# Government of the People's Republic of Bangladesh
# Ministry of Water Resources

# River Management Improvement Program (Phase I)

# ENVIRONMENTAL AND SOCIAL ASSESSMENT

# EXECUTIVE SUMMARY

**May 2015**

# Contents

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## List of Acronyms

| | |
|---|---|
| ADB | Asian Development Bank |
| BDT | Bangladesh Taka |
| BOD | Biological Oxygen Demand |
| BRE | Brahmaputra Right-bank Embankment |
| BSM | Brahmaputra system model |
| BWDB | Bangladesh Water Development Board |
| CEAP | Construction Environmental Action Plan |
| CIIA | Cumulative and Induced Impact Assessment |
| CNGO | Coordinating Non-governmental Organization |
| COD | Chemical Oxygen Demand |
| CPR | Common Property Resources |
| CSC | Construction supervision consultants |
| DoE | Department of Environment |
| ECA | Environmental Conservation Act |
| ECC | Environmental Clearance Certificate |
| ECoP | Environmental Code of Practice |
| ECR | Environment Conservation Rules |
| EHS | Environment, health, and safety |
| EIA | Environmental Impact Assessment |
| EMF | Environmental Management Framework |
| EMP | Environmental Management Plan |
| ERP | Emergency Response Plan |
| ESA | Environmental and Social Assessment |
| EMP | Environmental Management Plan |
| FAA | Flood affected area |
| FAP | Flood Action Plan |
| FGD | Focus group discussion |
| GoB | Government of Bangladesh |
| GRM | Grievance redress mechanism |
| HH | Household |
| HSE | Health, safety, and environment |
| HYV | High yielding variety |
| IESC | Important environmental and social component |
| ILRP | Income and Livelihood Restoration Plan |
| IPCC | Intergovernmental Panel on Climate Change |
| IPM | Integrated pest management |
| IPMP | Integrated Pest Management Plan |
| IPoE | Independent Panel of Experts |
| IUCN | International Union of Conservation of Nature |
| IWM | Institute of Water Modeling |
| M&E | Monitoring and Evaluation |
| NGO | Non-governmental organization |
| O&M | Operation and maintenance |
| OP | Operational Policy |
| OHS | Occupational health and safety |
| PCR | Physical Cultural Resources |
| PMU | Project Management Unit |
| RAP | Resettlement Action Plan |
| RMIP | River Bank Improvement Program |
| RS | Resettlement site |
| SAP | Social Action Plan |
| SDP | Social Development Plan |
| SECO | Social, Environmental and Communication Office |
| TDS | Total dissolved solids |
| VEC | Valued Environmental Component |
| USD | US Dollars |
| WB | World Bank |
| WBG | World Bank Group |

# 1. Introduction

The River Management Improvement Program (RMIP or the Program)[1] is a three-phased proposed investment by the Government of Bangladesh (GoB) along the nearly 140km of right bank of the Jamuna River. The Program will reconstruct the historic Brahmaputra Right Embankment[2] (BRE) and secure it against river bank erosion to protect about 3.8 million people living on some 300,000 ha of floodplains in the north western region of Bangladesh from inundation resulting from extreme flood events; and to protect the river bank from on-going erosion. The program has three major interventions: (a) reconstruction of the BRE; (b) construction of riverbank protection structures through long revetments and strengthening of existing riverbank protection works; and (c) construction of a highway on the countryside of the new embankment. RMIP-I or Phase I (the Project) of the Program will specifically focus on first two interventions, improving flood and erosion control, within a 50 km of the priority reach of the Jamuna right bank located about 17 km upstream of the Jamuna Bridge. A comprehensive Environmental and Social Assessment (ESA) has been carried out for the Project and presented in six volumes. This Executive Summary presents a summary of the potential environmental and social impacts of the Project as described in ESA documents. Mitigation measures are described and included in relevant environmental and social management plans to address potential impacts as well as to enhance the environmental and social benefits of the project.

## 1.1. Background

**Erosion and flooding issues of the lower Brahmaputra or the Jamuna River.** The lower Brahmaputra, known as Jamuna in Bangladesh is one of the largest sandbed braided rivers in the world. The Jamuna was originally a small distributary channel of the Brahmaputra, originating about 10 km downstream of the Teesta confluence with the Brahmaputra. Sometime during the late 17$^{th}$ century, the Brahmaputra River started flowing into the present course of the Jamuna River, due to avulsion (change of river course). During the last two centuries since the avulsion the Jamuna has been undergoing several morphological changes such as increase in width and westward migration. These have been mainly due to neotectonics (movements of the earth curst) and the great 1950 Assam earth quake. In the last 40 years, the Jamuna has widened by 50%, going from 8 km to 12 km. These morphological changes have led to erosion of thousands of hectares of fertile cultivable floodplains every year rendering thousands of people landless and homeless. In addition to unpredictable riverbank erosion, floods are the other major natural hazard. While typically 20% of the country is flooded during the annual monsoon, more severe floods can inundate up to two-thirds of the country. River bank erosion of the Jamuna is expected to increase in the future due to continued neotectonic activity, unstable geomorphological conditions in the Brahmaputra catchment area and increased flood volumes due to climate change.

**Brahmaputra Right Embankment and Riverbank Protection Works.** During the mid-1960s about 180 km of flood embankment was built on the right bank of the Jamuna, historically known as Brahmaputra Right Embankment (BRE), to protect about 240,000 ha of floodplain from annual flooding and foster agricultural growth. However, due to ongoing riverbank erosion, this embankment had to be frequently retired (rebuilt behind the former alignment) and in some places, as much as nine times. Often riverbank erosion during the flood season result in breaching of the embankments which in turn led flash flooding and damage of standing crops, houses and public infrastructure in areas typically 50,000 ha in size. To address the riverbank erosion of the Jamuna, the government has so far constructed, since the 1980s, about 56 km of riverbank protection on the right bank.

**Environmental effects of historic BRE and bank protection works**. Protection from floods through BRE has resulted in significant agricultural production in the region. However, the BRE has acted as a barrier to lateral fish migration between the Jamuna and floodplains and hydrological connectivity between the Jamuna and *khals* (small rivulets) and *beels* (depressions on floodplains), which are

[1] The earlier name of the Program was River Bank Management Program (RBIP)
[2] BRE is also referred as JRE, the Jamuna Right Embankment in design documents

major floodplain fish habitats. This has caused significant reduction in the production of floodplain fisheries and affected the livelihoods of the fishermen.

**Need for rehabilitation of BRE**. The original BRE had a setback distance of about 1.5 km from the Jamuna's right bank and it was assumed to have bank erosion life of 25-30 year span. In the 1970s the embankment started to fall under sporadic erosion attacks. During the 1980s, the frequency of the BRE breaches by erosion increased rapidly as longer sections came within the range of rapidly eroding river bends which could cause bank-line erosion rates of several hundred meters per year in early stages of bend formation. To prevent flooding, these breaches were typically closed by local BRE retirements at about 200 meter setbacks. As a result of this minimal setback distance the BRE has been retired several times in many places and at present only 61 km of the original BRE has remained in place. Currently, many long stretches of the BRE are very close to the river-bank line and are prone to risk of erosion. In addition to erosion risk, the existing BRE is insufficiently high to prevent major floods from overtopping. A 50-year flood would potentially overtop the 6 km of embankment in seven locations and a 100-year flood would overtop 38 km in 13 locations.

Between 1973 and 2014, nearly 88,000 ha arable floodplain land was lost to the river, and nearly 2,800 ha of homestead land eroded, displacing an estimated population of 168,000 people. This displacement has had negative effects on the riparian residents, who generally have high poverty levels, and crowded low-quality dwellings with restricted access to civic amenities and roads. Regular episodes of flooding and river bank erosion continue to threaten the integrity of the BRE, causing subsequent displacement and exposing large rural and urban areas, such as Sirajganj, to destructive flooding and inhibiting economic growth. The cost of average annual damages resulting from the bank erosion and breach of the BRE is estimated to be about US$ 158 million. This includes (i) loss of about 200 ha of floodplain land, including 104 ha of agriculture land, (ii) loss of about 1,105 houses and damage of about 51,735 houses, and (iii) damage of about 7,000 ha of paddy crop. Hence there is an urgent need for reconstruction of existing degraded BRE and secure it against river bank erosion to prevent further breaching of the BRE and the need for future retirements,

**Flood and Erosion Victims**: The loss of cultivable and homestead land from erosion have made floodplain dwellers virtually destitute. Flooding and riverbank erosion have remained, to date, major sources of human suffering for those living in the project area. Historically, thousands of the displaced families have settled as squatters on the BRE or moved to slums in bigger cities like Dhaka. About 115,000 settlers, who live on the BRE, are generally very poor as is visible from the settlements they live. These settlements consist of temporary houses made of wood that has often been salvaged from their previous homes, with bamboo fences and straws and with corrugated tin sheet roofs. These families live under a constant threat of eviction as well as further erosion of embankment putting additional stress, especially on female family members. Some of the families had changes their residences along with retirement of embankments. The instability of life along the river and the overcrowd living on the embankment adversely affects income, education, housing, land ownership, livelihood, and food security. While the embankment is often the last resort for these families, the many settlements compromise the maintenance and structural integrity of the embankment. The floodplain victims narrated many stories of losses, displacements and homelessness during social surveys and a sample of such story is presented in Box 1.

## 1.2. The Proposed Program and Project

The GoB through the Bangladesh Water Development Board (BWDB) is preparing the RMIP to rehabilitate the existing degraded BRE and secure it against riverbank erosion along 140 km length from the Teesta River to the Jamuna Bridge. The Project (RMIP-I) will cover a 50 km long priority reach between Simla and Hasnapara. BWDB has approached the World Bank for financing the Program. BWDB is also planning to reconstruct the remaining sections of the BRE through an Asian Development Bank (ADB) funded project.

**Location**: The location map of the RMIP and RMIP-I is shown in Figure 1.

**Proposed works**: The physical works that are proposed for the RMIP-I are as follows:

- Reconstruction of 12 km of existing embankment and construction of 38 km of new embankment;
- Strengthening of 18.6 km of existing bank protection works and construction of 18 km new bank protection works through revetments;
- Upgrading of five existing spurs and one groyne;
- Construction of four new fish passes cum regulators to restore the ecological connectivity between the floodplains; and to provide supplementary irrigation water in the floodplain areas during the flood/monsoon season in case of long dry spells; and
- Construction of two new regulators across the embankments to provide supplementary irrigation

**Implementation period**: The program will be designed and implemented in three phases over a period of 10 years. RMIP-I covering 50 km priority reach will be implemented in Phase I over a period of 5 years. Phase II covers the remaining 87 km while Phase III focuses on the construction of a highway on the countryside of the reconstructed embankment.

## 1.3. The Environmental and Social Assessment

**Studies and documentation**: This executive summary of the ESA is based on field studies and data collected between 2014 and 2015 by various consultant teams hired by BWDB. These studies have been documented three volumes, (i) Environmental Management Framework (EMF) for the entire Program, (ii) Environmental Impact Assessment (EIA) for the priority reach, and (iii) Environmental Baseline for the entire program; and three volumes of social documentation grouped under Social Action Plan (SAP), (i) Volume 1 Project Context, Socio-Economic Baseline, Consultations and Communication Strategy (ii) Volume 2 Resettlement Action Plan (RAP), and (iii) Volume 3 Social Development Plan (SDP). All these documents are available under separate covers and have been disclosed on the BWDB website.

**Contents of the present document**: After a description of the Bangladesh legal and administrative framework and the applicable World Bank policies in chapter 2, a project description is presented in chapter 3, followed by a discussion of project alternatives in chapter 4. A description of the physical, biological and socio-economic environment is given in chapter 5. Climate change aspects are discussed in Chapter 6. Potential adverse effects of the project are described in chapter 7 and potential cumulative impacts and concerns associated with other river management projects are presented in chapter 8. Possible mitigating measures to offset, reduce or compensate potential negative impacts of the project are included in the EMP that is summarized in chapter 9. Finally, chapter 10 provides an overview of all stakeholder consultations and activities for disclosure and access to the information.

## 1.4. Composition of Study Team

**Design and Independent consultants**: The EIA study has been carried out by a multi-disciplinary team of international and national experts. The design team has contracted International Union for Conservation of Nature (IUCN) to prepare the EIA and EMF. However, as World Bank policies require that EIA be carried out by an independent team from the project design team, two independent individual consultants have been hired by BWDB to review and provide guidance on the work of the IUCN team as they carry out their work, as well as to update and supplement the IUCN drafts as required to meet international standards and prepare the final EIA and EMF in accordance with Bank requirements. An Independent Panel of Expert (IPOE) for environmental study was also involved for ensuring the quality of the study.

**Environmental study team:** The EIA team comprised of Dr. Venkata Nukala (EIA advisor and independent reviewer), Mr. Mohammad Omar Khalid (international team leader), Mr. Mohammad Shahad Mahabub Chowdhury (Study Coordinator and Fish Specialist), Mr. Sunil Baran Debroy (Water Resources Specialist), Ms. Bushra Nishat (Climate Change Specialist), Dr. Monirul Khan, (Social

Specialist), Dr. Nowsher Ali Sarder (Agriculture Specialist), Prof. Dr. Monirul H. Khan (Wildlife Specialist), Dr. Md. Kamrul Hasan (Ornithologist) and Mr. Junaid Kabir Choudhury (Ecologist).

**Social study team:** The social team consisted of Dr. Mohammad Zaman (international team leader), Dr. Hafiza Khatun (Resettlement Specialist), Dr. Md. Humayun Kabir (Social Survey and Safeguard Specialist), Khairul Matin (Resettlement Specialist), Shariful Islam (Consultation Specialist), Dr. Mohammad Maniruzzaman (Social Assessment Specialist), Minhaz Anwar (Communication Specialist), Dewan Ali Arshad (Livelihood Specialist), Shamima Pervin (Gender Specialist), Anwarul Hoque (Public Health Specialist) and Solveig Haupt (Public Health Specialist/International).

**Box 1. Story of a flood and erosion victim – " a rich man in the morn is destitute by dark"**

Amir Hossain is a former elected member of the local government system. He was a man of good economic standing and considered a *bhadralok* (elite) in local standards. Amir was weeping all the time while telling his story. He recalled that one night in September 1994 at 2.00 am, his son rushed to him and said that there was nothing left between the river and their house due to sudden bank erosion and breaches in the embankment. When he rushed outside with his son they could only save two people. The river washed away the remaining 59 persons in their settlement. The river used to be miles away from their house. The forces of floodwater washed away the soil underneath the riverbank and then the top of the bank line collapsed with all those who lived on the embankment.

Amir had 10 acres of land and employed many agricultural labourers. They used to harvest about 10 t of rice every season. He was the only son of his father. But then the Jamuna took away their land and everything else. Amir Hossain's case epitomizes the local proverb: *nodir ekul bange okul ghore eito nodir khela, sokal belar raja arbhai fakir sondhabela* (breaking this bank, building that bank, this is the river's lark; it makes the rich man of the morn a destitute by dark).

At the beginning, he recalled, he hesitated to reach out for help due to his social status, but after a few days he asked for help to each and every one he knew. After two years, he eventually ended up with work at a factory in Dhaka with some of his family members. In his old age, he is now supported by his son (a member of semi-police force who is guarding the border). He mentioned that most of his neighbours work as wage labourers, as there are no other opportunities to earn a living. He want that the river widening must be stopped and said, "we want to give whatever need to secure our lives."

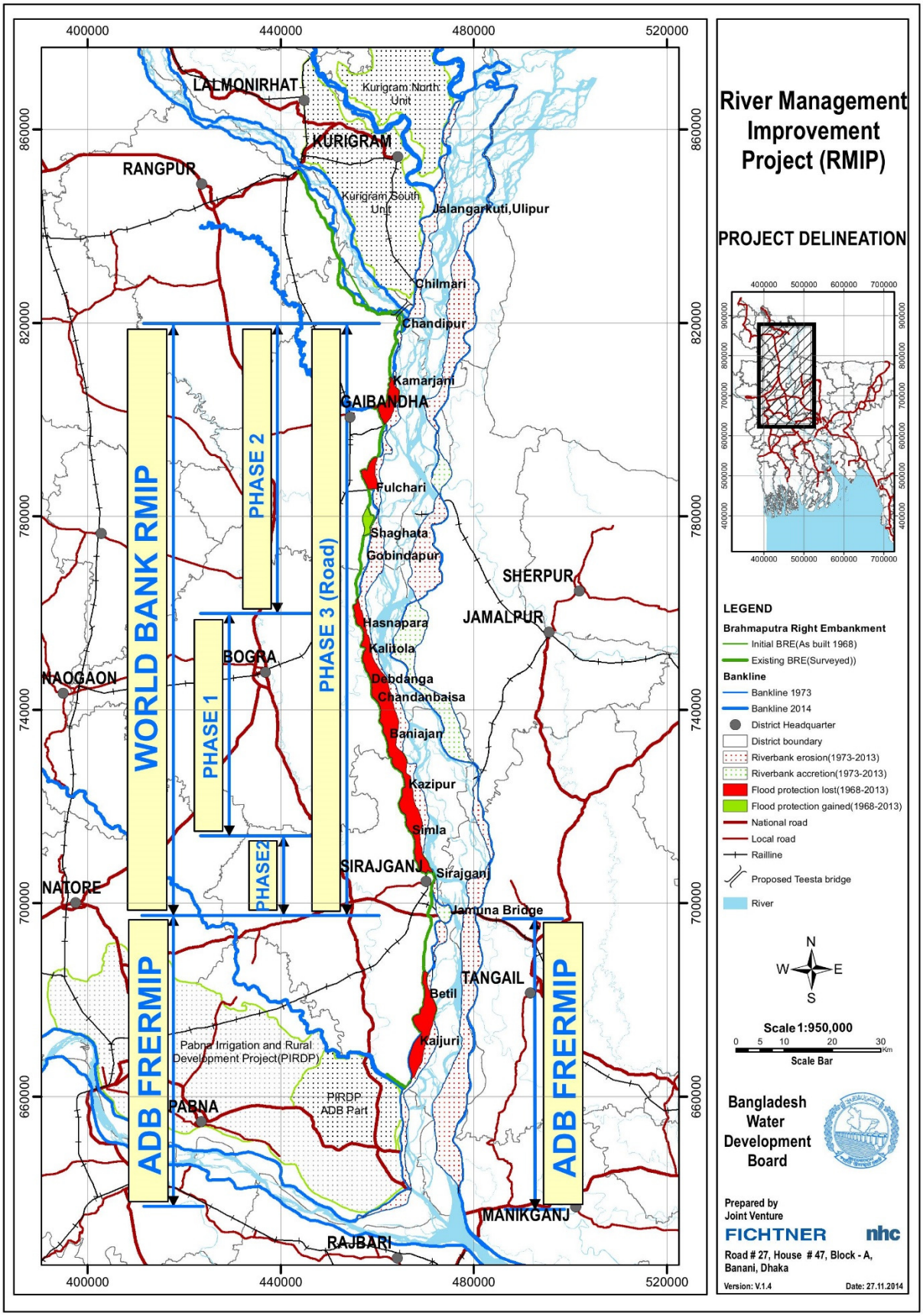



**Figure 1: Location of Priority and Remaining Works under RMIP**

# 2. Policy, Legal and Administrative Framework

## 2.1. Applicable Legislation and Policies in Bangladesh

**Bangladesh Environmental Conservation Act, 1995 and amended in 2010**: The Environmental Conservation Act (ECA) of 1995 is the main legislative framework related to environmental protection in Bangladesh. This umbrella Act includes laws for conservation of the environment, improvement of environmental standards, and control and mitigation of environmental pollution. This Act has established the Department of Environment (DoE), and empowers its Director General to take measures as he considers necessary which includes conducting inquiries, preventing probable accidents, advising the Government, coordinating with other authorities or agencies, and collecting and publishing information about environmental pollution. According to this act (Section 12), no industrial unit or project shall be established or undertaken without obtaining, in a manner prescribed by the accompanying Rules, an Environmental Clearance Certificate (ECC) from the Director General of DoE.

In accordance with this Act, the RMIP-I will need to be cleared by DoE before commencing the project following procedures given in the Environment Conservation Rules (ECR) 1997 (discussed below).

**Other Relevant Acts, Laws and Rules in Bangladesh**: Other legislation relevant to the proposed project are listed below.

