Environmental Impact Assessment (Update)

Project No.: 44167-015
May 2021

Bangladesh: Flood and Riverbank Erosion Risk Management Investment Program – Project 2

Prepared by the Bangladesh Water Development Board for the Asian Development Bank.

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Government of the People's Republic of Bangladesh

Bangladesh Water Development Board

Asian Development Bank

Prepared for Project Loan No TBC and Grant No TBC

Flood and Riverbank Erosion Risk Management Investment Program (FRERMIP) - Project-2

Environmental Impact Assessment (Update)

May 2021

Prepared by:
Bangladesh Water Development Board (BWDB)
Financial support: Asian Development Bank (ADB)
Technical Support: ISPMC (NHC-EMM JV)

Flood and Riverbank Erosion Risk Management Investment Program Project-2

Institutional Strengthening and Project Management Consultant (ISPMC)

Document Name: Environmental Impact Assessment
Document No. FRERMIP-T2-ES-P-EIA-05

Issue and revision record

Revision	Date	Originator	Checker	Approver		Description
				Name	Signature	
A	26 Jan 2017	Md. Amir Faisal	Wandert Benthem	Knut Oberhagemann		Initial draft
B	16 Nov 2017	Md. Amir Faisal	Wandert Benthem	Knut Oberhagemann		Updated in accordance with latest designs and river situation
C	13 Dec 2017	Md. Amir Faisal	Wandert Benthem	Knut Oberhagemann		Updated in accordance with latest designs and river situation
D	22 Feb 2018	Md. Amir Faisal	Wandert Benthem	Knut Oberhagemann		ADB comments of 8 and 13/2/2018 Incorporated and addressed including referencing IUCN status of animals
E	20 April 2020	Zinat Naznin, Wim Giesen	Md Amir Faisal	Knut Oberhagemann		Updated as per latest design as of 5th April 2020 including the removal of Harirampur embankment and in accordance with comments from PMO on 05/11/2019 with updates to data series where available
F	02 Jun 2020	Wim Giesen	Hiba Khan	Knut Oberhagemann		Updated on basis of comments matrix provided by ADB on 18 May 2020.
G	30 June 2020	Wim Giesen	Hiba Khan	Knut Oberhagemann		Update on basis of comments matrix provided by ADB (Sumit Pokhrel) on 26 June 2020.
H	April/May 2021	Jesper Mathiesen	Wim Giesen	Knut Oberhagemann		Update to reflect reduction in scope of works and ADB's comments

contributing Team Members comprise

Md. Amir Faisal	National Environmental Specialist
Dr Md. Shahjahan Howlader	National Fisheries Specialist
Wandert Benthem	International Environmental Specialist
Wim Giesen	International Environmental Specialist (replaces Wandert)
Zinat Naznin	Junior Engineer
Knut Oberhagemann	Team Leader
Jesper Mathiesen	River Engineer

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Flood and Riverbank Erosion Risk Management Investment Program Project 2

Institutional Strengthening and Project Management Consultant (ISPMC)

Key Data

Name of Project:	**Flood and Riverbank Erosion Risk Management Investment Program**
Borrower, Executing Agency and Implementing Agency:	Government of Bangladesh (GoB) Bangladesh Water Development Board (BWDB) Department of Disaster Management (DDM)
Financing (Project 2):	Asian Development Bank (US$ 157 million). ADB Loan No. TBC. Government of Bangladesh (US$ 37.91 million) Government of the Netherlands (US$ 17.89 million). GoN Grant No. TBC
Consultant:	Joint Venture of Northwest Hydraulic Consultants Ltd. (Canada) and Euroconsult Mott MacDonald Ltd. (UK) in association with Deltares (Netherlands), Resource Planning and Management Consultants (Bangladesh) and CEGIS (Bangladesh).
Contracting Authority:	PD, FREMIP, BWDB, Dhaka
Start/ End Dates:	ADB Loan Agreement: 27 June 2014 (approved), 14 August 2014 (signed), 17 September 2014 (effective) Multi-tranche financing facility (10 years): August 2014 to August 2024 Dates for FRERMIP: - Tranche 1 project: August 2014 to June 2021 - Tranche 2 Project: July 2021 to June 2024
Beneficiaries:	Local stakeholders directly and indirectly benefitting from river flood protection works and land reclamation and development
Subproject Sites/ Location/ Areas	Focus of works are along the Jamuna-Padma river corridor, from Bangabandhu (Jamuna) bridge to confluence with Meghna River at Chandpur; i.e. Reaches 3, 4 and 5. FRERMIP Project 2 comprises the three priority subprojects, JRB-1, JLB-2 and PLB-1 which extend over (parts of) the districts: Sirajganj, Tangail, Pabna and Manikganj.

	km²	**ha**
Total Area of all Sub Projects	9,292.3	929,230
FRERMIP SPs (JRB1, JLB2): Total Area	1,794.1	179,409
FRERMIP SPs: Agricultural Benefit Area	317.8	31,779
FRERMIP SPs: Population		2.6 million
FRERMIP SPs: Population Density		690/ km²
FRERMIP SPs: No. of Households		2.03 million
FRERMIP SPs: Average HH Size		5.2
Master Plan Total Area	15,950.0	1,595,000
Master Plan Agricultural Benefit Area (flood risk mitigated)	5,000.0	500,000
Land Reclamation Area in River Corridor, Total	1,500.0	150,000
Land Reclamation Area in River Corridor, FRERMIP	660.0	66,000

EXECUTIVE SUMMARY

Introduction

This report presents the findings of an Environmental Impact Assessment (EIA) study that was carried out as part of the ongoing ADB-financed *Flood and Riverbank Erosion Risk Management Investment Program (FRERMIP)*. FRERMIP is a multitranche financing facility (MFF)[1] 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. The program is implemented in two tranches: Tranche 1 (2014-2021), Tranche 2 (2021-2024). For the Tranche 1 works an EIA study was conducted in 2013-2014. in connection with the feasibility study for the FRERMIP MFF. This EIA report has been updated to include interventions proposed under its Tranche 2 project (Project 2).

Project 2 has the same impact, outcome and outputs as Project 1, and is aligned with the following impact: livelihood in the project area improved. Project 2 will have the following outcome: flood and riverbank erosion risks in the subproject areas reduced. The MFF provided a loan amount of $58 million for a total Project 1 cost of $108 million; further financing of the program is provided by the Government of Bangladesh and the Government of the Netherlands ($15.3 million). For Project 2, the loan amount is $157 million for a total project cost of $212.8 million; further financing includes a grant by the Government of the Netherlands ($17.89 million) and the Government of Bangladesh ($37.91 million)

CONTEXT

The Investment Program 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 sites, the program moves to more systematic riverbank stabilization in Project 2, which will potentially be contributing towards river-reach stabilization to be completed in following projects with a time horizon of 2040.

The stabilization approach is making use of the currently ongoing consolidation of the river morphology developing towards a more accentuated channel pattern like observed in the 1970s, before the dramatic widening (from the 1970s to 2000s) took place, likely caused by the large earthquake in Assam. India in 1950

In parallel, existing, degraded or eroded embankment lines 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 Investment Program 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, riverbanks 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 holistic river stabilization with less channels potentially having some similarity to the river system before the passing of the

[1] The MFF FRERMIP antiapted three individual loans for three individual projects, planned to be implemented with overlapping project periods, building on each other. The overall MFF had a original duration of 9 years with each project planned with an implementation period of about 4 years. In April 2021, ADB approved the extension of the MFF till 26 June 2024 (10 years) and at the request of the government the original second and third tranches have been combined into a final and single tranche (Tranche 2).

	sediment wave of the Great Assam Earthquake. In parallel to studies undertaken under FRERMIP, the government investigates other river restoration alternatives[2]. Sites for FRERMIP have been sescted to follow the 'adaptive approach', reacting to the river behaviour and to influence the river towards river stabilization. The anticipated benefits are considerable: (i) reduced loss of agricultural and other land to river erosion, (ii) reduced flood damage to agriculture (and so on) and (iii) increased agricultural production on less-flooded agricultural land. **THE ASSESSED PROJECT** The assessed project is the proposed Tranche 2 project (Project 2) of the Investment Program. The Tranche 1 project (Project 1) works were located in the same three subprojects and are similar in nature to the Project 2 works. The program area is defined by the upstream boundaries of the Jamuna (or Bangabandhu) bridge (in the Jamuna) and the location of the potential Ganges barrage (in the Ganges) and the downstream boundary of the Padma bridge (in the Padma). The program influence area thus includes the Lower Jamuna, including the bifurcation about 20 km downstream of the Jamuna bridge, the confluence of Jamuna and Ganges and the Upper Padma river and will likely impact tributaries and distributaries in this area. Within this area, three subprojects were identified. While these subprojects were selected considering hydraulic and morphological aspects, they also follow administrative boundaries to enable efficient project implementation. The subprojects are: - JRB-1 (Jamuna Right Bank) along the Jamuna right bank from the Jamuna bridge to the joining of the Hurasagar, - JLB-2 (Jamuna Left Bank) along the Jamuna left bank between the old offtake of the Dhaleswari and the confluence with the Ganges, and - PLB-1 (Padma Left Bank) along the Padma left bank from the confluence to downstream of the Faridpur char. Project 2 physical works consist of riverbank erosion protection works along critically eroding locations in the three sub-projects, construction and rehabilitation of an existing embankment in JRB-1 and channel closure and reclamation of char land in JLB-2. Assessment of the resettlement and compensation requirements of all Project 2 works are dealt separately from this EIA in Resettlement plans and framework.
Impacts	**INTERVENTIONS AND IMPACTS – GENERAL** The Brahmaputra river system (including the braided Brahmaputra in Assam, India and the Jamuna in Bangladesh as well as the Padma and Lower Meghna) is a morphological dynamic system 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 corridor has developed from a more stable single or double channel pattern in the late 1960s to a vastly expanded braided corridor with numerous main, medium, and minor channels by the early 2000s. The reach downstream of Bangabandhu (Jamuna) Bridge still exhibited a largely single channel characteristic in the early 1970s, of 6 km wide. By 2000 the width exceeded 11 km. During this expansion densely populated fertile floodplains 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 meandering channels,

[2] The River Stabilization Plan (2020) investigated one single and one multiple-channel option for Jamuna and Padma as a first step towards river stabilization.. The developments during implementation will be monitored and the plan will be updated based on new findings and morphological assessment..

	many drying up during the dry season. More recently the Brahmaputra river system exhibits much less lateral erosion and slowly returns to a more stable channel pattern. This 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 floodplains, such as the Bangladesh Delta Plan 2100 and, in connection with this, the River Stabilization Plan. Riverbank protection works at the subproject sites have the purpose of protecting the existing lands from erosion. These works have numerous primary intended direct beneficial impacts. Along the erosion-protected reaches, the works reduce the risk that erosion of agricultural land will destroy livelihoods, impoverish vulnerable families, and result in displaced persons' lack of options other than squatting public lands or migrating to the slums of Dhaka. Another intended direct benefit is to reduce risk of erosion damage to existing and future infrastructure (roads, bridges settlements, schoolsetc.) and in particular to minimize the risk of existing or future flood embankment breaching. River changes associated with riverbank protection works under this investment program have been assessed through specific morphology studies[3] which conclude among others that the initial (Tranche 1) riverbank protection works have low impact on the overall river course and morphology of the Jamuna, including the immediate downstream areas. At most riverbank protection sites, the work results in deeper channels along the protected bank but with only limited impact on downstream areas was observed. The morphology study also assessed the relevance of the riverbank protection works built under Project 1 and previous projects, on future potential channel patterns, part of the larger-scale river stabilization plan. The morphology of the Lower Jamuna is defined by (i) the Jamuna bridge, which created a large attached char on the right bank at Enayetpur and a single channel with a length of about 20 km, (ii) the bifurcation of the Jamuna into a right (western) and a left (eastern) channel, (iii) the large central char enclosed by these right and left channels and (iv) the confluence of the two channels just some 4 km upstream of the confluence of the Jamuna and Ganges rivers. The bifurcation in the current configuration, which is stable since about 10 years, has an asymmetrical flow pattern with about 60% of the flow passing through the left channel. This, and interventions in previous projects (namely the ADB-financed Jamuna-Meghna River Erosion Mitigation Project, JMREMP) have largely stabilized the right channel with the left channel left mostly instable. Keeping this configuration in the future appears to be beneficial for further river stabilization as it limits the variability of parameters influencing the performance of riverbank protection and river training works. The Project 1 interventions have started protecting parts of the left channel and led to some stabilization of a river bend at Chauhali. Interventions under Project 2 will build on the previous achievements by: - Stabilization of the bifurcation through the construction of riverbank protection at Enayetpur (JRB-1) and upstream Chauhali (JLB-2), - Reduction of an eroding channel and reclamation of charland at Solimabad (JLB-2), and - Halt ongoing erosion at Benotia (JRB-1) and upstream of Harirampur (PLB-1)

[3] Annex B and C of River Stabilization Plan, BWDB, 2020.

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 higher fish diverversity and population at protected banks, compared to unprotected banks. The size of the fishes depend on the size of the gaps between protection elements, hence large voids in concrete blocks tend to attract larger fish, specifically carnivores, but fewer while geotextile bags ('geobags') have more but smaller voids, attract smaller fishes but in larger numbers. The Center for Environmental and Geographic Information Services (CEGIS, 2011) identified overall positive impacts of geotextile bag revetments on water resources, fisheries, the algae community, the ecosystem and the socio-economy. Key findings are that there is no change in water quality and the terrestrial habitat is protected. During construction, geotextile bag revetments cause local shifting of the migratory routes of the dolphins[5]. However, these effects are reversible, and the constructed revetments do not impact on the free movement of dolphins and the benthic habitat is restored over geotextile bag revetments within some seasons. With respect to the overall use of the recommended riverbank protection technology, CEGIS 2011 concludes: "Considering all environmental, social and technical consequences of the geotextile bag use under water, it might be concluded that compared with CC block use alone, geotextile 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 ensured and monitored.

"Dolphins utilizing riverine habitats potentially impacted by the program works are part of a transboundary (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 outside the program influence area cannot be ruled out. Localized stable and deeper channels in front of the program protective works are more attractive for dolphins as they provide preferred migration routes. First studies (in 2007 and 2011 as mentioned above) 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 (which is during the rising and falling of flood waters in June/July and October/November respectively).

However, large-scale, systematic riverbank protection works implemented along large portions of the riverbank are expected to alter the nature of the river by (i) deepening of the river channels and (ii) reduction of the width of the channels. Both will likely lead to an increase of flow velocitiy and a lower number of sandbanks (both chars and small, shallow banks) in the river. This, in turn, may impact the composition of the aquatic fauna as these conditions favor larger species and negatively impact smaller species. While these effects will likely not ensue from the interventions of Project 2 alone, these are likely to take effect during the lifetime of the project and will be required to be monitored following the establishment of a baseline under Project 2.

The construction of the flood embankment planned for JRB-1 under in Project 2) will disrupt the annual flooding of floodplain land and therefore hamper the migration of fish to spawning grounds on the floodplain and supply of soils and nutrients to the flooded areas. These impacts are planned to be mitigated through the construction of regulators with fish passes allowing the migration of aquatic fauna and the intake and drainage of water.

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

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

SPECIFIC JRB-1 INTERVENTIONS AND IMPACTS

Interventions in JRB-1 will include riverbank protection works at Enayetpur (7 km) and Benotia (3.5 km) as well as construction of a flood embankment (7.9 km) as the continuation of the Kaijuri embankment, constructed under Project 1.

Riverbank protection work will be placed alongside the riverbank in the same manner as earlier works without impacting much on land and water habitat. The flood embankment will be constructed on floodplain land, partially following the course of a previous, now derelict embankment.

In terms of environmental enhancements, different measures are planned:

- BWDB/MoWR will request the Bangladesh Inland Water Transport Authority (BIWTA, under the Ministry of Shipping (MOS)) to place navigation buoys along all protected riverbanks every kilometre, to protect fish habitats from systematic overfishing with floating nets. Also, BWDB will establish and maintain a database of riverbank protection works, dredging works and other related works.
- The countryside slopes of the embankment shall be used for tree plantation of local resilient varieties to help re-establishing a diverse vegetation cover.
- The riverside slope of the embankments shall be planted with resilient grass suitable to provide limited wave protection, where no full wave protection shall be required. Especially vetiver, katkin and dhoincha are recommended.
- Two regulators with fish passes will be constructed to assure connectivity between the main river and the floodplain.
- It is proposed that bird, dolphin and/or fish sanctuaries be established at appropriate locations by the appropriate authorities in cooperation with the BWDB and future river training works.

Impacts expected from JRB-1 interventions include:

- Loss of riverside habitat: some is temporary, as vegetation on banks will be replanted on the embankment slopes; however, as the river morphology will change
- reduction of hydraulic connectivity between river and floodplain, as new works including embankment will serve to protect against flooding and erosion; this affects fish migration and floodplain biota, which can only partly be mitigated with fish-passes and regulators.

Specific JLB-2 Interventions and Impacts

Interventions in JLB-2 will include construction of (i) riverbank protection at upstream Chauhali (15.5 km), (i) the choking of the Solimabad channel through dredging of the main Jamuna channel and overloading of the Solimabad channel with sediment in combination with plantations to capture fine sediments on the Solimabad char and, following the choking of the Solimabad channel (iii) the construction of a stable offtake for the Ghior Khal distributary in combination with some more riverbank protection to connect the offtake to the existing riverbank protection at Chauhali. The exact nature and extend of the latter are to be determined following the choking of the solimabad channel.

Environmental mitigation and enhancement measures follow the same principles as applied to the works at JRB-1. In addition to the typical works alongside the floodplains, the around 100 m wide strip between the protected riverbank and the embankment on the char shall be planted with dhoincha, katkin, vetiver or any other helpful plant for land reclamation to combine a technical function with income generation and environmental enhancement. The thick layer of reeds provides habitat.

Specific PLB-1 Interventions and Impacts

	In PLB-1, about 4 km of riverbank protection will be constructed under Project 2 to extend the existing protection upstream to halt ongoing erosion and to prevent outflanking of the works. Impacts and mitigation measures are the same as for JRB-1 and JLB-2. **CONSTRUCTION IMPACTS** Routine impacts of construction-phase activities will 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** Three rounds of public consultation were undertaken during preparation of Project 1 and Project 2 EIA. The first two rounds (2013-2014) presented the proposed project and EIA terms of reference to stakeholders for their review and suggestions and presented the draft EIA results to stakeholders for their comments. Stakeholder concerns are at most moderate, and are resolvable through continued dialogue and accommodation during design and implementation. During the third round (2016-2017) stakeholders in JRB-1 and JLB-2 were revisited and the proposed Project 2 works presented and responses were sought and incorporated in the subproject designs. **RECOMMENDED ACTIONS** Mitigation of the impacts is complex and challenging. It will not result in all residual impacts being reduced to insignificance, but mitigaton (as indicated in the EMP, and following SOPs) will reduce them to levels considered acceptable by government (e.g. MoE) and society at large. To the extent possible, impacts will be mitigated through measures purpose-designed to the impact and setting. Many mitigation measures have been mainstreamed into the engineering designs, which also incorporate significant impact avoidance features e.g. leaving distributaries open and embankment afforestation. It is important to recognize potential cumulative effects when moving from emergency type riverbank protection (that target initial perceived risks and are reactive) during the initial project towards more systematic river stabilization in the priority reaches during following tranches. Project 1 incorporated a comprehensive river stabilization study to develop and assess potential future stabilization options as well as impacts and mitigation measures. In addition, this study accounted for the potential cumulative and transboundary 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 categorization	The environmental safeguards for the investment program were first outlined in an Environmental Assessment and Review Framework (EARF) in May 2014 (updated in March 2021). In addition, a Strategic Environmental and Social Assessment (SESA) for the main River Stabilization Plan that was first drafted in 2016 and has been updated and expanded several times since. The SESA, developed in coordination with the Government of the Netherlands, was finalized and accepted in April 2020. The document will be updated during implementation of Project 2. The Project 2 EIA team conducted compliance monitoring of the Environmental Management Plan (EMP) implementation of Project 1 works which yielded important insights in which impacts were/were not significant. This team also conducted a SESA for the wider long-term River Stabilization Plan (RSP) that identified significant impacts.

	Lessons learnt from Project 1 implementation include: (i) Environmental training of contractors and EA (PMO and SMO) officers was successful, but due to high fluctuation in personel, this has to be continued in the future, (ii) the EA (PMO and SMOs) had no dedicated environmental safeguard personnel, and (iii) it was found that not sufficent background data as baseline is available. This was partially addressed through a fisheries study and will be further addressed through a biodiversity study under Project 2 to strengthen baseline, assess impacts of river stabilization and update suitable mitigation measures for timely implementation. Schedule 1 of Government of Bangladesh's (GoB) Environmental Conservation Rules act of 1997 lists 69 types of projects listed as Red category, including: i) engineering works where the capital investment is more than 1 million Taka; and ii) construction/reconstruction/expansion of flood control embankment, polder, dike, and so on. Hence, according to the government regulations, Project 2 is a Red category project requiring an IEE, EIA and EMP, and environmental clearance from the Bangladesh DoE. **The clearance for Project 2 was obtained in December 2020.** Identified potential or likely **significant** negative impacts of Project 2 interventions, are anticipated to include the following: 1. Reduced river connectivity between the river and the (current) floodplain, affecting surface and groundwaters and fisheries resources. 2. Loss of natural terrestrial, aquatic and wildlife habitat, affecting biodiversity and fisheries production. 3. Alteration of the main river channel from a wide, braiding river to a less braided, narrower course, resulting in permanent loss of river associated habitats. The impacts of the planned interventions under Project 2 are anticipated to result in significant impacts, in particular on fish, fisheries and wildlife habitat, which are likely to be lasting and to extend beyond the sites of physical works. These expected impacts result in a categorization of the project as **environment Category A**, according to the ADB safeguard policy statement (2009)[6]. To establish a baseline and to monitor the impacts, a biodiversity study is included under Project2.
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 Wetland Biodiversity Rehabilitation Project of GIZ /Department of Fisheries/BWDB, recently concluded in areas of Padma adjacent to the JRB-1 project area. • *Impacts on open water fish biodiversity and production.* Measures to mitigate these impacts (i) include open water fisheries-related measures (such as fish-passes and buoys to curb use of nets) 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 will be documented in the Resettlement Action Plan for Project-2.

[6] Asian Development Bank Safeguard Policy Statement June 2009.

	The EMP will be implemented by the Project Management Office supported by the Institutional Strengthening and Project Management Consultant (ISPMC) team who includes environment specialists. There will be provisions for appointing an NGO and a separately hired specialist environmental management organization to expand the biodiversity database for the study area and outline the establishment of one or more fisheries sanctuaries 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. A significant EMP item for the Project 2 works is the construction of 2 regulators plus fish-passes at JRB-1, designed to maintain connectivity between the river and the floodplain. At about USD 1 million per regulator, this is a significant EMP investment; other key EMP investmentis include installing buoys by BIWTA/MoS in consultation with BWDB/FRERMIP at 1 km intervals along 60 km of the left bank of the Jamuna River with the dual purpose to indicate the navigation channel and prevent illegal fishing practice with drift nets. Most of the mitigation and environmental enhancement measures in the EMP however, are the responsibility of the contractors, or are the responsibility of BWDB staff, or other parties, and these are thus mostly cost items that are paid from other budget lines. As total costs of the Project 2 works are estimated to be around $ 212.8 million, the total EMP implementation costs are estimated at $ 5 million, or 2.4% of the total project costs for Project 2.
Design- and Implementation -Phase Public Consultation	Stakeholder consultation will continue during project implementation to provide information to stakeholders about the project and to receive their inputs and concerns. Meetings will include 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 (GRM)	Under Project 1, three local Grievance Redress Committees (GRCs) were formed, one in each subproject area. While these will continue during implementation of Project 2, they require strengthening to enable effective functioning. To enahance the capacity, it is proposed to assign two national GRM specialists (male and female) to facilitate the (re)- establishment and operation of the GRCs at each site. A Joint Verification Team (JVT) consisting of 3 members (Representatives from BWDB, DC, INGO) will visit the sites before planning and construction for investigation of land and resettlements or other related assets. Then a Property Valuation Advisory Team (PVAT) consist of 4 members (Representative from BWDB, DC, INGO) will assess the costing of the identified assets in the alignment of the intervention. The concerned office will pay the Affected Person (AP)s CCL and Resettlement Grants as per PVAT's decision. If any AP has any complaint against any decision, then he can submit his complaint to the GRC. Each GRC consists of 5 members (Representatives from BWDB, UP, AP, INGO). Aggrieved persons are free to access the country's legal system regardless of GRC involvement.
Reporting and Monitoring	Reports will be prepared according to ADB's and government (BWDB, MoWR, DoE, ERD, PC and others) requirements. These include Quarterly Progress Reports (QPR), semi-annual Environmental Monitoring Reports, Work Completion Reports, Training Reports, IMED Reports, Project/Work Completion Reports, Facility Completion Report. The reports will be disclosed on ADB, BWDB and the project's website. Environmental Monitoring Reports will be prepared by the PMO with close consultation with the Environmental Focal Point (EFP), the Gender Progress Report will be prepared by the PMO with close consultation with the

	Gender Focal Point (GFP) and the Resettlement Plan Implementation Progress Report will be prepared by the PMO with close consultation with the Resettlement Focal Point (RFP). 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 regular review missions involving ADB, the Executing Agency and the Implementing Agency.

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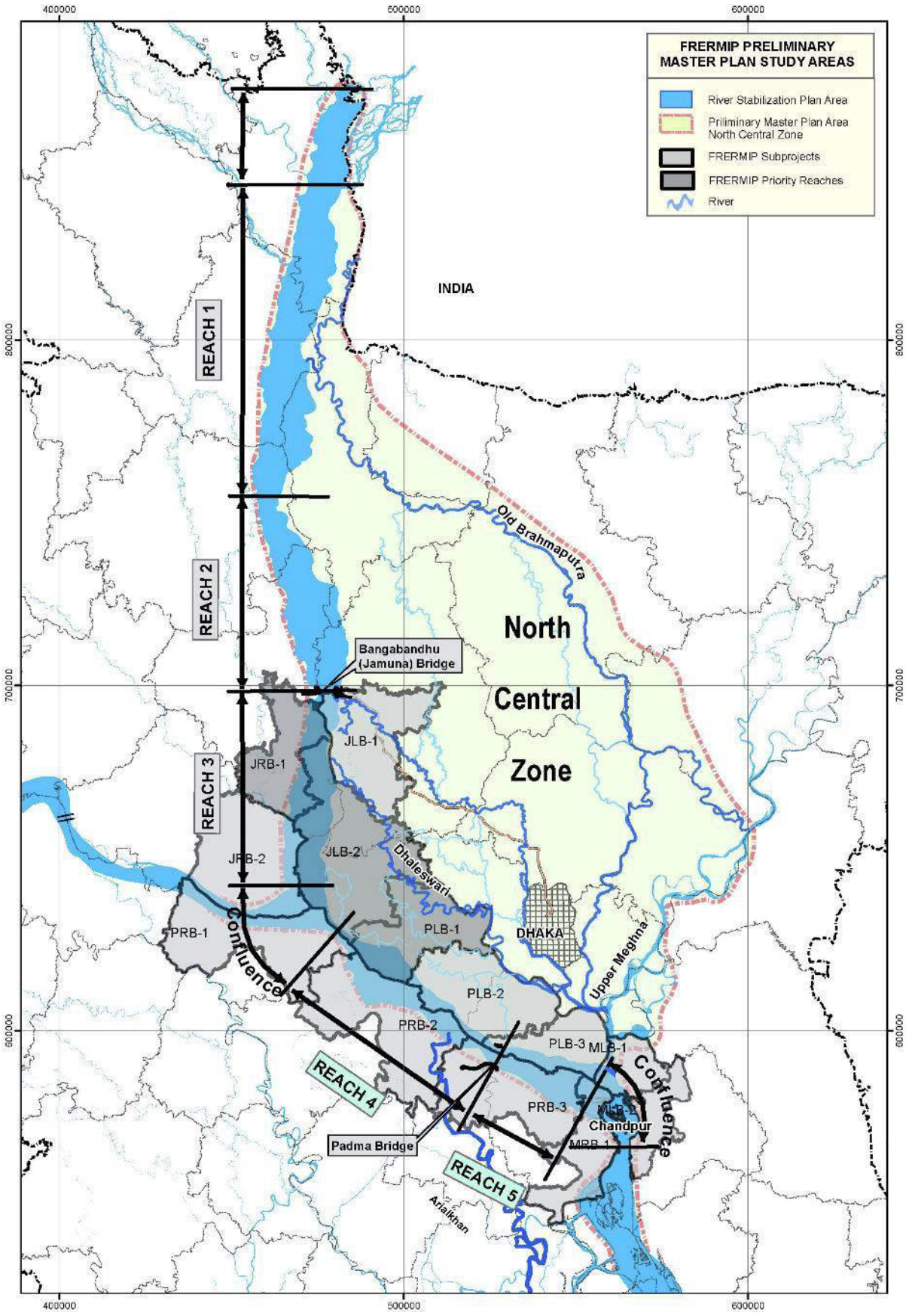
ADB	Asian Development Bank
AIFRERMIP	Assam Integrated Flood and Riverbank Erosion Risk Management Investment Program
BBA	Bangladesh Bridge Authority
BBS	Bangladesh Bureau of Statistics
BCCSAP	Bangladesh Climate Change Strategy and Action Plan
BDT	Bangladesh Taka
BMD	Bangladesh Meteorology Department
BWDB	Bangladesh Water Development Board
CAS	Catch Assessment Survey
CC	Cement concrete
CEGIS	Centre for Environmental and Geographic Information Services
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
ECA	Ecologically Critical Area
EIA	Environmental Impact Statement
EMM	Euroconsult Mott MacDonald Ltd. (UK)
EMP	Environmental Management Plan
EOP	Environment-on-project
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
FES	Fishing Effort Survey
FGD	Focus Group Discussion
FRA	Feeder Road Type A
FRB	Feeder Road B
FRERMIP	Flood and Riverbank Erosion Risk Management Investment Program

FS	Feasibility Study / Frame Survey
FWIP	Future-with-project
FWOP	Future-without-project
GoB	Government of Bangladesh
GRC	Grievance Redress Committee
GRM	Grievance Redress Mechanism
GPA	Guidelines for Project Assessment
IEE	Initial Environmental Examination
IESC	Important Environmental and Social Component
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
JLB	Jamuna Left Bank
JRB	Jamuna Right Bank
JVT	Joint Verification Team
KII	Key Informant Interview
MFF	Multi-tranche Financing Facility
MLB	Meghna Left Bank
MPO	Master Planning Organization
NGO	Non-governmental organization
NHC	Northwest Hydraulic Consultants Ltd. (Canada)
NWRD	National Water Resources Database
PC	Public consultation
PCR	Public Cultural Resources
PLB	Padma Left Bank
PMBP	Padma Multipurpose Bridge Project
PMO	Project Management Office
PPTA	Project Preparation Technical Assistance
PWD	Public Works Department
RCC	Reinforced Cement concrete
RBIP	Riverbank Improvement Project
RRA	Rapid Rural Appraisal
SRDI	Soil Resource Development Institute
UFO	Upazila Fisheries Office
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
WARPO	Water Resources Planning Organization



Subprojects of FRERMIP

1 INTRODUCTION

1.1 Overview

1. The project area of the Flood and Riverbank Erosion Risk Management Investment Program (FRERMIP) comprises about 244,316 ha of which approximately 15% consists of water bodies and the remainder consists of terrestrial habitats including charland. 13% (up to 37% during the monsoon season, with rivers 30,783 ha and floodplain 59,782 ha) is occupied by rivers and a minor percentage (less than 2%; khal 312 ha, beels 1258 ha, kol 605 ha, fish ponds 1,235 ha) is occupied by other water bodies. The hydrology of the area is dominated by the three major rivers: Jamuna, Ganges and Padma. FRERMIP is financed through an Asian Development Bank (ADB) multitranche financing facility (MFF)for the benefits of the Government of Bangladesh (GoB). It aims at sustaining incomes and livelihoods of people living along the fore-mentioned three main rivers by enhancing resilience to flood and riverbank erosion. Project outputs from Project 2 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. Total project costs are $ 212.8 million ($157 m loan from ADB, $36.91 million of GoB counterpart funds, and $17.89 million as a grant from the Government of the Netherlands).

2. An Environmental Assessment Review Framework (EARF) and an Environmental Impact Assessment (EIA) report, both of May 2014, were prepared for the investment program and the Project 1 feasibility studies under the ADB-financed project preparation technical assistance project Main River Flood and Bank Erosion Risk Management Program (PPTA No. 8054 BAN). The EARF has been updated for Project 2 in 2021.

3. The EARF sets forth (i) the safeguards procedures to be followed during subsequent tranches / projects, (ii) safeguards-related criteria to be considered in the selection of subprojects for subsequent tranches, and, regarding executing agency safeguards capacity, (iii) an assessment and recommendations for appropriate institutional strengthening.

4. The 2014 EIA for Project 1 was made for three (3) subprojects: Jamuna Right Bank 1 (JRB-1), Jamuna Left Bank 2 (JLB-2), and Padma Left Bank 1 (PLB-1). Project 1 construction interventions comprised riverbank protection works through application of sandbags and concrete blocks, rehabilitation and construction of new embankments and drainage structures. The draft EIA report was reviewed by the Netherlands Commission for Environmental Assessment (NCEA) and comments were to the extent possible at that stage incorporated in the version of May 2014 of the report (Annex 11).

5. This EIA is for the same three subprojects for Project 2. Construction interventions for Project 2 are the same as those of Project 1 1. This EIA for Project 2 is an update of the approved EIA report of Project 1.

1.2 Objectives

6. The Investment Program aims to provide security and 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 *versus* Study Area

7. The project area of the proposed investment encompasses the river reach of the Jamuna River from south of the Jamuna Bridge and the proposed Ganges Barrage site to Chandpur on the Lower Meghna. The Jamuna and Ganges river courses downstream of these

two major river works are somewhat independent of upstream river developments. The total project area supports 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.

8. The EIA study area has focused on three subprojects, i.e. JRB-1, JLB-2 and PLB-1, selected from 13 subprojects into which the Main River Project (MRP) area was divided based on discussions among BWDB, ADB and the PPTA consultant. Subprojects are divided at Upazilas boundaries, most of which follow main river tributaries and distributaries and have not changed since 1961, facilitating the calculation of long-term trends from Upazilas-wise datasets. Each subproject covers three to four upazilas and has a population of approximately 1 million. Six subprojects were selected for pre-feasibility level investigation using a multi-criteria assessment approach, and works were implemented in JRB-1, JLB-2 and PLB-1 under Project 1. These three subprojects were retained for the feasibility study of Project 2.

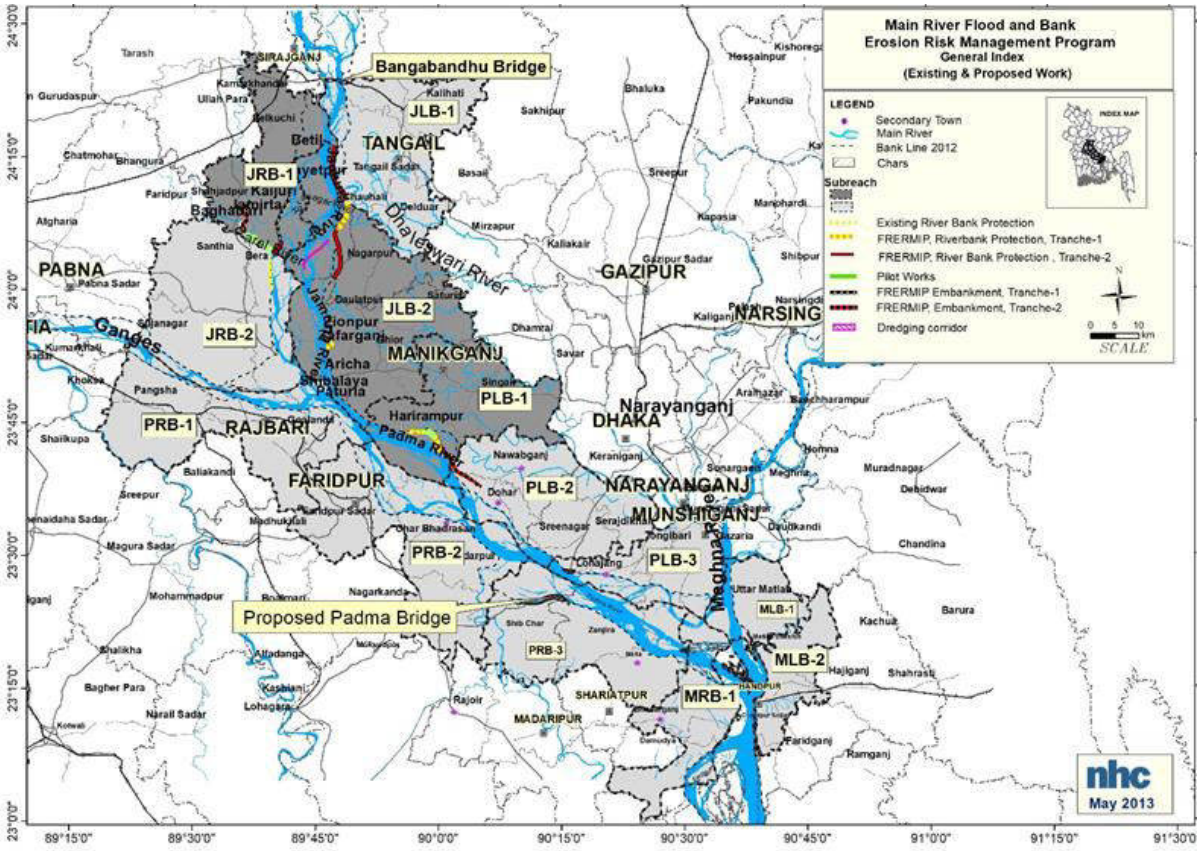


Figure 1-1. Project area with subprojects

1.4 EIA Team Members

The EIA for Project 1 was prepared by the following specialists:

- Dr Sara Bennett, International Environmental Specialist
- Mr Mujibul Huq, Environmental Adviser, CEGIS
- Dr Anil Chandra Aich, Soil and Agriculture Specialist, CEGIS
- Dr Dilruba Ahmed, Senior Sociologist, CEGIS
- Mr Ashok Kumar Das, Senior Fisheries Biologist, CEGIS
- Mr Kazi Kamrull Hassan, Senior Water Resources Planner, CEGIS
- Mr Amanat Ullah, Senior Ecologist, CEGIS
- Mr Fahad Khan Khadim, Junior Water Resources Engineer, CEGIS

- Mr Roland Nathan Mondol, Junior Fisheries Biologist
- Mr Mobashir Bin Ansari, Junior Sociologist
- Mr Saifuddin Mahmud, Junior Sociologist
- Mr Zahid Hasan Dhali, Junior Agriculturist

This updated EIA was prepared by the following specialists:

- Mr Wandert Benthem, International Environmental Specialist
- Mr Md. Amir Faisal, National Environmental Specialist
- Dr Md. Shahjahan Howlader, National Fisheries Specialist
- Mr. Wim Giesen, International Environmental Specialist

1.5 Report Format

This EIA has the following twelve 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 conditions 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 river stabilization works

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

Chapter 9: Grievance Redress Mechanism

Chapter 10: Analysis of alternatives

Chapter 11: Environmental Management Plan

Chapter 12: Conclusions and recommendations

2 POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

2.1 Introduction

9. 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

NATIONAL CONSERVATION STRATEGY (NCS, 1992)

10. The NCS was drafted in late 1991, submitted to Government in early 1992, and then approved in 1993. After Bangladesh endorsed 1980's World Conservation Strategy, the government (with assistance from IUCN) started working on developing the NCS document for Bangladesh. The objectives of the NCS are to: i) Provide guidance for future resource use and for conservation of resources; and ii) Suggest actions to be adopted by the government to ensure conservation of resources while keeping up the current pace of resource utilisation and economic development.

NATIONAL ENVIRONMENTAL POLICY (NEP, 1992)

11. The Bangladesh NEP 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 Environmental Policy designates the Department of Environment (DoE) as the approving agency for all such IEEs/EIAs to be undertaken in the country.

NATIONAL ENVIRONMENTAL MANAGEMENT ACTION PLAN (NEMAP, 1995)

12. The NEMAP is a wide ranging and multi-faceted plan building on and extending 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 sets out the framework within which the recommendations of the National Conservation Strategy are to be implemented. NEMAP provides the framework for implementing the NCS.

13. NEMAP has the following broad objectives:

(i) Identification of key environmental issues affecting Bangladesh;
(ii) Identification of actions necessary to halt or reduce rate of environmental degradation;
(iii) Improvement of the natural and built environment;
(iv) Conservation of habitats and biodiversity;
(v) Promotion of sustainable development; and
(vi) Improvement in the quality of life of the people.

BANGLADESH CLIMATE CHANGE STRATEGY AND ACTION PLAN (BCCSAP, 2009)

14. The BCCSAP was formulated in 2008 to coordinate the country's response to climate change, and be presented as a coordinated effort at the UNFCCC 2009 COP in Bali. The BCCSAP demonstrates the government's commitment to low carbon development and ensuring that infrastructure is climate proof, both of which are of direct relevance to Project 2 design and implementation.

15. The BCCSAP 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.

2.1.2 Environmental Conservation Act (ECA, 1995) and Amendments

ECA '95

16. 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 that is now repealed.

(I) The main objectives of ECA '95 are:
   a. conservation and improvement of the environment; and
   b. control and mitigation of pollution of the environment.
(II) The main strategies of ECA '95 can be summarized as:
   a. 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 (by 2015, 13 Ecologically Critical Areas had been declared in Bangladesh, none of which are in the project area);
   b. Regulations in respect of vehicles emitting smoke harmful for the environment; Environmental clearance;
   c. 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;
   d. Promulgation of a standard limit for discharging and emitting waste; and
   e. Formulation and declaration of environmental guidelines.

17. 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.

18. A schedule attached to the Environment Conservation Rules 1997 categorizes projects as Green, Orange A, Orange B, and Red, with green having least impact and red having major

environmental impacts and identifies for each category the level of environmental impact assessment required and other clearance application procedures and information.

19. 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 ten years imprisonment or a maximum fine of BDT1,000,000 or both. The Department of Environment (DOE) executes the Act under the leadership of the DG.

ECA AMENDMENT 2000

20. 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

21. 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; and (v) authority for trials of environmental cases.

ECA AMENDMENT 2010

22. 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. This amendment empowered the government to enforce more penalties than before. Moreover, affected persons were given provision for putting objections or taking legal actions against the polluters or any entity creating nuisance to affected person.

ENVIRONMENT COURT ACT (ECA, 2010)

23. This act provides for the establishment of 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. This act allows government to take necessary legal action against any parties who creates environmental hazards/damage to environmentally sensitive areas as well as human society. According to this act, government can take legal actions if any environmental problem occurs due to FRERMIP interventions.

ENVIRONMENTAL CONSERVATION RULES (ECR, 1997)

24. The ECR were issued by the Government of Bangladesh in exercise of the power conferred under the Environment Conservation Act (Section 20), 1995. Under these Rules, the following aspects, among others, are covered:

(i) Declaration of ecologically critical areas
(ii) Classification of industries and projects into four categories
(iii) Procedures for issuing the Environmental Clearance Certificate (ECC)

(iv) Determination of environmental standards.

25. Rule 3 defines the factors to be considered in declaring an area 'ecologically critical area' (ECA) as per Section 5 of ECA 95. It empowers the Government to declare an area 'ECA' if it is satisfied that the ecosystem of the area has reached or is threatened to reach a critical state or condition due to environmental degradation. The Government is also empowered to specify which of the operations or processes shall not be carried out or shall not be initiated in the ecologically critical area.

26. Rule 7 classifies industrial units and projects into four categories depending on environmental impact and location for issuance of ECC. These categories are: Green, Orange A, Orange B, and Red.

27. All existing industrial units and projects and proposed industrial units and projects that are low polluting are categorized under "Green" and shall be granted Environmental Clearance. For proposed industrial units and projects falling in the Orange-A, Orange-B and Red Categories, firstly a site clearance certificate and thereafter an environmental clearance certificate will be required. A detailed description of these four categories of industries has been given in Schedule-1 of ECR '97. Apart from the general requirement for every Red category proposed industrial unit or project the application must be accompanied with a feasibility report, Initial Environmental Examination (IEE), Environmental Impact Assessment (EIA) based on approved terms of reference (ToR) by DoE, and Environmental Management Plan (EMP). As per ECR '97, water resources development projects fall under the 'Red' category project, as do engineering works where the capital investment is more than 1 million Taka. Therefore, the FRERMIP project is a 'Red' category project which requires IEE, EIA. And EMP for environmental clearance from DoE.

28. The ECR '97 describes the procedures for obtaining Environmental Clearance Certificates (ECC) from the Department of Environment for different types of proposed units or projects. Any person or organization wishing to establish an industrial unit or project must obtain ECC from the Director General. The application for such certificate must be in the prescribed form together with the prescribed fees laid down in Schedule 13, through the deposit of a Treasury Challan in favor of the Director General. The fees for clearance certificates have been revised in 2010. Rule 8 prescribes the duration of validity of such certificate (three years for green category and one year for other categories) and compulsory requirement for renewal of certificate at least 30 days before expiry of its validity.

EIA GUIDELINES FOR INDUSTRIES (1997)

29. Sets forth IEE and EIA requirements for various industrial sectors and activities.

ENVIRONMENTAL CLEARANCE PROCEDURE FOR RED CATEGORY PROJECTS

30. Figure 2-1 shows the application procedure for obtaining site / environmental clearance. To obtain an environmental clearance certificate for category Red projects (i.e. the Project documented here), the following documents and materials must be submitted with the application to DoE:

(i) Project feasibility report, where applicable
(ii) Environmental impact assessment report
(iii) Environmental management plan
(iv) No Objection Certificate from relevant local authority (where applicable)
(v) Other necessary information, where applicable

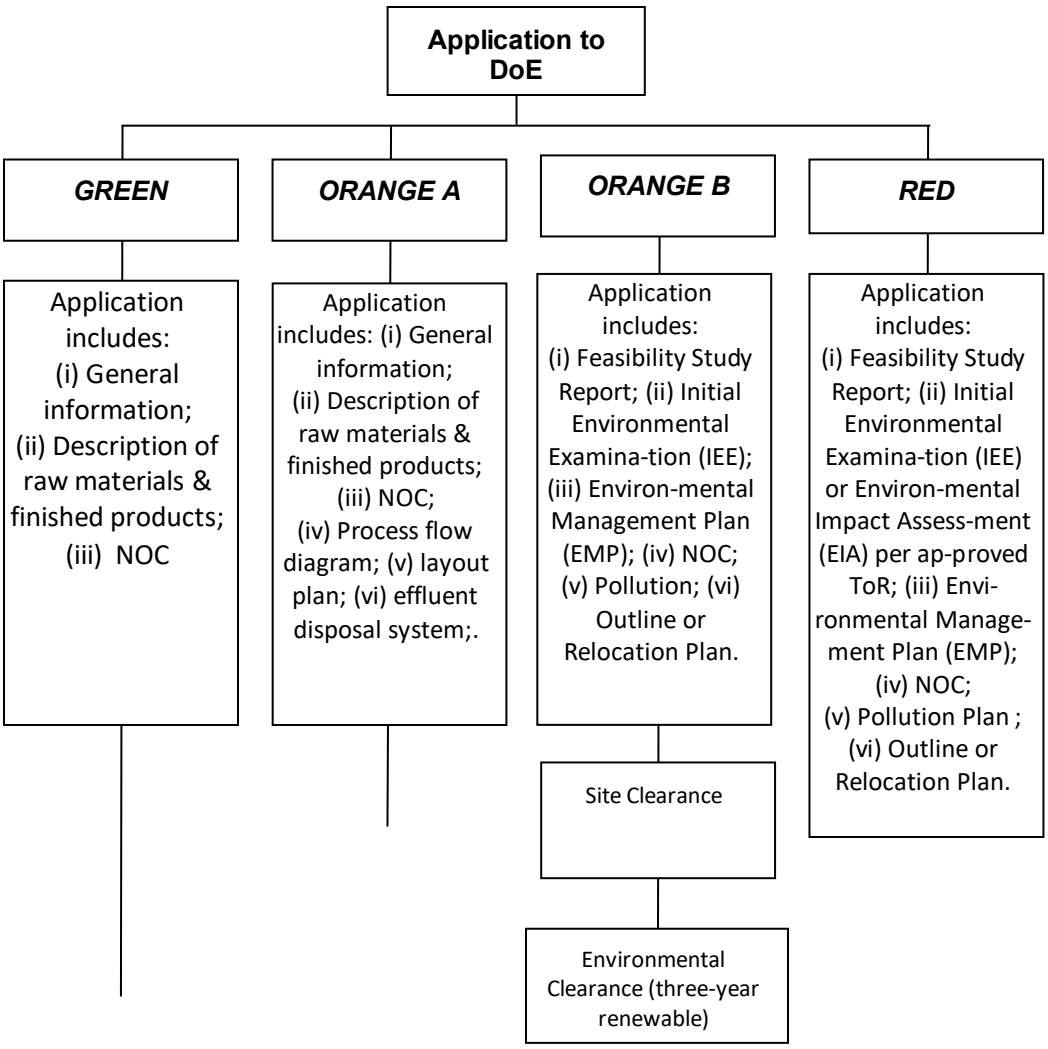


Figure 2-1. Application procedure for obtaining site and environmental clearance

2.1.3 Water Policies, Plans, and Legislation

NATIONAL WATER POLICY (1999)

31. Endorsed by the GoB in 1999, the National Water Policy (NWP) aims to provide guidance to the major players in water sector for ensuring optimal development and management of water. According to the policy, all agencies and departments entrusted with water resource management responsibilities (regulation, planning, construction, operation, and maintenance) are required to enhance environmental amenities and ensure that environmental resources are protected and restored in executing their tasks.

32. The policy has several clauses related to water resource development projects for ensuring environmental protection. Some of the relevant clauses are:

(i) Clause 4.5b: Planning and feasibility studies of all projects will follow the Guidelines for Project Assessment, the Guidelines for People's Participation (GPP), the Guidelines for Environmental Impact Assessment, and all other instructions that may be issued from time to time by the Government.

(ii) Clause 4.9b: Measures will be taken to minimize disruption to the natural aquatic environment in streams and water channels.
(iii) Clause 4.9e: Water development plans will not interrupt fish movement and will make adequate provisions in control structures for allowing fish migration and breeding.
(iv) Clause 4.10a: Water development projects should cause minimal disruption to navigation and, where necessary, adequate mitigation measures should be taken.
(v) Clause 4.12a: Consider environmental protection, restoration and enhancement measures consistent with National Environmental Management Action Plan (NEMAP) and the National Water Management Plan (NWMP).
(vi) Clause 4.12b: Adhere to a formal environment impact assessment (EIA) process, as set out in EIA guidelines and manuals for water sector projects, in each water resources development project or rehabilitation program of size and scope specified by the Government from time to time.
(vii) Clause 4.13b: Only those water related projects will be taken up for execution that will not interfere with aquatic characteristics of those water bodies.

33. Most of the above clauses are applicable to the FRERMIP.

NATIONAL WATER MANAGEMENT PLAN (2001, APPROVED 2004)

34. The National Water Management Plan (NWMP) 2001, approved by the National Water Resources Council in 2004, envisions to establish an integrated development, management and use of water resources in Bangladesh over a period of 25 years. Water Resources Planning Organization (WARPO) has been assigned to monitor the national water management plan. The major programs in the Plan have been organized under eight sub-sectoral clusters: i) Institutional Development, ii) Enabling Environment, iii) Main River, iv) Towns and Rural Areas, v) Major Cities; vi) Disaster Management; vii) Agriculture and Water Management, and viii) Environment and Aquatic Resources. Each cluster comprises of several individual programs, and a total of 84 sub-sectoral programs have been identified and presented in the investment portfolio.

GUIDELINES FOR ENVIRONMENTAL ASSESSMENT OF WATER MANAGEMENT (FLOOD CONTROL, DRAINAGE AND IRRIGATION) PROJECTS (APPROVED 2003, PUBLISHED 2005)

35. 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, considering 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."

THE NATIONAL DRINKING WATER SUPPLY AND SANITATION POLICY (1998)

36. The goal of the National Drinking Water Supply and Sanitation Policy (1998) is access 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.

THE NATIONAL POLICY FOR ARSENIC MITIGATION (2004)

37. 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.

38. 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. Any resettlement on Project 2 should bear in mind the issues related to arsenic in drinking water.

INLAND WATER TRANSPORT AUTHORITY ORDINANCE (1958)

39. 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.

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

BANGLADESH WILDLIFE (PROTECTION AND SAFETY) ACT 2012

40. The Act is to provide for the conservation and safety of biodiversity, forest and wildlife of Bangladesh by repealing the existing law relating to the country's conservation and management of wildlife; I Act:

(i) 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 mollusc, 22 species of crustacean, 24 species of insect, 41 species of plant and 13 species of orchid. Of these, 8 amphibian-, 58 reptile-, 41 bird-, and 40 mammal species are listed as endangered in the Bangladesh IUCN Red Data Book (2000).

(ii) 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 of wild animals, parts of wild animals, trophies, meat or other products without licence

(iii) 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.

(iv) Mandates five years imprisonment and BDT 200,000 fine for killing a cheetah, clouded cheetah, gibbon, sambar deer, crocodile, gavial, whale and dolphin.

(v) Mandates two years imprisonment and BDT 200,000 fine for killing a wild or migratory bird.

(vi) Empowers the Government to create an eco-park, safari park, botanical garden, or breeding ground on any state-owned forest land, land or waterbody.
(vii) Mandates two years imprisonment for farming, woodcutting, burning, and construction on such reserves.

BANGLADESH WILDLIFE (PRESERVATION) ORDER (1973) AND ACT (1974)

41. The Bangladesh Wildlife Preservation (Amendment) Act 1974 regulates the hunting, killing, capture, trade and export of wildlife and wildlife products. It provides a list of protected species and game animals, and 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:

(i) *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;
(ii) *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;
(iii) *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 protecting natural resources, including wildlife vegetation, soil, and water.

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

PROTECTION AND CONSERVATION OF FISH ACT (1950)

43. This Act provides power to the government to:

(i) Make and apply rules to protect fisheries.
(ii) Prohibit or regulate erection and use of fixed engines; and construction of temporary or permanent weirs, dams, bunds, embankments and other structures.
(iii) Prohibit the destruction of fish by explosives, guns, and bows in inland or coastal areas.
(iv) Prohibit the destruction of fish by poisoning, pollution, or effluents.
(v) Prescribe the seasons during which fishing is allowed.
(vi) Prohibit fishing during spawning periods.
(vii) Specify officials having authority to detect breaches of this Act.

EAST-BENGAL PROTECTION AND FISH CONSERVATION ACT (1950) AND AMENDMENTS

44. East-Bengal Protection and Fish Conservation Act (1950) and Amendments 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 rulemaking regarding destruction of, or any attempt to destroy, fish by poisoning of water or depletion of fisheries by pollution, industrial effluent, or otherwise.

PROTECTION AND CONSERVATION OF FISH RULES (1985)

45. 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.”

THE NATIONAL FORESTRY POLICY (1994)

46. 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.

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

THE BIODIVERSITY CONSERVATION STRATEGY AND ACTION PLAN 2004

48. 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:

(i) Identification of key environmental issues affecting Bangladesh;
(ii) Identification of actions necessary to halt or reduce the rate of environmental degradation;
(iii) Improvement of the natural and built environment;
(iv) Conservation of habitats and biodiversity;
(v) Promotion of sustainable development; and
(vi) Improvement in the quality of life of the people.

2.1.5 Agriculture and Land Use Policies and Legislation

NATIONAL AGRICULTURE POLICY (1999)

49. 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 12 upazila-level programs to address soil erosion in Madhupur Tract, Barind Tract, and the piedmont.

NEW AGRICULTURAL EXTENSION POLICY (1996)

50. The goal of the New Agricultural Extension Policy 1996 is 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 Bangladesh agriculture. 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.

51. 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. 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; and (v) effective linkages to support three-way information flow between farmers, extension agents, and research institute staff.

NATIONAL LAND USE POLICY (2001)

52. 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 considering local geological differences, to rationalize the currently unplanned expansion of residential, industrial, and commercial construction.

NATIONAL ENVIRONMENTAL POLICY

53. Bangladesh National Environmental Policy of 1992 is one of the key policy documents of the Government and sets out the basic framework for environmental action. The Environment Policy delineates the Department of Environment (DoE) as the approving agency for all such IEE/EIAs to be undertaken in the country. The objectives of Environmental Policy are to i) Maintain ecological balance and overall development through protection and improvement of the environment; ii) Protect the country against natural disaster; iii) Identify and regulate activities which pollute and degrade the environment; iv) Ensure environmentally sound development in all sector; v) Ensure sustainable, long term and environmentally sound use of all national resources, and vi) Actively remain associated with all international environmental initiatives to the maximum possible extent. The Policy covered all geographical regions and 15 development sector like Agriculture, Industry, Health & Sanitation, Energy and Fuel, Water Development, Flood Control and Irrigation, Land, Forest, Wildlife and Bio-diversity, Fisheries and Livestock, Food, Coastal and Marine Environment, Transport and Communication, Housing and Urbanization, Population, Education and Public awareness.

THE BANGLADESH BIODIVERSITY ACT, 2017

54. The Act was passed in line with Bangladesh's constitutional mandate under Article 18A and international mandates under Convention on Biodiversity. This Act regulates the Biodiversity conservation and sustainable use of its resources. The Bangladesh Biodiversity act includes National Fisheries Policy, 1988, National Livestock Development policy 2007, National

Forest Policy 1994, Bangladesh Wildlife (Protection and Safety) Act, 2012. It delegates the duties for granting permission to such access on the National Biodiversity Committee, who shall also determine the equitable sharing of benefits accrued from biodiversity, biological resources and traditional knowledge.

JALMAHAL MANAGEMENT POLICY, 2009

55. Government of Bangladesh set out "Government Jalmahal management Policy, 2009" in order to conserve Biodiversity of fisheries and income generating of fish farmer and fisherman. The Policy stipulates specific rules for leasing out of lands and water bodies owned by Government (khas land) to the fish farmer and fisherman. The policy provides formation of committees in different levels of the Government to lease out Jalmahal up to 20 acres and above.

BALUMAHAL AND SOIL MANAGEMENT ACT, 2010

56. Balumahal and Soil Management Act, 2010 provides to overcome the hazards faced and extraction of sand/soil in a planned manner during leasing out of Balumahal. The act imposes the restriction of extraction of sand from specified area on certain conditions. This act includes the illegal extraction of sand as offence and subject to trail for penalty of such activities.

2.1.6 Environmental Quality Standards

57. Environmental quality standards relevant to the Project, for air quality, noise, and sewage discharge, are provided in Table 2-1, Table 2-2 and Table 2-3.

Table 2-1. Bangladesh Standards for Ambient Air Quality

No.	Area	Suspended Particulate Matter	SO_2	Co_2	NOs
		(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 (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 defined as the time between 6 Am. to 9 pm.
2. Night-time is defined 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-l3, Environment Conservation Rules, 1997. (Page 3131, Bangladesh Gazette, 28 August 199, trans. from Bengali].

Notes: i) These standards are applicable for discharge into surface and inland water bodies; ii) Chlorination is to be done before final discharge.

2.2 Project-Relevant International Environmental Agreements in Force in Bangladesh

58. Of the international environmental agreements to which Bangladesh is a party,[7] 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: a. sustainable use of biological diversity components,

(iv) fair and equitable sharing of genetic resources utilization benefits.

(v) 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.

(vi) Convention on Climate Changes (Known as Kyoto Protocol, Japan, 1997) International treaty on climate change and emission of greenhouse gases.

(vii) Convention on Occupational Health services (Geneva, 1985) To promote a safe and healthy working environment.

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

59. These instruments document the GOB commitment to biodiversity conservation, climate change and disaster risk management generally, at all levels (global-national-regional-local and ecosystem-habitat-species), and specifically to the provisions of these agreements.

2.2.1 ADB Safeguards: Policy and Guidelines/Guidance Documents

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

ENVIRONMENT AND SOCIAL

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

ENVIRONMENT

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

SOCIAL

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

3 APPROACH AND METHODOLOGY

61. 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

62. The EIA study for the project interventions under Project-2 has been carried out following the DoE and WARPO guidelines for water resources projects. The overall approach of the study is shown in Figure 3 1.

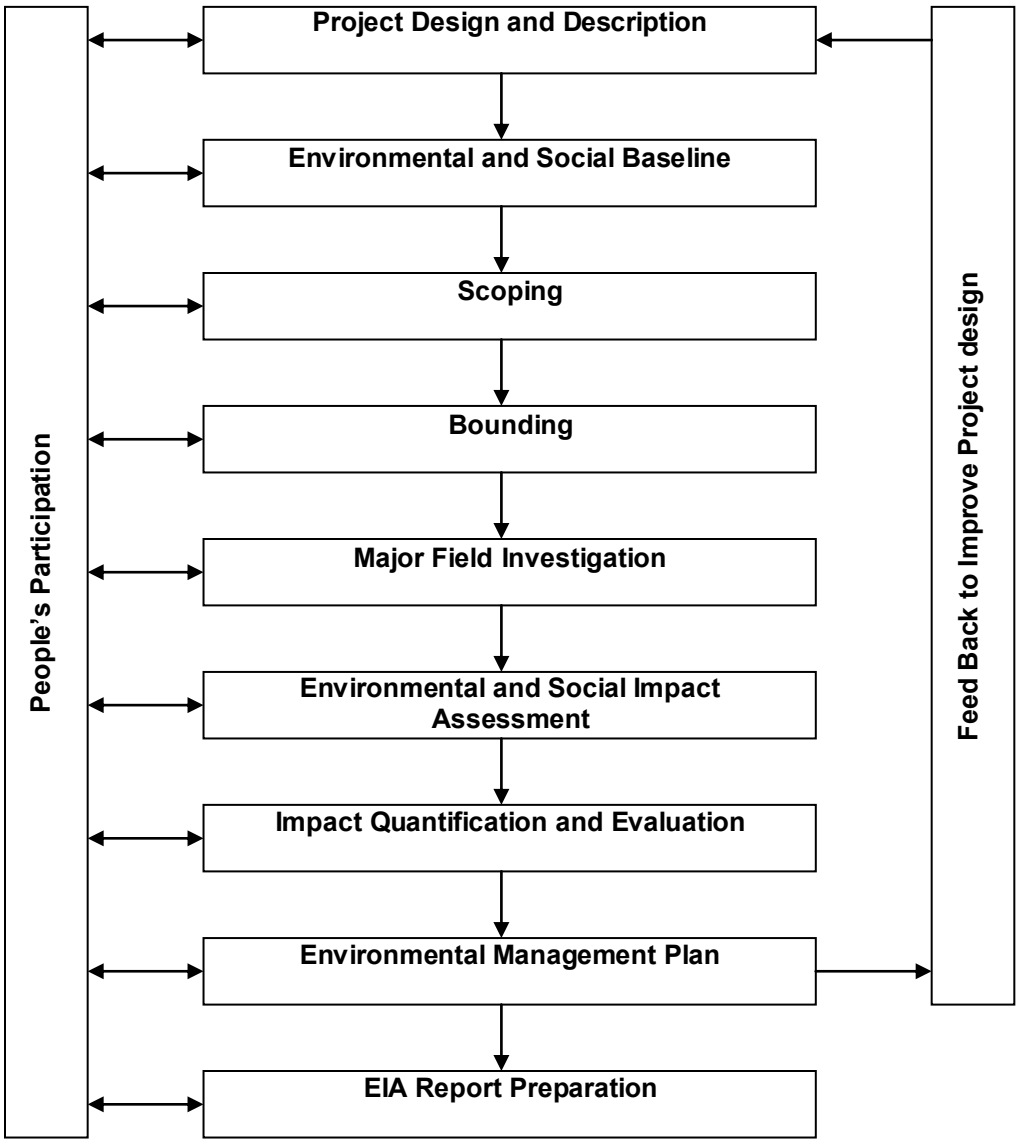


Figure 3-1: Overall approach of the EIA study

3.2 Methodology

63. The step-wise, detailed methodology followed for the EIA study is briefly described below.

3.2.1 Project Design and Description

64. Interventions proposed for Project-2 were the basis of this EIA study. Initial information and specifications of the proposed interventions was obtained from the FRERMIP consultant team. This was followed by development of a base map using the images and data available with CEGIS in GIS data layers. Thereafter the 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 field visits. Opinions 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

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

WATER RESOURCES

66. Water resource data under the heading river hydrology, river morphology, groundwater 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 visits 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, and so on.

67. 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 was 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 expert judgment.

68. The specific data on different events of water resources were gathered and analyzed using the methodology presented in Table 3-1.

Table 3-1. Data collection for the EIA study

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 trothing
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
Ecology		
Birds, dolphins, fish	Bangladesh Bird Club, IUCN, DoF, DoE	Meetings, collection of reports, field visits
Vegetation	Various	Reports, field visits

69. 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).

70. 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).

LAND RESOURCES

71. 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 Agricultural Extension (DAE) during field visits.

AGRICULTURE RESOURCES

72. 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 was collected from primary sources through extensive field survey by developing questionnaires 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.

LIVESTOCK RESOURCES

73. The present status of livestock (cattle/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 was also collected from secondary sources from the Upazila Livestock office.

FISHERIES RESOURCES

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

75. **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 areas with interventions and areas without interventions to find the difference between them in terms of fisheries impact.

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

77. **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, and so on.

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

79. **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, and so on, were also collected.

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

81. **Data Analysis and Output:** Fish productions 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 was estimated basin wise and then holistically. Secondary information that was collected from the UFOs and literatures were used to supplement primary data in production estimation.

ECOLOGY

82. Information on bio-ecological zones and their characteristics has been collected from publications of Bangladesh office of the 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 land use information on different ecosystem was generated through analysis of recent satellite images. Field investigation methods included physical observation; transect walks, habitat surveys and consultations with local people. Field visits were carried out in delineating the ecological baseline condition. Public consultation was carried out through Focus Group Discussions (FGD) and Key Informant Interview (KII) methods. An inventory of common flora and fauna was developed based on field surveys and the data base of IUCN Bangladesh.

SOCIO-ECONOMIC RESOURCES

83. 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.

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

(i) Data was collected from BBS, 2011 and reviewed relevant literatures from BWDB;
(ii) Reconnaissance field visit and discussion with BWDB officials and local stakeholders for primary data collection;
(iii) PRA /RRA, FGDs, KII for primary data collection;
(iv) 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 and Bounding

85. A scoping process was followed for selecting Important Environmental and Social Components (IESCs) which are likely to be impacted by the proposed interventions under

Project-2. Scoping was done in two stages. The Tranche-1 EIA study team made a preliminary list of the components pertaining to their disciplines, which could be impacted by the project. This 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.

86. During the second phase of the scoping process the Project-2 EIA study team conducted compliance monitoring of Environmental Management Plan (EMP) implementation of Tranche-1 construction works, which yielded important insight in which impacts where significant, and which were not. This team also conducted the Strategic Environmental and Social Assessment (SESA) of long term River Stabilization Plan (RSP) that identified significant impacts. Finally, this team prepared the required Initial Environmental Examination (IEE) and ToR for the EIA study of Project-2, which was then reviewed by the DoE and ADB, commented upon and approved for implementation.

87. The area likely to be impacted by the project interventions under Project-2 was delineated in consultation with the BWDB in addition to feedback received from the local people during baseline consultation. The processed RS tools were used for this purpose but there were some errors 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.

3.2.4 Major Field Investigation

88. The EIA study team members collected intensive data on possible impacts of the project after procuring the project plan. Data on the IESCs were collected from the field. 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 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.

3.2.5 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 because of interaction of specific project activities with the existing environmental settings. The impacts of proposed interventions were estimated based on difference between the future-without-project (FWOP) condition and the future-with-project (FWIP) condition. The FWOP conditions were generated through trend analysis and consultation with the local people. This reflected the 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 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 as follows:

(i) Changes in IESC status pertaining to water resources;
(ii) Changes in IESC status pertaining to land resources, agriculture, livestock and poultry;

(iii) Changes in IESC status pertaining to fisheries;
(iv) Changes in IESC status pertaining to ecological resources; and
(v) Changes in IESC status pertaining to socio-economic condition.

3.2.6 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.

3.2.7 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.

3.2.8 EIA Report Preparation

93. At the end of the process, this report was prepared incorporating all the findings of the EIA study. The EIA for the Tranche-1 works formed the base and this was updated to the extent needed for Project-2 works.

4 PROJECT DESCRIPTION

4.1 Project-2 Civil Works

94. Project-2 consists of:

(i) Around 30.0 km of riverbank protection – including:
  (a) JRB-1: 10.50 km (3.50 km at Benotia and 7 km at Enayetpur);
  (b) JLB-2: 15.50 km upstream of Chauhali ;
  (c) PLB-1: 4km at Harirampur
(ii) Reduction of the size of a actively eroding near-bank channel through overloading with sediment and plantations to capture sediment;
(iii) 7.9 km of embankments including:
  (a) JRB-1: 7.9 km at Kaijuri/ Shahjadpur to complete the 21.3km of embankment constructed under Tranche 1 including 2 regulators with fish passes;
(iv) Offtake structrure following channel closure in combination with additional riverbank protection to connect to existing works. The exact nature and extend of this intervention is to be determined following the channel closure works, and
(v) Around 40 km of adaptation works and 6km allowance for emergency works.

95. Road construction was originally included in the MFF, but was not carried out under Project 1 and has been removed from Project2 for the following reasons:

(i) Insufficient funds under Project 1 to expand works to include road construction, and
(ii) The BWDB is not strictly mandated to build roads and RHD as well as LGED have already indicated strong interest to build the roads.

Figure 4-1 provides a map of FRERMIP works.

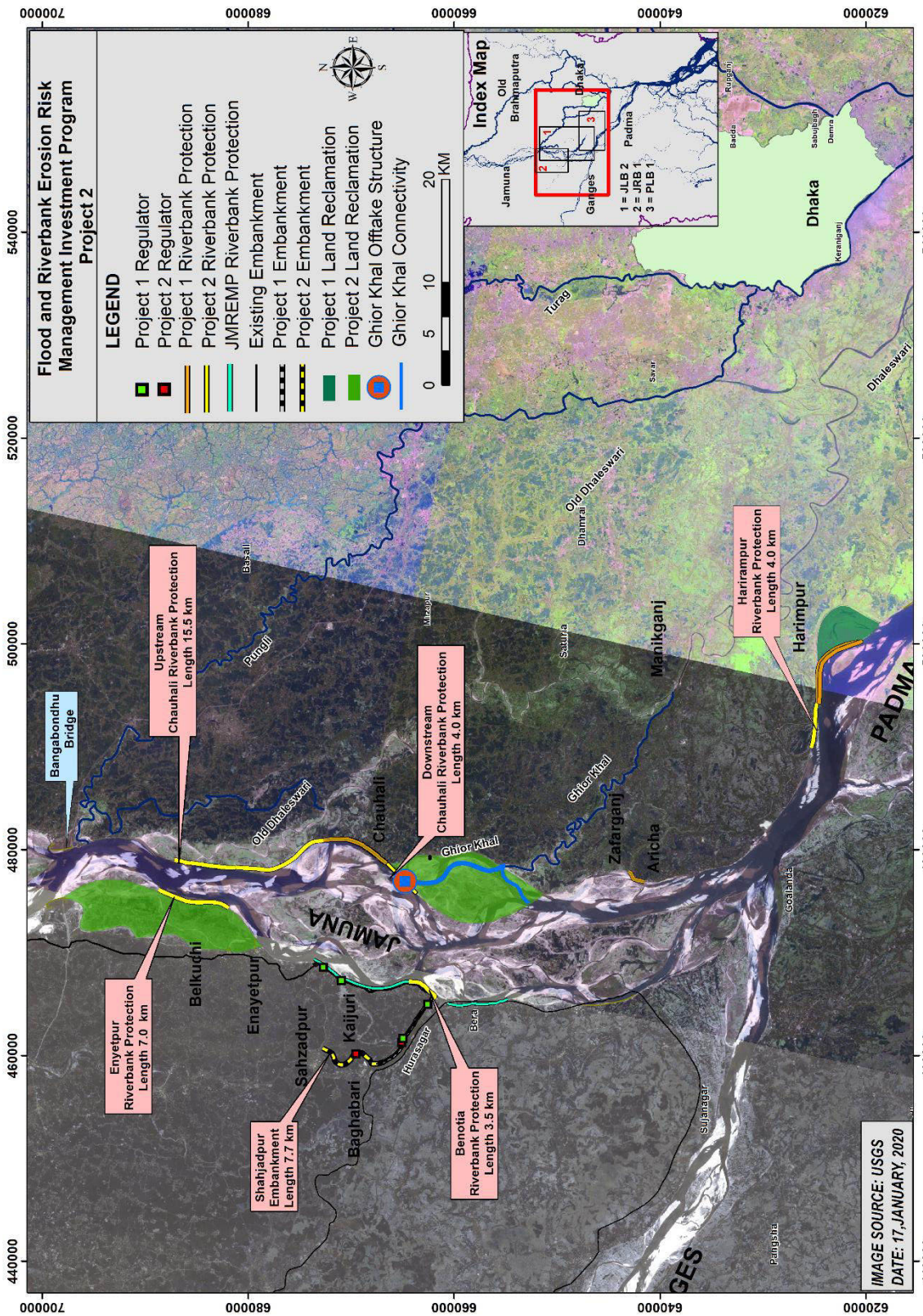


Figure 4-1. FRERMIP works

4.2 Description of proposed dredging

96. Dredging within the context of river stabilization may include dredging for:

(i) Underwater slope preparation for riverbank protection works, particularly on unconsolidated loose char soils,
(ii) River training purposes including forming pilot or cut-off channels and choking (overloading with sediment) unwanted channels
(iii) Embankment construction (sand core),
Low-flow navigation channels, and
(iv) Speeding up offtake and distributary re-development by increasing capacity and flows along the distributaries for improved water supply as well as inland navigation.

97. Project 2 will use five of six possible dredging measures compared in Table 4-1.

Table 4-1. Comparative Assessment of Different Types of Dredging

Purpose	**Dredging proportion**	**Technical feasibility and appropriateness of measure for Project-2**	**Likely economic benefit**	**Risks/ Uncertainty**
For revetment construction particularly on weaker soils to establish stable slopes and deeper apron setting levels	Depending on soil conditions and related apron setting level	Feasible measure and suitable to establish more stable underwater slopes prior to dumping geo-bags. This reduces need for strengthening/adaptation work. Implementation during dry season is demanding as higher dredging requirement is required	• Reduced risk of failure • Reduced maintenance and strengthening/ adaptation works requirements	• Low – this measure reduced risk • Deep water/ high capacity dredging required
River training measures including (i) pilot channels for leading/ training flow, (ii) sand plug / choking channel ("*building with nature*")	90%	Measure likely suitable for river stabilisation and training, but needs study and piloting for effectiveness. This is planned for Solimabad – downstream of Chauhali (JLB-2)	• Effective stabilisation measure • Dredged material will be used for channel closure	Measure is a pilot and results will be compared against model work and lessons will lead to future refinement/ improvement
Dredging sand for embankment construction	> 60% of construction cost, and depending on volume of wave protection and regulators	Standard measure for modern embankments which minimize the use of fertile, intensively agriculturally used topsoil.	• Reduced environmental impact • Improved bearing capacity for road construction • Contribution	Low, as technically sound measure also implemented under Tranche 1

Purpose	Dredging proportion	Technical feasibility and appropriateness of measure for Project-2	Likely economic benefit	Risks/ Uncertainty
			to channel stabilization	
Dredging low-flow channels, particularly between protected river bank bends for navigation	100%	Navigation dredging to flow river stabilisation, and likelihood of larger ships needing navigable river in FRERMIP area. This is a part of the intelligent dredging for channel closure by dredging of low-flow channels to use the material in the channel closure.	• Low at this time due to limited dry season navigation	• Dredging at this time likely to be less economically feasible • Taken up by BIWTA
Speeding up offtake and distributary re-development by increasing capacity and flows along the distributaries for improved water supply as well as inland navigation	100%	Flood management structure required at head of distributary before dredging initiated for dry season flows. Dredging along distributary to increase/ restore dry season flows should ideally follow on from flood management structure construction at head. Disposal of dredged material may be problematic	Likely to be high to: (i) address declining water tables and quality, (ii) increase availability of surface lean season flows for irrigation, reducing dependence on tubewells, (iii) increased supply to Dhaka metropolis, (iv) improved navigation, (v) improved connectivity for fisheries, and (v) improved habitats	• Increased flows along distributary may lead to some bank instability leading, for example, to failure of bridges/ other structures. • Disposal of dredged material • Studies required to firm up desired flows

4.3 Technologies used

98. Project 2 river stabilization depends on three technologies, in line with government priorities:

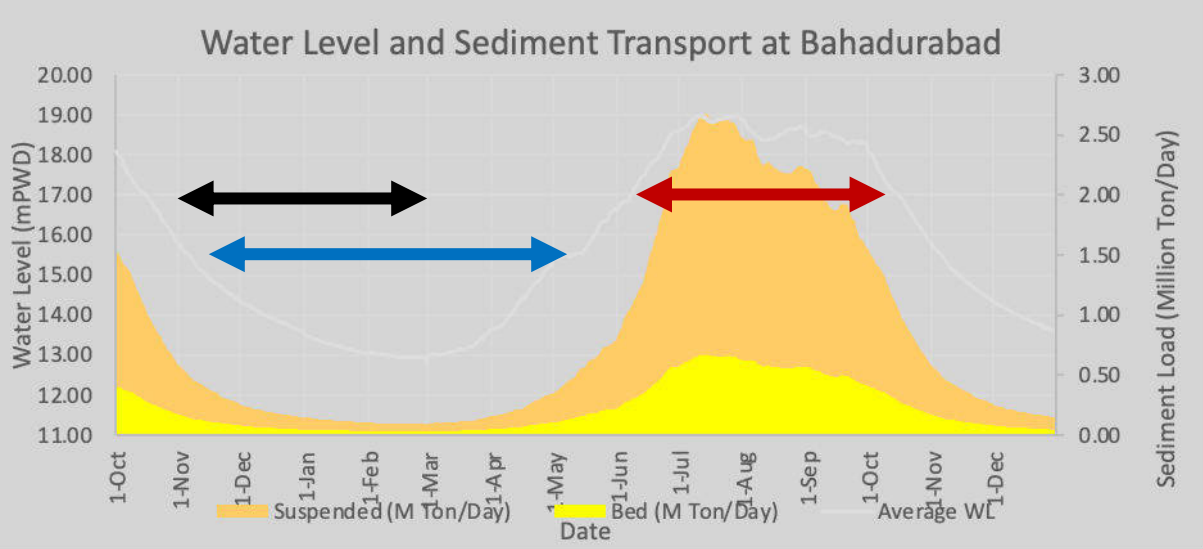
(i) Providing a reliable **boundary between floodplain and river**, or land and water through long-guiding revetments acting as “bend control” to encourage a more meandering and stable channel pattern. These revetments have a demonstrated self-dredging ability and result in a more predictable channel pattern even when only built along parts of the riverbank. This technology is classified as structural measure.

(ii) **Multi-purpose dredging** supports a more stable river environment, through navigation dredging during the dry season, supporting the construction of

riverbank protection, and providing the source material for revetment and embankment construction[8], and the raising of land above high flood levels. Dredging is limited to the sand fraction of the transported sediment (bed material load) which only constitutes around one quarter of the total sediment load.

(iii) Sediment harvesting extends river stabilization into the flood season by capturing the dominant part of the sediment transport, the suspended sediment. This deposited finer sediment provides Bangladesh's fertile topsoil allowing multiple cropping. The suspended sediment can best be attracted through the indigenous technique of reed plantations. Applied systematically, it turns into a bio-engineering technique in "**Building with Nature**".

99. The combination of above three technologies provides significant advantages as it allows an integrated, phased approach and reduces cost due to actively encouraging natural forces to participate in the stabilization effort. Figure 4-2 provides an overview of the application particularly in line with the sediment transport, which is relevant for two of the technologies. Consistent with FRERMIP Tranche-1, riverbank protection will provide the backbone for stabilizing the Lower Jamuna channel while continuing the development process of long-term sustainable solutions. River stabilization techniques particularly dredging and "building with nature" will be developed and applied for recovering some 6,000 ha of land at Solimabad, downstream of Chauhali, Sirajganj District.



DREDGING **RIVERBANK PROTECTION** **BUILDING WITH NATURE**



[8] The use of compacted dredged sand for 21km of embankment construction at Shahjadpur, Sirajganj Division allowed completion of the embankment in one season at significantly lower cost.

Figure 4-2. The three basic technologies for river stabilization and their use during the year

100. Project-2 will build almost 7.9km of flood embankments allowing the work started under Tranche-1 will be completed at Shahjadpur. Embankment construction will use compacted sand, dredged from the river and provide for two regulators with fish passes, to connect floodplain waterbodies with the main rivers.

4.4 Innovations applied

101. In Project-2, innovative technologies will be further applied following the piloting and successful implementation in Tranche-1, namely (i) embankment construction with compacted dredged materials.

4.4.1 Grout-filled Jute Mattress

102. Utilization of grout-filled jute mattress aims to replace wave protection made of placed concrete blocks through a mattress that is much faster to implement and also saves material, resulting in lower costs and a smaller environmental impact. Use of jute as mattress material instead of more conventionally used geotextile allows the utilization of locally available material while avoiding the use of artificial materials (Figure 4-3).

Figure 4-3. Installation of grout-filled jute mattress (Harirampur Feb 2019)

4.4.2 Embankment construction with compacted dredged materials

103. Project 1 has successfully introduced a modern work design and construction methodology for embankment fill dependant on directly placed and compacted dredged sand-fill for the embankment core (Figure 4-4). This modern design not only increases construction

speed, allowing the embankment to be built in one dry season, but also reduces the cost as well as the social and environmental impact, by not mining valuable topsoil used for farming.

Figure 4-4. Embankment construction at JRB-1 with compacted dredged sand (Kaijuri, Feb 2019)

5 ENVIRONMENTAL AND SOCIAL BASELINE

104. The environmental and social baseline condition in the study area has been characterized by 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:

(i) Bangladesh Bureau of Statistics (BBS)
(ii) Bangladesh Water Development Board (BWDB)
(iii) National Water Resources Database (NWRD)
(iv) Water Resources Planning Organization (WARPO)
(v) Soils Resources Development Institute (SRDI)
(vi) Bangladesh Meteorology Department (BMD)
(vii) Department of Agricultural Extension (DAE)
(viii) Department of Fisheries (DoF)

5.1 International Union for Conservation of Nature (IUCN).

105. Note that an expanded Environmental and Social Baseline is provided in Annex O, while a summary is provided in Chapter 5, in response to request from the ADB on 18 May 2020 to reduce the length of the main document.

5.2 Physical Environment

5.2.1 Rainfall

106. The project influence area lies in the northwest part of Bangladesh where the climate is sub-tropical in nature with three seasons namely summer/pre-monsoon from March to May, monsoon from June to October, and winter season from November to February. Lower rainfall makes this area both atmospherically and pedologically drier than the rest of the country. The rainy season is hot and humid with about 88% of the annual rainfall in the area. The winter is predominately cool and dry. The summer is hot and dry interrupted by occasional heavy rainfall, whereas monsoon comes in the month of June and recedes in late October. 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. 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.

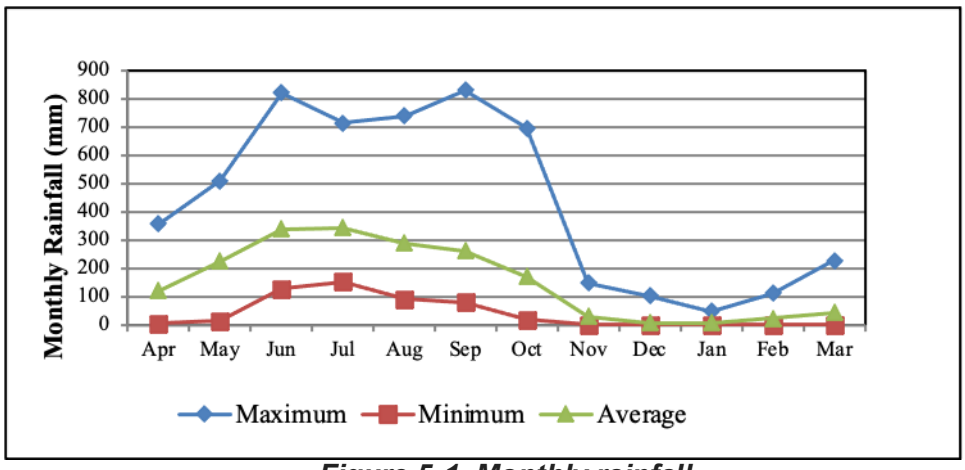


Figure 5-1. Monthly rainfall

5.2.2 Topography

107. Figure 5-2 shows the 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, and so on) 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.

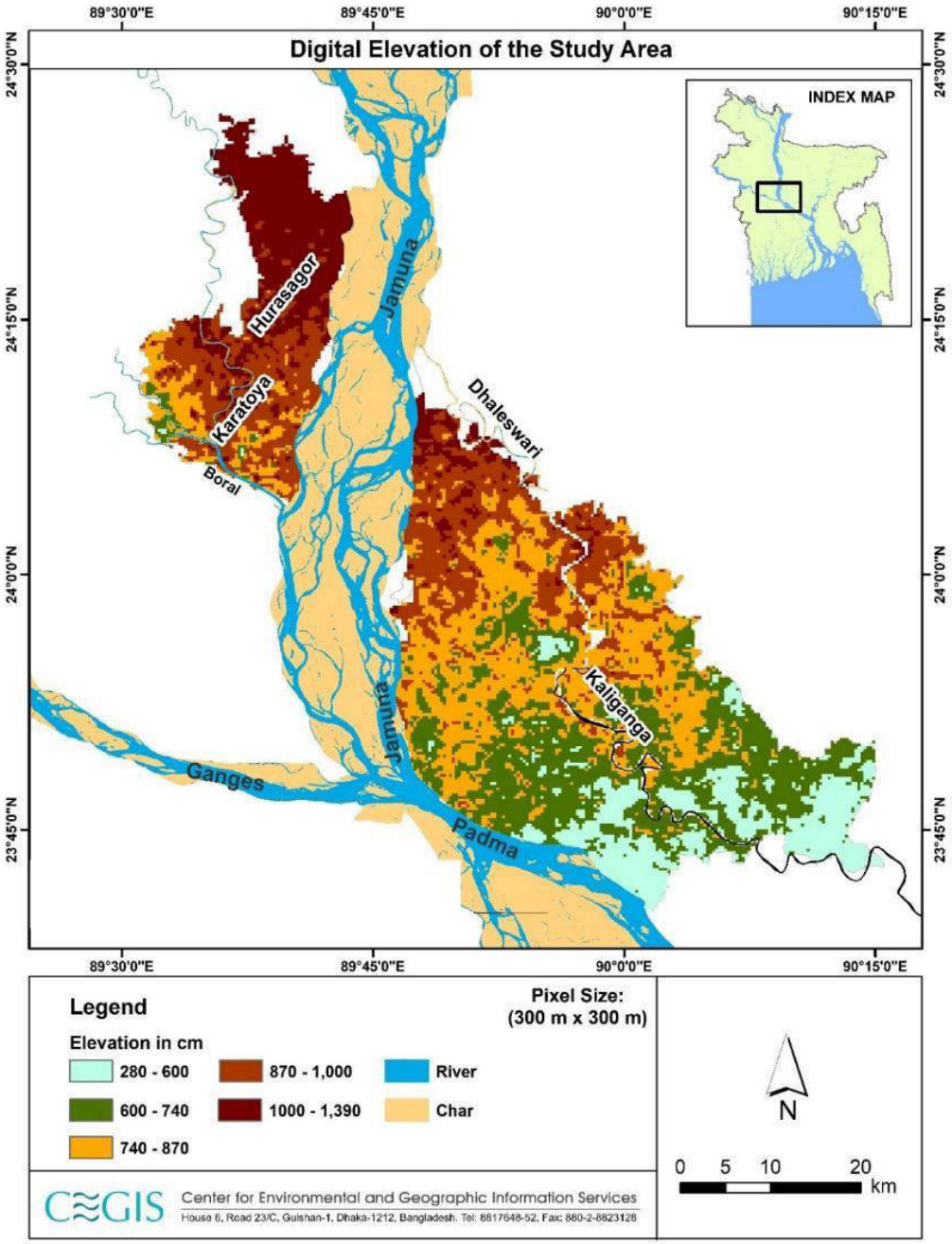


Figure 5-2. Topography of the study area

5.3 Water Resources

5.3.1 River System

108. The study area, consisting of the two sub-reaches JRB-1 and JLB-2, comprises about 244,316 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: Jamuna, Ganges and Padma.

109. 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 m³/s at Bahadurabad Transit. The flow varies from a low of

8,000 m³/s to a maximum of 100,000 m³/s. Bankfull discharge is around 48,000 m³/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.

110. The Ganges/Padma (above its confluence with the Jamuna) has a long-term mean flow of about 12,000 m³/s or about 60% of the Jamuna. Flood discharges reach 80,000 m³/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 m³/s.

111. 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.

112. Table 5-1 and Table 5-2 show the seasonal maximum and minimum and mean discharge values of the Jamuna and Padma rivers from 1981 to 2015 at two stations, Bahadurabad transit and Baruria transit (BWDB, 2015). The Jamuna maximum is about 100,000 m^3/s (July) while the Padma maximum is about 140,000 m^3/s (September-October).

