

**Government of the People's Republic of Bangladesh**



**Bangladesh Water  
Development Board**



**Japan  
Fund for  
Poverty  
Reduction**



*Project Preparatory Technical Assistance No. 8054 BAN*

---

# **Main River Flood and Bank Erosion Risk Management Program**

---

**Final Report, Annex J  
Environmental Impact Assessment, Tranche 1**

**February 2014**



**Resource Planning &  
Management  
Consultants Ltd.**

**nhc**  
northwest hydraulic consultants



**Asian Development Bank**

Funded by the Japan Fund for Poverty Reduction

**Government of the People's Republic of Bangladesh  
Bangladesh Water Development Board**

Project Preparatory Technical Assistance 8054 BAN

**Flood and Riverbank Erosion Risk Management Investment  
Program**

**Final Report, Annex J  
Environmental Impact Assessment, Tranche 1**

**February 2014**

**Document Status**

|                                |   |
|--------------------------------|---|
| Title:                         | Annex J, Environmental Impact Assessment, Tranche 1                                       |
| Principal Author:              | Sara Bennett PhD, International Environment Specialist, PPTA Team<br>Kamrul Hassan, CEGIS |
| Contributions:                 | CEGIS Environmental Assessment Team   |
| Review and addressing comments | Knut Oberhagemann,<br>CEGIS   |

Final Version: R7, 28 FEB 2014

## Table of Contents

|   |             |
|---|-------------|
| <b>Abbreviations and Acronyms.....</b>  | <b>xi</b>   |
| <b>Glossary.....</b>  | <b>xiii</b> |
| <b>Executive Summary.....</b>   | <b>xv</b>   |
| <b>1. Introduction.....</b>   | <b>1</b>    |
| 1.1 Overview.....   | 1           |
| 1.2 Objectives.....   | 1           |
| 1.3 Project area.....   | 1           |
| 1.4 EIA Team members.....   | 2           |
| 1.5 Report Format.....  | 3           |
| <b>2. Policy, Legal and Administrative Framework.....</b>                               | <b>0</b>    |
| 2.1 Introduction.....   | 0           |
| 2.1.1 Environmental Protection Policies and Legislation.....                            | 0           |
| 2.1.2 Environmental Conservation Act (1995) and Amendments.....                         | 1           |
| 2.1.3 Water Policies, Plans, and Legislation.....                                       | 3           |
| 2.1.4 Wildlife, Fisheries, Forestry, and Biodiversity Policies and Legislation.....     | 6           |
| 2.1.5 Agriculture and Land Use Policies and Legislation.....                            | 8           |
| 2.1.6 Environmental Quality Standards.....  | 9           |
| 2.2 Project-Relevant International Environmental Agreements In Force In Bangladesh..... | 10          |
| 2.2.1 ADB Safeguards: Policy and Guidelines/Guidance Documents.....                     | 10          |
| <b>3. Approach and Methodology.....</b>   | <b>12</b>   |
| 3.1 Overall Approach.....   | 12          |
| 3.2 Methodology.....  | 13          |
| 3.2.1 Project design and description.....   | 13          |
| 3.2.2 Baseline data collection and analysis.....  | 13          |
| 3.2.3 Scoping.....  | 16          |
| 3.2.4 Bounding.....   | 17          |
| 3.2.5 Major Field Investigation.....  | 17          |
| 3.2.6 Impact Assessment.....  | 17          |
| 3.2.7 Impact Evaluation.....  | 18          |
| 3.2.8 Preparation of Environmental Management and Monitoring Plan.....                  | 18          |
| 3.2.9 EIA Report Preparation.....   | 18          |
| <b>4. Project Description.....</b>  | <b>19</b>   |
| 4.1 Introduction.....   | 19          |
| 4.2 Project Context: The FRERMIP Programme.....   | 19          |
| 4.2.1 FRERMIP Background and Objectives.....  | 19          |
| 4.2.2 FRERMIP Location and Area.....  | 20          |
| 4.2.3 FRERMIP Implementation Schedule.....  | 20          |
| 4.3 Project –Tranche 1.....   | 20          |
| 4.3.1 Proposed Interventions.....   | 20          |
| 4.3.2 Project Implementation Arrangements.....  | 25          |
| 4.3.3 Implementation Schedule.....  | 26          |