- Bangladesh Environment Conservation Rules (ECR), 1997 empowers the GoB to declare ecologically critical areas, classification of industries and projects into various categories, procedures for issuing the environmental clearance certificate, and determination of environmental standards;
- Water Act 2013 is based on the National Water Policy, and designed for integrated development, management, extraction, distribution, usage, protection and conservation of water resources in Bangladesh
- Bangladesh Wildlife (Protection and Safety) Act 2012 protects 1,307 species of plants and animals; and mandates imprisonment and fines for wildlife poaching, capturing, trapping, and trading;
- Bangladesh Wildlife (Preservation) Order (1973) and Act (1974) regulates the hunting, killing, capture, trade and export of wild life and wild life products. It designates a list of protected species and game animals. It empowers the Government to declare areas as game reserves, wildlife sanctuaries, and national parks to protect the country's wildlife;
- Protection and Conservation of Fish Act (1950) provides power to the government to: make and apply rules to protect fisheries; prohibit or regulate erection and use of fixed engines; and construction of temporary or permanent weirs, dams, bunds, embankments and other structures. The Act prohibits destruction of fish by explosives, guns, and bows in inland or coastal areas; and destruction of fish by poisoning, pollution, or effluents. The Act prescribes the seasons during which fishing is allowed, prohibits fishing during spawning periods, and specifies officials having authority to detect breaches of this Act;
- 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;
- The Forest Act of 1927 as amended in 1989 grants the government several basic powers, largely for conservation and protection of government forests, and limited powers for private forests. The 1927 version of the act was amended in 1989 for extending authority over "any [Government-owned] land suitable for afforestation";
- The Private Forest Act of 1959 allows the Government to take over management of improperly managed private forest lands, any private lands that can be afforested, and any land lying fallow for more than three years;

- Embankment and Drainage Act, 1952 consolidates the laws relating to embankments and drainage providing provision for the construction, maintenance, management, removal and control of embankments and water courses for the better drainage of lands and for their protection from floods, erosion or other damage by water;
- The Bangladesh Labor Act, 2006 provides the guidance of employer's extent of responsibility and workmen's extent of right to get compensation in case of injury by accident while working.

**Relevant National Policies and Plans**: The national policies relevant to the proposed project and its environmental and social assessment are briefly described below.

- National Water Policy (1969) aims to provide guidance to the major players in water sector for ensuring optimal development and management of water;
- National Water Management Plan, 2001 (Approved in 2004) envisions to establish an integrated development, use and management plan for water resources in Bangladesh over a period of 25 years;
- The National Land Use Policy, enacted in 2001, aims at managing land use effectively to support trends in accelerated urbanization, industrialization and diversification of development activities;
- National Agriculture Policy, 1999 aims to make the nation self-sufficient in food through increasing production of all crops including cereals and ensure a dependable and secure food system for all. The policy particularly stresses on research and development of improved varieties and technologies for cultivation in water-logged and salinity affected areas. The policy also recognizes that adequate measures should be taken to reduce water-logging and salinity and provide irrigation facilities for crop production;
- National Integrated Pest Management Policy enables farmers to grow healthy crops and increase their income on a sustainable basis while improving the environment and improving community health. To achieve these objectives, the integration pest management (IPM) Policy aims to pursue the following strategies: to expand IPM on a sustainable basis by establishing a national IPM program; and to facilitate co-ordination of all IPM activities in Bangladesh;
- National Fisheries Policy, 1996 focuses on aquaculture and marine fisheries development and includes the following mandates: (i) Maintaining biodiversity in all natural water bodies and in marine environment, (ii) Ensuring that chemicals harmful to the environment will not be used in fish shrimp farms; (iii) Using environment friendly fish shrimp culture technology; (iv) Expanding fisheries areas and integrating rice, fish and shrimp cultivation; (v) Undertaking control measures against activities that have a negative impact on fisheries resources and vice-versa; and (v) Formulating laws will to ban the disposal of any untreated industrial effluents into the water bodies.

**International Treaties signed by Bangladesh**: Bangladesh is a signatory to a number of international environment-related treaties, conventions, declarations and protocols. The following are the relevant international treaties and conventions to which Bangladesh is a party:

- Convention on Biological Diversity, Rio de Janeiro (1992);
- United Nations Framework Convention on Climate Change, Rio de Janeiro (1992);
- Vienna Convention for the Protection of the Ozone Layer, Montreal (1987);
- Convention on Wetlands of International importance especially as Waterfowl Habitat, Ramsar (1971) and its amending protocol, Paris (1982);
- Convention on Conservation of Migratory Species of Wild Animals (1979);
- Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), Washington (1973);
- Convention concerning the Protection of World Culture and Natural Heritage (World Heritage Convention) (1972);
- International Plant Protection Convention (1951); and

- Kyoto Protocol (1997) and Copenhagen Accord (2009) on climate change.

## 2.2. Environmental Procedures

**Environmental Impact Assessment**: In accordance with the Bangladesh Environmental Conservation Rules, the flood protection works are designated as red category and hence an EIA is to be prepared.

**EIA Approval**: 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 (one year for red category) and compulsory requirement for renewal of certificate at least 30 days before expiry of its validity.

## 2.3. World Bank Safeguard Policies

The World Bank's environmental and social safeguard policies relevant to the project include the following:

**Environmental Assessment (OP 4.01)**: The proposed RMIP-I has been classified as Category A, since some of the potential impacts are likely to be significant and diverse. The World Bank requires an environmental and social assessment for all "Category A" projects proposed for Bank financing, in order to ensure that these projects are environmentally and socially sound and sustainable. In accordance with the requirements of Operational Policy (OP) 4.01, environmental and social assessment has been carried out and EMP prepared to mitigate or minimize all potential adverse environmental and social impacts.

**Natural Habitat (OP 4.04)**: The Jamuna River and its floodplain provide habitat to a wealth of aquatic and terrestrial biodiversity. While no net loss or permanent degradation of critical natural habitat is expected to result from the project, the proposed activities will have impacts on some areas of natural habitat; hence, this policy is triggered. Habitat restoration and enhancement measures as well as ongoing ecological monitoring will be included in the project to mitigate and/or compensate for any adverse impacts in accordance with this policy.

**Pest Management (OP 4.09)**: Improved protection from floods by the embankment may induce land use changes in the protected area including a shift toward higher-value crop production as well as intensified agriculture. This in turn may result in increased usage of chemical pesticides and fertilizers in the medium to long term. Therefore, this policy is triggered, and an Integrated Pest Management (IPM) Plan will be developed during project implementation, with linkages to the already on-going integrated pest management (IPM) initiatives in the region.

**Physical Cultural Resources (OP 4.11)**: As part of the environmental and social assessment studies for the project, a full baseline assessment has been carried out, including consultations, to identify any physical cultural resources (PCR) in the project influence area. This assessment has revealed that the Project will need to relocate twenty mosques, four temples, one church, six *Eidgahs* (place for offering Eid prayers) and five graveyards. However none of these resources require any special protections that warrant a PCR management plan as per the policy. The mosques, temples and *Eidgahs* will be reconstructed and graves relocated as an integral element of the resettlement action plan (RAP) and in full consultation with project-affected persons. In addition, the 'chance find' procedures are also included in the EMP.

**Involuntary Resettlement (OP 4.12)**: The Project requires about 370 ha of land acquisition as well as displacement of 3,628 households (15,558 persons). A Resettlement Action Plan (RAP) has been prepared in line with relevant Bangladesh laws and OP 4.12.

**International Waterways (OP 7.50)**: This policy is triggered since the Brahmaputra/Jamuna is an international waterway. However, as Bangladesh is the downstream country within the Brahmaputra/ Jamuna basin, the proposed project is not expected to change the quality or quantity of water flow and adversely impact the other riparian countries. As such, in accordance with the policy a waiver to the notification requirement has been granted.

In addition, the following policies and guidelines have been taken into account in the project design:

**Access to Information**: This policy sets out the Bank's requirements for disclosing and sharing information. The policy reaffirms the Bank's commitment to transparency and accountability in its activities for promoting development effectiveness and poverty reduction. The EIA, EMF and SAP and this Executive Summary have been disclosed at BWDB website in addition to sharing them with the stakeholders including the local community. These reports are also disclosed in the World Bank InfoShop. Public disclosure meetings were held through a national level work shop in Dhaka on 25 January 2015 and four sub-district level meetings in April 2015.This Executive Summary is also available in Bangla language at BWDB website and locally with all sub-district administration offices.

**Environmental Health and Safety Guidelines**: The World Bank Group Environment, Health, and Safety (EHS) General Guidelines (2007) contain performance levels and measures for development of industrial projects that are considered to be achievable within the new facilities at reasonable costs by current existing technology. These guidelines apply to the project, particularly with respect to air emissions, ambient air and noise quality standards, waste water quality, hazardous material and waste management, and occupational and community health and safety management.

**Gender Policy (OP 4.20)**: The World Bank's Gender Policy aims to reduce gender disparities and enhance women's participation in the economic development of member countries. During the social assessment, gender aspects have been considered and women's participation has been ensured to the extent possible while carrying out the stakeholder consultations. A gender action plan has been prepared as part of the Social Development Plan under the SAP.

Environmental and social policies of the World Bank that are <u>not</u> applicable to the project include:

**Indigenous People (OP 4.10)**: There are no indigenous communities residing in the project influence area and therefore this OP is not triggered.

**Forestry (OP 4.36)**: The policy recognizes the need to reduce deforestation and promote sustainable forest conservation and management in reducing poverty. Though the proposed project will support some compensatory tree plantation on the reconstructed embankment, this OP is not triggered since the project is not located in any forested area and will therefore not have any direct or indirect impact on forests. The tree plantation on the embankment will nonetheless be carried out fully in compliance with the paragraph 7 of OP 4.36 on plantations.

**Safety of Dams (OP 4.37)**: The dam safety Policy is not triggered since embankments will not qualify as 'dams'. Nonetheless, while the embankments do not qualify as 'dams', many of the same risks and concerns associated with potential dam failure are also relevant in the context of the embankments. The project has therefore convened an Independent Panel of Experts (IPoE) to provide guidance on diverse project aspects including technical, environmental and social.

**Projects in Disputed Areas (OP 7.60)**: Projects in disputed areas may raise a number of delicate problems affecting relations not only between the Bank and its member countries, but also between the borrower and one or more neighboring countries. This policy is not applicable, since the project is not located in or near any disputed territory.

## 2.4. Compliance Status with Bangladesh Legislation and World Bank Policies

The present compliance status of the project with Bangladesh legislation and World Bank safeguard policies is indicated in Table 1.

**Table 1: Compliance of Project with GoB Legislation and World Bank Safeguard Policies**

| | Legislation/Policy | Actions Taken to Comply |
|---|---|---|
| GoB | Environmental Conservation Act | BWDB has submitted the EIA report to DOE on 16 March 2015 for environmental clearance |
| | International treaties | Verification of protected sites, Red List and protection of vulnerable habitats. |
| | Public information and disclosure | The draft EIA, EMF and SAP reports have been disclosed on BWDB's website. Stakeholder consultation workshops were held in Dhaka and in the project area to disclose the project information and environmental and social assessment. |
| World Bank | Early screening and Scoping | Scoping consultations were held in the project area in August – September, 2014. |
| | Participatory approach | Key informant interviews, participatory rural appraisals, consultation meetings and focus group discussions were held. |
| | Integrate environmental and social assessment | Natural environment, public health, and social aspects are integrated in planning documents. |
| | Natural Habitats | Verification of protected sites and ecosystems, Red List and endangered flora and fauna has been done. Discussions with relevant district government departments and conservation NGOs were held on potential impacts and mitigation or compensation measures. The project will also include biodiversity monitoring and conservation activities to protect sensitive aquatic habitats. |
| | Risk assessment | Health and safety risks for population and workers are identified in the EIA and will be included in tender documents. |
| | Climate Change and floods | Impact of climate change effects are considered in estimating future flood levels and volumes. Embankment design considered a freeboard of 1.5 m to accommodate climate change impacts and other uncertainties. |
| | Cumulative Impacts | Cumulative impact assessment has been conducted as part of the EIA to cover the impacts of all existing embankment and bank protection structures, and anticipated river improvement programs in the Jamuna. Conservation programs and land use planning studies are recommended to address cumulative impacts. |
| | Alternatives | Alternatives considered included: "without project" case; alternatives to bank protection, embankment and roads, embankment materials and resettlement sites. Alternatives analysis looked at environmental and social as well as technical and financial considerations. |
| | Pollution | Baseline survey of environmental quality has been carried out. Stricter environmental standards were applied and ECoPs will be included in contractors' bidding documents. |
| | Physical Cultural Resources | No physical cultural resources which warrant special treatment under the World Bank OP 4.11 were identified in the project impact area. Relocation and reconstruction of community religious structures are covered in RAP. Chance find procedures will be included in bidding documents. |
| | Gender | Gender consultations were carried out during social assessment and a gender action plan has been prepared as part of SAP. |
| | Public Health | Public health aspects were studied and a public health action plan is prepared as part of SAP. |
| | Consultation and access to information | Consultations have been held in all the project villages and with all the relevant stakeholders. The EMF, EIA and SAP reports have been disclosed on BWDB website and WB InfoShop. Public disclosure meeting was held during January and April 2015. This ESA Executive Summary has been translated in to Bangla and placed on BWDB website and also in all sub-district administration offices in the project influence area. |

# 3. Project Description

## 3.1. Background

**Key Features of the BRE**. The BRE comprises of 180 km of embankment along the right bank of the Jamuna and 40 km of embankment along the right bank of the Teesta, the main tributary of the Jamuna in Bangladesh. The BRE was constructed in the 1960s, from Kaunia in Rangpur district to Bera in the Pabna district, to protect the 240,000 ha of surrounding area from flooding of the Jamuna and to improve agricultural production in the area.

**Frequent Retirements of BRE**. Originally the BRE had a setback distance of about 1.5 km from the Jamuna bank line. Over the years the embankment has been increasingly under attack from westward shifting of the river and consequent bank erosion, causing the embankment to breach at several locations. After such breaches, the embankment had to be retired from its original alignment and reconstructed. The retired embankments were typically constructed with around a 200 meter setback distance to prevent flooding. In many places, the embankment has been retired several times. Presently, only about 61 kilometers of the original BRE remains intact, and the overall setback distance is steadily reducing with more and more embankment length being within the reach of annual average erosion rates. Consequently, the integrity of the BRE is threatened and large areas of rural and urban areas are increasingly being exposed to the risk of flooding.

**Bank Protection Works**. Since the 1990s the BWDB has been constructing protruding riverbank protection structures such as hard points and groynes. Hard points at Sirajganj, Sariakandi, and Mathurapara, and a groyne at Kalitola were constructed from 1995 to 1998. The structures were heavily damaged, first in 1998 and 1999 and repeatedly later, and have required ongoing maintenance and re-construction. Due to the high cost of the “hard points”, the BWDB developed a satisfactory alternative in the form of guiding revetments since the mid-2000s, which have demonstrated a lower failure rate and better protected the embankment steadily.

## 3.2. Project Objective

The overall program (RMIP) development objective is to reduce the adverse impacts of flooding and erosion along the right bank of the Jamuna, enhance sustainable management of the Jamuna and improve transport connectivity of the sub-region. The project-specific (RMIP-I) development objective is to improve flood and erosion management capacity, and increase protection against river flooding and erosion along the 50 km priority reach in the Jamuna right bank.

## 3.3. Program Area, Work Sequencing, and Key Components

**RMIP Area and Selection of Priority Reach**. The RMIP covers the existing 140 km long BRE from the Teesta River to the Jamuna Bridge while the future ADB ‘Flood and Riverbank Risk Management Investment Program (FRERMIP) Project’ will cover the remaining 40km length of BRE from downstream of the Jamuna Bridge. The 70km BRE reach from upstream of Jamuna Bridge to Hasnapara is under heavy erosional attack with frequent embankment breaching and retirements. Out of this, the 50-km length between Simla and Hasnapara is designated as a priority reach due to (a) high erosion rate (an average of 3.3 km of wide floodplain was eroded over the last 40 years), (b) risk of embankment breaching due to reduction of distance from the bank to embankment tThe embankment setback distance has reduced from typically 1.5 km in 1973 to 390m in 2014), (c) risk of avulsion in to the Bengali River, which runs parallel to the Jamuna and over a length of some 15 km it is located as close as 350 m to the Jamuna bankline, a distance that could be eroded in one year, and (d) presence of limited bank protection works.

## 3.4. Project Components

***(a) Component A: Rehabilitation and Improvement of Brahmaputra River Embankment Scheme (US $472 million).*** This component would consist of the civil works required for embankment rehabilitation and associated riverbank protection works. Details of the proposed interventions are given in Table 2.

**Table 2: Proposed Interventions in RMIP-I**

| Intervention | RMIP -1 |
|---|---|
| New Embankment | 38 km |
| Upgrading Embankment | 12 km |
| New Revetment | 18 km |
| Upgraded Revetment | 18.6 km |
| Upgraded Spur | 5 |
| Upgraded Groyne (Kalitola) | 1 |
| Regulators | 2 |
| Fish Passes | 4 |
| Culverts | 2 |

**Component A1: Embankment Rehabilitation and Improvement (US$ 190 million).** This subcomponent aims to increase community resilience to flooding by rehabilitating embankments along 50 km of the priority reach. The reconstructed embankment will be realigned from the existing embankment in various locations, so that it can follow a continuous gentle alignment for two reasons. First, irregular embankment alignment induce sharp abruptions to flood water that generate deep scour at the toe of the embankment leading to failure. Second, the smooth alignment will allow for the development of road. The embankment will have at least 100 m set back distance from the riverbank to minimize disturbance to existing settlements and to protect from riverbank erosion. The cross section of proposed embankment is shown in Figure 2. The design features of the embankment include:

**Height of the crest** in the priority reach is typically 5.5m high with 96% of the length below 7.5m. The design flood level was determined through a series of hydrological calculations and hydraulic modelling of flow rates and water levels for a range of return periods. The flood level incorporates a climate change allocation. The embankment has been designed to incorporate an additional 1.5 m height, called freeboard, to account for climate change impacts, uncertainty in flood statistics, wave run-up, morphological changes, local settlements or subsidence.

**Service Road.** The embankment provides a wide platform on the countryside, which is able to accommodate up to four lanes of highway. Future road options will be investigated during Phase III. During Phase I, a two lane construction road will be constructed on country side berm for emergency and local access, connected in nine places to the local road network. In addition, 12 local crossings (ramp cum stairs) will be built to facilitate the movement of people, livestock and non-motorized vehicles. The unoccupied part of the berm will have suitable vegetation coverage to discourage unauthorized settlement.

**Loads** - the proposed embankment is designed for load combinations including earthquake, rapid drawdown (from receding floodwaters), and seepage.

**Fish Passes and Regulators** - Past retired embankments contain no openings for water exchange between river and floodplain. The proposed reconstructed embankment will change this by providing two regulators and four fish passes in the priority reach. The regulators and fish passes will facilitate fish migration, assist supplementary irrigation during the flood season, and increase soil fertility and groundwater recharge. Excavation of *khals* and *beels* connected to the fish passes and regulators will be carried out under the EMP (Component B2) in order to extend the ecological connectivity between the Jamuna and floodplain.

**Toe Protection** - both toe lines will be protected from encroachment by placing open cell pavers along the river side and planting trees on the country side, so that farmers can't plough into the protective clay layer.

**Width** - subsoil conditions indicate that a wide embankment is needed to avoid geotechnical failure from seepage. The typical cross section will be between 60 and 70 m including a 2.5 m wide strip between land acquisition boundary and embankment toe line as a buffer.

**Vegetation** - the country-side embankment slope will be used for vegetation, not only as compensation area for tree plantation and to provide community forestry benefits to local communities, but also to discourage unauthorized settlement. The tree plantation is designed to be effective during the initial time with construction road and with modification also when a full two-lane highway is built. The crest of the embankment will be covered with open cell pavers to allow vegetation growth, fix the crest level, and discourage through traffic.

**Setback Distance** - the setback distance from the river will range from 100 to 700m, with 50 percent of the length below 400 m. The minimum distance of 100 m has been selected for geotechnical reasons: in case the riverbank fails locally, the failure boundary needs to be far enough from the embankment to avoid compromising the flood protection and road.

**Potential Failure from Overtopping** - the safety of the embankment against failure from overtopping, either from waves or extreme peak flows, is increased by the wide paved road on the country side, which protects against retrogressive failure and sudden breach.

**Component A2: Riverbank Protection (US$ 282 million).** This component aims to increase community resilience to bank erosion and provide increased protection against river attacks and embankment breaches along 50km of priority reach. The riverbank protection is designed to cope with the high energy flow along the right bank of the Jamuna and expected to lead to a more stable channel with flow parallel to the riverbank, which would favor navigation in future.

The riverbank above the low water level will be protected by concrete blocks and in some areas a new technology of grout-filled mattresses will be used. The underwater slope will be protected with three layers of robust end affordable sand-filled geotextile bags. Toe aprons will be protected with multiple layers of geobags for self-launching in case of scour. Layout of bank protection works is shown in Figure 3.