Table 5-1. Seasonal maximum & minimum discharge of Jamuna and Padma (1981-2015)

Season	Jamuna River (Bahadurabad Transit)		Padma River (Baruria Transit)	
m^3/s	Maximum	Minimum	Maximum	Minimum
Dry (December-February)	16232	3140	17384	3040
Pre-Monsoon (March-May)	43600	2702	40700	3196
Monsoon (June-September)	103129	10500	141935	9528
Post-Monsoon (October-November)	66100	6190	77800	9050

Source: BWDB

Table 5-2. Mean discharge of Jamuna and Padma (1981- 2015)

Season	Jamuna River (Bahadurabad Transit)	Padma River (Baruria Transit)
m^3/s		
Dry (December-February)	5685	7829
Pre-Monsoon (March-May)	9869	10722
Monsoon (June-September)	40101	57712
Post-Monsoon (October-November)	18432	28809

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

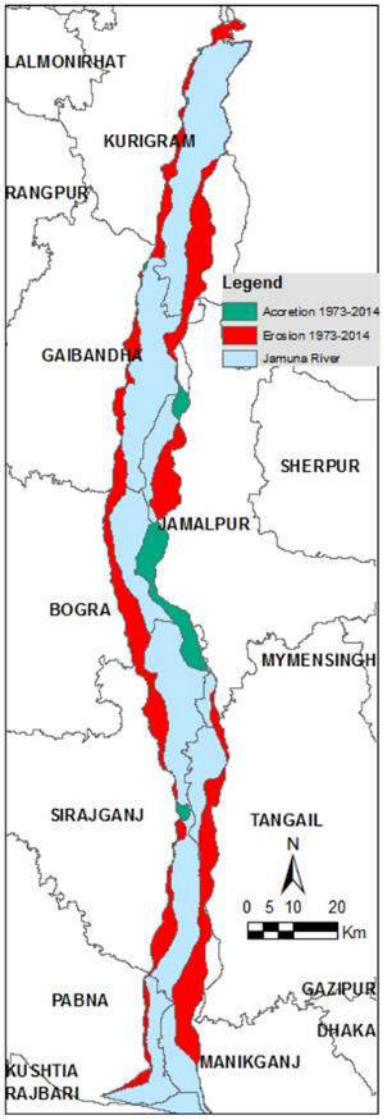
114. The distributaries of these major rivers inside the study area are Hurasagar, Dhaleswari, Kaliganga, Baral, Gohala, and Ichamati rivers. The Ichamati is the only Padma tributary passing

through the study area; the other tributaries connect directly to the Jamuna. Some small water bodies (*Kadaibadla Beel, Pandaha Beel, Khalsir Beel, Nalai Beel, Bharua Beel, Gharilpur Beel* and so on) are found inside the study area. Most are connected to the tributary channels during monsoon.

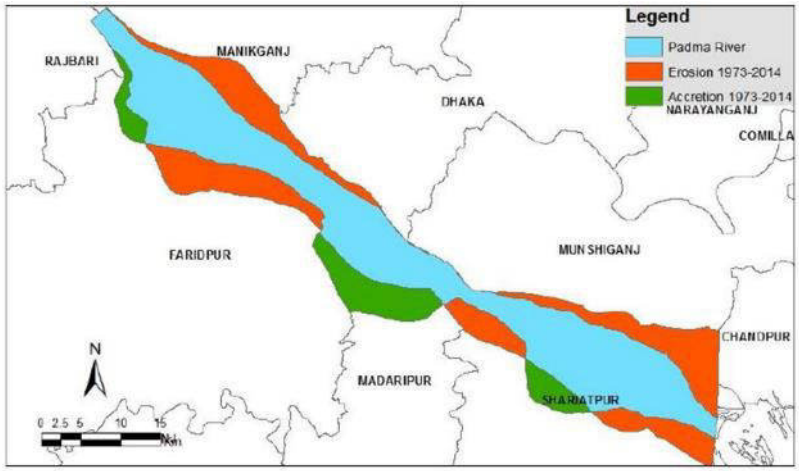
5.3.2 Erosion and Accretion

115. The width of Jamuna River has changed over the years and analysis shows a widening trend since 1900 which accelerated after the 1980s, causing an increase in bank erosion. The erosion rate was high before the 1990s, but since the start of this century it has decreased significantly due to natural causes and human interventions such as the construction of riverbank protection structures. However, the last 40 years has seen more erosion than accretion.

116. A westward migration of the Jamuna riverbed has been a prominent feature since the initiation of the avulsion of the Brahmaputra River from its old path into the Jamuna River. The Jamuna transported some 1 billion tons of sediment annually in the 1960s, but since then its sediment load has gradually dropped by 2.5 times during the 1980s. It is believed that a sediment slug generated by the great Assam earthquake of 1950 has attributed to this rapid decrease of sediment.



117. The Padma River carries the combined discharge of Brahmaputra and Ganges and has an annual average discharge of 30,000 m^3/s, mainly due to southwest monsoon precipitation occurring in June-October while the remainder is generated from base flow and snow melt in the Himalayas. In terms of discharge it is the third largest river in the world.



dma

Rivers in 1973-2014 (CEGIS, 2014)

5.3.3 Surface Water Levels and Water Quality

118. 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.

119. Water levels Secondary data on water levels were collected for the Jamuna and Padma rivers from the BWDB stations at Sirajganj and Aricha. The maximum and minimum water levels in different seasons (1981-2015) are shown below in Table 5-3. The table shows that in monsoon the average surface water levels of Jamuna and Padma rivers remain about 12.50 m PWD and 8.04 m PWD, respectively. In the dry season, the Padma River becomes extremely shallow, but the Jamuna River remains deep. Table 5-4 shows the average values of water levels of the two major rivers in different seasons (1981 to 2015).

Table 5-3. Maximum and minimum water levels of Jamuna and Padma (1981-2015)

Season	**Jamuna River (Sirajganj station)**		**Padma River (Aricha Station)**	
m+PWD	Maximum	Minimum	Maximum	Minimum
Dry (December-February)	9.14	6.11	4.88	2.00
Pre-Monsoon (March-May)	12.38	6.03	7.30	1.94
Monsoon (June-September)	15.11	9.17	10.76	4.26
Post-Monsoon (October-November)	13.69	7.79	9.50	3.75

Source: Bangladesh Water Development Board

Table 5-4. Jamuna and Padma Rivers mean water levels (1981-2015)

Season	**Jamuna River (Sirajganj station) [m+PWD]**	**Padma River (Aricha Station) [m+PWD]**
Dry (December-February)	7.41	3.22
Pre-Monsoon (March-May)	8.30	3.72
Monsoon (June-September)	12.50	8.04
Post-Monsoon (October-November)	10.24	6.20

Source: Bangladesh Water Development Board

120. **Water quality –**The standard values of seven surface water quality parameters and their suitability set by the DoE are indicated in Annex O. On the whole, water quality seems reasonable to good in the Jamuna and Padma rivers, except dissolved oxygen (DO), which is low during the months July-November/December.

5.3.4 Groundwater

121. Groundwater level data are analysed using data of three BDWB observation wells in three districts (Sirajganj, Manikganj and Tangail) of the study area. Figure 5-4 shows variations of mean groundwater levels. The Tangail average groundwater 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 decline in groundwater table (up to 6 meters) was observed in 1997 and 2001.

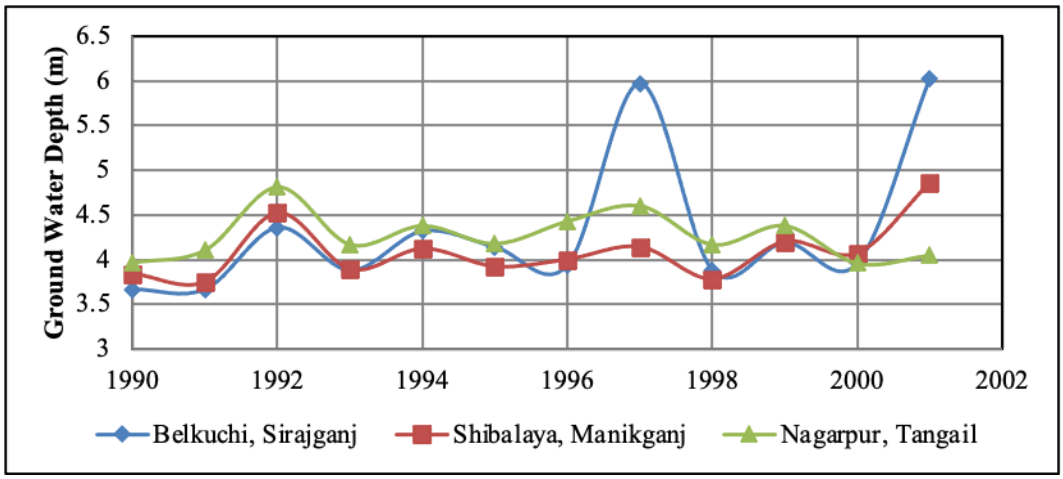


Figure 5-4. Mean groundwater levels in Sirajganj, Manikganj, and Tangail (1990-2001)

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

Table 5-5. Groundwater depth at three locations at three 10-year intervals

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

5.3.5 Flood Management

123. Due to the flat topography of Bangladesh, just a small increase in water level above the riverbank causes full-scale inundation. Figure 5-5 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.

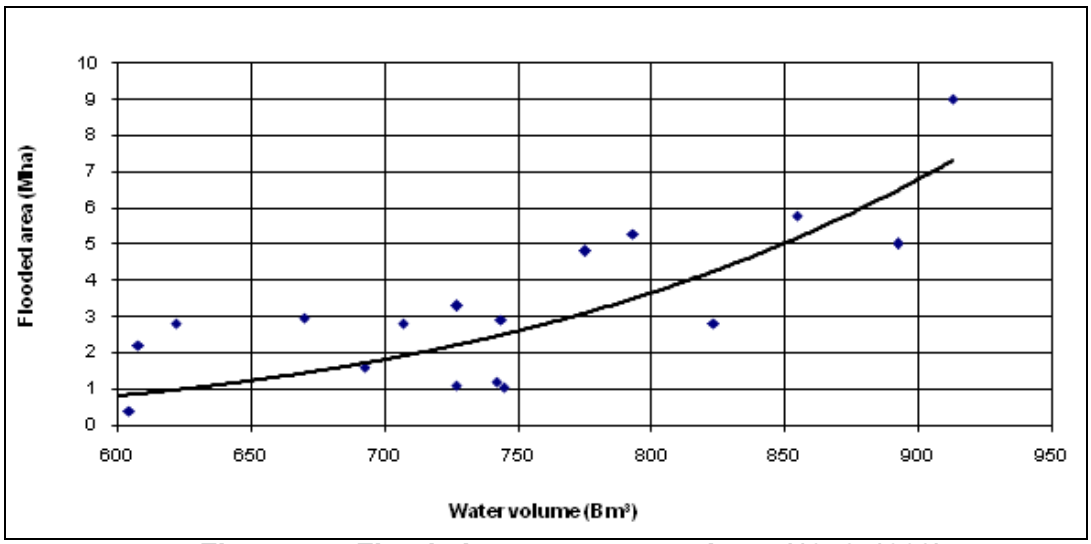


Figure 5-5. Flooded area vs water volume (1972-1993)

124. 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 19.5 m PWD. The probability of flood in a year for the Padma is about 60 % and for the Jamuna is about 75%. The average duration of flood is about 23 days in the Padma basin and about 14 days in the Jamuna basin. Major floods may last up to 65 days on the Padma (e.g. 1998) and up to 63 days on the Brahmaputra-Jamuna (e.g. 1998).

5.3.6 Morphology

125. 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.

5.3.7 Erosion

126. Riverbank erosion is the most important natural cause of landlessness and forced resettlement of people in the study area. During 1973 to 2018, erosion and accretion along the Jamuna and Padma rivers was 132,766 ha and 30,983 ha respectively (net erosion was 101,783 ha). In 2018, net erosion along the Jamuna and Padma was 2,168 ha of which 385 ha were settlements. The eroded lands also included about 63 m of district road, 1,645 m of Upazila road and 1,967 m of rural road. 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.

Table 5-6. Erosion & accretion from 1973-2018 (cumulative)

River	Erosion, Ha	Accretion, Ha	Net Erosion, Ha
Jamuna	94,616	16,738	77,878
Ganges	37,412	27,071	10,341
Padma	38,150	14,245	36,725
Total	**170,178**	**58,054**	**124,944**

Source: CEGIS 2019, Prediction of Riverbank Erosion April 2019, p. 1-3

5.3.8 Char Formation

127. Charlands 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 homesteads, render land unproductive, and destroy livestock. In the Jamuna floodplains, about 50% of the people live in the island and attached chars whereas in the Padma char areas, this is about 27% (Bangladesh Flood Action Plan, 1993). Charlands are formed mainly because of the low flow in the rivers in the dry season. Erosion along the sides of the Jamuna and Padma rivers result in the siltation of inside the rivers, which results in the formation of charlands.

5.4 Land Resources

5.4.1 Land Use

128. The total study area is about 244,316 ha of which about 184,200 ha is net cultivable area (NCA). Settlements and water bodies constitute about 11% and 13% respectively. Land use in the study area is presented in Table 5-7.

Table 5-7. Land use

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

Sources: CEGIS estimation from SOLARIS

5.4.2 Drainage Characteristics

129. 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 5-8.

130. Most of the area (83%) of the NCA is under imperfectly drained condition. The rest (17%) 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 5-8. Drainage characteristics

Drainage classes	Drainage characteristics	Area (ha)	% of NCA
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 m 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).

5.4.3 Land reclamation

131. About 150,000 ha of land is to be stabilized and reclaimed under the RSP programme, which consists of currently (unstable) char land and low-lying floodplain land. Project 2 will reclaim about 8,000 ha (6,000 in Solimabad in JLB-2 and 2,000 at Enayetpur in JRB-1). Figure 5-14 provides a map of the areas and locations to be reclaimed. It is anticipated that land stabilization will lead to reduced human suffering, greater investment and higher productivity, but also greater use of agrochemicals (and hence pollution), loos of floodplain habitats and competing land claims.

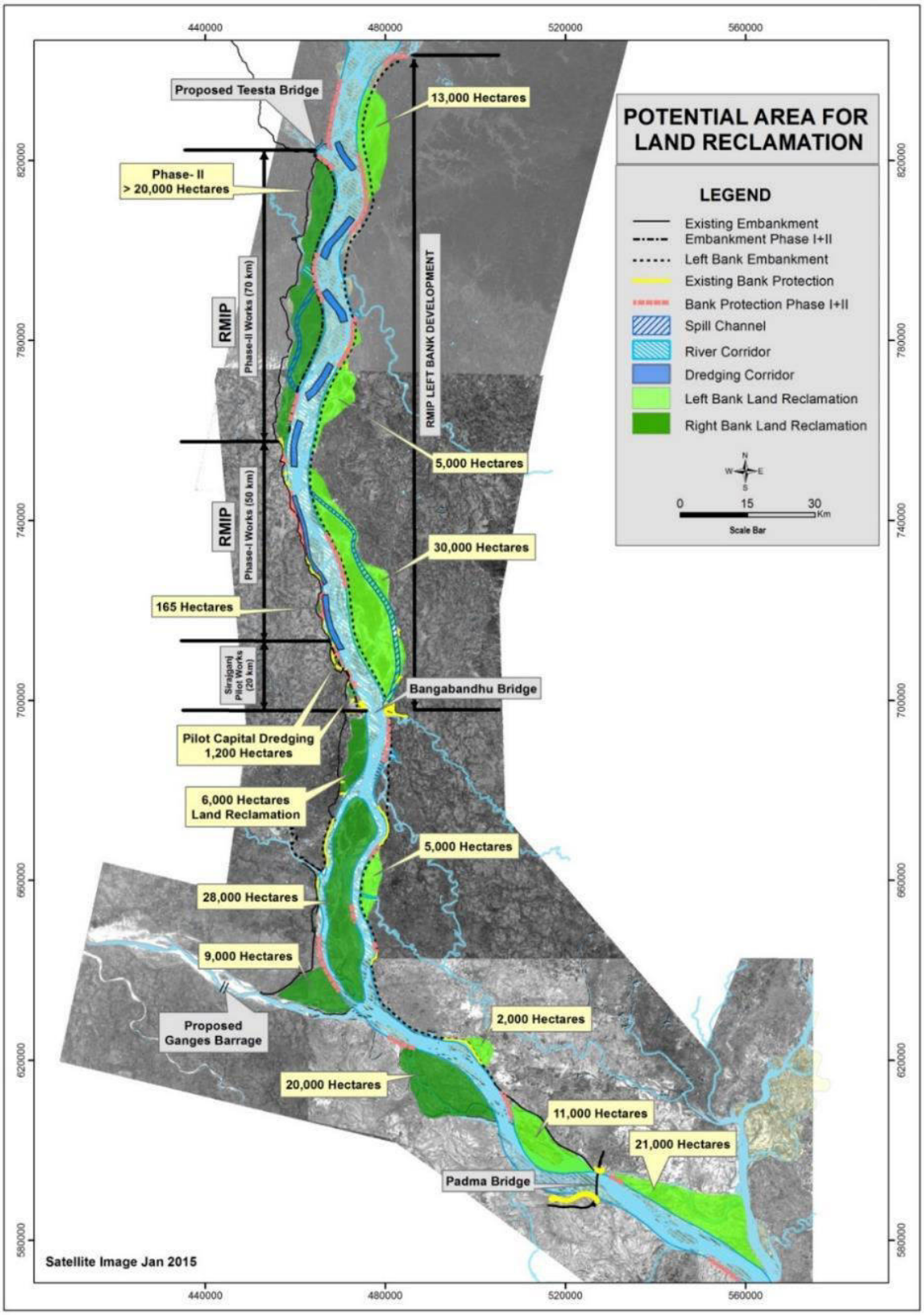


Figure 5-6. Land Reclamation Plan under RSP Interventions

5.5 Fisheries

5.5.1 Introduction

132. The study area is a major fish producing region of the country with diversified freshwater fisheries resource bases consisting of the Jamuna, Padma and Meghna rivers, their tributaries and distributaries, seasonal and perennial Khals (canals), Beels (floodplain depressions) and the associated flood lands. The tributaries/distributaries and the canals act as the major connecting links between the river and the floodplain and thus play a vital role in maintaining fisheries biodiversity and productivity. Fish biodiversity is also rich in the area but is declining due to indiscriminate fishing, obstruction of migration routes (especially in the dry season), discharge of industrial wastes, poor fisheries management, siltation, oil spills, insecticide contamination, and loss of critical habitats to siltation and bank erosion.

5.5.2 Problems and Issues

133. Major problems and issues identified during the baseline study are as follows:

(i) Loss of connectivity from the main river to the beel specially in the dry season.
(ii) Decrease in capture fisheries production due to the loss of habitat and change of present aquatic ecological condition.
(iii) Reduction of and obstruction to fish migration mainly between the river and the floodplain.
(iv) Fishing of brood fish especially in the overwintering period.
(v) Breeding and feeding grounds are gradually being destroyed and decreasing due to dewatering, siltation and bank erosion.
(vi) Decrease of fish production due to the use of current jal, mainly used to catch the fingerlings (i.e. young fish).
(vii) Use of harmful insecticides in the crop fields, which along with the industrial pollutants affect the aquatic ecosystem.

5.5.3 Fish Migration

134. Thirty-six (17%) of 218 freshwater fish species in Bangladesh are considered migratory, but the overall fish migration in the study area is moderate to poor. The Jamuna and Padma rivers form the base for fish migration; tributaries/distributaries and canals are the migration routes connecting the floodplains. Major distributaries in the Project-2 area are Hurasagar on the right bank and the Pungli, Old Dhaleshwari and Ghior Khal/Ichamoty which connects the project influence area. Moreover, during pre-monsoon and monsoon (availability of water in khal) Shameshpur Khal, Banigati Khal, Balorampur Khal 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 for the Manikganj district maintain the major arteries for fish migration.

135. Fish migration usually occurs during pre-monsoon to some extent, but largely during peak monsoon. Reportedly, feeding and spawning migration of riverine and beel resident fish species occurs through open khals and channels between beels and rivers and over bank spill during the period of late May to August. Certain categories of fish (i.e. the 36 species mentioned above) are dependent on migration to complete their lifecycle and when opportunity of migration fails particularly due to the loss of river-floodplain connectivity, their lifecycle cannot be completed which affects their propagation and contribution to fisheries. Fish migrations may be categorized as bi-directional, from river to floodplain and vice versa, and bi-dimensional, passive and active. All migrations from the floodplain to the river in the post monsoon are, however, active movements. These fish migrations between river and floodplain will be affected by the

project interventions, particularly by the embankments. Some possible measures like designing fish friendly sluice gates with fish passes and other fish supporting structures and fish friendly operation of the sluice gates will minimize the adverse impacts on fish migration.

5.5.4 Beels

136. Beels are wetlands that are temporary connected to the river during flood season through khals (natural channels that receive water during high water levels) and disconnect after the flood. As freshwater reservoirs these are important for biodiversity by acting as spawning grounds for several fish species. There is a total of 24 beels in the area out of which 13 are proposed to be fish sanctuaries. A list including coordinates in Bangladesh Transverse Mercator Projection (BTM) is shown below (Table 5-10). Figures 5-7 and 5-8 indicate the locations of these beels.

Table 5-9. Beels in the project area

Name of Beel	Proposed sanctuary	Upazila	Easting	Northing
Arial Beel	No	Sreenagar	486695	759376
Banagram Beel	Yes	Nagorpur	482718	663713
Belabadh	No	Horirumpur	498690	625599
Bohora	No	Daulatpur	486397	647835
Chandahar beel	Yes	Singair	521289	627509
Dholeshwari river	Yes	Saturia	496158	650665
Diyar Beel	No	Horirumpur	495666	626342
Gajaria Beel	No	Sadar Manikgon	498568	639687
Ichamati kol	Yes	Shibalay	482200	638636
Kanthapur Ichamati dead river	Yes	Horirumpur	499561	626268
Ichmati river	No	Dohar	505359	622082
Joymontop kol	No	Singair	518337	632214
Kadaibadla Beel	Yes	Shahjadpur	462999	674980
Kushumhati khal	Yes	Kartikpur	508244	613156
Kutirchar Ichamati dead river	Yes	kamarkhand	459293	694441
Majar kol	No	Shahjadpur	460332	673684
Mallar Beel	Yes	Char ghior	489003	643027
Neelwaya Beel	No	Ghior	486140	647127
Nimaikhali Beel	Yes	Daulatpur	486146	648775
Padma river	No	Mainat Ghat	507017	611861
Patal Beel	Yes	Sadar Manikgon	502187	637840
Shunshi Beel	Yes	Nagorpur	492396	657421
Uthuli	No	Shibalay	481881	636623
Kodalia Beel	Yes	Chowhali	481023	665413

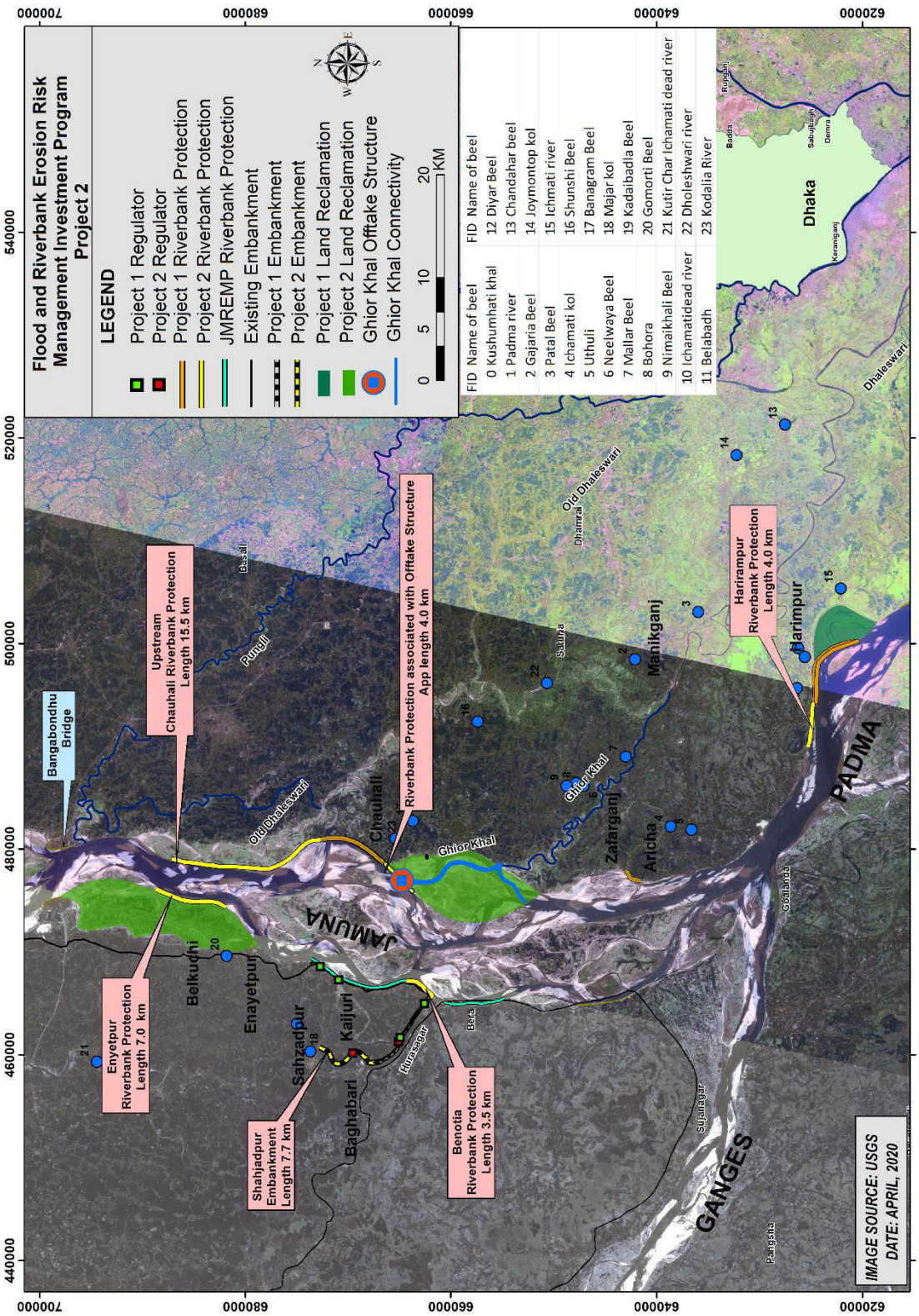


Figure 5-7. Map of beels and Project-2 interventions

5.5.5 Fish Biodiversity

137. Fish biodiversity and abundance is declining in recent years. Major causes are both natural and anthropogenic interventions. Natural causes are mainly siltation of the water bodies resulting in the shrinkage of spawning and feeding grounds affecting natural recruitment and production. Man made hazards are overfishing, negative impacts of water management interventions particularly affecting river-floodplain connectivity impeding flooding of the fish habitat and fish migration affecting fish propagation and production, agro-chemical and industrial pollutions causing deterioration of water quality of the aquatic ecosystems.

138. Efforts for conservation of fish and fisheries are limited except for the Hilsha fishery for which a program of the Department of Fisheries (DoE) is running resulting in substantial improvement in Hilsha catch in recent years. Overfishing is the major challenge which may be tackled by awareness development and making arrangement to discourage indiscriminate fishing. FRERMIP plans to initiate such work in the study area.

5.6 Ecological Resources

5.6.1 Fish habitats

139. Fish habitats of the study area may be divided into basically two types: River Fish habitat and Floodplain Fish habitat. The former can be sub-divided into (i) Bankline habitat; (ii) Charland habitat and (iii) Main Channel habitat, each having distinctive bio-ecological features. Basic differences among these three sub-habitats are seasonality, depth and characteristic fishery. Main channels form the deepest parts and perennial areas making safe home for deep water fish, dolphin and shelter for overwintering river fish. The bankline ecosystem consists of the river corridor area beyond the main channel on two sides of the main channel. In the peak season, bankline habitat is flooded making good base for breeding and shelter of fishlings. In the lean season, the shallow bankline area dries out. Charlands are usually sandbars situated beyond the main channel. As it matures, it may be coalesced with the riverbank forming the river floodplain. Charlands may be vegetated or non-vegetated. Submerged vegetated charlands are also a safe eco-niche for breeding and early development of many fish.

140. Floodplain fish habitat consists of (i) distributaries and canals; (ii) beels and floodlands; and (iii) closed water bodies. Most distributaries are perennial though some are now heavily silted off takes. Canals are seasonal or perennial. Beels are also seasonal or perennial. Floodlands are seasonal by nature. Closed water bodies are mostly homestead ponds and impoundments which may be seasonal or perennial.

141. In the aquatic ecosystem (river and floodplain) of the study area a characteristic fisheries-related annual bio-ecological cycle takes place. As the water level rises in the river in March, bankline and charland vegetated areas are inundated creating breeding and shelter sites for early development of fishlings. At the same time, floodplains are inundated by river flow and thereby creating shallow waters with vegetation suitable for breeding and fishlings. With respect to breeding and early development there are four categories of fish: (i) river fish with breeding and early development in the river; (ii) river fish breeding in the river but early development in the floodplain; (iii) river fish breeding and early development in the floodplain; and (iv) floodplain fish breeding and early development in the floodplain.

142. Fish breeding starts in March and continues up to August (in the river). In shallow waters of the floodplain, fishlings grow through September. When the river water starts receding, grown-up fish sub-adults along with their migrating parents return from the floodplain to the river. Similarly, river-born sub-adults move from bankline and charland shallow waters to the deeper waters as the bankline and charland dry up. Synchronously, reed vegetation of the

bankline and charlands will end their annual lifecycle in September-October and dry up making room for newer seedlings which make next year's fish breeding ground. The braided river system provides a good niche for fish and fishery.

143. The study area consists of 8 Upazila's of 4 Districts (3 in Sirajganj, 2 in Manikganj, 2 in Dhaka and 1 in Chandpur district) under 2 sub-reaches (JRB-1, JLB-2). Field studies conducted in the three sub-reaches show that capture fisheries habitats with an area of some 93,975 ha include rivers, khals, perennial and seasonal beels and seasonal floodlands while culture ponds measure only 1,235 ha. Table 5-10 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 fish take shelter when river water levels drop. Deep areas play a vital role in fish propagation. The major problems in these riverine fish habitats are siltation and erosion.

Table 5-10. Fish habitats

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	Fishpond	1,235
		Sub total:	*1,235*
		Total:	*93,975*

Source: CEGIS field Survey, 2013

5.6.2 Bioecological Zones - Introduction

144. 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 Beel, and (v) Ganges floodplain.

145. **MAJOR RIVERS.** 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. 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 waterfowl are directly or ecologically dependent on these rivers and their associated ecosystems. However, river biodiversity is under severe pressure.

146. **BRAHMAPUTRA–JAMUNA FLOODPLAIN.** 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 (i.e. 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 and so on, many of which yield valuable products. The faunal diversity in this zone is also rich.

147. **CHALAN BEEL.** Chalan Beel, the center of which is located some 10 km north-westest of the JRB-1 area (outside project area, but under influence of project) 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 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. Significant species diversity of Chalan Beel includes amphibian, reptiles, turtles and tortoises and otters, along with a host of wetland associated plants.

148. **GANGES FLOODPLAIN.** 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. The Ganges-Jamuna channel is constantly shifting within its active floodplain, eroding and depositing large areas of new charlands in each flooding season. The stagnant water bodies and channels, rivers and tributaries of the Ganges floodplain support a habitat of rich biodiversity to some extent, including free-floating aquatic vegetation is prominent. Nearly all the major groups of oriental birds are represented in this zone by one or more species. In addition, migratory birds are found here during the winter. In addition, different species of freshwater tortoises, turtles and amphibians are also found in the rivers and ponds.

5.6.3 Seasonal and Perennial Wetland Habitats and Flora

149. Wetland habitats of the study area include charland, swamp, and grasslands:

(i) **Charland** occupies significant part of the study area. The Jamuna and Padma Rivers are 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 depends on the time since char formation. At species level, Shon *Crotalaria 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 carnea* ssp. *fistulosa* appear.

(ii) **Swamps.** Chalan Beel area is favorable for a good growth of wetland trees like Hizal *Barringtonia acutangula* and Barun.

(iii) **Grassland** species include Binna *Vetiveria zizanioides* and Durba Gash *Cynodon dactylon*.

5.6.4 Aquatic Ecosystems

150. 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.

151. Freshwater 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.

5.6.5 Aquatic Ecosystem Services

152. The floodplain 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. The flood cycle and its associated ecosystem

purify the water quality deteriorated by the discharge of effluents and waste and use of agrochemicals.

5.6.6 Threats to Aquatic Ecosystems

153. In the study area, river erosion and siltation occur 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. The population of both flora and fauna is disrupted.

5.7 Critical Habitat

154. In accordinance with ADB SPS 2009 requirements, the significance of project impacts and risks on critical habitat need to be assessed as an integral part of the EIA process. A Critical Habitat Assessment (CHA) for the proposed Project 2 was prepared to determine whether the proposed subproject sites are critical habitat, (details are in Appendix A-2).

155. The assessment identifies the triggers for the potential critical habitat in the target proposed project area. It is desk-based and involved review of data and information from this EIA, IUCN database, online sources and other wildlife studies. The purpose of the assessment is to document the CHA's findings and demonstrate that the proposed project meets the requirement of ADB Safeguard Policy on critical habitats. The CHA is used to identify the specific species and habitats that could trigger critical habitat and designated or Internationally recognized sites within the project area of influence.

156. The assessment is to practice and document the environmental due diligence on priority wildlife population, and identify approaches to address ADB SPS 2009 requirement on critical habitat[9]. Where further details and guidance is required, the International Finance Corporation (IFC) Guidance Note 6 (GN6)[10] thresholds have been adopted to support the assessment through its critical habitat criteria thresholds. The first stage is screening the list of species exhibited in Annex A-2 (Tables A1-4 to 8. The second step is to identify the priority species and habitats that trigger the critical habitat policy of SPS 2009. Next is to assesses each relevant ecological receptors against the critical habitat criteria in accordance with the ADB requirements and supporting IFC thresholds. Impacts and corresponding mitigation measures are defined in this document as well.

157. The ecological area of assessment (AoA) is established to determine the presence of any critical habitat for each priority species with regular occurrence in the project's area of influence, or ecosystem. AoA is needed to delineate the assessment and applicability of the critical habitat criteria, and the thresholds to determine critical habitat for the species and/or ecosystems.The AoA of the proposed project is comprised of three different bioecological zones: (i) Brahmaputra–Jamuna floodplain, (ii) Chalan Beel, and (iii) Ganges floodplain.

[9] Critical habitat includes areas with high biodiversity value, including habitat required for the survival of critically endangered or endangered species; areas having special significance for endemic or restricted-range species; sites that are critical for the survival of migratory species; areas supporting globally significant concentrations or numbers of individuals of congregatory species; areas with unique assemblages of species or that are associated with key evolutionary processes or provide key ecosystem services; and areas having biodiversity of significant social, economic, or cultural importance to local communities. Critical habitats include those areas either legally protected or officially proposed for protection, such as areas that meet the criteria of the Word Conservation Union classification, the Ramsar List of Wetlands of International Importance, and the United Nations Educational, Scientific, and Cultural Organization's world natural heritage sites.

[10] https://www.ifc.org/wps/wcm/connect/5e0f3c0c-0aa4-4290-a0f8-4490b61de245/GN6_English_June-27-2019.pdf?MOD=AJPERES&CVID=mRQjZva

158. Based on the CHA, there is presence of Ganges River Dolphin (*Platanista gangetica*) population in the AoA. There are 206 individuals of *P. gangetica* along the Jamuna-Bhrahmaputra river system based on the study of Aziz (2019). According to the study on "The Conservation Action Plan for the Ganges River Dolphin 2010-2020", the global population estimates are about 3,500 individuals throughout its distribution range (Sinha et al. 2014). Taking into consideration of the figures from the studies, the AoA has 5.9% of the global population of *P. gangetica* and expected to have more than 5 pairs capable of breeding. Thus, the proposed project area is a critical habitat under Criterion 1(a)[11].

159. The proposed project area is a major fish producing region of the country with diversified freshwater fisheries resource bases, which are Jamuna and Padma rivers. Fish production sources are basically divided into two categories: capture (or open water fishery) and aquaculture (or closed water fishery). Fishery production in the proposed project areas are classified into (i) river capture fishery; (ii) floodplain capture fishery; and (iii) floodplain aquaculture. Capture fishery is a major source of fish for the local people and market, and aquaculture is less developed due to the flood threats and lack of improved technology. Thus, the proposed project area is a critical habitat under Criterion 5.

160. To mitigate the impacts on wildlife, bird and fish sanctuaries are proposed in the EIA. The combined area of the proposed bird sanctuaries is 18,510 ha in various identified areas. The fish sanctuaries will be established or piloted along a 10-km (left bank) length of river. Given that the buoys are to be placed 300m from the bank, the estimated combined area of the riverine/fish sanctuary will be around 300 ha.

5.8 River Sediment Quality

161. Multi-purpose dredging will be carried out and will mainly use the sand fraction, which is the bulk of total sediments. The sand fraction is less likely to contain harmful compounds as these are more likely associated with organic and clay fractions to which potentially harmful organic compounds and heavy metals are more likely to adhere or become absorbed. As assessed by Ramesh et al. (2000)[12], (naturally occurring) heavy metals are usually trapped by the high content of illite clay in these sediments.

162. According to Dutta and Subramanian (1997)[13] the sediment load of the Ganges-Brahmaputra-Meghna river system consists exclusively of fine sand, silt and clay at their lower reaches within Bangladesh, with no mention of organic matter content. Illite and kaolinite are the major clay minerals and occur in almost equal proportion in riverbed sediments. The heavy mineral assemblage is dominated by unstable minerals which are mostly derived from high-rank metamorphic rocks. In their study on the qualitative impacts of floodplain sedimentation, Hossain and Ali (2004)[14] found that all the micronutrients either decreased or remained virtually unchanged after flood season. Among the macronutrients, nitrogen, potassium and magnesium in floodplain soil decreased by 60%, 4.1% and by 4.2%, respectively; while phosphorus and calcium increased by 41% and 83%, respectively after flood season. Copper, iron, manganese and zinc in floodplain soil decreased by 17%, 2%, 5% and 7%, respectively. At the same time

[11] Criterion 1(a) ≥ *0.5% of the global population AND ≥5 reproductive unitsGN16 of a CR or EN species.*

[12] Ramesh, R., A. Ramanathan, S. Ramesh, R. Purvaja and V. Subramanian (2000) – Distribution of rare earth elements and heavy metals in the surficial sediments of the Himalayan river system. Geochemical Journal, Vol. 34, pp. 295-319.

[13] Datta, D.K. and V. Subramanian (1997) – Texture and mineralogy of sediments from the Ganges-Brahmaputra-Meghna river system in the Bengal Basin, Bangladesh and their environmental implications. Environmental Geology 30(3):181-188. DOI: 10.1007/s002540050145

[14] Mohammad Asad Hossain, M.A. and M.A. Ali (2004) – Floodplain sedimentation in nutrient and heavy metal transfer in Jamuna and Padma rivers. Journal of Civil Engineering (IEB), 32(2): 87-110.

they found that arsenic, chromium and lead contents of the floodplain soil increased after flood by 31%, 25% and by 30% on an average, respectively, possibly due to partitioning of these heavy metals from the aqueous (river water) phase to soil e.g., by adsorption.

163. Sediments may include harmful compounds such as arsenic, heavy metals and pesticides, but these appear mainly to be absorbed onto clay (and possibly silt) fractions, which are not being targeted for multi-purpose dredging. Also, according to Dutta and Subramanian (1997)[15]the sediment load of the Ganges-Brahmaputra-Meghna river system consists exclusively of fine sand, silt and clay at their lower reaches within Bangladesh, with no mention of organic matter content. Organic matter appears to be mainly present as dissolved organic carbon (DOC). Rikta et al. (2016)[16] found that water quality parameters showed that Padma River was not polluted during the sampling (wet) season and all parameters were within the permissible limit recommended by DoE except turbidity and total coliform. BOD values ranged from 2.95mg/l to 4.67mg/l and the average BOD was 3.77mg/l. However, river water samples clearly indicate the presence of organic matter, including humic and fulvic acids, which are (a main) part of DOC.

164. Hossain and Ali (2004)[17] found in their study on the qualitative impacts of floodplain sedimentation that all micronutrients either decreased or remained virtually unchanged after flood season. Among the macronutrients, nitrogen, potassium and magnesium in floodplain soil decreased by 60%, 4.1% and by 4.2%, respectively; while phosphorus and calcium increased by 41% and 83%, respectively after flood season. Copper, iron, manganese and zinc in floodplain soil decreased by 17%, 2%, 5% and 7%, respectively. At the same time they found that arsenic, chromium and lead contents of the floodplain soil increased after flood by 31%, 25% and by 30% on an average, respectively, possibly due to partitioning of these heavy metals from the aqueous (river water) phase to soil e.g., by adsorption. Arsenic is understandably of concern and needs to be taken seriously. However, Chowdhury et al. (2003)[18] found that "the arsenic content of fresh suspended sediment carried by running incoming sediment after post flood period ranges 4.067 to 5.466 mg/kg, which is not significantly higher than the usual arsenic contents of soils in Bangladesh." They also confirm that the arsenic is usually higher in the silt and clay fraction (where it may be 3.5-6.5 mg/kg), compared to the sand fraction (1-3.5 mg/kg), which is the fraction that will be mainly used in the proposed multi-purpose dredging. Hence, there does not appear to be a significant concern regarding the dredging of sandy sediments for land reclamation.

5.9 Socio-economic Conditions

5.9.1 Area and population

165. Socio-economic information is presented for the study area upazilas – twelve upazilas of Sirajganj, Tangail and Manikganj districts (Table 5-11). The study area population is 2.89 million (BBS Census Report, 2011). This includes 1.42 million males and 1,47 million females in

[15] Datta, D.K. and V. Subramanian (1997) – Texture and mineralogy of sediments from the Ganges-Brahmaputra-Meghna river system in the Bengal Basin, Bangladesh and their environmental implications. Environmental Geology 30(3):181-188. DOI: 10.1007/s002540050145

[16] Rikta, S.Y., M.S. Rahaman, J.J. Mehjabin, M.K. Uddin, M.M. Kabir and S.M. Tareq (2016) – Evaluation of water quality parameters and Humic substance status of Bangshi, Dhaleshwari and Padma Rivers in Bangladesh. International Journal of Environmental Sciences Volume 6 (6): 1129-1130.

[17] Mohammad Asad Hossain, M.A. and M.A. Ali (2004) – Floodplain sedimentation in nutrient and heavy metal transfer in Jamuna and Padma rivers. Journal of Civil Engineering (IEB), 32(2): 87-110.

[18] Chowdhury, M.A.I., M.F. Ahmed and M.A. Ali (2003) – Influence of Upstream Sediment on Arsenic Contamination of Groundwater in Bangladesh. Chapter 3 in: M.F. Ahmed, M.A. Ali and Z. Adeel (Eds.), Fate of Arsenic in the Environment. BUET, Dhaka and UN University, Tokyo. Pp: 21-36.

661,000 households having an average household size of 4.37 persons. Population density is about 1,200 person /km^2.

Table 5-11. Administrative units of Bangladesh

River Reach	BWDB Zone	Sub-project	Districts	Upazilas
3	North West	JRB-1	Sirajganj	Belkuchi
				Kamarkhanda
				Shahjadpur
3	North Central	JLB-2	Manikganj	Daulatpur
				Ghior
				Saturia
				Shibalaya
			Sirajganj	Chauhali
			Tangail	Nagarpur

Source: Spatial GIS Analysis, CEGIS 2012

5.9.2 Livelihoods

OCCUPATION

166. Agriculture is the main occupation of 76% of households. About 16% of the population works in the service sector; and the remaining 8% works in the industrial sector (Table 5-12).

167. Both male and female members of households are engaged in livelihood activities, but the participation of female members is small compared to male participation. In the study area only 2% female members are working whereas 98% male members are engaged in income generating activities.

Table 5-12. Primary occupation

Upazilas	Agriculture		Industry		Service	
	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: Bangladesh Bureau of Statistics

5.9.3 Poverty and Safety Nets

LANDOWNERSHIP PATTERN

168. The land ownership pattern is correlated with poverty incidence in the area. The RRA found that about 30% of the households are absolute or landless and the remaining 70% have land for mainly agriculture use and also for settlement and commercial uses (Table 5-13).

Table 5-13. Landownership

Land Holding Categories	Distribution of Household (%)
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

169. 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%.

INCOME POVERTY

170. 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.

171. 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 owners and businessmen, are in a surplus position. In the study area consumption is higher than income which perpetuates poverty intergenerationally.

INCOME AND EXPENDITURE

172. Household income and expenditure are key indicators of socio-economic status. In the study area, monthly household income and expenditure vary from BDT 5000 to 20,000. About 75% of households are engaged in agricultural labour. The wage rate varies between BDT 300 to 400 per day. A few in-migrating labourers stay in the area for a year, returning home at the end of the year with all their income. Women's participation in the agricultural sector is negligible. Field findings show that most income comes from three sectors i.e. agriculture, small business and remittance, and that household consumption

5.9.4 Natural Disasters

173. 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 5-14.

Table 5-14. Effects of recent natural disasters

Disaster	Frequency	Affected Area (%t)	Affected House Holds (%)	Crop Damaged (%)	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.

5.9.5 Vulnerable Communities

174. In the study area, three types of people could be considered as vulnerable. These are (i) marginal farmers having less than BDT 5,000 monthly income; (ii) fishermen; and (iii) women-headed households. Even though most landowners 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.

5.9.6 Historical, Cultural and Archaeological Sites

Significant historical, cultural and archaeological sites in the program area are indicated on the map on Historical, Cultural and Archaeological sites in Annex O. These will not be adversely affected by the project, and to some extent they will receive more adequate protection from flooding by implementation of the project.

6 PUBLIC CONSULTATION AND DISCLOSURE

6.1 Introduction

175. This chapter presents the objectives, process and outcome of the consultations carried out with the institutional as well as grass root stakeholders (i.e. local communities) of the FRERMIP. Also discussed in this chapter are the disclosure requirements for the present EIA. FRERMIP is a large-scale project impacting directly on the lives of the people as well as communities living in and around the existing and proposed alignments. This project has multiple dimensions encumbering agriculture, fishery, livelihood, physical environment and others. It aims at protecting lives and properties in addition to consolidating livelihood opportunities in the area. It involves a large amount of physical activities such as earthworks, construction and others – activities that may potentially have negative impacts on the environment and people, as discussed in this EIA report. The consultations have been conducted with representative communities and governmental officials to solicit their opinions and views about the project and its potential impacts.

6.2 Objectives of Public Consultation and Disclosure Meetings

176. The consultations have enquired into topics such as agricultural practices, flooding, loss of crops, fisheries, water use, flora and fauna, and other aspects relevant to the proposed project. During consultation the project proposed intervention were explained, and the consultees were asked for their opinions, suggestions and concerns.

177. The key objectives of the consultations carried out for the FRERMIP include the following:

(i) Inform key stakeholders about the project objectives and key interventions.
(ii) Share with the stakeholders the nature, objective and extent of the present EIA study.
(iii) Promote participation of the local people, local level government stakeholders, elected representatives and other community representatives to create opportunity to play a role and express their views.
(iv) Analyze household and community level issues and draw early attention for mitigation and/or resolution of issues.
(v) Acquire suggestions of the community for mitigating anticipated adverse environmental and social impacts and expected benefits of the Project.
(vi) Obtain the views of vulnerable groups, discuss project impacts and benefits on these groups, and ascertain their expectations regarding project benefits.
(vii) Develop strategies to minimize potential social and environmental adverse impacts in conjunction with government stakeholders.
(viii) Prepare the community with confidence and capacity to deal with displacement, environmental and resettlement management.

6.3 Approach and Methodology of Public Consultation and Disclosure Meeting

178. Public consultation is a qualitative exercise with an empirical approach. It enables raising issues with the direct and indirect stakeholders and through a process of consultation and discussion and registering views and opinions. Public meetings, Focus Group Discussions (FGDs), Key Informant Interviews (KII), and Personal Interviews are the main tools of data collection that have been employed for the present consultations.

179. The respondents were selected purposively and carefully. Thematic aspects (e.g. agriculture, ecology, fisheries) were given importance in the selection of the respondents. With the help of checklists and obtaining prior consent, the FGDs were conducted in a systematic manner with an attention of gender balance in the composition of the respondents. The consultation sessions were open, interactive, and were properly recorded.

180. The respondents who shared their views and opinions included the following: public representatives, general residents of the area, squatters, tenants, river erosion victims, farmers, fishermen, vendors, and small-scale businessmen. Some of them live on the embankment; some on char lands while others were from the countryside. The institutional consultations were carried out with officials of the key departments including BWDB, Department of Environment (DoE), Agriculture Department, Fisheries Department, and local body institutions.

6.4 Disclosure, Consultation and Participation during Project Preparation

181. Three 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 and was started in early-2013 on February 26, 2013. 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 Important Environmental and Social Components (IESCs; see chapter 7) to be assessed for project impacts.

182. A second round of PCMs was undertaken when this environmental assessment report became available in draft form in mid-2013, 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.

183. A third round of consultation was conducted for particularly the Tranche-2 interventions, i.e. in 2016/2017, specifically focusing on the Tranche-2 works of the FRERMIP.

6.5 Stakeholder Comments and Concerns

6.5.1 First Round (Started on 26/02/2013)

184. During the environmental assessment process, a first round of public consultation meetings was held in four locations (Figure 6-1) to present the location to stakeholders and document their concerns. The records of this round are presented in Appendix E.

185. 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.

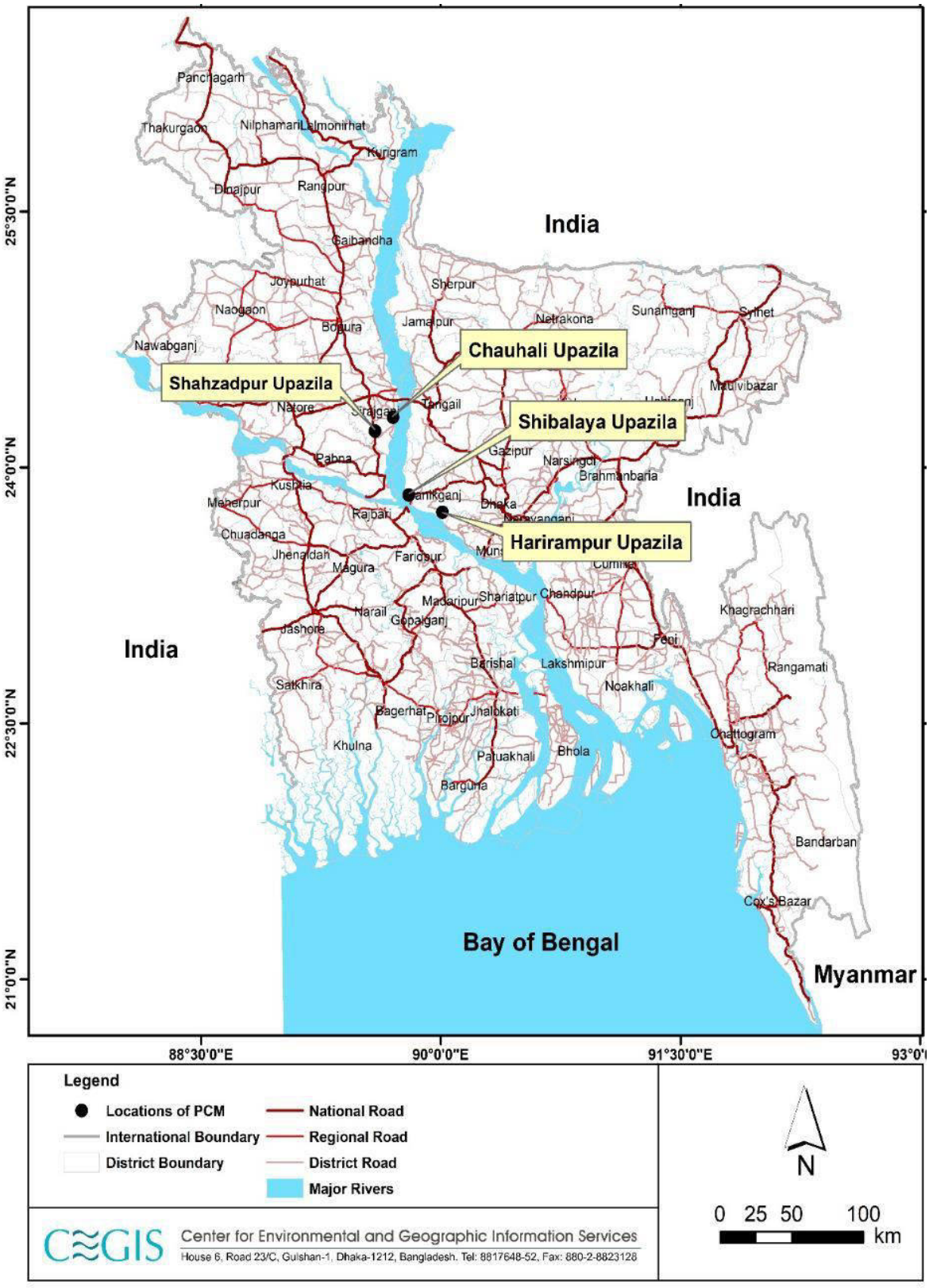


Figure 6-1. First round public consultation meeting locations

Note: Harirampur was first included in Project-2, hence it was included in the consultation meetings.

186. Judging from the level of 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.

187. 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.

188. 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 not covered 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, labourers, and so on. 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.

6.5.2 Second Round

189. 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 2-9 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 Appendix F.

190. 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.

191. 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.

6.5.3 Third Round

192. In continuation of the first and second round of public consultation, a third round was conducted between October 2016 and October 2017 to assess opinions and receive feedback from local stakeholders on specifically the Project-2 interventions. The proposed works were explained to the public in six public meetings, i.e. two meetings held at Harirumpur (PLB-1), one at Shahjadpur (JRB-1) and three at Chauhali (JLB-2) of Sirajganj and Manikgonj districts. The records of this round are presented in Appendix G.

193. The major objectives of the meetings were to disclose the proposed interventions of Project-2 and receive the local stakeholder's opinion and suggestions on the interventions. The stakeholders including persons affected by river erosion and flooding expressed their views in favour of the Project-2 interventions and were satisfied by the implementation of the Project-1 works. They demanded extension of the bank protection works and protection from monsoon flood through embankments and provision of regulators for drainage and fish movement. The EIA team sheared these stakeholder opinions with BWDB officials and ISPMC's team members for technical solution.

194. Participants of the different meetings urged to implement the project as soon as possible. They expressed their concern about compensation of land and homesteads that will be lost due to the project interventions and the loss of livelihoods. Almost all participants in the meetings consented to accept temporary air pollution and noise generated during the construction phase of the project.

195. Participants in the different meetings requested to provide regulators with fishpasses to get rid of drainage congestion and obstruction to fish migration at suitable locations in the embankments.

196. Local people in public and FGD meetings noted that migratory birds are being hunted illegally, particularly at night, and that therefore less migratory birds are found during the winter season in the project area. They demanded to take lawful administrative action against poachers.

197. While discussing the protection against flooding by construction of embankments that will bring safety to homesteads, crops and fisheries and improve communication and health and hygiene, people welcomed the project. Stakeholders realized that flood protection works by construction of embankments will or may sacrifice their lands. However, they demanded compensation for the land, homesteads, etc. that will be affected by the project.

198. During meetings at Solimabad in Chauhali Upazila the people demanded to protect their land, homestead and other assets from the recently developed (3-4 years ago) active channel from Jamuna. While disclosing the proposed intervention (closure dam) to mitigate sufferings of the local people, they expressed their full consent to the proposed interventions and urged to implement the work swiftly. They also expressed to render full cooperation during implementation of the work.

6.5.4 Further Consultations and Information

199. In November and December 2020, members of the local population were consulted through local members of the BWDB (Upazila level engineers) based on a questionnaire. The consultations mainly aimed to provide further knowledge to the local population about project interventions and status and resettlement and land acquisition issues. However, also general concerns of the population, including environmental issues, were assessed. Generally, the planned interventions were perceived well, and no fundamental objections were raised.

200. In addition to the consultations, a brochure in Bangla was prepared, outlining the project interventions as well as the process and entitlements for resettlement. This brochure has been distributed among the local population from May 2021. Key aspects described in the brochure relate to (i) project details, (ii) entitlement matrix, (iii) cut-off dates, (iv) grievance redress mechanism, and (v) compensation mechanisms.

201. To continue the consultations of beneficiaries and affected people, BWDB will determine the relevant polices and protocols of the government in line with managing COVID-19 risks.

These will serve as guide and compliance of BWDB for the conduct of public consultations with the local populations. Using online communication platforms will also be considered as long as the target people have access to such technology. Local members of the BWDB will continue to reach out to the population to disseminate information through brochures, questionnaires, and other forms of media, as appropriate, thus providing project information updates to, and receiving feedback from, the people. All information from the consultations will be documented in the semi-annual monitoring reports and verified by the external monitoring expert to be engaged by BWDB and retained for the entire duration of the implementation of Project 2.

6.6 Summary of Concerns, All Meetings

202. **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 designs will have to be changed unless construction of erosion works begins this year (2017). To allow this construction to start in 2017, 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 2017 construction start to avoid future problems.

203. **Dredging.** River dredging has not been included in subproject designs at the time of the meetings, and participants stated that embankments will not control flooding or erosion without it, and therefore it should be incorporated in the project. Some participants suggested capital dredging from Jamuna Bridge to Brahmankanda of Harirampur Upazila under Manikgonj District. Participants also suggested that fisheries habitat could be restored through dredging of internal channels in the Project-2 area. In the meantime, however, revision of Project-2 design means that multi-purpose dredging is now included in the interventions, in combination with riverbank protection works, so at least part of the concerns has now been addressed. Primary capital dredging of the river is not being considered as this is regarded as unsustainable and too costly.

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

205. **Flood protection plans.** Participants expressed concern 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.

6.7 Additional Concerns from Specific Meetings

206. **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 9,000 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 threatened by erosion this year (2017). To protect this area, participants suggested seeking preparatory funds from the ADB and the BWDB. Riverbank protection from Kaijuri to Baghabari is also essential this year (2017) 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.

207. **Shahjadpur, Sirajganj (JRB-1).** Coordination 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 embankment and revetment. While disclosing the proposed flood embankment along Hurasagar, they are in favour of the proposed intervention. Participants demanded construction of road-cum-flood embankment as it will facilitate smooth communication to Shahjadpur Sadar and Dhaka-Tangail road. They also informed that the existing embankment on this alignment is partially eroded due to river erosion and suggested to use this alignment to reduce the land acquisition cost.

208. **Chouhali, Sirajganj (JLB-2).** The area in Chouhali Upazila most vulnerable to erosion is the Upazila Sadar. BWDB has been using sandbags as temporary measure to protect the riverbank from sudden severe erosion, but these temporary measures are found not effective as sustainable solution. Many participants stated that these sandbag revetments are presently not suitable for the mighty Jamuna river due to its severe 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 of 12 km built in this Upazilla along the right bank of Jamuna River during the year at significant cost, was eroded due to severe flood and intensive erosion of mighty Jamuna River. 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. They demanded to extend the length of the protective work and necessary repairs of the protective works already done under Tranche-1. Local people urged in two public meetings at Solimabad to control the erosion which started a few years back and aggravated seriously recently.

6.8 Incorporation of Concerns in Project and Mitigation Designs

209. Some concerns relate to known issues that have been and are being attended to (e.g. 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 (e.g. 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 the public continues to be consulted.

6.9 Implementation-Phase Stakeholder Disclosure, Consultation and Participation

210. 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. A protocol will be established for COVID-19 proof consultation meetings with a small number of representatives from local stakeholders, and in first instance the priority will be to assess if there are any changes since the previous rounds of consultation.

6.10 Grievance Redress Mechanism

211. At each of the Project-2 subproject locations, a local Grievance Redress Committee (GRC) will be set up during the design stage and operate throughout the implementation phase.

212. A further elaboration on the establishment and operation of the Grievance Redress Mechanism is provided in Chapter 9.

6.11 Reporting and Monitoring

213. Environmental monitoring reports will be issued bi-annually disclosure on ADB's website. The environmental monitoring reports will also be incorporated into the January 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 Focal Person with the help of the consulting team's environmental specialists.

214. 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.

7 IMPORTANT ENVIRONMENTAL AND SOCIAL COMPONENTS

7.1 Introduction

215. 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's IESCs, and, as needed, identified additional IESCs they believed could be impacted by the proposed interventions.

216. 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

217. Every year, bankline erosion in the study area grasps a huge amount of land damaging valuable assets and infrastructure. 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 the available surface water can hardly meet the demand of local people. The interventions will have significant effects on 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 may affect the net accretion inside the Jamuna River.

7.2.2 Flooding

218. 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 infrastructure, causing bank erosion, disrupting communication system, and so on. Interventions such as construction and re-sectioning of embankments are likely to cause significant impacts in the flood occurrence, extent and duration.

7.2.3 Drainage Congestion

219. 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 that eventually cause waterlogging 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.

7.2.4 Water logging

220. 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 levels, which may create water logging on a permanent basis. Provision of regulators is likely to resist the occurrence of waterlogging, but in places where regulators would not be placed, waterlogging problems might arise.

221. Excavation of canals connecting the floodplain will enhance flooding. Excavation of beels to ensure that parts are at least 2m deep in the dry season, will increase beel productivity by promoting dry season survival. Six beels recommended to be established as fish sanctuaries are prioritized for deepening; these are: Chandahar, Char Ghior Mallar, Gomorki, Kadaibadla, Patal and Shonsi beels.

7.2.5 Water Availability and Water Use

222. In the dry season, groundwater as well as surface water is used to some extent for irrigation and domestic purposes, while in the wet season, surface water is predominantly used. 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 may affect the local people's access to surface water and its multipurpose usage.

7.2.6 Navigation

223. Navigation through the major and internal rivers is an important mode of transport in the study area. It is important for socio-economic aspects, ecological balance and the different uses of water. The provision of interventions may affect the navigation status of the rivers.

7.2.7 Surface Water Quality

224. Surface water quality 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 may impact the quality of surface water. The bank revetment works would impact 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

225. Land types are categorized based on the depth of inundation of cultivated land during the wet season. Areas under different 'land types' was selected as an IESC.

7.3.2 Dredging and Sand Carpeting

226. Dredging results in spoils that may be used to fill sandbags for riverbank protection works, river closures (sandplug) or for dumping on charland, in other river sections, on other (e.g. agricultural) land, or may be used for landfills (economic zones, settlements). Although dredging is an important part of the Project-2 interventions, spoils are mostly used to fill sandbags and built embankments and the river closure at Chauhali. Large-scale land covering with dredging spoils is not foreseen for the Project-2 works. Sand carpeting or smothering of agricultural land may take place through overtopping of embankment during high flood levels in the river. Area of agricultural land affected by sand carpeting was selected as an IESC.

7.3.3 Land Loss

227. Land loss through riverbank erosion is a major problem in the study area. The proposed bank protection is expected to check and largely reduce such loss of agricultural land. Temporary loss of agricultural land is likely to take place during the pre-construction phase if labour 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

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

7.4.2 Crop Production

229. Agricultural crop production is expected to increase through riverbank 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

230. 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 and Irrigation Water Availability

231. Irrigation supports greater and more reliable agricultural productivity. Both surface water and groundwater are used for irrigation use.

7.5 Fisheries

7.5.1 Fish Habitat

232. There will be changes in fish habitat both in the river and floodplain area due to the river stabilization process. River habitat will be altered due to the direct effect of bank revetment, dredging and reduction of braided system. Floodplain habitat will be indirectly affected by the embankments by being under flooded due to the reduction of river-floodplain connectivity.

7.5.2 Riverine Fish Habitats

233. In the river, fish habitat will reduce in spatial dimensions simply because the river will become narrower and confined between revetments. The bankline ecosystem will be altered from vegetated soft substrata to non-vegetated harder substrata altering the present pristine habitat. The river will also become deeper, and the shallower, bank-line ecosystem will be reduced. Braided habitat systems as well as the charland ecosystems will shrink, while bottom habitat will be deeper. Therefore, the size and characteristics of the river ecosystem will be altered significantly by the project interventions.

7.5.3 Beel and Khal Fish Habitats

234. Some of the riverine fishes (37 out of 200+ freshwater species) migrate towards the beels through khals for breeding and propagation. Beels are the breeding and feeding grounds of indigenous fish species and play a vital role in stock recruitment. The khals are at present silted up due to closure, construction of water regulating structures, the construction of earthen

bund, and so on. In addition, the beels have also silted up rapidly and indigenous fish species might disappear from the area. The proposed interventions will modify fish habitats in the study area.

7.5.4 Floodplain Fish Habitat

235. Floodplain fish habitat, consisting of beels, khals and flooded land, will be impacted indirectly but significantly by the river stabilization interventions. The embankment along the riverbanks to contain flooding will reduce the connectivity between the river and the floodplain, which will in turn affect fish habitats.

7.5.5 Fish Migration

236. Under the pristine situation, large number of fish undertake migratory movement between the rivers and the floodplain for breeding, early development, feeding and overwintering. But this will be largely affected by the riverbank embankments to contain flooding. The fish migration issue is included as an IESC under this study.

7.5.6 Fish Species Diversity

237. When there will be negative changes in the floodplain ecosystem due to reduced inundation of fish habitat and impeded fish migration, there will be significant reduction in natural recruitment and biodiversity. Besides, the beels may silt up rapidly and the indigenous species of fishes might disappear from the area.

7.5.7 Capture and Culture Fish Production

Fish production will be impacted due to the river stabilization interventions both in the river and floodplain area. In the river ecosystem, reduction and alteration of habitat will affect fish production. Deeper rivers will, however, support the deep river fishery and dolphins. In the floodplain fish production will be decreased 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 fish production.

7.6 Ecological Resources

7.6.1 Terrestrial Ecosystem

238. The terrestrial ecosystem provides habitat for 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 the terrestrial ecosystem as well as its population. Physical settings of the existing ecosystem may be changed, for example, terrestrial communities due to bank protection of the river.

7.6.2 Aquatic Ecosystem

239. Aquatic ecosystems provide support not only to aquatic life but also supply vital ingredients to terrestrial ecosystems. Unlike terrestrial ecosystems, any impact on the aquatic system is generally not confined to the local area, it also affects 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, niches, and so on.

7.6.3 Floral Composition and Diversity

240. Composition and floristic diversity of khal, beel, homestead and crop field vegetations are sensitive to the hydro-morphological condition of its habitats. The impact of the proposed bank protection activities would change the hydro-morphological condition of rivers and change the floristic composition and diversity both on terrestrial and aquatic habitats in the study area.

7.6.4 Faunal Composition and Diversity

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

7.7 Socio-Economic Conditions

7.7.1 Land Ownership and Tenure

242. Much of the land is occupied or used in one way or another but many people do not own the land in the sense that they posses a formal title, particularly on char lands. Large areas are 'khas' (government) land, however, and much of the land is privately owned while some of the khas land has been leased out to current land users. Land use on large areas will change as a result of the river protection works, and this will or may affect current users. Many of these are among the most vulnerable and disadvantaged people in the country who should not be further deprived by development of the lands which would go against government's policy of reducing regional disparity.

7.7.2 Land Acquisition

243. Land will be acquired for implementation of the riverbank protection works, embankment and regulators constructions following the FRERMIP Land Acquisition Plan of ADB Guidelines and GoB's related acts, rules and guidelines.

7.7.3 Income Generation

244. Project interventions could increase employment opportunities in agriculture and fishery sectors as well as in the field of non-agricultural trades.

7.7.4 Communications

245. One of the outcomes of the project is to protect embankments from erosion and roads on top of embankments, important for transport and communication in an area will therefore not be affected.

7.7.5 Poverty

246. People cultivate agricultural lands by the side of the river, and this contributes to production. Food security of the local people will be ensured by increased crop production in protected agricultural lands.

8 IMPACT ASSESSMENT AND POSSIBLE MITIGATION MEASURES

8.1 Environmental categorization

247. The Important Environmental and Social Components (IESCs) for the project have been selected and validated in Chapter 7. Following the analyses of all the secondary information available, major field investigation was conducted in May 2013, by a multidisciplinary team of experts from CEGIS. The information collected from that field visit period was analysed in order to assess and evaluate the impacts of each previously selected IESC. Further field work was conducted during implementation of Tranche-1 works in the period November 2015 to January 2017. This chapter contains the details on impact assessment and evaluation for the implementation of the Project-2 works.

248. The impact assessment concentrates on the Project-2 works. Impacts focus on the main interventions, i.e. riverbank protection through the deposition of geo-textile sandbags and concrete blocks, construction of embankment, and drainage/fish pass structures, as well as the establishment and operation of worker's camps, and transport of materials, whether by boat, road or else. Consequently, this EIA aims at supporting the investigation of suitable stabilization solutions, minimizing potential impacts of larger scale river stabilization, and suggesting appropriate mitigation measures for the ongoing Tranche-1 and the proposed Project-2.

249. During the second phase of the scoping process, the Project-2 EIA study team conducted compliance monitoring of the Environmental Management Plan (EMP) implementation of Tranche-1 construction works which yielded important insight in which impacts were significant, and which were not.

250. As the long-term river stabilization plan for the targeted river system contains a number of uncertainties, the RSP follows an Adaptive Delta Management approach whereby decisions relating to the design stabilised river are continually adjusted in line with growing basic planning data and observed impacts of initial activities. In the short term (until 2030), implementation of the RSP (including Project-2) will focus on systematic stabilization of two mid-reaches (reaches 3 & 4), alongside continuous collection of core river data and addressing erosion issues in the remaining reaches on an as-needed basis before preparing stabilization strategies for Reaches 1, 2 and 5 based on in-field experience.

251. Works are proposed for Project 2 along three subprojects as described in Section 4.

8.1.1 Environmental category according to Government of Bangladesh

252. Schedule 1 of Government of Bangladesh's (GoB) Environmental Conservation Rules act of 1997 lists 69 types of projects listed as Red category, including: i) Engineering works where the capital investment is more than 1 million Taka; and ii) Construction/reconstruction/expansion of flood control embankment, polder, dike, etc… Hence, according to GoB regulations the project is a Red category project requiring an IEE, EIA and EMP for environmental clearance from the Bangladesh DoE.

8.1.2 Environmental category according to Asian Development Bank policies

253. Compliance monitoring of the Environmental Management Plan (EMP) implementation of Tranche-1 construction works yielded important insight in which impacts were significant, and which were not. Based on these insights, potential impacts along with their level and likelihood of occurrence were listed for Project-2, and the main impacts are listed in Table 8-2.

Construction will also have a host of additional impacts reported in this EIA, such as noise, dust pollution, increased traffic hazards, disposal of hazardous waste, enhanced carbon emissions during construction, and so on. However, most of these are temporary, and are often at least partially mitigable.

Table 8-2. Potential main environmental impacts during implementation of Project-2

	Potential impact	**Level & likelihood of impact**
1	Significant effects on the morphological changes (i.e. erosion and accretion) of the area, also impacting riverine habitats linked to this morphology.	Significant and likely permanent, but perhaps more on a cumulative basis
2	The construction and re-sectioning of embankments is likely to increase water level which may create waterlogging on a permanent basis.	Unlikely, and levels are uncertain
3	Interventions proposed may affect the local people's access to surface water.	Positive in some areas, possibly negative in others; uncertain, requiring monitoring via EMP
4	Fish habitat will be reduced simply because the river will be narrower than its present width. Floodplain aquatic (wetland) habitats will be degraded or extirpated due to reduced flooded area, depth, and duration; reduced hydrologic connectivity; and physiochemical / water quality changes.	Likely and significant, only partially mitigable
5	This in turn will adversely affect floodplain-dependent open water fish species migration, population levels, and catch levels, as well as wetland biodiversity, services, and products more generally. In turn, this may affect the nutrition, health, and economic status of poor people.	Likely and significant, only partially mitigable
6	Flood-control-led expansion of high-yielding varieties (HYVs) may increase utilization of ground- and surface waters 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.	Likely and potentially significant, but mitigable
7	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.	Likely, but moderate and (partly) mitigable
8	Turbidity due to dredging is not considered as directly problematic as the dredging quantities are very small compared to the total sediment load of the Padma River. Hence dredging has no major short-term impact on the river morphology.	Likely, but moderate and temporary impacts
9	Direct disposal of these dredged materials in the river will increase turbidity of river water, and as a result river fishes and aquatic animals will be affected.	Likely and potentially significant, albeit during construction phase only

254. Potential or likely **significant** negative impacts of the RSP interventions, including those of Project-2, are expected to include the following:

(i) Reduced river connectivity between the river and the (current) floodplain, affecting surface and groundwaters and fisheries resources.
(ii) Loss of natural terrestrial, aquatic and wildlife habitat, affecting biodiversity and fisheries production.
(iii) Alteration of the main river channel from a wide, braiding river to a less braided, narrower course, resulting in permanent loss of river associated habitats.

255. The impacts of the planned interventions under Project-2 are expected to result in significant impacts, in particular on fish, fisheries and wildlife habitat, which are likely to be lasting and to extend beyond the sites of physical works. These expected impacts result in a categorization of the project as **environment Category A**, according to the ADB safeguard policy statement (2009)[19]. To establish a baseline and to monitor the impacts, a biodiversity study is included in Project 2.

256. Both positive and negative impacts of the Project-2 works have been identified for the construction and post-construction (operation and maintenance) phases, as well as mitigation measures, and these are detailed in the following sections (sections 8.2–8.6). As similar works will be conducted in the three Project-2 sub-reaches, the impacts have been generalized, but at the end of this chapter the main expected negative impacts and mitigation measures are summarized per site.

8.2 Positive Impacts

8.2.1 Construction – Overview

257. Construction of the works will require a large labour force (thousands of workers) for prolonged periods of time. Labourers will be contracted mostly from local communities. This will increase income and thereby boost the local economy.

8.2.2 Operation and Maintenance – Overview

258. After completion of the construction works, the interventions are expected to have multiple positive and beneficial effects on the people and economy of the area. First of all, the riverbank protection will prevent recurrent riverbank erosion and the associated loss of homesteads and cultivated land. Also, the improved embankment will also significantly reduce the flooding events and associated economic losses. Finally, roads constructed on embankments will facilitate local mobility as well as long-distance transportation. These factors are likely to have profound positive impacts on the local people and their economic conditions. The permanent delineation of river and floodplain will provide stability and allow the riparian population to plan. The increased safety against riverbank erosion and flooding as well as improved mobility and connectivity will bring in further development and investment to the protected areas that is currently not possible because of the exposure of these areas to natural hazards coupled with the vulnerability due to relative isolation and poor infrastructure. Three of the more significant positive impacts are further described in the following sub-sections.

8.2.3 Control of Riverbank Erosion

259. During the last four to five decades, the Jamuna-Padma-Meghna river system has undergone significant changes in width, bank erosion and braiding intensities. Recent research suggests that sediment slugs generated by the 1950 Assam earthquake were the main driver for those rapid changes. Riverbank erosion has resulted in loss of valuable land along the

[19] Asian Development Bank (2009) Safeguard Policy Statement June 2009

riverbanks. For example, the average rate of riverbank erosion along the Jamuna River north of Jamuna Bridge during last 40 years has been about 6 ha per km per year, resulting in loss of about 15,700 ha of valuable land during the period (RMIP, 2015). Along the same reach, another 6,000 ha may be lost due to riverbank erosion during the coming 30 years if no measures are taken to arrest the trend. The riverbank erosion not only causes loss of land but also attacks the already existing embankment, causing frequent breaches that in turn result in flooding of the protected floodplain causing substantial losses to private and public assets as well as crops and cultivation fields.

260. If no protective measures are taken and if the River Stabilzation Plan is not implemented (the Without-Intervention Scenario), the prevailing situation of a highly dynamic river and floodplain environment will remain, resulting in severe riverbank erosion at many locations and land accretion at others, and continued significant loss of land annually; it is estimated that around 1850 ha will be lost every year by erosion.

8.2.4 Improved Flood Protection

261. Overbank spills regularly cause flooding in vast areas along the banks of the Jamuna-Padma-Lower Meghna River system. Over the years, embankments have been built along the banks but increasingly these have come under attack from bank erosion causing the embankment to breach. After such breaches, embankments usually need to be retired backwards, away from their original alignment and reconstructed. Retired embankments are typically constructed with around a 200-m setback distance to prevent flooding, which however corresponds to only few years of significant erosion. In many places, the embankment has been retired multiple times. Presently, many reaches of embankment are close to the riverbank line, making the closing of breaches increasingly difficult. Consequently, the integrity of the embankments is being threatened and large areas of rural and urban areas are increasingly exposed to flooding.

262. As part of the economic analysis of the program, the average yearly value of the above-described damages is being estimated. There are three main benefit streams: (i) avoided flood losses – to infrastructure including houses and crops; and (ii) incremental agricultural and aquaculture benefits from increased production. Other benefit streams, such as navigation or road transport, potential industrialization, and so on, are typically not taken into account. (iii) the embankment rehabilitation and reconstruction works envisaged under the proposed program will help avoid the losses described above and will result in savings the annual losses that are likely to take place caused by the flooding if no protective measures are undertaken.

263. The rehabilitation of existing and construction of new embankment will greatly improve the effectiveness of these structures against floods. Under the proposed program, the condition of the existing embankment has been reconsidered and re-designed: the width is increased to ensure that breaches and seepage do not take place and height is being increased catering to 200-year flood level (and a freeboard) with climate change provision along the main rivers (Jamuna-Padma-Meghna) and 100-year flood level (and a freeboard) along other rivers. In addition, squatters will be removed from the embankment (after payment of compensation), allowing effective monitoring and maintenance of the new embankment once constructed. This will greatly reduce the risks of embankment breaching or over-topping hence significantly increase the protection of the area from floods and associated losses. Stable riverbanks will remove the problem of squatting as no families are involuntarily resettled by erosion anymore. In addition to the above the increased protection against riverbank erosion and flooding – combined benefits of the riverbank revetment and embankment reconstruction – will also bring in area development as well as investment that are currently not feasible because of the threats of bank erosion and flooding.

8.2.5 Land Cover and Land Use Changes

264. The program influence area is dominated by settlements and cultivation. Although cropping intensity on the floodplains is high, there is good potential to further moderately increase it. Protection against erosion and flood damage will stimulate farmers towards increased crop intensity and toward high value crops. However, the cropping pattern could be changed by increasing the trend of growing high value crops. Area coverage of different crops is expected to increase in some locations due to protection of seasonal flood by the embankment. On the other hand, area coverage of some crops may decrease due to poor profit margins. The trends of crop production per unit area for a couple of decades suggest that increase of yield (t/ha) for different crops will continue for some time by using modern production technologies and increased inputs. Once there is no threat of flood, it is expected that farmers will invest in more cultivation inputs and as a result the production per unit area will increase.

265. Earlier studies (for example RMIP, 2015) indicate that based on the changed cropping pattern and increased yield, there will be an increase in the agricultural income from the program influence area. While the western floodplain has been embanked, the eastern one is largely without embankment. Hence, increased agriculture production is expected in the newly embanked areas.

266. While increased agricultural income will positively impact the livelihood of local farmers, the increased cropping intensity and changed cropping pattern will potentially cause an increased use of agrochemicals such as urea, TSP (Triple Super Phosphate) and MP (Muriate of Potash). The increased use of agrochemicals can potentially cause an enhanced level of soil and water contamination and pose health hazards for the farm workers and for other communities in the project influence area.

8.2.6 New Fisheries Habitat

267. The envisaged riverbank protection works are almost exclusively longitudinal river training revetments made of geotextile bags filled with sand below the low waterline and concrete blocks or grout-filled mattresses above this line. Contrary to the unprotected riverbank that mainly consist of compressed but loose sand that erodes rapidly, the bags and blocks form a stable substrate that may provide shelter, feeding and breeding places for some fish and other (semi)aquatic life. As the bags and blocks do not form a completely flat and closed layer, small openings may remain that provide shelter. Algae and other small organisms may find a suitable substrate on the bags and blocks on which fish and other vertebrates may feed. Revetments (esp. concrete blocks) are generally known to create good fish habitats.

268. The planned interventions will result in a non-braided stable river ecosystem with narrower and deeper, faster flowing channels. This will create an aquatic environment favourable for deep water and current-dependent fauna such as Hilsha fish, but is unfavourable for shallow-water fish that prefer low current velocities, such as most fingerlings. As opposed to the steep eroding riverbank, the protected one provides easy access to the river.

8.3 Negative Impacts

8.3.1 Construction – Overview

269. The key potentially negative impacts associated with the construction phase of the Project-2 works include changes in aquatic habitat because of riverbank protection works (e.g. slope levelling) as well as from sand extraction from the riverbank; changes in land form and land use because of rehabilitation of existing and construction of new embankment; land acquisition for construction of new embankment and resulting displacement of people; use of

natural resources particularly river sand; health and safety risks associated with handling of hazardous materials and operation of construction machinery; air quality deterioration because of operation of construction vehicles and machinery as well as excavation activities; noise generation caused by the operation of construction machinery and vehicles; contamination of land and water caused by wastes generated from construction activities and camp operation; loss of trees that need to be removed for construction of embankment; risk of accidents associated with movement of construction vehicles and machinery; blockage of local routes caused by construction activities; and impacts on sensitive receptors such as schools along the embankment.

270. Most of these adverse impacts are of a local and temporary nature (e.g. during the construction phase only) and can be mitigated relatively easily with proper mitigation measures that form part of best international practice. Permanent negative impacts associated with the construction works such as lost or damaged properties (trees, houses, land) and livelihoods are to be compensated for as per relevant policies of the GoB and financing agencies and in accordance with the Resettlement Action Plan (RAP) that has been developed and is to be implemented by the program.

8.3.2 Operation and Maintenance – Overview

271. The potentially negative impacts associated with the O&M phase of the interventions include changes in river morphology caused by riverbank protection; changes in aquatic habitat caused by riverbank revetment; blockage of local routes caused by embankment and roads; effects on water bodies and associated habitats caused by disruption of hydrological and ecological connectivity between main river and internal rivers, beels and khals; noise generation and air quality deterioration caused by vehicular traffic on embankment roads; risks of accidents associated with vehicular traffic on embankment roads; and increased usage of agrochemicals caused by agricultural intensification due to enhanced protection against riverbank erosion and flooding. The loss of vertical riverbanks results in the disappearance of nesting habitat for a range of bird species.

272. Once the river training works have been constructed some 6,000 ha of land will be reclaimed in subproject JLB-2 (Feasibility Report for Tranche- 2 (Project 2), August 2019) while it is government policy to ensure food self-sufficiency (particularly rice) and that reclaimed land should be made available for the landless and marginal farmers. It has also been noted that there is a large and growing demand gap in the supply of meat, milk and eggs (particularly in urban areas) and it is policy for agriculture to intensify and diversify. However, much of the land to be stabilised and reclaimed is of low fertility which may take 12-15 years to bring to a condition where rice cropping can contribute to food self-sufficiency and much of the land is char land that is currently being used for arable agriculture. There is a need to ensure that these current land users, who are amongst the most vulnerable and disadvantaged people in the country, are not further disadvantaged by the development of these lands that would go against government's policy of reducing regional disparity.

8.3.3 Riverbank Protection & Construction/Rehabilitation of Embankments & Regulators

273. **Impact.** These interventions result in significant changes in land use, land cover and habitats, and limit the supply of water to support local communities, agriculture and fisheries throughout the year. If no, inadequate or insufficient regulators/fish passes are provided, the connectivity between the main river and floodplain will be affected, which is of importance for migratory fish and other animal species since their reproduction and survival rely on such connectivity. Even with mitigation measures, the post-construction condition will be less

favourable for the aquatic environment as compared to prior to the intervention. Compensation measures, if diligently carried out, may however, cover some of the anticipated fish production losses.

274. Adverse on-site environmental impacts of constructing bank protection and embankment works will mostly be of a local and short-term nature and can be mitigated by minimizing pollution of the environment by proper management practices on construction sites as well as in and near worker's camps.

275. New embankment construction may result in the loss of agricultural land, homesteads and/or businesses resulting in a loss of income and livelihood. The rehabilitation of embankments may also result in loss of income depending on the degree to which the embankment has been squatted upon. Both interventions are likely to require resettlement programmes and income and livelihood restoration.

276. **Mitigation.** As noted above, negative impacts of the riverbank protection and embankment works will need to be addressed through various management interventions that include ensuring connectivity between the river and the floodplain through operation of regulators and fish passes, and actions that enhance fisheries – as is outlined below.

8.3.4 Dredging and Excavation Works

277. **Impact.** The impact of dredging largely depends on the location and on what is done with the dredging spoil. Under FRERMIP, dredging has so far primarily been done for the collection of sand for filling of geotextile bags and for embankment construction and is conducted in the river itself where the sand content of the river floor is highest. Usually this is within a distance of a few kilometres from the construction sites. Impact of this type of dredging during the dry season construction window is believed to be low, local and temporary: fish, dolphins and other wildlife will temporarily avoid the area but will return once the dredger has ceased work or moved elsewhere. Impact on on-site fish habitat is also expected to be low or insignificant as most of the river's bottom sediment is expected to be loose material. Some dredging works in channels will be part of Project-2 implementation, and a channel near Chauhali will be closed with dredged sand (sandplug). This will be so-called "intelligent dredging" designed to stimulate certain river morphological developments. Dredging may also be done to keep navigation channels open during the dry season. Giving priority to large-scale dredging as the key intervention for river stabilization in Bangladesh, as promoted by the Prime Minister in January 2018, it not foreseen under FRERMIP.

278. Dredgers are usually noisy due to lack of adequate noise silencing equipment, and produce smoke and smell, being mostly a nuisance to their crew. People, animals and plants on land will usually not be affected.

279. Impacts of dredging and excavation may be different when spill canals are to be created, or when silted canals or distributaries need to be opened or deepened. This may involve loss of used land, damage to crops or other assets, loss of natural habitat, and hindrance to people and animals.

280. Dredged spoils may be dealt with in different ways. These will either be transported by barge to geotextile sandbag filling or embankment construction sites, or be dumped somewhere else, mostly to fill low lying areas that are potentially secured or reclaimed. Transport to bag filling or embankment construction areas will not involve significant impacts i.e. other than engine fumes, noise produced by barges, and carbon emissions. Spoil dumping may involve transport by barge as well or pumping through floating pipes to disposal sites. The latter may be other parts of the river (open water where this will not hamper navigation) or char or khas land.

281. Dredged spoil deposition sites may cover large areas that prior to the works are in use for agriculture, livestock, fisheries or that provide habitat for wild animals and plants and that temporarily or permanently will be lost. Spoil deposits can be expected to have a high sand content and thus low soil fertility, and therefore it may take years before these lands become productive. However, this is not expected in Project-2, where dredge spoils will be used for geotextile bag filling and for the Solimabad closure.

282. Dredging will or may affect the aquatic environment in four possible ways: (i) destabilizing the bottom ecology, (ii) channel deepening creates an altered ecosystem that may not be good for aquatic life, (iii) destroying potential fisheries habitat as the spoil deposition sites are targeted to be partly water bodies, and (iv) changing water quality. Changes in water quality include:

(i) pollution from dredging equipment and fuel
(ii) increased turbidity (already high, but expected to increase significantly, e.g. locally by an order of magnitude), and
(iii) suspended solids (these contribute to turbidity, but also directly affect aquatic life, e.g. by smothering plants and fish gills).

283. These impacts on water quality are mostly temporary and local (i.e. in a plume many km's downstream), although smothered plants and other biota may take time to recover.

284. **Mitigation.** Pollution, health and safety issues associated with the dredging activities and in and around workers' camps (air, noise, solid/liquid waste) are to be prevented through adequate best practice management and frequent monitoring.

285. Negative impacts of the dredging and excavation works can, to some extent, be mitigated by creating and enhancing alternative fish and wildlife habitats, for example through the establishment of Fish and Wildlife Sanctuaries – see below.

286. Fish habitat and fish production losses may not be possible to mitigate, the resultant impact in terms of fish production loss may be made up by appropriate compensation measures.

287. Conducting a water quality monitoring programme prior (for baseline), during and after construction. Especially TSS, visibility and EC will be important.

8.3.5 Reduced Flooding – Baseflow

288. **Impact.** The overall river stabilization works (dredging, bank protection and embankments to prevent flooding) are expected to reduce the width of the river system (from the current braided system to a one or two channel system) and to deepen the main channel(s) which is expected to lower to some extent the low water levels. This may particularly impact water levels in distributaries, notably the Old Brahmaputra, Dhaleswari and Arial Khan.

289. The Old Brahmaputra and the Dhaleswari have been receiving less water in the past few years, which has led to a gradual decrease in flow along these rivers and resulted in many other impacts downstream such as deterioration of groundwater availability, reduction in surface water availability, impact on domestic water supplies, reduced irrigation opportunity, reduced crop and fisheries production, reduction in navigability, declining biodiversity and (particularly with the Dhaleswari) increase in both surface and groundwater pollution. The Arial Khan has not experienced a recent reduction of inflow, but also here the inflow depends on the morphological conditions at the offtake.

290. Preparation of the program includes study of the offtakes of these three rivers with the aim of re-establishing/maintaining flow from the main rivers as well as determining minimal environmental base flow. An IWM study in 2015 of the Dhaleswari offtake noted that the aim is to divert 245 m^3/s from the Jamuna River into the Dhaleswari/Pungli/Bangshi/Turag/Buriganga river system with 141 m^3/s to the Buriganga River to bring the dissolved oxygen levels up to 4 mg/l from the current 1 mg/l.

291. Reduced flooding will affect the floodplain fisheries ecosystem and thereby fish production. Advantages are: groundwater recharge, fisheries, navigation, water quality, irrigation improvement.

292. **Mitigation.** In general the social and environmental impacts of re-establishing/maintaining flow along these distributary rivers will be overwhelmingly positive but there will also be negative environmental impacts associated with the construction works at the offtakes where mitigation measures such as those outlined above will be required.

8.3.6 Reclaimed Land

293. **Impact.** Impacts of land reclamation are felt at various levels and concern dredging and excavation (8.3.4), reduced flooding (8.3.5), fisheries (8.3.7), natural habitats and wildlife (8.3.8) and of course on local (char dwelling) communities, which is dealt with here. Part of the land to be stabilised and reclaimed under Project-2 is char land. The inhabitants of most of the chars and their land are not included in much of Bangladesh's official data and estimates of the char population vary. Char people, the choira, are defined by their vulnerability and poverty. Their main income source is (subsistence) agriculture supplemented by animal husbandry, small businesses and fishing. Riverine char population are severely deprived and faces multiple livelihood challenges with high poverty levels not only through lack of income and assets but also who experience limited access to healthcare, education, markets and other government institutions as well as inadequate infrastructure. Labour markets are also constricted with limited diversification and few off-farm employment opportunities.

