FLOOD AND RIVERBANK EROSION RISK MANAGEMENT INVESTMENT PROGRAM (FRERMIP) PROJECT-1

ADB LOAN NO. 3138-BAN (SF) AND GRANT NO. 0396-BAN (EF)

STRATEGIC ENVIRONMENTAL AND SOCIAL ASSESSMENT (SESA) OF RIVER STABILIZATION

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LIST OF ABBREVIATIONS

ADB	Asian Development Bank
BDP	Bangladesh Delta Plan
BPC	Bangladesh Planning Commission
BWDB	Bangladesh Water Development Board
CC	Concrete cement (block)
DoE	Department of Environment
DoF	Department of Fisheries
EARF	Environmental Assessment Review Framework
ECA	Ecologically Critical Area
ECC	Environment Clearance Certificate
ECR	Environmental Conservation Rules
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
FAP	Flood Action Plan
FCD	Flood Control & Drainage
FGD	Focus Group Discussion
FRERMIP	Flood and Riverbank Erosion Risk Management Investment Program
FSCD&SRMB	Feasibility Study of Capital Dredging and Sustainable River Management in Bangladesh
FYP	Fifth Year Plan
GED	General Economic Division (of BPC)
GoB	Government of Bangladesh
MDP	Millennium Development Goals
MoEF	Ministry of Environment and Forests
MoWR	Ministry of Water Resources
NAPA	National Adaptation Program of Action
NCA	National Conservation Act
PPTA	Project Preparation Technical Assistance
RBIP	River Bank Improvement Program (later renamed into RMIP)
RMIP	River Management Improvement Program (earlier named RBIP)
SEA	Strategic Environmental Assessment
SESA	Strategic Environmental and Social Assessment
ToR	Terms of Reference

EXECUTIVE SUMMARY

This preliminary Strategic Environmental and Social Assessment (SESA) provides a key environmental background relevant for the emerging river management activities in Bangladesh. This SESA targets primarily members of the FRERMIP team that is preparing a River Stabilization Plan for the Jamuna-Padma-Lower Meghna river system in Bangladesh, but is also meant to inform Client and financing institutions, and other relevant or interested parties on initial findings and progress made thus far.

The aim of the SESA, as stated in the Consultant's Terms of Reference, is *to assess the impacts of the* [considered] *investment program* [for river stabilization] *as a whole* [while] *taking into consideration other factors and development plans that are known and likely to be implemented in the future.* The latter include but are not limited to a number of technical documents, such as the Flood Action Plan (FAP, 1990s), the Capital Dredging Study (FSCD&RMP) of the Bangladesh Water Development Board (BDWD), the proposed River Management Improvement Program (RMIP), the ongoing Flood and Riverbank Erosion Risk Management Investment Program (FRERMIP), and the ongoing formulation of the Bangladesh Delta Plan 2100.

Although some guidance is provided in ADB regulations, conducting strategic environmental (and social) assessment (SEA/SESA) in Bangladesh is a novelty according to the Department of Environment (DoE) and SEA is not yet included in government's environmental law or policies. However, the new National Environment Policy that is currently in preparation will reportedly address SEA.

The present SESA shows similarities to a normal EIA in the sense that it provides an overview of the relevant regulatory framework, describes in general terms the considered interventions (as far as these are known at this stage), and identifies expected impacts – both positive and negative – and possible mitigation measures. A SESA differs from a usual EIA however in that it focuses on regional development comprising several interventions over a long period of time rather than on a local site-specific intervention, and that attempts are made to identify how this development affects policies and how environmental sustainability in the study area concerned can be maintained, and even better, enhanced.

The study area is formed by the active channels of the Jamuna-Padma-Lower Meghna river system between the Indian border in the north and Meghna Estuary in the south, with an average active river corridor width of 10-12 km. These rivers are highly dynamic and prone to riverbank erosion, resulting in the loss of about 3,200 ha of land annually for the Jamuna and Padma rivers forcing the movement and disruption or loss of livelihood of some 30,000 people (assuming 1,000 people/km^2) resulting in thousands of people migrating to urban centres where victims of riverbank erosion form the majority of slum dwellers (CEGIS 2015). Frequent flooding events disrupt lives and livelihoods. Rivers and distributaries are silting up continuously, leading to reduced navigability and drainage congestion.

As part of the river stabilization planning process various intervention scenarios are being considered. All aim at riverbank protection (with sand-filled geotextile bags under water complemented by hard materials at the upper exposed slope). Most scenarios intend to provide a more stable channel pattern by preventing riverbank erosion at key locations through a combination of riverbank protection and river training works including dredging. These measures are typically combined with the construction or rehabilitation of flood embankments and regulators, which require a certain amount of resettlement. Furthermore, the stabilized channel pattern of the main rivers allows to provide stable offtake locations to assure a certain base flow in distributaries all year round. A time horizon of 25 years is foreseen for implementation of these works, and current rough estimates of the planning team indicate that a budget of USD 2.2 billion would be required.

The considered interventions to counteract and control flood and riverbank erosion will first and foremost overwhelmingly result in a range of positive impacts and benefits. The local population living alongside the main rivers dominantly asks for addressing the erosion threat as their prime concern. During construction of the works thousands of (mostly unskilled) labourers will be contracted from local communities, thereby increasing their income and boosting local economies. Once completed, the riverbank protection works will minimise the recurring bank erosion and the associated loss of homesteads and cultivated land. The new/improved embankments will significantly reduce flooding and economic losses in the floodplains. Roads constructed on embankments will facilitate local mobility as well as long-distance transportation. Increased safety against river bank erosion and flooding as well as improved mobility and connectivity will bring in further development and investment to the area that is currently not possible because of the its relative isolation and vulnerability.

Key potentially negative impacts associated with the initial construction phase of the program include changes in aquatic habitat because of riverbank protection works (e.g. slope levelling) as well as from sand extraction from the river bed; changes in land form and land use because of rehabilitation of existing and construction of new embankments; land acquisition for construction of new embankment and resulting displacement of people; use of natural resources particularly river sand; health and safety risks associated with handling of hazardous materials and operation of construction machinery; air quality deterioration because of operation of construction vehicles and machinery as well as excavation activities; noise generation by operation of construction machinery and vehicles; contamination of land and water caused by waste generated from construction activities and camp operation; loss of trees that need to be removed for embankment construction ; risk of accidents associated with movement of construction vehicles and machinery; blockage of local routes caused by construction activities; and impacts on sensitive receptors such as schools along the embankments and access routes.

Most, if not all, of these adverse impacts are of a local and temporary nature, and can be mitigated relatively easily with proper mitigation measures that form part of best international practice. Permanent negative impacts associated with the construction works such as lost or damaged properties (trees, houses, land) are to be compensated for as per policies of the GoB and financing agencies and in accordance with the Resettlement Action Plan (RAP) that is to be developed for and implemented by the program.

The potentially long-term negative impacts associated with the O&M phase of the program pertain to the river as well as the floodplain and include changes in river morphology caused by riverbank protection; changes in aquatic habitat caused by riverbank revetment; blockage of local routes

caused by embankments and roads; effects on water bodies and associated habitats caused by disruption of hydrological and ecological connectivity between main and internal rivers, *beels* and *khals*; noise generation and air quality deterioration caused by vehicular traffic on embankment roads; risks of accidents associated with vehicular traffic on embankment roads; and increased usage of agro-chemicals caused by agricultural intensification due to enhanced protection against riverbank erosion and flooding.

Preliminary mitigation measures have been formulated for the most significant of the above-mentioned adverse impacts.

In terms of evaluating environmental sustainability of the proposed river stabilization program, seven (7) criteria are proposed and a number of indicators with which these can be measured, i.e.

For the river and floodplain:

- Conservation of biological diversity
- Maintenance of a productive river and floodplain fisheries
- Maintenance of ecosystem's health and vitality
- Conservation and maintenance of wildlife populations
- Legal, institutional and economic framework for conservation and sustainable management

And for the floodplain:

- Maintenance of wetlands
- Maintenance and enhancement of long-term economic benefits to meet the needs of local communities

The relevance of these criteria for the current regulatory framework is assessed, as well as how monitoring of criteria and indicators may help in achieving environmental sustainability.

Finally, tables showing a systematic listing of potential positive and negative impacts of the proposed program for river stabilization in Bangladesh, as well as their significance, are presented.

1 INTRODUCTION

1.1 Background

Within the framework of the ongoing ADB-funded *Flood and Riverbank Erosion Risk Management Investment Program* (FRERMIP), implemented by the Ministry of Water Resources (MoWR) and the Bangladesh Water Development Board (BWDB) between 2014-2023, a long-term strategic and holistic River Stabilization Plan for the Jamuna-Padma-Lower Meghna river system is being developed, as well as a Preliminary River Management Master Plan, i.e. between September 2015 and end-2016.

The aim of the River Stabilization Plan, hereafter called the Plan, is long-term stabilization of the main rivers between the Indian border in the north and the Meghna Estuary in the south by formulation of a strategic 25-year investment plan for riverbank erosion and flood management. Preparation of the Plan includes holistic morphology analyses, but also examines and incorporates findings and results of relevant other studies and projects such as the Flood Action Plans (FAP), Capital Dredging Feasibility Study by BWDB (FSCD&SRMB), formulation of the Bangladesh Delta Plan 2100 by the government, the World Bank's Riverbank Management Improvement Program (RMIP, 2015) upstream of Jamuna Bridge, and the feasibility study for FRERMIP (2014).

The preliminary River Management Master Plan being developed under FRERMIP aims at grasping an overall view on future interventions for sustainable and multi-use of the Jamuna-Padma-Lower and Upper Meghna river system, including their major tributaries and distributaries to connect the Jamuna and Upper Meghna rivers, but excluding the *haor* area upstream of the Upper Meghna. As such the Master Plan study area is thus substantially different and larger than the River Stabilization Plan area (Figure 3-1), however addresses the issues in a broader and more general sense.

1.2 Issues and Challenges

Being located in lower riparian and flat terrain implies that Bangladesh is facing temporal and spatial concerns regarding resources management, partly because the availability of water resources largely depends on upper riparian countries. While the country experiences water scarcity during the dry season, for example in the Barind and drought-prone areas, a significant portion of the country is flooded during the monsoon. These large seasonal variations affect particularly the water-related economic activities such as agriculture, irrigation, fisheries, etc. Pollution is adversely affecting surface and groundwater quality, particularly in urban and industrial areas, hampering the use of these resources. Groundwater lowering due to over-extraction causes concern over the sustainability of the use of the valuable groundwater resource, particularly in urban areas, but also leads to soil subsidence and further flooding risks, whereas low lying areas, including wetlands, are often subjected to encroachment due to unplanned development. Rapid population growth, increased resource use and economic development put pressure on the natural environment, including on biodiversity and fish stocks and ecosystems.

One of the more recent challenges is the vulnerability of the delta to the impacts of climate change, due to natural limitations and technical and capacity drawbacks. Climate change induced problems include sea level rise and saltwater intrusion.

The major rivers are highly dynamic and prone to bank erosion, resulting, among others, in thousands of people forced to move annually and migrate to urban centres for alternative living. In addition the floodplain habitat is destroyed and typically replaced by temporarily exposed low lying sand bars of low fertility. Frequent flooding events disrupt lives and livelihoods for the people in the floodplain and, not least, in the river chars. Rivers are both eroding and depositing, leading to reduced navigability and drainage congestion. Inappropriate land and water management practices, coupled with inadequate operation and maintenance of water infrastructure in many places threaten the sustainability of the resources.

Many of the challenges that Bangladesh is facing are closely related to its downstream location and include the need to build a climate resilient society, prevent and mitigate natural disasters, maintain and improve the coastal defences, sustain food security, strengthen the capacity to implement flexible strategies for sustainable development, and last but not least, enhance transboundary cooperation in river basin management.

1.3 Purpose and Scope of the Present Report

As outlined in the *Environmental Assessment and Review Framework* (EARF; May 2014) that was prepared for FRERMIP, in addition to the environmental assessments for sub-projects in future tranches, a 'Strategic Environmental Assessment (SEA)' is to be conducted during Tranche 1 (2015-2017). The aim of the SEA, as stated in the EARF, is "*to assess the impacts of the investment program as a whole taking into consideration other factors and development plans that are known and likely to be implemented in the future. The SEA will focus on key issues which include changes in river morphology, access to agriculture, impacts on livelihoods, fisheries, land use, and community resilience to disasters. Key issues will be identified through a scoping exercise with key stakeholders. Cumulative impacts of riverbank protection structures on downstream riverbank alignment will also be examined.*"

The ToR for the ISPMC includes as part of its *Task 4: Developing a long-term strategic and holistic river stabilization and river training plan,* hereafter called the River Stabilization Plan, the "*preparation of the SEA for the entire investment program, in consideration of similar interventions by other schemes and projects in the area*".

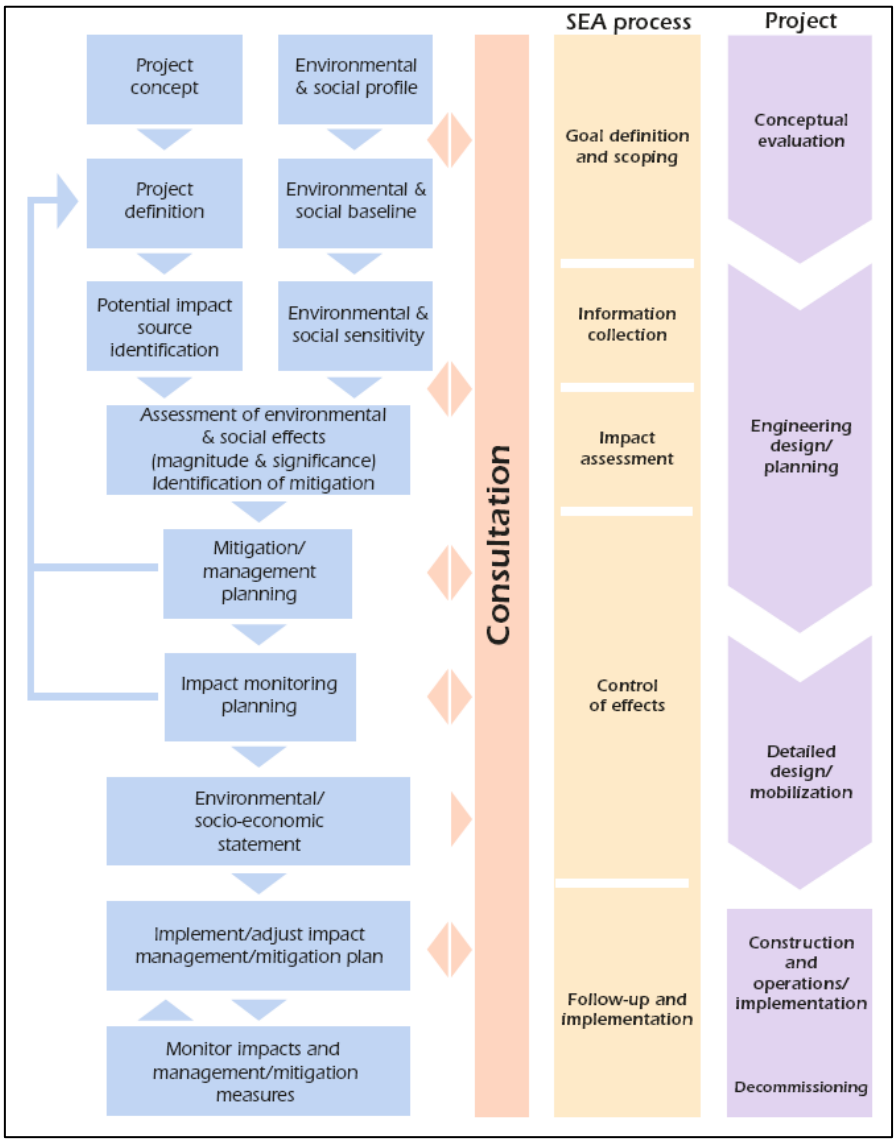
Given the fact that environmental impacts of developments are usually closely related to or overlap with social impacts that also have to be taken into consideration , the present document has been renamed as *Strategic Environmental and Social Assessment* (SESA).