|           |  |           |
|-----------|--|-----------|
| 4.3.4     | Tranche 1 Subprojects.....   | 26        |
| 4.3.5     | Associated Facility Analysis.....  | 27        |
| 4.3.6     | Labor Requirement, Construction Materials, and Equipment .....                   | 28        |
| 4.3.7     | Camps .....  | 34        |
| 4.3.8     | Transportation of Materials.....   | 34        |
| <b>5.</b> | <b>Environmental and Social Baseline.....</b>                                    | <b>35</b> |
| 5.1       | Physical Environment .....   | 35        |
| 5.1.1     | Climate.....   | 35        |
| 5.1.2     | Stratigraphy and Seismicity .....  | 38        |
| 5.1.3     | Topography .....   | 38        |
| 5.2       | Water Resources.....   | 38        |
| 5.2.1     | River System .....   | 38        |
| 5.2.2     | Surface Water Levels and Quality .....   | 41        |
| 5.2.3     | Water Resources Functions.....   | 43        |
| 5.3       | Land Resources.....  | 47        |
| 5.3.1     | Agro-Ecological Regions.....   | 47        |
| 5.3.2     | Land use.....  | 51        |
| 5.3.3     | Land type.....   | 51        |
| 5.3.4     | Soil Texture.....  | 51        |
| 5.3.5     | Available Soil Moisture.....   | 52        |
| 5.3.6     | Drainage Characteristics .....   | 52        |
| 5.4       | Agriculture Resources.....   | 53        |
| 5.4.1     | Farming Practices .....  | 53        |
| 5.4.2     | Crop Production Constraints.....   | 53        |
| 5.4.3     | Crop Calendar, Crop Pattern and Cropping Intensity.....                          | 54        |
| 5.4.4     | Cropped Area.....  | 55        |
| 5.4.5     | Crop Production.....   | 56        |
| 5.4.6     | Crop Damage .....  | 57        |
| 5.4.7     | Agricultural Inputs.....   | 57        |
| 5.4.8     | Minor Irrigation.....  | 57        |
| 5.5       | Livestock and Poultry.....   | 58        |
| 5.5.1     | Livestock and Poultry Health.....  | 59        |
| 5.5.2     | Constraints of Livestock and Poultry Rearing .....                               | 59        |
| 5.6       | Fisheries.....   | 59        |
| 5.6.1     | Open Water Fish Habitat.....   | 60        |
| 5.6.2     | Fish Production .....  | 62        |
| 5.6.3     | Fish Migration.....  | 63        |
| 5.6.4     | Fish Species Suitable for Fish Pass/Friendly Structures in Jamuna Catchment..... | 65        |
| 5.6.5     | Fish Biodiversity .....  | 66        |
| 5.6.6     | Species of Conservation Significance.....  | 67        |
| 5.6.7     | Area of Conservation Significance.....   | 67        |
| 5.6.8     | Fish Marketing and Post-Harvest Facilities .....                                 | 68        |
| 5.6.9     | Fisher's Lifestyle.....  | 68        |

|           |  |           |
|-----------|--|-----------|
| 5.6.10    | Fisheries Management .....   | 69        |
| 5.7       | Ecological Resources .....   | 69        |
| 5.7.1     | Bioecological Zones - Introduction.....  | 69        |
| 5.7.2     | Terrestrial Habitats and Flora .....   | 71        |
| 5.7.3     | Seasonal and Perennial Wetland Habitats and Flora .....                          | 71        |
| 5.7.4     | Terrestrial Fauna.....   | 72        |
| 5.7.5     | Aquatic Ecosystems .....   | 73        |
| 5.7.6     | Other Aquatic Fauna.....   | 75        |
| 5.7.7     | Aquatic Ecosystem Services .....   | 75        |
| 5.7.8     | Threats to Aquatic Ecosystems .....  | 75        |
| 5.8       | Socioeconomic Condition .....  | 75        |
| 5.8.1     | Area and Location.....   | 75        |
| 5.8.2     | Demography .....   | 76        |
| 5.8.3     | Livelihood.....  | 77        |
| 5.8.4     | Quality of Life .....  | 79        |
| 5.8.5     | Education .....  | 82        |
| 5.8.6     | Electricity .....  | 82        |
| 5.8.7     | Poverty and Safety Nets .....  | 83        |
| 5.8.8     | Natural Disasters .....  | 85        |
| 5.8.9     | Social Safety Nets and Poverty Reduction Measures.....                           | 85        |
| 5.8.10    | Transportation.....  | 86        |
| 5.8.11    | Educational Institutions.....  | 87        |
| 5.8.12    | Population Migration.....  | 87        |
| 5.8.13    | Gender and Women .....   | 88        |
| 5.8.14    | Vulnerable Communities .....   | 89        |
| 5.8.15    | Common Property Socio-Cultural Places and Resources.....                         | 89        |
| <b>6.</b> | <b>Public Consultation and Disclosure .....</b>                                  | <b>90</b> |
| 6.1       | Disclosure, Consultation, and Participation during Project Preparation .....     | 90        |
| 6.2       | Stakeholder Comments and Concerns .....  | 90        |
| 6.2.1     | First Round .....  | 90        |
| 6.2.2     | Second Round .....   | 91        |
| 6.3       | Summary of Concerns, All Meetings.....   | 92        |
| 6.4       | Additional Concerns from Specific Meetings.....                                  | 92        |
| 6.5       | Incorporation of Concerns in Project and Mitigation Designs .....                | 93        |
| 6.6       | Implementation-Phase Stakeholder Disclosure, Consultation and Participation..... | 93        |
| 6.7       | Grievance Redress Mechanism .....  | 94        |
| 6.8       | Reporting and Monitoring.....  | 94        |
| <b>7.</b> | <b>Important Environmental and Social Components .....</b>                       | <b>95</b> |
| 7.1       | Introduction.....  | 95        |
| 7.2       | Water Resources.....   | 95        |
| 7.2.1     | Erosion and Accretion .....  | 95        |
| 7.2.2     | Flooding .....   | 95        |
| 7.2.3     | Drainage Congestion .....  | 95        |