294. As the river corridor becomes narrower due to channel stabilization, this results in a change in river morphology from a wide, braiding system to a narrower, less braiding one. In the process, riverine habitat important for fish, birds and wildlife will be permanently lost, and this can be mitigated for in only a small degree, e.g. by replanting shore lining vegetation. Some habitats such as gravel islets important as nesting areas for terns, will largely be lost in the subproject area.

295. **Mitigation.** Land quality of reclaimed lands needs to be assessed for deciding the optimal land use. One method of land quality assessment is Land Zoning and the Ministry of Land is in the process of undertaking Land Zoning for the whole country. Unfortunately, the Jamuna-Padma corridor is one of the last areas to be completed. The rationale behind the exercise is to promote optimal land use, to reduce land degradation by 'improper land use,' to reduce the indiscriminate conversion of agricultural land to other uses and to maintain ecosystem services and biodiversity as much as possible. Land Zoning is a tool for GoB in stimulating, facilitating and regulating the land resources of the country and as such will be important in the land use planning of stabilised and reclaimed land.

296.

297. It can be assumed that the development of the stabilised and reclaimed land in the river corridor will be a mix of land uses of agriculture (low, medium and high input), industry (manufacturing/agro-industry/Special Economic Zones), livestock, forestry, fisheries and settlement and therefore the process by which different land uses are selected for different

areas needs to be set out. At present this is largely conceptual, but the aim is to set out government's vision against the requirements of different land uses against land in the river corridor.

298. A two-stage process is envisaged:

(i) **Stage 1.** Assessment of suitability of each LSRA (Land Stabilization and Reclamation Area) block for major land uses – SEZ & Settlement, Commercial Agriculture, Medium-scale Supported Agriculture
(ii) **Stage 2.** Planning of development of each LSRA block for the whole range of land uses – as above plus livestock, forestry, aquaculture and low input agriculture

299. The two-stage process allows for the identification of areas most suitable for immediate development where the first stage is a screening stage. This will identify LSRA blocks most suitable for immediate investment and can highlight what infrastructure investments need to be made as well as enabling a phased approach to be planned.

300. The second stage will be the land use planning of each block with areas identified for different land uses. This phase will require a high level of stakeholder consultation.

301. Further detail on land reclamation, land use and the planning process is provided in a Annex H4 of the River Stabilzation Plan (2020).

8.3.7 Fisheries

302. **Impact.** Rapid, large-scale expansion of flood control developments that started in Bangladesh in second half of the 20th century, caused serious concern about its impact on inland fisheries because catches from floodplains began to fall. This triggered studies into the impact of flood control on inland fisheries, including those of the Flood Action Plan (FAP) 17. Some of the main impacts are described below, as well as possible mitigation measures derived from these and other studies that are relevant for and applicable to the current plan/program.

303. **River stabilization.** Channelization or removal of a braided of a river system will or may result in (i) loss of fisheries habitat; (ii) an altered ecosystem, good for deep water fish but unfavourable for shallow water fish; (iii) increased river flow, which may be good for rheophilic (current loving) fish, unfavourable for fish that prefer lower flow velocities; or may be achieved by (iv) dredging which will affect the fisheries ecosystem by destabilizing bottom fisheries, and creating a deeper river bed that may no longer provide a habitat for current biota; dredged materials may destroy potential fisheries habitat. Revetment of riverbanks to contain bank erosion will replace soft fragile aquatic habitat by stable, relatively harder eco-base the precise impact of which will have to be determined but may not be significantly harmful for the fisheries. Construction or rehabilitation of embankments along riverbanks to contain river flooding may result in the loss of river floodplain connectivity affecting floodplain flooding and obstructing fish migration making the floodplain less productive.

304. ***Loss of catch through loss of habitats.*** There will be fisheries habitat loss due to the channelization of the rivers and reduced flooding due to the levee development even with the provision of sluice gates. The habitat loss will result in the reduction of fish catch.

305. ***Reduced biodiversity and migratory fish.*** Flood control has an adverse impact on fish diversity, and comparison of different fish groups shows that there is greater reduction in diversity of migratory fish species than floodplain residents. Fish species that migrate to the floodplain either for breeding or early development will be affected by the loss or reduction of

river-floodplain connectivity. Reduced hydrological connectivity across embankment sluice gates reduces lateral fish movements in two ways: first, by reducing the number of fish entry points on to the floodplain and thereby concentrating fish into fewer channels where they are more susceptible to capture, and secondly by closing gates of regulators for extended periods during pre-monsoon and monsoon (high river water levels). Gate closure also blocks the entry of fish hatchlings or fingerlings carried downstream in rivers by passive drift and prevents them reaching nursery areas on floodplains. Even when gates are open, severe hydraulic conditions (current) reduce densities and supply rates in regulated rivers.

306. ***Increased capture at regulators.*** Regulators/fish passes prove to be excellent points to capture fish. Flood control structures are deliberately closed to prevent or hinder the passage of fish, or opened, to facilitate capture. If improperly designed or sited, structures may act as obstacles to passage: for example, some fish may avoid long and narrow passages, where water flow may be too high.

307. ***Agriculture practice.*** Exclusion of external river water under full flood control for increased cultivation of HYV T. aman substantially reduces the options available to mitigate against adverse impacts of fisheries, compared to those available under controlled flooding for deepwater aman cultivation, which leaves the fisheries ecosystem functional.

308. ***Social and economic impacts.*** In case of a reduction of fish production due to flood control, all groups dependent on the fisheries lose income, a cheap source of animal protein and employment opportunities. This affects subsistence, seasonal and professional fishermen, and leaseholders and fish traders.

309. **Mitigation and Compensation.** In addressing adverse impacts of flood control works on fisheries a distinction is required between mitigation and compensation. Compensation measures rely on aquaculture or culture-based methods to increase fish production and thereby compensate for lost tonnage of fish due to flood control. In contrast, mitigation measures are designed to reduce or avoid losses to capture fisheries.

310. Fisheries production loss due to river stabilization interventions cannot be fully mitigated, compensation measures will have to be adopted and fortunately there is ample scope to do it in the planning area.

311. Planned and recommended structural and non-structural fisheries impact mitigation/ compensation measures are described below.

(i) ***Structural Measures*** include the following:
   (a) Development of major distributaries such as the Dhaleswari, Arial Khan and Old Brahmaputra to sustain natural flow to feed adjacent floodplain ecosystems. Measures will need to be taken to increase the flow in the Dhaleswari system to flush the dead ecosystem of Buriganga.
   (b) Spill way canals to provide additional supply floodplains to support the fisheries ecosystems.
   (c) Provision of fish passes along sluice gates that favour fish migration.
   (d) Fixing RL of Regulators to maintain flooding of F2-F4 land types[20] to support fisheries ecosystems.
   (e) Excavation of canals connecting floodplain will enhance flooding. Excavation of beels will increase beel productivity.

[20] F2 (medium land (0.9m-1.2m)), F3 (low land (1.2m-3.6m)) and F4 (very low land (> 3.0m)) based on the inundation depth.

(f) Establishment of Fish/Biodiversity Sanctuaries in the floodplain and, if possible, in rivers (various sanctuaries are proposed – see Appendix C [bird sanctuaries] and Appendix D [fish sanctuaries]).

(ii) ***Non-structural Measures*** that may be applied include:

(a) Fish friendly operation of regulators.
(b) Community based management of fisheries related activities.
(c) Management of fisheries particularly for rational fishing.
(d) Providing training for (a) awareness building and (b) adoption of improved technology.
(e) Extension support for fisheries management and improved aquaculture.
(f) Other measures that may be considered within full flood control and controlled flooding areas, some with a more regional focus, are the following.

312. ***Production of deep water aman and capture fisheries*** contrary to expectations of planners, farmers usually prefer controlled flooding by external rivers for the continued production of deepwater rice rather than attempting to convert to HYV Aman on lowlands prone to rainfall flooding – but this practice is in decline now.

313. ***Habitat rehabilitation and protection*** to reduce the loss of winter and pre-monsoon habitats. Important dry season habitats such as perennial beel and baor in which the magnitude, extent and duration of flooding has been reduced should be rehabilitated by reconnection to original feeder river systems and maintenance of adequate dry season water levels.

314. ***Beel management*** meant to increase survival of fish broodstock during the dry season when vulnerability to over-fishing in flood controlled areas is widespread. This can be achieved by establishment of Fish Sanctuaries, which provides shelter for fish and prevents the most opportunistic fishing methods. Floating buoys along the riverbank have been proposed by for example RMIP to prevent the use of floating nets, and this will reduce pressures on river fish.

315. ***Prohibited fishing zones on regulators.*** Flood control structures that block or delay movements of fish in rivers or canals thereby increasing their susceptibility to capture should be legally declared prohibited fishing zones. Such zones vary depending on size and location of the structure and size and nature of the regulated water course.

316. ***Protection of river (duar) fisheries***. River duar (scour holes) are of great importance as winter refuges for large species of fish, particularly catfish and carp. These sites are intensely fished during the dry season. Fishing during the dry season should be prohibited but requires frequent river patrols by DoE to enforce regulations.

317. ***Conversion of full flood control to partial control.*** In some areas full control and river confinement has resulted in high water levels and responses to cut embankments to reduce flooding. Conversion to a partial control regime would allow for deep water aman and increase fisheries potential.

318. ***Establishment and/or strengthening local water-user groups*** to represent the full range of sectors affected by modified flooding patterns, including those engaged in capture fisheries. Representatives should form a local committee in association with relevant government departments to establish and run operating procedures of regulatory structures.

8.3.8 Natural Habitats and Wildlife

319. **Impact.** As a result of the river stabilization works, the active river corridor will be narrower and thereby a substantial part of the char lands will disappear. These low-lying lands are, like the entire river system itself, highly dynamic but parts of these provide resting and feeding grounds for wildlife, particularly migratory birds for part of the year, especially in winter (October-March), when water levels are receding, thereby exposing potentially rich feeding areas.

320. Also, the areal extent and diversity of areas with varying water depth (shallow, medium, deep) will be reduced, and thereby this will limit the availability of suitable or preferred habitat for fish, dolphins and other aquatic life.

321. Natural terrestrial habitats will be affected too. Although the riverbank protection and embankment works will require clearing of some vegetation including trees, the main impact here is loss of floodplain habitat, including patches of natural vegetation (reeds, shrub, bush, trees) associated with water fringes, depressions and low-lying areas that may not be flooded or provided with less or no water at all because of the proposed works, and loss of vertical riverbanks that provide breeding habitat for a range of bird species.

322. The level of impact is difficult to predict but is believed to be substantial. It is expected that biodiversity in the impact area will reduce. On the other hand, birds and other wildlife are highly mobile, they usually select those areas for feeding and resting where these is little disturbance and sufficient food. But as the river channel is so dynamic, these change all the time.

323. **Mitigation.** As compensation for natural habitat lost it is advised to establish nature sanctuaries. Two dolphin sanctuaries have been established already near Jamuna Bridge, but it is to be assessed to what extent these are successful, and how these will be affected by the proposed development.

324. Also, the Bangladesh Bird Club (BBC) has developed a couple of years ago a proposal for establishment of two sanctuaries for migratory birds (one north of Jamuna Bridge and the other in the Lower Ganges) and submitted these the DoE, but for various reasons this did not result on formal establishment, so such proposal should be reconsidered and re-submitted. In November 2017 the BBC provided a report on possible locations where bird sanctuaries may be established (Appendix C). The feasibility and possible incorporation of these in the FRERMIP implementation works will be further assessed.

8.3.9 Worker's Camps

325. **Impact.** Construction of riverbank protection and flood control works requires large numbers of labourers. Although some of these are from the immediate surroundings, many of them live far away and are accommodated in worker's camps. Typically, these camps are temporary settlements consisting of basic tents for hundreds of workers and which are located on hired land close to a project office. The camps include basic support facilities such as one or more tube-wells, cooking sites and simple sanitary facilities. The latter particularly may give rise to complaints by nearby residents in the areas concerned, such as is the case in some of the worker's camps already established under FRERMIP. Here people from the surrounding areas complain about a bad smell and unhealthy conditions that negatively affect their living conditions. Also waste management is of a low standard or absent almost everywhere in these camps, and tube-wells are not or poorly protected.

326. The root cause of the noted problems may be with the Contractors, and their supervisors: although there is an Environmental Management Plan (EMP) enclosed in their contracts they generally show little interest in it and sometimes even do not know what is in it. Although in principal (and per contract) Contractors are to provide minimum sanitary facilities, they merely leave it up to the workers to 'manage' these.

327. As per the ADB guidelines for project management, the project promoter (BWDB) is responsible for establishing and running a Grievance Redress Mechanism (GRM) at each site which require strengthening for effective implementation of Project-2.

328. **Mitigation.** Contractors are to comply with their contract requirements in terms of environmental management, which includes among others the appointment of a full-time Environmental Inspector, improving basic support facilities and waste management.

329. The project promoter is to establish and run a Grievance Redress Mechanism in accordance with agreed obligations.

8.3.10 Ecosystem services

330. **Impact.** The cycle of regular flooding of the floodplains does not only lead to human suffering, but also provides a number of ecosystem services such as replenishment of nutrients (e.g. by deposition of a thin layer of fertile silt in agricultural land), restocking of wetlands (e.g. beels, jeels) with fish and other aquatic species, flushing of pollutants (e.g. agrochemicals flushed out of agricultural land) and groundwater recharging. Receding floodwaters also contribute to the maintaining of water levels in the rivers, and hence add to an overall buffering of water resources. Reducing levels and extent of flooding has highly positive impacts by reducing human suffering and increasing acreages of stable agricultural land, but this comes at the cost of reducing the aforementioned ecosystem services.

331. **Mitigation.** Some of the impacts can be mitigated, for example, by adding regulations and fish-passess, increasing connectivity of distributary rivers with the floodplain, and excavating (some of) the beels. However, a number of ecosystem services will need to be replaced (e.g. more fertilisers used by farmers to replace nutrients deposited as silt), or at a minimum need to be monitored to assess actual impacts as these are difficult to predict (e.g. impact on groundwater recharging).

8.3.11 COVID-19

332. The COVID-19 pandemic only fully evolved when Project 2 feasibility documents had already been completed. Now COVID-19 management has become a highly important issue in context of environment, health and safety (EHS), including at construction sites. These circumstances require adaptive responsive management to avoid, minimize and manage the situation. The construction works involves a large workforce of national and international staff who may face unprecedented health risks.

333. **Mitigation.** To continue the project work in this adverse situation, the country's health rules, together with World Health Organization protocols, set mitigation measures that should be complied with to avoid self-infection as well as spreading of COVID-19. It is therefore needed to confirm to the stakeholders that the project is taking adequate precautions to prevent and minimize the outbreak of COVID-19 and identify what to do in the event of outbreak. The following COVID-19 precautionary management should be disclosed to the local community and all concern before commencement of the civil works.

- A designated team will be established to address COVID-19 issues and safeguard to workers including project people and national and international experts.

- Immediate response to COVID-19 would include ensuring social distancing in (and outside) our project offices and on building sites, increased personal hygiene measures (e.g. handwashing), and a direct move towards more online meetings and discussions instead of face-to-face, wherever possible.

- Project will identify i) location ii) existing project resources iii) availability of supplies iv) capacity of local emergency/health services.

- Procedures for response to COVID-19 management will be prepared and distributed to all contractors and sub-contractors for strict compliance.

- Provision of training and awareness on prevention and safety issues related to COVID-19

8.4 Climate Change & Emissions

8.4.1 Climate change

334. Climate change is believed to impact 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, discharges in the main rivers are expected to increase between 6 and 15% for moderate and average flood events by 2040 (see PPTA main reports and IWM, 2008). The increase in discharge might be offset by increased water storage for hydro-power generation (outside Bangladesh). 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.

335. 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 adjusting 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 riverbank. Furthermore, embankment designs follow best international practice providing 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 embankments 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.

8.4.2 Emissions & implementation

336. Materials used for these interventions have been decided during earlier feasibility studies and are relatively easy to produce and apply and at low cost, i.e. geotextile bags manually-filled with dredged river sediment (sand). Alternative materials for the interventions below water would have been hard rock or manually cast concrete (CC) blocks, but as this not readily available in Bangladesh this is to be imported from India or Bhutan, adding to cost and GHG emissions..

337. Emissions linked to usage of hard rock in revetments are mainly related to mining and transport but are not well researched in Bangladesh. The emissions relating to mining include carbon monoxide, nitrogen oxides, CO_2 and hydrogen sulphide, while transport emissions are associated with moving rock by barges from Assam and surrounding states to Bangladesh.

338. For concrete, about 90% of the mixture by weight is made up of water, sand, stone or gravel, and other ingredients. The process of mining, crushing and combining these ingredients requires relatively little energy: the bulk of the CO_2 embodied in concrete derives from the cement content in the concrete mix. According to Sanal (2018), per tonne of concrete, the cement component leads to 0.35 to 0.91 tonnes of CO_2 emissions, depending on the cement type and mix. The other components of the concrete have a joint emission factor of about 0.22-0.27 tonnes of CO_2. However, the environmental impact of rock mining – apart from CO_2 emissions – are significant. In North-eastern India leads to forest denudation, water depletion and pollution, soil and air pollution, reduction in biodiversity, soil erosion, rock instability, and degradation of agricultural land (Lamare & Singh, 2016). For these reasons it is known that in Assam, geotextile bags are being used despite the presence of hard rock in the area, following a ban on mining to reduce emissions and the pollution of nearby rivers and streams.

339. With regard to the transport of materials, transport by barge – or 'inland waterways vessel' – is an environmentally friendly transport mode compared to trucks on the road. Various studies (Pillot, Guiot, Le Cottier, Perret, & Tassel, 2016) with barges using a pusher tug give CO_2 emissions of between 30 and 60 kg per km, for cargo loads between 2,700 and 4,000 tonnes. This corresponds to about 13 gCO_2 emissions per tonne of cargo. ECTA (2011) uses a slightly higher figure of 18.1 gCO_2 per tonne-km for downstream transport, however this is based on a 50% load factor only. For transport from Assam to Bangladesh, the transport is in downstream direction, with the vessels likely to return empty. Using heavy 40-44 tonne trucks with a near-full load, the carbon emission factor is 39.7 gCO_2 per tonne per km (ECTA, 2011). Note that all these figures are based on international data and the use of outdated vessels or vehicles may lead to higher emissions. In all cases the final emissions calculation will also depend on the use of the transport mode in the opposite direction: if the vessel or vehicle returns empty, higher emissions have to be assigned to the one-way transport.

340. A key difference between the use of concrete blocks versus geotextile bags is the volume and weight of transportable cargo. As the geotextile bag containers are hydraulically filled with sand at or near the site prior to placement, only the containers themselves will need to be transported. Therefore, for concrete blocks the number of trips and/or the cargo load per trip will be significantly higher, with resulting higher emissions.

8.5 Cumulative & Induced Impacts

341. Cumulative impacts can be defined as the additional changes caused by a proposed development in conjunction with other similar developments or as the combined effect of a set of developments, taken together. Induced impacts include both direct and indirect impacts. These cumulative and induced impacts include the following:

342. ***Flood affected area.*** Upstream (transboundary) water diversion schemes to transfer water from the Jamuna/Brahmaputra Basin to water-scarce regions in India, and other planned or existing development, may reduce river discharge in the medium/long-term significantly and could thereby affect the flood affected area in the study area. This may require other or additional interventions to reduce negative impacts. Dams that store floodwater and discharge this during the dry season may alter the hydrograph.

343. ***Downstream flood risk*** constructing flood embankments on the flood plains along the (stabilised) banks will reduce the respective risk behind these dikes but will further increase the

flood water levels, when no additional flood conveyance compensation is being realised. This effect is evident in the initial stages, but also in the long-term when cumulative effects are felt leading to bed degradation, and flood levels may still rise for extreme floods.

344. ***River morphology & risk of breaching.*** The cumulative effect of the envisaged works will be beneficial in controlling further erosion and flooding of the river system's floodplains and displacement of hundreds of thousands of people. Channel flows will be controlled by the structures installed and it is likely that these will maintain greater depth and flow velocities. This would increase stability of the channels and reduce the risk of raised riverbeds. On the other hand, stabilized river channels may lower low water levels both in Bangladesh and India and reduce dry season inflow to distributaries, causing regional or local water shortage. The works will increase the security of existing flood embankments against breaching and may promote expansion of new embankments into presently un-protected sections of the floodplain.

345. ***Aquatic biodiversity.*** Experience from other countries (People's Republic of China: Yellow River, USA: Mississippi) and in Bangladesh learns that cumulative impacts of river stabilization works on aquatic biodiversity will generally be negative. Mitigation measures (e.g. regulators, fish-passes, buoys, sanctuaries), if properly designed, constructed and operated, may diminish/reduce the extent and intensity of these impacts. Production losses from capture fisheries may be compensated by aquaculture practices, although this may not benefit fisherfolk who lose capture fisheries resources, and it does not replace biodiversity losses. Establishing additional fish- or wildlife reserves and restoring connectivity with the floodplain may mitigate biodiversity loss to some degree.

8.6 Summary of Main Anticipated Impacts & Mitigation Measures per Subproject Site

8.6.1 JRB-1

346. Riverbank protection work will be placed alongside the riverbank in the same manner as earlier works without impacting much on land and water habitat. Land acquisition and resettlement activities are less than during Tranche-1. On average, it is assumed that a strip of approximately 5 to 20m width will be acquired alongside the whole length of the riverbank protection works.

347. For the flood embankment, a full land-acquisition and resettlement process will be conducted. However, the flood embankment alignment has been chosen to reduce the impact on existing settlements and therefore minimizing the resettlement impact.

348. In terms of environmental enhancement, different measures are planned:

(i) Along all protected riverbanks navigation buoys will be suggested to BIWTA/DoF (Department of Fisheries) to place with kilometer spacing to protect fish habitats from systematic overfishing with floating nets. BWDB will provide necessary data to DOF & BIWTA for the purpose[21].

(ii) Two (2) regulators with fish passes are to be installed to improve connectivity and facilitate fish migration.

(iii) Both the landward and riverside slopes of the embankment may be planted with Vetiver, Katkin & Dhoincha for slope protection as well as to help re-establishing a diverse vegetation cover.

[21] Installing navigation buoys in support of fishreies will be an innovative approach for Bangladesh, and neither DoF nor the BIWTA has any experience to do such work and may need to recruit expertise for this purpose.

(iv) The riverside slope of the embankments shall be covered with resilient grass (e.g. katkin / *Saccharum spontaneum*) suitable to provide limited wave protection, where no full wave protection shall be required.

(v) Bird-, dolphin- and/or fish sanctuaries will or may be established at appropriate locations by the relevant authorities. The project will suggest appropriate locations and take these into account during planning of future works.

8.6.2 JLB-2

349. Environmental mitigation and enhancement measures follow the same principles as applied to the upstream works at JRB-1. In addition to the typical works alongside the floodplains, large, low-lying areas of the Solimabad char will be covered with dhoicha, katkin, vetiver or any other plant helpful for reclamation to combine a technical function with income generation and environmental enhancement. The thick layer of reeds provides habitat while dampening the wave impact.

8.6.3 PLB-1

350. A strip of about 5 to 20m width will be acquired along the length of protection.

351. Environmental mitigation and enhancement measures follow the same principles as applied to the upstream works at JRB-1 and JLB-2

8.6.4 Impact of Tranche-1 and JMREMP Intervention

352. JMREMP built 17 km of bank protection work at right bank of lower Jamuna from Koitola to Koijhuri. Almost full length of these bank protective work is in good condition. There is a big local bazar named Nakalia bazar which was under tremendous threat of erosion is now substantially protected by the bank protection work. So, the control of erosion ensured the settlement living along the river side and trading sites resulting poverty reduction and enhancement of socio-economic status of the local people. The JMREMP bank protection work also provide additional domestic use of river water as the protection work have the flexible underwater works (geotextilebags).

353. In the contrary important bank protective work have been constructed under Tranche-1 at Chauhali and Harirampur. In both the cases late construction after the 2015 flood season has resulted in less desirable river alignment as the eroding channel had cut deeply into the floodplains with higher than expected land loss creating an insecure situation of the local people. The Embankment planned for Tranche-1 is completed by March 2020, and the impact of embankment construction is yet to be fully experienced.

9 GRIEVANCE REDRESS MECHANISM

9.1 Project 1 Experience

354. Key Project 1 experiences are summarized below, both for social and environmental aspects.

9.1.1 Social

355. There was in incidence whereby the upper slope of the works was cut back before the resettlement plan had been implemented, which meant that houses were removed before the land had been acquired. This is against regulations and is of course unacceptable.

356. The principle of temporary protection in the first years was developed during Tranche 1 to allow geotextile bags to be placed on the natural bank level in the first year while underwater dumping occurs and then hard protection, which requires a shallower slope to be placed a year later, when land acquisition has been completed. This technique also allows emergency or critical work to be implemented without being subject to delays due to land acquisition.

357. Land acquisition delays for the embankment and in particular for the approach and exit channels of the new regulators in Tranche 1, resulted in delays in construction and regulators not being operational during the 2019 flood season despite being completed. Starting the land acquisition process as soon as possible allows the land up to riverbank level to be demarked as BWDB land and stopping people settling there would greatly improve the effectiveness of Project-2 embankment construction.

358. Due to fund shortages, some of the social plans, such as resettlement villages for squatters, could not be implemented. These should be prioritised in Project-2 as they are a key part of for displaced persons to find a new hold in society.

9.1.2 Environmental

359. A systematic long-term fish study was carried out under FRERMIP Tranche 1 which found new types of fish and fish behavioural patterns in the study / project area. More research on the aquatic habitat in future is recommended to better understand the effects of the works and to optimise these where possible

360. With some monitoring, in most cases Contractors were following the minimum environmental standards as per their environmental management plan. The main issues that required improvement were dust levels and so a greater focus on dust suppression e.g. through water spraying should be given in Project 2.

9.2 ADB's Guidance on GRM

361. According to the ADB Safeguard Policy Statement (2009) on the Local Grievance Redress Mechanism: "ADB requires that the borrower/client establish and maintain a grievance redress mechanism to receive and facilitate resolution of affected peoples' concerns and grievances about the borrower's/client's social and environmental performance at project level. The grievance redress mechanism should be scaled to the risks and impacts of the project. It should address affected people's concerns and complaints promptly, using an understandable and transparent process that is gender responsive, culturally appropriate, and readily accessible to all segments of the affected people."

362. The EARF provides the general guidance on GRM establishment and operation, and states among others: “The BWDB will determine a suitable grievance redress mechanism to address concerns related to environmental and social safeguards. The grievance redress system will include a system by which parties affected by project activities, could raise their concerns to contractors, relevant government officials, and officers of the BWDB.”

363. Stakeholders with concerns have the option of contacting community-based organizations (CBOs) formed during implementation. Complaints received by CBOs will either be promptly resolved locally if possible or referred to the upazila chairman’s office. If not resolved, the complaints will be reffered to the Greivance Redress Committee (GRC).

364. The GRC will be formed at two levels (i.e. SMO and PMO levels) for any grievances involving resettlement benefits, relocation, environment, health and safety and other assistance.

365. **SMO level:** The local GRC shall review and resolve grievances within 10 days of receiving any complaints at each level and will maintain written records of all the appeals received. The GRC at SMO level is constituted of the following members:

(i) Executive Engineer (Field/equivalent)–Convener
(ii) Sub Assistant Engineer from BWDB–Member Secretary
(iii) Chairman of concerned Union Parishad–Member
(iv) Representative of DPs–Member
(v) Representative of Implementing NGO–Member
(vi) The committee can co-opt any members (like concerned ward members, ward women members etc.) for assisting to comply its responsibilities.

366. **PMO level,** the GRC will be constituted of the following members headed by the Project Director to deal with any grievances accelerated from the SMO level.

(i) Project Director (PD) – Convener
(ii) Chief Resettlement Officer (CRO) - Member Secretary
(iii) Resettlement Specialist, Supervision Consultant–Member

367. Affected peoples (APs) will be able to submit their grievance/complaint about any aspects of resettlement plan implementation and compensation and other safeguard concerns. Grievances can be shared with the BWDB verbally or in written form, but in case of the verbal form, the Implementing NGO representative in the GRC will write it down in the first instance during the meeting at no cost to affected people. They will sign and formally produce to the GRCs at respective office of the Implementing NGO assisting the BWDB. During consultation meetings, the Implementing NGO will disseminate information on how to access and the availability of GRM to ensure people are aware of the GRC entry points and have ease of access thereto. Signboards with contact office details will be publicly displayed and a complaints box will be placed at each construction site to ensure accessibility to the GRM.

368. The GRCs will be formed to resolve resettlement and compensation and safeguard issues not to be addressed under legal suit in the courts. The GRCs will receive grievance cases from the affected persons through Implementing NGO. The Implementing NGO will assist the APs in lodging their resettlement complaints in a proper format acceptable to the GRCs after they get ID cards from BWDB or informed about their concerns.

369. The appeal procedure and conflict resolution will be as follows:

(i) All complaints from the APs will be received at the field office of Implementing NGO, the member secretary of the GRCs with a copy to the concerned Local Government Institution representatives.
  (a) The representative of the Implementing NGO in the GRCs upon receipt of complaints will inform the convener (BWDB representative) of the GRC and the convener will organize a hearing session from the complainants in concerned UP Chairman's office from where the complaint was receipt.
  (b) The GRC will review the proceedings and pass verdicts to convey to the concerned AP through the Implementing NGO.
  (c) If there are such matters relating to arbitration through the courts, the matter will be referred to the court.
  (d) The GRC will settle the disputes within maximum 10 days of receiving the complaints from the APs at each level.

(ii) Resolution of the GRCs will be adopted in the process of resettlement for issuance of ID cards, determination of loss and entitlements and payment and other safeguard problems.

(iii) APs may seek grievance redress through appropriate judicial or administrative systems of the State at any stage of the GRC process. APs may also submit complaints to ADB's Accountability Mechanism after good faith effort to resolve complaints through the GRC and concerned ADB operations departments.[22]

9.3 GRM Implementation

370. For implementation of the GRM it is proposed to assign two national GRM specialists, one female and one male, who regularly visit the Project-2 implementation sites, consult with the local communities and site office staff (Supervising Consultant and Contractor), and who report on their findings on a quarterly basis. Their tasks and responsibilities are as follows:

(i) Familiarize with the Project-2 works, the EARF and the EIA for the works, and main project parties (BWDB/PMO, ISPMC, site office staff and contractors, communities, CBOs, upazila chairman's office, etc.);

(ii) Setting up a formal local complaint mechanism including a simple Modus Operandum (manual) with standard Grievance Action Form (GAF), routing and filing system, and how to ensure public access;

(iii) Facilitating the establishment of local Grievance Complaint Committees and a procedure on how complaints will be received and resolved, record keeping, and reporting;

(iv) Quarterly Progress Reporting in a format agreed with the BWDB and the development partner ADB .

371. Both GRM Specialists are to be appointed at the start of and for the duration of the entire the Project-2 contract – their approximate time input is estimated at on average one (1) person-month per quarter during the construction seasons (November-June), although establishing the GRCs at the start of the Project-2 works is expected to require initially a near fulltime input.

[22] ADB Accountability Mechanism: https://www.adb.org/who-we-are/accountability-mechanism/how-file-complaint

10 ANALYSIS OF ALTERNATIVES

372. The three sub-reaches selected for Project-2 of the FRERMIP physical works: JRB-1, JLB-2 and PBL-1, were chosen from 13 sub-reaches into which the FRERMIP program area was divided based on discussions among BWDB, ADB and the PPTA consultant. These 13 sub-reaches 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). Of the six sub-reaches scoring highest[23], these three sub-reaches were screened out due to a lack of active erosion and/or conflicts with other immediately planned interventions.

373. While riverbank protection was placed according to immediate needs especially for growth centers ("something to defend"), embankment construction considered alternatives especially for the area JLB-2. BWDB contemplates the establishment of polders (ring-embankments) covering large parts of JLB-2 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 [24].

374. As such various alternative interventions have been considered. One of these has been large-scale Capital Dredging for which a national feasibility study was conducted (2010-2015). However, large-scale capital dredging on the one hand, and riverbank protection on the other, are different solutions to the same problem, and it is neither logical nor cost-efficient to implement both on a large scale simultaneously. Large-scale dredging is believed not be sustainable due to (continued) high costs and the high sediment load of river waters (resulting in rapid refill), and is therefore not further considered as a viable scenario under the present river stabilization planning process. However, limited dredging of river sections may be considered to stimulate the development of a desired future river planform with more stable river channels and a narrower active river corridor by the river itself, whereby dredged material is placed at selected locations in the floodplain and on chars.

10.1 Without-Project scenarios

375. **Without JRB-1.** It is expected that without additional riverbank protection along JRB-1, the embankment and important infrastructure in the Enayetpur area will remain vulnerable and the goal of the project will not be achieved.

376. **Without JLB-2.** The future geometry of the two downstream Jamuna branches fully depends on the discharge distribution at the bifurcation. Without countermeasures (stabilization works) there is a risk that the bifurcation changes over time with increased discharge in the right channel and reduced in the left one or vice versa. Other changes could happen within the channel pattern, for example the cut-off channel at Chauhali could develop and change the downstream channel pattern. As a consequence of these changes, the downstream channel pattern would change in two ways: riverbank erosion would take place in yet unprotected reaches, and existing work to stabilize the downstream channel might turn out to be ineffective as in the wrong location.

[23] The score of highest ranking sites is between 300 & 370 points, while the lowest ranged between 200 & 260 points.
[24] Annex D of the feasibility study, "River and Charland Morphology and River Engineering" provides more background.

377. **Without PLB**-1. Not constructing the riverbank protection extension at Harirampur might pose a risk of outflanking the works constructed in Tranche-1. This in turn would likely result in the destruction of these works and consequently result in the erosion of the attached char that was reclaimed and stabilized through the Project 1 protection.

378.

11 ENVIRONMENTAL MANAGEMENT PLAN

379. In previous chapters, the possible positive and negative impacts have been identified and evaluated. In addition to that, mitigation measures have been mentioned to address adverse impacts. This chapter presents the Environmental Management Plan (EMP) prepared 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.

380. The EMP has been organized per construction and post-construction phase (operation and maintenance), to facilitate the monitoring process. Impacts and mitigation measures broadly cover the three topics: (i) construction, (ii) biodiversity and (iii) fisheries and aquaculture. Most construction related impacts are mitigated by contractors during construction. Issues pertaining to biodiversity and fisheries/aquaculture, especially related to the construction of the embankment at JRB-1 will be implemented through a specialist firm/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, fisheries/aquaculture will be supported to compensate for the loss of open water fisheries on the floodplain after the construction of the embankments. Fisheries and aquaculture have a strong relevance for the poor and is part of the livelihood component of the resettlement plan, which is a separate compensation mechanism.

381. The layout of the EMP is as follows:

Construction phase
- Site offices
- Riverbank protection
- Embankment construction
- Drainage structures/regulators-cum-fish passes

Post construction phase per site
- Decommissioning
- Water resources
- Land resources
- Agricultural resources
- Fisheries resources
- Ecological resources
- Socio-economic resources

382. In addition to mitigating direct impacts of the ongoing Tranche-1 and planned Project-2 works, a specialist firm/NGO may be retained to elaborate on the biodiversity baseline and study the establishment of fisheries sanctuaries, in accordance with future stabilization plans, looking beyond the localized Tranche-1 and Project-2 measures and aiming at identifying and mitigating any impacts from larger scale river-reach stabilization.

383. Note that mitigation of impacts on local community members and their livelihoods are addressed via the Resettlement Action Plan.

11.1 Construction Phase for Each Site

11.1.1 Site offices, labour sheds, stockyards, etc.

IESC	Location	Impacts	Mag. Of impact*	Mitigation / Enhancement / Compensation / Contingency	Magn. with EMP*	Type of Impact	EMP cost (Lakh Tk)	Responsible Agency
Activity	**Construction of site office, labour shed(s) with proper water and sanitation facilities, garbage disposal system, stock yard and construction camp(s), materials, equipment and other machines,**							
Air quality	River and roadsides	Minor impact may occur from dust generated due to movement of vehicles	-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	Short Term	N/A	Implementation: Contractor Monitoring: Nominated Engineer (SMO, BWDB)
Noise	Same as above	Low impacts caused due to noise generation for mobilization of construction materials and construction of site office, labour shed, stockyard	-2	Mitigation: Working hours to be restricted to 8 h to 17 h only; Noise levels due to vehicular movement are to be kept within permissible limit; Construction camps, office, labour shedare to be located sufficiently away from settlements.	-1	Short Term	N/a	Same as above

IESC	Location	Impacts	Mag. Of impact*	Mitigation / Enhancement / Compensation / Contingency	Magn. with EMP*	Type of Impact	EMP cost (Lakh Tk)	Responsible Agency
Land loss	Same as above	Loss of 200 ha of existing land	0	Construction activities should be carried out as per design. Sites should preferably be constructed on fallow or khas land. Landowners affected by the construction of sites on agriculture land should be noticed ahead of time so that the area might not be affected for growing crops. Labour 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	Short Term	No cost or cost for land due to activities on site	Implementation: Deputy Commissioner, specialist NGO Monitoring: PMO
Health and safety	Same as above	Unsanitary and unsafe conditions on site leading to illness and accidents. Risk of spread of coronavirus disease	-4	Proper sanitary facilities to be provided on site PPE equipment available on e.b. boats Prepare and implement a comprehensive	-1	Short term	Contractor budget	Implementation: Contractor Engage health and safety supervisor to implement H&S measures and

IESC	Location	Impacts	Mag. Of impact*	Mitigation / Enhancement / Compensation / Contingency	Magn. with EMP*	Type of Impact	EMP cost (Lakh Tk)	Responsible Agency
		(COVID-19)		COVID-19 Health and Safety Guidance Plan following i) following national regulations and health advice, and (ii) international good practice recommendations. The guidance should include the protocols on the following: (i) Prerequisite measures before opening the worksites; (ii) Worksite entrance ; (iii) Worksite management; (iv) Camp management; (v) Worksite awareness-raising; (vi) Risk exposure assessment guidance; (vii) Engage an employee/staff to oversee health and safety issues, and (viii) Monitoring and reporting mechanism. The protocols should include requirements on wearing masks and PPE, physical distancing, hand washing, disinfection, checking body temperature, ventilation,				COVID-19 guideline Engage health worker for a daily temperature check and record for workers Engage EHS staff or assign an existing staff to handle COVID-19 in case if detected Monitoring: Nominated Staff (SMO, BWDB)

IESC	Location	Impacts	Mag. Of impact*	Mitigation / Enhancement / Compensation / Contingency	Magn. with EMP*	Type of Impact	EMP cost (Lakh Tk)	Responsible Agency
				management of waste, awareness, and morning briefings. Conduct a risk assessment of worksite and prepare on-site plan as per H&S guideline; Avoid labor-intensive works as much as possible; Ensure all to use the Personal Protective Equipment (PPE) as appropriate; Ensure all equipment and vehicles used are routinely disinfected; Provide thermometer, soap, sanitizer, disinfectant, PPE at worksite/camp; Place adequate washbasins, disinfectant tub, dispenser for sanitizer; Provide regular briefing/training on preventive requirements to the workers and post enough COVID-19 awareness posters throughout the worksites; and Maintain COVID-19				

IESC	Location	Impacts	Mag. Of impact*	Mitigation / Enhancement / Compensation / Contingency	Magn. with EMP*	Type of Impact	EMP cost (Lakh Tk)	Responsible Agency
				weekly monitoring and reporting mechanism at the worksite; including any necessary actions to be taken				

11.1.2 Riverbank Protection

IESC	Location	Impacts	Mag. of impact*	Mitigation / Enhancement / Compensation / Contingency	Magn. with EMP*	Type of Impact	EMP cost (Lakh Tk)	Responsible Agency
Activity	Bank Protection: Slope pitching and turfing; dredging of sand from the river; filling and dumping of geo-textile bags on and along the riverbank, Around 30km of riverbank protection, including: JRB-1: 10.5 km (3.5 km at Benotia and 7 km at Enayetpur), JLB-2: 15.5 km at Upstream Chauhali and PLB-1: 4 km at Harirampur extension.							
Air quality	Places adjacent to the riverbank where bags will be dumped and placed	Minor amount of dust may be generated during the works	-2	Mitigation: Water to be sprinkled on regular intervals, as and wherse required	-1	Short term	N/a	Implementation: Contractor Monitoring: Nominated Engineer (SMO, BWDB)
Noise	Same as above	Low impacts would be caused during excavation & dredging of soil, operation of mixture machine and vehicular movements	-2	Mitigation: Working hours to be restricted to 8:00 AM to 5:00 PM only; Noise levels due to vehicular movement, excavation and dredging activities are to be kept within permissible limit; proper silencers on machinery, equipment and boat to be installed	-1	Short term	N/a	Same as above

IESC	Location	Impacts	Mag. of impact*	Mitigation / Enhancement / Compensation / Contingency	Magn. with EMP*	Type of Impact	EMP cost (Lakh Tk)	Responsible Agency
Surface water quality	Same as above including Tranche-1 area	Surface water quality might be affected due to the disposal of waste generated from labourers 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 quality of river water.	-4	Mitigation: The dredging locations should be selected so that dredge spoil would be minimized. Proper waste disposal system is to be implemented.	-1	Short term	6	Same as above
Fish habitat	Same as above	Temporary damage would occur in seasonal fish habitat along the riverbank due to either changes in water quality (e.g. turbidity) due to dredging/ dumping or clearance of	-2	Dredging to be done during the dry season Vegetation clearance should be done as low as possible 2 no regulators help to provide fish passage	-1	Long term	N/a	Implementation: Contractor Monitoring: Nominated Engineer (SMO, BWDB) in coordination with DoF

IESC	Location	Impacts	Mag. of impact*	Mitigation / Enhancement / Compensation / Contingency	Magn. with EMP*	Type of Impact	EMP cost (Lakh Tk)	Responsible Agency
		vegetation cover or draped by the filling earth during earth work						
Fish Biodiversity	Same as above	Riverine fish species i. e. hilsa, major carp species, eel (baim), big and small catfish (boal, ayr, magur), etc. may leave the project area	-2	Dredging to be done during the dry season Vegetation clearance should be done as low as possible	-1	Long term, permanen t	N/a	Same as above
Fish Migration	Same as above	Both longitudinal (Hilsa) and lateral migration for fish will temporarily be disturbed	-2	Dredging to be done during the dry season Vegetation clearance should be done as little as possible	-1	Short term	N/a	Same as above
Fish production	Same as above	Capture fish production would temporarily be declined within the project area	-2	Dredging to be done during the dry season Vegetation clearance should be done as low as possible	-1	Long term	N/a	Same as above
Terrestrial and aquatic ecosystem diversity	Same as above	Trees, shrub and herbs and nesting sites on riverbank and aquatic and flora and fauna	-5	Minimize damage as much a possible; create replacement habitat as part of post-construction mitigation (see below), incl.:	-3	Long term	50 Tk.500/no including planting and guarding	Implementation: Contractor Monitoring: Nominated Engineer (SMO, BWDB) in

IESC	Location	Impacts	Mag. of impact*	Mitigation / Enhancement / Compensation / Contingency	Magn. with EMP*	Type of Impact	EMP cost (Lakh Tk)	Responsible Agency
		will be destroyed.		Plantation of 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				coordination with DoF and DoE, NGO
Health and safety	Same as above	Unsanitary and unsafe conditions on site leading to illness and accidents Risk of spread of coronavirus	-4	Proper sanitary facilities to be provided on site Sufficient and proper gangways to be provided on boats and landings PPE equipment available on e.b. boats Prepare and implement a comprehensive COVID-19 Health and Safety Guidance following i) following national	-1	Short term	Contractor budget	Implementation: Contractor Engage health and safety supervisor to implement H&S measures and COVID-19 guideline Engage health worker for a daily

IESC	Location	Impacts	Mag. of impact*	Mitigation / Enhancement / Compensation / Contingency	Magn. with EMP*	Type of Impact	EMP cost (Lakh Tk)	Responsible Agency
		disease (COVID-19).		regulations and health advice, and (ii) international good practice recommendations. The guidance should include the protocols on the following: (i) Prerequisite measures before opening the worksites; (ii) Worksite entrance ; (iii) Worksite management; (iv) Camp management; (v) Worksite awareness-raising; (vi) Risk exposure assessment guidance; (vii) Engage an employee/staff to oversee health and safety issues, and (viii) Monitoring and reporting mechanism. The protocols should include requirements on wearing masks and PPE, physical distancing, hand washing, disinfection, checking body temperature, ventilation, management of waste, awareness, and morning briefings. Conduct a risk assessment of a worksite and prepare on-site plan as per H&S guideline;				temperature check and record for workers Engage EHS staff or assign an existing staff to handle COVID-19 in case if detected Monitoring: Nominated Staff (SMO, BWDB)

IESC	Location	Impacts	Mag. of impact*	Mitigation / Enhancement / Compensation / Contingency	Magn. with EMP*	Type of Impact	EMP cost (Lakh Tk)	Responsible Agency
				Avoid labor-intensive works as much as possible; Ensure all to use the Personal Protective Equipment (PPE) as appropriate; Ensure all equipment and vehicles used are routinely disinfected; Provide thermometer, soap, sanitizer, disinfectant, PPE at worksite/camp; Place adequate washbasins, disinfectant tub, dispenser for sanitizer; Provide regular briefing/training on preventive requirements to the workers and post enough COVID-19 awareness posters throughout the worksites; and Maintain COVID-19 weekly monitoring and reporting mechanism at the worksite; including any necessary actions to be taken				
Employment	Same as above	Temporary employment will	+1	Ensure employment for local people for both	N/a	Short term	N/a	Same as above

IESC	Location	Impacts	Mag. of impact*	Mitigation / Enhancement / Compensation / Contingency	Magn. with EMP*	Type of Impact	EMP cost (Lakh Tk)	Responsible Agency
		be created for labourers		technical and non-technical works. If possible at least 60% labour should be recruited locally				
Community organizations	Same as above	Positive impacts, due to awareness-raising and employment provided to members.	+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 riverbank protection work, spoil soils, on farm water management, LCS, EMG .	+4	Long term	Tk. 100	Implementation: specialist NGOs Monitoring: PMO / DDM / DAE

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

11.1.3 Embankment Construction/Reconstruction

IESC	Location	Impacts	Mag. of impact*	Mitigation / Enhancement / Compensation / Contingency	Magn. with EMP*	Type of Impact	EMP cost (Lakh Tk)	Responsible Agency
Activity	Embankment Construction and Rehabilitation: Excavation of earth materials from the location of embankment; dredging of soil from the river; dumping of earthen materials on the embankment; embankment surface labeling through dumping machine; movement of vehicles for carrying materials. Around 7.70 km of embankments including: a) JRB-1: 7.7 km at Kaijuri/ Shahjadpur							
Air quality	Places adjacent to the riverbank where embankments will be built or rehabilitated	Minor amount of dust may be generated during excavating and dumping of earth materials, surface labeling with dumping	-3	Mitigation: Water to be sprinkled on regular intervals, as and where required	-2	Short term	N/A	Implementation: Contractor Monitoring: Nominated Engineer (SMO, BWDB)

IESC	Location	Impacts	Mag. of impact*	Mitigation / Enhancement / Compensation / Contingency	Magn. with EMP*	Type of Impact	EMP cost (Lakh Tk)	Responsible Agency
		machine and vehicular movements						
Noise	Same as above	Low impacts would be caused during excavation and dredging of soil and vehicular movements	-2	Mitigation: Working hours to be restricted to 8 h to 17 h only; Noise levels due to vehicular movement, excavation and dredging activities are to be kept within permissible limit	-1	Short term	N/A	Same as above
Surface water quality	Same as above	The surface water quality might be affected due to the disposal of waste generated from the labour shed into the river. Additionally, minor quantity of sediments would be generated in the rivers during dredging of soil from riverbed, which would temporarily hamper the aesthetic quality of river water.	-4	Mitigation: The dredging locations should be selected so that dredge spoil would be minimized. Proper waste disposal system is to be implemented. Conducting a water quality monitoring program prior and during construction to record change, and adapt operation – as required	-1	Short term	Tk. 3.00	Same as above
Drainage congestion	Same as above	Low impact may occur due to the rehabilitation of embankment temporarily blocking offtakes	-2	Constructing regulators cum fish passes at appropriate locations	-1	Short term	Included in cost of construction of regulators with fish pass	Same as above

IESC	Location	Impacts	Mag. of impact*	Mitigation / Enhancement / Compensation / Contingency	Magn. with EMP*	Type of Impact	EMP cost (Lakh Tk)	Responsible Agency
Land loss	Same as above	X ha of land	-1	Topsoil (0-15cm) should be managed properly for conserve 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 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 to be paid for any crop damage. Contractor to avoid cultivation fields during construction. Contractor to avoid agricultural land for material borrowing and material stockpiling. Contractor to ensure that no vehicular movements take place inside cultivation fields. Contractor to ensure that no	+1	Short term	70.00	Same as above

IESC	Location	Impacts	Mag. of impact*	Mitigation / Enhancement / Compensation / Contingency	Magn. with EMP*	Type of Impact	EMP cost (Lakh Tk)	Responsible Agency
				material is dumped inside cultivation fields. Contractor to maintain liaison with communities				
Crop production loss	Same as above	Loss of crop production is expected to be about x metric ton for bank rehabilitation, construction of new embankment, and disposal of spoil materials	-1	In cases where the disruption to farming becomes unavoidable, adequate cash compensation should be provided to the landowners / share-croppers. Exact amount of compensation should be determined based on the amount of land temporarily or permanently 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 labour 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	Medium term	Included in RAP	Implementation: Deputy Commissioner NGO. Monitoring: BWDB

IESC	Location	Impacts	Mag. of impact*	Mitigation / Enhancement / Compensation / Contingency	Magn. with EMP*	Type of Impact	EMP cost (Lakh Tk)	Responsible Agency
Fish habitat	Same as above	Temporary damage would occur in the seasonal habitat due to either clearance of vegetation cover or by filling earth during construction work	-4	Assure connectivity between river and floodplain: construction of 2 regulators with fish passes in JLB-1. Average cost: $ 1 million/regulator of which 35% for fish pass Vegetation clearing to be done as low as possible	-2	Short term	2520	Implementation: Contractor Monitoring: Nominated Engineer (SMO, BWDB) in coordination with consultant and DoF
Fish migration	Same as above	Lateral migration of fish will temporarily or permanently be disturbed	-4	Assure connectivity between river and floodplain (see fish pass - Section 10.1.4) Vegetation clearing to be done as low as possible	-2	Short term		Same as above
Terrestrial and aquatic ecosystem diversity	Same as above including Tranche-1 area	Trees, shrub and herbs and nesting sites on riverbank and aquatic and flora and fauna may be destroyed.	-5	Minimize damage as much a possible; create replacement habitat as part of post-construction mitigation (see below), incl.: Plantation of 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	-3	Long term	200	Implementation: Contractor Monitoring: Nominated Engineer (SMO, BWDB) in coordination with DoF and DoE

IESC	Location	Impacts	Mag. of impact*	Mitigation / Enhancement / Compensation / Contingency	Magn. with EMP*	Type of Impact	EMP cost (Lakh Tk)	Responsible Agency
				committee should be formed to protect the saplings. Awareness development activities should be conducted by the committee or nature club				
Health and safety	Same as above	Unsanitary and unsafe conditions on site leading to illness and accidents Risk of spread of coronavirus disease (COVID-19)	-4	Proper sanitary facilities to be provided on site Sufficient and proper gangways to be provided on boats and landings PPE equipment available on e.b. boats Prepare and implement a comprehensive COVID-19 Health and Safety Guidance following i) following national regulations and health advice, and (ii) international good practice recommendations. The guidance should include the protocols on the following: (i) Prerequisite measures before opening the worksites; (ii) Worksite entrance ; (iii) Worksite management; (iv) Camp management; (v) Worksite awareness-raising; (vi) Risk exposure assessment guidance; (vii) Engage an employee/staff to oversee health and safety issues,	-1	Short term	Contractor budget	Implementation: Contractor Engage health and safety supervisor to implement H&S measures and COVID-19 guideline Engage health worker for a daily temperature check and record for workers Engage EHS staff or assign an existing staff to handle COVID-19 in case if detected Monitoring: Nominated Staff (SMO, BWDB)

IESC	Location	Impacts	Mag. of impact*	Mitigation / Enhancement / Compensation / Contingency	Magn. with EMP*	Type of Impact	EMP cost (Lakh Tk)	Responsible Agency
				and (viii) Monitoring and reporting mechanism. The protocols should include requirements on wearing masks and PPE, physical distancing, hand washing, disinfection, checking body temperature, ventilation, management of waste, awareness, and morning briefings. Conduct a risk assessment of a worksite and prepare on-site plan as per H&S guideline; Avoid labor-intensive works as much as possible; Ensure all to use the Personal Protective Equipment (PPE) as appropriate; Ensure all equipment and vehicles used are routinely disinfected; Provide thermometer, soap, sanitizer, disinfectant, PPE at worksite/camp; Place adequate washbasins, disinfectant tub, dispenser for sanitizer; Provide regular briefing/training on preventive requirements to the workers and post				

IESC	Location	Impacts	Mag. of impact*	Mitigation / Enhancement / Compensation / Contingency	Magn. with EMP*	Type of Impact	EMP cost (Lakh Tk)	Responsible Agency
				enough COVID-19 awareness posters throughout the worksites; and Maintain COVID-19 weekly monitoring and reporting mechanism at the worksite; including any necessary actions to be taken				
Employment	Same as above	Temporary employment will be created for labourers	+1	Ensure employment for local people for both technical and non-technical works. If possible, at least 60% labour should be recruited locally	N/a	Short term	N/a	Same as above
Community organisations	Same as above	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 riverbank protection work, spoil soils, on farm water management, LCS, EMG.	+4	Long term	Tk. 100	Implementation: specialist NGOs Monitoring: PMO / DDM / DAE

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

11.1.4 Drainage Structure / Regulators cum fish passes/off-take Ghior Khal

IESC	Location	Impacts	Mag. of impact*	Mitigation / Enhancement / Compensation / Contingency	Magn. with EMP*	Type of Impact	EMP cost (Lakh Tk)	Responsible Agency
Activity	Construction of a drainage structure / sluice / fish pass within the embankment/ Re-establish flow of the Dhaleswari offtake by diverting flow from the Jamuna River into the Ghior Khal , to improve water quality (e.g. DO levels up to 4 mg/l, from present 1 mg/l) and support fisheries and aquatic life, improve groundwater recharging, navigation, and so on.							
Air quality	Strategic location within rehabilitated/ new embankment	Minor amount of dust may be generated during construction works and vehicular movements	-2	Mitigation: Water to be sprinkled on regular intervals, as and where required	-1	Short term	N/a	Implementation: Contractor Monitoring: Nominated Engineer (SMO, BWDB)
Noise	Same as above	Low impacts would be caused during construction and works and vehicle movements	-2	Mitigation: Working hours to be restricted to 8:00 Am to 5:00 PM only; Noise levels due to vehicular movement to be kept within permissible limit	-1	Short term	N/a	Same as above
Surface water quality and surroundings	Same as above	The surface water quality might be affected due to the disposal of waste generated from the construction site into the river or surroundings.	-4	Mitigation: Proper waste disposal system is to be implemented.	-1	Short term	N/a	Same as above
Drainage congestion	Same as above	Low impact may occur due to the rehabilitation of	-2	Constructing regulators cum fish passes at appropriate	-1	Short term		Same as above

IESC	Location	Impacts	Mag. of impact*	Mitigation / Enhancement / Compensation / Contingency	Magn. with EMP*	Type of Impact	EMP cost (Lakh Tk)	Responsible Agency
		embankment temporarily blocking offtakes		locations				
Health and safety	Same as above	Unsanitary and unsafe conditions on site leading to illness and accidents Risk of spread of coronavirus disease (COVID-19)	-4	Proper sanitary facilities to be provided on site Sufficient and proper gangways to be provided on boats and landings PPE equipment available on e.b. boats Prepare and implement a comprehensive COVID-19 Health and Safety Guidance following i) following national regulations and health advice, and (ii) international good practice recommendations. The guidance should include the protocols on the following: (i) Prerequisite measures before opening the worksites; (ii) Worksite entrance ; (iii) Worksite management; (iv)	-1	Short term	Contractor budget	Implementation: Contractor Engage health and safety supervisor to implement H&S measures and COVID-19 guideline Engage health worker for a daily temperature check and record for workers Engage EHS staff or assign an existing staff to handle COVID-19 in case if detected Monitoring: Nominated Engineer (SMO, BWDB)

IESC	Location	Impacts	Mag. of impact*	Mitigation / Enhancement / Compensation / Contingency	Magn. with EMP*	Type of Impact	EMP cost (Lakh Tk)	Responsible Agency
				Camp management; (v) Worksite awareness-raising; (vi) Risk exposure assessment guidance; (vii) Engage an employee/staff to oversee health and safety issues, and (viii) Monitoring and reporting mechanism. The protocols should include requirements on wearing masks and PPE, physical distancing, hand washing, disinfection, checking body temperature, ventilation, management of waste, awareness, and morning briefings. Conduct a risk assessment of a worksite and prepare on-site plan as per H&S guideline; Avoid labor-intensive works as much as possible; Ensure all to use the				

IESC	Location	Impacts	Mag. of impact*	Mitigation / Enhancement / Compensation / Contingency	Magn. with EMP*	Type of Impact	EMP cost (Lakh Tk)	Responsible Agency
				Personal Protective Equipment (PPE) as appropriate; Ensure all equipment and vehicles used are routinely disinfected; Provide thermometer, soap, sanitizer, disinfectant, PPE at worksite/camp; Place adequate washbasins, disinfectant tub, dispenser for sanitizer; Provide regular briefing/training on preventive requirements to the workers and post enough COVID-19 awareness posters throughout the worksites; and Maintain COVID-19 weekly monitoring and reporting mechanism at the worksite; including any necessary actions to be taken.				
Employment	Same as above	Temporary	+1	Ensure employment	N/a	Short	N/a	Same as above

IESC	Location	Impacts	Mag. of impact*	Mitigation / Enhancement / Compensation / Contingency	Magn. with EMP*	Type of Impact	EMP cost (Lakh Tk)	Responsible Agency
		employment will be created for labourers		for local people for both technical and non-technical works. If possible at least 60% labour should be recruited locally		term		
Community organisations	Same as above	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 riverbank protection work, spoil soils, on farm water management, LCS, EMG etc.	+4	Long term	Tk. 100	Implementation: specialist NGOs Monitoring: PMO / DDM / DAE

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

11.2 Post-Construction Phase at Each Site

11.2.1 Decommissioning of Site Offices, Labour Sheds, Stock Yards

IESC	Location	Impacts	Mag. of impact*	Mitigation / Enhancement / Compensation / Contingency	Magn. with EMP*	Type of Impact	EMP cost (Lakh Tk)	Responsible Agency
Activity	Decommissioning of site office, labour shed(s) with water and sanitation facilities, garbage disposal system, stock yard and construction camp(s), materials, equipment and other machines							
Air quality	River and roadsides	Minor impact may occur from dust generated due to movement of vehicles	-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	Short term	N/a	Implementation : Contractor Monitoring: Nominated Engineer (SMO, BWDB)
Noise	Same as above	Low impacts caused due to noise generation for demobilization of construction materials and decommissioning of site office, labour shed, and stockyard – as may be applicable	-2	Mitigation: Working hours to be restricted to 8 h to 17 h only; Noise levels due to vehicular movement are to be kept within permissible limit. Buildings and yards may remain and be given another purpose/ landowner / sold	-1	Short term	N/a	Same as above
Waste and disposal	Same as above	Littering of rest and waste materials from decommissioning of	-3	Reuse, recycle or sell left over materials Remove worker's camps	-1	Short term		Implementation : Contractor

IESC	Location	Impacts	Mag. of impact*	Mitigation / Enhancement / Compensation / Contingency	Magn. with EMP*	Type of Impact	EMP cost (Lakh Tk)	Responsible Agency
		buildings, worker's camps and construction yards may affect the local environment		including sanitation facilities (toilets) in an environmentally sound way				Monitoring: PMO
Public health	Same as above	Limited access to toilet, unhygienic environment due to huge gathering of labourers can create disturbance to health	-5	The labour sheds and toilets including all materials used during construction should be removed in an environmentally sound way	-3	Short term		Same as above

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

11.2.2 Water Resources

IESC	Location	Impacts	Mag. of impact*	Mitigation / Enhancement / Compensation / Contingency	Magn. with EMP*	Type of Impact	EMP cost (Lakh Tk)	Responsible Agency
Erosion	Location adjacent to the bank protection work	Agricultural lands and settlements will be saved from erosion. Roadway communication will be established along Jamuna and Padma rivers	+6	Enhancement: Implementing Katkin and other small scale plantation along the slope of protective works and 6700 ha reclaimed land. Providing fencing, biological protection (bamboo, other trees) at the country side of	+7	Long term	200	Implementation: Community organizations Monitoring: Department of Forestry, BWDB Field Division

IESC	Location	Impacts	Mag. of impact*	Mitigation / Enhancement / Compensation / Contingency	Magn. with EMP*	Type of Impact	EMP cost (Lakh Tk)	Responsible Agency
				protective works to ensure soil stability				
Drainage congestion	Water will be drained out from the sub reaches to Jamuna and Padma rivers	Low impact may be generated as the conveyance capacity of internal rivers and lakes will be stressed, resulting in drainage congestion problems	-1	Mitigation: Operation of regulators cum fish passes and places where required	0	Short term	N/A	Implementation: Joint committee Monitoring: DoF, DAE, BWDB Field Division
Flood	Sub-reaches	Significant impact in flooding. This would lead to a better control in both irrigation and social status of the people in the sub-reaches	+5	Enhancement: Providing vegetative cover along the slope of the embankments and afforestation works in the countryside of the embankment	+8	Long term		Implementation: PMO BWDB Monitoring: BWDB, DoE Community organizations Monitoring Department of Forestry, Field Division, BWDB
Water Availability and Use	Agricultural lands near the possible location of regulators and sluices	Socio-economic status of farmers would be enhanced due to their increased chances of practicing Aman crops	+3	Enhancement: Providing inlets through embankments to allow farmers in using river water in irrigation	+5	Long term	N/a	Implementation: Joint committee Monitoring: DAE, DoF, BWDB Field Division
Water quality	Surface	Pollution (waste	-3	Monitoring	+2	Long term	2.00	DoE, DoF, or

IESC	Location	Impacts	Mag. of impact*	Mitigation / Enhancement / Compensation / Contingency	Magn. with EMP*	Type of Impact	EMP cost (Lakh Tk)	Responsible Agency
	waters disconnected from the river	accumulation) and clogging with water weeds		through visual observation and with portable online kits				other appropriate organization
Water quality (2)	Ghior Khal channel, after construction of the off-take	Improved water quality due to improved flow from the Jamuna (aim is to divert 245 m3/s from the Jamuna River into the Dhaleswari).	+6	Monitoring of various water quality parameters esp. DO, BOD, suspended sediment.	+6	Medium term to Long term		DoE, DoF, or other appropriate organization

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

11.2.3 Drainage Structure / Regulators cum fish passes/off-take Ghior Khal

IESC	Location	Impacts	Mag. of impact*	Mitigation / Enhancement / Compensation / Contingency	Magn. with EMP*	Type of Impact	EMP cost (Lakh Tk)	Responsible Agency
Activity	Construction of a drainage structure / sluice / fish pass within the embankment/ Re-establish flow of the Dhaleswari offtake by diverting 245 m3/s from the Jamuna River into the Dhaleswari/Pungli/Bangshi/Turag/Buriganga river system, to improve water quality (e.g. DO levels up to 4 mg/l, from present 1 mg/l) and support fisheries and aquatic life, improve groundwater recharging, navigation, and so on.							
Regulator with fish pass	Other sites (15-17)	Maintaining connectivity between the river and the (former) floodplain	--	Proper location	+3	Long term	Tk. 800/ regulator, of which est. 35% for fish pass (total 9)	BWDB
Construction of off-take structure to	Mouth of Ghior Khalriver	Improved connectivity between river	--	Use of off-take structure	+6	Medium to Long term	TBC	BWDB

IESC	Location	Impacts	Mag. of impact*	Mitigation / Enhancement / Compensation / Contingency	Magn. with EMP*	Type of Impact	EMP cost (Lakh Tk)	Responsible Agency
divert 245 m3/s from Jamuna to Dhaleswari		and floodplain, improved water quality, fisheries, navigation & groundwater recharging						

11.2.4 Land Resources

IESC	Location	Impacts	Mag. of impact*	Mitigation / Enhancement / Compensation / Contingency	Magn. with EMP*	Type of Impact	EMP cost (Lakh Tk)	Responsible Agency
Land type change	Entire project area	Minimize riverbank erosion, drainage congestion/water logging, flooding, siltation etc to x 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	+4	Long term	See section 10.1.2	Implementation : specialist NGOs Monitoring: PMO / DDM / DAE

IESC	Location	Impacts	Mag. of impact*	Mitigation / Enhancement / Compensation / Contingency	Magn. with EMP*	Type of Impact	EMP cost (Lakh Tk)	Responsible Agency
				practiced to improve soil fertility in the project area. Crop diversification with multi-crops might improve environmental condition of the soil.				
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 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 organic manure in the land, practicing of green manure, crop diversification through leguminous crops etc.	+6	Long term	Estimate is to be done as observed field condition	Implementation : specialist NGOs Monitoring: PMO / DDM / DAE

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

11.2.5 Agricultural Resources

IESC	Location	Impacts	Mag. of impact*	Mitigation / Enhancement / Compensation / Contingency	Magn. with EMP*	Type of Impact	EMP cost (Lakh Tk)	Responsible Agency
Crop production	Entire project area	Additional rice production due to improved productivity.	+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 organizations in project activities would enhance crop production.	+6	Long term	N/a	Implementation: specialist NGOs Monitoring: PMO / DDM / DAE
Improved irrigation facilities	Entire project area	Additional surface water irrigated area would be increased due to re-excavation of khals	+3	Farmers expand surface irrigation during rabi and boro season Community organizations get training in irrigation management	+4	Long term	Tbd	Implementation: Community organizations Monitoring: DAE
Agrochemicals	Entire project area	Increase in use of agrochemicals, due to improved livelihood security.	-2	Awareness raising about judicious use of pesticides, fertilisers and agrochemicals in general.	0	Medium to Long-term	TDB	Implementation: community organizations & agricultural extension officers

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

11.2.6 Fisheries Resources

IESC	Location	Impacts	Mag. of impact*	Mitigation / Enhancement / Compensation / Contingency	Magn. with EMP*	Type of Impact	EMP cost (Lakh Tk)	Responsible Agency
Fish habitat	Whole project area	Estimated net loss of 6,700 ha of fish habitat due to land reclamation + habitat altered due to the revetment 1,300 ha	-7	1. Proper protective device will have to take to protect the deep pools (dor/duars). Use of surface water during the breeding period should be stopped. Culture fisheries should be developed Perennial beels should be developed under sanctuary program Some flood water from the river should be allowed during normal or low floods (through sluice gates)	-4	Long term	Tbd	Implementation : specialist NGOs, community organizations Monitoring: PMO in coordination with Department of Fisheries
Fish migration	Along riverbanks and connection to floodplain	Obstructed fish migration	-5	Fish friendly operation of regulator cum fish pass gates	-3	Long term	N/a	Implementation : Trained Sluice gate/Fish Pass operation Committee , Monitoring: Department of Fisheries (DoF)
Fish biodiversity & production enhancement	Whole project area	Capture fish species diversity would be moderate to low.	-7	1. River fish sanctuary by installing 100 buoys along 100 km of Project-2 area (1 km	+3	Long term	1040	Implementation : specialist NGOs,

IESC	Location	Impacts	Mag. of impact*	Mitigation / Enhancement / Compensation / Contingency	Magn. with EMP*	Type of Impact	EMP cost (Lakh Tk)	Responsible Agency
		Fish production loss est. at 1,400 ton (loss due to revetment and fish migration impediment ignored)		apart, 300 m from left bank) for navigation guidance and preventing indiscriminate fishing. 2. Proper protective device at 9 regulators. 3. Establishment of 12 perennial beels as Fish Sanctuaries @ $ 13,000/sanctuary, one per upazila 4. Re-excavation of khals: 12 x 5 = 60 km @ 2/m3: $ 42,000/km 5. Beel nurseries in 12 fish sanctuaries 6. Beel restocking 7. Regulators with fish passes. 8. Training to increase the aquaculture practices of high-valued fish species.			93.60 124.80 2000.00 $ 12.00 12.00 300.00	community organizations Monitoring: PMO / DoF
Sub-Total including regulators with fish passes							6102.00	

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

11.2.7 Ecological Resources

IESC	Location	Impacts	Mag. of impact*	Mitigation / Enhancement / Compensation / Contingency	Magn. with EMP*	Type of Impact	EMP cost (Lakh Tk)	Responsible Agency
Ecosystem composition and diversity	Whole project area	Protection of homestead, roadside and social forest habitat. Vegetation coverage of the project area will improve. Faunal composition and diversity would be deteriorated.	+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	Long term	3.00	Implementation : specialist NGOs, community organizations Monitoring: PMO / Department of Forestry
Protected areas	Whole project area	Reduced habitat suitable for endangered and threatened wildlife species and plants	-5	Establish one or more wildlife sanctuaries focusing on dolphins and migratory birds in consultation with key conservation organizations such as DoE, IUCN, WWF and Bangladesh Bird Club	-3	Long term	5.00	Implementation : specialist NGOs, community organizations Monitoring: PMO / Department of Forestry

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

11.2.8 Socio-Economic Resources

IESC	Location	Impacts	Mag. of impact*	Mitigation / Enhancement / Compensation / Contingency	Magn. with EMP*	Type of Impact	EMP cost (Lakh Tk)	Responsible Agency
Communication	Whole project area	Road transport will improve if embankments will be provided with crest pavements	+3	N/a	N/a	Long term	Project Cost	BWDB
Employment	Whole project area	Job opportunities are expected to increase, e.g. in farming and fish culture	+2	Ensure/arrange training from DAE and DoF for local labourers	N/a	Long term		Implementation : Tbd Monitoring: PMO
Income generation	Whole project area	Income is expected to increase for all levels of society	+4	Implement livelihood program for vulnerable groups directly affected by the project interventions	N/a	Long term		Implementation : Tbd Monitoring: PMO

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

11.3 Monitoring Plan

11.3.1 Monitoring during the Construction Phase

384. A preliminary standard checklist for monitoring of EMP compliance is provided below. Alternatively, use can be made of the EMP compliance monitoring formats that were developed and used by ISPMC during implementation of the Tranche-1 works as from November 2015.

Book No. _____ Monitoring Report No._____
Date:_____ Time:_____
Contract:_____
Contractor:_____
Work Sites (s):_____

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				14	Dispensary working, Doctor present			
2	Correct Disposal of Liquid Waste				15	Ambulance Functional			
3	Vehicles and dredger With No Smoke or Noise				16	No Loss to Flora or Fauna (Specially Tree)			
4	Vehicles Within Speed Limit				17	Re-excavation work			
5	No Pollution from construction site				18	Placement of dredging spoil			
6	No Oil/Diesel Spills on Land or Water				19	Top-soil protection system from embankment area			
7	No Social Issue Created				20	Placement of Top Soil			
8	Any Threat Caused to Riverine area				21	Plantation system			
9	Water Sprinkled on embankment				22	Presence of Child Labour			
10	No embankment and riverbank soil erosion				23	Labour camp location & management in order			
11	Safety dress, helmet and field boots used				24	Drinking water and sanitation facilities for labour			
12	Health precautions taken				25	No Burning of wood in camp			
13	Turfing materials				26	Women wage			
					27	Water quality			

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)

11.3.2 Monitoring during the Post-Construction Phase

385. 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 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.

Water Resources

Indicator	Method	Location	Frequency	Monitoring Cost (Lakh 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 embankments	Twice in a year (pre- and post-monsoon)	Tbd	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)	Tbd	BWDB
Physical condition of the riverbank protection works	To check if the Geo-bags are in place	Locations where bank protection works have been carried out (Benotia, Chauhali, Zaffarganj)	Twice in a year (pre- and post-monsoon)	Tbd	BWDB
River planform	Checking the diversion phenomenon, conveyance characteristics and plan forms of a number of rivers	Karatoya offtake (JRB-1)	Once in a year (post monsoon)	Tbd	BWDB
Water quality	Visual observation and portable online kits	Surface waters in river and disconnected beels	Bi-annual	Tbd	DoE, DoF, else
Sub-total				Tbd	

Fisheries Resources

Indicator	Method	Location	Frequency	Monitoring Cost (Lakh Tk/Yr)*	Responsible Agency
Fish habitat status	Habitat observation	Selected locations in the whole project area	Two times per year, and continue for 2 years after project completion	2	DoF/Consultant Team
Fish migration	Catch monitoring, RRA and FGD Ichthyoplankton sampling	Selected locations in the whole project area. At regulator/Fish Pass point	Two month e.g. May-Oct per year. (2 years beyond the project period	2	DoF/Consultant Team
Fish species and fish production	Catch monitoring and Fish Market Survey	Entire study area	Once per month in each location for 2 year after completion of proposed activities.	2	DoF/Consultant Team
Aquaculture	Interviewing fish farmers and Fish Market Survey	Selected ponds and flood land culture system	One time per month (Will continue 2 year)	2	DoF//Consultant Team
Public awareness	Participate in national and international days, e.g. Fish Week, Environment Day, Wetland Day etc.	In the study area	Selected schedule (Will continue 2 year)	2	Consultant Team /DoF, Community based FMOs, CBOs and other nature clubs.
			Sub-total	**10**	

Ecological Resources

Indicator	Method	Location	Frequency	Cost (Lakh Tk.)	Responsible Agency
Survival rate of planted saplings	Observation and counting	Selected locations in the project area	1 year after plantation, but every day by the recruited guard	Tbd	BWDB in coordination with local group
Sub-total				**Tbd**	

Socio-economic Resources

Indicator	Method	Location	Frequency	Monitoring Cost (Lakh Tk)*	Responsible Agency
Land tenure and land use				Tbd	
Roadway communication	RRA	Selected locations in the project area	Once	Tbd	BWDB/consultant and contractor
Income generation					
Protection of municipal area including markets and homesteads					
Sub-total				Tbd	

12 CONCLUSIONS AND RECOMMENDATIONS

12.1 Conclusions

386. The program has inbuilt mechanisms to reduce environmental impacts, and many mitigation measures have been 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 implemented under Project 1 with protection of critically eroding riverbanks along the Lower Jamuna and Padma rivers and were completed by the 2019 flood season while embankment construction is ongoing.

387. Extensive feasibility studies are currently being finalized for the Project-2 works, of which the present EIA is a part. These cover future impacts of river stabilization and associated embankment works. During Project-2, first measures for larger scale river stabilization are planned, with the design based on the Tranche-1 study outcomes and supported by environmental monitoring and mitigation measures.

388. With respect to flood mitigation and river stabilization, the program considers the following detailed approach: the program aims to reduce flood risks at one priority sub-project (JRB-1) along the Lower Jamuna and Padma Rivers by providing new/rehabilitated embankments.

389. The program intends to mitigate negative impacts at the planning and design level, and through additional compensation measures. Planning and design account for:

(i) leaving key distributaries open to limited flood flows to support the continued deposition of fertile sediments as well as flood season navigation;
(ii) designing the offtakes of the distributaries as part of the river stabilization work, in order to improve dry season flows;
(iii) providing embankments with sluice gates specifically for local drainage[25], and
(iv) designing embankments in accordance to international practice to reduce the risk of failure, while mitigation measures address:
(v) loss in floodplain biodiversity, and
(vi) open water fisheries.

390. At community-level, flood risk management training will be provided to the flood affected population to raise the awareness to the residual risk after strengthening the existing flood embankment lines.

391. To protect the flood embankments, riverbanks 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, the following approach has been adopted:

(i) a multi-disciplinary river stabilization study[26] covering the whole Brahmaputra system from the Indian border is being conducted, supported by
(ii) piloting stabilization measures, focusing on bio-engineering techniques or “building with nature”;

[25] As it is not possible to locate sluice gates, cost have been reflected in the embankment kilometer cost.
[26] encompassing potential future river morphologies including the system response 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.

(iii) siting of physical works will be planned using an innovative dynamic methodology that responds to evolving river behaviour. Mitigation of potentially negative impacts of the planned river stabilization will be based on

(iv) a river sanctuary study covering river- and floodplain land and planned start during 2017 potentially followed by implementation of one or more sanctuaries in a suitable river reach.

12.2 Recommendations

392. Mitigation of embankment and revetment operation-phase impacts described in Chapter 8 – on aquatic habitats and their biodiversity including fisheries, and on people who depend on them, will be implemented in three work packages:

(i) Aquaculture expansion (from Project-2). Compensation measures rely on aquaculture or culture-based methods to increase fish production and thereby compensate for lost tonnage of fish due to flood control. In contrast, mitigation measures are designed to reduce or avoid losses during capturing fisheries (see 8.3.7).

(ii) Wetland biodiversity mitigation and rehabilitation (from Project-2). This will occur via the improved off-takes and flow of the distributaries, desilting of beels, and the installation of regulators and fish passes (2 at Shahjadpur, 6 at Harirampur-Dohar; in addition, 1 regulator without fish pass at H-D). The proposed fish and bird sanctuaries (see below) all contribute to mitigation of wetland biodiversity loss.

(iii) Sanctuaries (studied under Project-2, implemented during the subsequent River Stabilization Plan). Details on the nine (9) proposed bird sanctuaries and the 52 proposed fish sanctuaries are included in Appendices C (bird) and D (fish). Note that these sanctuaries also contribute to maintaining wetland biodiversity.

393. The anticipated environmental impacts of Project 1 have proved to be acceptable under the circumstances, and those of Project 2 are expected to be of a similar nature and extent, provided the mitigation measures set forth in the EMP under Chapter 11 are implemented.

Environmental Impact Assessment (Update)

Project No.: 44167-015
May 2021

Bangladesh: Flood and Riverbank Erosion Risk Management Investment Program – Project 2

Prepared by the Bangladesh Water Development Board for the Asian Development Bank.

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APPENDIX A1 - SPECIES TABLES

Table A1-1: 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 sp.	*Rakton*	*Tree*	*Firewood*	*Rare*
Alostonia macrophylla	*Chatim*	*Tree*	*Ornamental*	*Common*
Alstonia scholaris	*Shatim/Shatian*	*Tree*	*Timber*	*Rare*
Amaranthus 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 flabellifer	*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*

Terrestrial Flora				
Scientific name	**Local name**	**Habit**	**Importance**	**Status**
Cassia alata	*Dardmardon*	*Shrub*	*Medicinal*	*Common*
Cassia occidentalis	*Barahalkasunda*	*Shrub*	*Fuelwood*	*Common*
Centella asiatica	*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 dactylon	*Durba Gash*	*Herb*	*Medicinal*	*Common*
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*
Eichhornia 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 jasminoides	*Ghandhoraj*	*Shrub*	*Flower*	*Common*
Heliotropium indicum	*Hatisuri*	*Herb*	*Medicinal*	*Common*
Hoya parasitica	*Parghaca*	*Climber*	*Medicinal*	*Common*
Ipomea fistulosa	*Dhol Kalmi*	*Shrub*	*Fuel*	*Common*
Leucaena leucocephala	*Ipil ipil*	*Tree*	*Timber*	*Common*
Litchi chinensis	*Lichu*	*Tree*	*Fruit*	*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*
Muntingia calabura	*Chinese chari*	*Tree*	*Ornamental*	*Very Rare*
Musa paradisiaca var. sapientum	*Kala*	*Shrub*	*Fruit*	*Common*
Nerium odorum	*Karobi*	*Shrub*	*Medicinal*	*Common*

Terrestrial Flora				
Scientific name	**Local name**	**Habit**	**Importance**	**Status**
Nicotiana plumbaginifolia	*Bantamak*	*Herb*	*Wild*	*Common*
Nyctanthes arbortristris	*Safali*	*Herb*	*Ornamental*	*Common*
Nymphaea nouchli	*Sapla*	*Herb*	*Medicinal, Vegetable*	*Common*
Ocimum americanum	*Tulshi*	*Herb*	*Medicine*	*Common*
Oryza sativa	*Dhan*	*Herb*	*Food*	*Common*
Phoenix paludosa	*Hental*	*Tree*	*Wildlife*	*Common*
Phoenix sylvestris	*Khejur*	*Tree*	*Fruit and Fuel wood*	*Common*
Pistia stratiotes	*Topapana*	*Herb*	-	*Common*
Pithecolobium dulce	*Dakshnia Babul*	*Tree*	*Ornamental, Avunue*	*Common*
Polyalthia longifolia	*Debdaru*	*Tree*	*Ornamental*	*Common*
Psidium guajava	*Peyara*	*Shrub*	*Fruit*	*Common*
Rauwolfia 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*
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 angustifolia	*Hogla*	*Herb*	*Domestic use*	*Common*
Zizyphus mauritiana	*Baroi*	*Tree*	*Fruit*	*Common*

Table A1-2: 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 A1-3: 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*
Ludwigia abscendens	*Keshordam*	*Herb*	*Medicinal*	*C*
Ludwigia hyssopifolia	*Keshordam*	*Herb*	*Medicinal*	*VC*
Marsilea 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 A1-4: Birds

Birds				
Scientific name	**English name**	**Local name**	**IUCN status**	**Local status**
Artamus fuscus	*Ashy Woodswallow*	*Metey Bonbabil*	*LC*	*CR*
Eudynamys scolopaceus	*Asian Koel*	*Ashio Kalakokil*	*LC*	*CR*
Anastomus oscitans	*Asian Openbill*	*Ashio Shamkhol*	*LC*	*CR*
Terpsiphone paradisi	*Asian Paradise-flycatcher*	*Ashio Shabulbuli*	*LC*	*UR*
Acridoteres ginginianus	*Bank Myna*	*Gaang Shalik*	*LC*	*UR*
Anser indicus	*Bar-headed Goose*	*Dagi Rajhash*	*LC*	*UWV*
Tyto alba	*Barn Owl*	*Lokkhi Pecha*	*LC*	*UR*
Ploceus philippinus	*Baya Weaver*	*Deshi babui*	*LC*	*CR*
Dicrurus macrocercus	*Black Drongo*	*Kala Fingey*	*LC*	*CR*
Milvus migrans	*Black Kite*	*Bhubon Chil*	*LC*	*CR*
Ciconia nigra	*Black Stork*	*Kala Manikjor*	*VU*	*WV*
Sterna acuticauda	*Black-bellied Tern*	*Kalapet Panchil*	*CR*	*UR*
Nycticorax nycticorax	*Black-crowned Night Heron*	*Kalamatha Nishibok*	*LC*	*CR*
Lonchura malacca	*Black-headed Munia*	*Kalamatha Munia*	*LC*	*UR*
Oriolus xanthornus	*Black-hooded Oriole*	*Kalamatha Benebou*	*LC*	*CR*
Alcedo hercules	*Blyth's Kingfisher*	*Machranga*	*DD*	*RR*
Haliastur indus	*Brahminy Kite*	*Shonkho Chil*	*LC*	*CR*
Metopidius indicus	*Bronze-winged Jacana*	*Dol Pipi*	*LC*	*UR*
Ketupa zeylonensis	*Brown Fish Owl*	*Khoira Mechopecha*	*LC*	*UR*
Larus brunnicephalus	*Brown-headed Gull*	*Khoiramatha Gangchil*	*LC*	*CWV*
Lanius cristatus	*Brown Shrike*	*Khoira Latora*	*LC*	*CWV*
Bubulcus ibis	*Cattle Egret*	*Go Boga*	*LC*	*CR*
Ixobrychus cinnamomeus	*Cinnamon Bittern*	*Khoira Bogla*	*LC*	*UR*
Motacilla citreola	*Citrine Wagtail*	*Sitrin Khonjon*	*LC*	*CWV*
Acrocephalus stentoreus	*Clamorous Reed Warbler*	*Bachal Nolfutki*	*LC*	*CWV*
Sarkidiornis melanotos	*Comb Duck*	*Nakta Hash*	*NT*	*RWV*
Larus ridibundus	*Common Black-headed Gull*	*Kalamatha Gangchil*	*LC*	*CWV*
Dinopium javanense	*Common Goldenback*	*Pati Kaththokra*	*LC*	*CR*
Tringa nebularia	*Common Greenshank*	*Pati Shobujpa*	*LC*	*CWV*
Hierococcyx varius	*Common Hawk-Cuckoo*	*Pati Chokhgelo*	*LC*	*CR*
Aegithina tiphia	*Common Iora*	*Pati Fatikjal*	*LC*	*CR*
Alcedo atthis	*Common Kingfisher*	*Pati Machranga*	*LC*	*CR*
Acridotheres tristis	*Common Myna*	*Bhat Shalik*	*LC*	*CR*
Columba livia	*Common Pigeon*	*Gola Paira*	*LC*	*CR*
Atthya ferina	*Common Pochard*	*Pati Bhutihash*	*LC*	*CWV*
Tringa totanus	*Common Redshank*	*Pati Lalpa*	*LC*	*CWV*
Actitis hypoleucos	*Common Sandpiper*	*Pati Batan*	*LC*	*CWV*
Tadorna tadorna	*Common Shelduck*	*Pati Chokachoki*	*LC*	*CWV*
Gallinago gallinago	*Common Snipe*	*Pati Chega*	*LC*	*CWV*
Orthotomus sutorius	*Common Tailorbird*	*Pati Tuntuni*	*LC*	*CR*
Megalaima haemacephala	*Coppersmith Barbet*	*Shekra Boshonto*	*LC*	*CR*

Birds				
Scientific name	**English name**	**Local name**	**IUCN status**	**Local status**
Nettapus coromandelianus	*Cotton Pygmy Goose*	*Dhola Balihash*	*LC*	*UR*
Phylloscopus fuscatus	*Dusky Warbler*	*Kalchey Futki*	*LC*	*CWV*
Upupa epops	*Eurasian Hoopoe*	*Pati Hoodhood*	*LC*	*UR*
Platalea leucorodia	*Eurasian Spoonbill*	*Kodali Bok*	*CR*	*RR*
Saxicola torquatus	*Eurasian Stone Chat*	*Pati Shilafidda*	*LC*	*CWV*
Anas crecca	*Eurasian Teal*	*Pati Tilihash*	*LC*	*CWV*
Dendrocygna bicolour	*Fulvous Whistling Duck*	*Raj Shorali*	*LC*	*CWV*
Spatula querquedula	*Garganey*	*Giria Hash*	*LC*	*CWV*
Prinia gracilis	*Graceful Prinia*	*Shundori Prinia*	*LC*	*RR (DD)*
Larus brunnicephalus	*Great Black-headed Gull*	*Palasi Gangchil*	*LC*	*CWV*
Phalacrocorax carbo	*Great Cormorant*	*Boro Pankouri*	*LC*	*CWV*
Casmerodius albus	*Great Egret*	*Boro Boga*	*LC*	*CR*
Parus major	*Great Tit*	*Boro Tit*	*LC*	*CR*
Centropus sinensis	*Greater Coucal*	*Boro Kubo*	*LC*	*CR*
Chrysocolaptes lucidus	*Greater Goldenback*	*Boro Kaththokra*	*LC*	*CR*
Charadrius leschenaultii	*Greater Sand Plover*	*Boro Dhuljiria*	*LC*	*CWV*
Merops orientalis	*Green Bee-eater*	*Shobuj Shuichora*	*LC*	*CR*
Tringa ochropus	*Green Sandpiper*	*Shobuj Batan*	*LC*	*UWV*
Phaeniocophaeus tristis	*Green-billed Malkoha*	*Shobujthot Malkoa*	*LC*	*CR*
Ardea cinerea	*Grey Heron*	*Dhupni Bok*	*LC*	*CR*
Charadrius squatarola	*Grey Plover*	*Metey Jiria*	*LC*	*CWV*
Motacilla cinerea	*Grey Wagtail*	*Metey Khonjon*	*LC*	*UWV*
Dendrocopos canicapillus	*Grey-capped Pygmy Woodpecker*	*Metetoopi Batkurali*	*LC*	*UR*
Ichthyophaga ichthyaetus	*Grey-headed Fish Eagle*	*Metematha Kura-eegol*	*NT*	*UR*
Gelochelidon nilotica	*Gull-billed Tern*	*Kalathot Panchil*	*LC*	*CR*
Corvus splendens	*House Crow*	*Pati Kak*	*LC*	*CR*
Passer domesticus	*House Sparrow*	*Pati Chorui*	*LC*	*CR*
Phalacrocorax fuscicollis	*Indian Cormorant*	*Deshi Pankouri*	*LC*	*V*
Cuculus micropterus	*Indian Cuckoo*	*Bokotakou Kokil*	*LC*	*CR*
Ardeola grayii	*Indian Pond Heron*	*Deshi Kanibok*	*LC*	*CR*
Coracias benghalensis	*Indian Roller*	*Bangla Nilkanto*	*LC*	*CR*
Lonchura malabarica	*Indian Silverbill*	*Deshi Chandithot*	*LC*	*UR*
Rynchops albicolis	*Indian Skimmer*	*Panikata*	*CR*	*RR*
Anas poecilorhyncha	*Indian Spot-billed Duck*	*Metey Hash*	*LC*	*UR*
Turdoides striata	*Jungle Babbler*	*Bon Satarey*	*LC*	*CR*
Acridotheres fuscus	*Jungle Myna*	*Jhuti Shalik*	*LC*	*CR*
Corvus macrorhynchos	*Large-billed Crow*	*Dar Kak*		*CR*
Caprimulgus macrurus	*Large-tailed Nightjar*	*Lenja Ratchora*	*LC*	*CR*
Leptoptilos javanicus	*Lesser Adjutant*	*Modontak*	*VU*	*RR*
Centropus bengalensis	*Lesser Coucal*	*Bangla Kubo*	*LC*	*CR*
Dinopium benghalense	*Lesser Goldenback*	*Bangla Kaththokra*	*LC*	*CR*
Charadrius mongolus	*Lesser Sand Plover*	*Soto Dhuljiria*	*LC*	*CWV*

Birds				
Scientific name	**English name**	**Local name**	**IUCN status**	**Local status**
Dendrocygna javanica	*Lesser Whistling Duck*	*Pati Shorali*	*LC*	*CR*
Megalaima lineata	*Lineated Barbet*	*Dagi Boshonto*	*LC*	*CR*
Phalacrocorax niger	*Little Cormorant*	*Choto Pankouri*	*LC*	*CR*
Egretta garzetta	*Little Egret*	*Choto Boga*	*LC*	*CR*
Charadrius dubius	*Little Ringed Plover*	*Choto Nothjiria*	*LC*	*CR/CWV*
Arachnothera longirostra	*Little Spiderhunter*	*Choto Makormar*	*LC*	*CR*
Calidris minuta	*Little Stint*	*Choto Chapakhi*	*LC*	*CWV*
Buteo rufinus	*Long -Legged Buzzard*	*Lombapa Tishabaj*	*LC*	*RWV*
Lanius schach	*Long-tailed Shrike*	*Lenja Latora*	*LC*	*CR*
Tringa stagnatilis	*Marsh Sandpiper*	*Bil Batan*	*LC*	*UWV*
Heliopais personata	*Masked Finfoot*	*Giolo Hansh*	*EN*	*RR*
Anas acuta	*Northern Pintail*	*Utturey Lenjahash*	*LC*	*CWV*
Anthus hodgsoni	*Olive-backed Pipit*	*Jolpaipith Tulika*	*LC*	*CWV*
Copsychus saularis	*Oriental Magpie-Robin*	*Udoi Doel*	*LC*	*CR*
Alauda gulgula	*Oriental Skylark*	*Udoi Ovrobhorot*	*LC*	*CR*
Zosterops palpebrosus	*Oriental White-eye*	*Udoi Dholachokh*	*LC*	*CR*
Pluvialis fulva	*Pacific Golden Plover*	*Proshanto Shonajiria*	*LC*	*CWV*
Anthus rufulus	*Paddyfield Pipit*	*Dhani Tulika*	*LC*	*CR*
Mycteria leucocephala	*Painted Stork*	*Rangila bok*	*CR*	*RR*
Alauda erythrorhynchos	*Pale-billed Flowerpecker*	*Metethot Fuljhuri*	*LC*	*CR*
Ceryle rudis	*Pied Kingfisher*	*Pakra Machranga*	*LC*	*CR*
Sturnus contra	*Pied Myna*	*Ashio Pakrashalik*	*LC*	*CR*
Gallinago stenura	*Pin-tailed Snipe*	*Lenja Chega*	*LC*	*CWV*
Prinia inornata	*Plain Prinia*	*Nirol Prina*	*LC*	*CR*
Nectarinia zeylonica	*Purple-rumped Sunbird*	*Begunikomor Moutushi*	*LC*	*CR*
Streptopelia tranquebarica	*Red Turtle Dove*	*Lal Konthighughu*	*LC*	*CR*
Pycnonotus cafer	*Red-vented Bulbul*	*Bangla Bulbul*	*LC*	*CR*
Vanellus indicus	*Red-wattled Lapwing*	*Hot Titi*	*LC*	*UR*
Anthus richardi	*Richard's Pipit*	*Richarder Tulika*	*LC*	*CWV*
Vanellus duvaucelii	*River Lapwing*	*Nodi Titi*	*NT*	*UR*
Sterna aurantia	*River Tern*	*Nodia Panchil*	*NT*	*UWV*
Psittacula krameri	*Rose-ringed Parakeet*	*Modna Tia*	*LC*	*CR*
Anthus roseatus	*Rosy Pipit*	*Golapi Tulika*	*LC*	*CWV*
Halcyon coromandra	*Ruddy Kingfisher*	*Lal Machranga*	*LC*	*RR*
Tadoma ferruginea	*Ruddy Shelduck*	*Khoira Chokachoki*	*LC*	*CWV*
Dendrocitta vagabunda	*Rufous Treepie*	*Khoira Harichacha*	*LC*	*CR*
Celeus brachyurus	*Rufous Woodpecker*	*Khoira Khathkurali*	*LC*	*CR*
Lonchura punctulata	*Scaly-breasted Munia*	*Butibook Munia*	*LC*	*CR*
Asio flammeus	*Short-eared-Owl*	*Chotokan Pecha*	*LC*	*RWV*
Pericrocotus cinnamomeus	*Small Minivet*	*Choto Saheli*	*LC*	*CR*
Glareola lactea	*Small Pratincole*	*Soto Babubatan*	*LC*	
Streptopelia chinensis	*Spotted Dove*	*Tila Ghughu*	*LC*	*CR*
Athene brama	*Spotted Owlet*	*Khuruley Kutipecha*	*LC*	*CR*

Birds				
Scientific name	**English name**	**Local name**	**IUCN status**	**Local status**
Pelargopsis capensis	*Stork-billed Kingfisher*		*LC*	*UR*
Ploceus manyar	*Streak Weaver*	*Dagi Babui*	*LC*	*RR(DD)*
Picus xanthopygaeus	*Streak-throated Woodpecker*	*Dagigola Kathkurali*	*LC*	*UR*
Turdoides earlei	*Striated Babbler*	*Dagi Satarey*	*LC*	*UR*
Megalurus palustris	*Striated Grassbird*	*Dagi Ghashpakhi*	*LC*	*CR*
Butorides striata	*Striated Heron*	*Khude Bok*	*LC*	*CR*
Gallicrex cinerea	*Watercock*	*Deshi Kora*	*LC*	*UR*
Motacilla flava	*Western Yellow Wagtail*	*Holdey Khonjon*	*LC*	*CWV*
Chlidonias hybrid	*Whiskered Tern*	*Julphi Panchil*	*LC*	*CR/WV*
Haliaeetus leucogaster	*White-bellied Sea Eagle*	*Sindhu Eagle*	*LC*	*RR*
Amauromis phoenicurus	*White-breasted Waterhen*	*Dholabook Dahuk*	*LC*	*UR*
Motacilla madaraspatensis	*White-browed Wagtail*	*Dholavru Khonjon*	*LC*	*UR*
Rhipidura albicollis	*White-throated Fantail*	*Dholagola Chatighurani*	*LC*	*CR*
Halcyon smyrnensis	*White-throated Kingfisher*	*Dholagola Machranga*	*LC*	*CR*
Motacilla alba	*White Wagtail*	*Dhola Khonjon*	*LC*	*CWV*
Tringa glareola	*Wood Sandpiper*	*Bon Batan*	*LC*	*CWV*
Egretta intermedia	*Yellow-billed Egret*	*Majhla Boga*	*LC*	*CR*
Treron phoenicopterus	*Yellow-footed Green Pigeon*	*Holdepa Horial*	*LC*	*CR*
Cisticola juncidis	*Zitting Cisticola*	*Bhomra Soton*	*LC*	*CR*

IUCN Status (Red List 2015): CR – Critically Endangered, EN – Endangered, VU – Vulnerable, NO – Not Threatened; NT – Near Threatened; LC – Least Concern; DD – Data Deficient

Local Status (2013): 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 A1-5: Mammals

Mammals				
English name	**Local name**	**Scientific name**	**IUCN status**	**Local status**
Asian House Shrew	*Chika/Chucho*	*Suncus murinus*	*LC*	*CR*
Asian Palm Civet	*Gandhagakul*	*Paradoxurus hermaphroditus*	*LC*	*CR*
Asiatic Brush-tailed Porcupine	*Shajaru*	*Atherurus macrourus*	*DD*	*RR*
Asiatic Longtailed Climbing Mouse	*Gecho Indur*	*Vandeleuria oleracea*	*LC*	*CR*
Bengal Fox	*Khek Shial/Shial*	*Vulpes bengalensis*	*VU*	*CR*
Common Tree Shrew	*Gecho Chucho*	*Tupaia glis*	*NT*	*RR*
Eastern House Mouse	*Nenti indur*	*Mus musculus*	*NO*	*CR*
Eurasian Otter	*Ud Biral*	*Lutta lutra*	*CR*	*UR*
Eurasian Wild Boar	*Buno Shukar*	*Sus scrofa*	*LC*	*CR*
Finless Porpoise	*Shishu*	*Neophocaena phocaenoides*	*NT*	*UR*
Fishing Cat	*Mecho Biral/Baghailla*	*Prionailurus viverrinus*	*EN*	*UR*
Ganges River Dolphin	*Shishu / Shushuk*	*Platanista gangetica*	*VU*	*CR*

Mammals				
English name	**Local name**	**Scientific name**	**IUCN status**	**Local status**
Golden Jackal	*Shihal*	*Canis aureus*	*LC*	*CR*
Greater Bandicot Rat	*Dhari indur*	*Bandicota indica*	*LC*	*CR*
Greater False Vampire Bat	*Badur*	*Megaderma lyra*	*LC*	*CR*
Greater Short-nosed Fruit Bat	*Kola badur*	*Cynopterus sphinx*	*LC*	*CR*
House Rat	*Indur*	*Rattus rattus*	*LC*	*CR*
Indian Crested Porcupine	*Shojaru*	*Hystrix indica*	*LC*	*UR*
Indian Flying Fox	*Baro Badur*	*Pteropus giganteus*	*LC*	*CR*
Indian Hare	*Khargosh*	*Lepus nigricolis*	*EN*	*UR*
Indian Pipistrelle	*Chamchika/ Cham Badur*	*Pipistrellus coromandra*	*LC*	*CR*
Irrawaddy Dolphin	*Mohonar Shushuk*	*OracaelLa brevirostris*	*NT*	*CR*
Jungle Cat	*Ban Biral*	*Felis chaus*	*NT*	*RR*
Large Indian Civet	*Baro Baghdash*	*Viverra zibetha*	*NT*	*CR*
Lesser Bandicot Rat	*Baro indur*	*Bandicota bengalensis*	*LC*	*CR*
Little Indian Field Mouse	*Metho indur*	*Mus booduga*	*LC*	*CR*
Northern Palm Squirrel	*Khatbirali*	*Funambulus pennantii*	*LC*	*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*	*NT*	*CR*
Small Indian Mongoose	*Benji, Nakul*	*Herpestes auropunctatus*	*LC*	*CR*
Smooth-coated Otter	*Ud Biral*	*Lutrogale perspicillata*	*CR*	*RR*

IUCN Status (Red List 2015): CR – Critically Endangered, EN – Endangered, VU – Vulnerable, NO – Not Threatened; NT – Near Threatened; LC – Least Concern; DD – Data Deficient

Local Status (2013): CR – Common Resident, C – Common UR – Uncommon Resident, RR – Rare Resident, V – Vagrant, WV – Winter Visitor; UWV – Uncommon Winter Visitor.