As the long-term river stabilization plan for the targeted river system is in the process of development, the main purpose of the present SESA document is to inform the ISPMC team, the Client (PMO/BWDB) and financing agency (ADB) as well as other relevant parties (e.g. DoE, DoF) timely on potential impacts resulting from or associated with implementation of the intended development, and possible remedial measures and budgetary consequences to be taken into account. Development of this SESA is meant to be done in parallel to the river stabilization planning process – as illustrated in Figure 1-1, below.

1.4 Methodology Used for Compilation of the SESA

For compiling the present report, use has primarily been made of data enclosed in main reports of key projects mentioned in Section 3.1, below (i.e. Capital Dredging; FRERMIP; RMIP) as well as reports prepared under the BDP 2100, the Padma Bridge project, Flood Action Plan documents, and other relevant developments, supplemented by fieldwork conducted for other components of the FRERMIP implementation (e.g. compliance monitoring of EMP implementation in Tranche-1 pilot sites) as well as earlier knowledge and experience gained by the Consultant in relevant other assignments in Bangladesh and other countries.

Figure 1-1. The process of SEA development



2 EXISTING POLICIES, LEGAL AND REGULATORY FRAMEWORK

2.1 Government of Bangladesh

To address the fore-mentioned issues and challenges the GoB is guided by a number of policies and strategies. The EIA (2015) for RMIP provides an elaborate overview of the existing policy and regulatory framework relevant to river stabilization and management in Bangladesh, the most recent and relevant of which include, more or less in chronological order, the following.

2.1.1 National Environmental Laws

Bangladesh National Conservation Act (NCA) – 1995 and Amendment – 2010

The main legislative framework for environmental protection in Bangladesh, including conservation of the environment, improvement of environmental standards, control and mitigation of environmental pollution. The Department of Environment (DoE) is the main implementing agency. Under this law, no industrial unit or project shall be established or undertaken without obtaining an Environmental Clearance Certificate (ECC) from the DoE. The Amendment of 2010 includes further ecological concerns such as the conservation of wetlands and hazardous waste disposal, and empowers the government to impose more penalties on offenders.

Bangladesh Environment Conservation Rules (ECR) – 1997

The Rules cover among others the declaration of Ecologically Critical Areas (ECA), procedures for issuing an ECC, and the determination of environmental standards. It empowers the government to declare an area as an ECA if it is satisfied that the ecosystem of the area has reached or is threatened to reach a critical state or condition due to environmental degradation. It also classifies industrial units and projects into four categories: Green, Orange A, Orange B and Red, and empowers the government to specify which operations or process shall not be carried out.

Bangladesh Environment Court Act – 2010

Enacted to resolve disputes and establishing justice over environmental and social damage caused by any development activities.

2.1.2 Relevant National Policies, Strategies and Plans

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

This Act designates a list of protected species and empowers the government to declare areas as game reserves, wildlife sanctuaries and national parks. A wildlife sanctuary is defined as an area that is closed to hunting, shooting or trapping of wild animals and an undisturbed breeding ground for the purpose of protecting all natural resources, including wildlife, vegetation, soil and water.

National Environment Policy – 1992

This policy addresses 15 sectors, among which is the water resource management, flood control and irrigation sector which seeks to:

- Ensure environmentally-sound utilization of all water resources;
- Ensure that water development activities and irrigation networks do not create adverse environmental impact;
- Ensure that all steps are taken for flood control including construction of embankments, dredging or rivers, digging of canals, etc. be environmentally sound at local, zonal and national levels;
- Ensure mitigation measures of adverse environmental impact of completed water resources development and flood control projects;
- Keep rivers, canals, ponds, lakes, *haors*, *baors* and water bodies and water resources free from pollution;
- Ensure sustainable, long-term, environmentally and scientifically sound exploitation and management of the underground and surface water resources and;
- Conduct environmental impact assessment before undertaking projects for water resources development and management.

Notably, guidance on conducting Strategic Environmental Assessment (SEA) is not provided in the policy, however DoE informed in June 2016 that a new Environment Policy is being prepared and that this addresses SEA as well.

National Environment Management Action Plan – 1995

This plan identifies the main national environmental issues which for the water sector includes flood damage, riverbank erosion, environmental degradation of water bodies, increased water pollution, shortage of irrigation water and drainage congestion due to siltation.

National Fisheries Policy – 1996

This policy recognizes that fish production has declined due to environmental imbalances, adverse environmental impact and improper implementation of fish culture and management programs. The policy focuses particularly on aquaculture and marine fisheries development, and suggests among others the following actions:

- Biodiversity will be maintained in all natural water bodies;
- Chemicals harmful to the environment will not be used in fish/shrimp farms;
- Environment-friendly fish/shrimp technology will be used;
- Expand fisheries areas and integrate rice, fish and shrimp cultivation;
- Control measures will be taken against activities that have a negative impact on fisheries resources.

National Agriculture Policy – 1999

Its overall objective is to make the country self-sufficient in food through increasing production of all crops including cereals and ensuring a dependable food security for all.

National Water Policy – 1999

Providing guidance to major players in the water sector for ensuring optimal development and management of water. The policy requires all agencies and departments entrusted with water resource management responsibilities (regulation, planning, construction, operation and

maintenance) to enhance environmental amenities and ensure that environmental resources are protected and restored in executing their tasks. The policy includes several clauses relevant to water resource development including:

- Clause 4.9b: Measures will be taken to minimize disruption of the natural aquatic environment in streams and water channels;
- Clause 4.9e: Water development will not interrupt fish movement and will make adequate provisions in control structures for allowing fish migration and breeding;
- Clause 4.12a: Full consideration will be given to environmental protection, restoration and enhancement measures consistent with the National Environmental Management Action Plan (NEMAP) and the National Water Management Plan (NWMP).

Millennium Development Goals 2000-2015 (MDG)

Bangladesh agreed, together with all UN member states and international organizations, to achieve eight development goals by the year 2015, all of which were to support or help addressing the above challenges.

National Water Management Plan – 2001

Envisions to establish an integrated development, management and use of water resources in Bangladesh over a period of 25 years. The Water Resources Planning Organization (WARPO) has been assigned to monitor plan implementation. The major programs in the plan have been organized under eight sectoral clusters, including 'main rivers'. Each cluster comprises a number of individual programs and a total of 84 sub-sectoral programs have been identified in the investment portfolio.

National Land Use Policy – 2001

Aims at managing land use effectively to support trends in accelerated urbanization, industrialization and diversification of development activities. The policy suggests to establish land data banks where among others information on accreted riverine and coastal chars will be maintained.

National Adaptation Programme of Action (NAPA) – 2005

As a response to the decision of the Conference of Parties (CoP) to the United Nations Framework Convention on Climate Change (UNFCCC), the MoEF prepared the NAPA, recognizing the necessity to address climate change and adaptation to its impacts. Among its 15 adaptation strategies are measures to cope with enhanced recurrent floods in major floodplains and the promotion of research on flood tolerant varieties of crops to facilitate adaptation in the future.

Bangladesh Climate Change Strategy and Action Plan (BCCSAP) – 2009

This plan builds on six pillars that include food security, social protection and health to ensure that the poorest and most vulnerable including women and children are protected from climate change; comprehensive disaster management; building of infrastructure such as coastal and river embankments; research; mitigation and low carbon development; and capacity building.

Perspective Plan 2011-2021

This plan was prepared with the goal to protect the country from natural and human-induced hazards, global warming and climate change. Among others the plan provides a road map to accelerated growth and approaches to eradicate poverty, inequality and human deprivation – to be achieved on a sustainable basis without damaging the environment.

National Sustainable Development Strategy (NSDS) – 2013

The NSDS was prepared to address the challenges that arise when development efforts are made without proper recognition of environmental impacts that lead to degradation of agro-ecosystems, rivers and wetlands, coastal and urban areas, surface and ground waters, forests, etc.

Bangladesh Water Act 2013

Based on the National Water Policy of 1999, this act is designed for integrated development, management, extraction, distribution, usage, protection and conservation of water resources in Bangladesh, and provides a framework for better water management of water resources in the country. It also provides for trans-boundary basin-scale initiatives for water management, and exchange of data on flooding, drought and pollution.

Post-2015 Development Agenda – 2015

This was a proposal to replace the MDGs, and focuses on 11 goals that are people-oriented, peace-centric and right based, inclusive participatory and accountable in nature, planet caring and generate a shared and sustainable prosperity. This plan summarizes the broader policy context.

National Five Year Plans

Since gaining independence in the early-1970's, the country has prepared national 5-year plans, the latest of which is the 7th FYP covering the period 2016-2020. The General Economic Division (GED) of the Bangladesh Planning Commission (BPC) is responsible for preparation of these plans for which a participatory approach is being followed.

Bangladesh Delta Plan 2100

By formulating the BDP 2100 the government aims at tackling the challenges in an integrated and coherent manner and to take concrete short-term (2015-2025), medium-term (2025-2040) and long-term (2040-beyond) steps towards developing a safe, resilient and prosperous delta. Preparation of the BDP 2100, led by the GED of the BPC, started in August 2014 and plan presentation is currently scheduled for the second half of 2016. The plan is to ensure broad-based growth and reduce poverty; ensure effective governance and sound institutions that help creating a caring society; address globalization and regional cooperation; provide energy security for development and welfare; build sound infrastructure and manage urban challenges; mitigate impacts of climate change; and promote innovation.

During formulation and implementation, the BDP 2100 will function in compliance with the existing FYP cycles of the country, but it will also be in alignment with the relevant sectoral plans such as the National Water Management Plan, Integrated Coastal Zone Management Plan, Master Plan for Hoar Areas, Master Plan for Agricultural Development in Southern Bangladesh, etc., whereas the FYP provides directives for the country's Annual Development Programme (ADP) and sectoral plans. In the local context the BDP 2100 is expected to guide community level interventions and hence, allows for better resources governance and transparency in program and project implementation at the local level.

2.2 Asian Development Bank

Environmental policies of the ADB are spelled out in the following guidelines, however, a prescribed or recommended structure or outline for an SEA/SESA is not provided herein:

- *Environmental Assessment Guidelines* (2003) – rather old but provides some guidance on how to conduct SEA.
- *Safeguard Policy Statement* (June 2009) – Stating that when the project involves the development of or changes to policies, plans, or programs that are likely to have significant environmental impacts that are regional or sectoral, SEA will be required. A SEA report will include (i) an analysis of the scenario, (ii) an assessment of long-term and direct impacts, and (iii) a description of the consultation process, and (iv) an explanation of option selection.
- *Environment Safeguards – A good practice sourcebook* (December 2012): SEA is 'an assessment of environmental impacts and risks associated with policies, programs and plans. An SEA may assess multiple policies, programs and plans within one study area, such as a river basin'.

The ADB *Environmental Assessment Guidelines* (2003) state what should be included in a SEA report (Table 2-1).

Table 2-1. Components of a SEA as per ADB's Environmental Assessment Guidelines (2003)

ADB's EA Guidelines (2003)	As addressed in the present SESA
Contain a description of the project and the affected environment extending beyond the physical boundaries of the project, focusing on key assets, sensitive areas and threats.	• Plan/Program description: Chapter 3 • Physical boundary planning area: Section 3.1 • Affected environment: Baseline including sensitive areas: Chapter 4 • Impacts: Chapter 5 and Chapter 8
Review environmental and sustainability objectives of the plan and propose a set of criteria, targets or indicators for evaluating the effects of the plan's policies and their alternatives.	• Plan/Program objectives: Chapter 3 • Relevant policies: Chapter 2 • Environmental and sustainability objectives: Chapter 6 • Indicators for effect evaluation: Chapter 6
Contain a systematic identification, prediction and evaluation of potential impacts, including indirect and cumulative ones, with a level of detail appropriate for appraising the plan and the information needs of decision-makers.	• Potential impacts: Chapter 5 and Chapter 8
Include recommendations on preferred alternatives and a description of suggested monitoring and mitigation measures.	• Alternatives: Chapter 5 • Monitoring: Chapter 6
Include recommendations for tiering its results to environmental assessments at lower levels of the planning hierarchy.	• Linkage SESA results to lower levels of planning hierarchy: Chapter 6
Clearly delineate and explain the methodology by which its findings have been obtained and report on findings from public consultation.	• SESA methodology: Section 1.4
Facilitate sustainability appraisal by (a) evaluating environmental sustainability; (b) presenting its findings in a way which will facilitate an integrated sustainability analysis (including proposing sustainability criteria).	• Evaluating environmental sustainability: Chapter 6 • Proposing sustainability criteria: Chapter 6

Strategic Environmental Assessments conducted in the framework of other ADB-funded programs have yielded lessons learned, such as for the Greater Mekong Region where it was concluded that SEA:

1. Improves the performance and efficiency of policy and planning by minimizing adverse impacts on environment and society.

2. Helps to avoid costly mistakes and missed opportunities caused by inadequate information about impacts and trade-offs.

3. Provides a framework for project-level assessment and coordination, in particular to understand cumulative impacts and reduce duplications.