|           |  |            |
|-----------|--|------------|
| 7.2.4     | Water Logging.....                                       | 95         |
| 7.2.5     | Water Availability and Water Use .....                   | 96         |
| 7.2.6     | Navigation.....  | 96         |
| 7.2.7     | Surface Water Quality .....                              | 96         |
| 7.3       | Land Resources.....                                      | 96         |
| 7.3.1     | Land Type .....  | 96         |
| 7.3.2     | Sand Carpeting .....                                     | 96         |
| 7.3.3     | Land Loss .....  | 96         |
| 7.4       | Agriculture .....  | 97         |
| 7.4.1     | Cropping pattern and intensity.....                      | 97         |
| 7.4.2     | Crop production.....                                     | 97         |
| 7.4.3     | Crop damage .....  | 97         |
| 7.4.4     | Irrigated Area& Irrigation Water Availability.....       | 97         |
| 7.5       | Fisheries.....   | 97         |
| 7.5.1     | Fish Habitat.....  | 97         |
| 7.5.2     | Riverine Fish Habitats .....                             | 97         |
| 7.5.3     | Beel and Khal Fish Habitats .....                        | 97         |
| 7.5.4     | Floodplain Fish Habitat .....                            | 98         |
| 7.5.5     | Fish Migration.....                                      | 98         |
| 7.5.6     | Fish Species Diversity .....                             | 98         |
| 7.5.7     | Capture and Culture Fish Production .....                | 98         |
| 7.6       | Ecological Resources.....                                | 98         |
| 7.6.1     | Terrestrial Ecosystem.....                               | 98         |
| 7.6.2     | Aquatic Ecosystem .....                                  | 98         |
| 7.6.3     | Floral Composition and Diversity .....                   | 98         |
| 7.6.4     | Faunal Composition and Diversity.....                    | 99         |
| 7.7       | Socio-Economic Condition.....                            | 99         |
| 7.7.1     | Land Acquisition .....                                   | 99         |
| 7.7.2     | Income Generation.....                                   | 99         |
| 7.7.3     | Communications.....                                      | 99         |
| 7.7.4     | Poverty.....   | 99         |
| <b>8.</b> | <b>Impact Assessment and Mitigation Measures .....</b>   | <b>100</b> |
| 8.1       | Categorization and Quantification.....                   | 100        |
| 8.2       | Climate Change.....                                      | 103        |
| 8.3       | Physical and Water Resources .....                       | 105        |
| 8.3.1     | Construction Phase .....                                 | 105        |
| 8.3.2     | Construction Phase .....                                 | 108        |
| 8.3.3     | Post-Construction Phase .....                            | 110        |
| 8.4       | Land Resources.....                                      | 114        |
| 8.4.1     | Pre-Construction Phase .....                             | 114        |
| 8.4.2     | Construction Phase .....                                 | 118        |
| 8.4.3     | Post-Construction Phase (Loss of land from erosion)..... | 122        |
| 8.5       | Agriculture Resources.....                               | 124        |
| 8.5.1     | Pre-Construction Phase .....                             | 124        |



|                 |   |            |
|-----------------|---|------------|
| 8.5.2           | Construction Phase .....  | 124        |
| 8.5.3           | Post-Construction Phase (JRB-1).....                                      | 126        |
| 8.6             | Fisheries Resources .....   | 127        |
| 8.6.1           | Pre-Construction Phase .....  | 127        |
| 8.6.2           | Construction Phase .....  | 127        |
| 8.6.3           | Post-Construction Phase .....   | 134        |
| 8.7             | Ecological Resources .....  | 146        |
| 8.7.1           | Pre-Construction Phase .....  | 146        |
| 8.7.2           | Construction Phase .....  | 146        |
| 8.7.3           | Post-Construction Phase .....   | 149        |
| 8.8             | Socio-economic.....   | 152        |
| 8.8.1           | Pre-Construction Phase .....  | 152        |
| 8.8.2           | Construction Phase .....  | 156        |
| 8.8.3           | Post-Construction Phase .....   | 160        |
| 8.9             | Summary of anticipated environmental Impacts and Mitigation Measures      | 166        |
| 8.9.1           | JRB-1 Flood Embankment Potential Impacts .....                            | 166        |
| 8.9.2           | JRB-1, JLB-2, and PLB-1 Riverbank Protection Works Potential Impacts .... | 170        |
| 8.10            | Future Mitigation Measures .....  | 171        |
| <b>9.</b>       | <b>Analysis of Alternatives.....</b>                                      | <b>173</b> |
| <b>10.</b>      | <b>Environmental Management Plan .....</b>                                | <b>174</b> |
| 10.2            | Subproject JRB-1.....   | 175        |
| 10.2.1          | Pre-Construction Phase .....  | 175        |
| 10.2.2          | Construction Phase .....  | 180        |
| 10.2.3          | Post-construction Phase .....   | 197        |
| 10.3            | Subproject JLB-2 .....  | 208        |
| 10.3.1          | Pre-Construction Phase .....  | 208        |
| 10.3.2          | Construction Phase .....  | 212        |
| 10.3.3          | Post-construction Phase.....  | 218        |
| 10.4            | Subproject PLB-1 .....  | 223        |
| 10.4.1          | Pre-Construction Phase .....  | 223        |
| 10.4.2          | Construction Phase .....  | 227        |
| 10.4.3          | Post-construction Phase .....   | 232        |
| 10.5            | Monitoring Plan .....   | 237        |
| 10.5.1          | Monitoring schedule for Pre-construction Phase.....                       | 237        |
| 10.5.2          | Monitoring schedule for construction Phase .....                          | 237        |
| 10.5.3          | Monitoring schedule for Post-construction Phase.....                      | 239        |
| <b>11.</b>      | <b>Conclusion and Recommendations .....</b>                               | <b>244</b> |
| 11.1            | Conclusion.....   | 244        |
| 11.2            | Recommendations .....   | 245        |
| <b>Annex 1:</b> | <b>List of Tables.....</b>  | <b>246</b> |
| <b>Annex 2:</b> | <b>Dolphin Threats .....</b>  | <b>259</b> |
| 1.1             | Threats .....   | 259        |
| 1.2             | Threats from Other Human Activities .....                                 | 259        |
| 1.2.1           | Use of Dolphin Products .....   | 259        |

