GOVERNMENT OF THE PEOPLE'S REPUBLIC OF BANGLADESH

Ministry of Water Resources

Bangladesh Water Development Board (BWDB)

Environmental Impact Assessment (EIA)

of

"Haor Flood Management and Livelihood Improvement Project"

(JICA Loan No.: BD-P80)

(Financed by GoB and JICA)

Consulting Services for Design, Construction, Supervision, and Other Related Services

VOLUME - I (Main Report)

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For

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(Main Consultant of HFMLIP)

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Acronyms and Abbreviations

BADC	Bangladesh Agricultural Development Corporation
BARC	Bangladesh Agricultural Research Council
BHWDB	Bangladesh Haor and Wetland Development Board
BWDB	Bangladesh Water Development Board
CEGIS	Center for Environmental and Geographic Information Services
DAE	Department of Agricultural Extension
DOE	Department of Environment
DPHE	Department of Public Health Engineering
FAP	Flood Action Plan
FD	Forest Department
FEC	French Engineering Consortium
FGD	Focus Group Discussion
FPCO	Flood Plan Coordination Organization
GDP	Gross Domestic Product
GIS	Geographic Information System
GMB	Ganga-Meghna-Brahmaputtra
HFMLIP	Haor Flood Management and Livelihood Improvement Project
IBRD	International Bank for Reconstruction and Development
ICRD	Integrated Coastal Resources Database
ICZMPP	Integrated Coastal Zone Management Plan Project
IFCDR	Institute of Flood Control and Drainage Research
IMO	International Maritime Organization
IPCC	Intergovernmental Panel on Climate Change
IUCN	International Union for Conservation of Nature
IWFM	Institute of Water and Flood Management
IWM	Institute of Water Modeling
JICA	Japan International Cooperation Agency
KII	Key Informant Interview
LGED	Local Government Engineering Department
MIDP	Municipal Infrastructure Development Plan
MOC	Ministry of Communication
MOCAT	Ministry of Civil Aviation and Tourism
MOEF	Ministry of Environment and Forest
MoF & DM	Ministry of Food and Disaster Management
MOFL	Ministry of Fisheries and Livestock's
MOH&P	Ministry of Housing and Public works
MOHFW	Ministry of Health and Family Welfare
MOI	Ministry of Industries
MOL	Ministry of Land
MOLE	Ministry of Labour and Employment
MOLGRD&C	Ministry of Local Government, Rural Development and Co-operatives
MOPE&MR	Ministry of Power, Energy and Mineral Resources
MOSICT	Ministry of Science and Information & Communication Technology
MOTJ	Ministry of Textile and Jute
MOWCA	Ministry of Women and Children Affairs Bangladesh

MOWR	Ministry of Water Resource
MP	Master Plan
MPO	Master Plan Organization
NCA	Net Cultivable Area
NGO	Non-Governmental Organization
NINA	Norwegian Institute for Nature Research
NWMP	National Water Management Project
NWRD	National Water Resources Database
PBS	Palli Biddyut Samiti
PRA	Participatory Rural Appraisal
PSMP	Power System Master Plan
RRA	Rapid Rural Appraisal
SRDI	Soil Resources Development Institute
WARPO	Water Resources Planning Organization

Glossary

Aman	A group of rice varieties grown in the monsoon season and harvested in the post-monsoon season. This is generally transplanted at the beginning of monsoon from July-August and harvested in November-Dec. Mostly rain-fed, needs supplemental irrigation in places during dry spell.
Arat	Generally, an office, a store or a warehouse in a market places from which Aratdar conducts his business.
Aratdar	Main actor act as a wholesaler or commission agent or covers both functions at the same time; carries out public auctions and is the main provider of credit in the marketing chain.
Aus	Pre-monsoon rice crop grown in Kharif I season and harvested in the monsoon season. These are broadcast/transplanted during mid April- mid May and harvested during mid July-mid August. Generally, rain-fed, needs irrigation for HYV T. Aus.
B. Aman	Broadcast or deepwater Aman
Beel	Beels are shallow lakes, which form in the lowest parts of the haor; sometimes these are perennial but more often seasonal. The water surfaces are contiguous with the ground water table and that beels are sustained from ground water to a large extent. Surface water does also collect in the beels during wet season, often spilling out of them into the main river system through khals.
Boro	A group of rice varieties sown and transplanted in winter and harvested at the end of the pre-monsoon season. These are mostly HYV and fully irrigated, planted in December-January and harvested before the onset of monsoon in April- May.
Causeway	A raised road way / embankment, across water or marshland, a structure so designed that will be filled with available earth up to the crest level to withstand pre-monsoon flood upto15th May, just after harvesting of Boro crops to let in water inside the haor area to a level for minimizing the erosion of submersible embankment during overtopping by monsoon flood and also allow normal navigation during monsoon uninterrupted. The dimensions are determined according is the size of the country boats plying in the area. It will retain the existing navigation facilities and efficient drainage during post-monsoon as envisaged in project planning.
Country boat	Wood hull boat of traditional design; capacity usually not more than 500 maunds

	(19 Tonnes)
DA	Development Area
District	An administrative unit comprising several upazilas.
Division	An administrative unit comprising several administrative districts
Duar	Scour hole in river bed which provides habitat for fish and river dolphins
Hat/Bazar	Riverine landing or assembly place, village market.
Haor	Haors are bowl-shaped depressions of considerable aerial extent lying between natural levees of the rivers or high lands of the northeast region of Bangladesh. In most cases, haors have been formed as a result of peripheral faulting leading to the depression of the haor area. In the wet seasons, the haors are full of water, but during the dry seasons, these are dried up except for the beels.
Hijal	Type of water tolerant tree
Household	Family unit, who share common resources for cooking and eating
Golda	Prawn (Macrobrachium rosenbergii), non-saline/fresh water species
Jalmohal	Section of river, individual or group of beels (depression), or individual pond owned by the government but leased out for fishing. They are also called Jalkar, or Fishery.
Kanda	Highland on the haor, used for cattle grazing, cropping or rice thrashing
Khal	A water drainage channel usually small, sometimes man-made. These may or may not be perennial.
Khas	Government owned land or water bodies
Kharif I&II	Pre-monsoon and monsoon growing season. Cropping season linked to monsoon between March-October, often divided into kharif-1 (March-June) and kharif-2 (July-October).
Koroch	A type of water-tolerant tree
Mouza	Land revenue boundary consisting of land plots
Paiker	Paikers are small scale urban fish retailers
Rabi season	Cropping season between November and February
Regulator	A device for controlling the level or amount of water for inlet & drainage purpose in connection with water resource project
T. Aman	Transplanted Aman
Taka (Tk)	Unit of Bangladeshi currency, I US $ = 78 taka (approx.)
Union	Geo-administrative unit under a Upazila comprising several villages/wards

1 EXECUTIVE SUMMARY

1. Haor Flood Management and Livelihood Improvement Project (HFMLIP) aims at the improvement of the performance of 15 existing subprojects and development of 14 new subprojects to enhance and sustain the livelihoods of people living in the selected subprojects. The strategic objective of the project is to achieve sustainable O&M of the project through handing over the water management infrastructure, to the stakeholders for improving economic growth and reducing poverty in a participatory way.

2. The objective of the environmental impact assessment (EIA) study is to comprehensively assess the environmental aspects of the proposed interventions under the project aimed for eco-friendly development and improvement of the socio-economic condition of the entire project area.
EIA is a legal requirement of the Department of Environment (DOE) under provisions of the Environmental Conservation Act (ECA), 1995 and the Environmental Conservation Rules (ECR), 1997of Bangladesh. According to ECR, 1997 of DOE an EIA needs to be carried out for this project. As per Japan International Cooperation Agency's (JICA) Guidelines for Environmental and Social Considerations (2010), the project activities fall under Category B for which only initial environmental examination (IEE) is required. The TOR approved by DOE for this EIA study will fill requirements of both JICA and the DOE.
This EIA has been conducted in accordance with the ECR, 1997, EIA Guidelines (1997) of the Government of Bangladesh (GOB) and other relevant national regulations and policies as well as JICA's Guidelines for Environmental and Social Considerations (2010), and finally as per approved Terms of Reference (ToR) by DOE (Attached at the end of this report).

3. The project contains 29 subprojects in 5 districts in the northeast region of Bangladesh, namely Kishoregonj, Netrokona, Sunamgonj, Habigonj and Brahmanbaria with a total envisaged coverage of 199,487 ha gross area having 162,630 ha cultivable area. The list of 29 subprojects with their location and area are shown in **Annex A.** The project requires construction of new 286.51 km, Re-sectioning of 1.550 km full and 8.09 km submersible embankment(Rehabilation), Re-excavation of canal rehabilitation 75.4 km and New 305.62 km, New installation of regulators 59 (New Haor), Replacement of gates 98 nos and reinstallation of regulators 5 nos (rehabilitation), Causeway[1] 16 nos. Pipe sluice 15 nos., Pipe inlet/outlet 25 nos, River dredging at 2 places (11.8 km). The project requires 404.839 ha land requirement for implementation of the project for which resettlement plan has been prepared. The total estimated budget for overall project implementation is BDT 99,337.72 million. The estimated civil construction cost as per physical intervention proposed is BDT 4830.926 million.

4. Identification, prediction and evaluation of potential impacts on various environmental components/parameters due to different project activities during design/pre-construction, construction,

[1]Causeway is a special arrangement associated to the water resources management facilities. For HFMLIP, causeways have been proposed over the khals in the new subprojects at their outfalls to prevent pre-monsoon flash flood, retain the existing navigation facilities and efficient drainage during post-monsoon period.

and operation stages have been done on the basis of preliminary studies, literature review, base line environmental survey, public consultation and expert's judgments. The anticipated environmental impacts due to implementation of the proposed project during different stages of the project were studied in detail and the most likely impacts were identified and mitigation measures were recommended for the project to adopt.

5. Based on the detailed evaluation of the likely impacts on various environmental parameters, an Environmental Management Plan (EMP) has been prepared. The Project Management Unit of BWDB along with the assistance of the Environment Specialist will be responsible for the implementation of the EMP. The total estimated EMP budget for the project implementation is BDT 5,96,15,600.

6. With the envisaged socio-economic development the overall standard of living among the people in the project area will increase. Poverty will be reduced due to the job opportunities created, especially for the landless and the destitute women can benefit when the WMOs commence operating.

7. The agricultural production is expected to increase due to the implementation of water resources infrastructure, construction and re-sectioning of existing full/submergible embankment, to protect boro crops from flash flood during pre-monsoon period, improved on-farm development. Incomes from agriculture will rise, having a spin-off on other sectors. The existing cropping intensity will rise from 110% to 130% and incremental paddy production will be 878,250 mt. The existing paddy production has been estimated at 2.7 million mt. and projected total paddy production has been calculated at about 3.5 million mt. Due to construction of new embankments, repair of existing embankments and sluices. Flash floods will be restricted which will help better crop production. By practicing crop rotation crop diversification, soil fertility will be improved resulting more crop production.

Through introduction of IPM /ICM method of insecticide control, positive impact on environment will occur, because by applying imbalanced chemical fertilizers and insecticides have negative effect on fish production, health hazards can be mitigated through practicing IPM/ICM practices restriction of brick fields within the project area will also keep the overall environmental conditions in a positive direction. Plantation of some recommended species of plants like Hijol, Korach that can survive under deep water flooding and also feed for some species of fishes will also keep the environment in a congenial manner.

8. Haor area has huge potential of fisheries, and with project the natural capture fish habitats will not be affected since the main intervention are submergible embankment along with the regulators will be much below the water level during monsoon. The regulators will be constructed having lower number of vantage along with causeways in case of putting structure where applicable to keep the navigation system uninterrupted. The causeway will be filled up with earth to block the overflow of flash flood into the haor area where rice crops are existing and earthwork removed prior to monsoon. The design height of crest level of submergible embankment is 8.6 to 10.10 m PWD and the monsoon

flood water level goes up-to 12.7 m. So, there will not be any barrier of fish movement during monsoon season. During the high flood season (June-October), all haors are covered with 3-6 m of water, thus forming a huge inland ocean. During the dry season (December-March) a number of small and large depressions or beels contain water. With the rehabilitation of ponds and the promotion of rice-fish culture will stimulate fish production. The specific management actions recommended to conserve remaining natural fish habitats will help conserve the remaining habitat in more organized manner.

9. People's consultations carried out demonstrated that rehabilitating the existing subprojects to be rehabilitated and new projects planned while addressing internal local water management problems, applying the concept of coordinated management of local water infrastructures through a participatory approach, is the best alternative that can generate maximum positive impacts.

10. In conclusion, the proposed project will have overall positive benefits by preserving and improving the pre-monsoon flash flood protection of boro crops, benefits provided by the existing facilities, and installment of additional small structures to address internal water management problems that have not been addressed in case of haors implemented earlier. Its successful implementation will also serve as a model to demonstrate the process of achieving substantial under-achieved development potentials of existing systems while sustaining their benefits through effective stakeholder participation.

The interventions to be undertaken will have some positive impacts and there will be no major negative impact on environment except some temporary and localized ones. Noise level will be increased only when heavy machineries will be operated during construction period which is the most temporary and localized one that will have no effect afterwards. Air quality monitoring of is not much important since impact is very low for rural/urban water sector development projects except producing dusts sometimes during construction stage.

Temporary and localized negative impacts on environment including noise and dust pollutions can be mitigated through mitigation measures.

11. To attain the overall objective of the project it is recommended that

I. After the dry season, the regulators should be operated in such a manner that the monsoon flood water while overtopping the submergible embankment, the water inside the haor will gradually be allowed to rise in tandem with the water level outside and minimum head is created between outside and inside water level to cause minimum damages to the earthwork.

II. After the monsoon season, for agriculture activities in the haor areas, the regulators should be operated in such a manner that the inside water drains out to create agricultural land available for cultivation in a timely manner for optimum benefits.

III. The subprojects are recommended for implementation on the basis of Feasibility Study findings and recommendations.

IV. The project needs to make sure that the WMO will take into account the potential pressure and weakness of the farmers/fishermen community when establishing the WMO institutional structure.

2 INTRODUCTION

2.1 Background

The "Haor Flood Management & Livelihood Improvement Project" aims at improving the living conditions of the people of 29 haors by reducing or eliminating damages caused by early pre-monsoon flush flood and by implementing other synergic interventions in agriculture and related sectors.

In the Upper Meghna area, situated in the northeastern region of Bangladesh, low land swampy areas called Haor extend widely. The whole of Haors are submerged during rainy season and make their ecosystem unique and rich in bio-diversity. The Haor Region (**Figure 2.1**) is about 9,000 km2, stretching over seven districts whose total area is about 20,000 km2. The area is home to about estimated 20 million people (18 million as of 2011 census), but despite the economic importance of the haors, people in the region are poorer than in any other parts of the country. One of the reasons of this situation is frequent damages suffered from pre-monsoon flood.

Flood management together with holistic development in the Haor area has been one of the substantial targets of the Government of Bangladesh (GOB). As such, Bangladesh Haor and Wetland Development Board (BHWDB) have formulated a Master Plan in April 2012 as a comprehensive development plan for the Haor area. The Haor Master Plan has proposed various water management and rural development projects.

In line with the goals of the government presented above, JICA has conducted a series of surveys and studies to extend its cooperation to Bangladesh. The "Preparatory Study on Cooperation for Disaster Management Sector" (2009 – 2010) established the necessity to focus its cooperation to Bangladesh on the Meghna River basin because of the seriousness of flood damages and the significant poverty conditions in the area. In view of this, JICA conducted the "Preparatory Survey on Cooperation for the Meghna River Basin Management Master Plan" (2010 – 2011), and the "Preparatory Survey on Cooperation Program for Disaster Management in Bangladesh" (2011 – 2012). These studies concluded that pre monsoon flood management in the Haor area is the key solution. Based on the outputs of these studies, JICA commenced the "Data Collection Survey on Water Resources Management in Haor Area of Bangladesh" (2012 – 2013) to review the projects proposed in the Haor Master Plan from technical and economic aspects and to propose priority projects. To confirm the feasibility of the proposed priority projects, JICA then conducted the "Upper Meghna River Basin Watershed Management Improvement Project" (2013 – 2014). This Study formulated the implementation Project comprising with the following components: (1) Pre-monsoon flood management, (2) Rural infrastructure development, and livelihood enhancement mainly through Component (3-1) Agricultural promotion, and (3-2) Fisheries promotion. It was also decided by JICA and GOB that component 1 and 3-1 are to be executed by Bangladesh Water Development Board (BWDB) while the other 2 components will be executed by Local Government Engineering Department (LGED). Components of the project are presented in **Table 2.1**.

Table 2.1: Project Components

Component 1: Construction and rehabilitation of flood management infrastructure
1) Submergible embankments construction
2) Full embankments rehabilitation
3) Sluice gates and regulators
4) Drainage canal

Component 2: Construction and rehabilitation of rural development infrastructure
1) Upgrading and/or rehabilitation of upazila, union, and community (village) roads (submergible and all-weather roads), including bridges and culverts.
2) Improvement and development of growth centers and rural markets (including protection works)
3) Improvement of ship landing facility (including protection work of ghats and surrounding areas)

Component 3: Implementation of livelihood improvement activities
1) Agriculture production improvement
2) Fishery production improvement

Out of 3 components of the project, Bangladesh Water Development Board (BWDB) will implement Component-1(Flood Management) and Component 3-1 Agricultural promotion. Component 1 outlines rehabilitation of existing flood management infrastructure and construction of new flood management infrastructure. BWDB under JICA finance has formulating the aspect of design and flood management in implementation of projects to protect Boro crops from pre-monsoon flash floods; however, full protection is also a requirement in some areas. The project aims to construct /rehabilitate and reconstruct flood management infrastructure in 29 haors (14 new and 15 rehabilitation) of greater northeast region (**Figure 2.2**).

The BWDB components of the project are presented in **Table 2.2**. This EIA is conducted for the BWDB components of HFMLIP considering the activities related to Component-1 and Component-3.1.

Table 2.2: Components for implementation by BWDB

Component	Item of works
Component-1	Rehabilitation of existing flood management infrastructure Construction of new flood management infrastructure
Component 3-1	Agriculture promotion subproject Small scale income generation subproject

For the implementation of the Project, BWDB appointed the JV of Nippon Koei Co., Ltd., Japan and BETS and CNRS of Bangladesh as the Main Consultant to carry out planning review, detail design, bidding assistance and construction supervision. The scope also includes preparation of Environmental Impact Assessment (EIA) and Resettlement Action Plan (RAP). The Main consultant started their service from April 2015.

Environmental impact assessment (EIA) study is a very important component that needs clearance from Directorate of Environment and also the Donors for implementation of the project. This EIA has been conducted in accordance with the ECR (1997), EIA Guidelines (1997) of the GOB and other relevant national regulations and policies as well as JICA's Guidelines for Environmental and Social Considerations (2010), and finally as per approved TOR given by DOE (Attached at the end of this report).

2.2 Brief Description

There are about 373 Haor/ Wetlands (**Table 2.3**) located in the districts of Sunamganj, Habiganj, Netrokona, Kishoreganj, Sylhet, Moulvibazaar and Brahmanbaria. These 373 Haors cover an area of about 8,58,460 ha which is around 43% of the total area of the Haor region. It is a mosaic of Wetland habitats' including rivers, Stream, canals, large area of seasonally flooded cultivated plants, and beels.

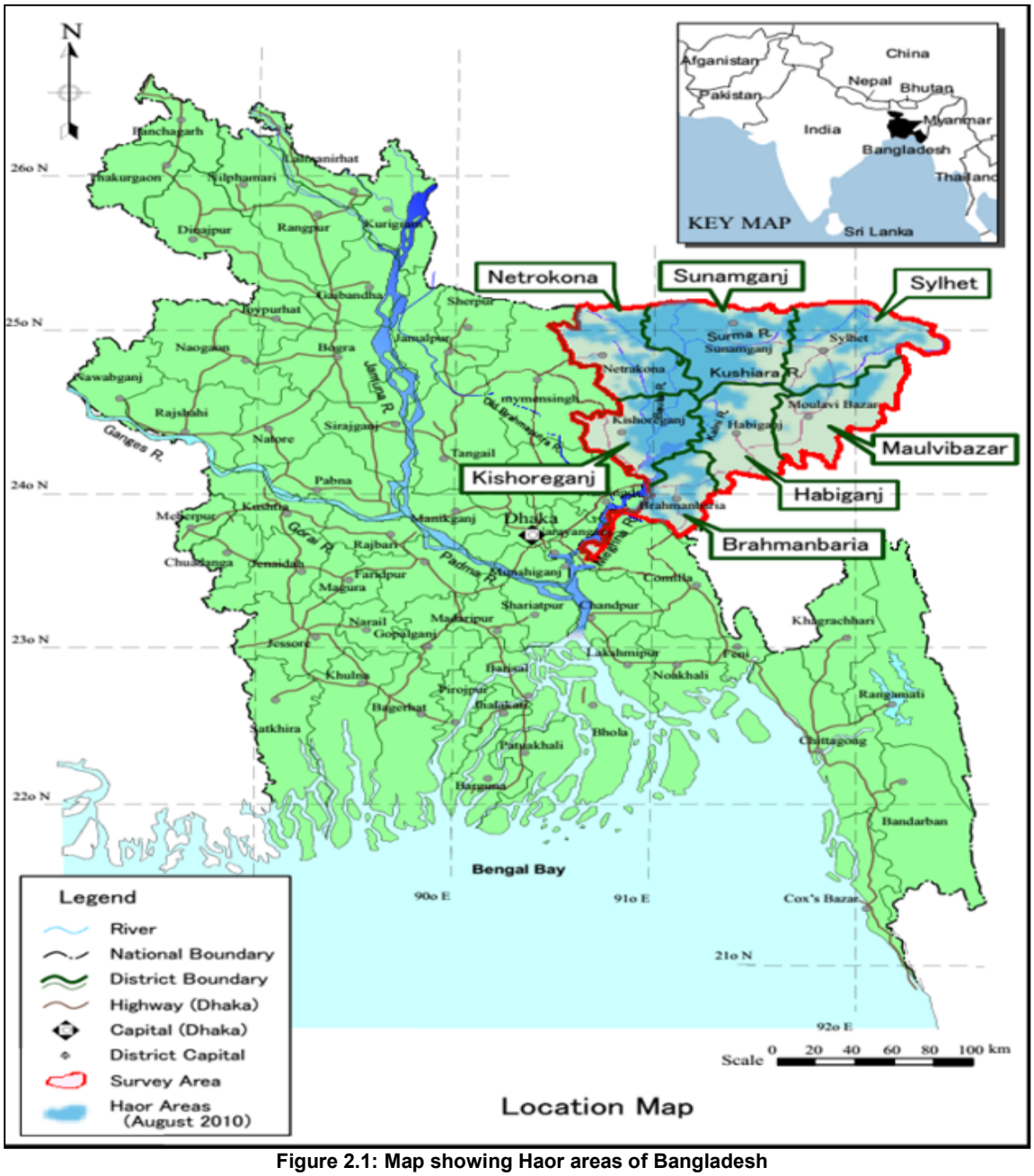


Figure 2.1: Map showing Haor areas of Bangladesh

Table 2.3: Number of haors in different districts

Districts	Total area in ha	Haor area in ha	No of Haors
Sunamganj	367,000	268,531	95
Sylhet	349,000	189,909	105
Habiganj	263,700	109,514	14
Maulovibazaar	279,900	47,602	3
Netrokona	274,400	79,345	52
Kishoreganj	273,100	133,943	97
Brahmanbaria	192,700	29,616	7
Total	**1,999,800**	**858,460**	**373**

Generally, Haors are categorized into 3 types based on geological locations and flooding characteristics: i) foot hill and near hill haors ii) flood plain haors iii) deeply flooded haors. Major Haor Types and respective Haor districts are shown in **Table 2.4**

Table 2.4: Major Haor Types found in Haor districts

District	Haor Types
Sylhet, Maulovibazar	Foothill and near hill haors
Netrakona, Kishoreganj, Brahmanbaria	Floodplain haors
Sunamganj, Netrakona, Habiganj	Deeply flooded haors

Haor Flood Management and Livelihood Improvement Project (BWDB part) consists of 29 Haor subprojects in 5 (five) districts falls under the category 2 as Flood Plain Haors and category 3 as Deeply flooded Haors.

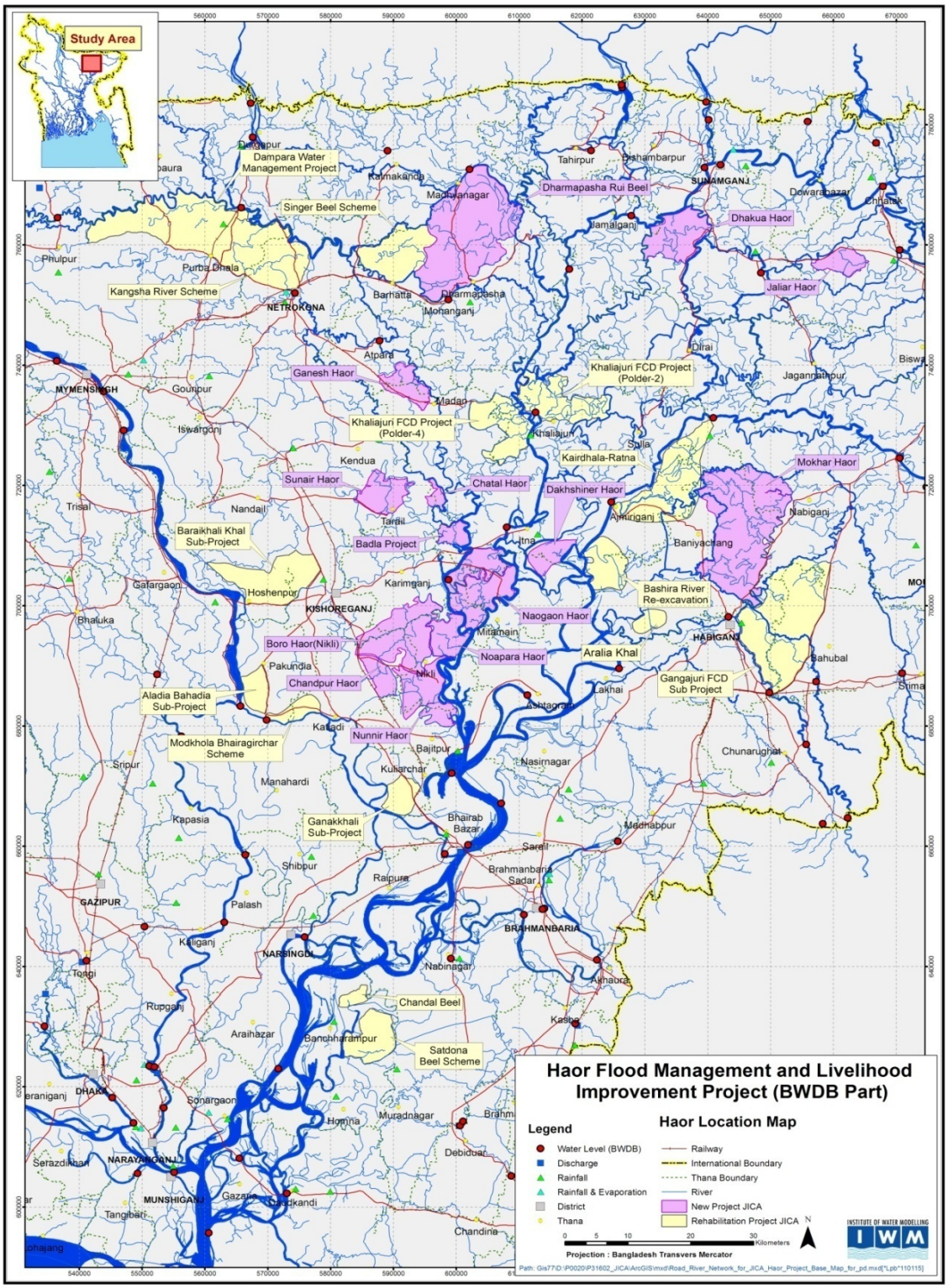
Objectives of the project:

The overall objective of the project is to reduce the damages from flood, improve access to basic infrastructure and increase agriculture and fishery productivity in the hoar areas in the upper Meghna river basin by-

- Rehabilitating and constructing the flood management facilities;
- Rehabilitating and constructing the rural infrastructures; and
- Implementing agriculture and fishery promotion activities, and thereby contributing to the improvement of living standard and activation of economic activities in the target area.

Location of the Work and Project Components

The Project will be implemented in twenty-nine (29) Haor areas stretching in five (5) districts namely Sunamganj, Habiganj, Netrakona, Kishoreganj, and Brahmanbaria having a gross area of 1,99,487 ha and Cultivable area of 1,62,630 ha in the northeast of Bangladesh. Out of these 29 Haors, there will be new interventions in 14 Haors while the there will rehabilitation works in 15 Haors. The list of 29 subprojects are placed in **Figure 2.2** and **Table 2.5** and brief description of all 29 haors, Re-habilitation of 15 Haor subprojects and development of 14 new haor subprojects, are shown in Annex A.



Source: IWM May 2015

Figure 2.2: Location of proposed new and rehabilitation haor Sub-projects

Table 2.5: Salient Features of Proposed 29 Haor Subprojects under HFMLIP

Sl. No.	Sub-project No.	Name of Subproject	Location		Gross area (Ha)	Cultivatable Area (Ha)
			District	Upazilla		
List of Rehabilitation Subprojects						
1	R-1	Dampara Water Management Scheme	Netrokona	Purbadhola	15,004	11,069
2	R-2	Kangsha River Scheme	Netrokona	Netrokona Sadar., Purbadhola,	11,337	8,477
3	R-3	Singer Beel Subproject	Netrokona	Barhatta	7,200	5,842
4	R-4	Boraikhali Khal Subproject	Kishoreganj & Mymensing	Kishoreganj Sadar., Hosainnpur, Nandail,	8,667	4,719
5	R-5	Alalia-Bahadia Subproject	Kishoreganj	Katiadi, Pakundia	2,464	1,128
6	R-6	Modkhola-Bairagir Char Subproject	Kishoreganj	Katiadi, Pakundia	2,060	1,213
7	R-7	Ganakkhali Subproject	Kishoreganj	Kuliarcha	2,652	1,807
8	R-8	Kair Dhala Ratna Subproject	Habiganj	Ajmiriganj, Baniachong,	11,900	11,205
9	R-9	Bashira River Re-Excavation Subproject	Habiganj	Ajmiriganj, Baniachong,	4,521	4,061
10	R-10	Aralia Khal Subproject	Habiganj	Baniachong,	1,501	1,406
11	R-11	Chandal Beel Subproject	Brahmanbaria	Bancharampur	1,012	842
12	R-12	Satdona Beel Scheme	Brahmanbaria	Bancharampur	5,049	4,153
13	R-13	Gungaijuri Haor Subproject	Habiganj	Habiganj Sadar. Baniachong, & Bahubal	20,441	17,418
14	R-14	Khaliajuri FCD Polder-2	Netrokona	Khaliajuri,	6,611	6,200
15	R-15	Khaliajuri FCD Polder-4	Netrokona	Khaliajuri,	7,201	6,866
Sub Total					**107,620**	**86,406**

Sl. No.	Sub-project No.	Name of Subproject	Location		Gross area (Ha)	Cultivatable Area (Ha)
			District	Upazilla		
List of New Sub-projects						
16	N-1	Boro Haor Subproject (Nikli)	Kishoreganj	Kishoreganj Sadar, Katiadi, Karimganj & Nikli	10,672	9,225
17	N-2	Naogaon Haor Subproject	Kishoreganj	Itna, Karimganj, Nikli & Mithamain	7,339	6,662
18	N-3	Jaliar Haor Project	Sunamganj	Chhatak	2,466	2,156
19	N-4	Dharmapasha Rui Beel Subproject	Sunamganj & Netrokona	Dharmapasha, Kalmakandha, Barhatta	21,540	14,803
20	N-5	Chandpur Haor Subproject	Kishoreganj	Katiadi & Nikli	2,288	2,022
21	N-6	Suniar Haor Subproject	Netrokona & Kishoreganj	Tarail & Kendua	4,428	3,477
22	N-7	Badla Haor Subproject	Kishoreganj	Itna &Tarail	2,087	1,798
23	N-8	Nunnir Haor Subproject	Kishoreganj	Bajitpur, Katiadi & Nikli	5,316	4,835
24	N-9	Dakhshiner Haor Subproject	Kishoreganj & Habiganj	Itna, Ajmiriganj & Mithamoin	4,845	4,410
25	N-10	Chatal Haor Subproject	Kishoreganj	Itna & Tarail	1,117	1,032
26	N-11	Ganesh Haor Subproject	Netrokona	Madan & Atpara	3,367	2,747
27	N-12	Dhakua Haor Subproject	Sunamganj	Sunamganj Sadar & Jamalganj	6,440	5,157
28	N-13	Mokhar Haor Subproject	Habiganj	Baniachong & Nabiganj	16,821	14,979
29	N-14	Noapara Haor Subproject	Kishoreganj	Austagram, Karimganj & Nikli	3,141	2,921
Sub-Total					**91,867**	**76,224**
				GRAND TOTAL	**199,487**	**162,630**

Source: IWM planning review 2016

The Scope of Work

The Scope of each project components of the BWDB Part are presented in **Table 2.6.**

Table 2.6: BWDB Portion of Project Components

Component	Item
Component 1 (Flood Management Infrastructure)	**Component 1-1: Flood management infrastructure development** 1. Rehabilitation of existing flood control facilities 2. Construction of new flood control facilities **Full Flood Embankment** Rehabilitation 1.55 km **Submergible Embankment** - Rehabilitation 8.09 km - New construction 286.51 km **Regulators** - Replacement of gates 98 nos. - Reinstallation of regulator 5 nos. - New installation 59 nos. **Causeway (New)** 16 nos. **Re-excavation of canals** - Rehabilitation 75.4 km - New 305.62 km **Pipe Sluice** **15 nos.** **Pipe inlet** **25 nos.** **River dredging (2 Places) –** **11.8 km** **Component 1-2: Capacity development** 1) Training for O&M manual preparation (for BWDB officials) 2) Training for water management organization (WMO) (formulation of WMO, management training, O&M technical training)
Component 3-1 (Agriculture)	**Component 3-1: Agriculture** 1) Field program (adaptive trial of new varieties, field demonstration improved agricultural practices, etc.) 2) Farmer training program (farming skills, organization strengthening, etc.) 3) Field staff empowerment 4) Small-scale farmer support 5) Farm machinery support 6) Technology development 7) Small-scale income generation (Vegetable, micro-poultry, fruit production, etc.)
Consulting Services (for BWDB)	1) Detailed design 2) Baseline survey 3) Tender assistance 4) Construction supervision 5) Capacity development support for WMO 6) Agricultural activities support 7) Environmental and social monitoring

Source: JICA Survey Team & IWM detailed Plan

Cost Estimation of Construction works

Estimated cost of civil construction works under HFMLIP is given in the following Table 2.7A & Table 2.7B

Table 2.7A: Cost of implementation of new haor sub-projects

Name of Scheme	Cost in Million Taka
a. Kishoreganj district	
1. Chandpur Haor Sub-project	30.05
2. Nunnir Haor Sub-project	272.33
3. Boro Haor (Nikli) Sub-project	209.00
4. Noapara Haor Sub-project	313.83
5. Naogaon Haor Sub-project	684.40
6. Badla Haor Project	175.60
7. Chatal Haor Sub-project	70.30
8. Dakhsiner Haor Sub-project	174.00
9. Sunair Haor Sub-project	186.01
Sub-Total-a	**2115.52**
b. Habigonj district	
1. Mokhar Haor project	620.00
Sub-Total -b	**620.00**
c. Netrokona district	
1. Ganesh Haor Sub-project	127.88
Sub-Total-c	**127.88**
d. Sunamgonj district	
1. Dhakua Haor Sub-project	534.1
2. Dharmapasha Rui Beel (Sunamganj & part of Netrokona)	790.80
3. Jaliar Haor Sub-project	89.60
Sub-Total-d	**1414.5**
TOTAL 14 Schemes (a+b+c+d)	**4277.900 Million Taka**

Note: Details of interventions with cost estimates are shown in Annex-A under brief of sub-projects

Table 2.7B: Cost of rehabilitation of old haor sub-projects

Name of Scheme	Cost in Million Taka
a. Kishoreganj district	
1. Baraikhalikhal Scheme	40.800
2. Alalia-Bahadia Scheme	12.100
3. ModhkholaBairagir char sub-project	10.000
4. Ganakkhali sub-project	10.000
Sub-Total-a	**72.900**
b. Habigonj district	
1. KaiardholaRatna Scheme	38.014
2. Bashira River Scheme	60.936
3. Aralia Khal Scheme	2.410
4. Ghuingajuri FCD Sub Project	10.734
Sub-Total-b	**112.094**
c. Brahmonbaria district	
1. ChandalBeel Scheme	22.032
2. SatdonaBeel Scheme	40.000
Sub-Total-c	**62.032**
d. Netrokona district	
1.Dampara Water Management Scheme	114.500
2. Kangsa River Scheme	83.000
3. Singer Beel Scheme	47.500
4.Khaliajuri Polder # 02 Scheme	30.500
5. Khaliajuri Polder # 04 Scheme	30.500
Sub-Total-d	**306.000**
TOTAL 15 Schemes(a+b+c+d)	**5,53.026 MillionTK (5,530.259 Lakh)**
Total (A+B) for 29 Sub-projects	**4830.926 million TK**

Note: Details of interventions with cost estimates are shown in Annex-A under brief of sub-projects

Extent of EIA

The project influence area or the impact zone has been defined as area within 500m boundary surrounding the project area. However, the project influencing area has been extended to 5 km wide area from the project boundary to analyze the land use and identify environmental sensitive areas that may be affected due to secondary impacts. Geographical Information System (GIS) was used based on recent satellite imageries of the project areas for above purposes. The impacts on ecologically sensitive areas if any (e.g. national parks, wildlife sanctuaries, biosphere reserve, and protected places) within 5 km of the project areas have also been assessed.

Objectives of EIA

The main objective of undertaking the EIA of HFMLIP is to provide baseline data/information, to determine the likely potential environmental impacts (beneficial and adverse) associated with the project activities and to provide mitigation measures. The overall objectives of the EIA are to:

- Assess the impacts on the physical environment (e.g. geology and topology, geomorphology, land use, soils, climate, hydrology, etc.), ecological environment (e.g. flora, fauna, environmental protected area), environmental quality (e.g. soil, dredged material, surface and ground water), environmental risks (e.g. climate change, flooding, cyclone, seismicity, etc.) and socio-economic environment (e.g. population, settlement and housing, traffic and transport, public utilities including water supply, sanitation and solid waste, economy and employment, cultural, archaeological and historical sites, etc.) related with the project activities.
- Engage stakeholders through public consultation, information disclosure regarding benefits, impacts, alternatives, mitigation measures and environmental management plans;
- Provide a quantitative or qualitative assessment of magnitude of each impact and prepare EMP to eliminate or reduce adverse environmental impacts; and
- Obtain environmental clearance certificate (ECC) from DOE.

2.3 Scope of Study

Following key tasks have been accomplished to meet the objective of the EIA as illustrated in the Terms of Reference:

- Collection and review of relevant documents;
- Collection and analysis of environmental data from secondary and primary sources (e.g. field survey);
- Public consultation with the relevant stakeholders;
- Establishment of baseline environmental condition;
- Identification and assessment of the potential environmental impacts (both positive and negative) along with mitigation measures;
- Climate change risk assessment
- Preparation of EMP (such as formulation of mitigation and monitoring plans);
- Institutional arrangement and capacity building; and
- Grievance Redress Mechanism

2.4 Methodology

The EIA of HFMLIP has been conducted in accordance with the ECR (1997), EIA Guidelines (1997) of the GOB and other relevant rules, regulations and policies as well as JICA Guidelines for Environmental and Social Considerations (2010). Primary and secondary data and information have been used in the EIA of the project. Discussions were held with the relevant stakeholders including directly affected people, government officials, community representatives, and a wide range of potential beneficiaries of the project. The main purpose of this approach was to obtain a fair impression of the people of the project and its environmental impacts. The list of stakeholders' consulted is in **Annex E.**

The following methodology was adopted for carrying out the EIA of the proposed project:

(I) Orientation

Meetings and discussions were held among the members of the EIA Consulting Team. This activity was aimed at achieving a common ground of understanding of various issues of the study and to agree on the approach and methodology including the scope and timeline for the study.

(II) Data Collection Planning

Subsequent to the concept clarification and understanding obtained, a detailed data acquisition plan was developed for the internal use of the EIA Consulting Team. The plan included identification of specific data requirements and their sources; determined time schedules and responsibilities for their collection; and indicated the logistics and other supporting needs for the execution of the data acquisition plan.

(III) Data Collection

The following data/information was collected. Secondary data were collected from different concerned government departments, books, reports and published materials to establish baseline profile for physical, ecological and socioeconomic environmental conditions.

Primary data were collected through baseline environmental survey and public consultation during 03 December 2015 to 12 April 2016 by one botanist, one zoologist and three environmental field surveyors. The Environmental Specialist along with Water Resources Engineer, Fisheries Specialist and Agriculture Specialist guided the survey team by visiting the field frequently during the survey. Following activities were performed for data/information collection:

- Site Reconnaissance
- Analysis of Maps and Plans
- Literature Review
- Desk Research
- Public Consultations
- Field Observations and Studies
- Focus Group Discussion (FGD)

Moreover, environmental quality analyses of soil, bed material, surface water, ground water, air and noise with selected parameters were conducted in the Soil, Water and Environment Laboratory of Dhaka University.

(a) Physical Environment

Information was collected on the existing physical environment, particularly as related to climate, topography and soil, geology and seismology, hydrology and drainage.

Climate

Monthly maximum and minimum temperature, rainfall, humidity and wind speed data recorded in the local weather station have been collected from the Bangladesh Meteorological Department in order to depict the climatic condition of the project areas.

Geology, Topography and Soils

Data related to geology, topography and soil were collected to establish the baseline of the project area and further to find out the impacts of the project during the preconstruction, construction and operational phases.

Hydrology and Drainage

Data related to hydrology and drainage was collected to identify the elements of the hydrological cycle that are likely to have impacts on the project and the possible impacts that the project could have on the hydrological regime. Field assessments included a determination and verification of all the existing inflows into the drain, assessment of drainage issues, interviews with local community members, and discussions with stakeholders.

(b) Biological Environment

Since the project included several beel areas, the assessment of flora and fauna, forest and wetlands, wildlife, endangered species, species diversity, fish and other aquatic animals was under taken. The status of the flora and fauna of the project area was determined during baseline environmental survey and relevant literatures were reviewed to assess the ecological status (e.g. habitat, existence, scientific name etc.) of the floral and faunal species. Both terrestrial and aquatic habitats were taken into consideration.

Terrestrial Flora and Fauna

During the baseline environmental survey, the diversity of terrestrial flora and fauna were identified. Following the survey work, a list of terrestrial flora and fauna has been prepared (**Annex C**).

Aquatic Flora and Fauna

Information on aquatic flora and fauna was gathered through the consultation with local people and consultation with the Forest Department and also through review of literature (**Annex C**).

(c) Environment Quality

Air Quality

Air quality measurements are essential to provide a description of the existing condition of ambient air and to provide a baseline against which changes can be measured and to assist in the determination of potential impacts of construction activities of the project on the ambient air quality. To monitor ambient air quality, Carbon Monoxide (CO), Sulphur dioxide (SO_2), Oxides of Nitrogen (NOx) and particulate matter (PM_{10}) have been included for ambient air quality monitoring.

Noise Quality

The noise monitoring was performed by the Department of Soil, Water and Environment of University of Dhaka. Existing sound level has been monitored in time weighted average Leq in dBA both at day and night time.

Ground /Drinking Water Quality

Sampling of ground water has been performed by DevConsultants' environment team and analysis of ground/drinking water has been carried in the laboratory of Department of Soil, Water and Environment of University of Dhaka for ten parameters (pH, Total Hardness as $CaCO_3$, Chloride as Cl^-, Nitrate as NO_3, Sulphates as SO_4, Fluorides as F^-, Salinity, Mn, Fe and As).

Surface Water Quality

Sampling of surface water has been performed by DevConsultants' environment team and analysis of surface water has been carried out in the laboratory of Soil, Water and Environment of University of Dhaka for seven parameters (pH, EC, DO, BOD, TDS, TSS).

Soil and Bed Material Quality

Samplings of soil and bed material were conducted by the DevConsultants' environment team and analysis of samples was done at the laboratory of the Department of Soil, Water and Environment of University of Dhaka. For soil quality analysis six parameters (pH, Texture, TOC, N, P and K) were analysed. For bed material five parameters (Zn, Cu, Pb, Cd and As) were analyzed.

(d) Environmental Risks

The issues of climate change as well as occurrences of flood, cyclone and seismicity have been considered as environmental risks.

(e) Socio- Economic Environment

The Consultants utilized a combination of desk research, field investigations, census data, structured interviews, maps, reports to generate the data required for description of the existing social environment and assessment of the potential impacts due to the project. Data was collected on the following aspects given below:

- Population: Demographic Profile
- Settlement and housing
- Traffic and transport
- Public Utilities: Water supply, sanitation and solid waste disposal
- Fisheries
- Agriculture
- Cultural, archaeological and historical sites
- Land Acquisition and Resettlement

Public Consultations

Public consultation is an important component of the EIA preparation activities. Local knowledge about the ecosystem and issues associated with the implementation of HFMLIP were carefully recorded and used in the impact assessment and developing the mitigation plan. Formal institutional level public consultation, in tandem with opportunistic informal ones involving local villagers and people whose livelihood depends on the project, were carried out.

Contents of the Report

This EIA report contains eleven chapters which have been formulated as per the requirements illustrated in the guidelines provided by DoE and the ADB's Safeguard Policy Statement, 2009. In this report, the consultants have formulated mitigation measures for activities that lead to negative impacts on the environment. This report consists of the following chapters:

Chapter 1 : Executive Summary
Chapter 2 : Introduction
Chapter 3 : Législation, Régulations and Policy Considérations
Chapter 4 : Project Descriptions
Chapter 5 : Baseline Environmental Conditions
Chapter 6 : Socio-Economic Environment
Chapter 7 : Identification, Prediction and Evaluation of Potential Environmental Impacts and Mitigation Measures
Chapter 8 : Environmental Management Plan
Chapter 9 : Public Consultations
Chapter 10 : Beneficial Impacts
Chapter 11 : Conclusions and Recommendations

2.5 Limitation

There was communication problem as the areas remain under water more than 6 months a year. Inundation of the working site, other wetland problems, which hampered data collection through field visits, conducting FGD, etc. for the EIA study. A great effort was necessary like using motor cycles, trawler, even walking for long distances to reach the stakeholders and organize meetings.

2.6 EIA Team Composition

DevConsultants Limited, Bangladesh is a renowned consultancy firm which was sub-contracted to prepare and deliver the EIA report for the twenty nine subprojects of HFMLIP. The DevConsultants Limited team members have many years of professional experience working in environmental impact assessment. The composition of the EIA team is provided in **Table 2.8**

Table 2.8: EIA study team composition

SL. No	Name	Qualification	Experience	Position
1	Md. Atalul Haq	BSc. Engineering, Civil (BUET) /Retired Member, BWDB, Also received many foreign and local short courses & training	51 Years in Water Reources Engineering (36 years in Govt. service and 15 years in consultancy, in the capacity of Team Leader/Deputy Team Leader)	Coordinator/ Water Resources Engineer
2	Md. Faruque Biswas	M.Sc. in Environmental Science	25 Years	Environment Specialist
3	Dr. Md. Shamsul Huda	Ph. D in Fisheris	50 Year	Fisheries Specialist
4	Dr. Md. Rezaul Karim	Ph. D in Agricultural Extension /Retired professor, Agricultural University	50 Years	Agriculture specialist
5	Dr. Md. Tajul Islam	Ph. D in Ecology	20 Years	Ecologist/ Environmentalist
6	M. Shamsul Hoque	Masters in Social Science	30 Years	Socio-Economist
7	Md. Sowkat Osman	Masters in Social Science	20 Years	Resettlement Specialist
8	Environmental Surveyor			Five numbers

The EIA study team worked under the supervision of Main Consultant and received periodic guidance from BWDB. The composition of Main Consultant's supervisory team is provided in **Table 2.9.**

Table 2.9: Main Consultant's supervisory team composition

Sl. No.	Name	Qualification	Experience	Position/Number
1.	Dr.A.K.M. Nurul Islam	Ph. D in Environmental Engineering	27 Years	Safe Guard Expert (International)
2.	Dr. Md. Kabil Hossain	Ph. D in Environmental Science	20 Years	Environment and Social Specialist (National)

2.7 References

This EIA has been conducted in accordance with the ECR (1997), EIA Guidelines (1997) of the GOB and other relevant rules, regulations and policies of GOB as well as JICA Guidelines for Environmental and Social Considerations (2010) and any project relevant international environmental agreements the country. Primary and secondary data and information have been used in the EIA of the project from different sources like reports and publications from GOB and other agencies, and web sites. Some of the references are provided below.

1. Bashar M. A., (2013.a), "Forests of Bangladesh and butterfly biodiversity", Environmental Biology and Biodiversity Laboratory, Dhaka University.
2. Coastal Wetland Biodiversity Management Project (CWBMP)-2006
3. Draft Final Report on data collection survey on water resources management in haor area of Bangladesh by Nippon Koei co. Ltd, October, 2013
4. Final Report of Preparatory Survey on Upper Meghna river Basin Watershed Management Improvement Project in The People's Republic of Bangladesh, Conducted by Nippon Koei co. Ltd, in favor of Japan International Cooperation Agency., February, 2014: Volume:1: Chapter1 to Chapter-13,
5. Identity of wildlife, Mohammad Sayed Ali, DFO Habiganj, 2016.
6. Inception Report, July, 2015 of IWM on "Mathematical Modeling and Topographic Survey under Consultancy Services for Management, Design, Supervision and other Related Services of Haor Flood Management and Livelihood Improvement Project (BWDB Part).
7. IUCN, Bangladesh 2003, Red Book of Threatened Fishes of Bangladesh. IUCN Bangladesh Country Office, Dhaka, Bangladesh.
8. IUCN, Bangladesh 2000, Red Book of Threatened Amphibians of Bangladesh. IUCN Bangladesh Country Office, Dhaka, Bangladesh.
9. IUCN, Bangladesh 2000, Red Book of Threatened Birds of Bangladesh. IUCN Bangladesh Country Office, Dhaka, Bangladesh.
10. IUCN, Bangladesh 2000, Red Book of Threatened Mammals of Bangladesh. IUCN Bangladesh Country Office, Dhaka, Bangladesh.
11. IUCN, Bangladesh 2000, Red Book of Threatened Reptiles of Bangladesh. IUCN Bangladesh Country Office, Dhaka, Bangladesh.
12. Khan, M.S. & Halim, M. 1987 Aquatic angiosperms of Bangladesh, Bangladesh National Herbarium, Bangladesh Agricultural Research Council.
13. Master Plan of Haor Areas, Department of Bangladesh Haor and Wetland Development Board (DBHWDB), Ministry of Water Resources, April 2012, studied by CEGIS, Bangladesh
14. MP Annex 2 Agriculture, Table 4.3 (CEGIS estimation from DAE & BBS data, 2010) Bangladehfigure-in2010/11; Year Book of Agricultural Statistics of Bangladesh, BBS, 2011;
15. Van Swaay, et al 2010. "The impact of climate change on butterfly communities 1990-2009".

3 LEGISLATIVE, REGULATION AND POLICY CONSIDERATION

3.1 Background

The proposed Haor Flood Management and Livelihood Improvement Project will be implemented in compliance with the applicable environmental laws and regulations of Bangladesh as well as guidelines given by Japan International Cooperation Agency Bangladesh has an environmental legal framework that is conducive to both environmental protection and natural resources conservation. This environmental legal framework applies to the HFMLIP. In addition, there are several laws and regulations related to environmental issues in Bangladesh. Many of these are cross- sectoral and partially related to environmental issues. This section presents an overview of the major Bangladesh environmental policies, laws and regulations that are relevant and may apply to activities supported by the project, institutional arrangement at national and sub-national level, JICA Guidelines for Environmental and Social Considerations (2010) and any project relevant to international environmental agreements the country is party to.

3.2 National Environmental Policies, Laws and Guidelines

3.2.1 National Environmental Policy, 1992

Bangladesh has adopted the National Environmental Policy (NEP) in 1992 aimed at sustainable development. The NEP sets out the basic framework for environmental action together with a set of broad sectoral guidelines for action. Major elements of the policy are:

- Maintaining the ecological balance for ensuring sustainable development;
- Protection against natural disasters;
- Identifying and controlling activities which are polluting and/or destroying the environment;
- Ensuring environment-friendly development in all sectors;
- Promoting sustainable and sound management of natural resources; and
- Active collaboration with international initiatives related to the environment.

The Environmental Policy of 1992, which amongst other policies, seeks to ensure that transport systems, including roads and inland waterways, do not pollute the environment or degrade resources. The Policy states that EIA should be conducted before projects are undertaken.