4. Builds consensus and public trust through its multi-stakeholder and participatory focus.

2.3 Conclusion

Strategic Environmental Assessment (SEA) or *Strategic Environmental and Social Assessment* (SESA) is currently not included in GoB's law or policy, however, a new National Environment Policy that is understood to introduce SEA is in preparation, due to be published later in 2016. Consulting the Department of Environment during the preparation of the present SESA, it was learned that SEA/SESA has not been conducted in Bangladesh and that the department is eager to receive a draft and to be informed on lessons learned from this experience.

Should the River Stabilization Plan be a proposed *project* instead of a strategic plan, then for the purpose of issuance of a required Environmental Clearance Certificate (ECC) under the Environmental Conservation Act (1995) and the Environmental Conservation Rules (1997) it would need to be classified in one of four categories. According to this categorization, all construction / reconstruction / expansion of flood control embankment / polder / dykes falls under Category Red, and therefore such an undertaking would need the preparation and submission to the DoE of an Initial Environmental Examination (IEE) and Terms of Reference (ToR) for an Environmental Impact Assessment (EIA) followed by the EIA itself and Environmental Management Plan (EMP). Public participation or consultation is not (yet) a condition in the ECR 1997 and/or EIA guidelines, however, DoE prefers the proponent to engage in public participation.

The Asian Development Bank has developed a number of safeguard guidelines for projects and programs it supports to ensure that all possible impacts are considered and mitigation measures are spelled out prior to implementation of any proposed project or program. These guidelines are to ensure that the quality of operations is uniform across different settings in countries where the bank operates. As the River Stabilization Plan may involve the development of or changes to policies, plans, or programs that are likely to have significant environmental impacts that are regional or sectoral, an SEA/SESA is required.

3 SCENARIOS FOR LONG-TERM RIVER STABILIZATION

3.1 Delineation of the Study Area

The study area for the River Stabilization Plan is depicted in Figure 3-1, and focuses on the active Jamuna/Padma and Lower Meghna river channel. Width of this channel varies but is on average 10-12 km wide (Jamuna mean 11.8 km, Padma mean 10.3 km, range 2.5-20 km – CEGIS, 2015). For comparison, the study area for the River Management Master Plan that is being developed under FRERMIP simultaneously is considerably larger and is also indicated in Figure 3-1.

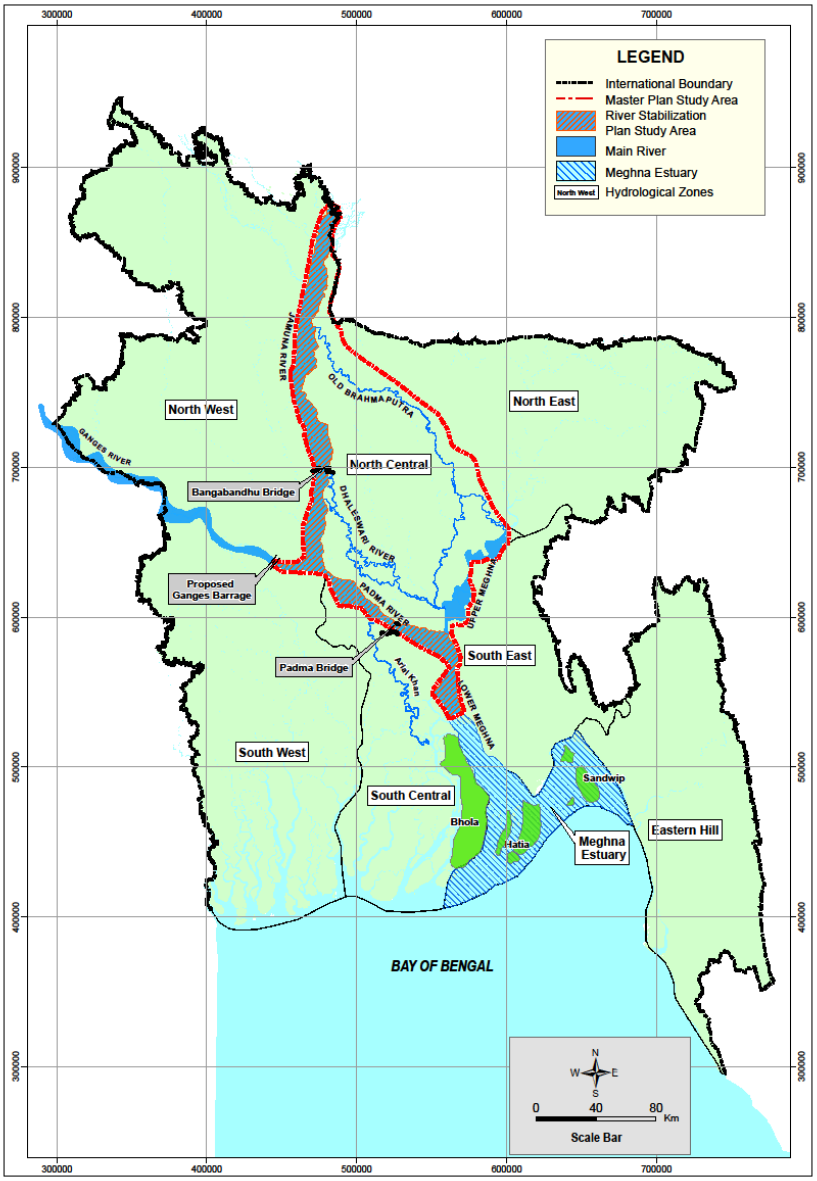


Figure 3-1. Study areas for the River Stabilization Plan and River Management Master Plan

3.2 Objective and Scope

The aim of the River Stabilization Plan is long-term stabilization of the main rivers between the Indian border in the north and the Meghna Estuary in the south by formulation of a strategic 25-year investment plan for riverbank erosion and flood management. This is to be attained through systematic riverbank protection along a defined river corridor and improved flood embankments to secure continued development despite future uncertainties for example from climate change. In places substantial lengths of riverbank protection have already been built and this has helped to stabilize the river locally. The precise components of the plan are still to be determined but are likely to be interventions that have been studied and proposed under four studies conducted more or less simultaneously between 2010 and 2015:

- GoB-funded *Feasibility Study of Capital Dredging and Sustainable River Management in Bangladesh* (2010-2015) – for 24 rivers including the Brahmaputra-Jamuna, Padma, Upper and Lower Meghna and Old Brahmaputra;
- ADB-funded PPTA for *Main River and Bank Erosion Risk Management Program* (FRERMIP; 2012-2014) – for the Jamuna and Padma Rivers between Chandpur and the Jamuna Bridge;
- World Bank-funded feasibility level *River Management Improvement Program* (RMIP; 2013-2015) – for the Jamuna River Right Bank north of the Jamuna Bridge up to the Indian border;
- The *Dhaka Chittagong Multi Modal Transport Corridor* (DCMMTC) recently approved by the World Bank and Government of Bangladesh.

These studies have provided the key components for the current approach adopted by the Ministry of Water Resources (MoWR) and the Bangladesh Water Development Board (BWDB) for river training and management in Bangladesh, i.e.:

(i) Large-scale capital dredging of river sections creating a narrower and deepened corridor, and depositing dredged materials at selected locations in the floodplain and on char land;
(ii) Riverbank protection through revetments, i.e. depositing sandbags (under water) and concrete blocks (above water) on river banks particularly along outer bends to prevent bank erosion;
(iii) Rehabilitation of existing embankments and constructing new embankments to help reduce flooding of residential and agricultural land;
(iv) Stabilising offtakes of distributaries to improve dry season inflow and hence groundwater recharge and irrigation, enhance water quality and allow for year-round navigation;
(v) Institutional strengthening.

While a narrower river corridor with deeper channels (likely one or two main channels) provides efficient conveyance of flood water and land reclamation, it comes at the risk of reducing low water levels, negatively affecting the river morphology with potential impacts on upstream riparian countries, also reducing distributary inflows, and degrading river ecology. The optimal width and depth will need to be a assessed in a careful balance of technical, social and environmental issues. This identified risk acknowledges that the presently wide and shallow river was much narrower (less than 6 km) some 50 to 100 years ago and likely similar to the now desired shape. This notwithstanding there are not much data to confirm the exact river characteristics from that period.

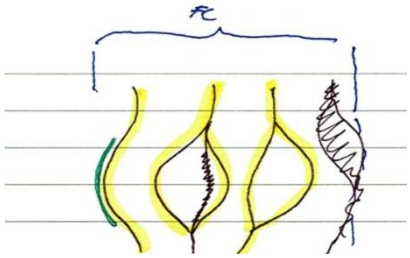
Large-scale capital dredging on the one hand, and riverbank protection on the other, are different solutions to the same problem, and it is neither logical nor cost-efficient to implement both on a

large scale simultaneously. Large-scale dredging is believed not be sustainable due to high costs and the high sediment load of river waters (resulting in rapid refill), and is therefore not further considered as a viable scenario under the present river stabilization planning process. However, *limited* dredging of river sections may be considered to stimulate the development of a desired future river planform with more stable river channels and a narrower active river corridor by the river itself, whereby dredged material is placed at selected locations in the floodplain and on chars.

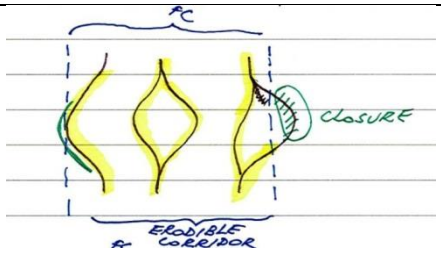
3.3 Possible Scenarios

Under the present River Stabilization Plan a number of scenarios for river stabilization and land reclamation are being considered. One or more of these scenarios may be applied to different sections of the river bed depending on the local characteristics, or they may not be used at all.

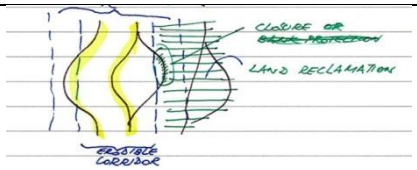
Scenario A0: No Land Reclamation

Description	Details	
Continuation of present approach, resulting in the gradual construction of semi-continuous bank protection works along bank far away from the axis of the river;	• River will remain as wide and as braided as it is now, apart from possible natural narrowing tendencies • Tendency of channels to stick to bank protection works, in particular when they are curved	

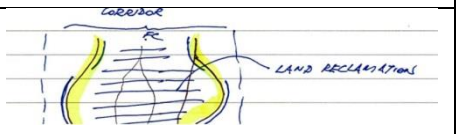
Scenario A1: Active Floodplain Management

Description	Details	
Any further widening tendency controlled by recurrent measures	• Recurrent measures consist of closure of aggressive second-order channels which erode outside a pre-determined and accepted width of the active first-order channel system • Important to timely predict the development of outflanking channels	

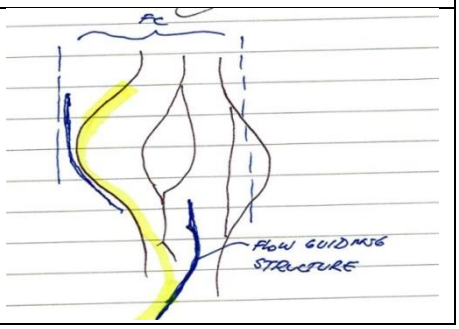
Scenario A1 + LR: Active Flood Management + Land Reclamation

Description	Details	
Part of river closed off and any further widening tendency of river controlled by recurrent measures	• Part of lost floodplain land recovered • Recurrent measures consisting of closure of aggressive second-order channels which erode outside a pre-determined and accepted reduced width of the active first-order channel system • River will return to a system with lesser anabranches and less chars • Important to timely predict the development of outflanking channels	

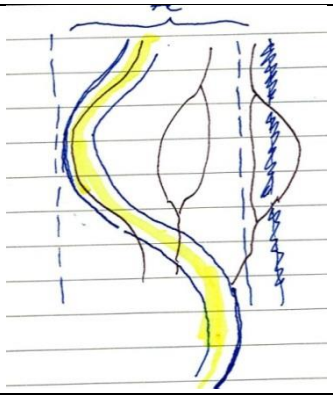
Scenario A2: Two-channel Anabranched Planform

Description	Details	
Planform consisting of two meandering channels (as proposed by e.g. Zhou and Chen, 1998) stabilised with bank protection works along the outer bends	• Two channels controlled upstream by bifurcation • Discharge and sediment transport of each channel varying • Channel might braid (with mid channel bars) or meander (with point bar) • Channels only protected along outer bend • Along inner bend possible char formation	

Scenario A3: Single Channel Planform

Description	Details	
Single channel with imposed meandering planform, with bank protection only along the outer bends and "natural" conditions elsewhere	• Channel carrying full bank discharge • Channel will be maximum 4 km wide • Char formation along inner bend possible • These will mostly be stable chars and not dynamic mid-channel chars	

Scenario A4: Fully Trained Single Channel Planform

Description	Details	
Imposed meandering planform and continuous bank protection along both banks and hence reduced width of the channel	• Bank protection along both sides of the river • River less than 3 km wide and possibly even less • Chars will be stable, depending on the imposed curvature • Channel will be deeper • Char level will be lower • Frequency of flooding of chars will increase	

3.4 Possible Interventions

Possible interventions under the above scenarios include dredging of a partial corridor, riverbank protection with geotextile sandbags and concrete blocks, construction of new embankments with fish passes and regulators and rehabilitation of existing ones, and creation of spill channels. River stabilization works as proposed by RMIP for a section of Jamuna River are, as an example, presented in Figure 3-2.