|  |                                    |            |
|--|------------------------------------|------------|
| 1.2.2  | Fisheries Bycatch .....            | 259        |
| 1.2.3  | Directed Catch .....               | 259        |
| 1.2.4  | Overexploitation of Fisheries..... | 260        |
| 1.2.5  | Pollution .....                    | 260        |
| <b>Annex 3: Public Consultation Meeting, First Round.....</b>                  |                                    | <b>262</b> |
| <b>Annex 4: Public Consultation Meeting, Second Round .....</b>                |                                    | <b>293</b> |
| <b>Annex 5: Standard Construction Contract Environmental Safeguard Clauses</b> |                                    | <b>317</b> |
| <b>Annex 6: Project Implementation Arrangements.....</b>                       |                                    | <b>321</b> |
| <b>Annex 7: Project Description, Jamuna Right Bank 1.....</b>                  |                                    | <b>323</b> |
| <b>Annex8: Project Description, Jamuna Left Bank 2.....</b>                    |                                    | <b>331</b> |
| <b>Annex9: Project Description, Padma Left Bank 1.....</b>                     |                                    | <b>337</b> |
| <b>Annex 10: Selection of Subreaches .....</b>                                 |                                    | <b>342</b> |
| <b>Annex 11: DOE Approved Terms of Reference .....</b>                         |                                    | <b>355</b> |

## List of Tables

|   |    |
|---|----|
| Table 2.1: Bangladesh Standards for Ambient Air Quality .....   | 9  |
| Table 2.2: Bangladesh Standards for Noise .....   | 9  |
| Table 2.3: Bangladesh Standards for Sewage Discharge.....   | 10 |
| Table 4.1: Tranche 1 Embankment Rehabilitation .....  | 26 |
| Table 4.2: Tranche 1 Embankment Construction .....  | 27 |
| Table 4.3: Tranche 1 Riverbank Protection.....  | 27 |
| Table 4.4: Tranche 1 Drainage Sluices.....  | 27 |
| Table 4.5: Embankment Re-Sectioning Details.....  | 29 |
| Table 4.6: New / Retired Embankment Construction Details .....  | 29 |
| 2. Annual O&M labor for embankment resectioning and construction of new / retired embankments has been estimated at five per cent of total construction labour (see above). Additionally (not shown above), every ten years thereafter a major repair may be necessary; the estimated labour requirement is 20 to 30 per cent of total construction labour. |    |
| Table 4.7: River Bank Protection Construction Details .....   | 30 |
| Table 4.8: Drainage Sluice Construction Details .....   | 33 |
| Table 5.1: Seasonal Discharge of Jamuna and Padma .....   | 41 |
| Table 5.2: Mean Discharge ( 1981- 2006) of Jamuna and Padma .....   | 41 |
| Table 5.3: Water levels of Jamuna and Padma.....  | 42 |
| Table 5.4: Jamuna and Padma Rivers Mean Water Levels(1991-2009) .....   | 42 |
| Table 5.5: Surface Water Quality of Jamuna and Padma .....  | 42 |
| Table 5.6: Bangladesh Water Quality Standard.....   | 43 |
| Table 5.7: Irrigable Areas and Water Consumption .....  | 44 |
| Table 5.8: Flood Duration, Padma and Brahmaputra/Jamuna Basins.....   | 45 |
| Table 5.9: Flood Level Frequency Analysis, Jamuna at Bahadurabad .....  | 45 |
| Table 5.10: Flood Level Frequency Analysis, Padma at Mawa .....   | 45 |
| Table 5.11: Agro-Ecological Zones.....  | 47 |
| Table 5.12: Soil Characteristics, Karatoya-Bangali Floodplain Region.....   | 49 |
| Table 5.13: Soil Characteristics, Active Brahmaputra-Jamuna Floodplain .....  | 49 |
| Table 5.14: Soil Characteristics, Young Brahmaputra and Jamuna Floodplain.....  | 50 |
| Table 5.15: Soil Characteristics, Active Ganges Floodplain Region .....   | 50 |
| Table 5.16: Soil Characteristics, Low Ganges River Floodplain .....   | 51 |
| Table 5.17: Land Use of the Study Area.....   | 51 |
| Table 5.18: Land Types of the Study Area .....  | 51 |
| Table 5.19: Soil Texture, 0-15 cm Depth.....  | 52 |
| Table 5.20: Soil Moisture of the Study area.....  | 52 |
| Table 5.21: Drainage Characteristics of the Study Area .....  | 52 |
| Table 5.22: Cropping Pattern by Land Type.....  | 55 |
| Table 5.23: Crop Production .....   | 56 |
| Table 5.24: Fertilizer and Pesticides.....  | 57 |
| Table 5.25: Minor Irrigation.....   | 58 |