3.2.2 National Environmental Management Action Plan (NEMAP), 1995

The National Environmental Management Action Plan (NEMAP) builds on the NEP and was developed to address specific issues and management requirements during the period 1995-2005. The plan includes a framework within which the recommendations of a National Conservation Strategy (NCS) are to be implemented. The NEMAP was developed with the following objectives:

- To identify key environmental issues affecting Bangladesh;
- To identify actions to halt or reduce the rate of environmental degradation;
- To improve management of the natural environment;
- To conserve and protect habitats and bio-diversity;
- To promote sustainable development; and

- To improve the quality of life.

To this end, it has grouped all the relevant necessary actions under four heads: institutional, sectoral, location-specific and long-term issues. The institutional aspects reflect the need of inter-sectoral cooperation to tackle environmental problems requiring new and appropriate institutional mechanisms at national and local levels. The sectoral aspects reflect the way the Ministries and agencies are organized and make it easier to identify the agency to carry out the recommended actions. The location-specific aspect focuses on particularly acute environmental problems at local levels. The long-term issues include environmental degradation of such degree that it might become more serious and threatening than they seem to be if their cognizance is not immediately taken.

3.2.3 Environmental Conservation Act, 1995 and Amendments

The Environmental Conservation Act (ECA), 1995

The ECA, 1995 authorizes the DOE to undertake any activity to conserve and enhance the quality of environment and to control, prevent and mitigate pollution. The DOE is the regulatory body and enforcement agency of all environmental related activities. The act includes amongst others the following main provisions:

- Declaration of Ecologically Critical Areas;
- Procedure for obtaining Environmental Clearance Certificate (ECC);
- Regulation with respect to vehicles emitting smoke harmful for the environment;
- Environmental regulations for development activities;
- Standards for quality of air, water, noise, and soils (including river bed materials) for different areas and for different purposes;
- Acceptable limits for discharging and emitting waste; and
- Formulation of environmental guidelines to control and mitigate environmental pollution, conservation and improvement of environment.

The Environmental Conservation Act, 1995 (Amendment 2000)

Environment Conservation Act of Bangladesh Amended in 2000 focuses on ascertaining responsibility for compensation in cases of damage to ecosystems, increased provision of preventive measures both for fines and imprisonment and the authority to take cognizance of offences.

The Environmental Conservation Act, 1995 (Amendment 2002)

- The 2002 Amendment of the ECA elaborates on the following parts of the Act:
- Restrictions on polluting automobiles;
- Restrictions on the sale, production of environmentally harmful items like polythene bags;
- Assistance from law enforcement agencies for environmental actions;
- Break up of punitive measures; and
- Authority to try environmental cases.

The Environmental Conservation Act, 1995, (Amendment 2010)

This amendment of the act introduces new rules and restriction on:

- No individual or institution (Gov. or Semi Gov., / Non Gov. / Self Governing) can cut any Hill and Hillock. In case of national interest; it can be done after getting clearance from respective department
- Owner of the ship breaking yard will be bound to ensure proper management of their hazardous wastes to prevent environmental pollution and health risk
- No demarked water body can be filled up/changed; in case of national interest; it can be done after getting clearance from the respective department; and
- Emitter of any activities/incident will be bound to control emission of environmental pollutants that exceeds the existing emission standards.

3.2.4 The Environmental Conservation Rules, 1997 and Amendments

The Environment Conservation Rules (ECR), 1997 provide a first set of rules under the ECA, 1995. These provide amongst others standards and guidelines for:

- Categorization of industries and development projects, including roads and bridges on the basis of actual and anticipated pollution load;
- Requirement for undertaking initial environmental examination (IEE) and EIA, as well as formulating an EMP according to categories of industries/development projects/activities;
- Procedure for obtaining ECC; and
- Environmental quality standards for air, surface water, drinking water, industrial effluents, emissions, noise and vehicular emissions.

Depending upon location, size and severity of pollution loads, projects/activities have been classified in ECR, 1997 into four categories: Green, Orange A, Orange B and Red respectively, to nil, minor, medium and severe impacts on important environmental components (IECs). According to ECR 1997 of DOE, the current project falls under Category Red.

3.2.5 Relevant National Policies

Considerable numbers of national policy documents have been prepared during recent years and these have been accepted by the GOB. These policy initiatives, strategies and plans emphasize the need for conservation of the environment and natural resources in order to achieve sustainable development. **Table 3.1** presents an outline of the other national legal instruments that will have relevance to development project with respect to the social and environment considerations. The EIA is prepared in compliance with these national policies.

Table 3.1: National Legal Instruments

Policy	Brief Description	Responsible Agency
Environment Court Act, 2000 and subsequent amendments in 2002, 2010	The aim and objective of the Act is to materialize the Environmental Conservation Act, 1995 through judicial activities. This Act established Environmental Courts (one or more in every division), set the jurisdiction of the courts, and outlined the procedure of activities and power of the courts, right of entry for judicial inspection and for appeal as well as the constitution of Appeal Court	Ministry of Environment & Forests (MOEF)
National Land Use Policy (2001)	The policy deals with land uses for several purposes including agriculture, housing, forestry, industrialization, railways and roads. The plan identifies land use constraints in these sectors. The salient features of the policy objectives relevant to the proposed project are as follows: To prevent the current tendency of gradual and consistent decrease of cultivable land for the production of food to meet the demand of expanding population; To ensure that land use is in harmony with natural environment; To use land resources in the best possible way and to play supplementary role in controlling the consistent increase in the number of landless people and contribute towards the elimination of poverty and the increase of employment; To protect natural forest areas, prevent river erosion and destruction of hills; To prevent land pollution; and To ensure the minimal use of land for construction of both government and nongovernment buildings.	Ministry of Land (MOL)
National Agriculture Policy,1999	The act deals with the programs related to make the nation self-sufficient in food through increasing production of all crops, including cereals, and ensure a dependable food security system for all.	Ministry of Agriculture
The National Water Policy (1999)	Protection and restoration of water resources; Protection of water quality including strengthening regulations concerning agro-chemicals and industrial effluents; Sanitation and potable water;	Ministry of Water Resources (MOWR)
Wetland Protection Act, 2000	Advocates protection against degradation and resuscitation of natural water-bodies such as lakes, ponds, beels, khals, tanks, etc. affected by man-made interventions or other causes; Prevents the filling of publicly-owned water bodies and depressions in urban areas for preservation of the natural aquifers and environment; and Prevents unplanned construction on riverbanks and indiscriminate	MOWR

Policy	Brief Description	Responsible Agency
	clearance of vegetation on newly accreted land.	
The Removal of Wrecks and Obstructions in inland Navigable Water Ways Rules, 1973	Removal of wrecks and obstructions in inland Navigable Waterways	Bangladesh Water Transport Authority
The Protection and Conservation of Fish Act 1950 and subsequent amendments in 1982	Protection and Conservation of fishes in Government owned water bodies	Ministry of Fisheries & Livestock (MOFL)
National Fisheries Policy, 1998	Preservation, management and exploitation of fisheries resources in inland open water; Fish cultivation and management in inland closed water; Prawn and fish cultivation in coastal areas; and Preservation, management and exploitation of sea fishery resources	Ministry of Fisheries & Livestock (MOFL)
The Embankment and Drainage Act 1952	An Act to consolidate the laws relating to embankment and drainage and to make better provision for the construction, maintenance, management, removal and control of embankments and water courses for the better drainage of lands and for their protection from floods, erosion and other damage by water	Ministry of Water Resources
National Forest Policy (1994) and Forest Sector Review (2005)	Afforestation of 20% land; Bio-diversity of the existing degraded forests; Strengthening of agricultural sector; Control of global warming, desertification, control of trade in wild birds and animals; Prevention illegal occupation of the forestlands, tree felling and hunting of wild animals.	Ministry of Environment & Forests (MOEF)
The Forest Act 1927, Amendment 2000 (Protected, village Forests and Social Forestry)	Declare any forests land or wasteland as protected forests; May stop public or private way or watercourse in the interest of preservation of the forest; Declare a reserved forest area as village forests; and Declare an area as Social forests or launch a social forestry programme in Govt. land or private land with permission.	FD, MOEF
National Biodiversity Strategy and Action Plan (2004); Bangladesh Biological Diversity Act 2012	Conserve, and restore the biodiversity of the country; Maintain and improve environmental stability of ecosystems; Ensure preservation of the unique biological heritage of the nation for the benefit of the present and future generations; Guarantee safe passage and conservation of globally endangered migratory species, especially birds and mammals in the country; Stop introduction of invasive alien species, genetically modified organisms and living modified organisms.	MOEF

Policy	Brief Description	Responsible Agency
Bangladesh Wildlife (Conservation and Security) Act, 2012	This Act was promulgated for conservation and security of biodiversity, forest and wildlife of the country. For the purpose the government may by notification in the official gazette a specific area or some areas as protected area. According to Bangladesh Wildlife (Conservation and Security) Act, 2012 protected area means all sanctuaries, national parks, community conservation areas, safari parks, eco-parks, botanical gardens notified under the provisions of sections 13, 17, 18 and 19 under Chapter IV and special biodiversity conservation area established under the provisions of section 22 under Chapter V and traditional heritage and kunjaban are declared under section 23.	MOEF
Bangladesh Climate Change Strategy and Action Plan (2009)	Establishment of six strategic pillars for action, including: food security, social protection and health, disaster management, protective infrastructure, research and knowledge management, decreased carbon development, and Capacity building and institutional strengthening.	MOEF
Acquisition and Requisition of Immobile Property Ordinance, 1982	Power to make rules conferred upon by the Section 46 of the Ordinance	Ministry of Land
Acquisition of Immovable Property Rules, 1982	Procedural detailed required for acquisition of immovable property Proceedings for acquisition Notes under section 3, 6 and 7 Declaration of acquisition and possession Declaration of abatement and revocation of proceedings Transfer of acquired land Assessment of compensation Utilized acquired property	Ministry of Land
Public Procurement Rule (PPR), 2008	This rule shall apply to the Procurement of Goods, Works or Services by any government, semi-government or any statutory body established under any law. The rule includes the adequate measure regarding the “Safety, Security and Protection of the Environment’ in the construction works. This clause includes mainly, the contractor shall take all reasonable steps to (i) safeguard the health and safety of all workers working on the Site and (ii) protect the environment on and off the Site and to avoid damage or nuisance to persons or to property of the public or others.	Ministry of Public Works (MOPW)
The Brick Burning (Control) Act, 1989 The Brick Burning (Control) Amendment Act, 1992, 2001and 2013	Control of brick burning; Requires a license from the MOEF for operation; Restricts brick burning with fuel wood.	MOEF
Bangladesh Labour Act, 2006	This Act pertains to the occupational rights and safety of factory workers and the provision of a comfortable work environment and reasonable working conditions. In the chapter VI of this law safety precaution regarding explosive or inflammable dust/ gas, protection of eyes, protection against fire, works with cranes and other lifting machinery, lifting of excessive weights are described. And in the Chapter VIII provision of safety measure like appliances of first aid,	MOL

Policy	Brief Description	Responsible Agency
	maintenance of safety record book, rooms for children, housing facilities, medical care, group insurance etc. are illustrated.	
Bangladesh Standard Specification for Drinking Water, 1990	Formulation and revision of national standards.	Public Health and Engineering Department
Inspection and Enforcement Manual 2008	This manual has been written to provide national standard and uniformity environmental sampling for the inspections, investigations in the Department of Environment (DOE) in Bangladesh.	Department of Environment (DOE)

3.2.6 EIA Guidelines for Industry, DOE, 1997

Based on the various activities of the industrial projects and on the requirements of the ECR, 1997, the EIA guidelines for Industry has been prepared by the DOE. This EIA include but not limited to the following items

- Introduction to the EIA in Bangladesh;
- Criteria for location of industrial plants;
- Steps involved in conducting EIA; and
- Review of the EIA report.

3.3 Categories of Projects

Under the ECR of the DOE, Bangladesh (1997), a classification system was established for development projects and industries on the basis of the location, the size and the severity of potential pollution. There are four categories of projects: green, orange A, orange B and Red with respectively no, minor, medium and severe environmental impacts. According to the guidelines illustrated in the ECR, the HFMLIP falls under the red category of projects as the proposed project involves construction of new submergible embankment and several other project activities that directly impact on the existing environment. Therefore, for this project, it was decided that it is necessary to prepare an EIA following prescribed format and submit to the DOE for getting the ECC of the project. The approval of the EIA and EMP is required before submitting an application for an ECC.

Under the ECA (1995) and ECR (1997), the project will be required to obtain a site clearance as well as an environmental clearance. The procedure for obtaining environmental clearance is given in **Figure 3.1**.

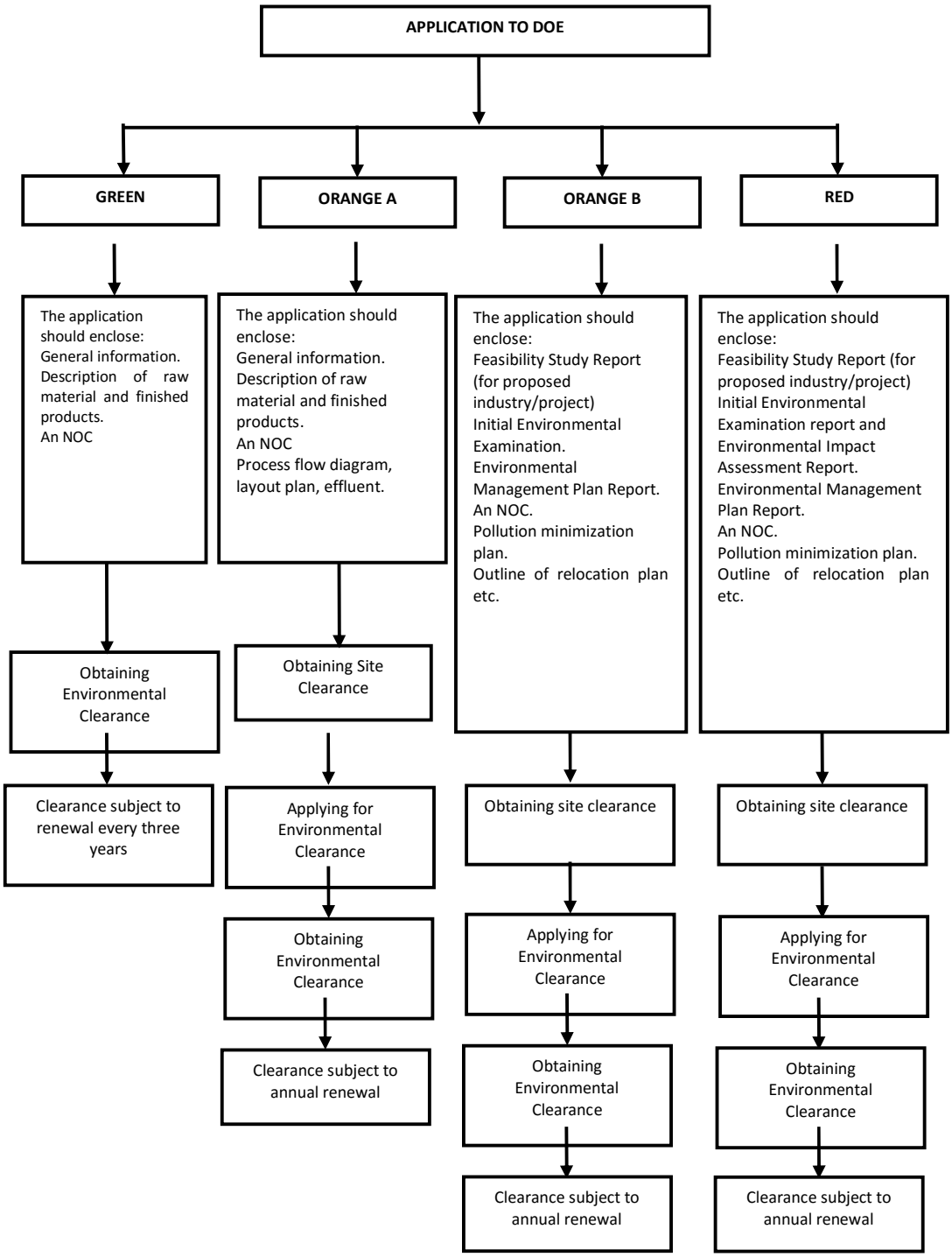

APPLICATION TO DOE
GREEN
ORANGE A
ORANGE B
RED
The application should enclose:
General information.
Description of raw material and finished products.
An NOC
The application should enclose:
General information.
Description of raw material and finished products.
An NOC
Process flow diagram, layout plan, effluent.
The application should enclose:
Feasibility Study Report (for proposed industry/project)
Initial Environmental Examination.
Environmental Management Plan Report.
An NOC.
Pollution minimization plan.
Outline of relocation plan etc.
The application should enclose:
Feasibility Study Report (for proposed industry/project)
Initial Environmental Examination report and Environmental Impact Assessment Report.
Environmental Management Plan Report.
An NOC.
Pollution minimization plan.
Outline of relocation plan etc.
Obtaining Environmental Clearance
Obtaining Site Clearance
Clearance subject to renewal every three years
Applying for Environmental Clearance
Obtaining site clearance
Obtaining site clearance
Obtaining Environmental Clearance
Applying for Environmental Clearance
Applying for Environmental Clearance
Clearance subject to annual renewal
Obtaining Environmental Clearance
Obtaining Environmental Clearance
Clearance subject to annual renewal
Clearance subject to annual renewal

Figure 3.1: Environmental Clearance Procedure

3.4 International Treaties

Bangladesh has signed many international treaties, conventions and protocols on environment, pollution control, bio-diversity conservation and climate change control, including the Ramsar Convention, the Bonn Convention on migratory birds, the Rio de Janeiro Convention on biodiversity conservation and the Kyoto protocol on climate change. An overview of some of the relevant international treaties and conventions signed by GOB is shown in **Table 3.2.**

Table 3.2: Relevant International Treaties, Conventions and Protocols signed by Bangladesh

Treaty or Convention	Year	Brief description	Responsible Agency
Protection of birds (Paris)	1950	Protection of birds in wild state	DOE/DOF
Conservation on wetlands of International Importance specially as waterfowl Habitat (Ramsar, Iran)	1971	Conservation and proper use of wetlands and their resources	DOE/DOF
Occupational hazards due to air pollution, noise & vibration (Geneva)	1977	Protect workers against occupational hazards in the working environment	Ministry of Health & Family Welfare (MOHFW)
Occupational safety and health in working environment (Geneva)	1981	Prevent accidents and injury to health by minimizing hazards in the working environment	MOHFW
UNESCO	1945	Convention Concerning the Protection of the World Cultural and Natural Heritage	Ministry of Education
Occupational health services (Geneva)	1985	To promote a safe and healthy working environment	MOHFW
Convention on Biological Diversity	1992	underpins the value of natural resources that provide food and livelihoods throughout the world	MOEF
CITES Convention (Convention on International Trade in Endangered Species)	1975	to ensure that international trade in specimens of wild animals and plants does not threaten their survival	FD/MOEF
International convention on climate changes (Kyoto Protocol)	1997	International treaty on climate change and emission of greenhouse gases	DOE/MOEF
UN REDD Program	2008	Reducing Emission from Deforestation and Forests Degradation in Developing Countries	MOEF

3.5 Japan International Cooperative Agency Policies

According to JICA Guidelines for Environmental and Social Considerations (2010), JICA classifies projects into four categories (A, B, C, or FI) according to the extent of environmental and social impacts, taking into account an outline of project, scale, site condition, etc. Categories are as follows:

Category A: Proposed projects are classified as category A if it is likely to have significant adverse impacts on the environment and society. Projects with complicated or unprecedented that are difficult to assess, or projects with a wide range of impacts or irreversible impacts, are also classified as *Category A.* These impacts may affect an area broader than the sites or facilities subject to physical construction. Category A, in principle, includes projects in sensitive sectors, projects that have characteristics that are liable to cause adverse and long-lasting environmental impacts; Projects are likely to be located in or near sensitive areas. An EIA, including an EMP, is required for all projects falling under Category A.

Category B: Proposed projects are classified as category B, if their potential adverse impacts on the environment and society are less adverse than those of Category A projects. Generally, they are site-specific; few if any are irreversible; and in most cases, normal mitigation measures can be designed more readily. An initial environmental examination (IEE), including an EMP, is required.

Category C: Proposed projects are classified as category C if they are likely to have minimal or little adverse impacts on the environment and society. An EIA or IEE is not required, although environmental implications need to be reviewed.

Category FI: Proposed projects are classified as category FI if they involve the investment of JICA funds to, or through, a financial intermediary.

Under the environmental categorization criteria of JICA, the present project falls within the Environmental Category B because of the following reasons:

- The project has less adverse environmental impacts than a Category-A project;
- The impacts are site-specific; only loss of agricultural lands is irreversible (explained in detail later), but in terms of total accumulated quantity of lands to be acquired for all substations under the project and the benefits incurred from their construction, this negative impact should treated as insignificant/ minor;
- The adverse impacts are site-specific, less severe, and can be mitigated with available ready-made mitigation measures;

3.6 National Standards

At present there are environmental standards in operation in Bangladesh, promulgated under the ECR of 1997. There are standards prescribed for varying water sources; ambient air; noise; odour; industrial effluent and emission discharges; and vehicular emissions. The standards, commonly known as Environmental Quality Standards (EQS), are legally binding. The Bangladesh standards for ambient air, noise, odour, sewage, industrial effluent and emission are furnished in **Annex H**.

3.7 Legal and Regulatory Provisions linked to the Project and its Activities

The legal and regulatory provisions linked or related to the project and its activities are presented in **Table 3.3**

Table 3.3: The legal and regulatory provisions linked or related to the project and its activities

Name of the Environmental law/regulation	Relevance to the project Direct/indirect/none	Institution or stakeholder organization approval should be sort.
The Environment Conservation Act, 1995	Direct	Ministry of Environment and Forests/ DOE
The National Land Use Policy, 2001	Indirect	Ministry of Land
The National Water Policy, 1999	Indirect	Ministry of Water Resources/ BWDB
The National Fisheries Policy, 1998	Indirect	Ministry of Fisheries & Livestock (MOFL)
National Forest Policy (1994) and Forest Sector Review (2005)	Indirect	Ministry of Environment and Forests/ BFD
Wetland Protection Act, 2000	Indirect	Ministry of Water Resources
Bangladesh Wildlife (Conservation and Security) Act, 2012	Indirect	Ministry of Environment and Forests

Note→Relevance to the project: 'Direct' is mentioned where formal approval is required

4 PROJECT DESCRIPTIONS

4.1 The Project and Its Location

The Project, HFMLIP, comprises rehabilitation of 15 haor subprojects and 14 no. new haor subprojects in 5 districts located in the North-eastern region of Bangladesh namely, Kishoregonj, Netrokona, Sunamgonj, Habigonj and Brahmanbaria with a small part of Mymensingh comprising a total gross area of 1,99,487 ha and net cultivable area of 1,62,630 ha (**Table 2.5).** The haor subprojects are shown in **Figure 2.2.** The Subprojects of HFMLIP are as follow (Details are places in **Annex A**):

List of New Sub-projects according to sub-project numbers.

i. N-1: Boro Haor (Nikli) Subproject is located in Kishoreganj Sadar, Katiadi, Karimganj and Nikli Upazila under Kishoreganj District;
ii. N-2: Naogaon Haor Subproject is located in Itna, Karimganj, Nikli and Mithamoin Upazila under Kishoreganj District;
iii. N-3: Jaliar Haor Subproject is located in Chhatak Upazila under Sunamganj District;
iv. N-4: Dharmapasha Rui Beel Subproject is located in Dharmapasha Upazila under Sunamganj District, and Kalmakandha, Barhatta and Mohanganj Upazila under Netrokona District;
v. N-5: Chandpur Haor Subproject is located in Katiadi and Nikli Upazila under Kishoreganj District;
vi. N-6: Suniar Haor Subproject is located in Kendua Upazila under Netrokona and Tarail Upazila under Kishoreganj District;
vii. N-7: Badla Haor Subproject is located in Itna, Karimganj and Tarail Upazila under Kishoreganj District;
viii. N-8: Nunnir Haor Subproject is located in Bajitpur, Katiadi and Nikli Upazila under Kishoreganj District;
ix. N-9: Dakhshiner Haor Subproject is located in Itna and Mithamoin Upazila under Kishoreganj District and Azmeriganj Upazila under Habiganj District;
x. N-10: Chatal Haor Subproject is located in Tarail and Itna Upazila under Kishoreganj District, and MadanUpazila under Netrokona District;
xi. N-11: Ganesh Haor Subproject is located in Madan and Atpara Upazila under Netrokona District;
xii. N-12:Dhakua Haor Subproject is located in Sunamganj Sadar, Dakshin Sunamganj and Jamalganj Upazila under Sunamganj District;
xiii. N-13: Mokhar Haor Sub-project is located in Habiganj Sadar, Ajmiriganj and Baniachong Upazila under Habiganj District;
xiv. N-14:Noapara Haor Subproject is located in Austagram, Karimganj and Nikli Upazila under Kishoreganj District.

List of Rehabilitation Subprojects according to Subproject Numbers.

i. R-1: Dampara Water Management Scheme Subproject is located in Purbadhala upazila under Netrokona District;
ii. R-2: Kangsha River Scheme Subproject is located in Netrokona Sadar and Purbadhola Upazila under Netrokona District
iii. R-3: Singer Beel Subproject is located in Barhatta upazila under Netrokona District
iv. R-4: Boraikhali Khal Subproject is located in Kishoreganj Sadar and Hosainnpur upazila under Kishoreganj and Nandail upazila under Mymensingh District
v. R-5: Alalia-Bahadia Subproject is located in Katiadi and Pakundia upazila under Kishoreganj District;
vi. R-6: Modkhola-Bairagir Char Subproject is located in Katiadi and Pakundia upazila under Kishoreganj District;
vii. R-7: Ganakkhali Subproject is located in Kuliar Char Upazila under Kishoreganj District;
viii. R-8: Kair Dhala Ratna Subproject is located in Ajmiriganj and Baniachong Upazila under Habiganj District;
ix. R-9: Bashira River Re-Excavation Subproject is located in Ajmiriganj and Baniachong Upazila under Habiganj District;
x. R-10: Aralia Khal Subproject is located Baniachong Upazila under Habiganj District;
xi. R-11: Chandal Beel Subproject is located in Bancharampur Upazila under Brahmanbaria District;
xii. R-12: Satdona Beel Scheme Subproject is located in Bancharampur Upazila under Brahmanbaria District;
xiii. R-13: Ghungaijuri Haor Subproject is located in Habiganj Sadar, Baniachong and Bahubal Upazila under Habiganj District;
xiv. R-14: Kakiajuri FCD Polder-2 Subproject is located in Kaliajuri Upazila under Netrokona District;
xv. R-15: Kaliajuri FCD Polder-4 Subproject is located in Kaliajuri Upazila under Netrokona District.

4.2 Project Components

A list of the target structures of the 14 new projects and 15 rehabilitation projects provided in the Data Collection Survey are presented and the in **Table 4.1.A and Table 4.1.B** respectively.

The submergible/dwarf embankments are built in the haor areas to save the main Boro crops from early flash floods during dry season the flood level being low at that time. Monsoon flood level is too high and such high embankment cannot be constructed as the same will have confinement effect and cannot be maintained due to high wave action. The gates of the regulators will be opened after harvesting of boro crop at the end of the pre-monsoon season in order to introduce flood water into the project area. This operation can avoid over topping from submergible embankment and therefore avoid damages to the embankment due to the overtopping. In the post-monsoon season will be less, the flood water which inundated the project area during the monsoon season will be rapidly drained through the canals and regulators after the monsoon season for agriculture purpose.

The regulators which need repair in the rehabilitation projects have been identified through the structural survey.

In the following **Table 4.1.A** the detail of Principal Features of new Haor sub-projects and in **Table 4.1.B** Rehabilitation of old Haor Projects have been shown in tabular form to know the intervention that have been proposed for the total 29 Haor Sub-projects, 15 rehabilitation and 14 new spread into 5 administrative districts.

Table 4.1A: Principal Features of New Haor Subprojects under HFMLIP (14 Nos.)

Sl. No	Name of Sub-Project	Embankment (km)		New regulator (with vent sizes) (Nos.)	Re-excavation of Khal/ Canal(km)	Causeways (with size) (nos.)	Pipe sluice	Pipe Inlet	River Re-excavation (Km)
		Full	Submergible						
1)	Boro Haor (Nikli)		2.96	5	21	3	1	2	-
2)	Naogaon Haor		63.3	6	40	4	2	5	-
3)	Jaliar Haor		8.0	2	12.0	-	-	-	-
4)	Dharmapasha Rui Beel		55.0	11	40.0	1	3	-	10
5)	Chandpur Haor		0.31	1	14.67	-	-	-	-
6)	Suniar Haor		2.6	4	27.0	1	-	-	-
7)	Badla Haor		21.0	2	9.70	1	1	2	-
8)	Nunnir Haor		31.36	6	34.93	1	2	9	
9)	Dakhshiner Haor		19.20	1	9.20	1	-	-	1.80
10)	Chatal Haor		6.27	2	0.15	-	1	-	-
11)	Ganesh Haor		2.80	4	11.97	-	2	-	
12)	Dhakua Haor		25.0	2	15.0	-	-	-	-
13)	Mokhar Haor		26.6	8	55.0	3	1	7	-
14)	Noapara Haor		22.11	5	15.0	1	2	-	-
	Sub-Total		**286.51**	**59**	**305.62**	**16**	**15**	**25**	**11.8**

Table 4.1B: Principal Features of Rehabilitation of Existing Haor Subprojects under HFMLIP (15 Nos.)

SL. No.	Name of Sub-Project	Re-sectioning of Embankment (km)		Reinstallation / new regulator (with vent sizes) (Nos.)	Re-excavation of canal (km)
		Full	Submergible		
1)	Dampara Water Management Scheme	0.200	0.460	15	12
2)	Kangsa River Scheme	0.040	-	16	-
3)	Singer Beel Scheme	0.100	0.130	1	2
4)	Baraikhali Khal Scheme	0.010	-	6	24.5
5)	Alalia-Bahadia Scheme	-	-	2	8.5
6)	Modkhola Bhairagir char Subproject Scheme	0.500	-	-	-
7)	Ganakkhali Sub-scheme	-	-	3	-
8)	Kair Dhala Ratna Scheme	-	0.060	9	-
9)	Bashira River Scheme	-	6.000	2	20
10)	Aralia Khal Scheme	-	-	4	2.4
11)	Chandal Beel Scheme	0.100		1	1.5
12)	Satdona Beel Scheme	-	-	2	-
13)	Ghungaijuri FCD Subproject	0.600		20	4.5
14)	Kaliajuri Polder #02 Scheme	-	0.810	19	-
15)	Kaliakjuri Polder #04 Scheme	-	0.630	3	-
Sub-Total		**1.550**	**8.090**	**103**	**75.4**

4.a Project Activities

4.a.1 List of the main Project activities to be undertaken

Designing of the major project infrastructure components for the HFMLIP, that include the following:

I. Re-excavation of canal/ Khal;
II. Construction and rehabilitation of regulator
III. Re-sectioning and rehabilitation of full embankment
IV. Construction and re-sectioning/rehabilitation of submergible embankment
V. Provision for pipe inlet and causeway
VI. Protection works by CC blocks for sluice;
VII. Protection works by grass turfing on the embankment slopes; and

The design of the project will be done to make sure that all above mention constructions are carried out according to the national design standards. Specific environmental precautions that need to be taken during the design are.

During the preconstruction/ site clearing stage

- Debriefing of the contractors with clear instructions on the scope and contract specifications and environmental standards expected
- The work site will be handed over to the contractor by the implementing agency.
- The contractor will clear the worksite by removing any debris, leveling the land, clearing any erected structures including dwellings, stack yards and sheds for transport and safe storing of construction materials and equipment.
- Recruit labor and assign them for work. Give priorities to recruit people from the area if such labor is available. Provide accommodation with adequate sanitary facilities and proper environmental safeguards. Provide facilities for supply of adequate water by installing drinking tube wells with sufficient
- Construct temporary access roads for vehicle parking and labor movement, transport of goods and equipment and also build fully functional temporary office sheds for officials assigned to the site

Activities during construction stage

- Sourcing of construction material and transportation to the site
- The construction materials stored with proper precautions at site.
- Deploy necessary equipment only after ensuring that they are meeting the necessary specifications.
- Ensure that all workers and staff are briefed adequately on work norms and practices to maintain highest work ethics.
- Ensure adequate health and safety at all work sites. Work to begin under constant supervision of qualified supervisors and conducting of regular inspection to ensure 100 percent compliance on aspects identified.

Activities during operation & maintenance Stage:

The project is about the management of water for achieving the best productivity possible. Setting up of the WMA and WMOs will happen prior to the operational phase and the members will be educated and made aware of the tasks, responsibilities of the organization.

- Operation and maintenance (O&M) of the built infrastructure according to the requirements of the beneficiary groups who will depend on efficient management of water and other resources.

4.a.2 Project Plan, design, standard, specification, quantification

4.a.2.1 Project Plan

Project plans for all the 29 subprojects have been prepared with the objective to mitigate flood damage and to improve people's living conditions in the Haor areas through the three components of the project of introducing Integrated Water Management practices to the subproject areas that will be improved by rehabilitation and construction of infrastructure needed for reducing of water logging and drainage congestion so that agricultural production will increase. To facilitate the process a project plan has been prepared in a participatory way by taking views of the stakeholders.

The interventions requested involve construction and re-sectioning of embankment (full and submergible), re-excavation of canal, construction and rehabilitation of regulator, creating better water management through participatory planning design and management of system, building ownership of the infrastructure by the users/WMG members and finally taking over responsibility of the infrastructures by them including operation and maintenance responsibility of the water management system by the Water Management Organization themselves.

Navigation, a vital issue in haor region, is kept in mind in project planning stage and special attentions are given to address the navigation issue in considering interventions. Provision for Causeway, a new type of intervention, has been kept to ease navigation along with some other functions like flash flood protection and flushing.

The project plan also includes capacity building of WMG members by imparting training on leadership, organizing agriculture Farmers Field School, demonstration of new improved HYV of rice, model vegetable gardening practices. Culture fishery will be promoted through organizing Field school of Fishery, demos, and fish sanctuaries.

The project also plans additional income generating activities and providing support for value addition to supply chains for sustainable economic development of the beneficiaries, and support to vulnerable destitute in the community.

4.a.2.2 Design

Opinion of the stakeholder had been taken while preparing project plan as the first step towards conducting feasibility reports and the intervention and design consideration was finalized and it re-confirmed while disseminating the project information with the stakeholders formally.

Design Water Level and Crest Elevation of Embankment

i) Safety Level

The subprojects are classified according to their embankment type. The sub projects involving submergible embankment would protect the landside area from the intrusion of haor water during the pre-monsoon period when the farmers harvest boro rice. It allows water to enter into the protected area and be submerged in the monsoon season. Meanwhile, the subprojects involving full flood embankment would protect the land side area from the intrusion of haor water throughout the entire year. This enables the cultivation of other crops even during the monsoon season when the haor water level is the highest. Subprojects involving full flood type embankments are usually planned in the peripheral area of deep haor areas. Submergible embankment is applied in deep haor areas, since full flood embankment may bring drainage problem, ecological problem, and conflicts between agricultural and fisheries people, and may also obstruct the supply of nutrition to the soil due to flooding. The safety level of embankment for flood is stipulated in the Standard Design Manual by the BWDB Design Circle as ten-year probable water level in the pre-monsoon season and 20-year probable water level in the monsoon season are applied to submergible e and full flood embankments, respectively. The elevation of operation decks of regulators should be higher than the 20-year water level in the monsoon season so that the gate can be operated even during the monsoon season. The subprojects should comply with these regulations as well as the Haor Master Plan and other BWDB projects.

ii) Design Water Level

The design water levels for each sub-project were computed in the Data Collection Survey through the following procedure:

1) Simulate the water levels from 1980 to 2010 for Bairab Bazar, Itna, Sunamganj , and Sylhet by using the recently measured water level data and river cross sections updated in the Data Collection Survey.
2) Carry out statistical analysis to estimate the probable water levels for Beira Bazar, Itna, Sunamganj, and Sylhet, and identify the flood year's corresponding to a ten-year water level in the pre-monsoon season and 20-year water level in the monsoon season.
3) Simulate the water levels at un-gauged locations along the rivers near the location of the subprojects for each return period.

The North-East Region Model (NERM) developed by IWM was used for the simulation. The input data areas follow:

a) Discharge of the main stream and tributaries at border with India as the upstream boundary condition,
b) Water level at Bairab Bazar as the down stream boundary condition, and
c) Rainfall inside the lazed area.

The crest elevation of the embankment is determined to have a free board of 0.3m for submergible embankment and 0.9 m for full flood embankment on the design water level. **Table 4.2** and **Table 4.3** shows the design water levels and design crest levels of the embankment and regulator operation decks.

Table 4.2: Subproject Design Water Levels and Crest Levels of Embankments (New Subprojects)

Subproject	Submergible Embankment		Regulator Deck Level	
	10-year WL in PM		20-year WL inM	
	Design Water Level (m+PWD)	Design Level crest (m+PWD)	Design Water Level (m+PWD)	Design Level Design (m+PWD)
Boro (Nikli) Haor	3.8-4.3m	4.1-4.6m	7.0m	7.9m
Naogaon	4-4.6m	4.3-4.9m	8.2m	9.1m
Jaliar	7.3m	7.6m	8.6m	9.5m
Dharmapasha	6.1m	6.4m	8.5m	9.4m
Chandpur	3.8m	4.1m	7.0m	7.9m
Sunair	4.9-5.2m	5.2-5.5m	4.3m	5.2m
Badla	4.6-4.9m	4.9-5.2m	7.10m	8.0m
Nunnir	3.8m	4.10m	7.0m	7.9m
Dakshiner	4.6-5.8m	4.9-6.1m	7.2m	8.8m
Chatal	4.9m	5.2m	7.2m	8.1m
Ganesh	6.0-6.4m	6.3-6.7m	7.6m	8.5m
Dhakua	3.8-6.30m	4.1-6.6m	6.30m	7.2m
Mokhar	4.5-9.25m	4.8-9.55m	7.2m	8.1m
Noapara	3.8-4.3m	4.1-4.6m	7.0m	7.9m

Duration of the flood management:

The duration of the flood management by constructing submergible embankment is only for 1 month 20 days (25 March to 15 May). From 16th May, filling of haor with water by operating the regulator gates and removal of earth from the causeway will reduce the damage of embankment crest while monsoon flood water will over top the submergible embankment. A flatter side slope of the new design of 1:3 (against 1:2 of old design) will also help in lessening the damage with greater stability. The removal of earth from causeway will also allow normal navigation is a new concept introduced under the project for new projects.

Table 4.3: Subproject Design Water Levels and Crest Levels of Embankments (Rehabilitation Haor)

Sub-Project	Submergible Embankment		Full Flood Embankment & Regulator Deck Level	
	10-year WL in PM	20-year WL in M	10-year WL in PM	20-year WL in M
	Water Level (m+PWD)	Design Level (m+PWD)	Water Level (m+PWD)	Design Level (m+PWD)
Dampara Water	6.3m	6.6m	11.7m	12.6m
Kangsa River	6.3m	6.6m	11.7m	12.6m
Singer Beel	6.1m	6.4m	9.0m	9.9m
Baraikhali Khal	7.2m	7.5m	10.6m	11.5m
Alalia-Bahadia	5.9m	6.2m	9.3m	10.2m
Modkhola Bhairagirchar	5.6m	5.9m	9.0m	9.9m
Ganakkhalli	4.0m	4.3m	7.9m	8.8m
Kairdhala Ratna	5.3m	5.6m	8.1m	9.0m
Bahira River	4.9m	5.2m	7.9m	8.8m
Aralia Khal	7.5m	7.8m	8.9m	9.8m
Chandal Beel	3.8m	4.1m	7.0m	7.9m
Satdona Beel	3.8m	4.1m	7.0m	7.9m
Gangajuri FCD	10.6m	10.9m	12.7m	13.6m
Kaliajuri polder#02	5.5m	5.8m	8.1m	9.0m
Kaliakjuri polder#04	5.2m	5.5m	8.0m	8.9m

Source: JICA Survey Team (2013)

a) Facility Plan

The gates of the regulators will be opened after harvesting of boro crops the end of the pre-monsoon season in order to introduce flood water into the project area. This operation can avoid over topping from submergible embankment and there for avoid damages to the embankment due to the over topping. In the post-monsoon season, the flood water which in undated the project area during the monsoon season will be rapidly drained through the canals and regulators.

The regulators which need repair in the rehabilitation projects have been identified through the structural survey.

The flow capacities of regulators in the new projects were determined by following the Standard Design Manual of BWDB. Then, the capacity of the regulators should be sufficient to ensure that the maxim mead difference across the regulator when the embankment is over topped should not exceed 0.3m with are turn period of one in ten years.

Firstly, the location and catchment areas of the regulators were set by using the digital elevation model (DEM) of BWDB. Then the capacity and number of gates were determined by following the manual. A list and the general features of the regulators in the new projects are shown in **Table 4.4.**

Table 4.4: List of Regulators in the New Subprojects

Sub-Project Name	Regulator	Catchment Des(ha)	Design WL (m PWD)	Number of gate	Invert level (m PWD)	Stilling Basin	
						Length	Wall height (m)
Badla Sub-Project	No.1	763	4.9	2	3.5	6.0	3.0
Badla Sub-Project	No.2	513	4.9	2	3.5	6.0	3.0
Dharmapasha Rui Beel	No.1	6860	6.1	17	2.0	10.0	4.0
Dharmapasha Rui Beel	No.2	2404	6.1	6	2.0	10.0	4.0
Dharmapasha Rue Beel	No.3	3184	6.1	8	2.0	10.0	4.0
Dharma pasha Rui Beel	No.4	1033	6.1	3	2.0	10.0	4.0
Dharma pasha Rui Beel	No.5	6923	6.1	18	2.0	10.0	4.0
Bara Haor	No.1	1961	6.0	5	3.0	9.0	4.0
Bara Haor	No.2	507	6.0	1	3.0	9.0	4.0
Ayner GupiHaor	No.1	809	4.0	3	2.5	6.0	3.0
BoroHaor (Nikli)	No.1	8053	5.0	18	3.0	7.0	3.0
BoroHaor (Nikli)	No.2	1096	5.0	3	3.0	7.0	3.0
Chandpur Haor	No.1	1573	4.9	4	4.0	5.0	3.0
Chandpur Haor	No.2	677	4.9	1	4.0	5.0	3.0
Dulalpur	No.1	355	4.0	2	1.5	8.0	3.0
Korati Beel Haor	No.1	726	4.8	1	2.8	7.0	3.0
Korati Beel Haor	No.2	2061	4.8	4	2.8	7.0	3.0
Kuniarbandh Haor	No.1	1327	4.0	1	3.5	3.0	4.0
Naogaon Haor	No.1	2394	4.9	9	2.0	8.0	4.0
Naogaon Haor	No.2	4760	4.9	17	2.0	8.0	4.0
Naogaon Haor	No.3	1125	4.9	4	2.0	8.0	4.0
Noapara Haor	No.1	783	4.5	2	2.8	6.0	3.0
Noapara Haor	No.2	586	4.5	1	2.8	6.0	3.0
Noapara Haor	No.3	1496	4.5	3	2.8	6.0	3.0
Nunnir Haor	No.1	2993	4.3	5	2.8	6.0	3.0
Nunnir Haor	No.2	1460	4.3	2	2.8	6.0	3.0
Nunnir Haor	No.3	894	4.3	2	2.8	6.0	3.0
Sarishapur Haor	No.1	1004	4.2	1	3.5	4.0	4.0
Bansharir Haor	No.1	333	5.8	1	4.5	6.0	3.0
Bansharir Haor	No.2	844	5.8	1	4.5	6.0	3.0
Chatal Haor	No.1	680	5.4	1	2.8	8.0	3.0
ChatalHaor	No.2	137	5.4	1	2.8	8.0	3.0
Dakhshiner Haor	No.1	1694	4.8	6	2.3	8.0	3.0
Dakhshine Haor	No.2	789	4.8	3	2.3	8.0	3.0
Dhakua Haor	No.1	3430	6.0	5	3.8	7.0	3.0
Dhakua Haor	No.2	877	6.0	1	3.8	7.0	3.0
Dhakua Haor	No.3	1655	6.0	3	3.8	7.0	3.0
Ganesh Haor	No.1	984	6.1	2	3.8	8.0	3.0
Ganesh Haor	No.2	1944	6.1	3	3.8	8.0	3.0
Jaliar Haor	No.1	914	7.3	2	6.0	6.0	3.0
Jaliar Haor	No.2	1297	7.3	2	6.0	6.0	3.0
Mokhar Haor	No.1	3983	5.6	3	3.5	7.0	3.0
Mokhar Haor	No.2	3388	5.6	3	3.5	7.0	3.0

Mokhar Haor	No.3	5473	5.6	5	3.5	7.0	3.0
Mokhar Haor	No.4	4496	5.6	4	3.5	7.0	3.0
Mokhar Haor	No.5	4087	5.6	4	3.5	7.0	3.0
Shelnir Haor	No.1	1972	5.2	1	4.8	3.0	5.0
Shelnir Haor	No.2	469	5.2	1	4.8	3.0	5.0
Shelnir Haor	No.3	589	5.2	1	4.8	3.0	5.0
Sunair Haor	No.1	3197	5.7	4	4.0	6.0	3.0
Sunair Haor	No.2	697	5.7	1	4.0	6.0	3.0

On the other hand, the canals which have deteriorated were listed based on the proposal in the Haor Master Plan. The master plan proposed compiling the results of the interview survey with the BWDB district offices and local government offices to identify the canals and required length for re-excavation. For the rehabilitation sub-projects which are not proposed in the master plan, the required length of the canals for re-excavation was identified through interview surveys with the BWDB district offices.

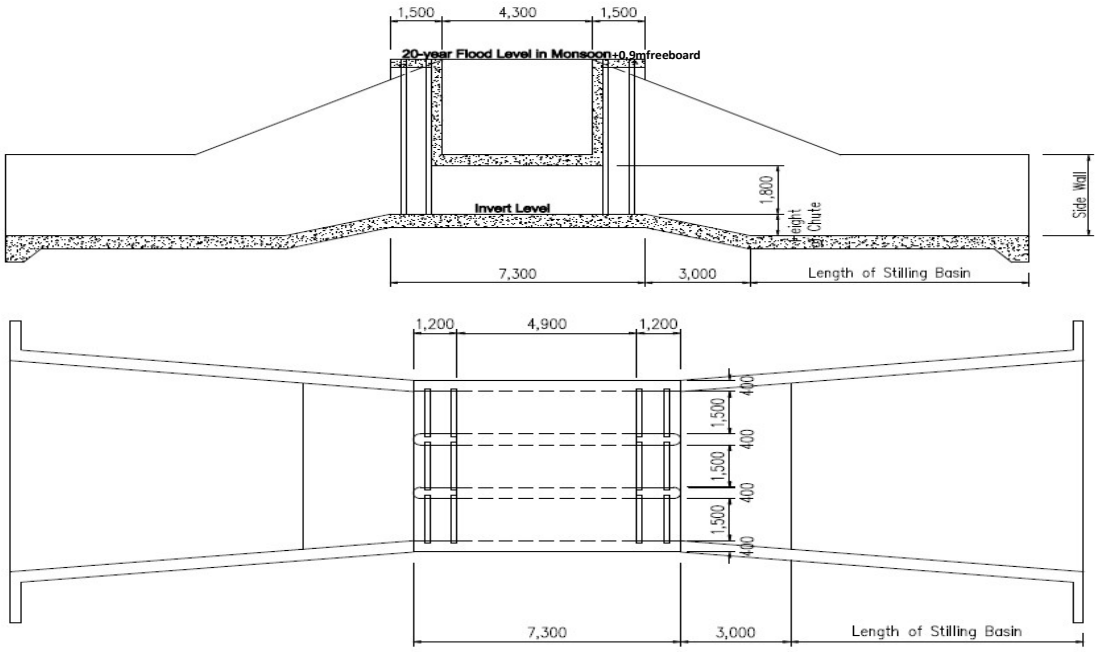


Figure 4.1: Typical Diagram of Regulator

Regulator can be also designed using the Standard Design Manual of BWDB. Some issues should be considered regarding quality control of structural concrete and types of regulators.

Flow capacities of regulators in the new projects were determined in line with the stipulations of the Standard Design Manual of BWDB that the capacity of their regulators should be sufficient to secure the maximum head difference across the regulator to be within 0.3m with a10-year return period when the embankment is overtopped. The sites where the regulators are to be provided were defender ferrying to the drainage channels in the digital elevation model (DEM) provided by BWDB.

b) Study of Facility Plan in the Detail Design Stage

Data Collection Survey on Water Resource Management for Haor Area conducted the hydraulic analysis with IWM using North East Regional Model (NERM) in order to determine the design water levels for full and submergible embankment of new and rehabilitation projects. The regulators of the new projects presented in **Table 5** were mainly planned by desk studies using DEM of BWDB. The length of re-excavation of the canals was determined through the interview surveys. There is a possibility there for that these facility plans do not reflect the actual site conditions. The fore going hydraulic studies must be updated during the implementation stage in addition to updating of topographic and hydrological information.

The objectives and scopes of necessary hydraulic studies in the detail design stage are as follows:

i) To obtain topographic information and clarify current hydraulic conditions and drainage system by further site reconnaissance, using data from the Survey of Bangladesh (SoB) and undertaking additional river/canal cross section survey,

ii) To obtain the latest hydrological and hydraulic data from existing observation stations,

iii) To calibrate NERM with updated to geographic and hydrological data for both pre-monsoon and monsoon floods,

iv) To establish the local model for the 15 rehabilitation subprojects and 14 new subprojects with MIKE-11 and connect with NERM,

v) To define ten-year flood for the pre-monsoon and 20-year flood for the monsoon,

vi) To determine the design water level of flood management facilities and required flow capacity of regulators and re-excavation of canal, and

vii) To propose the location and number of vents for regulators and typical cross section of drainage canals for re-excavation in each sub-project.

4.a.2.2.1 Facility Design

4.a.2.2.1.1 Embankment

Embankments should be basically designed to comply with the Standard Design Manual by the BWDB Design Circle. However, there is not sufficient description and stipulations in the Standard Design Manual especially regarding embankment material, quality control and construction method to maintain the required strength for stability of the embankment. In addition, there are many embankments the crest there of are eroded by over topping and deformed by wheel trucks by site reconnaissance. Surface protection may be needed not only for the slopes but also for the crest of embankments.

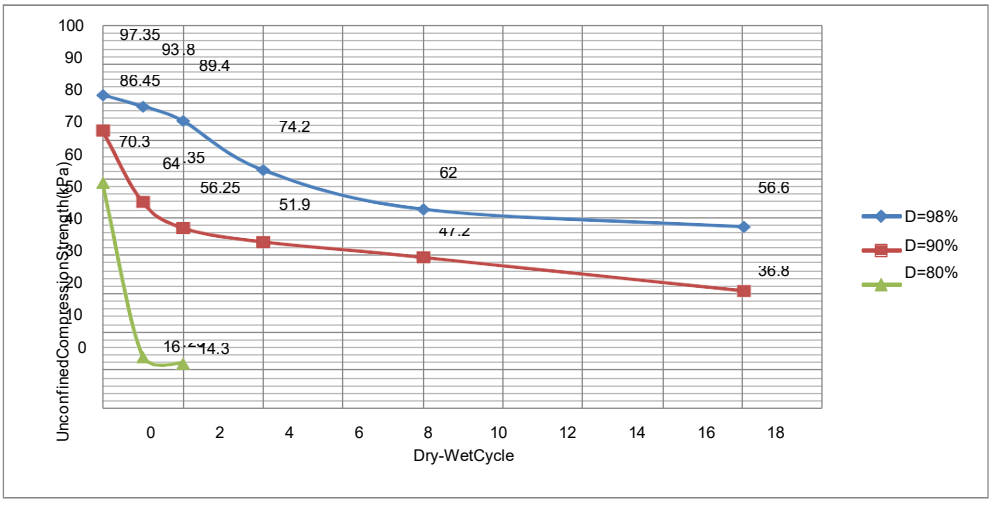
a) Embankment Materials

Embankment material is usually procured from adjacent ground of the embankment site. Such materials composed of fine material of which more than 90% is occupied by silt and clay (grain size < 0.075mm). Compacted embankment which does not include coarse material may cause cracks due to drying shrinkage and causes gully erosion and decrease of strength by soaked with water. However, it is practically not easy to obtain coarse material and mix with fine silt and clay in case of the haor area, hence other measures should be considered.

b) Construction Method and Quality Control

Contract drawings of embankments usually mention to use 7.0 kg rammer for compaction work. However, BWDB pointed out that any equipment such as rammer is seldom to be used in the actual construction. According to geo technical investigation carried out in the Data Collection Survey, the required cohesion of embankment for its stability should be more than 14kN/m^2 (this cores ponds to 28kN/m^2 for unconfined compression strength), and the expected initial unconfined compression strength of embankment is 60–100 kN/m^2 in case of 90%degree of compaction according to the unconfined compression test and tri-axial compression test. Therefore, 90% degree of compaction is enough for the required strength of embankment.