Table A1-6: Amphibians

Amphibians				
English name	**Local name**	**Scientific name**	**IUCN status**	**Local status**
Asian Brown Tree Frog	*Gecho Bang*	*Polypedates leucomystax*	*LC*	*CR*
Balloon Frog	*Photka Bang*	*Uperodon globulosis*	*VU*	*CR*
Cricket Frog	*Jhijhi Bang*	*Limnonectes limnocharis*	*LC*	*CR*
Green Frog	*Sabuj Bang*	*Euphlyctis hexadactylus*	*LC*	*UR*
Indian Bull Frog	*Sona Bang*	*Hoplobatrachus tigerinus*	*LC*	*CR*
Indian Common Toad	*Kuno Bang*	*Duttaphynus meanostictus*	*LC*	*CR*
Indian Tree Frog	*Gecho Bang*	*Polypedates maculatus*	*LC*	*UR*
Large Tree Frog	*Baro Gecho Bang*	*Rhacophorus maximus*	*VU*	*UR*
Leaping Frog	*Pana bang*	*Hylarana tytleri*	*LC*	*UR*
Ornate Microhylid	*Cheena Bang*	*Microhyla ornate*	*LC*	*CR*
Southern Cricket Frog	*Jhijhi Bang*	*Fejervarya syhadrensis*	*LC*	*CR*
Two-striped Grass Frog	*Kaad Bang*	*Hylarana taipehensis*	*DD*	*RR*

IUCN Status (Red List 2015): CR – Critically Endangered, EN – Endangered, VU – Vulnerable, NO – Not Threatened; NT – Near Threatened; LC – Least Concern; DD – Data Deficient

Local Status (2013): CR – Common Resident, C – Common, UR – Uncommon Resident, RR – Rare Resident, V – Vagrant, WV – Winter Visitor; UWV – Uncommon Winter Visitor.

Table A1-7: Reptiles

Reptiles				
English name	**Local name**	**Scientific name**	**IUCN Status**	**Local Status**
Banded Krait	*Shakini*	*Bungarus fasciatus*	*LC*	*CR*
Bengal Monitor	*Ghuy Shap*	*Varanus bengalensis*	*NT*	*CR*
Brooks House Gecko	*Tiktiki*	*Hemidactylus brookii*	*LC*	*CR*
Brown Roofed Turtle	*Baro Kori Kasim*	*Pangshura smithii*	*NT*	*UR*
Checkered Keelback	*Dhora Shap*	*Xenochropis piscator*	*LC*	*CR*
Common Garden Lizard	*Roktochosha*	*Calotes versicolor*	*LC*	*CR*
Common House Gecko	*Tiktiki*	*Hemidactylus frenatus*	*LC*	*CR*
Common Krait	*Kal-keutey Shap*	*Bungarus caeruleus*	*LC*	*UR*
Common River Terrpain	*Boro Kasim*	*Batagur baska*	*CR*	*RR*
Common Smooth Water Snake	*Painna Shap*	*Enhydris enhydris*	*LC*	*CR*
Common Vine Snake	*Laodoga Shap*	*Ahaetulla nasuta*	*LC*	*UR*
Common Wolf Snake	*Gharginni Shap*	*Lycodon aulicus*	*LC*	*CR*
Crowned River Turtle	*Kali Kasim*	*Hardella thurjii*	*EN*	*UR*
Estuarine Crocodile	*Lonapanir Kumir*	*Crocodylus porosus*	*EN*	*UR*
Ganges softshell Turtle	*Khalua Kasim*	*Nilssonia gangetica*	*EN*	*UR*
Gharial	*Ghorial/Baishal*	*Gavialis gangeticus*	*CR*	*UR*
Indian Rat Snake	*Daraj Shap*	*Ptyas mucosa*	*LC*	*CR*
Indian Roofed Turtle	*Kori/Hali Kasim*	*Pangshura tecta*	*LC*	*CR*
Jerdon's Blind Snake	*Dumukh Shap*	*Indotyphlops jerdoni*	*LC*	*CR*
Keeled Grass Skink	*Anjoni*	*Eutropis carinata*	*LC*	*CR*
King Cobra	*Raj Gokra*	*Ophiophagus hannah*	*VU*	*UR*
Median Roofed Turtle	*Majhari Kaitta*	*Pangshura tentoria*	*NT*	*UR*
Monocled Cobra	*Gokhra Shap*	*Naja kaouthia*	*NT*	*RR*
Narrow-headed Softshell Turtle	*Sim Kasim*	*Chitra indica*	*CR*	*UR*
Olive Keelback	*Maita Shap*	*Atretium schistosum*	*LC*	*CR*
Olive Ridley Turtle	*Jalpaironga Samudrik Kasim*	*Lepidochelys olivacea*	*VU*	*CR*
Peacock-marked Softshell Turtle	*Dhum Kasim*	*Aspideteres hurma*	*EN*	*CR*
Pond Tortoise	*Kalo Kasim*	*Melanochelys trijuga*	*NT*	*UR*
Red Crowned Roofed Turtle	*Kori Kasim*	*Batagur kachuga*	*CR*	*UR*
Spectacled Cobra	*Khoiya Gokhra Shap*	*Naja naja*	*NT*	*CR*
Spotted Flapshell Turtle	*Patapori*	*Lissemys punctate*	*LC*	*UR*
Spotted Litter Skink	*Anzoni*	*Sphenomorphus maculatus*	*LC*	*CR*
Spotted Pond Turtle	*Mogom Kasim*	*Geoclemys hamiltonii*	*EN*	*UR*
Three- Striped Roofe Turtle	*Dhoor Kasim*	*Batagur dhongoca*	*CR*	*UR*
Tokay Gecko	*Takkhak*	*Gekko gecko*	*LC*	*CR*
Yellow Monitor	*Sona Guy*	*Varanus flavescens*	*NT*	*RR*

Reptiles				
English name	**Local name**	**Scientific name**	**IUCN Status**	**Local Status**
Yellow-bellied House Gecko	*Tiktiki*	*Hemidactylus flaviviridis*	*LC*	*CR*
Ring Lizard	*Ram Godi*	*Varanus salvator*	*VU*	
Painted Bronzeback Tree Snake	*Gecho*	*Dendrelaphis pictus*	*LC*	

IUCN Status (Red List 2015): CR – Critically Endangered, EN – Endangered, VU – Vulnerable, NO – Not Threatened; NT – Near Threatened; LC – Least Concern; DD – Data Deficient
Local Status (2013): CR – Common Resident, C – Common, UR – Uncommon Resident, RR – Rare Resident, V – Vagrant, WV – Winter Visitor; UWV – Uncommon Winter Visitor.

Table A1-8: Fish (Jamuna River March 1993 – February 1994)

Riverine Fish Species					
Nr	**Local name**	**English name**	**Scientific name**	**IUCN assessment**	
				Global status	**Local status**
1	*Bali chata*	*Balitora Minnow*	*Psilorhynchus balitora*	*LC*	*LC*
2	*Ghora Poia*	*Gongota Loach*	*Canthophrys gongota*	*LC*	*NT*
3	*Kachki*	*Ganges River-sprat*	*Corica soborna*	*LC*	*LC*
4	*Phasa*	*Gangetic Hairfin Anchovy*	*Setipinna phasa*	*LC*	*LC*
5	*Nuna Baila*	*Short Goby*	*Brachygobius nunus*	*NE*	*LC*
6	*Chiring*	*Gobi*	*Apocryptes bato*	*LC*	*LC*
7	*Ghaura*	*Garua Bacha*	*Clupisoma garua*	*NE*	*EN*
8	*Baghair*	*Dwarf Goonch*	*Bagarius bagarius*	*NT*	*CR*
9	*Kajuli*	*Gangetic Ailia*	*Ailia coila*	*NT*	*LC*
10	*Magur*	*Indian Torrent Catfish*	*Amblyceps mangois*	*LC*	*LC*
11	*Rita*	*Rita*	*Rita rita*	*LC*	*EN*
12	*Gang Tengra*	*Gangetic Gagata*	*Gagata youssoufi*	*LC*	*NT*
13	*Gang Tengra*	*Kosi Tengra*	*Nangra nangra*	*LC*	*LC*
14	*Sisor*	*Sisor Catfish*	*Sisor rhabdophorus*	*LC*	*CR*
15	*Kauwa/Ceni a*	*Indian Gagata*	*Gagata cenia*	*LC*	*LC*
16	*Ilish*	*Hilsa Shad*	*Tenualosa ilisha*	*LC*	*LC*
17	*Gang Magur*	*Canine Catfish*	*Plotosus canius*	*NE*	*NT*
18	*Koi Puti*	*Shirtnod Gizzaerd Shad*	*Anodontostoma chacunda*	*LC*	*LC*
19	*Khorsula*	*Yellowtail Mullet*	*Sicamugil cascasia*	*LC*	*VU*
20	*Piali*	*Aspidopara*	*Aspidoparia morar*	*LC*	*VU*
21	*Kalabata*	*Gangetic Latia*	*Crossocheilus latius*	*LC*	*EN*
22	*Rani*	*Necktie Loach*	*Botia Dario*	*LC*	*EN*
23	*Khorsula*	*Corsula Mullet*	*Rhinomugil corsula*	*LC*	*LC*
24	*Shilong*	*Silond Catfish*	*Silonia silondia*	*LC*	*LC*
25	*Kutakanti*	*Kosi Hara*	*Hara hara*	*LC*	*LC*
26	*Poa*	*Pama Croaker*	*Otolithoides pama*	*NE*	*LC*

Riverine Fish Species					
Nr	Local name	English name	Scientific name	IUCN assessment	
				Global status	Local status
27	Shangus		Himantura sp.		

IUCN Status (Red List 2015): LC – Least Concern, NT – Near Threatened, NE – Not Evaluated, CR – Critically Endangered, EN – Endangered, VU – Vulnerable (Ref. EIA FRERMIP Tranche-1, 2014, FAP 1994)

Migratory Fish Species					
Nr	Local name	English name	Scientific name	IUCN assessment	
				Local status	Global status
1	Catla	Catla	Catla catla	LC	NE
2	Kalibaus	Organfin Labio	Labeo calbasu	LC	LC
3	Rui	Rohu	Labeo rohita	LC	LC
4	Mrigal	Mrigal	Cirrhinus cirrhosus	NT	VU
5	Bata	Bata Labeo	Labeo bata	LC	LC
6	Raik	Reba	Cirrhinus reba	NT	LC
7	Chital	Humped Featherback	Chitala chitala	VU	LC
8	Ayre	Long-whiskered Catfish	Sperata aor	VU	LC
9	Guzza Ayre	Giant River Catfish	Sperata seenghala	VU	LC
10	Golsha Tengra	Bleeker's Mystus	Mystus bleekeri	LC	LC
11	Kabashi Tengra	Gangetic Mystus	Mystus cavasius	NT	LC
12	Bacha	Batchwa Vacha	Eutropiichthys vacha	LC	LC
13	Batashi	Indian Potasi	Pseudeutropius atherinoides	LC	LC
14	Boal	Freshwater Shark	Wallago attu	VU	NT
15	Kani Pabda	Pabda Catfish	Ompok pabda	EN	NT
16	Modhu Pabda	Butter Catfish	Ompok bimaculatus	EN	NT
17	Pabda	Pabo Catfish	Ompok pabo	CR	NT
18	Katari	Large Razorbelly Minnow	Salmophasia bacaila	LC	LC
19	Fulchela	Finescale Razorbelly Minnow	Salmostoma phulo	NT	LC
20	Ghora Chela		Securicula gora	NT	LC
21	Chapila	Indian River Shad	Gudusia chapra	VU	LC
22	Kash Khaira	Indian Glass Barb	Chela laubuca	LC	NE

Ref. EIA RFERMIP Tranche-1 2014; FAP-1994; IUCN 2015

Floodplain Resident Fish Species					
Nr	Local name	English name	Scientific name	IUCN assessment	
				Local status	IUCN status

1	*Baro Baim*	*Tiretrack Eel*	*Mastacembelus aramatus*	*EN*	*NE*
2	*Guchi Baim*	*Striped Spinyeel*	*Macrognathus pancalus*	*LC*	*LC*
3	*Tara Baim*	*One striped Spinyeel*	*Macrognathus aculeatus*	*NT*	*NE*
4	*Lal Chanda*	*Ranga Chanda*	*Pseudambassis lala*	*LC*	*NE*
5	*Nama Chanda*	*Elongate Glass*	*Chanda nama*	*LC*	*LC*
6	*Kata Chanda*	*Indian Glassy Fish*	*Chanda baculis*	*NT*	*LC*
7	*Shing*	*Stinging Catfish*	*Heteropneus fossilis*	*LC*	*LC*
8	*Magur*	*Walking Catfish*	*Clarias batrachus*	*LC*	*LC*
9	*Shol*	*Snakehead Murrel*	*Channa striatus*	*LC*	*LC*
10	*Taki*	*Spotted Snakehead*	*Channa punctatus*	*LC*	*LC*
11	*Gojar*	*Giant Snakehead*	*Channa marulius*	*EN*	*LC*
12	*Tit Puti*	*Twospot Barb*	*Pethia ticto*	*VU*	*LC*
12	*Puti*	*Spotfin Swamp Barb*	*Puntius sophore*	*LC*	*LC*
14	*Deshi Sarputi*	*Olive Barb*	*Systomus sarana*	*NT*	*LC*
15	*Phutani Puti*	*Spotted Sail Barb*	*Pethia phutunio*	*LC*	*LC*
16	*Gilli Puti*	*Golden Dwarf Barb*	*Pethia gelius*	*NT*	*LC*
17	*Kanchon Puti*	*Red Barb*	*Pethia conchonius*	*LC*	*LC*
18	*Kanpona*	*Blue Panchax*	*Aplocheilus panchax*	*LC*	*LC*
19	*Gutum*	*Peppered Loach*	*Lepidocephalichthys guntea*	*LC*	*LC*
20	*Chep Chala*	*Silver Hatchlet Barb*	*Chela cachius*	*VU*	*LC*
21	*Baila*	*Freshwater Goby*	*Glossogobius giuris*	*LC*	*LC*
22	*Napit Koi*	*Blue Perch*	*Badis badis*	*NT*	*LC*
23	*Darkina*	*Blackline Rasbora*	*Rasbora daniconius*	*LC*	*LC*
24	*Chebli*	*Giant Danio*	*Devario aequipinnatus*	*DD*	*LC*
25	*Anju*	*Zebra Danio*	*Danio rerio*	*NT*	*LC*
26	*Mola*	*Mola Carplet*	*Amblypharyngodon mola*	*LC*	*LC*
27	*Keti*	*Cotio*	*Osteobrama cotio cotio*	*NT*	*LC*
28	*Kaikla*	*Freshwater Garfish*	*Xenentodon cancila*	*LC*	*NE*
29	*Soto Kholisa*	*Hick-lipped Gourami*	*Trichgaster labiosus*	*LC*	*LC*
30	*Lal Kholisa*	*Red Gourami*	*Trichgaster lalius*	*LC*	*LC*
31	*Kholisa*	*Striped Gourami*	*Trichgaster fasciata*	*LC*	*LC*
32	*Tengra*	*Striped Dwarf*	*Mystus vittatus*	*LC*	*LC*
33	*Bajari Tengra*	*Tengra Mystus*	*Mystus tengara*	*LC*	*LC*
34	*Potka*	*Ocellated Pufferfish*	*Tetraodon cutcutia*	*LC*	*LC*

APPENDIX A2 Critical Habitat Assessment

I. Introduction

Overview

1. This document summarizes the findings of the Critical Habitat Assessment (CHA) for the proposed BAN: Flood and Riverbank Erosion Risk Management Investment Program – Project 2 (BAN:FRERMIP T2). This assesment identifies the triggers for the potential critical habitat in the target proposed project area. This is desk-based and involved review of data and information from this EIA report, International Union for Conservation of Nature (IUCN) database, online sources[1] and other wildlife studies.

2. The assessment is to practice and document the environmental due diligence on priority wildlife population, and identify approaches to address ADB Safeguard Policy Statement (SPS) 2009 requirement on critical habitat. Where further detail and guidance is required, the International Finance Corporation (IFC) Guidance Note 6 (GN6) thresholds have been adopted to support the assessment through its critical habitat criteria thresholds. The first stage is screening the list of species exhibited in Appendix A1 (Tables A1-4 to 8) of BAN:FRERMIP T2's EIA report where all protected areas, species known or likely to be present within proposed project alignment and have been categorized by their nature conservation status. The second step is to identify the priority species and habitats that trigger the critical habitat policy of SPS 2009 . Next step is to assesses each relevant ecological receptors against the critical habitat criteria in accordance with the ADB requirements and supporting IFC thresholds. Impacts and corresponding mitigation measures are defined in this document as well.

[1] https://ebird.org/home, https://www.inaturalist.org/observations, https://reptile-database.reptarium.cz/, https://www.wii.gov.in/, https://www.fishbase.se/search.php, https://www.nationalredlist.org/ and https://www.iucnredlist.org/

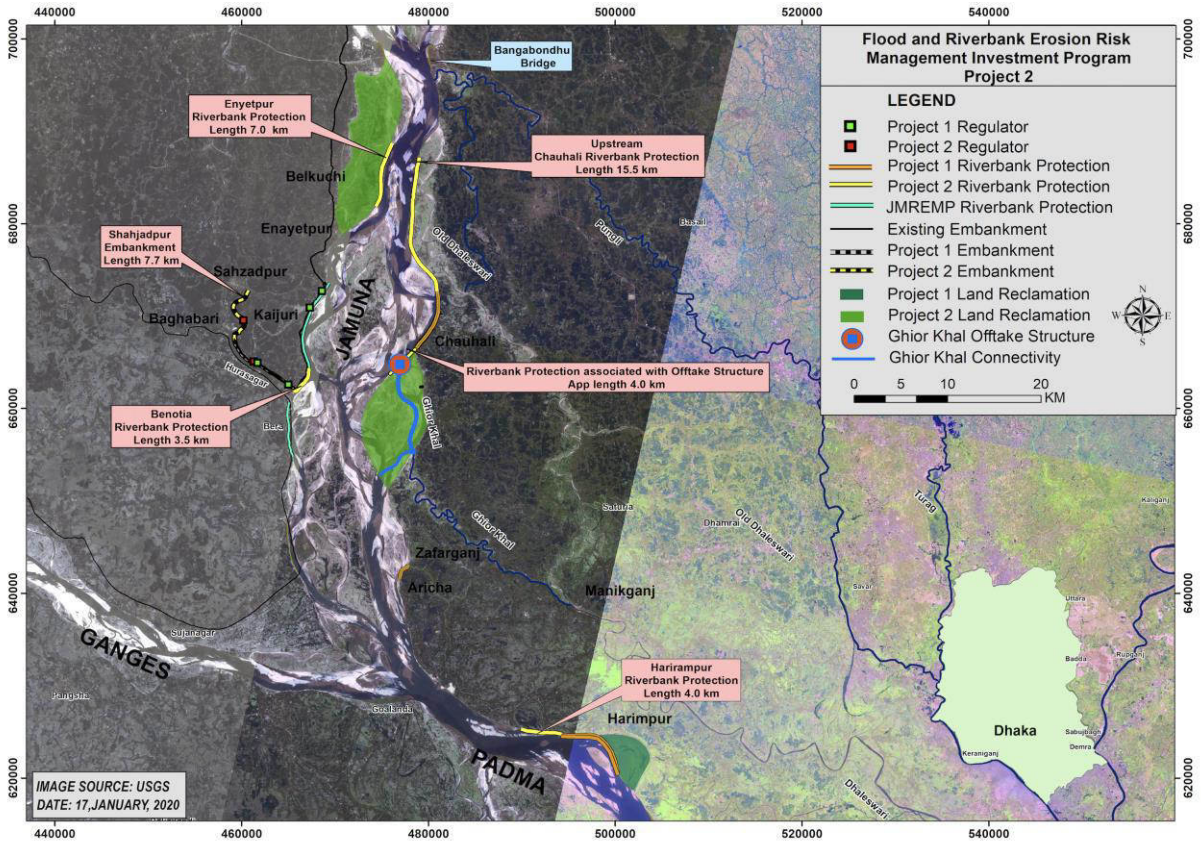

Figure 1. Components of the BAN:FRERMIP T2.

Objective

3. The purpose of this assessment is to document the CHA's findings and demonstrate that the proposed project meets the requirement of ADB Safeguard Policy on critical habitats. The CHA is used to identify the specific species and habitats that could trigger critical habitat and designated or Internationally recognized sites within the project area of influence.

II. Policy

4. Based on SPS 2009 requirement, the proposed project need to assess the significance of project impacts and risks on biodiversity as an integral part of the EIA process. The EIA is focused on the major threats to biodiversity, which include damage of habitat and negative impacts on their population, and on the use of natural resources in an unsustainable manner. To support the EIA process, this assessment determines whether the proposed project sites are critical habitat or not. When a proposed project will deem affect and/or at least covers identified critical habitat/s, project should be able to demonstrate the following requirements:

a. There are no measurable adverse impacts, or likelihood of such, on the critical habitat which could impair its high biodiversity value or the ability to function.

b. The project is not anticipated to lead to a reduction in the population of any recognized endangered or critically endangered species or a loss in area of the habitat concerned such that the persistence of a viable and representative host ecosystem be compromised.

c. Any lesser impacts are mitigated.

III. Area of Assessment (AoA)

5. The ecologically AoA is established to determine the presence of any critical habitat for each priority species with regular occurrence in the project's area of influence, or ecosystem. AoA is needed to delineate the assessment and applicability of the critical habitat criteria, and the thresholds to determine critical habitat for the species and/or ecosystems.The AOA of the proposed project is comprised of three different bioecological zones: (i) Brahmaputra–Jamuna floodplain, (ii) Chalan Beel, and (iii) Ganges floodplain (Figure 2).

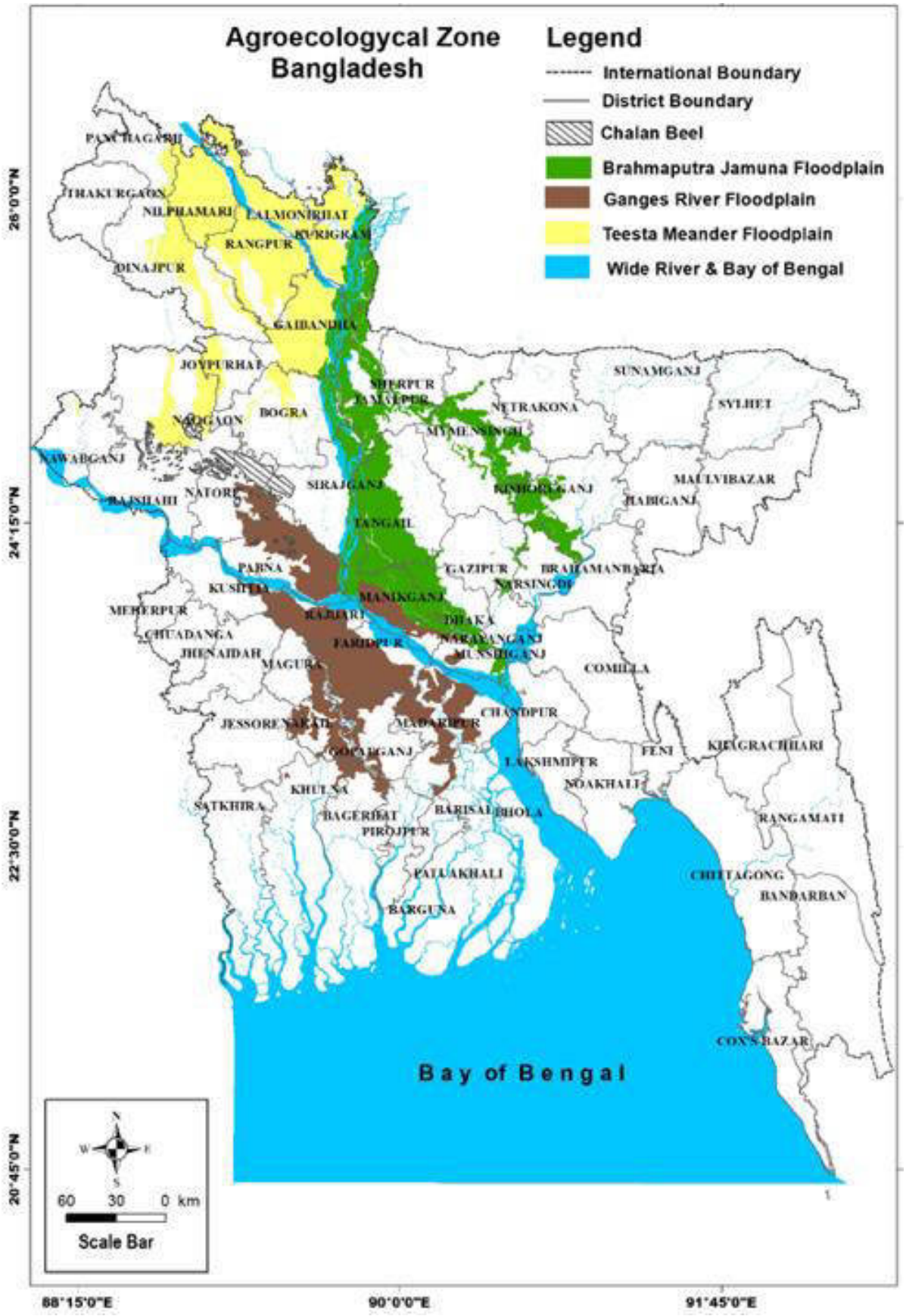

Figure 2. Major floodplains in Central Bangladesh

Brahmaputra–Jamuna Floodplain

6. The Brahmaputra-Jamuna floodplain comprises active channels of the Brahmaputra River and the adjoining areas of the young floodplain lands. The main river course is distinctively braided and consists of several interconnecting channels from different districts of the country. The Jamuna remains flooded during the monsoon with dense aquatic vegetations. However, it dries up in the winter leaving only patches of water holes in the central part of this zone.

7. This ecosystem possesses a unique variety of plants that yield valuable uses such as medicinal herbs, fruit yielding trees, array of shrubs, creepers and climbers, flowering trees etc. Most common snake (i.e. poisonous) in the floodplain area is the Banded krait (*Bungarus fascinatus)*, which is easily identified by its broad black and yellow bands. Variuos mammals such as bats, several species of monkeys and pangolins are found, along with various birds of prey.

Chalan Beel

8. Chalan Beel is an extensive low land area at the lower Atrai basin. This is consisted of other smaller beels connected to one another to form a continuous water body during the rainy season. The beel area expands into a vast water body.

9. 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. 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.

Ganges Floodplain

10. Mostly situated in the districts of Rajshahi, Pabna, Jessore, Kushtia, Faridpur, Shariatpur and Barisal, Ganges floodplain is made of the active floodplains of the Ganges River and the adjoining meandering floodplains. The adjoining meander floodplains mainly comprise a smooth landscape of ridges, basins and old channels. The Gangetic alluvium is readily distinguishable from the old Brahmaputra, Jamuna and Meghna sediments by its high lime content. The Ganges-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.

11. This floodplain is characterised by mixed vegetation. Stagnant water bodies and channels, rivers and tributaries in the floodplain support a habitat of rich biodiversity. In the beels and other water bodies, free-floating aquatic vegetation is prominent. The common plant species are Panimorich (*Polygonum orientale*), Jhanji (*Hydrilla verticillate*), Helencha (*Alternanthera philoxeroides*), Topapana (*Pistia stratiotes*), Chechra (*Schoenoplectus articulatus*), Shada shapla (*Nymphaea nouchali*), Keshordam (*Ludwigia adscendens*), Kolmi (*Ipomoea aquatica*), Dhol kolmi (*I. carnea* ssp. *fistulosa*), Hijal (*Barringtonia acutangula*), Tentul (*Tamarindus indica*) and Biash (*Salix tetrasperma*).

12. Nearly all the major groups of oriental birds are represented in this zone by one or more species. Besides, different species of freshwater tortoises and turtles are also found in the rivers and ponds. The amphibian species found in this zone include a few species of toads, frogs and tree frog.

Terrestrial Habitats and Flor

13. Terrestrial habitats of the AoA 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.

14. **Settlement / homestead vegetation.** As a traditional community practice, man-made plantation cultivated in the yard adjacent to the house for financial and mundane needs. The Narikel (*Cocos nucifera*), Aam (*Mangifera* sp.), Supari (*Areca catechu*), Bansh (*Bambusa* spp.), Akashmoni (*Acacia auriculiformes*), and Bot (*Ficus bengalensis*) were observed frequently during the field survey.

15. **Cropland vegetation.** Found along the periphery of cultivated lands as weeds that grow and expand through self-propagation. Dominant weed species are Shyama Ghash, Durba Ghash, Badali ghash, and Chawla ghas.

16. **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*) and Khejur (*Phoenix sylvestris*).

17. **Social forest.** Located on small areas of fallow lands, cropland periphery, and near settlements and graveyards. Species are Akashmoni (*Acacia auriculiformes*), Bansh (*Bambusa* spp.), Mehogany (*Swietenia mahogani*).

18. **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 auriculiformes*), Sisu (*Dalbergia sissoo*), Pitali (*Trewia nudiflora*), Bamboo (*Bambusa* spp.), Khejur (*Phoenix sylvestris*), Bon Begun (*Solanu nigrum*) are common.

19. **Urban Area.** Built up areas with low density of vegetations. The wildlife population and floral condition and distribution are low. But still some small mammals, reptiles, and birds are present in these areas.

Seasonal and Perennial Wetland Habitats and Flora

20. Wetland habitats of the study area include charland, swamp, and grassland.

21. **Charland.** Occupies significant part of the AoA. The Jamuna and Padma Rivers are 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 depends on the time since char formation. At species level, Shon (*Crotalaria retusa*), Nol (*Phragmites karka*) and Kaisa are the first colonizers, whereas Mutha (*Cyperus sp*), Kolmi (*Ipomoea sp*), Binna (*Vetiveria zizanioides*) and Durba (*Cynodon sp*) are the subsequent successor. At the terminal succession, some bushy plant species such as Dholkolmi (*Ipomoea carnea* ssp. *fistulosa*) appear.

22. **Swamps.** Chalan Beel area is favorable for a good growth of wetland trees like (Hizal *Barringtonia acutangula*) and Barun.

23. **Grassland** species include Binna (*Vetiveria zizanioides*) and Durba Gash (*Cynodon dactylon*).

Terrestrial Fauna

24. Among the terrestrial fauna, groups of animals present in the area include birds, mammals, amphibians and reptiles.

25. **Birds – residents and short-range migrants**. Common terrestrial birds in the study area include the 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*),

Brahminy Kite (*Haliastur indus*). Uncommon residents include the Barn Owl (*Tyto alba*, Bank Myna *Acridotheris ginginiarus* and Bronze-winged Jacana *Metopidius indicus*. Uncommon winter visitors include the Bar-headed Goose *Anser indicus*, several sand piper and tern species.

26. **Birds – long-range migratory species.** Bangladesh is on the Central Asian Flyway between the Palaearctic and the Indian subcontinent. Migratory birds that move along the Central Asian Flyway utilize the Brahmaputra-Jamuna-Padma-Ganges char and other habitats.

27. **Mammals.** Species still present include Little Indian Field Mouse (*Mus booduga*), Golden Jackal (*Canis aureus*), Small Indian Mongoose (*Herpestes auropunctatus*), Indian Flying Fox (*Pteropus giganteus*) and Greater Short-Nosed Fruit Bat (*Cynopterus sphinx*).

28. **Amphibians.** Common terrestrial species are Indian Common Toad (*Duttaphrynus melanostictus*) and Indian Bullfrog (*Hoplobatrachus trigerinus*).

29. **Reptiles.** The Yellow-bellied House Gecko (*Hemidactylus flaviviridis*), Common Garden Lizard (*Calotes versicolor*), Yellow Monitor (*Varanus flavescens*) and Banded Krait *Bungarus fasciatus*, are present in the AOA. King Cobra (*Ophiophagus hannah*) and Indian Cobra (*Naja naja*) were reported by local people as present in the area.

Aquatic Ecosystems

30. The hydrological cycle water levels and flows that create diverse aquatic habitats for the benefit of aquatic biota. Aquatic ecosystems include a range of riverine, floodplain, and pond habitats that become interconnected during monsoon season. Freshwater wetlands are classified as seasonal and perennial. Seasonal wetlands usually remain inundated for four to five months, and occupies the lower croplands, while perennial wetlands hold water throughout the year. Wetlands serve as the grazing ground for fish and other aquatic fauna and provides habitat for many aquatic flora and fauna.

31. **Aquatic Flora.** Present in both seasonal and perennial water bodies. The submerged species are Fodder (*Hydrilla verticillate*), *Vallisneria spiralis, Aponogeton Sp*. and Gechu. The free-floating species are Kachuripana or waterhyacinth (*Eichhornia crassipes*), Kutipana (*Azolla* sp.), and Khudipana (*Lemna perpusilla*).

32. **Aquatic Fauna**. Ganges River Dolphin (*Platanista gangetica*) is native to the Ganges and Brahmaputra rivers in Bangladesh. 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). Ganges River Dolphins utilizing riverine habitats potentially affected by the project are part of a transboundary (Bangladesh-India) population that may include individuals who migrate internationally between Bangladesh and India.

Priority Biodiversity Species of the Assessment

Birds Species

33. The species of birds are found everywhere in the country of Bangladesh. There are various avian species found even within densely populated cities and towns. More birds are found in the rural areas where there are farmlands, orchard and abundant homestead plants. Majority of these birds thrive and breed in areas where there is limited human activities such as different types of forests, haor (large lakes), estuarine inter-tidal zones, along the Bay of Berngal, and rivers and flooded zones.

34. Large amount of water from the melting glaciers of the Himalayas and seasonal rain due to monsoon flow along Jamuna and Padma rivers and other rivers until the Bay of Bengal. During the rainy days off monsoon, the rivers of Jamuna and Padma grow and inundate nearby embankments.

Other rivers of the country exhibit this kind of condition as well. According to IUCN (2015), nearly 50% (8M ha) of the country become a maze of wetlands for four to five months. These are called beels or flooded fields. Perennial rivers such as Jamuna and Padma, and the beels formed due to flooding are important habitats for birds.

35. Jamuna and Padma rivers and beels support a wide variety of birds. These wetlands are habitats of many species and seasonal residence of many migratory species of birds. Based on the IUCN Red List Report (2015), major users of rivers as habitat are ducks, grebes, rails, crakes, storks, herons, cormorants, kingfishers and many passerine species. Of the passerines the notable species are starlings, mynas, stonechats, martins, munias, pipits, wagtails, grassbirds, warblers etc. The iconic species of this habitat are Black-bellied Tern (Sterna acuticauda), Painted Stork (Mycteria leucocephala), and Black Stork (Ciconia nigra), which are the target bird species of this assessment.

36. **Black-bellied Tern *(Sterna acuticauda*)**. This is an elegant tern with a long tail and an obvious slender orange bill. The adults kinds capable to breed are characterized with a full black cap and dark feathers at belly region. On the otherhand, younger ones or non-breeding adults have paler color of the feathers at the belly and only solid black patch at the nape. *Sterna acuticauda* breeds on sandy banks of rivers, and forages over a wider range of wetland habitats similar to those at the Jamuna and Padma rivers. This bird species lives in the fresh waters, such as at the proposed project locations. It is diurnal and forages in flight, dipping to the water surface, flying over lands and close to water[2]. Black-bellied nourishes with small fishes, crustaceans and insects found in their habitat.

37. According to IUCN documents, this bird is an extremely rare resident of the large rivers of Bangladesh such as Jamuna and Padma rivers. Over 20 years, the population of this species has declined more than 90% (98 in 1995 and 2 in 2012). The population estimate is currently placed at 10,000-25,000 individuals, roughly equating to 6,700-17,000 mature individuals, until more data are available. Although countrywide survey has not been conducted, it can be assumed with certainty that the population is less than 50. This resident species is, therefore, assessed Critically Endangered (global and national) due to small and restricted population.

38. Extent of Occurrence (EOO)[3]: 4,647 km^2. Area of Occupancy (AOO)[4]: 793 km^2

Figure 3.[5] Black-bellied Tern *(Sterna acuticauda)* habitat is lowland rivers and marshes, and sometimes ditches and pools.

[2] p.85. https://portals.iucn.org/library/sites/library/files/documents/RL-549.3-003-v.3.pdf

[3] EOO is the area contained within the shortest continuous imaginary boundary which can be drawn to encompass all the known, inferred or projected sites of present occurrence of a taxon, excluding cases of vagrancy.

[4] AOO is the smallest area essential at any stage to the survival of existing populations of a taxon.

[5] https://ebird.org/media/catalog?taxonCode=blbter1&regionCode=&mediaType=p

39. **Painted Stork (*Mycteria leucocephala*).** According to the information from eBird's website, this bird species is a large stork with prominent long yellow bill that curves downwards at the tip. The adults are primarily white from head to body, and black striped markings on the wings and bright pink on tertials. The younger ones have duller color, with a brown wash, and absence of chest band. Often seen near water bodies such as wetlands, marshes, and flooded agricultural fields. Wetlands International (2013) estimated 25,000 individuals in South Asia and up to 10,000 individuals in South-East Asia. Approximately 25,000-35,000 individuals or 16,000-24,000 mature individuals.

40. The Mycteria leucocephala is rarely found in the charland, coastal areas and in some of the larger wetlands of the Bangladesh during winter. The species' Extent of Occurrence is 135,764 km^2 and Area of Occupancy 9,929 km^2. Based on the Red List of Bangladesh report, this bird species seen in Bangladesh have never exceeded 50 and the habitats are continually degraded. Thus, the species is evaluated as Critically Endangered at the national level and Endangered in the global status.

41. EOO: 1,35,764 km². AOO: 9,929 km²

Figure 4.[6] Display of different feather colors of Painted Stork (*Mycteria leucocephala*)

42. **Black Stork (*Ciconia nigra*).** The adult *Ciconia nigra* has glossy black overall with white belly feathers. It has long pointed red bill and reddish legs (Figure 5). *C. nigra* breeds at swampy coniferous and mixed forests, and builds nest on high trees. The migrating birds into the country inhabits grasslands, agricultural fields, and along the margins of lakes and rivers. Most populations of *C. nigra* are migratory and travel on a narrow front along well-defined routes. It forages in shallow parts of the river, flood-plains, pools in dry riverbeds and occasionally grasslands especially where there are stands of reeds or long grass.

43. The global population is estimated to number c.24,000-44,000 individuals (Wetlands International 2006). This rare winter migrant inhabiting the banks of large rivers of Bangladesh has an area of occupancy estimated to be less than 2000 km^2 . Its preferred habitats are being continually degraded and the species, therefore, meets the threat category Vulnerable (national level) and Least Concerned (global status).

44. EOO: 98,782 km^2, AOO: 1,584 km^2

[6] https://ebird.org/media/catalog?taxonCode=paisto1&regionCode=BD&mediaType=p

Figure 5.[7] Image of an adult Black Stork (*Ciconia nigra*).

Table 1: Priority bird species in the CHA.

Scientific name	English name	Local name	National IUCN Status	Global IUCN Status
Sterna acuticauda	*Black-bellied Tern*	*Kalapet Panchil*	*CR*	*EN*
Mycteria leucocephala	*Painted Stork*	*Rangila bok*	*CR*	*NT*
Ciconia nigra	*Black Stork*	*Kala Manikjor*	*VU*	*LC*

Mammals

45. The geographical characteristic of the country is unique for the diverse habitat types, and mammals are found in the entire types of habitats throughout Bangladesh. There are different habitats in the country, which are inhabited by the mammalian species depending on the geographic location, climatic condition and floral composition. These are forests (mixed evergreen, deciduous and mangrove), grasslands, homestead vegetations, marine and inland wetlands.

46. Based on the information of Red List of Bangladesh for mammals, wetlands of Bangladesh support large number of aquatic mammals of the country. Nearly 50% of the total land surface of the country are considered as wetland, which includes rivers, natural lakes, freshwater marshes, baors (oxbow lakes), beels (floodplain depressions), ponds, one large water reservoir (Kaptai Lake), and extensive seasonally inundated floodplains. Wetlands of the country are significant for Gangetic River Dolphin (*Platanista gangetica*), otters species, small cats and other small mammals. Ganges River Dolphin (*P. gangetica*) has already disappeared from most of the tributaries of Ganges-Brahmaputra-Meghna river systems due to siltation, insufficient water flow and restricted to a very few larger channels.

47. **Fishing Cat (*Prionailurus viverrinus*).** Prefers wetlands, marshes and haor areas. It has been recorded at rural areas along river systems or close to water bodies and in countryside thickets on banks of wetlands zones. It is active during night time and found active at dawn and dusk as well. Its diet comprise manly fish, but would eat any small animal that it can catch. Often these include poultry, ducks and geese, kids of goat and sheep when this cat lives near human settlements.

[7] https://ebird.org/media/catalog?taxonCode=blasto1&regionCode=BD&mediaType=p

48. This cat species is widely distributed with low population density. It is suspected that more than 50% of its population has been declined during the last two decades according to the Red List of Bangladesh of IUCN (2015). Its Area of Occupancy and habitat quality have been reduced and the process is still continuing. Thus, it has been categorized as Endangered (national) and Vulnerable (global status).

49. EOO: 2,11,043 km^2. AOO: 28,999 km^2

Figure 6.[8] Fishing Cat (*Prionailurus viverrinus*) is a medium-sized wild cat of South and Southeast Asia.

50. Bengal Fox (*Vulpes bengalensis*). Unlike the *P. viverrinus*, this Bengal Fox is found mostly in family or groups. Basically, this mammal is nocturnal but active during the day as well, especially throughout monsoon season when overcasting of sky is frequent. *V. bengalensis* hunts small mammals (e.g. rodents), reptiles, insects and crabs occasionally supplemented by sweet fruits. It uses underground burrow network during the day to rest and hide. It has preference on semi-arid, flat to undulating terrain, scrub, foothills and grassland habitats where it can hunt and dig dens.

51. Figure 7.[9] *Vulpes bengalensis* is a small fox species with an elongated muzzle, long-pointed ears, and bushy tail.

52. *V. bengalensis* is endemic to the Indian subcontinent and ranges from the foothills of the Himalayas in Nepal to the southern tip of the Indian peninsula and native to Bangladesh. It is distributed in the western part of the country (west side of the river Jamuna except the Sundarbans), but a small population occurs in the bordering area of Moulvibazar. Before, it occurs widely in

[8] https://www.iucnredlist.org/species/18150/50662615

[9] https://www.iucnredlist.org/species/23049/81069636

Bangladesh, but the range has now become restricted. The Extent of Occurrence and Area of Occupancy have declined, therefore qualifies for Vulnerable category (national) and Least Concerned in global status.

53. EOO: 81,352 km^2. AOO: 33,367 km^2

54. **Ganges River Dolphin (*Platanista gangetica*).** The body of the Ganges River Dolphin is brownish in color and stocky at the middle. This mammal feeds on a variety of shrimps and fish, including carp and catfish. Where salinity level is low, *P. gangetica* lives exclusively in freshwater river systems and the estuaries. This species occurs in all connected rivers and tributaries of Ganges-Brahmaputra-Meghna system. This dolphin species is present in seasonally flooded and lowlands. The *P. gangetica* is mostly found in deep pools in the river meanders and confluences.

55. Ganges River Dolphin is facing a high risk of human impact throughout the distribution range such as destruction of natural forests and putting dams of the upper reaches of all trans-boundary rivers in the neighboring countries that is causing massive siltation in all floodplain rivers. There has been decline in the Extent of Occurrence, as well as habitat quality, especially in the Ganges and Brahmaputra River basins. This is associated with the construction of barrages in the upstream countries. Due to siltation, *P. gangetica* has isappeared from most of the tributaries of Ganges-Brahmaputra-Meghna river systems due to siltation and insufficient water flow. Hence, this dolphin species is now restricted to a few larger channels. It is assuming that at least 30% decline of population has occurred during last three generations with the decline in its habitat and incidental catch in drag net according to IUCN (2015). The species has been assessed as Vulnerable (national) based on the ongoing threats to its population and Endangered at the global status.

56. EOO: 1,42,000 km^2. AOO: 7,338 km^2

Figure 8.[10] Ganges River Dolphin (*Platanista gangetica*) has the long and pointed nose characteristic of all river dolphins.

Table 2. Priority mammal species in the CHA.

English name	Local name	Scientific name	Global IUCN Status	Local ICUN Status
Fishing Cat	*Mecho Biral/Baghailla*	*Prionailurus viverrinus*	*EN*	*UR*
Bengal Fox	*Khek Shial/Shial*	*Vulpes bengalensis*	*VU*	*CR*
Ganges River Dolphin	*Shishu / Shushuk*	*Platanista gangetica*	*VU*	*CR*

[10] https://www.iucnredlist.org/species/41758/151913336

Reptiles

57. Based on Red List of Bangladesh (Vol. 4, 2015), the geographic condition of Bangladesh supports four main types of habitats for reptiles. These are (i) forests (1.45 million ha.) that includes mangroves; (ii) wetlands (2.90 million ha) including rivers, estuarine areas and floodplains (seasonal), lakes and marshlands; (iii) bushy, grassy and bamboo (0.80 million ha); and (4) homestead vegetation (0.27 million ha) of the country. Other major land uses are housing areas (0.15 million ha) and agricultural areas (9.19 million ha) that are not considered suitable as reptile habitats.

58. In terms of land cover, the wildlife habitats of Bangladesh can broadly be categorized into forests and non-forests. The forest habitat is classified into the following types: (i) moist deciduous forest, (ii) mixed-evergreen, (iii) Mangroves and (iv) freshwater swamp forest. The non-forests are divided into: (i) homestead forest and (ii) open water area both freshwater and marine. For this assessment, open waters such as river is only considered in view of the location of the proposed project.

59. Jamuna and Padma rivers safeguard species of reptiles such as the freshwater turtles. The small canals serve as bridge or connection between rivers and floodplains, beels, haors and baors. Thus, these rivers support reptiles and other amphibious reptiles as well. In addition, ponds and ditches are good habitats for freshwater turtles as source of diet and shelter.

60. **Crowned River Turtle *(Hardella thurjii*).** Inhabits pools, ponds, canals, slow-moving rivers, lakes and even estuaries. This species is semi-aquatic that thrives in both terrestrial and freshwater. It has diet on plants such as grasses, sedges, aquatic weeds and water hyacinth, animals (i.e. prawns and fishes). This turtle species nests at sand banks in winter from November to January.

61. Although the EOO and AOO are quite extensive, the species is rarely seen due to the decline of both population and continuing damage on its habitat. It is found in all the major rivers and tributaries principally in the Brahmaputra, Buriganga, Dakatia, Dholeswari, Gomti, Jamuna, Kirtonkhola, Kushiyara, Meghna, Padma, Sitalakhaya, Surma, and Tista rivers as well as in fresh water wetlands (IUCN, 2015). Illegal trade and habitat destruction have caused local extinction from many places. Based on geographic range it signifies Vulnerable (global) but population projection signifies it as Endangered (national).

62. EOO: 73,888 km^2. AOO: 5,771 km^2

Figure 9.[11] Crowned River Turtle *(Hardella thurjii*) is an aquatic species endemic in South Asia.

[11] https://reptile-database.reptarium.cz/species?genus=Hardella&species=thurjii

63. **Ganges softshell Turtle (*Nilssonia gangetica*)**. According to IUCN documents, this species of turtle inhabits the major river systems of the country, including the Ganga-Padma, Jamuna-Brahmaputra and Surma-Kushiara-Megna and flood-plains. *N. gangetica* home range is not known, but found up to an elevation of 10 m (IUCN, 2015) . It is an omnivorous and active during daytime, and feeds on aquatic macrophytes and animal matter. There are two breeding seasons: July to October is the major and December to January a minor peak.

64. The EOO (45,348 km^2) and AOO (2,140 km^2) are large due to the river systems and their tributaries where the species occurs sporadically (IUCN, 2015). The population has declined more than 50% due to trapping in fishers' net, poaching for meat, bones and carapace and over-exploitation. Therefore, the species is categorized as Endangered (national) and Vulnerable (global).

65. EOO: 2,13,986 km^2. AOO: 45,348 km^2

Figure 10.[12] Ganges Softshell Turtle (*Nilssonia gangetica*) inhabits deep rivers and ponds with mud and sand bottoms.

66. **Gharial (*Gavialis gangeticus*)**. This is under the crocodilian family. It inhabits deep and fast flowing waters, but prefers rivers with reduced current. This species can lay an average of 40 eggs on sandy eroded banks. This freshwater species is predominantly piscivorous or feeding on fish, and also eats turtles, birds and small mammals. *G. gangeticus* is solitary in nature, and several individuals move in a group occasionally. This type of crocodile is both diurnal and nocturnal.

67. Figure 11.[13] Gharial (*Gavialis gangeticus*) is a type of Asian crocodile distinguished by their long, thin snouts.

[12] https://www.iucnredlist.org/species/39618/97400216

[13] https://www.iucnredlist.org/species/8966/149227430

68. IUCN has documented that this species is Critically Endangered at the national and global level due to population reduction. There exists no breeding population in the country and habitat has dwindled severely in the past few decades.

69. EOO: 47,109 km^2. AOO: 5,983 km^2

70. **Narrow-headed Softshell Turtle (*Chitra indica*)**. This turtle species lives in freshwater and submerged in the sandy bottoms of deep areas most of the day. During winter season, *C. indica* spends time basking on sandbars also known as called chars. It can lay eggs on sandy banks with an average of 118 eggs. Its diet is composed mainly on fish, mollusks and crustaceans. In Bangladesh, the breeding season is from February to May.

71. The species is rare in the country. No specimen of this species has been documented for several years, which indicates that the species is close to extermination from Bangladeshi river systems. Therefore, it is considered as Critically Endangered (national) and Endangered (global).

72. EOO: 2,08,257 km^2. AOO: 7,143 km^2

Figure 12.[14] *C. indica* is widespread in South Asia and can be found in the Indus, Ganga, Godavari, Coleroon, Mahanadi and Padma rivers.

73. **Red Crowned Roofed Turtle (*Batagur kachuga*)**. Thrives in deep flowing rivers with terrestrial nest sites. It is entirely aquatic and found in large rivers. This is herbivorous and feeds on aquatic vegetation. This species is diurnal and active in the morning and afternoon, when this turtle species basks on the shore, sandbanks and logs. The females can lay up to 30 eggs on sandbanks during the months of March and April.

[14] https://www.semanticscholar.org/paper/Chitra-indica-(Gray-1830)-%E2%80%93-Narrow-Headed-Softshell-Pritchard-Dijk/f3e130aaf1641f8b037ef70809ff389618d5cd66/figure/0

Figure 13.[15] Red Crowned Roofed Turtle (*Batagur kachuga*) is historically widespread in Central Nepal, North-East India and Bangladesh.

74. Based on IUCN (2015), the Extent of Occurrence of *B. kachuga* is 61,207 km^2 and the Area of Occupancy is 3,718 km^2. These are beyond the threshold of any Threatened Category but the species is very rare in its entire range in the Ganges (Padma) River System of Bangladesh and sparingly sighted and the population reduction is more than 80% in the last 10 years. Thus, it is assessed as Critically Endangered (national and global).

75. EOO: 61,207 km^2. AOO: 3,718 km^2

76. **Spotted Pond Turtle (*Geoclemys hamiltonii*)**. The Spotted Pond Turtle is carnivorous species. Its diet include mollusks, insect larvae, earthworms, meat and fish, fruits and leaves. The females lay up to 24 eggs in a clutch, and can reproduce more than one time in a year. *G. hamiltoni* inhabits freshwater river systems, wetlands, shallow water, beels, haors and ponds.

77. It is an uncommon species in the Ganges and Brahmaputra river systems and adjacent water bodies. There are few sighting records in Chittagong, Dhaka, Jessore, Manikganj, Narshingdi and Sylhet. Based on IUCN document, the population has declined more than 50% due to anthropogenic activities and habitat loss. Therefore, the species is categorized as Endangered (national and global).

78. EOO: 1,48,173 km^2. AOO: 7,453 km^2

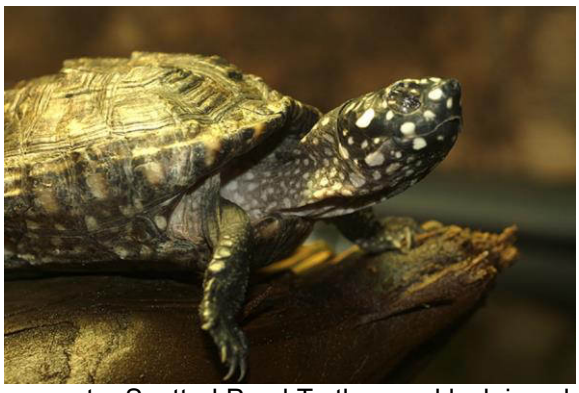

Figure 14.[16] As the name suggests, Spotted Pond Turtles are black in color with yellowish streaks or spots and wedge-shaped marks.

[15] https://reptile-database.reptarium.cz/species?genus=Batagur&species=kachuga&search_param=%28%28search%3D%27Batagur+kachuga%27%29%29

79. **Three-Stripe Roofed Turtle (*Batagur dhongoka*)**. An turtle species thriving in deep flowing large rivers such as Padma and Jamuna River systems. It uses the sandbanks and riverbanks of these rivers for basking and laying eggs. This diurnal species is semi-aquatic. Males are omnivorous, which feeds on water plants and mollusks, while females eat plants. It can up to 35 eggs on sandbank during the months of March and April.

80. The EOO of *B. dhongoka* is broad covering 84,102 km^2, and the AOO covers 4,508 km^2, which are beyond the threshold of Threatened Category. However, the species is very rare in its entire range in the Padma and the Jamuna rivers of Bangladesh. Also, it is assumed to have very small and restricted population and the population reduction is more than 90% in the last 10 years (IUCN, 2015). This taxon has been assessed as Critically Endangered (national and global).

81. EOO: 85,265 km^2. AOO: 5,876 km^2

Figure 15[17]. *Batagur dhongoka* is a river turtle and highly susceptible to major hydrological projects.

Table 3. Priority reptile species in the CHA.

English name	Local name	Scientific name	Global IUCN Status	Local IUCN Status
Crowned River Turtle	*Kali Kasim*	*Hardella thurjii*	*EN*	*UR*
Ganges softshell Turtle	*Khalua Kasim*	*Nilssonia gangetica*	*EN*	*UR*
Gharial	*Ghorial/Baishal*	*Gavialis gangeticus*	*CR*	*UR*
Narrow-headed Softshell Turtle	*Sim Kasim*	*Chitra indica*	*CR*	*UR*
Red Crowned Roofed Turtle	*Kori Kasim*	*Batagur kachuga*	*CR*	*UR*
Spotted Pond Turtle	*Mogom Kasim*	*Geoclemys hamiltonii*	*EN*	*UR*
Three- Striped Roofed Turtle	*Dhoor Kasim*	*Batagur dhongoca*	*CR*	*UR*

[16] https://reptile-database.reptarium.cz/species?genus=Geoclemys&species=hamiltonii&search_param=%28%28search%3D%27Geoclemys+hamiltonii%27%29%29

[17] https://www.iucnredlist.org/species/10953/152042542

Fish

82. In Bangladesh, increase of human population and high utilization of natural resource, agricultural production and industrial operations along with poor water management have have resulted led to the widespread threats for freshwater fish. Although, there are soecies cope with man-made pressures, majority of fish exhibited limited tolerance on habitat destruction and rapid changes of the ecosystems. It is widely recognized that changes in the fish habitats in Bangladesh caused due to both natural and anthropogenic processes have led to the high degree of population decline and disappearances of some fish species from the country. Siltation of water bodies is also reducing the fish habitat. The major human induced impacts on freshwater fishes of Bangladesh are habitat destruction and fragmentation through blockade of migration routes, invasive alien species, over-exploitation, disease, aquatic pollution incidental mortality and climate change (IUCN Bangladesh 2015).

83. **Pabda Catfish (*Ompok pabda*).** This catfish species inhabits both moving (lotic) and still (lentic) freshwaters. It is found in many freshwater bodies of the country including canals, beels, lake, ponds and floodplains. Usually, this is a surface feeder and omnivorous that feeds on aquatic insects, crustaceans, moss, protozoa, etc. It also hunts on fish fry and larvae. The species is widely distributed throughout Bangladesh and reported from Padma, Jamuna and Meghna.

84. *O. pabda*'s population is decreasing due to habitat shrinkage caused by massive siltation and wetland conversion. The Extent of Occurrence and Area of Occupancy data, however, do not exceed the threshold values of any threatened category and there is no known fragmentation of its habitat (IUCN 2015). Therefore, Endangered Category (national) is retained for the species, and Not Threatened category on the global status.

85. EOO: 1,21,601 km^2. AOO: 13,519 km^2

Figure 16.[18] Overexploitation of Pabda Catfish (*Ompok pabda*) for food is a major threat and resulted in population declines.

86. **Butter Catfish (*Ompok bimaculatus*).** Prefers to inhabit quiet, shallow, muddy water. This species can be found in canals, beels and inundated fields. This fish is omnivorous and predatory in nature that feeds on crustacean larvae, fish fries, zooplankton and algae. It is distributed throughout the country but particularly reported from the Bangali River of Bogra, Halda River of Chittagong, Tanguar and Hakaluki Haor, Brahmaputra-Jamuna, River Mahanada and Padma River.

[18] https://www.fishbase.se/photos/PicturesSummary.php?ID=13327&what=species

Figure 17.[19] Butter Catfish (Ompok bimaculatus) is known to occur in freshwaters, mangroves and estuaries.

87. *O. bimaculatus* is reported as fairly distributed species, but it is less common than other catfish species. The species has started to disappear from many water bodies and the population decline is also continuing due to habitat shrinkage caused by siltation and wetland conversions. Population abundance of the species has probably declined by more than 60% during the last two decades (IUCN, 2015). Considering the declining population trend, the Extent of Occurrence and Area of Occupancy exceed the threshold values of Threatened Categories. Therefore, this species has been assessed as Endangered (national) and Near Threatened (global).

88. EOO: 2,17,468 km^2. AOO: 11,128 km^2

89. **Mrigal (*Cirrhinus cirrhosus*).** A plankton feeder and browses on algae in marginal shallows. At the juvenile stage, Mrigal is omnivorous and turns into herbivorous at the adult stage. It breeds during the months of May to July in shallow sections of rivers. This species is widely distributed throughout Bangladesh, particularly in the river Padma, Jamuna, Brahmaputra, Titas, Sangu and from the Halda River. The species had been introduced outside the native range for stocking reservoirs for aquaculture.

90. *C. cirrhosus* is widely distributed but not common in its natural habitats. The distribution of Mrigal was observed in most survey sites, but their abundance was found low. Habitats of the species are being destroyed due to the human activities. This species is assessed as Near Threatened (national) considering significant population decline due to habitat loss and Vulnerable at the global IUCN status.

91. EOO: 1,89,935 km². AOO: 9,012 km²

Figure 18.[20] *C. cirrhosus* inhabits fast flowing streams and rivers, but can tolerate high levels of salinity.

[19] https://www.fishbase.se/photos/PicturesSummary.php?StartRow=5&ID=6535&what=species&TotRec=14

92. **Freshwater Shark (*Wallago attu*)**. Widely distributed in the aquatic habitat systems throughout Bangladesh. This fish species inhabits rivers, large and small, beels, reservoir, baors and enters the floodplains and roadside ditches. This is voracious and carnivorous fish, and well known predatory aquatic species. It hunts on large fishes, frogs and other aquatic animals owing to its large mouth size.

93. *W.* attu was enlisted in the IUCN Redlist for Bangladesh as an Endangered species (IUCN 2000) due to its highly declining population, caused by threats like siltation, overexploitation, aquatic pollution, etc. Since the species is distributed throughout country and some individuals escaped specimens from fish culture ponds, the population are getting increasing to the declining natural population. Considering this factor, the species has been assessed as Vulnerable (national and global).

94. EOO: 1,21,601 km². AOO: 13,519 km²

Figure 19.[21] *W. attu* prefers muddy tanks subject to periodical flooding from a nullah or river.

95. **Tiretrack Eel (*Mastacembelus armatus*).** The species of eel is carnivorous in habit. At the juvenile stage, this fish feeds on crustaceans and insect larvae. While the adults feed on barbs, minnows, other small fishes, shrimps and prawns and tadpoles. *M. armatus* prefers the bottom substrate of rivers, ponds and inundated fields. It is distributed in rivers, canals, beels, ponds and inundated fields in the freshwater regimes throughout Bangladesh. It also can tolerate brackish water.

96. The current low population of *M. armatus* and its declining trends can be the result of the decrease of its natural habitats due to different human activities. Based on local information collected through field visits and personal cconsultation with local people, it is assumed that this fish species has reduced more than 50% by the last two decades. Therefore, *M. armatus* is assessed as Endangered (national) and Least Concerned (global).

97. EOO: 2,17,468 km^2. AOO: 1,1857 km^2

[20] https://www.fishbase.se/photos/UploadedBy.php?autoctr=14376&win=uploaded

[21] https://www.iucnredlist.org/species/166468/174784999

Figure 20.[22] *M. armatus* is a large elongated fish that has a snakelike body and no pelvic fins.

98. **Giant Snakehead (*Channa marulius*)**. Carnivorous and predatory fish. It is a surface dweller and also prefers deep clear water with muddy, sandy and rocky bottom. During the dry season, it has the ability to go dig into the mud to avoid desiccation and death. It breeds with the onset of monsoon. This species is found in Padma distributaries, Borulia haor, Mahananda, Choto Jamuna, Ichanoi Beel, Dogger Beel (Chandpur), Titas, larger haors in Greater Sylhet and Mymensingh Districts, beels and larger water bodies in Dhaka, Manikganj and Tangail Districts.

99. *C. marulius* is a wide spread fish species in the country. There is no reported population decline, but it is inferred that the fish's population has been reduced over 50% in the last 10 - 15 years due to over exploitation and habitat destruction. This species is assessed as Endangered (national) and Least Concerend (global).

100. EOO: 70,254 km^2. AOO: 1,352 km^2

Figure 21.[23] *C. marulius* is a large species of snakehead native to South Asia.

101. **Humped Featherback (*Chitala chitala*).** Carnivorous and predatory on aquatic insects, molluscs, shrimps and small fishes. At the juvenile stage, its diet are insects and tender roots of aquatic plants. It uses nest for breeding and protection. The species has the characteristics to congregate in large numbers within the habitat. Its is a widely distributed species in rivers, beels, haors, reservoirs, canals and ponds. The species is specifically reported from the river Brahmaputra, Jamuna, Padma, Meghna, Someshwari and Kongsho River of Netrokona, Korotoa and Atrai River of Dinajpur, the Surma River of Sylhet, the Kirtonkhola and Shugandha River of Barishal Division.

102. Based on studies, this species is suspected to have decline on its population over the last 20 -25 years. This species was assessed as Endangered in the country. However, there are still widespread existing threats and there are continuing population decline. Therefore, threatened category Endangered is retained for the species at the national level and Near Threatened (global).

103. EOO: 1,31,403 km^2. AOO: 7,302 km²

[22] https://www.fishbase.se/photos/UploadedBy.php?autoctr=1578&win=uploaded

[23] https://www.fishbase.se/photos/UploadedBy.php?autoctr=14372&win=uploaded

Figure 22.[24] *C. chitala* is a knifefish are found in the Brahmaputra, Indus, Ganges and Mahanadi River basins.

104. **Long-whiskered Catfish (*Sperata aor*).** A freshwater species inhabits rivers and their tributaries, channels, reservoirs, large beels and occasionally found in ponds and ditches. This is a predatory fish that preys on fishes, shrimps and other bottom dwelling organisms. It has the ability to digs out pit in the bottom of slow moving or stagnant portion of the river or in a beel, baor and haor where it can lay eggs and maintains the territory. *S. aor* is widely distributed within Bangladesh rivers such as Padma, Jamuna and Meghna.

105. Its Extent of Occurrence and Area of Occupancy are much higher than the lower thresholds for any threatened category. Despite this, the species has continued population decline and was previously assessed as Vulnerable (IUCN Red List 2000). The threats on this species are not removed and declining trend in population still continues. Due to habitat loss and fishing pressure and other threats, the species is assessed as Vulnerable (national) and Least Concerned (global).

106. EOO: 1,46,159 km^2. AOO: 16,677 km^2.

Figure 23.[25] *S. aor* is a demersal and potamodromous species which inhabits rivers, ponds, lakes, channels and reservoirs.

[24] https://www.fishbase.se/photos/UploadedBy.php?autoctr=21402&win=uploaded

[25] https://www.fishbase.se/photos/PicturesSummary.php?ID=5496&what=species

107. **Giant River Catfish (*Sperata seenghala*).** This catfish species is mainly bottom-feeder. It is also a predatory, which feeds on benthos species, fish larvae and algae. The fish is known to occur in Padma River and Meghna River. *S. seenghala* occurs throughout Bangladesh and is found in a wide range of water bodies. Although, the species was assessed as Endangered in the past (IUCN Bangladesh 2000), however, recent field and market surveys clearly indicate that the species is fairly abundant. Although, its population decline continues due to habitat loss and fishing pressure, and about 50% decline in population might have occurred during the last 25 years. Considering the habitat loss and population decline the species is assessed as Vulnerable (national) and Least Concerned (global).

108. EOO: 1,35,628 km^2. AOO: 10,399 km^2

Figure 24.[26] Giant River Catfish (*Sperata seenghala*) is commercially fished as well as popular a gamefish.

109. **Two-spot Barb (*Pethia ticto*)**. Two-spot Barb can live in both fresh and brackish waters. It is an omnivorous fish, which feeds on mosquito larvae, detritus, vegetation and associated aquatic insects, including chironomid larvae. *P. ticto* is widely distributed in inland waters of Bangladesh. The species was previously abundant in the rivers, creeks, canals, reservoirs, lakes, beels, haors, baors and ponds of Bangladesh. Based on surveys, the fish population shows decline over the last 15 years due to over exploitation and habitat destruction (Latifa et al. In Press, M. S. Ahmed, pers. comm.). Therefore, the species is assessed as Vulnerable (national) and Least Concerned (global).

110. EOO: 2,17,468 km^2. AOO: 11,128 km^2.

Figure 25.[27] Two-spot Barb (Pethia ticto) is found in still and shallow rivers with muddy bottoms.

[26] https://www.fishbase.se/photos/UploadedBy.php?autoctr=1573&win=uploaded

[27] https://www.fishbase.se/photos/UploadedBy.php?autoctr=15085&win=uploaded

111. **Silver Hatchlet Barb (*Chela cachius*)**. Common and widespread species in all freshwater habitats such as haor, baor, beels, floodplain, canals, ditches, ponds, rivers and streams of the country. This species is found in Brahmaputra-Jamuna River, Matshaya Rani Fish Sanctuary - Brahmaputra River, Padma River and ponds, ditches, canals and tanks throughout the country. The species population has declined over 30% in last 15 years due to pollution from industrial effluents, pesticides and agrochemicals, and habitat destruction. Siltation, drying up of habitats, destruction of breeding grounds and fishing by dewatering are the major threats to the species. Hence, the species is assessed as Vulnerable (national) and Least Concerned (global).

112. EOO: 78,908 km^2. AOO: 1,334 km^2

Figure 26.[28] *C. cachius* inhabit all types of freshwater habitats, but prefers streams, ponds and tanks with minimal current.

Table 4. Priority fish species in the CHA.

Local name	English name	Scientific name	IUCN Local status	IUCN Global status
Kani Pabda	*Pabda Catfish*	*Ompok pabda*	*EN*	*NT*
Modhu Pabda	*Butter Catfish*	*Ompok bimaculatus*	*EN*	*NT*
Mrigal	*Mrigal*	*Cirrhinus cirrhosus*	*NT*	*VU*
Boal	*Freshwater Shark*	*Wallago attu*	*VU*	*NT*
Baro Baim	*Tiretrack Eel*	*Mastacembalus armatus*	*EN*	*NE*
Gojar	*Giant Snakehead*	*Channa marulius*	*EN*	*LC*
Chital	*Humped Featherback*	*Chitala chitala*	*VU*	*LC*
Ayre	*Long-whiskered Catfish*	*Sperata aor*	*VU*	*LC*

[28] https://www.fishbase.se/photos/PicturesSummary.php?ID=13220&what=species

Local name	English name	Scientific name	IUCN Local status	IUCN Global status
Guzza Ayre	*Giant River Catfish*	*Sperata seenghala*	*VU*	*LC*
Tit Puti	*Twospot Barb*	*Pethia ticto*	*VU*	*LC*
Chep Chala	*Silver Hatchlet Barb*	*Chela cachius*	*VU*	*LC*

IV. Assessment

113. CHA is a process to identify areas with high biodiversity value, which are considered particularly sensitive to impacts and where special attention must be given. The CHA process commences with initial biodiversity screening to identify potential CH trigger habitats or species present within the AoA. If such triggers are present the following process should then be followed (as per IFC guidance):

1. Define the AoA area of analysis to be used for the assessment. The extent of this area will depend on the biodiversity features of interest and the ecological functions required to maintain them.

2. Determine trigger species and habitats for which the analysis is to be undertaken.

3. Undertake desktop review of available data to understand the biodiversity within the landscape.

4. Confirm biodiversity triggers likely to meet critical habitat criteria to each biodiversity feature (see detailed information on trigger thresholds below).

5. Determine critical habitat based on assessment of all collected data.

114. Critical habitat is a subset of both natural and modified habitat that deserves particular attention due to high biodiversity value, which includes at least one or more criterion. The critical habitat definition of ADB SPS 2009 uses the different criteria defined in the IFC's Guidance Note 6 Biodiversity Conservation and Sustainable Management of Living Natural Resources (updated on 2019). There is no one criterion more important than any other for critical habitat designations or for determining compliance with SPS 2009. These values are referred to as "critical habitat criteria", where each is described in the subsequent paragraphs and assessment of each species considered in the assessment.

115. **Criterion 1.** Areas with high biodiversity value, including habitat required for the survival of critically endangered (CN) or endangered (EN) species. Those wildlife listed as nationally or regionally CR or EN in IUCN guidance are covered under Criterion 1. Thresholds for Criterion 1 are the following:

(a) ≥ 0.5% of the global population AND ≥5 reproductive unitsGN16 of a CR or EN species.

116. There are 16 of terrestrial and aquatic species considered for assessment under this criterion. These priority wildlife species in the AoA have status of either EN or CR on national and global levels. The assessment used the IUCN Red List classification for the priority species. Information of the population are taken from different sources (i.e. Red List of Bangladesh 2015, IUCN) , and no actual survey is done to collect information of the species' population. Table 5 shows the summary of the

findings and set of brief profiles for critical habitat qualifying wildlife species, focusing on rationale of how likely to occur in the proposed project area.

Table 5. EN and CR species covered in the CHA.

Biodiversity type	Species	Present in AOA	Remark
Bird	*Sterna acuticauda*	Possibly	Information from the e-bird website[29] has indicated sightings of this species in the AoA. However, no actual survey/data to show presence.
Bird	*Mycteria leucocephala*	Possibly	Information from the e-bird website[30] has indicated sightings of this species in the AoA. However, no actual survey/data to show presence.
Mammal	*Prionailurus viverrinus*	Possibly	Volume 2 of Red List of Bangladesh (2015) has information of the species' geographic location in the country, "It is widely distributed throughout the country both in the countryside or homestead woodlands and in all kinds of natural forests and wetlands."
Mammal	*Platanista gangetica*	Yes	Survey done in 2015-2016 recorded 206 River Dophins in the Jamuna-Brahmaputra system (Aziz, 2019)
Reptile	*Hardella thurjii*	Likely	Volume 4 of Red List of Bangladesh (2015) has information of the species' geographic location in the country. This speices is found in Brahmaputra, Jamuna, Padma and lother major rivers.
Reptile	*Nilssonia gangetica*	Likely	Volume 4 of Red List of Bangladesh (2015) has information of the species' geographic location in the country. It lives in the major river systems such as Ganga- Padma and Jamuna-Brahmaputra.
Reptile	*Gavialis gangeticus*	Likely	The taxon is found in the Padma, Jamuna and Tista River of northern part of Bangladesh (Khan 1992, 2015)
Reptile	*Chitra indica*	Likely	Volume 4 of Red List of Bangladesh (IUCN, 2015) has information of the species' geographic location in the country. Known to live in larger rivers such as Brahmaputra, Jamuna, Padma, and others.
Reptile	*Batagur kachuga*	Likely	Found in the Ganges (Padma) River

[29] Open link to see sightings of species: https://ebird.org/species/blbter1/BD

[30] Open link to see sightings of species: https://ebird.org/species/paisto1/BD

			System (Khan 1982a, b)
Reptile	*Geoclemys hamiltonii*	Likely	It is mostly seen in freshwater wetlands, in the Ganges and Brahmaputra river systems and their adjacent water bodies,
Reptile	*Batagur dhongoka*	Likely	the species is restricted to the Ganges (Padma) and Jamuna River Systems, also found in the suburbs of Dhaka (Khan 1982a, b).
Fish	*Ompok pabda*	Likely	The species is widely distributed throughout Bangladesh and reported from Padma and Jamuna and other wetlands
Fish	*Ompok bimaculatus*	Likely	It is distributed throughout the country (Parween 2007) but particularly reported from Brahmaputra-Jamuna (Rahman and Akhter 2007) and Padma River (Mohsin et. al. 2013).
Fish	*Mastacembelus armatus*	Possibly	No information sources that will indicate findings of this species in the Jamuna and Padma Rivers.
Fish	*Channa marulius*	Likely	Volume 5 of Red List of Bangladesh (IUCN, 2015) states this species is found in Padma River and other wetlands.
Fish	*Chitala chitala*	Likely	Volume 5 of Red List of Bangladesh (IUCN, 2015) states that this species is specifically reported from the river Brahmaputra, Jamuna, Padma and other rivers.

117. Based on the information above, only the Ganges River Dolphin (*Platanista gangetica*) has indicated the presence of its population in the AoA. Information from the study of Aziz (2019)[31] along the Jamuna-Bhrahmaputra river system states that a total of 206 sightings, comprising 87 in Nagarbari, 96 in Mohongonj and 23 in Boral locations (IUCN Bangladesh, 2018b)[32]. Accortding to the study on "The Conservation Action Plan for the Ganges River Dolphin 2010-2020", the global population estimates are about 3500 individuals throughout its distribution range (Sinha et al. 2014)[33]. Taking into consideration of the figures from the studies, the AoA has 5.9% of the global population of *P. gangetica* and expected to have more than 5 pairs capable to breed. All reptiles and fish species appear to be present in the AoA, however, not enough data is given by the sources of information.

(b) the loss of which (VU) would result in the change of the IUCN Red List status to EN or CR and meet the thresholds in (a).

[31] Aziz, M.A (2019) Final Report atlas on Ganges River Dolphin and Irrawaddy Dolphin of Bangladesh. Expanding the Protected Area System to Incorporate Important Aquatic Ecosystems Project. Bangladesh Forest Department, Ministry of Environment, Forests and Climate Change.

[32] IUCN Bangladesh, 2018b. Wetland Biodiversity Rehabilitation Project. Dhaka.

[33] Sinha, K., Behera, S., Choudhary, B.C., 2010. The Conservation Action Plan for the Ganges River Dolphin 2010-2020.

118. There are 8 species considered for assessment under Criterion 1 (b). All wildlife species have status of VU at national and global levels. IUCN Red List classification is used for this criterion. Information of the population are taken from different sources (i.e. Red List of Bangladesh 2015, IUCN) , and no actual survey is done to collect information of the species' population. Table 6 shows the summary of the findings and set of brief profiles for critical habitat qualifying wildlife species, focusing on rationale of how likely to occur in the proposed project area.

Table 6. Vulnerable species covered in CHA.

Biodiversity type	Species	Present in the AoA	Remarks
Bird	*Ciconia nigra*	Possibly	Information from the e-bird website[34] has indicated sightings of this species in the AoA. However, no actual survey/data to show presence.
Mammal	*Vulpes bengalensis*	Possibly	Uncommon resident of Bangladesh, which is currently distributed in the western part of the country (west side of the river Jamuna except the Sundarbans).
Fish	*Cirrhinus cirrhosus*	Likely	This species has been reported from the vast and different regions of the country, in particular from the river Padma, Jamuna and Brahmaputra
Fish	*Wallago attu*	Likely	Widely distributed in all aquatic habitat systems throughout the country (Rahman 2005, Ahmed 2008, Hossain et al. 2009, Bashar et al. 2009, Akhtaruzzaman and Alam 2012).
Fish	*Sperata aor*	Likely	Widely distributed within Bangladesh (Rahman 2005)
Fish	*Sperata seenghala*	Likely	It is known to Padma River
Fish	*Pethia ticto*	Likely	It occurs in rivers, canals, beels, ponds and similar waters in Bangladesh (Rahman 1989, Mian et al. 2013).
Fish	*Chela cachius*	Likely	Found in Brahmaputra- Jamuna River (Rahman and Akhter 2007).

119. Information from data sources do not indicate the actual or estimates of VU species (i.e. fish, mammal and bird) in the AoA. The information given is the geographic distribution of these wildlife such as along the river systems of Jamuna and Padma. Possible and likely presence of the VU species suggest there could be presence of such wildlife, and should be given attention on mitigating impacts due to the proposed project implementation.

[34] https://ebird.org/species/blasto1/BD

(c) As appropriate, areas containing important concentrations of a nationally or regionally listed EN or CR species.

120. There is no species identified as under Criterion 1 (c).

121. **Criterion 2**. This includes restricted-range species or endemic plants and animals, which have limited extent of occurrence (EOO). As an example, terrestrial vertebrates and plants having EOO of less than 50,000 square kilometers (km^2) are involved in this criterion. Species habitat along the coast, riverine, and aquatic habitats that do not exceed 200 km width at any point and global range of $\leq$500 km linear geographic span[35] is define as restricted range as well. The threshold for Criterion 2 is the following:

(a) Areas that regularly hold ≥10% of the global population size AND ≥10 reproductive units of a species.

122. There is no species identified as under Criterion 2 (a).

123. **Criteria 3.** Habitats or sites that are critical for the survival of migratory[36] and congregatory species[37]. Thresholds for Criterion 3 are the following:

(a) ≥ 1% of the global population of a migratory or congregatory species at any point of the species' lifecycle.

(b) Areas that predictably support ≥10% of the global population of a species during periods of environmental stress.

124. The table below shows the species that are migratory. All of these priority species that migrate are fish species. No enough information or data to illustrate the population of these species in the AoA. Information given is only the geographic distribution of these species along the river systems of Jamuna and Padma. Likely occurrence of migratory species suggest there could be presence of such wildlife, and should be given attention on mitigating impacts due to the proposed project implementation.

Table 7. Migratory species covered in the CHA.

Biodiversity type	Species	Present in AoA	Remarks
Fish	*Cirrhinus cirrhosus*	Likely	This species has been reported from the vast and different regions of the country, in particular from the river Padma, Jamuna and Brahmaputra
Fish	*Wallago attu*	Likely	Widely distributed in all aquatic habitat systems throughout the country (Rahman 2005, Ahmed 2008, Hossain et al. 2009, Bashar et al. 2009, Akhtaruzzaman and Alam 2012).

[35] Linear geographic span is the distance between occupied locations furthest apart.

[36] Migratory species is defined as any wildlife of which a significant proportion of its members cyclically and predictably move from one geographical area to another (including within the same ecosystem).

[37] Congregatory species are defined as species whose individuals gather in large groups on a cyclical or otherwise regular and/or predictable basis.

Fish	*Sperata aor*	Likely	Widely distributed within Bangladesh (Rahman 2005)
Fish	*Sperata seenghala*	Likely	It is known to Padma River
Fish	*Ompok pabda*	Likely	The species is widely distributed throughout Bangladesh and reported from Padma and Jamuna and other wetlands
Fish	*Ompok bimaculatus*	Likely	It is distributed throughout the country (Parween 2007) but particularly reported from Brahmaputra-Jamuna (Rahman and Akhter 2007) and Padma River (Mohsin et. al. 2013).
Fish	*Chitala chitala*	Likely	Volume 5 of Red List of Bangladesh (IUCN, 2015) states that this species is specifically reported from the river Brahmaputra, Jamuna, Padma and other rivers.