Dredging of a Partial Corridor

Instead of large-scale capital dredging - which is costly but not sustainable - dredging of a partial corridor will help the river erode a deeper channel by itself, which will increase discharge capacity and achieve a preferred channel. This option is to be implemented simultaneously with other river

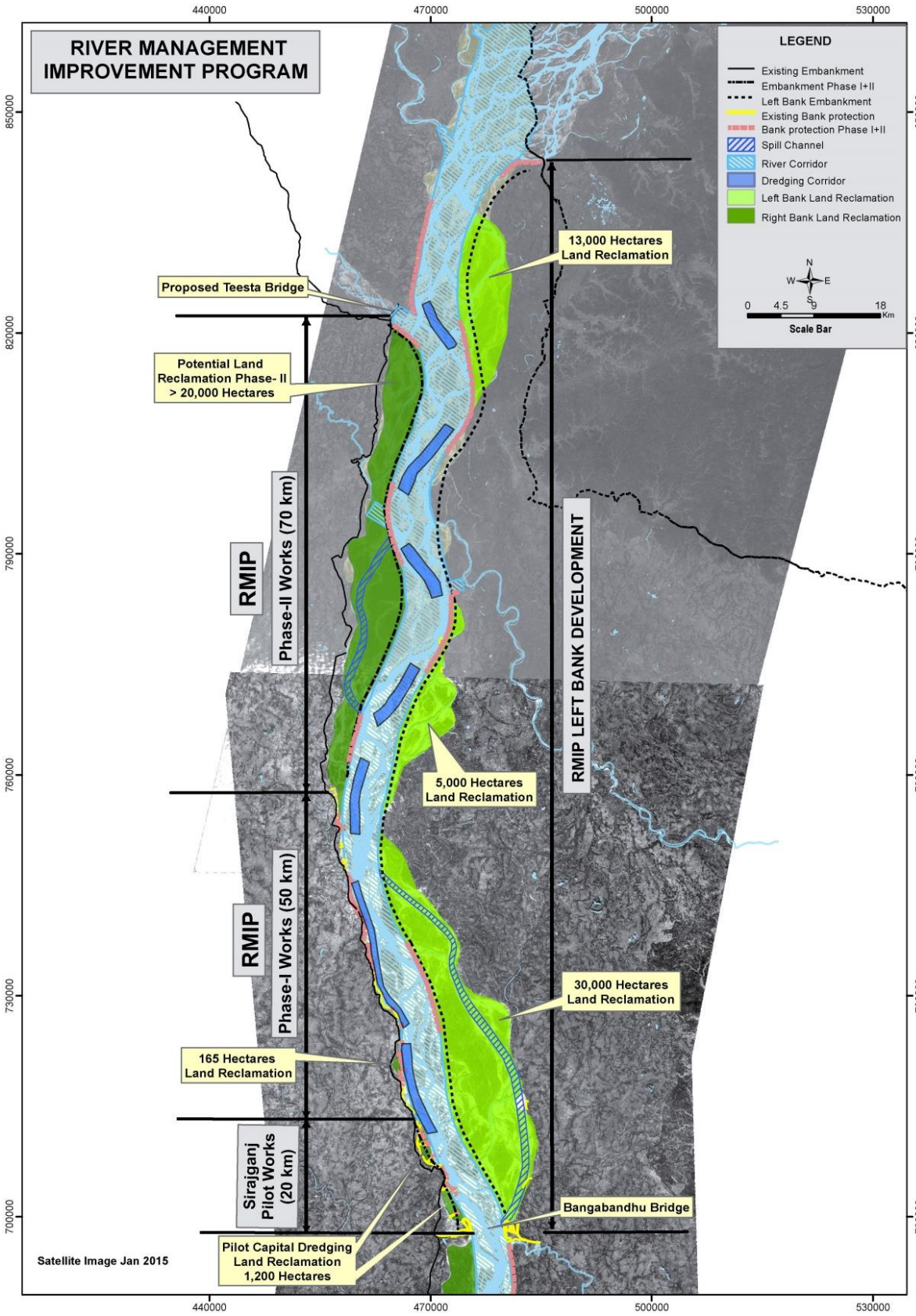


Figure 3-2. Proposed RMIP interventions along a section of Jamuna River (example)

stabilization works such as riverbank protection and stabilization works. Under this intervention river sediment is dredged by dredgers that either dump the dredged material in barges or pump it to deposition sites (Figure 3-6/1 & 2). The latter may be low-lying, unused *char* land or *khas* land, or similar. If the dredged material is of a suitable composition (high sand content) it may be used to fill geobags or for embankment construction.

Riverbank Protection with Geotextile Sandbags and Concrete Cement (CC) Blocks

Riverbank protection has been and currently is carried out with the use of sand-filled geobags and concrete cement blocks or grout-filled mattresses at the predecessor JMREMP sites and the three sub-projects of FRERMIP; this methodology has been developed in the recent past and has been applied successfully in Bangladesh since the late 1990's (Figure 3-5).

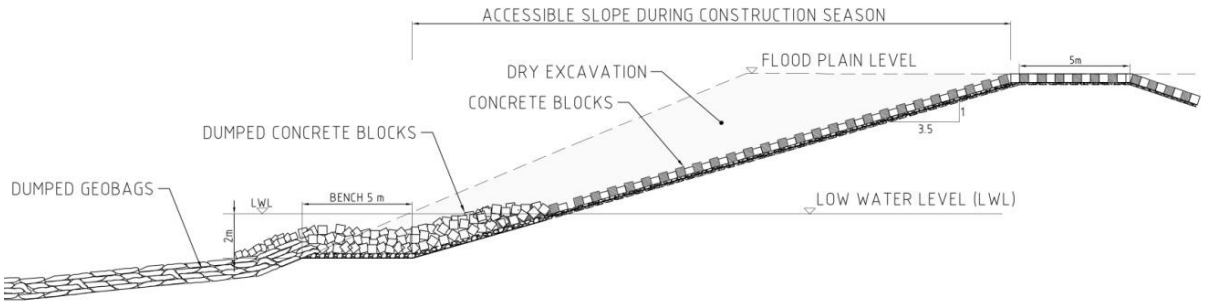


Figure 3-3. Typical cross-section of riverbank protection works with geo-sandbags and concrete blocks

The geotextile bags are made of a durable material (50 years life expectancy) and are filled with sediment (sand) that has been dredged from a nearby location, usually from low-lying sand bars in the middle of the river (Figure 3-5/1; 3-5/2). Bags are usually filled with 125 to 280 kg of sand, closed and dumped from geo-positioned barges below the low water line whereas the concrete blocks are placed above the low water line (Figures 3-3, 3-5/3, 3-5/4, 3-5/5). Bag filling and dumping as well as concrete-block making and placing is all done by labourers manually.

Construction of New Embankments and Regulators and Rehabilitation of Existing Ones

Modern flood embankment design incorporates a service road on the land side for emergency access and maintenances purposes, which in Bangladesh is a suitable combination due to the general lack of road and rail links. Various designs may be suitable depending on the local conditions, and a wide embankment body may be required for geotechnical stability due to the shortage of cohesive soils in large parts of the planning area (Figure 3-4).

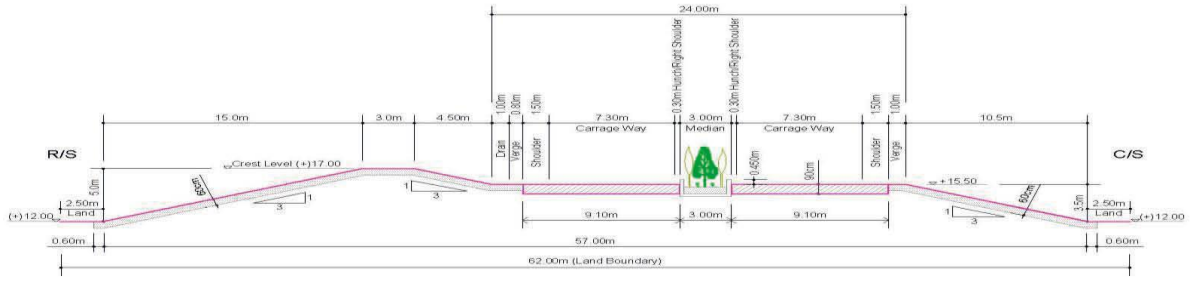


Figure 3-4. Example embankment incorporating a 2-lane road

1. Sand mining from a dredger in the middle of Padma River

2. As Picture 1

3. Unloading sand barges manually

4. Filling and closing of geotextile sandbags

5. Dumping sandbags from geo-positioned barge

6. On-site manufacturing of CC-blocks

7. Riverbank protection works in Harirampur

8. Southern limit of the riverbank protection works in Chauhali showing effectiveness against current and wave action.

Figure 3-5. River stabilization interventions as applied by FRERMIP in pilot areas (2015/2016)

As the embankments are to prevent inland areas from unplanned flooding, they are to be equipped with a number of regulators/fish passes for discharge of internal drainage water and for controlled intake of flood water. These regulators will also have a number of primarily environmental purposes i.e.:

- Maintaining floodplain aquatic ecosystems including facilitating fish migration to and from the floodplain;
- Increasing ground water recharge potential behind the embankment;
- Providing the opportunity for supplementary floodwater irrigation during the flood season with additional fine silt and clay sediment for increased soil fertility.

Creation of Spill Canals

On the basis of morphological planning studies, a number of spill canals have been planned, the purpose of which is to provide extra capacity in case of high discharge volumes but also to sustain fisheries and nature in general as these canals are supposed to carry water throughout the year.

Resettlement Sites

Implementation of the plan will require land for structural works. For this a resettlement plan is to be developed in accordance with policies of the GoB and program-financing institutions. The main principles for resettlement planning are:

- Minimize negative impacts as much as possible;
- Carry out resettlement and income and livelihood restoration activities to improve or restore the pre-program standards of living of affected persons;
- Inform and consult affected persons regarding compensation options (cash/replacement land) and income and livelihood restoration designs;
- Provide compensation for acquired assets at replacement rates;
- Pay compensation for acquired lands, structures/immovable properties, and other eligible benefits prior to ground levelling and demolition of structures.

3.5 Phasing and Timing

The plan for River Stabilization of the main rivers in Bangladesh is being prepared for the coming 25 years consisting of an initial plan being periodically (say every 5 years) updated. This plan forms part of the long term plan prepared by the Delta Plan 2100. The plan will be implemented through a number of programs and projects based on detailed feasibility studies for each phase of implementation, including other preparatory activities such as conducting an EIA (see Chapter 2). It typically takes several years before implementation can start. Various river stabilization activities have been carried out in the planning area, or are ongoing (for example pilot implementation under FRERMIP) or may start shortly (RMIP). Any stabilization work will require careful planning and may need additional study as interventions carried out will impact river behaviour, and thus further works.

3.6 Costs and Financing

Although considerable further planning is required, a first and preliminary cost estimate for a Riverbank Stabilisation Program (from Teesta/Jamuna confluence to Padma Bridge) has been made by the FRERMIP Consultant. Base costs are estimated at about USD 2 billion. If physical contingencies are included, the cost increases to USD 2.25 billion (Table 3-1).

Table 3-1. Preliminary cost estimate for a long-term River Stabilization program for Jamuna-Padma rivers as per June 2016

Cost Component (1)	Unit	Length	Unit Rate (USD M)	Total Cost (USD M)	% Base Cost
Bank protection works	Km	275	3.20	880	43
New flood embankments	Km	550	0.90	495	24
Rehabilitation of existing flood embankments	Sum			100	5
Dredging for navigation	Sum			150	7
Land acquisition & resettlement (12% / **2)**	Sum			177	9
Social & environmental safeguards (3% / **3)**	Sum			54	3
Program management (10%) / **4)**	Sum			186	9
Base cost				2,042	100
Physical contingencies (10%)				204	10
Total Cost				***2,246***	***110***

(1) From Teesta/Jamuna confluence to Padma Bridge; **(2)** Proportion of costs of bank protection works and flood embankments; **(3)** Proportion of costs of bank protection works, flood embankments and dredging; **(4)** proportion of all component costs

The lengths of bank protection works and flood embankments required for riverbank stabilisation (which include on-going works) has only been roughly estimated. More detailed planning will lead to more precise estimates.

With regard to financing, riverbank stabilisation works would be funded by donor agencies and GoB. The World Bank and/or ADB are expected to be the main donors providing about 80% of funds with GoB contributing 20%. The loan would be provided on concessional terms, i.e. low interest rates with repayments stretched over 25 to 40 years, including a 5 to 10 year grace period. In addition, bilateral donors (such as The Netherlands) could provide grants to meet costs of technical assistance, social/environmental safeguards etc.

4 BASELINE

Much information has been collected on the Jamuna-Padma-Meghna river system, for example through various Flood Action Plan (FAP) studies during the 1990's, as well as through more recent and elaborate studies such the Capital Dredging Feasibility Study, RMIP, FRERMIP, Jamuna and Padma Bridge studies, and others. This chapter aims at providing a short summary description of the most relevant topics for the river system concerned, based on these earlier works.

4.1 Physical Environment

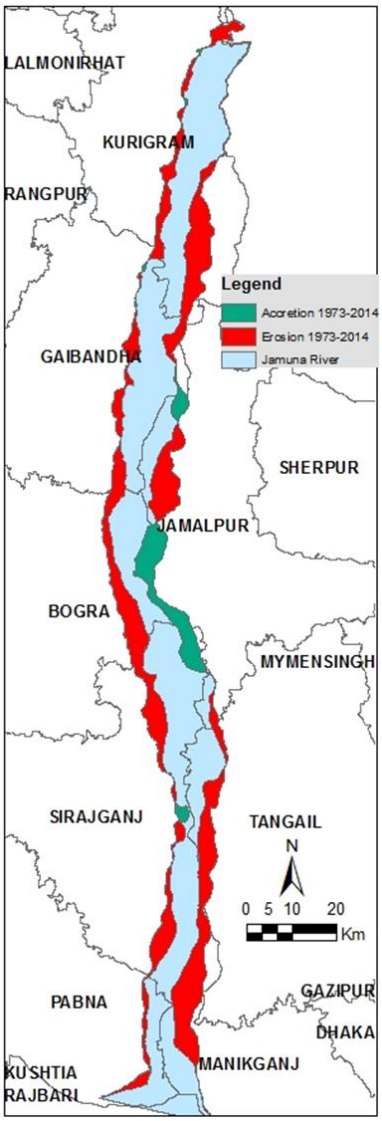


Figure 4-1. Erosion-accretion along Jamuna River during 1973-2014 (CEGIS 2014)

The Brahmaputra/Jamuna-Padma-Lower Meghna river system is one of the world's largest braided (various intertwined channels) rivers. highly dynamic and unpredictable. It is one of the four main rivers of Bangladesh (Jamuna, Ganges, Padma, and Meghna).

The Jamuna River is a continuation, from the Old Brahmaputra offtake, of the Brahmaputra River that originates high in the Himalayas. Flow of the Jamuna is generated from monsoon precipitation, base flow and snow melt. Mean annual flood flow is about 20,000 m^3/s. Most of the bed materials in Jamuna are fine sand.

The Jamuna River branched off from the current Old Brahmaputra River some 200 years ago, at present it is more than 200 km long and some 10-12 km wide on average. The width of the river has changed over the years and analysis shows a widening trend since 1900 which accelerated after the 1980s causing an increase in bank erosion. The erosion rate was high before the 1990s, but since the start of this century it has decreased significantly due to natural causes and human interventions such as the construction of river bank protection structures. However, the last 40 years has seen more erosion than accretion (Figure 4-1).