On the other hand, dry- wet cycle test was conducted in the Data Collection Survey in order to evaluate decrease of local durability by degree of compaction under repeated dry and submergence condition in the haor area. In this dry-wet cycle test, the unconfined compressive strength was used as an indicator for local durability, and unconfined compression tests were conducted for three degrees of compaction (80%, 90%, and 98%) and at six dry-wet cycles (0, 1, 2, 4, 8, and 16 cycles). As shown in **Figure 4.2**, the unconfined decompression strength has the local durability decreases under the repeated dry and submergence process.



Source: JICA Survey Team

Figure 4.2: Results of Dry-Wet Cycle Test in Data Collection Survey

In the case of 80% degree of compaction, the strength decreased rapidly and the specimens cannot keep their form. In the cases of D=90% and 98%, the strengths decreased to 36.8 kN/m^2 (42% of initial strength) and 56.6kN/m^2 (58% of initial strength), respectively.

The seductresses in strength are inferred to be cause by deterioration on the upper and bottom surfaces of specimens under the dry-wet process. This means that the effect of infiltration of water and dry action which causes deterioration of embankment can be limited in the surface layer of the embankment by a higher degree of compaction. In other words, a higher degree of compaction is inferred to be able to bring higher surface durability of embankment.
As the total length of embankment is extremely long, a high degree of compaction, such as from 95% to 98%, is required as much as possible so that the maintenance cost of the embankment can be reduced.

Additional soil tests and trial embankments will be required before or during the detail design stage to identify and specify physical and chemical characteristics of embankment material, adjustment method of grain size distribution and moisture content, appropriate type and method of equipment and machine for compaction.

c) Foundation of Embankment

It was confirmed by the circular slip analysis including foundation ground carried out in the Data Collection Survey that the embankment will best able on foundation ground of which cone resistance is more than 0.7 MPa. Dutch Cone Tests (DCTs) conducted in the Data Collection Survey resulted that cone resistance in most of the foundation ground was more than 0.8 MP; however, cone resistance of less than 0.7 MPa was observed in some parts of the foundation ground.

The DCTs should be carried out at least every 500 m in areas where in the ground seems to have low strength and low bearing capacity in order to identify the super soft layer which has cone resistance of less than 0.7 MPa.

d) Shape of Embankment

Although the Standard Design Manual recommends a slope gradient of 1:3.0 for both the side slope of submergible embankment and the river side slope of full embankment, the actual designs adopt 1:2.0 for one side slope or both slopes. The embankment slope erotically maintains stability even for 1:2.0 gradients if they expect initial strength obtained from the unconfined compression tests under 90% degree of compaction conducted in the Data Collection Survey is used. However, also pregradient of 1:3.0 is absolutely required considering cracks due to drying shrink age, uncertainty of quality control, and decrease of durability due to repeated submergence.

On the other hand, although the Standard Design Manual recommends that the crest width of embankment should be 4.3m, the actual design adopted 3.6m. However, the crest width of 4.3 m

must be selected, since vehicles traffic may affect the shoulder of the slope if a narrow width such as 3.6 m is selected.

e) Surface Protection

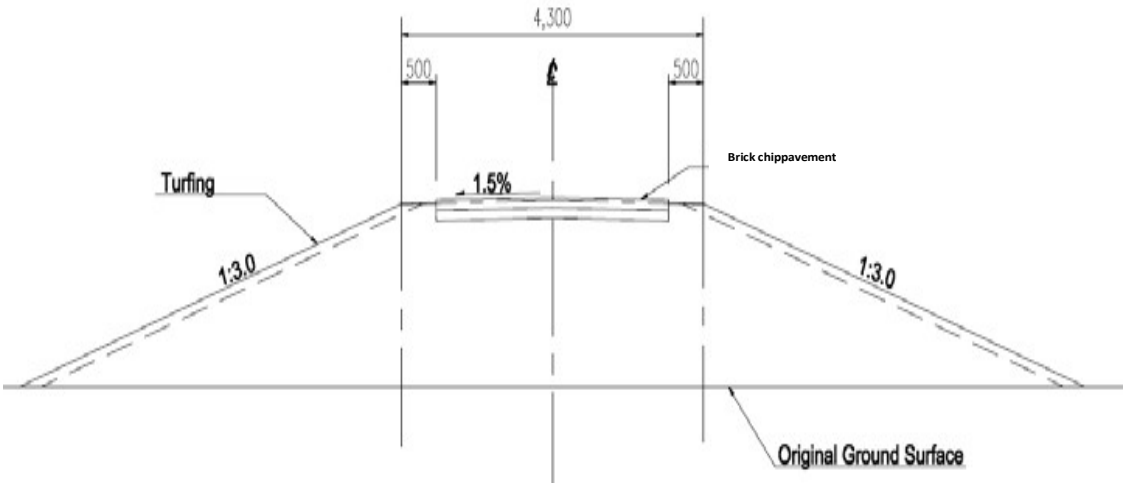
The slope of the embankment made by BWDB is usually protected by turfing using local grass called dubra grass. However, the crest of embankment is not usually covered by any pavement, since the road construction is not the responsibility of BWDB.

In order to protect the road from deterioration due to erosion and wheel trucks, pavement with bricks or concrete should be applied on the crest of embankment as "inspection road" for structures of BWDB. The shape of embankment is given in **Table 4.5** and a typical section of the embankment is shown in **Figure 4.3.**

Table 4.5: Shape of Submersible Embankment and Full Flood Embankment

Item		Submergible Embankment	Full Flood Embankment	Note
Design Water Level		10-year water level in the pre-monsoon season	20-year water level in the monsoon season	
Crest Width		4.3m	4.3m	
Slope Gradient	Country Side	1:3.0	1:2.0	
	River Side	1:3.0	1:3.0	
Free Board		0.3m	0.9m	
Slope Protection		Turfing	Turfing	
Pavement		C.C. block over sand filling (20% of total length) *		
Degree of Compaction		85% (with modified proctor test)	85% (with modified proctor test)	

Note: *It is desirable to provide pavement for the entire stretch of embankment in order to avoid deterioration of embankment; however, BWDB was limited only to pave 20%of the total length of embankment due to budget limitation. The stretch of pavement should be extended as long as possible in the detail design stage or transportation on the embankment should be restricted to avoid damage from wheel trucks. From studying of Table 4.2 it can be guessed that average monsoon high flood water level is about 2-3 m above the crest level of submergible embankment crest allowing free flow of water during monsoon.



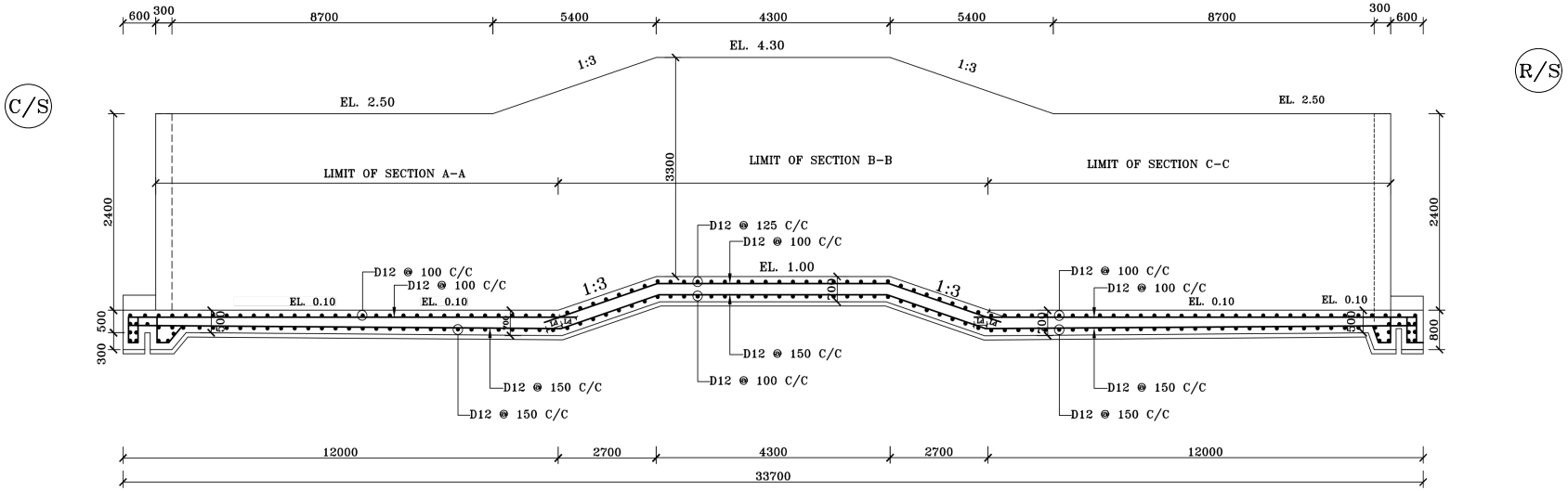
Source: JICA Survey Team (2013)

Figure 4.3: Typical Section of Embankment

4.a.2.2.1.2 Causeway

Causeway is a special arrangement associated to the water resources management facilities. For HFMLIP, causeways have been proposed over the khals in the new subprojects at their outfalls to prevent pre-monsoon flash flood, retain the existing navigation facilities and efficient drainage during post-monsoon. The causeways will be filled with locally available earth (gunny bags) in the month of February to withstand pre-monsoon flood. The opening of causeway would be filled to the crest level of proposed submersible embankment at the site. The filled material would be removed just after harvesting of Boro crops (in mid May) to let in water inside the haor area for minimizing the erosion of submersible embankment due to head difference at the over-topping the submersible embankment.

The project being participatory, 380 Water Management Groups (WMGs) has been planned to be formed for different activities. They will operate and maintain the causeway and will also fill up the openings of causeways and remove the earth therein to allow filling up the haors with water immediately after harvesting Boro crops. WMGs will also be trained up on O&M aspects for repairing the damaged embankment and regulator gates. They will arrange and raise fund by themselves and use this fund in such O&M activities when require. **Typical design of Causeway is presented in Figure 4.4.**



Typical Causeway: Section

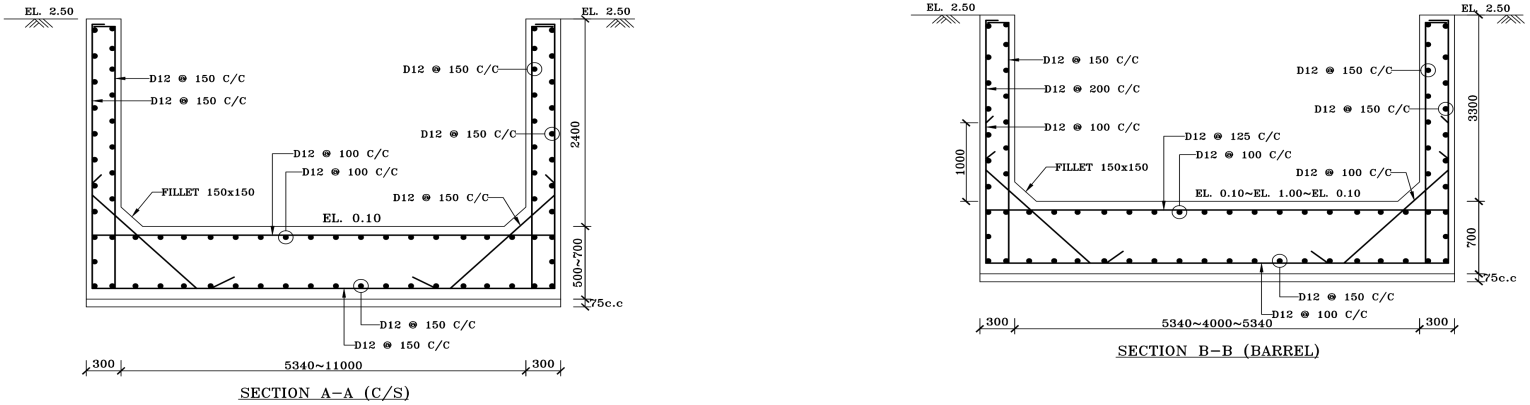


Figure 4.4: Typical design of Causeway (front view)

4.a.3 Standard

BWDB design office has established standards for different works, like, full embankment, submergible/dwarf embankments where the pre-monsoon high flood level is much low compared to monsoon high flood level, in case of haor areas, Regulators including submergible regulators, river bank and wave protection works, Gates of different size to meet the design requirements, Khal excavation, dredging, official & residential buildings, roads, barrages, weirs, rubber dams etc.

4.a.4 Specification

BWDB has its own design and specification manuals. The design and drawings furnished by design office shows the detailed specification of cement, sand, stone & brick chips used for concrete for the designed strength required for the infrastructures as per field condition.

4.a.5 Quantification

Based on the design & drawing of the structure, the field level engineers of BWDB prepared the bill of quantities for floating tenders in implementing project.

4.b Project Schedule

The phase and timing for development of the project:

The phase and timing for development of the Project is shown in **Figure 4.5** in view of time available for construction and procurement of works and Goods due to physical and weather condition shown in **Table-2.8** earlier. The table shows how much time is available in a year for both field/construction work in case of study and for construction work because of heavy rainfall and inundation of the project area. The **Figure 4.5** showing project schedule took into account the DPP timing on commencement and completion of physical works.

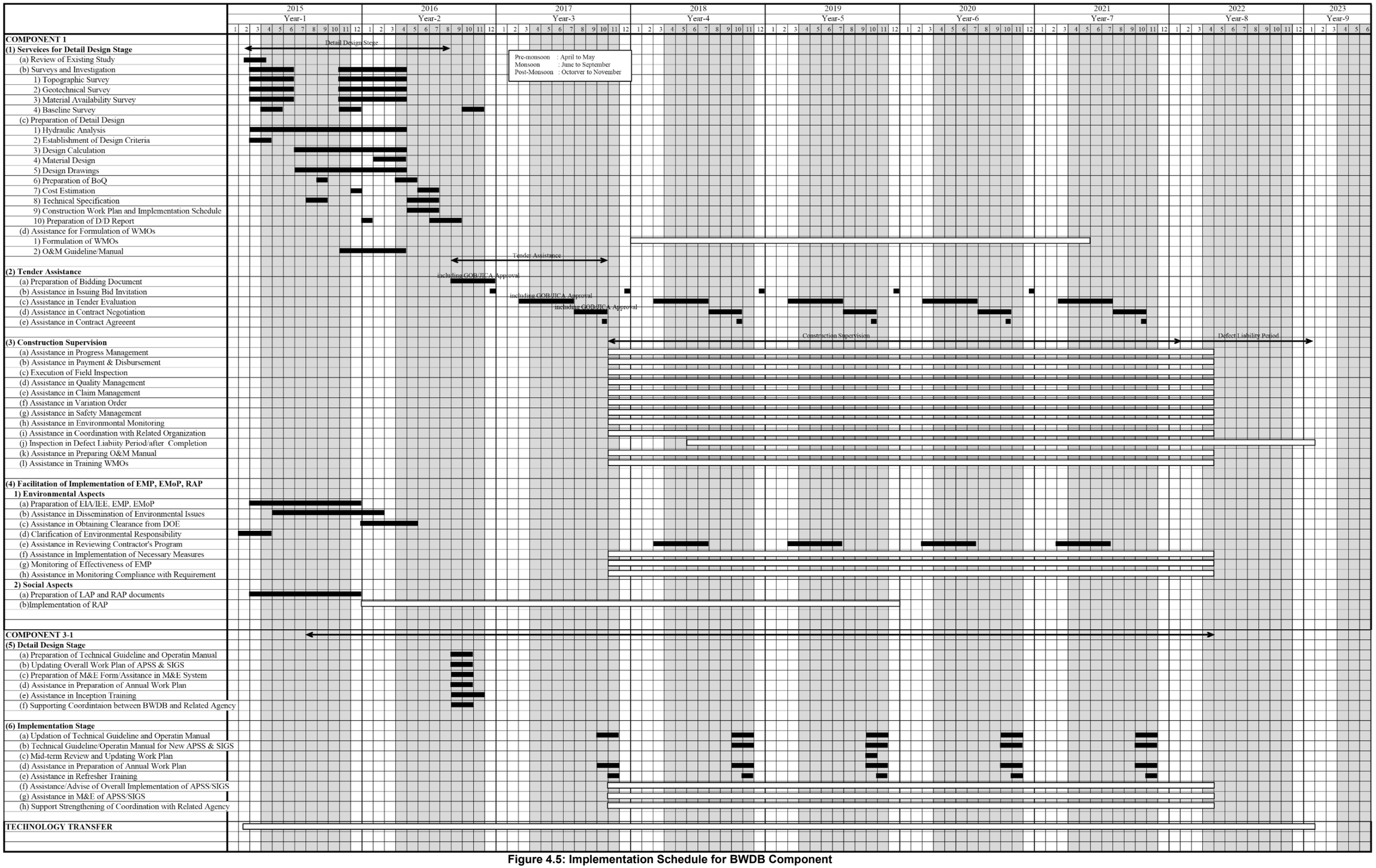


Figure 4.5: Implementation Schedule for BWDB Component

4.c Resources and Utilities Requirement

Resources required for development of the project.

4c.1: Soil/earth: Soil/earth required for the embankment re-sectioning works to meet the Specification specified in the design drawing furnished by the design office after detailed design is done. If local earth is not suitable to meet the standard soil/earth is hauled from some distance not far from the work site. Naturally the soils/earth available in the proposed area meets the specification.

4c.2: Sand: Coarse sand/normal sand required for the embankment re-sectioning works to meet the Specification specified in the design drawing furnished by the design office after detailed design is done. Both good coarse /normal sand is available in the river beds that come from foothills of India. These sands are the best sand available in Bangladesh and these are ferried by contractors throughout Bangladesh especially for high strength concretes.

4c.3: Cement: The Portland Cement is normally used in the construction works are now produced in Bangladesh. Even at the village level shops, cement is available and there is no worry about availability of cement in the construction works.

4c.4: MS rod: The MS rod normally used in the construction works are now produced in Bangladesh. Even at the village level shops, MS rods, plain as well as deformed is available and there is no worry about availability of MS rod in the construction works of these types of small works.

4c.5: MS gates: MS gates are built as per drawings furnished by design office. MS plates, Stainless nuts/screws required for Gate construction are also available in the country. Local workshops and also Mechanical Workshops of BWDB are able to manufacture gates by fulfilling design standards.

4c.6: MS shuttering plates: For achieving good finished surface of concrete works MS plates are used in concrete works that are exposed to views. In concrete works plastering with sand/cement is not allowed as these has no function with the strength required and simply wastage of money.

4.d Map and Survey information

Following maps are presented.

i. Project location maps showing 29 subprojects- 1 no. (Figure 2.1)
ii. Existing and proposed structures including topography for all 29 subprojects- 29 nos. (Figure B.1 to Figure B.29).
iii. Physiological Map of Project Area 1 no. (Figure 5.1)
iv. Geological Map of Project Area- 1 no. (Figure 5.2)
v. Land use map of Bangladesh- 1 no. (Figure 5.3)
vi. Climatic Sub regions of Bangladesh- 1 no. (Figure 5.4)
vii. Transboundary River System in Upper Meghna River Basin (figure 5.7)
viii. River System of Haor Area (Figure 5.8)
ix. Location maps of environmental quality analysis sample (Figure 5.9)
x. Flood Prone Areas of Bangladesh (Figure 5.16)
xi. Earthquake zone of Bangladesh (Figure 5.17)

5 BASELINE ENVIRONMENTAL CONDITIONS

5.1 General

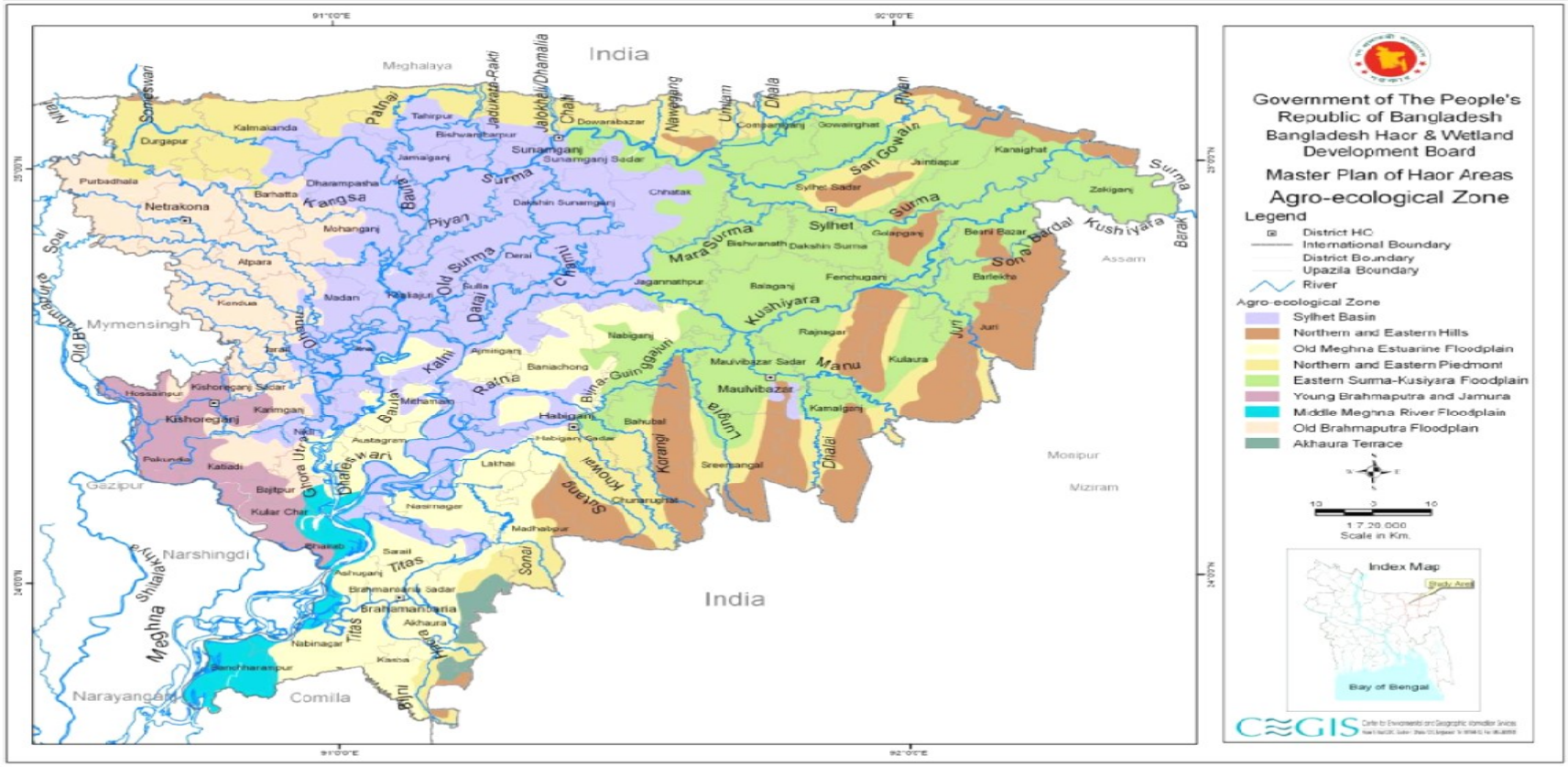
This chapter describes the existing conditions of the environmental components (e.g. climate, topography and soil, land use, water, noise level, ambient air quality, flora, fauna etc.) in the project area. The primary objectives of this chapter are to provide an environmental baseline data that helps to identify Important Environmental (IECs) of the subproject area and to assess the potential impacts on the IECs which may be caused by the project activities during pre-construction, construction and operation & maintenance (O & M) stages. The baseline data includes an inventory of physical resources and, ecological resources that represent the project influencing area.

The information to establish the baseline of the project area was collected from different secondary (e.g. government and private sector agencies) and primary (e.g. field survey, site visits, public consultation, professional judgment etc.) sources.

In order to assess the impacts of the proposed Project on people living in the vicinity of the project area, detailed survey was conducted and existing environmental and socio-economic conditions and salient features of the area were duly observed. During the detailed site visit, relevant government agencies/departments were also consulted for the collection of the relevant data. To establish baseline soil, bed material and water (surface & ground) conditions of the area; ambient air quality and noise level were not required to be tested considering the nature of project implementation of which no significant change of ambient air quality and noise are expected. Surface and ground water samples were collected by the EIA team from different water sources in the project area, and those water samples were sent to the laboratory for analysis.
The project influence area (PIA) (impact zone) for the EIA covered 500m surrounding each subproject area of the project in order to include sufficient coverage of the receiving environment in accordance with the impacts of the Project. In case of identifying environmentally/ecologically sensitive and culturally/historically protected areas, up to 5 km surrounding the each subprojects of the project has been considered as PIA.

5.2 Physical Environment

Physiographic of the study area was classified based on the combination of the geological material in which particular kinds of soil have formed and the landscape on which they occur. Seven districts comprising the haor area are placed on the following eleven (11) physiographic units, based on agro-ecological regions of Bangladesh prepared by Food and Agriculture Organization (FAO) shown in **Figure 5.1**. The units are Northern and Eastern Piedmont Plains, Northern and Eastern Hills, Sylhet Basin, Eastern Surma-Kushiyara Floodplain, Old Brahmaputra Floodplain, Young Brahmaputra and Jamuna Floodplain, Active Brahmaputra-Jamuna Floodplain, Old Meghna Estuarine Floodplain, Madhupur Tract, Middle Meghna River Flood plain and Akhaura Terrace.



Note: Nine units are shown in this figure because small units in this area are not indicated.

Source: Master Plan of Haor Area, April 2012

Figure 5.1: Physiographic Map

5.2.1 Geology and Topology

The core haor area, alternatively referred to as the Haor basin or the Sylhet basin, is estimated to spread over an area between 4,450 km² and 25,000 square kilometers by experts. The total area of Haor-type wetland ecosystem in Bangladesh is 80,000 square kilometers. In the geological depression of the haor basin, subsidence is continuing at an estimated rate of 20 mm per year. In some places it has sunk by around 10 m in the last few hundred years. The area, by some experts, is further divided into three zones by standards of morphology and hydrology:

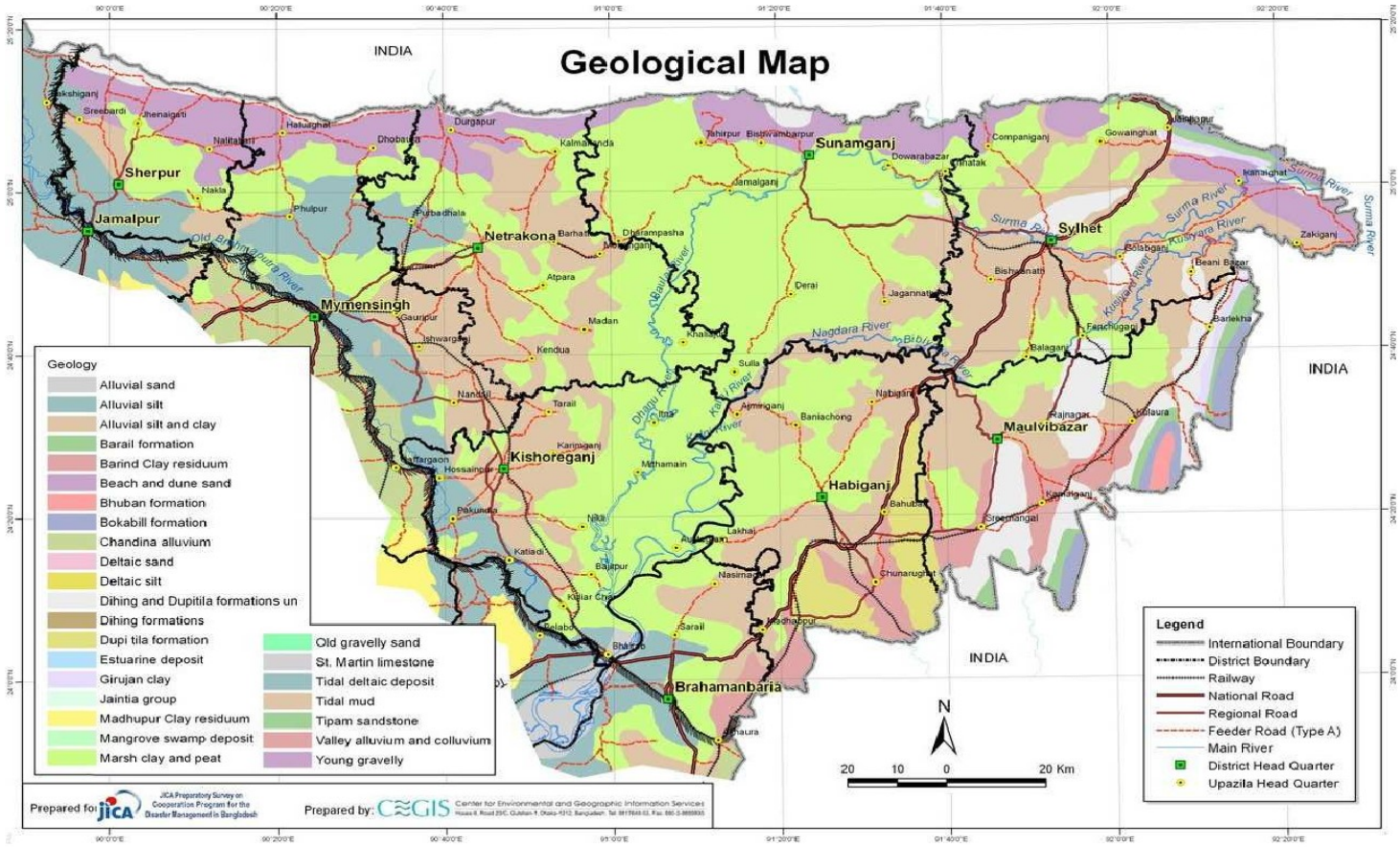
- **The piedmont area:**
  This area is an accretion zone where rapid siltation of coarser materials take place along the levees by flash floods. Across the down-slope of levees lie the back swamp, acting as reservoir by storing water and substantially reducing flood peak downstream.
- **The floodplain area:**
  The floodplains, with milder slopes, are located at the middle of the basin. This zone receive sediments that is moderately finer and considerably lower in volume. Back swamps along this section fill and drain several times in each monsoon, helping to reduce flood peak downstream.
- **The deeply flooded area:**
  This deepest part of the wetlands is known more as the beel. During monsoon the beels and floodplains become deeply flooded and turn into a single water reservoir, especially in the Surma-Kushiyara-Meghna basin.

Soil within the same haor system can vary in texture, drainage class, fertility, and other parameters. The transition from the wettest to the driest areas in the floodplains occurs over distances varying from several kilometers to several meters.

The Indian sub-continent has been formed by a collision between the northward moving Indian plate and the static Eurasian Plate since Cretaceous period. Part of the northeast Indian plate has fractured and sank below the sea-level during the Oligocene period. Since then the Bengal Basin has started to form subsiding tectonic basin slowly, filling up with deltaic sediment. **Figure 5.2** shows the geological map of the project area.

Topology:

The study area forms such a low-lying basin compared with other regions of the country. Land below EL. 5m PWD extends virtually as far as the Meghlaya Foothills. Outside of this area, floodplain lands situated 200km from the sea are found at EL. 8 to 20m PWD. Approximately 25 per cent of the study area lies below EL. 5m and 50 per cent lies below EL. 8m.



Source: Adapted from Geological Map provided by CEGIS

Figure 5.2: Geological Map of the Project Area

5.2.2 Geomorphology

The Haor areas are one of the largest wetland systems in the northeast region of Bangladesh with relative natural state. The haor consists of several beels of various sizes (Akondo, 1989; BFD, 2012). The haors are located at an altitude of 2.5-5.5 meters above mean sea level.

The wetland is bounded on the north by the Shillong Plateau, an elevated block of Pre- Cambrian Basement rock which has been draped over by late Mesozoic and Cenozoic sediments. The south face of the plateau has been dissected by steep, V-shaped canyon that follows structurally through controlled valleys. The southern escarpment of the plateau is bordered by the east-west rending Dauki Fault which forms a distinct lineament separating the lowlands in Bangladesh from the mountains in India (NERP,1993 b). Most of the haor area is covered by the Young Piedmont. Alluvial plain which comprises the alluvial fans of the Shilling plateau and also the adjoining basins and basin depressions. The fan soils are poorly to imperfectly drained, strongly mottled brown, loamy sands to clay loams, poorly structured to strongly to very strongly acid reaction. The very poorly drained basin deposits comprise strongly reduced heavy clay lacking any sign of profile development.

The haors are located right at the foothills of the Meghalaya & Garo Hills. Apart from the features, location of this haor is another factor for its high biomass production. The haor system is mainly rendered with the black flow of river waters from Baulai, Patnai and Jadukata rivers. Few hill streams flow into the haor system but the major water thrust comes from the south because of the back flow. The hill streams do bring in some sediment but considering the volume of water held in the haor and the area of the haor itself It is significant that because of the low quantity of silt and its dissemination during flooding season these haors are deep enough where the rate of sedimentation is comparatively high. Due to this backflow the water is relatively clean, free from suspending materials and with less residual matter. As a result, the water is transparent and sunlight can penetrate to quite a considerable depth. This increases the logic area of the water body facilitating the photosynthesis is and making it the most productive area (with high biomass) within the northeastern haor basin. It is because of these important physical features that this wet land is still capable of maintaining the ecosystem to its near-natural state resulting in high biomass production.

The Haor area of harbours some of the last vestiges of natural swamp forest and is totally flooded in the monsoon season. The floral diversity in these haors are very rich which makes it an ideal place for the migratory birds. As a result, every winter about 100 types of migratory birds come to these haors who make their temporary habitat here and some of these birds also find this area suitable for their breeding.

The haors are also extremely rich in terms of fisheries resources and is considered as one of the largest and most important “mother fishery” (center for recruitment and dispersal of fish and thus influence the fish production in adjacent floodplains) in the country for floodplain freshwater species. These haors are also a unique habitat for waterfowls.

5.2.3 Land-use

The haor districts cover a gross area of about 2 million ha, of which about 55 percent is cropped land, and the rivers, channels (khals), water bodies, forests, homesteads, ponds, hills and infrastructure occupy the remainder. The number of farm households in the haor districts is 1.68 million and non-farm households 1.37 million. Of the total farm households, about 80 percent are small (owning less than 1 ha of cultivated land), 17 percent are medium (owning 1 to 3 ha of cultivated land) and 3 percent are large (more than 3 ha of cultivated land). The large farms usually operate their lands using tenants or hired labor.

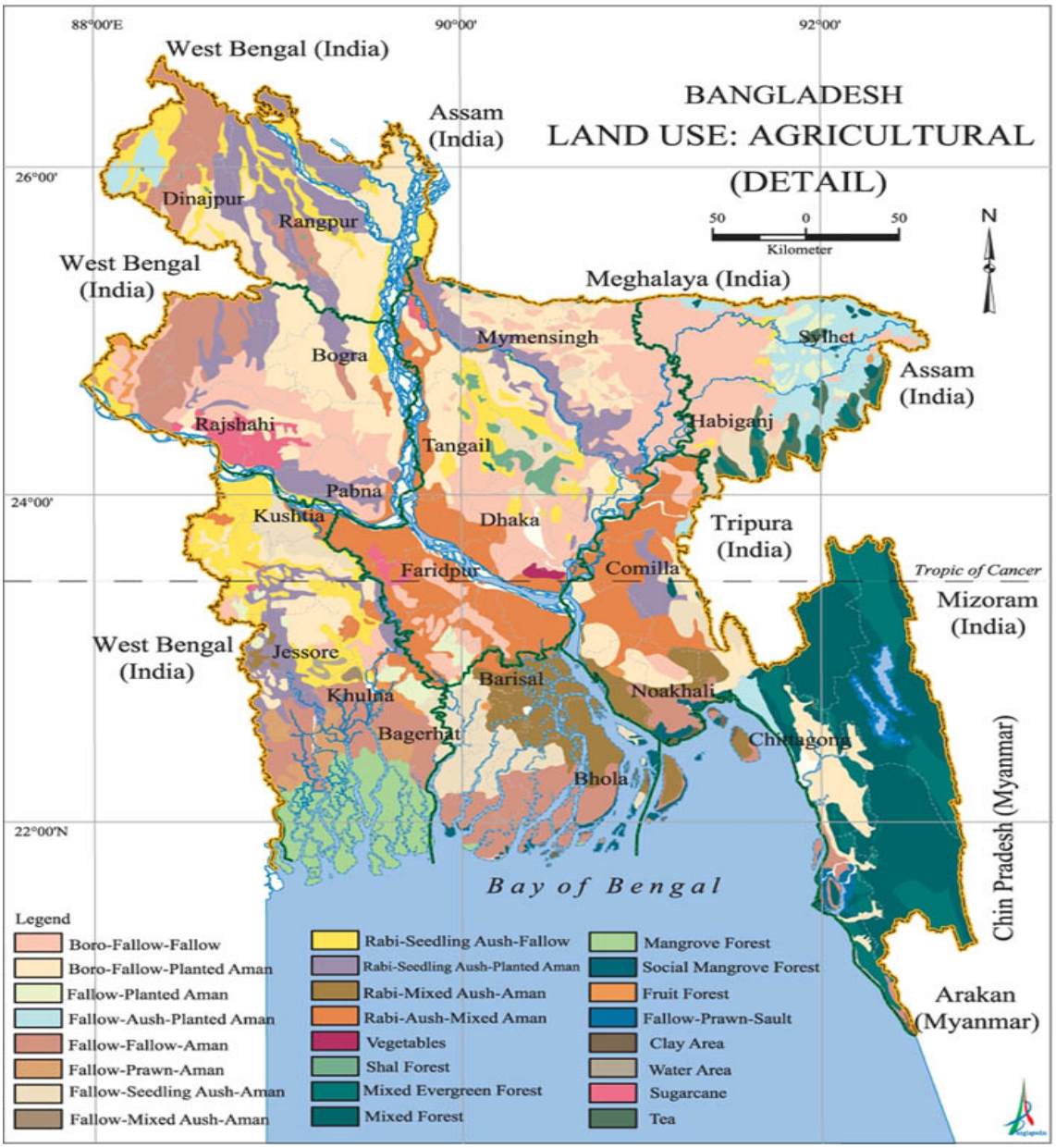


Figure 5.3: Land use map of Bangladesh

5.2.4 Soils

The soils of the Project Area are grey silty clay and clay on the higher parts that dry out seasonally and grey clays in the wet basin. Peat occupies some wet basin centers. The soils have a moderate content of organic matter and soil reaction is mainly acidic. About 74% of the top soil texture of the haor region is clay to silty clay, 21% silt and the rest are clayey silt, sandy silt and sand.

5.2.5 Meteorology

The northeast region of Bangladesh is located entirely to the north of the Tropic of Cancer, and hence its climate is characterized by the sub-tropical monsoon. The sub-tropical monsoon results intense regional and orographic rains caused by the interface of the mist air masses incoming from the Indian Ocean through the Bay of Bengal with a predominant northeastern direction and the steep and high hills located at the foothills in the states of Assam, Meghalaya and Tripura in India. The hills in these states of India experience very severe precipitation, and some of the more intense precipitations in the world fall in the hilly areas, where the average annual rainfall is around 12,000 mm.

The hydro-meteorological seasons of the northeast region are generally classified into:

- Pre-monsoon season extending from April to May,
- Monsoon season from June through September,
- Post-Monsoon season from October to November, and
- Dry season from December through March.

Climate:

The subprojects of HFMLIP are located in the north-eastern (B) and the south-central (G) climatic sub-regions of Bangladesh (**Figure 5.4**).

The climate of the area is subtropical monsoonal with an average annual rainfall of approximately 4,000 mm. Over 80% of the rain falls during the monsoon season from June to October. Temperatures normally vary between 26 and 31 °C in the pre-monsoon period (March to May), 28 to 31 °C in the rainy season and 26 to 27 °C in winter.

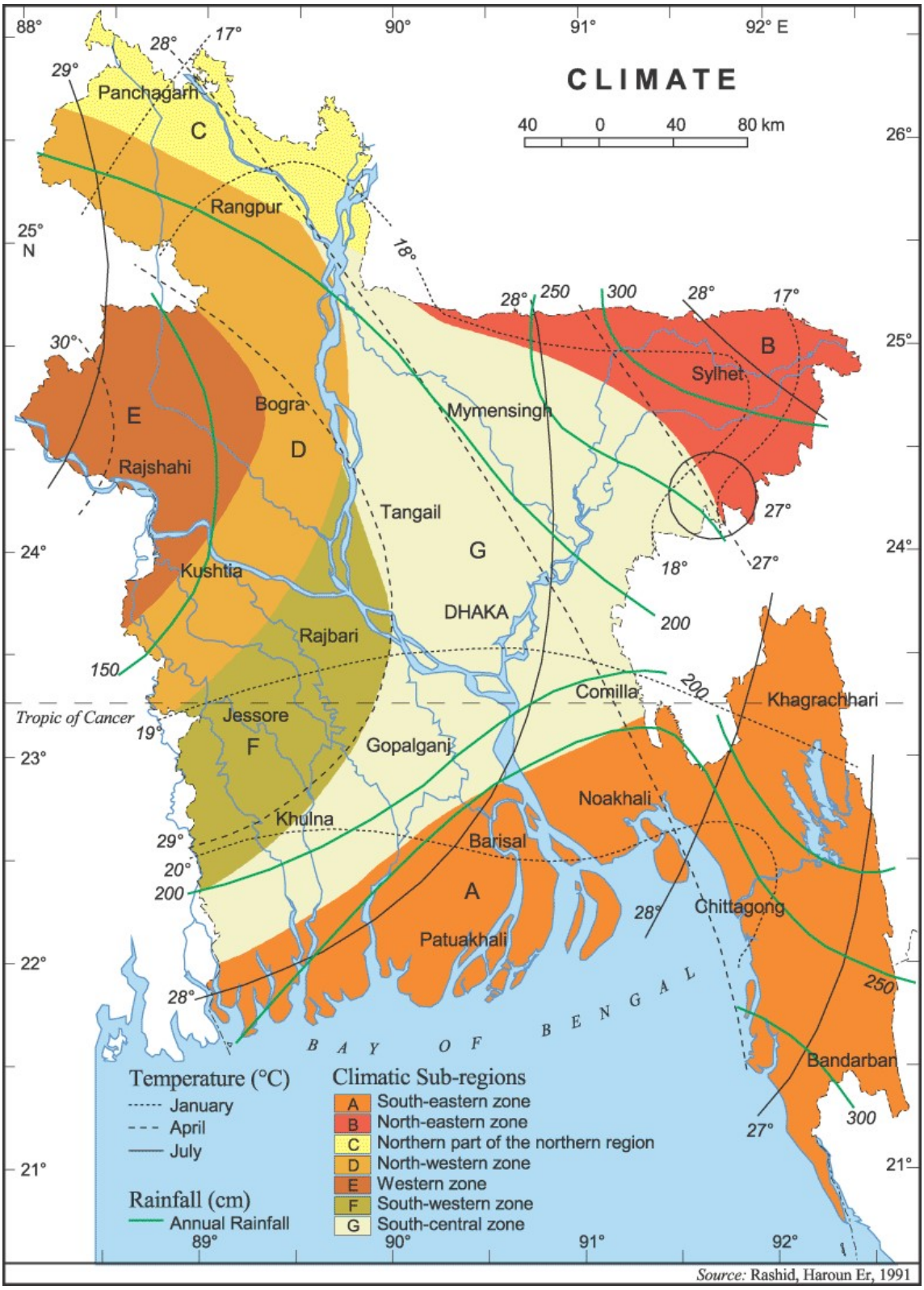


Figure 5.4: Climatic sub-regions of Bangladesh

The climatic conditions of the project areas are described based on the meteorological station data of nearby stations belonging to BMD and rainguage stations of BWDB. The data have been spatially interpolated to derive the meteorological parameters for the study district.

(a). Rainfall

The rainfall data of the meteorological stations of BMD and those belonging to BWDB have been used for rainfall analysis. **Table5.1** shows the seasonal rainfall for some stations of BWDB. The values in the parenthesis indicate percent of annual rainfall. The rainfall in Kishoregonj is about 2,383 mm but that for Itna situated in the haor area is 3,237 mm. The pre-monsoon season (March-May) gets high rainfall which lies between 555-768 mm over these stations. Around 20-25 % of the annual rainfall occur in the pre-monsoon rainfall, most of which occur in the month of May. The relatively high rainfall in the month of late April and May causes flash floods. These floods damage the mature boro rice of the haor area causing tremendous economic loss to the people of the locality.

Table 5.1: The seasonal rainfall (mm) for BWDB stations located in Kishoreganj.

District	Station names	Location		Winter (mm)	Pre-monsoon (mm)	Monsoon (mm)	Percentage of the annual rainfall post-monsoon	Annual (mm)
		Lon (E)	Lat (N)					
Kishoreganj	Kishoreganj	91.0	25.5	51 (1.7%)	555 (22.9%)	1,602 (67.2%)	195 (8.2%)	2383
	Itna	91.1	25.5	53 (1.3%)	768 (23.7%)	2,177 (67.3%)	259 (7.7%)	3237

(b). Temperature

The annual distribution of monthly minimum and maximum temperature for the station Mymensingh nearest to Kishoregonj is shown in **Figure-5.5**. The figure shows the bimodal characterizes of Maximum temperature with peaks in April and October. During the months April-October relatively high temperature is maintained within the range 30-33 ^{0}C. The lowest minimum is found in January. The minimum temperature shows the lowest in January (12 ^{0}C) and highest in August (26 ^{0}C).

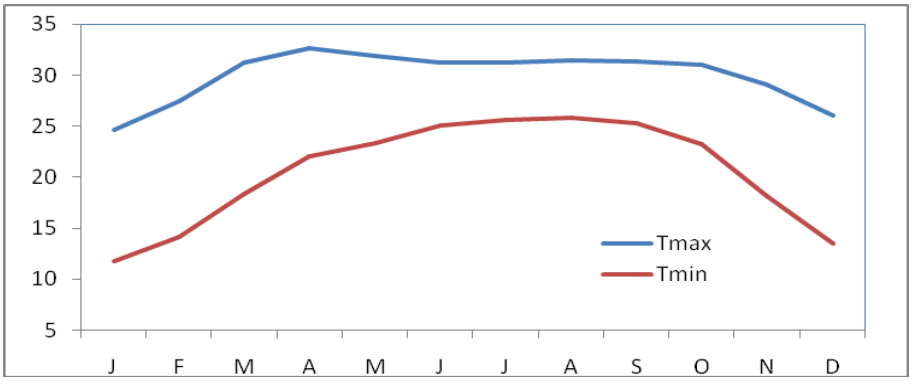


Figure 5.5: Annual Distribution of minimum and maximum temperature (Oc) at Mymensingh (90.5 lon and 25.7 lat)

(c). Evapo- transpiration.

Evapo transpiration is very high in the month of April over the haor area and low in January. The average evapo- transpiration varies from 2.0-3.5 mm /day during dry season and 3.9-5.8 mm/day for the rainy season over the haor area (Source: Master Plan of Haor Area, April 2012).

(d). Humidity

The historical data at Mymensingh (nearest station to Netrokona and Kishoregonj shows that in the project site the average relative humidity varies from 69-70 % in the winter to 80% -87.00% in pre-monsoon and monsoon seasons. (Source: Master Plan of Haor Area, April 2012)

(e). Wind

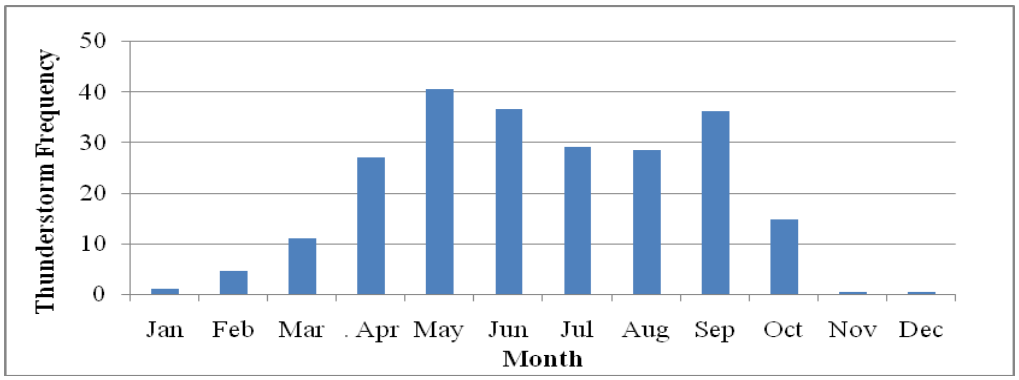
The mean monthly wind speed and the monthly maximum wind speed have been shown in **Table-5.2** for the meteorological station Mymensingh. The mean monthly wind speed varies from 5.5 km/hour in December to 9.8 km in June. From April to August high wind speeds from 8.5-9.8 km/hr are recorded Mean monthly maximum wind speed varies from 11 km/hour (December) to 25 km/hour in August. High monthly wind speed is found April-August (20.5-25.5 km/hour).

Table 5.2: Monthly mean of daily wind speed and average maximum win speed in Mymensingh (1977-2001)

Mean & average	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly mean of wind speed km/hr	5.2	6.5	7.1	9.8	9.8	9.5	9.1	8.5	7.2	6.3	5.2	5.5
Average of monthly maximum wind speed (km/hr)	11.0	13.2	15.5	20.5	20.5	18.6	16.9	25.5	15.6	15.1	10.6	9.1

Data Source [BMD]

The available data shows that very high frequency of thunder storms associated with stormy winds occur over the project area during the pre-monsoon months March-May. The thunder storms sometimes transform in the stage of tornadoes. The tornado speed may go up to 300 km/hour which causes severe destruction of infrastructure and damages to crops and trees. The wind direction is northwesterly in the winter and in the summer it is south / south-easterly too easterly in the pre-monsoon and monsoon period. The frequency of thunderstorms for Mymensingh is shown in **Figure-5.6**. Very high rainfall is associated with these thunderstorms. According to the figure the highest frequency of thunder storms occurs in the month of May and the associated rainfall causes severe flash floods in the pre-monsoon season, especially in the month of May.



[Data Source: BMD]

Figure 5.6: Frequency of thunder storms at Mymensingh (long 90.53, lat 25.72) during 1978-2010

5.2.6 Hydrology

The river system for the upper Meghna River including the portion of the water shed inside India. The Barak River drains the Assam region and distributes the flows through a bifurcation near the border between Bangladesh and India. Data from 1980 to 2008 indicates that an average of around 40% flows into the Surma River channel and 60% inflows to the Kushiyara River during most part of the year. During the dry season, the Kushiyara River carries around 88% of the Barak inflow due to the physiography at the bifurcation. Because of sediment deposition at the Surma River portion of the bifurcation, the tendency is that flow proportion increases with time into the Kushiara channel while the Surma River is silted over.

Water contribution from transboundary rivers of Barak, Meghalaya and Tripura systems is 42,670 million $m^3$30, 376 million $m^3$and 15,716 million m^3 respectively. The contribution of water from transboundary river systems from India and Bangladesh in the region are as described below: -The catchment area of the Barak River system is 26,165 km^2, which contributes 26% of the total inflow in the region.

- The catchment areas of the Meghalaya river system are 9,904 km^2, which contribute 19 % of the total inflow in the region.
- The catchment areas of the Tripura river system are 7,434 km^2, which contribute 10 % of the total inflow in the region,
- The contribution in side Bangladeshis 23,137 km^2, which is 43% of the total in flowing the region.
- The contribution from the Old Brahmaputra in the region is2%.

The water balance for the study area is presented in **Table 5.3**. The proportion of annual average flow between the India and Bangladesh territories is 57%:43%.