125. **Criterion 4**. Areas with unique assemblages of species or that are associated with key evolutionary processes or provide key ecosystem services. According to IFC Guidance Note 6, the structural attributes of a region, such as its topography, geology, soil, temperature, and vegetation, and combinations of these variables, can influence the evolutionary processes that give rise to regional configurations of species and ecological properties. These are areas with distinct landscape features associated with particular evolutionary processes or populations of species, which are especially distinct and have special conservation concern due to the species' distinct evolutionary history.

126. There is no unique assemblages of species associated with key evolutionary processes or provide key ecosystem services in the proposed project areas thus do not qualify as critical habitat under this criterion.

127. **Criterion 5.** Areas having biodiversity of significant social, economic, or cultural importance to local communities.

128. The proposed project area is a major fish producing region of the country with diversified freshwater fisheries resource bases, which are Jamuna and Padma rivers, their tributaries and distributaries, seasonal and perennial khals or canals, beels or floodplain depressions and flood lands. Fish production sources are basically divided into two categories: capture (or open water fishery) and aquaculture (or closed water fishery). Fishery production in the proposed project areas are classified into (i) river capture fishery; (ii) floodplain capture fishery; and (iii) floodplain aquaculture. Capture fishery is a major source of fish for the local people and market, and aquaculture is less developed due to the flood threats and lack of improved technology. The capture fishery is a major fish production (84%) and culture fishery has lesser contribution (16%).

129. The proposed project area have biodiversity significant economic importance to local communities. Hence, the proposed project is critical habitat under this criterion.

130. **Criterion 6:** Critical habitats include those areas either legally protected or officially proposed for protection, such as areas that meet the criteria of the Word Conservation Union classification, the Ramsar List of Wetlands of International Importance, and the United Nations Educational, Scientific, and Cultural Organization's world natural heritage sites.

131. There is no legally protected or officially proposed for protection under the classifications any of the international organizations mentioned above. Thus, the proposed project is not critical habitat based on this criterion.

132. However according to Integrated Biodiversity Assessment Tool (IBAT) simulation, there are protected areas along the Jamuna-Padma river systems that important to note. These are (i) Nagarbari-Mohonganj (408 ha.), (ii) Silanda-Nagdemra (24 ha) and (iii) Nazirganj (146 ha.) that are declared wildlife sanctuary by the government of Bangladesh. Located at the Jamuna-Brahmaputra river system, the Nagarbari-Mohonganj and Silanda-Nagdemra support a number of Ganges River Dolphins in these area. The Nazirganj is located on bank of Padma River and falls under Sujanagar Upazila, District of Pabna, which is a Ganges River Dolphin hotspot. The proposed project will not overlap with any of the locations of these wildlife sanctuaries.

V. Impacts and Mitigation Measures

133. **Impacts on Fisheries.** Removal of a braided of a river system (or Channelization) in some parts of the proposed project areas may result in (i) loss of fisheries habitat; (ii) an altered ecosystem (good for deep water fish but unfavourable for shallow water species); (iii) increased river flow that is unfavourable for fish that prefer lower flow velocities; and (iv) dredging which will affect the fisheries ecosystem. Construction or rehabilitation of embankments along riverbanks to contain river flooding may result in the loss of river floodplain connectivity affecting floodplain flooding and obstructing fish migration making the floodplain less productive. There will be fisheries habitat loss due to the channelization of the rivers and reduced flooding due to the embankment development even with the provision of sluice gates. The habitat loss will result in the reduction of fish catch.

134. Flood control has an adverse impact on fish diversity. Fish species that migrate to the floodplain either for breeding or early development will be affected by the loss or reduction of river-floodplain connectivity. Reduced hydrological connectivity across embankment limits the lateral fish movements in: (i) reducing the number of fish entry points on to the floodplain and thereby concentrating fish into fewer channels where susceptible to capture and (ii) closing gates of regulators for extended periods during pre-monsoon and monsoon. Gate closure blocks the entry of fingerlings by passive drift and prevents them reaching nursery areas on floodplains.

135. **Mitigation and Compensation.** In addressing adverse impacts of flood control works on wildlife species and habitats, structural and non-structural mitigation/ compensation measures are recommended below.

(i) ***Structural Measures*** include the following:

(a) Development of major distributaries such as the Dhaleswari, Arial Khan and Old Brahmaputra to sustain natural flow to feed adjacent floodplain ecosystems. Measures will need to be taken to increase the flow in the Dhaleswari system to flush the dead ecosystem of Buriganga.

(b) Spill way canals to provide additional supply floodplains to support the fisheries ecosystems.

(c) Provision of fish passes along sluice gates that favour fish migration.

(d) Establishment of Biodiversity Sanctuaries in the floodplain – see Appendix C (bird sanctuaries, 185 km^2)[38] and Appendix D (fish sanctuaries)[39].

[38] Jamuna River: Sirajganj (63 km²), Belkuchi (3.48 km²), Andharmanik (8.32 km²), Maddhapara (27.8 km²), and Aricha Ghat (11.2 km²). Padma River: Moinot Ghat (14.3 km²), Mawa Ghat (12.3 km²) and Naria (44.7 km²).

[39] River sanctuary (100 km) and floodplain sanctuary (12 nos.)

(ii) ***Non-structural Measures*** that may be applied include:

(e) Fish friendly operation of regulators.

(f) Community based management of fisheries related activities.

(g) Management of fisheries particularly for rational fishing.

(h) Providing training for (a) awareness building and (b) adoption of improved technology.

(i) Extension support for fisheries management and improved aquaculture.

(j) Other measures that may be considered within full flood control and controlled flooding areas, some with a more regional focus, are the following.

136. **Impacts on habitats and wildlife.** As a result of the river stabilization works, the active river corridor will be narrower and thereby a substantial part of the charlands will disappear. These low-lying lands are highly dynamic but parts of these provide resting and feeding grounds for wildlife, particularly migratory birds for part of the year when water levels are receding, thereby exposing potentially rich feeding areas. Also, the areal extent and diversity of areas with varying water depth (shallow, medium, deep) will be reduced, and thereby this will limit the availability of suitable or preferred habitat for fish, dolphins and other aquatic life.

137. Terrestrial habitats will be affected as well. The main impact here is loss of floodplain habitat in some locations proposed project areas, including patches of natural vegetation (reeds, shrub, bush, trees) associated with water fringes, depressions and low-lying areas that may not be flooded or provided with less or no water at all because of the proposed works, and loss of vertical riverbanks that provide breeding habitat for a range of bird species.

Mitigation. As compensation for habitat lost it is advised to establish nature sanctuaries. For birds, areas of their sanctuaries were identified based on the population, nests and breeding pairs, and on the use of the location for roosting and feeding by maximum number of species. These locations have been proposed as bird sanctuaries in Appendix C of the EIA report. For Ganges River Dolphin (*Platanista gangetica*) and other migratory fish species, it is important to protect critical habitat in both riverine and floodplain areas. At the same time, it is important to improve connectivity, and project excavation of canals connecting the floodplain will enhance flooding. Excavation of beels to ensure that parts are at least 2m deep in the dry season, will promote dry season survival. Six beels recommended to be established as fish sanctuaries are prioritized for deepening; these are: Chandahar, Char Ghior Mallar, Gomorki, Kadaibadla, Patal and Shonsi beels. Critical riverine habitat will be protected by installation of sturdy navigation buoys in the river, 1 km apart, 300 m away from the bank along the whole bank line indicating the navigation route. Such demarcated areas are expected to be relatively free from river transport and (drift net) fishing, and serve as a riverine fish sanctuary. It is expected that these measures combined will improve options for survival of endangered and migratory species. Please see Appendix D of the EIA report for details of the fish sanctuaries.

138. **Impacts on ecosystem services.** The cycle of regular flooding of the floodplains provides a number of ecosystem services such as replenishment of nutrients, restocking of wetlands with fish and other aquatic species, flushing of pollutants and groundwater recharging. Receding floodwaters also contribute to the maintaining of water levels in the rivers, and hence add to an overall buffering of water resources. Reducing levels and extent of flooding has highly positive impacts to nearby communities, but this comes at the cost of reducing ecosystem services.

139. **Mitigation.** Some of the impacts can be mitigate by adding regulations and fish-passes, increasing connectivity of distributary rivers with the floodplain, and excavating (some of) the beels. However, a number of ecosystem services will need to be replaced (e.g. more fertilisers used by farmers to replace nutrients deposited as silt), or at a minimum need to be monitored to assess actual impacts as these are difficult to predict (e.g. impact on groundwater recharging).

140. **No Net Loss**. As a result of the river stabilization works, the active river corridor will become narrower and thereby a part of the char lands will disappear. These low-lying lands are, like the entire river system itself, highly dynamic but parts of these provide resting and feeding grounds for wildlife, particularly migratory birds for part of the year, especially in winter (October-March), when water levels are receding, thereby exposing potentially rich feeding areas. Overall, it is expected that biodiversity in the impact area will reduce. However, birds and other wildlife are highly mobile and will

select those areas for feeding and resting where these is little disturbance and sufficient food. To offset this loss, critical habitat for threatened and migratory bird species identified by the Bangladesh Bird Club in 2017 are proposed to be protected as bird sanctuaries. The combined area of the proposed bird sanctuaries is 18,510 ha.

141. Spillway canals, fish-passes and excavation of channels and *beels* will improve fish habitat and connectivity, while fish sanctuaries will provide for improved fish (species) survival. The combined area of the proposed floodplain fish sanctuaries is variable, as this depends on seasonal changes in water levels. In the wet season the combined area is 1,062 ha, while in the dry months this dwindles to around 160 ha. In combination with improved connectivity (due to canal excavation) and extra excavation of floodplain water bodies such as *beels*, it is expected that this habitat will increase and improve in status due to the project. The riverine sanctuary is to be established (piloted) along a 10-km (left bank) length of river and given that the buoys are to be placed 300m from the bank, the combined area of the riverine sanctuary will be 300 ha.

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APPENDIX B - DOLPHIN THREATS

THREATS

1. 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.

2. This species is 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.

USE OF DOLPHIN PRODUCTS

3. Dolphin oil is used by people 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 Kushyiara River 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

FISHERIES BYCATCH

4. 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 8-10-cm mesh size and are used to catch large broodstock in river duars.

DIRECTED CATCH

5. 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.

OVEREXPLOITATION OF FISHERIES

6. 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.

POLLUTION

7. 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.

8. 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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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.

APPENDIX C - POTENTIAL BIRD SANCTUARIES

The Bangladesh Bird Club (BBC) provided a draft report on Proposed Bird Sanctuaries along Jamuna and Padma Rivers by Sayam Chowdhury in October 2017. The following sections have been taken from this report.

Sanctuaries were identified based on the results of the surveys conducted during the dry seasons of last six years and by compiling secondary information. The following criteria were used to identify sanctuaries: 1) number and species of breeding pairs and nests of River Tern, River Lapwing, Little Tern, Small Pratincole, Indian Spot-billed Duck, Bristled Grassbird, Stonechats and Prinias; 2) used for roosting and feeding by maximum number of species of migratory species such as ducks, terns, shorebirds, raptors and passerines; and 3) relatively undisturbed and away from human settlements.

Proposed site along Jamuna and Padma Rivers norht of Jamuna Bridge

1. Site: Sirajganj – Jamuna River

Area: 15,580 Acres (63 Km²)

Habitat Type: Mainly sand dunes but also mudflat, small patches of grasslands and river channels.

GPS Coordinates:

North-west: 24°36'47.34"N, 89°39'28.93"E
North-east: 24°34'17.52"N, 89°43'49.80"E,
South-east: 24°30'28.68"N, 89°43'10.78"E
South-west: 24°33'4.83"N, 89°40'20.88"E

Figure 1: Map of the proposed sanctuary at Sirajganj, Jamuna River.

Description: A total of 86 species of birds were recorded at this site, comprising 44 residents and 42 migratory species of which 8 are globally and 7 are nationally threatened. Of the 8 globally threatened species, one is listed as Endangered (Steppe Eagle Aquila nipalensis), three as Vulnerable and four as Near Threatened. Nationally threatened species include Critically Endangered Woolly-necked Stork Ciconiaepiscopus, One Endangered, two Vulnerable and hree Near Threatened species. Ground nesting birds such as Terns, Pratincoles, Lapwings and Ringed Plovers use the sand dunes of this area to breed during the dry season. Stonechats, Prinias, Munias, and Grassbirds use grassland areas for foraging, roosting and breeding. Mudflat portions are also considered as major habitats for resident and migratory waterbirds.

Proposed sites along Jamuna and Padma Rivers south of Jamuna Bridge

2. Site: Belkuchi – Jamuna River

Area: 859 Acres (3.48 Km²)

Habitat Type: Mainly Sand dunes with short grasses and mudflats.

GPS Coordinates:

North-west: 24°18'50.91"N, 89°46'16.50"E
North-east: 24°17'53.21"N, 89°46'25.51"E
South-east: 24°16'48.18"N, 89°45'39.81"E
South-west: 24°17'46.13"N, 89°45'46.63"E

Figure 2: Map of the proposed sanctuary at Belkuchi, Jamuna River.

Description: A total of 32 species occur at Belkuchi site, comprising 20 resident and 12 migratory bird species. The site is a foraging area for Indian Spotted Eagle Aquila hastatais, which is considered as nationally Endangered (EN) and globally Vulnerable (VU). As the habitat of this mostly sand dunes, it is important for ground nesting birds such Terns (River Tern), Pratincoles, Lapwings. Mudflat portion of this area offers important habitat for waterbirds.

3. Site: Andharmanik – Jamuna River

Area: 2,055 Acres (8.32 Km²)

Habitat Type: Andharmanik supports different habitat types, which is dominated by grassland habitats, sand dunes, wide river channel and small area of mudflats.

GPS Coordinates:

North-west: 24°15'2.44"N, 89°43'55.73"E
North-east: 24°14'10.56"N, 89°44'44.88"E
South-east: 24°13'15.18"N, 89°43'7.45"E
South-west: 24°14'19.83"N, 89°43'12.52"E

Figure 3: Map of the proposed sanctuary at Andharmanik, Jamuna River.

Description: Among 66 species of Andharmanik site, 37 are resident and 29 are migratory including 4 globally and nationally threatened species. These include the Steppe Eagle Aquila nipalensis (EN) three other globally vulnerable species such Greater and Indian Spotted Eagle and Woolly-necked Stork. Sand dunes of this area used by ground nesting birds like River Tern, Pratincoles, Larks and Lapwings. The grassland offers important breeding, feeding and roosting habitat to Stonechats, Prinias, Munias, Grassbirds including globally threatened (VU) Bristled Grassbird.

4. Site: Maddhapara – Jamuna River

Area: 6,860 Acres (27.8 Km²)

Habitat Type: Dominated by sand dunes and followed by mudflats and grasslands with narrow channels.

GPS Coordinates:
North-west: 24°10'40.63"N, 89°45'57.94"E,
North-east: 24° 8'43.66"N, 89°47'59.42"E,
South-east: 24° 6'22.91"N, 89°43'54.42"E,
South-west: 24° 8'36.24"N, 89°45'13.69"E

Figure 4: Map of the proposed sanctuary at Moddhapara, Jamuna River.

Description: Amongst the 50 species that occur at Moddhapara site, 23 are resident and 27 are migratory species. This site supports 4 globally and 2 nationally threatened species including the globally Endangered Steppe Eagle, Vulnerable Indian Spotted Eagle and Bristled Grassbird. At this site, sand dunes are used by ground nesting birds like Terns, Pratincoles, Lapwings and Larks. On the other hand, Stonechats, Prinias, Munias and Grassbirds (including globally Vulnerable Bristled Grassbird) use this area for foraging, nesting and roosting. The wet sands, mudflats and narrow channels are also important for resident and migratory waterbirds.

5. Site: Ghior Khal Mouth – Jamuna River

Area: 2,584 Acres (10.5 Km²)

Habitat Type: The site comprises sand dunes, mudflats and grasslands. A narrow and shallow river channel also runs through the site.

GPS Coordinates:
North-west: 24° 1'29.63"N, 89°44'50.33"E,
North-east: 24° 0'52.68"N, 89°46'39.17"E,
South-east: 23°58'44.62"N, 89°45'18.04"E,
South-west: 24° 0'17.36"N, 89°45'8.40"E

Figure 5: Map of the proposed sanctuary at Ghior Khal, Jamuna River.

Description: At Ghior Khal site supports a total of 62 species of which 36 are resident and 26 migratory. 4 species globally threatened and 3 species nationally threatened. Out of 4 globally threatened species one Endangered (Steppe Eagle Aquila nipalensis), two Vulnerable and one Near Threatened species use this habitat type. Dry and sandy areas of this site are used by ground nesting birds like Terns, Pratincoles, Lapwings, Bee-eaters and Larks. The grassland in the northwest corner of this site is utilized by Stonechats, Prinias, Munias, Grassbirds including globally threatened (VU) Bristled Grassbird for nesting, forgarging and roosting.

6. Site: Aricha Ghat – Jamuna River

Area: 2,768 Acres (11.2 Km²)

Habitat Type: Mainly dry sand and sand dunes with shallow water channels and some mudflats.

GPS Coordinates:
North-west: 23°49'19.64"N, 89°45'7.65"E

North-east: 23°47'45.70"N, 89°45'44.34"E
South-east: 23°46'42.50"N, 89°44'1.90"E
South-west: 23°47'58.69"N, 89°43'47.34"E

Figure 6: Map of the proposed sanctuary at Aricha Ghat, Jamuna River.

Description: This site supports 33 species including 17 resident and 16 migratory. Although is this is largely disturbed as it is located very near to the ferry station, the area is still likely to support ground nesting birds like Terns including River Tern, Pratincoles, Lapwings, Bee-eaters and Larks.

7. Site: Moinot Ghat – Padma River

Area: 3,544 Acres (14.3 Km²)

Habitat Type: Grassland dominates this site with some sandy and wet areas.

GPS Coordinates:
North-west: 23°39'7.03"N, 90° 0'21.58"E,
North-east: 23°37'35.82"N, 90° 1'41.77"E,
South-east: 23°34'51.79"N, 90° 2'16.35"E,
South-west: 23°37'19.43"N, 90° 0'31.14"E

Figure 7: Map of the proposed sanctuary at Moinot Ghat, Padma River.

Description: Moinot Ghat site supports a total of 79 species including 49 resident and 30 migratory. Amongst the 79 species, 7 are considered as globally and 6 as nationally threatened. Out of 7 globally threatened species, the Endangered Steppe Eagle and

Vulnerable Indian and Greater Spotted Eagles use this site for foraging during winter. It is hotspot for globally vulnerable Bristled Grassbird as a number of breeding pairs were observed from this area in summer 2017. Two other globally Near Threatened species such as Painted Stork and Black-headed Ibis were also recorded from this area. This grassland is a major habitat for breeding resident birds such as Bush Chats, Prinias, Munias, Avadavats and Grassbirds. This area is also used by migratory quails, swallows, martins, pipits and wagtails.

8. Site: Mawa Ghat– Padma River

Area: 3,049 Acres (12.3 Km²)

Habitat Type: This site is mixed with grassland and sandy habitat; the grassland part is important for birds.

GPS Coordinates:
North-west: 23°27'30.18"N, 90°14'7.78"E
North-east: 23°26'57.96"N, 90°16'44.06"E
South-east: 23°26'1.68"N, 90°14'24.28"E
South-west: 23°26'59.60"N, 90°12'30.74"E

Figure 8: Map of the proposed sanctuary at Mawa Ghat, Padma River.

Description: A total 47 species were recorded from this site including 31 resident and 16 migratory species. The grassland part of this area is breeding habitat for Globally Threatened Bristled Gassbird and are used by other birds for breeding, foraging and roosting such as Bush Chats, Weavers, Prinias, Munias and Avadavats. This area is also used by migratory quails, swallows, martins, pipits and wagtails.

9. Site: Naria– Padma River

Area: 11,040 Acres (44.7 Km²)

Habitat Type: Naria site supports a wide variety of habitats including grasslands, sand due and shallow water channels.

GPS Coordinates:
North-west: 23°23'39.90"N, 90°23'0.76"E
North-east: 23°19'45.46"N, 90°31'48.41"E
South-east: 23°19'25.63"N, 90°29'53.45" E
South-west: 23°21'3.33"N, 90°24'11.56"E

Figure 9: Map of the proposed sanctuary at Naria, Padma River.

Description: A total of 74 species of birds are likely to occur here including 47 resident and 27 migratory of which 6 are considered as globally and 5 nationally threatened. Out of 6 globally threatened species, the Endangered Steppe Eagle and Vulnerable Indian and Greater Spotted Eagles use this site for foraging during winter. It is hotspot for globally vulnerable Bristled Grassbird as a number of breeding pairs were observed from this area in summer 2017. This grassland is a major habitat for breeding resident birds such as Bush Chats, Prinias, Munias, Avadavats and Grassbirds including the globally threatened (VU) Bristled Grassbird. This area is also used by migratory quails, swallows, martins, pipits and wagtails. The sandy area of this site is likely to support ground nesting birds like Terns including River Tern, Pratincoles, Lapwings, Bee-eaters and Larks.

Declaration and Management of Riverine Sanctuaries

These riverine sanctuaries could follow any of the following protected area status and follow guidelines as per government rules. The legal status of land designated as a protected area, invariably all the protected area in Bangladesh is declared under the Bangladesh Wildlife (Preservation) Order 1973 are 'reserved forest' declared under the Forest Act, 1927 and Wildlife (Conservation and Security) Act, 2012.

Declaration of sanctuary

(i) The Government may, by notification in the official Gazette, in the light of national forest policy and forest master plan, and considering natural, geomorphological features, biodiversity and environmental significance, declare any Government forests or part of such forests or any Government land or wetland or any specified area as sanctuary, specifying the demarcation, for the conservation of forest and habitat of wildlife.

(ii) The sanctuary declared under sub-section (1) may be called as wildlife sanctuary, bird sanctuary, elephant sanctuary or wetland dependent animal sanctuary or, as the case may be, marine protected area.

(iii) When a wetland is declared as sanctuary, measures shall be taken to protect the occupational, traditional or the right of livelihood of local community of the area such as – fishermen, boatmen, etc.

Prohibitions related to sanctuary

In a sanctuary no person shall:

- Cultivate any land;

- Establish or undertake any industrial operation;
- Harvest, destroy or collect any plant;
- Set any kind of fire;
- Enter into a sanctuary with any weapon without the permission of the Chief Warden or the officer authorised by him in this behalf;
- Disturb or threat any wildlife, or use chemicals, explosives or any other weapon or substances which may Destroy wildlife habitat;
- Introduce any exotic animal or plant;
- Introduce any domestic animal or allow any domestic animal to stray;
- Dump any materials detrimental to wildlife;
- Explore or dig for extraction of minerals;
- Fell any plant or part thereof except silvicultural operations required for natural regeneration of plants;
- Divert, stop or pollute watercourse; or
- Introduce any alien and invasive plant species.

Notwithstanding anything contained in sub-section (1), after the commencement of this Act, no person, institution or company shall establish or operate any industrial factory or brickfield within 2 (two) kilometers from the boundary of a sanctuary.

Management of sanctuary

The Government may, for each sanctuary, prepare a management plan in accordance with the manner prescribed by rules. The Chief Warden shall bear all responsibilities of implementation and management of management plan. Proposed regulations could be:

(i) MoFE and DoE shall bear all responsibilities of implementations and management
(ii) The Government (MoFE & DoE) may for each sanctuary, prepare a management plan in accordance with manner prescribed by rules
(iii) Allow the operation of tourism shop for any commercial purpose which is essential for management of sanctuary
(iv) Take necessary steps for ensuring the safety of wildlife and its habitats
(v) Imporve habitat, protect breeding ground, prevent disturbance during breeding and raise plantation suitable for wildlife in limited scale for ensuring food security
(vi) Prohibition of fishing activities on movement on movement of watercrafts
(vii) Prohibit after identifying the activities detrimental to environment within 2 (two) kilometers from the border of sanctuary area
(viii) Undertake necessary step in minor resettlement is needed under resettlement framework
(ix) The authority may conduct public awareness campaign program about wildlife conservation
(x) Government may constitute a committee for co-management specifying the terms of reference of the committee.
(xi) Government may ensure imposition of penalties mentioned in Art 38(1) & 38(2) of wildlife (Conservation and Security) Act, 2012.

APPENDIX D - PROPOSED FISH SANCTUARIES

D1 Introduction

D1-1 Background

A Fish Sanctuary is a demarcated protected area where fish along with other aquatic biota can live and propagate safely without being indiscriminately fished or disturbed. Establishment of a fish sanctuary is one of the effective tools for conserving fish stock, preserving biodiversity and increasing fish production. Prior to the 1980's, there was no need for fish sanctuaries in Bangladesh because the fishery was rich and underexploited. In the backdrop of floodplain fishery degradation, mainly due to the creation of water management infrastructure to support HYV rice production, the flooding of fish habitat diminished, and this restricted the movement of fish, particularly for breeding and early development. Efforts to establish fish sanctuaries started in the 1980s and by 2005, the Department of Fisheries (DoF) had established 550 Fish Sanctuaries in the inland waters of Bangladesh including 52 in the FRERMIP area (Table D1-1) and fish production enhanced up to 140% due to the positive effect of the fish sanctuaries (DoF 2015).

Table D1-1. List of existing fish sanctuaries in the FRERMIP project area

Adjacent River Reach	Sub-project Area	District	Upazila	Nr. of Fish Sanctuary	Remarks
Jamuna	JLB-1	Tangail	Delduar		
			Kalihati	11	3 operating
			Sadar	1	
	JLB-2	Manikgonj	Daulatpur		
			Ghior	1	
			Saturia		
			Shibalaya		
	JRB-1	Sirajgonj	Belkuchi		
			Kamarkhanda		
			Shahjadpur		
			Chouhali	2	
	JRB-2	Pabna	Bera	9	2 operating
			Santhia	8	3 operating
			Sujanagar		
Meghna	MLB 1&2	Chandpur	Uttar Motlab		
			Sadar	1	
			Daksin Matlab		
	MRB-1	Shariatpur	Bedargonj	2	
			Goshair Hat	4	1 operating
Padma	PLB-1	Manikgonj	Ghior	1	
			Sadar		
			Singair		
	PLB-2	Dhaka	Nawabgonj		
			Dohar	1	
		Munshigonj	Sreenagar		
			Serajdikhan		
	PLB-3	Munshigonj	Lohajang		
			Sadar		
			Tongibari		
	PRB-1	Rajbari	Goalanda		
			Pangsha		
			Sadar		
	PRB-2	Faridpur	Bhanga	3	1 0perating
			Char hadrashan	1	
			Sadar	1	
			Sadarpur		

	PRB-3	Madaripur	Shib char	6	1 operating
			Total	***52***	

Source: Fish Sanctuaries of Bangladesh, DoF 2015

Present status of fish sanctuaries in Bangladesh

A recent DoF report (2015, DoF) shows that there are 550 Fish Sanctuaries established in the floodplain and small rivers of the country besides the river areas declared as Fishing Ban Zones for conservation of breeding and early development of Hilsha (*Tenulosa ilisha*). Thus there are two basic types of aquatic sanctuaries in Bangladesh, i.e. (i) Floodplain Sanctuary mostly of 0.5-0.1 ha size with structural delimitations situated in the floodplain and small rivers, and (ii) River Sanctuary in the form of declared river area with a ban on fishing. Effort for establishment of such reserved areas in the rivers for Hilsha fishery started mostly in the 1990s when the Hilsha fishery declined significantly.

BOX-1 Present Status of River Fishing Prohibited Areas

The strip between Shatnol and Char Alexander in Meghna River; Shahbazpur channel of Meghna River; Tentulia River adjacent to Bhola district; and Andharmanik River near the Bay of Bengal were declared fish sanctuaries in 2003-2004. The other major sanctuary is located in Shariatpur district, in the estuary of Padma and Meghna Rivers; this place was given the status in 2010-2011.

These are called sanctuaries because catching fish in these places is prohibited during the two breeding seasons. For the Andharmanik sanctuary, the breeding season is November-January. For the remaining four, the season spans March-April. At present, the five sanctuaries cover a total riverine area of 350 km^2; the upcoming one is about 60 km^2 in size (Abu Naser, 2010)

Also, there are such declared areas in the Sunderbans and adjacent rivers, i.e. about 30 km^2 mainly for conservation of the Ganges River Dolphin including a ban on all sorts of fishing efforts in the area. Recent evaluation shows that fish production increased up to 140%, and fish diversity by about 10% due to establishment of these sanctuaries. Hilsha fishery has increased from 219,532 Ton in 2000 to 387,211 Ton in 2015, apparently due to the conservation measures taken. On the downside however, it appears that most floodplain fish sanctuaries are either non-existent, or non-operating, due to (i) poor establishment and (ii) ineffective management, while in the declared river fish ban area there is considerable indiscriminate fishing of Jatka.

D1-2 Importance of Fish Sanctuaries for FRERMIP

It is foreseen that FRERMIP interventions for river stabilization will have a substantial impact on fish habitats and production, and to mitigate this, various structural and non-structural mitigation measures are proposed, such as the establishment of Fish Sanctuaries in the river and in the floodplain of the project influence area. In the backdrop of foreseeable significant reduction and changes in the river fish habitat, loss of scope for fish migration to the floodplain due to limitation of river-floodplain connectivity and reduction of flooding of the floodplain, are all expected to result in the decrease of fish biodiversity and production. Establishment of fish sanctuaries will be a major management measure for mitigation of the fisheries impacts.

D1-3 Strategic plan for FRERMIP Fish Sanctuaries

River Fish Sanctuary

Establishment of Fish Sanctuaries in the major river area with some physical delimitation will be an innovative effort in Bangladesh. It is planned to install sturdy Navigation Buoys in the river, 1 km apart, 300 m away from the bank along the whole bank line indicating the navigation route. The as such demarcated area is expected to be relatively free from river transport and (drift net) fishing. This effort will be challenging but not impossible because (i) there is already an established practice of putting Navigation Buoys in rivers along navigation routes, and (ii) river fisheries management practices by imposing restriction on fishing in certain areas is already known to river fishers. Besides, awareness development training, community-based management of the Sanctuary and regulatory measures through the concerned government departments (DoF & DoE) will be arranged to ensure effective management of the river fish sanctuary. It is planned that around the water regulators with fish passes that will be constructed as part of the FRERMIP interventions, there will be arrangements for fish shelters and breeding hubs to ensure safe habitation and breeding of river fish.

Floodplain Fish Sanctuary

There is an established practice of making fish sanctuaries in the floodplain. And there are lessons learned from the practice. Floodplain sanctuaries are mostly established under certain projects of 3-5 years' term and the sanctuaries mostly collapsed after the expiry of the concerned project for want of needful maintenance and management measures. Secondly, because of the poor structural make up, framed by bamboo poles, the fish sanctuary infrastructure collapses in about 3 years. These issues regarding the establishment and management of the Fish Sanctuary were pointed out by DoF officials who suggested that fish sanctuaries will be durable and effective if these problem areas could be addressed befittingly. Hence it is planned to use more durable methods such as concrete poles instead of Bamboo, and community-based management will be arranged with the necessary training for awareness development and improvement of management skills of the local stakeholders.

Recent field surveys reveal that floodplain Fish Sanctuaries could be established in every project upazila. However, it would not be advisable to establish all possible fish sanctuaries in the area under this project. The preferred strategic approach will be to establish one Model Fish Sanctuary (MFS) in each upazila (TableD1-2, Figure-1) with durable infrastructure and perpetuating arrangement for community-based management of the MFS.

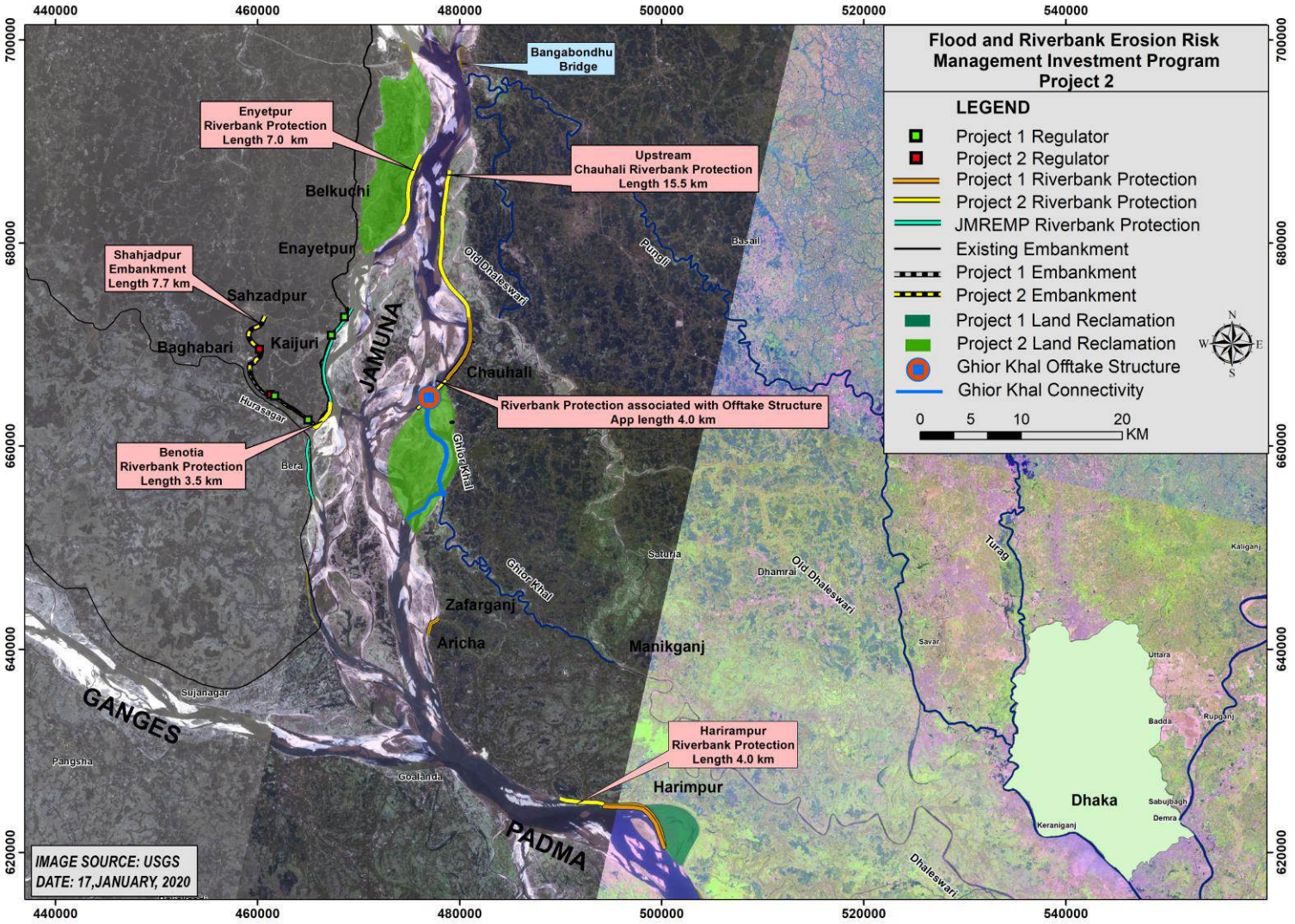
Table D1-2. Proposed Fish Sanctuaries in the Project-2 Area

Source: Fish Sanctuaries of Bangladesh, DoF 2015

Present status of fish sanctuaries in Bangladesh

No	Name of the Sanctuary	Location				Size(ha)	Ownership	Connectivity (Name)
		Water Body	Project Sub-reach	Adm.District Upazila /Union	Coordinates	Max/Min (ha)	Public/Private	Canal, Dis/Tributary, River
1	Chandahar Beel	Beel	PLB-1	Dis:Manikgonj Upa:Singair U:Chandahar	E=521289 N=627509	72/20	Public	Kaliganga and Dholeshwari river
2	Gopinathpur Beel	Beel	PLB-1	Dis:Manikgonj Upa:Horirumpur U:Gopinathpur	E=491548 N=625916	700/.50	Private 70% Public 30%	Bahadurpur khal/ Padma
3	Patal Beel	Beel	PLB-1	Dis:Manikgonj Upa: Sadar Pourosova	E=502187 N=637840	20/5	Public	Bhanumati/ kaliganga River /Padma
4	Nimaikhali Beel	Beel	JLB-2	Dis:Manikgonj Upa:Doulatpur U:ChakMirpur	E=486146 N=648775	15/5	Public	Kaliganga/ Jamuna
5	Char Ghior Mallar Beel	Beel	JLB-2	Dis:Manikgonj Upa:Ghior	E=489003 N=643027	40/10	Public	Kaliganga/Jamuna

				U:Ghior				
6	Dholeshwari Gopalpur Ghat	River	JLB-2	Dis:Manikgonj Upa:Saturia U:Boraid	E=496158 N=650665	12km	Public	Gazikhali River +Dholeshwari/ Jamuna
7	Ichamati kol-Jagannath	Tributary	JLB-2	Dis:Manikgonj Upa:Shibalay U: Uthuli	E=482200 N=638636	8km/3km	Public	Ghoshbarir khal+Baradia/Ichamati Kol/Jamuna
8	Kodalia river	Tributary	JLB-2	Dis:Sirajgonj Upa:Chowhali U:Khaspukuria	E=481023 N=665413	60/20ha	Public	Dholeshwari /Jamuna
9	Bonogram Beel	Beel	JLB-2	Dis:Tangail Upa:Nagarpur U:Goyahata	E=482718 N=663713	50/10ha	Public	Jamuna
10	Gomorki Beel	Beel	JRB-1	Dis:Sirajgonj V: Gomrekhi U:Daulatpur	E=469603 N=681808	65/25ha	Public	Jamuna (there is a sluice gate)
11	Kutir Char Ichamati Dead River	Tributary	JRB-1	Dis:Sirajgonj Upa:kamarkhand U:BhodraGhat	E=459293 N=694441		Public	Jamuna
12	Kadai Badla Beel	Beel	JRB-1	Dis:Sirajgonj Upa;Shahjadpur U: Beltola	E=462999 N=674980	40/15ha	Public	Korotoya River/Jmauna


Flood and Riverbank Erosion Risk Management Investment Program Project 2
LEGEND
Project 1 Regulator
Project 2 Regulator
Project 1 Riverbank Protection
Project 2 Riverbank Protection
JMREMP Riverbank Protection
Existing Embankment
Project 1 Embankment
Project 2 Embankment
Project 1 Land Reclamation
Project 2 Land Reclamation
Ghior Khal Offtake Structure
Ghior Khal Connectivity
0 5 10 20
KM
Bangabondhu Bridge
Enyetpur Riverbank Protection Length 7.0 km
Upstream Chauhali Riverbank Protection Length 15.5 km
Shahjadpur Embankment Length 7.7 km
Riverbank Protection associated with Offtake Structure App length 4.0 km
Benotia Riverbank Protection Length 3.5 km
Harirampur Riverbank Protection Length 4.0 km
Belkuchi
Enayetpur
Sahzadpur
Baghabari
Kaijuri
Chauhali
Harimpur
Zafarganj
Aricha
Manikganj
Dhaka
JAMUNA
GANGES
PADMA
Old Dhaleswari
Ghior Khal
Pungli
Basail
Hurasagar
Bera
Saturia
Dhamrai
Turag
Savar
Uttara
Badda
Rupganj
Sabujbagh
Demra
Keraniganj
Kaliganj
Sujanagar
Pangsha
Goalanda
Dhaleswari
IMAGE SOURCE: USGS
DATE: 17,JANUARY, 2020
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700000
680000
660000
640000
620000

Figure D1-1. Location of the proposed Project-2 Model Sanctuary Sites

D1-4 Management of Fish Sanctuaries

Good management of the fish sanctuary is key to derive expected results. It is ascertained that the sanctuary established in the initial phases by the DoF ended in failure mainly due to lack of good management. Subsequently, community-based management measures were adopted with good results. So it is planned that community-based management will be ensured for the sanctuary with effective monitoring under joint supervision of BWDB and DoF. FRERMIP has a positive situation in this respect because the FRERMIP MFF is expected to be continued till 2023 with possibility of extension. So the project team will continue to monitor the management of the fish sanctuaries. It is believed that the community will be meanwhile adapted to good fish sanctuary management practices.

D1-5 Conclusion and Recommendations

It is foreseen that there will be potential impacts of the FRERMIP interventions on the fisheries sector and establishment of fish sanctuaries will be an effective mitigation measure for the impact. In the river area, potential fish habitats in the braided system and along the bankline will be lost and will be partially replenished by the proposed river sanctuaries which will also reduce possibilities for indiscriminate fishing. In the floodplain, anticipated fisheries loss due to the loss of connectivity by riverbank embankments impacting floodplain flooding and fish migration to and from the floodplain, will be partially covered by the added production expected due to the establishment of fish sanctuaries. Establishment of fish sanctuaries will be implemented by DoF as a works, with the financial assistance of BWDB/ADB.

D1-6 Selected Project-2 sites for Fish Sanctuaries

River Sanctuary: 100 km along the 100 km of left riverbank of Project-2 river area

- Navigation Buoys (NB): 100 for 100 km Tranche area @ 1 per km; @ USD 13,000 per NB = USD 1,300,000
- River fish Breeding Hub along the Regulator/Fish Pass: 9 locations near the regulators: 9 x $ 13,000 = $ 117,000

Floodplain Sanctuaries: 12 in 12 Upazilas

- Establishment of Floodplain Fish Sanctuaries: 12 sites in 12 upazilas @ USD 13,000/site= USD 156,000
- Re-excavation of canals: 12 x 5 km = 60 km @ $ 2/m^3: $ 42,000/km, total $ 2,500,000
- Beel nurseries in 12 fish sanctuaries: $ 15,000
- Beel restocking in 12 fish sanctuaries: $ 15,000

Regulators with Fish Passes: 2 in JLB-1; 1 in other location tbd. Cost: $ 1 million/regulator, 35% of costs is for fish pass: $ 2 million x 0.35 = $ 700,000

Training in fish sanctuary management and sustainable production

Topics include awareness development; orientation; operation & maintenance; fisheries management; fish culture technology: 300 trainings in 3 years @ BDT 100,000/training = BDT 3 million = $ 375,000

Total cost = $ 7,628,000

APPENDIX E - PUBLIC CONSULTATION MEETING, FIRST ROUND

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 the EIA of 16 May 2014.

To limit file size of this report, all participant signature forms and photos regarding Round 1 enclosed in the original EIA for Tranche -1 (2014) have been omitted.

Stakeholder Concerns and Meeting Documentation

Summaries of stakeholder concerns expressed in each meeting are provided in the following tables.

Table E1-1

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 E1-2. 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

Table E1-3. 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
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
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
Requirements of embankment
Construction of new embankment along the riverbank
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 household, livestock etc.
Impacts on Charlands
Increase density in Muradpur Char for relocation
Erosion of Charlands if construction cross dam or river

Resettlement/ Relocation issues

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
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
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.
Present community social services the affected areas and relocated areas
Presently, there is inadequacy of social services both in the affected and relocated area
Will this situation be improved or deteriorated after relocation?
The present situation must be improved if the concerned authority manages it effectively and relocate them in desired locations
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.
What are the patterns of transport and communication in the affected area/relocated area?
Rickshaw, Nosiman, tempo, boat, CNG, Horse cab, and bicycle are the main transportation in the affected and relocated area. But overall transportation and communication facilities are not good.
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.

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
ADB and GoB policies on involuntary resettlement Local people do not know the policies on involuntary resettlement of ADB and GoB 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 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 Cut-off date for listing affected properties
Income restoration and generation
What are the current income generating activities of APs? Agriculture Fish culture Livestock rearing Small entrepreneurship Employed Business Etc. 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 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. 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 labour than less work Land price will be increased Social neighborhood will increased How many people can be absorbed? About 75 to 80 percent people can be absorbed 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 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

Name of NGOs prevailing in the relocation site Proshika, BRAC, ASA, Manob Mukti Sangstha, BDPC Etc. 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 Social safeguard and safety nets At present the coverage of social safety net is quite 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 A3-4. 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. Reported by: Muhammad Shifuddin Mahmud, Professional, CEGIS
Issues, questions, responses, comments
People's perception, opinion and attitude
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.) 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 Impacts of the project People opined that this project would bring immense socio-economic benefits for them
Resettlement/ Relocation issues
Impact of land acquisition on different group of people Loss of homesteads Damages of agricultural land Increases the number of landless of people 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 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. Present community social services the affected areas and relocated areas Presently, there is inadequacy of social services both in the affected and relocated area Will this situation be improved or deteriorated after relocation? The present situation would improve if the concerned authority manages it effectively and relocate them in desired locations 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. 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. 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. 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
ADB and GoB policies on involuntary resettlement Local people do not know the policies on involuntary resettlement of ADB and GoB 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 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 Cut-off date for listing affected properties
Income restoration and generation
What are the current income generating activities of APs? Agriculture Fish culture/capture Livestock rearing Small entrepreneurship Employed

Business Etc. 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 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. 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 labour than less work Land price will increase Social neighbourhood will increase How many people can be absorbed? About 70 to 75 percent people can be absorbed 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 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
Name of NGOs prevailing in the relocation site Proshika, BRAC, Grammeen Bank, GKT, BARSIC, Bangladesh Red Crescent Society 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 Social safeguard and safety nets At present the coverage of social safety net is quite 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 these resources.

Table E1-5. 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. Reported by: Manju Ara, Jr. Professional, CEGIS
Issues, questions, responses, comments
People's perception, opinion and attitude
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 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 riverbank 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. 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
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
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
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.
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.
Will this situation be improved or deteriorated after relocation?
The present situation must be improved if the concerned authority manages it effectively and relocate them in desired locations
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.
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, Motorcycle etc. same kind of vehicles will be used. There are street facilities for communication. Overall transportation and communication facilities are not good.
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.
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

ADB and GoB policies on involuntary resettlement
Local people do not know the policies on involuntary resettlement of ADB and GoB
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

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
Cut-off date for listing affected properties

Income restoration and generation

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, businessmen, job holder and other professionals.
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.
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.
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 labour than less work
Land price will be increased
Social neighborhood will be increased
How many people can be absorbed?
Almost affected people could be people can be absorbed.
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
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

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.
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.
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
Requirements of new embankment and protect work

Table E5-6. 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. <u>Reported by:</u> Mobasher Bin Ansari, Professional, CEGIS
Issues, questions, responses, comments:
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 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? 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 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? 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
Main problems due to erosion and flooding: Flooding riverbank erosion Damage of households and assets Damage of bridge, culvert and livestock etc. Peoples' responses to the FRERMIP project: Participants expressed positive attitude to the project implementation and demanded its early implementation adjacent villages of Padma Riverbank; Impacts of the project People opined that this project must bring immense socio-economic benefits for them
Resettlement/ Relocation issues
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.
Positive impact of land acquisition on different group of people: To save agricultural land, households, bridges and culvert from riverbank erosion and flood. Increase agricultural production The stone base construction work from gravel layer will ensure its longevity. Unanticipated Impacts on Charlands No unanticipated impacts will observe on Charlands people rather these activities will ensure more food production and safety for them. 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. Relocation of houses and other establishments, Relocation of houses and other establishments will possible in new Charlands, 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.
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
Will this situation be improved or deteriorated after relocation?
After relocation this situation may not improve as high but definitely improve after few years
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.
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.
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 exist in the project area
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

ADB and GoB policies on involuntary resettlement
Local people are totally unknown about ADB and GoB policies on involuntary resettlement issues.
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.
People's preference and previous experience on mode of compensation payment
People's preferences on mode of compensation payment only through money.
Cut-off date for listing affected properties: N/A

What are the current income generating activities of APs?
Agricultural farming
Fishing (culture/capture)
Livestock rearing
Small cottage/Handicraft
Employed/service
Small business
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.
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
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.
How many people can be absorbed?
About 50 percent people can be absorbed
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.
How many people need to be trained and for what occupation?
People identified at least 80% of local are needed to be trained up on these particular occupation as:
Improve agricultural farming
Fishing (culture/capture)
Small cottage/handicraft etc.

Social Development Support

Name of NGOs prevailing in the relocation site
BRAC, Grameen Bank, PPD, Manab Mukti, UNDP, ASA
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.
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 landowners 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 crossroad which run beside the riverbank 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.

APPENDIX F - PUBLIC CONSULTATION MEETING, SECOND ROUND

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 are provided below.

To limit file size of this report, all participant signature forms and photos regarding Round 2 enclosed in the original EIA for Tranche -1 (2014) have been omitted.

STAKEHOLDER CONCERNS AND MEETING DOCUMENTATION

Table F1-1: Meeting Venues, Second 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 F1-2: 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

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-1 area.

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 these 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 to 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.

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.

Riverbank 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 eros6ion 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.

APPENDIX G - PUBLIC CONSULTATION MEETING, THIRD ROUND

OVERVIEW OF MEETINGS

Six third-round public meetings were conducted at Harirampur, Shahjadpur & Chauhali and four FDG attended by 336 participants. Locations, dates, numbers and types of participants, and meeting photos are provided below.

STAKEHOLDER CONCERNS AND MEETING DOCUMENTATION

Summaries of stakeholder concerns expressed in the meetings are provided in Sections A5-0 and A5-0. Copies of the meeting sign-in sheets are shown in Photos E1-8 to E1-16.

Table G1-1: Meeting Venues, third Round Public Consultation & FDG Meetings

District	Upazila	Union	Meeting venue	Meeting date	Time
Manikganj	Harirampur	Bahadurpur	Office room of Gopinathpurbeel water Management committee	17/10/2016	11:00 am
Sirajgonj	Shahjadpur	Ratankandi	Rantankandi Ideal High School	22/02/2017	2:00 pm
Sirajgonj	Chauhali	Chauhali	Chauhali Degree College	15/03/2017	3:00 pm
Manikgonj	Harirampur	Boyra	Boyra Union Parishad	27/09/2017	11:00 am
Sirajgonj	Chauhali	Solimabad	Union parishad building	09/10/2017	11:00 am
Sirajgonj	Chauhali	Khaspukuria	Khaspukuria union Parishad	09/10/2017	2:00 pm
Pabna	Bera	Bera Sadar	Bera Fisheries Office	27/12/2016	11:00 am
Pabna	Bera	Koitala	Courtyard of Mr. Akash kalidas house	27/12/2016	3:00 pm
Pabna	Pabna Sadar	Pabna Sadar	District Fisheries Office	27/12/2016	7:30 pm
Sirajganj	Shahjadpur	Verakhola	Verakhola old regulator site	28/12/2016	9:30 am

Table G1-2: Public Consultation and FGD Meeting Participants Details

Meeting venue	Type of Participants	No. participants
Harirampur (PLB-1) Public Meeting	BWDB staff, ADB consultants, Former UP Chairman, farmer, Fishermen, local notable persons, local social worker, healthcare assistants, businessmen, traders, and NGO staff	28
Shahjadpur (JRB-1) Public meeting Ratankandi	BWDB staff, UP Chairman, Public representatives, farmer, fishermen, local notable persons, local social worker, healthcare assistants, businessmen, traders, student and NGO staff	121
Chauhali (JLB-2) Public Meeting	BWDB staff, Public representatives, farmer, fishermen, local notable persons, freedom fighter, village doctor, local social worker, healthcare assistants, businessmen, traders and NGO staff	87
Harirampur (PLB-1) Public meeting Boyra	BWDB staff, UP Chairman, Public representatives, farmer, fishermen, local notable persons, local social worker, businessmen, traders and NGO staff	26
Chauhali (JLB-2)	BWDB staff, Upazila Chairman, Public representatives, farmer, fishermen,	21

Meeting venue	Type of Participants	No. participants
Public Meeting Char Solimabad	local notable persons, local social worker, businessmen, teacher, Imam, traders	
Chauhali (JLB-2) Public Meeting Khaspukuria	BWDB staff, Upazila Chairman, UP Chairman, Public representatives, farmer, fishermen, local notable persons, local social worker, student, businessmen, teacher, Imam, traders	25
Bera (JRB-1) FGD	BWDB staff, consultants, Former UP Chairperson, farmar, fisheries office, NGO staff	7
Bera (JRB-1) FDG	BWDB representatives, consultants, ex. UP members, farmer, owner of bird satctuary, local resident	6
Pubna (JRB-1) FDG	ISPMC consultant, Dirstrict Fisheries officer	3
Shahjadpur (JRB-1) FDG	BWDB staff, ISPMC consultants, Former UP Chairperson, farmer, fishermen, boatman, businessmen,	12

SUMMARY OF CONCERNS, ALL MEETINGS

Erosion - Stakeholders and local people were informed about the project intervention of bank protection in order to establish river stabilisation. They were fully agreed in favour of bank protection but emphasized the need to ensure that construction work is of high quality. They also demanded to get compensation of their land used for the Project in a short period.

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 incorporated in the project.

Land use - Stakeholders were advised that the project would induce significant changes in land type, land use, and increased food production. They agreed the out come of the project implementation though they have limited idea about the project benefits other than erosion and flood control.

Fish habitat - Stakeholders were informed that the project is expected to have negative impacts on fish and other aquatic fauna due to reduction of river width by the proposed interventions. Local participants suggested restoring fisheries habitat through pilot dredging of channels and provide adequate number of fish pass regulators for connectivity with the flood plain and river.

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, households in Horirampur of Manikgonj and Chouhali of Sirajgonj district would require relocation to suitable alternate sites before the beginning of construction, per Project-2 resettlement plans.

Improved road transportation - Participants were informed that flood 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.

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 eraly construction start.

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.

NOTES OF SPECIFIC MEETINGS

Harirampur, Manikganj (PLB-1 area)

The participants in the public meeting at Gopinathpur are strongly in favour of constructing the flood embakment from Paturia to Dohar (32 Km.) but they arged to add more ventage of the regulator and provide fish pass which is being constructed by LGED. They also requested to provide adequate number of regulaters with fishpass provision in different proper locations of the embankments.

They demanded to take program for bank protection work at the upstream of bank protection work done in 2015-16 dry season as there is still erosion there. The also requested to construct atleast one boat pass fasilities in this area to make it convenient for transporting their commodity to the local bazer.

They informed that the Embankment constructed by LGED is dwarf and weak in section as such they had to face a lot of trauble during rainy season as some portion of the embankment breached or tend to breach. They urged to strengthen the Embankment around the Gopinathpur beel area

In connection of the land acquisition issues, they are willing to give land which is required for Project implementations but the emphasized for getting compensation in time.

Shahjadpur, Sirajganj (JRB-1 area), FGD

The participants in the FGD meeting opined to extent the Embankment up to Baghabari from where the Project-1 embankment ends. They stromgly recommended that the riverside slope of the embankment should be protected for wave action as there occur high wave during monsoon.

They demanded to provide regulator with adequate noumber of ventage and also rehabilate the existing regulator which was constructed in the previous project. They also requested to lower down the sill level of the regulators for fish migration.

Bera, Sirajganj (JRB-1 area), FGD

A FDG meeting was conducted at the courtyard of Mr. Akash Kalidas who established a bird sactuary in his residence containg 165 decimal of land. He informed a considerable no of migratory birds come every year during winter season. But this number is decreasing as some people of the locality hunt birds unlawfully when the birds used to collect food from beels and fields at night. The owner of the sanctuary and local people demanded to take admistrative legal action against the bird hunters.

Shahjatpur, Sirajganj (JRB-1)

A public meeting was held at Ratankandi Ideal High School where the participants demanded to construct flood embankment from Verakhola to Shahjadpur- koijuri road. They informed that there was embankment along this alignment but it was eroded by the river

erosion. So there was land acquisition by BWDB which may be followed to save the cost of land acquisition. They erged to provide regulators with fish pass where necessary.

Chauhali, Serajgonj (JLB-2)

The participants in a public meeting at Chauhali Degree Collage informed the protective work done in 2015-16 dry season have been eroded in some places. They demanded to repear these damaged portions on emergent basis. They also informed during the flood season crops damaged due to innandation of field. While disclosing that proect has a plan to stabilize the Jamuna River and construct flood embankment along both banks of the Jumuna, they strongly supported the project plan and expressed their full cooperation in implementing the project plan.

Another two public meetings were conduced in this sub-reach, one at Char Solimabad another at Kaskaulia of Chauhali Upazila to receive the local public opinion for the proposed closure dam on the newly developed channel from Jamuna. The local people informed the newly developed channel eroded their homestead and other assets and it is aggravated day by day. They demanded to control this erosion. While informing the participants of the meeting that project has freamed a plan to construct a closure dam over this newly developed channel for depositing silt and therby the erosion will be checked, they strongly supported the plan and demanded to implement the work with emergent basis. They expressed their full cooperation in implementing the work.

Public Consultation Matrix- Comments/Opinion of the Participants and address by the Project

Sl. No.	Comments/Opinion of the participants during consultation	Addressed in the Project
General Comment		
1.	While informing stakeholders and local people about the project interventions they are fully agreed in favour of bank protection and demanded to extend the protection work. They emphasized the need to ensure that construction work is of high quality	The bank protection work will be done as per technical need of the specific location. Quality of bank protection work will be ensured by Consultants, field staff of PMO and regular task force team of BWDB
2.	The participants raised their voice to get compensation of the land used for Project interventions in short time	The PMO staff and engaged NGO will pursue on regular basis to the concerned Deputy commissioner's office so that the compensations could be paid with in shortest possible time
3.	Stakeholder were informed that the proposed embankment to protect flooding. They expressed that only the embankment construction will not control flood. They are in favour of river dredging and demanded for incorporation of dredging in the project.	The issue was discussed with river stabilization technical team. They will provide dredging if it is feasible in context of river stabilization.
4.	Participants suggested restoring fisheries habitat through pilot dredging of channels and provide adequate number of fish pass regulators for connectivity with the flood plain and river	The EIA team shared these stakeholder opinions with BWDB officials and ISPMC's team members for technical solution. The suggestion is well taken. The design team is providing fish-pass regulators to

Sl. No.	Comments/Opinion of the participants during consultation	Addressed in the Project
		restore connectivity with the flood plain and river at feasible locations
5.	While informing the stakeholders that during construction temporary air pollution and noise may cause, which they consented to accept these impacts during construction	Noted and included in the EIA
6.	Probable project affected people expressed their views to relocate to suit able alternative sites before the start of construction	These issues will be addressed in the Resettlement program of the Project.
7.	Participants demanded for providing appropriate road facilities.	Project have a plan to provide road facilities over the flood embankment
8.	Participants enquired about the employment opportunities of the local people in the project work	Project construction will provide temporary employment opportunities to local people
9.	Participants recommended to include dredging as they believe flood and erosion control could not be achieved without dredging.	The scope River dredging to control erosion will be thoroughly investigate by the project design team. Necessary arrangement will be provided after feasibility study of the Project.
10.	Participants were concerned about development projects initiated by the ruling party will lose priority if/when the opposition party is in power. So, they strongly urged early implementation of the Project.	Noted and included in the EIA
11.	Participants expressed concerned about the effectiveness of the subproject in controlling flooding. Proposed interventions should be designed to provide protection from the highest monsoon water level.	Renowned international and national experts are taking care of it
Public Consultation of the Specific Meetings		
12.	At Gopinathpur public meeting the participants were in favour of constructing flood embankment from Paturia to Dohar. They urged to add more ventage of the regulator and provide fish pass which is being constructed by LGED. They also requested to provide adequate number of regulators with fish pass provision in suitable location of the embankments	Renowned international and national experts are taking care of it
13.	The participants in the FGD meeting at Shahjadpur, Sirajgonj (JRB-1) opined to extent the Embankment up to Baghabari from where the Project -1 embankment ends. They recommended that the riverside slope of the embankment should be protected from wave action as there occur high wave during monsoon. They demanded	The proposal for constructing embankment has been included in the Project-2 work. The experts of the team is working for fish pass regulators along with the sill level as requested.

Sl. No.	Comments/Opinion of the participants during consultation	Addressed in the Project
	to provide regulator with adequate numbers of ventage and also rehabilate the existing regulator. They also requested to lower down the sill level of the regulators for fish migration	
14.	The participants of the FGD meeting at Bera Sirajgonj (JRB-1) informed that a considerable number of migratory birds come every year during winter season, but this number is decreasing as some people of the locality hunt the birds unlawfully when birds used to collect food from beels and fields at night. The local people asked to take administrative legal action against poacher	Noted and included in EIA. The opinion has been sheared with BWDB official for taking necessary action.
15.	The participants in a public meeting at Ratankandi Ideal High School demanded to construct flood embankment from Verakhola to Shahjadpur-Koijuri road. They informed there was land acquisition by BWDB in the previous embankment which may be followed to save the cost of land acquisition for new embankment.	The requested embankment reach has been included in the Project-2 interventions. The Pervious land acquisition by BWDB has been followed as per as feasible.
16.	The Public meeting at Chauhali Degree Collage, the participants demanded to repair the damaged portion of the protective work done in 2015-16 on emergent basis. They also urged to save their crops from monsoon flood.	The Project has taken up to repair the damage portion of the protective worked done in 2015-16. The participants were informed that Project has a plan to construct flood embankment along the bank of the Jamuna as a part of River stabilization plan.
17.	The participants in public meeting at Char Solimabad and Kaskaulia (JLB-2) demanded to control the erosion of the newly developed channel which eroding their homestead and other assets.	The Project has a program to construct a closure dam at the mouth of the newly developed channel in 2017-18 dry season. This will ensure the erosion control and about 5000 ha of land will be reclaimed by silt deposition.

Some example photos of public consultation meetings (PCM) at various locations

PCM at Bhadurpur, Harirampur

PCM at Ratankandi, Shahjadpur

PCM at Chauhali

PCM at Boyra, Harirampur

PCM at Char solimabad, Chauhali

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~~First~~ Third Round Meeting Sign-in sheet, Gopinathpur, Harirampur, Manikgonj

গোপীনাথপুর বিল এলাকায় মৎস্য অভয়াশ্রম প্রকল্প বাস্তবায়নের জন্য উপস্থিতির তালিকা

স্থান: বাহাদুরপুর বাজার গোপীনাথপুর বিল (মৎস্য) লি: এর অফিসে

তারিখ: ১৭.১০.২০১৬ ইং

ক্রমিক নং	নাম	পেশা/পদবী	মোবাইল নং	স্বাক্ষর
০১	সুরেশ চন্দ্র দত্ত	সভাপতি (গো: বিল (মৎস্য))	01731-994455	[signature]
০২	মো: লাভলু প্রামানিক	সাধারণ সম্পাদক (গো: বিল (মৎস্য))	01728-403934	[signature]
০৩	মো: সাইদুল ইসলাম	ইউপি সদস্য	-	
০৪	মো: মোস্তাফা হোসেন	" "	-	মো: হোসেন
০৫	মো: আ: জলিল খান	সমাজ সেবক	01711103296	
০৭	মো: আরশেদ আলী	" "	01715-136380	মো: আরশেদ
০৮	মো: জাহিদুল হক	সাবেক (ইউপি সদস্য)	01731-803361	[signature]
০৯	মো: নুরু মিয়া	সমাজ সেবক	01729-769866	নুরু মিয়া
১০	মো: শফিকুর রহমান	C.A গোপীনাথপুর বিল (মৎস্য)	01734-003259	[signature] 17.10.16
১১	মো: আব্দুর রহিম	কৃষক	-	আ: রহিম
১২	মো: রহমত আলী	কৃষক	-	রহমত আলী
১৩	" আ: আলিম	ব্যবসায়ী	01734-250602	[signature]
১৪	" আ: মান্নান	দিনমজুর	-	[signature]
১৫	" আজাদ আলী	সাবেক ইউপি সদস্য	01771259696	[signature]
১৬	" কবিবুর রহমান	অবসরপ্রাপ্ত	01738072064	কবিবুর
১৭	" সোলায়মান খান	ব্যবসায়ী	-	সোলায়মান খান
১৮	" ফজলু মিয়া	জেলে	-	[signature]
১৯	" মুনসুর আলী	কৃষক	-	[signature]

Thir Round Meeting Sign-in sheet, Gopinathpur, Harirampur, Manikgonj

গোপীনাথপুর বিল এলাকায় মৎস্য অভয়াশ্রম প্রকল্প বাস্তবায়নের জন্য উপস্থিতির তালিকা

স্থান: বাহাদুরপুর বাজার (গোপীনাথপুর বিল (তালুকদার) লি: [illegible]

তারিখ: ১৭.১০.২১ইং

ক্রমিক নং	নাম	পেশা/পদবী	মোবাইল নং	স্বাক্ষর
২০।	মোঃ সাইদুর রহমান	ব্যবসায়ী	01685597040	মোঃ সাইদুর রহমান 17/10/21
২১।	" আবু সাঈদ মিয়া	" "	01734-603261	[illegible]
২২।	" মোঃ সাহেব মিয়া	"	01799393640	[illegible]
২৩।	" তৈয়বুর আলী	কৃষক	-	[illegible]
২৪।	মোঃ আমিনুর রহমান	Env. Specialist ISPMC,	01715-315227	[illegible] 17/10/21
২৫।	মোস্তাফিজ আলমান	Jr. Water Resources Engg.	01676915340	[illegible]
২৬।	মির্জা হাবিবুর রহমান	Construction Engineer	01711031190	[illegible]
২৭।	মুঃ নুরুল আমীন	Site-Engineer	01818794401	[illegible]
২৮।	মোহাম্মদ [illegible]	Res. Engineer	01715022212	[illegible]

Third Round Meeting Sign-in Sheet, Ratankandi, Shahjadpur

FRERMIP
Flood and Riverbank Erosion Risk Management Investment Program

আহমেদপুর থেকে বাদলবাড়ি পর্যন্ত ৬.৫০ কিঃমিঃ প্রস্তাবিত বন্যা নিয়ন্ত্রন বাঁধ নির্মাণ সম্পর্কিত মত বিনিময় সভার অংশগ্রহণকারীগণের নাম ও সাক্ষর

স্থানঃ রতনকান্দি আদর্শ হাই স্কুল
হাবিবুল্লাহ নগর ইউনিয়ন পরিষদ, শাহজাদপুর, সিরাজগঞ্জ

সময়ঃ দুপুর ২ টা তারিখঃ ২২/০২/২০১৭

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সময়ঃ দুপুর ২ টা তারিখঃ ২২/০২/২০১৭

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আহমেদপুর থেকে বাদলবাড়ি পর্যন্ত ৬.৫০ কিঃমিঃ প্রস্তাবিত বন্যা নিয়ন্ত্রন বাঁধ নির্মাণ সম্পর্কিত মত বিনিময় সভার অংশগ্রহণকারীগণের নাম ও সাক্ষর

স্থানঃ রতনকান্দি আদর্শ হাই স্কুল
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সময়ঃ দুপুর ২ টা তারিখঃ ২২/০২/২০১৭

ক্রমিক নম্বর	নাম	পেশা / পদবি	সাক্ষর
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FRERMIP
Flood and Riverbank Erosion Risk Management Investment Program

আহমেদপুর থেকে বাদলবাড়ি পর্যন্ত ৬.৫০ কিঃমিঃ প্রস্তাবিত বন্যা নিয়ন্ত্রন বাঁধ নির্মাণ সম্পর্কিত মত বিনিময় সভার অংশগ্রহণকারীগণের নাম ও সাক্ষর

স্থানঃ রতনকান্দি আদর্শ হাই স্কুল
হাবিবুল্লাহ নগর ইউনিয়ন পরিষদ, শাহজাদপুর, সিরাজগঞ্জ

সময়ঃ দুপুর ২ টা তারিখঃ ২২/০২/২০১৭

ক্রমিক নম্বর	নাম	পেশা / পদবি	সাক্ষর
৩৭			
৩৮			
৩৯			
৪০			
৪১			
৪২			
৪৩	মোঃ		
৪৪			
৪৫			
৪৬			
৪৭			
৪৮			
	মোঃ জাকারিয়া হো:	U.R.D.S	

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ক্রমিক নম্বর	নাম	পেশা / পদবি	সাক্ষর
৪৯			
৫০			
৫১			
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৫৪			
৫৫			
৫৬			
৫৭			
৫৮			
৫৯			
৬০			

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ক্রমিক নম্বর	নাম	পেশা / পদবি	সাক্ষর
৬১	মোঃ আমিনুর রহমান	ব্যবসা	
৬২			
৬৩			
৬৪			
৬৫			
৬৬		ব্যবসা	
৬৭		ছাত্র	
৬৮	মোঃ আবিদুল ইসলাম মোল্লা		
৬৯			
৭০			
৭১			
৭২			
৭৩		VRDS	

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ক্রমিক নম্বর	নাম	পেশা / পদবি	সাক্ষর
৭৪			
৭৫			
৭৬			
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৭৯			
৮০			
৮১			
৮২			
৮৩			
৮৪			
৮৫			

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Joint Venture:
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Mott MacDonald

Project Office:
House 45 (2nd Floor)
Road 27, Banani
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সময়ঃ দুপুর ২ টা

তারিখঃ ২২/০২/২০১৭

ক্রমিক নম্বর	নাম	পেশা / পদবি	সাক্ষর
৮৬	মো: আমনাম আলী	ছাত্র	আমনাম
৮৭	মো: আক্কাস সরদার	দর্জি	আক্কাস
৮৮	মো: [illegible]	[illegible]	[illegible]
৮৯	মো: হিদায়েত সরদার	ছাত্র	হিদায়েত
৯০	মো: কাবিল সরকার	ছাত্র	কাবিল
৯১	মো: হেবেল আলী	ছাত্র	হেবেল
৯২	মো: আলাউদ্দীন	কৃষি	আলাউদ্দীন
৯৩	মো: [illegible]	কৃষি	[illegible]
৯৪	মো: [illegible]	কৃষি	[illegible]
৯৫	মো: রফিকুল	কৃষি	রফিকুল
৯৬	আব্দুর রহিম	ছাত্র	রহিম
৯৭	[illegible]	[illegible]	[illegible]

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সময়ঃ দুপুর ২ টা তারিখঃ ২২/০২/২০১৭

ক্রমিক নম্বর	নাম	পেশা / পদবি	সাক্ষর
৯৮	মো: রাজ্জাক		মো: নেফাজ
৯৯	মো: নুরুল ইসলাম		
১০০	মো: আরিফুল ইসলাম		মো: মৃত্যু হারান
১০১	মো: আমিনুল ইসলাম		[illegible]
১০২	বাদশা		বাদশা
১০৩	মো: হাবিবুর রহমান		হাবিবুর
১০৪	মো: আরিফুল ইসলাম		
১০৫	মো: বাবুল আকতার		[illegible]
১০৬	মো: রুহুল আমিন আলী		[illegible]
১০৭	মো: নুর ইসলাম		
১০৮	সোহেল	কৃষক	
১০৯	সোহরাব আলী	কৃষক	

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সময়ঃ দুপুর ২ টা তারিখঃ ২২/০২/২০১৭

ক্রমিক নম্বর	নাম	পেশা / পদবি	সাক্ষর
১১৩	[illegible]	[illegible]	[illegible]
১১৪	[illegible]	[illegible]	
১১৫	[illegible]		
১১৬	[illegible]	[illegible]	
১১৭	[illegible]		
১১৮	[illegible]		
১১৯	[illegible]		
১২০	[illegible]		
১২১	[illegible]		
১২২	[illegible]		
১২৩	[illegible]	[illegible]	[illegible]
১২৪	[illegible]	[illegible]	
১২৫	[illegible]		
১২৬	[illegible]		
১২৭	[illegible]		
১২৮	[illegible]		
১২৯	[illegible]	কৃষি	[illegible]
১৩০	[illegible]	[illegible]	[illegible]
১৩১	[illegible]	[illegible]	[illegible]

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স্থানঃ চৌহালী ডিগ্রী কলেজ
চৌহালী, সিরাজগঞ্জ

সময়ঃ দুপুর ৩ টা

তারিখঃ ১৫/০৩/২০১৭

ক্রমিক নম্বর	নাম	পেশা / পদবি	স্বাক্ষর
১			
২			
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৫			
৬			
৭।			
৮।			
৯।			
১০			
১১			
১২			

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স্থান: চৌহালী ডিগ্রী কলেজ
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সময়: দুপুর ও টা

তারিখ: ১৫/০৩/২০১৭

ক্রমিক নম্বর	নাম	পেশা / পদবি	স্বাক্ষর
১৩	[illegible]	[illegible]	
১৪	[illegible]	[illegible]	
১৫	[illegible]	[illegible]	
১৬	[illegible]	[illegible]	
১৭	[illegible]	[illegible]	
১৮	[illegible]	[illegible]	
১৯	[illegible]	[illegible]	
২০	[illegible]	[illegible]	
২১	[illegible]		
২২	[illegible]	[illegible]	
২৩	[illegible]		
২৪	[illegible]		

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চৌহালী, সিরাজগঞ্জ

সময়: দুপুর ৩ টা

তারিখ: ১৫/০৩/২০১৭

ক্রমিক নম্বর	নাম	পেশা / পদবি	সাক্ষর
২৫।	[illegible]	[illegible]	
২৬।	[illegible]	[illegible]	
২৭।	[illegible]	[illegible]	
২৮।	[illegible]		
২৯।	[illegible]	[illegible]	
৩০।	[illegible]	[illegible]	
৩১।	[illegible]		[illegible]
৩২।	[illegible]	[illegible]	[illegible]
৩৩।	[illegible]	[illegible]	[illegible]
৩৪।	[illegible]	[illegible]	[illegible]
৩৫।	[illegible]	[illegible]	[illegible]
৩৬।	[illegible]	[illegible]	[illegible]

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সময়ঃ দুপুর ৩ টা

তারিখঃ ১৫/০৩/২০১৭

ক্রমিক নম্বর	নাম	পেশা / পদবি	স্বাক্ষর
৩৭।	[illegible]	[illegible]	
৩৮।	[illegible]	[illegible]	
৩৯।	[illegible]	[illegible]	
৪০।	[illegible]	[illegible]	
৪১।	[illegible]	[illegible]	
৪২।	[illegible]	[illegible]	
৪৩।	[illegible]	[illegible]	
৪৪।	[illegible]	[illegible]	
৪৫।	[illegible]	[illegible]	
৪৬।	[illegible]	[illegible]	
৪৭।	[illegible]	[illegible]	
৪৮।	[illegible]	[illegible]	

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স্থান: চৌহালী ডিগ্রী কলেজ
চৌহালী, সিরাজগঞ্জ

সময়: দুপুর ৩ টা তারিখ: ১৫/০৩/২০১৭

ক্রমিক নম্বর	নাম	পেশা / পদবি	স্বাক্ষর
১৩।	[illegible]	কৃষক	[illegible]
২৩।	[illegible]	কৃষি	[illegible]
৩৩।	[illegible]	কৃষক	[illegible]
৪৩।	[illegible]	কৃষি	[illegible]
৫৩।	[illegible]	কৃষি	[illegible]
৬৩।	[illegible]	[illegible]	[illegible]
৭৩।	[illegible]	[illegible]	[illegible]
৮৩।	[illegible]	কৃষি	[illegible]
৯৩।	[illegible]	কৃষক	
১০৩।	[illegible]	[illegible]	[illegible]
১১৩।	[illegible]	কৃষক	[illegible]
১২৩।	[illegible]	কৃষি	[illegible]
১৩৩।	[illegible]	কৃষি	[illegible]

ISPMC
Institutional strengthening and project management consultant

Joint Venture:
nhc northwest hydraulic consultants
Mott MacDonald

Project Office:
House 45 (2nd Floor)
Road 27, Banan
Dhaka 1213, Bangladesh

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স্থানঃ চৌহালী ডিগ্রী কলেজ
চৌহালী, সিরাজগঞ্জ

সময়ঃ দুপুর ৩ টা

তারিখঃ ১৫/০৩/২০১৭

ক্রমিক নম্বর	নাম	পেশা / পদবি	স্বাক্ষর
৬১।	মোঃ কুদ্দুস হক	কৃষক	
৬২।	[illegible]	[illegible]	[illegible]
৬৩।	মোঃ আঃ হালিম	কৃষক	হালিম
৬৪।	মোঃ তাহির মন্ডল	কৃষক	তাহির
৬৫।	[illegible]	[illegible]	[illegible]
৬৬।	[illegible]	[illegible]	[illegible]
৬৭।	মোঃ মেসবাহউদ্দিন	কৃষি	মেসবাহ
৬৮।	[illegible]	[illegible]	[illegible]
৬৯।	মোঃ আঃ কাদির মিঃ	[illegible]	[illegible]
৭০।	[illegible]	[illegible]	
৭১।	মোঃ শামিকুল ইসলাম	[illegible]	[illegible]
৭২।	আহমদ	[illegible]	

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স্থান: চৌহালী ডিগ্রী কলেজ
চৌহালী, সিরাজগঞ্জ

সময়: দুপুর ৩ টা তারিখ: ১৫/০৩/২০১৭

ক্রমিক নম্বর	নাম	পেশা / পদবি	স্বাক্ষর
০১।			
০২।			
০৩।			
০৪।			
০৫।			
০৬।			

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স্থানঃ চৌহালী ডিগ্রী কলেজ
চৌহালী, সিরাজগঞ্জ

সময়ঃ দুপুর ৩ টা

তারিখঃ ১৫/০৩/২০১৭

ক্রমিক নম্বর	নাম	পেশা / পদবি	সাক্ষর
৭৯	[illegible]	শিক্ষক (অব:)	[signature]
৮০	মো: শাহজাহান সিরাজ	নির্বাহী প্রকৌশলী বাপাউবো, চৌহালী	[signature] ১৫.০৩.১৭
৮১	মো: আনিসুর রহমান	[illegible]	[signature] ১৫/৩/১৭
৮২	মঞ্জুরুল হক	ডিপুটি টিম লিডার ফিজিবিলিটি স্টাডি	Manjurul Haq
৮৩	মো: আবুল বাসার	সহকারী পরিচালক উপজেলা [illegible]	[signature]
৮৪	মো: ফরিদুল ইসলাম	সিভিল ইঞ্জিনিয়ার (পরামর্শক) FRERMIP	[signature]
৮৫	মো: জাহাঙ্গীর আলম	চাকুরী VRDS	[signature]
৮৬	মো: সরোয়ার হোসেন	চাকুরী VRDS	[signature]
৮৭	মো: [illegible]	চাকুরী VRDS	Zakir

ISPMC
Institutional strengthening and project management consultant

Joint Venture: nhc northwest hydraulic consultants | Mott MacDonald

Project Office:
House 45 (2nd Floor)
Road 27, Banani
Dhaka 1213, Bangladesh

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স্থান ঃ [illegible]
সময় ঃ ১১:৩০ তারিখ ঃ ২৭/০৯/২০১৭

ক্রমিক নম্বর	নাম	পেশা/পদবি	স্বাক্ষর
১	[illegible]	[illegible]	[illegible]
2	[illegible]	[illegible]	[illegible]
৩	[illegible]	[illegible]	[illegible]
৪	[illegible]	[illegible]	[illegible]
৫	[illegible]	[illegible]	[illegible]
৬.	[illegible]	[illegible]	[illegible]
৭.	[illegible]	[illegible]	[illegible]
৮.	[illegible]	[illegible]	[illegible]
৯.	[illegible]	[illegible]	[illegible]
১০	[illegible]	[illegible]	[illegible]
১১	[illegible]	[illegible]	[illegible]
১২	[illegible]	[illegible]	[illegible]
১৩	[illegible]	[illegible]	[illegible]
১৪	[illegible]	[illegible]	[illegible]

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স্থান ঃ
সময় ঃ
তারিখ ঃ ২৭/০৯/২০১৭

ক্রমিক নম্বর	নাম	পেশা/পদবি	সাক্ষর
১৫	রেজিয়া	গৃহিণী	রিজিয়া
১৬	মালেকা	গৃহিণী	
১৭	মঞ্জু	গৃহিণী	মঞ্জু
১৮	তাওহীদা আক্তার	গৃহিণী	তাওহিদা
১৯	মনোয়ারা	গৃহিণী	মনোয়ারা
২০	রোজিনা	গৃহিণী	রোজিনা
২১	মজিবর প্রামানিক	কৃষিজীবি	মজিবর
২২	নুর ইসলাম	কৃষি	নুর ইসলাম
২৩	খলিলুর রহমান খান ([illegible])	সদস্য, ইউপি	[illegible]
২৪	মোহাম্মদ আজম সিকদার	[illegible] ওয়ার্ড ইউপি	[illegible] 27.09.17
২৫	মো: রুকনুল হাসান	সদস্য, ইউপি	Rukunul
২৬	মোসলেম উদ্দিন	কৃষিজীবি	মোসলেম

ISPMC
Institutional strengthening and project management consultant

Joint Venture:
nhc northwest hydraulic consultants Mott MacDonald

Project Office:
House 45 (2nd Floor)
Road 27, Banani
Dhaka 1213, Bangladesh
Phone: 0088 (0) 2 986 1194
Email: ahmad.sajid@mottmac.com

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স্থান : চর সলিমাবাদ
সময় : ১১:০০
তারিখ : ১৯/১১/২০১৭

ক্রমিক নম্বর	নাম	পেশা/পদবি	সাক্ষর
১	আব্দুল্লাহ আল মামুন	চেয়ারম্যান উপজেলা পরিষদ	[signature]
২.	মো: আ: সাত্তার সরকার	প্র: শি: (অব:)	[signature]
৩।	বি, এম তৌহিদুর রহমান	সহকারী শিক্ষক	[signature]
৪	আলহাজ্ব মো: মোতাহার হোসেন মোল্লা	সমাজসেবক ব্যবসায়ী	[signature]
৫।	মো: আ: লতিফ মিয়া	[illegible]	[signature]
৬।	মো: আ: মালেক	[illegible]	[signature]
৭	শেখ ছাইদুল ইসলাম	[illegible]	[signature]
৮	মো: জহুরুল ইসলাম	সহকারী শিক্ষক	[signature]
৯	মো: [illegible]	[illegible]	[signature]
১০	মো: [illegible]	[illegible]	[signature]
১১	মো: সাইদুর রহমান	সহকারী শিক্ষক	[signature]
১২	মো: আবুল কালাম আজাদ	প্রভাষক	[signature]
১৩।	মো: [illegible]	[illegible]	[signature]
১৪।	মো: রবিউল করিম	সমাজ সেবক	[signature]

ISPMC
Institutional strengthening and project management consultant

Joint Venture:
nhc northwest hydraulic consultants
Mott MacDonald

Project Office:
House 45 (2nd Floor)
Road 27, Banani
Dhaka 1213, Bangladesh
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স্থান :
সময় :

তারিখ : ১০/০৯/২০১৭

ক্রমিক নম্বর	নাম	পেশা/পদবি	সাক্ষর
১	[illegible]	[illegible]	[illegible]
২	[illegible]	[illegible]	[illegible]
৩	[illegible]	[illegible]	[illegible]
৪	[illegible]	[illegible]	[illegible]
৫	[illegible]	[illegible]	[illegible]
৬	[illegible]	[illegible]	[illegible]
৭	[illegible]	[illegible]	[illegible]

S/

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স্থান : খাষপুকুরিয়া
সময় : ১:৩০ মি:

তারিখ : ১৭/০৩/২০১৭

ক্রমিক নম্বর	নাম	পেশা/পদবি	সাক্ষর
১।	আব্দুল্লাহ আল মামুন	মোকসুদুর চৌহালী উপজেলা	[illegible]
2	মো: আ: মজিদ সরকার	চেয়ারম্যান খাষপুকুরিয়া ইউপি	[illegible]
৩	মো: আব্দুর রউফ মিয়া	সদস্য ইউনিয়ন পরিষদ খাষপুকুরিয়া	রউফ মিয়া
৪	মো: মোস্তফা মন্ডল	মেম্বার ৪নং ওয়ার্ড	[illegible]
৫	মো: আবু দাউদ মাস্টার	চাকুরী	[illegible]
৬	মো: তারিকুল ইসলাম	শিক্ষক	[illegible]
৭	মো: আবু সাঈদ মিয়া	ব্যবসা	[illegible]
৮।	মো: আমজাদ আলী মিয়া	প্রধান শিক্ষক	[illegible]
৯।	মো: আবু সাঈদ	চাকুরী	[illegible]
১০।	" রুহুল আমিন	ইউ.পি. সদস্য	রুহুল আমিন
১১।	" মোস্তফা কামাল	ব্যবসা	মোস্তফা
১২।	" আমজাদ হোসেন	গৃহস্থালী	[illegible]
১৩।	" আবু সাঈদ	কৃষক	[illegible]
১৪।	" আনোয়ার হোসেন	কৃষক	[illegible]

ISPMC
Institutional strengthening and project management consultant

Joint Venture:
nhc northwest hydraulic consultants
Mott MacDonald

Project Office:
House 45 (2nd Floor)
Road 27, Banani
Dhaka 1213, Bangladesh
Phone: 0088 (0) 2 986 1194

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স্থান :
সময় :

তারিখ : ১৭/০৩/২০১৭

ক্রমিক নম্বর	নাম	পেশা/পদবি	সাক্ষর
১৫।	মো: কালাচান মোল্লা	কৃষক	কালাচান
১৬।	" মনু বাহাদুর মোল্লা	কৃষক	বক্কার
১৭।	" জয়নাল আবেদিন	কৃষক	জয়নাল
১৮।	" সুরুজ মোল্লা	কৃ০১৬৩২৫৫৩	সুরুজ মিয়া
১৯।	" মো: কাদের মোল্লা	সভাপতি ইউ. পি	মো: কাশেম
২০।	" রবিউল ইসলাম	ছাত্র	মো: রবিউল
২১।	" সোহরাব মিয়া	শিক্ষক	সোহরাব
২২।	" নজরুল ইসলাম	ছাত্র	জ: ইসলাম
২৩।	" আবদুল	কৃষক	আবদুল
২৪।	" ইদ্রিস আলী	দিনমজুর	ইদ্রিস
২৫।	মো: শাহজাহান মিরাজ	নি: প্র/বাগডের মেম্বাইল	[illegible]

ISPMC
Institutional strengthening and project management consultant

Joint Venture: nhc northwest hydraulic consultants, Mott MacDonald

Project Office:
House 45 (2nd Floor)
Road 27, Banani
Dhaka 1213, Bangladesh
Phone: 0088 (0) 2 986 1194

Third Round FGD meeting Sign-in Sheet, Verakhola, Shahjadpur

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Focus Group Discussion

List of Participants

Location: ভেরাখোলা, শাহজাদপুর   Date: ২৮/০২/২০
Venue: ভেরাখোলা [illegible]   Time - 9:30 AM

SL NO	Name	Occupation	Mobile No	Signature
১।	মো. [illegible] খাঁন	সাবেক চেয়ারম্যান গালা ইউ.পি	01711-394679	[illegible]
২।	মো: [illegible]			[illegible]
৩।	মো: সেকান্দার	ব্যবসা [illegible]		সেকান্দার
৪।	মো: আব্দুল [illegible]	কৃষি কাজ		[illegible]
৫।	জুলহাস	~~[illegible]~~ চাকরি		জুলহাস
৬।	মো: মোর আলী	চাকরি		মো: মোর আলী
৭।	মো: ইব্রাহ আলী	কৃষি কাজ		ইব্রাহ
৮।	আ: [illegible]			আ: [illegible]
৯।	মো: নাসির উদ্দিন	কৃষি কাজ		নাসির
১০।	মো: মজনু [illegible]	কৃষি		[illegible]
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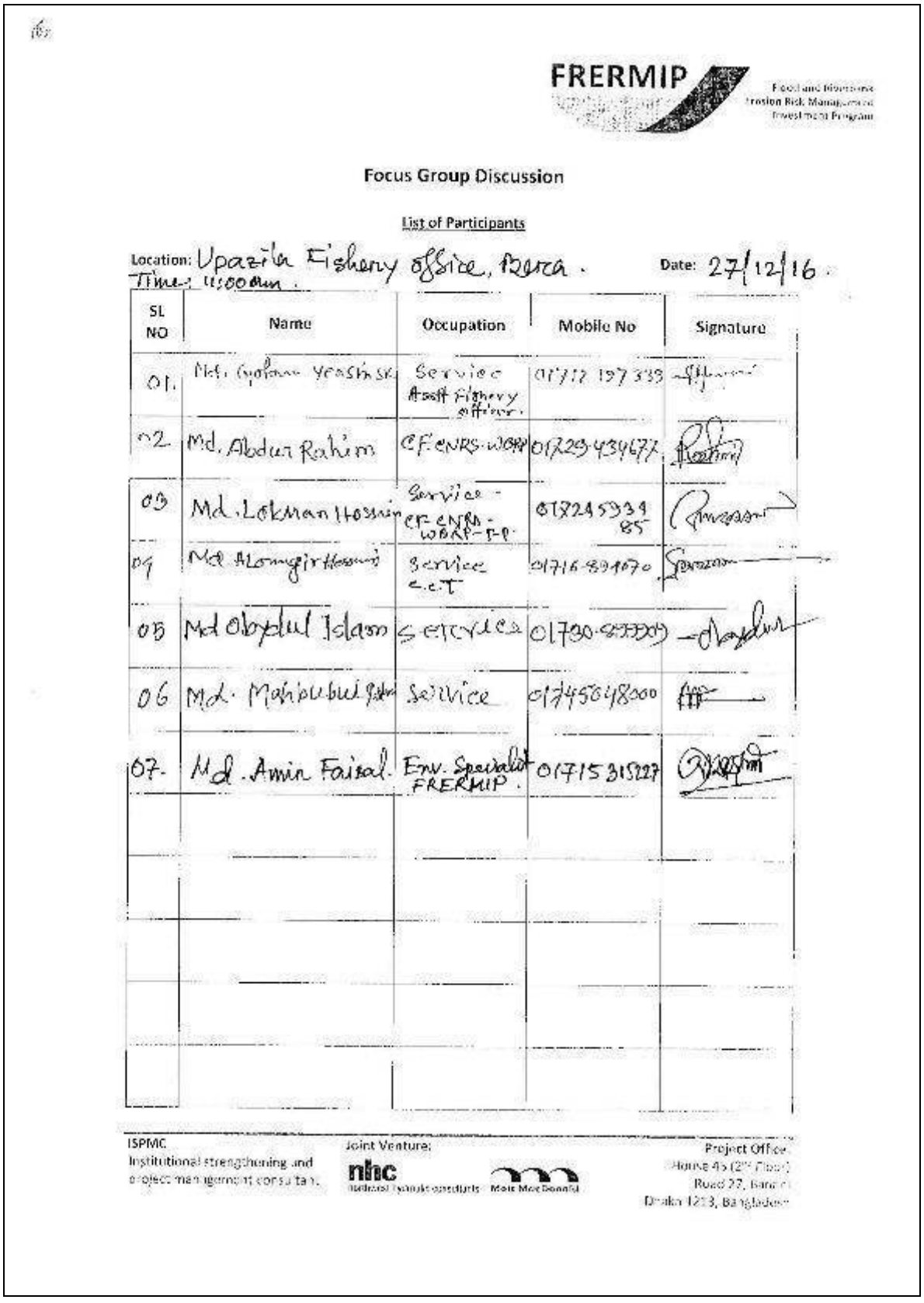
১২।	[illegible] খাঁ	"		[illegible]

ISPMC
Institutional strengthening and project management consultant

Joint Venture: nhc, Mott MacDonald

Project Office: House 45 (2nd Floor), Road 27, Banani, Dhaka 1213, Bangladesh

Third Round FGD meeting Sign-in Sheet, Fisheries Office, Bera



FRERMIP

Focus Group Discussion

List of Participants

Location: Upazila Fishery office, Bera. Date: 27/12/16.
Time: 11:00am.