|  |     |
|--|-----|
| Table 5.26: Livestock and Poultry .....  | 59  |
| Table 5.27: Fish Habitat.....  | 60  |
| Table 5.28: Fish Production by Habitat .....                                     | 62  |
| Table 5.29: Seasonality of Fishing Types .....                                   | 62  |
| Table 5.30: Migratory Fish Species.....  | 63  |
| Table 5.31: Khal Locations and Connections .....                                 | 64  |
| Table 5.32: Beel Sanctuaries.....  | 65  |
| Table 5.33: Fish Pass/Fish Friendly Structure: Large Non-Carp Fish Species ..... | 65  |
| Table 5.34: Fish Pass/Fish Friendly Structure: Barbs and Catfish.....            | 66  |
| Table 5.35: Fish Pass/Fish Friendly Structure: Other Small Fish Species.....     | 66  |
| Table 5.36: Fish Species of the Study area .....                                 | 66  |
| Table 5.37: Fish Species of Conservation Significance .....                      | 67  |
| Table 5.38: Administrative Units of Bangladesh.....                              | 76  |
| Table 5.39: Demographic Information .....  | 76  |
| Table 5.40: Age Distribution.....  | 76  |
| Table 5.41: Primary Occupation.....  | 77  |
| Table 5.42: Employment.....  | 79  |
| Table 5.43: Literacy Rates.....  | 82  |
| Table 5.44: Landownership.....   | 83  |
| Table 5.45: Annual Income and Expenditure Level.....                             | 85  |
| Table 5.46: Effects of Recent Natural Disasters .....                            | 85  |
| Table 5.47: Social Safety Net Programs .....                                     | 85  |
| Table 5.48: NGOs Programs .....  | 86  |
| Table 5.49: Road Network .....   | 86  |
| Table 5.50: Navigation Routes.....   | 87  |
| Table 5.51: Academic Institutions.....   | 87  |
| Table 5.52: Labor Migration.....   | 88  |
| Table 8.1: JRB-1 Impacts on Land Type.....                                       | 166 |

## List of Figures

|   |    |
|---|----|
| Figure 2.1: Application Procedure For Obtaining Site and Environmental Clearance..... | 4  |
| Figure 3.3-1: Overall approach of the EIA study.....                                  | 12 |
| Figure 4-1: Riverbank Protection, Representative Cross-Section .....                  | 20 |
| Figure 4.1: Construction Schedule .....   | 23 |
| Figure 4.3: Embankment, Representative Cross-Section .....                            | 24 |
| Figure 5.1: Monthly rainfall of the study area .....                                  | 36 |
| Figure 5.2: Monthly temperature of the study area.....                                | 36 |
| Figure 5.3: Relative humidity of the study area .....                                 | 36 |
| Figure 5.4: Evaporation of the study area .....                                       | 37 |
| Figure 5.5: Windspeed of the study area .....   | 37 |
| Figure 5.6: Sunshine hours per day .....  | 38 |

|  |     |
|--|-----|
| Figure 5.7: Mean Ground Water Levels, Sirajgang, Manikganj, and Tangail (1990-2001)..... | 43  |
| Figure 5.8: Flooded Area Vs Water Volume (1972-1993).....                                | 44  |
| Figure 5.9: Crop Calendar .....  | 54  |
| Figure 5.10: Fish Marketing Channels .....   | 68  |
| Figure 5.11: Housing Tenancy .....   | 77  |
| Figure 5.12: Employment Status.....  | 79  |
| Figure 5-1.13: Distribution of Housing Types.....  | 80  |
| Figure 5.14: Drinking Water Sources.....   | 81  |
| Figure 5.15: Sanitation .....  | 81  |
| Figure 5.16: Medical Treatment.....  | 82  |
| Figure 5.17: Household Access to Electricity .....                                       | 83  |
| Figure 5.18: Landholding.....  | 84  |
| Figure 5.19: Self-Assessed Poverty Status.....   | 84  |
| Figure 5.20: Decision-Making By Women.....   | 88  |
| Figure 5.21: School Enrollment.....  | 89  |
| Figure 8.1: Effect of JRB-1 on Water Levels, 2003 Flood Condition .....                  | 167 |
| Figure 8.2: JRB-1 Land Type Areas, Pre-Project .....                                     | 168 |
| Figure 8.3: JRB-1 Land Type Areas, Post-Project .....                                    | 168 |

## List of Pictures

|  |    |
|--|----|
| Photo 5.1: Boro Seedbed.....                               | 53 |
| Photo 5.2: Mustard.....                                    | 53 |
| Photo 5.3: Surfacewater-Irrigated Agricultural Field ..... | 58 |
| Photo 5.4: Openwater Fish Habitat.....                     | 59 |
| Photo 5.5: Openwater Fish Habitat.....                     | 59 |
| Photo 5.6: Livelihoods.....                                | 78 |
| Photo 5.6.1: Jhupri House.....                             | 78 |
| Photo 5.6.2: Kutcha House.....                             | 78 |
| Photo 5.6.3: Semi-Pukka House.....                         | 78 |
| Photo 5.6.4: Pukka House.....                              | 78 |

## List of Maps

|  |    |
|--|----|
| Map1.1: Location of Project area.....  | 2  |
| Map 4.1: Proposed Interventions Color-Coded by Tranche.....                    | 21 |
| Map 4-2: Proposed Tranche 1 Interventions.....                                 | 22 |
| Map 4.3: JRB-1 Proposed Camp and Infrastructure Locations .....                | 34 |
| Map 5.1: Location of Study area in the Tectonnnnnnic units of Bangladesh ..... | 39 |
| Map 5.2: Topography of the Study area.....                                     | 40 |
| Map 5.3: Agroecological Region of the Study Area .....                         | 48 |
| Map 5.4: Fish Habitat area in the study area .....                             | 61 |

|  |    |
|--|----|
| Map 5.5: Map - Range, South Asian River (Gangetic) Dolphin ..... | 74 |
| Map 6.1: First Round Public Consultation Meeting Locations ..... | 91 |