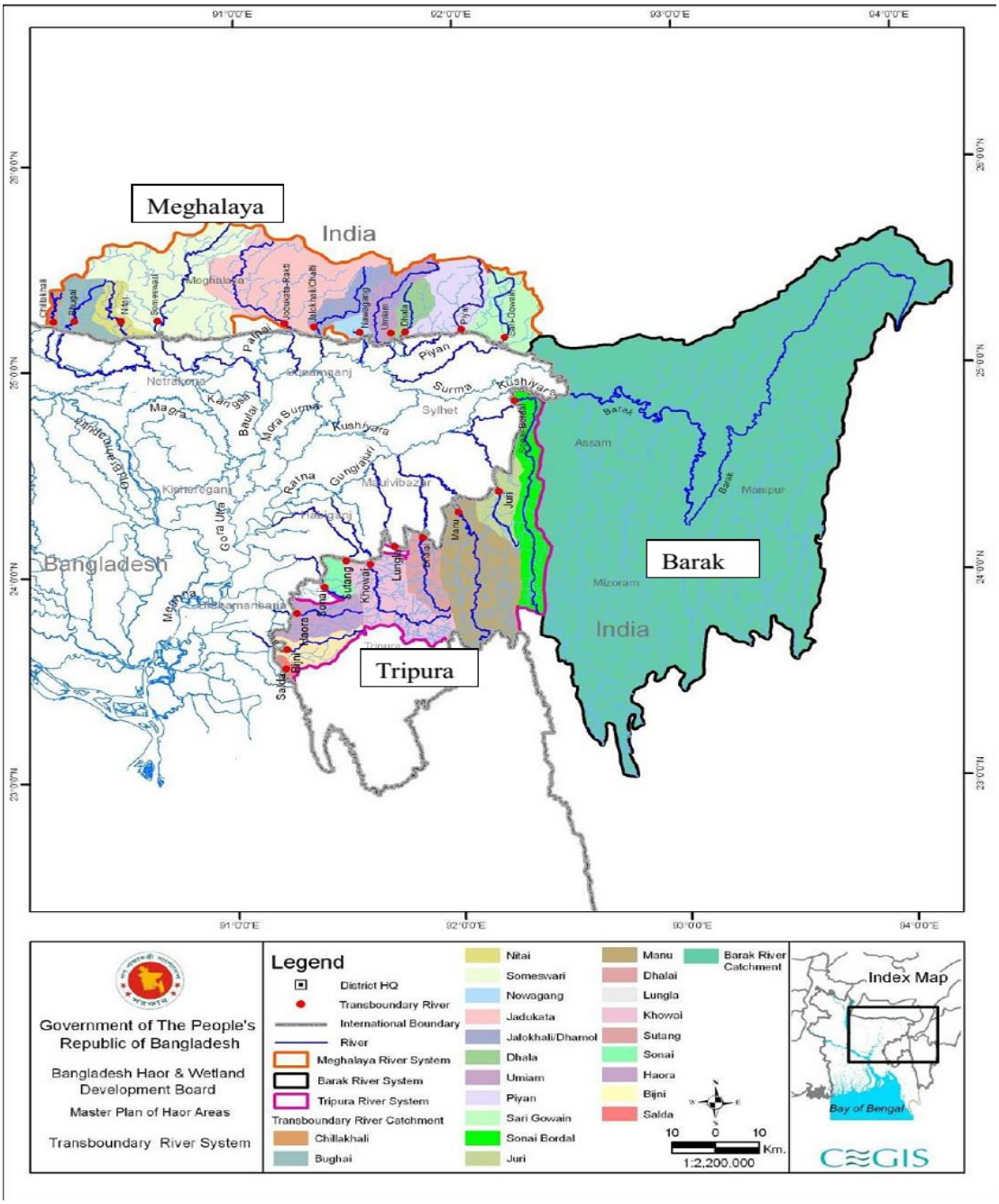
Table 5.3: Water Balance in the Haor Area (1960-2009)

River system	Total flow (mil.m^3)
(A) Barak	42,670
(B) Meghalaya	30,376
(C) Tripura	15,719
(D) Brahmaputra	3,532
(E) Total inflow from India(A+B+C+D)	**92,297**
(F) Local contribution from Bangladesh	**69,422**
Total Inflow(E+F)	**1,61,719**

Source: Compiled by JICA Study Team based on Haor MP, 2012

5.2.6.1 River System

The majority of the rainfall volume that flows through for the Bangladeshi Northeast Region comes from India where the largest flow volumes, floods, and sediment yield occurs. **Figure 5.7**shows the River System for the upper Meghna River including the portion of the watershed inside India.



Source: Master Plan of Haor Area, April, 2012

Figure 5.7: Transboundary River System in Upper Meghna River Basin

A large volume of water and sediment inflows that supplies the Northeast Region from Bangladesh are yield through the Assam (Barak), Meghalaya and Tripura catchments. Most of the watershed is located inside India and only 35% is in the Haor areas. Table 5.4: summarizes the drainage areas and the average flow distribution of the river system main rivers and Table-5.5 shows the rivers distribution draining the trans-boundary catchment system from India.

Table 5. 4 : Distribution of Transboundary and International River Catchments

Catchment system	Area(km^2)	% of total area
Meghalaya	9,904	15
Tripura	7,434	11
Barak	26,165	39
Bangladesh	23,137	35
Total	66,640	100

Source: JICA Study, based on Master Plan of Haor Area April 2012

Table 5.5: Transboundary Rivers contributing in different Catchment System

Catchment system	River name
Meghalaya	Nitai, Someswari, Jadukata, Jalokhali/ Dhomali, Dhala, Piyan, Sari Gowain
Barak	Surma, Kushiyara
Tripura	Lungia, Khowai, Sutang, Haor, Dhalai, Manu, Sonai-Bordal

Source: Master Plan of Haor Area, April-2012

The Barak River drains the Assam region and distributes the flows through a bifurcation near the border between Bangladesh and India. Data from 1980 to 2008 indicates that an average of around 40% flows into Surma River channel and 60% inflows to the Kushiyara River during most part of the year. During the dry season and due to the physiographic at the bifurcation the Kushiyara River carries around 88% of the Barak inflow. Because of sediment deposition at the Surma River portion of the bifurcation the tendency is that flow proportion will increase with time into the Kushiara channel while the Surma River will be silted over. **Table 5.6:** Summarizes the average seasonal inflow distribution for the Kushiyara and Surma Rivers.

Table 5.6: Distribution of Average Seasonal Inflow of Kushiyara and Surma Rivers

(Unit: million m^3)

River name	Station name	Pre-monsoon	Monsoon	Post-monsoon	Dry	Total annual flow
Kushiyara	Sheola	3,670	16,172	3,459	1,111	24,412
Surma	Kanairghat	2,416	13,345	2,056	146	17,963
Total		6,086	29,518	5,515	1,257	42,376

Note: Data from 1965 to 2007, Source: BWDB

The Meghalaya system drains the Someswari and Jadukata trans-boundary rivers. The Someswari system drains around 23% of the flow while the Jadukata flows around 21% of this system. **Table 5.7** shows the seasonal distribution for the Meghalaya system while **Table-5.8** summarizes the distribution flows for the Tripura system. **Tables 5.9 & Table-5.10** tabulates the average input flows and percentages through several catchments.

Table 5.7: Distribution of Average Seasonal Inflow among the Rivers of the Meghalaya System

(Unit: million m^3)

River name	Station name	Pre-monsoon	Monsoon	Post-monsoon	Dry	Total annual flow
Nitai	Ghosegaon	104	873	101	29	1,107
Someswari	Durgapur	602	5,270	845	247	6,964
Jadugata	Laurergarh Saktiarkhola	576	5,034	570	218	6,398
Jalokhali/ Dhomali	Muslimpur	261	2,486	268	118	3.133
Dhala	Islampur	383	2,401	247	63	3,094
Piyan	Jaflong (Spill)	542	3,970	371	113	4,996
Sari-Gowain	Sarighat	752	3,346	398	90	4,586
Total		**3,220**	**23,380**	**2,800**	**878**	**30,278**

Note: Data from 1965 to 2007, Source: BWDB

Table 5.8: Distribution of Average Seasonal Inflow among the Rivers of the Tripura System

(Unit: million m3)

River name	Station name	Pre-monsoon	Monsoon	Post-monsoon	Dry	Total annual flow
Lungla	Motiganj	61	147	36	18	262
Khowai	Shaistaganj	311	729	206	127	1,373
Sutang	Sutang Rly. Bridge	102	345	104	58	609
Haora	Gangasagar Rly. Bridge	137	273	74	101	585
Dhalai	Kamalganj	228	665	147	53	1,093
Manu	Monu Rly. Bridge	648	1,784	356	125	2,913
Sonai-Bordal	Jaldhup	868	3,242	682	109	4,901
Total		**2,355**	**7,185**	**1,605**	**591**	**11,736**

Note: Data from 1965 to 2007, Source: BWDB

Table 5.9: Average Seasonal Inflow through Different Catchments (Volume)

(Unit: million m^3)

Catchment System	Pre-monsoon	Monsoon	Post-monsoon	Dry	total annual flow
Barak	6,086	29,518	5,515	1,257	42,376
Meghalaya	3,320	23,380	2,800	878	30,278
Tripura	2,355	7,185	1,605	591	11,736
Total	**11,661**	**60,082**	**9,920**	**2,725**	**84,389**

Note: Data from 1965 to 2007, Source: Master Plan of Haor Area, April 2012

Table 5.10: Average Seasonal Inflow through Different Catchments (Percent)

(Unit: %)

Catchment system	Pre-monsoon	Monsoon	Post-monsoon	Dry	Total annual flow
Barak	52	49	56	46	50
Meghalaya	28	39	28	32	36
Tripura	20	12	16	22	14
Total	**100**	**100**	**100**	**100**	**100**

Note: Data from 1965 to 2007, Source: Master Plan of Haor Area, April 2012

5.2.6.2 River Network within the Project Areas

Three major river systems govern the project area such as Surma-Baulai, Kalni-Kushiyara and Kangsa-Dhanu system. **Figure 5.8** shows river system in project areas.

Surma-Baulai System carries the flow of the Surma and a large number of transboundary rivers flowing from the north to south. Among others Surma, Baulai and Sari-Gowain are the major rivers in this system. This river system meets Kalni-Kushiyara system at Bajitpur upazila of Kishoreganj district. Discharge and Water Level of Surma river are shown in **Table 5.11A.**

Table 5.11A: Seasonal variation of hydrological parameters in the Surma River at Kanairghat (station Id: 266)

Season	Discharge (m^3/s)			Water level (m, PWD)		
	Maximum	Mean	Minimum	Maximum	Mean	Minimum
Pre-monsoon	1,532	388	29	12.53	7.90	5.92
Monsoon	2,185	1,232	377	15.52	12.22	8.37
Post-monsoon	1,508	363	31	12.52	8.15	5.56
Dry	332	26	6	7.31	5.98	5.53
Yearly	2,185	555	6	15.52	8.51	5.53

Source: Master Plan of Haor Area, April 2012, CEGIS

Kalni-Kushiyara System having the major rivers in this system Kalni, Kushiyara, Sonai-Bordal, Juri, Manu, Dhalai and Lungla meets with Surma-Baulai system at Bajitpur upazila of Kishoreganj district. Discharge and water level of Kushiyara River are shown in **Table 5.11B**.

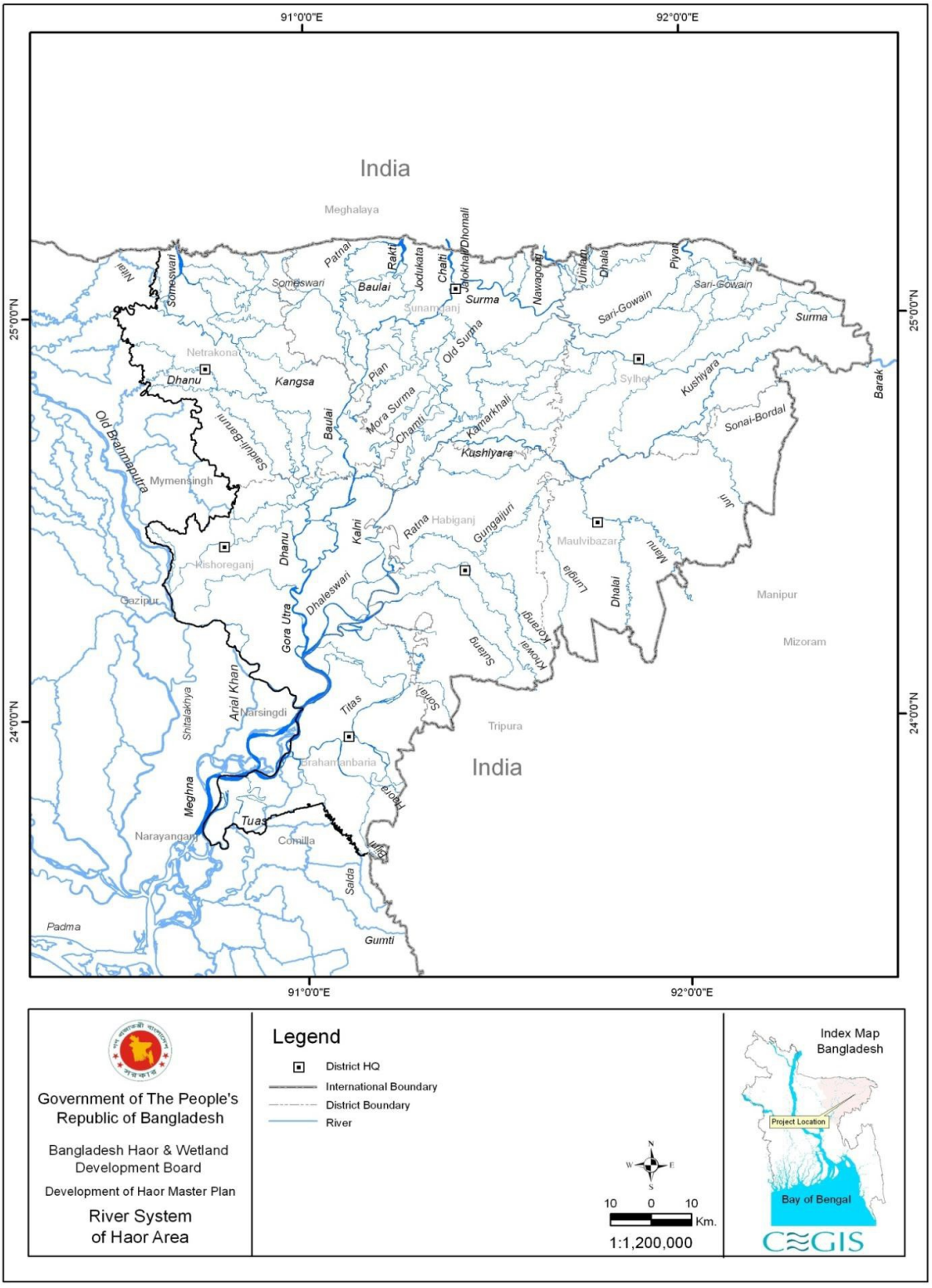
Table 5.11B: Seasonal variations of hydrological parameters in the Kushiyara River at Sheola (station Id: 173)

Season	Discharge (m^3/s)			Water level (m, PWD)		
	Maximum	Mean	Minimum	Maximum	Mean	Minimum
Pre-monsoon	1,582	506	151	12.31	7.97	5.22
Monsoon	2,315	1,558	631	13.96	12.28	9.05
Post-monsoon	1,716	598	209	12.65	9.08	6.33
Dry	531	128	70	7.91	5.35	5.38
Yearly	2,315	709	70	13.96	8.72	5.38

Source: Master Plan of Haor Area, April 2012, CEGIS

In the **Kangsa-Dhanu System** Kangsha and the Dhanu are the major rivers and drains at the Meghna River at the borders of Bajitpur and Bhairab upazilas.

Construction of new projects might increase flooding in the nearby haors, rivers etc. but it has been confirmed by IWM mathematical model, but the increase observed is minor (8 to 10 cm only) and that will be taken care of by the free board (30 cm) provided in the design crest level of the submersible embankment



Source: Master Plan of Haor Area, April 2012

Figure 5.8: River system of the haor area

5.3 Biological Environment

5.3.1 Habitats

The Haor areas are one of the largest wetland systems in the northeast region of Bangladesh with relative natural state. The haor consists of several *beels* of various sizes. Field visits indicated that the subproject sites and adjacent floodplain ecology has largely been changed in the area. Natural factors such as flood, river erosion, climatic effects, natural calamities, etc. also have impacted on ecological characteristics; however, the study area seems to be moderate to highly disturb by the natural factors as well as anthropological activities.

The beels, khals and rivers together in subprojects present a unique ecosystem in the riverine environment of the subproject areas. The environment of the northeast of Bangladesh where the subprojects are located is subjected to mainly one crop paddy cultivation having risks of damage by early flash flood. The ecosystems found today in subproject area can be categorized into three main categories

i. Low lying crop cultivation area with paddy cultivations
ii. Homestead with home garden crops, and build up area with embankments, etc.
iii. Flood plains that remains under water during most of the dry period and other aquatic systems such as ponds and khals where the fisheries activities are taking place.

The environment assessment covered these three main ecosystems independently. However, the subproject activities are expected to take place in all three areas of the ecosystems and thus may have cumulative impacts.

In view of the direct relationship between the project activities and the ecosystems mentioned above a detail flora and fauna survey of the areas was undertaken.

As part of the EIA of HFMLIP, an environmental baseline study was carried out in areas surrounding the project site. The specific objective of the baseline study is to gather information on the existing biological environment of the areas (ecosystems dynamics) in and around the project site; to gather and assess peoples' perception on environmental aspects of the proposed project. The baseline ecological survey primarily focused on identifying floral and faunal diversity and distribution within and surrounding of the subproject sites.

The main purposes of the ecological survey were:

- To identify ecosystems diversity in the project area and enlist the plant and wildlife species with their national and international status,
- To enlist keystone, rare and threatened flora and fauna,
- To investigate the distribution and abundance of flora and fauna including fish species,
- To make an assessment of the impacts for the proposed project activities on the ecological environment.

A rapid survey was conducted during field visits during December 2015 to April 2016. The EIA team visited areas surrounding the project site to collect first-hand information on floral and faunal diversity. Literature review and informal interviews with local people were also conducted as a part of the EIA. Information gathering on faunal and mammalian species was through visual observations on walk

through the area and also through discussion with the local people. Fish and fishery information were collected through field study; fishermen interview as well as local fish market survey. Floral survey was conducted through visual and rapid field survey. Local status of species considering availability in the locality was taken in terms of Common, Fairly Common and Rare. However, a species locally identified as rare may not necessarily be threatened for grater geographical context.

According to the IUCN Red Book 2001 species are classified as Extinct, Critically Endangered, Endangered, Vulnerable and Lower Risk based on status of each species to understand the importance for conservation of those species. Species under Critically Endangered, Endangered and Vulnerable are combined termed as Threatened.

On the basis of habitat, the species are divided into two major categories viz. (a) aquatic, and (b) terrestrial

5.3.2 Aquatic Life and fisheries

Aquatic plants (macrophytes)

In total 76 species of aquatic macrophytes have been identified under 54 genera is belonging to 40 families. From the study, a total of 32 dicotyledonous, 41 monocotyledonous and 3 Pteridophytes have been identified. Plants categories on the basis of habitats have observed that herbs 73 species followed by trees 03. Out of 76 species of recorded aquatic macrophytes and their local status are abundance-16, common- 34 rare-24 and endangered-2 species. Uses of recorded aquatic plants are as weed-37 followed by medicinal-20, vegetables-09, fodder-4, timber-03, fruit-02, and fuel-1 in the project area. Inventory of identified aquatic macrophytes along with their local name, scientific name, family, types, habit, local status, and uses are given in **Annex C.**

Fisheries resources in the sub-project area

Most of the Haor in the project area are important for fisheries. They provide the winter shelter for the mother fishery, and in the early monsoon these mother fisheries produce millions of fries for the entire downstream fishing communities. The diversity of wetland habitats, seasonal inundation and fluctuation of water regime and connectivity of the haor with the Rivers, canal, khals, beels system make the haor suitable for capture fisheries production. Free flow of water at the early monsoon from River to the haor facilitates immigration of fish from the river to the haor. Varied depth classes of the haor basin provide habitats for young fish grow larger, adults to grow maturity and the brood fish to spawn at various suitable habitats. Consequently, protection of these fisheries not only benefits local people, but also yields gains for all the people in the lower floodplains. A total of 100 fish species reported have been found in the Haor in a survey conducted during December 2015 to January 2016. From survey, secondary information and public consultation total 99 fish species recorded from all sub-project from 74 genera under 34 families are given in table-6 and subproject wise status if fish species are in **Annex C**. Among them 32 threatened fish species identified and categorized according to red data book of fishes IUCN-Bangladesh. Among them 11 are critically endangered and 10 are endangered and 11 are vulnerable (IUCN Bangladesh, 2003). However, fishing practices now being observed and the habitat degradation, if continue, would accelerate the process of species extinction.

If appropriate conservation measures are not taken, the still rich fisheries (number of diversity) of the haor would collapse in near future

5.3.3 Terrestrial habitat and Flora and Fauna

Terrestrial plants (macrophytes)

In total 204 species of terrestrial plants have been identified from 158 genera belonged to 65 families. From the study, a total of 157 dicotyledonous, 45 monocotyledonous from angiosperm group and 2 species from pteridophyta group have been identified and there was no gymnosperm recorded. Plants categories on the basis of habitats are observed that trees- 70 followed by herbs- 78, shrubs- 46 and Climbers- 10.

Medicinal-93, fruits-25, timber-24, ornament-18, fuel-14, vegetable-12, compost-05 and others-13 species. Inventory of terrestrial macrophytes recorded from the study area during survey. Inventory of identified terrestrial macrophytes with local name, scientific name, family, types, habit and uses. At a glance summery of information of terrestrials macrophytes in the study area analysed in different ways, and sub- project wise status of existing terrestrial's plants are given in **Annex C**.

Terrestrial fauna in the study area

A total of 246 wildlife species, comprising 14 species of amphibians, 50 species of reptiles, 30 species of mammals, 152 bird's species occur within the survey area (Table 5.12). The assessment is based on frequency of occurrence of fauna and public consultations.

Table 5.12: Summary of Terrestrial Fauna Findings in the Study Area

Group	Total No.	Threatened Status				Not Threatened
		Critically Endangered	Endangered	Vulnerable	Lower risk	
Amphibians	14	0	1	6	7	
Reptiles	50	4	19	20	7	
Mammals	30	4	8	6	12	
Birds	152	14	13	2	3	120
Total	**246**	**22**	**41**	**34**	**29**	**120**

A full inventory of the wildlife species has been developed based on the results from all sampling sites that is provided in table C-7 to Table C-11 in **Annex** C.

5.3.4 Threatened Species

According to the IUCN Red Book 2001 species are classified as Extinct, Critically Endangered, Endangered, Vulnerable and Lower Risk based on status of each species to understand the importance for conservation of those species. Species under Critically Endangered, Endangered and Vulnerable are combined termed as Threatened.

A total of 246 wildlife species, comprising 14 species of amphibians, 50 species of reptiles, 30 species of mammals, birds 152 and bird's species recorded within the survey area. The assessment is based on frequency of occurrence of fauna and public consultation shows that no amphibian's species are critically endangered, 1 species are endangered, and 6 are vulnerable and 7 are lower risk. In case of

reptiles 4 species recorded critically endangered, 19 endangered, 20 vulnerable and 7 are lower risk. Out of 30 mammals, 4 are critically endangered, 8 are endangered, and 6 are vulnerable and 12 species are lower risk. Out of 152 bird's species 14 species are critically endangered, 13 species are endangered, 2 species are vulnerable, 3 species are lower risk and 120 species are not threatened.

Amphibians

Within the findings of amphibians dicroglossid frogs were found highest in number. Members of the Microhylidae family usually prefer paddy fields, grasslands, gardens, arable lands, homestead forests, roadsides, drainage and ditches. The niche preferences of these frogs were dump areas such as under refuse, trash and vegetation, rocks, logs, burrows and leaf litter. Asian Brown Tree Frog (Polypedates leucomystax) is a tree dwelling frog belonging to the family Rhacophoridae, and recorded by community in homestead forests, along roadsides and around human habitation. It is arboreal; niche preferences were branches of the trees, tree holes, from lower to mid canopy, bushy areas and nearby stagnant water bodies. This frog was very common and was found highest in number among tree frog species.

The Indian Bull Frog (Hoplobactrachus tigerinus) is listed in the CITES Database. Two species viz., Green Frog (Euphlyctis hexadactylus), and Indian Tree Frog (Polypedates maculatus) were also observed within the study area. Among the species one species is endangered which is Taipeh Frog (Rana taipehensis), 6 species are Vulnerable and the rest are lower risk in the study area. Most of the species were recorded in the form bamboo near homestead and crop fields. Inventory of amphibian in the project area are given in table C-7 and sub-project wise list of amphibians are in Annex-C.

Reptile

50 reptile's species were recorded during field surveys of genus 37 under 10 families. According to Red data Book of IUCN on reptiles have been recorded of each species are given in the last column of table C-8 and detail in sub-project wise are in **Annex-C**. Out of which 4 species are Elongated Tortoise (Indotestudo elongate), Flying Lizard (Draco blanfordii), Reticulated Python (Python reticulate), Russell's viper (Vipera russelli) are critically Endangered and 19 species are (Ganges Soft shell Turtle- Aspideretes gangeticus, Peacock-marked Soft shell Turtle - Aspideretes hurum, Banded Krait-Bungarus fasciatus, Common Krait-Bungarus saeruleus, Golden Flying Snake-Chrysopelea ornate, Malayan Box Turtle-Cuora amboinensis, Copperhead Trinket Snake-Elaphe radiate, Black Pond Turtle- Geoclemys hamiltonii, Brahminy River Turtle-Hardella thurjii, Assam Roofed Turtle - Kachuga sylhetensis, Indian Tent Turtle-,Kachuga tentoria, Green Keelback Snake-Macropisthodon plumbicolor, Bangladesh Black Turtle-Melanocheys trijuga, Binocellate Cobra-Naja naja,King Cobra-Ophiophagus hanna, Rock Python-Python molurus, Spot-tailed Pit Viper-Trimeresurus erythrurus, Bamboo Pit Viper -Trimeresurus gramineus, Ring Lizard/ Water Monitor- Varanus salvator, and Yellow Monitor -Varanus flavescens) endangered and 20 species were recorded vulnerable.

Mammals

The survey period is not realistic for wildlife assessment. However, few common species have been seen. Thus interviews were held with local elite, hunters, to assess the presence of mammals. National status of each mammal according to red data book of IUCN are given in the last column of Table C-9 and detail checklist on mammals in sub-project wise are in **Annex-C.**

30 species mammals of 22 genuses under 15 families during the survey and public consultation in 29 subproject area. Out of 29 species identified, 5 species are threatened including gangetic river dolphin (Platanista gangetica) or Susuk, other than that 4 critically endangered Pigtailed Macaque (Macaca nemestrina), Slow Loris (Nycticebus coucang), and Common Otter (Lutra lutra) Bear Cat (Arctictis binturong). 8 endangered like Jungle Cat (Felis chaus), Indian Crested Porcupine (Hystrix indica), Rufous-tailed Hare Lepus nigricollis), Smooth-coated Otter (Lutra perspicillata), Ganges River Dolphin (Platanista gangetica), Large Indian Civet (Viverra zibetha), Fishing Cat (Prionailurus viverrinus), Capped Langur (Trachypithecus pileatus).

Gangetic Dolphin - The population of the Gangetic Dolphin is decreasing day by day, mainly as a consequence of human activities. Many individual dolphins suffocate after getting entangled in fishing nets, which is causing significant reduction in local population numbers. Damsalong the dolphin migration route prevents it from migrating and separate potential breeding populations. Young are born year-round in this species, mainly over October to March with a significant birth peak takes place in December and January, at the beginning of the dry season, and again from May to July. Gestation lasts eight to nine months. Decreasing depth of the river and excessive movement of water transport vehicles is causing the segregation of the populations.

Birds

Birds were assessed during walk-over surveys. Bird's information also collected through people's interview. Identification of birds was by both visual and vocal characteristics. The bird inventory was coordinated with the vegetation/ecosystem types identified during the floristic survey. Timing for observations of birds was usually through the whole spot survey that is around one hour. The survey area and overall proposed all subprojects mostly covered seasonal wetlands as floodplain, hence identified water birds over the inundated agricultural field and especially emphasized to locate and collect information on bird colony, roosting places and nesting sites.

As the habitat changes during the dry season the water birds remain close to the perennial water bodies including canals, rivers and other water areas. Mentionable included waterfowl (ducks and geese) and fish-eating birds (herons and kingfishers), both resident and migratory. Other bird species observed in wetland areas are Cinnamon Bittern (Ixobrychus cinnamomeus), Purple Swamphen (Porphyrio porphyrio), Bronze-winged Jacana (Metopidius indicus), White Breasted Waterhen (Amaurornis phoenicurus), Little Grebe (Tachybaptus ruficollis), Black-crowned Night Heron (Nycticorax nycticorax) and three species of kingfisher, little cormorant (Phalacrocorax niger) and 5 species of egrets & herons.

A total of 29 threatened species of birds recorded of genus 25 under 21 families. National status of each mammal is given in the last column of Table -10 according to IUCN-Bangladesh red data book on birds. Among them 14 species are critically endangered (Alexandrine Parakeet- Psittacula eupatria, Black Francolin- Francolinus francolinus, Black-breasted Parrot bill- Paradoxornis flavirostris, Comb Duck- Sarkidiornis melanotos, Dollar Bird- Eurystomus orientalis, Great Hornbill- Buceros bicornis,Greater Adjutant- Leptoptilos dubius, Grey Peacock Pheasant- Polyplectron bicalcaratum, Malayan Night Heron- Gorsachius melanolophos, Painted Stork - Mycteria leucocephala, Pale-capped Pigeon- Columba punicea, Pallas's Fish Eagle- Haliaeetus leucoryphus, Spot-throated Babbler- Pellornium albiventre, and Yellow-throated Laughing Thrush- Garrulax galbanus). 13 species are endangered (Black-bellied Tern- Sterna acuticauda, Black-headed Munia- Lonchua Malacca Blyth's Kingfisher- Alco Hercules, Brown fish owl - Bubo zeylonensis, Grey Nightjar- Caprimulgus Indus, Kalij Pheasant- Lophura leucomelanos ,Lesser Adjutant - Leptoptilos javanicus, Manipur Bush Quail- Perdicula manipurensis, Oriental Pied Hornbill- Anthracoceros albirostris, Red-headed Trogon- Harpactes erythrocephalus, Spot bellied Eagle owl- Bubo nipalensis, Streaked Spider hunter- Arachnothera magna, and Tawney Fish Owl- Ketupa flavipes) and 2 species are vulnerable and 3 species are lower risk and the rest are not threatened. Total 145 bird species have been recorded during the survey under 115 genuses. An inventory of birds is in table C-10 and detain in subproject wise are in Annex-C.

Moreover, due to the habitat change by changing of landscape for construction of embankments and other structures, some species will be in rare and/ or endangered category locally.
A few of the threatened species are in Annex-C**.**

5.3.5 Environmental Protected Area

Based on the Bangladesh Wildlife (Conservation and Security) Act, 2012, some specific areas of environmental importance are declared as environmental protected areas (EPA) in the name of sanctuaries, national parks, community conservation areas, safari parks, eco-parks, botanical gardens notified under the provisions of sections 13, 17, 18 and 19 under Chapter IV and special biodiversity conservation area established under the provisions of section 22 under Chapter V and traditional heritage and kunjaban are declared under section 23 for some specific purpose of environmental protection. There is no such EPA in and around the HFMLIP area.

Moreover, based on the Environment Conservation Act, 1995 and the Environment Conservation Rules, 1997 some specific areas of ecologically important are declared as ecologically critical area (ECA) for conservation of ecological condition of that area restricting certain activities detrimental to the environment. There is no such ECA in the project area. The Tanguar Haor ECA is situated at northern boarder in Sunamganj district,

Tanguar haor whose total area is approximately 160 kilometers including all geographic features and land use is located in the Northeastern part of Sunamganj district, it shares a border of approximately

17 kilometers with Nongstoin, India in its north. The haor is almost 2.5 kilometers away from neighboring Netrokona district in the west (IUCN report). It is located close to Dharmapasha Rui beel and the peripheral aerial distance between them is about 8 km as learnt from XEN Netrokona.

5.4 Environmental Quality

Baseline data for environmental quality monitoring was gathered on air quality, noise pollution, water quality, soil quality and river bed sediment quality at 14 locations in the project area having assistance from Department of Soil, Water and Environment of Dhaka University in sample collection from the field following specific guidelines and analysis in the laboratory.

A guideline for sampling locations selection

Sampling locations will be selected considering the locations of project interventions. Considerations for selecting locations for specific purposes follow.

Ground Water:

- Existing ground water source (tube well) near to proposed large construction site of water management structures.
- Proximity to homestead.

Surface Water:

- Existing surface water source (khal/ river) near/downstream to proposed major construction site of water management structures.
- Proximity to homestead
- Proximity to ghat

Soil:

- Soil sample adjacent to proposed large construction site of water management structures / burrow pit
- Proximity to homestead

Dredged material:

- Dredged material (khal/ river) near/downstream to a specific industrial concern/ farm, if any, in the project influence area; or
- Dredged material (khal/ river) near/downstream to proposed construction site of water management structures of nearby village or community; or
- Dredged material (khal/ river) near/downstream to proposed construction site of water management structures

Air:

- Site of proposed construction site of water management structures (involving heavy construction works); or
- Site of proposed construction site of water management structures (involving heavy construction works) of nearby village or community;

Noise:

- Site of proposed construction site of water management structures (involving heavy construction works); or

- ❖ reSite of proposed construction site of water management structures (involving heavy construction works) of nearby village or community;

Analytical Methods Used in the Study

Ambient Air Quality Monitoring Technique:

SPM and PM10: High Volume Air Sampler Method was employed for the determination of **SPM** (TSP and PM10) in ambient air. Airborne particulate matter retained/captured on the filter is determined gravimetrically. **NOx, SOx and CO etc.:** Direct measurement of NOx, SOx and CO etc. was conducted on a spot over a period of 1-h by using **Gray Wolf Toxic Gas Monitor** equipped with NOx, SOx and CO sensors in a single Probe TG-502, data logger and mobile computing software.

Noise Level Monitoring:

A Noise/Sound Level Sensor was used to measure the intensity of various sound sources. Measurements were taken during different times of the day and night and at different locations and the changing levels were observed. Day and night and dB(A) Min and Max values as required were provided.

Soil, Water and Sediment:

Methods mentioned in **Table 5.13** were followed for the determination of various parameters as requested in Soil, Water and Sediment samples.

Table 5.13: Methods for determination of various parameters in soil, water and specimen

SL. NO.	Parameters (Soil, Sediment and Water)	Analytical Methods
1	pH	pH meter (1:2.5)
2	Electrical Conductivity (EC)	EC meter (1:5)
3	Total Organic Carbon (TOC)	Wet oxidation method
4	Total Nitrogen (N)	Micro Kjeldahl Distillation
5	Total Phosphorus (P)	Yellow colour spectro photo metric method
6	Total Potassium (K)	Acid digestion and Flame photometer
7	Iron (Fe); Manganese (Mn)	Acid digestion and AAS
8	Zinc (Zn); Copper (Cu); Lead (Pb); Cadmium (Cd); Arsenic (As) (mg/kg)	Acid digestion and Atomic absorption spectrophotometer (AAS)
9	Total Hardness	EDTA Titration Method
10	TDS	TDS Multi meter
11	TSS	Gravimetric method
12	BOD; DO	DO meter
13	Chlorite; Fluoride	Titri metric method
14	Nitrate; Sulphate	Spectrophotometer
15	Coliforms	Microbiological method
16	Particle Size Distribution (Sand, silt, clay)	Hydrometer method
17	Texture	Marshal's Textural Triangle Method

Sampling Locations in the Project Area

Sampling locations for different environmental components are selected at/ nearby spots of a proposed intervention/structure. The sampling locations are shown in **Table 5.14**and **Figure 5.9**.

Table 5.14: Sampling Locations in the Study Area

SL. No.	Name of Subproject	Geographical Co-ordinates	Description of the Location
1	Boro Haor (Nikli) Subproject	$24^0$33'44" N $90^0$93'55" E	Teliahati of Boro Haor (Nikli) Subproject
2	Nunnir Haor Subproject	$24^0$15'84" N $90^0$55'63" E	Par Bajitpur of Nunnir Haor Subproject
3	Chandpur Haor Subproject	$24^0$16'83" N $90^0$53'00" E	Koundia of Chandpur Haor Subproject
4	Noapara Haor Subproject	$24^0$20'54" N $90^0$59'23" E	Nolua Khal of Noapara Haor Subproject
5	Naogaon Haor Subproject	$24^0$30'87" N $91^0$00'51" E	Berachapra Khal of Naogaon Haor Subproject
6	Badla Haor Subproject	$24^0$36'69" N $91^0$00'12" E	Shantopur of Badla Haor Subproject
7	Dakhshiner Haor Subproject	$24^0$48'75" N $91^0$17'64" E	Joysidhol of Dakhshiner Haor Subproject
8	Suniar Haor Subroject	$24^0$54'99" N $90^0$88'08" E	Tarail of Suniar Haor Subroject
9	Chata lHaor Subproject	$24^0$61'27" N $90^0$92'44" E	Sajdul Baruni of ChatalHaor Subproject
10	Ganesh Haor Subproject	$24^0$72'59" N $90^0$91'06" E	Hanskuri of Ganesh Haor Subproject
11	Jaliar Haor Subproject	$24^0$91'54''' N $91^0$54'96" E	Jawar Bazar of Jaliar Haor Subproject
12	Dharmapasha Uui Beel Subproject	$24^0$90'71" N $91^0$01'36" E	Bhatakpur of Dharmapasha Uui Beel Subproject
13	Dhakua Haor subproject	$24^0$98'25" N $91^0$01'36" E	Jaynagar Bazar of Dhakua Haor subproject
14	Mokher Haor Subproject	$24^0$68'31" N $91^0$38'38" E	Lakhipur of Mokher Haor Subproject

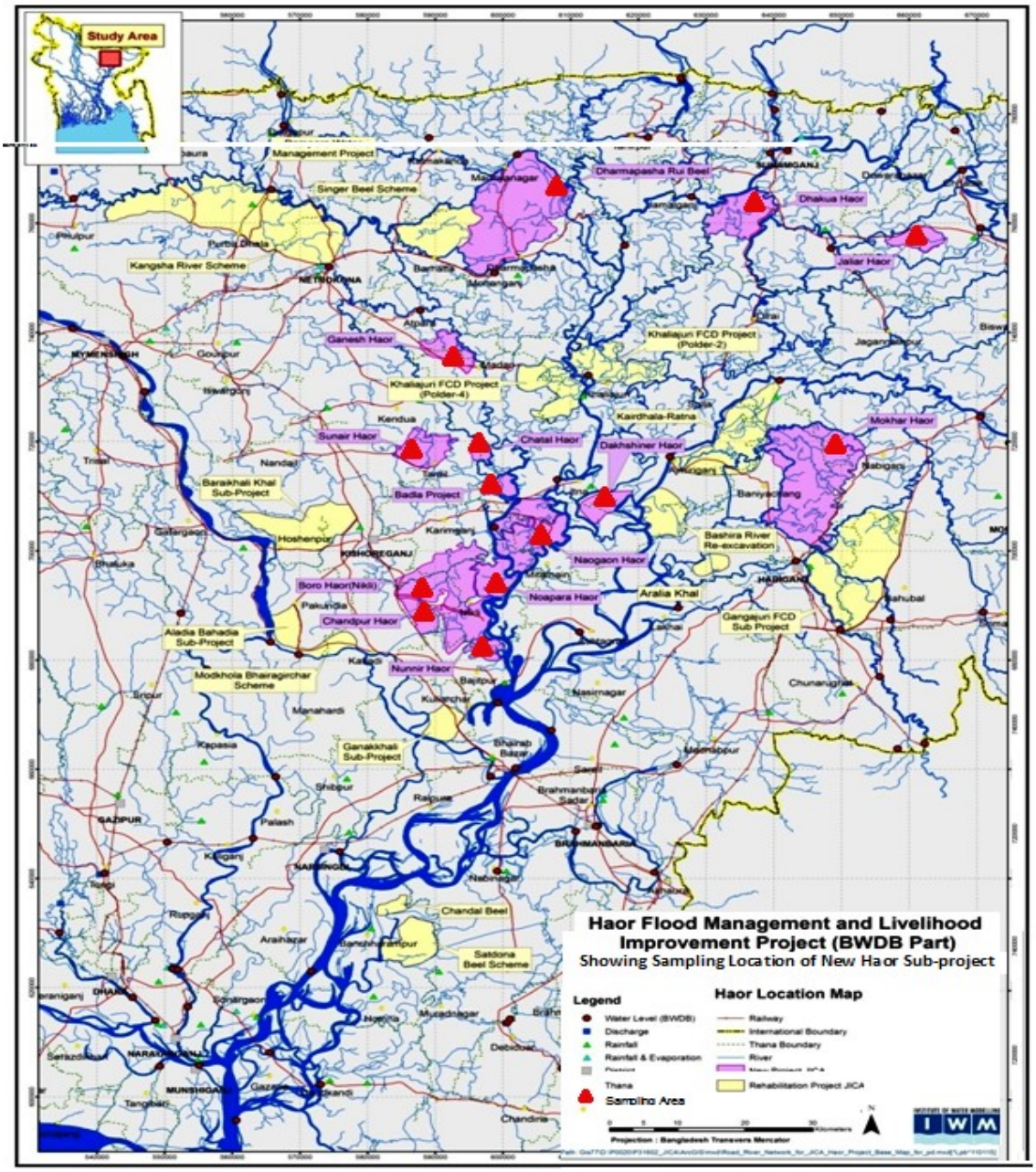


Figure 5.9: Sampling locations of the project area

5.4.1 Air Quality

It was expected that no significant change of air quality will happen due to the project. Even then, as part of the primary environmental baseline data generation in the project areas, 14 (fourteen) ambient air quality stations were sampled and monitored using high precision ambient air quality monitoring samplers in 14 different subproject areas of the project. Different air quality parameters like SPM, PM_{10}, CO, O_3, NO, NO_2, NOx, SO_2, etc. were considered for study. The details of the ambient air quality analytical results are given in

Table 5.15. The photographs showing the Ambient Air Quality (AAQ) Monitoring carried out during the study period is given in **Figure 5.10**

Figure 5.10: Air quality monitoring

Analytical Results:

Table 5.15: Test result of ambient air quality analysis in 14 new haors

Name of subprojects	Unit	Different Parameters' Concentration in the Air (Average value)							
		SPM	PM_{10}	CO	O_3	NO	NO_2	NO_x	SO_2
Boro Haor (Nikli) Subproject	µg/m³	35.3	20.6	1516	19.15	155	302	457	0
Nunnir Haor Subproject	µg/m³	104.5	65.4	1401	23.07	155	208	363	9.675
Chandpur Haor Subproject	µg/m³	45.3	22.6	1477	14.15	163	311	474	0.17
Noapara Haor Subproject	µg/m³	72.3	42.1	1482	19.09	247	260	507	0.167
Naogaon Haor Subproject	µg/m³	88.5	52.1	2166	16.19	90	296	386	0.083
Badla Haor Subproject	µg/m³	89.0	53.1	2129	14.22	83	263	346	0.173
Dakhshiner Haor Subproject	µg/m³	87.3	49.1	2057	14.81	133	259	382	0.133
Suniar Haor Subroject	µg/m³	82.3	46.1	2477	25.30	271	196	467	1.2
Chatal Haor Subproject	µg/m³	72.4	39.2	1662	17.11	218	238	456	0.05
Ganesh Haor Subproject	µg/m³	54.4	31.7	2492	13	164	254	418	5
Jaliar Haor Subproject	µg/m³	68.4	44.2	2831	21	202	354	556	5
Dharmapasha Rui Beel Subproject	µg/m³	84.3	47.6	2475	19	134	215	349	3
Dhakua Haor subproject	µg/m³	41.6	23.3	1393	18	107	194	301	3
Mokher Haor Subproject	µg/m³	65.4	35.2	1624	16.0	197	189	386	3
DOE urban Standards 2005	µg/m³	200	150	40,000	235	NSY	200	-	365
WHO guidelines	µg/m³	50	25	30,000	-	-	40	-	20

Source: Primary data under this EIA. Sampling and testing carried out by Department of Soil, Water & Environment of Dhaka University during March-April 2016

5.4.2 Ground Water Quality

Ground water is abundant in Bangladesh and the aquifers are highly productive. The sediments are predominantly non-indurate and easy to drill by hand, at least to shallow levels. Water tables vary across the study area but are typically shallow at around <5.0–10 m below the ground surface. These factors have made groundwater an attractive and easily accessible resource and have led to a rapid proliferation in the use of groundwater over the last few decades. The majority wells are private tube

wells, which penetrate the shallow alluvial aquifers to depths typically of 10–60 m. Irrigation boreholes typically tap deeper aquifers in the study region of 70–100 m depth.

To assess the shallow and deep ground water quality of the project area, fourteen water samples were collected in the month of March- April 2016 and analyzed for various physico-chemical parameters like pH, Total hardness as CaCO3, Chlorides, Nitrates as NO_3, Sulphates as SO_4, Total Dissolved Solids, Fluorides as F-, Mn, Fe, As, etc. in the laboratory of the Department of Soil, Water and Environment of Dhaka University. The ground water samples collections are shown in **Figure 5.11**; and the analytical results are given in **Table 5.16**.


Figure 5.11: Ground water sample Collection

Analytical Results:

The results of analysis of Ground Water sample are given below:

Table 5.16: Analytical Results of Ground Water Samples taken from 14 new haors

Name of Subproject	Results of Test Parameters									
	pH	$CaCO_3$ (mg/L)	Cl^- (mg/L)	NO_3 (mg/L)	SO_4 (mg/L)	Fe (mg/L)	Mn (mg/L)	As (mg/L)	F (mg/L)	TDS (mg/L)
Boro Haor (Nikli) Subproject	6.90	57	8.55	BDL	BDL	1.0208	0.0342	0.0296	0.0393	285
Nunnir Haor Subproject	7.21	40	1.66	BDL	BDL	0.0833	0.0440	0.0093	0.0483	244
Chandpur Haor Subproject	7.13	76	16.76	0.2947	BDL	0.01238	0.9158	0.0294	0.2824	285
Noapara Haor Subproject	7.03	73	17.76	0.0947	BDL	0.04233	0.0138	0.0214	0.0814	272
Naogaon Haor Subproject	7.22	52	21.10	BDL	BDL	0.0103	0.0166	0.1119	0.5367	408
Badla Haor Subproject	7.42	23	44.54	BDL	BDL	0.4740	0.0097	0.0341	0.5367	464
Dakhshiner Haor Subproject	7.16	55	7.20	BDL	BDL	0.0416	0.0107	0.0598	0.1334	323
Suniar Haor Subproject	6.85	128	35.55	BDL	BDL	0.0270	0.1213	0.0033	0.0576	153
Chatal Haor Subproject	7.78	28	83.29	BDL	BDL	0.3074	0.0215	0.0046	0.0986	442
Ganesh Haor Subproject	6.97	172	225.31	0.342	BDL	0.1450	0.0444	0.0116	Nil	767
Jaliar Haor Subproject	7.30	20	6.5188	0.337	BDL	0.1614	0.0193	0.0463	Nil	308
Dharmapasha Rui Beel Subproject	6.71	230	1.302	BDL	BDL	15.0038	0.1167	0.0165	Nil	337
Dhakua Haor subproject	6.90	102	1.182	0.360	BDL	0.029	0.0975	0.0273	0.0642	212
Mokher Haor Subproject	6.76	62	1.892	BDL	*BDL	0.3828	0.0888	0.0038	0.2661	132
Bangladesh Standard for drinking purposes	6.5-8.5	200-500	150-600	10	400	0.30-1.0	0.10	0.05	-	1000

Source: Primary data under this EIA. Sampling and testing carried out by Department of Soil, Water & Environment of Dhaka University during March- April 2016

5.4.3 Surface Water Quality

The project area is drained by rivers, khals, streams, etc. and the same are in swift flow during the monsoon period and also having considerable flow during non-monsoon period. In order to assess the surface water quality in the project area three surface water samples were collected in the month of March-April 2016 and analyses for various physico-chemical parameters pH, EC, Total Dissolved Solids, TSS, DO, BOD, Coliforms, etc. in the laboratory of the Department of Soil, Water and Environment of Dhaka University. The surface water samples collections are shown **Figure 5.12**; and the analytical results are given in **Table 5.17**

Figure 5.12: Surface water sample collection

Table 5.17: Analytical Results of Surface Water Samples taken from 14 new haors

Name of Subproject	Results of Test Parameters						
	pH	EC (µS/cm)	DO (mg/L)	BOD 5days (mg/L)	TDS (mg/L)	TSS (mg/L)	Coliforms
Boro Haor (Nikli) Subproject	6.68	225	5.89	1.35	95	509	4.5×10^3
Nunnir Haor Subproject	6.78	480	5.48	1.58	226	96	1.66×10^2
Chandpur Haor Subproject	6.87	548	5.92	1.98	262	187	3.16×10^4
Noapara Haor Subproject	7.07	168	6.46	1.49	75	33	Nil
Naogaon Haor Subproject	6.98	187	6.59	1.37	83	76	1.5×10^4
Badla Haor Subproject	6.94	170	6.51	1.21	74	128	8.3×10^2
Dakhshiner Haor Subproject	7.00	168	6.58	2.01	73	100	Nil
Suniar Haor Subproject	6.77	348	6.34	1.27	73	49	1.66×10^2
Chatal Haor Subproject	6.70	228	6.68	0.98	100	162	Nil
Ganesh Haor Subproject	6.77	273	6.51	2.21	113	30	Nil
Jaliar Haor Subproject	6.85	88	5.94	3.21	31	30	Nil
Dharmapasha Rui Beel Subproject	6.66	209	5.31	0.75	84	16	Nil
Dhakua Haor subproject	6.86	58	5.51	3.45	21	36	Nil
Mokher Haor Subproject	6.42	85	6.71	1.56	32	48	Nil
Inland Surface Water Standard for Fish	6.5-8.5	-	5.00 or more	6.00 or less	-	-	-
Inland Surface Water Standard for Irrigation	6.5-8.5	2250 (At25^{0}C temp.)	5.00 or more	10 or less	-	-	1000 or less
Bangladesh Standard for drinking water purposes	6.5-8.5	-	6.00	2 or less	1000	10	50 or less

Source: Primary data under this EIA. Sampling and testing carried out by Department of Soil, Water & Environment Of Dhaka University during March- April 2016. - Test error found, so result is not obtained.*

Analytical results show that the surface water in the project influence area is found to be satisfactory

for fishery and irrigation purposes. However, as the tests done here are only one off test it is recommended that the tests be carried out over a longer period to capture the seasonal variation in water quality during construction as well as part of after care services. It is therefore recommended that a more comprehensive representative samples be collected from the rivers and khals subject to various activities under the project be collected to establish a baseline water quality. The monitoring of such criteria over several seasons is therefore recommended.

5.4.4 Soil Quality

Soil quality is the capacity of a specific kind of soil to function, within natural or managed ecosystem boundaries, to sustain plant and animal productivity, maintain or enhance water and air quality, and support human health and habitation. The land in the area is mostly used for agricultural cultivation and water bodies for fish cultivation.

As part of the EIA Studies, soil samples were collected from three locations of the project and analyses for various physico-chemical parameters pH, Texture, TOC, Nitrogen, Potassium, Phosphorous, etc. in the laboratory of the Department of Soil, Water and Environment of Dhaka University. The soil samples collections in the project influence area are shown in **Figure 5.13**; and analytical results are given in **Table 5.18**.

Figure 5.13: Soil sample collection

Analytical Results:

The results of analysis of Surface Soil sample are given below:

Table 5.18: Analytical Results of Surface Soil Samples taken from 14 new Haors

Name of Subproject	Results of Test Parameters					
	pH	Texture	TOC (%)	Total N (%)	Total P (%)	Total K (%)
Boro Haor (Nikli) Subproject	6.38	Silty clay loam	1.38	0.14	0.059	0.181
Nunnir Haor Subproject	6.68	Silty clay loam	1.08	0.12	0.087	0.21
Chandpur Haor Subproject	6.90	Silty clay loam	0.98	0.08	0.077	0.19
Noapara Haor Subproject	6.60	Silt loam	0.44	0.05	0.067	0.12
Naogaon Haor Subproject	6.55	Silty clay	0.78	0.08	0.057	0.13
Badla Haor Subproject	6.56	Silty clay loam	0.58	0.04	0.075	0.15
Dakhshiner Haor Subproject	5.86	Silt loam	0.56	0.07	0.045	0.11
Suniar Haor Subproject	6.12	Loam	0.77	0.10	0.0624	0.14
Chatal Haor Subproject	6.20	Silty clay	0.98	0.11	0.0648	0.15
Ganesh Haor Subproject	5.90	Loam	0.78	0.10	0.0584	0.18
Jaliar Haor Subproject	5.78	Sandy clay loam	1.08	0.14	0.0774	0.22
Dharmapasha Rui Beel Subproject	5.87	Sandy loam	1.06	0.12	0.068	0.21
Dhakua Haor subproject	5.52	Clay loam	1.12	0.14	0.071	0.23
Mokher Haor Subproject	5.40	Sandy clay loam	1.34	0.16	0.062	0.22

Source: Primary data under this EIA. Sampling and testing carried out by Department of Soil, Water & Environment of Dhaka University during March- April 2016

Analytical results show that the soil in the project area has been degraded and need enrichment for better productivity based on establishing baseline data for specific sites by conducting site specific soil quality analysis.

5.4.5 Sediment / Dredged-material Quality

During the construction of new retired embankment and re-sectioning of existing embankments, soils needed will be met with the material from re-excavation and de-silting of khal/river and sediment/bed-material from the nearby river. As the silt is build up every season after flooding, it will be beneficial to excavate this silt deposited from the river provided they meet the physical quality needed for embankment construction. However, the stipulated guidelines for such extractions in terms of depth of excavation will be followed. Though naturally sedimentation causes every year after flooding, severe sedimentation will not be caused by the project interventions rather river and canal re-excavation will remove the sediment. Care should be taken so that the spoil material will not be spread out in the nearby flood plain and return into the river/canal. So it can be concluded that the project will not cause any sedimentation.

As part of the EIA Studies, sediment samples were collected from four locations of the project and different parameters like Texture, percentage of Sand, silt & clay, organic matter, Nitrogen, Potassium, Phosphorous, Zn, Cu, Pb, Cd, and as analyses to know the concentrations of heavy metals detrimental to health and environment in the laboratory of the Department of Soil, Water and Environment of Dhaka University. The locations of sediment samples collections in the project influence area are shown in **Figure 5.14**; and analytical results are given in **Table 5.19**.