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

The Padma River carries the combined discharge of Brahmaputra

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

The course of the Padma River has changed significantly in the last 200 years from braided to straight, and through meandering back to braided. Analysis shows that during this period the river widened and that the left bank migrated (Figure 4-2).

The migration has been small where cohesive sediment is present. Due to this shifting, the Padma eroded thousand hectares of land between 1973 and 2014.

Sediment rating curve analysis of the river shows a significant decrease in bed material load from 1960s to 1990s, while wash load (silt and clay) has been increased during the same period. Agricultural and forestation activities in the upper riparian countries can be attributed to this trend.

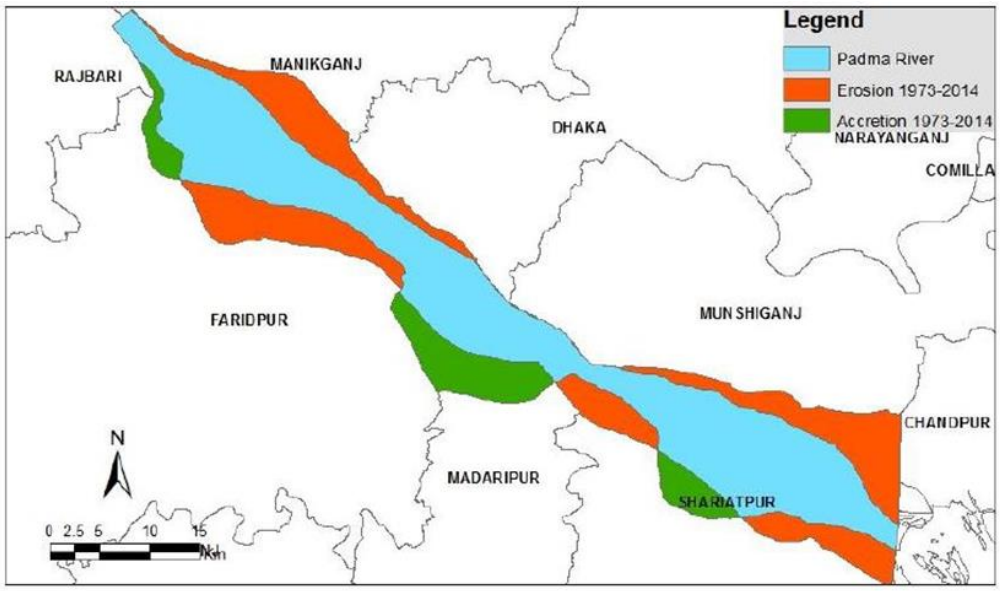


Figure 4-2. Erosion-accretion along Padma River during 1993-2014 (CEGIS 2014)

The planning area lies in the north-central part of the Bangladesh with a sub-tropical monsoon climate and three seasons namely summer/pre-monsoon from March-May, monsoon from June-October, and winter from November to February. The rainy season is hot and humid with about 88% of the annual rainfall. The winter is predominantly cool and dry.

The planning area is flat but slopes from north to south and towards the east. The plain in and around the river channel comprises a belt of unstable alluvial land constantly being formed and eroded by shifting river channels. As a consequence there is a relief of broad and narrow ridges and depressions in many locations. Large parts of the floodplain are used for agriculture whereas the rest of the land is occupied by settlement, homestead forestry, bamboo plantations and chars and water bodies. *Chars* or river islands/shoals are an important feature of a braided river system as the Jamuna-Padma-Meghna, but these are highly variable in time and space in terms of their location. All rivers in the planning area are interconnected by numerous *khals*, tributaries and distributaries that form a hydrological network in the north-central region. The most important distributaries, or

major rivers, are the Old Brahmaputra and the multiple channels of the Dhaleswari System. Other types of surface water resources include *beels*, wetlands and natural water channels or *khals*.

The hydrology and inundation patterns of almost 40% of the floodplains in Bangladesh are influenced by the Jamuna. As a result, major floods that have occurred over the years can be linked to high water levels in this river. Years with flooding disasters in the past 70 years are 1954, 1974, 1984, 1987, 1988, 1998 and 2004, resulting in loss of life and properties and billions of dollars of damage.

4.2 Biological Environment

Bangladesh is rich in biodiversity due to its location in the subtropical belt at the confluence of two biotic realms: Indo-Himalayas and Indo-China, however it is under tremendous pressure mainly due to the rapidly expanding human population, increased rate of exploitation of the natural resources and the resulting gradual loss of natural habitats. The loss of natural forests and conversion of wetlands are the primary reasons for the loss of wild plants and wildlife in the country. Still, the planning area harbours suitable habitats for a wide range of flora and fauna, many of which are of fisheries and wildlife importance: for example for the Ganges River Dolphin and wintering ground for migratory birds, besides diverse types of fish habitat. Two newly declared (in 2013) dolphin sanctuaries in the planning area (north of Jamuna bridge) aim at the survival of dolphins in the Jamuna. Two sanctuaries for migratory birds were proposed some years ago, north of Jamuna bridge and in the lower part of the Ganges, but have still not been established. Also there are a number of fish sanctuaries mostly located in the floodplain and the recently developed strategy for community-based management of fish sanctuaries is a promising tool for sustenance of the aquatic biodiversity.

The ecosystem in the planning area can be divided in two groups: (i) aquatic and (ii) terrestrial. The aquatic ecosystem comprises of wetlands with either flowing or stagnant water, whereas the terrestrial ecosystem includes human-induced (villages and crop fields) and natural (riparian grassland, reeds lands and islands which are high enough only to be flooded during extreme peak flows. These still support a range of wild plant and animal species, including a number of globally and/or nationally vulnerable and endangered species.

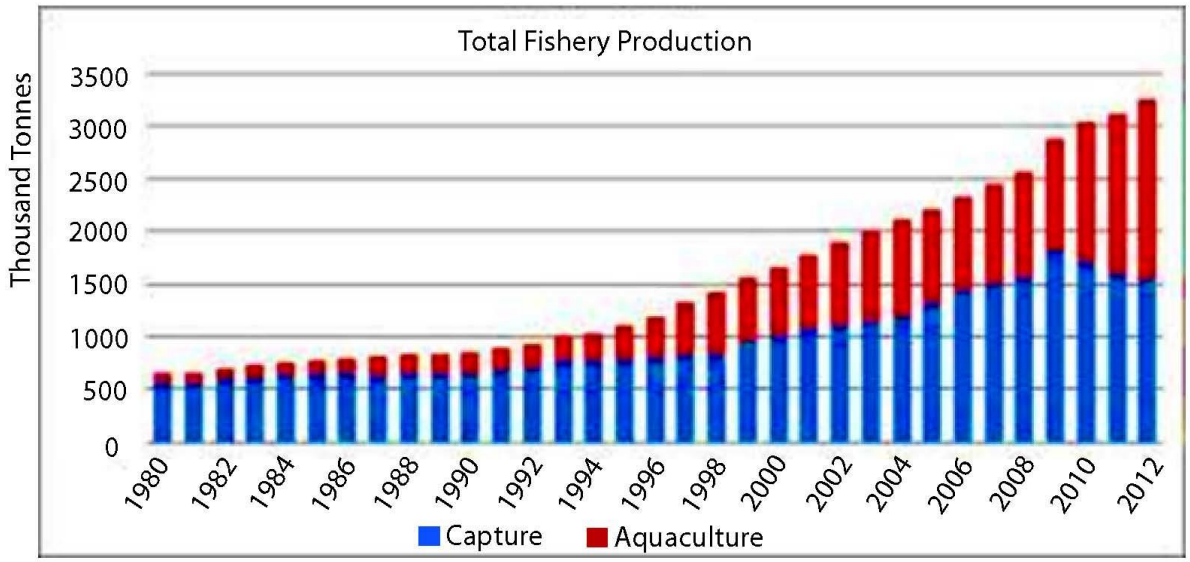
4.3 Socio-economic Environment

Population density in the planning areas varies but is usually in the order of 1,000 people / km^2. Administratively, the planning area is divided into districts, *upazillas* or sub-districts, unions, *mauza* or revenue villages and villages. The majority of the households in the planning area is engaged in agriculture and wholesale and retail trade, but increasingly employment is found in construction work, transport and industry, particularly the garment sector.

Farming practices in the planning area depend on physical, biological, climatological and socio-economic factors. Crops are grown during two seasons: *kharif* (March-October) and *rabi* (November-February). During the former mostly (Aus and Aman) rice, jute and vegetables are produced whereas during the *rabi* season crops such as (Boro) rice, pulses, spices, mustards, potato and other vegetables are grown. Main agricultural constraints include erosion, drainage congestion, siltation of inland waters, and scarcity of water for irrigation. Livestock and poultry keeping play a significant role in the rural agro-based economy as well, however shrinking and degrading pastures, fodder shortages, disease, and lack of veterinary services are among key problems encountered.

Fisheries is one of the main economic activities in the project area but capture fisheries is declining in recent years mainly due to over-fishing, reduced flooding and obstruction to fish migration created by embankments, silting up of inland waters, shrinkage of spawning and feeding grounds, water quality degradation from agricultural and industrial pollution. Aquaculture practices have been thriving in recent years and can be further improved to compensate for the foreseeable capture fisheries production losses.

Figure 4-3. Comparative development of capture and culture fisheries production in Bangladesh



5 INTERVENTION IMPACTS AND MITIGATION

5.1 Positive Impacts

5.1.1 Construction – Overview

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

5.1.2 Operation and Maintenance – Overview

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

Three of the more significant positive impacts are further described in the following sub-sections.

5.1.3 Control of Riverbank Erosion

During the last four to five decades, the Jamuna-Padma-Meghna river system has been undergoing strong metamorphosis in width, bank erosion and braiding intensities. Recent research suggests that sediment slugs generated by the 1950 Assam earthquake were the main driver for those rapid changes. In particular, riverbank erosion has resulted in loss of valuable land along the riverbanks. For example, the average rate of riverbank erosion along the Jamuna river north of Jamuna Bridge during last 40 years has been about 6 ha per km per year, resulting in loss of about 15,700 ha of valuable land during the period (RMIP, 2015). Along the same reach, another 6,000 ha may be lost due to riverbank erosion during the coming 30 years if no measures are taken to arrest the trend. The riverbank erosion not only causes loss of land but also attacks the already existing embankment, causing frequent breaches that in turn result in flooding of the protected floodplain causing substantial losses to private and public assets as well as crops and cultivation fields.

As part of the economic analysis of the River Stabilization Plan, the average yearly value of the above-described damages is being estimated. The variables considered include: (i) loss of land by type of land use; (ii) loss of houses; (iii) loss of social and other structures; and (iv) household relocation cost. The revetment works envisaged under the proposed plan will help avoid the losses

described above and will result in savings of about USD 110 million per year, i.e. the annual losses that are likely to take place caused by the riverbank erosion if no protective measures are taken.

5.1.4 Improved Flood Protection

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

As part of the economic analysis of the program, the average yearly value of the above-described damages is being estimated. There are three main benefit streams: (i) avoided flood losses – to infrastructure including houses and crops; and (ii) incremental agricultural and aquaculture benefits from increased production. Other benefit streams, such as navigation or road transport, potential industrialization etc. are typically not taken into account. The embankment rehabilitation and reconstruction works envisaged under the proposed program will help avoid the losses described above and will result in savings of about USD 75 million per year – the annual losses that are likely to take place caused by the flooding if no protective measures are undertaken.

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

5.1.5 Land Cover and Land Use Changes

The program influence area is dominated by settlements and cultivation. Although cropping intensity on the floodplains is high, there is good potential to further moderately increase it. Protection against erosion and flood damage will stimulate farmers towards increased crop intensity and toward high value crops. However, the cropping pattern could be changed with increasing the trend of growing high value crops. Area coverage of different crops is expected to increase in some locations due to protection of seasonal flood by the embankment. On the other hand, area coverage of some crops may decrease due to poor profit margins. The trends of crop production per unit area

for a couple of decades suggest that increase of yield (t/ha) for different crops will continue for some time by using modern production technologies and increased inputs. Once there is no threat of flood, farmers will invest in more inputs for cultivation and as a result the production per unit area will increase.

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

While increased agricultural income will positively impact the livelihood of local farmers, the increased cropping intensity and changed cropping pattern will potentially cause an increased use of agro-chemicals such as urea, TSP (Triple Super Phosphate) and MP (Muriate of Potash). 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 other communities in the project influence area.

5.1.6 New Fisheries Habitat

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

The planned interventions will result in a non-braided stable river ecosystem with narrower and deeper, faster flowing channels. This will create an aquatic environment favourable for deep water and current-loving fauna such as Hilsha fish, but is unfavourable for shallow-water fish that prefer low current velocities, such as most fingerlings.

As opposed to the steep eroding riverbank, the protected one provides easy access to the river.

On the other hand, a range of potentially negative impacts can be expected on the fisheries in the planning area, particularly if the interventions result in closing of large areas from influx of water and obstruction of fish movement – as is outlined below.

5.2 Negative Impacts

5.2.1 Construction – Overview

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

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

Most if not all of these adverse impacts are of a local and temporary nature, and can be mitigated relatively easily with proper mitigation measures that form part of best international practice. Permanent negative impacts associated with the construction works such a lost or damaged properties (trees, houses, land) and livelihoods are to be compensated for as per relevant policies of the GoB and financing agencies and in accordance with the Resettlement Action Plan (RAP) that is to be developed for and implemented by the program.

5.2.2 Operation and Maintenance – Overview

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

In the following sections a further elaboration is given on some of the more significant adverse impacts of the works, both construction and O&M. A systematic, tabulated assessment of all impacts of the works, both positive and negative, is provided in Annex 1.

5.2.3 Riverbank Protection and Construction/Rehabilitation of Embankments and Regulators

Impact

On the negative side these interventions result in significant changes in land use, land cover and habitats, and limit the supply of water to support local communities, agriculture and fisheries throughout the year. If no, inadequate or insufficient regulators/fish passes are provided, the connectivity between the main river and floodplain will be affected, which is of importance for migratory fish and other animal species since their reproduction and survival rely on such connectivity. Even with mitigation measures, the post-construction condition will be less favourable for the aquatic environment as compared to prior to the intervention. Compensation measures, if diligently carried out, may however, cover some of the anticipated fish production losses.

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

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

Social impacts of these works are on livelihoods through income reduction and livelihood dislocation that can be mitigated by focusing on income and livelihood restoration since most affected people are likely to be day labourers and/or share croppers rather than land owners.