SL NO	Name	Occupation	Mobile No	Signature
01.	Md. Golam Yeasin Sk.	Service Asstt Fishery officer.	01717 197 333	
02	Md. Abdur Rahim	CF-ENRS-WORP	01723 434677	
03	Md. Lokman Hossain	Service - CF-ENRS-WORP-I-P	01724 5334 85	
04	Md Alomgir Hossain	Service C.C.T	01716-891070	
05	Md Obydul Islam	Service	01730-[illegible]	
06	Md. Mahbubul [illegible]	Service	01745648000	
07.	Md. Amin Faisal.	Env. Specialist FRERMIP.	01715 315227	

ISPMC
Institutional strengthening and project management consultant.

Joint Venture:
nhc
Mott MacDonald

Project Office:
House 45 (2nd Floor)
Road 27, Banani
Dhaka 1213, Bangladesh

Third Round FGD meeting Sign-in Sheet, Koitola, Bera

FRERMIP Flood and Riverbank Erosion Risk Management Investment Program

Focus Group Discussion

List of Participants

Location: Birol ~~Sanctuary~~ Sanctuary, Koitola, Bera. Date: 27/12/16
Time: 3:00 pm

SL NO	Name	Occupation	Mobile No	Signature
1	Sree Akash Kalidas Koitola up.	Bird sanctuary owners		
2	Sree Fanindranath Sh	Local people		
3	Sree Basudev Sahil	Farmer	01713745302	
4	Sree Banesh chandra sen	Land owner	01741061673	
5	Md Mizanure Rahman	Ex V.P member	01678668391	
6.	Md. Amin Faisal	Environment specialist-	01715315227	

FRERMIP

Flood and Riverbank Erosion Risk Management Investment Program

Focus Group Discussion

List of Participants

Location: District Fisheries office, Pabna. Date: 27/12/16

Time: 7:30 PM

SL NO	Name	Occupation	Mobile No	Signature
01	Md. Golam Rabbani District Fisheries Office Pabna	Dept. of Fisheries (DOF) Govt. of Bangladesh	01712715430	
02	[illegible]	[illegible]	01715315227	

APPENDIX H - STANDARD CONSTRUCTION CONTACT ENVIRONMENTAL SAFEGUARD CLAUSES

H1 Environmental Protection and Control of Pollution

H1-1 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.

H1-2 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, 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 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.

H1-3 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 labour, 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.

H1-4 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. The budget for this purpose in the contract package should be arranged.

H1-5 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.

For any damage to the standing crops due to intervention of the project activities, the compensation will be paid to the affected person (AP) on receiving his/her claim to GRC.

H2 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 labourers 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).

H3 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.

H4 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.

APPENDIX I - PROJECT IMPLEMENTATION ARRANGEMENTS

I-1 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, DoF, DAE, DoFo 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

I-2 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 a Chief Engineer/Additional Chief Engineer/Superintending Engineer and supported by two Superintending Engineers and four Executive 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.
(vi) A environmental monitoring section headed by an Executive Engineer in PMO to moniror the EMP compliance and other environmental issues of the Project supported by SMOs, an International Environmental Specialist and a national Environmental Specialist from the ISPMC team.

Figure A1-1 depicts the ~~program~~ project management organogram for BWDB/FRERMIP management, as provided by the PMO in ~~February 2018~~ June 2020.

I-3 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.

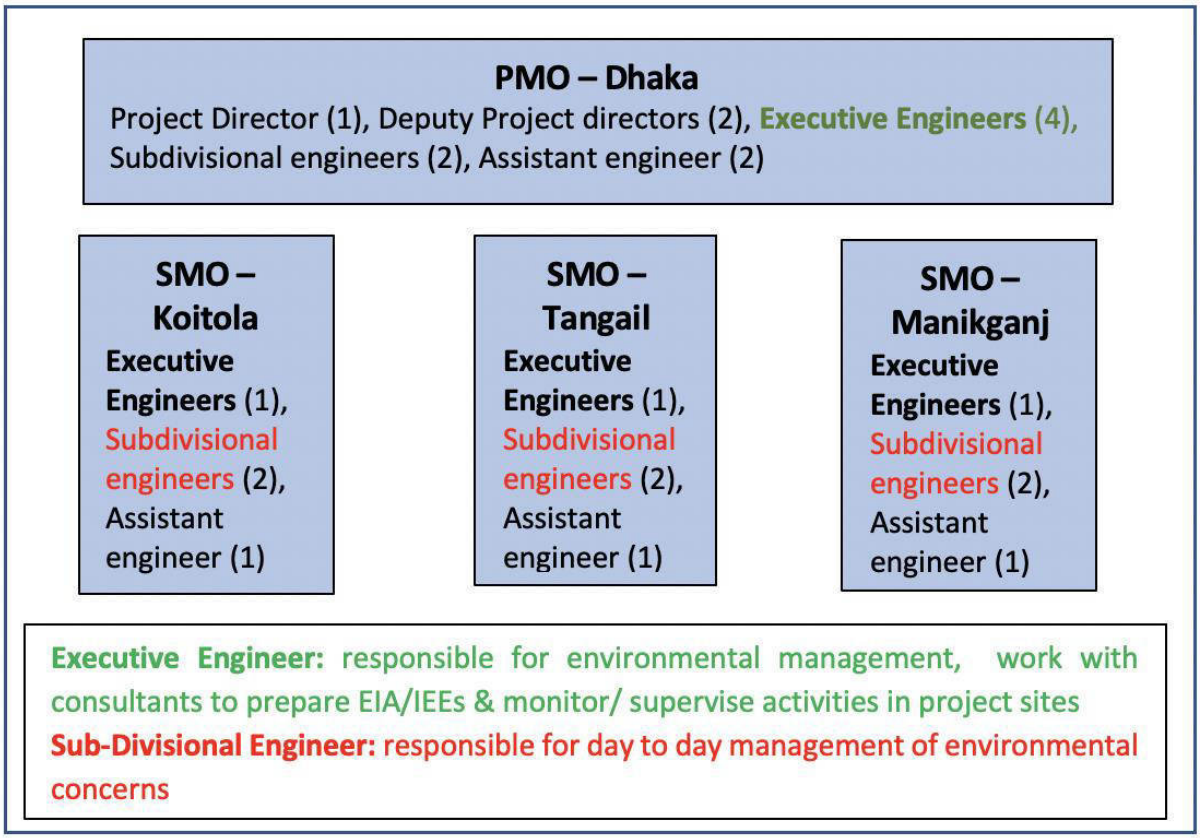
I-4 Management Information and Reporting

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 FRERMIP (Individual Consultants, 2012). Component (iii) has been developed further for BWDB and forms part of the institutional report. The reporting requirements form also part of ADB's project implementation memorandum.

Figure I1-1 PMO/SMO responsibility framework for FRERMIP Project2



APPENDIX J - BIODIVERSITY BASELINE AND FISHERIES DEVELOPMENT STUDY

Terms of Reference for Consultancy Services for Updating the Biodiversity Baseline and Monitoring Plan; Preparation of a Fisheries Development Plan

J-1 Background

1. The ADB-funded *Flood and Riverbank Erosion Risk Management Investment Program* (FRERMIP), aims to sustain incomes and livelihoods of people living along selected reaches of the Jamuna and Padma Rivers 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 2015 until 2023. Tranche-1 of the MFF consisting of three sub-projects: Jamuna Right Bank 1 (JRB-1), Jamuna Left Bank 2 (JLB-2), and Padma Left Bank 1 (PLB-1) – marked as 'FRERMIP recovery of lost floodplain' in Figure 1.

2. The Program includes structural measures, extensive non-structural activities, institutional strengthening, as well as preparing a long-term strategic river stabilization plan for the Jamuna, Padma and Lower Meghna rivers, i.e. between the Indian border and the estuary mouth (Figure 1).

3. 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.

4. After initially protecting critically eroding riverbanks at priority areas under Tranche-1 (November 2015 to end-2018), and conducting the wider long-term strategic river stabilization study (November 2015 to mid-2016), 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 (BRE) 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.

5. The riverbank protection approach builds on and extends technical principles established under the *Jamuna-Meghna River Erosion Mitigation Project* (JMREMP; 2004-2010). Embankment designs follow best international practice providing access along a land-side planform with the opportunity to raise embankments later in response to climate change requirements with limited means. Tranche-1 JLB-2 and PLB-1 physical works consist of riverbank-erosion protection works along critically eroding areas only. JRB-1 consists of limited riverbank-erosion protection works in support of existing works and the restoration of degraded and eroded flood embankments, specifically a section of the most downstream

part of the historic Brahmaputra Right Embankment. Flood embankments will also be rehabilitated behind the JLB-2 and PLB-1 erosion protection works, but not until Project-2.

6. The FRERMIP was prepared through Project Preparatory Technical Assistance (PPTA) 8054, called *Main River Flood and Bank Erosion Risk Management Program* (MRP) that delivered its (draft) final report in December 2013 – the final ADB version became available in May 2014. Among others this PPTA resulted in an Environmental Assessment and Review Framework (EARF, first version May 2014), its purpose being to guide the preparation of future tranches of the FRERMIP. It also produced a full EIA for the planned FRERMIP interventions for Tranche-1 (May 2014).

7. Specific guidance is required as the FRERMIP intends to move from localized riverbank protection towards stabilization of first river reaches of the main rivers in central Bangladesh. This approach includes the reclamation of lost floodplain land 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 accounts for the dynamic river morphology that experienced dramatic changes over the last 40 years, which are still ongoing.

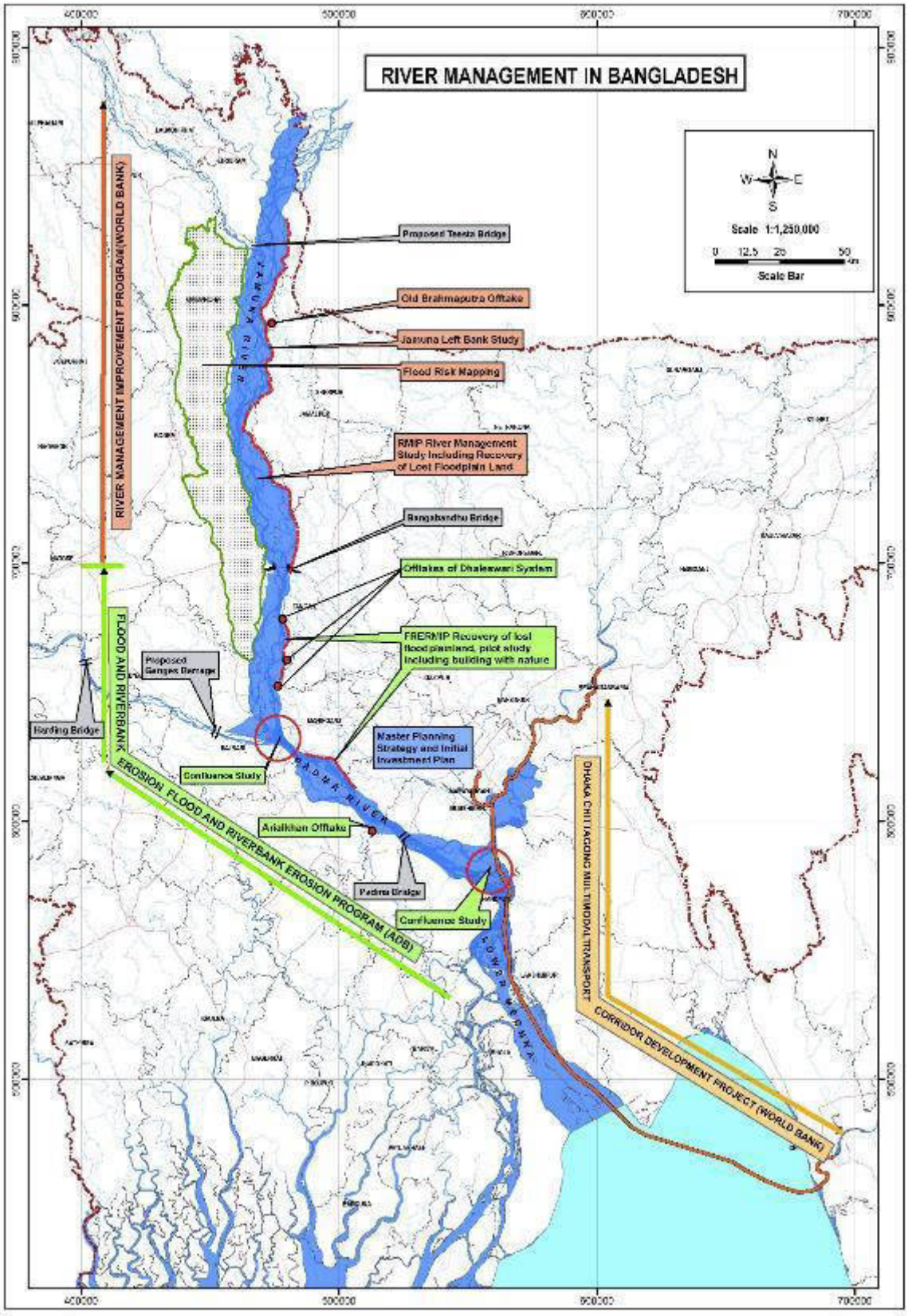


Figure J-1 –FRERMIP's physical intervention area, and study area for the Long-term Strategic River Stabilization Plan: Jamuna / Padma / Lower Meghna

8. The historic river course, some 40-years ago, has exhibited planforms that are relevant for future planning. To this end the study of historic habitat characteristics will help to determine a suitable baseline for the rapidly changing river environment but also allow to draw analogies to future planned river courses, narrower than today's river.

9. The anticipated benefits of the planned works 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 and pond-fish production on less-flooded agricultural land.

10. While its anticipated benefits are considerable, the Program potentially negatively impacts both the floodplain and the river environment. 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 water quality. Erosion protection of the Program may alter river morphology along reaches beyond the works, change 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 (e.g. fish, birds, dolphins).

11. The FRERMIP 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 started in Tranche-1 with protection of critically eroding riverbanks and the reconstruction of the destroyed BRE, 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 Project-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.

12. The FRERMIP 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.

13. Mitigation measures suggested for larger-scale river stabilization include:

(i) Development of stabilization alternatives and assessing environmental impacts in the Jamuna-Padma-Meghna river system through a Long-term Strategic River Stabilization Study, i.e. from November 2015 to June 2016.
(ii) Biodiversity baseline elaboration, both in river and floodplain, identification of locations for fish sanctuaries, and their establishment.
(iii) Development of EIA studies for each subsequent tranche.
(iv) Formulation of fisheries and aquatic biodiversity development plans to enhance fisheries production to compensate for adverse biodiversity and fisheries impacts.

14. 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 charland faster into floodplain land.

J-2 Objectives

15. Simultaneously with conducting the Long-term Strategic River Stabilization Study (Figure 2) environmental measures for potential larger-scale river stabilization (Figure 3 provides preliminary options) need to be investigated and suitable mitigation measures, such as aquatic sanctuary identified and detailed. This involves:

(i) Identify historic developments and changes pertaining to the number of species and areas available to them within the river belt and adjacent floodplains from the 1960s to 2015.
(ii) Identification of monitoring indicators for major flora and fauna components in the study area, i.e. the Jamuna-Padma-Lower Meghna(river and floodplain) between the Indian border and the estuary mouth, and 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.
(iii) Elaborating on the already existing biodiversity baseline for the study area's influence areas, i.e. building further (rather than duplicating) on baselines already established under FRERMIP and RMIP. The focus here is on identifying and mapping important habitats for fish, (migratory) birds, dolphins and other wildlife in river and floodplain of the study area, and assessing how these may be impacted (e.g. form/increase or reduce/disappear) by the river stabilization options proposed as part of the long-term strategic river stabilization plan.
(iv) Considering the environmental and fisheries impacts, various strategic development options for river stabilization in the study area as proposed under the long-term strategic river stabilization plan.
(v) Analysing the effectiveness of existing (fish) sanctuaries and other protected areas in the study area, and proposing improvement, including capture and pond culture fisheries to document past trends and needed improvements.
(vi) Identifying, as necessary and if deemed feasible, suitable locations for sanctuaries or other protected areas, and developing detailed plans for establishment of such sanctuaries or protected areas, to compensate for project impacts and that contribute to a long term conservation of aquatic and terrestrial habitat.
(vii) Assessing historic development of fisheries/aquaculture, their present status and prospect of contributions to the aquatic biodiversity and fisheries impacts.

J-3 Consulting Services

16. Consulting services are solicited from one or more firm/NGO/research institute experienced in setting ecological baselines, biodiversity monitoring, defining conservation status of species and their conservation strategy and restoration, establishment and management of (fish) sanctuaries, and aquaculture practices with proven international and national experience to provide necessary technical services. The consulting team will include a mix of experts with experiences in biology of the various species and habitats. The interested party/ies should have experience in similar works and preferably have working experience in Bangladesh.

17. Sanctuary Establishment Plans should include a detailed Management & Monitoring Plan. The latter should identify the responsible persons/organizations and present a site-specific or/and species-specific management /monitoring plan for the required inputs.

J-4 Scope of Services

18. The consultants of the firm/NGO/research institute shall familiarize with the FRERMIP, RMIP and other relevant project documentation, as well as liaise with the team conducting the Long-term Strategic River Stabilization Study, and maintain close coordination with the Environment Unit of PMO. The scope of works is defined as follows.

Task 1 – Existing environmental/biodiversity baselines

(i) Identify, collect and study relevant existing environmental/biodiversity baselines for the long-term river stabilization study area[40] and identify information gaps.
(ii) Describe based on available information historic developments, changes and trends pertaining to the number of species and areas available to them within the river belt and adjacent floodplains from the 1960s to 2015.
(iii) Oversight and summary of relevant existing biodiversity baselines for the study area.

Task 2 – Biodiversity baseline for Project-2 area

(i) Biodiversity baseline for the Project-2 area (river and floodplain) through existing information and additional field data collection (including seeking local knowledge) as needed with a focus on (i) critically endangered and economically important species, including Hilsa and dolphin, resident and migratory birds, and other wildlife; (ii) frequency , abundance, distribution and migration patterns, dislocation of indicator species of wildlife in the study area; (iii) distribution and extent of key habitats (e.g. river, beel, channel, chars, mudflats, sandflats, reeds, agricultural fields, homesteads, etc.);
(ii) Mapping important habitats for key biodiversity and economic species in the study area for the period 1960s to 2015 as per available data;
(iii) Analysis of key environmental issues impacting on biodiversity;
(iv) Identification of key monitoring indicators;
(v) Biodiversity Monitoring Plan, including methodology, key monitoring indicators, responsible organisations, frequency, reporting, costs.

Task 3 – River stabilization impacts for Project-2 area

(i) Identify FRERMIP impacts (positive and negative) on biodiversity and recommend remedial measures and visualization of results (tables, graphs, maps);
(ii) Identify impacts (positive and negative) of planned river stabilization interventions options on the biodiversity and key habitats (distribution, extent), propose alternatives and mitigation measures and visualization of results (tables, graphs, maps);
(iii) Stakeholder consultations will be conducted as needed and may include public representatives, Department of Environment, Department of Fisheries, Department for Wildlife Conservation, NGOs, representative of major professional groups (fishermen, agriculture farmers, etc. – men and women) and charland dwellers at the sites.

[40] Currently the Jamuna/Padma/Lower Megna between the Indian border and the Bay of Bengal. The Study Area will be delineated in January 2016.

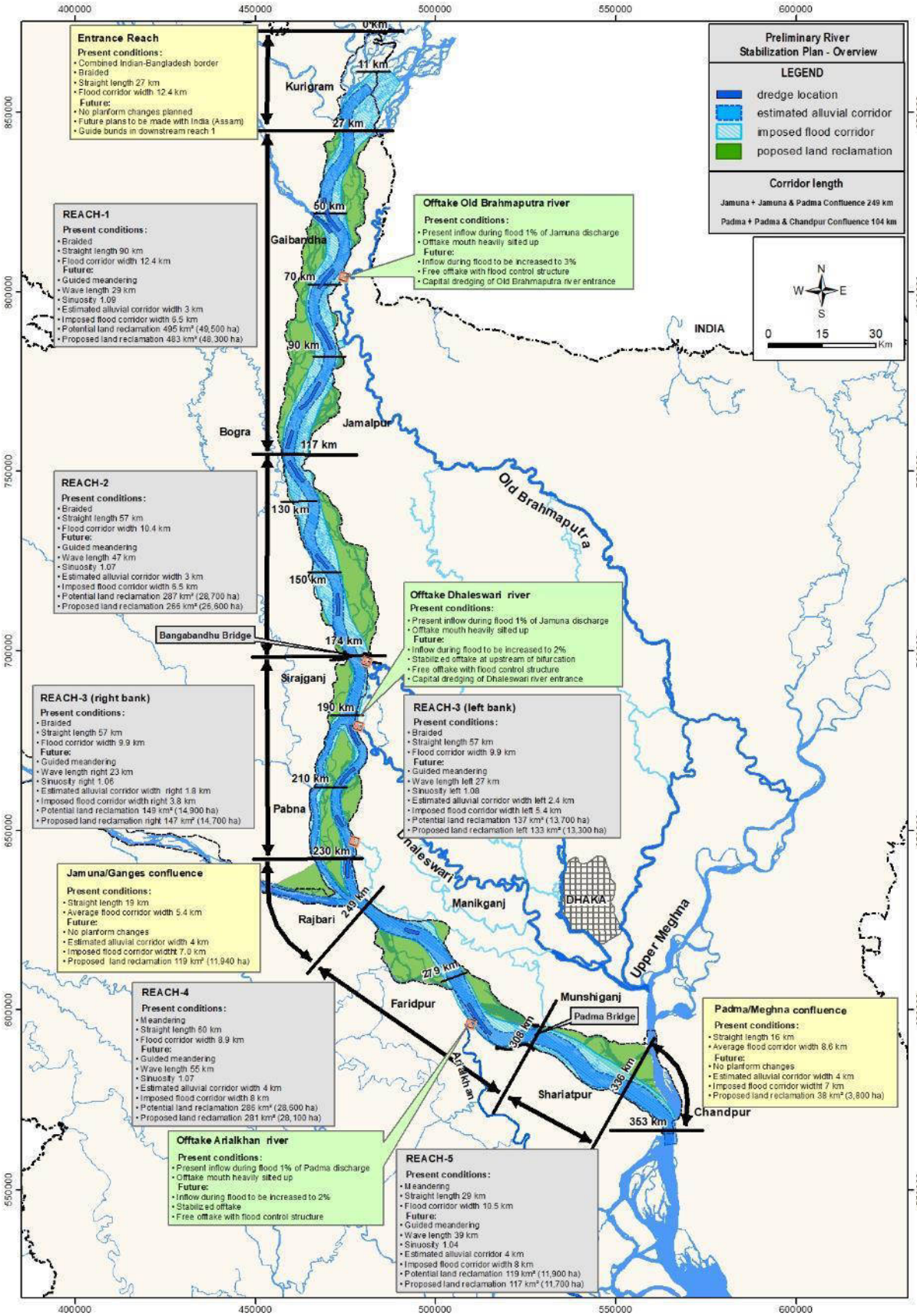


Figure J1-3 – Reference project option for long-term river stabilization from River Stabilisation Plan (2020)

Task 4 – Aquatic sanctuary and fisheries development in Tranche-1 and Project-2 areas

(i) Identify the location of existing (fish) sanctuaries and assess for these their functioning (success / failures), analyse constraints, including capture and pond fisheries to document past trends, and determine requirements for effective sanctuary operation and management; if such areas do not exist within Tranche-1 and -2 areas, a number of representative sanctuaries will be studied elsewhere (e.g. north of Jamuna bridge – see RMIP report, July 2015)
(ii) Identification of and recommend suitable locations, with justification, where one or more sanctuaries may be established in the Tranche-1 and -2 areas, including guaranteeing sustained connectivity to the river ecosystem;
(iii) Public consultations with charland dwellers, local leaders, representatives of local fisheries, forestry, environment, wildlife conservation departments or units, relevant NGOs, representative of major professional groups (fishermen, agriculture farmers, etc. – men and women) at the sites and consider outcomes in identifying suitable locations.

19. The following criteria should be considered for the sanctuaries:

(i) Located in the lower Jamuna downstream of Jamuna Bridge;
(ii) Location be relatively insensitive to river erosion;
(iii) Chars with reedlands with submerged areas are generally suitable due as these provide aquatic and bird habitat as well terrestrial habitats;
(iv) Consider existing erosion and accretion processes on site and the impact of short- and medium-term (FRERMIP) and impacts from long-term river stabilization interventions;
(v) Proposed locations may need to be located or raised to a height of 1-3 m above the monsoon water level and should contain a number of water bodies or channels and have least seasonal connection to the main river system;
(vi) Consultations with local community and government organizations is needed to agree on the project location;
(vii) Potential location sites will be mapped and zoned on the existing revenue maps to enable BBA to identify land for acquisition purposes.

Task 5 – Biodiversity Sanctuary/ Protected area planning

Two basic types of sanctuaries/ protected area should be planned

(i) River Charlands Sanctuary/Wildlife protected area specially for aquatic birds/mammals
(ii) Floodplain Sanctuary specially for biodiversity/Fisheries development

20. Sanctuary Establishment Plans should be prepared for at least two sites for River Sanctuary and for a number of locations to be identified for Floodplain Sanctuary, including:

(i) Detailed design including demarcation of core and buffer zones, as well as connections with open (river) water;
(ii) Site location reflected on the mouza maps for land acquisition purposes;
(iii) Existing and required infrastructure such sluice, bridge, road, fish pass, etc., as well as needed repair and maintenance works;
(iv) Core zone to include charland and river: a critical part of the design process will focus on the establishment of nursing and feeding areas for fish, crustaceans, turtles, dolphins, etc.;
(v) Access paths and hides for observation for eco-tourism;

(vi) Experience from fish sanctuaries developed in Hakaluki in 2008 by the DoE under the 'Coastal and Wetland Biodiversity Management Project' in Brahmaputra River by Bangladesh Agriculture University and Wetland (Floodplain) Sanctuary established under the Wetland Biodiversity Rehabilitation Project of giz-DoF and Fish Sanctuary established under the Community based Fisheries Development Project of DoF and LGED will be considered in the design;

(vii) Stakeholder consultations will be conducted, and outcomes considered in planning the establishment of Sanctuary.

Note: morphological statistical information on river, char and floodplain dynamics (including water depth, cross-sections, charland extent and movement, erosion/accretion rates) in the study area will be made available by FRERMIPs morphologists.

Task 6 – Fisheries development

(i) Assessment of adverse impacts of the project interventions on the river and floodplain capture and culture fisheries including aquatic biodiversity;

(ii) Identification of the impacted fisheries community in the river and Floodplain capture and culture fisheries sector;

(iii) Assessment of status of the technology and methods of exploitation of the river and floodplain capture and culture fisheries of the subproject area;

(iv) Assessment of potential of and outline methods for development of the fisheries sector to compensate for adverse impacts of the project intervention;

(v) Detailed description of the plan for and functional details of the fisheries development program including aquatic biodiversity, fish, fisheries and fisheries community.

J-5 Time Frame

21. The expected to start in 2020 and will be conducted in a period of 14 months (12 months of field study and 2 months of assessment and reporting), including revisions based on comments by BWDB~~B~~, other agencies and ADB.

J-6 Reporting Requirements/Deliverables

22. The firm/NGO/research institute will prepare and submit the following reports and deliverables during the Services:

- Inception Report (Month 1) – including outlining the methodology for data collection and analysis, data sources to be used, detailed work and outcome planning.
- Report on existing baselines and information gaps (Month 2)
- Draft Biodiversity Baseline and Monitoring Plan & Impacts of Planned Developments (Month 6) – including an updated biodiversity baseline, and impacts of river stabilization options visualized in tables / graphs / maps.
- Final Biodiversity Baseline and Monitoring Plan & Impacts of planned Developments (Month 8)–addressing comments received from various parties.
- Draft Sanctuary Analysis & Establishment Plan and Fisheries Development Plan (Month 12).
- Final Sanctuary Analysis & Establishment Plan and Fisheries development Plan (Month 14) – addressing comments received from various parties.
- Monthly progress notes as per agreed template.

In addition, the firm/NGO/research institute will conduct the following meetings/workshops:

- Presentation of the inception report
- Presentation of the draft Biodiversity Baseline, Monitoring Plan and Development Impact report;
- Presentation of the draft Sanctuary Analysis and Establishment Plan(s);
- Meetings with stakeholders and public consultation as needed.

J-7 Staffing and Inputs

	Position	No	Person month	Minimum qualification	Field and minimum experience
	A. Professional Staff				
	International				
1	Environmentalist / Team Leader	1	10	MSc in environmental/ aquatic or allied science	15 years' experience in planning and management of aquatic environmental management project
	National				
2	Ecologist /Fisheries Specialist, Deputy Team Leader	1	10	MSc in environmental/ aquatic or allied science	8 years' experience of working in aquatic environmental project
3	Botanist/Forestry Specialist	1	5	MSc in botany/forestry/bio sciences	5 years' experience in relevant fields
4	Fisheries Specialist	1	10	MSc in fisheries/aquatic or allied science	8 years' experience working in fisheries
5	Aquaculture Specialist	1	6	MSc in aquaculture/aquatic of allied bio sciences	5 years' experience in relevant field
6	Civil Engineer	1	4	BSc in civil, construction engineering	10 years of experience in design and construction of river protection works and hydraulic structures
7	RS/GIS Specialist	1	4	BSc in GIS/RS urban/rural planning / geography	10 years' experience in mapping and zonal planning.
	Field Staff				
8	Field Surveyor/Data collector	3	12*	BSc in any field of bio Sciences	3 years' experience in relevant field work
	Office staff				

	Position	No	Person month	Minimum qualification	Field and minimum experience
9	Office manager	1	12*	Graduate	5 years' experience in office maintenance/support stafft
10	Office boy /Messenger	1	12*	SSC	years' experience

Considering proposed extended period of consultancy service

APPENDIX K - NCEA COMMENTS ON 2014-EIA & ISPMC RESPONSE

The consultant that conducted the PPTA for FRERMIP issued its draft EIA report, version R7, for the project on 28 February 2014. The Netherlands Embassy in Dhaka then contracted the Netherlands Commission for Environmental Management (NCEA) to review the report. Subsequently the NCEA conducted the review in two phases: Phase 1 focused, among others, on the February version on the EIA report in which the NCEA noted some shortcomings, after which the ADB decided to adjust the EIA report, which resulted in a next version of the report, i.e. of 16 May 2014 (https://www.adb.org/sites/default/files/project-document/80829/44167-013-eia-02-0.pdf).

Then, during Phase 2 the NCEA reviewed this revised version of the report and came up with recommendations. NCEA's findings were presented in its advisory review report, dated 26 June 2014, downloadable from: http://api.commissiemer.nl/docs/os/i00/i0098/27-06-2014_final_advice_bangladesh.pdf.

The following matrix indicates how the (summarized) comments of the NCEA have been or are being addressed.

Nr	*Summary of NCEA's comments on the EIA of 16 May 2014*	Response of ISPMC
1.	*Justification and comparison of alternatives – This has not been studied in the EIA nor in the feasibility study, for example the Capital Dredging Study and FRERMIP's comprehensive stabilization plan to identify potential river stabilization solutions to be implemented in an adaptive manner with minimal impact on river and char development. Include the findings of the feasibility studies in the development of the planned SEA study.*	Alternatives are being considered in FRERMIP's long-term River Stabilization Plan for the active Jamuna/Padma and Lower Meghna River channel, as well as in its long-term River Management Master Plan. As part of these plans a Strategic Environmental and Social Assessment (SESA) has been prepared, addressing among others downstream and cumulative impacts of proposed interventions in the JPM river system. Capital dredging is considered by the FRERMIP consultant as an unfeasible solution to sustained long-term river management.
2.	*Downstream impacts of the Brahmaputra Right Embankment project under JRB-1 are not presented in the report. These should be studied in the long-term morphological / stabilization study that will be carried out during Tranche-1 and the findings could be presented in the SEA.*	There could be two levels of impacts: associated with the riverbank protection stabilization works to secure the embankment and associated with the impact of the embankment works on flood levels. Potential downstream river instability is mitigated through a 7 km long riverbank protection work from the Hurasagar to Kaitola, which was completed under JMREMP in 2008. This protection work is

Nr	*Summary of NCEA's comments on the EIA of 16 May 2014*	Response of ISPMC
		in good condition. In conjunction with the upstream 10 km long protection between Kaijuri and Verakhola, an about 30 km long river reach has been stabilized morphologically as demonstrated by successive dry season imagery. The impact on flood levels is not measurable as the embankment gap did not withdraw large amounts of flood waters. In addition, the BRE was closed from the mid-1980s until the mid-1990s before it eroded and the work only relates to the closure of an embankment gap as opposed to new construction. In summary, the reach has become stable with no discernible downstream embankment of the reconstructed BRE the JLB-1 sub-project. This has been included in this EIA.
3.	*Livestock – Given the fact that grazing on chars and floodplains provides food to livestock, the present use of the floodplains by livestock and the economic importance for people owning livestock, as well as the influence of the proposed interventions on the availability and quality of grazing land is insufficiently described in the EIA report.*	The ultimate goal of the FRERMIP is to stabilize the main rivers with two main purposes (i) a stable delineation between floodplain and river, and (ii) reclamation of lost floodplain land, converting infertile sand bars into fertile floodplains. The latter will lead to increased opportunity for using the land for agriculture but also intensive livestock, horticulture, etc. The overall larger floodplain area available after river stabilization will provide the opportunity for even increased grazing areas. Therefore, it is expected that grazing will continue within the stabilized river corridor, as well as on agricultural lands of the former and floodplains when there are no crops.
4.	*Fisheries – Although indications are provided on commercial and subsistence fishermen in some areas, part-time fishers have not been mentioned. This is important as the majority of landless households are involved in fishing during part of the year. The proposed remedy to mitigate lost fish potential with development of*	In recent years, fishing is becoming challenging while more rewarding jobs are becoming available, even in rural areas. While professional fishers somehow survive, occasional fishers change their profession. In certain areas, part-time fishers do not exist anymore. Aquaculture is thriving in the country, requiring substantial numbers of labourers. As

Nr	*Summary of NCEA's comments on the EIA of 16 May 2014*	Response of ISPMC
	aquaculture is not realistic as particularly poor people do not possess land and means to develop aquaculture.	salaries offered in the aquaculture sector are significantly higher than other sources of income in the rural setting, this can compensate for production loss due to river mangement interventions. For those that still continue with part-time fishing, fish will be benefitted in two ways: (i) the stabilized river will attain a maximum depth similar to the one observed in the 1960s before the sediment wave changed its character, and (ii) through regularly spaced fish passes in the embankment lines to reconnect floodplain and river from pre- to post-monsoon. In addition, fish sanctuaries will be established in the main river channels to provide sheltered habitats for fish to recover. These measures are expected to enhance fish stocks, provided that fish sanctuaries and fish passes are effectively managed, i.e. by communities themselves. The SESA details various mitigation measures.
5.	*Brick industry – The EIA does not address the brick making industry in the floodplains. The brick manufacturing sector contributes significantly to Bangladesh' carbon emissions. As considerable quantities of concrete will be used for FRERMIP made from brick chips, the impact on floodplain and carbon emissions needs to be addressed.*	The BWDB has not used brick chips for cc blocks for riverbank protection works since 2001, among others because cc blocks made with brick chips are too light to effectively protect banks from erosion. Instead shingles/crushed stone is used in manufacturing cc blocks for riverbank protection works. These chips are collected in and transported from Madhyapara, Dinajpur, Northern Bangladesh. To further reduce transportation cost, and carbon emissions, the use of grout-filled mattresses will be considered, only requiring sand and cement as ingredients.
6.	*People affected – Negative impacts of the project interventions on people that will be affected have insufficiently been described. Apart from losing grazing land this may include sharecroppers or other farmers without official land titles who may lose access to land due to more influential people claiming land*	The outcome of river stabilization will be increased land available for farming, industry, settlements etc. This notwithstanding, a land redistribution process will take place in areas formerly eroded. Large-scale land reclamation therefore depends on a suitable land law regularizing the process of land acquisition and compensation of existing char land,

Nr	*Summary of NCEA's comments on the EIA of 16 May 2014*	Response of ISPMC
	due to its higher production potential.	stabilizing the river in that area, and land-use zoning and land development. The existing owners can be identified from mouza maps superimposed with banklines from the last 30 years.
7.	*Gender aspects – The Gender Action Plan is incomplete, lacks clear implementation arrangements and in its present form does not guarantee that the objective of the program of effective gender mainstreaming will be achieved.*	Noted, however the GAP is not applicable to the EIA.
8.	*Biodiversity aspects – The report does not provide insight in the impact of the program on protected areas; for some species the baseline does not provide sufficient insight in crucial habitats for the survival of all protected species of global and national significance, and the extent to which these species and habitats might be influenced by the program.*	A Terms of Reference for updating the biodiversity baseline and preparation of a fisheries development plan, included as Annex 13 in the May 2014-EIA has been revised based on the currently available information and needs, and this will be tendered in 2017. The updated ToR is enclosed in an Annex of the present EIA.
9.	*Anti-erosive measure – The proposed planting of trees on (slope) embankments is not appropriate to reduce erosion. Protection with shrubs and low vegetation is generally more effective for rain and wind erosion on such places.*	This is correct and the trees do not fulfill the function of erosion protection. They are rather placed as compensation for trees cut during embankment construction and to improve driveability. This was already incorporated in the May 2014 version of the EIA report.

APPENDIX L - ADB COMMENTS ON DRAFT EIA & ISPMC RESPONSE

ADB submitted its comments on the draft EIA for Project-2 of 12 December 2017 on 8 February 2018, with further comments on particularly the annexes of the report on 13 February 2018. In the table below these ADB comments are listed and the ISPMC's response indicates how the comments have been addressed in the current final version of the report.

Page	Item/section	*ADB comments*	ISPMC Response
2	Figure 1-1.	*Replace with clearer map*	Figure replaced.
26	Figure 4-3.	*Replace with clearer map*	Figure deleted – see Figure 1-1.
28	Figure 4-4.	*Replace with clearer map*	Figure replaced.
36	Figure 5-1 & Figure 5-2	*Update with more recent data of monthly rainfall and temperatures*	Data was requsted from BWDB, but not provided.
36	Table 12 1. Reaches along Padma left bank.	*Please check the coordinates (start x/y and end x/y) for the Reaches 1a, 1b, 2a, 2b and 3 if they fall along the Padma left bank.*	Checked but OK; all are along the Padma left bank. Coordinates were determined with the BTM (Bangladesh Transverse Mercator) projection which is commonly used by BWDB and SoB.
38	Table 12 2. Location and purpose of regulators for the whole embankment length from Paturia to Dohar	*Please check the coordinates (easting and northing) for the Regulators 1-6 if they fall along whole embankment length. They seem not in the location of the project area.*	Checked but OK. Initially there were 34 km of embankment and 6 regulators, but reduced to 17 and 4 respectively, due to economic feasibility. All structures are in the project area. Table 4-9 and Figure 4-10 revised.
41	Paragraph 148	*Presence of "()". Please revise accordingly*	Revised.

Page	Item/section	*ADB comments*	ISPMC Response
41-45	Table 5-1, Table 5-3, Table 5-10	*Update with more recent data on discharges of Jamuna – Padma, water levels, and ground water levels.*	Data was requsted from BWDB, but not provided.
52	Table 12 3. Surface water quality of Jamuna and Padma	*Where are the surface water quality of Jamuna and Padma River for the months of July to December? Please include surface water quality of Jamuna and Padma for the months of July to December. This will serve as part baseline information of the river system.*	Table expanded.
62	Paragraph 209 and Table 12 4. Land use	*The paragraph and Table 12 5 do not match. Please revise accordingly*	Paragraph and Table corrected.
67- 68	Items 5.5.1 Health and Disease and 5.5.2 Rearing Constraints	*These are not related to the project scope. Please remove these items*	Sections deleted.
68	Paragraph 234	*Please provide a map for the locations of the seasonal and perennial khals (canals), beels (floodplain depressions) and the associated flood lands*	Map added.
68	Paragraph 235	*Please include in the sentence the source of the information. "Fish biodiversity is also rich in the area but is declining due to indiscriminate fishing, obstruction of migration routes (especially in the dry season), discharge of industrial wastes, poor fisheries management, siltation, oil spills, insecticide contamination, and loss of critical habitats to siltation and bank erosion."*	Done.
69	Figure 5-15. Open water (l) and bankline fish habitat	*Include the location of the photograph where they are taken*	These pictures were taken from the FRERMIP Tranche-1 EIA (2014) that did not mention the location. Two new pictures included with known location.
72	Paragraph 250	*Please include in the sentence the source of the information. "Three types of fishers are found in the study area, i.e. (i) commercial or fulltime fishers; (ii) occasional or part time fishers; and (iii) subsistence fishers. Commercial or fulltime fishers are professional*	Done.

Page	Item/section	*ADB comments*	ISPMC Response
		fishers."	
73	Figure 5-17. Seasonality of fishing and types	*Please include in the sentence the source of the information for the table*	Source added.
77	Table 12 6. Locations of Beels and their connectivity (Project-2 area)	*Provide map for the table*	This requires major further inputs that will be conducted as part of the various baseline studies planned.
80	For the items under 5.7.1 Bioecological Zones - Introductions	*Provide a map showing the Teesta Floodplain, Major Rivers, Brahmaputra–Jamuna Floodplain, Chalan Beel, and Ganges Floodplain.*	Map provided.
83	Terrestrial Fauna	*Revisit the IUCN category of each species mentioned in the EIA. Indicate the appropriate IUCN category for each species in the area. As an example, Varanus flavescens has a status of Lower Risk/least concern to the IUCN website, however, Varanus flavescens in the EIA (paragraph 305) is endangered. This creates confusion on the status of the species. Also, spell the scientific names correctly.*	Species list in annexes checked with IUCN Red List (2015) and main text adjusted.
86	Paragraph 322	*Please indicate the source of information stated in the Climate Change in Bangladesh.*	Indicated.
99	5.8.10 (b) Waterways	*Provide map for the waterways that will show the navigation routes of the area mentioned in paragraph 348. Please delete paragraph 349*	Waterways map added, paragraph 348 rewritten. Paragraph 349 deleted.
102	5.8.16 Historical, Cultural and Archaeological Sites	*Provide map for the Historical, Cultural and Archaeological Sites*	Map added.
112	7.2.1 Erosion and Accretion	*Please provide a baseline information for the paragraph 412. There are no baseline information of the sediment loading or amount of total suspended solids (TSS) in the Chapter 5. Environmental and Social Baseline of the EIA Report.*	Baseline on erosion/accretion added as Section 5.2.2.

Page	Item/section	*ADB comments*	ISPMC Response
110	Grievance Redress Mechanism	*Make a separate chapter for this section. Add a flow diagram that will show the components and time frame of the mechanism*	Chapter (9) on GRM added.
134	EMP 10.1.1 Noise, Mitigation / Enhancement / Compensation / Contingency	*Please add the concept of "hours of operation are observed"*	Usually at site work starts at 8 AM and ends at 5 PM. Vehicle movement for mobilization of construction materials and operation of construction equipment should be limited within this period of the day.
135	EMP 10.1.1 Public Health, Mitigation / Enhancement / Compensation / Contingency	*What are the provisions to waste disposals?*	Rural toilets in Bangladesh are usually water- and smell-proof pits equipped with concrete circular slaps with a filtering arrangement at the bottom. Liquid passes while solids develop through anaerobic decomposition. After 5-6 months of working period in dry season the toilet is dismantled and the pit is covered with earth.
135	EMP 10.1.1	*What are the provisions to maintain the conditions of the immediate surface water and ground water to the site office, labour sheds, stock yards, etc.?*	Solid waste from labourer sheds is collected in bins and dumped into a ditch which is covered with earth at site closure. BoQs include solid waste management and provision of tube wells for drinking and cooking purposes. Sanitary

Page	Item/section	*ADB comments*	ISPMC Response
			toilets for labourers are located at a safe distance from site office and sheds. Working season takes place in dry season when groundwater level is low, limiting risk of overflow.
136	EMP 10.1.2 Bank Protection, Mitigation / Enhancement / Compensation / Contingency	*Please add the concept of "hours of operation are observed"*	Minor quantity of dust may be generated during working season which may be suppressed by sprinkled with water. This operation may be conducted from 9 AM to 4 PM (three times a day). Re noise: operation should be limited to between 8 AM to 5 PM.
136	EMP 10.1.2 Surface water quality, Mitigation / Enhancement / Compensation / Contingency	*Add the usage of sediment traps that would capture eroded materials along the immediate downstream of the bank protection activities*	No such arrangements for sediment traps to capture eroded materials is used/exists in bank protection work.
139	EMP 10.1.3 Surface water quality, Mitigation / Enhancement / Compensation / Contingency	*Add the usage of sediment traps that would capture eroded materials along the immediate downstream during the embankment construction and rehabilitation*	As above.
Annex 1	Table A1-1, A1-2, A1-3, A1-4 and A1-8	*Indicate each of the species' IUCN status*	IUCN Bangladesh does not assess conservation status of biota under Table A1-1 (terrestrial flora), A1-2 (cropfield vegetation) and A1-3 (wetland

Page	Item/section	*ADB comments*	ISPMC Response
			vegetation). Tables A1-4 to A1-8 checked and corrected.
Annex 4	Table -2. Proposed Fish Sanctuaries in the Project-2 Area	*Are the coordinates in the table correct? They do not seem fall into the area of Project-2.*	Coordinates are being checked – see response on comment 36 and 38, above.
Annex 1	Table A1-1, A1-2, A1-3, A1-4 and A1-8	*For information and consistency for all the tables, indicate each of the species' IUCN status.*	Achieved to the extent possible at this stage.
Annex 1	Table A1-9	*This can be a part of Annex 2 because the information in the matrix pertains to the potential impacts to river dolphins wherein Annex 2 contains the threats to river dolphins.*	Removed from A1 and included in A2.
Annex 1	Table A1-10	*The information in the table seems irrelevant for this annex. Consider removing this matrix from the annex and incorporating it into the groundwater baseline section of the main report instead.*	Removed from A1 and included in Main Report under Section 5.2.3 (groundwater).
Annex 9	Project Implementation Arrangements	*Based on the organizational chart for BWDB program management, the set up was made in 2013. Are there any changes in the management set-up? If there are any updates, please include any revisions or updates on the program management in this annex.*	Chart replaced for latest version (Feb 2018).

APPENDIX M

LIST OF ADMINISTRATIVE UNITS

Table A1-1: Administrative Unit under MFF with Population Data

Administrative Unit			
Sub-project	**District**	**Upzilla**	**Population Data**
Jamuna Right Bank 1 (JRB-1)	Sirajganj	Belkucchi	352835
		Kamarkhandi	138645
		Shahjadpur	561076
Jamuna Right Bank 2 (JRB-2)	Pabna	Bera	256793
		Santhia	380301
		Sujanagar	278096
Jamuna Left Bank 1 (JLB-1)	Tangail	Kalihati	410293
		Tangail Sadar	521104
		Delduar	207278
Jamuna Left Bank 1 (JLB-1)	Sirajganj	Chauhali	160063
	Tangail	Nagrapur	288092
	Manikganj	Daulatpur	112442
		Saturia	171494
		Ghior	146292
		Shibalaya	171873
Padma Left Bank 1 (PLB-1)	Manikganj	Harirampur	139318
		Manikganj Sadar	309413
		Singair	287451
Padma Left Bank 2 (PLB-2)	Dhaka	Nawabganj	318811
		Dohar	226439
	Munshiganj	Serajdikhan	288107
		Sreenagar	259887
Padma Left Bank 3 (PLB-3)	Munshiganj	Lohajang	159242
		Tongibari	197173
		Munshiganj Sadar	383263
Padma Right Bank 1 (PRB-1)	Rajbari	Pangsha	243285

Administrative Unit			
Sub-project	**District**	**Upzilla**	**Population Data**
		Rajbari Sadar	331631
		Goalanda	112732
Padma Right Bank 2 (PRB-2)	Faridpur	Faridpur Sadar	469410
		Char Bhadarasan	63477
		Sadarpur	186254
Padma Right Bank 3 (PRB-3)	Madaripur	Shib Char	318220
	Shariatpur	Zanjira	194019
		Naria	231644
Megna Left Bank 1 (MLB-1)	Chandpur	Uttar Matlab	292057
Megna Left Bank 2 (MLB-2)	Chandpur	Chadpur Sadar	465919
		Matlab Dakshin	210050
Megna Right Bank 1 (MRB-1)	Shariatpur	Bhedarganj	253234
		Gosairhat	157665

APPENDIX N - PMO COMMENTS ON DRAFT EIA & ISPMC RESPONSE

PMO submitted its comments on the draft EIA (November 05, 2019). In the table below these PMO comments are listed and the ISPMC's response indicates how the comments have been addressed in the current final version of the report.

Sl. No.	PMO Comment	ISPMC Notes / Response to Project Management Office (PMO)	Location (Section/sub section/para/page no.)
A.	**General Observations**		
A1.	PMO has sent to you the ToR/Report Structure of the EIA via the Memo No. : PMOFRERMIP/E-4/871; Date: 17 October 2016 which was approved by the Department of Environment (DOE). Our development partner Asian Development Bank (ADB) has given their consent for following the GOB style through the email (attached as enclosure-I) and requested to ensure including all necessary items in the report to meet ADB's requirement. You are hereby requested to recast the EIA report by strictly following the approved ToR.	Although the report does not follow the exact order of the structure mentioned in the ToR of DoE and ADB in the memo, the contents cover all aspects as required by ADB and DoE. Note that it also follows the same structure as the already approved EIA for Tranche-1.	
A2.	The Report should be recast following the approved FSR (T-2). It is mentionable that in the FSR (T-2) report, no physical intervention is proposed under MLB-2 area. The FRERMIP financing plan needs to be updated as per actual	While the work locations and design of interventions have changed, the fundamental nature of works remains the same so that it can be expected that the environmental impacts are similar. The report has been updated to the T-2 design on 31 March 2020	
A3.	In the Executive Summary, there should be a table showing the sub-project area name, district name, upazila and union name (for proposed interventions) of T-2 project and in the main body of the report, there should be another table including the previous showing all the FRERMIP	This table has been included in an appendix that lists Administrative units.	Appendix M

Sl. No.	PMO Comment	ISPMC Notes / Response to Project Management Office (PMO)	Location (Section/sub section/para/page no.)
	(T1 , 2 & 3) sub-project areas' districts and upazilas name.		
A4.	In the Executive Summary of the report, there should be an A3 size clear colour satellite real image showing only T-2 proposed interventions and locations. In the main body, there should be two A3 size clear colour satellite real image (one showing only T-2 proposed interventions and another showing implemented T-1 interventions, proposed T-2 interventions and planned T-3 interventions as per approved FSR).	Maps are provided as appropriate. An A3 Map with satellite imagery has been provided in Appendix I	Various locations throughout (e.g. 4-1)
A5.	All the information and data provided in the submitted EIA report should be updated till the date (October 2019). So there need more data collection and updating. Hence, the report will be more acceptable.	Where data could be collected this was updated. Note that the purpose of the EIA is to provide an assessment of the long-term impacts of a project on the environment, which depend on long-term data series and trends. As the nature of the planned interventions was not altered fundamentally, significant changes to the EIA are not anticipated and therefore a repetition of the study is not required.	Paragraphs and data in 5.1.1 are updated.
A6.	To make the report more presentable, the whole report (including all appendices) should be in same Font, Font size, Letter spacing and more colourful with clear A3 maps (if suggested).	The report has been thoroughly edited to make it presentable	Throughout the whole report
A7.	The version name of the report should be updated at the bottom of each page of the report. The present header of the main body of the report	These have been done	In the whole report

Sl. No.	PMO Comment	ISPMC Notes / Response to Project Management Office (PMO)	Location (Section/sub section/para/page no.)
	should be deleted.		
A8.	It will be convenient to go through the whole report easily if all the para written here along with serial numbers	Although done in the first EIA, this has not been re-applied in the latest versions of the ESIA, as not all parties found it useful.	N.a.
B			
B1.	Cover Page: Please mention that the report prepared by Bangladesh Water Development Board (BWDB) with the financial assistance from ADB and technical assistance from ISPMC (NHC-EMM JV). Please also mention that the report is prepared for the proposed project of "Flood and Riverbank Erosion Risk Management Investment Program (FRERMIP)- Project-2" which may be implemented under the proposed ADB Loan 44167-015-BAN: Flood and Riverbank Erosion Risk Management Investment Program - Project-2.	These have been done however the ADB loan number has not yet been confirmed for Project-2 and this has been indicated	Cover page and page iii
B2	Page ii: proposed project name and loan number should be corrected for T-2. The revision date and the contributing team members' names should be updated.	Corrected and updated	Page-ii
B3	Page iii: proposed project name and loan number should be corrected for T-2. "ENVIRONMENT AND CLIMATE CHANGE and Main Report" may be deleted as the page is showing only the key data. Project start/end time may be updated as per approved FSR (T-2).	Corrected and updated	Page-iii
B4	Page iv: In 1st para Tranche-I, 2 & 3 duration should be updated as per	Durations have been updated. The	Page-v, 1st para

Sl. No.	PMO Comment	ISPMC Notes / Response to Project Management Office (PMO)	Location (Section/sub section/para/page no.)
	approved FSR (T-2). In 2nd para financing plan should be updated as per 2nd revised T-1 DPP and approved FSR (T-2). Please provide another detailed financing plan for T-2	financing amount and detailed financing plan are part of the FSR and can be found there. These are subject to changes during negotiations between GoB and ADB	
B5	Page v: In 4th para, provide the zila, upazila & union against each sub-project area. Please delete related description for MLB-2 as there is no work proposed for MLB-2 are in FSR (T-2).	List of administrative units is included in Appendix M. Corrected for MLB-2. The MFF covers four sub-projects. While currently no works are planned in MLB-2, it remains part of the MFF area and may be covered in Tranche 3.	Page-vi, 1st para of the Assessed Project, Executive summary included in Appendix M
B6	Page vi: In 1 st para, Total estimated cost for T-2 is 361.30 million US$ (as per FSR: T-2) instead of $ 143 million	Included. As per updated FSR for T-2 estimated total cost is 262 million USD	Page-vi, 2nd para of the Assessed Project sub head, Executive Summary
B7	Page viii: In 4th para, correct '20113' with '201 3' and in 3 no. reference correct 'Geob-Bags' with 'Geo-bags'	Corrected	Page-ix 3rd para, Sub head-Riverbank protection intervention impacts-General

Sl. No.	PMO Comment	ISPMC Notes / Response to Project Management Office (PMO)	Location (Section/sub section/para/page no.)
			Reference-5
B8	Page ix: please make one para instead of 1 st & 2nd para. In 3rd para, provide Dolphin habitats reknowned area list which are related with FRERMIP area. The line "and India cannot be ruled out" should be deleted, In 4tl para repetition of "than" should be omitted.	The sentence has been refreshed deleting India. Repetition removed.	Page-x 2nd para, Sub head-Riverbank protection intervention impacts-General
B9	Page x: In 2nd para, 1 st point, the line "Along all protected riverbanks navigation buoys will be placed with kilometer spacing" may be replaced with "BWDB/MoWR will request BIWTNMoS to place navigation buoys along all protected riverbanks with kilometer spacing. In these regard, BWDB will provide the data of riverbank protection works. dredging works and other related works". In 3rd point, the line "Vetiver, Katkin and Dhoincha are specially suggested here" may be added at the end. In 4th point, regulator nos. is 'nine' instead of 'two' as per FSR (T-2). Please recast 4th and 6th para as in the FSR (T-2), there is no proposal for any physical work at any charland area. In 6th para, the line "char shall be covered with katkin or vetiver plantation." may be replaced with "char shall be covered with dhoincha, katkin, vetiver or any other helpful plant for land reclamation to.."	1st , 3rd , and 4th point have been refreshed. 4th and 6th paragraph: this refers to the embankment planned to run over the Solimabad char which is to be built in Tranche-3 after successful closure of the Solimabad channel through intelligent dredging and material placement.	Page-x & xi, 8.6.1 and Appendix D 8.6.2, P. 138
B10	Page xi: in 1 st para: requirement of land (27 ha) for RBP need justification and should be as per FSR (T-2). The sub-heading "Specific MLB-2 Interventions and Impact" should be deleted as it is a repeated sub-	This sub heading has been refreshed The justification for land acquisition is found in the resettlement framework and	Page-xi

Sl. No.	PMO Comment	ISPMC Notes / Response to Project Management Office (PMO)	Location (Section/sub section/para/page no.)
	heading.	resettlement plans	
B11	Page xii: in 2nd para, the line "whole Brahmaputra System from the upstream areas at Kurigram in Bangladesh to the Bay of Bengal." should be recast with more specific location information considering the FRERMIP study area (downstream of Bangabandhu Bridge).	This paragraph refers to the river stabilization plan prepared under FRERMIP Tranche-1, which covers the entire length of the Jamuna and Padma rivers, including areas outside of FRERMIP T-1 project area	Page-xii
B12	Page xiii: 2nd & 4th para should be recast with accurate estimated cost as per FSR (T-2). Please keep in mind that placing of buoys is not the mandate of BWDB. It is the mandate of BIWTA/MoShipping. BWDB can help BIWTA only by providing related necessary data. GRM: The paragraph may be replaced as: "During implementation of Tranche-I project, there were formed 3 local Grievance Redress Committee (GRC) for each sub-project area/site. These may continue for Project-2 project implementation. However, as per development partner ADB's guideline, Grievance Redress Mechanism (GRM) will be effective for Land Acquisition, Resettlement, Environment, Gender and related any other issues during project and intervention implementation. It's proposed to assign national GRM specialist (male or female or both) to boost grievance mechanism and facilitate GRCs. The GRCs formed during Tranche-I may need reform as per revised resettlement framework or other related ADB guideline if required, A Joint Verification Team (JVT) consists of 3 members (representative from BWDB, DC, INGO) will visit the site before planning and construction for investigation of land and resettlements or other related assets. Then a Property Valuation Advisory Team (PVAT) consist of 4 members (Representative form BWDB,	The para has been refreshed Text has been refreshed as per advice mentioned in the comment	Page-xiii, 2nd para Page-xiii & xiv

Sl. No.	PMO Comment	ISPMC Notes / Response to Project Management Office (PMO)	Location (Section/sub section/para/page no.)
	DC, INGO) will assess the costing of the identified assets in the alignment of the intervention. The concern office will pay the Affected Person (AP)s CCL and Resettlement Grants as per PVAT's decision. If any AP has any complain against any decision, then he can submit his complain to the GRC. Each GRC consists of 5 members (representative from BWDB, UP, AP, INGO). Aggrieved persons are free to access the country's legal system regardless of GRC involvement."		
B13	Page xiv: 1 st para may be replaced with "As per development partner ADB's requirement, Quarterly Progress Report (QPR) will generate and will send to the concern offices. In addition to that semi-annual Environmental Monitoring Report, Work Completion Report, Training Report, IMED Report, Project Completion Report and any other report required for BWDB, MoWR, ERD, PC and ADB or other GOB part will be formulated and circulated among the concerns. The reports will be disclosed on ADB, BWDB and project's website. Environmental Monitoring Report will be prepared by PMO with close consultation with the Environmental Focal Point (EFP), Gender Progress Report will be prepared by PMO with close consultation with the Gender Focal Point (GFP) and Resettlement Plan Implementation Progress Report will be prepared by PMO with close consultation with the Chief Resettlement Officer (CRO) and In last line, ", and the implementation consultant" may be deleted.	1st para of Reporting and Monitoring has been refreshed as per advice mentioned in the comment Last line deleted	Page-xiv

Sl. No.	PMO Comment	ISPMC Notes / Response to Project Management Office (PMO)	Location (Section/sub section/para/page no.)
B14	Page xxii: Enrich the ACRONYMS with the terms used in the report	Acronym list has been expanded	Page-xxiii & xxiv
B15	Page xxvi: Figure 1 may be replaced with more clearly, colourful and A3 sized map.	A clear new map is included	page-xxvi
B16	Page 1: 1 st para: May need to recast the paragraph following your Table 5-27. 2nd para: Total project cost may be corrected as per 2nd revised T-1 cost and FSR (T-2) cost. 6th para: last line may be replaced with "The EIA Report for proposed Project-2 project is formulated in connection with the approved EIA report for Tranche-I project,"	1st & 2nd para have been updated 6th para: Last line has been refreshed as suggested	Page-1, 1st para 5th para
B17	Page 2: 1 st para: the clause "and the World Bank supported Riverbank Improvement Project (RBIP)" may be deleted. The population data provided here should be in tabular form showing each Upazila wise population data. Figure 1-1: may be replaced with clearer one.	Development of the Jamuna river upstream of the Jamuna bridge is supported by World Bank. Upazila wise population data provided in Appendix New figure is provided	Information is included in appendix M Page-2
B18	Page 3: 1.5 Report Format: Please follow the General Observation (a).	Corrected	Page-3
B19	Page 9: Figure 2-1 may not be suitable in this para. This figure may be shifted to a new para.	The figure has been shifted under Environmental clearance procedure for red category project	Page-8

Sl. No.	PMO Comment	ISPMC Notes / Response to Project Management Office (PMO)	Location (Section/sub section/para/page no.)
B20	Page 13: 'National Environment Policy', 'Biodiversity Act', 'Balu Mahal Nitimala', 'Jol Mahal Nitimala' and related may need to be added here	The policy and act have been included as suggested	Page-13 & 14
B21	Page 14: Is there any update available for Schedule 2, 4 & 8 of Environmental Conservation Rules 1997, if yes, then please provide the update.	There is no update available for schedule 2, 4 & 8 of Environmental Conservation Rules 1997	Page-15
B22	Page 24: The T-2 map may be A4/A3 in size. Table 4-1: Please provide the interventions' tentative location (chainage, length, union, upazila and zila).	The T-2 map is enlarged and is provided in A3 in Appendix I	page-27 Appendix I
B23	Page 25: Table 4-2: Please add regulator cum fishpass/boatpass number, land reclamation (if any), dredging and slope protection piloting works (if any). 4.2 Technologies Used: Please provide intervention wise individual technology, which will be used during physical work implementation. Please give emphasis on dredging component, as it is related with DOE, BIWTA, MOL and local Administration. So that achieving clearance/no objection certificate from concern agency will be easier and timely.	No, of regulators with fishspasses (2 no.) is mentioned in the text below Table 4-2 This information can be found in Table 4-3	Page 26 Page-29

Sl. No.	PMO Comment	ISPMC Notes / Response to Project Management Office (PMO)	Location (Section/sub section/para/page no.)
B24	Page 27: 1 st Para: "Project-2 will build more than 25 km of flood embankments.." may be replaced with "Project-2 will build 25.30 Km of flood embankments.." The line "A number of regulators..." may be replaced with "8 regulator cum fishpasses and 1 regulator cum fish/boatpass.,". 2nd para: the line "with compacted dredge-fill" may be replaced with "with compacted dredged matetrials".	No boat pass is planned under Project-2 and 2 no regulators with fish passes are planned following the removal of Haririampur embankment Replaced as suggested	Page-32
B25	Page 28: (ii) the line "with compacted dredge-fill" may be replaced with "with compacted dredged matetrials".	Replaced as suggested	Page-32
B26	Page 31; Last para: please provide only the Project-2 area information (sub-project/ district wise) in the line "Mean Rainfall in the project area is approximately 1800 mm/year'.	There are two BWDB rainfall station which falls under T-2 area i.e. Faridpur & Tangail. Taking rainfall data of these two stations up to 2019 and mean of these will give approximate mean annual rainfall in the project area. This data was requested in November 2019 and was not received and therefore could not be updated	n/a
B27	Page 32, 33: Figure 5-1, 5-2, 5-3, 5-4 & 5-5 should be elaborated (please mention the area, avg. or specific, station location etc.). Please update the data till date (October 2019).	Figure 5-2. 5-3, 5-4. 5-5 & 5-6 have been updated up to 2018	Page-34, 35 & 36
B28	Page 35: Figure 5-7: Please omit the 'CEGIS logo'.	As CEGIS is the originator of the figure, the logo cannot be omitted, but then the caption has to state the source	Page-37
B29	Page 36: Figure 5-8: Please omit the lCE-GIS logo'	Same response to comment B28	Page-38

Sl. No.	PMO Comment	ISPMC Notes / Response to Project Management Office (PMO)	Location (Section/sub section/para/page no.)
B30	Page 37: Table 5-1 & 5-2: Please update the data till date (October 2019)	This data was requested in November 2019 but was not received. So, Table 5-1 & 5-2 could not be updated	
B31	Page 39: Table 5-3 & 5-4: Please update the data till date (October 2019) Table 5-5: Please add a column showing the values you described in the para 'water quality'.	This data was requested in November 2019 but was not received. Table 5-3 & 5-4 could not be updated. Table 5-5 has been modified	Page-41 & 42
B32	Page 40: Table 5-6: The data may be updated till date (October 2019).	Table 5-6 contains reference values rather than measured values and therefore has not been changed.	Page-43
B33	Page 41: 1 st para: There may be a para heading named 'Ground Water Salinity'	The salinity in Jamuna and Padma River is considered as 0 ppt. So, ground water salinity may be considered as zero, certainly in the Reaches under consideration.	Page-43, 2nd para
B34	Page 46: 2nd & 3rd para: These two para should be updated till date (October 2019) and the data provided here should be 'source' supported. Char Formation: In this discussion, there should be periodical satellite images showing the morphology during char accretion/erosion	2nd & 3rd para have been updated up to 2018 and source has been mentioned A detailed analysis of the complex morphological processes in the Jamuna and Padma river would exceed the scope of this report. The relevant information can be obtained elsewhere (River stabilization plan, FAP reports, etc)	Page-48

Sl. No.	PMO Comment	ISPMC Notes / Response to Project Management Office (PMO)	Location (Section/sub section/para/page no.)
B35	Page 47: 3rd para: please correct the numbering. 4th para: The line "Characteristics of the study area's agro.." should be replaced with "The study area's agro.." as the Table 5-11 is showing only the area. Table 5-12 & 5-13: Please provide the decimal value for the range showing here. Page 49: Figure 5-13: Please omit 'CEGIS logo'. The map should be shown under district/upazila boundary.	Numbering of 3rd para is corrected and line in 4th para has been changed as suggested This data is from BRAC fertiliser guide as per the source and so numerical data is not available Pl. response to the comment B28	Page-49 Page-50 Page-51
B36	Page 50: Table 5-14, 5-15 & 5-16: Please provide the decimal value for the range showing here. 2nd para: the line "become moderately deeply or deeply.." should be replaced with "become moderately deep or deeply..".	This data is from BRAC fertiliser guide as per the source and so numerical data is not available The line has been changed as suggested	Page-52 & 53 Page-53, 2nd para
B37	Page 51: Last para: The line "are about 21, 8, 22 and 14 respectively,." should be in compliance with Table 5-18	The line has been corrected as per Table 5-20	Page-54, 2nd para
B38	Page 53: 2nd para: the line "Most of the area (82%)... The rest (18%)..." should be replaces with " Most of the area (83%)... The rest (17%)	The line has been corrected as per Table 5-23	Page-55, 3rd para
B39	Page 63: Figure 5-17: The 'CEGIS logo' may be omitted and the map should be more clear showing districts boundary	Pl. see response to comment B28 A clear map has been provided	Page-66

Sl. No.	PMO Comment	ISPMC Notes / Response to Project Management Office (PMO)	Location (Section/sub section/para/page no.)
B40	Page 65: 3rd para: The line "The study area consists of 8 Upazila's of 4 districts (should be recast as per approved FSR (T-2). Please show the T-2 project area in tabular format. The line "of some 93,000 ha." may be replaced with "of some 93,975 ha..".	The study area is independent of the approved feasibility study, which is a result of the study. The line has been corrected as suggested	Page-68, 3rd para
B41	Page 66: Table 5-29: The table may recast for only T-2 area	The impact of the FRERMIP T-2 works will have impact on the total project area. Therefore, data for the entire area is provided	Page-69. Table 5-31
B42	Page 70: Table 5-30: The table may recast for only T-2 area	Pl. see response to comment B41	Page-73, Table 5-32
B43	Page 75: 1 st para: The line "lists are given in Annex 1" may be replace with "lists are given in Appendix A".	The line has been corrected	Page-77
B44	Page 76: TEESTA FLOODPLAIN: This para may be not suitable here as the area may not be under T-2 area	The para has been deleted	Page-79
B45	Page 77: Figure 5-21 : The map should be more clear showing the district boundary. Last para: The line "this zone was heavily forested,..: should be checked again	Clear map with district map provided The paragraph has been deleted	Page-80
B46	Page 80: 1 st para: Please check whether there is any natural forest or not. Last para: please correct the serial number.	There is no natural forest in these regions Serial number has been corrected	Page-83
B47	Page 82: AQUATIC FAUNA: Please recast the whole discussion with the	Updated study/information up to October 2019 is not available. This type of	Page-85 & 86

Sl. No.	PMO Comment	ISPMC Notes / Response to Project Management Office (PMO)	Location (Section/sub section/para/page no.)
	updated data (October 2019).	study/survey is not conducted frequently. The available discussion with aquatic fauna is consider sufficient for baseline of the report. Detail discussion on threat of Dolphin is also provided in Appendix-B	
B48	Page 86: Table 5-37: Please provide the source of data.	Source provided	Page- 89 , Table 5-39
B49	Page 87: The table 5-38 should be recast as per approved FSR (T-2) area, Table 5-39: The data provided here should be unit base.	Table 5-38 has been revised as table 5-40. The unit has been provided in text	Page- 90, Table 4-40, 2nd para
B50	Page 88: Table 5-41 may be recast for Upazila targeted for T-2 project area (FSR_T-2). Please mention the source of data	Pl. see response to comment B41 Source mentioned	Page- 92. Table 5-43
B51	Page 89: Table 5-41 may be recast for Upazila targeted for T-2 project area (FSR_T-2)	Pl. see response to comment B41	Page- 92. Table 5-43
B52	Page 92: Table 5-43 may be recast for Upazila targeted for T-2 project area (FSR_T-2)	Pl. see response to comment B41	Page-96. Table 5-45
B53	Page 95: Please mention the Expenditure and Income Unit in the Table 5-45	Table 5-45 has been revised as Table 5-47	Page-99, Table-5-47
B54	Page 96: Table 5-49 may be recast for Upazila targeted for T-2 project area (FSR_T-2).	Pl. see response to comment B41	Page-100, Table 5-51
B55	Page 97: Table 5-50 & 5-51 may be recast for Upazila targeted for T-2 project area (FSR_T-2)	Pl. see response to comment B41	Page-101, table-5-52 & 5-53

Sl. No.	PMO Comment	ISPMC Notes / Response to Project Management Office (PMO)	Location (Section/sub section/para/page no.)
B56	Page 98: Table 5-52 may be recast for Upazila targeted for T-2 project area (FSR_T-2)	Pl. see response to comment B41	Page-102, Table 5-54
B57	Page 99: 2nd para: please mention the study area (district & upazila).	This refers to the FRERMIP study area	Page-103, 2nd para
B58	Page 101: Figure 5-34: the map may be replaced with the map showing only the district boundary and historic, archeological site. Map showing road connectivity is not preferable here	Figure 5-34 has been revised showing district boundary	Page-105
B59	Page 103: 3rd para: the line "this study in early-2013..." may be replaced with the actual date. 6th para: 'Annex 5' may be replaced with 'Appendix E'.	Actual date provided Annex 5 has been replaced by Appendix E	Page-107. 3rd para 6th para
B60	Page 104: Figure 6-1: The 'CEGIS logo' may be omitted. The map may be replaced with the map showing districts boundary only. Road connectivity is seeming irrelevant here	For CEGIS logo pl. see response to comment B28. The quality of this map has been improved so that it is clearer, as it is a CEGIS map the roads could not be removed.	Page-109
B61	Page 105: The 3rd para should be recast as the consultation should be under T-2 project only. 5th para: 'Annex 7' may be replaced with 'Appendix G'. 6th para: Omit the duplication of 'and'.	3rd para: this refers to the consultations held in preparation of Tranche 1. As this EIA is connected to Tranche-1 and the consultations are an ongoing project, this should be mentioned here 5th para and 6th para has been replaced as suggested	Page-109, 4th para Page-110

Sl. No.	PMO Comment	ISPMC Notes / Response to Project Management Office (PMO)	Location (Section/sub section/para/page no.)
B62	Page 106: The Third Round Consultation may not cover all the T-2 Upazilas/districts. There may need recast of this 6.53 paragraph	The Third Round Consultations cover all relevant upazilas	Page-109 & 110
B63	Page 107: 1 st para: the two lines "is threatened by erosion this year." & "Baghabari is also essential this year.." should be replaced with the specific year/period of threatening. 3rd para: the line "where 40-50% of the area has already eroded away," Should be recast with the accurate statistics of erosion & accretion for that Upazila. The line "BWDB has been using sandbags 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" may be replaced with "BWDB has been using sandbags as temporary measure to protect the riverbank from sudden severe erosion, but these temporary measures are found not effective as sustainable solution. Many participants stated that these sandbag revetments are presently not suitable for the mighty Jamuna river due to its severe erosion intensity." The line "An embankment built in this Upazila at a cost of BDT 38 crore was destroyed by erosion" may be recast with the line "An embankment of Km. built in this Upazila along the right bank of Jamuna river during the year at a cost of BDT … …crore was eroded due to severe flood and intensive erosion of mighty Jamuna river," Is there any meetings for other Upazilas?	1st para: has been refreshed as suggested 3rd para: has been refreshed as suggested	Page-111, 3rd para Page-111, 5th para
B64	Page 108: 2nd para: The line "Stakeholder engagement will continue during implementation facilitated by an NGO engaged for this purpose" may be replaced with "Stakeholder engagement was continued during	This refers to the stakeholder engagement during implementation of Project-2	Page-112, 2nd para

Sl. No.	PMO Comment	ISPMC Notes / Response to Project Management Office (PMO)	Location (Section/sub section/para/page no.)
	planning process of the project. During implementation, GRM will be effective for any claim regarding environment issue for the affected persons and will be facilitated by an INGO engaged for this purpose." Footnote 15: 'Annex Jl' may be deleted.	The resettlement framework from 2013 is the original document covering the MFF.	
B65	Page 109: 2nd para: the line "into the December and July version of..." may be replaced with "into the January and July version of..." The components described in Chapter 7 may be short version duplication of the components of Chapter 5. Please follow DOE approved ToR, where special emphasis given on "Environmental and Social Impacts (Positive and Negative both)". Chapter 7 need to recast accordingly.	Corrected as per suggestion This chapter is intended to select environmental and social component that may likely be impacted the items whose information given in chapter 5 in connection with the planned works. The mentioned detailed impact assessment is presented in chapter 8.	Page-113, 2nd para Page-114, Chapter-7
B66	Page 110: 6th para: The line "proposed interventions are likely to impact the.]' may be replaced with the line "proposed interventions may impact the...	Changed as suggested.	Page-115, 3rd para
B67	Page 115: 3rd para: the line "..during the period (RMIP 2015)" may be replaced with only the period but no the project name. 4th para: the estimate "USD 110 million per year," need justification here, or provide the source	This is a reference to a report prepared under the RMIP study. Hence the project name cannot be removed 4th para: has been refreshed	Page-122, last para Page-123, 1st para
B68	Page 116: 2nd para: the estimate "USD 75 million per year," need justification here, or provide the source.	The para has been refreshed	Page-123, 3rd para
B69	Page 118: 2nd para: the estimate "5000 ha of land will be reclaimed" need	The para has been revised. Source of	Page-125, 4th para

Sl. No.	PMO Comment	ISPMC Notes / Response to Project Management Office (PMO)	Location (Section/sub section/para/page no.)
	justification here, or provide the source	estimate is FSR for T-2.	
B70	Page 121: 2nd & 5th para: the study was done for 'Choira' area, which is not our FRERMIP (T-2) area. So the study area need to be reset according to the proposed T-2 area. However, Land Reclamation is not a major component under T-2 project.	This relates to the people living on chars within the project area, including the Solimabad char, which is subject to be stabilized through Project-2. Irrespectively of interventions directly on the char, the population is impacted by interventions along the river and a holistic study without consideration of chars and char population is not possible	Page-128, 6th para
B71	Page 122: 2nd para: the whole 2nd para need to be deleted as the para is not suitable for EIA Study Report	Land tenure is an essential parameter for the implementation of any intervention, including environmental management measures.	Page-129, 6th para
B72	Page 124: 4th para: No. IV) : The word 'IL' may be replaced with 'RL' and the Land Types (F2F4) shown here need to be elaborated here or as footnote. 6th para: The word 'HYV Taman' may be replaced with 'HYV Aman'	4th para: IL stands for invert level; Explanation has been provided in footnote Changed as per suggestion	Page132, 1st para Footnote 21 3rd para
B73	Page 126: 2nd para: (Annex3) may be replaced with '(Appendix C)'. 3rd para: The line "Here people from the surrounding areas complain about a bad smell and unhealthy conditions that negatively affect their living conditions" may be deleted. 5th para: the line "but thus far this isn't	Corrected as mentioned 3rd para: this is a finding from consultations and an impact from the project, which has to be addressed. Explanation of measures	Page-133, 8th para Page-134. 1st para

Sl. No.	PMO Comment	ISPMC Notes / Response to Project Management Office (PMO)	Location (Section/sub section/para/page no.)
	operational anywhere" may be deleted	taken will be included The sentence has been refreshed	 Page-134, 3rd para
B74	Page 127: last para: duplication of 'that' word may be omitted	corrected	Page-137, 4th para
B75	Page 128: 3r para: No.(I) : The line 'Along all protected riverbanks navigation buoys will be placed with kilometer spacing to protect fish habitats from systematic overfishing with floating nets} May be replaced with 'Along all protected riverbanks navigation buoys will be suggested to Department of Fisheries to place with kilometer spacing to protect fish habitats from systematic overfishing with floating nets. BWDB will provide necessary data to DOF & BIWTA for the purpose." No (II) : The line "The countryside slopes of the embankment shall be used for tree plantation of local resilient varieties to help re-establishing a diverse vegetation coved' may be replaced with the line "The countryside & riverside both slopes of the embankment may be covered with Vetiver, Katkin & Dhoincha plantation for slope protection as well as to help re-establishing a diverse vegetation cover." 5th para: The line "Typically, the land used alongside the protection char banks would be in order of 250m wide, and contain the slope protection above low water level, a berm and the embankment" may be recast following the design and drawing of T-2 RBP works. It is mentionable that under T-2, there is no char bank protection work.	Changed as suggested Changed as suggested 5th para: see answer to comment B70	Page-138. No.(I) Page-138. No (II) Page-138. 3rd para
B76	Page 129: 2nd & 3rd para: the required land of 27ha & 90ha need justification or source of data. The line "About 7km of the alignment	Some of these comments longer relevant as no embankment at PLB-1 is proposed	Page137 & 138

Sl. No.	PMO Comment	ISPMC Notes / Response to Project Management Office (PMO)	Location (Section/sub section/para/page no.)
	(40%) will be placed on newly reclaimed charland" need to be recast as per approved FSR (T-2). 4th para: the line "In total 5 regulators... need to be checked. 6th para: The line "The embankment planned for Tranche-I is yet to start due to unavoidable delay in tendering process" need to be recast as per actual field condition. 9.1 Tranche-I Experience: 1 st & 2nd para: need to recast as per last update (please follow QPR16 or latest draft 17)	under the updated design as per client preference 6th para: has been refreshed 9.1: The para has been refreshed	Page-138 & 139 Page-140
B77	Page 131: 4th para: The line "For implementation of GRM it is proposed to assign two..." may be replaced with the line 'For implementation of GRM, there may be two..."	This change would not make it clear that these are additional positions	Page-142, 3rd para
B78	Page 132: 1 st para: No (IV): the line " in a format agreed with the ISPMC Team Leaded' may be replaced with ...in a format agreed with the BWDB and the development partner ADB". 3rd para: The line "the FRERMIP project area was.." may be replaced with "the FRERMIP program area was....	1st para: changed as suggested 3rd para: Changed as suggested	Page-142, 3rd para (IV) Page-143, 1st para
B79	Page 133: last para: the line "specialist firm/NGO will be retained.." may be replaced with "specialist firm/NGO may be retained.." Provide the Impact Magnitude Scale here in a tabular format	Changed as suggested Impact Magnitude scale have been provided against each intervention in EMP table	Page-144, 4th para EMP table
B80	Page 136: 11.1.2 'Bank Protection' may be replaced with 'Riverbank	Changed as suggested	Page-147, 11.1.2

Sl. No.	PMO Comment	ISPMC Notes / Response to Project Management Office (PMO)	Location (Section/sub section/para/page no.)
	Protection'. Noise: Mitigation: may be 'Working hours to be restricted to 8:00 AM to 5:00 PM. only'	Changed as suggested	
B81	Page 137: Surface Water Quality: Mag. of Impact may be -3 & EMP Cost may be 2.00	The impact magnitudes are determined by national and international environmental experts. This test will be conducted at different locations	Page-148
B82	Page 139: Terrestrial and Aquatic Ecosystem Diversity: Mag. of Impact may be -1 & Mag with EMP may be -l	The impact magnitudes are determined by national and international environmental experts.	Page-150
B83	Page 140: Health and Safety: Mag. of Impact may be -3	Same response to comment B 82	Page-151
B84	Page 141: Employment: Mag. of Impact may be +3. Community Organizations: EMP Cost: Check FSR (T-2) for accurate costing	Same response to comment B 82	Page-152
B85	Page 142: 11.113: 'Embankment Construction and Rehabilitation' may be replaced as 'Embankment Construction/Reconstruction'. Air Quality: Mag with EMP may be -1. Page 143: Noise: Mitigation: may be 'Working hours to be restricted to 8:00 AM to 5:00 PM	Changed as suggested Same response to comment B 82 Changed as suggested	Page- 152 & 153
B86	Page 144: Drainage Congestion: Mitigation: may be 'Constructing Regulators cum Fish/Boat pass at appropriate locations'.	Changed as suggested Cost may be incurred from anywhere from	Page-154

Sl. No.	PMO Comment	ISPMC Notes / Response to Project Management Office (PMO)	Location (Section/sub section/para/page no.)
	Land Loss: Mag with EMP may be 0 and for EMP Cost, please check present ongoing works' BOQ of the Contract Agreement	project, but it will be reckoned as EMP cost and magnitude is consider with EMP	
B87	Page 146: Crop Production Loss: Mag with EMP may be +1 & the list of Responsible Agency may need recast	Same response to comment B 82	Page-156
B88	Page 148: Fish Habitat: Mag of Impact may be -3 & Mag with EMP may be -1. Mitigation: please mention all 9 regulators which are proposed in FSR (T-2)	Same response to comment B 82. 7 no of these regulators are no longer proposed as PLB1 embankment has been removed from the design as per Client preference. 2 no fish regulators have been mentioned as mitigation	Page-157
B89	Page 149: Terrestrial and Aquatic Ecosystem Diversity: Mag. of Impact may be -3 & Mag with EMP may be -1. In Impacts: the line '..and fauna will be destroyed' may be replaced with '..and fauna may be destroyed'	Same response to comment B 82 Impact column changed as suggested	Page-158
B90	Page 151: Health and Safety: Mag of Impact may be -3	Same response to comment B 82	Page-159
B91	Page 152: Employment: Mag of Impact may be +2. Community Organizations: EMP Cost: Please mention the decimal figure	Same response to comment B 82 Sub section corrected	Page-160
B92	Page 153: 11.14 'Drainage Structure/Sluice/Fishpass' may be replaced with 'Drainage Structure/Rgulators cum Boat/Fishpass' Page 154: Noise: Mitigation: may be 'Working hours to be restricted to 8:00 AM to 5:00 PM. Drainage Congestion: the word 'sluices' may be replaced with 'regulators	Changed to “regulators cum fish passes” Working hours restriction mention as suggested	Page-161

Sl. No.	PMO Comment	ISPMC Notes / Response to Project Management Office (PMO)	Location (Section/sub section/para/page no.)
	cum boat/fish pass'. EMP cost: mention the decimal figure	Changed to “regulators cum fish passes”	
B93	Page 155: Health and Safety: Mag of Impact: may be -2. Employment: Mag of Impact: may be +2. Community Organizations: EMP Cost: mention the decimal figure	Same response to comment B 82 Same response to comment B 82 Figure included	Page-160
B94	Page 158: Waste and Disposal: Mag of Impact may be -2. Public Health: Mag of Impact may be -3 & Mag with EMP may be -1	Same response to comment B 82 Same response to comment B 82	Page166
B95	Page 159: Erosion: Mitigation: check the figure of .6,700ha'. Drainage Congestion: Mitigation: the word 'sluices' may be replaced with 'regulators cum boat/fishpass'	Pl. check the figure 6700 ha Changed to “regulators cum fish passes”	Page-176
B96	Page 162: Sand Carpeting: EMP Cost: Mention the decimal figure	At this stage figure cannot be provided. It will be quantified after assessing field condition	Page-170
B97	Page 164: Improved Irrigation Facilities: EMP Cost: Mention the decimal figure	Cost will be finalised after observing field condition	Page-172
B98	Page 165: Fish Habitat: Impacts: The line 'Estimated net loss of 6,700 ha of fish habitat due to land reclamation + habitat altered due to the revetment 1,300 ha' need to be check following the FSR (T-2). Fish Migration: Mitigation: the word 'sluices' may be replaced with 'regulators cum boat/fishpass'. Mag with EMP may be -2	This has not been mentioned in FSR T2 Changed as per suggestion	Page-174

Sl. No.	PMO Comment	ISPMC Notes / Response to Project Management Office (PMO)	Location (Section/sub section/para/page no.)
B99	Page 166: Fish Biodiversity & production enhancement: Mitigation (1, 3 & 7): placing buoys is not the mandate of BWDB but the mandate of Department of Fisheries or BIWTA. BWDB can provide the RbP Works' data to the concern organizations. Hence 1, 3 & 7 no. mitigation need to be recast as per.	It is a mitigation measure provided by the expert which should be included in EMP. During implementation the responsibility/ mandate will be sort out	Page-175
B100	Page 169: Communication: Impacts: the line '...be provided with crest pavements..' may be replaced with ...be provided with 10m wide crest of the flood protection embankments..} EMP Cost: Mention the decimal figure following the FSR (T-2). Responsible Agency: should be BWDB	A crest alone will not improve road transport unless it is paved, as otherwise this is subject to encroachment Project cost (Tbd) Changed as suggested	Page-179
B101	Page 171: Monitoring Plan 10: 'No embankment and bank soil erosion' may be replaced with 'No embankment and riverbank soil erosion'	Changed as suggested	Page-180
B102	Page 176: 3rd para: The line 'aquatic habitats including charlands and their...' may be recast as there are no works in charlands under FSR (T-2). The recommended action I, II & III should be more elaborate that which agency will implement those actions as BWDB is not mandated to do those. Different agencies can do those actions and BWDB can assist concern agencies providing related data for this purpose. The line 'Finalization of the Tranche-I works (in 2018) can proceed without further environmental study' need to recast as per present situation.	The sentence has been refreshed without including charlands The action I, II & III has been refreshed The para has been refreshed	Page-186

Sl. No.	PMO Comment	ISPMC Notes / Response to Project Management Office (PMO)	Location (Section/sub section/para/page no.)
B103	Page 186,187, 188, 189, 190: IUCN Status & Local Status: Please update the list as per latest 2019 status	The list was last updated in 2015 and it will be updated in 2025 again	Page- 196 to 200
B104	Page 193: 1 st para: The line 'Perhaps the most significant issue is the building more than 50 dams along many rivers,..' may need recast with more specific data (number of dams and relevant river names), like the relevant upstream river of Jamuna and Padma. 3rd para: The line 'Dolphin oil is used by people in Bangladesh as a liniment,' should be replaced with the line 'Dolphin oil & organs are used by the people around the world,...'.	This comment is related to the destruction habitat of dolphins across the sub-continent and so the names of the rivers or dams are not relevant and will not affect the statement's validity. A sentence in the main report can be added referring to the overall effect of dolphins. This document relates to Bangladesh, however refreshed according to Client preferences	Page-205
B105	Page 197-203: The proposed Bird Sanctuary Site 1, 2, 3, 4, 5, 6, 7, 8 & 9 should be more specific by mentioning Union, Upazila and District name	The bird sanctuary sites are provided with maps and GPS coordinates instead, which is more specific than union & upazila name.	Page-209 to 215
B106	Page 206: 1 st para: Please provide the Fish Sanctuary DoFo data up to the date (October 2019) and provide the data only for T-2 area as per approved FSR Page 207: 1 st para: may recast the report as per latest DoFo report	No updated data/report regarding the no. of Fish Sanctuaries in the Tranche -2 in October 2019 is available with the DoF. However, field report of the ISPMC Team of August 2019 indicated that there are 5 Fish Sanctuaries, most of them non-functional, in the Tranche -2 area including the DoF and NGO supported ones.	Page-218 & 219

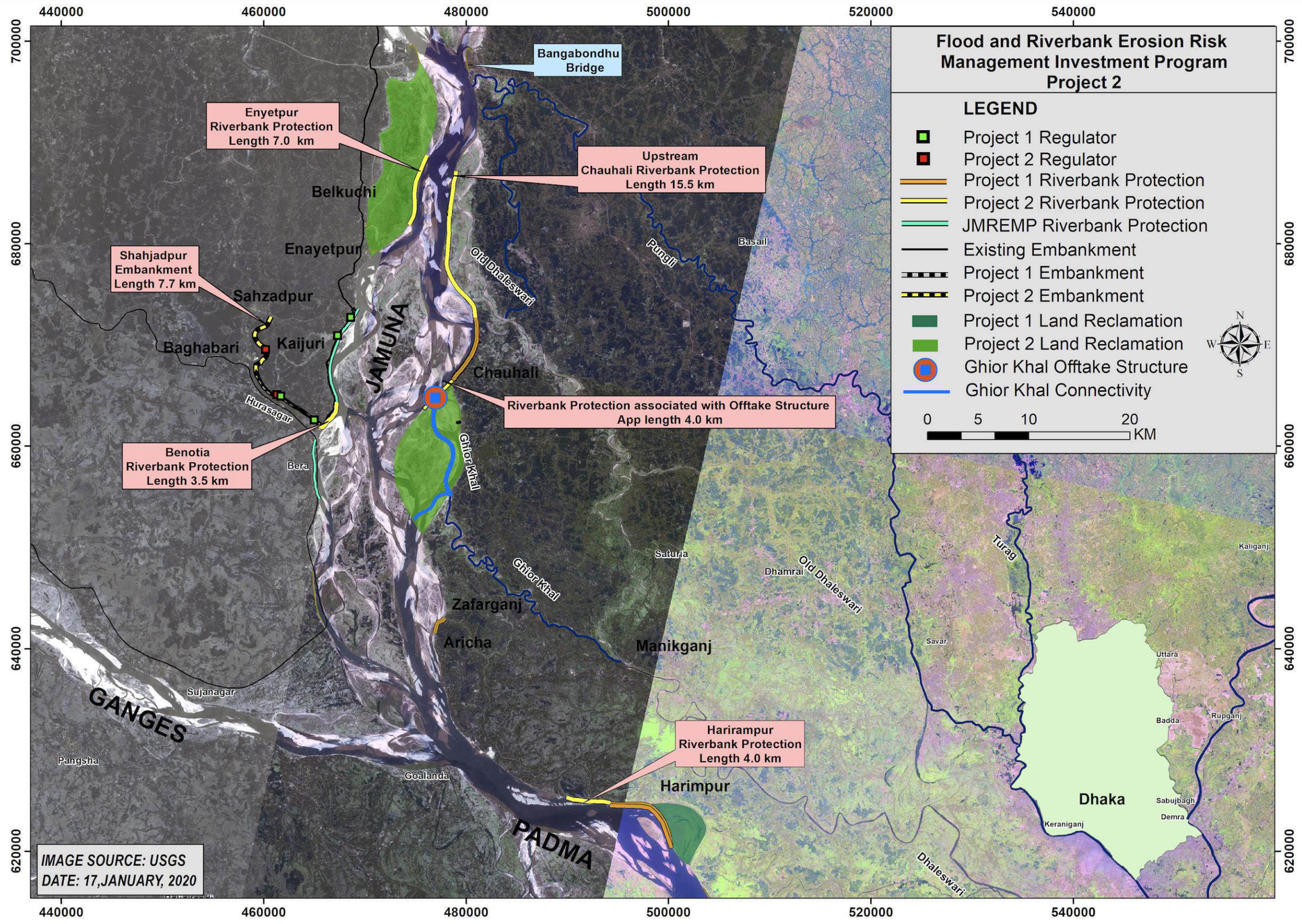
Sl. No.	PMO Comment	ISPMC Notes / Response to Project Management Office (PMO)	Location (Section/sub section/para/page no.)
B107	Page 210: Figure DI-I: the map should be more clear and the figure title may be 'Proposed location of model sanctuary which is located under T-2 project site. 1 st para: the line because the project will continue till 2023 with...' may be replaced with the line .because the FRERMIP MFF program is expected to be continued till 2023 with...'.	Clear map provided The sentence has been changed as suggested	Page-222 Page-223, 1st para
B108	2nd para: The para may be recast as per the sense that BWDB is not mandated to implement fish sanctuaries in the project area. DoF is mandated to do that. BWDB may assist DoF by providing necessary data in purpose of Sanctuary establishment. ADB may finance DoFi in respect of establishment of fish sanctuary to mitigate the adverse effect of fish production & habitat due to T-2 project implementation	2nd para has been refreshed. DOF initiated establishing Inland Fish Sanctuaries as extension measures in the 1980s, and now several NGOs and private efforts are there to establish and maintain Fish Sanctuaries. Project evaluation of sanctuaries found many to be deficient, and an improved approach is needed.	Page-223
B109	Page 213: Table El-3: Please correct the project name and proponents may be BWDB, ISPMC & ADB	At that time, no ISPMC was engaged, hence the proponent was NHC	Page-225
B110	Page 231: Table Gl-l: is there any consultation meeting for Tangail? If so, then please mention the details. Table Gl-2: name may be 'Public Consultation and FGD Meeting Participants Details'	There were no consultation meetings in Tangail. Type mistake has been corrected	Page-244
B111	Page 239 & 240: Please check the meeting date for both and make confirm whether the meeting is for first round or third	The consultation meeting is for third round The meeting date is ok	Page-252

Sl. No.	PMO Comment	ISPMC Notes / Response to Project Management Office (PMO)	Location (Section/sub section/para/page no.)
B112	Page 269: 5th para: asphalt (hot mix) plants is not suitable here as there is no asphalt work under proposed T-2 project	Asphalt removed	Page-282
B113	Page 271: 4th para: to implement the line 'including the use of noise barriers', there should kept budget provision in the Contract Agreement of work packages. 9th para: deduction of contractor's bill for crop damage (if any) during the intervention construction may not feasible under the present GOB rules. The AP can submit his/her claim to the GRC for appropriate compensation for this case. Last para: tubewell testing: there should kept budget provision in the contract agreement/BoQ for water quality tests and the liability should be upon the contractors side	4th para: Refreshed as suggested 9th para: The para has been refreshed as suggested Last para: testing of tube well should be kept under contractor's contract budget	Page-284, 4th para Page-284, 9th para Page-284, last para
B114	Page 272: 4th para is a good initiative and should be included in the tender documents under T-2 project	noted	Page-285
B115	Page 273: 1 st para: other associated organizations may be DoF (Forests), DOE, DoF (Fisheries) 3rd para: (i): The line may be 'Headed by an CE/ACE/SE and supported by two SE and 4 EEs	1st para changed as suggested 3rd para (i) refreshed as suggested	Page-286 1st para 3rd para (i)
B116	Page 274: 2nd para: The serial number need to be refresh. 3rd para: need to recast as per present T-1 & it's components' progress	2nd para: serial number corrected This section refers to the implementation arrangements rather than the status of the project and so have not changed	Page-287, 2nd para Page-287, 3rd para
B117	Page 275: The heading name should be 'Model terms of Reference.....'	This terms of reference is for engagement of a NGO to conduct a study under the	Page-288, heading name

Sl. No.	PMO Comment	ISPMC Notes / Response to Project Management Office (PMO)	Location (Section/sub section/para/page no.)
	3rd para: The line 'A total of 50km .36 km of embankment..' need to be recast as per the data shown in the approved FSR (T-2) 4th para: the line ....the dramatic widening (from 1970s to 2000s) took place.' Please provide the satellite image at 10 years interval for 1970 to 2019 in favour of this line. The line 'for example if the existing embankments unexpectedly breach' may be deleted. Last para: the line 'established under the successful Jamuna-Meghna. May be replaced with the line 'established under the Jamuna-Meghna…..'.	project. Some expertise opinion will be provided in the study report which may be implemented to mitigate/enhance the biodiversity lose due to project interventions. So the heading should not be changed 3rd para: This has now been changed in line with the latest design 4th para: these information are available in other reports as the FAP reports and would exceed the scope of this report. A references has been provided. The CbFRM is aimed to mitigate losses of property and life in case of embankment breaches and therefore this has to remain here as example Replaced as suggested	3rd para 4th para 4th para Last para
B118	Page 276: Please reduce the gap between the 1 st & 2nd para	Done as mentioned	Page- 289, 1st & 2nd para
B119	Page 277: Please provide more clear map	A more clear map provided	Page- 290
B120	Page 282: Please provide the map showing only FRERMIP area. RMIP map is not suitable here	This has been updated with a map from the river stabilization plan	Page- 296

Sl. No.	PMO Comment	ISPMC Notes / Response to Project Management Office (PMO)	Location (Section/sub section/para/page no.)
B121	Page 284: 4th para: The line 'the expected to start in 2018… 'may be replaced with the expected to start in 2020…'.	Changed as mentioned	Page-297, 4th para

APPENDIX I –A3 Project-2 Map



APPENDIX O - Environmental and Social Baseline

The environmental and social baseline condition in the study area has been characterized by 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:

i. Bangladesh Bureau of Statistics (BBS)
ii. Bangladesh Water Development Board (BWDB)
iii. National Water Resources Database (NWRD)
iv. Water Resources Planning Organization (WARPO)
v. Soils Resources Development Institute (SRDI)
vi. Bangladesh Meteorology Department (BMD)
vii. Department of Agricultural Extension (DAE)
viii. Department of Fisheries (DoF)
ix. International Union for Conservation of Nature (IUCN).