Figure 5.14: Sediment/ dredged material sample collection

Table 5.19: Analytical Results of River Bed Materials

Name of Subproject	Result in Percentage (%)			Texture	Result in Percentage (%)				Results of Test Parameters (mg/kg)				
	Sand	silt	clay		OM	N	P	K	Zn	Cu	Pb	Cd	As
Boro Haor (Nikli) Subproject	24	55	21	Silt loam	1.18	0.12	0.081	0.21	68.85	20.86	10.25	*BDL	3.91
Nunnir Haor Subproject	24	48	28	Silt loam	2.18	0.265	0.169	0.24	65.55	22.59	12.27	*BDL	16.16
Chandpur Haor Subproject	81	10	9	Loamy sand	0.38	0.04	0.028	0.10	18.71	3.57	1.40	*BDL	1.98
Noapara Haor Subproject	33	55	12	Silt loam	0.73	0.07	0.055	0.14	49.26	12.52	5.95	*BDL	2.83
Naogaon Haor Subproject	18	52	30	Silty clay loam	1.21	0.189	0.050	0.11	65.42	21.55	15.28	*BDL	5.01
Badla Haor Subproject	11	65	24	Silt loam	0.72	0.09	0.065	0.12	69.46	22.49	11.72	*BDL	4.21
Dakhshiner Haor Subproject	81	13	6	Loamy sand	0.22	0.04	0.025	0.06	13.83	1.73	0.96	*BDL	1.10
Suniar Haor Subproject	40	33	27	Loam	0.81	0.11	0.061	0.12	41.48	13.12	6.77	*BDL	3.39
Chatal Haor Subproject	48	30	22	Loam	1.16	0.14	0.091	0.28	78.19	22.72	11.63	*BDL	6.94
Ganesh Haor Subproject	51	31	18	Loam	0.89	0.12	0.061	0.20	51.97	14.96	8.41	*BDL	2.46
Jaliar Haor Subproject	46	25	29	Sandy clay loam	0.73	0.11	0.078	0.19	70.69	14.83	19.46	*BDL	0.90
Dharmapasha Rui Beel Subproject	38	46	16	Loam	0.78	0.12	0.062	0.18	69.24	16.33	10.21	*BDL	1.58
Dhakua Haor subproject	33	41	26	Loam	0.88	0.12	0.066	0.20	73.92	15.33	12.77	*BDL	2.39
Mokher Haor Subproject	46	20	34	Sandy clay loam	1.10	0.13	0.065	0.22	49.75	8.35	9.66	*BDL	3.17
**PEC									**459**	**144**	**128**	**4.98**	**33**

*BDL: Below detection limit for Cd = 0.001 mg/kg
**PEC: Probable Effect Concentration, Prediction of sediment toxicity using consensus-based freshwater sediment quality guide (US EPA, 2000).
Source: Primary data under this EIA. Sampling and testing carried out by Department of Soil, Water & Environment of Dhaka University during March- April 2016

Analytical results show that the sediment quality in the project selected khals/rivers in the project area is found to be satisfactory for use in embankments.

However, it is important that the excavation work is carried out without damaging the river banks and other river training structures. The project will guide the contractors who will supply the soil material to follow those guidelines and also comply with the EMP.

5.4.6 Noise

As part of baseline data collection noise level has been monitored at 14 different locations of HFMLIP. Precision integrated sound level meter having statistical unit with digital display is being used by the Soil, Water & Environment Department of University of Dhaka for ambient noise level monitoring in the present study. Noise monitoring locations and noise levels are being recorded. The noise quality monitoring in study area are given in **Figure 5.15**. Analytical results are given in **Table 5.20**.

Figure 5.15: Noise level monitoring

According to the noise level monitoring data (**Table 5.20**) it is observed that almost all of the minimum and maximum noise level monitored exceeded the standard for sound at residential and mixed area[2].Time weighted average noise level (Leq) at both the locations has also exceeded the day and night time noise level standard for residential and mixed area.

The results of noise level monitoring are given below:

Table 5.20: Result of noise level monitoring in 14 new haors

Sample Code	Day			Night			National Standard: (Area)
	Min (dBa)	Max (dBa)	Leq (dBa)	Min (dBa)	Max (dBa)	Leq (dBa)	Day/Night (dBa)
N-1	62.4	74.5	64.5	42.6	55.2	40.8	Silent Area-45/35
N-2	46.4	71.5	60.5	44.6	58.2	53.8	
N-3	46.4	70.5	60.5	44.6	62.2	56.8	Residential Area-50/40
N-4	44.4	60.5	55.5	43.6	58.2	54.8	
N-5	41.4	50.5	48.5	40.1	48.2	46.2	
N-6	40.4	51.5	45.5	39.9	50.2	44.8	Mixed Area - 60/50
N-7	40.4	50.5	44.5	38.9	44.2	40.5	
N-8	48.4	59.5	55.4	42.9	54.2	50.4	
N-9	42.4	66.5	54.5	40.9	56.2	50.4	Commercial Area-70/60
N-10	44.4	64.5	53.6	40.1	57.2	49.8	
N-11	42.4	62.5	51.8	39.6	56.2	48.8	
N-12	45.4	72.5	59.1	43.6	58.9	51.2	Industrial Area-75/70
N-13	41.4	48.5	44.9	40.1	46.2	42.4	
N-14	48.4	58.5	52.9	40.0	48.2	43.3	

Source: Primary data under this EIA. Sampling and testing carried out by Department of Soil, Water & Environment of Dhaka University during March- April 2016

[2] Mixed area has been defined as mainly residential area, and also simultaneously used for commercial and industrial purposes, ECR 1997.

5.5 Environmental Risks

5.5.1 Climate Change

Bangladesh is particularly vulnerable to climate change. Two-thirds of the country is less than 5 meters above sea level, making it one of the most flood prone countries in the world. Severe flooding during a monsoon causes significant damage to crops and property with severe adverse impacts on rural livelihoods. Future climate change seems likely to increase the destructive power of monsoon floods.

The General Circulation Models considered in the forth assessment of Inter-Governmental Panel of Climate Change produced a clear consensus that temperatures in the Ganges-Brahmaputra-Meghna (GBM) basin would rise by 1 to 3 °C by 2050 along with increases of about 20% in precipitation. Another study forecast that just a 1°C increase in temperature and 5% rise in precipitation would result in an increase of 20% in the area flooded in Bangladesh (Mirza, M.Q., R.A. Warrick, N. J. Ericksen, and G.J. Kenny,1998: Trends and persistence in precipitation in the Ganges, Brahmaputra and Meghna Basins in South Asia, Hydrological Sciences Journal)

The proposed project will be located in the haor basin of the north-east of the country. This area is at particular risk from climate change. It is a tectonic depression, and is being pushed down as the Indian plate collides with the Eurasian plate. According to Johnson and Alan (Sedimentation and Tectonics of the Sylhet Troughin Geological Society of America Bulletin, 1991) the Sylhet sub-basin is sink in gat 2.1 cm per year because of down-thrusting under Shillong massif. However Good bred and Kuehl (Enormous Ganges-Brahmaputra Sediment Discharge during Strengthened Early Holocene Monsoon, Geology, 2000), based on analysis of sediment thickness, say the rate of sinking is much less at 2-4mm/year

This sinking will mean that annual flooding will become more extensive. This will be exacerbated by sea level rise (SLR). It had been thought that 60 cm SL Rover 100 years would raise river level at Chandpur (downstream from the basin on the Meghna River) by 15-20 cm. But in fact river bed level will also rise so the river level will rise by about 50cm. This will affect rate of drainage of haor basin, but exact effect (combined with tectonic sinking) has not yet been calculated. Even without SLR, the river level at Chandpur will rise due to extension (progradation) of the delta to the south, meaning that rivers will have further to go before they reach the sea

The sinking of land and rise in river levels is not being offset by inflow of sediment from India as the rivers from the Indian hills do not carry much silt. This is in contrast to other parts of Bangladesh where the Jamuna (Brahmaputra) and Padma (Ganges) carry vast silt loads some of which is deposited in flood plains raising land levels. In addition, one of the rivers that a flow in to the bas in from India is to be dammed and other rivers could be dammed in future. A dam would reduce the silt flow on its river by 25% to 33% during its life of about100 years

Finally, the area is vulnerable to flash floods resulting from rainstorms in the Indian hills. These hills include places with the world's highest recorded rainfall (Cherrapunji in Meghalay asham annual average rainfall of 11,430 millimeters, and nearby Mawsynram has an average of 11,873 millimeters). Cherrapunji holds two worlds records-the maximum amount of rainfall in a single year: 22,987

millimeters in 1860-1 and the maximum amount of rain fall in a single month: 9,300millimeters in July1861. Flash floods resulting from torrential rain in the pre-monsoon season cause extensive losses to the main crop grown in the area (dry season boro paddy). Farmers reckon that they may lose one crop in four, and so only apply low levels of input. The project area is vulnerable to Flash Flooding **(Figure 5.16)** and starting from the pre-monsoon season, the area remains flooded during the entire monsoon seasons (generally from May to September of each year).

5.5.2 Flooding

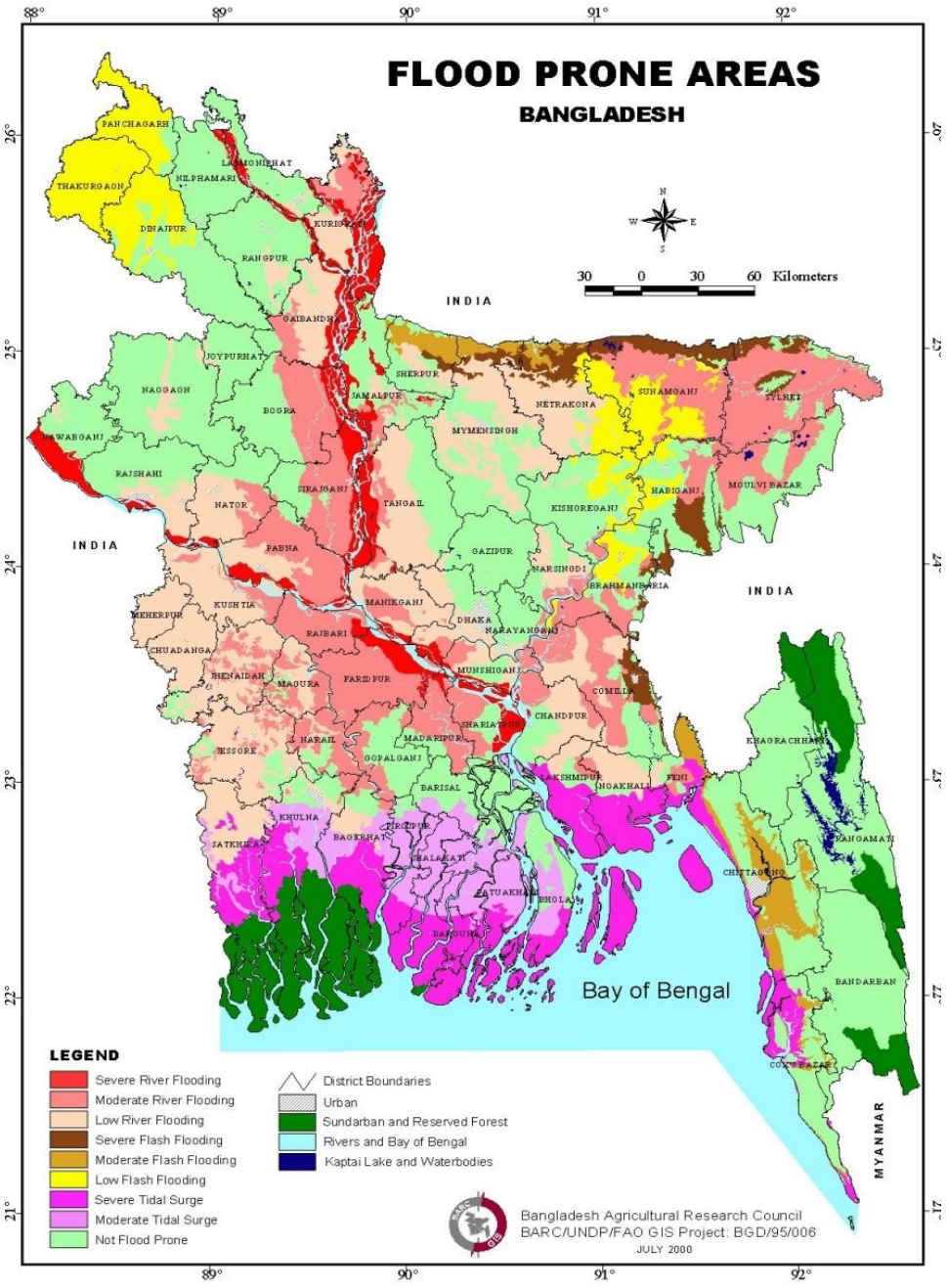


Figure 5.16: Flood Prone Areas of Bangladesh

5.5.3 Seismicity

Bangladesh has continually been one of the seismically active regions of the world, and has experienced numerous large earthquakes during the past 200 years. Many of seismic-tectonic studies have been undertaken on the area comprising the Indo-Burman ranges and their western extension and in the northern India. Major active fault zones of the country have been delineated through geological trenching and dating methods. A list of reference of this is provided in Haque, (1990), using data from various sources. A seismic zoning map of Bangladesh has been proposed in 1979 by Geological Survey of Bangladesh (GSB) dividing the country into three seismic zone which was accompanied by and outline of a code for earthquake resistant design. Later, a new updated seismic zoning map and detailed seismic design provisions have been incorporated in Bangladesh National Building Code (BNBC 1993). A seismicity map of Bangladesh and its adjoining areas has also been prepared by BMD and GSB. Bangladesh has been classified into three seismic zones with Zone-1 is the most and Zone-3 is the least vulnerable to seismic risks (**Figure 5.17**). The northern part of the project area falls under Seismic Zone-1 means the most vulnerable to seismic risks; whereas the southern part of the project area falls under Seismic Zone-2 means the moderate vulnerable to seismic risks. **Table 5.21**and **Table 5.22** show the earthquakes history in Bangladesh

Table 5.21: History of Earthquakes in Bangladesh

Date	Name	Magnitude (Richter)	Epicentral Distance from Dhaka (km)	Epicentral Distance from Sylhet City (km)	Epicentral Distance from Chittagong (km)
10 January, 1869	Cachar Earthquake	7.5	250	70	280
14 July, 1885	Bengal Earthquake	7.0	170	220	350
12 June, 1897	Great Indian Earthquake	8.7	230	80	340
8 July, 1918	Srimongal Earthquake	7.6	150	60	200
2 July, 1930	Dhubri Earthquake	7.1	250	275	415
15 January, 1934	Bihar-Nepal Earthquake	8.3	510	530	580
15 August, 1950	Assam Earthquake	8.5	780	580	540

Source: Choudhary, 2005

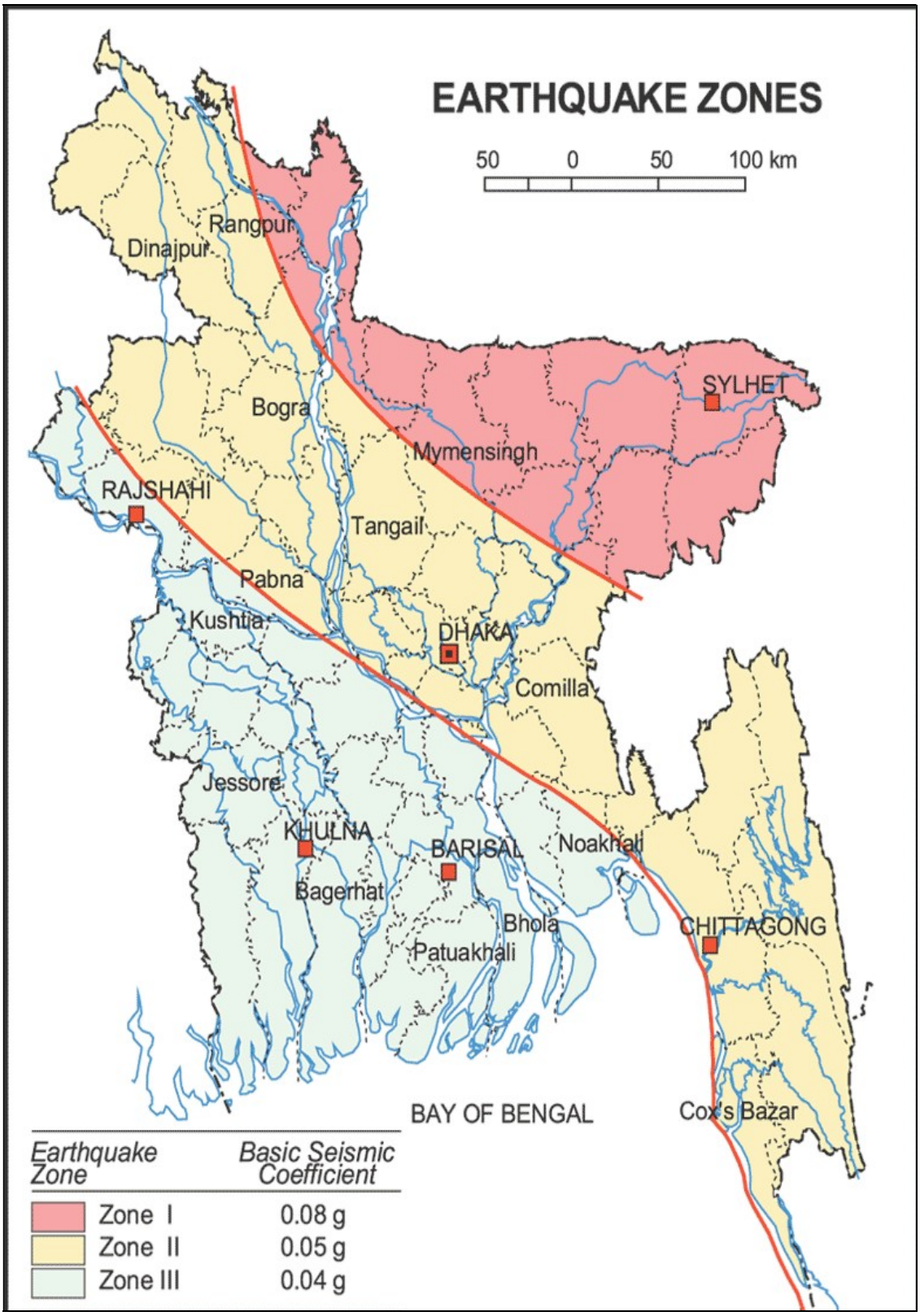


Figure 5.17: Earthquake Zone of Bangladesh

Table 5.22: Recent earthquake data in the wider Project Area

Date	Time (UTC)	Latitude (deg.min.sec)	Longitude (deg.min.sec)	Magnitude	Distance (km) from Dhaka Seismic Observatory	Region
18/09/2011	12:40:47.00	27:75.00N	088:20.00E	6.8	495	Sikkim, India
01/08/2011	00:26:08.17	24:04.65N	093:41.97E	4.0	343	India-Myanmar Border
27/08/2011	00:55:59.00	23:45.00N	090:93.00E	4.0	69	Chandpur region, Bangladesh
28/07/2011	17:53:39.12	25:02.00N	088:58.00E	4.4	228	Nawgaon Region, Bangladesh
22/07/2011	00:58:49.36	24:20.67N	092:02.85E	4.1	183	Bangladesh-India Border Region
03/07/2011	00:15:10.12	25:27.92N	092:01.46E	3.6	253	Shilong Region, India
30/06/2011	21:45:33.00	25:50.00N	093:25.00E	3.6	326	North Chachar Hills, Assam, India
21/06/2011	04:50:58.93	23:24.43N	090:51.65E	4.0	64	Comilla-Chandpur Border Region, Bangladesh
09/06/2011	07:34:23.73	23:26.40N	089:43.80E	4.5	108	Rajbari-Faridpur Border Region, Bangladesh.

Source: Bangladesh Meteorological Department, Dhaka, 2011

6 SOCIO-ECONOMIC ENVIRONMENT

This chapter describes the existing conditions of socio-economic components (e.g. population/ demography, settlement and housing, traffic and transport, economy and employment, cultural, archaeological and historical resources, etc.) in the project area.

The primary objectives of this chapter are to provide a baseline data that helps to identify Important Social Components (ISCs) of the subproject area and to assess the potential impacts on the ISCs which may be caused by the project activities during pre-construction, construction and operation & maintenance (O&M) stages. The baseline data includes an inventory of economic development and socio-cultural resources represent the project influencing area.

The information to establish the baseline of the project area was collected from different secondary (e.g. government and private sector agencies) and primary (e.g. field survey, site visits, public consultation, professional judgment etc.) sources.

In order to assess the impacts of the proposed Project on people living in the vicinity of the project area, detailed survey was conducted and existing socio-economic conditions and salient features of the area were duly observed. During the detailed site visit, relevant government agencies/departments were also consulted for the collection of the relevant data. Information on socio-cultural resources and economic development were collected through field survey, secondary sources and also by the social and resettlement study team of the project.

6.1 Population, demographic profile and ethnic composition

The total population of the seven haor districts in the Northeast Region is 17.88 million as in 2011 census compared to 14.94 million in 2001 census (BBS, 2012). The average yearly growth rate for the previous 10 years is 1.97%, which is higher than the national rate of 1.47%. There are about 3.44 million households in the haor districts, which results in into average size of 5.2 persons per household. The highest number of population lives in Sylhet (3.43 million) and the lowest in Maulvibazaar (1.92 million). Similarly, Sylhet has the largest household size of 5.76, while Kishoreganj has the smallest size of 4.64. The sex ratio in the haor districts on average is 97.78:100, which indicates that there are 97.8 males per 100 females. The national sex ratio is 100:100. Brahmanbaria district has the highest population density (1,510 per km^2), while only 659 people live per km^2 in Sunamganj district. The overall population density in the haor districts is 894 per sq km, which is lower than the average population density in Bangladesh, which is 976 per km^2. %. Ethnic population mainly lives in Habiganj and Maulvibazar. District wise population, its density and sex ratio are given in **Table 6.1.**

Table 6.1: District-wise Population, Density and Sex Ratio, 2010

District	Population (mil.)	Sex Ratio (M: F)	Population density perk^2
Sunamganj	2.47	100.35	659
Habiganj	2.07	96.88	792
Netrakona	2.23	99.37	798

6.2 Settlement and Housing

Land Ownership: The number of farm households in the 7 haor districts is 1.68 million and non-farm households 1.37 million as per JICA survey. Of the total farm households, about 80 percent are small (owning less than 1 ha of cultivated land), 17 percent are medium (owning 1 to 3 ha of cultivated land) and 3 percent are large (more than 3 ha of cultivated land). The large farms usually operate their lands using tenants or hired labor.

Land Tenure: Owner operation is common. About 71 percent of the total farm households operate their own land. Owner-cum tenant operated and tenant operated households account for 20 and 9 percent of the total farm households, respectively. The large landowners generally share out their lands to tenants. The share cropping system is that one-half of the produce is retained by the landowners but they provide no inputs. The landowners generally provide 50 percent of the inputs costs.

The rate of urbanization is the highest in Sylhet district, where the current rate is 21.94%, followed by Kishoreganj, where the rate is 16.79%. The lowest urbanization is in Sunamganj, which is only 10.38%. The national average of urbanization is23.3.

All the haor districts except Sylhet have an urbanization rate which is less than the national average indicating that much of the areas of these districts remain in their rural/natural form and thus, the human settlements are scattered leaving vast lands for agricultural cultivation. There is no ethnic population in the haor areas. The ethnic population mainly lives in the highland/hilly areas of Moulvibazar and Habigonj districts.

People in haor areas reside in raised/elevated lands which are not submerged throughout the year. However, the wave action of the huge lake-like haor causes erosion at the banks of these elevated lands. Therefore, loss of land due to erosion is another serious problem to the hoar people and erosion protection/control is an important measure that they need.

6.3 Traffic and Transport

(1) Road transport

Haor areas remain under water for 4-6 months during the pre-monsoon and monsoon seasons. The roads are submerged during these seasons making it impossible to travel from one place to other without boats. The transportation networks of waterways and roadways have developed over the years in keeping with the unique characteristics of haors. Eleven Upazilas out of the total 69 Upazilas in the haor districts are not connected with the RHD network.

(2) Inland navigation

Inland waterways have been used as a major way of transporting cargo and passengers in the haor area. There are 25 Inland Water Transport (IWT) routes covering a length of 1828.8 km of inland waterways, which remain navigable during the monsoon season (May-September). However, during the lean period (October-April) inland vessels cannot navigate in major parts of the waterways.

6.4 Public Utilities

6.4.1 Water Supply

Most of the households in the haor area are using tube-well water (groundwater) for drinking purpose. About 50% of the households are dependent on surrounding river/pond water for domestic use. As a result, in spite of having good safe water access, the haor people are affected by many water borne diseases.

6.4.2: Sanitation

Bangladesh is on its way to achieving the MDGs targets. However, burdened with poverty and stressed with infrastructure inadequacy, the overall health status in the haor region continues to lag behind the national benchmark with the prevalence of both communicable and non-communicable diseases. The sanitation facilities of the haor area are poor compared to other parts of the country. Use of sanitary latrine is only 44% in the haor area.

6.4.3: Solid Waste

Solid waste includes kitchen waste, used or damaged/broken household goods and agriculture and domestic animal waste. Traditional households in most subproject areas use kitchen and animal waste for composing in pits. Agriculture and organic/wood waste is uses for fuel in cooking stoves. Plastic and metal are commonly sold for recycling.

6.5 Economy and Employment

6.5.1 Employment Structure

Agriculture, especially paddy cultivation, is the main economic activity in the region. The rice production in the haor region is about 5.3 million tons, grown in 710,000 ha, resulting to almost 16% of the national rice production. Farmers plant boro rice in December when the haor is drained up. Generally, the harvesting period spans from mid-April to mid-May. However, flash floods often occur in this region during the pre-monsoon period. The timing of the flash flood clashes with the boro harvesting period. The annual damage caused by the flash floods was estimated at BDT 3,486 million (Haor Master Plan, Haor Board, 2012). Thus, flash flood damage control in the haor area has been a major concern.

Since the haor area usually has only one crop, the job opportunities in the agriculture sector is very limited and less than compared to the other part of the country which has multiple agricultural crops and different types of businesses opportunities over the year.

Although agriculture is the main economic activity, the haor area is also recognized for open water fisheries. Much of the haors remain under water until November and these areas are used for open water fisheries.

Roads and embankments in the haor area get inundated during the monsoon season (June-October) and therefore, the only means of communication in the haor area is waterway/boat communication. However, during the dry season, communication is equally difficult as there are only few intra-haor roads. The year-round poor communication system has adverse impact on socioeconomic aspects including education and health, jobs and income, and produce storage and marketing.

6.5.2 Cultural issues in Employment

Cultural Issues; the population living in the haor areas are mainly agricultural farmers and fishermen. Also semi-skilled and skilled labors are engaged in trade related to agricultural inputs, fishery tools and feed business. During construction of the project, labors will be engaged for the construction works, transportation of materials, material handling etc.

Job Opportunity

Job opportunity in the project areas will improve with the project implementation as came out from the respondents of the questionnaires. The construction of the facilities proposed and operation and maintenance works in the project under project implementation will create a direct impact to the local community. Furthermore, some dwellers living around the roas development project have better access to the city centers where more jobs are available. They have a chance to work as rickshaw pullers/drivers along the developed road.

Damage reduction on private and public own assets

The damage on private and public owned assets caused by floods could be alleviated by the project. Referring to household survey conducted by JICA Survey Team, the average respondents reported that the damage caused by floods amounted to BDT 10,000 in 2000 and 2004. The significant amount of damage loss is expected to be saved with the project.

Damage reduction on fisheries output

Not only agricultural crops, but also fishery production could be saved from the flood damage after the project implementation.

Reduction in human dislocation

The economic cost of dis-location of dwellers can be reduced as the flooding will be reduced by the project. The beneficiaries can utilize their saved cost and time to other economic activities such as agriculture or own business.

6.6 Fisheries

6.6.1 Fisheries in Bangladesh

Fisheries sector play a vital role in improving the socio economic status of the people of Bangladesh. The role of fisheries in the national economy is very important. According to the government statistics about 60% of the national protein in our food comes from fish. Of the total national income, the

Fisheries sector alone contributes 4% to the national export income; the contribution of fisheries sector is third. About 1.2 million people are engaged full time and another 10.2 million are engaged in part time in this sector for their livelihoods. (Source: Statistical year book of Fisheries, 2012)
Bangladesh is one of the world's most important inland fishing nations. Aquaculture development has been strongly promoted by both the public and private sector in an attempt to meet the need of fish for food for the country's population of approximately 156 million. Annual production reached the level of 1.7 million tons in 2012, with 91 percent originating from freshwater and 9 percent from brackish water. The production is dominated by finfish (92 percent) mainly carps, which provide inexpensive fish for domestic consumption. Another 8 percent of the total production is farmed shrimp destined mostly for export market. Marine catches have been stable in 2009 and 2010 around 600,000 tones

6.6.2 Fisheries activities in the Project

Fisheries are a substantial livelihood component in the haor area together with agriculture. Therefore, development of is a crucial component of the project to in relieving or alleviating the haor areas from the vicious cycle of poverty and disasters. Several fisheries development interventions are proposed in the subproject areas to be protected by the works through flood management.

The haor areas are considered the largest basin in the economy, comprising of 373 haors/wetlands according to Haor Master Plan (HMP) in April 2012. During the monsoon season, about 90 % of the project area of 1.7 million ha, is inundated and about 48% of the water flooded areas are in the flood plain, having huge fisheries resources, at an average depth of about 5 m. During the weight season, the inundation removes the rigid boundaries of private land, and the fisheries resources become common property. Peoples have a free access to the fisheries in the open water.

Haor basins have unique ecosystem that compromises a diversified wetland of complex hydrological, biological and ecological system and supports a significant rare and vulnerable species including endemic fishes and fresh water prawn. However, haor basin is not clearly delineated. During the high flood season (June – October), all haor covered 3-5 m depth of water, thus forming a huge single water body. When the water recedes various haor basins can be roughly recognized during dry season (December- March), a number of small and large depressions or beels contain water. A significant number of haor have high potential for fish production. Among them, Kairdola Rata (Hobiganj) and Chandpur haor (Kishoreganj) indicate good production (average 355 kg/ha/yr) for beel fisheries; Nunnair haor (Kishoreganj), Naogaon haor (Kishoreganj) and Mokhar haor (Hobiganj) are the potential production rate (average 300 kg/ha/yr) for canal fisheries; Aralia khal (Hobiganj), Naogaon haor (Kishoreganj) and Ganesh haor (Netrokona) are the more productive area (average 3000 kg/ha/yr) for pond in culture fisheries.

6.6.3 Present Fisheries Resources and its production

All the subproject areas of the project have the potential of both captured and cultured fisheries and play a vital role to improve socio economic status of the people generating employment and income and, providing considerable portion of protein to the people.

Fisheries resources base in the subproject area consists of floodplains, khals, khas water bodies (beel), river, inundated paddy fields, and few borrow pits and ponds. People of the subproject area catch fish from flood plain from June to mid-November when water is available in these areas. People especially the fishermen catch fish from the rivers, small ditches of the haor, and canal during December to end of mid-April each year. The highest catch is recorded in the month of March/ April from small ditches and canal and in October from the floodplain each year. During flood, natural fish mainly the riverine fish and other indigenous fish can enter into the subproject area through rivers, canals and over flow the submerged embankment for food, shelter, breeding and rearing purpose. The common open water fishes are Tengra, shing, Kakila, chanda, Taki, Koi, small Chingri, Baim, Taki, Shol, Puti and Magur fish etc but their availability has reduced due to many causes like blocked migration route, destruction breeding and feeding ground, etc. Some species like Gonia, Boal, Sorputi, bagair, Chitol, Foli, Pabda and Aor have been being endangered in some localities.

In the entire Project Area, there are a number of fisheries related problems, mainly monsoon, floods, siltation of the khal/channels and drainage congestion. All of these features are not favorable for healthy growth of both culture and capture fishery resources. During the dry season most of the khals and ponds of the area suffer from shortage of water supply and some become dry causing problem is fish culture. Fish and other aquatic resources have declined due to siltation, and loss of connection between beels and rivers.

The sub project area has both culture and capture fisheries firmly rooted in the local socio- economic lifestyle. As apparent from table below, culture fishery is the dominating one as far as production rate but relatively the area is small than capture fisheries area. Beel fish production in the sub project area is remarkable both in area and production. In the capture fishery, the floodplain fishery is significant as far as area and also productivity.

Cultured fishes generally Silver carp, Catla, Rui Mrigel, Pangus, Common carp, Grass carp, Thai puti and Tilapia, there are about 46,371 private ponds and 303 government ponds with an area of 6888.19ha and its estimated total production was19268.15MT in the 29 sub project areas. The highest number of ponds (7677). are found in Boraikhali subproject (kishorganj district), followed by Kangsia (7216 no.) sub project (Netrokona district) and 6006 no. in Alaibhadia subproject (Kishorganj district) and the lowest number of private ponds (92) are found in Satdona (Brahambanbaria district). The highest number (52) of govt. pond is found in Dharmapasa subproject (Kishorganj disdrict), the lowest numbers of govt. pond (1) is occurred in Suniar and Borohaor sub project in Kishorganj district. Government ponds are very important to hand over the poor WMG member to create an employment opportunity as well as increase the fish production. The average production for both the ponds (private & govt.) were 2880 kg/ha/yr and the highest production rate was found in Netrokona district, 2895 kg/ha/year, followed by Hobiganj district 2890 kg/ha/yr and the lowest (2678 kg/ha/yr) was recorded from Kishorganj district, source Upazila Fisheries Officer and FGD. Only a small number of rice-fish cultures is found in Dhampara sub project (Netrokona) and its area is about 8 ha. There also a number of borrow pit/ditch in subproject areas with an area of 1503.40 ha and its total production is

2055.44 MT and the highest area (819.73 ha) is found in Sunamganj district. An average production of subproject is 1,338 kg/ha/yr.

There are three government fish hatcheries and 37 private owned hatcheries in the sub project area. The governed operated hatcheries are located in the district of Kishorganl (Kotadi), Hobiganj (Kursi) and Sunamgong (Santlganj). Many nurseries and fish farming communities in the area are dependent on the hatchling or spawns from these two sources. They supply mainly 6 species (rui, catla, mrigel, silver carp, grass carp and raj puti). These species are very popular for aquaculture particularly in pond and ditches. FGD reported that there are 2,315 nurseries in the project area where majority are private owned nurseries at 2,295 while the remaining 20 are owned by the government.

In capture fisheries, there are about 119,090.43ha of capture fisheries in the 29 sub projects of the 5 districts and its total production was 35,875.69 MT/year. The highest production (30853.11 MT) is found in flood plain, due to huge amount of area (110537.02 ha) of floodplain in 29 subprojects, followed by beel production (4277.46 MT). A total of 229 canals are found in 29 sub project with an area of 1069.29 ha.

Most of the canal are silted up and need re-excavation. There are a lot of perennial and seasonal beel in the project area which is very productive and rich in biodiversity. Some beels are leased out by local elite person to increase the production as well as earn the revenue. But beels of the project area are gradually silted up due to a lot of sediments are coming from the upper part of the haor. As a result, changed the breeding and feeding ground of indigenous fishes, and indirectly it is being supporting the destruction of fisheries biodiversity as well as decreasing fish production.

Only a few number of sanctuary activities are found but there is a lot of scope in water bodies to develop a sanctuary to boost up the population of indigenous fish species as well as to conserve the aquatic flora and fauna. There is also a plenty of beels and canals to conduct the community based fisheries management through the direct involvement of WMG members particularly for increase the fish production as well as create an employment opportunity in WMG members but most of the water bodies now under control of local elite person.

The captured fish production is declining day by day due to continuing degradation of water bodies, obstruction of fish migration due to embankment, unsuitability of the khals for fish habitation for siltation, killing the brood fish indiscriminating way, destroying fish breeding and rearing grounds, harvesting the small fish through small mesh size net and over fishing due to huge demand for the large population etc. Fish culture is gradually increasing as a result of converting the farmlands and adopting advanced technologies of fish production.

Present total annual fish production in the sub projects are estimated as 57,199 MT with an area of 127, 482 ha.

Table 6.2: District wise area and production before the project intervention

❖ Culture fisheries

Types of water bodies	Pond			Borrow pit / ditch			Total area (ha)	Total production (mton) /yr
Districts	**Area (ha)**	**Total production (mton)/yr**	**Average production rate/ yr (mton/ha)**	**Area (ha)**	**Total production (mton)/yr**	**Average production rate/ yr (mton/ha)**		
Kishorganj	3011.21	8064.53	2.678	17.01	24.12	1.418	3028.22	8088.65
Netrokona	3229.01	9347.49	2.895	357.14	487.72	1.366	3586.15	9835.21
Hobiganj	163	471.02	2.890	170.75	235.00	1.376	333.75	706.02
Sunam ganj	440.47	1259.78	2.860	819.73	1115.86	1.361	1260.20	2375.64
B. Baria	44.5	125.33	2.816	138.78	192.74	1.389	183.28	318.07
Total	**6888.19**	**19268.15**	**2.88**	**1503.40**	**2055.44**	**1,338**	**8391.59**	**21323.59**

Source: FGD & respective upazila fisheries office

❖ Capture fisheries

Types of water bodies	Beel			Canal			Floodplain			Total area (ha)	Total production (mton /yr)
Districts	Area (ha)	Total production (mton)/yr	Average production rate/ yr (mton/ha)	Area (ha)	Total production (mton)/yr	Average production rate/ yr (mton/ha)	Area (ha)	Total production (mton)	Average production rate/ yr (mton/ha)		
Kishorganj	3662.6	1723.346	0.470525	446.05	**298.8535**	0.67	43507.49	11747.02	0.27	**47616.14**	13769.22
Netrokona	2558.79	1632.556	0.638019	295.2	**230.256**	0.78	30815.3	8936.437	0.29	**33669.29**	10799.25
Hobiganj	949.2	702.826	0.74044	187.16	**121.654**	0.65	29665.88	8306.445	0.28	**30802.24**	9130.925
Sunamganj	232.84	169.9732	0.73	124.88	**84.9184**	0.68	2966.456	860.2722	0.29	**3324.176**	1115.164
B. Baria	80.7	48.762	0.604238	16	**9.44**	0.59	3581.9	1002.932	0.28	**3678.6**	1061.134
Total	**7484.13**	**4277.462**		**1069.29**	**745.1219**		**110537**	**30853.11**		**119090.4**	**35875.69**

Source: FGD & respective upazila fisheries office

Table 6.3: Summary of culture and capture fisheries area and its estimated production

(before the project intervention)

Types of fisheries water bodies	Area (ha)	Production (mton/yr)	Remarks
Culture fisheries	8391.59	21323.59	
Capture fisheries	119090.44	35875.69	
Total	**12,7482.03**	**57,199.28**	

With project intervention

To free the local people of the curse of mal-nourishment, they need more fish in their diet which can be made possible only by producing more fish in a sustainable way and making it affordable to poor including the fishermen and the disadvantaged people, especially the womenfolk. Considering the prevailing local situation and the potential opportunities that the project can create, a number of measures have been proposed for the production increase both in culture and capture fisheries. An overall an average annual incremental production of 12,747.40MT of fish with project intervention will be in the final year of the project, when the proposed enhancement program like introduce the modern fish culture technique, ensure quality fingerling and feed, arrange motivational tour in success full farmers or success full development project, introduce the more community fish culture practice, propagate the natural fish species through the development of sanctuary and banned the brood fish harvesting will be implemented.

This production increase is also dependent on supply of quality inputs in appropriate quantities, following the project training guideline into the production systems. Another important issue is ensuring dissemination of technological knowledge to all the local farmers including the farmers not directly trained by the project through the trained farmers as well as the WMO.

Table 6.4: District wise area and fish production after the project intervention

A. Culture Fisheries

Habitat	Pond				Ditch/ borrow pit				
Districts	**Pre project pro. (mton/yr)**	**Post project production (mton)/yr**	**Incr. production (mton/yr)**	**%**	**Pre project pro. (mton/yr)**	**Post project pro (mton/yr)**	**Incr. produ (mton/yr)**	**%**	**Total incremental pro.(mton/yr)**
Kishorganj	8064.53	10539.24	2474.70	30.7	24.12	31.29	7.17	29.74	2481.87
Netrokona	9347.49	11947.34	2599.85	27.8	487.72	625.00	137.28	28.15	2737.13
Hobiganj	471.02	599.84	128.82	27.3	235	298.81	63.81	27.15	192.63
Sunam ganj	1259.78	1651.76	391.98	31.1	1115.86	1352.55	236.69	21.21	628.68
B. Baria	125.33	153.53	28.20	22.5	192.74	238.69	45.95	23.84	74.15
Total	**19268.15**	**24891.70**	**5623.55**	**av. 29.18**	**2055.44**	**2546.35**	**490.91**	**av. 23.88**	**6114.46**

Source: FGD & respective upozila fisheries office

B. Capture Fisheries

Habitat	Beel				Canal				Floodplain				Total incre. pro./yr (MT)
Districts	**Pre project proc. (mton)**	**Post project pro. (mton)**	**Incre production (mton/yr)**	**%**	**Pre project production. (mton)**	**Post project production (mton)**	**Incre production (mton/yr)**	**%**	**Pre project pro. (mton)**	**Post project pro. (mton)**	**Incre l prod (mton/yr)**	**%**	
Kishorganj	1723.35	3149.84	1426.49	82.77	298.85	334.54	35.68	11.94	11747.02	13487.32	1740.30	14.81	3202.47
Netrokona	1632.56	2456.44	823.88	50.47	230.26	245.02	14.76	6.41	8936.44	9860.90	924.46	10.34	1763.10
Hobiganj	702.83	1186.50	483.67	68.82	121.65	138.50	16.84	13.85	8306.45	9196.42	889.98	10.71	1390.49
Sunam ganj	169.97	228.18	58.21	34.25	84.92	91.16	6.24	7.35	860.27	934.43	74.16	8.62	138.62
B. Baria	48.76	78.28	29.52	60.53	9.44	10.72	1.28	13.56	1002.93	1110.39	107.46	10.71	138.25
Total	**4277.46**	**7099.24**	**2821.77**	**av. 65.96**	**745.12**	**819.93**	**74.81**	**av. 10.04**	**30853.11**	**34589.46**	**3736.35**	**Av. 12.11**	**6632.94**

Source: FGD & respective upozila fisheries office

Table 6.5: Summary of pre and post project production with incremental production and its percentage

Habitat	Before project (mton/yr)	After project (mton/yr)	Incremental production (mton/year)	Incremental %	Average Inc. %
Culture fisheries	21323.59	27438.05	6114.46	28.67	23%
Capture fisheries	35875.69	42508.63	6632.94	18.49	
Total	**57,199.28**	**69,946.68**	**12,747.40**		

Sourse: FGD & respective upozila fisheries office

6.6.4 Commercial important fishes

The haor basin area in the project area is the largest flooding basin, which is composed of 29 haors that are rich in fresh water fish and prawn biodiversity and is often recognized as the “fish mine” of Bangladesh. Out of 260 species of fresh water fish in Bangladesh, 143 native and 12 exotic species along with giant fresh water prawn and other several prawn species are known to live in local the water bodies.

Cultured fish species: Rui, Catla, Mrigel, Silver carp, Grass carp, Rajputi, Tilapia, Mirror carp, Big head, Black carp and Pungus

Captured fish species: Boal, Guizza ayre, Ayre, Rui, Catla, Mrigel, Magur, Sing, Pabda, Tenga, Gulsa, Bacha, Shol, Taki, Tila shol, Gazar, Chitol, Foli, Punti, Chela, Mola, Rani, Gutum, Phaisa, Kachki, Chanda, Chata, Chapila, Koi, Kholisha Bheda, Golda chingri, Gura chingri

Threatened species of fish: Nandina, Royna, Bhagna, Pangus, Pabda, Guiza Ayer, Kala bozuri, Batasi, Mohashol, Bagair Ekthutia, Ekthutia, Kani pabda, Bagair, Kani pabda, Sorputi

6.6.5 Commercial factors

A disproportionate amount of population growth occurs in the project areas, which has put additional pressure on the haor resources and about 12 percent of population of the country (17.88 million-census-2011) live in the haor areas (density of population in the haor area is 894 per sq. km which is lower than the population density of the country, which is 976 per sq. km). Indirect effect of rural residential and agricultural development of haor water sheds associated with burgeoning population will causes continued degradation of haor ecosystem.

Population growth in haor areas, has resulted increased demand for fish production. As a result of projected increased demand. The increased demand of fish is expected to come with higher prices and production costs of aquaculture and an increasing nationalized supply chain.

Increased pressure on fishery resources will require timely management responses to restore as needed, and maintain resources sustainability.

6.6.6 Fishing Community

Most poor people often depend at least seasonally.

Fishing Communities lives scattered in different areas of the Project. Field survey indicates that there are three categories of fisherman- (i) Professional (ii) Subsistence (iii) Occasional. The Socio-economic condition of the community in the area differs from category to category. There are about 367,899 (source HMP data survey) fishers are involved in full time or part time for their livelihood in the project area and in the monsoon, 90 % of the haor surrounding peoples go to fishing for their family consumption. Mainly they live in Kaliakanda, Duldia, Goripur, Pardiarkul, Joisddi, Dampara, Kursi, Buribari, Guroi, Puchbhania, Boraibari Singpur, Jaor, Bahadia, Jaria, Danamunganj, Koikata, Shriram, Baushi, Khaliajuri, Kaderpur, Naogathi, Jaganathpur, Mojan, Sunai, Pakurhati, Maddahnagar, Chamarjani, Gaggor, Join agar, Mohan pur, Vim khali, DokhinKhurma, Mokha, Kagapasha, Jalsukha, Rasulpur, Badanpur, Azmiriganj, Murdahapur, Kalighar, Khasvita, Paharia kandi, Dauria, Mirpur and Rupsaodi village.

Out of the total fishing population, professional fishermen constitute the smallest group. Their socio-economic condition is very poor and has a small quantity of land, mostly, no agricultural land but only homestead land. They live as squatters or illegal occupants in government owned lands in temporary mud huts or thatched houses. They are the neglected or economically marginalized people in the society and are usually deprived of health and education. They are engaged in this profession since long but suffer heavily due to lack of fishing facilities (lack of fish habitat, fish, fishing gear, fishing craft, credit etc.). As a result, they have started leaving this profession and switching over to other profession like, day laborer in other's lands, fish supplier to arat dar, fish seller, earth cutters and peddler etc. Some have opted to migrate to urban areas and run rickshaws.

The left-over fishing households presently available in the area are living from hand to mouth. If ignored from the development process, they could suffer further in the light of reduce water body available for their livelihood.

The subsistence fishermen are mostly agriculture farmers that engage themselves in fishing activities only during monsoon period, fishing in their surrounding floodplain, whatever catch they get, they consume it for themselves. And they sell the surplus catch after meeting their own consumption. The reduction in the floodplains and capture fisheries can affect their income as well as increase the expenses unless their income is increased due to other alternate income generation activities and agriculture. According to BBS (2010), 2.5% -3% of the northeast populations are full-time fishermen (professional fishermen) where 70% of the households are engaged in subsistence fishing.

The third category of fishermen in the area is occasional fisherman. They too are relatively poor people, and are known as Neo-fishermen. Their main profession is rickshaw pulling, earth cutting, day labour. on some occasions,

On the whole fishermen community in the area is leading a miserable life. But they are an active man-power. They could be utilized in their respective profession provided they are integrated in to the social development and provided with facilities and support.

There are many identified and unidentified fishermen based associations in the project area and these are mostly concentrated in some specific patches of different subprojects. Main objectives of

association is to remain united so as to get uninterrupted fishing activities in common properties, good price of their harvested fish and also helping the jeopardize fishermen during hardship. However they do not hold a strong voice or position in the society and may exerts less influence in decision making on common issues such as water allocation and management.
According to UFOs in the Haor Management Plan (HMP), over 267,500 fishers are fishing in the haor basin, out of which 80% are male and 20% are female.

Fish farming community

There are over 50 thousand pond fish farmers in the project area. Pond aquaculture is the dominated by production of carps and exotic carps, followed by two important species Tilapia and Pangus. Fish culture practice of the small fish farming community in the project area are mostly pond based and borrow pit area, in addition to some other types of culture practices that are present in the area i.e. community based fish culture in canal, pen culture in canal and cage culture, it is very small quantity.

6.6.7 Fish processing and marketing system

About 85-90% of fish production in the haor is utilized in fresh forms but in more remote areas, a large portion of catch may be processed. The main products are sun dried and semi fermented. Smoking or salting is not practiced. Fresh fish is normally sold in ungated form. Limited use of ice is made to preserve fish destined for local market but all fresh fish (except live fish) destined for distant markets is preserved in ice.

Sun dried fish is the common form of processed product and the source of protein for land less and marginal peoples. Women mainly do sun drying activities. Sun dried fish is one of the main source of protein for land less and marginal peoples. Sun drying is used for large catches of small fish harvested from beels and dried fish is also stored for future sale when traders and fishermen cannot agree on the price of fresh fish. Some catches such as large prawn, major carp, large cat fish, and some small fish that are used for export undergo high quality processing in surrounding factories of haor. Fish marketing is relatively well organized in haor area. There are three levels of traders are as follows.

Nikaries are active in directly buying fish from fishermen. Typically, they go to khola (fishing camp) or ghat (fish landing or assembly place) and buy the fish from fishermen or jalmohal lease holders, either by auction or bargain. If a nikari has purchased fish from his own capital, or has borrowed capital without a sale contract, he has two main options, namely (i) transport to a fish to a local retain market (mach bazaar) and sell it himself or (ii) transport to local whole sale market (or arat) and sell to an Aratdar or a *Paikar.*
Aratdar are large scale, well capitalized whole sale fish traders and
Paiker are small scale urban fish retailers.
Large consignment of high value fish destined to Dhaka and other destined town may pass through a series of traders before reaching the consumers, with most of the finance put up by large whole sellers in Dhaka cooperation with district whole sellers and jalmohal leaseholders.

6.6.8 Constraints and Issues

Capture fisheries

Silting up of beels and canals reduces the depth as well as water volume negatively impacting fish production. In the canals of the project, the exploitation pressure is very high. No care is taken as to the future of fish stock. Fishermen use sometimes nets with too small mesh gear to catch as much fish as possible gradual bringing many species to extinction. There is no effective enforcement of the fish conservation act.

The water demand for agriculture and fisheries is often at odds and even within one sector the demands are not similar everywhere in the system. Agriculture requires certain dry periods for harvesting, while fisheries needs water throughout the year.

The main conflict related to beels is between the leaseholders of the beels for fishery and agriculture farmers. During the monsoon, the leaseholders and fishermen want to flood the beels and surrounding floodplain while farmers want to keep their land flood free for agriculture. Flood protected agriculture and open water capture fisheries are in principle conflicting systems as far as water requirements are concerned.

In the FCD/I system, not only the fish stock and yields of captured fish declined, but access to this traditionally common property has profoundly changed. In the past, fishermen and particularly subsistence fishermen were free to fish in the beels and in the floodplains. At present, the right to fish in government beels or govt. water bodies like deepest part of haors is frequently obtained through the auctioning of leases by the Deputy Commissioner (DC), although under the new Fish Legislation this practice is not allowed. The leaseholders are usually rural elite or businessmen who allow fishermen to fish in their leased water bodies. This change in the access regime also has profound effects on water management conflicts centering on the beel, as leaseholders are influential members of the society. Hence they often determine the drainage and resulting water levels in beels.

Heavy drought also creates a major problem for fisheries. Floodplain / beel area are being reduced, ultimately reduce the shelter, feeding and rearing grounds of fish and hampered their life cycle for migration. As a result, some species are threatened or endangered. Ultimately the productions are being decreased. Further, in the project area, only water is found in lower parts of the haor, which part can only save the mother fish/ brood fish but some ill motive peoples are being harvesting the brood fish.

There is a gradual decline in the natural production of fry and fingerlings in open waters during the last three decades due to indiscriminate fishing of brood stocks and spawn, destruction of breeding grounds by blocking the migrate routes through the erection of embankments and unplanned roads and indiscriminate use of agro-chemicals and pesticides. Many commercial fish species are adversely affected in their surrounding due to the occurrence of severe fast and undesirable changes which are detrimental to their survival and viability.

Culture fisheries

Extension and training

DoF provide extension services during the year through different projects periods to a limited number of farmers. Some activities were continued although, again, in limited number due to the lack of manpower and availability of funds. NGOs like Grameen Bank, BRAC and ASA etc. are also working in and around the sub-project. Most of the NGOs are working with a few numbers of fish farmers. But to achieve the production target, all ponds are to be covered for aquaculture.

Most of the farmers follow the traditional culture technology. They have no knowledge on modern fish culture technology. DoF and NGOs have conducted few trainings on carp and Genetically Improved Farm Tilapia (GIFT) culture only. To proper utilize fishery resources and to increase fish production, farmer Field School (FFS) on carp nursery management, value fish culture (magur, sing, & koi), Thai pangus, pen culture, fry stocking management and sanctuary management are essential.

Feed

Quality feed is a prerequisite for rapid growth of fish at present. There is a lack of raw materials for feed processing factory to prepare quality feed and this is gradually increasing the price of fish feed. It is a main obstacle for more fish production in this area as fish farmers are not able to purchase quality feed for their fish ponds.