Mitigation

As noted above, negative impacts of the riverbank protection and embankment works will need to be addressed through implementation of a fair and effective resettlement and/or compensation program and through various management interventions that include ensuring connectivity between the river and the floodplain through operation of regulators and actions that enhance fisheries – as is outlined below.

5.2.4 Dredging and Excavation Works

Impact

The impact of dredging largely depends on the location and on what is done with the dredging spoil. Under FRERMIP, dredging is so far exclusively done for the collection of sand for filling geotextile bags and for embankment construction and is conducted in the river itself where the sand content of the river floor is highest. Usually this is within a distance of a few kilometres from the construction sites. Impact of this type of dredging during the dry season construction window is believed to be low, local and temporary: fish, dolphins and other wildlife will temporarily avoid the area but will return once the dredger has ceased work or moved elsewhere. Impact on on-site fish habitat is also expected to be low or insignificant as most of the river's bottom sediment is expected to be loose material. Major dredging works in the river channels will also be part of the project implementation. This will be so-called "intelligent dredging" designed to stimulate certain river morphological developments. Dredging may also be done to keep navigation channels open during the dry season.

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

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

Dredged spoils may be dealt with in different ways. These will either be transported by barge to geotextile sandbag filling or embankment construction sites, or be dumped somewhere else, mostly to fill low lying areas that are potentially secured or reclaimed. Transport to bag filling or embankment construction areas will not involve significant impacts i.e. other than engine fumes and

noise produced by barges. Spoil dumping may involve transport by barge as well or pumping through floating pipes to disposal sites. The latter may be other parts of the river (open water where this will not hamper navigation) or *char* or *khas* land.

Dredged spoil deposition sites may cover large areas that prior to the works are in use for agriculture, livestock, fisheries or that provide habitat for wild animals and plants and that temporarily or permanently will be lost. Spoil deposits can be expected to have a high sand content and thus low soil fertility, and therefore it may take years before these lands become productive.

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

Mitigation

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

Negative impacts of the dredging and excavation works can, to some extent, be mitigated by creating and enhancing alternative fish and wildlife habitats, for example through the establishment of Fish and Wildlife Sanctuaries – see Section 5.2.7 and 5.2.8, below.

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

Lost or damaged lands, crops or other assets will be compensated for in line with a Resettlement Action Plan that is to be developed for the proposal programme.

5.2.5 Reduced Flooding – Base Flow

Impact

The overall river stabilization works (dredging, bank protection and embankments to prevent flooding) are expected to reduce the width of the river system (from the current braided system to a one or two channel system) and to deepen the main channel(s) which is expected to lower to some extent the low water levels. This may particularly impact water levels in distributaries, notably the Old Brahmaputra, Dhaleswari and Arial Khan. The Old Brahmaputra and the Dhaleswari have been receiving less water in the past few years, which has led to a gradual decrease in flow along these rivers and resulted in many other impacts downstream such as deterioration of groundwater availability, reduction in surface water availability, impact on domestic water supplies, reduced irrigation opportunity, reduced crop and fisheries production, reduction in navigability, declining biodiversity and (particularly in relation to the Dhaleswari) increase in both surface and groundwater pollution. The Arial Khan has not experienced a recent reduction of inflow, but also here the inflow depends on the morphological conditions at the offtake.

Preparation of the program includes study of the offtakes of these three rivers with the aim of re-establishing/maintaining flow from the main rivers as well as determining minimal environmental base flow. An IWM study in 2015 of the Dhaleswari offtake noted that the aim is to divert 245 m^3/s

from the Jamuna River into the Dhaleswari/Pungli/Bangshi/Turag/Buriganga river system with 141 m^3/s to the Buriganga river to bring the dissolved oxygen levels up to 4 mg/l from the current 1 mg/l.

Reduced flooding will affect the floodplain fisheries ecosystem and thereby fish production.

Advantages are: groundwater recharge, fisheries, navigation, water quality, irrigation improvement.

Mitigation

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

5.2.6 Fisheries

Impact

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

- **River stabilization:** Channelization or removal of a braided of a river system will or may result in (i) loss of fisheries habitat; (ii) an altered ecosystem, good for deep water fish but unfavourable for shallow water fish; (iii) increased river flow, which may be good for rheophilic (current loving) fish, unfavourable for fish that prefer lower flow velocities; or may be achieved by (iv) dredging which will affect the fisheries ecosystem by destabilizing bottom fisheries, a deeper river bed which may not be usable for the predecessors (present users), dredged materials may destroy potential fisheries habitat. Revetment of river banks to contain bank erosion will replace soft fragile aquatic habitat by stable, relatively harder eco-base the precise impact of which will have to be determined but may not be significantly harmful for the fisheries. Construction or rehabilitation of embankments along river banks to contain river flooding may result in the loss of river floodplain connectivity affecting floodplain flooding and obstructing fish migration making the floodplain less productive.

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

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

- **Reduced fish migration:** Reduced hydrological connectivity across embankment sluice gates reduces lateral fish movements in two ways: firstly by reducing the number of fish entry points on to the floodplain and thereby concentrating fish into fewer channels where they are more susceptible

to capture, and secondly by closing gates of regulators for extended periods during pre-monsoon and monsoon (high river water levels). Gate closure also blocks the entry of fish hatchlings carried downstream in rivers by passive drift and prevents them reaching nursery areas on floodplains. Even when gates are open, severe hydraulic conditions (current) reduce densities and supply rates in regulated rivers.

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

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

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

Mitigation and Compensation

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

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

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

Structural Measures

- Development of major distributaries such as the Dhaleswari, Arial Khan and Old Brahmaputra to sustain natural flow to feed adjacent floodplain ecosystems. Also measures will need to be taken to increase the flow in the Dhaleswari system to flush the dead ecosystem of Buriganga.

- Spill way canals to provide additional supply floodplains to support the fisheries ecosystems.

- Provision of fish passes along sluice gates that favour fish migration.

- Fixing IL of Regulators to maintain flooding of F2-F4 land types to support fisheries ecosystems.

- Excavation of canals connecting floodplain will enhance flooding. Excavation of beels will increase beel productivity

- Establishment of Fish/Biodiversity Sanctuaries in the floodplain and, if possible, in rivers.

Non-structural Measures

- Fish friendly operation of regulators

- Community based management of fisheries related activities

- Management of fisheries particularly for rational fishing

- Providing training for (a) awareness building and (b) adoption of improved technology

- Extension support for fisheries management and improved aquaculture

Other Measures

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

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

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

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

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

- **Conversion of full flood control to partial control:** In some areas full control and river confinement has resulted in high water levels and responses to cut embankments to reduce

flooding. Conversion to a partial control regime would allow for deep water *aman* and increase fisheries potential.

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

5.2.7 Natural Habitats and Wildlife

Impact

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

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

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

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

Mitigation

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

Also, the Bangladesh Bird Club has developed a couple of years ago a proposal for establishment of two sanctuaries for migratory birds (one north of Jamuna Bridge and the other in the Lower Ganges) and submitted these the DoE, but for various reasons this did not result on formal establishment, so such proposal should be reconsidered and re-submitted.

5.2.8 Worker's Camps

Impact

Construction of riverbank protection and flood control works requires large numbers of labourers. Although some of these are from the immediate surroundings, many of them live far away and are accommodated in worker's camps. Typically these camps are temporary settlements consisting of

basic tents for hundreds of workers and which are located on hired land close to a project office. The camps include basic support facilities such as one or more tube-wells, cooking sites and simple sanitary facilities. The latter particularly may give rise to complaints by nearby residents in the areas concerned, such as is the case in some of the worker's camps already established under FRERMIP. Here people from the surrounding areas complain about a bad smell and unhealthy conditions that negatively affect their living conditions. Also waste management is of a low standard or absent almost everywhere in these camps, and tube-wells are not or poorly protected.

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

As per the ADB guidelines for project management, the project promoter (BWDB) is responsible for establishing and running a Grievance Redress Mechanism (GRM) at each site but thus far this isn't operational as yet anywhere.

Mitigation

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

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

5.3 Cumulative Impacts

Cumulative impacts can be defined as the additional changes caused by a proposed development in conjunction with other similar developments or as the combined effect of a set of developments, taken together. The following environmental components are considered in this context:

(i) **Climate change** is likely to lead to increased river discharge volumes in the near future followed by reduced discharges and continuously rising sea level resulting in a need for altered requirements for riverbank and flood protection works as well as the drainage capacity of rivers. Failure to address such cumulative impact timely and adequately may result in that actions taken to implement the River Stabilization Plan will be fully or partly nullified.

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

(iii) **River morphology** – The cumulative effect of the envisaged works will be beneficial in controlling further erosion and flooding of the river system's floodplains and displacement of hundreds of thousands of people. Channel flows will be controlled by the structures installed and it is likely that these will maintain greater depth. This would increase stability of the

channels. On the other hand, stabilized river channels may lower low water levels both in Bangladesh and India and reduce dry season inflow to distributaries, causing regional or local water shortage.

(iv) **Aquatic biodiversity** – Experience from other countries (China: Yellow River, USA: Mississippi) and in Bangladesh learns that that impacts of river stabilization on aquatic biodiversity will generally be negative. Mitigation measures, if properly conducted, may diminish/reduce the extent and intensity of these impacts. Production losses from capture fisheries may be compensated by aquaculture practices, however this will not replace biodiversity losses.

6 ENVIRONMENTAL SUSTAINABILITY

6.1 Objectives

Sustainability is the capacity to endure. In ecology the word describes how biological systems remain diverse and productive over time. For humans it is the potential for long-term maintenance of well-being, which in turn depends on the maintenance of the natural world and natural resources herein.

Within the framework of river stabilization in Bangladesh, environmental sustainability' is regarded as the ability to continue indefinitely with a certain resource use level defined at a specific point of time, including the harvesting of renewable resources (for example fish), generation of pollution (for example solid waste), occurrence of specific plant or animal species (for example dolphins), and depletion of non-renewable resources (for example good quality groundwater). If levels at a point in time cannot be maintained indefinitely, then they are not sustainable.

A difficulty here is to define the 'point in time'. Is that the present time, or should it for example be the middle of the 20th century when river channels were narrower, but also when the environment was less affected by humans.

Although it may technically be possible to stabilize the river system in a planform that resembles the mid-1950s, given the drastically expanded population and accompanying resource use, it is unrealistic to expect that 'the environment' (for example coverage by natural vegetation, size and distribution of wildlife populations) can return to a level of some 60-70 years back. However, through adequate interventions it may be possible to stabilize the present decline of natural habitats, fisheries and wildlife populations, and even better to enhance and strengthen these.

The present chapter aims at providing tools with which environmental sustainability of the proposed interventions of the Plan can be measured.

6.2 Criteria and Indicators

Criteria and Indicators (C&I) are policy instruments by which environmental sustainability of, in this case, river stabilization may be evaluated and reported on. C&I is a conjunctive term for a set of objectives and variables/descriptions that allow evaluating whether the objectives are achieved or not.

In general Criteria and Indicators:

- Help to define, understand and promote the concept of sustainable management;
- Provide a common framework to describe, monitor, assess and report on trends and progress if measured periodically;
- Reflect a holistic approach to the river system as an ecosystem, highlighting the full range of values;
- Facilitate policy dialogue and the development of policies or strategies ;
- Help to implement water resources and conservation/protection related policies, plans and programmes;

- Contribute to cross-sectoral sustainability assessments, as well as assessments for other sectors (e.g. forestry, energy, climate change, agriculture, sustainable land management);
- Guide river management practice;
- Help to identify the changes in river management;
- Help to develop standards and indicators.

Indicators show changes over time for a criterion and demonstrate the progress made towards its specified objective. Periodically measured indicators reveal the direction of change with respect to criterion.

Quantitative indicators are expressed in measurement units and the necessary data are collected via regular inventories, field surveys, remote sensing, etc.

Qualitative indicators have to be described and assessed and the data are collected using questionnaires. They are used to describe legal and institutional frameworks of river or environmental management, as well as policies and instruments for the implementation.

The following criteria (bold font) and indicators (bullet points) are proposed for measuring environmental sustainability of the River Stabilization Plan for the Jamuna-Padma-Lower Meghna river system.

Criterion 1 – Conservation of biological diversity

- Ecosystem Diversity
- Species Diversity
- Genetic Diversity

Criterion 2 – Maintenance of wetlands

- Areal extent
- Water quality
- Resource use
- Pollution

Criterion 3 – Maintenance of a productive river and floodplain fisheries

- Area available for inland fisheries
- Fish stocks available and suitable for production
- Annual production as compared to sustainable harvest levels

Criterion 4 – Maintenance of ecosystems health and vitality

- Scale and impacts of agents and processes affecting river and flood plain health and vitality
- Area and type of human-induced disturbance

Criterion 5 – Conservation and maintenance of wildlife populations

- Ganges Dolphin
- Migratory Birds
- Other Species

Criterion 6 – Maintenance and enhancement of long term socio-economic benefits to meet the needs of local communities

- Production and consumption
- Investment
- Recreation and tourism
- Cultural, social, and spiritual needs and values
- Employment and community needs
- Community participation

Criterion 7 – Legal, institutional and economic framework for conservation and sustainable management

- Extent to which the legal framework (laws, regulations, guidelines) supports the conservation and sustainable management of biodiversity, fisheries and wildlife populations
- Extent to which the institutional framework supports the conservation and sustainable management of biodiversity, fisheries and wildlife populations
- Extent to which the economic framework supports the conservation and sustainable management of biodiversity, fisheries and wildlife populations
- Capacity to measure and monitor changes in the conservation and sustainable management of biodiversity, fisheries and wildlife populations
- Capacity to conduct and apply research and development aimed at improving the management of biodiversity, fisheries and wildlife populations, including development of scientific understanding of river and floodplain ecosystems, characteristics and functions

The relevance of these criteria for the laws, policies and plans outlined in Chapter 2 is indicated in Table 6-1.

6.3 Monitoring

It is anticipated that monitoring and reporting against the above-mentioned criteria and indicators will:

- Improve information about the current state of the environment and trends in general, and specifically biodiversity, fisheries and wildlife populations in the Jamuna/Padma-Lower Meghna river system, including the adjacent floodplain;
- Define sustainable management of the river ecosystem;
- Allow credible performance reporting to relevant national and local government and non-governmental organisations and communities;
- Facilitate inter/intra-agency communication and data exchange;
- Improve stakeholder/community consultation and participation in sustainable ecosystem management;
- Draw on existing data resources and identify where other relevant data may exist;
- Influence research directions to ensure knowledge gaps are identified and addressed;
- Highlight the water resources sector's contribution to sustainable development in the Jamuna-Padma-Lower Meghna river system; and
- Improve the efficacy of management systems, policies and procedures.

