpretation and readjustments which should be maintained.

Annex 13: Photographs

Riverbank Protection alongside JRB-1

Riverbank erosion in the area of Chauhali and Jaffarganj, JLB-2

Unprotected riverbank at PLB-1, Harirampur area

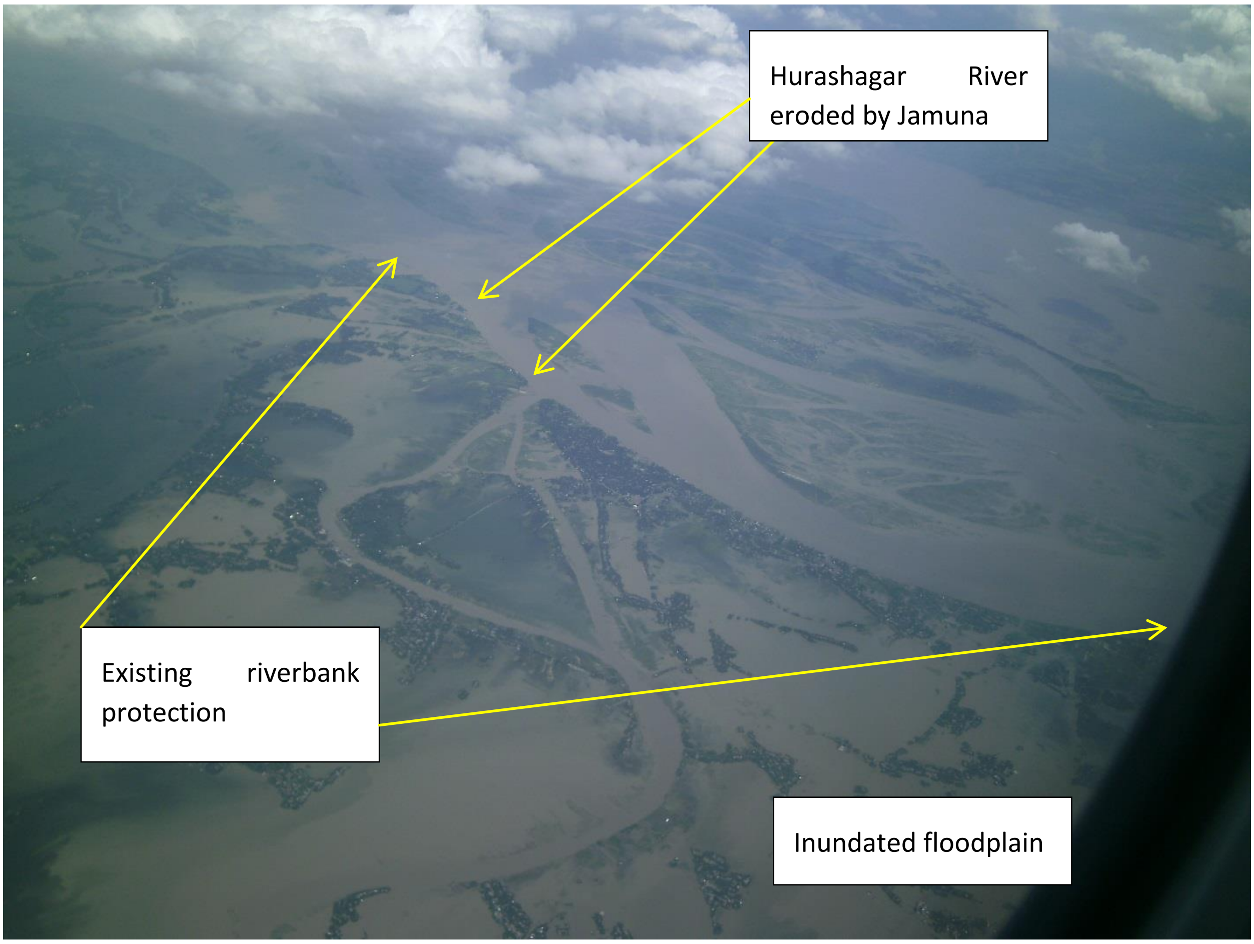
Unprotected riverbanks

Embankment along the Hurasagar/Baral

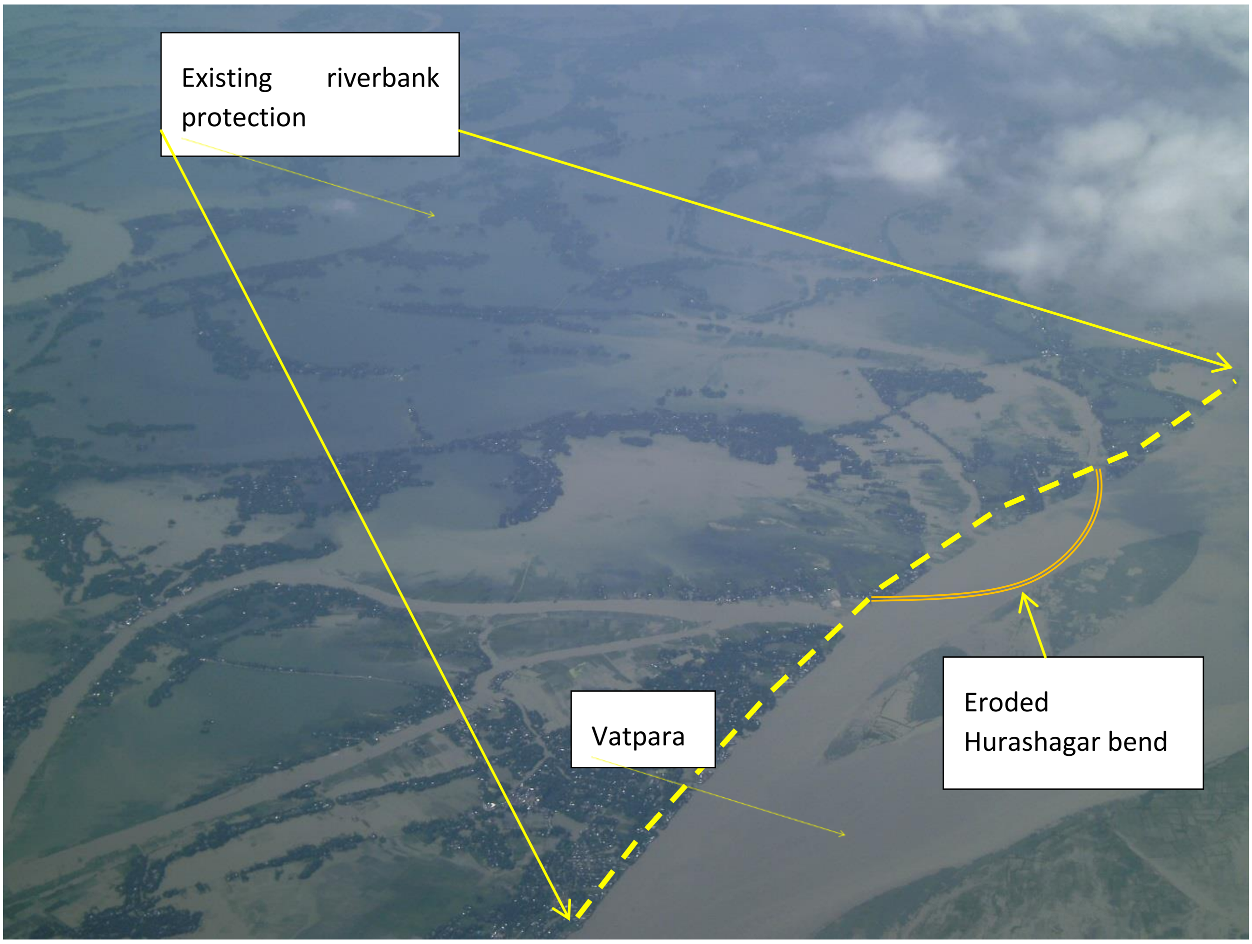
Resettlement Survey

Disfunctional Sluice gate at JRB-1

JRB-1 7-July 2013 flooding



This view was taken from an aircraft flying from Delhi to Dhaka. The picture shows the Jamuna in the background and the Hurashagar River meandering through the JRB-1 starting from the top left and leaving at the bottom of the picture. The Hurashagar was eroded by the Jamuna, which means that the flow now spills into the Jamuna at Kaijuri, which the downstream channel at Kaijuri acts as spill channel during Jamuna floods, flooding the area.



A closeup view of the protected area downstream of the Hurashagar meander bend that was eroded by the Jamuna. The riverbank of the Jamuna was protected against further erosion from 2009 to 2011.

Dredging of sand for embankment construction

Annex 14: Wetland biodiversity and aquaculture program

I. Wetland biodiversity and aquaculture program activities

- Fish sanctuary can play a vital role to increase the fish diversity and improve the richness of fish species and fish production. Fish sanctuary should be established in coordination with the local DoF (Department of Fisheries) Officials. The criteria for fish sanctuary are given below;

Target of Sanctuary

- Protection of Riverine fish species to increase the species diversity as well as incremental production of fishes.

Required minimum area for sanctuary

- About 10% (In dry season water area) of *duar area needs to protected as a fish sanctuary in river. *(Duar - means the deep area in the river).
- Buffer zone should be about 10% around the Fish sanctuary.