O1 Physical Environment

O1-1 Climate

Seasonality

The project influence area lies in the northwest part of Bangladesh where the climate is sub-tropical in nature with three seasons namely summer/pre-monsoon from March to May, monsoon from June to October, and winter season from November to February. Lower rainfall makes this area both atmospherically and pedologically drier than the rest of the country. The rainy season is hot and humid with about 88% of the annual rainfall in the area. The winter is predominately cool and dry. The summer is hot and dry interrupted by occasional heavy rainfall, whereas monsoon comes in the month of June and recedes in late October. Meteorological data such as rainfall, temperature, humidity and wind speed were collected from Bangladesh Meteorological Division (BMD) and analyzed for assessing local climate that are directly related to water resources of the study area.

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.

Meteorology Stations

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

Rainfall

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. No up to date rainfall data was available however as this is long time series data small fluctuations were deemed unlikely to significantly affect the analysis.

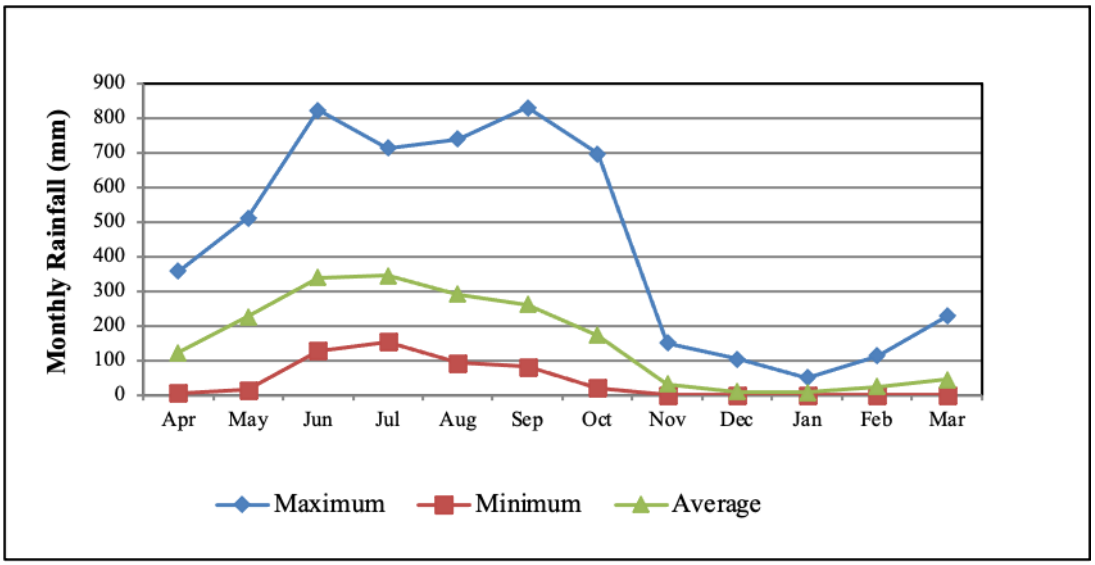
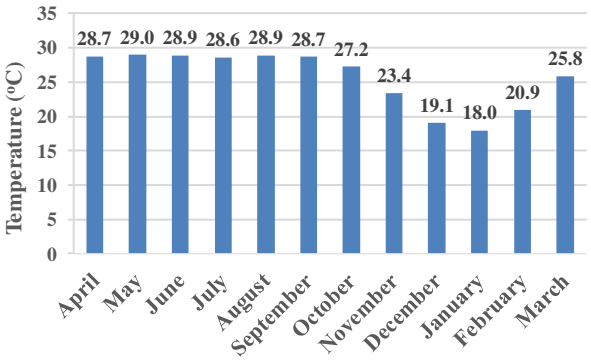


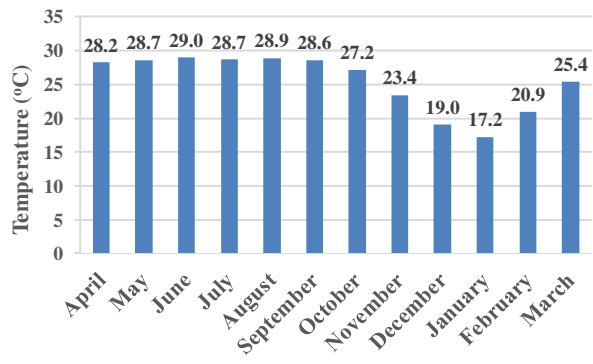
Figure** Fehler! Kein Text mit angegebener Formatvorlage im Dokument.**-1. Monthly rainfall

Temperature

Figure 5-2 shows average monthly temperatures 1948-2019 at Faridpur and 1987-2019 at Tangail. These range from 18.0 to 29.0°C in Faridpur and 17.2°C to 29.0°C in Tangail, with higher values (>8°C) from April to October, and lower values from November to March.



Faridpur (1948 – 2019)



Tangail (1987 – 2019)

Figure** Fehler! Kein Text mit angegebener Formatvorlage im Dokument.**-2. Monthly temperature

Humidity

Figure 5-3 shows average monthly humidity 1948-2019 at Faridpur and 1987-2019 at Tangail. These range from 65 to 87% in Faridpur and 67 to 84% in Tangail, with lower values (≤ 80%) from November to May and higher values from June to October.

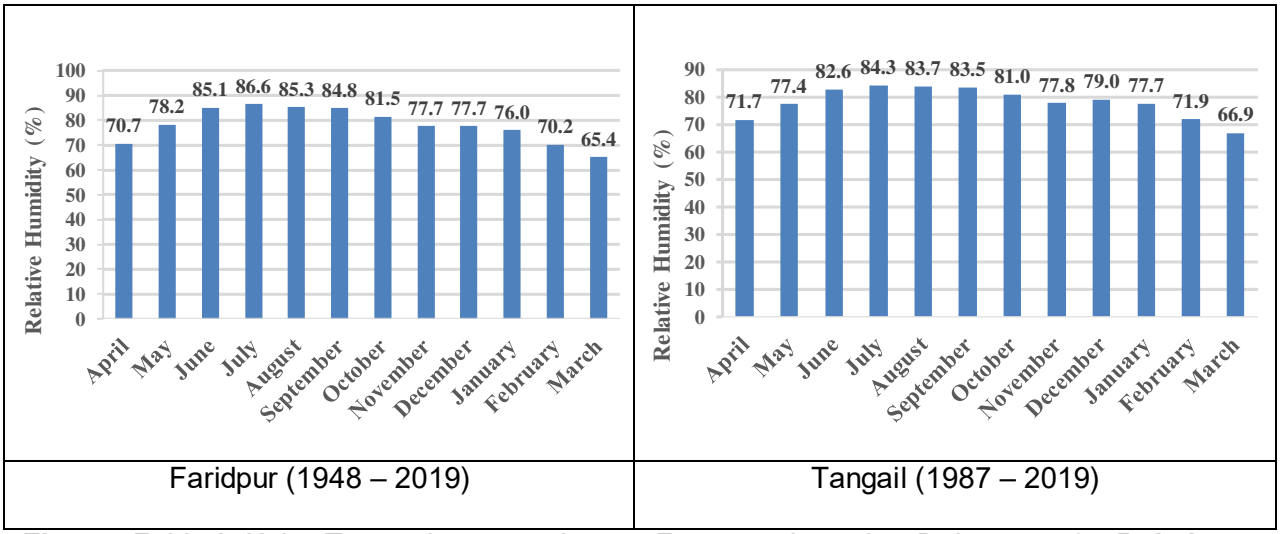


Figure** Fehler! Kein Text mit angegebener Formatvorlage im Dokument.**-3. Relative humidity

Evaporation

Figure 5-4 shows average monthly evaporation 1987-2018 at Faridpur (no data for 2019 was available). Values range from 3.77 to 12.47 mm per day, with lower values (≤9.27 mm per day) July through February, and higher values from March through June.

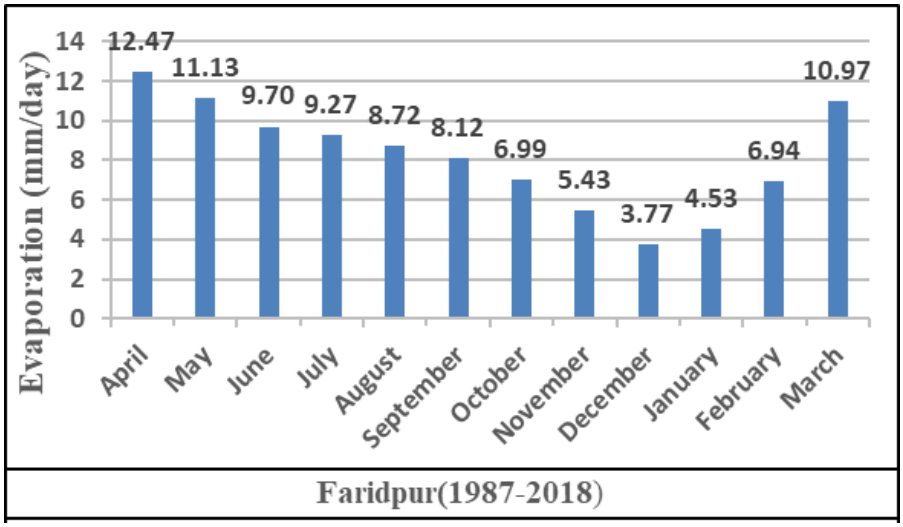


Figure** Fehler! Kein Text mit angegebener Formatvorlage im Dokument.**-4. Evaporation

Windspeed

Figure 5-5 shows the average monthly wind speed 1948-2019 at Faridpur and 1987-2019 at Tangail. The highest value occurred in May (200 km/day in Faridpur) and the lowest in December (91 km/day in Tangail).

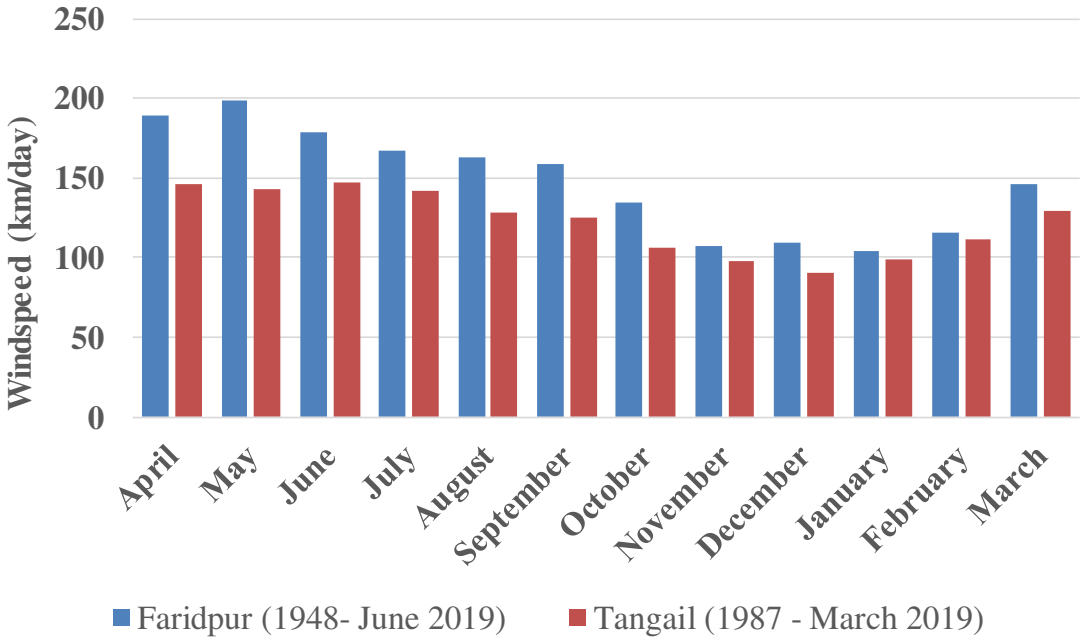


Figure** Fehler! Kein Text mit angegebener Formatvorlage im Dokument.**-5. Windspeed

Sunshine Hours

Figure 5-6 shows the average monthly sunshine hour per day data 1985-2018 at Faridpur and 1987-2018 at Tangail (no data for 2019 was available). The highest value occurred in April (8.0 hours per day in Faridpur) and the minimum in July (4.0 hours per day in Tangail).

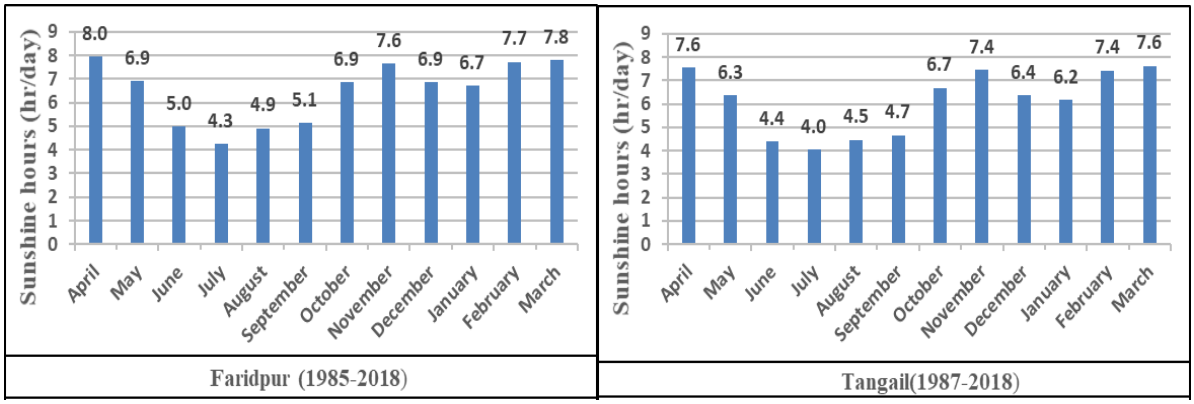


Figure** Fehler! Kein Text mit angegebener Formatvorlage im Dokument.**-6. Sunshine hours per day

O1-2 Stratigraphy and Seismicity

Figure 5-7 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 northwest lies in the Calcutta-Mymensingh hinge, and another small part in the southwestern Bansal Gravity High. The study area falls in a seismic zone that has a medium earthquake vulnerability.

O1-3 Topography

Figure 5-8 shows the 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, and so on)

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.

O1-4 Water Resources

O1-4-1 River System

The study area, consisting of the two sub-reaches JRB-1 and JLB-2, comprises about 244,316 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: Jamuna, Ganges and Padma.

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 8,000 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.

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% of the Jamuna. Flood discharges reach 80,000 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.

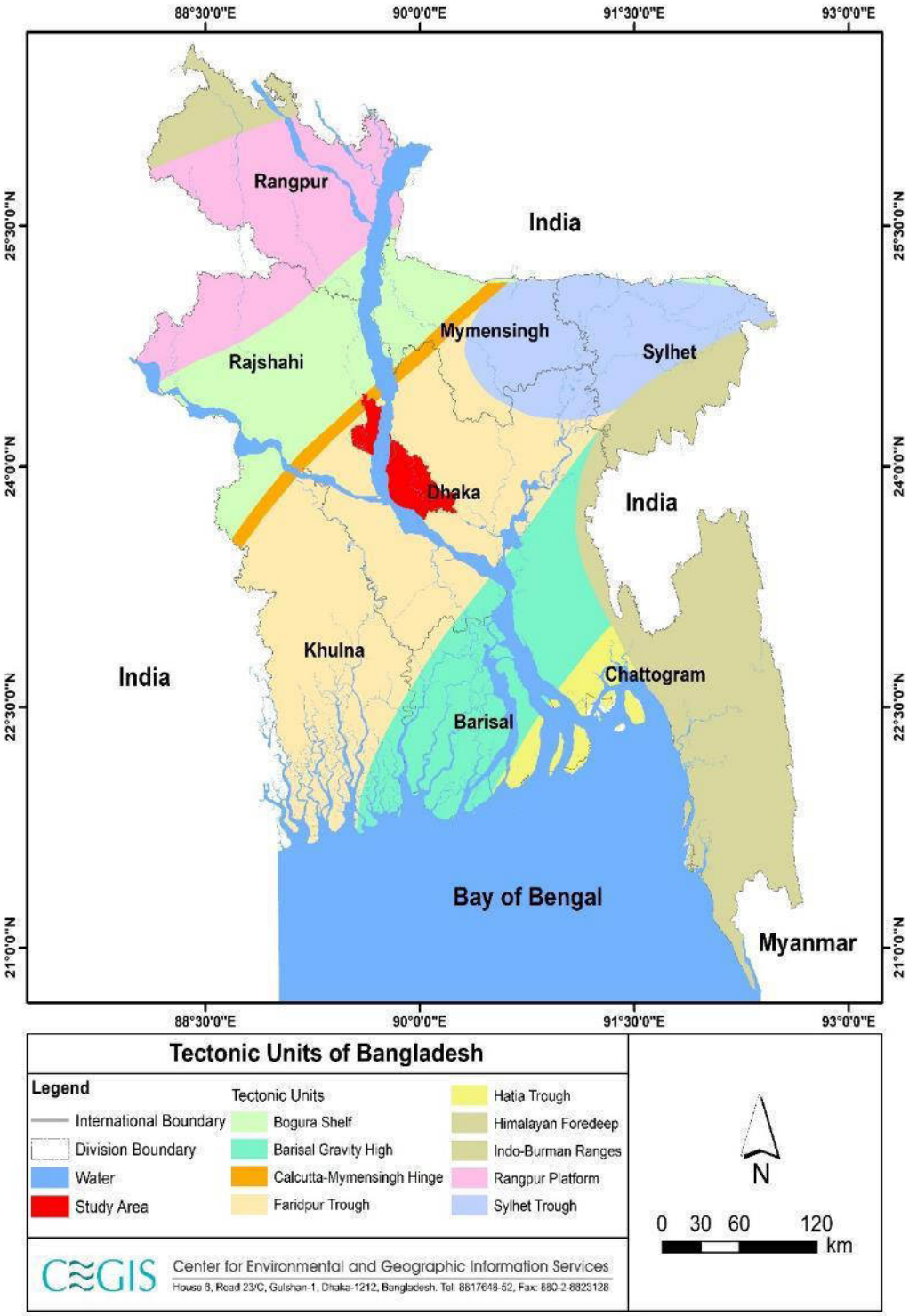


Figure** Fehler! Kein Text mit angegebener Formatvorlage im Dokument.**-7. Location of the study area in the tectonic units of Bangladesh

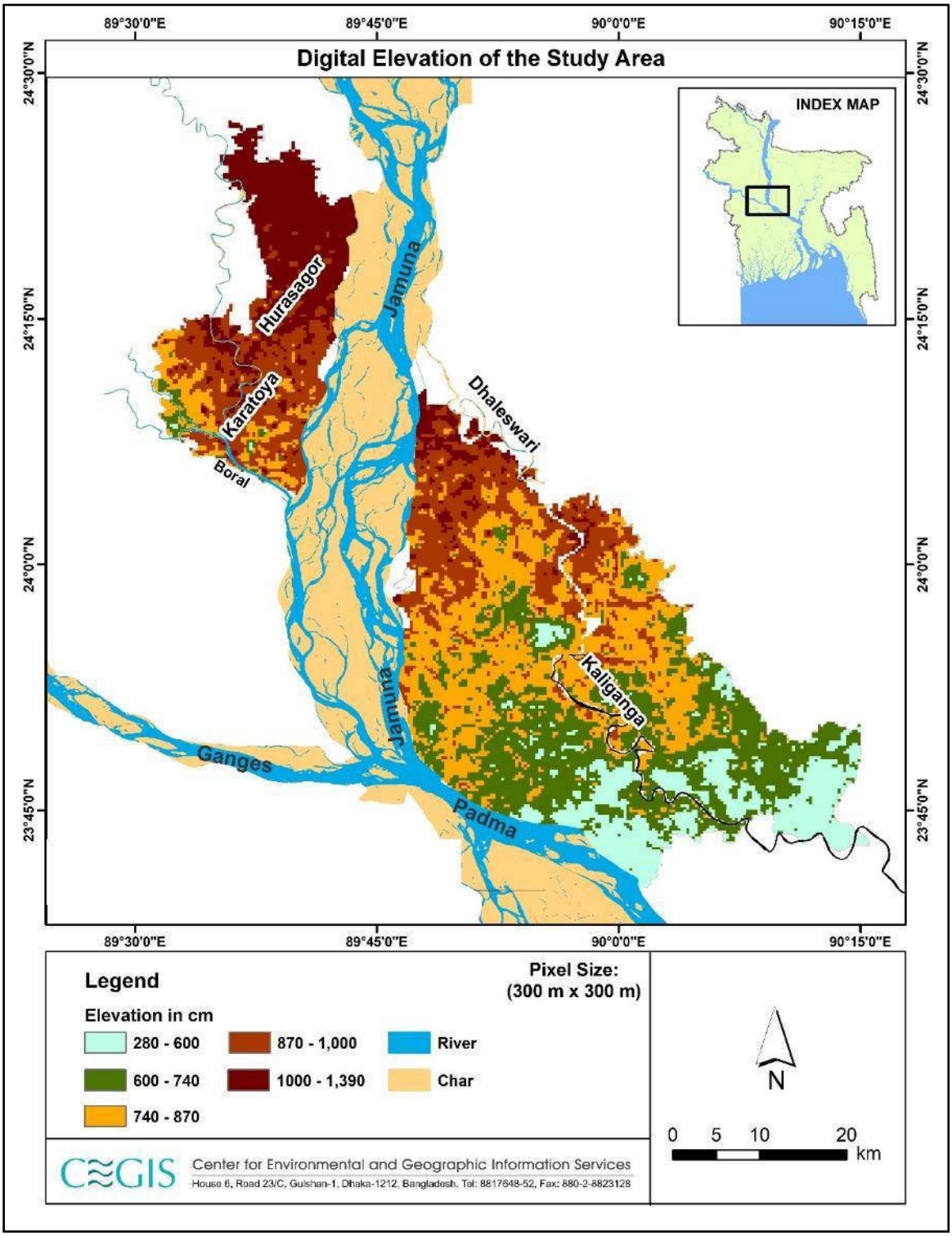


Figure** Fehler! Kein Text mit angegebener Formatvorlage im Dokument.**-8. Topography of the study area

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.

Table 5-1 and Table 5-2 show the seasonal maximum and minimum and mean discharge values of the Jamuna and Padma rivers from 1981 to 2015 at two stations, Bahadurabad transit and Baruria transit (BWDB, 2015). The Jamuna maximum is about 100,000 m^3/s (July) while the Padma maximum is about 140,000 m^3/s (September-October).

Table** Fehler! Kein Text mit angegebener Formatvorlage im Dokument.**-1. Seasonal maximum & minimum discharge of Jamuna and Padma (1981-2015)

Season	Jamuna River (Bahadurabad Transit)		Padma River (Baruria Transit)	
m^3/s	Maximum	Minimum	Maximum	Minimum
Dry (December-February)	16232	3140	17384	3040
Pre-Monsoon (March-May)	43600	2702	40700	3196
Monsoon (June-September)	103129	10500	141935	9528
Post-Monsoon (October-November)	66100	6190	77800	9050

Source: BWDB

Table** Fehler! Kein Text mit angegebener Formatvorlage im Dokument.**-2. Mean discharge of Jamuna and Padma (1981- 2015)

Season	Jamuna River (Bahadurabad Transit)	Padma River (Baruria Transit)
m^3/s		
Dry (December-February)	5685	7829
Pre-Monsoon (March-May)	9869	10722
Monsoon (June-September)	40101	57712
Post-Monsoon (October-November)	18432	28809

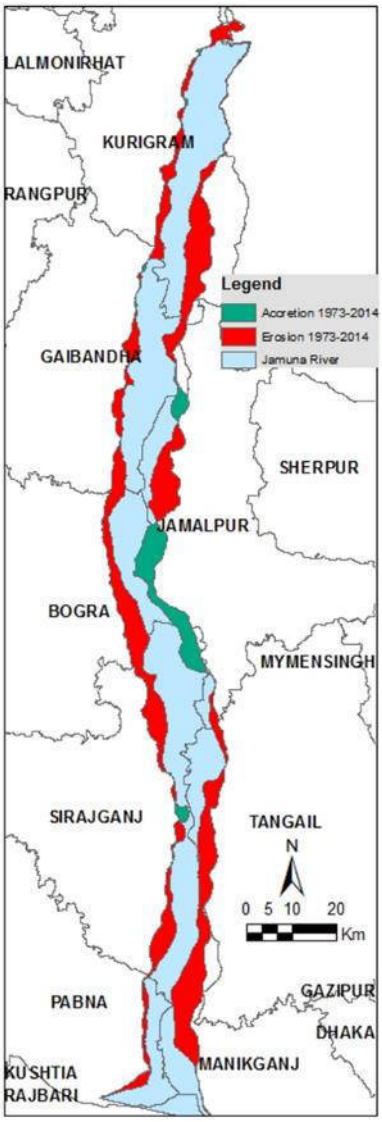
Main river water levels and discharges are not strongly related to local precipitation, since the majority of river runoff is generated outside the country. The most severe floods occur when the Jamuna and Ganges Rivers peak together such as occurred in 1988.

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

O1-4-2 Erosion and Accretion

The width of Jamuna River has changed over the years and analysis shows a widening trend since 1900 which accelerated after the 1980s, causing an increase in bank erosion. The erosion rate was high before the 1990s, but since the start of this century it has decreased significantly due to natural causes and human interventions such as the construction of riverbank protection structures. However, the last 40 years has seen more erosion than accretion.

A westward migration of the Jamuna riverbed has been a prominent feature since the initiation of the avulsion of the Brahmaputra River from its old path into the Jamuna River. The Jamuna transported some 1 billion tons of sediment annually in the 1960s, but since then its sediment load has gradually dropped by 2.5 times during the 1980s. It is believed



that a sediment slug generated by the great Assam earthquake of 1950 has attributed to this rapid decrease of sediment.

The Padma River carries the combined discharge of Brahmaputra and Ganges and has an annual average discharge of 30,000 m^3/s, mainly due to southwest monsoon precipitation occurring in June-October while the remainder is generated from base flow and snow melt in the Himalayas. In terms of discharge it is the third largest river in the world.

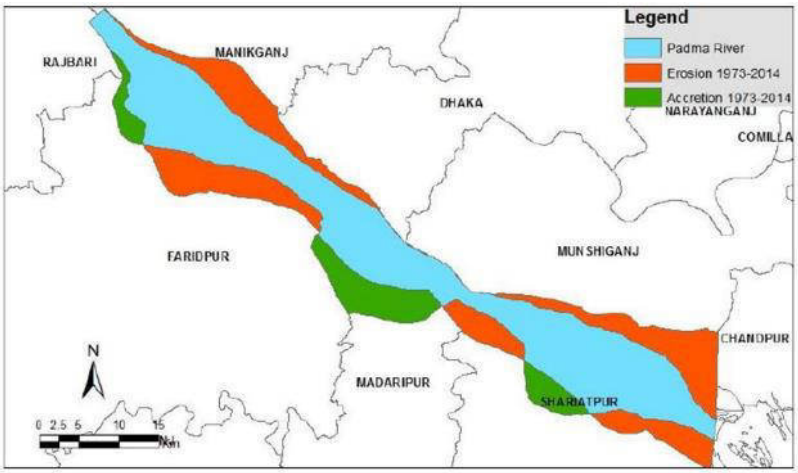


Figure** Fehler! Kein Text mit angegebener Formatvorlage im Dokument.**-9. Erosion and accretion along Jamuna and Padma Rivers in 1973-2014 (CEGIS, 2014)

O1-4-3 Surface Water Levels and Water Quality

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.

Water levels. Secondary data on water levels were collected for the Jamuna and Padma rivers from the BWDB stations at Sirajganj and Aricha. The maximum and minimum water levels in different seasons (1981-2015) are shown below in Table 5-3. The table shows that in monsoon the average surface water levels of Jamuna and Padma rivers remain about 12.50 m PWD and 8.04 m PWD, respectively. In the dry season, the Padma River becomes extremely shallow, but the Jamuna River remains deep. Table 5-4 shows the average values of water levels of the two major rivers in different seasons (1981 to 2015).

Table** Fehler! Kein Text mit angegebener Formatvorlage im Dokument.**-3. Maximum and minimum water levels of Jamuna and Padma (1981-2015)

Season	**Jamuna River (Sirajganj station)**		**Padma River (Aricha Station)**	
m+PWD	Maximum	Minimum	Maximum	Minimum
Dry (December-February)	9.14	6.11	4.88	2.00

Pre-Monsoon (March-May)	12.38	6.03	7.30	1.94
Monsoon (June-September)	15.11	9.17	10.76	4.26
Post-Monsoon (October-November)	13.69	7.79	9.50	3.75

Source: Bangladesh Water Development Board

Table** Fehler! Kein Text mit angegebener Formatvorlage im Dokument.**-4. Jamuna and Padma Rivers mean water levels (1981-2015)

Season	**Jamuna River (Sirajganj station) [m+PWD]**	**Padma River (Aricha Station) [m+PWD]**
Dry (December-February)	7.41	3.22
Pre-Monsoon (March-May)	8.30	3.72
Monsoon (June-September)	12.50	8.04
Post-Monsoon (October-November)	10.24	6.20

Source: Bangladesh Water Development Board

Water quality –The standard values of seven surface water quality parameters and their suitability set by the DoE are shown in Table 12-6 and 5-6. On the whole, water quality seems reasonable to good in the Jamuna and Padma rivers, except dissolved oxygen (DO), which is low during the months July-November/December.

Table** Fehler! Kein Text mit angegebener Formatvorlage im Dokument.**-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	Jan	29	7.8	8.29	22	66	0.02	11
		Feb	30	7.8	8.29	23	65	0	11
		Mar	32	7.8	8.29	21	66	0.02	10
		Apr	28	7.8	8.28	21	64	0.02	10
		May	28	7.7	8.26	21	65	0.01	11
		Jun	27	7.6	8.21	21	65	0	11
		Jul	28	6.7	0.52	54	164	0.51	17
		Aug	28	7.0	0.26	56	112	1.59	10
		Sep	28	6.9	1.15	54	107	1.45	11
		Oct	28	7.1	0.67	55	109	1.67	12
		Nov	25	7.0	0.48	80	160	1.27	18
		Dec	22	7.5	8.60	77	125	0.29	9
Aricha	Padma	Jan	28	7.3	8.16	24	69.2	0.2	12
		Feb	30	7.3	8.12	24	69.2	0.2	12
		Mar	30	7.3	8.16	25	69.2	0.2	10
		Apr	30	7.3	8.16	23	69.2	0.2	10
		May	27	7.3	8.1	22	69.2	0.2	10
		Jun	28	7.3	8.1	23	69.2	0.2	12
		Jul	29	6.8	3.05	50	100	1.89	10
		Aug	28	6.4	0.25	76	153	0.07	9
		Sep	26	6.5	0.35	91	181	1.85	18
		Oct	28	7.0	1.13	53	106	1.86	11
		Nov	25	7.0	0.63	59	118	1.19	12
		Dec	22	7.1	1.22	84	169	0.13	17

Source: Bangladesh Water Development Board

Table** Fehler! Kein Text mit angegebener Formatvorlage im Dokument.**-6. Bangladesh surface water quality standards

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	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	Irrigation
	22	Fishing
Temperature (°C)	20-30	Irrigation
	20-30	Fishing

Source: Bangladesh DoE

O1-4-4 Groundwater

Groundwater level data are analyzed using data of three BDWB observation wells in three districts (Sirajganj, Manikganj and Tangail) of the study area.

Figure 5-4 shows variations of mean groundwater levels. The Tangail average groundwater 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 decline in groundwater table (up to 6 meters) was observed in 1997 and 2001.

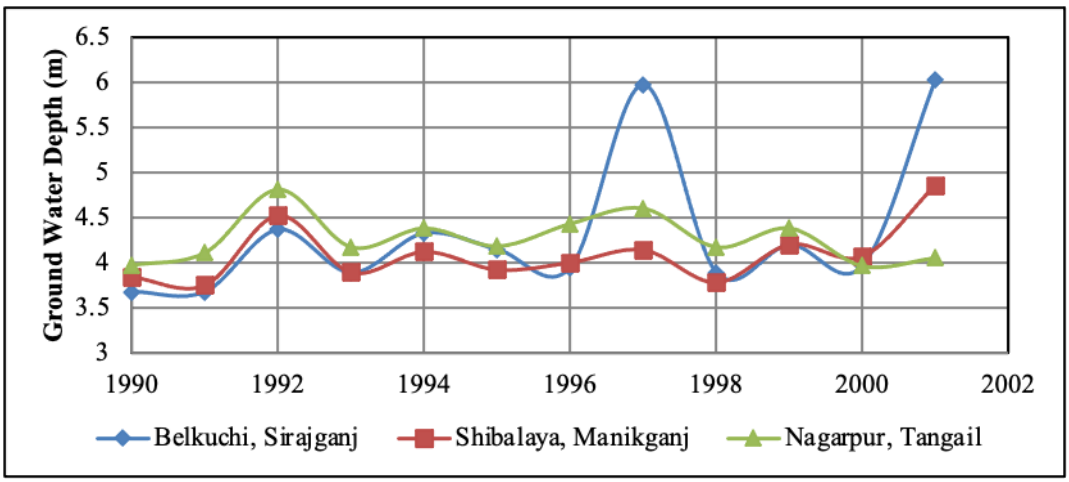


Figure** Fehler! Kein Text mit angegebener Formatvorlage im Dokument.**-10. Mean groundwater levels in Sirajganj, Manikganj, and Tangail (1990-2001)

Table 5-5 shows the groundwater table (GWT) at 10-year intervals at the three locations. Values are shown for both the dry (April) and wet (September) period. In the dry season, increased use of groundwater by local people lowers the GWT. During the monsoon, surface water recharges the groundwater and GWT rises upward. In 2000 compared to 1990, the dry season GWT had dropped whereas wet season GWT had risen.

Table** Fehler! Kein Text mit angegebener Formatvorlage im Dokument.**-7. Groundwater depth at three locations at three 10-year intervals

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

Ocean water has a salinity of 35 ppt whereas in the Bay of Bengal close to Bangladesh coast it is 30–32 ppt. This is due to discharge of fresh water by the three large rivers. The salinity in Jamuna and Padma River is considered as 0 ppt. The extreme lower part of Padma river near Chandpur has very low salinity which varies between 0-1 ppt.

O1-4-5 Navigation

The Jamuna River is categorized as Class II by the Bangladesh Inland Water Authority (BIWTA, 1991), which means the river remains navigable throughout the whole year and links major inland ports or places of economic importance to class-I route (***Figure 12-11***).

The available average draft in the Jamuna is 1.75 m across the river and recent surveys show the minimum available water depth in the river from Sirajganj to Bahadurabad is 1-1.3 m and from Bahadurabad to Chilmari is a 1.2-2.2 m (Mishra and Hussain, 2012). The river is also a part of the India-Bangladesh protocol route and the route is used by cargo vessels to carry goods to Pandu in India. At the local level, people from charlands use the river to access the mainland mainly for earning livelihood, education and health care purposes. Smaller mechanized boats are used mainly for carrying people and goods and for fishing activities.

O1-4-6 Water Resources Functions

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.

Irrigation

The net cultivable area (NCA) for Project-2 is approximately 184,200 ha, comprised of 51% clay and 49% loam soil. The water required to irrigate the entire NCA is approximately 2.8 billion m^3 for a single season of Boro rice planted in the Rabi winter season (generally November-February) and harvested in the Kharif monsoon season (generally March-October). 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 billion m^3 each. Therefore around 3.9 billion m^3 water would be required for irrigating the entire 184,200 ha NCA. However, of this area, only 55% area is irrigable. **Table 12-8** shows the proportion of irrigable areas and water consumed by these areas annually (Minor Irrigation Project, 2010). Approximately 2.15 billion m^3 of water is annually available for irrigation from different surface and groundwater sources and around 1.75 billion m^3 of water would be further required to provide irrigation in the entire NCA.

Table** Fehler! Kein Text mit angegebener Formatvorlage im Dokument.**-8. Irrigable areas and water consumption

Irrigation methods used	**Area** (ha)	**Percentage of NCA**	**Annual Water Requirements**
Groundwater			
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% non-irrigated area into irrigation coverage
Total non-irrigated area	82,220	45	

Source: Minor Irrigation Project, 2010

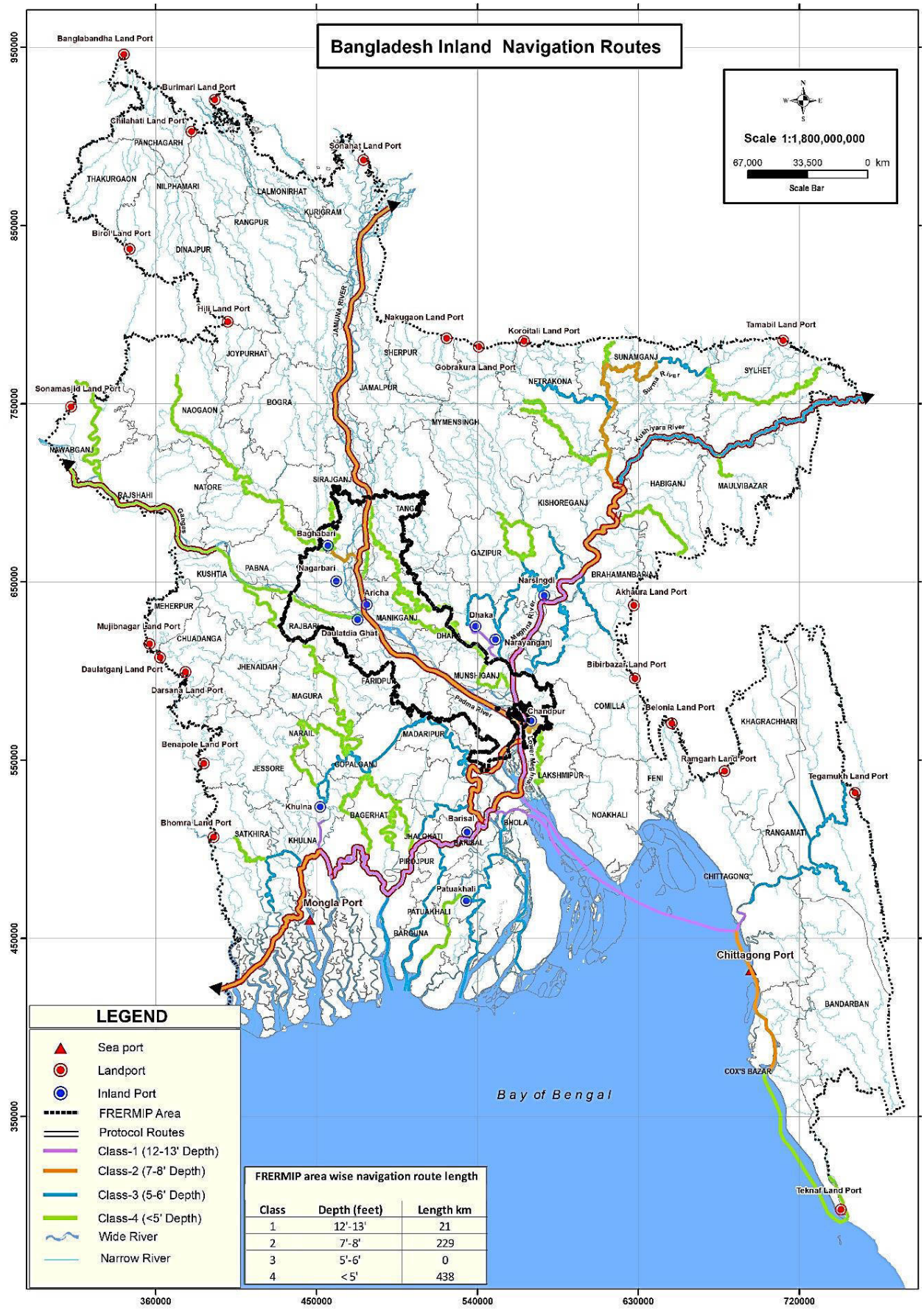


Figure** Fehler! Kein Text mit angegebener Formatvorlage im Dokument.**-11. Main waterway navigation routes in Bangladesh

Due to the flat topography of Bangladesh, just a small increase in water level above the riverbank causes full-scale inundation. Figure 5-5 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.

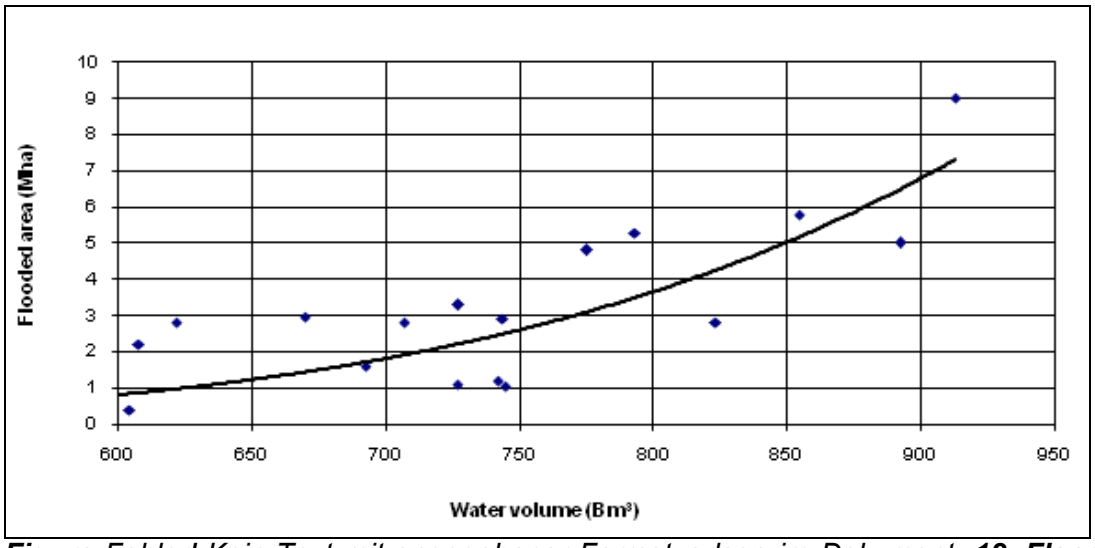


Figure** Fehler! Kein Text mit angegebener Formatvorlage im Dokument.**-12. Flooded area vs water volume (1972-1993)

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 19.5 m PWD. The probability of flood in a year for the Padma is about 60 % and for the Jamuna is about 75%. The average duration of flood is about 23 days in the Padma basin and about 14 days in the Jamuna basin. The duration of floods previously affecting the Padma/Jamuna basin is given in Table 12-9.

Table** Fehler! Kein Text mit angegebener Formatvorlage im Dokument.**-9. 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

Table 12-10 and Table 12-11 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 20-year flood is about 23 cm at Bahadurabad and 38 cm at Mawa.

Table** Fehler! Kein Text mit angegebener Formatvorlage im Dokument.**-10. 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** Fehler! Kein Text mit angegebener Formatvorlage im Dokument.**-11. 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*	20 year	*50 year*	*100 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

The severe land erosion along riverbanks and charlands of the study area cause continuous siltation in major tributary rivers (e.g. Karatowa, Baleswari, Baral, Hurasagar, Ichamati) 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, waterlogging 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. Due to the backwater effects of the two major rivers, drainage congestion problems occur. Some areas near JRB1 interventions at Belkuchi, Shahjadpur etc. undergo moderate drainage. Drainage of areas near the JLB2 intervention (Nagarpur, Saturia, Shibalaya etc locations) is poor.

Morphology

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.

Erosion

Riverbank erosion is the most important natural cause of landlessness and forced resettlement of people in the study area. During 1973 to 2018, erosion and accretion along the Jamuna and Padma rivers was 132,766 ha and 30,983 ha respectively (net erosion was 101,783 ha). In 2018, net erosion along the Jamuna and Padma was 2,168 ha of which 385 ha were settlements. The eroded lands also included about 63 m of district road, 1,645 m of upazila road and 1,967 m of rural road. 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.

Table** Fehler! Kein Text mit angegebener Formatvorlage im Dokument.**-12. Erosion & accretion from 1973-2018 (cumulative)

River	Erosion, Ha	Accretion, Ha	Net Erosion, Ha
Jamuna	94,616	16,738	77,878
Ganges	37,412	27,071	10,341
Padma	38,150	14,245	36,725
Total	**170,178**	**58,054**	**124,944**

Source: CEGIS 2019, Prediction of Riverbank Erosion April 2019, p. 1-3

Char Formation

Charlands 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 homesteads, render land unproductive, and destroy livestock. In the Jamuna floodplains, about 50% of the people live in the island and attached chars whereas in the Padma char areas, this is about 27% (Bangladesh Flood Action Plan, 1993).

In the Jamuna River, about 85% reduction in flow takes place during dry period. The mean depth of Jamuna River recorded near the Sirajganj Sadar reduces by approximately 40%. About 87% reduction inflow takes place in the Padma River from monsoon to dry period. The average depth of the river reduces by approximately 60% (from 8.19 m during monsoon to 3.23 m in the dry season). This significant reduction of dry season flow eventually increases the char lands during the dry season.

Charlands are formed mainly because of the low flow in the rivers in the dry season. Erosion along the sides of the Jamuna and Padma rivers result in the siltation of inside the rivers, which results in the formation of charlands.

O1-5 Land Resources

O1-5-1 Agro-Ecological Regions

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, temperature and flood regimes create major problems for planning environmental and agricultural research, extension and development activities.

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 (***Figure 12-13***).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°C); (v) winter temperature, and (vi) frequency of occurrence of extremely high (> 400°C) summer temperature.

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) Lower Ganges River Floodplain (AEZ-12).

The distribution of agro-ecological regions in the study area is presented in ***Figure 12-13***.

The study area's agro-ecological regions are presented in Table 12-13.

Table** Fehler! Kein Text mit angegebener Formatvorlage im Dokument.**-13. Agro-ecological zones

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

Karatoya-Bangali Floodplain Region (AEZ-4)

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 12-14.

Table** Fehler! Kein Text mit angegebener Formatvorlage im Dokument.**-14. Soil characteristics in 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%)	4.7-7.8	L	VL-L	L-M	L	L-M	Opt	Opt	L-M	L-M	Opt

Med highland (44%)	5.4-7.9	L	VL-L	L-M	L	L-M	Opt	Opt	L-M	L-M	Opt
Med lowland (14%)	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 Floodplain Region (AEZ-7)

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 riverbanks 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 m 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 Floodplain Region is presented in Table 12-15.

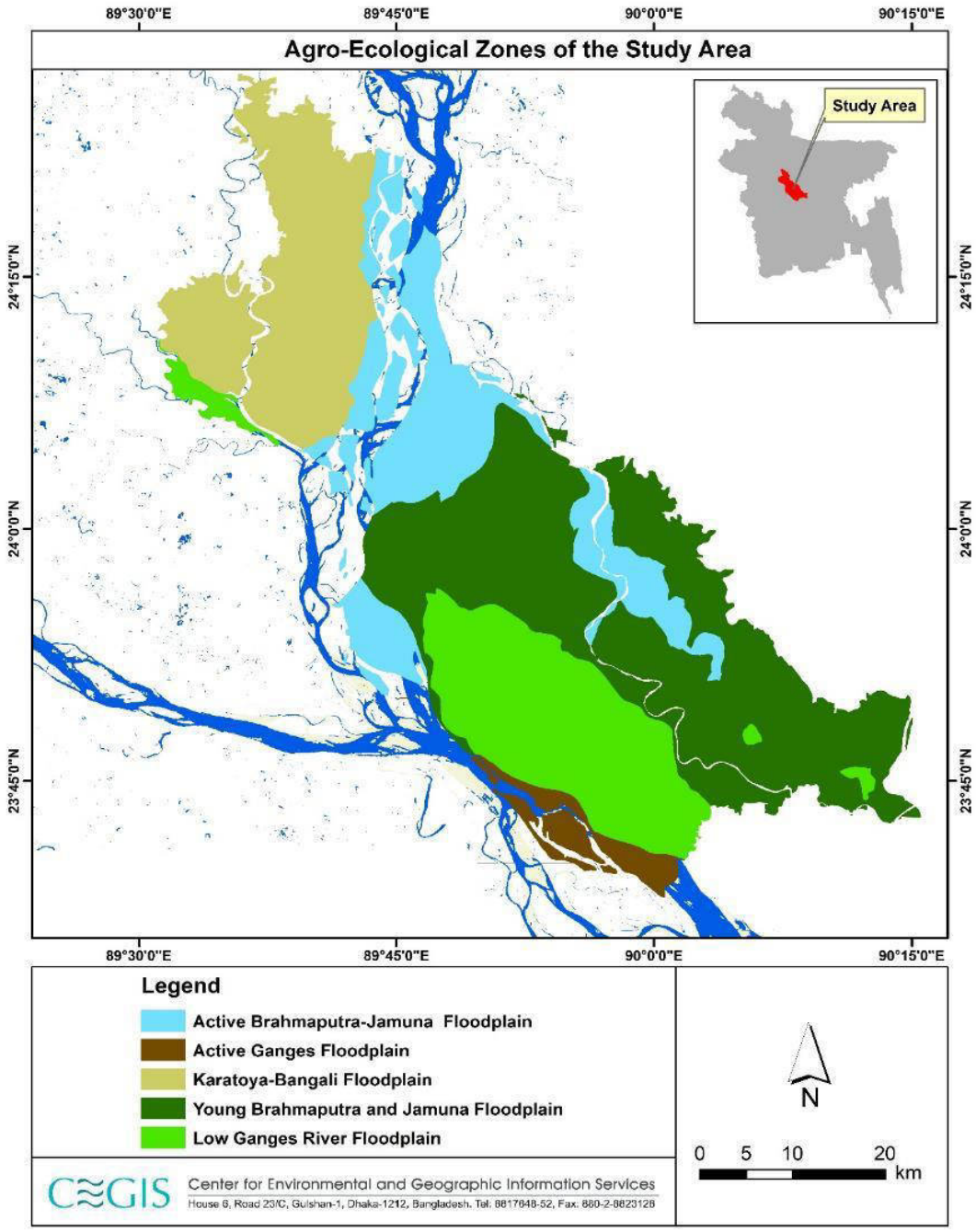


Figure** Fehler! Kein Text mit angegebener Formatvorlage im Dokument.**-13. Agro-ecological regions in the Study Area

Table** Fehler! Kein Text mit angegebener Formatvorlage im Dokument.**-15. 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%)	5.7-8.2	L	L	L-M	L-M	L-M	L-M	L-M	L-M	L-M	M
Medium lowland (20%)	6.0-8.2	L	L	L-M	L-M	L-M	L-M	L-M	L-M	L-M	M

Source: BRAC 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)

This region comprises 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 of the soils of Young Brahmaputra and Jamuna Floodplain are presented in Table 12-16.

Table** Fehler! Kein Text mit angegebener Formatvorlage im Dokument.**-16. 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%)	5.6-7.5	VL-L	VL-L	L	M	L	M	M	L-M	L-M	M
Med highland (42%)	5.4-7.5	VL-L	VL-L	L	M	L	M	M	L-M	L-M	M
Med lowland (19%)	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)

The agro-ecological region 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 riverbank are eroded, new alluvium is 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 m 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 the Active Ganges Floodplain Region are presented in Table 12-17.

Table** Fehler! Kein Text mit angegebener Formatvorlage im Dokument.**-17. 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%)	7.1-8.1	L	L	L-M	M	L-M	H	H	L	M	M
Med highland (33%)	7.1-8.1	L	L	L-M	M	L-M	H	H	L	M	M
Med lowland (18%)	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.

Lower Ganges River Floodplain (AEZ-12)

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 deep or deeply flooded in the rainy season.

The soils of the Lower Ganges River Floodplains are silt loams and silty clay loams on the ridges and silty clay loams to heavy clays on lower sites. In 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 Lower Ganges River Floodplain are presented in Table 12-18.

Table** Fehler! Kein Text mit angegebener Formatvorlage im Dokument.**-18. Soil characteristics, Lower Ganges River Floodplain

Major land type	**Soil pH**	**Soil OM**	**Nutrients status**								
			N	*P*	*K*	*S*	*Ca*	*Mg*	*Zn*	*B*	*Mo*
High land (13%)	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%)	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%)	6.0-8.3	L-M	L	L	M-Opt	L-M	Opt-H	Opt-H	L-M	M-Opt	Opt
Lowland (14%)	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

O1-5-2 Land Use

The total study area is about 244,316 ha of which about 184,200 ha is net cultivable area (NCA). Settlements and water bodies constitute about 11% and 13% respectively. Land use in the study area is presented in Table 5-7.

Table** Fehler! Kein Text mit angegebener Formatvorlage im Dokument.**-19. Land use

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

Sources: CEGIS estimation from SOLARIS

O1-5-3 Land Type

Land type classifications are based on depth of inundation on agriculture land during monsoon season due to normal flooding. This land type classification is based on depth of inundation during the monsoon season due to normal flooding on agriculture land. There are five land types: High Land (HL, flooding: depth 0-30 cm); Medium Highland (MHL, flooding depth: 30-90 cm); Medium Lowland (MLL, flooding depth: 90-180 cm); Low Land (LL, flooding depth: 180-360 cm); and Very Lowland (VLL, flooding depth: above 360 cm) (MPO, 1986). The percentages of land type of high land, medium highland, medium lowland, lowland and very lowland are about 4, 37, 37, 21 and 1 respectively of the total area. The detailed land type is presented in Table 12-20.

Table** Fehler! Kein Text mit angegebener Formatvorlage im Dokument.**-20. Land types

Land type	**Area (ha)**	**% of NCA**
Highland	8,153	4
Medium Highland	68,045	37
Medium Lowland	68,023	37
Lowland	39,376	21
Very Lowland	1795	1
Total	*184,200*	*100*

Sources: CEGIS estimation from SOLARIS

O1-5-4 Soil Texture

Soil texture is the relative proportions of sand, silt and clay; important for agriculture crop production. The percentages of texture of surface soil of the study areas are about 7, 44, 39, 6 and 4% for clay, clay loam, loam, sand, sandy loam respectively of the NCA. Data on soil texture is presented in Table 12-21.

Table** Fehler! Kein Text mit angegebener Formatvorlage im Dokument.**-21. Soil texture, 0-15 cm depth

Texture	**Area(ha)**	**% 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

O1-5-5 Available Soil Moisture

The available soil moisture is 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 Table 12-22.

Table** Fehler! Kein Text mit angegebener Formatvorlage im Dokument.**-22. Soil moisture

Soil Moisture	Area	% of NCA
High	134,373	72.9
Medium	49,485	26.9
Low	342	0.2
Total	184,200	100

Source: CEGIS estimation from SOLARIS

O1-5-6 Drainage Characteristics

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 5-8.

Most of the area (83%) of the NCA is under imperfectly drained condition. The rest (17%) 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** Fehler! Kein Text mit angegebener Formatvorlage im Dokument.**-23. Drainage characteristics

Drainage classes	Drainage characteristics	Area (ha)	% of NCA
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 m 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).

O1-5-7 Land reclamation

About 150,000 ha of land is to be stabilized and reclaimed under the RSP programme, which is to consist of currently (unstable) char land and low-lying floodplain land. Figure 5-14 provides a map of the areas and locations to be reclaimed. It is anticipated that land stabilization will lead to reduced human suffering, greater investment and higher productivity, but also greater use of agrochemicals (and hence pollution), loos of floodplain habitats and competing land claims.

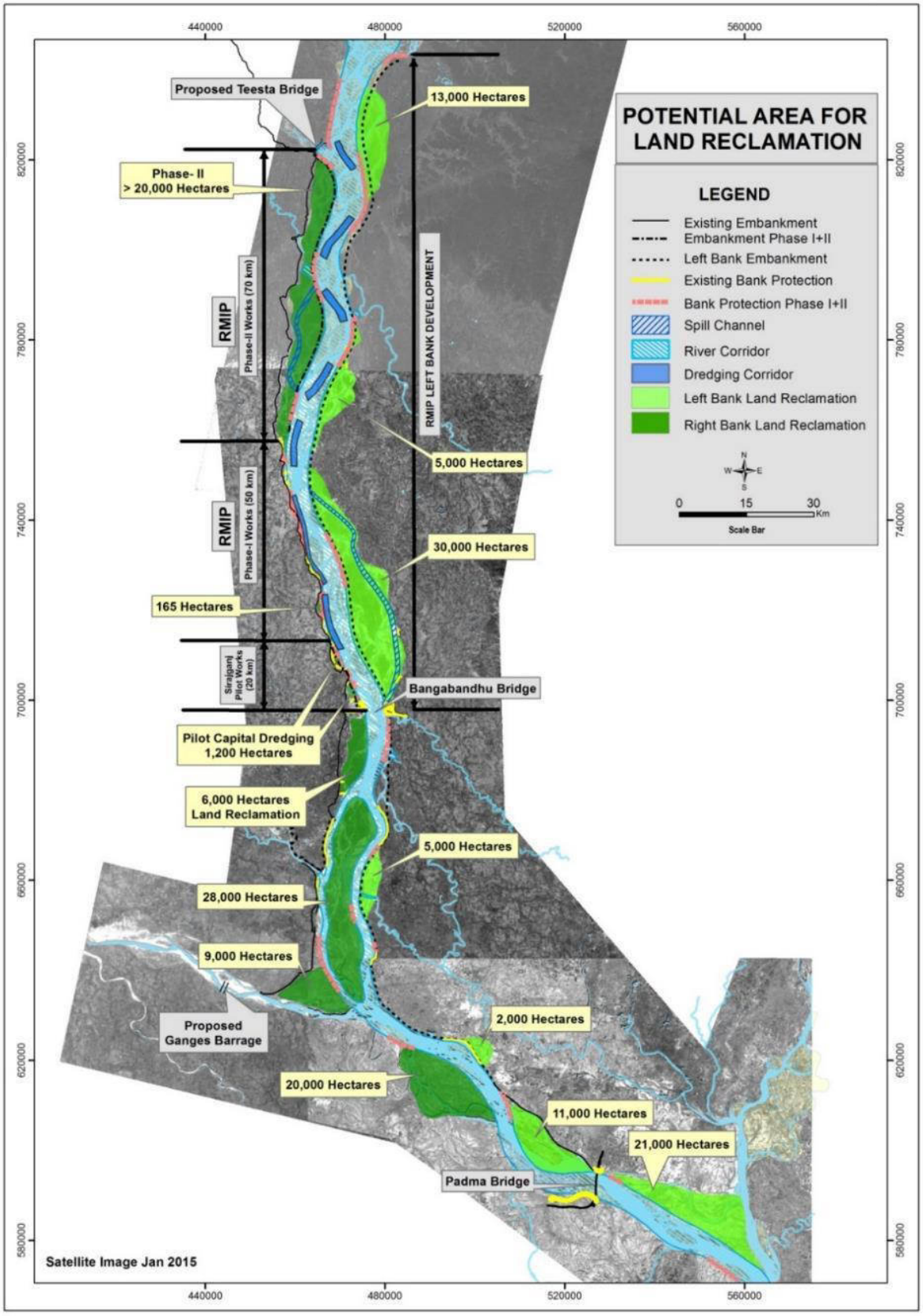


Figure** Fehler! Kein Text mit angegebener Formatvorlage im Dokument.**-14. Reclaimed Land Resulting from FERMIP Interventions

O1-6 Agriculture Resources

O1-6-1 Farming Practices

Farming practices in the study area are largely controlled by physical, biological, climatological and socio-economic 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.

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.

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 (Figure 12-15), pulses, spices, mustard (Figure 12-15), 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.

Figure** Fehler! Kein Text mit angegebener Formatvorlage im Dokument.**-15. Boro seedbed (left) and mustard field (right)

O1-6-2 Main Constraints of Crop Production

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 riverbank erosion cause loss of fertile agriculture lands.

O1-6-3 Cropping Pattern and Intensity

Figure 12-16 shows the cropping pattern. The cropping pattern is 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.

Cropping patterns practiced on land types in the study area are presented in Table 12-24, 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.

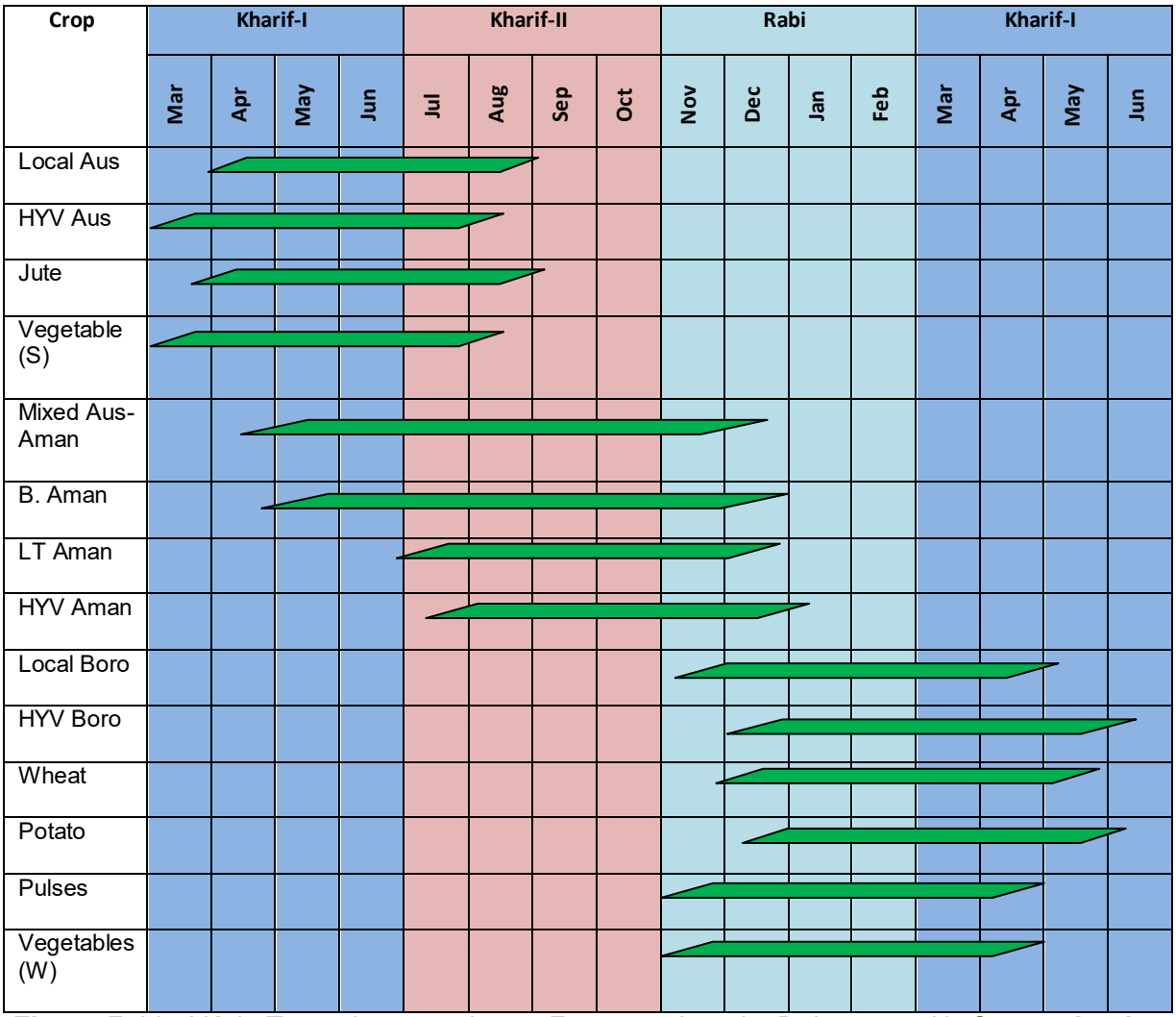


Figure** Fehler! Kein Text mit angegebener Formatvorlage im Dokument.**-16. Crop calendar

O1-6-4 Cropped Area

Details on crop production are shown in Table 5-23 which exhibits that the total cropped area is 335,099 ha of which 240,052 ha is under rice crop cultivation. Therefore, about 72% of the total cropped area in the study area is under rice crop and the rest (28%) is covered with non-rice crops. Pulses and jutes are the major among the non-rice crops which occupied about 26% and 17% of the total cropped area respectively. The other non-rice crops covered 57% of the total cropped area which include spices, oilseeds, wheat, potato and vegetables crops.

From Table 5-24 it is calculated that among the rice crops, Aus covers 11%, Aman covers 39% and Boro covers 50% of the cropped area. About 70% 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.

Table** Fehler! Kein Text mit angegebener Formatvorlage im Dokument.**-24. 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

Land type	Kharif-I (March-June)	Khartif-II (July-Oct)	Rabi (Nov-Feb)	Area (ha)	Per cent of NCA
	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.

Table** Fehler! Kein Text mit angegebener Formatvorlage im Dokument.**-25. 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

No.	Crop	Area (ha)	Damage-Free			Damaged			Total Production (tons)
			Area (Ha)	Yield (t/ha)	Production (Tons)	Area (Ha)	Yield (t/ha)	Production (Tons)	
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%							

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

O1-6-5 Crop Production

Crop production data, presented in Table 12-25, indicates that the major agricultural production of the study area comes from rice crops. The annual total rice production stands at about 268,154 metric tons. There is a production loss in rice production which is calculated as 63,080 MT. Among the rice crops, Boro is contributing about 54% (144,551 MT) followed by T. Aman 33% (89,494 MT), T Aus 8% (22,093 MT) and Mixed Aus-Aman 4% (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 133,336 MT. The non-rice crops are pulses (about 35,219 MT), spices (about 17,676 MT), jute (about 19,737 MT), mustard (about 20,282 MT), vegetables (about 4,994 MT) and potato (about 2,111 MT).

O1-6-6 Crop Damage

Table 12-25 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% of Boro crop area suffered damage annually and yield of this crop was reduced by about 24 to 26%. 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% area of Aman crop was affected by flood, river erosion and drainage congestion during the months of August and September. Early drought also delays 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).

O1-6-7 Agricultural Inputs

Fertilizers and pesticides are used for all crop cultivated in the study area (Table 12-26). 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 damage 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 12-26.

Table** Fehler! Kein Text mit angegebener Formatvorlage im Dokument.**-26. Fertilizer and pesticides

Crop name	Fertilizer (Kg/ha)				Pesticides		
	Urea	TSP	MP	Gypsum	No. 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.

O1-6-8 Minor Irrigation

Table 5-27 shows that in the study area about 55% of the cultivable areas are irrigated. Groundwater 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 pumps and traditional methods that lift surface water from rivers, canals, and beels (Figure 12-17).

Figure** Fehler! Kein Text mit angegebener Formatvorlage im Dokument.**-17. Surface water irrigated agricultural field

Table** Fehler! Kein Text mit angegebener Formatvorlage im Dokument.**-27. 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%)*

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

O1-7 Livestock and Poultry

Livestock and poultry play a significant role in the agro-based economy of Bangladesh. Table 12-28 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** Fehler! Kein Text mit angegebener Formatvorlage im Dokument.**-28. Livestock and poultry

Livestock/Poultry	**Number of Livestock/Poultry**
Cattle/cow	974,817
Buffalo	1,563

Livestock/Poultry	Number of Livestock/Poultry
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.

O1-8 Fisheries

O1-8-1 Introduction

The study area is a major fish producing region of the country with diversified fresh water fisheries resource bases consisting of the Jamuna, Padma and Meghna rivers, their tributaries and distributaries, seasonal and perennial Khals (canals), Beels (floodplain depressions) and the associated flood lands (Figure 12-18). The tributaries/distributaries and the canals act as the major connecting links between the river and the floodplain and thus play a vital role in maintaining fisheries biodiversity and productivity.

Fish biodiversity is also rich in the area but is declining due to indiscriminate fishing, obstruction of migration routes (especially in the dry season), discharge of industrial wastes, poor fisheries management, siltation, oil spills, insecticide contamination, and loss of critical habitats to siltation and bank erosion (FRERMIP EIA Tranche-1, 2014). Indiscriminate fishing practices include capture of brood-fish especially during winter and use of current jal to catch juvenile fish, especially of hilsa, and dewatering of beels for irrigation or fishing. Aquaculture practices are also prevalent in the study area but relatively less developed due to the flood threat and lack of improved technology.

FRERMIP interventions for river stabilization involving the construction of riverbank embankment to contain flooding, revetment of the bankline to stop erosion, and selective dredging to induce channel diversion will result in a narrower, non-eroding and non-flooding channel which will reduce the expanse of fisheries habitat and river-floodplain connectivity. It will furthermore alter the bankline and braided system of huge fisheries potential resulting in the reduction of catch fishery both in the river and the floodplains. Befitting mitigation measures to cover the adverse impacts are planned under the project interventions.

The area of intervention of the Project-2 works is mainly in the same sub-project area as the Tranche-1 works, i.e. JRB-1 and JLB-2, but with new dimensions: embankments, a closure dam and mid-river charland development with land reclamation in addition to revetments. Major target areas of interventions in the Chouhali reach form important aquatic ecosystems which will substantially be affected by the proposed interventions.

O1-8-2 Problems and Issues

Major problems and issues identified during the baseline study are as follows:

(I) Loss of connectivity from the main river to the beel specially in the dry season.
(II) Decrease in capture fisheries production due to the loss of habitat and change of present aquatic ecological condition.
(III) Reduction of and obstruction to fish migration mainly between the river and the floodplain.

(IV) Fishing of brood fish especially in the overwintering period.

(V) Breeding and feeding grounds are gradually being destroyed and decreasing due to dewatering, siltation and bank erosion.

(VI) Decrease of fish production due to the use of current jal, mainly used to catch the fingerlings (i.e. young fish).

(VII) Use of harmful insecticides in the crop fields, which along with the industrial pollutants affect the aquatic ecosystem.

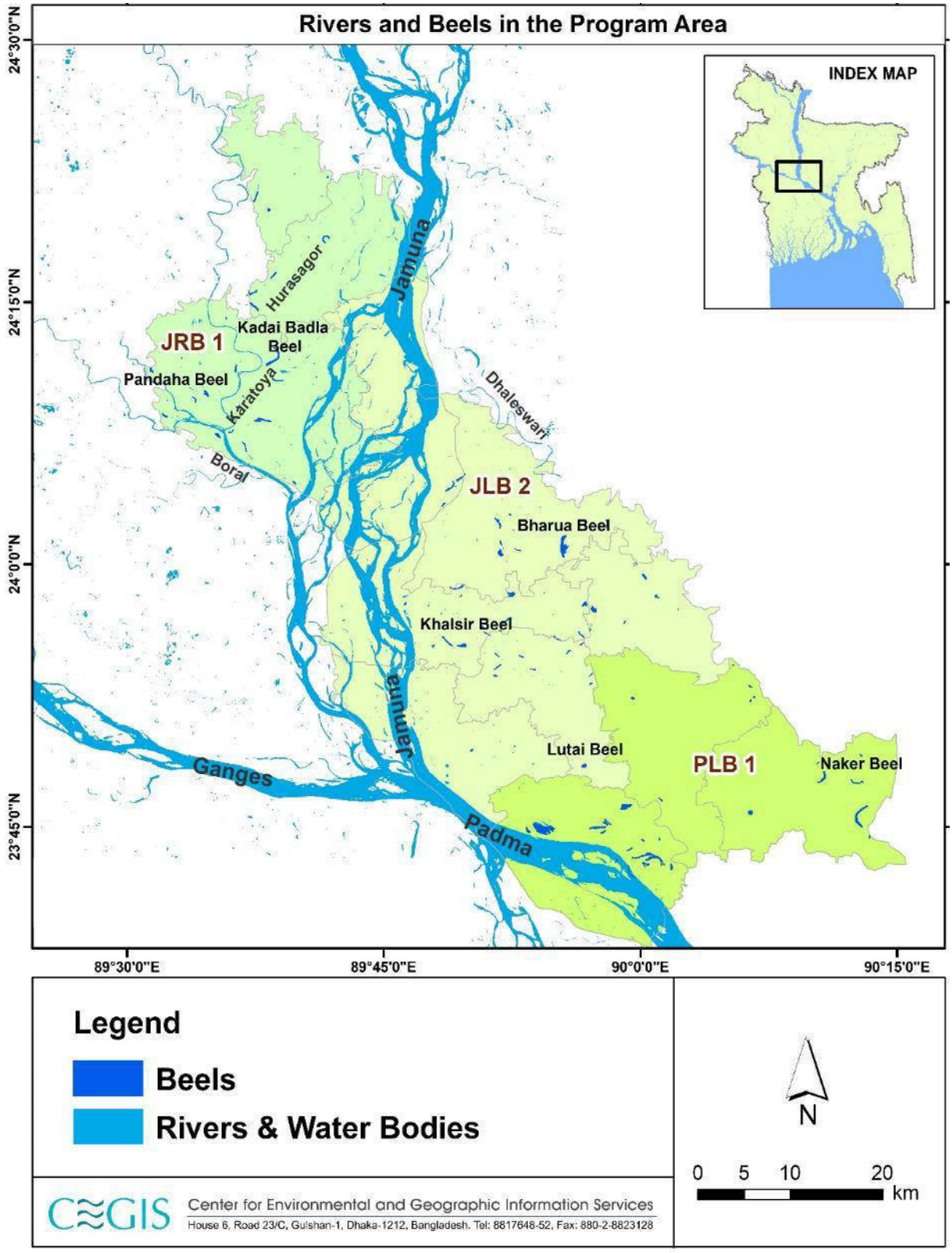


Figure** Fehler! Kein Text mit angegebener Formatvorlage im Dokument.**-18. Rivers and beels as potential fish habitats in the program area

O1-8-3 Fish habitats

Fish habitats of the study area may be divided into basically two types: River Fish habitat and Floodplain Fish habitat. The former can be sub-divided into (i) Bankline habitat (Figure 12-19); (ii) Charland habitat and (iii) Main Channel habitat, each having distinctive bio-

ecological features. Basic differences among these three sub-habitats are seasonality, depth and characteristic fishery. Main channels form the deepest parts and perennial areas making safe home for deep water fish, dolphin and shelter for overwintering river fish. The bankline ecosystem consists of the river corridor area beyond the main channel on two sides of the main channel. In the peak season, bankline habitat is flooded making good base for breeding and shelter of fishlings. In the lean season, the shallow bankline area dries out. Charlands are usually sandbars situated beyond the main channel. As it matures, it may be coalesced with the riverbank forming the river floodplain. Charlands may be vegetated or non-vegetated. Submerged vegetated charlands are also a safe eco-niche for breeding and early development of many fish.

Figure** Fehler! Kein Text mit angegebener Formatvorlage im Dokument.**-19. Bankline fish habitat in Harirampur (l) & open water near the Jamuna-Padma confluence

Floodplain fish habitat consists of (i) distributaries and canals; (ii) beels and floodlands; and (iii) closed water bodies. Most distributaries are perennial though some are now heavily silted off takes. Canals are seasonal or perennial. Beels are also seasonal or perennial. Floodlands are seasonal by nature. Closed water bodies are mostly homestead ponds and impoundments which may be seasonal or perennial.

In the aquatic ecosystem (river and floodplain) of the study area a characteristic fisheries-related annual bio-ecological cycle takes place. As the water level rises in the river in March, bankline and charland vegetated areas are inundated creating breeding and shelter sites for early development of fishlings. At the same time, floodplains are inundated by river flow and thereby creating shallow waters with vegetation suitable for breeding and fishlings. With respect to breeding and early development there are four categories of fish: (i) river fish with breeding and early development in the river; (ii) river fish breeding in the river but early development in the floodplain; (iii) river fish breeding and early development in the floodplain; and (iv) floodplain fish breeding and early development in the floodplain.

Fish breeding starts in March and continues up to August (in the river). In shallow waters of the floodplain, fishlings grow through September. When the river water starts receding, grown-up fish sub-adults along with their migrating parents return from the floodplain to the river. Similarly, river-born sub-adults move from bankline and charland shallow waters to the deeper waters as the bankline and charland dry up. Synchronously, reed vegetation of the bankline and charlands will end their annual lifecycle in September-October and dry up making room for newer seedlings which make next year's fish breeding ground. The braided river system provides a good niche for fish and fishery.

With respect of the ownership and user's right, rivers, distributaries, canals and most beels are public water bodies while some beels, ponds and impoundments are private property. Public water bodies like canals and beels are leased to fishermen groups but other public water bodies are common property and open to all for fishing, transportation and irrigation.

The study area consists of 8 Upazila's of 4 Districts (3 in Sirajganj, 2 in Manikganj, 2 in Dhaka and 1 in Chandpur district) under 2 sub-reaches (JRB-1, JLB-2). Field studies conducted in the three sub-reaches show that capture fisheries habitats with an area of some 93,975 ha include rivers, khals, perennial and seasonal beels and seasonal floodlands while culture ponds measure only 1,235 ha. Table 5-10 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 fish take shelter when river water levels drop. Deep areas play a vital role in fish propagation. The major problems in these riverine fish habitats are siltation and erosion.

Table** Fehler! Kein Text mit angegebener Formatvorlage im Dokument.**-29. Fish habitats

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	Fishpond	1,235
		Sub total:	*1,235*
		Total:	*93,975*

Source: CEGIS field Survey, 2013

O1-8-4 Fish Production and Effort

Fish production sources are basically divided into two categories: capture/open water fishery and aquaculture/closed water fishery and these are of three types in the study area as in the whole country: (i) river capture fishery; (ii) floodplain capture fishery; and (iii) floodplain aquaculture. Capture fishery has more area but less production with less but natural productivity requiring nearly no production/management cost/effort, but aquaculture requires less area but more management/ production cost with higher productivity. In the project area, capture fishery, particularly the rivers, is the major source of production and aquaculture is less developed due to the flood threat and lack of improved technology. Table 12-30 shows the fish production per habitat type in the project area. As these illustrate, the major fish production (84%) comes from the capture fishery and culture fishery has lesser contribution (16%).

Table** Fehler! Kein Text mit angegebener Formatvorlage im Dokument.**-30. Fish production by habitat in JRB-1, JLB-2 and PLB-1 area

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	

Sl. No.	Habitat Category	Habitat Type	Total production (MT)	%
		Sub total:	18,213	84
2	Culture	Fishpond	3,446	
		Sub total:	3,446	16
		Total:	21,659	100

Source: Field observation, FRSS 2010-2011; note: PLB-1 is included in this assessment as it was originally part of Project-2

A comparative analysis of fish production of the project districts shows that overall average fisheries production and capture fisheries production is higher in the study area compared to the other districts. But culture production is relatively lower in the project districts (Table 12-31).

Table** Fehler! Kein Text mit angegebener Formatvorlage im Dokument.**-31. Comparative status of fish production in the project districts

Project Districts	Fish Production 2014-2015 (MT)									
	Capture Fishery				Culture Fishery					
	River	Beel	Flood Plain	Sub-total	Pond	Seasonal Culture waters	Pen Culture	Cage Culture	Sub-total	Total
Dhaka	492	748	4672		7425	3306	2510	20		
Manikganj	1185	484	10188		7950	3241	23	00		
Tangail	437	2132	9911		32189	6015	245	00		
Sirajganj	2405	612	30665		14800	2923	5	20		
Chandpur	21746	280	22293		35599	1799	0	227		
Total (Project districts =PD)	27265	4256	77729	109250	98043	17248	2783	267	118341	227591
Average/ PD	5453	851	15545	21850	19609	3450	557	53	23668	45518
Total (Country)	174878	92678	730210	997766	1613240	201280	13070	1969	1829559	2827325
Average (Country)/ District	2732	1448	11409	15590	25207	3145	284	328	28587	44176

Source: FRSS, 2016. Fisheries Statistical Report of Bangladesh, DoF

Fish Marketing

Fish marketing has a different approach and pattern in river and floodplain areas. In the river area, overnight catches are brought to the wholesale market, usually near the riverbanks, early in the morning. From the wholesale markets, fish are taken to three destinations: (i) interior village markets; (ii) Aratdars (middlemen or fish stockists); and (iii) fish processing factories. Stockists usually send fish to distant markets like Dhaka and a part to the factories depending on the demand.

Floodplain fishers and aquaculture farmers sell their fish at the fishing spot, in local markets or to middlemen/Aratders who send the fish to distant markets or processing factories. Fish processing factory agents sometimes collect fish from aquaculture farms and carry it in specialized refrigerated vans to factories. There are major fish markets 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 ice factories mainly located near wholesale markets. There are few fish landing centers in the study area but most of these with poor facilities. There is no storage capacity except in large landing centers like Chandpur. Transportation facility at root level is on foot, rickshaw and CNG auto rickshaw. The generalized fish marketing channel is shown in Figure 5-19.

Fishers, Fishing Gear and Fishing Methods

Three types of fishers are found in the study area, i.e. (i) commercial or full-time fishers; (ii) occasional or part time fishers; and (iii) subsistence fishers. Commercial or fulltime fishers are professional fishers (ISPMC Team, 2017). The Department of Fisheries issues fishing licences to them and registers their names as bonafide fishers. Part time fishers are those who fish occasionally particularly when they find fishing is more rewarding than other work or if they cannot find other work. An example is seasonal hilsha fishing – large numbers of occasional fishers get to fishing during the peak hilsha season.