## Abbreviations and Acronyms

|           |  |
|-----------|--|
| ADB       | Asian Development Bank   |
| AIFRERMIP | Assam Integrated Flood and Riverbank Erosion Risk Management Investment Program  |
| BBA       | Bangladesh Bridge Authority  |
| BBS       | Bangladesh Bureau of Statistics  |
| BCCSAP    | Bangladesh Climate Change Strategy and Action Plan   |
| BDT       | Bangladesh Taka  |
| BMD       | Bangladesh Meteorology Department  |
| BWDB      | Bangladesh Water Development Board   |
| CC        | Pre-cast concrete  |
| CEGIS     | Centre for Environment and Geographical Information Systems  |
| CEMP      | Contractor's environmental management plan   |
| CIA       | Cumulative impact assessment   |
| DAE       | Department of Agricultural Extension   |
| DDM       | Department of Disaster Management  |
| DOE       | Department of Environment  |
| DOF       | Department of Fisheries  |
| EAP       | Environmental action plan  |
| EARF      | Environmental assessment review framework  |
| ECA       | Environment Conservation Act   |
| ECAs      | Ecologically critical area   |
| EIA       | Environmental impact statement   |
| EOP       | Environment-on-project   |
| EMP       | Environmental management plan  |
| F0        | Area flooded to a maximum of 0-30 cm, either (i) MPO land type, remains flooded for three days or more to this depth in the 1:2 year return flood event; or (ii) hydrologic model area, instantaneously flooded to this depth in the modeled event (any return period) |
| F1        | Area flooded 30-90 cm maximum (see F0)   |
| F2        | Area flooded 90-180 cm maximum (see F0)  |
| F3        | Area flooded 180-300 cm maximum (see F0)   |
| F4        | MPO land type, over 300 cm maximum 3-day flood depth, 1:2 event  |

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



## Glossary

### *Bengali terms and place names*

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

### *English terms*

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

<sup>1</sup>Master Plan Organization (MPO). 1987. “Agricultural Production System”. Technical Report No. 14.Dhaka.

In this formulation (which is conceptually different from and fundamentally incompatible with MPO's), the F0-F4 areas vary with return period; and, for the 1:2 year classification, the modeling classification, relative to the MPO values, may be biased towards deeper flooding given that it uses a less stringent flood duration criterion (instantaneous rather than three-day).

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

## Executive Summary

### Introduction

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

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

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

### Critical Facts

#### The Context - FRERMIP

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

FRERMIP as whole aims to reduce the flood risk at three priority subprojects by providing new and rehabilitated embankments, leaving distributaries open, along selected reaches of the Jamuna and Padma Rivers. To protect these embankments, river banks will be progressively stabilized, starting at critically eroding reaches. Over time, and in conjunction with other government programs this

---

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

approach may lead to a general river stabilization with less channels potentially having some similarity to the river system before the passing of the sediment wave of the Great Assam Earthquake. In parallel to this study, Government investigates other river restoration alternatives<sup>3</sup>. Siting of physical works for FRERMIP will be planned using an innovative dynamic methodology that responds to evolving river behaviour (“adaptive approach”).

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

### **The Assessed Project**

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

### **Significant Findings**

#### **JRB-1 Flood Embankment Potential Impacts**

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

Several negative impacts may occur without mitigation measures. Floodplain aquatic (wetland) habitats will be degraded or extirpated due to reduced flooded area, depth, and duration (mentioned above); reduced hydrologic connectivity; and physiochemical / water quality changes. This in turn will adversely affect floodplain-dependent openwater fish species migration, population levels, and catch levels, as well as wetland biodiversity, services, and products more generally. These impacts can in turn adversely affect the nutrition, health, and economic status of poor people.

---

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

The embankment can impede cross-drainage resulting in drainage congestion, adversely affecting agriculture within the protected area, and block the movement of migrating fish.

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

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

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

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

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

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

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

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

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

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

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

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

First studies on the interaction of riverbank protection works with the environment have been conducted in 2007 and 2011<sup>4</sup>. The JMREMP, 2007 study found that there were more fish species and higher population numbers at protected banks, as opposed to unprotected banks. The size of the fish depends on the size of the voids in the protection, which means that large voids in concrete blocks tend to attract larger fish, specifically carnivores, but fewer numbers, while geobags, having more but smaller voids, attract smaller fish in larger numbers. CEGIS, 2011 identified overall positive impacts of geotextile bag revetements on water resources, fisheries, the algae community, the ecosystem and the socio-economy. Important findings are that there is no change in water quality,

---

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

the terrestrial habitat is protected, and the socio-economic conditions are improved for the local population, including employment opportunities during construction, health and sanitation conditions, fishing opportunities, and especially the situation of women. Geotextile bag revetments might change the composition of fish species, alter the habitat of the benthic community, as well as cause local shifting of the migratory routes of the dolphins<sup>5</sup> during construction. However, these effects are reversible and the constructed revetments do not impact on the free movement of dolphins and the benthic habitat is quickly restored over geobag revetments. With respect to the overall use of the recommended riverbank protection technology, CEGIS 2011 concludes:

*“Considering all environmental, social and technical consequences of the geobag use under water, it might be concluded that compared with CC block use alone, geo-bag use under water with CC block used above water is more environmentally sustainable, socially acceptable, technically feasible and economically cost effective if the quality requirements and design requirements are assured and monitored.”*

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

### **Land Acquisition, Resettlement, and Construction Impacts**

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

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

### **Stakeholder Comments and Concerns**

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

### **Recommended Actions**

#### **Overview**

Mitigation of the aforementioned impacts is complex and challenging. It will not result in all residual impacts being reduced to insignificance, but it will reduce them to levels considered acceptable under the circumstances. To the extent possible, impacts will be mitigated through measures purpose-designed to the impact and setting. Many mitigation measures have been aggressively

---

<sup>5</sup> Dolphins normally chose the thalweg, i.e. the deeper part of the river for migration

mainstreamed into the engineering designs, which also incorporate significant impact avoidance features e.g. leaving distributaries open and embankment afforestation.