The riverbank protection will be built to the highest standards applied to protect land largely used for agriculture, incorporating flat slopes above low water and wide aprons along the toe that reduce the risk of catastrophic failure. The bank protection works will also cover rehabilitation and strengthening of existing spurs and groynes.

***(b) Component B: Land Acquisition and Implementation of Social and Environmental Management Plans (US$ 90 million).*** This component will implement planned social and environmental programs to mitigate the social and environmental risks in the project, including resettlement, and provide development assistance to local communities in the project area.

**Component B1: Social Action Plan (US$ 75 million).** The aim of the Social Action Plan is two-fold. First, to mitigate the adverse social impacts of the project associated with acquisition of nearly 370ha and resettlement of affected people. This will cover the development of 15 resettlement villages to cover the large population living on the embankment and affected by the new alignment. Second, to promote local area and social development along the embankment through small-scale income and livelihood restoration, gender and public health action programs.

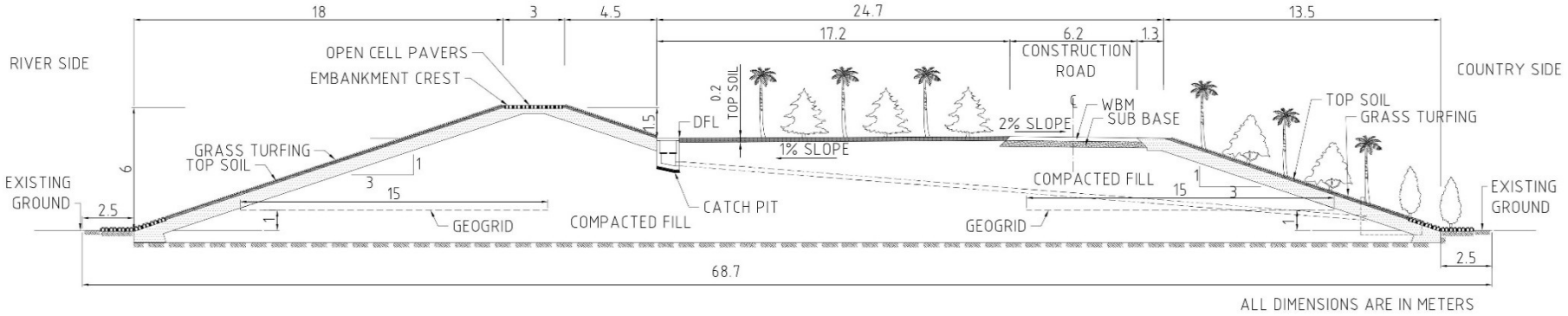



**Figure 2: Typical Cross-Section of the Proposed Embankment**

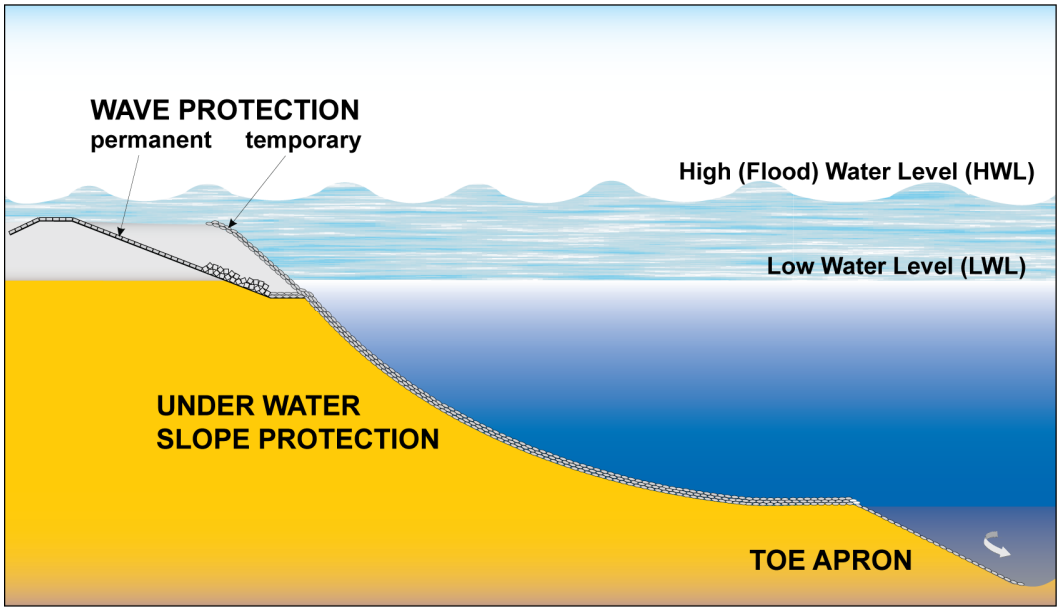



**Figure 3: Layout of Bank Protection Works**

**Component B2: Environmental Management Plan (US$ 15 million).** All construction-related environmental issues would be addressed in the construction contracts; thus the cost of such measures is included in Component A. This component would include those aspects that will be considered separately. These include environmental monitoring of river and floodplain, charland and ecosystem conservation programs, fishery development programs, community activities pertaining to the optimization of fertilizer and agricultural process, which may intensify as a consequence of the more reliable environment.

***(c) Component C: Institutional Strengthening, Capacity Building of BWDB, Technical Assistance and Training and Future Project Preparation and Strategic Studies (US$ 33 million).*** This component will cover consulting services for project implementation and will cover the following two subcomponents.

**Component C1: Institutional Strengthening of BWDB and Advice, (US$ 18 million)**. This subcomponent would build capacity of the BWDB to carry out effective operation and maintenance (O&M) programs of the embankment scheme with road and the associated riverbank protection work. The component comprises: Procurement Panel and a Panel of Experts, effective river survey system and a comprehensive Embankment Asset Management System

**Component C2: Future Project Preparation and Strategic Studies (US$ 15 million)**. This subcomponent would support the preparation of Phase II and III, as well as other strategic studies to address technical, financial, or management issues, mitigation measures, pilot projects and preparation of future projects of strategic importance to river management that may be identified during program implementation.

***(d) D: Construction Supervision, Monitoring and Evaluation of the Project Impacts and Social and Environmental Management Plan (US$ 55 million).*** This component will cover consulting services for project implementation. This includes: (i) Construction Supervision and Implementation Support, (ii) Third Party Monitoring and Evaluation of Project, and supervision of implementation of EMP, SAP, RAP; and (iii) Project Management Support.

## 3.5. Construction Material and Sources

The construction materials required for embankment, road, river bank revetment, and other project components will include earth, sand-filled geotextile bags (geobags), cement, concrete aggregates, brick chips, bitumen, steel for concrete reinforcement, and building material for housing. Some of these materials will be obtained from within the project influence area: sand from the river bank and earth from the base of the new embankment and existing embankment when this fails on the alignment of the new one. Other materials such as cement, steel, and brick chips will be procured from local/national markets, whereas some of the materials such as concrete aggregates and asphalt may have to be imported. The estimated average labour requirement during construction is 270 persons per day. These will include engineers, technicians, supervisors, surveyors, mechanics, foremen, machinery operators, drivers and skilled and unskilled labor. Unskilled workers will be mainly hired locally and include women. Construction camps for each construction site are to be established by the contractor. The contractor will select the location of the camp through consultation with the local communities and BWDB.

## 3.6. Sustainability of RMIP-I

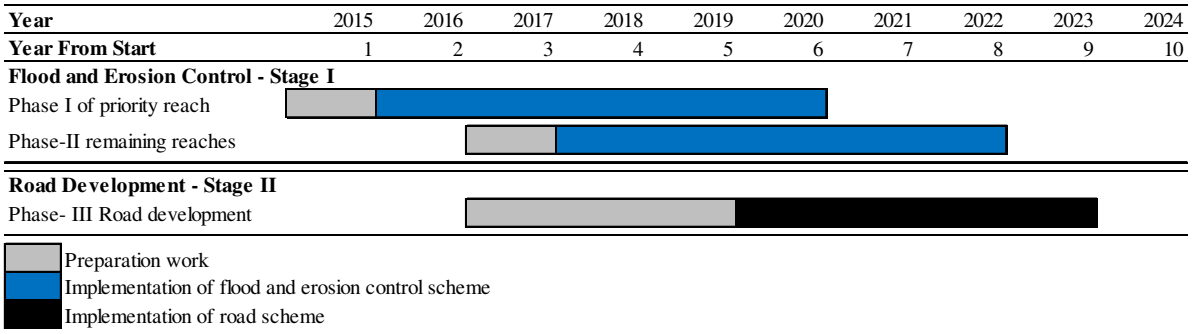
The main reasons for historic failure of BRE are ongoing river bank erosion and insufficient funding for operation and maintenance works. The proposed physical interventions have been carefully designed to ensure its long-term sustainability. The embankment is accompanied by riverbank protection work to increase its protection against river erosion. The riverbank protection works also increases the reliability of the embankment to be used as a road. The embankment crest and width are designed to account for climate change and uncertainty by adding extra freeboard to protect against higher

floodwater levels. The strong design will reduce incidences of breaches and thereby reduce the cost for O&M.

The project's strong emphasis on institutional capacity building will further enhance its sustainability. Significant support for training will be provided to the BWDB O&M divisions. This will include the deployment of advanced monitoring and river surveying instruments and tools to allow numerical interpretation and visualization of surveyed data for early detection of breaches and timely O&M. In addition, an asset management system will be developed for the BWDB to monitor the performance of the proposed infrastructure over time.

## 3.7. Construction Schedule

The construction of Phase I is planned to be completed in five years. A summary construction schedule for all phases is shown below.




## 3.8. Project Cost

The cost of Phase I, II and III are estimated to be USD 650 million, USD 840 million and USD 270 million, respectively. The details of estimated project cost of RMIP-I is shown in Table 3.

**Table 3: Cost Estimate of RMIP-I**

| Project Cost by Component and Subcomponent | | Total million USD |
|---|---|---|
| **Component A: Rehabilitation and Improvement of Brahmaputra River Embankment Scheme** | | **472.0** |
| A1 | Embankment Rehabilitation and Improvement | 190.0 |
| A2 | Bank Protection and Revetment | 282.0 |
| **Component B: Implementation of Social and Environmental Management Plans** | | **90.0** |
| B1 | Social and Resettlement Management Plan | 75.0 |
| B2 | Environmental Management Plan | 15.0 |
| **Component C: Institutional , Capacity Building of BWDB, Technical Assistance and Training and Future Project Preparation and Strategic Studies** | | **33.0** |
| C1 | Strengthening of BWDB, Independent Panel of Experts and Technical Assistance | 18.0 |
| C2 | Future Project Preparation and Strategic Studies | 15.0 |
| **Component D: Construction Supervision, Monitoring and Evaluation of the Project Impacts and Social and Environmental Management Plan** | | **55.0** |
| D1 | Construction Supervision and Implementation Support | 30.0 |
| D2 | Third Party Monitoring and Evaluation of Project, and Supervision of EMP, SAP, RAP | 5.0 |
| D3 | Project Management Support and Audit | 20.0 |
| **Total Project Cost** | | **650.0** |

# 4. Project Alternatives

## 4.1. No Project alternative

**Damages from Jamuna Right Bank Erosion**. A morphological model has been developed by the design consultant to study the historical trends in morphological changes of the Jamuna, trends in floodplain erosion, as well as to predict the future riverbank erosion for the next 30 years. Annual damages caused by erosion of the Jamuna right bank, in terms of loss of agricultural land and residential structures, are summarized below and total annual cost of these damages are estimated to be about US$ 18.3 million in 2015 prices.

- About 200 ha of floodplain land, including about 104 ha of agriculture land will be lost annually to the river. The affected land will also include about 22 ha of water bodies that provide habitat for floodplain aquatic species and spawning grounds for migratory fish species.
- About 1,105 residential structures (93.5 percent structures are adobe/mud walled) will be lost annually to the river.
- About 5.7 non-residential structures such as schools and shops will be lost annually to the river.

**Damages from Breach of BRE**. Breaches of the embankment cause flooding of the floodplains damaging the standing *Aman* paddy (main crop in flood season), livestock, houses, and other social and physical infrastructure, and livelihood of the local communities. Historical data on annual flood damages of last 27 years was collected from local government offices and a summary of extent of these damages are presented below. It can be expected that without the project scenario, the extent of damages will be similar in future and total value of these damages would be about US$ 140 million per year (in 2015 prices).

- About 7,000 ha of *Aman* paddy is completely damaged and about 4,900 ha are partially damaged annually.
- About 396 livestock are lost each year.
- About 51,735 houses are damaged each year. About 80 percent of these houses are semi-permanent structures that are partially damaged and remaining 20 percent are temporary structures that are fully damaged.
- About 130 km of paved road and 148 km of unpaved road is damaged annually.

**Current approaches by BWDB to address Bank Erosion.** In the absence of the proposed project, the ongoing right bank erosion of the Jamuna would continue to damage the floodplain agriculture land and settlements and infrastructure. The BWDB generally responds to these problems by (i) accepting the bank erosion and relocating the embankment periodically and repeatedly and (ii) sporadic emergency protection works to control the erosion and retirement of embankments. However, both these approaches are not acceptable, neither to the BWDB nor the local population due to their low reliability.

## 4.2. Alternatives for River Bank Protection

The concept of providing systematic protection started with the development of “hard points” in the early 1990s as part of the Flood Action Plan, Component 1 (FAP1). With the exception of construction at two locations, the technically demanding and expensive FAP1 strategy was not implemented by BWDB. As an alternative, the BWDB developed and implemented lower cost “RCC-spurs” from the end of the 1990s until the mid-2000s. While these were initially successful, most of them spurs failed due to progressively increasing protrusion and river attack. After repeated failures, BWDB gradually abandoned spurs. From the early 2000s BWDB pilot-tested and implemented about 30 km of low-cost and more sustainable “long guiding revetment” based on earlier FAP1 and FAP21 technologies, over

a length of 17 km along the Jamuna right bank. Revetments have largely replaced all other options and are preferred as they have fewer impacts on the river and char ecology and provide better protection from the bank erosion.

## 4.3. Alternatives for Embankment and Road

BWDB is mandated to build roads on flood embankments, as a common practice globally for emergency access. The RMIP embankment road will be built with a higher than emergency standard, in order to provide regional and inter-regional connectivity. The following options were considered in the planning of the road:

- Option 1: Widening of existing embankment with local road on the crest.
- Option 2: Rehabilitated embankment with improved alignment on the floodplain at safe distance from the riverbank and a two-lane road with a provision for toll collection.
- Option 3: Rehabilitated embankment with improved alignment with separate four-lane highway as through road and adjacent local roads and bridges for crossing the highway.
- Option 4: Embankment on filled land in the river with separate four lane highway and local road connections similar to Option 3.

The phased implementation of Option 3 has been recommended after recognizing current and future development and communication needs, as well as the potential for developing the embankment into a tolled road in the future. The road will be developed in Phase III, with two lanes and level crossings initially, but, with the possibility to widen it after 20 years to a four-lane highway that is separated from the local road network.

## 4.4. Alternatives for Embankment Material

Construction of the embankment requires 12 million $m^3$ of earth fill. Two possible sources of embankment material are: (i) soil excavated from the floodplains and agriculture land and (ii) sand extraction from low lying sandbars in the river for the embankment core with a cladding outer layer. Option 1 was rejected due to the substantial impact on already scarce availability of cultivable land. The other option of sand extraction from the river will have some localized and temporary impact on the aquatic habitat during the dry season extraction period. The impacts can be minimized with improved sand extraction methodology and locating extraction points away from sensitive aquatic habitats. The amount of sand to be extracted from the river will be small compared to an annual sediment load of around 400 million $m^3$.The highly dynamic river morphology will replenish excavated sand during the following flood season and hence the impacts from any sand extraction will be temporary. Cladding material for embankment is usually extracted from the floodplain agricultural lands. However, for embankment rehabilitation this material will be borrowed from t old embankment parts that fall within the new alignment and topsoil from the abase of newly constructed embankment. The available amount is sufficient for all cladding work.

## 4.5. Alternatives for Resettlement Sites

The project requires resettlement of about 3,628 households. Based on recent experiences in Bangladesh with similar projects on embankment rehabilitation and Padma Bridge, four alternatives have been considered for planning of resettlement sites: (i) Alternative1: No Resettlement Site (RS). Affected households (HH) will be encouraged to relocate on their own with eligible compensation and assistance from the project and provision for additional incentives; (ii) Alternative 2: Large RS (for 300 to 500 HHs) to be development by the project; (iii) Alternative 3: Small Group (10 to 20 HHs) relocation by members of extended families; and (iv) Alternative 4: Small RS– within the same area with access to existing civic amenities. All alternatives, except for Alternative 2 (on development of large resettlement sites) will be followed up under RMIP-I.

# 5. Description of Environment

## 5.1. Physical Environment

**Definition of the study area or project influence area**: The influence area of the overall program considers areas that are likely to be directly or indirectly affected by the RMIP construction and operation activities. This includes but is not limited to what extent the project would impact floodplain areas, lateral fish migration, hydrology, road network, and the project footprints. The northern boundary is the confluence of the Teesta with the Jamuna and the southern boundary is the Jamuna Bridge approach road. The western boundary is the entire floodplain area that will be protected by the embankment (up to the Dhaka-Bogra-Rangpur highway) and the eastern boundary is the first major channel of the Jamuna, which is located about 1 to 2 km away from the current river bank.

**Physiography**: The physiography in this area is dominated by characteristics of the braided Jamuna River with meandering channels, chars (shoals) and alluvial floodplains. The Jamuna typically shows two to three channels per cross-section and a total width of 8 to 12 km. Chars are variable in time and space in terms of their geographic location. They survive through the constant interplay of erosion and accretion and only 25 percent of the chars of the Jamuna last more than 9 years. The flood plain areas extensively cultivated and also densely populated. Land use in the project influence area is covered 7 percent by the Jamuna, 41 percent by agriculture, 49 percent by settlements and 3 percent by chars (159 chars in September 2014).

**The Jamuna River**: The Jamuna river drains an area of almost 0.57 million $km^2$, nearly four times the area of Bangladesh. Its main stem and many tributaries flow through four countries: China, India, Bhutan and Bangladesh. The hydrograph of the river is strongly seasonal with a long low water season between October and May (dry or low flow season) and a high water season between June and September (monsoon or high flow season). This hydrology is driven primarily by summer snowmelt in the upper catchment and monsoon rainfall. The river usually peaks in July when the average maximum discharge is about 50,000 $m^3/s$. The mean annual flow of the Jamuna at Bahadurabad guage station was around 40,000$m^3/s$ during the period from 1965 to 2006. During the dry season, the discharge is less than 10,000$m^3/s$ and as low as 5,000$m^3/s$ in early March. During the monsoon season, the monthly discharge varies from 30,000 to 50,000$m^3/s$. The annual season of monsoon flows transports around one trillion cubic meters of water and more than half a billion tons of sediments from the southern Himalayan mountains to the delta and the Bay of Bengal.

**Climate**: The climate is sub-tropical, with three seasons namely summer/pre-monsoon from March to May, monsoon from June to September, and winter season from November to February. Maximum temperature occurs in the month of April (30ºC) and minimum temperature in January (21ºC). Average annual rainfall is around 1900 mm.

**Hydrology**: The major tributaries of the Jamuna in the project influence area are Bengali, Ichamati, Ghagot and Hurasagar. There are several small rivulets (known as *khals*) crisscross the floodplains. These *khals* are once connected with the Jamuna, but now the connectivity was lost after construction of BRE. *Beels* (the depressions in the floodplains) are the other major water bodies which receive flood waters from the rivers and monsoons.

**Inland Navigation**: The Jamuna is categorized as Class II by Bangladesh Inland Water Authority, which means the river remains navigable throughout the whole year and links major inland ports or places of economic importance to Class-I routes. The available average draft in the Jamuna is 1.75m across the river and recent surveys show that the minimum available water depth in the river from Sirajganj to Bahadurabad is 1m to 1.3m and from Bahadurabad to Chilmari is a 1.2 to 2.2 m during dry season.

**Geology**: The geology is dominated by quaternary sediments deposited by the Ganges-Padma and Brahmaputra-Jamuna-Teesta and their numerous tributaries and distributaries. The area is underlain by Tertiary and Quaternary sediments and recent alluvial deposits originating in the foothills of the Himalaya. The stratification of the sediments is generally composed of non-cohesive materials of sand

and silt with patched of cohesive deposit of clay. The surface soils are usually grey silt loams and silty clay loams.