Fish diseases

Generally during winter season fish is attacked by different diseases like white spot disease, tail rotten disease, dropsy disease, and burble damage of shrimp. As most of the farmers do not follow modern fish culture technology so they run into problems. Lack of quality medicines to control diseases is another problem facing the fish farmers.

Credit

Many farmers do borrow money at high interest rates from surrounding money lenders and NGOs like Grameen Bank, BRAC and others. They have no access to a national bank for credit having a lower interest rate due to lack of information, awareness and proper communication.

Government properties

A lot of govt. pond and borrow pits are now under control of the local elite or muscleman/ influential. peoples. Project will take the proper initiative to hand over the govt. properties to poor WMG members, especially to the poor WMG women.

Marketing

Generally, fish farmers and fishermen sell their fishes to the surrounding fish markets through middleman / faria at low prices because they have no alternative option. Ice is not sufficiently available to preserve their harvested fish. The price is increased from farm gate (farmer level) to the retail markets with about 20% to 30%.

6.6.9 Fisheries Management-Issues to address

The continued improvement of fishery management in the area should receive the highest priority, especially of those activities and/or policies that should take place despite interventions. Some of these activities, including the following major special issues were identified during the study period in the project areas and discussion held with concerned officials of the Upazila and stakeholders.

- **Loss of Fisheries habitat**: Local people have opined that the gradual loss of fish habitats will create a lot of problems in the area, such as price hike of fish, less availability of fish as per demand, loss of income source for fishery folk. So all these constraints need to be solved by restoration of lost fish-habitat.
- **Transfer of profession:** Profession change is also an issue in the sub project among the fisherman community. Fish habitat loss is directly linked with profession change. Loss of fish habitat means loss of fishing ground for fisherman. So in such circumstance the professional fisherman are switching over to other profession like-richshaw pulling, earth-cutting, share harvesting of fish, nursery management and day labour.
- **Conflict between fishermen and farmers**: the operation of existing sluice gates creates problems between fishers and agricultural farmers. When one group is interested for water other is not. The conflict of interest may be mitigated by suitable water management for the area through formation of WMGs and WMA.
- **Cultivable ponds:** There is a good number of cultivable in the area. These ponds if brought under scientific aquaculture practice will contribute a substantial role to enhance aquaculture production in the project area.
- **Government should facilitate DoF and** other concerned department and NGO's will provide Need-based Training to fish farmers and fishermen which would be help them increase fish production through better management and rational utilization of water resources.
- **Government officials specially extension** workers and NGO's should motivate fish farmers and actively encourage them to introduce scientific fish culture. In this regard interested aquaculture might also be encouraged.
- **Commercial banks and** NGO's should make special arrangement for disbursing loan (seed money) on soft terms and condition to small-scale fish farmers and fisherman.
- **The Government and NGO's** should initiate support programmes to create employment opportunities for fisherman and their family members so that they can earn throughout the year and not depend entirely on Seasonal fishing.
- **Women involved in fisheries activities** (e.g. fish drying and net making) Women usually earn small amount of income and have no work during lean period. The government and NGO's should come forward to facilitate woman to be employed in income generating activities so that they can supplement their household needs.
- **General education and skill development** training might facilitate women to have more work in fisheries and non-farm activities.

6.7 Agriculture

6.7.1 Background

The haor areas in the northeast part of Bangladesh are placed under very vulnerable socioeconomic or season of boro rice, which is the primary source of income of people in the survey areas. Seasonal flooding which restricts agricultural activities and production to six to seven months in the year deprives employment opportunities for the people. The main component of the project is the rehabilitation and new construction of embankment is in the target haor areas, will substantially mitigate such socioeconomic vulnerability of the areas. However, for further enhancement of livelihood of the people, the promotion of agriculture and fishery subsectors is essential as the two subsectors are the primary economic activities of most of the people living in the area.

6.7.2 Present Conditions of Agriculture in haor Areas

Agriculture promotion, together with flood managements is one of the main aspects of the project and it is aimed at freeing people in the haor area from the vicious cycle of poverty and vulnerability to disaster. The agriculture sector, which consists of crop and livestock is the most important economic activity in the haor areas.

The households engaged primarily in agriculture sector activities account for 55% of the total households depending on agriculture sector represent 88%of the total study area (Census of agriculture 2008). Farmers start in plant boro rice in December and harvest in April when the water level of the haor is lowest. In April, however, floods triggered by heavy pre-monsoon rains called flash floods tend to submerge the paddy, depriving farmers of their only source of income. Poverty due to flash floods in the haor area has been one of the most serious issues of the Government of Bangladesh. However, the agricultural activities in the area face serious constraints such as early flash floods, prolonged inundation, limited landholding sizes, poor communication and transportation systems, insufficient agricultural extension services and others. Accordingly, the livelihood of most of the people is poor and unstable and they are forced to live merely at subsistence level.

6.7.3 Different Agricultural Features in the area

The project covers 5-districts and sub-divided in to 29 sub-projects. Agricultural information was collected by a group of trained field workers through Focus Group Discussions (FGD). Data were collected from all the 29 sub-projects by discussions with the farmers. Information thus collected were compiled, tabulated and report prepared on different important aspects. This report has been prepared on an average and district basis. Relevant basic agricultural information was also collected from Upazila and District Agriculture Offices. The Agriculture Census, BBS, CEGIS, JICA reports on the agro-demographic features and land holding and tenure statuses are also consulted.

Farm Households

The total households in the project districts is numbered to **2251327** (Agriculture Census-2008). Among the households in the project districts farm households and non-farm households were 56% and 44% respectively as in **Table 6.6**

Table 6.6: Farm households and Non-farm households

District	Farm households	Non-farm households	Total Households
Sunamganj	206,720	180,485	387,205
Habigonj	197,143	145,035	342,178
Netrokona	282,651	175,821	458,472
Kishorgonj	308,733	289,019	597,752
Brahmanbaria	257,400	208,230	465,720
Total	**1252647**	**998590**	**2251327**

Soils

The characteristics and distribution of major soils in the study area are shown in the following Table 6.7

Table 6.7: Major Soils distributed in the Area

Soil Type	Characteristics and Distribution
Acid Basin Clays	Strongly Acid heavy clays, permenantly wet (Sunamgonj, Kishorgonj and Habiigonj)
Non-calcareous Dark grey Floodplain Soils	Dark grey and brown soils with dark grey flood coatings with seasonally acid top soils and near neutral sub-soils (Kishorgonj, Brahmonbaria, Netrokona)
Association of Grey Floodplain Soils & 2	Association of seasonally wet or shallowly flooded Grey Floodplain Soils & 2 (Netrokona)
Association of Grey Floodplain Soils & 1	Association of seasonally wet or shallowly flooded Grey Floodplain Soils & 1(Habigonj).

Land use and Type

(1) Haor Type

As shown in Table 6.8 below, the haor areas can be categorized in two types based on geological locations and flooding characteristic.

Table 6.8: Major Hoar types found in the Study Area Districts

Districts	Haor Type
Kishorgonj, Netrokona, Brahmonbaria	Floodplain haors
Sunamgonj, Netrokona, Habigonj.	Deeply flooded haors

(2) Land Use

The land use features of the Study area and project area are categorized as shown in Table 6.9 into 3-categories: i) Agricultural land ii) Settlement and iii) Water body and Forest

Table 6.9: Land Use in the Project Area

	Land Use Category				
	Agricultural land	**Settlement**	**Water Body**	**Forest**	**Total**
Study Area (ha)	1,515,423	109,642	50,364	72,925	1,948,354
Proportion (%)	77.8	15.9	2.6	3.7	100
Project Area (ha)	156,393	23,473	5,611	0	185,476
Proportion (%)	84.3	12.7	3.0	0	100

Source: GIS data Master Plan of Haor Areas,2012 CEGIS

(3) Land Type

Haor areas are commonly categorized into Land types defined by land level (height) and based on the depth of inundation during the monsoon season. The definition and distributions of land types in the study Area and Project area are shown as Table 6.10.

Table 6.10: Land Types in the Study Area and Project Area

Land Type	Definition	Area Extent by Proportion (%)	
		Study Area	Project Area
Highland	Land which is above flood level	22.9	6.0
Medium Highland	Land which is normally flooded about 90 cm deep during the flood season	11.3	16.4
Medium Lowland	Land which is normally flooded between 90 cm and 180 cm deep during the flood season	11.3	16.4
Lowland	Land which is normally flooded between 180 cm and 300 cm deep during the flood season	47.7	55.5
Very Lowland	Land which is normally flooded more than 300 cm deep during the flood season.	6.2	1.4

Source: GIS data Master Plan of Haor Areas, 2012, CEGIS

Present Crops: Yield and Production

In the haor areas of the districts, the rice area is as high as 95%. Boro rice in haor areas of the districts is 80% and similarly followed by t. aman rice. This indicates the dominance of cropping pattern of monoculture of boro rice in the haor areas.

Due to construction of new embankments, repair of existing embankments and sluices. Flash floods will be restricted which will help better crop production. By practicing crop rotation crop diversification, soil fertility will be improved resulting more crop production.

Through introduction of IPM /ICM method of insecticide control, positive impact on environment will occur, because by applying imbalanced chemical fertilizers and insecticides have negative effect on fish production, health hazards which can be mitigated through practicing of above practices Restriction of brick fields within the project area will also keep the overall environmental conditions in a positive direction.

The annual production of rice in the Study Area and the project districts was estimated at 3,900,000 mt and 5,200,000 mt, respectively. The production of other crops was at 1,500,000 mt and 960,000 mt respectively (source: Haor master plan-2012). The production of rice and other crops in the Study Area, project districts, and haor areas have been estimated in the Master Plan of Haor Area.

Table 6.11: Yield Levels of Rice and Other Crops in Haor Areas

Unit:t/ha

Agriculture Land Utilization	Aus	TAman	BAman	Boro	TotalRice	Vegetables	Oilseeds	Pulses	Potato	Wheat	Maize
Yield Levels of Haor Areas											
Sunamganj	2.2	2.1	-	3.4	3.0	16.2	1.2	1.3	16.5	2.2	-
Habiganj	2.5	2.7	1.4	3.6	3.0	15.5	1.1	1.2	9.1	2.3	6.0
Netrakona	2.2	2.4	-	3.3	2.9	20.0	0.9	1.1	12.8	2.5	-
Kishoreganj	2.5	2.6	-	4.1	3.5	5.7	1.1	1.0	15.9	2.0	4.4
Brahmanbaria	2.0	2.4	1.2	3.8	3.1	11.1	1.2	0.9	11.1	1.9	2.0
Sylhet	2.5	2.6	1.3	4.1	3.0	15.0	1.1	1.2	11.7	2.2	5.2
Maulvibazar	2.6	2.5	1.0	3.2	2.7	14.5	0.9	0.8	12.0	1.8	-
Study Area	2.5	2.5	1.4	3.6	3.1	14.4	1.1	1.2	13.6	2.3	5.2
Project Districts	2.3	2.4	1.3	3.6	3.1	13.7	1.1	1.1	13.1	2.2	4.1
Overall Yield Level Project Districts	2.4	2.4	-	3.9	3.4	-	-	-	17.9	2.6	-
Bangladesh	1.9	2.4	-	3.9	2.9	-	-	-	18.3	2.6	6.2

Source: MP Annex 2 Agriculture,

Table 4.3 (CEGIS estimation from DAE & BBS ata, 2010) Bangladehfigure-in2010/11; Year Book of Agricultural Statistics of Bangladesh, BBS, 2011; Overall project district: average of 3 years from 2010/11 to 2012/13; source: project districts DAOs-xx

Present Farming Practices

The present farming practices for the production of boro rice, which is by far the most important crop in the haor areas, are summarized in **Table 6.12**.

Table 6.12: Prevailing Farming Practices of Boro Rice

Works	Prevailing Farming Practices
Land Preparation	Land preparation is carried out by power tiller or draft animal. The use of power tiller has become a common and prevailing farming practice. Land preparation works consist of plowing and laddering/leveling in case of draft animal, or consist of rotary harrowing and laddering in case of power tiller. In the haor areas, shortages in power tiller or draft power during the boro planting season are a serious problem.
Seed and Nursery	➢ The use of HYV is common for boro rice. Hybrid rice is also introduced. ➢ Cultivation of local variety for boro rice is limited. ➢ Seeding rate is 30 to 40 kg/ha. Wet seedbeds are prepared in rice fields. ➢ Nursery prepared from mid-November to early December.
Transplanting	➢ Regular planting of four to ten week old seedlings (depending on receding of inundation water), but random planting is also practiced. Broadcasting is seldom for boro rice. ➢ Transplanting is to be done by January at the latest.
Fertilization	➢ Basal dressing before final land preparation. ➢ Urea is commonly applied, while the use of DSP and K-fertilizer is limited. ➢ Top-dressing of urea and pesticide application are commonly practiced.
Field Management	➢ Water management, weeding (1-3 times/season) and application of pesticide by use of sprayer.
Harvesting	➢ Harvesting manually by use of sickle. The use of power thresher has become common, but pedal threshers are still being used. Threshing using cattle (treading) is also practiced depending on the location. Manual threshing by beating rice plant against a wooden bar, bamboo frame or floor is also practiced. ➢ Paddies, except those kept for family consumption, are usually sold to collector agents immediately after harvesting without drying.
Post-harvest Operation	➢ Post-harvest operations include threshing, drying, winnowing and storing. Paddy is sun-dried and winnowed for family consumption. Dried paddies are stored in earthen or bamboo containers. ➢ Milling is done by a small and mobile rice milling machine. Rice straw is transported to housing yards and stored in open space for animal feeding.

Source: Prepared by the JICA Survey

Cropping Patterns

The haor areas are basically boro rice monoculture areas and the prevailing main cropping pattern is fallow- fallow- boro rice. However, in some areas, a cropping pattern of fallow- aman –boro rice (double cropping of rice) is practiced. The prevailing cropping pattern in haor areas has been estimated as shown in the following **Table.6.13**.

Table 6.13: Prevailing main Cropping Patterns in Haor Areas

Cropping Pattern 1/				
Districts	**Kharif 1 (March –June)**	**Kharif II (June/July –Nov./Dec)**	**Rabi 9 Janu – April/May)**	**% of NCA/2**
Sunamgonj	Fallow	Fallow	Boro rice	75.9
	Fallow	T. aman	Boro rice	10.8
Habigonj	Fallow	Falow	Boro rice	71.9
	Fallow	T. aman	Boro rice	17.5
Netrokona	Fallow	Fallow	Boro rice	70.0
	Fallow	T. aman	Boro rice	27.3
Kishorgonj	Fallow	Falow	Boro rice	87.1
	Fallow	T. aman	Boro rice	10.2
Brahmandaria	Fallow	Fallow	Boro rice	78.1
	Fallow	T. aman	Bororice	14.5

1/ Kharif II and Rabi Cropping season

2/ NCA- Net Cultivated Area

Rice Production

As shown in the above Table on Cropping Pattern based on the responses by the Farmers during Focus Group Discussions (FGD), boro rice cultivation covers about 90% of NCA and rest 10% of land being cultivated by other crop whose production contributes very minimum. So importance has been given to Boro rice production. Hence, after compilation, per hectare boro rice production has been estimated at 4.8 tons.

Fertilizer Use

In the haor areas, Farmers seldom use balanced fertilizer i.e. NPK ZN, they normally use Urea (N) in the Boro rice without considering recommended doses. Farmers mentioned, they use Urea fertilizer because it gives tremendous vegetative growth which they consider that the yield will be increased. If we consider the standard application of Fertilizer in Bororice field they use minimum doses.

Insecticide use:

Farmers of the haor areas, apply any type of insecticides with their common sense. They know the names of some common insecticides which are readily available in the nearby market. For insecticide application, Farmers normally depend on local dealers and without confirming the doses from the technical staff of DAE.

Agricultural Problems in the Haor areas

The most common problems/constraints reported by the Farmers present during FGDs are irrigation issues followed by farm input issues, flash floods/ heavy rainfall, poor drainage boro rice monoculture, production losses in harvest and post-harvest operations inadequate extension activities, etc.

Agricultural Issues in the Survey Area

The Master Plan of Haor Areas (2012) identified problems in agriculture through the participatory planning approach. This survey compiled the data provided by the master plan to identify the specific issues related to agricultural development in the survey area. The identified is sues are (1) crop damages due to flood, (2) poor drainage , (3) poor irrigation systems, (4) rainfed agriculture, (5) rice monoculture, (6) farming operations, (7) shortage of farm machinery , (8) production losses in harvest and post-harvest operations, (9) lack of agricultural facilities, (10) marketing issues, (11) inadequate extension services, (12) inadequacy of research program, (13) inadequate farm input supply, (14) weakly organized water management organizations (WMO), (15) limited accessibility to farm credit, and (16) limited land holding size, landless households, and poor female headed households. Problems /Constraints for Agriculture Reported by the District Offices.

The problems/constraints for agriculture promotion reported by DAOs of the project districts in the interview survey conducted by the JICA Survey Team are summarized in **Table 6.14**.

Table 6. 1 4 : Major Problems/Constraints Reported by DAOs

Issue	Major Problems/Constraints Reported
Farming	Early flash flood, labor shortage during boro rice harvesting period, shortage of quality HYVriceseeds, shortageoffarmmachinery, andinappropriatefarmingpractices
Post-harvesting	Lack of storage facility at home or in the village, and lack of space for drying
Extension Services	Poor logistics support, lack of training facility in block, and extension service area (block) size is too large
Marketing	Selling at low prices or forced to sell just after harvest due to poor transportation facilities and lack of transportation means, and lack of nearby market to sell products
Others	Limited accessibility to farm credit (complex procedures)

Source: Results of interview survey by the JICA Survey Team

Findings of Household Survey

The results of the household survey conducted by the JICA Survey Team regarding the problems/constraints for agriculture promotion, respondent's suggestions to solve such problems/constraints, immediate needs, and future aspirations for agriculture promotions are summarized in the following **Table-6.15.**

Table 6.15: Findings of Household Survey: Crop Subsector

I. Problems/ Constraints for Agriculture Promotion	
Issues(Problems/Constraints)	**Major Issues**
1. Irrigation Issues	general: costive: water shortage.
2. Farm Inputs Issues	general: costive: supply problem:
3. Flash Flood/Heavy Rain	flash flood/heavy rain:
4. Transport/Road Issues	lack of road/transportation means:
5. Agronomic Issues	insect/pest occurrence; high production cost:
6. Labor/Machinery Shortage	Shortage off arm machinery/draft power; labor shortage/high labor cost:
7. Marketing Issues	limited access to markets/unfair marketing price:
8. Farming Capital Issue	shortage of farming capital:
9. Other	
Total	
II. Suggestions to Solve Problems/Constraints for Agriculture Promotion	
Constraints	Major Suggestions
1. Irrigation Issues	electricity/fuel supply etc; irrigation system improvement:
2. Farm Inputs Issues	reduce inputs prices: 64; improvement of inputs supply:50
3. Flood Management	rehabilitation/construction of embankment: 89; river dredging: 40; etc.
4. Road Construction / Improvement	road construction/improvement:55
5. Agronomic Issues	farmer training: 13; appropriate chemical use: 8; etc.
6. Labor/Machinery Shortage	reducing hiring cost: 25; provision of machinery/hiring services: 9; etc.
7. Marketing Issues	higher/fixed/fair price of paddy:22
8. Farming Capital Issue	improvement of access to credit/interest free credit:24
9. Other	

Table:6.16: Summary of pre and post Project agriculture production with incremental percentage

Pre Project Condition			**Total production (mt. ton)**	**Cropping intensity**
Crops	**Area(ha)**	**Yield (mt/ha)**		
Boro(L)	47,000	3.5	164,500	
Boro (HYV)	125,000	4.0	500,000	
Total	172,000		**664,500**	**110**
Post Project Condition			**Total production (mt. ton)**	**Cropping intensity**
Crops	**Area(ha)**	**Yield (mt/ha)**		
Boro (HYV)	203,000	5.5	**1,116,500**	**130**

- Incremental Production: 4,52,000 mt. ton/year
- Incremental percentage increase: 68% per year
- Incremental production value: 632.80 crore BDT /year

(Note: Paddy price is 14,000 BDT/ton)

6.7.4 Issues and Proposed Development Approaches/ Directions for Agricultural Promotion

For agricultural promotion, comprehensive or integrated approaches should better be taken to materialize agricultural potential existing in the haor areas. Furthermore, livelihood improvement through agriculture the agriculture promotion should primarily be realized because the agricultural sector is by far the most important economic activity in the haor areas.

Crop production in the project area is vulnerable to flash flood and drainage congestion. Rice is a main crop damaged by flooding. flash floods usually occur during the pre-monsoon season [March to May].in the haor area losses in boro rice production are reported almost every other year in the haor area and in case of devastating food, farmers suffer complete losses of their crops. Floods also seriously affect harvest and postharvest operations and marketing of boro rice in the haor area because the time available for such operations is restricted by the timing of their occurrences. However, some programs should be taken regarding drainage, irrigation, rain fed agriculture/cropping pattern change in boro rice varieties, adequate extension service.

Sands carpeting and sedimentation caused by floods also adversely affect agriculture in the areas. The envisaged works under the project, such as rehabilitation or new construction of embankments, would substantially mitigate flood damages caused by flash floods [and some seasonal floods in some rehabilitation project areas]

Impeded drainage, slow drainage or drainage congestion of inundation water from fields results in the delay of farming activities in the project area, such as transplanting of boro rice, harvesting of aman rice and sowing of dry land rabi crops. The project works will mitigate such drainage problems to a certain extent through the provision of drainage facilities. specially in the areas provided with full embankments, substantial mitigation of seasonal flooding would be realized under the project [synergy effects], as stated earlier.

In general, most of irrigation systems in the haor area have been reported to be poorly established and operated/managed. It is observed that haor area indicates the possibly of expansion of irrigated areas through the improvement of on farm level irrigation canals and rehabilitation or construction of field level irrigation facilities.

The development approach/direction to be taken is the empowerment of water management groups [WMGs] in the project area as a short term strategy. Efficient utilization of irrigation water through the improvement of water management would mitigate the irrigation cost problem to a certain extent. Considering agricultural promotion one approach to be taken for this issue is to improve on farm level water management through the empowerment of water user’s groups. Crop production in rain fed fields suffers from flash floods and water shortage during the dry and pre-monsoon season.

The development approaches/directions to be taken include the promotion of crop diversification by introducing early HYV boro rice, and the cultivation of upland crops or vegetables of short growth duration in low lying areas by adjusting the planting schedule is risky due to late drainage and early flooding. the availability of such short duration boro variety namely IRATON -38 AND BINADHAN-7 which requires 115-125 days for harvesting maybe introduced in the area. The availability of such variety should be considered because of their short duration and will not affect by flash flood. However, the adoption of other variety still limited because of farmer's preference to the present varieties (BRRI-dhan 28&29 which are long duration boro variety which requires 145 to160 days) and inaccessibility of such new variety. Presently, Farmers are cultivating BRRIdhan-28 &29 which requires 140 -160 days for harvesting and during this period flash flood occurs.

Introduction of Integrated Pest/ Crop Management (IPM/ICM) with the assistance from the Department of Agricultural Extension (DAE). Moreover, organic manure to be applied instead of imbalanced application of chemical fertilizer. Crop rotation need to be practiced After the monsoon season, for agriculture activities in the haor areas, the regulators should be operated in such a manner that the inside water drains out to create agricultural land available for cultivation in a timely manner for optimum benefits.

People's consultation carried out demonstrated that rehabilitating the existing haor projects and new project planned while addressing internal local water management problems. Applying the concept of coordinated management of local water infrastructure through a participatory approach is the best alternative that can generate maximum positive impacts.

These issues should better be addressed in an integrated manner by introducing farmer –participated extension activities for dissemination of improved farming practices in a large scale. The strengthening of field extension activities is considered essential in order to realize expected project benefits of the present projects.

In conclusion, the project will have overall positive benefits by preserving and improving the pre-monsoon flash flood protection, benefits provided by the existing facilities and installment of additional small address internal water management problems that have been addressed in place of implement. Its successful implementation will also serve as a model to demonstrate the processes of achieving substantial under achieved development potential of existing systems while sustaining their benefits through effective stakeholder's participation.

6.7.5 Future Plan for Developing Agriculture and Recommendation

The Haor -project is planned for pre monsoon flood protection along with efficient post monsoon drainage facilities. The following future plan and their proposed recommendation are very essential to improve livelihood through increasing the agriculture production in the Haor:

Increasing Cropping Intensity

The cropping intensity can be raised from 110% to 130 %, with the inclusion of

i) Introducing 30-40 days duration vegetables in between short life cycle but high yielding Aman and Rabi rice varieties.

ii) Relay cropping

Crop Diversification

For improving the nutritional status of the beneficiaries the following steps can be initiated:

a) New technology adaptation
   i. Floating vegetable cultivation
   ii. Hydroponic agriculture for vegetable production
   iii. Bed planting method
   iv. High value crop cultivation instead of cereal crop

Post-Harvest Operation

To take initiative for constructing threshing floor and providing different farm machinery (small scale) in the -project area for ensuring effective post-harvest operation especially in boro season.

Seed Supply

For increasing crop yield in the-project area quality seed of HYV be supplied among the beneficiaries which was produced in the farmer's demonstration field.

Introducing Short Life Cycle HYV

For ensuring livelihood improvements, it is very mandatory to introduce short life cycle HYV (crop) instead of a bit long life cycle HYV. These types of practices may increase crop yield through multiple cropping patterns.

Kharif-II		**Comments**
Existing	Proposed	BRRI Dhan 62 are highly recommended as because, the total life cycle of BRRI Dhan 62 is 100 days and yield is almost 4 Ton/ha. Whereas the total life cycle of existing Aman rice varieties are ranging from 130-140 days.
BRRI Dhan 32 BRRI Dhan 40 BRRI Dhan 41 BRRI Dhan 49	BRRI Dhan 62	
Rabi		
Existing	Proposed	The life cycle of BRRI Dhan 69 is 15 days shorter than BRRI Dhan 28 & BRRI Dhan 29. Whereas the total life cycle of existing BRRI Dhan 28 & BRRI Dhan 29Varieties are ranging from 150-160 days.
BRRI Dhan 28, BRRI Dhan 29	BRRI Dhan58 BRRI Dhan 69	

*(*Regarding this issue, it may be mentioned that we can save the time at least 40 to 45 days in between Aman and Rabi season which will provide a scope to introduce short life cycle vegetables (Lalshak, Bottle gourd as a shak etc), thus increasing the cropping intensity.)

Training

Conducting the farmer's training according to their need.

Demonstration

Arrange demonstration, field day and other promotional activities to promote sustainable technology in the farmer's field through WMO.

Construction

Constructing of threshing floor need based demand from the WMO for ensuring effective post-harvest operation.

Changing the Harvesting Time

If it is possible to change the harvesting time earlier, the farmers become benefited from the following aspects-

i) It is possible to reduce the crop harvesting labor cost
ii) Possible to save the crop from early flash flood
iii) Possible to introduce inter crop as vegetable (Lal Shak) between Aman and Rabi.

6.8 Cultural, Archaeological and Historical Sites

There are no cultural areas like school, college, madrasa, mosque, eidgah, temple, graveyard, etc. along the proposed embankments of the project. There is no archaeological or historical site in the project influence area

6.9 Land Acquisition and Resettlement

The construction of new embankments will require 404.839 ha land acquisition. It will mainly involve with the agricultural land, vacant land with water logging and water bodies of varying depth along the route of the new embankments. So land acquisition and proper compensation will be required. Resettlement Plan for the project is being prepared based on which proper compensation to the affected persons will be paid. However, the project will not cause any involuntary resettlement.

7 IDENTIFICATION, PREDICTION AND EVALUATION OF POTENTIAL ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

7.1 Identification, Prediction and Evaluation of Potential Impacts

This chapter identifies the potential significant impacts related with project location, design construction and operation phases of the project on the physical, biological and socioeconomic domains of the environment. An environmental impact is defined as any significant change to an existing condition or services of the environment.

Identification, predication and evaluation of potential impacts have been done on the basis of preliminary studies, baseline data collected from secondary and primary sources, and experts' judgment.

Considering the types of the interventions expected in the proposed projects, the following environmental parameters are selected for the screening purpose. Considering the scale and type of the projects a total of 35 Important Environmental Components (IECs) were selected after consulting with several projects in same kind of scale and appropriateness. The IECs were classified in five categories such as Natural Environment, Agriculture, Ecological Parameters, Environmental Pollution and Social Environment. **Table 7.1** presents the type of IECs and their rationale for proposed projects.

Table 7.1: Rational to Select Environmental Parameters

Environmental Parameters/ Important Environmental Components (IECs)		Rationale
Natural Environment		
1	Topography	Due to implementation of the project, topography of the project site might change.
2	Soil Erosion and Siltation	Any water resources intervention has relationship with erosion and siltation
3	Regional Hydrology (Flooding, Drainage Congestion and Water Logging)	Large scale intervention can change regional hydrology. The interventions can have impact on flood regime and its control. Haor area also suffers from drainage issues, structural measures can either increase or decrease such situation.
4	Ground Water Table	Change of inundation period can interfere with the ground water table.
5	Soil characteristics/ fertility	Change of cropping pattern, type and intensity can alter soil characteristics and fertility.
6	Landscape and Land use	Large scale structural project can have impact on topography and landscape. Major intervention can also cause change in land use pattern, for example, once flood free, residential area can appear in place of agricultural land
7	Land Subsidence	Embankments are huge sections. It will create huge vertical pressure on the land surface. Without proper geotechnical investigation, if the project is implemented it may create land subsidence.
8	Sand Carpeting	Sand carpeting is a problem in the haor areas which affects fertility of the agricultural land.
9	Water Transport and Navigation	Construction of water management structures associated with rivers and khals will somehow affect water transport and navigation. Appropriate design, construction and management practices will help mitigate water transport and navigation problems.

Environmental Parameters/ Important Environmental Components (IECs)		Rationale
Agriculture		
10	Crop Production	Project may create some flood free area which may ultimately be taken as cultivable land by the farmers. As a result, crop production might increase.
11	Crop Damage	Project will protect the damage of the crops from flash flood.
12	Irrigated Area	People may cultivate in more land as projects ensure less damage.
Ecological Parameters		
13.	Fisheries	Construction of new embankments and associated flood control structures such as regulators may impact on natural migration and spawning of fish. Fish may also migrate laterally into adjacent floodplains for spawning during flood season. Moreover, disposal of waste into nearby water bodies during construction may be harmful for fish. Filling up wetlands may extinct fish culture.
14	Wildlife	Hoar is basically flooded wetland. Such area is home of bio-diversity.
15	Forest / Tree / Crop	Any large scale water resources project usually interacts with forest
16	Wetlands eco-system/ Bio diversity	Hoar is basically a flooded wetland. Interventions can cause change in wetland characteristics
17	Endangered Species	If there are endangered species in the project site, they may be threatened which will lead to their extinction.
18	Environmentally Protected and Sensitive Areas.	Environmental study should confirm the existence of protected and culturally important areas
Environmental Pollution		
19	Air Pollution	Air pollution may occur through the use of vehicles and equipments, cleaning of materials, coating of construction materials, dust from stone/brick crushing etc.
20	Ground & Surface Water Pollution	Accidental spillage of toxic chemicals such as fuel, lubricants, and solvents may pollute water.
21	Noise and Vibration	This can occur during construction activities
22	Soil Contamination	Soil can get polluted due to construction activities
23	Waste Disposal	This can be an issue during construction period
Social Environment		
24	Land acquisition and/or resettlement	Land acquisition will impact on local income and social order.
25	Homestead Loss	In order to acquire land, force displacement of people in the project area may happen. This will lead an enormous disruption of social life in the local population.
26	Income Loss	Agricultural land acquisition, loss of fisheries, loss of business activities and loss of employment may have anticipated.
27	Income gain	Implementation of the project will protect the crops from flash flood.
28	Employment	Employment will create at construction stage. More agricultural labor force also will be required.
29	Food Intake	Food intake may increase.
30	Historical and Cultural Loss	Construction of new embankments may damage mosque, graveyards etc. The influx of non-local labors may also result social disruption.
31	Worker's Health and Safety	Health risk is related to handling of construction equipments, various chemical materials during construction phase.
32	Road Accident	During the construction and reconstruction activities, operation of heavy vehicles and machineries may cause traffic accidents in and around the proposed project sites. Also, accidents may occur to the workers during the construction.

Environmental Parameters/ Important Environmental Components (IECs)		Rationale
33	Water Rights	There are no water rights, fishing rights or rights of common in and around the proposed Project sites. However, local people utilize rivers of the for washing their laundries, daily water supply and swimming in the river, thus it will be affected by the construction activities of the new projects.
34	Ethnic Minorities and Indigenous People	Ethnic minorities and Indigenous people may be affected.
35	Hazards(Risks) infectious disease such as HIV/AIDS	Construction and reconstruction activities may increase the HIV/AIDS infection. During construction period, a lot of labor will be flocked to the project side who may bear HIV/AIDS virus. The mixture of the labor with the local people may spread HIV/AIDS.

Table 7.2: Impact scale and magnitude:

Significant –ve impacts	**Some –ve impacts**	**No impact**	**Some +ve impacts**	**Significant +ve impacts**
A- **(highly significant)**	**A** **(low significant)**	**(no impact)**	**B** **(low significant)**	**B+** **(highly significant)**
If the action is/results in				
irreversible damage to ecosystem sustainability loss of spp or diversity endangered spp affected loss of habitat for wild sp high toxicity changes to a large area changes to large number of people's life rapid depletion of resource effects vulnerable groups in the society increase in factors contributing to climate change	❖ damages sustainability but reversible ❖ set back to a survival of sp ❖ change of part of habitat ❖ low toxicity ❖ changes to relatively small area ❖ changes to a relatively small number of people ❖ marginal contribution to climate changes	Not relevant or no impact to be noted	❖ Some improvement to sustainability ❖ Could Improve spp diversity ❖ Could Improve habitat conditions of wild sp. ❖ May improve living conditions and health of people ❖ Slightly improve the overall environment in the area ❖ Helps vulnerable groups ❖ Some positive controls to climate change factors	❖ Enhances the ecosystem sustainability ❖ Definite improvement to spp diversity ❖ Enhances habitat quality ❖ Definite improvements to habitat condition of wild sp ❖ Make major improvements to living conditions and health of people ❖ Major improvements to overall environment in the area ❖ Improve status of vulnerable groups ❖ Positively reduce climate change factors

The detail of Impact analysis and screening are shown in the following tables.

Table 7.3: Screening Matrix for project interventions

Important Environmental Components (IECs)		Overall Rating	Planning/Design/Pre-construction Phase			Construction Phase					Project operation
			Land Acquisition	Removal of structures	Removal of trees and vegetation	Earth works including quarrying	Vehicle & machine operation & maintenance	Concrete and crusher plants operation	Traffic restriction in and around the construction area	Sanitation and waste (labor camp)	
Natural Environment											
1	Topography	A	-	-	-	A	-	-	-	-	-
2	Soil Erosion and Siltation	A	-	-	-	A	-	-	-	-	
3	Regional Hydrology (Flooding, Drainage Congestion and Water Logging)	A	-	-	-	A	-	-	-	-	A
4	Ground Water Table	-	-	-	-	-	-	-	-	-	-
5	Soil characteristics/ fertility	-	-	-	-	-	-	-	-	-	-
6	Landscape and Land use	B	-	-	-	A	-	-	-	-	B
7	Land Subsidence	-	-	-	-	-	-	-	-	-	-
8	Sand Carpeting	B	-	-	-	-	-	-	-	-	B
9	Water transport and navigarion	A	-	-	-	A	A	A	A		A
Agriculture											B
10	Crop Production	B	-	-	-	-	-	-	-	-	B
11	Crop Damage	B	-	-	-	-	-	-	-	-	B
12	Irrigated Area	B	-	-	-	-	-	-	-	-	B
Ecological Parameters											
13	Fisheries	A	-	-	-	A	-	-	-	-	B
14	Wildlife	B	-	-	A	A	-	-	-	-	B
15	Forest / Tree / Crop loss	B	-	-	A	-	-	-	-	-	B
16	Wetlands eco-system/ Bio diversity	A	-	-	A	A	-	-	-	-	B
17	Endangered Species	A	-	-	A	A	-	-	-	-	A
18	Environmentally Protected and Sensitive Areas.	-	-	-	-	-	-	-	-	-	-
Environmental Pollution											
19	Air Pollution	A	-	-	-	A	A	A	-	-	-
20	Ground & Surface Water Pollution	A	-	-	-	-	-	-	-	A	-
21	Noise and Vibration	A	-	-	-	-	A	A	-	-	-
22	Soil Contamination	A	-	-	-	-	A	A	A	A	-
23	Waste Disposal	A	-	-	-	-	-	A	-	A	-
Social Environment											
24	Land acquisition and/or resettlement	A	A		-	-	-	-	-	-	-
25	Homestead Loss	-	-	-	-	-	-	-	-	-	-
26	Income Loss	B	A	-	A	-	-	-	-	-	B
27	Income gain	B+	-	-	-	-	-	-	-	-	B+
28	Employment	B	-	-	-	B	B	-	-	-	B
29	Food Intake	B	-	-	-	-	-	-	-	-	B
30	Worker's Health and Safety	A	-	-	-	A	A	A	A	-	-
31	Historical and Cultural Loss	-	-	-	-	-	-	-	-	-	-
32	Accidents	A	-			A	A	A	A	-	-
33	Water Rights	-	-	-	-	-	-	-	-	-	-
34	Ethnic Minorities and Indigenous People	-	-	-	-	-	-	-	-	-	-
35	Hazards(Risks) infectious disease such as HIV/AIDS	A	-	-	-	A	A	A	-	-	-

Rating:

A- **:** Significant Negative impact is expected
A **:** Some Negative impact is expected
B **:** Some Positive impact is expected
B+ : Significant Positive impanct is expected
- : No impact is expected

Table 7.4: Overall Result for Conceivable Impacts

Important Environmental Components (IECs)		New Submergible Embankment construction
Natural Environment		
1	Topography	A
2	Soil Erosion and Siltation	A
3	Regional Hydrology (Flooding, Drainage Congestion and Water Logging)	A
4	Landscape and Land use	B
5	Sand Carpeting	B
6	Water transport and navigation	A
Agriculture		
7	Crop Production	B
8	Crop Damage	B
9	Irrigated Area	B
Ecological Parameters		
10	Fisheries	A
11	Wildlife	B
12	Forest / Tree / Crop loss	B
13	Wetlands eco-system/ Bio diversity	A
14	Endangered Species	A
Environmental Pollution		
15	Air Pollution	A
16	Ground & Surface Water Pollution	A
17	Noise and Vibration	A
18	Soil Contamination	A
19	Waste Disposal	A
Social Environment		
20	Land acquisition and/or resettlement	A
21	Income Loss	B
22	Income gain	B+
23	Employment	B
24	Food Intake	B
25	Worker's Health and Safety	A
26	Accidents	A
27	Hazards(Risks) infectious disease such as HIV/AIDS	A

Rating:

A- **:** Significant negative impact is expected

A **:** Some Negative impact is expected

B **:** Some Positive impact is expected

B+ **:** Significant Positive impacts is expected

- **:** No impact is expected

As we can see from the above screening, out of 35 environmental parameters 27parameters are either negatively or positively impacted by the project interventions. These 27environmental parameters are carefully studied, consolidated and potential impacts and mitigation measures are described in the following section.

Summary of Potential Impacts of the Project

During Design/Preconstruction Stage: Impacts during design/ preconstruction stage will be localized and temporary in nature. They are reversible and will have no long term effects on the environment. Following environmental components are addressed during design/ preconstruction stage.

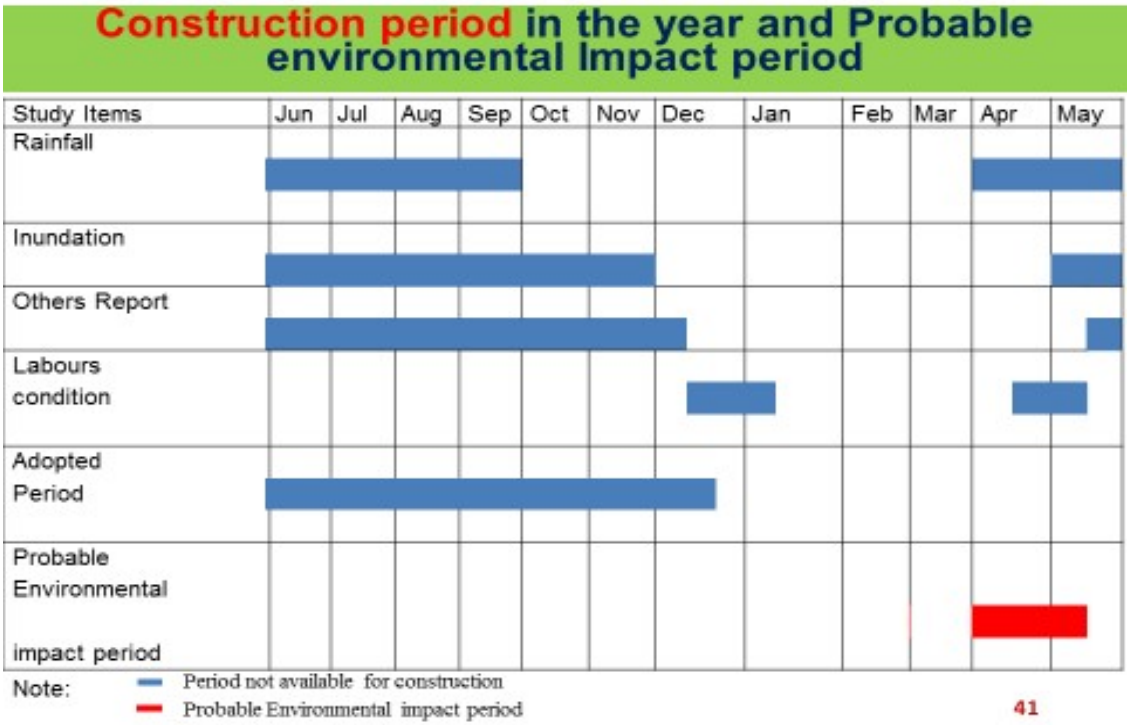
- Improper Design
- Water trasnpost and navigation
- Land Acquisition/ Loss of Land
- Loss of Terrestrial Habitat
- Agricultural areas

During Construction Stage

Environmental impacts during construction phase are expected to be of temporary nature. Construction period will be very short from 1.5 to 2 months only (Table 7.5). Construction impacts are considered to be minimal as all the construction works will be carried out within the boundaries of each site and will be controlled via the mitigation measures defined in the EMP. Contractors should be issued with a copy of the EMP at the time of bidding and make it mandatory to price their quotation to comply fully with the EMP recommendations. Each contractor who wins the project construction will make adequate arrangements and have sufficient capabilities and capacity to implement all recommendations of the EMP at all stages or the project construction.

- Hydrological aspects of the area
- River/ Khal erosion
- Water trasnpost and navigation
- Landscape
- Wildlife
- Fisheries
- Loss of Agricultural land
- Soils of agricultural lands
- Dredging and Dredged Materials
- Surface Water Pollution
- Ground Water (GW)/ Drinking Water(DW) Pollution
- Air quality and noise levels ocial Conflicts due to Construction Workers from Other Areas
- Job Opportunity
- Health and Safety

Table 7.5: Annual Construction Period showing the environmental impact period



During Operation and Maintenance Stage

Impacts during operation and maintenace stage will be localized and temporary in nature. They are reversible and some of them will have longterm positive effects on the environment. Following environmental components are addressed during operation and maintenace stage.

- ❖ Vagetation coverage
- ❖ Agriculture area and agrochemical usage

Climate change induced impacts of the project

Climate change is a global issue. Climate change induced impacts of the project is considered and mitigation measures are discussed on the following climate change issues

- ❖ Flood
- ❖ Drainage and droughts
- ❖ Greenhouse gas emission

7.2 Potential Impacts and Mitigation Measures

The potential environmental impacts along with possible mitigation measures are as follows:

7.2.1 Common Impacts Along with Mitigation Measures

The potential environmental impacts due to implementation of the project components as mentioned in Chapter 4 Construction of 286.51 km submergible embankment(new), Resectioning of 1.55 km full and 8.09km submergible embankment, Re-excavation of canal 381.02km (rehabilitation & new haor), construction of 59 new and rehabilitation of 103 regulators, Water pipe, Causeway, etc. are almost similar in nature. Therefore, the common environmental impacts due to implementation of the projects are given under the following sections:

7.2.1.1 During Design/Preconstruction Stage

Impacts during design/ preconstruction stage will be localized and temporary in nature. They are reversible and will have no long term effects on the environment. Following environmental components are addressed during design/ preconstruction stage.

- **Improper Design**

Impact: Improper design will lead to environmental degradation. Due to lack of proper selection of environmental friendly construction materials as well as lack of environmental specifications, budget and clauses in the relevant documents, implementation of the project components will not be environmentally friendly.

Mitigation: All the works of the subproject-wise components of the project are to be designed in accordance with the national design standards or international standards. The Contractors' contract shall be bound to implement the EMP/technical specification related to environment.

- **Water trasnpost and navigation**

Impact: There will be a need to carry huge constion material through water ways and store at/ nearby the construction sites during preconstruction stage affecting water transport and navigation along the nearby rivers and khals.

Mitigation: Water management structures have been designed in such a way that it does not disturb normal water transport and navigation facilities. Construction materials to be handled and stored in planned way. Moreover, provisions of causeway are kept, where required, for keeping water transpo and navigation un-interepted.

- **Land Acquisition/ Loss of Land**

Impact: The construction of new embankments will require 404.839 ha land acquisition. It will mainly involve with the agricultural land, vacant land with water logging and water bodies of varying depth along the route of the new embankments. So land acquisition and proper compensation will be required. Details are shown in RP (Resettlement Plan).

Mitigation: for the project is being prepared based on which proper compensation to the affected

persons will be paid. Prior to start construction adequate compensation should be given to the PAPs in-time according to RP.

❖ **Loss of Terrestrial Habitat**

Impact: There may be some disturbances and damages to terrestrial habitats due to clearing of worksites for construction and reconstruction of structures like regulator, embankment, causeway, pipe sluice, and soil extraction for embankment re-sectioning, construction, etc.

Mitigation: Disturbances and damages of terrestrial habitats due to clearing of worksites can be reduced by clearing of land near the work site only and avoid using productive land for taking borrow soil for earth work.

❖ **Agricultural areas**

Impact: There will be some negative impact of low intensity on agriculture lands due to clearing of worksites for construction/ rehabilitation of regulator, embankment, causeway, pipe sluice, etc, as well as from collecting soil for such construction/ rehabilitation.

Mitigation: Negative impact of low significance on agriculture due to clearing of worksites will be reduced by planning for utilizing soils from dry riverbed/ khal or where new fish ponds are to be constructed in farmer's plots for such earth works.

7.2.1.2 During Construction Stage

Environmental impacts during construction phase are expected to be of temporary nature. Construction impacts are considered to be minimal as all the construction works will be carried out within the boundaries of each site and will be controlled via the mitigation measures defined in the EMP. Contractors should be issued with a copy of the EMP at the time of bidding and make it mandatory to price their quotation to comply fully with the EMP recommendations. Each contractor who wins the project construction will make adequate arrangements and have sufficient capabilities and capacity to implement all recommendations of the EMP at all stages or the project construction.

❖ **Hydrological aspects of the area**

Impact: There will be very little impact after design consideration. Construction of water management structures' design was set considering the confinement effect of existing haors; and also increase in design flood level of existing haors will be minimum and within the free board due to construction of new haors.

Due to construction of temporary by-passes and other alternative structures during the construction or repair of structures like culverts, regulators, embankments, etc., natural surface run off of water during the rainy times can be affected. However, if not properly constructed with adequate provisions for rapid drainage, these temporary structures may still cause local flooding. Dredging, piling and

diversions at the locations of constructing the structures may also hinder existing surface water flow and as a result, localized drainage congestion may occur. Hence, if diversions with adequate pipe culverts are not provided and dredged materials are not properly managed the flooding of new areas can occur. Stockpiling of materials dredged from the khal/riverbeds for the construction/repairing of embankment if exposed to floods may also result in increased erosion and subsequent siltation in the adjacent water bodies.

Mitigation: During construction of all temporary or permanent structures such as the by-passes culverts or gates, proper practices will be applied to avoid drainage congestion. The contractor will be asked to provide adequate drainage provisions to meet the highest rainfall situations recorded.

The stockpiling of earth shall not cause any interruption of the regular water flow in the surface water streams. If the area does not have enough space for stock piling of the dredged material or construction soil, the contractor will be asked to stockpile in a nearby location suitable for stock piling and transport them as and when needed.

All wastes will be disposed in a controlled manner at designated sites approved by the project engineer only according to the characteristics of the waste. Adequate cross drainage structures shall be built to drain off water into water bodies. Careful attention will be given so that there are no negative impacts caused by the temporary diversion roads at the regulator and culverts construction/reconstruction sites. Adequate number and size of pipe sluice have to be provided at the embankment to avoid drainage congestion.

Once the construction or repair phase is over, the contractor shall be required to immediately remove and dispose the material and construction debris in a manner without affecting the drainage or environmental functions of another location. Ideally, disposing such material if not used for reconstructions will be done in adjacent dug holes such as brick pits that may have been abandoned and unused.

The contractors will therefore be required to identify exact locations where the dredged material are deposited prior to commencement of the construction activities and made sufficient provisions in their budgets to provide such services. Obtaining the required approvals for such deposition, if any, will be part of the contract awarded to the contractors.

- **River/ Khal erosion**

Impact: Re-excavation of 381.02km khal will involve about huge amount of soil required to be dredged out from the beds of those khals and rivers. There will be some risks of khal/ river bed erosion if appropriate measures are not taken during excavation of those water bodies and management of re-excavated materials.

Mitigation: The contractors will be required to follow the khal/river excavation plan prepared for the purpose. The plan shall identify the suitable locations for extraction of soils and seek approval from relevant authorities. The Contractor needs to follow proper contracts and guidelines for dredging and dredging material disposal. Prior to start dredging, the quality of bed materials will be tested for

checking the presence of heavy metals not detrimental to human health and environment. Proper compaction of disposed materials will be ensured.

- **Water trasnpost and navigation**

Impact: There will be a need to carry huge constion material through water ways and store at/ nearby the construction sites during preconstruction stage affecting water transport and navigation along the nearby rivers and khals.

Mitigation: Water management structures have been designed in such a way that it does not disturb normal water transport and navigation facilities. Construction materials to be handled and stored in planned way. Moreover, provisions of causeway are kept, where required, for keeping water transpo and navigation un-interepted.

- **Landscape**

Impact: New construction of 286.51km submergible embankment, Resectioning of 9.64 km full and submergible embankment, Re-excavation/ rehabilitation of 75.4 km canal, construction of 59 new and rehabilitation of 103 regulator, Water pipe, Causeway, etc.will have some effects on landscape in the project area.

Mitigation: All the water management structures and facilities need to be maintained properly to have positive impact on environment in the long run.

- **Wildlife**

Impact: New construction of 286.51 km submergible embankment, Resectioning of 9.64 km full and submergible embankment, Re-excavation/ rehabilitation of 75.4 km canal, construction of 59 new and rehabilitation of 103 regulator, Water pipe, Causeway, etc. will have some effects on wildlife(specially birds) in the project area due to manyfold disturbances

Mitigation: Construction works to be carried out following sufficient measures prescribed in the EMP ensuring minimum disturnances to the wildlife

- **Fisheries**

Impact: New construction of 286.51 km submergible embankment, Resectioning of 9.64 km full and submergible embankment, Re-excavation/ rehabilitation of 381.02 km canal, construction of 59 new and rehabilitation of 103 regulator, Water pipe, Causeway, etc. will have some effects on fisheries in the project area due to manyfold disturbances including habitat change, change of breeding ground, etc.

Mitigation: Construction works to be carried out following sufficient measures prescribed in the EMP including provision of safe passage during breeding period and minimal disturbances during construction period.

❖ **Loss of Agricultural land**

Impact: There will be a direct loss of acres agricultural land for construction of 294.79 km submergible embankment only affecting agriculturfal production. Moreover, there will be some negative impact of low intensity on agriculture lands due to construction/ rehabilitation of regulator, embankment, causeway, pipe sluice, etc, as well as from collecting soil for such construction/ rehabilitation.

Mitigation: Along with the compensation of land as per RP, the project will promote use of appropriate technologies and ICM techniques in agriculture during the O & M stages. The training programs to promote such techniques shall be introduced through the project.

❖ **Soils of agricultural lands**

Impact: Having to plough new lands and/or dig burrow pits for soil for embankment repairs from adjacent lands, will increase possibility of soil loss through erosion. The future repair works and piling after excavations may also contribute to such increased erosion possibilities.

Mitigation: If suitable, will use soils from river or khal beds or its flood plains for embankments. It is preferred as those pits could well be re-silted during following flooding seasons. The project will promote use of ICM techniques in agriculture and minimize the extent that need to be harrowed to reduce soil disturbances during the O and M stages. The training programs to promote such techniques shall be introduced through the project.

❖ **Dredging and Dredged Materials**

Impact: Re-excavation of 381.02 Km. of Khals and 11.80 Km. of river will be dredged out and will produced huge amount of solid waste. The construction of 294.79 km submergible embankment will require filling materials (river/khal bed soil) to provide prescribed height of the embankment. The filling materials will be collected from the nearby khal/river-beds. If some of the owners of the ponds and lands nearby to the embankment want to use their area for fisheries project, the contractor may collect filling materials from that area.