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

### **Environmental Management Plan**

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

- *Construction-phase impacts.* Management will be through the inclusion of standard environmental safeguard clauses in construction contract bidding packages, Contractor's Environmental Management Plans (CEMPs) and BWDB construction supervision.
- *Impacts on critical habitats and trans-boundary/internationally migrating/threatened species:* The proposed mitigation measures are modelled after the ongoing Wetland Biodiversity Rehabilitation Project of GIZ /Department of Fisheries/BWDB, currently under implementation in areas of Pabna adjacent to the JRB-1 project area..
- *Impacts on openwater fish biodiversity and production.* Measures to mitigate these impacts (i) include openwater fisheries-related measures and (ii) expansion of aquaculture, particularly in areas benefitting from Project-led reductions in flood and erosion risk.
- *Land acquisition and resettlement impacts.* Management measures are documented in Final Report, Annex J1 Resettlement Framework, and Annex J2, Resettlement Plan for Tranche 1.

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

### **Future Mitigation Measures – Preparing for Tranche-2 and 3**

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



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

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

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

### **Design- and Implementation-Phase Public Consultation**

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

### **Grievance Redress Mechanism**

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

### **Reporting and Monitoring**

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

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

# 1. Introduction

## 1.1 Overview

1. The project area of the Flood and Riverbank Erosion Risk Management Investment Program (FRERMIP) comprises about 2,44,000 ha of which approximately 13 percent are occupied by rivers and a very minor percentage (approximately 0.6 percent) is occupied by other water bodies. The hydrology of the area is dominated by the three major rivers, the Jamuna, the Ganges and the Padma.
2. FRERMIP is an Asian Development Bank (ADB) multi-tranche financing facility (MFF) being prepared in partnership with the Government of Bangladesh (GOB). It aims to sustain incomes and livelihoods of people living along the three main rivers of Bangladesh – the Jamuna, the Ganges, and the Padma – by enhancing resilience to flood and riverbank erosion. Project outputs will (i) strengthen the flood and riverbank erosion management system, and (ii) establish, at priority erosion sites, sustainable, integrated non-structural and structural risk management measures. The MFF would provide a maximum loaned amount of approximately US\$250 million over a nine-year period in three tranches of USD60 million, USD100 million, and USD90 million respectively.
3. This report presents the findings of an Environmental Impact Assessment (EIA) of the three Subprojects proposed for inclusion in Tranche 1: Jamuna Right Bank (JRB) 1, Jamuna Left Bank (JLB) 2, and Padma Left Bank (PLB) 1.
4. A companion document, the Environmental Assessment and Review Framework (EARF) sets forth (i) the safeguards procedures to be followed during subsequent MFF tranches, (ii) safeguards-related criteria to be considered in the selection of subprojects for subsequent tranches, and, with regard to Executing Agency safeguards capacity, (iii) an assessment and recommendations for appropriate institutional strengthening.
5. The EIA and EARF were prepared as part of the Tranche 1 feasibility studies under the ADB project preparation technical assistance project *Main River Flood and Bank Erosion Risk Management Program* (PPTA No. 8054 BAN).