**Seismicity**: According to Bangladesh National Building Code, the Project area is located in Zone 3, which corresponds to a maximum earthquake of 6.5 g magnitude (for 2500 years return period) and an intensity of VII to VIII on the Modified Mercalli Scale. According to this code, all the buildings in this zone are to be designed for a 4.3 g magnitude earthequake (2/3 of maximum earth quake). For design of embankments and bank protection works in RMIP-1, a conservative estimate of 5g magnitude has been adopted by the design consultant considering liquefaction and slope stability issues.

**Groundwater**: On the floodplains, groundwater is found at shallow depths (1.2 to 3.8 m) and used extensively for drinking purposes. From the water quality analysis of six hand pump operated tube wells in the project area, it is noticed that electrical conductivity of groundwater ranges from 207 to 840 µS/cm, and two wells have shown exceedances in iron (ranges from 0.2 to 3.17 mg/l) and manganese (ranges from 0.05 1.87 to mg/l) over national and WHO standards (0.3 mg/l for iron and 0.4 mg/l for manganese) probably because of the contamination from iron fixtures of the tube well. Though arsenic is not observed in the sampled water wells, high concentrations of arsenic is reported in some pockets of the floodplains and all the water wells in the project area that contain arsenic were identified and demarcated by the Department of Public Health Engineering. At some places, groundwater is also being used for irrigation.

**Surface water quality**: The water of the Jamuna is generally low in total dissolved solids, ranging from 48 mg/l in the wet season to 85 mg/l in dry season. However, the turbidity levels are very high.

**Air quality**: Ambient air quality in the influence area has shown exceedances in suspended particulate matter when compared to the national standards as well as the World Bank Group (WBG) EHS standards of ambient air quality. Concentrations of particulate matter are particularly high (ranging from 261 to 1,188 $\mu g/m^3$) exceeding ambient air quality standards of the WBG EHS (50 $\mu g/m^3$) and Bangladesh (200 $\mu g/m^3$).

**Noise quality**: Noise levels are generally within the national as well as WBG EHS standards. The night time noise levels were found in the range of 30 to 48 dB (national and WBG standards for residential areas are 35 and 45 dBA), and day time noise levels were found in the rage of 34 to 51 dB (national and WBG standards for residential areas are 45 and 55 dBA).

## 5.2. Biological Environment

**General Biodiversity**: According to the Integrated Biodiversity Assessment Tool, the project influence area falls in to IUCN's Freshwater Key Biodiversity Area and Bird Life International's Important Bird Area. About 17% of all the species recorded in Bangladesh occur in the project area. These include 367 species of flora, 25 species of mammals, 255 species of birds, 36 species of reptiles, 15 species of amphibians and 156 species of fish. Within the animal species, Ganges River Dolphin (Platanista gangetica) and Softshell Peacock Turtle (Nilssonia hurum) are the nationally endangered species located in the Jamuna river belt. Fishing Cat (Felis chaus) and Jungle Cat (Felis viverrina) are two nationally endangered mammals; and Yellow Monitor (Varanus flavescens) and Binocellate Cobra (Naja naja) are the two nationally endangered reptiles that are rarely seen in the floodplains of the Jamuna. Dolphin and fishing cat are globally endangered species, and peacock softshell turtle is globally vulnerable species. Of the fish species, 89 are commercially important and 53 are nationally threatened. Based on extensive stakeholder consultations and literature review, it is understood that the Gharials are not present in the Jamuna. There are two types of migratory fish species in the Jamuna, hilsa (Tenualosa ilisha) and major carps. Both species are commercially very important. Hilsa is an anadromous fish that lives in sea and migrates up the Padma and Jamuna, reportedly as far as India for breeding. Carps migrate from the Jamuna to the floodplains along with the floodwaters for spawning, but construction of the historic BRE has restricted this migration.

**Protected and sensitive areas:** There are no protected areas in the project's influence area; however, the Jamuna provides some excellent habitats for the Ganges River Dolphin and wintering grounds for many migratory birds. The two dolphin sanctuaries, Nagarbari-Mohanganj Wildlife Sanctuary (408 ha) and Shilonda-Nagdemra Wildlife Sanctuary (146 ha), declared in 2013, are located outside and downstream of the project's influence area. These sanctuaries were established to address ongoing threats on dolphin population such as (i) impact on habitat from increased boat traffic and dredging activities, (ii) accidental tangling in fish nets, and (iii) decline in fish prey. During filed investigations, 19 dolphins were in wet season of 2014 (September and October) and 45 dolphins were noticed in dry season of 2015 (February and March). Embayments on the downstream of chars (locally known as *koles*) offer breeding habitat to many fish species and are known areas of conservation significance. Eight *koles* are identified in the project area, however number and location changes over time with the natural morphological river changes.

**Terrestrial ecosystems**: The terrestrial ecosystem in the project's influence area is dynamic and is heavily influenced by the water flow of the Brahmaputra-Jamuna River System. It is dominated by agricultural landscape and homestead areas, but there are also large areas of *chars* that are mostly covered by sun grass, reeds and other natural vegetation. There is no riparian vegetation due to ongoing erosion of river banks. The terrestrial ecosystem supports about 25 mammal species including nationally threatened species such as Small Indian Mongoose, Golden Jackal, Jungle Cat and Fishing Cat. The habitat range of floodplain mammal species has been decreasing due to ongoing bank erosion. Trees around the agricultural fields and homesteads are dominated by exotic species such as eucalyptus and acacia.

**River and Floodplain Wetland Ecosystems**: The Jamuna and its tributaries provide habitat for numerous species of vertebrates and invertebrates. Most of those species are found throughout the Jamuna and also other rivers and floodplain systems in the country; for them the project influence area is not a critical biotope. The fresh water aquatic ecosystem of Jamuna River and its tributaries are the lifeline of the endangered dolphin and turtle. The chars act as nesting habitat of turtles. Connection between river and floodplain wetland are corridors for migratory fish (to and from breeding and nursing grounds). The Jamuna is also a corridor for migratory birds.

**River and Charland Ecosystem**: The young, vegetated charlands form a major habitat for the vertebrate fauna: mammals, birds, reptiles and amphibians. These areas are relatively free from noise and other disturbances, while the mixed vegetation and the large number of water bodies support a rich hunting, feeding and roosting habitat. A range of waterfowl, both local and migratory, are directly or ecologically dependent on charland ecosystems. Chars, especially their submerged extensions, act as reproduction area for many riverine fish and crustacean species. Aquatic reptiles (including endangered turtles) lay their eggs in the sandy beaches on the chars. Given the shortage of land in Bangladesh, stabilized charlands are quickly occupied by farmers and fishermen, profiting from the natural richness of these new and fertile lands.

**Bird Migration**: Huge congregations of migratory winter birds can be seen during November-March in the floodplains and chars of the Jamuna. Winter birds from the Himalayas, Central Asian highlands and faraway places like Siberia move to relatively warm swampy lands in Bangladesh including the project influence area to escape the freezing cold, and feed on various animal and plant food that are abundant in the mudflats, sandflats, rice fields and other areas. Usually, migratory water birds fly in the north-south direction. Birds start arriving from early November and stay till March-April. An estimated 500,000 birds of about 150 species (mainly ducks, waders and warblers) travel to Bangladesh each winter. A total of 84 migratory bird species and 139 resident bird species were recorded during dry season survey of February – March of 2015, The common migratory birds noticed were Ruddy Shelduck (Tadorna ferruginea), Northern Pintail (Anas acuta), Gadwall (Anas strepera), Common Sandpiper (Actitis hypoleucos), Wood Sandpiper (Tringa glareola), and Little Stint (Calidris minuta). Three threatened migratory birds are recorded. Greater Spotted Eagle (Aquila clanga) and Painted Stork (Mycteria leucocephala) are vulnerable species and Eurasian Curlew (Numenius arquata) is near threatened species recorded in the project area. Fifteen chars have been identified as important

habitats for both migratory and resident birds, of which eight chars are located in the project area. The major threats to migratory birds are habitat degradation, collection of eggs for food and hunting, and human disturbances. Due to continued human population growth, these threats are very prominent.

**Fish**: The Jamuna is an important source of fresh water fish in Bangladesh. In a braided river like the Jamuna, fish favorable environment generally exists around the stable river banks, braided channels, deep channels, near shallow chars and embayment in the chars (*koles*). While in the floodplains the beels and khals are major fish habitats.

**Fish Migration**: Carps migrate from the Jamuna to the inundated floodplains adjacent to the river channel during the late dry season or early rainy season in order to spawn in the nutrient-rich waters. The eggs and larvae of these species drift downstream and enter the floodplain with the floodwater, where they feed on the developed plankton. At the end of the rainy season, the adults and young migrate to the main river channel in order to avoid the harsh conditions of the floodplain during the dry season. Spawning migration starts in May, with the onset of the southwest monsoon, and continues until the end of July; juvenile fish migrate back to the Jamuna coinciding with the receding of water in October. Connecting *khals* between the Jamuna and other water bodies are vital for sustaining successful fish migration at different seasons. The migratory requirements of the carps in key physical terms are: (i) velocity from 0.3 to 1.2 m/s and (ii) depth from 1 to 3 m. Currently the fish migratory routes are blocked by the impervious embankment line, which resulted in great loss of floodplain and river fisheries and the livelihood of fishermen. Four potential migratory routes that can be restored were identified during field studies in the priority reach.

**Fisheries**: Both capture and culture fisheries types exist in the project influence area. Annual total fish production in the project area has been estimated at about 8,500 t. The river contributes the largest share of this production followed by floodplains, *beels* and *koles*. Fish production from *khals* is insignificant as most of those are either dried up during the peak dry season or remain closed by flood control structures. The fish production of the Jamuna has declined by about 3,200 t in the last 30 years, primarily because of increased fishing pressure and a decrease in the floodplain habitats caused by the construction of flood control, drainage and irrigation systems, and the consequent obstruction of movement by fry and fingerlings from rivers. More than 3,500 fishermen were identified during the catch assessment survey along the right bank. Fishing is one of the few available livelihood opportunities for most of the landless people of the project influence area.

## 5.3. Social and Economic Environment

**Demography**: The RMIP protects parts of three districts and 21 upazilas (sub-districts) of which 12 are affected by flood and riverbank erosion and 9 by flooding alone. The project area belongs to four upazilas namely, Kazipur, Sirajganj Sadar, Sariakandi and Dhunat. The total population of all upazilas in the program area is 3.8 million and the project area is 1.1 million. The average population density of the program upazilas (1,382 personskm$^2$) is above the Bangladesh average of 1,200 persons/km$^2$. Average household size is about 4.

**Income and Occupation:** Based on socio-economic surveys of 3,310 households in the program area, nearly half of all households have an income below the Bangladesh poverty line of 6,367 BDT (about 80 USD) per month. Majority of households (HHs) make their income through day labour, mostly in agriculture (896 HHs or 972 persons) or construction (658 HHs or 722 persons), work their own land (644 HHs or 697 persons) or work in transport (474 HHs or 498 persons). Only very few households depend directly on farming from land along the river as a source of income as most of them lost their land to the river. Unemployment is a real problem for these communities, especially for women and young people. The average monthly incomes for most common occupations are as follows: (i) agricultural worker BDT 5,149, (ii) construction worker BDT 5,802 (iii) agriculture landowner BDT 6,362 and (iv) transportation BDT 5,992. A total of 1,342 persons receive currently some type of social support, mostly a stipend or allowance for the elderly.

**Education:** The overall education level is low. Fifty percent of the surveyed households reported to be illiterate, while 24% have only primary level of education. Female functional literacy is only about 35%

against national level women literacy level of 49%. Male functional literacy is 41% compared to and 54% nationally. These imply that despite having schools, many children, particularly boys need to work to support their family and girls get married off early.

**Health Services**: Most households (about 45%) consult a pharmacy for common diseases, which are in reality medicine shops in the informal sector found at any bazar. About 20% seek help at the Health and Family Planning Center or the upazila health complex (14%). Absenteeism of doctors and lack of doctors and facilities are common problems in the public health sector. The journey to the nearest district hospital that can manage more severe cases and illnesses becomes often a challenge for these communities who lack resources for transportation and need to rely on a debilitating road system.

**Agriculture**: The floodplain areas are traditionally fertile land with fine-grained alluvium deposits, but their productivity is limited due to the depth of flood water during the monsoon. Before construction of BRE in the 1960s the traditional crops were broadcast deep-water *aman*[3] rice (low yield potential 1.5 – 2 t/ha during productive years), *aus* rice (also with low yield) and local *aman* rice that was mostly vulnerable to flood damage. Some other crops like grass pea, corn, gram pulse, chili, and sugarcane were the crops in the dry season. The farmers were very poor and under threat of migration from their locality due to lack of livelihood support. After construction of the embankment the scenario of crops and livelihoods started to change. The floodplain areas became productive and started to produce good local *aman* rice (reducing the areas of broadcast deep-water *aman*). Dry land crops like vegetables and oilseeds started to occupy the areas of corn/gram pulse and sugarcane. At present the farmers are mostly cultivating High Yielding Varieties (HYV) of Transplanted *Aman* and HYV *Boro* rice instead of local low yield varieties, Aus being almost wiped out from the area. The yield of rice has increased from 1.5 – 2.0 t/ha to 3.5 – 6.0 t/ha. Similarly the production per unit area of other popular crops increased. Farmers use large amount of chemical fertilizers as of other areas of the country. The rate of fertilizer use per ha generally varies from farm to farm based on fertility status of plot and financial state of the producers. The major chemical fertilizers used in the area are Urea, TSP, MoP and Gypsum. Urea is widely used for *boro* rice, potato, maize, jute and other crops. The use of pesticides depends on the degree of pest infestation.

[3] Three types of rice are grown in the country: Aus rice either transplanted or broadcast cultivated in pre-monsoon period (Mar to June); Aman rice either transplanted or broadcast in monsoon period (July to October); and Boro rice cultivated in dry/winter season (November to February).

# 6. Climate Change Considerations

**Climate change scenario of Bangladesh**: Climate change may result in increased rainfall intensities, rise of future sea levels, higher temperatures and higher wind speeds. These changes may consequently result in increases in flood volumes, river water levels and velocities, which are all factors that may affect the design of RMIP. Climate change projections for Bangladesh were available through studies carried out at regional scale by IPCC (2007), IWM (2008) and BSM (2014). However there are a lot of uncertainties associated with these projections, Estimations of river flows from these projections using simplified assumptions will further add to the overall uncertainty. Nonetheless, the key predictions associated with the worst case climate projections scenario are summarized below and have been taken into consideration when designing the project.

**Temperature and rainfall projections**: Maximum, mean and minimum temperatures are projected to rise between 2° and 4° C by the year 2100. The monsoon rainfall is predicted to increase by 5 percent in 2039 and by 13 percent in 2069.

**Future sea level rise**: Sea level rise in the Bay of Bengal is the combined effect of global sea level rise, local changes in sea level due to ocean density and circulation changes and possible subsidence or uplift of the delta. However, even in the high-end, low-probability scenario of sea level rise to 2100, the effect would not expect to reach up to RMIP site, which is located about 400 km inland.

**Wind forces**: Cyclone intensities may increase by 10 to 20%. Wind forces can increase to 110 km/h and during cyclones even up to 126 km/hr. This may have the effect of increasing wave run-up during storm events.

**Flood volumes and river water levels**: Based on flood frequency analysis of historical flows of Jamuna at Bahadurabad, the design discharge for RMIP, a flood event of 100 year return period, is estimated at 109,000 $m^3/s$. Due to climate change peak discharges at Bahadurabad are expected to increase between 6 and 16 percent. Due to climate change, the flood discharge of 100 year return period would increase to between 116,000 $m^3/s$ and 126,000 $m^3/s$. This translates into an increase between 0.2 to 0.3 m in river water levels for a 6 percent increase flood volumes, and between 0.3 to 0.4 m for a 16 percent increase in flood volumes. Higher volumes of water and increased discharge due to climate related changes would also effect bank erosion and bed scouring.

**Climate change adaptation in RMIP design**: A 100-year flood discharge is generally adopted in Bangladesh for design of major flood embankments and river training works. A 6 percent increase in this 100-year flood is proposed for the design of RMIP to accommodate climate change. The design water level for the embankments is proposed to increase by 0.5 m, and a further 1 m of freeboard is recommended to allow for more severe flood events, uncertainties in future hydrologic and morphological changes and wave run-up. Hence a total addition of 1.5 m is recommended to the current 100-year water level. The following climate change adjustments are also proposed for the following design parameters:

- **Scour depth**: The scour depth is calculated to be 33 m for guiding revetments, based on the augmented design flow accounting for climate change.
- **Design velocity**: The augmented design velocity for guiding revetments based on increased flows due to climate change, is calculated to be 3.4 m/s.
- **Hydraulic Structures**: The impact of climate change on regulators and other hydraulic structures including road works has been allowed for in their design assuming a 6% increase in design flows.

# 7. Potential Impacts and Mitigation Measures

## 7.1. General

The RMIP, in part, can be considered as an environmental improvement project since it will (i) address ongoing erosion and flooding problems and their impacts on floodplain ecology (ii) protect about 3.8 million people living on some 300,000 ha of floodplains from inundation resulting from extreme flood events, (iii) protect the river bank from further erosion, which otherwise will erode annually about 200 ha of floodplain land, and (iv) bring significant positive effects for the people and economy of one of the most poverty stricken areas of the country. The existing BRE has acted as a barrier disconnecting the Jamuna from its floodplains since the 1960s. This has resulted in a great loss of floodplain fisheries and thus, loss of livelihood of fishermen. The RMIP will address these historical impacts associated with the BRE by (i) restoring fish migratory routes from the Jamuna to floodplains through building of fish passes, (ii) restoring hydrological connectivity between the Jamuna and floodplains through regulators, and (iii) restoring losses in floodplain fisheries through a comprehensive fisheries development program. The negative impacts associated with the implementation of RMIP will mostly result from the construction activities.

## 7.2. Impact Assessment Methodology

Potential environmental and social impacts were identified through review of feasibility study reports, field visits and stakeholder consultations. The significance of potential impacts was assessed using the following criteria:

**Impact Magnitude**: The potential impacts of the project have been categorized as major, moderate, minor or negligible on the basis of parameters such as: (a) duration of the impact; (b) spatial extent of the impact; (c) reversibility; (d) likelihood; and (e) legal standards and established professional criteria.

**Sensitivity of Receptor**: The sensitivity of a receptor has been determined based on review of the population (including proximity/numbers/vulnerability) and presence of features on the site or the surrounding area. Each detailed assessment has defined sensitivity in relation to the topic.

**Assigning Significance**: Following the assessment of magnitude, the quality and sensitivity of the receiving environment or potential receptor has been determined and the significance of each potential impact established using the impact significance matrix shown in Table 4.

**Table 4: Significance of Impact Criteria**

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

## 7.3. Summary of Assessed Impacts

The project's potential impacts and their significance have been assessed using the methodology described in Section 7.2 above. A summary of these impacts and their significance is presented in Table 5.