Table 6-1. Relevance of sustainability criteria for legal/policy framework

Sustainability criteria Acts / Policies / Plans	Crit. 1 Biological diversity	Crit. 2 Wetlands	Crit. 3 Productive fisheries	Crit. 4 Ecosystem health & safety	Crit. 5 Wildlife	Crit. 6 Comm. needs	Crit. 7 Legal Inst.
Bangladesh National Conservation Act (1995/2010)	✓✓	✓✓	✓	✓✓	✓		✓✓
Bangladesh Environment Conservation Rules (1997)	✓✓	✓✓	✓	✓✓	✓		✓✓
Bangladesh Environment Court Act (2010)	✓	✓	✓	✓✓	✓	✓✓	✓✓
National Environment Policy (1992)	✓	✓	✓✓	✓✓	✓	✓✓	✓✓
National Environment Management Action Plan (1995)	✓	✓	✓	✓✓	✓	✓	✓
National Fisheries Policy (1996)	✓✓	✓	✓✓	✓✓		✓✓	✓✓
National Water Policy (1999)	✓	✓✓	✓✓	✓✓			✓✓
National Agriculture Policy (1999)						✓✓	✓✓
National Water Management Plan (2001)		✓	✓	✓		✓	✓
National Land Use Policy (2001)						✓	✓
National Adaptation Program of Action (2005)		✓		✓		✓	✓
Bangladesh Climate Change Strategy and Action Plan (2009)				✓		✓✓	✓✓
Millennium Development Goals (2005-2015)	✓	✓	✓	✓		✓	✓
Perspective Plan (2011-2021)				✓		✓✓	✓
National Sustainable Development Strategy (2013)	✓	✓	✓	✓✓	✓	✓	✓
Bangladesh Water Act (2013)		✓	✓	✓		✓	✓✓
Post-2015 Development Agenda (2015)	✓	✓	✓	✓		✓	✓✓
National Five Year Plan (2015-2020)			✓	✓		✓✓	✓
Bangladesh Delta Plan 2100	✓	✓	✓	✓✓	✓	✓✓	✓✓

✓✓ High relevance – most relevant Acts/Policies are indicated in dark blue
✓ Some relevance

7 STAKEHOLDER CONSULTATION

As stated earlier, this preliminary version of the Strategic Environmental and Social Assessment of long-term stabilization of main rivers in Bangladesh was prepared primarily on the basis of a review of some highly relevant and recent reports of projects and programs that have studied or implemented river stabilization in Bangladesh on a sub-regional or more local scale.

In addition to this review a social impact assessment and project intervention perception survey has been undertaken by Focus Group Discussions. This survey focused on people living on chars and within the currently flooded floodplain of the Jamuna-Padma river corridor in areas likely to be stabilised and reclaimed.

Since the project interventions propose to change the living conditions of people living on chars a rapid social impact assessment has been undertaken to assess current living conditions and what the potentially affected people think about the project interventions as regards their future aspirations. This survey is ongoing but has been stopped during Ramadan (June 2016) but initial outcomes are given below, and a summary report is given in Appendix 1.

- **Current Vulnerability** – The people living on chars are happy to live in there but they feel vulnerable because of river erosion and/or flood damage.
- **Livelihood** – Their main livelihoods are agriculture, and raising goats, cows and horses and fishing in the river.
- **Problem Ranking** – River flooding and erosion is the primary problem, lack of sanitation facilities, lack of educational institutions and lack of health support are further issues.
- **Project acceptance** – They are happy to have their char stabilised and wish to live in one place in their life so that their children will not need to move due to erosion as they have done.
- **Industrialisation acceptance** – They are in favour of a special economic zone (SEZ) being established and they will be happy to have employment within their char. Agro-processing including livestock such as dairy is highly acceptable as is garment manufacturing.
- **Tenure vulnerability** – People owning private land are secure in their tenure. All people, including those tenants on khas land say that SEZs should be established on khas rather than private land and that there is enough khas land on chars for this to happen. Good agricultural land should not be used for SEZs.
- **Future aspirations** – They want a secure life, to live where they currently live with employment opportunities for them and their children. They do not want to move to the big city and hate slum life, much preferring life on the char.

Consultation of stakeholders on the preliminary findings and for further development of the present SESA could therefore focus on the following topics:

- Does the scope, structure and content of the present SESA generally meet the expectation, and is it regarded as a useful tool in ensuring that the planned technical river stabilization interventions are environmentally and socially sound and sustainable?

- Have any relevant laws, policies or plans been omitted?

- Does the present SESA require amendments in the regulatory framework if the plan would be implemented, and if so which changes would be required?

- Does the description of the planned river stabilization interventions provide sufficient detail to be able to determine possible positive and negative impacts associated with these? If not what sort of further detail would be needed?

- Have impacts, positive and negative, of the interventions for the purpose of this SESA been adequately addressed, and if not what sort of change (structure, level of detail, additional topics) would be needed?

- Does the chapter on environmental sustainability meet the expected requirements to be able to evaluate the effect of the plan on the regulatory framework, and if not what amendments would be required?

8 IMPACT TABLES

As indicated above the overwhelming impact of all the proposed interventions is positive but they will all also have negative impacts on the communities in the study area primarily associated with income reduction due to relocation but also including adverse income distribution consequences with large land owners gaining most benefits. Mitigation processes need to be set up to ensure that income and livelihood restoration is as equitable as possible.

There will also be impacts on cultural heritage (i.e. not only physical structures such as graves, mosques, areas of worship but all landscape elements deemed to be of importance), but also community facilities, occupational health and safety, and community health and safety including the spread of AIDS/HIV. Consultations are required with communities to identify impacts and necessary mitigation measures.

There could be other impacts on the entire way of life for many people. For example, if reclaimed land is used for large scale farming, small farmers could become workers in these large scale farms. Similarly, with increased industrialisation, small scale farmers may become industrial workers. Preliminary consultation of those living on the chars indicates that indeed they want industry to provide employment and they suggested agro-processing as suitable industries that they could feed into.

Table 8-1 presents a preliminary listing of potential interventions that may be undertaken as part of the River Stabilization Plan implementation with their expected environmental and social impacts, positive and negative.

Table 8-2 provides a key to the significance of the identified impact criteria.

Table 8-1. Significance of impact criteria

Magnitude of potential impact	Sensitivity of receptors			
	Very severe	Severe	Mild	Low / negligible
Major	Critical	High	Moderate	Negligible
Medium	High	High	Moderate	Negligible
Minor	Moderate	Moderate	Low	Negligible
Negligible	Negligible	Negligible	Negligible	Negligible

Table 8-2. Potential interventions and expected adverse environmental and social impacts

Intervention	Potential impact	Impact duration	Spatial extent	Reversible (Y/N)	Likelihood	Magnitude	Sensitivity	Significance prior to mitigation	Significance after mitigation	Mitigation measure
No-project scenario										
None	Continued riverbank erosion and associated impacts	Long term	Local	Yes	Certain	Major	Severe	High negative	--	--
None	Continued flooding and associated impacts	Long term	Local	Yes	Certain	Major	Severe	High negative	--	--
None	Continued navigation constraints, particularly during dry season	Long term	Local	Yes	Certain	Major	Severe	Negative	--	--
With-project scenario										
All interventions	Control of riverbank erosion	Long term	Local	Yes	Certain	Major	--	--	High positive	Revetments
All interventions	Improved flood protection	Long term	Local	Yes	Certain	Major	--	--	High positive	Embankment rehab & construction
All interventions	Improved navigability	Long term	Local	Yes	Certain	Major	--	--	Positive	River narrowing, dredging
Impacts related to project siting										

Intervention	Potential impact	Impact duration	Spatial extent	Reversible (Y/N)	Likelihood	Magnitude	Sensitivity	Significance prior to mitigation	Significance after mitigation	Mitigation measure
All interventions	Land scape, land cover and land use changes	Long term	Local	No	Certain	Major	Severe	High negative	Moderate negative	GoB supported land improvement program
All interventions	Loss of natural vegetation and trees	Long term	Local	Yes	Certain	Major	Severe	High negative	Moderate negative	Seeding / planting
All interventions	Loss of riverbank & aquatic habitat	Long term	Local	No	Certain	Medium	Severe	High negative	Moderate negative	Creating protected areas, assuring connectivity
All interventions	Loss of floodplain habitat	Long term	Local	No	Certain	Major	Severe	High negative	Moderate negative	Creating wetlands, assuring connectivity
All interventions	Low water levels	Seasonal	Local	No	Certain	Medium	Mild	Moderate negative	Moderate negative	--
All interventions	Drainage congestion and waterlogging	Long term	Local	No	Likely	Medium	Mild	Moderate negative	Low negative	Regular maintenance
All interventions	Land acquisition and resettlement	Long term	Local	No	Certain	Major	Severe	High negative	Moderate to low	Fair and reasonable compensation
All interventions	Loss of agriculture	Long term	Local	No	Certain	Major	Very severe	High negative	Moderate negative	Fair and reasonable compensation
All interventions	Loss of community facilities and places of religious significance	Long term	Local	No	Certain	Major	Severe	High negative	Moderate to low	Fair and reasonable compensation

Intervention	Potential impact	Impact duration	Spatial extent	Reversible (Y/N)	Likelihood	Magnitude	Sensitivity	Significance prior to mitigation	Significance after mitigation	Mitigation measure
All interventions	Blocked access because of road & embankment	Long term	Local	No	Certain	Major	Mild	Moderate negative	Low negative	Alternative routing
Construction										
Large-scale dredging	Dredging activities on a massive scale with expected short-term effectiveness due to high river sediment loads and rapid refill of dredged areas requiring frequent (continuous?) re-dredging	15 years	Local	Yes	Certain	Major	Severe			
	Air pollution	15 years	Local	Yes	Certain	Medium	Mild	Moderate negative	Low negative	Use of modern low pollution equipment
	Noise	15 years	Local	Yes	Certain	Medium	Mild	Moderate negative	Low negative	Use of modern low noise emission equipment
	Water pollution by solid / hazardous wastes (e.g. fuel spills)	15 years	Local	Yes	Certain	Medium	Mild	Moderate negative	Low negative	Waste management
	Fisheries loss	15 years	Local	Yes	Certain	Medium	Severe	High negative	Moderate	Enhancement or creation and management of

Intervention	Potential impact	Impact duration	Spatial extent	Reversible (Y/N)	Likelihood	Magnitude	Sensitivity	Significance prior to mitigation	Significance after mitigation	Mitigation measure
									negative	alternative fisheries sites
	Disturbance to wildlife, particularly dolphins and (migratory) birds, reptiles, etc.	15 years	Local	Yes	Certain	Medium	Severe	High negative	Moderate negative	Enhancement or creation and management of alternative wildlife areas (sanctuaries)
	Health and safety of Contractor's workers	15 years	Local	Yes	Certain	Medium	Mild	Moderate negative	Negligible	Proper best practice
Establishing / running worker's camps	Land loss	15 years	Local	Yes	Certain	Medium	Mild	Moderate negative	Low negative	Fair and reasonable compensation
	Crop / tree loss	15 years	Local	Yes	Likely	Medium	Mild	Moderate negative	Low negative	Fair and reasonable compensation
	Fuel spills	15 years	Local	Yes	Likely	Medium	Mild	Moderate negative	Low negative	Proper fuel handling and waste management
	Other pollution	15 years	Local	Yes	Likely	Medium	Mild	Moderate negative	Low negative	Proper waste management
	Health and safety of Contractor's workers	15 years	Local	Yes	Certain	Medium	Mild	Moderate negative	Negligible	Proper best practice
Depositing dredged	Many spoil dump sites, e.g. 178 sites along Jamuna R,	Long term	Local	No	Certain	Major	Severe	High negative	Moderate negative	Soil improvement through organic and fertilizer additions (time and effort

Intervention	Potential impact	Impact duration	Spatial extent	Reversible (Y/N)	Likelihood	Magnitude	Sensitivity	Significance prior to mitigation	Significance after mitigation	Mitigation measure
material	Padma R and Lower Meghna R – covering more than 460,000 ha, each site (2000-3000 ha; max 37,5000 ha) covered by a layer of spoil in part on current agriculture land; fertility expected to be low / disrupted possibly for decades.									consuming & costly)
	Loss of agriculture land, including crops	Long term	Local	Yes	Certain	Major	Severe	High negative	Moderate negative	Fair and reasonable compensation
	Loss of natural vegetation and habitats	Medium term	Local	Yes	Certain	Major	Severe	Moderate negative	Low negative	Enhancement or creation and management of alternative natural habitats (e.g. sanctuaries)
	Destroyed landscape fabric and loss of historic, cultural & social values by covering land with a layer of spoil deposits	Long term	Local	Yes	Certain	Major	Severe	High negative	--	None

Intervention	Potential impact	Impact duration	Spatial extent	Reversible (Y/N)	Likelihood	Magnitude	Sensitivity	Significance prior to mitigation	Significance after mitigation	Mitigation measure
	Blockage of natural drainage, navigation and fish migration	Long term	Local	No	Certain	Medium	Mild	Moderate negative	Low negative	Proper planning & implementation of navigation & migration routes / connectivity
	Blockage of access routes due to piping	15 years	Local	Yes	Certain	Medium	Minor	Low negative	Negligible	Proper management of access
	Health and safety of Contractor's workers	15 years	Local	Yes	Certain	Medium	Mild	Moderate negative	Negligible	Proper best practice
Establishing / running worker's camps	See above									
Riverbank protection through revetments (sandbags and concrete slabs)		Long term	Local	No	Certain	Major				
Collection of borrowing material	Air pollution	Short term	Local	Yes	Likely	Medium	Mild	Moderate negative	Low negative	Use of modern low pollution equipment
	Noise	Short term	Local	Yes	Likely	Medium	Mild	Moderate negative	Low negative	Use of modern low noise emission equipment

Intervention	Potential impact	Impact duration	Spatial extent	Reversible (Y/N)	Likelihood	Magnitude	Sensitivity	Significance prior to mitigation	Significance after mitigation	Mitigation measure
	Water pollution	Short term	Local	Yes	Certain	Major	Severe	High negative	Low negative	Proper environmental management
	Soil contamination	Short term	Local	Yes	Certain	Major	Severe	High negative	Low negative	Proper environmental management
	Solid waste and hazardous waste	Short term	Local	Yes	Certain	Major	Severe	High negative	Low negative	Proper environmental management
	Aquatic habitat deterioration	Medium term	Local	Yes	Certain	Major	Severe	High negative	Moderate to low negative	Enhancement or creation and management of alternative fisheries sites
	Floodplain deterioration	Medium term	Local	Yes	Certain	Major	Severe	High negative	Low negative	Enhancement or creation and management of alternative fisheries sites
	Char land deterioration	Medium term	Local	Yes	Unlikely	Minor	Mild	Low negative		
	Health and safety of Contractor's workers	15 years	Local	Yes	Certain	Medium	Mild	Moderate negative	Negligible	Proper best practice
Establishing / running worker's camps	Land loss	15 years	Local	Yes	Certain	Medium	Mild	Moderate negative	Low negative	Fair and reasonable compensation
	Crop / tree loss	15 years	Local	Yes	Likely	Medium	Mild	Moderate negative	Low negative	Fair and reasonable compensation