Dredging in the river has some physical and ecological impacts. The dredging activities have the chance of increasing river/khal bank erosion and higher flood risk downstream. During dredging the existing aquatic habitats will be dislocated. The surface water quality will be affected and there is a chance of spilling/seepage of oil in the river. While collecting filling materials from the nearby ponds and lands, it may affect the surrounding agricultural land and local people will be temporarily disturbed due to noise and dust creation. Prior to use the river bed materials, the quality of material (especially heavy metals) should be confirmed.

Mitigation: Proper plan for disposal and use of dredged material is an important issue from the environmental point of view. Prior to start dredging, the quality of bed materials to be confirmed by testing presence of heavy metals not detrimental to human health and environment. The spoil materials will be dumped in a suitable location maintaining safe distance. These spoil materials will be used as low land filling, for agricultural purpose, market extension, approach road, for preparing vegetable ground and repairing of homestead. All reasonable steps must be taken to avoid increased erosion of the banks and bed work must not be carried out when fish are likely to be spawning in the affected surface water, or in the period between spawning and the subsequent emergence of juvenile fish. While dredging, special care must be given to prevent any spillage/seepage of oil from the dredging machines and wastes from the workers on the river water. Prior to start dredging, the river bed materials should be confirmed by testing of heavy metals such as Pb, As, Zn, Hg, Cr, Cd, etc.

- **Surface Water Pollution**

Impact: Surface water quality in the adjacent rivers, canals and ponds might degrade during construction stage due to disposal of solid wastes, sewage effluent, and dredged materials, accidental spillage of petroleum products, cement, bentonite and hazardous chemicals. The surface water at fourteen locations near the proposed construction sites in the project has been sampled and tested in Laboratory of Department of Soil, Water and Environment, University of Dhaka to assess the existing surface water quality.

The result of analysis has been compared with the inland surface water quality standard for fish and irrigation illustrated in the ECR 1997. According to the test result, all the surface water samples related to parameters tested are found within standard for surface water to be used for irrigation purposes.

Mitigation: Water quality protection measures like dust suppression on the embankment, erosion & sedimentation control, spillage prevention, and proper solid and liquid waste management at construction site may help to protect the surface water quality. Vegetation on the slope of the embankment will prevent erosion and sedimentation to the surface water body.

In order to minimize the adverse impact on water quality, the following mitigation measures are proposed:

- The contractors will dispose of the debris /muck material to a designated disposal site.
- In sections along the river / water bodies, earth and construction materials will be disposed at least 500m away from them, so as not to block rivers/water, resulting in adverse impact on water quality.
- All necessary measures will be taken to prevent earthworks and RCC works from impeding the rivers and water canals.
- Construction vehicle and equipment should not be washed in the nearby water bodies.
- All reasonable measures will be taken to prevent the wastewater produced in construction from entering into creek and stream.
- Quality of surface water (parameters: pH, DO, BOD, COD, SS, TSS etc.) will be monitored at

fourteen locations along the alignment.

- Contractor's camps will be provided with sanitary latrines that do not pollute surface waters.

❖ **Ground Water(GW)/Drinking Water(DW) Pollution**

Impact: The GW/DW will be required for construction, domestic and drinking purposes for the construction workers. Drinking and domestic water requirement for worker's camp will be arranged by the contractor. Contamination of groundwater is not envisaged since construction camp will have septic tanks or mobile toilets depending on the number of workers in the camp. However accidental spillage of hazardous liquid on the construction camps may contaminate the GW/DW.

Mitigation: The contractor will make arrangement for water required for construction in such a way that the water availability and supply to nearby communities remain unaffected. Handling and storage of the potential contaminants has to be organized under strict condition to avoid water pollution during construction. Handling and storage of the potential contaminants should be done by the experienced workers. Proper monitoring should be done by the experienced person. The DW quality monitoring should be carried out at least quarterly during construction. If monitored parameters are not within the EQS limit, the contractor should provide potable water for all workers at all construction sites & camps. Handling of hazardous liquid should be done carefully by the designated experienced person.

❖ **Air quality and noise levels**

Impact: The impact on air quality during construction is expected only in the immediate vicinity of the work site. Increased dust and particulate matter is expected from aggregate production, transport route and construction sites where use of diesel equipment for earth moving and excavation operate. These impacts can be expected to be high during the dry windy periods. However, the anticipated ambient air quality and noise problems will be localized and minor lasting only during the construction stage.

Mitigation: Newly exposed soil surfaces on the embankment during construction shall be regularly watered to prevent wind erosion and dust. When materials are transported contractor will be asked to ensure box trucks are covered during transporting of construction materials to minimize dust pollution. All machines and plants used for construction purposes shall be required to follow manufacturers' specifications to prevent/minimize gaseous emission and noise. The mixing of concrete using cement shall be done carefully preventing inhalation by workers. Also such operations shall be done without being exposed to windy conditions and avoid doing such cement mixing in areas close to where public gather.

The contractor will be required to spray water regularly (dry weather conditions) during construction phase to reduce dust problems. Construction equipment will be maintained to acceptable standards; Machinery causing excessive pollution (e.g. visible clouds of smoke and noise) shall not be allowed in construction sites; Vehicles delivering materials will be asked to be covered with tarpaulin to reduce spills; Construction material, machinery and equipment will be maintained in a good working condition

and shall be handled with due precaution and only by trained staff. It is recommended that project to arrange to provide adequate training and protective gear to workers who are designated to handle cement and other hazardous construction material as they tend to ignore or ignorant about long term health impact of such exposures.

❖ **Social Conflicts due to Construction Workers from Other Areas**

Impact: A considerable quantities of workers will be required for implementation of each subproject & all these workers may not be available from local community. There for construction workers will also come from other areas & due to this, social conflicts may arise between local & outsider workers.

Mitigation: Equal facilities such as payment, medical facilities, transportation, accommodation, sanitation etc., should be provided for both local & outsider workers. Local public leaders & local administrators' involvement is to be required in case conflicts arise.

❖ **Job Opportunities**

Impact: At the peak of construction, it is likely to provide employment of a considerable personnel in various positions of the projects. The contractor will be responsible for creating these employment opportunities. Priority will need to be given to the local community for unskilled labour. This may result in an increase on household income. At the time of construction, business opportunity will also be increased in the Khulna & Bagerhat Districts.

Mitigation: Based on the nature of job, adequate salary with other social benefits should be ensured for the workers in time. The demand may create short-fall for the people in the area, as well as people can enhance their businesses in supplying daily needed commodities, over-the-counter medicines, fast/ dry foods and training accessories. The local inhabitants can also boost up their business through laundry and washing facilities during construction. Job opportunities should be arranged for the PAPs.

❖ **Health and Safety**

Impact: The health and safety for the workers and community is an essential factor that may have impacts if not addressed during construction phase.

Mitigation: The project will ensure that during construction proper environmental safeguards for safety are taken by demarcating the work sites to be clearly visible during day and night to prevent any accidents happening. Use of luminous tapes for marking the work sites and night lamps to indicate the work sites will be made compulsory for the contractors who will be hired for the construction works.

Workers will also be required to be provided with adequate health and sanitary facilities and the workers accommodation will be required to be set up with sufficient facilities. This will be included as a contractual requirement of the contractor.

7.2.1.3 During Operation and Maintenance Stage

Impacts during operation and maintenance stage will be localized and temporary in nature. They are reversible and some of them will have long-term positive effects on the environment. Following environmental components are addressed during operation and maintenance stage.

- **Vegetation coverage:**

  Impact: Loss of paddy due to clearing of worksites

  Mitigation: Swamp species will be planted on the embankment sides.

- **Agriculture area and agrochemical usage**

Impact: With increased agricultural activities the use of agrochemicals (pesticides and fertilizers) will increase and the potential pollution of soil, water and environment will aggravate

Mitigation: It is important that agriculture production is increased through technological improvements and high yielding varieties, however usually these high yielding varieties will lead to use of higher quantities of agrochemicals in the fields. It is strongly recommended that WMO capacity to make people aware of the agrochemical hazards if overused or misused be improved. The IPM and ICM practices will be encouraged and promoted among the farmers.

- **Wildlife**

Impact: Construction of 294.79 km submergible embankment, re-sectioning of 1.55 km full embankment, construction & rehabilitation of regulators, providing causeways and pipe structures will have some effects on wildlife in the project area due to many fold disturbances.

Mitigation: Construction works to be carried out following sufficient measures prescribed in the EMP

- **Fisheries**

Impact: Construction of 294.79 km submergible embankment, re-sectioning of 1.55 km full embankment, construction & rehabilitation of regulators, providing causeways and pipe structures will have some effects on fisheries in the project area due to manyfold disturbances including habitat change, change of breeding ground, etc.

Mitigation: Water bodies and water management structures to be managed by the WMOs so that water bodies and water resources become congenial to fisheries development in the project area. Different fish species have different maturity stage and different breeding time. Breeding season and time of fishes depends on ecological condition, temperature, availability of feed and others. Most of the fish species start their breeding from end of the May and continue till September. A few species

start breeding in April. Breeding time of some important fresh water fishes before and after 15 May in the project area are given in the table 6.6. From the life cycle analysis of some fresh fishes it is observed that no major impacts will be happended on breeding by intervention of the project.

Table 7.6: Some of fish species in the project area with their breeding month

S/N	Local name	English name	Scientific Name	Breeding month	Breeding %	
					Before 15 May	After 15 May
1	Bara baim	Spiny eels	*Mastacembelus armatus*	June-November	0%	100%
2	Bata mach	Carps and barbs	*Labeo bata*	May-July	17%	83%
3	Chapila	Indian River Shad	*Gudusia chapra*	April & August	50%	50%
4	Chital	Knif fish	*Chitala chitala*	June-July	0%	100%
5	Dhela	Squarehead catfish	*Osteobrama cotio*	May - July	17%	83%
6	Golsha tengra	Catfishes	*Mystus cavasius*	June -September	0%	100%
7	Koi	Climbing perches	*Anabas testudineus*	April-September	10%	90%
8	Magur	Walking catfishes	*Clarias batrachus*	May-August	13%	87%
9	Meni/ Bhedi	Mud perches/ leaf fishes	*Nandus nandus*	May-July	17%	83%
10	Mola	Mola Carplet	*Amblypharyngodon microlepis*	May, August & October	17%	83%
11	Pabda	Pabda/Catfish	*Ompok pabo*	May-August	13%	87%
12	Shing	Stinging catfishes	*Heteropneustes fossilis*	May-September	10%	90%
13	Shorpoti	Surpunti	*Puntinus sarana*	April-August	10%	90%

Reference: Bangladesher Mithapanir Chhoto Mach, May, 2008. Dr. Md. Enamul Haque

7.2.2 Climate change induced impacts of the project

Climate change is a global issue. Climate change induced impacts of the project is considered and mitigation measures are discussed on the following climate change issues

- Flood
- Drainage and droughts
- Greenhouse gas emission

7.2.2.1 Impact due to Changes in Climatic Condition

Climate change and its associated impacts will be experienced through changing temperatures and precipitation, rising sea levels, changes in the frequency and severity of climate extremes and in the dynamics of hazardous conditions (IPCC, 2007). Developing countries are considered to be particularly susceptible to climate change because of their exposures and sensitivities to climate-related extremes, and especially because of their limited adaptive capabilities to deal with the effects of hazardous events. Given this limited capacity to adapt, they are considered to be particularly vulnerable to damages associated with climate, just as they are particularly vulnerable to other stresses.

Bangladesh is recognized worldwide as one of the most vulnerable countries to the impacts of climate change. This is due to dominance of floodplains, low elevation from the sea, high population density, high levels of poverty, and overwhelming dependence on nature, its resources and services. The country has a history of extreme climatic events claiming millions of lives and destroying past development gains. The people and social system have knowledge and experience of coping with the effects of such events–to some degree and extent. Historically, Bangladesh is trying to adapt with the changing environment. The Inter-Government Panel on Climate Change (IPCC) has identified the country as one of the most vulnerable countries to climate change, which may severely affect lives and livelihoods of millions of Bangladeshi people in the coming decades. In this regard, Bangladesh has already prepared the National Adaptation Programme on Action (NAPA) and Climate Change Strategy and Action Plan (MOEF, 2005 and MOEF, 2009).

According to the fourth assessment, report of IPCC, continued greenhouse gas emissions at or above current rates would cause further warming and induce many changes in the global climate system during the 21st century, which would very likely be more severe than those observed during the 20th century would. The climate change impacts are described for the following two aspects:

i. Likely changes in the climatic conditions with respect to temperature, flooding and drainage aspects; and
ii. Greenhouse gas emission reduction

The increasing trend of temperature shows that it will increase 1.3°C by the 2050s while rainfall will increase by 8%. The maximum estimated change in temperature for the project area is 2°C in 2050s. These possible changes should be considered in the design and implementation of the project.

7.2.2.2 Climate Change Impact on Flooding

Impact: The secondary impacts of climate change are expected to be not only in magnitude but also in frequency. For example, there are chances of not only increasing of flood water levels but also reduction of flood return periods. This indicates that a 20-year return period flood might become a 15-year return period flood under climate change scenarios.

Mitigation: Additional embankment height to incorporate climate change induced flooding is required in design. The designs had been carried out using the 20-year flood data and it is anticipated this will meet the risks posed by climate induced flood events.

7.2.2.3 Climate Change Impact on Drainage

Impact: The future trans-boundary inflows of the major rivers (Ganges, Brahmaputra, Swameswari, Dhanu, Surma, Kushiara and Meghna) during the monsoon period indicate that inflows into Bangladesh are on average projected to increase over the monsoon period which will somehow be

applicable for HFMLIP areas. As a result of these increased discharges, the drainage structures throughout the area have to drain much more water under climate change scenario.
Mitigation: Adequate numbers of drainage facilities along with larger openings have been considered during designing the structures for the project, potential impact of climate change is considered during all stages of designing.

The increase in river inflow from India will result in higher water levels, during and immediately after rainy seasons while the bee areas get inundated due to rainfall in Bangladesh. The haor/beel areas will be difficult to drain out and this will result in longer inundation/flooding periods. Such impact due to climate change may need to be tackled either by deepening and retaining the water within a deepened beel and freeing some area early for cultivation or by introducing short term varieties. It must be noted that deepening the beel at selected places will also help sustain the associated capture fisheries and wildlife as recommended elsewhere in this EIA report.

7.2.2.4 Greenhouse Gas (GHG) emissions

Impact: The project may have associated benefits with respect to Greenhouse Gas (GHG) emission reduction.

Mitigation: Climate change issues must be considered while finalizing the project design. Tree planting will be done on the slopes of the embankments as per the prescription of forest department after completion of the project construction activities. Plantation of trees is one of the ways of mitigating greenhouse gas emission. Planting of new forests can help militate against climate change by removing CO_2 from the atmosphere.

It is recommended to establish tree covers either along the embankments, as wind shields to protect the vast fields with no such covers or even as plants around the sanctuary. Also the rationale use of chemical fertilizers and promotion of organic fertilizers should be promoted and IPM techniques introduced as part of the extension work.

7.3 Project Impact matrix:

Table 7.7: Comparison of impacts before and after changes due to EIA recommendations

Environmental components	Impacts before implementation of EIArecommended mitigations					Impacts after EIA on feasibility study and recommended mitigations			
	Environmental Features	Pre -construction	Construction	O&M	Remarks in potential impact	Mitigations and Recommendations to be adopted	Pre construction	Construction	O & M
Natural Environment	Topography	-	A	-	Improper excavation for reconstruction/construction of embankments and canals may degrade existing topography.	Some change is expected. Design to be followed strictly for construction/ reconstruction of interventions.	-	A	-
	Soil Erosion and Siltation	-	A	-	Having Sloughing of new lands and Burrow pits for soil embankment repairs on adjacent lands will increase soil loss thru erosion	If suitable, use soils with soil high in clay from river or khal beds for embankments as those pits could well be re-silted during next flooding seasons. Use ICM techniques right harrows to reduce soil disturbances	-	-	-
	Regional Hydrology (Flooding, Drainage Congestion and Water Logging)	-	A	-A	Project interventions may affect regional hydrology by restricting/ controlling natural water flow, although for a short period for producing/ saving crop	-Design was set considering the confinement effect of existing haors; and also increase in design flood level of existing haors will be minimum and within the free board due to construction of new water management structures. -It is important to construct water management structures as per design and follow the operational guideline strictly	-	-	-
	Landscape and Land use	-	A	B	The major physical components of the new submergible embankment projects are construction of new Embankments along with regulators and excavation of canals. Improper excavation for reconstruction/ reconstruction of embankments and canals may degrade existing topography.	Proper excavation for reconstruction/ reconstruction of embankments and canals is important.	-	B	B+

Environmental components	Impacts before implementation of EIArecommended mitigations					Impacts after EIA on feasibility study and recommended mitigations			
	Environmental Features	Pre -construction	Construction	O&M	Remarks in potential impact	Mitigations and Recommendations to be adopted	Pre construction	Construction	O & M
	Sand Carpeting	-	-	B	Sand carpeting is a problem in the haor areas which affects fertility of the agricultural land. Some of the upstream rivers carry huge amounts of sand. When these rivers overspill, they deposit large amounts of sand on fertile land making them unsuitable for cultivation.	It is expected that due to implementation of the project sand carpeting might reduce.	-	-	B+
	Navigation: travel and fishing boats	-	A	A	Work disrupts but navigation can improve when de-silted	If khals are better managed with regular desilting navigation can be improved; introduction of causeway will minimize navigation impacts	-	-	-
Agriculture	Crop Production	-	-	B	Crop is susceptible to damage by flash flood. Projects will reduce damage of the crops during flash flood	Projects will reduce damage of the crops during flash flood and overall production will increase.	-	-	B+
	Crop Damage	-	-	B + _	Crop is susceptible to damage by flash flood. Projects will reduce damage of the crops during flash flood	Project will protect the damage of the crops from flash flood.	-	-	B+
	Irrigated Area	-	-	B + -	Crop is susceptible to damage by flash flood. People may cultivate in more land as projects ensure less damage.	People may cultivate in more land as projects ensure less damage.	-	-	B+
Ecological Parameters	Fisheries	-	A	B	Construction of new embankments and associated flood control structures such as regulators may impact on natural migration and spawning of fish. Fish may also migrate laterally into adjacent floodplains for spawning during flood season. Moreover, disposal of waste into nearby water bodies during construction may be harmful for fish. Filling up wetlands may extinct fish culture.	The functions of water management structures to affect the gereral hydrology including the water management/control in only 1.5 to 2 months during dry season to protect crop from flash flood. There will be operational guides to increase fish production	-	-	B+

Environmental components	Impacts before implementation of EIArecommended mitigations					Impacts after EIA on feasibility study and recommended mitigations			
	Environmental Features	Pre -construction	Construction	O&M	Remarks in potential impact	Mitigations and Recommendations to be adopted	Pre construction	Construction	O & M
	Wildlife	-	A	B-	Negative impact may occur due to loss of natural habitat from construction new embankments. The impact on the wildlife will be also during the construction activities arising from noise, vibration and human activities.	ICM practices in the field and plantation activities on available areas as well as educational/promotional activities will help create congenial atmosphere for wildlife	-	-	B
	Forest / Tree / Crop loss		A	B	Negative impact may occur due to loss of natural habitat from construction of new embankments	Plantation activities on available areas as well aseducational/ promotional activities will help create congenial atmosphere for wildlife	-	A	B+
	Wetlands eco-system/ Bio diversity	A	-	-	Some negative impact may anticipate as mostly agricultural land is used for construction of new embankments. Interventions can cause change in wetland characteristics.	ICM practices in the field and plantation activities on available areas as well as educational/promotional activities will help maintain witland ecosystem/ biodiversity in haor area	-	-	B
	Endangered Species	A	-	-	Negative impact may occur due to loss of natural habitat from construction of new embankments	ICM practices in the field, establishing safe area of endangered species, plantation activities on available areas as well as educational/promotional activities will help maintain ecosystem/ biodiversity in haor area and protection endangered species from further deterioration.	-	-	B
Environmental Pollution	Air	-	A	-	During construction, air pollution may occur through the use of vehicles and equipments, cleaning of materials, coating of construction materials, dust from stone/brick crushing etc. During earth work dust may release. Will also result during dry windy weather at worksites	Maintain vehicles and equipments; sprinkle water at or near worksites	-	-	-
	Surface Water & Ground water	-	A	-	During construction, accidental spillage of toxic chemicals such as fuel, lubricants, and solvents may pollute water.	Proper care and safe disposal of toxic chemical.	-	-	-

Environmental components	Impacts before implementation of EIArecommended mitigations					Impacts after EIA on feasibility study and recommended mitigations			
	Environmental Features	Pre -construction	Construction	O&M	Remarks in potential impact	Mitigations and Recommendations to be adopted	Pre construction	Construction	O & M
	Noise & Vibration	-	A		During construction period noise pollution will be generated by the use of vehicles, stone crushing, generators etc.	Work only during daytime. Use machinery complying with allowed noise and vibration levels	-	-	-
	Soil	-	A	-	Accidental spillage of gasoline, chemicals, liquid waste, disposal of dredged spoils etc may pollute soil quality.	Proper care and safe disposal of toxic chemical.	-	-	-
	Waste Disposal	-	A		Accidental spillage of toxic chemicals such as fuel, lubricants, and solvents may pollute water and soil. Pollutions may also occur from temporary labor camp during construction period. Accidental spillage of toxic chemicals such as fuel, lubricants, and solvents may pollute water and soil. Pollutions may also occur from temporary labor camp during construction period.	Proper care and safe disposal of toxic chemical and other waste.	-	-	-
Social Environment	Land acquisition and/or resettlement	A	-	-	New embankment project will require acquiring primarily agricultural land. Land acquisition will impact on local income and social order.	Proper compensation as per RP	-	-	-
	Income Loss	-	-	B	New projects land acquisition will impact on local income and social order.	Proper compensation as per RP and involvement of affected persons in project activities	-	B	B+
	Income gain	-	-	B	Implementation of the project will protect the crops from flash flood.	More crop production will result income gain	-	B	B+
	Employment	-	B	B	Employment will create at construction stage. More agricultural labor force also will be required.	Employment will create at construction stage. More agricultural labor force also will be required.	-	B	B+
	Food Intake	-	-	B	Food intake will increase.	Employment generation, income gain and more crop production will result er food intake	-	B	B+
	Worker's Health and Safety	-	A	-	During construction period health hazards may occur if proper occupational health and safety guidelines are maintained.	Proper occupational health and safety guidelines to be maintained.	-	-	-

Environmental components	Impacts before implementation of EIArecommended mitigations					Impacts after EIA on feasibility study and recommended mitigations			
	Environmental Features	Pre -construction	Construction	O&M	Remarks in potential impact	Mitigations and Recommendations to be adopted	Pre construction	Construction	O & M
	Accidents	-	A	-	During the construction and reconstruction activities, operation of heavy vehicles and machineries may cause traffic accidents in and around the proposed project sites. Also, accidents may occur to the workers during the construction.	Proper occupational health and safety guidelines to be maintained.	-	-	-
	Hazards(Risks) infectious disease such as HIV/AIDS	-	A	-	Construction and reconstruction activities may increase the HIV/AIDS infection. During construction period, a lot of labor will be flocked to the project side who may bear HIV/AIDS virus. The mixture of the labor with the local people may spread HIV/AIDS.		-	-	-
	Globle warming and Climate changes	-	-	A	Due to high fertilizer (urea) use and reduce wetlands	Increased fertilizer (urea) use can be controlled / reduced thru ICM more trees planted along embankment and will compensate loss of trees due to project activities. Better managed haors will held minimize the loss of wetland ecosystems.	-	-	B

Pre construction activities involve: Design, testing, Land clearing and resettlements etc

Construction Activities involve: all activities involved in carrying out the construction of infrastructure. The tasks may include (but not limited to) Dismantling, repairs, building new structures, logistical moment and transportation, earth work such as cutting and filling, worker camps, temporary structures, removal of construction debris etc.

8 ENVIRONMENTAL MANAGEMENT PLAN

8.1 General

This chapter describes Environmental Management Plan (EMP) for 29 sub projects of HFMLIP. It aims to provide environmental management guidance by delineating compliance requirements, accountabilities and performance objectives, and contains practical recommendations to reduce the potential environmental impacts which may occur as a result of the project activities. Since, HFMLIP is comprised of development of water management structural facilities which have both positive and negative environmental impacts at the pre-construction, construction and operational phases. It is therefore necessary to manage the environmental issues timely with proper manner with the help of EMP in compliance with the environmental guidelines of the DOE. The purpose of this EMP is to protect the environment of the project areas by facilitating mitigation measures and management plan of potential adverse impacts arising from the project implementation. An adequate provision for EMP implementation budget is also made in the project to ensure its successful implementation.

The EMP is necessary on the grounds that it will help manage the environment by off-setting or mitigating the negative impacts with possible measures and enhancing the positive impacts. Thus, it is recommended that EMP be made a part of the tender documentation as a requirement to be fulfilled by contractors so that when they make estimates sufficient attention is paid to EMP recommendations.

The main objectives of the EMP for the project are:

I. Define the responsibilities of the related project stakeholders in accordance with the three project phases (design, construction and operation& maintenance);
II. Facilitate the implementation of the mitigation measures by providing the technical details of each sub-project impact, and proposing an implementation schedule of the proposed mitigation measures;
III. Define a monitoring mechanism and identify monitoring parameters to ensure that all proposed mitigation measures are completely and effectively implemented;
IV. Identify training requirements at various levels;
V. Identify the resources required to implement the EMP and outline corresponding financing requirements; and
VI. Providing a cost estimate for all proposed EMP actions.

8.2 Environmental Mitigation Plan

On the basis of the identified environmental impacts and recommended mitigation measures linked with the project activities, Environmental Mitigation Plan has been prepared which will be followed at the pre-construction, construction and operation stages. While preparing the EMP, highly significant impacts, where applicable, are taken into consideration to recommend possible mitigation measures. A mitigation measure will be considered as successful when it complies with the Environmental Quality Standards (EQS) outlined in ECR, policies, and legal requirements set by DOE and other relevant institutions of the GOB. In absence of any environmental quality standard of DOE, other relevant international environmental quality standard will have to be followed. The details of EMP have been formulated in the Table 8.1:

Table 8.1: Environment Mitigation Plan

Environmental Component	Impact	Actions to be taken	Implementing Agency/ Authority	Supervision Agency
Design and Preconstruction Stage				
Terrestrial habitat	-Damage to terrestrial habitats due to clearing of worksites for construction	-Clearing of land near the toe; -Plan to avoid using productive land for burrow soil for earth work (if dredged material is not utilized).	PMO/ WMO/ Contractor	PMO
Agricultural areas	-Damage on agriculture due to clearing of work sites	-Plan for utilizing soils from dry riverbed/ khan for such earth works.	Contractor	PMO
Wetlands and water bodies	-Damage of wetland resources due to clearing of work sites	-Provision for keeping ecologically and hydro logically important natural wetland habitat undisturbed -Planning drainage structures favorable for fish migration	PMO/ WMO/ Contractor	PMO
Rives and Khals and dredged materials	-Soil will be dredged out from beds of khals due to re-excavation	-Adoption of appropriate measures to avoid/ minimize negative impacts. -Identifying suitable location for disposal of dredged materials -Testing presence of heavy metals not detrimental of human health and environment.	PMO/ WMO/ Contractor	PMO
Climate change	-Climate change impact on flooding and drainage	-Considering the climate change induced impact water management structures including height of the embankment have to be designed	Design consultants	PMO
Construction Stage				
Hydrology/ Drainage	-Temporary drainage congestions at construction sites	-Provision for adequate temporary drains at construction of drainage structures (if required)	Contractor	PMO
Air quality and noise levels	-Dust Generation due to construction activities and transport of construction materials -Emissions and noise from vehicles, equipment and machinery.	-Vehicles transporting construction material will be covered. -Construction equipment will be maintained to a good standard -Emitting machinery will be banned from construction sites; -Dust and noise suppression program	Contractor	PMO/ DOE

		-Sprinkle water twice a day throughout the construction period. -Proper dust collection and control systems to be installed at stone crushers -Air quality monitoring will be carried out as per the schedule		
Surface water bodies including wetlands	-May reduce the surface water need for aquatic/bird life during dry periods.	-Retain water in a sufficient area/ depth to meet dry period requirement -Design of regulators/sill to meet this requirement.	Contractor	PMO / DOE
Soils and agricultural lands	-Digging burrow pits for soil, repairing embankment to adjacent lands will create erosion	-Use soil high in clay from river or khal beds for embankments as those pits well be re-silted during next flooding seasons.	Contractor	PMO/ DOE
River/ Khal erosion	-Re-excavation of khals will pose risks to khal/ river bed erosion unless appropriate measures are taken.	-Identify suitable locations for extraction that will cause least damage. -Proper compaction of disposed materials will be ensured	PMO/ WMO/ Contractor	PMO
Health and safety	-Construction workers are susceptible to accident during construction work.	-Personal protective equipment (PPE) (ear plug, safety glasses, helmets, protective footwear and gloves) to be provided to all workers -First Aid Box at construction site; -Sanitation and safe drinking water for workers; -Adequate signage, lighting, barriers, yellow tape etc.	Contractor	PMO
Operation and Maintenance Stage				
Vegetation coverage	-Loss of paddy due to clearing of worksites	-Swamp species will be planted on the embankment sides.	WMO/ PMO/ FD	PMO/ FD
Agrochemical usage	-Use of pesticides and fertilizers will be increased and the potential pollution of soil, water and environment will aggravate	-The IPM and ICM practices should be encouraged and promoted among the farmers.	WMO/ PMO	PMO
Conflicts on resources	-FCDI facilities will create conflicts of resource bases between agriculture, fisheries and other competing users;	-Planned management of land, water and other resources to be ensured for agriculture and fisheries users.	WMO/ PMO	PMO

Occupational Health and Safety Measures

Occupational/Workers health and safety should be ensured at workplace. Labour shade/labour camp(s) should be set up at workplace for using in resting period and to protect heat stress. Toilet should be set up near labour camp keeping safe distance for sanitation facility. Number of toilets to be set up will depend on number of labors will remain in each camp. For safe drinking water for the worker's sufficient tube wells should be set at labour camp. For women separate shade and toilet facility should be ensured. Each camp to be provided with primary aid box, saline,

PPE (Personal protective equipments) etc. Sufficient lightings should be ensured at camp during night time. LCS guideline should be followed for women. There should be proper waste management system and the camp should be hygienic in condition.

The protection of labors, supervisors, project staffs, contractors and other responsible persons those will be involve in the project should be ensured. Safety boot, helmet, dress etc. should be provided among the workers during construction work and earth works.

It will have needed organized efforts and procedures for identifying workplace hazards and reducing accidents and exposure to harmful situations and substances. It also includes training of personnel in accident prevention, accident response, emergency preparedness, and use of protective clothing and equipment.

Emergency response

Workplaces need a plan for emergencies that can have a wider impact. Special procedures are needed for emergencies such as serious injuries, explosion, flood, poisoning, electrocution and fire, release of radioactivity and chemical spills. Quick and effective action may help to ease the situation and reduce the consequences. All workplaces are required to have procedures in place to effectively manage emergencies that could happen at work.

8.3 Environmental Monitoring Plan

Environmental monitoring is an essential tool for environmental management as it provides the basic information for rational management decisions. The purpose of the monitoring program is to ensure that the envisaged purposes of the project are achieved and result in desired benefits to the target population. To ensure the effective implementation of the mitigation measures, it is essential that an effective monitoring program be designed and carried out. Compliance monitoring will be conducted in accordance with the environmental monitoring plan provided with this report (Table 8.2).

The objective of environmental monitoring during the construction and operation phases is to compare the monitored data against the baseline condition collected during the study period, and to assess the effectiveness of the mitigation measures and the protection of the ambient environment based on national standards. The main objectives of the pre-construction, construction and operation& maintenance stages of monitoring plans are to:

- Monitor the actual impact of the works on physical, biological and socioeconomic receptors within the project area for indicating the adequacy of the EIA;
- Recommend mitigation measures for any unexpected impact or where the impact level exceeds that were anticipated in the EIA;

- ❖ Ensure compliance with legal and community obligations including safety on construction sites;
- ❖ Monitor the rehabilitation of borrow areas and the restoration of construction camp sites as described in the EMP;
- ❖ Ensure the safe disposal of excess construction debris and extracted dredged material;
- ❖ Appraise the adequacy of the EIA with respect to the project's predicted long-term impacts on the corridor's physical, biological and socio-economic environment;
- ❖ Evaluate the effectiveness of the mitigation measures proposed in the EMP and recommend improvements, if and when necessary;
- ❖ Ensure that critical habitats that could be affected are saved and sustained with their environmental functions

Components to be monitored

Monitoring has two components:

I. Compliance monitoring, which checks whether prescribed actions have been carried out, usually by visual observation and by the use of checklists.

II. Effects monitoring which records the beneficial and adverse consequences of activities on the biophysical and social environment. This is often done by repeat measurements of a set of objectively verifiable indicators.

Monitoring for this project will concentrate on compliance monitoring to ensure that measures are being implemented on time and according to sound environmental principles.

Environmental Monitoring Reports

Quarterly environmental monitoring reports will be produced based on the regular monitoring of implementation of planned activities. Monitoring formats have been prepared. According to the actual requirements more formats will be developed during the time of construction works. Some of the Quarterly Monitoring Report Formats and Environmental Monitoring Checklists are presented in **Annex I**.

Table 8.2: Environmental Monitoring Plan

Environmental Components	Parameters/ Units	Standards/ Guidelines	Location	Monitoring Period/ Frequency/ Sampling, No/year	Responsibility	
					Implementation	Supervision
Pre-construction Stage						
Bed Materials	Texture, percentage of Sand, silt & clay, organic matter, Nitrogen, Potassium, Phosphorous, Zn, Cu, Pb, Cd, and As	Government of Bangladesh (GOB) and JICA standard	Proposed re-excavation/ dredging sites (one each subproject)	Once prior to start dredging	Contractor	PMO
Air and Dust	SOx, NOx, CO, CO_2, SPM and PM_{10} .5	Air quality standard by DOE, Bangladesh	i) Nikli of Boro Haor subproject ii) Madan of Ganesh Haor subproject	Once	Contractor	PMO
Water Quality	Surface water: pH, EC, Total Dissolved Solids, TSS, DO, BOD, Coli forms, etc.	Surface water quality standard by DOE, Bangladesh	River/ Khal at all construction sites	Once	Contractor	PMO
	Groundwater: pH, Total hardness as CaCO3 Chlorides, Nitrates as NO_3, Sulphates as SO_4 , Total Dissolved Solids, Fluorides as F-, Mn, Fe, As, etc.	Groundwater quality standard by DOE	At all construction/ work sites	Once	Contractor	PMO
Tree Felling and site clearances	Tree numbers and area involved to be verified	By Inspection visits to potential sites	Each subproject area	During tree felling and site clearing operations	Contractor/ WMO/ PMO	PMO
Construction Stage						
Water Quality	Surface water: pH, TDS, EC, TSS, Fe, NH_3 – N, Cl_2, DO, COD, BOD_5, Oil and Greases	Water quality standard by MOEF, Bangladesh	River/ Khal at all construction sites	Once in a quarter	Contractor	PMO
	Groundwater: pH, Mn, As, Fe, Cl^-, Total hardness, TC, FC	Water quality standard by MOEF, Bangladesh	At all construction/ work sites	Once in a quarter	Contractor	PMO
Soil Erosion	Visual check for Soil erosion signs and siltation	Acceptable to BWDB	All major water bodies near	Once during rainy	Contractor	PMO/

Environmental Components	Parameters/ Units	Standards/ Guidelines	Location	Monitoring Period/ Frequency/ Sampling, No/year	Responsibility	
					Implementation	Supervision
	Suspended matters and sediments in drained waters		subproject area	seasons		
Drainage Congestion	Check drainage plan implemented correctly Conduct regular inspection	Acceptable to BWDB	Construction site	Weekly during monsoon	Contractor	PMO
Soil Pollution	❖ Check how waste is disposed off: whether done in proper way that will prevent leakages, and blockages of water bodies or other lands ❖ Careful and proper handling of oil and other hazardous liquids used by construction equipment	Acceptable to BWDB /JICA standards	Construction sites, dumping site	Regularly	Contractor	PMO
Fisheries	Impact on fish productivity, breeding and spawning	Acceptable to BWDB and DOF	All major water bodies	Regularly	Contractor	PMO
Operation & Maintenance Stage						
Water Quality	Surface water: pH, EC, Total Dissolved Solids, TSS, DO, BOD, Coli forms, etc.	Water quality standard by DOE, Bangladesh	At 14 locations (one near each operational site)	Once per year per site in dry season	WMO/ PMO	PMO
	Groundwater: pH, Total hardness as CaCO3, Chlorides, Nitrates as NO_3, Sulphates as SO_4, Total Dissolved Solids, Fluorides as F-, Mn, Fe, As, etc.		At 14 locations (one near each operational site)	Once per year per site	WMO/ PMO	PMO
Soil Erosion	Visual check for soil erosion and siltation including water quality of water draining khals	Acceptable to BWDB	All major water bodies near subproject area	After first precipitation	WMO/ PMO	PMO
Fisheries	Impact on fish productivity, breeding and spawning	Acceptable to BWDB /DOF	All major water bodies near subproject area	End of first year of operation and subsequent years afterwards	WMO/ PMO	PMO

8.4 EMP Implementation Schedule

An implementation schedule has been prepared based on the environmental components that may be affected during the pre-construction, construction and operation of the project. Since the project is likely to have impact on various components of environment, a comprehensive EMP implementation schedule covering terrestrial and aquatic ecology, soil erosion, drainage, tree cover, air quality, noise, and vibration are provided in Table 8.3. Monitoring Plan has been separately done for pre-construction, construction and operation stages of each subproject separately.

There will be a provision for environmental audit at the middle of the project implementation to check the main issues raised and level of compliances with the EMP and to make necessary recommendations as an EMP action.

8.5 Environmental Management Plan implementation Budget

The estimated budget for the implementation of the EMP of each of the subprojects of HFMLIP is presented in Table 8.3. The overall costs of the EMP will comprise:

I. Environmental monitoring through sample collection and analysis;
II. Any remedial measures necessary to reduce or avoid environmental damage; and
III. Designing and implementing all mitigating and enhancement measures for six years.

The total environmental budget for the project is estimated as BDT **59615600**.

Table 8.3: Environmental Budget for HFMLIP

SL. No	Environmental Items	Quantity	Rate (BDT)	Amount (BDT)	Implementing Agency
A	**Pre-Construction Stage**				
1	EIA Preparation	Salary of International & National consultant and others		**30000000**	PIU
B	**During Construction Stage**				
1	EMP monitoring	Salary of International & National consultant and others		20000000	PIU
2	EMP monitoring				
	Air quality test	1Per season /subproject	30000x2x14	840000	Contractor
	Surface water quality test	1Per season /subproject	30000x2x14	840000	Contractor
	Sound level monitoring	1Per season /subproject	2000x2x14	56000	Contractor
	Drainage congestion	Per season/ subproject	Included under Civil Works	500000	Contractor
	Erosion and Siltation Control (River bank protection work)	Per season/ subproject	Included under Civil Works	180000	Contractor
	Disposal and management of solid wastes	Per season/ subproject	Included under Civil Works	200000	Contractor
	Occupational Health and Safety (PPE, ambulance, clinic, First Aid Box etc)	Per season/ subproject	Included under Civil Works	290000	Contractor
	Traffic signs and Road/Navigation Safety (Installation of traffic signs and ensure road/navigation safety)	Per season/ subproject	Included under Civil Works	290000	Contractor
			Sub-Total of B	**23196000**	
C	**Post construction/Operation stage**				
	EMP monitoring Evaluation cost		LS	**1000000**	PIU
			Total (A+B+C)	**54196000**	
			Contigencies 10%	5419600	
			Grand Total	**59615600**	

8.6 Institutional Arrangement

8.6.1 Overall Institutional Framework

The Environmental Management of the Project will involve a number of national level agencies. These main agencies will include:

i. The BWDB, under the control of the Ministry of Water Resources (MOWR) and guidance and supervision of the Governing Council (GC) of the Board, would be the lead agency of the project
ii. Department of the Environment (DOE), Ministry of Environment and Forestry, responsible for enforcement of the national environmental legislation
iii. A Project Steering Committee (PSC) headed by Secretary, MOWR and participated by representatives of the DOE and other relevant ministries and agencies to be formed for the coordination of project implementation and relevant environmental issues at the central level
iv. A Joint Management Committee (JMC) participated by representatives of BWDB and relevant line departments, local governments, and WMOs to jointly decide on Project activities and post-Project O&M activities including mitigation measures that will be undertaken by responsible line departments (including Department of Public Health Engineering (DPHE) responsible for supporting pilot arsenic mitigation), private providers, NGOs, and WMOs

8.6.2 Project Level Institutional Framework

The BWDB will be the executing agencies for the Project under the overall management and coordination of the Project. A Project Management Office (PMO) to be set up at the BWDB HQ in Dhaka, and headed by the Project Director at the level of Chief Engineer or Additional Chief Engineer (**Figure 8.1**). The overall responsibility for the environmental management and monitoring for the Project including liaison with DOE Dhaka divisional office will be with the PMO assisted by the consultants. PMO will monitor, support, and guide the operation of the Environmental Management Plan implemented through the designated organizations and contracted agents. An environmental management monitor will also be included in the consultants' team to monitor and advice on its operation on a part time bases throughout the Project implementation period, along with an environmental specialist who will provide capacity development support.

At the district level, Project Implementation Unit (PIU) headed by an Executive Engineer will be responsible for implementing project activities of the entire subproject in the district assisted by Sub Divisional Engineers (SDEs),

At the subproject level, subproject management office (SMO) will be established within the subproject area (by converting the existing O&M divisional and sub-divisional offices of BWDB) to execute day-to-day subproject implementation activities, following the annual and periodic activity plans prepared with and endorsed by the subproject JMC. An experienced senior executive engineer will be assigned

as full-time subproject manager in each SMO, who will be closely supervised and guided by Superintending Engineer in Eastern Circle, BWDB, who serves as subproject advisor. To effectively manage environmental issues, PMO environmental staff and consultants will participate in JMC and ensure that EMP has been duly incorporated in the subproject periodic activity plans. An environmental officer will be placed in SMO to monitor and support the concerned mitigation activities and relevant indicators, with the assistance of the environmental monitor in the consultant's team and staff in PMO.

Under the Project, localized water management infrastructures (water retention structures, inlet/outlet, small regulators, and irrigation and drainage canals) with a command area of less than 5,000ha in principle are expected to be managed by WMOs after these facilities are constructed and on-the-job O&M training is provided. EMP activities associated with these infrastructures will be undertaken by the concerned WMOs during the O&M phase, with the monitoring and support by the SMO and PMO

Institutional Arrangement for Implementation of Haor Flood Management and Livelihood Improvement Project, (BWDB Part).

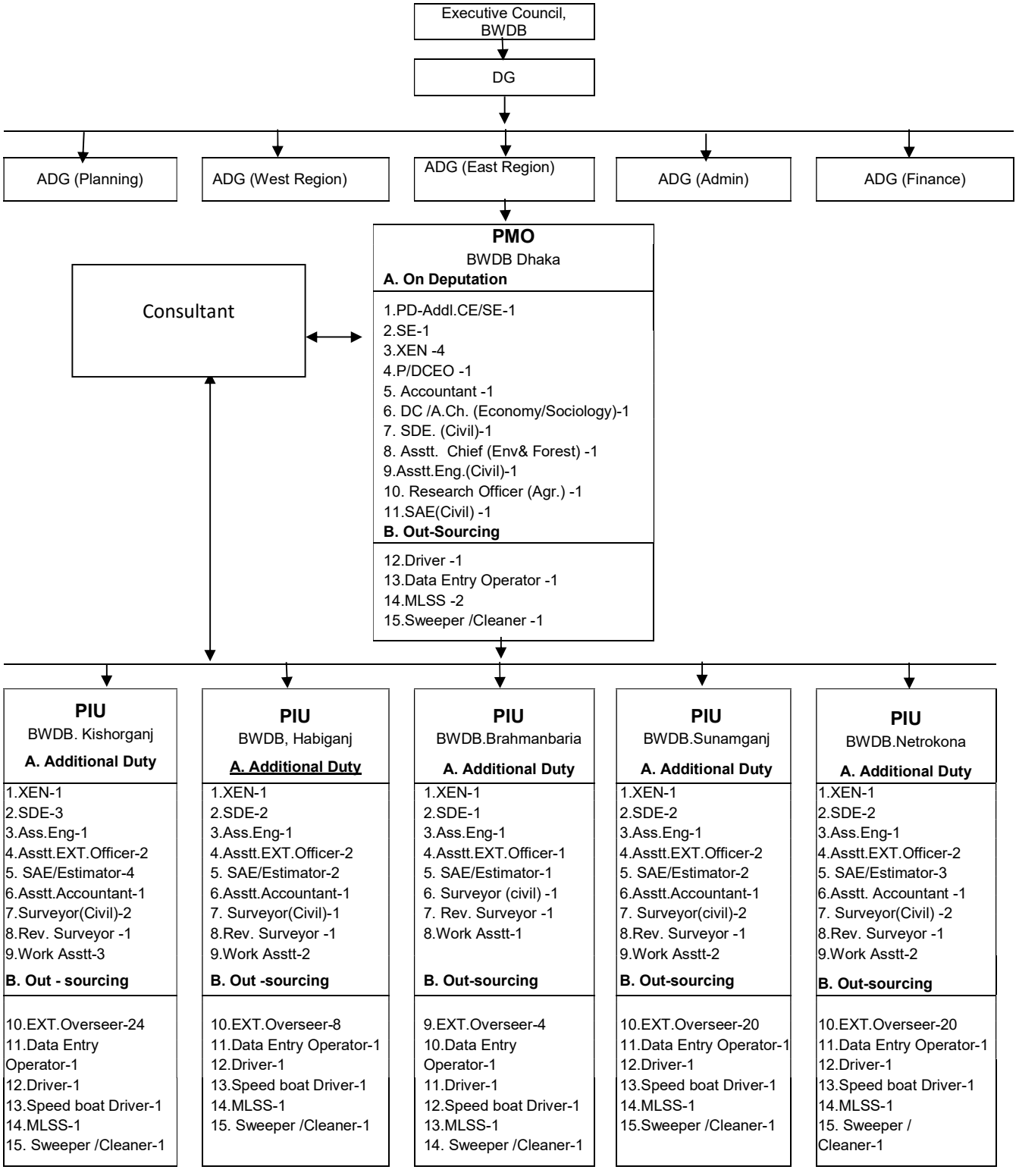


Figure 8.1: Institutional Framework

8.6.3 Capacity Strengthening

In order to manage environmental issues, appropriate institutional arrangements and capacities need to be in place, with clear definition of a range of required activities, powers and responsibilities of the concerned organizations including the WMOs. The assessment of environmental impacts and mitigation measures have identified the need for effective operation of environmental management activities within the pre-construction, implementation, and O&M activities, to ensure optimal management of water resources, and due local resource mobilization for sustainable O&M while minimizing the negative environmental impacts. These have to be operated with necessary hardware and software to establish and monitor appropriate indicators.

The key to effective environmental management would be well-trained and motivated human resources within BWDB in particular, and collaborating agencies and WMOs as well. As to BWDB, sensitivity to non-engineering issues, ability to work with beneficiary population and affected people, skills to coordinate conflicts need to be developed on top of engineering skills already in place. To meet the requirements, BWDB has made some progress in diversifying the skill mix to establish positions for social, environmental, and other subject matter specialists. However, these need to be further expanded with establishment of skills development and career progression path. BWDB, with the support of the GC, is in the process of improving the service rules for recruitment, promotion, and job rotation, which is expected to further the progress made.

Within this context, competence levels of BWDB staff to adapt to the demand of the Project as well as other water sector interventions need to be enhanced. BWDB is also in the process of developing appropriate human resources development policy and plan, with the support of the GC. In coordination with the ongoing programs for capacity strengthening assisted by external funding agencies including JICA, the proposed Project also intends to identify capacity gaps in terms of effectively implementing EMP and provide training to BWDB and other concerned organizations including WMOs through the consultants. In the absence of sufficient environment subject matter specialists, capacity strengthening of the existing engineers to address environmental issues would also be provided.

In the context of the EMP implementation in the two subproject areas, the Project through consulting services would also provide necessary hardware (such as monitoring equipment and computer facilities) and software, with a focus on establishing effective environmental and other monitoring indicators, and its effective recording, reporting, and auditing mechanisms.

8.6.4 Grievance redress mechanism

This section describes the grievance redress framework (formal and informal channels) setting out the time frame and mechanism for resolving complaints about environmental performances. The concern/grievances from local/affected people may come up related to inappropriate implementation of various components of EMP or the overall road upgrading itself. These issues will be addressed through acknowledgement, evaluation and corrective action and response approach. A grievance

redress mechanism (GRM) will be established to receive, evaluate, and facilitate the resolution of affected people's concerns, complaints, and grievances about the social and environmental performance of the project. The GRM aims to provide a trusted way to voice and resolve concerns linked to the project, and to be an effective way to address affected people's concerns.

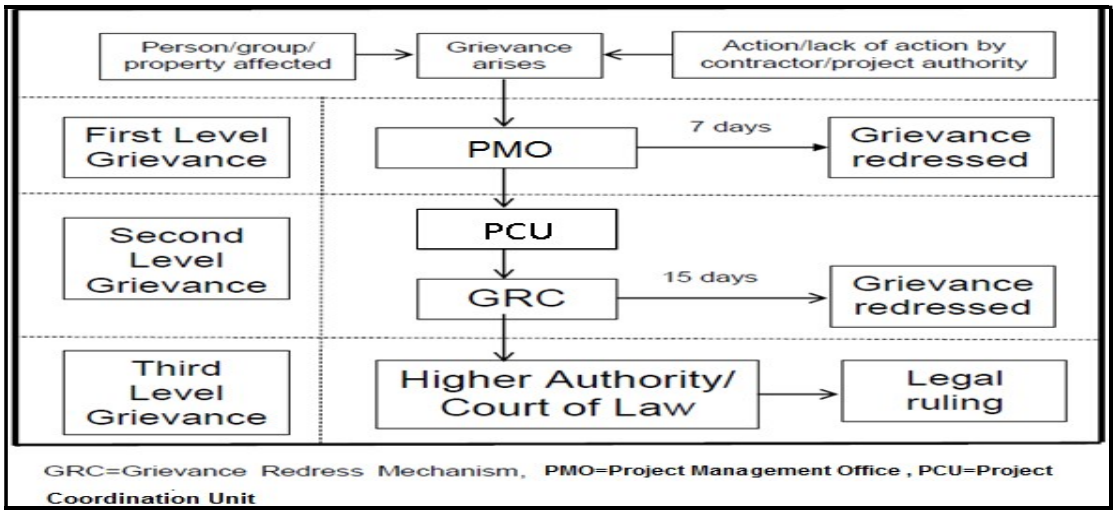


Figure 8.2: Proposed Grievance Redress Mechanism

The Project Coordination Unit (PCU) of BWDB shall make the public aware of the GRM through public awareness campaigns. The contact phone number of the respective PCU will serve as a hotline for complaints, and shall be publicized through the media and placed on notice boards outside their offices and at construction sites. The project information brochure will include information on the GRM and shall be widely disseminated through the project area by the Environmental Specialist in the PCU, with support from the NGOs and communication firm. Grievances can be filed in writing or by phone with any member of the PCU. Figure 8.1 represents how GRM will be implemented for the HFMLIP.

First Tier of GRM: The Executive Engineer, PCU of BWDB (member of CC of BWDB HQC) shall be the designated as the key specialist for grievance redress (1st tier). Resolution of complaints will be done within 7 working days. Investigation of grievances will involve site visits and consultations with relevant parties (e.g., affected persons, contractors, field level government officials, etc.) Grievances will be documented and personal details (name, address, date of complaint, etc.) will be included, unless anonymity is requested. A tracking number shall be assigned for each grievance, including the following elements:

- Initial grievance sheet (including the description of the grievance), with an acknowledgement of receipt handed back to the complainant when the complaint is registered;
- Grievance monitoring sheet, mentioning actions taken (investigation, corrective measures); and
- Closure sheet, one copy of which will be handed to the complainant after he/she has agreed to the resolution and signed off.

The updated register of grievances and complaints will be available to the public at the PCU office, construction site, and other key public offices along the project area. Should the grievance remain unresolved, it will be elevated to the second tier.

Second Tier of GRM: The Chief of CC of BWDB HQC (Dy/Adl. Chief of ----Division of BWDB), will activate the second tier of GRM by referring the unresolved issue (with written documentation). The Grievance Redress Centre (GRC) shall be established by the PCU of BWDB before commencement of site works. The GRC will consist of the following persons: (i) project director; (ii) representative of city ward; (iii) representative of the affected persons; (iv) representative of the local deputy commissioner's office (land); and (v) representative of the DOE for environmental related grievances. A hearing will be called with the GRC, if necessary, where the affected person can present his or her concerns and issues. The process will facilitate resolution through mediation. The local GRC will meet as necessary when there are grievances to be addressed. The local GRC will suggest corrective measures at the field level and assign clear responsibilities for implementing its decision within 15 working days. The contractor will have observer status on the committee. If unsatisfied with the decision, the existence of the GRC shall not impede the complainant's access to the government's judicial or administrative remedies.