**Table 5: Potential impacts and their significance**

| Impact from various activities | Magnitude | Sensitivity | Significance Prior to Mitigation | Residual Significance |
|---|---|---|---|---|
| **Impacts related to Project siting** | | | | |
| Control of Riverbank Erosion | Major | - | High positive | High positive |
| Improved flood protection | Major | - | High positive | High positive |
| Land cover and land use changes | Major | Mild | Moderate negative | Low negative |
| Loss of natural vegetation and trees | Major | Mild | Moderate negative | Low negative |
| Loss of riverbank/aquatic habitat | Medium | Mild | Moderate negative | Low negative |
| Loss of flood plain habitat | Major | Severe | High negative | Low negative |
| Drainage congestion and water logging | Medium | Mild | Moderate negative | Low negative |
| Land acquisition and resettlement | Major | Severe | High negative | Low to moderate negative |
| Loss of agriculture | Major | Severe | High negative | Low to moderate negative |
| Impacts on Community Facilities and Places of Religious Significance | Major | Severe | High negative | Low to moderate negative |
| Blocked access because of road and embankment | Major | Mild | Moderate negative | Low negative |
| **Environment impacts during construction phase** | | | | |
| Impacts of borrowing of material (sand extraction) | Major | Severe | High negative | Low negative |
| Air pollution | Medium | Mild | Moderate negative | Low negative |
| Noise | Medium | Mild | Moderate negative | Low negative |
| Water pollution | Major | Severe | High negative | Low negative |
| Soil contamination | Major | Severe | High negative | Low negative |
| Solid wastes and hazardous wastes | Major | Severe | High negative | Low negative |
| Impacts on aquatic habitat | Major | Severe | High negative | Low to moderate negative |
| Impacts on floodplain habitat | Major | Severe | High negative | Low negative |
| Impacts on *charland* habitat | Minor | Low | Minimal | Minimal |
| Site clearance and restoration | Medium | Severe | Moderate negative | Low negative |
| **Social impacts during construction phase** | | | | |
| Impacts on cultural heritage | Medium | Mild | Moderate negative | Low negative |
| Impacts on community facilities | Medium | Mild | Moderate | Low negative |

| Impact from various activities | Magnitude | Sensitivity | Significance Prior to Mitigation | Residual Significance |
|---|---|---|---|---|
| | | | negative | |
| Occupational health and safety | Major | Severe | High negative | Low to moderate negative |
| Community health and safety | Major | Severe | High negative | Low to moderate negative |
| **impacts during O&M** | | | | |
| Changes in river morphology and chars | Nominal | Severe | Minimal Negative | Minimal negative |
| Generation of solid waste | Major | Severe | High negative | Low negative |
| Air pollution | Medium | Mild | Moderate negative | Low negative |
| Noise generation | Medium | Mild | Moderate negative | Low negative |
| Water pollution | Medium | Mild | Moderate negative | Low negative |
| Community health and safety | Major | Severe | High negative | Low to moderate negative |
| Risk of embankment breaches | Major | Very Severe | Critical | Low to moderate negative |

## 7.4. Environmental impacts from Project Siting

**Control of River Bank Erosion**: During the last four to five decades, the Jamuna has been undergoing strong changes in width, bank erosion, and braiding intensities. Riverbank erosion not only leads to loss of land, but also attacks on the already dilapidated embankment. This causes 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. The revetment works envisaged under the proposed RMIP will help avoid the losses described above and will result in savings of about US $ 17.33 million per year – the annual losses that are likely to take place caused by riverbank erosion if no protective measures are undertaken.

**Improved Flood Protection**: Originally, the BRE had a setback distance of about 1.5 km from the riverbank of the Jamuna. Over the years the embankment has been increasingly under attack from bank erosion causing the embankment to breach at several locations. After such breaches of the embankment, it needed to be retired into the floodplain away from its original alignment and reconstructed. The rehabilitation of the embankment will greatly improve the effectiveness of this structure against floods. In addition, the squatters will be relocated from the embankment (in accordance with the Resettlement Action Plan) 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 increasing the protection of the area from floods and associated losses.

**Land Cover and Land use Changes**: Currently about 7,000 ha of *aman* crop is being damaged annually due to breaching of BRE. Improved flood protection from RMIP may result in improved cropping patterns with increasing trend of high value crops. Based upon changed cropping pattern and increased yields, there will be an increase in the agricultural income from the project influence area. It is estimated that there will be a net increase in agriculture income of more than BDT 2 billion (USD 25 million) per year from the project influence area. While the increased agricultural income will positively impact the livelihood of local farmers, the changes in cropping pattern will potentially cause

an increased use of agro-chemicals. The increased use of agro-chemical can potentially cause an enhanced level of soil and water contamination and pose health hazards for the farm workers and also for the nearby communities. An integrated pest management plan will be prepared by the RMIP during project implementation. This plan will identify integrated pest management programs (IPM) that are already under implementation in Bangladesh and facilitate linkage with these programs, as well as provide additional measures as needed to address any increase usage of agro-chemicals in the area.

**Loss of natural vegetation and trees:** About 170,000 trees will be cut during site preparation works. Most of the tree species comprises timber (e.g. eucalyptus and acacia) and horticultural species (e.g. mango, jackfruit). Except for the economic value of eucalyptus and acacia, these species have no significant benefit for the ecosystem. A compensatory tree plantation will be carried out along the slopes of embankment. About 140 ha of land is available for this purpose. A limited number of tree species have been proposed for the compensatory plantation in view of the ease of management and in accordance with the WB OP 4.36. About 2,500 trees (1,875 timber and 625 fruit species) will be planted per hectare; hence a total of about 350,000 trees will be planted along the embankment slopes and managed through social forestry. The plant species are selected based on top soil requirements, the root depths and embankment protection.

**Loss of Riverbank/Aquatic Habitat**: Revetment works may potentially impact about 102 ha of riverbank area, which serves as an aquatic habitat during high flow season. However, this part of the aquatic habitat was once an eroded floodplain habitat. After construction of the revetment, the geobags create a suitable fish habitat as phytoplankton grows on their surface. Hence the revetment will not result in any net loss of aquatic habitat. However, a habitat monitoring will be initiated during the construction phase and will be continued thereafter to fully understand the impact of revetment on the aquatic habitat, and propose adaptive management measures as required. In addition, a biodiversity conservation program will be developed and implemented targeting sensitive aquatic habitats and other areas of important habitat for key species.

**Loss of Floodplain Habitat**: The embankment works (including resettlement sites) will affect about 340 ha of terrestrial habitat, however most of this area is completely modified and is currently either under cultivation or included in built-up area (homesteads or other physical infrastructure). The BRE has acted as a barrier, causing changes in the natural ecosystems of floodplain resulting in great loss of biodiversity and natural resources as well as livelihood opportunities for the communities. Four areas within the project area have been identified where re-establishing of ecological connectivity will help to restore the biodiversity of the area, particularly facilitating fish migration. Re-excavation of *khals* and *beels* will be carried out with community participation to further enhance the fish habitat in the floodplains. User committees will be formed and trained to maintain the fish passes. The potential increase in fish production after completion of the project is estimated to be about 1,880 t per year.

**Drainage Congestion and Water Logging**: Some regulators were constructed across the original BRE to facilitate irrigation and drainage, however many have either been blocked or do not function properly. As a result some cultivated lands particularly near Baliaghuri in Sirajganj are facing drainage congestion and water-logging problems. In the absence of mitigation, similar impacts would be expected due to the proposed project works. Similarly, there is a possibility of water-logging and drainage congestion between the old embankment and the new one to be constructed under RMIP. Storm water drainage facilities are included in the design of embankments and resettlement sites, and culverts will be constructed through the old embankment to ensure proper drainage.

## 7.5. Social impacts from Project Siting

**Land Acquisition and Resettlement**: A summary of land acquisition and resettlements impacts of RMP-I is given in Table 6. The project will acquire 370 ha of land and physically displace 3,628 households (15,558 people) of which 3,480 are residential households, 148 are business units, and 84 are residence-cum business. In addition 2,045 households will suffer from economic displacement due to loss of agricultural land (1437 HH), trees (591 HH) fish ponds (11 HH) and water wells (6 HH). The project will also affect 78 common properties such as mosques. Overall, the project will affect 5,751

households and 23,584 people (male 9,253 and female 8,982). Out of the 370 ha affected land, 74% is agriculture land, 17% is homestead land and the rest is bamboo groves and orchards. The loss of land and structures will be compensated by replacement value based on current market prices and standing crops. Other resettlement benefits associated with structure, trees, business, wage, share cropping, crops, fish stock, etc. will also be paid. Vulnerable and female-headed households will receive special assistance. People in the Project area, especially project-affected people, will be eligible for provisions under social development programs such as Income and Livelihood Restoration Plan, Gender Action Plan and Public Health Action Plan.

**Table 6: Summary of Resettlement Impacts**

| Impacts/Types of losses | | Sirajganj | | Bogra | | Total |
|---|---|---|---|---|---|---|
| | | Sirajganj Sadar | Kazipur | Dhunat | Sariakandi | |
| **A.** | **Alignment Length and Required Land Acquisition** | | | | | |
| 1. | Total length of alignment/km | 5.595 | 13.276 | 7.895 | 22.759 | **49.525** |
| **2.** | Required Land acquisition in ha including resettlement site (50 ha) | 40.23 | 94.67 | 57.04 | 178.03 | **370** |
| **B.** | **Number of physically displaced HHs requiring relocation**[4] | | | | | **3,628** |
| 1. | Affected Residential HHs only | 164 | 812 | 424 | 856 | 2,256 |
| 2. | Affected Business HHs only | 04 | 60 | 29 | 55 | 148 |
| 3. | Affected Residential & Business HHs only | 04 | 39 | 03 | 38 | 84 |
| 4. | Affected Residential & Agricultural land only | 00 | 02 | 02 | 15 | 19 |
| 5. | Affected Residential Structure & Land other than Agricultural | 93 | 212 | 259 | 557 | 1121 |
| B.1. | Number of person required relocation | 1,264 | 5,006 | 3,116 | 6,172 | **15,558** |
| B.2 | Average HH Size | 4.75 | 4.45 | 4.34 | 4.03 | 4.28 |
| **C.** | **Number of Affected units loosing other assets** | | | | | 891 |
| 1. | Affected CPRs | 7 | 9 | 18 | 44 | **78** |
| 2. | Affected sallow tube-well | 0 | 01 | 03 | 02 | **06** |
| 3. | Only trees affected HHs | 62 | 156 | 95 | 278 | **591** |
| 4. | Affected Fish Pond only | 01 | 00 | 01 | 09 | 11 |
| **D.** | **Affected HHs loosing agricultural plots only** | | | | | |
| D.1. | Number of HH's losing agricultural plots[5] | 171 | 369 | 648 | 249 | **1,437** |
| D.2. | Affected population due to loss of agricultural land | 953 | 2,189 | 3,386 | 1,498 | 8,026 |
| D.3. | Average HHs size | 5.57 | 5.93 | 5.22 | 6.08 | 5.70 |
| **E.** | **Additional data by categories (already embedded in A,B,C& D)** | | | | | |
| 1. | Number of total affected HHs (B+C+D.1) | 437 | 1,494 | 1,366 | 1,779 | **5,751** |
| 2. | Number of affected population(B.1+C+D.2) | 2,492 | 7,926 | 6,648 | 9,234 | **23,584** |
| 3. | Total no. of trees on private land | 14341 | 37719 | 31376 | 53504 | 136,940 |
| 4. | No of trees affected on government land | 475 | 12971 | 5924 | 14650 | 34,020 |
| 5. | Number of wage labourer affected | 27 | 57 | 75 | 77 | 128 |
| **E.1.** | **Total number of Vulnerable HHs** | | | | | **2,762** |
| 1. | Female Headed HH | 34 | 170 | 80 | 182 | 466 |
| 2. | Poor HH | 90 | 316 | 247 | 650 | 1,303 |
| 3. | Land Less HH | 57 | 337 | 148 | 231 | 773 |
| 4. | Elderly headed HH | 17 | 45 | 51 | 74 | 187 |
| 5. | Disabled HH | 2 | 12 | 3 | 16 | 33 |
| F | Severely Affected Households | | | | | |
| 1. | HH Losing >10% of their income due to loss of productive lands | 12 | 58 | 19 | 111 | 200 |

[4] Refers to affected HHs and Businesses to be relocated
[5] No relocation required

Resettlement Sites. Nearly 40% of the displaced households are willing to relocate to the resettlement sites. The project will provide 15 resettlement sites with a provision to relocate 1870 households with all basic infrastructure facilities such as water supply, sanitation, access roads and internal roads, drains, mosques, and schools. The resettlement site planning includes around 10% contingency space knowing that during the process more people opt for the resettlement villages. Cash compensation will be provided for households who opt for self-relocation and provisions are made in RAP budget for augmenting civil amenities in host villages. The resettlement sites were selected in consultation with the affected communities in such a way that they are close to their original location of residence and not located in any environmentally sensitive areas. In addition, a series of due diligence measures are taken while designing of the resettlement sites for the safety of the relocated people. These include: (i) resettlement sites are located minimum 100 m away from the protected riverbanks (similar to 100 m minimum setback distance adopted between bank protection works and embankments to avoid impacts from localized bank protection failures); (ii) immediate river bank protection works will be carried out before developing the resettlement sites (and is part of the resettlement village construction contract) to prevent them to be exposed to the risk of bank erosion; (iii) the resettlement sites will be raised to a 100 year a flood level (including climate change allocation) and properly compacted, and (iv) slopes of the resettlement sites that are exposed to flood waves will be protected with concrete blocks against wave erosion similar to the main embankment.

**Loss of Agriculture and Other Sources of Income:** The project interventions in the priority reach are likely to affect 276 ha of agricultural land and a total of 232 business structures. About 94% percent of the agricultural plot owners will lose less than 10% of their income due to loss of agricultural land. Due to linear type acquisition process, 92% land owners are losing land partially and 98% will be losing land less than 50 decimal of land (0.2ha. Therefore, project impact over land is moderate. The major impact on livelihood will be mostly from relocation of 148 shops/kiosks – about 95% of them are on the current embankment. Livelihood and restoration programs including skill development are proposed in RAP. Once the Program is completed with bank protection works, a reconstructed embankment, and a road on the country side, it will bring stability and renewed confidence for investment in the region and also promote much-needed access to local and national markets. The Project thus has a great potential to break the cycle of poverty and improve life and livelihoods in the area.

**Impacts on Community Facilities and Places of Religious Significance:** The project interventions will affect a total of 78 common community facilities which include religious facilities like mosques and graveyards (however none of these facilities require any special protections warranting a PCR management plan as per the OP 4.11). The affected common property resources are 20 mosques, 7 madrasahs, 4 temples, one church, 5 graveyards, 6 *eidgahs* 21 schools, 9 government offices and 5 health centers. About 95% schools and mosques are temporary structures and can be easily dismantled and re-established. Due to endemic erosion, these structures were shifted 2 to 8 times in the last 35 years. The project will reconstruct the affected facilities in complete coordination and participation of the relevant community and in a culturally and socially acceptable manner. The graveyards will be shifted to nearby locations with community participation.

**Barrier/Severance Effect:** The embankment will act as a barrier for the movement of the people between the country side and river side. Twelve local crossings (ramp cum stairs) to facilitate the movement of people, livestock and non-motorized vehicles and 9 vehicular crossings are included on the embankment. Riverbank revetment may also potentially block access of the people to the river since slope of the concrete blocks can potentially make it difficult for the people and livestock to cross it. Stairs and ramps will be built on the bank protection works to access the river.

## 7.6. Significant Environmental Impacts during Construction

**Impacts from Borrow Areas/Sand Extraction:** For the entire works under Phase I, about 23 million $m^3$ of sand (about 4.6 million $m^3$ of sand annually) would be needed over a period of 5 years for construction of the embankment (12 million $m^3$) and filling of geo-bags for riverbank protection (11million $m^3$). The Jamuna carries about 600 million tonnes or 400 million $m^3$ of sediment load

annually of which only 1.2% of the sediment load will be used annually for the proposed sand extraction. The sand extraction areas will rapidly be covered with fresh sediments hence minimizing any long lasting impacts. However, during the construction phase, the sand extraction may cause negative impacts on the habitat of dolphins and fish due to (i) generation of high sediment flows, (ii) disturbance of benthic habitat, (iii) noise from construction machinery, and (iv) accidental spillage of fuels and bilge water from construction boats. Sand extraction from the river, through small suction pumps, will be carried out in an environmentally and ecologically safe manner: only small quantities will be collected from any single location and intermediate stretches will be left undisturbed (the stretch of extraction will not exceed 100 m at a single location and there will be a gap of minimum 50m between two extraction sites). Sand extraction will not be permitted near sensitive habitats and sediment barriers will be provided around the extraction areas. To address accidental spillage of fuels and bilge water, the contractor will be required to take utmost care to prevent spillage and will prepare an emergency preparedness plan. The contractor will make booms, absorbents and skimmers available on site along with trained personnel to recover spilled oil from the water surface. No earth will be taken from any cultivated fields.

**Air Pollution and Greenhouse Gas Emission from Construction Works**: It is estimated that about 19,000 t of $CO_2$ will be emitted during the entire construction period from all the construction activities. These emissions could deteriorate the ambient air quality and affect public health, densely populated areas and crowded markets being also particularly vulnerable. Dust generated from these activities could also impact crops and livestock. Dust generation will be restricted as much as possible and water sprinkling carried out as appropriate, especially where earthmoving, and excavation are carried out. Emissions from construction equipment and traffic will comply with World Bank EHS guidelines and will be monitored.

**Noise Pollution from Construction Works**: Noise levels produced by vehicles, machinery, concrete mixing, and other construction activities will exceed the applicable standards. Noise control measures will be implemented near sensitive sites like schools, religious places and markets, and noise levels will be monitored.

**Water Pollution:** During the construction phase, sand extraction and launching of geo-bags along the riverbank may cause local increase in water turbidity, but this increase unlikely to have a significant impact on overall water quality and aquatic fauna primarily because of its temporary and localized nature. Construction camps, offices and warehouses will generate substantial quantities of waste water, estimated about 75,000 liters per day. Other possible causes of land or water contamination include accidental leakage or spillage of fuels, oils, and other chemicals, and waste effluents from workshops and washing bays. All such discharges to the river will be treated to comply with relevant standards before release.

**Soil Contamination**: Soils in the construction area and nearby agricultural lands will be prone to pollution from construction activities and facilities. Storage sites for fuel and hazardous materials and their handling are also potential sources for soil and water pollution. Contractors will be responsible to prepare and implement a waste and pollution management plan. For effluents to be discharged from workshops, camps, and offices, treatment arrangements such as retention ponds and septic tanks will be incorporated in the facility designs. Filling up of the embankments and resettlement sites with river sand will be carried out in small blocks of compartments to allow sediments to settle first and to drain out the clear water. The excavated soils from the khals will be used by the communities to fill up their homestead lands. Generally there is a huge demand of excavated soils for this purpose and hence the communities will be allowed to use this soil.

**Generation of Solid Waste and Hazardous Waste:** It is estimated that about 150 kg of domestic solid wastes will be generated daily from the construction camps and offices. Most of this waste will be bio-degradable. Small quantities of hazardous waste will also be generated from the vehicle maintenance. It is imperative that such waste is responsibly disposed of. Contractors will be required to prepare and implement a Waste and Pollution Management Plan in accordance with the WB EHS Guidelines and environmental codes of practices (ECoPs).

**Impact on Aquatic and Floodplain Habitats**: Sand extraction from the riverbank, launching of geo-bags, and placement of concrete blocks for the river revetment may affect the aquatic habitat by increasing water turbidity. Embankment construction per se is not considered likely to have any direct impact on terrestrial or aquatic wildlife or their habitats since no sensitive ecological hot spots have been identified. However accidental leakage and spillage of contaminants, or dumping of solid waste/debris may affect these habitats. Potential impacts on aquatic fauna can be addressed by not operating along long sections of river bank at one time, as mentioned earlier. Discharges from batching plants, construction yards and construction camps will be contained, and. any discharges to the river will be treated to comply with national standards. Construction-related boat movement will be restricted to within 500 m of river banks to reduce their impact on river dolphins, and boat speeds will be limited to 15 km/h. Pingers will be used to chase dolphins form construction areas.

**Impact on Charland Habitat:** Construction activities are not likely to affect wintering birds that are mainly found on chars (shoals) spread across the river channels. Contractors will be required to use mufflers or acoustic enclosures for equipment, and to ensure that their workers refrain from as disturbance and poaching. To mitigate light pollution on the birds, contractors will be required to use lower wattage flat lens fixtures that direct light down and reduce glare, and avoid use of floodlights. In addition, a biodiversity conservation program will be developed and implemented targeting important chars.

**Site clearance and Restoration**: After completion of the construction, contractors will be required to remove all left over construction material, debris, spoil, and other wastes. Camps sites will be completely cleaned and restored in original condition to the extent possible. No waste will be disposed of out in khals, beels and ponds.

## 7.7. Significant Social Impacts during Construction

**Impact on Cultural Heritage**: Many of religious structures will have to be relocated because of the rehabilitation of the embankment. The contractors will be required to prepare code of conduct to be followed by all site personnel - to respect religious beliefs and sites, and to conduct in a culturally appropriate manner. In addition, 'chance find' procedures will be followed in case of accidental discovery of any sites or artifacts of religious, historical, or cultural importance.

**Impact on Community Facilities**: A few schools and other community facilities exist along the embankment. The potential impacts of the project on these schools could include relocation, air quality deterioration, noise, and safety hazards. The construction activities can potentially damage the existing public and private infrastructures such as local roads, foot paths, and boat jetties. For noise, air quality, and safety hazard, the contractors will be required to ensure that activities in the vicinity of the sensitive receptors such as schools are carried out in a manner so as to minimize these risks (e.g., carrying out the construction activities after the school time). The construction site will be fenced near such places to minimize safety hazards. Safety signage will be placed and coordination will be maintained with the facility management as well as with the community to minimize the risks. Finally, any complaints of related to project impacts on the sensitive receptors will be addressed through a grievance redress mechanism.