Sanctuary Materials

- Sanctuary materials are bamboo, branches of hizol / Shewra trees, rope, water hyacinth / aquatic vegetation like halencha, flag, Steel or concrete signboard etc. The sanctuary materials should be withdrawn from the river before the monsoon and again set the materials after the monsoon (In the month of September / October).

Sanctuary Establishment **period**

- After monsoon (In the month of September / October).

Technical support

- The technical support should be provided by the related Government Officials e.g. Department of Fisheries especially from the related upazila with consultation with District fisheries Office.

Financial support

- All financial support should be provided by the related project or by the Government (establish the sanctuary, protection and maintainace).

Management Activities of Fish Sanctuary

- Management committee should be formed to manage the activities.
- Committee members (11 to 15 members) should be local fishers, community people (beneficiaries), students, teacher and local elites, DoF (Department of Fisheries) representatives.
- Awareness program should be conducted through local fishers, community, students, teacher and local elites to disseminate of its importance.
- Observation of national and international days and discussion, circulation of leaflet, sun cap, Gangy, umbrella, poster, establishment of bill boards in favor of fish sanctuary.
- To conduct these activities by the DoF or local or national NGO's (experienced in fisheries) may be involved to do the activities properly and timely. Also inform the local community/stake holders about wetland resources and its importance in our daily life.
- The local beneficiaries' group should be involved to protect the sanctuary and repair in certain interval.

Monitoring Activities

- Monitoring by the DoF Officials or selected NGos with the help of local management committee for protection.
- Guarding especially in the night.
- Conduct the Meeting (Monthly) and reporting to the related authorities (DoF or NGOs).
- Monitoring/ observing of fish catch (upstream and downstream within 500 m) by the fisheries or NGO official in conjunction with the related management committee for observation of fish species and fish production.

Cost of Fish Sanctuary

Cost of fish sanctuary means cost of sanctuary materials, repairing, meeting, awareness development, signboard etc. Minimum cost of fish sanctuary for first two years are given below,

Area = 50 Decimal

Category	Sanctuary materials including labor (Taka)	Flag /steel or CC sign boards etc (taka)	Repairing / maintenance including labor cost for 2nd year (Taka)	Community meeting and awareness (two year) (Taka)	Total cost (two year) (Taka)
Sanctuary in the duar area (50 decimal)	➸ Bamboo= 100 nos.X200 tk=*20,000/=* ➸ Branches of trees =*10,000/=* ➸ Labor =20 nosX500 tk = *10,000/=* ➸ Boat, wire etc =3,000/=	*7000/=*	*10,000/=*	*5,000/=*	*65,000/=*

Taka Sixty Five Thousand only. *(Staff and logistic costs are not included here)

II. Terms of References of NGO

Objectives

The main objective of the project is increase the fish production and capture habitat through aquaculture extension and management of wetland resources in a sustainable manner.

Scope of Works

The program is expected to focus the pond owners as well as fisherman in the project area. . The main program is to: "*Capacity development and awareness building for pond owners and resource users, fish farmer and DoF professionals in respect of fish production and resource management "*. The program includes:

Training for Pond Owner

- To develop the capacity of fish culture technique, stocking species. Stocking period, food supply, health monitoring, fishing period, fish marketing, record keeping etc.
- Nursery development and management procedure

Training for Fisherman

- To develop the awareness about fish bio-diversity conservation, fish sanctuary, fish migration process and fish migration obstruction etc.
- Aware them about negative impacts of over fishing, catch of brood fish and fishing during breeding season
- To provide knowledge about the use of fishing gear of Government approved size and avoid using harmful fishing gears / equipment such as monofilament gill net, low mesh size berjal, mosharijal etc.

Training for Fish Farmer

- Training on different culture technique in different water bodies
- To introduce practical knowledge on adapting natural hazards.
- Give an outline to understand how their livelihoods might be improve through fish culture
- Marketing time and marketing channel
- Fish transportation procedure to ensure minimum wastage etc

Formation of Community Based Organization (CBOs) or Resource Management Committee (RMC) and trained them

- Formation of CBOs or RMC in the project area.
- Identify and strengthen the activities of CBOs / RMC for sustainable fisheries and wetland management in the project area.

- Aware the committee member about fisheries and wetland related rules and regulations.
- Importance of habitat conservation and significance of fish diversity.
- Inform the Importance of natural resources in our daily life.

Skill development for Field level professional (GO, NGO and other concerns)

- Develop the skill of wetland and fisheries monitoring techniques /procedures
- To develop skill on pollution, water quality, contamination and other environmental and ecological issues, their management and mitigation measures etc.
- To introduce fisheries co- management systems.
- Co-ordination with Government and projects Authorities
- Prepare a monitoring plan for aquaculture and wetland resources.
- Prepare annual report.