The functions of the local GRC are as follows: (i) resolve problems and provide support to affected persons arising from various environmental issues, including dust, noise, utilities, power and water supply, waste disposal, traffic interference, and public safety, as well as social issues such as land acquisition, asset acquisition, and eligibility for entitlements, compensation, and assistance; (ii) reconfirm grievances of displaced persons, categorize and prioritize them, and aim to provide solutions within a month; and (iii) report to the aggrieved parties about developments regarding their grievances and decisions of the GRC.

The Executive Engineer, PCU will be responsible for processing and placing all papers before the GRC, maintaining database of complaints, recording decisions, issuing minutes of the meetings, and monitoring to see that formal orders are issued and the decisions carried out.

Third Tier of GRM: In the event that a grievance cannot be resolved directly by the PMUs (first tier) or GRC (second tier), the affected person can seek alternative redress through the city ward committees or in appropriate courts. The PMUs or GRC will be kept informed by the city corporation authority. The grievance redress mechanism and procedure is depicted in Figure 8.1. The monitoring reports of the EMP and the resettlement plan implementation shall include the following aspects pertaining to progress on grievances: (i) number of cases registered with the GRC, level of jurisdiction (first, second, and third tiers), number of hearings held, decisions made, and the status of pending cases; and (ii) lists of cases in process and already decided upon, which may be prepared with details such as name, identification with unique serial number, date of notice, date of application, date of hearing, decisions, remarks, actions taken to resolve issues, and status of grievance (i.e., open, closed, or pending).

9 PUBLIC CONSULTATIONS

9.1 General Consideration

This chapter deals with the information disclosure to the public and consultation sessions held with the different stakeholders that are likely to be affected adversely and/or beneficially due to the implementation of the proposed irrigation and drainage project. The purpose of public participation and consultation was to gather opinions and suggestions on any environmental issues considered relevant by the people living in the area of the Project impact zone. The public consultation is an essential part of the environmental assessment process and has been undertaken both formally and informally throughout the study to ensure that the knowledge, experience and views of stakeholders and the general public are taken into account during the EIA. The information shared and recorded has been applied where relevant to justify design, alignment, construction methodology and timing changes, in order to reduce predicted negative environmental impacts. The consultation process was carried out as per the environmental guidelines of DOE and JICA.

The consultation task had the following objectives:

- Share information with stakeholders on proposed improvement works and expected impacts on the physical, biological and socio-economic environment of the project area;
- Understand stakeholders' concerns regarding various aspects of the project, including the existing land use pattern, adverse and benefits of the project, and the likely impact of construction and operation related activities;
- Provide an opportunity to the public to influence project design in a positive manner;
- Obtain local and traditional knowledge before decision making;
- Increase public confidence about the proponent, reviewers and decision makers;
- Reduce conflict through the early identification of controversial issues, and work through them to find acceptable solutions;
- Create a sense of ownership of the proposal in the mind of the stakeholders; and
- Develop the proposal which is truly sustainable.

9.1.1 Identification of Stakeholder

During the field survey, significant efforts were made to identify the possible categories of stakeholders and their stakes. During the field survey different stakeholders identified were the villagers/local residents, government officials, farmers, fishermen, businessmen, shop keepers, public representative, and NGO's. All those stakeholders had different types of stakes according to their professions and livelihood characteristics.

9.1.2 Information Disclosure

The ddiscussions were primarily focused on receiving maximum inputs from the participants regarding their acceptability and environmental concerns arising out of the project. The purpose of this stakeholder consultation is to identify the views of major institutional and project affected persons and stakeholders in the project area, and to identify issues of relevance to the EIA, as well as any impacts which the project may have on project planned by the stakeholders, and to assess any mitigation measures which may be undertaken to minimize any adverse impacts of the proposed project. Subsequently, stakeholder consultation is one of the important parts of the EIA to address the environmental aspects as well as socio-economic issues from stakeholders' point of view. Issues were discussed in depth with the government officials and NGOs while in case of the people those issues were touched upon which are relevant to them. To begin with, they were given a brief outline of the project's objectives, type and components of the project in a simplified manner and in their native language. A set of pre-determined common questions were provided to the stakeholders to seek their perception of the project. The discussion with the stakeholders was focused mainly on the following points:

- Whether they have heard about the project or not and their understanding regarding the activities and requirements of the project;
- Any concerns about significant negative impacts of the project on different components of the environment (e.g. surface water, ground water, soil, air, and biotic and abiotic lives and the ecosystems as a whole) and the possible mitigation measures of the impacts;
- Past experience with Inundation/flood in the project area;
- Presence of wildlife and issues relevant to their conservation;
- About environmentally sensitive issues; and
- Overall expectation of the stakeholders regarding the HFMLIP.

Information disclosure meetings and findings

The information disclosure meetings were held in four districts out of five excluding Brahmonbaria. On 6 June, 2016 at Kishoreganj, 15 June at Habiganj, 21 June, at Netrokona and 12 July at Sunamganj. All the meetings were presided by the respective Deputy Commissioner. The meetings were participated by Zila Parishad Chairman, Upazila Chairman, UNOs, ADCs, Police Super, representatives from DAE, Fishery Department, DoE, BWDB, LGED, Media persons, local elites.

Some of the participants opted for zoning of fishery and agriculture, banning of fishing of brood fishes, deepening of haors for easy drainage and deepening of beels for conserving fish species and for their sanctuaries, about the number of subprojects and their costs etc. All of the participants welcomed the implementation of the haor subprojects informed to them district wise. The proceedings are shown in Annex-G of Volume-II.

1.Proceedings of the Information disclosure meeting at Kishoreganj on 06 June, 2016

The meeting was organized by Project Management Office (PMO) with the Consultants (Nippon Koei, Co. Ltd, BETS, and CNRS), IWM and DevConsultants ltd on June 6, 2016.
The meeting was arranged at the Conference room, Deputy Commissioner, Kishoreganj
The meeting was presided over by Mr. Md. Azim Uddin Biswas, Deputy Commissioner, Kishoreganj.

Participants–Total participants were 29; among them DC, ADC general, ADC (Revenue), Zila Parishad Administrator, UNO Sadar, representatives of BWDB, LGED, IWM, DAE, DC-office, Dev-consulting Ltd, BETS and NGOs. (List of participants with their signature is in Annex-G, Table G.1).

Dr. Md. Zahid of PMO opened the discussion with background of the project, its objective and the meeting on Information Disclosure with emphasis on Environmental Aspects. Important suggestions, recommendations from the participants of meeting to be incorporated in the planning for better sustenance of the implementation work, and O&M.
The information was presented by Md. Sohel Masud, Director Flood Management Division, IWM through power point. After that an open discussion was conducted by the Deputy Commissioner, Kishoreganj.

The Deputy Commissioner thanked Mr. Md. Sohel Masud for the detailed presentation. He said that presentation is good but high technical, actually we wanted to know the cost effective relation of each sub-project. How to benefit the marginal. land less, vulnerable people or hard core farmer through each sub project. He wanted to know in each sub-project what kinds of activities to be conducted, how people will get benefit after implementation the project. He also said that activities should be integrated and not to damage the environment, if, any, then take management plan. He wants to see from the project, for each subproject how much money will be spent and amount of paddy will be saved from the damage by flash flood. He wanted to see the example of success of such project anywhere in Bangladesh by BWDB. Mechanism of success project to be deployed in these sub-projects also. How to sustain the project and the community will get ownership from the project. Water holding capacity to be increased in the river and beel through dredging, desilting the silted beel, canal, and river altogether for proper drainage. For the better development of community, community ownership of the project, train them for capacity building for better implementation the project.

ADC (general) Tarafdar Md. Akter Zamil mentioned that the previous implementation work done by BWDB for which reputation was not good. We want to see the success case of any project and need to strengthen the coordination among the officers of intra and inter department for the better development of project.
ADC (Revenue)-Md. Mahbub Hasan Shahin said that who will supervise, where our beneficiaries do not become victim, apprise them what is their role to implement the project, how to incorporated them in the project including women participation.

Md. Shafiqul Islam DD, DAE Kishoreganj said that he is always ready to assist or support the project work and he will dedicate himself for any sorts of problem to be solved and will assist for the sake of project.

Md. Abdus Salam O/M specialist of the main consultant said that from the project preparatory survey, feasibility study etc. had been done.

Saiful Malek Chowdhury, Secretary, Kishoreganj Press Club said that in his life has seen many failure projects in the Kishoreganj district because of lack of coordination among different department and implementation of work started in odd time.Md. Zillur Rahman, administrator of Zila Parishedof Kishoreganj said that lacking of coordination of representatives of BWDB, in case of implementation of any work in the Kishoreganj district with other officials.

Md. Ataul Haq, Team Leader (Coordinator) responded on some technical questions during meeting. For the sustain, the program WMG/WMA must be formed. They will follow up and supervise the implementing activities during and after construction for save their crops from flash flood and other natural calamities.
Md. Abu Naser, UNO Sadar said that actually there is lacking of coordination and cooperation among different departments in case of implementation of any work. To achieve the milestone, it will be required integration otherwise failure will happen having no scope of sustainability.
Kazi Shahin Khan President Kishoreganj press club said that they want to know the proper design and measurement of each sub-project in the presentation but having right to know and to be concerned about biodiversity of haor area.
Aktaruzzaman SDE-Kishoreganj said that they implemented different project in different locations with success but problem is not getting proper fund for O&M and so, many projects face dysfunctional or giving low output.

Md. Al Helal Masud, of PMO said that project has opportunity to train up the WMG on duck rearing, poultry rearing, small scale enterprise, sewing, vegetable gardening and provide quality seeds for better production for their livelihood development. Raising of awareness will enable for banning the destructive activities for fishing like dewatering the beel, poison used in the water for fishing, current net use. Training to be conducted on IPM, ICM, farmer’s field school etc.

Dr. Md. Zahidul briefly discussed on agricultural promotion for Livelihood development in the project area through Agriculture Promotion Support Subproject (APSS) and Small Scale Income Generation Subproject (SIGS). Small scale income generation (Vegetable, micro-poultry, fruit production, etc), sanitation support service scheme, Safe-Drinking Water, Support Service Scheme, biogas Scheme for WMG member etc.

Dr. Tajul Islam Ecologist said that they conducted a survey on flora and fauna in all sub-project area by a team of sociologist, ecologist, wildlife specialist, fisheries expert, agriculture and social science expert. Information collection, impact study through consultation meeting, Focus Group Discussion (FGD), In-depth interview, house hold survey and physically sub-project site had been performed by them. Conducted consultation meeting and in-depth interview with concerned Upazila Fisheries and Agriculture officials,

Dr. Md. Kabil Hossain, Environmental and Social Specialist said that project has taken initiatives for better implementation of the project activities and having scope will incorporate the important issues in the final planning for the better implementation of the project and its O&M.

According to the requirements of DoE as part of EIA study, environmental information disclosure meetings in subproject areas have been performed on June 6, 2016. The presentation materials covered objective of the Project, concept of the new subprojects, proposed physical works in the new subprojects, function of flood management infrastructures of the new haors. Details of work items of new and old Haors under HFM&LIP and the objective of environmental study. Baseline environmental condition (Physical Environment, Biological Environment, Environment Quality, Environmental Risks), Potential Environmental Impacts (Impacts during pre-construction stage, impacts during construction stage, impacts during operation and maintenance stage), Environmental Management Plan (EMP) (Environmental mitigation plan and Environmental monitoring plan) were the key issues of the disclosure meeting. Proposed interventions and possible impacts with probable mitigation measures had been disclosed in the meeting.

The presentation covered environmental aspect in detail but no negative comments received from the participants indicates they felt there will be no negative impact and so the project may be implemented as planned and presented to the audience. Their main issue was flood management, navigation and fishery which have already been taken care of in the project planning. Dr. Md. Kabil Hossain Environmental and social specialist of the Main Consultant was present all through during the presentation and answered the questions of the participants related to environment and social issues.

Chairperson closes the meeting through addressing issue of floating gardening and suggested to do it widely in the haor area or periphery of haor. Demonstration and production of different types of vegetables and spices in the Haor area like onion, garlic, ladies finger, zinger, cabbage, cauliflower, Radish, bringal etc. Especially in monsoon they have no work and should be encouraged them to do practices with different types of vegetables cultivation in the periphery of the haor. He concluded the session endorsing the implementation of Sub-projects planned under Kishoreganj district

2. Proceedings of the Information Disclosure Meeting at Habiganj on 15 June, 2016

Information Disclosure Meeting on Environmental Aspects on Haor Flood Management and Livelihood Improvement Project-BWDB part was arranged at the conference room of DC, Habiganj on 21 June, 2016.

The meeting was presided by Ms. Sabina Alam, Deputy Commissioner, Habiganj. The meeting was organized by Project Management Office (PMO) and Consultants (Nippon Koei, Co. Ltd, BETS, and CNRS) and DevConsultant ltd. The venue was Conference room, Deputy Commissioner, Habiganj and information was presented through power point on 15 June, 2016.

Participants –Total participants were 35; among them DC, ADC general, ADC (Revenue), UNO-Sadar and Bahubal, representatives of BWDB, DAE, DC-office, press club, district information officer, FD, and DevConsultants ltd (List of participants with signature is in Annex-G, **Table G.2)**

The Deputy Commissioner opened the meeting. Welcome speech was given by Mr. Ataul Haq, Team Leader/Coordinator of the EIA Study team briefly discussed on project background and objectives of project, and particularly on Environmental aspect, participatory approach, community involvement, ownership of the community, WMG and WMA formation and ultimately motivating the feeling of ownership of the beneficiaries and stakeholders for sustainable O & M.

The semi-detailed information was presented through power point presentation describing objectives, interventions to be implemented, investment cost and O&M arrangements to increase agriculture, fishery productivity and livelihood improvement in the hoar areas.

This was followed by Open discussion conducted by Deputy Commissioner, Habiganj.

Ashfaqul Haque Chowdhury-UNO Sadar discussed on group formation and sustainability. Group formation is not major task. Group to be formed, strengthening them; their capacity builds up, monitoring and finally institutionalization the group for sustainable development.

Md. Alamgir Khan-District Correspondent BTU said that Lokkibaur Swamp forest (Gortir Jungle) 3km far from Baniachang Upazila, to be taken initiative to conserve the site for wildlife and also for breeding ground for fish and fisheries. He apprised that already Meso Bagh/ jackal, snake in the swamp forest has almost threatened, while once Water lily, shaluk, fishes like pabda, tilapia, chital were abundant but now extinct from this haor. He informed that the name of the haor should be “Ghungaijuri haor” and not Gangaijur. Mr. Ataul Haq Team Leader (Coordinator) responded on some technical questions during meeting. For sustaining the program WMG/WMA are being formed. They will take care about the quality of works and follow up O & M activities during and after construction for save their crops from flash flood and other natural calamities.

Mr. Sabbasachi Chowdhury-Executive engineer, BWDB Habiganj raised the issue that LGED by constructing roads within the haor area changed hydrological boundary and made dysfunctional some regulators for which 3 nos. new regulators are to be constructed. Since no representatives from LGED attended, the DD agriculture felt dissatisfaction. BWDB & LGED signed a MOU for sharing any development activities, XEN BWDB informed the meeting.

Md. Rashedul Kabir-Wildlife and biodiversity conservation officer said that haor area are good habitat for wildlife especially migratory birds due to development work will be in haor area and negative impact on migratory birds and having any plan conservation aspect for migratory birds.

Md. Al Helal Masud Co-coordinator of PMO said that project has opportunity to train up the beneficiaries of project. Through training and demonstration on duck rearing, poultry rearing, small scale enterprise, sewing, vegetable gardening and provide quality seeds for better production for their livelihood development this would be carried out through development of WMG which are being formed. Awareness raising for banning the destructive activities for fishing like dewatering the beel, poison use in the water for fishing, current net use. Training to be conducted on IPM, ICM, farmer field school etc. He also said we done base line survey and consultation meeting at Upazila and UP level with all walks of people.

Dr. Md. Tajul Islam, Ecologist said that the consultants conducted a survey on flora and fauna in the all sub-project area by a team of sociologist, ecologist, wildlife specialist, fisheries expert, agriculture and social science expert. Check listed of all plants (aquatic and terrestrial), fishes, wildlife (amphibian, reptiles, mammals, and birds) in the sub-project area including their status like critical endangered, endangered, vulnerable, rare and common. According to red data book on vascular plants and red data books on amphibian, reptiles, mammals, birds and fishes species were identified and listed.

Mr. Kaikobad Khan-UAO sadar said our farmer use agro-chemical in their crops for pest control but need to aware them about the negative impact of pesticide use in their crops. The local people should be trained up on IPM, ICM, home stead gardening, hanging garden, floating garden etc.

Mr. Ashfaqul Haq Chowdhury-UNO Sadar said to sensitize the community people for that project and for their project they will maintenance for their better livelihood.

According to the requirements of DoE as part of EIA study, environmental information disclosure meetings in subproject areas have been performed in June 15, 2016. The presentation materials covered objective of the Project, concept of the new subprojects, proposed physical works in the new subprojects, function of flood management infrastructures of the new haors. Details of work items of new and old Haors under HFM&LIP and the objective of environmental study. Baseline environmental condition (Physical Environment, Biological Environment, Environment Quality, Environmental Risks),

Potential Environmental Impacts (Impacts during pre-construction stage, impacts during construction stage, impacts during operation and maintenance stage), Environmental Management Plan (EMP) (Environmental mitigation plan and Environmental monitoring plan) were the key issues of the disclosure meeting. Proposed interventions and possible impacts with probable mitigation measures had been disclosed in the meeting.

The presentation covered environmental aspect in detail but no negative comments received from the participants indicates they felt there will be no negative impact and so the project may be implemented as planned and presented to the audience. Their main issue was flood management, navigation and fishery which have already been taken care of in the project planning. Dr. Md. Kabil Hossain Environmental and social specialist of the Main Consultant were present all through during the presentation and answered the questions of the participants related to environment and social issues.

Deputy Commissioner, Habigonj concluded the meeting through addressing issue of floating gardening and suggested to do it widely in the haor area or periphery of haor. Demonstration and production of different types of vegetables and spices in the Haor area like onion, garlic, ladies finger, zinger, cabbage, cauliflower, Radish, bringal etc. Especially in monsoon they have no work and should be encouraged them to do practices with different types of vegetables cultivation in the periphery of the haor. He concluded the session endorsing the implementation of Sub-projects planned under Habiganj district.

3.Proceedings of Information Disclosure Meeting at Netrokona on 21 June,2016

Information Disclosure Meeting on Environmental Aspects on “Haor Flood Management and Livelihood Improvement Project-BWDB part “was arranged at the conference room of DC, Netrakona on 21 June, 2016 and was presided over by Dr. Md. Mushfiqur Rahman, Deputy Commissioner, Netrokona. The meeting was organized by Project Management Office (PMO) and Consultants (Nippon Koei, Co. Ltd, BETS, and CNRS) and DevConsultants ltd.

Participants –Total participants were 24; among them DC, ADC Revenue, UNO-Sadar, representatives of BWDB, DAE, DC-office, press club, BTV, DFO, DLO, DoE, DevConsultants Ltd, BETS, Nippon Koei Co Ltd, &NGOs (List of Participants with their signature are in Annex-G, **Table G.3).**

The Information disclosure meeting was opened by the DC, Netrokona.Welcome speech was given by Mr. Ataul Haq, Team leader of EIA Study Team, who briefly discussed on project, background of the project, aim and objectives location, interventions to be carried out and the responsibility of O & M by forming WMG/WMAs.

Power Point Presentation was presented by the EIA Consultants before the audience. After the presentation, Open discussion was conducted by the Deputy Commissioner, Netrokona.DC, Netrokona Additional Deputy Commissioner Revenue, representatives from DAE, Livestock, Fisheries, BWDB gave their opinion on some aspects related to their department but all agreed about the implementation of the 5 rehabilitation projects and one new (Ganesh Haor) projects in Netrokona district. DC, Netrokona wanted to know the amount of investment to be done and was satisfied with the project approach. Some views were expressed about siltation of out Fall Rivers and how to stop fishing during breeding season of fishes in the same way as done in case of preventing Hilsa fish catching during spawning and breeding season through financial help to the fishermen for not catching fishes during the critical period. Some audience proposed about declaring some Haors as Sanctuary.

Dr. Md. Aftab Hossain District Livestock Officer proposed to use special grasses for cow feed.
Dr. Nilothpol Talukdar-ADC(Revenue)spoke about establishment of sanctuary, threatened species to be conserved and also fisheries resources will have to be increased and pointed out about Guna Haor at Faridpur under khaliajuri FCD project for the establishment of fish sanctuary.

Mr. Ataul Haq, Team Leader (Coordinator) of the EIA study team responded to some technical questions during the open discussion and said it is their information sharing meeting and the views of the participants will be reflected in the final EIA report. He also reported that for sustainable development of the project and proper O&M, WMGs are being formed who will take care of quality of works and also take O&M responsibilities by themselves.

Mr. Al-Helal Masud-Field Coordinator of PMO responded to the questions from Deputy Commissioner. As DC wanted to know whether there is any scope or fund allocated for the livelihood development of the fishing community through income generation activities. Mr. Masud responded that for the establishment of beel nursery, fish sanctuary, IGA for fishermen in the project is area being undertaken under the project. He mentioned that under the project fund has been allocated around Tk.180 million for farmer field school, demonstration, quality seed supply and pen culture and Tk.30 million for enhancement and production of fishery resources in the project area, particularly field oriented demonstration program which the DC and other participants liked.

Shah Md. Enamul Haque-DFO, Netrokona said that fisheries department selected some site for fish sanctuary but due to fund crisis implementation was not possible. He expects this may be done under the HFMLIP project.

On behalf of DD, DoE, Mr, Faijul Kabir of DoE participated in the meeting with some issues related to Haor environment pointed out by DD and these are as follow (see attachment after the end of this proceeding):

- During dry season fishing will not be allowed by dewatering the beel
- Livelihood to be managed for the haor dependable people
- Over fishing and over extraction of aquatic plants should not be done in the haor area.
- By discussion with forest department of forestation of swamp species like hijal, karach, barun, jarul, etc. to be planted.
- Hunting or catching of birds(resident and migratory) be banned strictly

  EIA team leader responded that these are mostly national issues and need to be settled at the highest inter-ministerial level meeting.

According to the requirements of DoE as part of EIA study, environmental information disclosure meetings in subproject areas have been performed in June 21, 2016. The presentation materials covered objective of the Project, concept of the new subprojects, proposed physical works in the new subprojects, function of flood management infrastructures of the new haors. Details of work items of new and old Haors under HFM&LIP and the objective of environmental study. Baseline environmental condition (Physical Environment, Biological Environment, Environment Quality, Environmental Risks), Potential Environmental Impacts (Impacts during pre-construction stage, impacts during construction stage, impacts during operation and maintenance stage), Environmental Management Plan (EMP) (Environmental mitigation plan and Environmental monitoring plan) were the key issues of the disclosure meeting. Proposed interventions and possible impacts with probable mitigation measures had been disclosed in the meeting.

The presentation covered environmental aspect in detail but no negative comments received from the participants indicates they felt there will be no negative impact and so the project may be implemented as planned and presented to the audience. Their main issue was flood management, navigation and fishery which have already been taken care of in the project planning. Dr. Md. Kabil Hossain Environmental and social specialist of the Main Consultant were present all through during the presentation and answered the questions of the participants related to environment and social issues.

Deputy Commissioner concluded the sessions through addressing issue of floating gardening and suggested to do it widely in the haor area or periphery of haor. Demonstration and production of different types of vegetables and spices in the Haor area like onion, garlic, ladies finger, zinger, cabbage, cauliflower, raddis, bringal etc. Especially in monsoon they have no work and should be encouraged them to do practices with different types of vegetables cultivation in the periphery of the haor. He concluded the session endorsing the implementation of Sub-projects planned under Netrokona district.

4. Proceedings of Information Disclosure Meeting at Sunamganj on 12 July,2016

The disclosure meeting on environmental aspects of Haor Flood Management and Livelihood Improvement Project (HFMLIP)-BWDB part was held in Sunamganj on 12 July 2016 through power point presentation with the district level stakeholders at the conference room of Deputy Commissioner, Sunamganj. The opening session was started by the valuable speech of the Deputy Commissioner, Sunamganj Sheikh Rafiqul Islam who presided over the meeting. Welcome speech was delivered by Engr. Mr. Ataul Haq, Team leader, EIA Team.
The information disclosure was presented through power point by EIA Study team. It was followed by open discussion as given below:

Participants -Total participants were 23; among them DC, ADC, Add SP, UNO- Sadar, Upozila Chairman, Representatives of BWDB, DAE, DC-office, DFO, DLO, DoE, LGED, DevConsultants Ltd, BETS, Main consultant of Nippon Koei Co Ltd, &NGOs (List of Participants with their signature are in Annex-G, Table G.4)
Kaizer Md. Farah, UNO, Sunamganj Sadar questioned about the proposed crop insurance in the nonstructural measures. He wanted to know that if there is any job opportunity for the local people.
Md. Lutfar Rahman, ADC (Revenue), Sunamganj expressed that Paddy culture and fish culture can be practiced in Haor by doing land zoning. But deep water tolerant variety of paddy should be identified and practiced in Haor. He also said that care should be taken about the use of chemical fertilizer in paddy field and fish feed use so that environment should not be polluted.

Md. Afsar Uddin, Executive Engineer, BWDB, Sunamganj, said that every year wave action damages the embankment in the haor areas. BWDB has no fund to repair the damages. The soil is silty-clay and unstable. So which soil will be appropriate for sustainability of the embankment needs careful consideration.
Dr. Md. Kabil Hossain, Environment and Social expert of the Main consultant, HFMLIP in response to the questions of the participants explained that this is a participatory project where water management groups (WMG) are being formed and Bangladesh Water Management Board (BWDB) will give registration to them. The WMG will create fund by giving subscription and that fund will be used in IGA and maintenance of the structures when needed.

Md. Ataul Haq, Team Leader, EIA team expressed that all the activities of project in Haor will be monitored by WMG. He also said that the members of WMG will be given training for increasing building their capabilities and ownership so they will feel the infrastructures as their own properties. Otherwise the project will not sustain. He also mentioned that all the structures will be handed over to the WMG as has been practiced in Southwest Project in Narail/Jessore area.
Md. Anwarul Amin, Executive Engineer, RHD, Sunamganj said that how much strong will be the fill material of causeway and whether they will sustain or not.
Md. Zahedul Haque, DD, DAE, Sunamganj said that BR-28 and BR-29 take 140-145 days but BR-62

and BR-69 take only 100 days for being harvestable. So less time consuming variety of paddy should be cultured and risk will be less. Vegetables may be cultured at the periphery of Haor and inside Haor on floating stages.

Sultan Ahmed, DFO, Sunamganj mentioned that as water entering into Haor would be stopped up to May 15, so research is needed to assess what type of impact will be occurred on environment specially on natural fishes. He expressed that if we close gate to protect crops from early flash flood in April, fish will not breed but when the gate is opened after 15 May, it may be there is no water due to climate change, then what will happen about fish production. He proposed for dredging the large Haor basin which can be used for fish sanctuary as well as water will be used for irrigation and excavated soil will be dumped to prepare high place for paddy storing and processing surrounding the higher places can be used as roasting or nesting site of wildlife.

Oliur Rahman, Upazila Chairman said that we should not culture paddy only, we also have to culture fishes in haor. He also expressed that we have to give importance to how to increase fish production in Haor. He added that unused and inactive regulators should be maintained for better use. He further expressed that comparatively high land in Haor area should be used for agriculture and low land should be used for fish culture. At last he said that ponds might be dug in low land area which can beused for brood fish culture, fish conservation, fish sanctuary and habitat for endangered fish species. Furthermore, in winter the water of the pond can be used for irrigation. Inside and outside water of Haor should be managed through installation of pump or regulators.

Prosanto Kumar Bishwas, NDC, Sunamganj expressed in open discussion session that if brood fishes do not enter in Haor during early flash flood period for existence of dyke, they will not release spawn as a result natural fish production will decrease. Md. Habib Ullah, Additional Police Super, Sunamganj said that bottom up planning theory should be followed for project implementation. He also expressed that Haor bottom will be used for fish sanctuary as it is risk for paddy culture.

At the closing event DCtold that early flash flood will be protected but what will happen in case of deep flood. He also said that though water is drained out but rain water again fills the Haor and create water logging. Submersible embankment or causeway whatever is constructed in Haor area care should be taken about fish breeding. He further told that in need fish pass should be built for free movement of fishes. He also suggested for dredging haor basin.

In conclusion it may be mentioned that during information disclosure meeting the following issues were raised that may please be taken care of in the final design and cost estimate.

(1) Desilting of Haors/Beels
(2) Dredging of rivers in a comprehensive way, from upstream to their outfall
(3) Zoning the haors into agriculture and fisheries area
(4) banning of fishing during its spawning and breeding time.
(5) Provision of fish passes so that the small fry can move into the haors without hindrance throughout the year.

It was pointed that beel management and fishery are LGED part of the project and they will take action as per basic concept of the project design.

Information disclosure meeting at Kishoreganj and Sunamganj District

Information disclosure meeting at Habiganj and Netrokona District

Figure 9.1: Photographs on Information Disclosure meeting at 4 districts

9.1.3 Compliance with Relevant Regulatory Requirements

Public consultation was undertaken as per the DOE and JICA's requirements. All the five principles of public consultation such as information dissemination, information solicitation, integration, coordination and engagement into dialogue were incorporated during the task. A framework of different environmental impacts likely from the project was strengthened and modified based on opinions of all those consulted, especially in the micro level by setting up dialogues with the village people from whom information on site facts and prevailing conditions were collected. The requirement of public consultation during the implementation of the project is proposed as part of the mitigation plan.

9.1.4 Major Comments Received

While a wide range of people from different administrative, social and economic backgrounds were consulted, their concerns and outcome of the consultation along with suggestions made by them are described in the following sections.

9.2 Focus Group Discussion

Each group consisted of more than twenty people that were gathered and discussions were held for minimum of one and half an hour to share information. This helped to gather their opinion and concerns. Altogether 29 FGDs were held starting from 03 November 2015 to 16January 2016. A total of 1120 participants, 782 male and 338 female, from different locations have taken part in those consultations. The schedules, venues and the participant's number are given in **Table 9.1** (Detail list of participants are presented in Table E.1 of **Annex E**); photos of FGD conduction are given in **Figure 9.1**

Table 9.1:Summary of the stakeholders participated during FGD

Sl. No.	SP No.	Name of Subproject	Focus Group Discussion				
			Date	Place	Male-Participant	Female-Participant	Total Participant
1	N-1	Boro Haor Project (Nikli)	03.12.2015	Village: Charia Kandi, Union: Danapatuli, Kishoreganj Sadar, Kishoreganj	42	0	42
2	N-2	Naogaon Haor Project	06.12.2015	Village: Singpur, Union: Singpur, Nikli, Kishoreganj	13	10	23
3	N-5	Chandpur Haor Project	05.12.2015	Village: Pardiarkul, Union: Sahasharam, Katiadi, Kishoreganj	14	14	28
4	N-6	Suniar Haor Project	14.12.2015	Village: Jawer, Union: Jawer, Tarail, Kishoreganj	38	0	38
5	N-7	Badla Haor Project	09.12.2015	Village: Pachkhania, Union: Baribari, Itna, Kishoreganj	18	20	38
6	N-8	Nunnir Haor Project	04.12.2015	Village: Guri, Union: Guri, Nikli, Kishoreganj	22	10	32
7	N-9	Dakhshiner Haor Project	17.12.2015	Village: Jaysidhy, Union: Jaysidhy, Itna, Kishoreganj	27	5	32
8	N-10	Chatal Haor Project	19.12.2015	Village: N Sohila, Union: Baribari, Itna, Kishoreganj	26	8	34
9	N-14	Noapara Haor Project	07.12.2015	Village: Madhadampara, Union: Dampara, Nikli, Kishoreganj	11	26	37
10	R-4	Boraikhali Khal Subproject	15.12.2015	Village: Gangatia, Union: Gabindapur, Hossainpur, Kishoreganj	33	0	33
11	R-5	Alalia-Bahadia Subproject	13.12.2015	Village: Bahadia, Union: Agaroshindhu, Pakundia, Kishoreganj	28	8	36
12	R-6	Modkhola-BairagirChar Subproject	10.12.2015	Village: Betal, Union: Masua, Katiadi, Kishoreganj	26	5	31
13	R-7	Ganakkhali Subproject	12.12.2015	Village: Kandi, Union: Soysuti, Kuliarchar, Kishoreganj	24	4	28
14	N-11	Ganesh Haor Project	21.12.2015	Village: Gopalasram, Union: Shukari, Atpara,	33	7	40

Sl. No.	SP No.	Name of Subproject	Focus Group Discussion				
			Date	Place	Male-Participant	Female-Participant	Total Participant
				Netrokona			
15	R-1	Dampara Water Management Scheme	31.12.2015	Village: Kapasia, Union: Ghagra, Purbadhola, Netrokona	38	5	43
16	R-2	Kangsha River Scheme	22.12.2015	Village: Jaria, Union: Jaria, Purbadhola, Netrokona	23	10	33
17	R-3	Singer Beel Subproject	28.12.2015	Village: Kaykona, Union: Chiram, Barhatta, Netrokona	27	12	39
18	R-14	Khaliajuri FCD Polder-2	24.12.2015	Village: Khaliajuri Sadar, Union: Khaliajuri, Kaliajuri, Netrokona	15	14	29
19	R-15	Khaliajuri FCD Polder-4	26.12.2015	Village: Jagannathpur, Union: Mendipur, Kaliajuri, Netrokona	41	29	70
20	N-4	Dharmapasha Rui Beel subproject	29.12.2015	Village: Paikurati, Union: Paikuriti, Dharmapasha, Sunamganj	26	14	40
21	N-3	Jaliar Haor Project	04.01.2016	Village: Maerkol Noyagaon Union: Dakhin Khurma, Chatak, Sunamganj	36	8	44
22	N-12	Dhakua Haor Project	03.01.2016	Village: Joynagar, Union: Mohonpur, Sunamganj Sadar, Sunamganj	27	4	31
23	N-13	Mokhar Haor Project	10.01.2016	Village: Moka, Union: Kagapasha, Baniachang, Habiganj	26	6	32
24	R-8	Kair Dhala Ratna Subproject	09.01.2016	Village: Jolsukha, Union: Jalsukha, Ajmiriganj, Habiganj	26	53	79
25	R-9	Bashira River Re-Excavation Subproject	12.01.2016	Village: Rasulpur, Union: Kakailchew, Ajmiriganj, Habiganj	17	52	69
26	R-10	Aralia Khal Subproject	11.01.2016	Village: Kursa Khagaura, Union: Khagarura, Baniachang, Habiganj	41	1	42
27	R-13	Gungaijuri Haor Subproject	06.01.2016	Village: Modahorpur, Union: Snanghat, Bahubal, Habiganj	37	1	38
28	R-11	Chandal Beel Subproject	14.01.2016	Village: Paharia Kandi, Union: Paharia Kandi, Bancharampur, Brahmanbaria	32	1	33
29	R-12	Satdona Beel Scheme	16.01.2016	Village: Mirpur, Union: Solimabad, Bancharampur, Brahmanbaria	15	11	26
		TOTAL			**782**	**338**	**1120**


Figure 9.2: Focus group discussions under progress

During the consultation, the participants expressed their opinions and suggestions about the implementation of the HFMLIP. They told that the project will add a new dimension to their lives by protecting boro crop and increasing agricultural production system in the area. Moreover, they were of the opinion that livelihood as well as socio economic status of the people will greatly improve due to increase of production and service related activities. The summary of the FGD's findings are presented in **Table 9.2**.

Table 9.2: Summary of the FGD Findings

Questions to the Groups	Participants opinion, comments and suggestions
1. The participants were asked about the present land use patterns of different land types of the area.	According to the participants, the majority portion of haor land is used for one crop rice cultivation during dry season which become vast water body for fish resources during rainy season; the built-up/ highland is used for Settlement, community service, plantation/ gardening, etc., medium highland is used for Irrigated crop, Rabi crop, etc.; low land including permanent water bodies are used for fisheriess purpose.
2. Question made on drainage conditions of the area?	Drainage congestion takes place in some areas due to siltation of khals, river and other drainage channels, requiring re-excavation.
3. Question made on river erosion of the areas?	River erosion has been observed in along some areas of Dhanu river, requiring measure for erosion control.
4. Question made on problem of siltation?	-Siltation of water bodies are a common problem in most of the SPs
5. Whether surface water is available round the year?	Most of the khals become dried up during dry period creating acute scarcity of surface water in March-April.
6. Average depth of ground water for Hand tube well along with fluctuation of discharge?	Average depth of Hand tube good ranges between 24 m and 60 m and their discharge get reduced during dry season (February- May) in most of SPs
7. Information on mode of irrigation and occurrence of drought?	River water is the only source of water for irrigation adjacent to the rivers; Shallow tube well are the most popular equipment with some Deep tube well and Low lift pump are the major equipment for irrigation. Use of indigenous equipment is almost non-existent
8. Biodiversity and availability?	Availability of some fish species is reducing at present, like Pabda, Rita, Sorpunti, Magur, Bashpata, Ayre, Boal etc. Culture fishery is expanding. Many faunal species like Jalpadma, Ponyal, Mohua, Jarul, Garjan, Telikadam, and Telsur have reducing trend. Birds like Bhubanchil, Baz, Sadachil, Ababil, Kali bok and Mammals like Bagdasha, Shushuk, Udd etc. have reducing trend.

Questions to the Groups	Participants opinion, comments and suggestions
9. Reduction of soil fertility/ productivity?	In general, soil fertility is maintained as almost all agricultural land remains under flood water for long times. Soil productivity is reducing due to use of excessive chemical fertilizer/ insecticides, less use of organic manure and lack of adoption of IPM, growing crops continuously with same types of crop etc.
10. What are the main reasons of crop damage?	Drought and flash flood are two major reasons for damaging the main agricultural crop- rice, in the project area.
11. Drinking water quality and availability?	Portable shallow TW water and Hand tube well is the main source of supplying drinking water.
12. Livestock animals?	Most of the dairy animals have reducing trend, whereas the poultry animals have increasing trend. Lack of feed/fodder, lack of treatment facilities, lack of training are the major limitations for improvement of livestock animals in the SPs.
13. What are the major sources of energy in the areas?	Cow-dung and crop residues are the major sources of renewable energy in the area, although fuel wood and leaves and twigs are also sources of renewable energy to a considerable extent. Cooking is the major field of using renewable energy followed by crop processing. There are some brick fields around the areas, where both coal and fuel wood is used.
14. Extent of air Pollution?	Air pollution has increasing trend mainly because of cooking, burning of crop by products, indiscriminate disposal of wastes, use of excessive chemical fertilizers and pesticides etc.
15. What are the major fertilizers used for crop production?	The farmers use urea, TSP, MP, DAP etc. where few people use organic manure. Various types of liquid and granular pesticides/ insecticides for crop protection. Use of chemical fertilizers has increasing trend every year, indicating continuous reduction of natural fertility of soil.
16. Information about sanitation facilities?	Ring slab toilets are the major facility for defecation, although there are some pucca latrines in the areas. A few open latrines are also found in the SP areas, open spaces (open field during dry period and open water bodies in other times) for the purpose is many areas which need to be improved. Some awareness training has been provided mostly by NGOs of the localities.
17. Women's involvement in IGA?	In general women are not actively involved in agricultural activities, but in some areas poor women are involved in raising paddy seedlings for transplantation. But they are involved in crop processing after harvest in all the SPs.
18. In-migration and out-migration	In-migration takes place during peak agricultural activities like harvesting of paddy, whereas out migration takes place by some garment workers, professional workers, some service holders etc. Out-migration also takes place in some areas during peak agricultural around the SSP area.
19. What are human diseases in the areas?	The major diseases in the area include Cold and fever, diabetes, female diseases, hyper-tension, indigestion, jaundice, scabies etc. Dengue and cancer are also found to be increasing at present. Scabies is caused by water decomposition as caused by jute retting in many areas.
20. Demand for the project?	The local people expressed demand of the proposed project for improvement of communication; improvement of water management facilities which will provide surface water availability for irrigation (by the re-excavation works); protection of rice crop from flash flood. Moreover, they expect various trainings which will facilitate involvement of various IGA works in addition to improvement of agriculture and fisheries, which will enhance income generation and improve their livelihood.

9.3 Other Stakeholder Consultations

Stakeholder consultations were performed among different stakeholders (farmer, businessman, teachers, local representatives, government officials, etc.) to achieve their personal view related to the environmental issues of this project. Details of other stakeholders' list are presented in **Table 2 of Annex E**. Photos of consultations with some of the stakeholders are shown in **Figure 9.2**.

Figure 9.3: Stake holders' consultation under progress

9.4 Findings of Public Consultations

9.4.1 Findings from FGD and other stakeholders' consultations

During the public consultation through FGD and stakeholder consultations, the local people in the project area expressed their opinions/comments. Most people expect quick implementation of the project.

The people of the area especially the farmers and fishermen are facing water related problems including early flooding, drainage congestion, irrigation insufficiency, and communication.

While many facilities are being managed without major incidents, conflicts of usage were reported by some stakeholders. Specifically, there are reported cases about the conflicts between farmers, fishermen and vested interest groups exploiting water control structures, but this was found only in some locations. The fishermen are restricted to some extent from for fishing in the open water and the interest groups are exploiting these groups.

9.5 Overall findings

In general, people are in favour of fish sanctuaries, but the fishers/leaseholders of water bodies are sometimes skeptical in allowing these activities to continue. However, where facilities have been constructed with active stakeholder consultation and formation of WMOs to manage those facilities, they tend to be managed with better performance in terms of successfully coordinating diverse stakeholder interests, although regular monitoring with social audits is also felt essential to sustain the optimal and agreed operational practices.

10 BENEFICIAL IMPACTS

The HFMLIP interventions will enhance and sustain the livelihoods of rural people through water management infrastructure and support services for agriculture, fishery development and gender & livelihood enhancement support activities; and (iii) strengthening institutions to operate these functions while delivering intended benefits with self-sustaining operation and maintenance (O&M) mechanisms.

With the socio-economic development by improving communication, socio-economic activities, social mobility, social bonding and health education, the overall standard of living will increase.

Poverty will be reduced due to the job opportunities created, especially for the landless and the destitute women.

Avoiding regular flash floods, the overall sectors within the economy will be allowed to develop without the regular setbacks the flash floods/floods cause. Planned improvements have taken the potential climate change impacts and made adjustments to ensure that the infrastructure will withstand and serve the communities to withstand potential climate change induce enhanced impacts. Professional fisher folks will be provided with priority (secured) opportunity to project-supported income enhancement activities such as fish culture in public water bodies created and enhanced.

Implementing identified environmental management activities including monitoring of environmental impact, mitigation, and enhancement indicators will help minimize negative environmental impacts and maximize positive impacts.

For the development of fisheries through increasing fish habitat following activities have been taken by BWDB and LGED which are staterd bellow:

BWDB part

- The HFMLIP project has provision for re-excavation of canal and rivers which will increase the fish habitat for brood and threatened fish species as well as increasing fish production. Approximately 309.75km Khal and River for 14 No. of New Haor & 149.00Km Khal for 15 No. of Rehabilitation Haor will be re-excavated under the project. In total 458.75Km Khal and River is programed for re-excavation which will improve the fishery component.

- For construction of 294.60 Km submersible embankment and 1.55 Km full embankment soil will be collected from silted fallow land which will increase the fish habitat.

- Establishment of permanent water bodies to increase and safe indigenous fish species through excavation of low land both of the Govt. and the private low land.

- Fish sanctuary can be declared in some re-excavated canal and river.

- In order to facilitate fish migration, all water management structures (like sluice gates, regulators, pipe sluice /embankments etc.) should be designed as fish friendly interventions.

LGED Part

LGED part having option for re-excavation of more or less 150 beels where fish sanctuary to be established, brood and threatened species will be conserved and increase fisheries resources. Following Measures to be taken by LGED for increasing fish habitat and fish production (Ref.-EIA report HFMLIP-LGED part July 2016)

- Beel connectivity and Khal excavation-210 Km,
- Development of Beels (Canal and Beel excavation)-150 Nos.
- Community Based Fisheries Resource Management (CbFRM),
- Floodplain Aquaculture Activities for income generation through pond culture, net-pen culture, cage culture, floodplain aquaculture adopting the Daudkandi model, fish processing and drying,
- Fisheries Support Services,
- Institutional Strengthening and Capacity development

Last but not the least; the project will be of environmentally sound, socially just and economically viable.

11 CONCLUSIONS AND RECOMMENDATIONS

11.1 Conclusions

The HFMLIP aims at the improvement of the performance of 15 existing haor projects and 14 new haor to enhance and sustain the livelihoods of rural people through water management infrastructure and support services for agriculture, fishery development and gender & livelihood enhancement support activities;

The proposed project will have overall positive benefits by preserving and improving the pre-monsoon flash flood protection of boro crops, benefits provided by the existing facilities, and installment of additional small structures to address internal water management problems that have not been addressed in case of haors implemented earlier. Its successful implementation will also serve as a model to demonstrate the process of achieving substantial under-achieved development potentials of existing systems while sustaining their benefits through effective stakeholder participation.

Construction of new projects might increase flooding in the nearby haors, rivers etc.but it has been confirmed by IWM mathematical model, but the increase observed is minor (8 to 10 cm) and that will be taken care of by the free board (30 cm) provided in the design crest level of subsermisible embankment.

The interventions to be undertaken will have some positive impacts and there will be no major negative impact on environment except some temporary and localized ones. Noise level will be increased only when heavy machineries will be operated during construction period which is the most temporary and localized one that will have no effect afterwards. Air quality monitoring of is not much important since impact is very low for rural/urban water sector development projects except producing dusts sometimes. The temporary and localized negative impacts on environment that can be mitigated through mitigation measures. The construction will be done in remote places so the problem of noise/dust pollution will have minimum effect in the area.

Avoiding regular flash floods, the overall sectors within the economy will be allowed to develop without the regular setbacks the flash floods/floods cause. Planned improvements have taken the potential climate change impacts and made adjustments to ensure that the infrastructure will withstand and serve the communities to withstand potential climate change induce enhanced impacts. Professional fisher folks will be provided with priority (secured) opportunity to project-supported income enhancement activities such as fish culture in public water bodies created and enhanced. Overall, the final impact of the project on all environmental aspects will be limited due and manageable to the mitigation measures.

EMP will be operated within this context, with appropriate capacity strengthening support including training and recommendations on institutional reforms provided through the consultants. People's consultations carried out demonstrated that rehabilitating the existing haor structures plus proposed new structures while addressing internal local water management problems, applying the concept of

coordinated management of local water infrastructures through a participatory approach, is the best alternative that can generate maximum positive impacts.

11.2 Recommendations

The project mainly focuses on agricultural demand but that there are several additional uses and users of water (fisheries, natural environment, domestic consumption, etc.) that need to be considered in the overall water management process.

To attain the overall objective of the project it is recommended that

I. After the dry season, when the paddy will be harvested, the regulators should be operated in such a manner that the monsoon flood water while overtopping the submergible embankment, the water inside the haor will gradually be allowed to rise in tandem with the water level outside and minimum head is created between outside and inside water level to cause minimum damages to the earthwork.

II. After the monsoon season, for agriculture activities in the haor areas, the regulators should be operated in such a manner that the inside water drains out to create agricultural land available for cultivation in a timely manner for optimum benefits.

III. The project needs to make sure that the WMO will take into account the potential pressure and weakness of the farmers/fishermen community when establishing the WMO institutional structure.

IV. The subprojects are recommended for implementation on the basis of Feasibility Study findings and recommendations.

12 Approved TOR for conducting EIA

Government of the People's Republic of Bangladesh
Department of Environment
www.doe.gov.bd
Head Office, E-16 Agargaon
Dhaka-1207

Memo No: DoE/Clearance/5514/2015/535 Date: 19/10/2015

Subject: Approval of Terms of Reference (TOR) for Environmental Impact Assessment (EIA) of Haor Flood Management and Livelihood Improvement Project in North-East Region.

Ref: Your Application dated 04/10/2015.

With reference to the above, the undersigned is directed to convey the approval of the Terms of Reference (TOR) for Environmental Impact Assessment (EIA) of Haor Flood Management and Livelihood Improvement Project in north-east region subject to fulfilling the following terms and conditions .

I. The project authority shall submit a comprehensive Environmental Impact Assessment (EIA) considering the overall activity of the said project in accordance with the TOR and time schedule submitted to the Department of Environment (DOE) and additional suggestions provided herein.

II. The EIA report should be prepared in accordance with following indicative outlines:

1. Executive summary
2. Introduction: (Background, brief description, scope of study, methodology, limitation, EIA team, references)
3. Legislative, regulation and policy consideration (covering the potential legal, administrative, planning and policy framework within which the EIA will be prepared)

4a. Project activities:

- A list of the main project activities to be undertaken during site clearing, construction as well as operation
- Project Plan, Design, Standard, Specification, Quantification, etc.

4b. Project schedule: The phase and timing for development of the Project

4c. Resources and utilities demand: Resources required to develop the project, such as soil and construction material and demand for utilities (water, electricity, sewerage, waste disposal and others), as well as infrastructure (road, drains, and others) to support the project.

4d. Map and survey information

Location map, Cadastral map showing land plots (project and adjacent area), Topographical map, Geological map showing geological units, fault zone, and other natural features.

5. Baseline Environmental Condition should include, inter alia, following: (Identification and Quantification of Physical Situation that has been proposed to be changed)

- Physical Environment : Geology, Topology, Geomorphology, Land-use, Soils, Meteorology, and Hydrology

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- Biological Environment: Habitats, Aquatic life and fisheries, Terrestrial Habitats and Flora and Fauna
- Environment Quality : Air, Water, Soil and Sediment Quality
- Relate baseline in both Quantitative and Qualitative term with the anticipated outcomes, achievement of goals, objectives and changes due to project interventions

6. Socio-economic environment should include, inter alia, following:
   - Population: Demographic profile and ethnic composition
   - Settlement and housing
   - Traffic and transport
   - Public utilities: water supply, sanitation and solid waste
   - Economy and employment: employment structure and cultural issues in employment
   - Fisheries: fishing activities, fishing communities, commercial important species, fishing resources, commercial factors.
7. Identification, Prediction and Evaluation of Potential Impacts (identification, prediction and assessment of positive and negative impacts likely to result from the proposed project).

   In identification and analysis of potential impacts'-the 'Analysis' part shall include the analysis of relevant spatial and non-spatial data. The outcome of the analysis shall be presented with the scenarios, maps, graphics etc. for the cases of anticipated impacts on baseline. Description of the impacts of the project on air, water, land, hydrology, vegetation-man maid or natural, wildlife, socio-economic aspect shall be incorporated in detail.

8. Management Plan/Procedures:

   For each significant major impact, proposed mitigation measures will be set out for incorporation into project design or procedures, impacts, which are not mitigable, will be identified as residual impacts Both technical and financial plans shall be incorporated for proposed mitigation measures.

   An outline of the Environmental Management Plan shall be developed for the project.

   In Environmental Monitoring Plan, a detail technical and financial proposal shall be included for developing an in-house environmental monitoring system to be operated by the proponent's own resources (equipments and expertise).
9. Consultation with Stakeholders/Public Consultation (ensures that consultation with interested parties and the general public will take place and their views taken into account in the planning and execution of the project)
10. Beneficial Impacts (summarize the benefits of the project to the Bangladesh nation, people and local community and the enhancement potentials)
11. Conclusion and Recommendations

III. Without approval of EIA report by the Department of Environment, the project authority shall not be able to open L/C in favor of importable machineries.

IV. Without obtaining Environmental Clearance, the project authority shall not be able to start the physical activity of the project.

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V. The project authority shall submit the EIA along with a filled-in application for Environmental Clearance in prescribed form, the applicable fee in a treasury chalan, the no objection certificates (NOCs) from the local authority, NOCs from forest department (if it is required in case of cutting any forested plant, private or public) and NOC from other relevant agencies for operational activity etc. to the Head Office of DOE in Dhaka with a copy to the Dhaka Regional, Sylhet and Chittagong Divisional Offices of DOE.

19.10.2015

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Copy Forwarded to :

1) Private Secretary to the Hon'ble Secretary, Ministry of Environment and Forest, Bangladesh Secretariat, Dhaka.
2) Director, Department of Environment, Dhaka Regional/Sylhet/Chittagong Divisional Office, Dhaka/Sylhet/Chittagong.
3) Assistant Director, Office of the Director General, Department of Environment, Head Office, Dhaka.

13 Plan and elevation of proposed infrastructures

14 ANNEXES

ANNEX A: Brief of 29 Sub-projects

ANNEX B: Analytical method used in field investigation on soil, water, noise & air quality

ANNEX C: Flora and fauna in the project area

ANNEX D: Summary of FGDs conducted in 29 Haor

ANNEX E: List of Participants in Public Consultations (FGD and Other)

ANNEX F: No Objection Certificates (NOC) from DCs

ANNEX G: Information Disclosure Meetings-Kishoreganj, Habiganj, Netrokona and Sunamganj

ANNEX H: National Environmental Quality Standards of Bangladesh

ANNEX I: Environmental Monitoring Checklist/formats