**Blockage of Local Roads/Routes/Jetties and Traffic Congestion**: Construction activities for riverbank protection may potentially block/hinder access to boat jetties and also hinder the boat traffic. Similarly, construction works on the embankment may block local roads and routes and may prevent the local people to cross the construction area. Furthermore, the construction works and associated vehicular traffic may cause traffic congestion on local roads, particularly near local markets and boat jetties. The contractor will prepare and implement a traffic management plan (for both vehicular as well as boat traffic). Consultations with the local communities will be carried out on an on-going basis and the construction schedule will be discussed with them to ensure that blockage of the local routes is minimized.

**Occupational Health and Safety**: Construction activities may pose health and safety hazards to the workers at site during use of hazardous substances, lifting and handling of heavy equipment,

operating machinery and electrical equipment, working near water or at height and more Inappropriate handling or accidental spillage/leakage of these substances can potentially lead to safety and health hazards for the construction workers as well as the local community. The contractor will prepare and implement Health, Safety and Environment (HSE) plan in compliance with WB EHS guidelines and ECOPs.

**Community Health and Safety**: During the construction phase, the population living in close proximity to the construction area, the construction workforce and individuals drawn to the area in search of income opportunities will all be exposed to a number of temporary risks such as safety hazards associated with the construction activities and vehicular movement, exposure to dust, noise, pollution, infectious disease, and various hazards, including potential conflict with "outsiders" to the project influence area about employment and income. The influx and accommodation of a large work force will result in increased concerns for the health and safety of local population, including the spreading of sexually transmitted diseases such as HIV/AIDS. Contractor's HSE plan will also include measures and protocols to protect the nearby community against the risk of accidents and mishaps. In addition, the EHS will also include emergency response procedures to be followed in case any accident does take place. Water supply wells to be established in resettlement sites and construction camps will be drawn from deeper aquifers (minimum 30 m depth) and will be ensured for compliance with national drinking water quality standards.

## 7.8. Environmental Impacts during Operation and Maintenance

**Potential Impacts in River Morphology and Chars**: Long guiding revetments do not deflect near-bank channels into the middle of the river and so do not affect the adjacent chars. They tend to produce slightly deeper and more stable channels flowing parallel to the river-bank, with a potential for some stabilization of the chars, although these effects cannot be quantified at the present state of knowledge. The changes in river morphology are mostly positive in nature, likely to take place over a long period of time and need to be regularly monitored for better understanding of the phenomenon. Furthermore, the morphological changes that may be caused by the proposed revetment will not extend beyond the few hundred meters downstream of the revetment. To better understand the cause and effect relationship of river bank revetment and morphological changes in the river, a long term monitoring program will be designed and initiated during the project implementation. The institutional strengthening component under the Project includes strengthening of 'River Survey' department of BWDB with a provision of vessels, fuel and monitoring equipment for bathymetric surveys and streamflow measurements. A biodiversity conservation program will be developed and implemented targeting protection of the bird habitats and nesting habitats of turtles in chars.

**Generation of Solid Waste:** Solid waste and hazardous waste will also be generated from road maintenance works and resettlement sites. This waste if not appropriately disposed has a potential to contaminate soil and water resources, thus negatively affecting communities as well as natural habitat. The BWDB will prepare an HSE Plan that will cover the appropriate disposal mechanism for various types of solid wastes.

**Air Pollution from Traffic**: Air pollution from the traffic along the service road will not be a concern until construction of the two lane highway in RMIP Phase III. After construction of highway, emissions from road traffic may affect the ambient air quality along the road embankment. Air quality modeling will be taken up during detailed design of road component in Phase III to predict the air quality. Further, during design stage, various options to reduce the traffic congestion will be considered to reduce traffic emission. These measures could include: (i) minimizing grade changes, at-grade crossings, and sharp curves which can promote congestion and (ii) design of roadway to shed water to minimize rolling resistance, as well as to enhance safety

**Noise Pollution from Traffic**: Noise pollution during O&M of service road will also not be a concern until completion of two lane highway in Phase III. Traffic noise will be a significant nuisance to the sensitive receptors such as schools and religious places located vary close to the road. During the

design of the road component, a detailed traffic noise modeling will be carried to out to design noise barriers (e.g. walls, vegetation) along the embankments to reduce the noise levels near sensitive receptors such as schools.

**Water Pollution**: Generally paved roads increase the amount of impermeable surface area, which increases the rate of surface water runoff. Increased storm water flow rates can lead to stream erosion and flooding downstream; cause soil erosion, and siltation of streams. During the O&M phase, some localized increase in turbidity may take place during any maintenance works on the bank revetment. Similarly, the maintenance works and O&M of resettlement sites can also generate a limited quantity of waste effluents. Appropriate storm water drainage arrangements were included in the design of service road and resettlement sites. The runoff will be released in a manner that it does not cause soil erosion. To address the potential issues associated with waste effluents generated by O&M activities, the HSE Plan prepared by the BWDB will include disposal mechanism for waste effluents as well.

## 7.9. Significant Social Impacts during Operation and Maintenance

**Community Health and Safety**: Similar to construction activities, significant community health and safety issues are associated with the maintenance activities. These will include pedestrian safety, traffic safety and emergency preparedness. Pedestrians will be at greatest risk of serious injury from collisions with moving vehicles. Emergency situations most commonly associated during O&M phase will include accidents involving single or multiple vehicles, pedestrians, and/or the release of oil or hazardous materials. During the O&M phase, the BWDB will be required to implement HSE procedures and prepare its own ERP.

**Risk of Embankment Breaches and Emergency Response Mechanism**: Though the RMIP aims to strengthen the embankment, breaches can still take place due a variety of reasons such as earthquakes and localized failures of revetment. Such breaches in the post RMIP completion phase can potentially cause considerably higher losses than currently being incurred because of the intensified cultivation and increased area development that is likely to take place because of the enhanced protection against riverbank erosion and floods. BWDB will prepare an ‘emergency response plan’ to address these issues in coordination with Ministry of Disaster Management and Relief. The plan will include an alert system for local communities in the event of a catastrophic breach so that people can escape to higher land. It will be disclosed and regularly discussed with the local communities so that they are fully aware of the system and know what to do in an emergency. The O&M units of BWDB will be strengthened by RMIP to develop asset management system of embankment and revetments, and to carryout day to day monitoring and evaluation as well as adaptation and maintenance ensuring that the breaches and failures can be prevented.

# 8. Cumulative and Induced Impact Assessment

## 8.1. Objective

The GoB has plans to rehabilitate existing river bank protection works and flood embankments along both right and left banks of the Jamuna, and also to construct new river bank protection works and embankments. The GoB also has plans for a $100 billion investment program, Capital Dredging Project, 'in all major rivers including the Jamuna for sustainable river management through extensive dredging programs to control river bed siltation and aggradation, reclaim land, and improve inland navigation. The objective of this cumulative and induced impact assessment (CIIA) is to evaluate the combined effects of proposed developments on the Jamuna River and its floodplains.

## 8.2. CIIA in Context of RMIP

**Study Boundaries:** In the context of RMIP, the spatial boundaries of CIIA are based on the extent of the Jamuna floodplain in Bangladesh. The length of Jamuna from the Indian border to the Ganges confluence is about 220km. According to GoB development plans, rehabilitation and construction of embankments and river bank protection works along both banks of the Jamuna, development of a road network along the right bank, and integrated river management program and inland water transport are considered as major developments for the next 20 years; hence these projects are considered for CIIA study.

**Valued Environmental Components (VECs):** The study focus on more relevant valued environmental components (VECs) related to river management programs of the Jamuna, which are morphology/erosion, flood affected area and aquatic biodiversity. The rationale for choosing these VECs are: (i) the RMIP and other future development projects in the CIIA study area are primarily targeted to control erosion and flooding issues of the Jamuna, (ii) the impacts on floodplain and charland ecology are related to erosion and floods, and (iii) these can be modeled to a reasonable extent using the available information and knowledge.

## 8.3. Morphology

**Background and Baseline conditions:** The Jamuna, originally a small distributary channel of the Brahmaputra, originates about 10 km downstream of the Teesta confluence with the Brahmaputra. Sometime between 1776 and 1830, due to avulsion, most of the Brahmaputra River started flowing through the present course of the Jamuna River. During the last two centuries since the avulsion, the Jamuna River has been undergoing several morphological changes like increasing its width, achieving metamorphosis of its planform and pursuing westward migration mainly due to neotectonics and the great1950 Assam earth quake. In 1830, the river was a single channel meandering river with an average river width of 6.2 km. By 1930, the river shifted noticeably westward on average by 1.9 km and its average width (5.55 km) was somewhat narrower than that in 1830 (6.24 km). Between 1914 and 1973, the river continued migrating westward while widening significantly and metamorphosing from meandering to braided form largely due to the increased sediment inflow resulting from the Great Assam Earthquake of 1950. This period is marked by high rate of widening, high rate of westward migration of centerline and right bank, and high rate of erosion along the right bank (Table 7). By 1973, the average width of the river had reduced slightly, but rapid westward migration has been continuing till to date (Figure 4).

**Table 7: Summary of the Jamuna right bank westward shift and changes in width**

| Period | Westward shift of right bank per year (m) | Change in average width (km) |
|---|---|---|
| 1830 – 1914 | 19 | - 0.49 |
| 1914 – 1953 | 106 | 3.56 |
| 1953 – 1973 | 26 | - 0.47 |
| 1973 – 2010 | 45 | 2.98 |

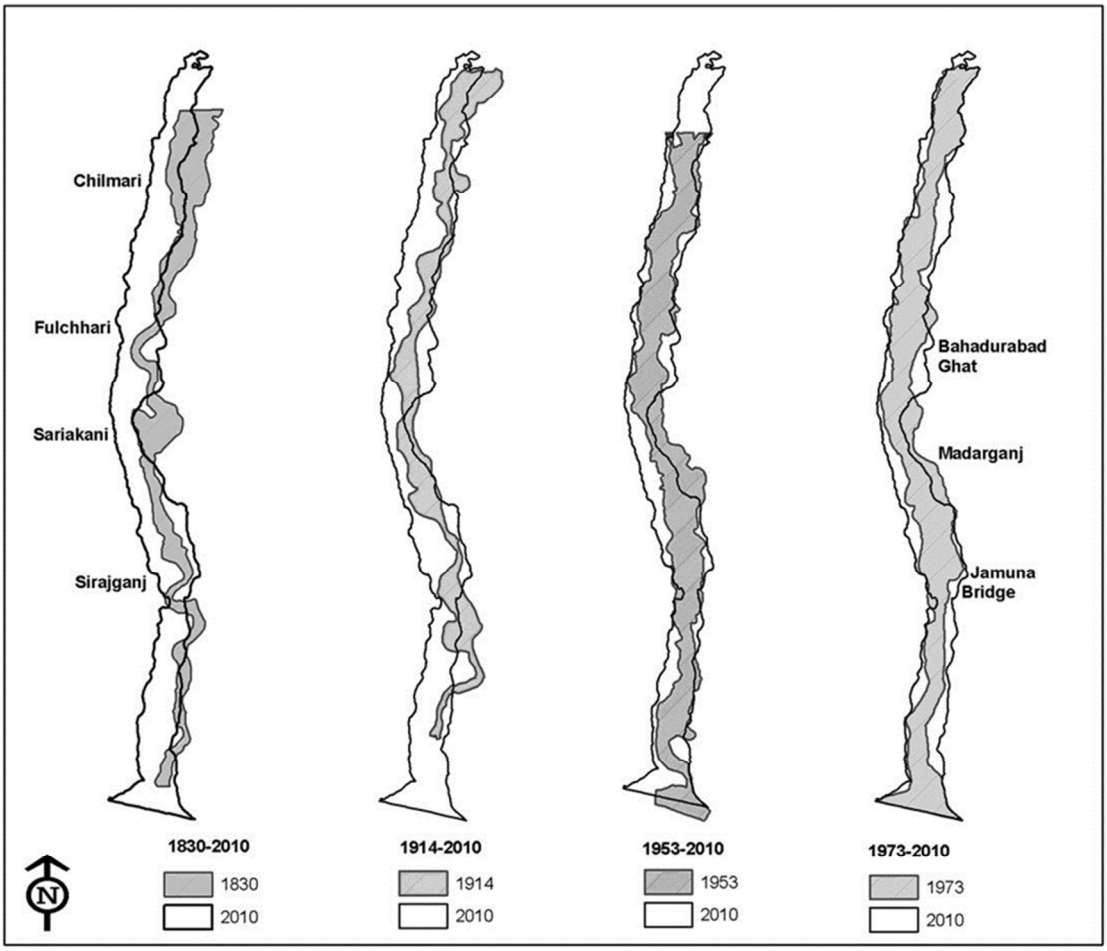



**Figure 4: Bankline changes of the Jamuna River 1830 – 2010**

**Erosion and Accretion:** The historical morphological changes in the Jamuna have led to significant erosion of floodplain and char land areas impacting floodplain and char dwellers. During last 40 years (1973 to 2014), about 88,000 ha of floodplain land was eroded on Jamuna due to its westward migration and widening causing the following significant impacts:

- **Landuse Changes**: Around 73,000 ha of fertile floodplain land, land that could have provided living space for around one million people at the present population density, has converted into low lying sandbars and river islands.
- **Ecological Changes**: These changes also affected beels and other surface water bodies that provide habitat for aquatic species and spawning grounds for migratory fish.
- **Population Displacement**: These morphological changes have displaced about one million people and severely impacted their livelihood sources.

**Future Trends:** For the last 180 years, morphological changes in the Jamuna River have primarily occurred due to extreme natural events such as earthquakes and neo-tectonics. Two such events, an avulsion at the end of 19th century and the Assam earthquake in 1950 largely shaped the current morphology of the river. Future morphological changes are also expected to depend largely on neo-tectonics, with major morphological adjustments of the fluvial system.

**Cumulative Impacts:** Structural interventions in the form of hard points, spurs, or revetments are the most effective way to counter riverbank erosion. Since 1the 990s, various structural interventions have been built on both banks of Jamuna and have worked effectively. Erosion had halted at the locations of structures, but it had been continued at the upstream and downstream of the structures. The bank protection works other than revetments have been found to deflect channel flows and can induce

erosion on both upstream and downstream of the protection works. While it is found that the revetments had little impact on the upstream and downstream areas. Apart from protecting the riverbank, protection works have the potential of attracting the flow and maintain channels along the revetments.

The cumulative effects of the bank protection works will be very beneficial in controlling further erosion. It is likely that the channel will flow along the structures maintaining a higher depth and that the channels will be more stable. The cumulative effects on the ecological habitats of both the river and charlands should be very positive.

However, assessing the impact of structural interventions on a complex braided river like Jamuna is a serious challenge. From an ecological view point, a regular monitoring program on aquatic and charland biodiversity should be implemented and coordinated by BWDB , as well as baseline data collection in areas of proposed future intervention, to gain a better understanding the relationship between morphological and land-use change and aquatic and charland biodiversity.

## 8.4. Flood Affected Area

**Background and Baseline Conditions:** The Brahmaputra river drains an area of almost 0.57 million $km^2$, nearly four times the area of Bangladesh. Its main stem and many tributaries flow through four countries: China, India, Bhutan and Bangladesh. Water in the Brahmaputra River is the foundation for food production, hydropower generation and other ecosystem services for an estimated 130 million people living within the boundaries of its basin. The flow of the Jamuna is mainly generated from monsoon precipitation and snow/glacier melt in the Himalayas. Flooding occurs during the months from June to October commonly peaking between July and early September while the lowest water levels are experienced from January to March. The extent of flood affected area in Jamuna catchment area in Bangladesh is about 28,320 $km^2$. The mean monsoon flow of Jamuna at Bahadurabad station was around 40,000$m^3$/s during the period from 1965 to 2006. The highest floods on the Jamuna River occurred in 1988, 1998, 2004 and 2007. The 1998 flood has the highest published discharge (103,129 $m^3$/s) on the Jamuna River which caused 1,100 deaths, rendered 30 million people homeless and damaged 0.5 million homes.

**Future Trends:** Flows and water uses in the upstream Brahmaputra basin are expected to change in future due to water development activities in the upstream riparian countries and climate change. The water development activities can be broadly classified as hydropower developments and inter-basin water transfers.

- **Hydropower dam development.** Though there is a huge hydropower potential, Brahmaputra River's water resources have been largely undeveloped. Bhutan, China, and India are all interested in developing the untapped hydropower in the basin (both on the mainstem and the tributaries). About 39 dams are planned in Brahmaputra in which ten dams are currently under construction (total installing capacity is about six gigawatts):
- **Water diversion scenarios.** China and India are both considering trans-boundary water diversions to transfer water from the Brahmaputra Basin to water-scarce regions of their countries. China's plans include diversion of about 20 billion cubic meters (BCM) per year to 60 BCM per year through "Greater Western Route Water Diversion Project". Similar water transfer projects have been proposed in India to divert about 34.43 BCM of water from the Brahmaputra River basin to the Ganges River basin through linked canals as part of a national-level River Interlinking Project.
- **Climate change**. The historical hydrologic regime is dominated by two different mechanisms: snow/glacier melt in the upper basin (the mountainous area mostly in China and Bhutan), and monsoon rainfall in the lower basin (the floodplains mostly in India and Bangladesh). Temperature increase and changes in precipitation patterns due to climate change will have different influences on these two mechanisms. Long-term observations (over 40 years) of temperature, precipitation and stream flow in the upper Brahmaputra basin all show increasing

trends. This may be partially attributable to melt water from retreating glaciers in the region. In the lower basin, most studies anticipated increases in stream flow as an effect of climate change, resulting from increases in monsoon rainfall.

**Cumulative Impacts:** A Brahmaputra System Model (BSM) study carried out by the University of Massachusetts (Yang et. al. 2014)[6] suggests that if no water diversion occurs, the flood affected area (FAA) will increase by 23 percent, 33 percent and 54 percent for near, middle and far future compare to baseline. China's largest diversion (60 bcm/year) will reduce FAA by 28 percent, 21 percent and 5 percent for near, middle and far future compared to the baseline. India's largest diversion (30 bcm/year), although cannot reduce the FAA, will mitigate the increasing trend and FAA will increase by 2 percent, 11 percent and 31 percent for near, middle and far future compared to the baseline under India's largest water diversions. The reduction in FAA will partially reduce the flood risk in Bangladesh. However, the reduction in FAA may not affect the agricultural productivity in Bangladesh since the irrigation in the country mostly met from rainfall and groundwater.

The cumulative effects of the proposed developments will reduce the risk of flooding in the Brahmaputra System. However the flood embankments, if not properly designed to facilitate lateral fish migration between rivers and floodplains, will have a potential to impact the productivity of floodplain fisheries. In addition to structural interventions, the modern flood risk management includes non-structural types of measures particularly landuse controls. Further studies are required to develop integrated catchment area landuse planning. The development of integrated landuse planning is also critical to address unplanned developments in the region.

## 8.5. Aquatic Biodiversity

**Baseline Conditions and Trend:** The Jamuna and its floodplains are the important source of both capture and culture fresh water fish in Bangladesh. Major habitats of capture fisheries are main river channels, *khals* and *beels*. These *beels*, *khals* and the Jamuna are naturally connected during floods and will act as migratory routes for the carp's fishes, which migrates to floodplains for spawning. The embankments constructed along the river bank have blocked this natural connectivity. The fisheries in the floodplains have been declining significantly since the construction of flood control embankments, which have blocked the migratory routes of carp fishes from the river to floodplains. The fish production in the Jamuna has also been declining since the construction of the embankments and also due to increased river and floodplain erosion (loss of floodplain habitat) and increased fishing pressure Annual total fish production decreased approximately 3,200 t in last 30 years.

**Cumulative Impacts:** The flood embankments constructed so far on the Jamuna have historically blocked fish migration routes between the river and its floodplains. The proposed embankments under RMIP and other future projects will restore connectivity through installation of fish passes. In addition a comprehensive fishery development program will be implemented under RMIP for restoration of floodplain habitat through re-excavation of *khals* and *beels*, artificial stocking of fingerlings and capacity building of fishermen for sustainable harvesting and marketing facilities. All these activities are expected to restore fish habitats and increase fish production.

The 'Capital Dredging Project' to improve navigation channels and reclaim land will have some impacts on the aquatic biodiversity of the Jamuna. Dredging will disturb the benthic habitat and the bottom fish feeders that depend on it. Dredged sediments will affect the quality of water and of the entire river habitat, which will also be at risk from oil spills and disposal of bilge water from barges.

To address the cumulative impacts associated with future dredging and induced environmental impacts from road construction and urbanization (discussed in next section), fish and dolphin sanctuaries need to be established in the Jamuna. Detailed ecological baseline studies are

[6] Yang, Y. C. E., Wi, S. Ray P. A., Brown, C. M. and Khalil, A. F. 2014. Modeling water resources the Brahmaputra River under future climate and social uncertainties. In preparation.

recommended for the entire CIIA study area to be carried out during implementation of RMIP-I, to identify suitable areas establish sanctuaries.