Intervention	Potential impact	Impact duration	Spatial extent	Reversible (Y/N)	Likelihood	Magnitude	Sensitivity	Significance prior to mitigation	Significance after mitigation	Mitigation measure
	Fuel spills	15 years	Local	Yes	Likely	Medium	Mild	Moderate negative	Low negative	Proper fuel handling and waste management
	Other pollution	15 years	Local	Yes	Likely	Medium	Mild	Moderate negative	Low negative	Proper waste management
	Health and safety of Contractor's workers	15 years	Local	Yes	Certain	Medium	Mild	Moderate negative	Negligible	Proper best practice
Embankment rehabilitation and construction										
Collection of borrowing material	Air pollution	Short term	Local	Yes	Likely	Medium	Mild	Moderate negative	Low negative	
	Noise	Short term	Local	Yes	Likely	Medium	Mild	Moderate negative	Low negative	
	Water pollution	Short term	Local	Yes	Certain	Major	Severe	High negative	Low negative	
	Soil contamination	Short term	Local	Yes	Certain	Major	Severe	High negative	Low negative	
	Solid waste and hazardous waste	Short term	Local	Yes	Certain	Major	Severe	High negative	Low negative	
	Aquatic habitat deterioration	Medium term	Local	Yes	Certain	Major	Severe	High negative	Low to moderate	

Intervention	Potential impact	Impact duration	Spatial extent	Reversible (Y/N)	Likelihood	Magnitude	Sensitivity	Significance prior to mitigation	Significance after mitigation	Mitigation measure
									negative	
	Floodplain deterioration	Medium term	Local	Yes	Certain	Major	Severe	High negative	Low negative	
	Char land deterioration	Medium term	Local	Yes	Unlikely	Unlikely	Minor	Negligible		
	Health and safety of Contractor's workers	15 years	Local	Yes	Certain	Medium	Mild	Moderate negative	Negligible	Proper best practice
Establishing / running worker's camps	Land loss	15 years	Local	Yes	Certain	Medium	Mild	Moderate negative	Low negative	Fair and reasonable compensation
	Crop / tree loss	15 years	Local	Yes	Likely	Medium	Mild	Moderate negative	Low negative	Fair and reasonable compensation
	Fuel spills	15 years	Local	Yes	Likely	Medium	Mild	Moderate negative	Low negative	Proper fuel handling and waste management
	Other pollution	15 years	Local	Yes	Likely	Medium	Mild	Moderate negative	Low negative	Proper waste management
	Health and safety of Contractor's workers	15 years	Local	Yes	Certain	Medium	Mild	Moderate negative	Negligible	Proper best practice
Stabilizing distributary										

Intervention	Potential impact	Impact duration	Spatial extent	Reversible (Y/N)	Likelihood	Magnitude	Sensitivity	Significance prior to mitigation	Significance after mitigation	Mitigation measure
off-takes										
Collection of borrowing material	Air pollution	Short term	Local	Yes	Likely	Medium	Mild	Moderate negative	Low negative	
	Noise	Short term	Local	Yes	Likely	Medium	Mild	Moderate negative	Low negative	
	Water pollution	Short term	Local	Yes	Certain	Major	Severe	High negative	Low negative	
	Soil contamination	Short term	Local	Yes	Certain	Major	Severe	High negative	Low negative	
	Solid waste and hazardous waste	Short term	Local	Yes	Certain	Major	Severe	High negative	Low negative	
	Aquatic habitat deterioration	Medium term	Local	Yes	Certain	Major	Severe	High negative	Low to moderate negative	
	Floodplain deterioration	Medium term	Local	Yes	Certain	Major	Severe	High negative	Low negative	
	Char land deterioration	Medium term	Local	Yes	Unlikely	Unlikely	Minor	Negligible		
	Health and safety of Contractor's workers	15 years	Local	Yes	Certain	Medium	Mild	Moderate negative	Negligible	Proper best practice
Establishing / running	Land loss	15 years	Local	Yes	Certain	Medium	Mild	Moderate	Low negative	Fair and reasonable

Intervention	Potential impact	Impact duration	Spatial extent	Reversible (Y/N)	Likelihood	Magnitude	Sensitivity	Significance prior to mitigation	Significance after mitigation	Mitigation measure
worker's camps								negative		compensation
	Crop / tree loss	15 years	Local	Yes	Likely	Medium	Mild	Moderate negative	Low negative	Fair and reasonable compensation
	Fuel spills	15 years	Local	Yes	Likely	Medium	Mild	Moderate negative	Low negative	Proper fuel handling and waste management
	Other pollution	15 years	Local	Yes	Likely	Medium	Mild	Moderate negative	Low negative	Proper waste management
	Health and safety of Contractor's workers	15 years	Local	Yes	Certain	Medium	Mild	Moderate negative	Negligible	Proper best practice
General social impacts on communities										
All	Impacts on cultural heritage	15 years	Local	Yes	Likely	Medium	Mild	Moderate negative	Low negative	Cultural and community enhancement programs
All	Impacts on community facilities	15 years	Local	Yes	Likely	Medium	Mild	Moderate negative	Low negative	Adequate and timely replacement of facilities
All	Loss of Income and Livelihoods	Short-term	Local	Yes	Likely	Medium	Mild	Moderate negative	Low negative	Compensation, resettlement/relocation & appropriate supporting measures

Intervention	Potential impact	Impact duration	Spatial extent	Reversible (Y/N)	Likelihood	Magnitude	Sensitivity	Significance prior to mitigation	Significance after mitigation	Mitigation measure
All	Social tension between groups	Medium term	Local	Yes	Likely	Medium	Mild	Moderate negative	Low negative	Ensure equitable arrangements and conflict resolution mechanism
All	Disruption of host communities	Medium term	Local	Yes	Likely	Medium	Mild	Moderate negative	Low negative	Compensation and appropriate supporting measures
All	Occupational health and safety	15 years	Local	Yes	Certain	Major	Severe	High negative	Low to moderate negative	
All	Community health and safety including spread of AIDS/HIV	15 years	Local	Yes	Certain	Major	Severe	High negative	Low to moderate negative	Proper awareness campaign & medical facilities
Operation and Maintenance										
O&M	Changes in river morphology	Long term	Local	Yes	Likely	Nominal	Severe	Low negative	Low negative	
O&M	Generation of solid waste	Long term	Local	Yes	Certain	Major	Severe	High negative	Low negative	Best practice waste management
O&M	Air pollution	Long term	Local	Yes	Likely	Medium	Mild	Moderate negative	Low negative	Best practice air pollution management
O&M	Noise generation	Long term	Local	Yes	Likely	Medium	Mild	Moderate negative	Low negative	Best practice noise pollution management

Intervention	Potential impact	Impact duration	Spatial extent	Reversible (Y/N)	Likelihood	Magnitude	Sensitivity	Significance prior to mitigation	Significance after mitigation	Mitigation measure
O&M	Water pollution	Long term	Local	Yes	Likely	Medium	Mild	Moderate negative	Low negative	Best practice water pollution management
O&M	Risk of embankment breaches	Long term	Local	Yes	Likely	Major	Very severe	Critical	Low to moderate negative	Monitoring and timely & adequate strengthening interventions
O&M	Community health and safety	Long term	Local	Yes	Certain	Major	Severe	High negative	Low to moderate negative	Awareness and health/safety programs

Appendix 1. Summary Report of FGDs

Potential Reclaimed/Stabilised Land: Social Perceptions Survey by Focus Group Discussions

Rationale

FRERMIP proposes to change the living conditions of people living on chars and within the floodplain of the Jamuna and Padma rivers through stabilisation and narrowing of the main river channel and by the provision of embankments on currently unprotected floodplains. A social impact assessment is therefore needed to find out the current living conditions and what potentially affected people think about the proposed interventions as regards their future aspirations.

Location

List of Chars visited:

1. **Village**: Tesondi, **Upazila:** Shibaloy; Manikgonaj.
2. **Village**: Patgram, **Upazila:** Harirampur; Manikgonaj.
3. **Village**: Nandolalpur, **Upazila:** Sadarpur, **District:** Faridpur (together with Mark Hopkins)
4. **Village**: Kuddus Mollar Kandi, **Upazila:** Sadarpur, **District:** Faridpur (together with Mark Hopkins)
5. **Village**: Khalpar Sarker kandi, **Upazila:** Sadarpur, **District:** Faridpur (together with Mark Hopkins)
6. **Village**: Koral Kandi/Narisha Zoar, **Upazila:** Dohar, **District:** Dhaka
7. **Village**: Char Janajatpur, **Upazila:** Shibchar, **District:** Madaripur

Stakeholders

What groups have been identified?

It was not easy to make choice the groups of stakeholders due to scattered living in Char land and also residential areas belong far away from the river side in many cases. So we organized meeting with the locality who are living in the char and depend on their livelihoods on agriculture production on char land. In some cases we also have meeting with the people live in khas land.

Vulnerability

How many times have people moved?

It was very significant to mention that people live in char have to move from 3 to 22 times which is depend on their age, location and land availability. An old man (95 years old) had to move for 22 times while a young man (23 years old) have moved 3 times.

Do they feel vulnerable living on chars?

The people living on char are very happy to live in there but they feel vulnerable because of river erosion and/or flood damage. They have lost their all permanent assets including land, trees, ponds etc. They only can save their moveable assets if they have time (if it is not sudden flood or erosion) that includes house made by CI sheets or other materials. But they could not save all of their belongings due to time constraint and also no transportation. A young man named Manik Molla of Kuddus Kandi told us that every shifting requires a minimum of Tk.50,000.00 cash and many of them have to take loan.

Livelihood

What are their main livelihoods?

Their main livelihoods are agriculture production on char land and raising goat, cows, horses and fishing in the river.

Problem Ranking

What do they see as their main problems?

We discussed the issue regarding their problems and they mentioned many but when we request them to rank those in priority number, we got answer always no.1 is river erosion and flood damage. They do not want anything else then river protection which will help them to be stabilised in the char land and rest of them they can manage.

It was seen that they have lack of sanitation facilities, lack of educational institutions, lack of health support, etc.

Project Acceptance

Are they in favour of the project, would they like their char stabilised?

Yes, they are very happy to have their char stabilised and so that they appreciate such type of project by which they can live in one place in their life and their children need not to move as they did.

Do they see any issues for themselves following stabilisation?

They want to be sure that their char will not go under water anymore. If they have a stable residence they will manage all other things by themselves. Anyway after several discussions many of them mentioned many options, some of those are:

- They feel their char land is very fertile so if they get good quality seeds of different crops including rice, serials, jute, vegetables, etc. With modern technology support will help them to grow their own food and other necessary goods.
- Hospitals and clinics are essential in every chars, now they have no services, they have to cross the river for any emergency, some quack (village doctor) are in some chars who can treat only fever or headache or diarrhoea but are not always succeeded as reported by the people.
- School with adequate teachers are a need in every char.
- No flood or cyclone shelter is existing in the char and they badly need it. In some places they also wanted matir dibi (earthen raised land) for their cows/horses.
- Many of the young peol are idle and have no work so they want some employment opportunity within their char and expect government will do that.

SEZ Acceptance

Are they in favour of SEZs being established on their char?

Yes they are in favour of special economic zone (SEZ) and they will be happy to have employment within their char.

What industries would they like to see in the SEZ?

There are lots of opinions regarding industries;

- some people feel that livestock will be good so Dairy farm is an option.
- Some people said Dairy Farm for meat will be another option.
- Garments was very common option in each char.
- Agriculture based industry mentioned by some people who are confident to process food and agriculture based product.
- Fisheries was also an option who are already involve with fishing wanted fish processing zone.

Any indications as to where on the char they would like to see a SEZ located (khas/private land, good/poor agricultural land)?

Many people mentioned that every char has khas land where SEZ can be established. They are not in favour of private land and good agricultural land, they all said khas land and poor agricultural land must be used for SEZ.

Do they see any problems with establishing SEZs?

They were in different opinions. In some chars people said there will be no problems establishing SEZs rather that will help them for livelihoods as well as appropriate use of khas land (now khas land occupied by influential people).

Another opinion is influential people will not agree to vacant the khas land and may create obstacle for having SEZs.

In some chars landless people live in khas land who does not want to lose that and they have no other choice to go so they also see difficulties to have SEZz.

One opinion is common that they all want SEZs in any forms by government or NGOs or private but not using the land already used for household or agriculture production.

Tenure Vulnerability

Do they feel secure in their land tenure?

Who have land title they are very much confident about their land tenure.

Who have allotment from government as landless to live in khas land they are also confident about their land tenure.

Any differences between private and khas land?

Private land owners have no doubt about their land tenure and enough confidence but those who live in khas land (without a lease) are not feeling secure but want governments sympathy for their residential allotment.

Future Aspirations

What future do they see for them and their children?

In general they want a secured life for them and their children but they do not how it would be possible if river erosion exist. Their first priority is to stop river/flood erosion. Then other options; i.e. education, health, employment, etc.

What would their ideal future for their cildren be?

All most all of them said, “a stable household land with productive agriculture land and proper schooling will be the best option for our children. They can manage all other requirements if they can sleep without thinking of moving houses what often happened in our life”.

Anything they particularly don’t want to happen?

They don’t want to move to the big city. They hate slum life; they are happy with their char life for open and fresh air, fresh foods/fish and community feelings what is absent in slum life.

Conclusion

The common demand of char people is river erosion must be stopped and river protection must save the old chars. They don’t afraid of hardship if they are secured from erosion they can make a healthy and wealthy living in established char.

Next Steps

What is planned after Eid/monsoon?

Begum Shamsun Nahar and team will visit some more chars as per maps locations and also some FGDs will be conducted in main land.

Next visits will start from late July then August-September continued, depend on the situation and weather.

What other areas need to be visited, groups consulted, etc.

We have consulted only household male and female members jointly or separately. We need to do some with institutional (school, hospitals etc.) and market based people as well as NGOs working in the chars and may be some government agencies working in the chars.