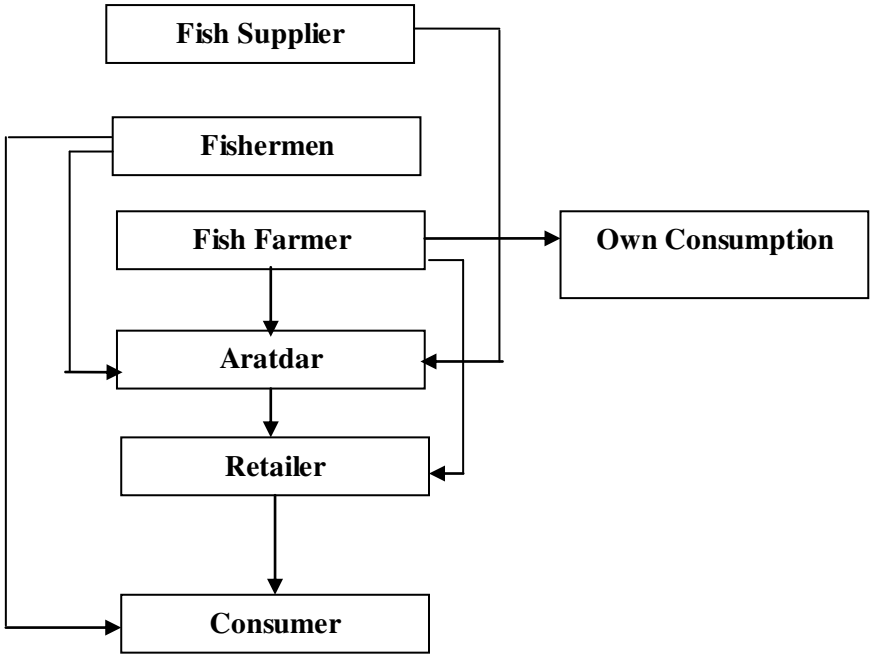


Figure** Fehler! Kein Text mit angegebener Formatvorlage im Dokument.**-20. Generalized fish marketing channels in the study area

Subsistence fishers fish any time anywhere for their consumption. The number and proportion of fishers varies per area and season. In the river area, along the bankline, most fishers are subsistence fishers. In the main river channel and charlands, almost all are commercial fishers. In the floodplain area, the number of subsistence fishers has dropped in recent years because it is less rewarding, and many other better paying jobs are available now. In a study carried out in the district of Manikgong (floodplain area), only 11% of the fishers were found to be subsistence fishers. In an FGD along the riverside, about 80% of the households were found to have some fishing gear (mostly cast net or trap) for subsistence fishing. In September 2016 (high fishing season), 38% were found to be occasional fishers and 62% professional fishers. In December 2016, there were very few fishers along the bankline except anglers because bankline fishery has a seasonal decline. In the main river professional fishers were found only.

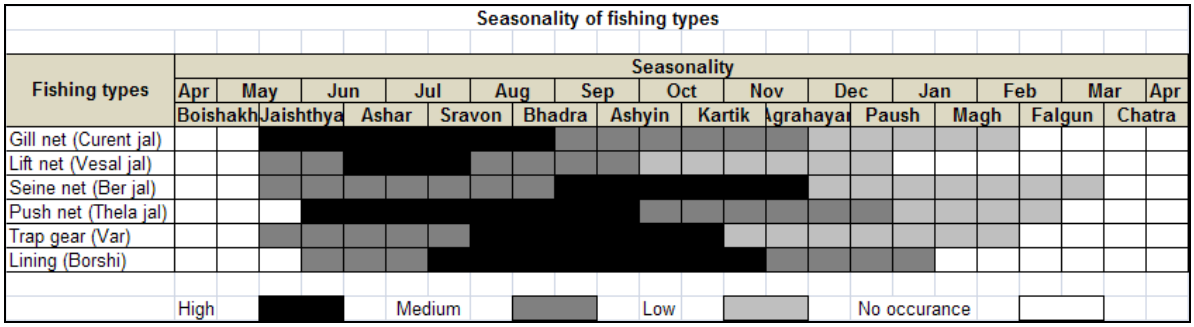
Average daily income of commercial fishers is BDT 300-350 during the monsoon (May to November). Income level of commercial fishers is decreasing day by day. Professional fishers are mostly continuing their efforts, but the occasional/part time fishers are increasingly decreasing in number and in certain areas they are all getting to other more profitable activities. The fishers are also vulnerable to '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 labourer in fish farms especially during the dry season. Fortunately, fish farming practices are increasing, and fish labourers are well paid in such farms. For example, in the Mymensingh area where farming is extensively practiced, fish farm labourers are hired from other areas and paid at least 50% higher salary compared to

other identical employments. The thriving aquaculture sector has opened opportunities for part time fishers who often change their jobs depending on the pay level.

Fishing Season

Fishing in floodplains, beels, rivers and khals starts in May and continues up to November except in the river. In the river, there is also clear seasonality in fishing area, pattern and catch. In the high season, June to September, fishing is done in all the three river sub-habitats – bankline shallow water, main channel and charland area with extensive fishing effort and varied catch. But in the lean season, major bankline fishery dwindles as the area dries out and grown up fish migrate to the deeper waters. Char fishery also diminishes during that season. The seasonality of major fishing is illustrated in Figure 12-21.

Figure** Fehler! Kein Text mit angegebener Formatvorlage im Dokument.**-21. Seasonality of fishing and types



Source: FRERMIP EIA Tranche-1, 2014

Fishing Crafts and Location

Country fishing boats are widely used to catch fish in the study area. The fishers catch fish in Jamuna, Karotoa, Ichamati, Baral, Dhalai, Sonai, Hurasagar (old part of Jamuna river) and Dhaleshwary rivers round the year. However, fishing in seasonal beels and floodplains is done in the monsoon only. The subsistence fishers catch fish in the same water bodies both during the monsoon and dry season.

Eight types of fishing gear and methods are used for fishing in the study area. Fishing nets used comprise 9 types, as follows:

(I) Gill nets (5 types) are: punti jal, bata jal, ilish jal/chandi jal, poa jal and fash jal. Names of the gillnets suggest the type of fish caught by the respective gill nets. Hilsa (Tenualosa ilisha), Poa (Otolithoides pama), Pangus (Pangasius pangasius), Poa (Otolithoides pama), Hilsa (Tenualosa ilisha), Bata (Labeo bata), Ayre (Mystus aor) and Bata (Labeo bata) are the main species caught.

(II) Siene nets are encircling nets and local varieties are known as Shatting jal/Jagat ber jal and Gosi jal/Khoti jal. Gosi jal is a very large size seine net used in the river area mostly. Most of the nets, fixed purse net, cast net, dip net, lift net and drag/push net are used both in the river and floodplain area.

(III) Fish traps are of all shapes and trapping arrangements; they are used extensively along the riverbankline and in the floodplain mostly for subsistence fishing.

(IV) Angling is done along the riverbankline and in the floodplain mostly for subsistence and sport fishing.

(V) Wounding gears are in shallow clear water fishing mostly in the floodplain area.

(VI) Katha fishing is the process of creating artificial shelter for fish by putting tree-branches, sometimes with feeding arrangement to allure the fish. Then the katha is encircled with nets and fished.

(VII) **Hand picking** is fishing with bare hands. This is a common subsistence fishing along the riverbanks and floodplain.

(VIII) **Dewatering** process of fishing is adopted in the floodplain in the lean season for fishing in the KUA (shall ditch) in the floodplain and in aquaculture farm ponds.

(IX) Fishing by poisoning is an illegal process of fishing sometimes adopted in the floodplain area particularly for pouching fish.

O1-8-5 Brackish Water and Pond Aquaculture

Brackish Water – There is no significant brackish water in the project area except that in certain seasons there is a slight increase in salinity (0.5-1.00 ppt) in the lower reaches of the Padma River.

Aquaculture (project area) – Aquaculture is relatively less developed in the project because of three reasons – flood threat, lack of knowledge about the technology and availability of open water fish. Field investigations show that every third year, coastal farmer's ponds are washed away by flood and so they are discouraged to head into the aquaculture venture though they are interested to get into the profitable fish farming. During public consultation meetings, when they were informed about the flood control works, they were seeking good fish farming technology and extension support to further their aquaculture practices.

With respect to aquaculture production the project districts are less productive (3.70 ton/ha) compared to the overall average productivity (4.33 ton/ha) of the country and much behind the best productivity (11.68 ton/ha) (Mymensingh district) of the country (Table 12-32).

There is scope of increasing aquaculture production in the project area 3 to 4-fold when flood threat is contained by FRERMIP interventions and technological support for improved aquaculture practices are provided under this project.

Table** Fehler! Kein Text mit angegebener Formatvorlage im Dokument.**-32. Comparative status of pond fish production and productivity in the project districts

Project Districts	Pond Area (ha)	Production (ton)	Productivity (ton/ha)
Dhaka	1,911	7,425	3.89
Manikgonj	2,577	7,950	3.08
Tangail	8,276	32,189	3.89
Sirajgonj	4,364	14,800	3.39
Chandpur	9,350	35,599	3.81
Total (Project districts=PD)	26,478	98,043	3.70
Average/PD	5,296	19,609	3.70
Total (Country)	372,397	1,613,240	4.33
Average/district(country)	5,819	25,287	4.33
Mymensingh (with highest aquaculture production)	27,342	319,421	11.68

Source: FRSS, 2016. Fisheries Statistical Report of Bangladesh, DoF

O1-8-6 Fish Migration

Thirty-six (17%) of 218 freshwater fish species in Bangladesh are considered migratory, but the overall fish migration in the study area is moderate to poor. The Jamuna and Padma rivers form the base for fish migration; tributaries/distributaries and canals are the migration routes connecting the floodplains. Major distributaries in the Project-2 area are Hurasagar on

the right bank and the Pungli, Old Dhaleshwari and Gior Khal/Ichamoty which connects the project influence area. Moreover, during pre-monsoon and monsoon (availability of water in khal) Shameshpur Khal, Banigati Khal, Balorampur Khal 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 for the Manikganj district maintain the major arteries for fish migration.

These khals carry waters from the above-mentioned rivers to both the perennial and seasonal beels. Fish migration usually occurs during pre-monsoon to some extent, but largely during peak monsoon. Reportedly, feeding and spawning migration of riverine and beel resident fish species occurs through open khals and channels between beels and rivers and over bank spill during the period of late May to August. During this period, fish species such as tengra, punti, chela, baim, gutum, taki, koi 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 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.

Certain categories of fish (i.e. the 36 species mentioned above) are dependent on migration to complete their lifecycle and when opportunity of migration fails particularly due to the loss of river-floodplain connectivity, their lifecycle cannot be completed which affects their propagation and contribution to fisheries. Some of the fishes throughout their life cycle have no dependence on the floodplain. But some of the fishes are found more dependent on the floodplain to complete their life cycle (Table 12-33).

Table** Fehler! Kein Text mit angegebener Formatvorlage im Dokument.**-33. Key (shell-)fish dependent on river-floodplain connectivity/Fish Pass

Category of Fish (Representative Species)	Habitation	Breeding	Early Development	Dependence on River-Floodplain Connectivity
Hilsha (*Tenualosa ilisha*)	Bay	River	River	No
Baspata (*Ailia coila*)	River	River	River	No
Pangus (*Pangasius pangasius*)	River	River	Estuary	No
Climbing Perch (*Anabus testudineus)*	Floodplain	Floodplain	Floodplain	No
Wallago catfish (*Wallago attu)*	River	Floodplain	Floodplain	Yes
Carp (*Catla catla*)	River/Floodplain	River	Floodplain	Yes
Giant Prawn (*Macrobrachium rosenbergii*)	River	Estuary	Floodplain	Yes

Fish migrations may be categorized as bi-directional, from river to floodplain and vice versa, and bi-dimensional, passive and active (Table 12-34). All fish migrations and some other live activities of the fish are influenced by the river flow and flooding. Fish-spawn/fingerlings of certain river breeders move passively with the river flow of the early monsoon flooding into the floodplain to be nursed there while some river fish enter the floodplain with the same flood pulse to breed in the floodplain.

All migrations from the floodplain to the river in the post monsoon are, however, active movements. These fish migrations between river and floodplain will be affected by the

project interventions, particularly by the embankments. Some possible measures like designing fish friendly sluice gates with fish passes and other fish supporting structures and fish friendly operation of the sluice gates will minimize the adverse impacts on fish migration.

Table** Fehler! Kein Text mit angegebener Formatvorlage im Dokument.**-34. Some aspects of fish migration and river-floodplain connectivity in the project area

Date/Period of migration	Life cycle stage	Migration activity	R-Fp connectivity needed for:	Type of Migration	Relationship with the R-F water flow
15 March – 15 May	Brood stock	Starts upward migration to upstream breeding ground, lateral migration to/from Floodplain	Lateral migration of Brood stock to and from Fp	Active	a. R-Fp migration along the water flow b. Fp-R migration against the water flow
15 April - 30 May	Egg/spawn	Lateral drifting migration to Floodplain	Lateral migration of Egg/spawn	Passive	Along the water flow
June-July	Fish fry	Lateral migration to the floodplain	Lateral migration of Fish fry	Mostly active	Along the water flow
15 Sept-15 Oct generalized	Young / adult fish	Back migration from Floodplain to river	Back migration to river	Active	Along the water flow

**Adopted mostly from IUCN Report 2015; ** Recent study has revealed some variations.*

Table** Fehler! Kein Text mit angegebener Formatvorlage im Dokument.**-35. Key migratory fish species

No	Scientific Name	Local Name
1	*Labio rohita*	Rui
2	*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
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** Fehler! Kein Text mit angegebener Formatvorlage im Dokument.**-36. Locations of Beels and their connectivity (Project-2 area)

Name of District	Name of Upazila	Source of River	Connecting Khal	Connecting water bodies (Beel/River/Floodplain)

Name of District	Name of Upazila	Source of River	Connecting Khal	Connecting water bodies (Beel/River/Floodplain)
Manikgonj	Harirumpur	Padma	-	Shoilokuta Beel
			-	Boroichora Beel
			-	Gopinathpur Beel
			-	Alamdi Beel
			-	Kanthopara Beel
			-	Ramgopladi Beel
			-	Dhumur Khola Beel
		Ichamati	-	Diyar Beel
		Kaliganga	-	Bhatsala Beel
	Sadar	Kaliganga	Kaliganga Khal	Patal Beel
		-	-	Gojaria
		Dhaleshwary	-	Ratna Beel
		Ichamati	-	Khabaishpur Beel
	Singair	Kaliganga	Kaliganga khal	Dharar Beel
			Charigram Khal	Atrai Beel
			Nuraniganga Khal	Mograr Beel
			Boldhara khal	Manikdaha Beel
			-	Bolta Beel
		Dhaleshwary	-	Nilambor Patti Beel
			-	Senior Beel
		Dhaleshwary Kaliganga	-	Chandahar Beel
		Dhaleahwary Kaliganga Jamuna	Joymontop Khal	Joymontop Kol
	Daulatpur	Jamuna Kaliganga	Gaighata Khal	Kalibari Kol
		Old Dholeshwary	-	Gazishail Kol
		Jamuna	-	Nimaikhali Beel
			-	Bohora Beel
			-	Dhola Pukur Beel
			-	Panchuri Beel
		Dholeahwary	-	Meer Ali gara Beel
			-	Nilua Beel
			-	Niraligala Beel
			-	Pasthobi Beel
			-	Ulail Beel
			-	Shampur Kum Beel
	Ghior	Old Dholeshwary	-	Choto Nilwaya Beel
			-	Char Ghior Mollar Beel
		Jamuna	-	Baijuri
			-	Char Baijuri
	Saturia	Gazikhali Dholeashwary	-	Hazi Bulbul Floodplain
		Dholeshwary	-	Boro Poila Floodplain
	Shibalay	Jamuna	-	Modhdhonagar Kol
			-	Char Shibalay
Dhaka	Dohar	Padma	-	Arial Beel
	Nawabgonj	Ichamati/Padma	-	Bilchuri Beel
		Padma	-	Arial Beel

Name of District	Name of Upazila	Source of River	Connecting Khal	Connecting water bodies (Beel/River/Floodplain)
		Ichamati	-	Nayanchori
Sirajgonj	Belkuchi	Hurasagor River	-	Rupnai Shondha Beel 01
		Hurasagor River	-	Rupnai Shondha Beel 02
		Jamuna	-	Jamuna Dead River
			-	Aguria Jamuna Dead River
			-	Someshpur Hura Sagor dead river
			-	Hura Sagor dead river
			-	Hura Sagor dead river
			-	Hura Sagor dead river
			-	Hura Sagor dead river
			-	Hura Sagor dead river
			Balorampur Khal	Chondi Beel
		Hurasagor (Old part of Jamuna), Jamuna River	Banigati Khal	Kamarullahpara Beel
			Khashnamoki Khal,	
			Kamarullahpara	
	Shahjadpur	Korotoya	Potazia Khal	Prannathpur Beel
		Boral		Kadiabadla Beel
		Bag-Jamuna Nageswary	Barabil Khal	Prandoho Beel
		Sonai	-	Charkai Beel
		Dholail	-	Shaildar Beel
	Kamarkhand	Hurasagor River (Old Part of Jamuna)	-	Nandina Madhu Beel
			-	Boronal Chongi Beel
			-	Konabari Beel
			-	Hura Sagor dead river
			Chaubari khal	Dashsika Beel
			Balorampur Khal	Pakuria Beel
	Chowhali	Boalkandi Channel	-	Moheshpur Beel
		Jamuna	-	Kodalia Beel
Tangail	Nagarpur	Jamuna	East Dhadra Vikon Khal	Baraposha Beel
		Jamuna		Kushtiya Beel
				Alokdiya Beel
		Jamuna	West dhadra vikon khal	Bongram Beel
		Dholeshwary	Baro Khal	Mailjani & Uladaab
			Shureshwary Khal	Shunshi Beel
			Nardohi Khal	Autpara Beel
		Dholeshwari /Jam		Kodaila

Source: Ref. FRERMIP Team Field Investigation, October 2017

O1-8-7 Fish Biodiversity

(k) The study area is rich in fish biodiversity: 120 fish species have been recorded. A fish species list of major commercial fishes is presented in

the following table and other lists are given in Appendix A.

Table** Fehler! Kein Text mit angegebener Formatvorlage im Dokument.**-37. Fish species of major commercial importance

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
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

Source: Upazila fisheries offices (P-present, A-absent)

Fish biodiversity and abundance is declining in recent years. Major causes are both natural and anthropogenic interventions. Natural causes are mainly siltation of the water bodies resulting in the shrinkage of spawning and feeding grounds affecting natural recruitment and production. Man made hazards are overfishing, negative impacts of water management interventions particularly affecting river-floodplain connectivity impeding flooding of the fish habitat and fish migration affecting fish propagation and production, agro-chemical and industrial pollutions causing deterioration of water quality of the aquatic ecosystems.

Efforts for conservation of fish and fisheries are limited except for the Hilsha fishery for which a program of the Department of Fisheries (DoE) is running resulting in substantial improvement in Hilsha catch in recent years. Overfishing is the major challenge which may be tackled by awareness development and making arrangement to discourage indiscriminate fishing. FRERMIP plans to initiate such work in the study area.

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 Table 12-38.

Table** Fehler! Kein Text mit angegebener Formatvorlage im Dokument.**-38. 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

O1-8-8 Fisheries Management

In the study area, there are three categories of fisheries management: (i) departmental management, (ii) community-based management and (iii) individual management. DoF basically administers the entire open water fisheries management but overall management measures are neither adequate nor effective particularly due to lack of adequate manpower and stakeholders' response to adhere to fisheries regulations. However, considerable success has been achieved in the management of Hilsha fishery in the country in recent years and as a result declining fishery has been rejuvenated. In the floodplains in recent year there have been several efforts for community-based fisheries management with considerable success. NGOs played a role along with DoF to achieve this. In the study area, fisher-based community associations have been established in Shahjadpur of Sirajganj, Nagarpur of Tangail and Daulatpur in Manikganj District in the study area. Fishing rights on existing fish habitats is limited. Upazila Fisheries offices conduct technical training on fish culture for fish farmers and some activities such as awareness meeting, nursery management, and linkage development among the fish traders in future. Status of enforcement of fisheries regulation is weak.

O1-9 Ecological Resources

O1-9-1 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 Beel, and (v) Ganges floodplain (Figure 12-22).

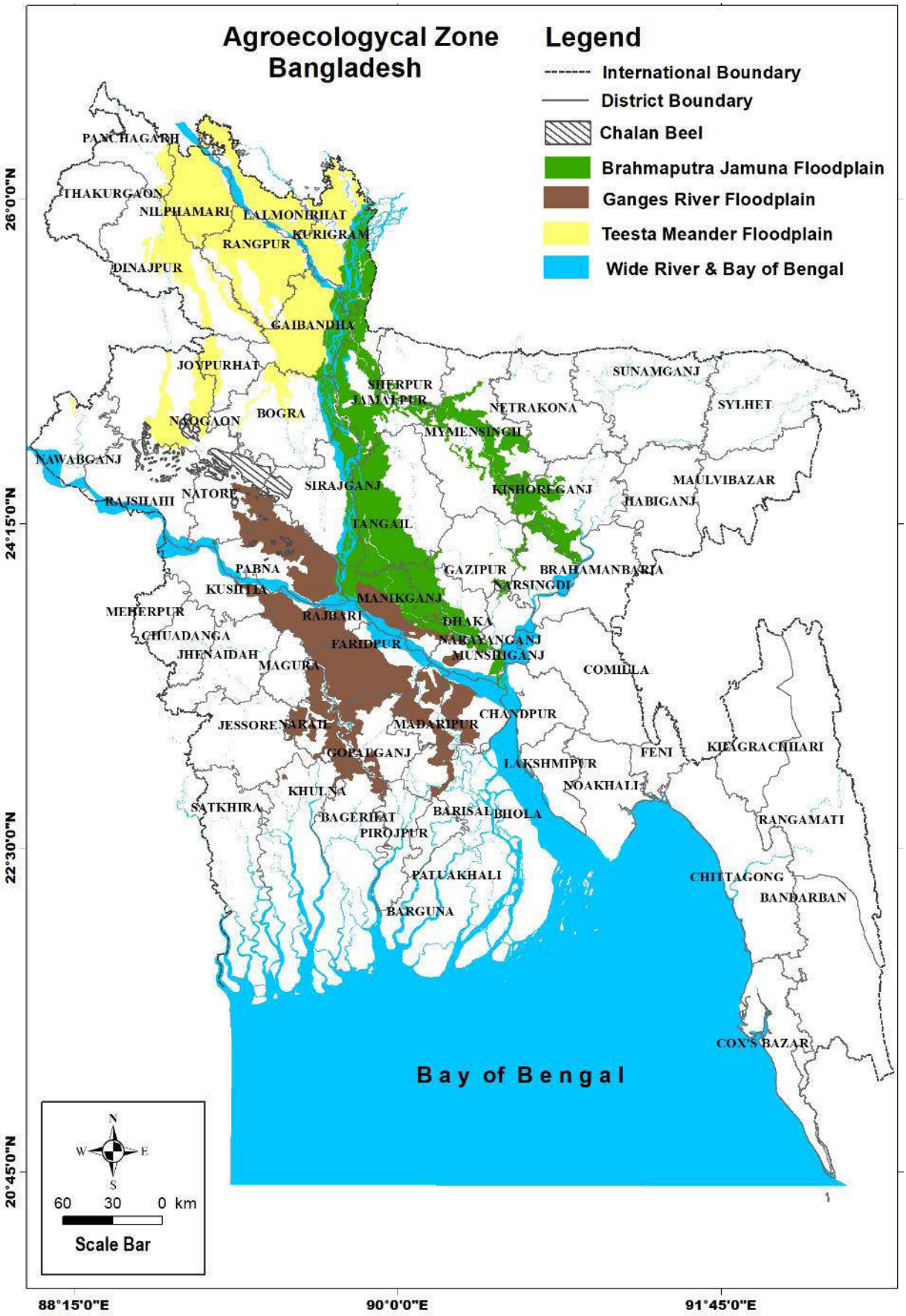


Figure** Fehler! Kein Text mit angegebener Formatvorlage im Dokument.**-22. Major floodplains in Central Bangladesh

Major Rivers

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 (or wild cane *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 waterfowl are directly or ecologically dependent on these rivers and their associated ecosystems. However, river biodiversity is under severe pressure.

Brahmaputra–Jamuna Floodplain

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 is easily identified by its broad black and yellow bands. Varios mammals such as bats, several species of monkeys and pangolins are found, along with various birds of prey.

Chalan Beel

Chalan Beel, the center of which is located some 10 km 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 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.

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, including the Smooth-coated Otter, IUCN Red Data listed as vulnerable in Bangladesh.

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 carnea* ssp. *fistulosa* (native to Central and South America), Shimul *Bombax ceiba* and Date palm *Phoenix sylvestri*s.

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.

Ganges Floodplain

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-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. Both plants and animals move and adapt with the pattern of flooding (Brammer, 1996).

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 stratiotes*, Chechra *Schoenoplectus articulatus*, Shada shapla *Nymphaea nouchali*, Keshordam *Ludwigia adscendens*, Kolmi *Ipomoea aquatica*, Dhol kolmi *I. carnea* ssp. *fistulosa*, Hijal *Barringtonia acutangula*, Tentul *Tamarindus indica* and Biash *Salix tetrasperma*. Moreover, grasses are abundant in the Ganges Floodplain and begin to grow as soon as the floodwater begins to recede. 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.

Nearly all the major groups of oriental birds are represented in this zone by one or more species. In addition, 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 frog.

O1-9-2 Terrestrial Habitats and Flora

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 Appendix A (Table A1-1 and Table A1-2).

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* sp., Supari *Areca catechu*, Bansh *Bambusa* spp.), Akashmoni *Acacia auriculiformes*, and Bot *Ficus bengalensis* were observed frequently during the field survey. Chatim and Swarna Lata are present but less common.

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, and Chawla ghas.

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* and Khejur *Phoenix sylvestris*. Among grasses, Durba and Chawla are common.

Social forest in the study area is found on small areas of fallow lands, cropland periphery, and near settlements and graveyards. Social forestry species are Akashmoni (*Acacia auriculiformes*, Bansh *Bambusa* spp., Mehogany *Swietenia mahogani.*

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 auriculiformes,* Sisu *Dalbergia sissoo*, Pitali *Trewia nudiflora*, Bamboo *Bambusa* spp., Khejur *Phoenix sylvestris*, Bon Begun *Solanu nigrum* are common. Less common floral species are Dumur *Ficus hispida*, Debdaru *Polyalthia longifolia* and Pakor *Ficus religiosa.*

Urban Area 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.

O1-9-3 Seasonal and Perennial Wetland Habitats and Flora

(l) **Overview –** Wetland habitats of the study area include charland, swamp, and grassland. Appendix A: Table A1-3 provides a species list of wetland vegetation.

(m) **Charland** occupies significant part of the study area. The Jamuna and Padma Rivers are 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 depends on the time since char formation. At species level, Shon *Crotalaria 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 carnea* ssp. *fistulosa* appear.

(n) **Swamps –** Chalan Beel area is favorable for a good growth of wetland trees like Hizal *Barringtonia acutangula* and Barun.

(o) **Grassland** species include Binna *Vetiveria zizanioides* and Durba Gash *Cynodon dactylon*.

O1-9-4 Terrestrial Fauna

Overview – Among the terrestrial fauna, groups of animals present in the area include birds (Appendix A: Table A1-4), mammals (Appendix A: Table A1-5), amphibians (Appendix A: Table A1-6), and reptiles (Appendix A: Table A1-7).

Terrestrial birds – residents and short-range migrants. Common terrestrial birds in the study area include the 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,* Brahminy Kite *Haliastur indus*. Uncommon residents include the Barn Owl *Tyto alba*, Bank Myna *Acridotheris ginginiarus* and Bronze-winged Jacana *Metopidius indicus*. Uncommon winter visitors include the Bar-headed Goose *Anser indicus*, several sand piper and tern species. The area supports also small numbers of species that appear on the Bangladesh-IUCN's Red List (2015) such as the Lesser Adjutant

Leptoptilos javanicus is Vulnerable; River Lapwing *Vanellus ducaucelli* and River Tern *Sterna aurantia* are Near Treathened; Masked Finfoot *Heliopais personatus* is Endangered; and Indian Skimmer *Rynchops albocollis*, Eurasian Spoonbill *Platalea leucorodia* and Painted Stork *Mycteria leucocephala* are Critically Endangered.

Terrestrial birds – long-range migratory species. Bangladesh is on the Central Asian Flyway between the Palaearctic and the Indian subcontinent. Migratory birds that move along the Central Asian Flyway utilize the Brahmaputra-Jamuna-Padma-Ganges char and other habitats potentially affected by Project-2 works. [41]

Mammals – The situation of mammals in Bangladesh is not good due to habitat shortage, food scarcity and hunting pressure. Several species have gone extinct since the 1970s. Mammmal species still present include Little Indian Field Mouse *Mus booduga*, Golden Jackal *Canis aureus*, Small Indian Mongoose *Herpestes auropunctatus*, Indian Flying Fox *Pteropus giganteus* and Greater Short-Nosed Fruit Bat *Cynopterus sphinx*. Several species still occurring are on the Bangladesh IUCN Red List (2015) for example: Ganges River Dolphin *Platanista gangetica*, Bengal Fox *Vulpes bengalensis* as Vulnerable; Finless Porpoise *Neophocaena phocaenoides*, Irrawady Dolphin *Oracaela brevirostris*, Jungle Cat *Felis chaus*, Large Indian Cevet *Viverra zibetha*, Small Indian Civet *Viverricula indica* and Common Tree Shrew *Tupaia glis* as Near Threatened; Eurasian Otter *Lutra lutra* and Smooth-coated Otter *Lutrogale perspicillata* as Critically Endangered.

Amphibians are found in terrestrial and aquatic environments. Common terrestrial species observed during the survey were Indian Common Toad *Duttaphrynus melanostictus* and Indian Bullfrog *Hoplobatrachus trigerinus*. The Common Tree Frog *Polypedates maculates* occurs in association with human settlement and forest periphery and the Balloon Frog *Uperodon globulosus* (IUCN: Vulnerable) lives both in burrows and forest patches and agricultural land. The latter species is considered as rare in the study area.

Reptiles – The Yellow-bellied House Gecko *Hemidactylus flaviviridis*, Common Garden Lizard *Calotes versicolor*, Yellow Monitor *Varanus flavescens* (IUCN: Near Theatened) and Banded Krait *Bungarus fasciatus*, were observed during the field survey. King Cobra *Ophiophagus hannah* (IUCN: Vulnerable) and Indian Cobra *Naja naja* were reported by local people as present in the area.

For several of the species recorded to be present in the area (Tables A1-4 to A1-8 in Appendix A) it is doubtful whether they still occur in this densely populated and intensively used part of Bangladesh, such as the Gharial *Gavialis gangeticus* (which may be nationally extinct) or the shy Masked Finfoot *Heliopais personatus* (which is probably now confined in its distribution to the Sundarbans only). The Biodiversity Baseline study (Annex 10) is going to investigate and verify the occurence of plant and animal species in the program area.

O1-9-5 Aquatic Ecosystems

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.
Freshwater 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.

[41] 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

Perennial wetlands hold water throughout the year.

Aquatic Flora

Aquatic flora is present in both seasonal and perennial water bodies. The submerged species are Fodder *Hydrilla verticillata*, *Vallisneria spiralis, Aponogeton Sp*. and Gechu. The free-floating species mentionable here are Kachuripana *Eichhornia crassipes* (waterhyacinth), Kutipana *Azolla* Sp., and Khudipana *Lemna perpusilla*. Of the rooted floating species, Keshordam *Ludwigia adscendens (syn. Jussiaea repens)* and Shapla *Nymphae nouchali* (waterlily) are common especially in perennial and seasonal beel.

Aquatic Fauna: South Asian River (Gangetic) Dolphin

The South Asian River (Gangetic) Dolphin *Platanista gangetica* is native to the Ganges and Brahmaputra rivers in Bangladesh and India (Figure 12-23).

During January-September 2011, a Dolphin survey was carried out in the Padma, Jamuna, and Hurashagar-Baral Rivers of Pabna district.[42] 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 about one dolphin per 1.72 km in the Padma and one per 0.69 km in the Jamuna. Adults accounted for 65% and juveniles for 35% 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. Recent surveys in 2015-2016 recorded 206 River Dophins in the Jamuna-Brahmaputra system (Aziz, 2019[43]).

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 fishers were involved in river dolphin conservation.

Dolphins utilizing riverine habitats potentially affected by the project are part of a transboundary (Bangladesh-India) population that may include individuals who migrate internationally between Bangladesh and India. Most international movement of dolphins occurs within peri-border areas as short-range tributary-to-mainstream trips, but longer-range migrations of individuals between the project's influence area and India cannot be ruled out.

The Ganges River Dolphin is on the IUCN Red List as Vulnerable. 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

[42] 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.

[43] Aziz, M.A (2019) Final Report atlas on Ganges River Dolphin and Irrawaddy Dolphin of Bangladesh. Expanding the Protected Area System to Incorporate Important Aquatic Ecosystems Project. Bangladesh Forest Department, Ministry of Environment, Forests and Climate Change. 47 pp.

on International Trade in Endangered Species (CITES) as a species in which international trade is probihited. Specific Threats to dolphins are summarized in Appendix-B.

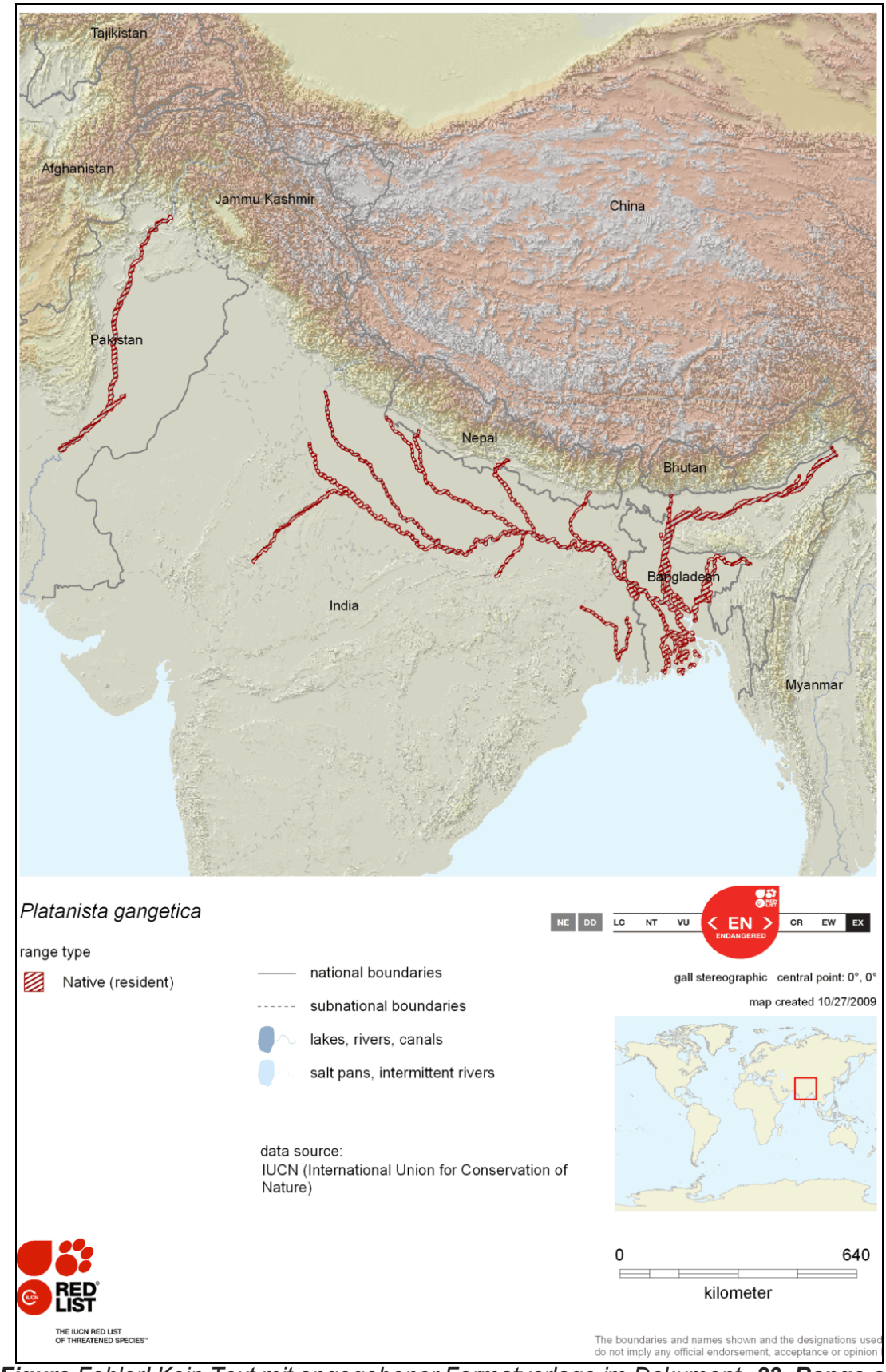


Figure** Fehler! Kein Text mit angegebener Formatvorlage im Dokument.**-23. Range of the South Asian River (Gangetic) Dolphin

O1-9-6 Aquatic Ecosystem Services

The floodplain 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. The flood cycle and its associated ecosystem purify the water quality deteriorated by the discharge of effluents and waste, and use of agrochemicals.

O1-9-7 Threats to Aquatic Ecosystems

In the study area, river erosion and siltation occur 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. The population of both flora and fauna is disrupted.

O1-10 Climate Change: Current and Predicted Conditions

In 2007, the International Panel on Climate Change (IPCC) considered data from climate observations across the world and concluded that the evidence for warming of the global climate is 'unequivocal'. Current projections estimate that the increase in global temperature by the end of this century will range from 1.8 - 4.0 °C predominantly depending on the level of future greenhouse gas emissions. However, these figures demonstrate that dangerous climate change – conventionally understood as a global temperature rise of 2 °C or greater – is becoming increasingly likely. And even this picture is evolving rapidly: recent studies suggest that the impacts of climate change may be even more severe and more rapid than those reported by the IPCC at the start of 2007. In a country like Bangladesh, the vulnerabilities will be emphasised and increased due to the dependence of livelihoods on climate sensitive natural resources and their weak social protection structures. They will be impacted with physical resources, human resources, social resources, natural resources and financial resources. A publication named "Promoting adaptation to climate change in Bangladesh" from Journal of Practical Action, UK (www.preventionweb.net/publications/views/20408) states that the projected impacts of climate change on Bangladesh are:

(I) Climate change is likely to bring particularly rapid temperature increases in Bangladesh – faster than the average global rate of warming.
(II) Winter temperatures will increase more than summer temperatures. The level of winter rainfall is expected to decrease, whilst summer rainfall will increase.
(III) Extreme weather events such as heatwaves and very high rainfall are likely to become more frequent. Tropical cyclone intensity is expected to rise by 10 - 20%.
(IV) It is certain that sea level will rise. The lowest anticipated rise in sea level is 40cm by the end of the century.

Some level of uncertainty is inevitable in measuring and anticipating climate change. Attributing individual current events to climate change is impossible due to inherent climate variability. A lack of observations over a sufficiently long time frame or narrow geographical area can hamper the analysis of climate trends. However, the degree of certainty of overall aspects of climate change has increased in recent years, between the publication of the IPCC's reports in 2001 and 2007.

Climate Change Projections: The majority of climate change projections relevant to Bangladesh have been made using regional climate models. These indicate that warming across Asia will accelerate. The rate of warming in the South Asia is projected to be

significantly faster than that seen in the 20th century, and more rapid than the global mean rate of warming:

(I) During December, January and February warming is expected to be at its greatest and associated with a decrease in precipitation, whilst the consensus of regional models is that summer rainfall will increase.

(II) Extreme weather events are projected to increase in frequency in South Asia, including heatwaves and high rainfall. Tropical cyclone intensity is also expected to rise by 10 - 20% as sea surface temperature rises by 2 – 4 °C.

(III) Glacial and sea-ice melt and the expansion of the oceans due to increased temperature mean that a rise in sea level is certain. The minimum change, suggested by the most conservative climate change models, is for a 40 cm rise by the end of the century. The predicted seasonal changes for the south Asia are summarized in the following table and graphs.

Table** Fehler! Kein Text mit angegebener Formatvorlage im Dokument.**-39. South Asia seasonal temperature & precipitation projections (relative to 1961-1990 av.)

	2010-2039				**2040-2069**				**2070-2099**			
	Temperature change °C		Precipitation change %		Temperature change °C		Precipitation change %		Temperature change °C		Precipitation change %	
	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low
Dec - Feb	1.17	1.11	-3	4	3.16	1.97	0	0	5.44	2.93	-16	-6
Mar - May	1.18	1.07	7	8	2.97	1.81	26	24	5.22	2.71	31	20
Jun-Aug	0.54	0.55	5	7	1.71	0.88	13	11	3.14	1.56	26	15
Sep - Nov	0.78	0.83	1	3	2.41	1.49	8	6	4.19	2.17	26	10

Source: Practical Action UK (2008) Promoting adaptation to climate change in Bangladesh. 12 pp. https://www.preventionweb.net/publications/view/20408

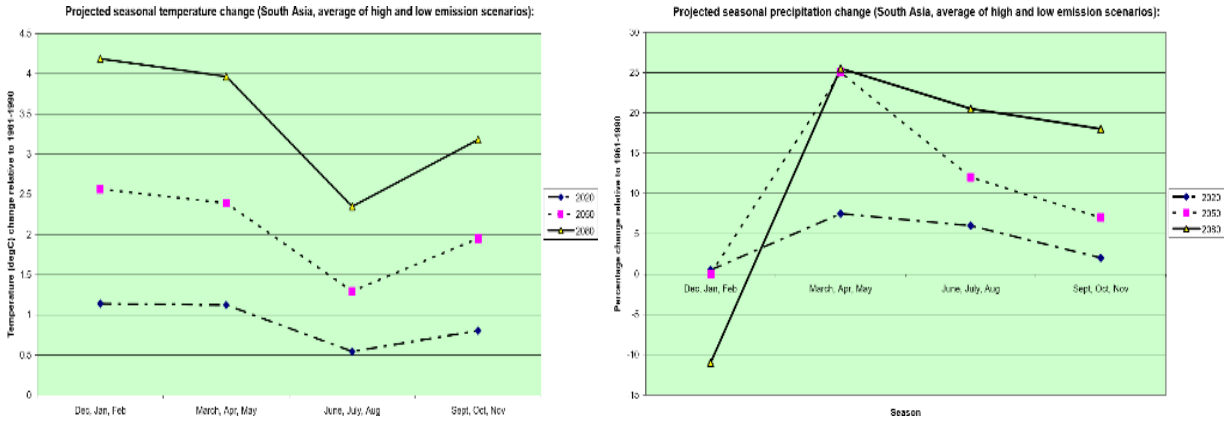


Figure** Fehler! Kein Text mit angegebener Formatvorlage im Dokument.**-24. Projected seasonal temperature change

O1-11 Socio-economic Conditions

O1-11-1 Area and Location

Socio-economic information is presented for the study area upazilas – twelve upazilas of Sirajganj, Tangail and Manikganj districts (Table 5-11).

Table** Fehler! Kein Text mit angegebener Formatvorlage im Dokument.**-40. Administrative units of Bangladesh

River Reach	BWDB Zone	Sub-project	Districts	Upazilas
3	North West	JRB-1	Sirajganj	Belkuchi
				Kamarkhanda
				Shahjadpur
3	North Central	JLB-2	Manikganj	Daulatpur
				Ghior
				Saturia
				Shibalaya
			Sirajganj	Chauhali
			Tangail	Nagarpur

Source: Spatial GIS Analysis, CEGIS 2012

O1-11-2 Demography

Table 12-41 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 1,200 person /km^2.

Table** Fehler! Kein Text mit angegebener Formatvorlage im Dokument.**-41. Demographic information

Households	Population			Size of Household
	Total	Male	Female	
661,136	2,893,578	1,424,675 49.2%	1,468,903 50.8%	4.37

Source: BBS Population Census 2011

Table 12-42 shows age group composition of the area. About 34% of the population is under 15 years of age; 57% is between 15 and 59; and 9% is over 60 years of age, for an approximate dependency ratio of 75.

Table** Fehler! Kein Text mit angegebener Formatvorlage im Dokument.**-42. 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

Most people live in dwellings owned by their household (Figure 12-25). [44] The exception is Manikganj Sadar Upazila which is more urbanized, where most dwellers live in dwellings owned by others.

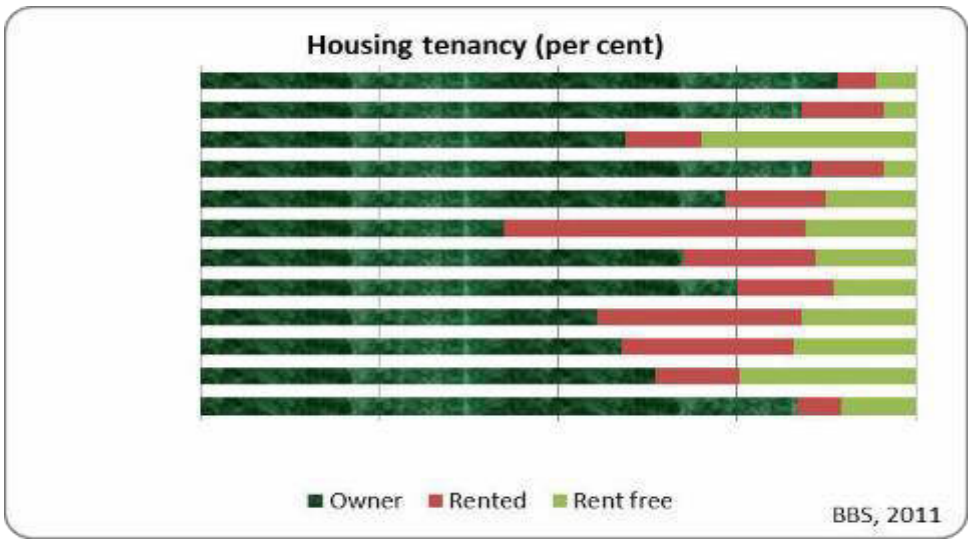


Figure** Fehler! Kein Text mit angegebener Formatvorlage im Dokument.**-25. Housing tenancy

O1-11-3 Livelihood

Occupation

Agriculture is the main occupation of 76% of households. About 16% of the population works in the service sector; and the remaining 8% works in the industrial sector (Table 5-12).

Both male and female members of households are engaged in livelihood activities, but the participation of female members is small compared to male participation. In the study area only 2% female members are working whereas 98% male members are engaged in income generating activities.

Table** Fehler! Kein Text mit angegebener Formatvorlage im Dokument.**-43. Primary occupation

Upazilas	Agriculture		Industry		Service	
	Male	Female	Male	Female	Male	Female

[44] 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.

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: Bangladesh Bureau of Statistics

Employment

Figure 12-26 shows the employment status of people in the study area. About 40% of the total population is employed, 47% is engaged in household work, only below than one per cent is looking for work and about 13% is not working (including children and physically challenged population).

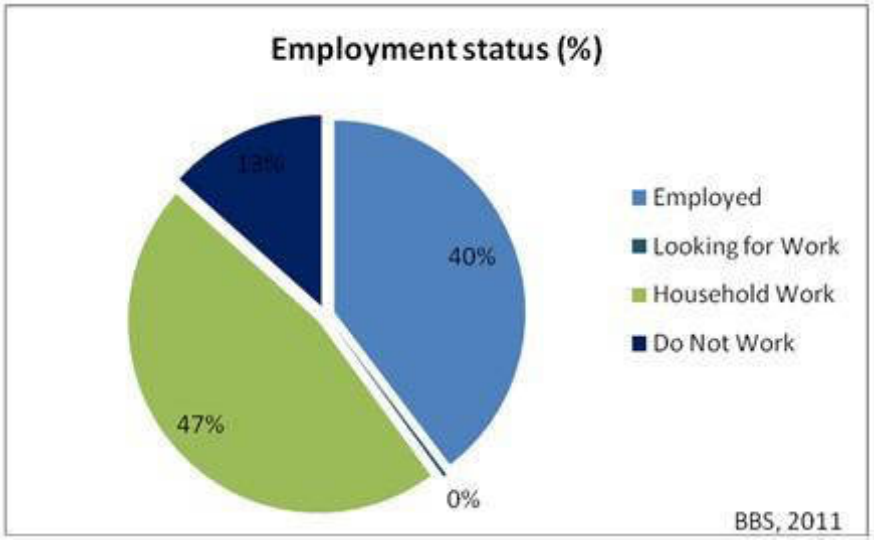


Figure** Fehler! Kein Text mit angegebener Formatvorlage im Dokument.**-26. Employment status

Table 12-44 shows the distribution of employment status by male and female in the study area. It is found that only 4% female members are employed whereas 34% male members are employed in the study area.

Table** Fehler! Kein Text mit angegebener Formatvorlage im Dokument.**-44. Employment

Upazilas	Employment (%)		Looking for work (%)		Household work (%)		Do not work (%)	
	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

O1-11-4 Quality of Life

Housing

In the study area, overall housing condition is unsatisfactory. On an average, only 3% of the houses are pukka (made of bricks and mortar) whereas 88% are *kutcha* (made of wood/bamboo, and other local materials; Figure 12-27. Statistics show that *kutcha* households are dominant in whole of the study area. People in the study area are mainly in the extremely poor category of housing type. [45]

Drinking Water

The overall status of drinking water in the area is satisfactory. Tube-well coverage is quite good in some upazilas e.g. 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% use tube-well water and the rest other sources (Figure 12-28).

[45] 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. 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.

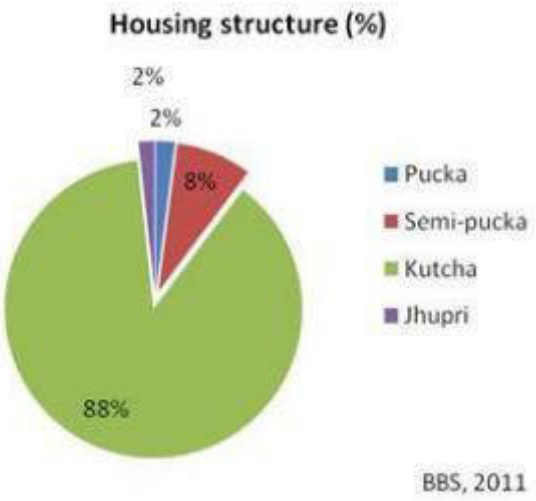


Figure** Fehler! Kein Text mit angegebener Formatvorlage im Dokument.**-27. Distribution housing types

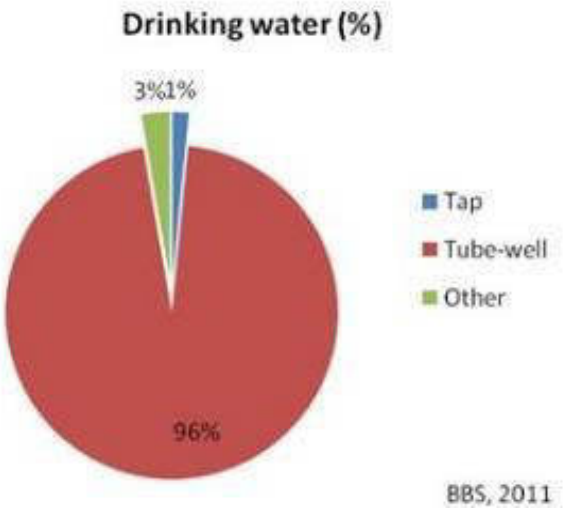


Figure** Fehler! Kein Text mit angegebener Formatvorlage im Dokument.**-28. Drinking water sources

Sanitation facilities are unsatisfactory in the study area. [46] Only 16% of study area households use hygienic (water-sealed) facilities; 47% use non-water-sealed facilities, 34% use non-sanitary facilities; and 1% lacks access to sanitation facilities.

Disease Incidence Ranking

According to local people's report, the diseases with 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).

Health Services and Facilities

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% due to impoverishment and communication problems (Figure 12-29). Local people's report that they are dissatisfied with the poor quality of available health services and facilities.

[46] 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.

	
	
Jhuri house	Kutcha house
	
Semi-Pukka house	Pukka house

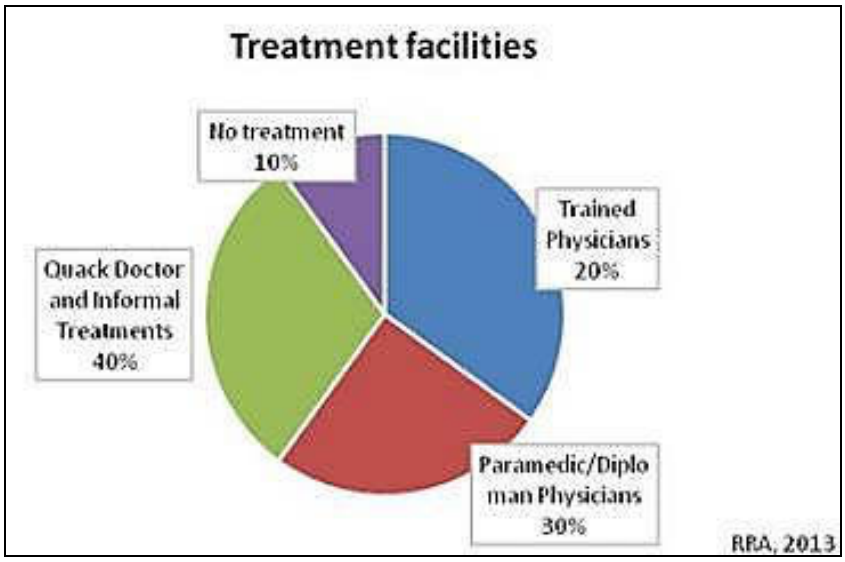


Figure** Fehler! Kein Text mit angegebener Formatvorlage im Dokument.**-29. Medical treatment

O1-11-5 Education

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 12-45). However, the tendency to be educated is now growing among the local people, and people show their interest in education. They send their children to the institutions in due time and try to continue with their education.

Table** Fehler! Kein Text mit angegebener Formatvorlage im Dokument.**-45. 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.

O1-11-6 Electricity

According to secondary census data, electrification in the study area is available to only 48 % of households (Figure 12-30). 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. As a consequence, the use of modern technology and access to information and entertainment is relatively high.

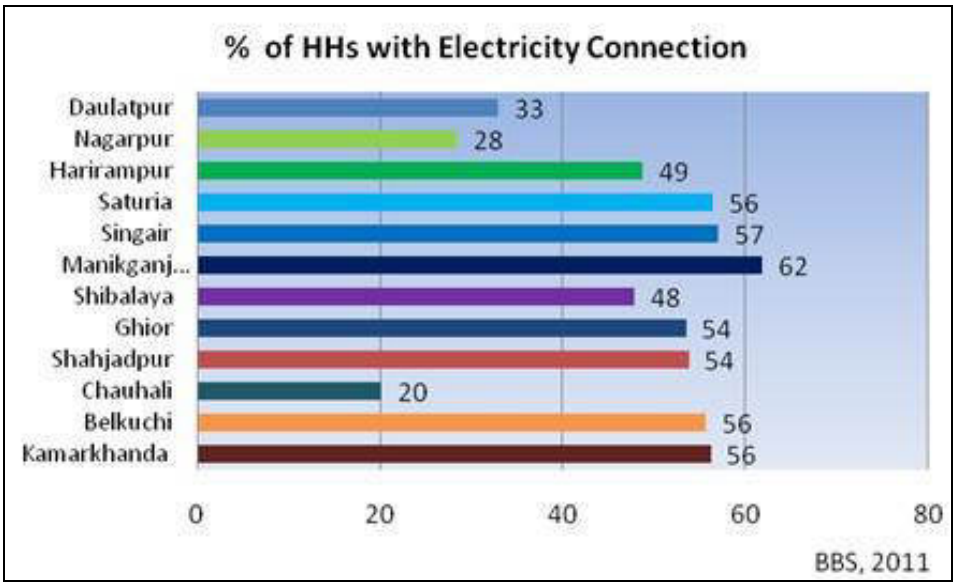


Figure** Fehler! Kein Text mit angegebener Formatvorlage im Dokument.**-30. Household access to electricity

O1-11-7 Poverty and Safety Nets

Landownership Pattern

The land ownership pattern is correlated with poverty incidence in the area. The RRA found that about 30% of the households are absolute or landless and the remaining 70% have land for mainly agriculture use and also for settlement and commercial uses (Table 5-13).

Table** Fehler! Kein Text mit angegebener Formatvorlage im Dokument.**-46. Landownership

Land Holding Categories	Distribution of Household (%)
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

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% (Figure 12-31).

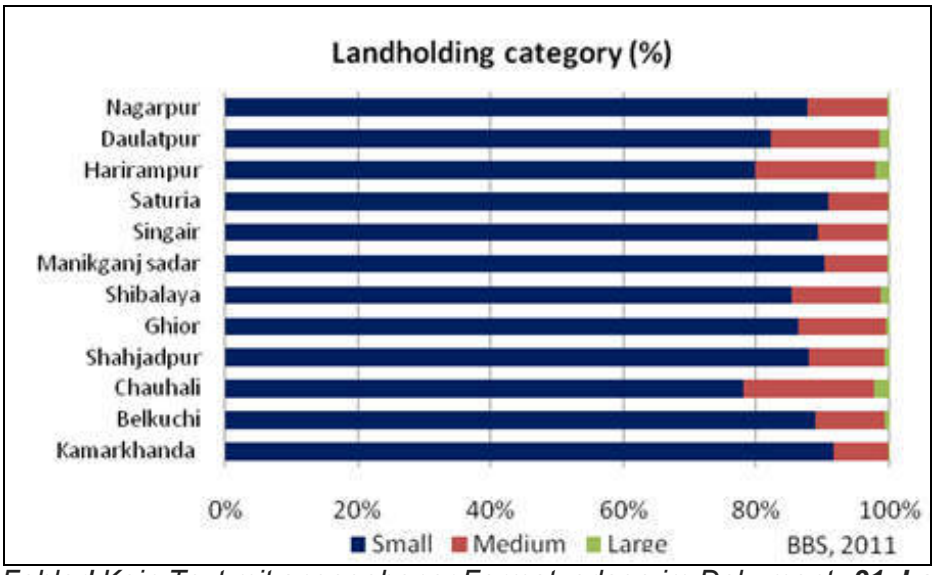


Figure** Fehler! Kein Text mit angegebener Formatvorlage im Dokument.**-31. Landholding

Income Poverty

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.

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 owners and businessmen, are in a surplus position (Figure 12-32). In the study area consumption is higher than income which perpetuates poverty intergenerationally.

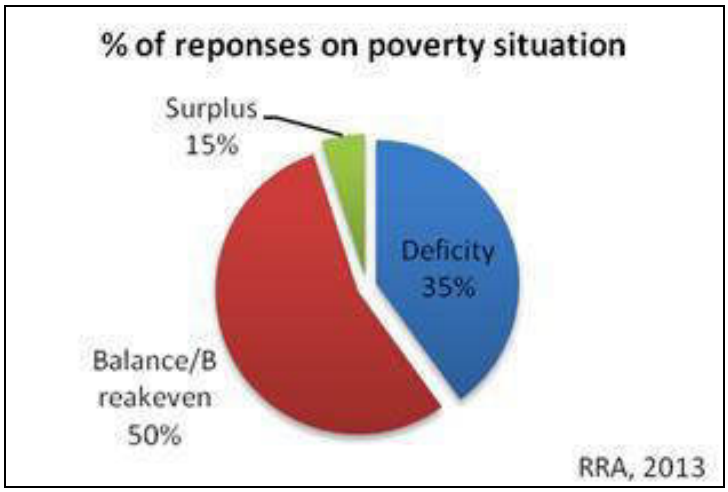


Figure** Fehler! Kein Text mit angegebener Formatvorlage im Dokument.**-32. Self-assessed poverty status of people

Income and Expenditure

Household income and expenditure are key indicators of socio-economic status. In the study area, monthly household income and expenditure vary from BDT 5000 to 20,000. About 75% of households are engaged in agricultural labour. The wage rate varies between BDT 300 to 400 per day. A few in-migrating labourers stay in the area for a year, returning home at the

end of the year with all their income. Women's participation in the agricultural sector is negligible (Table 12-47). Field findings show that most income comes from three sectors ie agriculture, small business and remittance, and that household consumption

Table** Fehler! Kein Text mit angegebener Formatvorlage im Dokument.**-47. 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.

O1-11-8 Natural Disasters

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 5-14.

Table** Fehler! Kein Text mit angegebener Formatvorlage im Dokument.**-48. Effects of recent natural disasters

Disaster	Frequency	Affected Area (%t)	Affected House Holds (%)	Crop Damaged (%)	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.

O1-11-9 Social Safety Nets and Poverty Reduction Measures

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 12-49).

Table** Fehler! Kein Text mit angegebener Formatvorlage im Dokument.**-49. Social Safety Net Programs

Social Safety Net Programs	Households/Communities %
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.

Local, national and international NGOs work in the study area (Table 12-50). 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. These NGOs are serving with microcredit while BRAC, ASA, and Uttaran are working for non-formal education, Health, human rights, water and sanitation, gender and children development programs. About 40% of households are found to benefit from NGO interventions.

Table** Fehler! Kein Text mit angegebener Formatvorlage im Dokument.**-50. NGOs Programs

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

Source: CEGIS fieldwork 2013.

O1-11-10 Transportation

Roads

Overall about 1,000 km of roads exist in the 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 493 km are R1 (regional road within the districts). Table 12-51 presents data on the road network in the study area.

Table** Fehler! Kein Text mit angegebener Formatvorlage im Dokument.**-51. 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.

Waterways

Waterways are the most important means of transportation in the area. The navigation routes in the study area include: 21 km of routes 3.5 to 4.0 m depth; 229 km of routes 2.1 to 2.5 m depth and 438 km of routes less than 1.5 m depth. Figure 5-11 and Table 12-52 show the main navigation routes in the project area. The area has one ferry ghat, two inland river ports, and two pilot stations. Waterways are gradually decreasing in size due to siltation.

Table** Fehler! Kein Text mit angegebener Formatvorlage im Dokument.**-52. 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.

O1-11-11 Educational Institutions

The area has 914 primary and secondary schools, 48 colleges, and 92 *madrasas* (religious schools; Table 12-53). 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** Fehler! Kein Text mit angegebener Formatvorlage im Dokument.**-53. Academic institutions

Upazila	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.

O1-11-12 Population Migration

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

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

A significant number of labourers living in the area (20%) are in-migrants who came seeking subsistence wages (Table 12-54). Most of these in-migrants are male, aged 15 to 47 and from socially excluded and economically impoverished backgrounds.

Table** Fehler! Kein Text mit angegebener Formatvorlage im Dokument.**-54. Labour migration

Type of	**Out Migration**		**In Migration**	
Migration	Destination	Per cent of population	Origin	Per cent of population
Seasonal labour migration	Dhaka, Tangail, Narayangong, Sylhet, Rajshahi, Manikgonj	60	Rajshahi, Pabna, Rangpur, Natore, Gaibandha, Bogra etc	20 (during harvesting period)

Source: RRA 2012

O1-11-13 Gender and Women

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 a minor role only 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 12-33 shows the scope of decision-making by women in the study area.

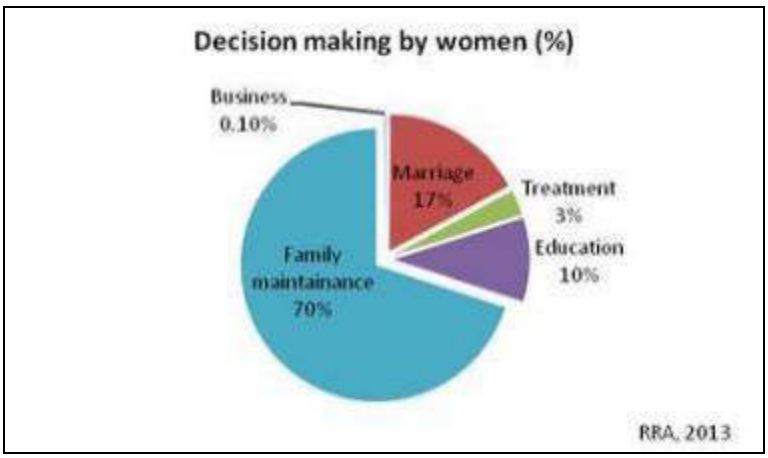


Figure** Fehler! Kein Text mit angegebener Formatvorlage im Dokument.**-33. Decision-making by women

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

Growing consciousness among local people, health services provided by the public and other health centers and NGO programs have each contributed to recent decreases in higher mortality rates for women. About 15% of the 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% of the women are getting proper nutrition and about 10% have access to the health centers, which are around 15 km away on average from their residence.

As shown in Figure 12-34, women's literacy in the study area has been increasing gradually, to 58%, while school attendance of males and females is now almost equal.

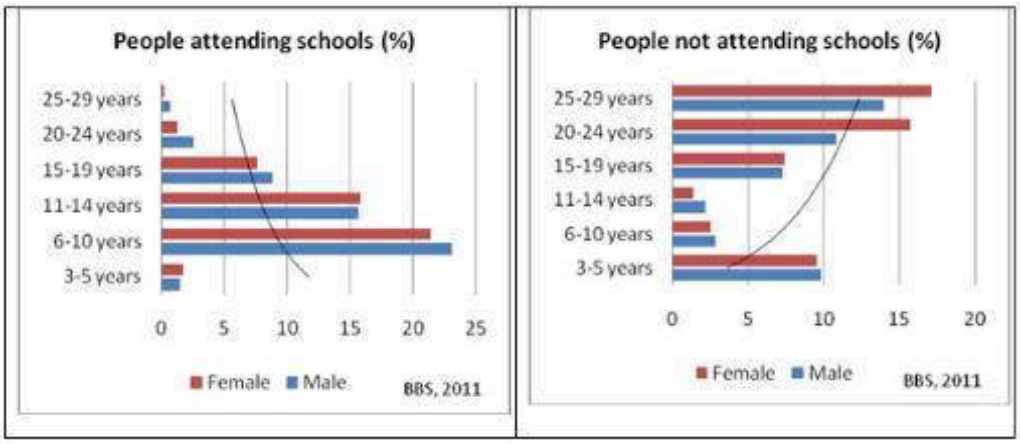


Figure** Fehler! Kein Text mit angegebener Formatvorlage im Dokument.**-34. School enrollment

O1-11-14 Vulnerable Communities

In the study area, three types of people could be considered as vulnerable. These are (i) marginal farmers having less than BDT 5,000 monthly income; (ii) fishermen; and (iii) women-headed households. Even though most landowners 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.

O1-11-15 Common Property Socio-Cultural Places and Resources

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 these places for religious, social, and cultural gatherings.

O1-11-16 Historical, Cultural and Archaeological Sites

Significant historical, cultural and archaeological sites in the program area are indicated on the map of Figure 5-34. Sirajgonj district covers a large part of the study area. In 1762, a severe earthquake changed the flow of the Jamuna River and created a new river named Baral. On the west bank of this Baral River, a new bazar (Ganj in Bengali) emerged and most of the land of this bazaar belonged to Zaminder Siraj Ali. After his name this bazaar got its recognition as Sirajgonj. Currently it is famous for its hand-loom cottage industries.

Sirajgonj district is rich in historical and cultural sites. Among these the followings are the prominent ones.

Rabindro Kachari Bari, Shahjadpur, Sirajganj-Shahjadpur is filled with the memory of the famous Nobel-laureate Rabindranath Tagore. This poet started to stay in Shahjadpur to oversee the administration of his father's zamindari or assets. He wrote many poems and novels when he used to stay here. The beauty of the village used to fascinate him much. Every year thousands of fans of the poet comes from all over the world to visit this historic spot.

Hatikumrul Navaratna Temple is located at the Navaratna village of Hatikumrul Union of Ullapara Upazila in Sirajganj district. It is believed to be a 300 years old temple having similar architecture to the Kantanagar Temple of Dinajpur by shape. This temple was built somewhere between 1704 - 1728, by a tahsildar named Ramnath Bhaduri. Some people believe that this is the largest Navaratna temple of Bangladesh.

Manikgonj district located in the central part of the study area and historical places are situated here. Some of these are as follows.

Baliati Palace is a massive palace complex comprising four major sections. The palace is under the Ministry of Archeology.

Nava Ratna Mandir temple was built around 1920s, owners of this palace tried to make the temple in European style rather using traditional Hindu mythological decor. The remarkable Navaratna adjoining the rajbari, built in honour of the family god and used during the 'Dol' festival, is among the tallest and most elegant ones of its kind.

Teota Zaminder Palace is located 3 km away from Aricha ghat. The 300-year old Teota Zamindar Palace at the village Teota under Shibalaya Upazila in Manikganj District still stands with pride and dignity becoming a living testimony to historical times.

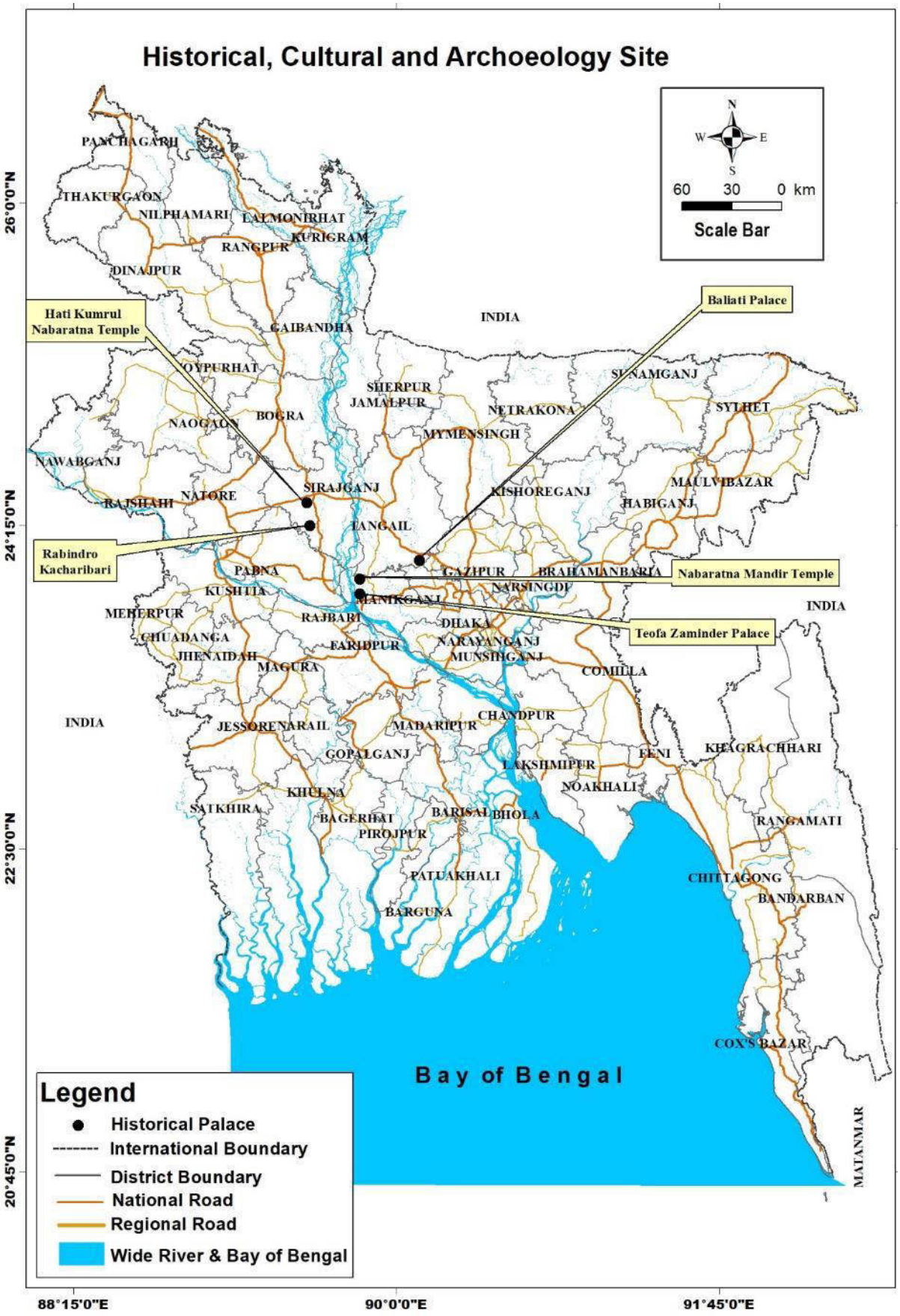


Figure** Fehler! Kein Text mit angegebener Formatvorlage im Dokument.**-35. Significant historical, cultural and archaeological sites in the program area

APPENDIX P - Preliminary Comment Matrix

Flood and Riverbank Erosion Risk Management Investment Program – Project 2
Environmental Impact Assessment Report (Comments from May 2020)

No.	Issue	Suggested action	Response
1	General issue: While the report is well prepared and comprehensive, however, it also tends to be exceedingly long. While the information (Baseline) is there, it is difficult to decipher which information is generic to the area and which is specific to the project site.	Please review the baseline section and use the most relevant information to impact analysis and discard other information that is affecting the flow of the report. Some of this information can probably be kept as an annex if necessary. Impacts depend on the type of intervention. The overall project area is relatively larger than some of the specific interventions such as the construction of embankment, which might have potently more significant impact, some level of disaggregation will be helpful to get a clearer picture. Please disaggregate the information (baseline and impact) at the site level and by intervention type (flood protection, dam etc), as much as possible. For example, which are the Khals and Beels that are within the zone of influence of the project? Which are of the conservation importance? What are the potential impacts? The information provided on 3rd of May on Impact of FRERMIP Project-2 works on Beels and wetlands presents somelevel of	The 77 page social and environmental baseline has been moved to a new Annex O, so as to retain available information. To improve the flow of the report, a new 22-page summary Social and environ-mental baseline has been inserted. The summary baseline is more site specific than the original baseline and includes three location maps (of beels and land reclamation areas).

		disaggregation. It is understandable that the site specific information on biodiversity might not be available. Please provide linkages to site and justification when national level data is being used.	
2	Some description of the project activities is outdated It is not clear construction of the road on the embankment is included in the current project design or not?	Please revise the description of project activities to reflect the most recent design Please clarify if the construction of the road is still withing the scope or not.	Latest description of Project-2 is now included. Road construction is no longer included, and an observation to this effect is included in 4.1.
3	Old maps and not necessarily relevant to Project-2	Please replace with the newly updated map, please include Project-2 specific details as much as possible.	Maps have been replaced.
4	<u>Cumulative and induced impact.</u> This section could be further elaborated in the context of the first tranche of the project, what will be the potential risk (e.g. downstream flood risk, inundation of adjacent floodplains, dike failure risk due to change in river morphology, raised riverbed, increase in water depth, and	Please further elaborate on this section. Please use report on Strategic Environmental and Social Assessment as a reference, wherever applicable.	The section has been added to re the points indicated, with some reference to the SESA.

	increased velocity of water etc.)		
5	<u>Impact assessment.</u> Impact assessment currently *focuses only on habitat and species*. It could be strengthened by taking a bit broader approach considering overall foregone ecosystem services, e.g. flushing of agriculture land (pollution), nutrient loading, drainage obstruction associated with hydrological regimes, if possible. More details on *reclaimed land* could be provided. This could include site-specific current characteristics, land-use, land-tenure. Future land-use plan. And, Impact, such as increase Agri-chemical use, pollution. Water quality impact of *dredging* should also be elaborated. While the impact of dredging is mentioned, it is not clear what is the current baseline, and what will be the additional change because of	Please elaborate this section to include ecosystem service, this might require including additional baseline information. Please provide a more detailed baseline and impact analysis on reclaimed land. Please elaborate baseline on water quality and impact of dredging.	The summary focuses on habitat and species as these are likely to be significantly affected. However, chapter 8 focuses on a broad range of social and environmental impacts, both positive (8.2) and negative (8.3), including aspects associated with pollution, nutrient loading and so on. As suggested, a section on (negative) impacts on ecosystem services (8.3.10) has been added. A map and paragraph on (to be) reclaimed land has been added to the baseline on land resources (5.3.7). Impacts of land reclamation are felt at various levels and concern dredging and excavation (8.3.4), reduced flooding (8.3.5), fisheries (8.3.7), natural habitats and wildlife (8.3.8) and of course on local (char dwelling) communities, which is dealt with in 8.3.6. Pollution & agro-chemical used has been added to 8.3.6. The impact of dredging is not just mentioned, but 1.5 pages is devoted to to this impact. In terms of impacts on aquatic environment, the EIA states: “Dredging will or may affect the aquatic environment in four possible ways: (i)

	the project activities.		destabilizing the bottom ecology, (ii) channel deepening creates an altered ecosystem that may not be good for aquatic life, (iii) destroying potential fisheries habitat as the spoil deposition sites are targeted to be partly water bodies, and (iv) changing water quality (e.g. pollution, turbidity, suspended solids)." The latter has been elaborated further. These are the anticipated changes, and the EIA specifies (via the EMP) that water quality is monitored, which will also provide a pre-dredging baseline. Section 5.2.3 provides a baseline on water quality for the Jamuna and Padma, but for monitoring this needs to be time and location specific.
6	<u>Consultation.</u> It seems that the last consultation was held in 2017.	It might be useful to undertake a consultation based on the finalized project design and include it in the report.	Public consultations were conducted in three rounds, two in 2013 and the third from 2016-2017, so a renewed consultation would have been appropriate. However, given present restrictions due to COVID-19, the completion of the ISPMC contract in June 2020 and the limited ability to use alternative strategies for face-to-face meetings (e.g. teams or zoom) in these rural settings, renewed consultations are not feasibile for the foreseeable future. Also, in principle, the types of interventions and impacts and hence the

			likely concerns of the stakeholders remain unchanged in the final design, so it is unlikely that new insights will emerge.

APPENDIX Q - Detailed Comment Matrix:

Flood and Riverbank Erosion Risk Management Investment Program – Project 2
Environmental Impact Assessment Report (Comments from June 2020)

No.	Issue	ADB comments – 26 June 2020	Response on 30 June 2020
1	<u>General issue:</u> While the report is generally well written, there are several paragraphs, which are very long and convoluted and might benefit from editing. Some sentences in EMP tables are incomplete (marked x) The report refers to old EARF and EIA of the program.	Please edit the document / complete the information as required. Please update based on updated EARF of Project-2 thorough out the report.	The 'x's' in the EMP tables are intentional, as they refer to unknown amounts (e.g. ha impacted, or extra rice production in tons). This has been updated in the latest revision (30 June 2020).
2	Executive Summary: Introduction: First sentence refers to the EIA of the program. This report is for the EIA of Project 2.	Please update	The 'program' referred to is the title of FRERMIP and that remains unchanged. Where appropriate the document refers to Project 2.

	The Assessed Project: Does not mention PLB 1	 Please add PLB 1 or provide justification, and adjust throughout the report	This has been added.
	Environmental categorization: needs to be updated based on new EARF for Project 2.	Please update	Environmental categorization is correct and updated; the EARF does not specify the environmental category.
	Impacts: understandably, the emphasis is on long term significant impacts such as habitat and species; however, it will be useful to add a summary of other impacts as well.	Please update	Other impacts such as on livelihoods, protection against floods and erosion are already mentioned in the 2.5 pages summary on impacts.
	Fourth Paragraph:"… Riverbank protection works at the two sub-project sites have the purpose of protecting the existing floodplain habitat from continuous and systematic erosion..." It should be three sub-projects.	Please update	Reference to number of sub-project sites has been removed.
	Fifth Paragraph. Difficult to understand.		This 5th paragraph has been rewritten/
	Sixth Paragraph. References to morphology studies are missing.		

	The last two sentences are not clear.	Please rewrite the paragraph	Reference provided.
	Specific JRB-1 Interventions and Impacts: Does not say anything about the impacts	Please provide a reference to morphology studies.	Unclear which two sentences are referred to.
	Specific JLB-2 Interventions and Impacts: Does not say anything about the impacts	Please rewrite the last two sentences	These have been added.
	Specific PLB-1 Interventions and Impacts: Does not say anything about the impacts	Please summarize the impacts of JRB-1	Reference is made to JRB-1, above.
	Recommended Actions "…. It will not result in all residual impacts being reduced to insignificance, but it will reduce them to levels considered acceptable under the circumstances…" is vague, acceptable by whom?	Please summarize the impacts of JLB-2 Please summarize the impacts of PLB-1	Reference is made to JRB-1 and JLB-2 impacts. Redrafted this, as indeed vague.
	"…emergency type riverbank protection…" not clear what does this mean		
	Environmental Management Plan	Please be specific, a reference to standards	

	"…(i) include open water fisheries-related measures…" Not clear what are the measures	and best practices will help Please clarify Please specify measures or give examples	These target initial perceived risks. Has been reworded. These include fish-passes and buoys to curb use of nets (now added to text).
	Introduction: Overview: First sentence. Long and convoluted. Also, what is the remaining 85% of land use? Second Paragraph. Outdated Third paragraph. Reference to MFF	Please rewrite Please update based on the new EARF for Project-2 Please update based on the updated EARF for Project-2	Reworded. 15% consists of water bodies, the rest consists of dryland area. This history of EARF and EIA has been updated. Reworded.
	Objective: Reference to Jamuna-Meghna River Erosion Mitigation Project (JMREMP). It suddenly appears here without providing any context or linkage to Project 2. "…It aims to sustain incomes and livelihoods of people…" The objective does not appear in line with Project 2 outcome and outputs	Please provide better context to JMREMP if necessary, otherwise, delete any reference to the JMREMP. Please clarify/ adjust, more along the line of flood and bank erosion risk management	Reference to JMREMP has been removed. The main aim is providing security, and sustaining incomes and livelihoods is a knock-on effect.

	Project Area *versus* Study Area. This section needs to be updated for Project-2 The first paragraph refers to the World Bank Project, however linkage to this project is not clear. If there is a link, this needs a discussion under the section on Cumulative Impact Assessment. "… The EIA study area has focused on two sub-reaches, i.e., JRB-1 and JLB-2…" PLB-2 is missing.	Please update Please clarify/ elaborate. Please add PLB-1 or justify not including it in the EIA	Reworded, and PLB-1 has been reinserted. Deleted, as PMO also questioned this previously. PLB-1 has been reinserted.
	POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK. National Conservation Strategy (NCS, 1992). One sentence does not say much about this strategy. What is the objective of the strategy and its relevance/linkage to Project-2? National Environnemental Management Action Plan (NEMAP, 1995). The period covering period 1995 to 2005 appears outdated, what is its relevance to Project-2? Bangladesh Climate Change Strategy and Action Plan (BCCSAP, 2009). What is the objective of the strategy and its relevance/ linkage to Project-2? Environmental Conservation Rules (ECR, 1997). Does Project-2 fall inside any 'ecologically critical area' (ECA)	Please elaborate Please update/ clarify Please add an introductory paragraph Please provide information Please add a sentence or two to clarify	This has been elaborated. As NEMAP was not updated after 2005, it still provides the framework for implementing the NCS. This has been added. The BCCSAP demonstrates the government's commitment to low carbon development and ensuring that infrastructure is climate proof, both of which are of direct relevance to Project 2 design and implementation. By 2015, 13 Ecologically Critical Areas had been declared in Bangladesh, none of which are in the project area. Any resettlement on Project 2 should bear in mind the issues related to arsenic in drinking

	The National Policy for Arsenic Mitigation (2004). Not clear what is the relevance to the Project-2. Bangladesh Wildlife (Protection and Safety) Act 2012. The introduction to this act is missing. Bangladesh Wildlife (Protection and Safety) Act 2012 Last sentence. "… GOB commitment to biodiversity conservation…" also climate change and disaster risk management	relevance to Project-2 Please introduce this act with a few sentences Please add climate change and disaster risk management	water. An introductory sentence has been added. Updated the last sentence of Section 2.2 to include this
	APPROACH AND METHODOLOGY Baseline Data Collection and Analysis: The collection of baseline on the existing infrastructure is missing. This is important because one of the major impacts is reduction of connectivity between river and floodplains, which is also affected by already built infrastructure such as embankments, roads, and settlements.	Please add a collection of baseline on existing infrastructure in approach and methodology. Also, add collection of baseline on other human activities such as navigation, existing use/land use (char) of braided river system.	This information was collected. Road network and waterways, including maps, are now included in Annex O, and have been moved here because a previous review by ADB found that the baseline (chapter 5) was way too long. Land use is included in 5.3 on Land Resources. A comment has been added to approach & methodology.
	Project Description Assessment of dredging. This title is confusing. Probably it should be Description of dredging instead of assessment The last paragraph is the description of embankment construction. It should be under separate title.	Please consider/ change Please adjust	Reworded as description of proposed dredging. Please note that it is included under 'technologies used', and not under the heading 'dredging'.
	Environmental and Social Baseline		

	Additional baseline discussed above under (approach and methodology) needs to be included Water Resources River System Last Paragraph. "…The tributaries of these major rivers inside the study area are Hurasagar, Dhaleswari, Kaliganga, Baral, Gohala, and Ichamati rivers.." it should be distributaries instead of tributaries?	Please include additional baseline information Please change	As explained above, this was moved to Annex O after being advised by ADB to reduce the length of chapter 5. This has been changed to distributaries.
	Ecological Resources Bioecological Zones - Introduction References to Chalan Beel. Chalan Beel is not in the Project-2 area. Arial Beel is probably a significant Beel in the Area.	Please update	Chalan Beel is not directly in the project area, but adjacent and likely to be influenced, hence it is included in the study area. 5.5.4 and table 5-10 lists the beels in the project area – this includes Arial beel but not Chalan beel.
	Impact Assessment and Possible Mitigation Measures The methodology suggests that the impact assessment will be done based on trend analysis for with and without project scenarios. This section should be better structured/ articulated to reflect this approach. Environmental categorization. TBD once categorization is finalized	Restructure/ rearticulate. Needs to be determined once categorization is finalized	Analyses were conducted on the Important Environmental and Social Components (IESCs) analyzed in chapter 7, under a with-/without project situation. Environmental categorization has already been determined in the REA, SESA and previous versions of the ESIA, and

			determined to be Category A.
	Negative Impacts Reduced Flooding – Baseflow "This may particularly impact water levels in distributaries, notably the Old Brahmaputra, Dhaleswari, and Arial Khan." Isn't construction of offtake supposed to increase the flow?	Please clarify	There is an increase is baseflow, but a decrease in flooding along these distributaries. The former improves some important aspects, such as river habitats, water quality and navigation, but the reduced flooding means that associated wetlands receive less water.
	Reclaimed Land & char dwellers It only discusses social impacts. Missing environmental impacts (habitat and species)	Please add	These are dealt with in detail elsewhere, as the first sentence explains: "Impacts of land reclamation are felt at various levels and concern dredging and excavation (8.3.4), reduced flooding (8.3.5), fisheries (8.3.7), natural habitats and wildlife (8.3.8) and of course on local (char dwelling) communities, which is dealt with here."
	"…Zaman (1996) notes that compliance with donor safeguards is hampered by an inadequate legal framework, the absence of an appropriate institutional framework, and often the lack of administrative and political will. CARE (2003) notes that while tenants' rights are enshrined in legislation they are 'almost invariably ignored in practice' and goes on to document the costs of corruption in transferring or securing access to land…" References are a bit outdated. Has any reform/ improvement taken place since then?	Please update	This has unfortunately not changed significantly since, and was recently (March 2020) raised by the NEMC on discussions about the SESA for FREMIP.
		Please add quantification/ evidence/	Inland fisheries production from capture fisheries has declined in the past two

	Loss of catch through the loss of habitats: Current trend is not clear. Is quantification possible for with and without project scenarios?	examples.	decades (and perhaps longer), in spite of increased effort. Decline of habitat (area and quality) is the only possible explanation. Freshwater fisheries production is boosted by aquaculture, but this often does not much benefit the poor.
	The section on Reduced biodiversity and migratory fish and Reduced fish migration should be combined. Is quantification possible?	Please add quantification/ evidence/ examples.	These have been combined. Few quantitative studies on impacts on fish migration have been carried out, but these are reportedly not very well designed.
	Increased capture at regulators "…for example, some fishes may avoid long and narrow tunnels, where water flow may be too high…" What kind of tunnels? Tunnels are usually associated with the fish passes on big dams.	Please clarify	"Tunnels" was probably incorrect, has been replaced with passages.
	Climate Change & Emissions Climate change "…Furthermore, embankment designs 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…." If this is the case then road and its environmental impact will have to be discussed as a part of induced impact	Please clarify/ update the section on induced impact as applicable	Roads are not included in Project 2, but may be added later (by other gov. agencies). The reference to road access has been deleted from this sentence.
	Analysis of Alternatives "…Considerations regarding the Without-Project		Without project scenarios have been added

	scenario have already been addressed in Chapter 4. ..” Scenarios need to be elaborated here. Chapter 4 is on project description.	Please address	(these were taken out of an earlier version of the ESIA, as deemed too elaborate).
	Environmental Management Plan The table on Riverbank Protection: Row on Fish Biodiversity. Specify if the impact is temporary or permanent. Clarify what “shift” means. Fish Migration. Vegetation clearance should be done as low as possible. Not clear where, and how is this a mitigation measure. Community organizations. The nature of “Positive impacts” is not clear. The table on Embankment Construction/Reconstruction: Land loss. X ha of land. Missing information. Crop production loss. x metric ton. Missing information. The table on Drainage Structure / Regulators cum fish passes/off-take Old Dhaleswari Construction of off-take structure to divert 245 m^3/s from Jamuna to Dhaleswari. Impact stated occurs Post-Construction Phase. Please move to the table on Post-Construction Phase. Please include any impact	Please update Please clarify/ adjust as needed Please elaborate on what are these positive impacts. Please complete Please complete Please complete	Permanent has been added after long-term; shift from has been replaced with ‘leave’ ‘Low’ has been replaced with as little as possible. Vegetation provides habitat. Positive impacts, due to awareness-raising and employment provided to members. 200ha is anticipated in the resettlement plan, and now included here. Crop loss of x MT is now removed. Parts moved to Post-construction Phase; see next comment. Has been moved; other impacts during construction phase (such as air quality,

	that will occur during the construction phase Mitigation measures state construction. Proper site selection is probably a more fitting mitigation measure. The table on Agricultural Resources The impact of pollution from agriculture activities is missing. Improved irrigation facilities x ha. Missing information. Fish migration. Degraded fish migration. Obstructed probably is a better choice of word	Please update Please consider/ update Please add impact and mitigation measure Please complete Please complete Please consider	noise, surface water quality, drainage congestion, health and safety, employment, community organization) are already included. Construction removed as mitigation measure. Already includes impacts and mitigation measures, not sure what is meant here. This has been added. Number of ha has been removed, as this cannot be assessed at this point in time, depends on too many factors, including farmers' perceptions and willingness to invest. Indeed, this has been replaced as suggested.