## 8.6. Induced Environmental Impacts

The north western part of the country, particularly the floodplains are comparatively under -developed due to continuous threats of erosion and floods from the Jamuna. Construction of bank protection works and flood embankments will lead to improved investments and development in the region. Urbanization in Bangladesh is growing in rapid pace especially along the road and railway corridors. With the construction of the highway along the RMIP embankment a rapid uncontrolled and unplanned urbanization may take place around the Project influence area. The construction of highway will also further lead to road network development in the region. All these induced developments may trigger several environmental issues at local and regional level.

It is expected that the connectivity of the north-western part of the region with the rest of country will provide increased accessibility to markets, ports and growth centers, leading to various economic developments with both positive and negative impacts. Negative environmental impacts include (i) air and noise pollution, (ii) generation of wastes due to increased living standards, (iii) health impacts due to pollution and waste generation, and (iv) loss of biodiversity. These impacts could be avoided or managed through integrated land-use planning as recommended under Master Plan Study to be carried during 2016 and 2017 in parallel with the Phase II feasibility study (under Component C2 of the RMIP-I). The study will identify areas of conservation significance and propose measures to prevent development activities from impacting the quality of their ecosystems.

# 9. Environmental Management Plan

## 9.1. General

**Various categories of mitigation measures**: The EMP includes the following categories of mitigation measures and plans: (i) generic and non-site-specific measures in the form of environmental codes of practices (ECoPs) presented in Annex I of the main EIA; (ii) project-specific and site-specific mitigation measures discussed in Chapter 7; (iii) construction environmental action plan (CEAP) requiring site-specific and contract-specific management plans to be prepared by contractors; (iv) social action plans (SAP) covering RAP, income and livelihood restoration, gender and public health; and (v) environmental improvement plans.

**Inclusion of EMP in contract documents**: In order to make contractors fully aware of the implications of the EMP and responsible for ensuring compliance, technical specifications in the tender documents will include compliance with mitigation measures proposed in the EIA and in WBG EHS guidelines. Contractors must be made accountable through contract documents for the obligations regarding the environmental and social components of the project.

**Construction Environmental Action Plan**: Contractors need to prepare site-specific management plans to address various environmental issues, showing how will comply with the requirements of ECoPs and EMP. Plans will be reviewed and approved by construction supervision consultant (CSC) and project management unit (PMU) before implementation of construction works.

## 9.2. Institutional Arrangements

The proposed organizational structure under PMU for implementation of EMP is shown in Figure 5.

**Project Management Office (PMU)** would be responsible for all aspects of project implementation including technical, operational and financial management, and overseeing the implementation of EMP. The PMU will include a Social, Environmental and Communication Office (SECO), which will be headed by a superintending engineer as the director. The director will be supported by (i) Executive Engineer - Environment, (ii) Executive Engineer - Social and (iii) various environmental and social consultants. The responsibilities of the SECO are: (i) supervising, facilitating and coordinating implementation of environmental and social plans including EIA and SAP; (ii) ensuring that contractors follow GoB regulations, World Bank Safeguard Policies, and other requirements mentioned in the EIA and SAP; (iii) identifying any issues of non-compliance and report these; (iv) suggesting mechanisms to link contractor performance in relation to the EMP to the timing of financial payments, incentives or penalties; and (v) interacting with stakeholders for their concerns about the construction activities. In order to effectively manage the EA process and EMP implementation, the SECO will be established and made operational before awarding the contract to contractor. BWDB is planning to establish a permanent unit called 'River Management Office' with a mandate to oversee implementation of all projects in country. 'Environmental Wing' of this office would be responsible for management of O&M related issues on social and environment.

**Construction Supervision Consultants** (CSC) will be responsible for supervising the contractors for the implementation of EMP. For this purpose, the CSC will appoint international and national environmental and social specialists, ecologists and an occupational health and safety specialist and environmental surveyors to ensure the EMP implementation during the project. They will supervise the contractor for the EMP implementation, particularly the mitigation measures. They will also be responsible for implementing the monitoring of effects of these measures. CSC will also hire the consultants and nongovernmental organizations to carry out additional studies and implementation of environmental and social plans not relevant to the contractors.

**Contractors** are also required to appoint appropriate number of environmental specialists, occupational health and safety specialists, environmental technicians, and community liaison officers for the implementation of EMP in the field, particularly the mitigation measures. The contractor will also be responsible for communicating with and training of its staff in the environmental/social aspects.

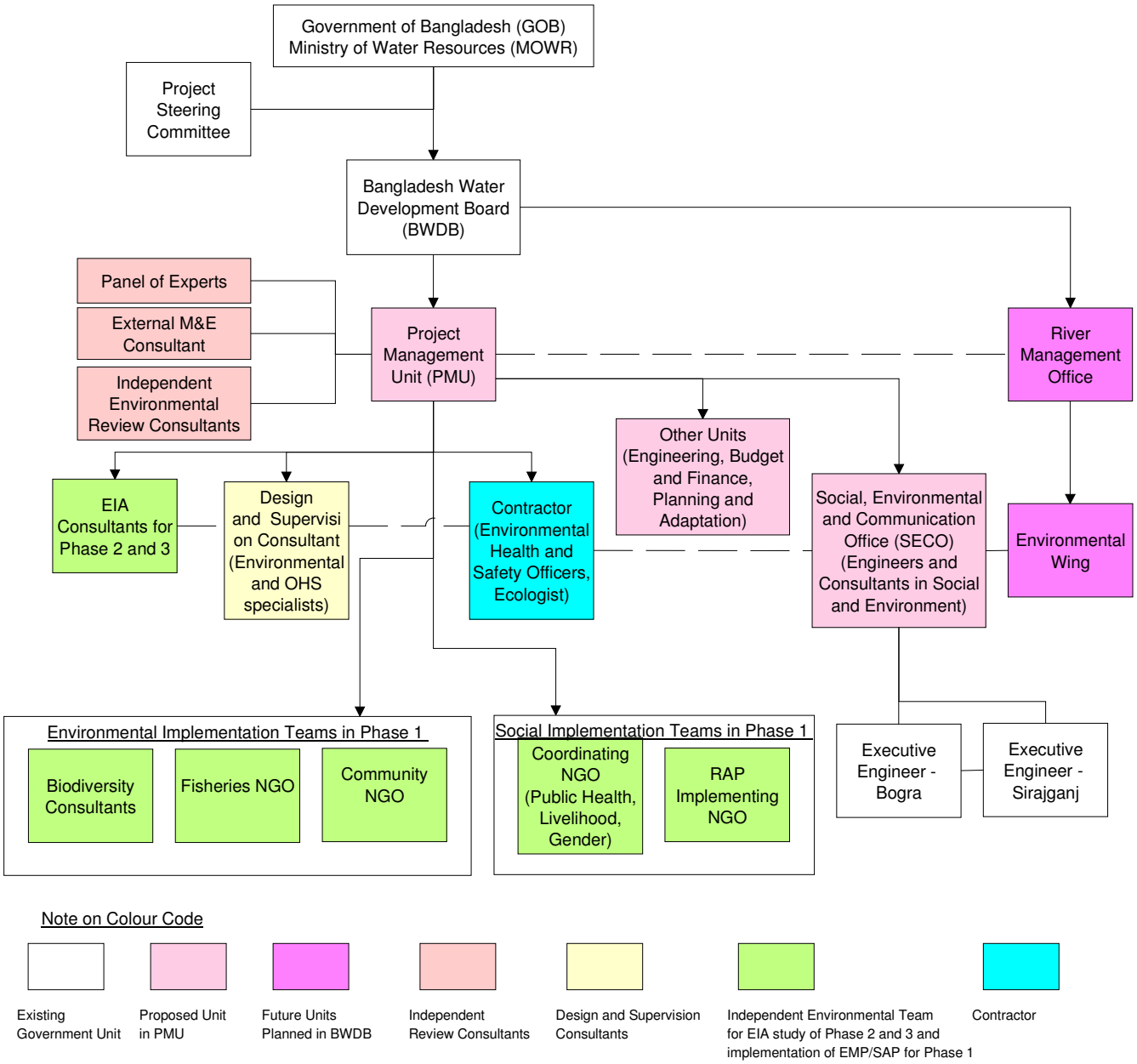



**Figure 5: Proposed Institutional Structure for Implementation of RMIP**

**External Monitoring and Evaluation Consultants** will be recruited by PMU to carry out independent monitoring and evaluation of implementation of EMP. The external monitor will have environmental and social experts and shall carryout external monitoring and evaluation.

**Independent Panel of Experts** will be recruited by PMU to carry out independent top level monitoring of implementation of EMP.

**Design and Supervision Consultants** will be responsible for construction supervision of Phase I works and engineering designs of Phase II and III.

**EIA Consultants** will be recruited by PMU to carry out environmental assessment and prepare EIA reports for Phase II and Phase III.

**Independent Review consultants** will be retained by the BWDB to advise, oversee and review of the environmental and social assessment to be carried out during Phase II and III.

## 9.3. Environmental and Social Management

### (a) Environmental Codes of Practice

A set of environmental codes of practice (ECoPs) has been prepared for various environmental and social management aspects: ECoP 1: Waste Management; ECoP 2: Fuels and Hazardous Substances Management; ECoP 3: Water Resources Management; ECoP 4: Drainage Management; ECoP 5: Soil Quality Management; ECoP 6: Erosion and Sediment Control; ECoP 7: Top Soil Management; ECoP 8: Topography and Landscaping; ECoP 9: Borrow Areas Management; ECoP 10: Air Quality Management; ECoP 11: Noise and Vibration Management; ECoP 12: Protection of Flora; ECoP 13: Protection of Fauna; ECoP 14: Protection of Fisheries; ECoP 15: Road Transport and Road Traffic Management; ECoP 16: River Transport Management, ECoP 17: Construction Camp Management; ECoP 18: Cultural and Religious Issues; ECoP 19: Workers Health and Safety; The Contractors will be contractually obligated to comply with these ECPs, presented in 'Annex I' of the EIA.

### (b) Site-specific Management Plans

The following site-specific plans will be prepared by the contractors to manage and mitigate/reverse potential adverse environmental impacts and all these plans will be submitted to the CSC for review and approval before contractor mobilization:

**Sand Extraction Plan** will be prepared and implemented by the contractors on the basis of the ECoPs and the mitigation measures given in EIA. The Plan will describe among others the methodology to be adopted, restrictions to be followed, prior survey to be conducted, and documentation to be maintained for the sand extraction.

**Pollution Prevention Plan** will be prepared and implemented by the contractors on the basis of the ECoPs and WBG EHS Guidelines (2007) that will be part of the bidding documents.

**Waste Disposal and Effluent Management Plan** will be prepared and implemented by the Contractor on the basis of ECoPs, EIA and WBG EHS Guidelines (2007).

**Drinking Water Supply and Sanitation Plan**: Separate water supply and sanitation provisions will be needed for the temporary facilities including offices, labor camps and workshops in order not to cause shortages and/or contamination of existing drinking water sources. A Plan will be prepared by the contractors on basis of the EMP and ECoPs, which are part of the bidding documents.

**Occupational Health and Safety Plan** will be prepared and implemented by the contractors on the basis of the WBG EHS Guidelines (2007), ECoPs, and other relevant standards.

**Traffic Management Plan** will be prepared by the contractors after discussion with BWDB and authorities responsible for roads and traffic. The Plan will identify the routes to be used by the contractors, procedures for the safety of the local community particularly pedestrians, and monitoring mechanism to avoid traffic congestion.

**Construction Camp Management Plan** will be prepared for each construction camp. The Plan will include the camp layout, details of various facilities including supplies, storage, and disposal.

**Fuel and Hazardous Substances Management Plan** will be prepared by the contractors on the basis of ECoPs as well as the mitigation plans given in EIA and in accordance with the standard operating procedures, relevant guidelines, and where applicable, material safety data sheets. The Plan will include the procedures for handling oils and chemical spills.

**In-stream Construction Works Management Plan** will be prepared by the contractors to address the environmental concerns associated with use of motor boats and barge mounted equipment on the basis of the mitigation measures given in ECoPs and EIA. The plan will address risk of spills, collision with dolphins and safety of construction workers.

**Emergency Preparedness Plan** will be prepared by the Contractor after assessing potential risks and hazards that could be encountered during construction.

**Environmental Management of Resettlement Sites** will be prepared by the Contractor in compliance with the stand-alone EMP prepared for Resettlement Sites and presented in the main EIA.

The following management plans wills will be prepared by the BWDB for implementation in O&M

**Emergency Preparedness Plan** will be prepared by BWDB for addressing emergencies associated with floods and bank erosion. The Plan will be submitted to the World Bank for review and approval prior to completion of construction.

**Health, Safety and Environment Plan** will be prepared by BWDB to address solid waste and emergencies associated with workers and community health and safety and to properly manage waste effluents generated from the maintenance works. The Plan will be submitted to the World Bank for review and approval prior to completion of construction.

**(c) Social Action Plan (SAP)**

**Resettlement Action Plan (RAP)**: The Project will require about 370 ha of land and affect a total of 15,558 persons for the construction of embankment. The social impacts largely include loss of residential and agricultural land, residential, commercial and communal structures, as well as loss of income and livelihoods. To address and mitigate these relocation and resettlement impacts, the Resettlement Action Plan (RAP) has been prepared. RAP has been designed as a "development" plan, therefore the overall objective of the RAP is to restore and/or improve the living standards of the affected persons from pre-project level.

**Social Development Plan (SDP):** The overall objectives of the SDP are to (i) Mitigate any negative social impacts related to the implementation of RMIP Phase I – Priority reach and to (ii) Support the overall development of the population in the Project area that lives a precarious life along the eroding river in respect to their livelihood, gender and public health status. The SDP is a 5-year program that encompasses a livelihood restoration and development, a gender mainstreaming as well as public health action plan for project-affected people and beneficiary communities. The SDP will cover the following programs and these programs will be implemented by various NGOs:

- **Income and Livelihood Restoration Programs (LARP):** Two major strategies will be pursued: 1) to restore income and livelihood of the directly project-affected population in short-term, and 2) to ensure sustainability of ILRP and long-term livelihood improvements. A number of interventions have been planned to support each strategy: i) Cash assistance to support lost income, ii) Assistance to re-establish businesses, employment in construction site and construction-supported sector as well as iii) Special assistance for vulnerable groups are planned to support strategy 1. To support strategy 2, the sustainability of the ILRP and long-term livelihood improvement, the following interventions have been designed: i) Community participation in tree, medicinal plantation and social forestry on embankment sides, ii) Fostering the cultivation of high value vegetables, iii) Improving the productivity of livestock sector, iv) Improving productivity of poultry sector, v) Improving the productivity of fisheries, vi) Training of skilled labor, vii) Installation of solar home systems and viii) Grants to support livelihood enhancing projects.
- **Gender Mainstreaming:** Five strategies have been derived from the gender analysis and impact assessment which will each be supported by a number of interventions. The strategies are as follows: i) Promote women's participation in design and implementation, ii) Enhance employment opportunities for women, iii) Ensure gender responsible resettlement measures, iv) Provide services and safeguards against social and health vulnerabilities, v) Enhance capacity on gender mainstreaming within BWDB. Key interventions are to i) Involve women in all important project committees for RMIP, ii) Give preference to women interested to seek employment as part of the RMIP including social forestry as part of the embankment maintenance, iii) Provide special assistance to female headed households during resettlement,

iv) Raise awareness on health issues and human trafficking, v) Provide skill training for birth attendants/community health workers and vi) Capacity building on gender mainstreaming for BWDB.

- **Public Health:** The key interventions will encompass i) Information Education and Communication programs on HIV/AIDS, tuberculosis, sexually transmitted diseases, assault, pollution, noise, road traffic and hand-washing, nutrition, 5 danger-signs of pregnancy, ii) Capacity development for public health staff on RMIP related risks/diseases, iii) Construction traffic safety measures, iv) Water-sealed slap latrines in resettlements sites and old embankment, v) Clean cooking stoves in resettlements sites and old embankment, vi) Safe tube wells in resettlements sites and, as required, on old embankment, vii) Skill training including health workers/birth attendants, viii) Prevention and management of pesticide poisoning as well as x) Women-friendly health services.

**Communication Strategy**: A formal communication strategy has been prepared for the project laying out various communication needs and outreach tools and explaining the responsibility of PMU to convey the project impacts and its implications for various stakeholders. A key aspect of this strategy shall be the communication of any project related impacts

### (d) . Environmental Improvement Plans

**Biodiversity conservation and monitoring**: Detailed ecological studies will be carried out, during implementation of Phase I, to broaden the existing baseline data. The EIA of Phase I identified eight potential sites of fish conservation and three locations of dolphin conservation in the project area. The proposed study will confirm these locations, identify additional locations and chars of conservation significance and prepare detailed conservation plans and implement these plans. A consulting firm will be hired to carry out the studies and to conduct biodiversity monitoring during the construction and post-construction periods.

**Floodplain fisheries development**: A comprehensive fisheries development program is proposed to restore the historical loss of floodplain fisheries, to include re-excavation of khals and beels, stocking of fingerlings, training of fishermen for sustainable harvesting, provision of fishing gear, and development of marketing facilities. The program will also cover formation and training of water management cooperatives for operation and maintenance of fish passes and regulators. A fisheries NGO will be responsible for implementing these plans. Plantation development will be carried out near beels, chars and resettlement sites.

**Pest management** will be carried out for training of farmers in integrated pest control. A community NGO will be responsible for preparation of integrated pest management plan and implementation.

## 9.4. Overview of Impacts and Mitigating Measures

An overview of all impacts and mitigating measures, including responsibilities and monitoring requirements, is given in Table 8.

**Table 8: Overview of Impacts and Mitigation**

| Impacts/Issues | Mitigation Measures | Time Frame | Cost (USD x $10^6$) | Responsibility | | Key Monitoring Indicators | Monitoring Frequency |
|---|---|---|---|---|---|---|---|
| | | | | Implementation | Supervision | | |
| **RMIP – PHASE I (overall impacts)** | | | | | | | |
| New and re- construction of embankments and bank protection works | - Desirable outcome of the project | 2016 onwards | 375 | Contractor | BWDB | - Area protected against erosion and flooding ; direct project beneficiaries and people protected, | Yearly |
| **ENVIRONMENTAL AND SOCIAL IMPACTS DUE TO PROJECT SITING** | | | | | | | |
| Land cover and land use changes (increased pesticide use) | - Integrated Pest Management Plan; Linkages with ongoing pest management programs | 2018 onwards | In budget of EMP | PMU | CSC, PMU | - to be developed under IPM | Six-monthly |
| Loss of natural vegetation and trees | - compensatory tree plantation along reconstructed embankment | 2016-2021 | In budget of EMP | PMU | CSC, PMU | - trees cut and trees planted | Monthly |
| Loss of riverbank/aquatic habitat | - positive benefit due to revetment | 2016-2019 | In budget of EMP | PMU | CSC, PMU | - habitat area created by geobags | Quarterly |
| Loss of flood plain habitat | - installation of fish passes and khal excavation<br>- floodplain fisheries development | 2017-2021 | In budget of EMP | Contractor, PMU | CSC, PMU | - O&M User committees are formed and trained, fish monitoring through underwater camera | Quarterly (monthly during flood season) |
| Drainage congestion and water logging | Installation of regulators and culverts | 2017-2021 | Project design | Contractor | CSC, PMU | - O&M user committees are formed and trained, area water logged | Quarterly (Monthly during flood season) |
| Land acquisition and resettlement | - implementation of RAP and social development programs | 2016-2021 | In budget of SAP | PMU | CSC, PMU | - peoples resettled and houses resettled in resettlement villages | Quarterly |
| Loss of agriculture and other income sources | - implementation of livelihood restoration measures | 2016-2021 | In budget of SAP | PMU | CSC, PMU | - progress of livelihood restoration | Quarterly |
| Impacts on Community Facilities and Places of Religious Significance | - Relocation of mosques and graveyards as part of RAP, | 2016-2021 | In budget of SAP | Contractor | - CSC, PMU, Local authority | - Cultural facilities affected and relocated | Quarterly |
| Blocked access because of road and embankment | - construction of pedestrian (stairs & ramps) and vehicular crossings | 2017-2021 | Project design | Contractor | CSC, PMU | community complaints | Quarterly |
| **ENVIRONMENT IMPACTS DURING CONSTRUCTION PHASE** | | | | | | | |
| Impacts of borrowing of material | Compliance with sand extraction plan | 2016-2021 | In budget of Contractor | Contractor | CSC, PMU | Sites approved, ongoing visual inspection of sand extraction | At the beginning of works and through sand extraction |
| Air pollution | - pollution prevention and implementation of ECoPs | 2016-2021 | In budget of Contractor | Contractor | CSC, PMU | Plan approved and implemented; community complaints | Quarterly |
| Noise | Noise control measures | 2016-2021 | In budget of | Contractor | CSC, PMU | Plan approved and | Quarterly |

| Impacts/Issues | Mitigation Measures | Time Frame | Cost (USD x $10^6$) | Responsibility | | Key Monitoring Indicators | Monitoring Frequency |
|---|---|---|---|---|---|---|---|
| | | | | Implementation | Supervision | | |
| | | | Contractor | | | implemented; community complaints | |
| Water pollution | - Pollution prevention and control plan | 2016-2021 | In budget of Contractor | Contractor | CSC, PMU | Plan approved and implemented | Quarterly |
| Soil contamination | - pollution prevention and control plan | 2016-2021 | In Contractors budget | Contractor | CSC, PMU | Plan approved and implemented | Quarterly |
| Solid wastes and hazardous wastes | - waste management and pollution control plan | 2016-2021 | In budget of Contractor | Contractor | CSC, PMU | Plan approved and implemented | Quarterly |
| Impacts on aquatic and floodplain habitat | - sand extraction plan, limit boat speeds to 15 km/h, proper treatment of waste effluents | 2016-2021 | In budget of Contractor | Contractor | CSC, PMU | Sites approved and ongoing monitoring of plan implementation | Before and during extraction |
| Impacts on *charland* habitat | No construction related activities on chars, use of low wattage lights | 2016-2021 | In budget of EMP | Contractor | CSC, PMU | Biodiversity monitoring studies | Six monthly |
| Site clearance and restoration | Site restoration and landscaping | 2016-2021 | In budget of Contractor | Contractor | CSC, PMU | Sites established and cleared | After construction |
| **SOCIAL IMPACTS DURING CONSTRUCTION PHASE** | | | | | | | |
| Impacts on cultural heritage | Chance find procedures, Code of conduct to construction workers | 2016-2021 | In budget of Contractor | Contractor | CSC, PMU | Community complaints | Quarterly |
| Impacts on community facilities | noise and air control measures near schools and hospitals | 2016-2021 | In budget of Contractor | Contractor | CSC, PMU | Noise and air quality monitoring; | Quarterly |
| Occupational health and safety | Implement health and safety, and emergency response plan | 2016-2021 | In budget of Contractor | Contractor | CSC, PMU | Plan prepared and implemented | Quarterly |
| Community health and safety | Public health action plan; traffic management and safety | 2016-2021 | In budget of SAP | Contractor | CSC, PMU | Plan prepared and implemented | Quarterly |
| **ENVIRONMENTAL AND SOCIAL IMPACTS DURING O&M** | | | | | | | |
| Changes in river morphology | Long term monitoring and biodiversity conservation measures | 2018 on wards | In budget of the project | BWDB | BWDB | River profile and stream velocities, biodiversity conservation measures | Quarterly |
| Generation of solid waste | Implementation of Health Safety Environment Plan | 2022 on wards | BWDB annual budget | BWDB | BWDB | Plan prepared and implemented | Six monthly |
| Air and noise pollution | Air and noise quality modeling in Phase III and appropriate measures | 2022 | BWDB annual budget | EIA Study team of Phase III | BWDB | to be developed | |
| Water pollution | Storm water drainage | 2022 on wards | BWDB annual budget | BWDB | BWDB | Working condition of drainage pits | Annually |
| Community health and safety | Implement health, safety and environment plan during maintenance works | 2018 on wards | In budget of SAP | NGOs | BWDB | Plan developed and implemented | Quarterly |
| Risk of embankment breaches and revetment failures | Regular monitoring and maintenance; emergency response mechanism in place | 2016 on wards | BWDB annual budget (from 2022) | BWDB | BWDB | Length maintained | Daily |

## 9.5. Monitoring Plan

Proposed monitoring plan to be carried during implementation of the project to ensure contractors compliance with the mitigation measures is given in Table 9 along with the monitoring indicators and frequency. CSC will be responsible for supervision of implementation of the plan.

**Table 9: Effects Monitoring Plan**

| Parameter / Activity | Location | Means of Monitoring | Frequency | Responsible Agency | |
|---|---|---|---|---|---|
| | | | | Implemented By | Supervised By |
| **During Construction** | | | | | |
| Sand extraction | At all sand extraction points | Ecological inspection of the site prior to development; and extraction carried out not in long stretches | Weekly | Contractor | CSC |
| Sediment Quality for heavy metals | Riverbed sediments at 5 locations | Laboratory analysis for analysis of metals and oil/grease (lead, cadmium, chromium, copper, manganese, mercury and zinc) | Before sand extraction | Contractor through a nationally recognized laboratory | CSC |
| Soil Pollution | Embankment & RS | Visual inspection that filling is through several compartments | Beginning of earth filling works | Contractor | CSC |
| | Embankment, RS and material storage sites | Ensure no contaminated effluent is leaving from the filling area to the nearby agricultural lands | Weekly | Contractor | CSC |
| Stability of slopes | Side slopes of embankment and Resettlement Sites | Compaction as per contract specifications, Visual inspection of erosion prevention measures and occurrence of erosion | Monthly | Contractor | CSC |
| Hydrocarbon and chemical storage | Construction camps and yards | Visual Inspection of storage facilities | Monthly | Contractor | CSC |
| Traffic Safety | Haul Roads | Visual inspection to see whether proper traffic signs are placed and flag-men for traffic management are engaged | Monthly | Contractor | CSC |
| Air Quality (dust, smoke) | Construction sites | Visual inspection to ensure good standard equipment is in use and dust suppression measures (e.g., spraying of waters) are in place. | Daily | Contractor | CSC |
| | Material storage sites | Visual inspection to ensure dust suppression work plan is being implemented | Monthly | Contractor | CSC |
| Air quality | Sensitive receptors along construction corridor | 24 hours continuous monitoring with the help of appropriate instruments and analyzers (particulate matter, carbon dioxide, sulphur and nitrogen oxides) | Quarterly | Contractor | CSC |

| Parameter / Activity | Location | Means of Monitoring | Frequency | Responsible Agency | |
|---|---|---|---|---|---|
| | | | | Implemented By | Supervised By |
| Noise | Construction sites | Noise measurement using noise meter; Ensure work restriction between 21:00-06:00 close to the sensitive locations | Weekly | Contractor | CSC |
| Surface Water Quality | At the baseline monitoring sites at five sites | Sampling and analysis of surface water quality (TDS, Turbidity, pH, dissolved oxygen, biological and chemical oxygen demand) | Quarterly | Contractor through a nationally recognized laboratory | CSC |
| Groundwater quality | Locations of tube-well installation (for workers camps and RS) | Depth of tube well should be more than 30m. Test water for arsenic iron and manganese before installing of casing. If the quality is found not suitable further deepening will be done. | During drilling of wells | Contractor trough a nationally recognized laboratory | CSC |
| | Water wells to be used by contractors for drinking | Laboratory analysis of all drinking water parameters specified in national standards | After development of wells | Contractor trough a nationally recognized laboratory | CSC |
| Plantation | Embankment slopes | Visual inspection to ensure plantations are taken care of. | Monthly | Contractor | CSC |
| Waste Management | Construction camps and construction sites | Visual inspection that solid waste is disposed at designated site | Monthly | Contractor | CSC |
| Drinking water and sanitation | Camps, offices | Ensure the construction workers are provided with safe water and sanitation facilities in the site | Weekly | Contractor | CSC |
| Flora and Fauna | Sensitive habitats in Project influence area | Survey and comparison with baseline environment<br>Ensure use of lighting at construction sites conforms with requirements to limit impacts to wildlife | Six-monthly | Biodiversity Conservation and Monitoring Consultant | CSC, BWDB |
| Fish migration | Fish passes | Underwater cameras and sample fish catch | Monthly after installation of fish passes | Consultants | CSC, BWDB |
| Cultural and archeological Sites | At all work sties | Visual observation for chance finds | Daily | Contractor | CSC, BWDB |
| Restoration of Work Sites | All Work Sites | Visual Inspection | After completion of all works | Contractor | CSC, BWDB |
| Safety of workers Monitoring and reporting accidents | At work sites | Usage of Personal Protective equipment and implementation of contractor OHS plan | Monthly | Contractor | CSC, BWDB |
| Grievances | In the project | Number of grievances | Monthly | PMU | CSC, BWDB |

| Parameter / Activity | Location | Means of Monitoring | Frequency | Responsible Agency | |
|---|---|---|---|---|---|
| | | | | Implemented By | Supervised By |
| | area | registered and addressed | | | |
| **During Operation and Maintenance** | | | | | |
| River morphology | In the Jamuna | Bathymetric surveys and stream flow measurements | Quarterly | BWDB | BWDB |
| Stability of protection works | Side slopes of embankment and Resettlement Sites | Visual inspection of erosion prevention measures and occurrence of erosion | Monthly | BWDB | BWDB |
| Plantation | Embankment slopes | Visual inspection to ensure plantations are taken care of. | Monthly | Contractor | CSC |
| Fish migration | Fish passes | Underwater cameras and sample fish catch | Monthly during migration season | O&M Committees | BWDB |
| Waste effluents | Along the revetments and embankments | Visual inspection that solid and liquid waste effluents are properly managed during maintenance works | Six-monthly | Environmental Wing of BWDB | BWDB |
| Pesticide residue in soil and water | Cultivation fields, *khals* and *beels* | Laboratory analysis of pesticide related parameters | Six-monthly | BWDB through a nationally recognized laboratory | BWDB |

## 9.6. Capacity Building

The environmental and social trainings will help to ensure that the requirements of the EMP are clearly understood and followed by all project personnel. The primary responsibility of providing these trainings to all project personnel will be that of the contractor and Supervision Consultants. The trainings will be provided to different professional groups separately such as managers, skilled personnel, unskilled labors, and camp staff.

## 9.7. External Monitoring

The BWDB will engage an Independent Monitoring & Evaluation Consultant to conduct external and independent monitoring and evaluation of the EMP implementation. The main purpose of the external monitoring will be to ensure that all the key entities including SECO, CSC, and contractors are effectively and adequately fulfilling their designated role for EMP implementation and that all the EMP requirements are being implemented in a timely and effective manner.

## 9.8. Grievance Redress Mechanism

The project will establish a grievance redress mechanism (GRM) for addressing grievances and complaints received from the project-affected persons. The fundamental objective of GRM will be to resolve any project-related grievances locally in consultation with the aggrieved party to facilitate smooth implementation of the social and environmental action plans. Another important objective is to democratize the development process at the local level and to establish accountability to the affected people. The procedures will however not pre-empt a person's right to go to the court of law. Under the GRM, two grievance redress committees (GRCs) will be

formed: local grievance redress committee (LGRC); and project grievance redress committee (PGRC).

## 9.9. Reporting

The SECO with assistance from CSC and contractors will produce environmental monitoring reports which will be submitted quarterly during the construction period and annually for three years after completion of construction. In addition SECO will also prepare semi-annual reporting for OHS related issues. One year after completion of construction, the SECO will submit a Project Completion Environmental Monitoring Report which will summarize the overall environmental impacts from the Project to all the co-financiers. The External monitors will submit the quarterly reports throughout the contract time, impact evaluation report at the end of each year and finally a completion Report at the end of contract period.

## 9.10. Cost of EMP

The total cost for the environmental management and monitoring activities has been estimated to be USD 20 million (Table 10). Of this amount, USD 15 million has been included under Component B2 of the project (see Table 3); the remaining amount of USD 5 million is included in other project components, as shown in Table 10. The cost of implementing the SAP is USD 65 million (Table 11).

**Table 10: Cost Estimates for Environmental Management and Monitoring of RMIP-I**

| | Description | Amount, million USD | Project Component (See Table 3) |
|---|---|---|---|
| 1. | Contractor's Budget (for development of management plans, staff, training, etc. | 1.00 | Component A: Rehabilitation / Civil Works |
| 2. | Air, noise and water quality monitoring during construction (quarterly for 5 years) | 0.50 | |
| 3. | Tree plantation development and maintenance along embankments | 1.00 | Component B2: Implementation of EMP |
| 4. | Baseline Ecological Studies, development of conservation plans and biodiversity monitoring during construction and operation (5 years), training to workers, monitoring of sand extraction sites | 2.00 | |
| 5. | Implementation of conservation plans prepared as part of the above studies (e.g. fish sanctuaries in koles, bird sanctuaries in chars, dolphin sanctuary in river); eco-tourism development | 3.00 | |
| 6. | O&M of fish passes (an agency to form and train the management communities, operation and maintenance, and monitoring equipment such as under water cameras) | 1.00 | |
| 7. | Fisheries development in the floodplains (improving connectivity of khals, artificial stocking of fingerlings, capacity building in sustainable harvesting, awareness raising, development of market facilities) | 2.00 | |
| 8. | Community Plantation development and maintenance (in resettlement sites, beels, riparian, etc.) | 1.00 | |
| 9. | Integrated pest management | 1.00 | |
| 10. | Resettlement sites management (O&M costs for sanitation and waste management, staff, etc.) | 1.00 | |
| 11. | Additional studies and Support | 2.00 | |
| 12. | Contingencies | 1.00 | |
| 13. | CSC Environmental Staff | 1.50 | Component D1: CSC |
| 14. | Independent Environment Consultants/M&E | 0.50 | Component D2: M&E |

| | Description | Amount, million USD | Project Component (See Table 3) |
|---|---|---|---|
| | | | Consultants |
| 15. | PMU Environmental staff | 1.00 | Component D3: PMU and Capacity Building |
| 16. | Capacity building and institutional strengthening | 0.50 | |
| | **TOTAL** | **20.00** | |

**Table 11: SAP Cost Estimates of RMIP-I**

| **Sub Component** | **Total in USD (million)** |
|---|---|
| **Compensation and RAP implementation** | 57 |
| Income and Livelihood | 2.63 |
| Gender Mainstreaming | 0.65 |
| Public Health | 2.8 |
| SDP/CNGO Implementation costs | 1.71 |
| Consultation | 0.032 |
| Communication Strategy | 0.41 |
| **Total** | **64.81** |

# 10. Stakeholder Consultations and Disclosure

## 10.1. Overview

Extensive consultations were carried out by both social and environmental study teams during the project preparation. Initial consultations were held during August and September 2014 to share the project objectives and terms of references of the proposed EIA study. The second round of consultations were carried out between January and April 2015 to disclose the results of EIA. Consultations involved multiple methods – for example, key informant interviews, village wise meetings, focus group discussions and workshops. Details of participants consulted are given in Table 12 and they include (i) affected communities and population around the project area, (ii) farmers and fishing community, (iii) national and local government authorities responsible for district administration, rural development, agriculture, fisheries, wildlife and environmental protection, and (iv) nongovernmental organizations.

**Table 12: Number of Persons Covered in Various Consultation Meetings**

| | Activities | No. of participants |
|---|---|---|
| 1. | Focus group discussions (353 meetings) | 4,166 |
| 2. | Consultation meetings (164 meetings) | 7,200 |
| 5 | Disclosure workshops | 262 |
| **Total** | | **11,628** |

## 10.2. Consultations Feedback

A summary of main issues raised with various stakeholders and how these issues are addressed and incorporated are shown in Table 13 and Table 14.

**Table 13: Key Issues Raised and Plans to Address the Issues**

| Environmental and Social Aspects | Description of Views and or Concerns | Action Plan |
|---|---|---|
| Flooding and inundation | Frequency of BRE breaching is increasing, more areas are under risk of flooding. | Rehabilitation of BRE under RMIP will address these issues |
| River Erosion | River erosion that destroys homestead and cultivable land should be stopped | River bank protection is included in RMIP |
| Water logging | With dysfunctional regulators, water logging taking place, sometimes embankment obstructs flow of water, cultivation is hampered | Rehabilitation of existing and construction of new regulators and culverts are included in RMIP |
| Crop destruction | Frequent floods destroy valuable crops | The proposed interventions under RMIP will address these issues |
| Flood and drought | Both flood and droughts are taking place. Long dry spells in the monsoon season affect the crop production. | Flooding will be controlled by the embankments. To address long dry spells, supplementary irrigation facility is provided through fish passes and regulators. |
| Blocked fish migration route and lack of fish cultivation | Inappropriate regulators, embankment, or lack of regulator affects fish migration route and its | Construction of fish passes are included in RMIP;<br>Excavation of *khals* and *beels* are also |

| Environmental and Social Aspects | Description of Views and or Concerns | Action Plan |
|---|---|---|
| in floodplains | cultivation | proposed. |
| Connectivity of river and other water bodies on floodplains | A number of places cited connectivity severely disturbed | Rehabilitation of existing and construction of new regulators is included in RMIP. Re-excavation of khals and beels are also proposed. |
| Compensation payments for land acquisition | Proper compensation rates; early payment of compensation; compensation for all losses | A comprehensive RAP is prepared |
| The Jamuna is moving towards - Bangali river | If avulsion of Jamuna in to Bangali river takes place, several thousand hectares of floodplain land will be lost | This reach is considered in the priority reach of RMIP and bank protection measures will be implemented in Phase I. |
| Promoting surface water irrigation | Ground water irrigation facing problem thus surface water irrigation preferred in some areas | Supplementary irrigation facilities through regulators and fish passes are proposed. |
| O&M of Regulators and fish passes | Inappropriate operation and inadequate maintenance of regulators can undermine the very objectives of these structures | Water user management committees will be formed and trained to operate and maintain the regulators and fish passes. |
| Water and air pollution | Local communities could be adversely affected by such pollution | EMP will include measures to minimize such impacts. Monitoring will also be carried out. |

**Table 14: Stakeholder Concerns in Phase I area**

| Stakeholders Type | List of concerned raised | Responses and mitigation measures under the Project – Summary |
|---|---|---|
| Women on the embankment | i. Shelter during flood;<br>ii. water and sanitation; safety at RS sites;<br>iii. need for education and empowerment; and<br>iv. livelihood sources and training for employment | i. Bank protection works will be undertaken by the project;<br>ii. RS sites are designed with necessary safety measures from floods, and will have water and sanitation facilities<br>iii. Project will hire a Coordinating NGO to deliver SDP over a 5-year period. |
| Wage Laborers | i. Employment opportunity in the project;<br>ii. livelihood and income sources at RS;<br>iii. training for alternative income and small businesses | i. Affected persons will get employment on a preferential basis in civil works;<br>ii. SDP will cover income and livelihoods measures for relocated people in RS.<br>iii. SDP will cover these measures |
| Land owners | i. Protection from any further erosion;<br>ii. proper and market price for land;<br>iii. options for resettlement on individual and family basis;<br>iv. compensation for structures and other assets | i. Revetment work by the project;<br>ii. replacement value for land as well as other assets as per project policy;<br>iii. multiple options for resettlement, including provision for self-managed resettlement by the affected families. |
| Vulnerable Groups | i. Protection from riverbank erosion;<br>ii. RS site location;<br>iii. livelihood opportunities at | i. Revetment work by the project;<br>ii. 15 Resettlement Sites along the first 50 km so that people can remain within their extended “communities” and benefit from |

| | | |
|---|---|---|
| | RS sites; and<br>iv. tracking for income and small business | social capital;<br>iii. SDP for employment and income in post-resettlement period. |
| Business owners | i. Compensation for loss of business;<br>ii. compensation for loss of business structures | iii. The project entitlement matrix will cover both loss of structure and loss of businesses. |
| Community Leaders | i. Protection from erosion;<br>ii. Proper compensation to affected persons, including resettlement of the embankment dwellers;<br>iii. Proper flood warning and forecasting for local people;<br>iv. Toll system for the 2-lane highway | i. Revetment works by the project;<br>ii. Replacement value for land and other assets; all affected persons will be eligible for relocation and resettlement at project costs;<br>iii. BWDB is establishing a system of early warning ;<br>iv. Highway will be constructed in Phase III, toll rate will be discussed with the communities in due course. |

## 10.3. Disclosure

A national stakeholder consultation workshop was held on 25th January 2015 to disclose the ESA reports. This meeting was held at Dhaka, at which respective relevant district organizations and institutes were invited. The consultation meeting was also attended by affected community, BWDB officials, and local civil society representatives. Similar disclosure meetings were held in the project area at four sub-district headquarters during April 2015 (at Dhunat on 6th April, at Kazipur on 8th April, at Sirajganj Sadar on 13th April, and at Sariakandi on 16th April). The ESA summary has been translated into Bengali and made available to the local communities. Both the environmental and social documents were disclosed on the website of BWDB on 5 February 2015 and World Bank InfoShop on 16 February 2015.