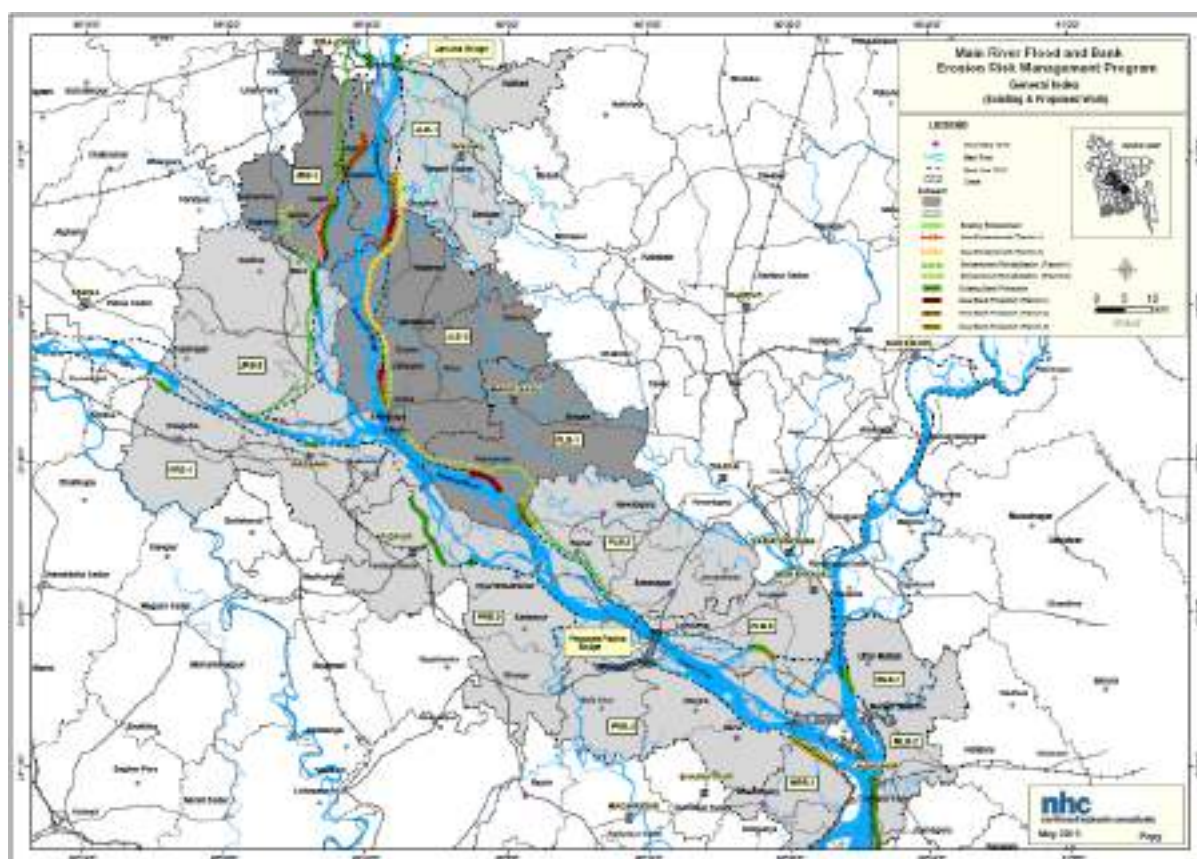
## 1.2 Objectives

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

## 1.3 Project area

7. The project area of the proposed investment encompasses the river reach of the Jamuna River from below the Jamuna Bridge and the proposed Ganges Barrage site to Chandpura on the Lower Meghna. The Jamuna and Ganges river courses downstream of these two major river works are somewhat independent of upstream river developments.
8. These upstream areas are expected to be included in the Ganges Barrage project and the World Bank-supported Riverbank Improvement Project (RBIP). The project area covers a total population of 10.5 million in 40 upazilas and 431 unions, with an average population density of nearly 1,600 persons per km<sup>2</sup> of floodplain land.

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



**Map 1.1: Location of Project area**

#### 1.4 EIA Team members

##### 10. International Consultant

Sara Bennett, PhD, International Environmental Specialist

##### 11. CEGIS Team-

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

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

### 1.5 Report Format

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

- Chapter 1:* Background, study area, objectives, scope of work in addition to presenting the list of the multi-disciplinary EIA study team members.
- Chapter 2:* The policy, legal and administrative framework.
- Chapter 3:* Approach and Methodology followed for conducting the EIA study.
- Chapter 4:* Description of the project including the present status of the infrastructure and the proposed interventions.
- Chapter 5:* Environmental and Social baseline condition in respect of meteorology, seismicity, water resources, land resources, agriculture, livestock, ecological resources and socio-economic condition.
- Chapter 6:* Public consultation and disclosure
- Chapter 7:* Important environmental and social components likely to be impacted by the proposed rehabilitation plan.
- Chapter 8:* Assessment of the impacts of the proposed rehabilitation plan on the environmental and social components pertaining to water resources, land resources, agriculture, livestock, ecological resources and socio-economic condition.
- Chapter 9:* Environmental Management Plan
- Chapter 10:* Conclusion and recommendations.

## 2. Policy, Legal and Administrative Framework

### 2.1 Introduction

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

#### 2.1.1 Environmental Protection Policies and Legislation

##### a. National Conservation Strategy (1992)

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

##### b. National Environmental Policy (1992)

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

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

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

17. NEMAP has the following broad objectives:

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

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

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

- (i) Food security, social protection and health to ensure that the poorest and most vulnerable in society, including women and children, are protected from climate change and that all

- programs focus on the needs of this group for food security, safe housing, employment and access to basic services including health;
- (ii) Comprehensive disaster management to further strengthen the country's already proven disaster management system to deal with increasingly frequent and severe natural calamities;
  - (iii) Infrastructure to ensure that existing assets are well maintained and fit-for-purpose and that urgently needed infrastructure is put in place to deal with the likely impact of climate change;
  - (iv) Research and knowledge management to predict the likely scale and timing of climate change impacts on different sectors of the economy and socio-economic groups, to underpin future investment strategies and to ensure that Bangladesh is networked with the latest global thinking on science and best practices of climate change management;
  - (v) Mitigation and low carbon development to ensure low carbon development options and implement these as the country's economy grows over the coming decades and the demand for energy increases; and
  - (vi) Capacity building and institutional strengthening to enhance the capacity of government ministries and agency, civil society and the private sector to meet the challenges of climate change and mainstream them as part of development action.<sup>6</sup>

## 2.1.2 Environmental Conservation Act (1995) and Amendments

### ECA '95

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

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

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

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

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

<sup>6</sup>Government of Bangladesh. 2008. "Bangladesh Climate Change Strategy and Action Plan." [http://www.moef.gov.bd/climate\\_change\\_strategy2009.pdf](http://www.moef.gov.bd/climate_change_strategy2009.pdf)

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

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

#### **ECA Amendment 2000**

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

#### **ECA Amendment 2002**

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

#### **ECA Amendment 2010**

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

#### **Environment Court Act (2010)**

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

#### **Environmental Conservation Rules (1997)**

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

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

---

<sup>7</sup>Government of Bangladesh. 1995. "The Bangladesh Environment Conservation Act, Act No. 1 of 1995" [http://www.moef.gov.bd/html/laws/env\\_law/153-166.pdf](http://www.moef.gov.bd/html/laws/env_law/153-166.pdf)



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

### **EIA Guidelines for Industries (1997)**

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

### **Environmental Clearance Procedure for Red Category Projects**

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

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

## **2.1.3 Water Policies, Plans, and Legislation**

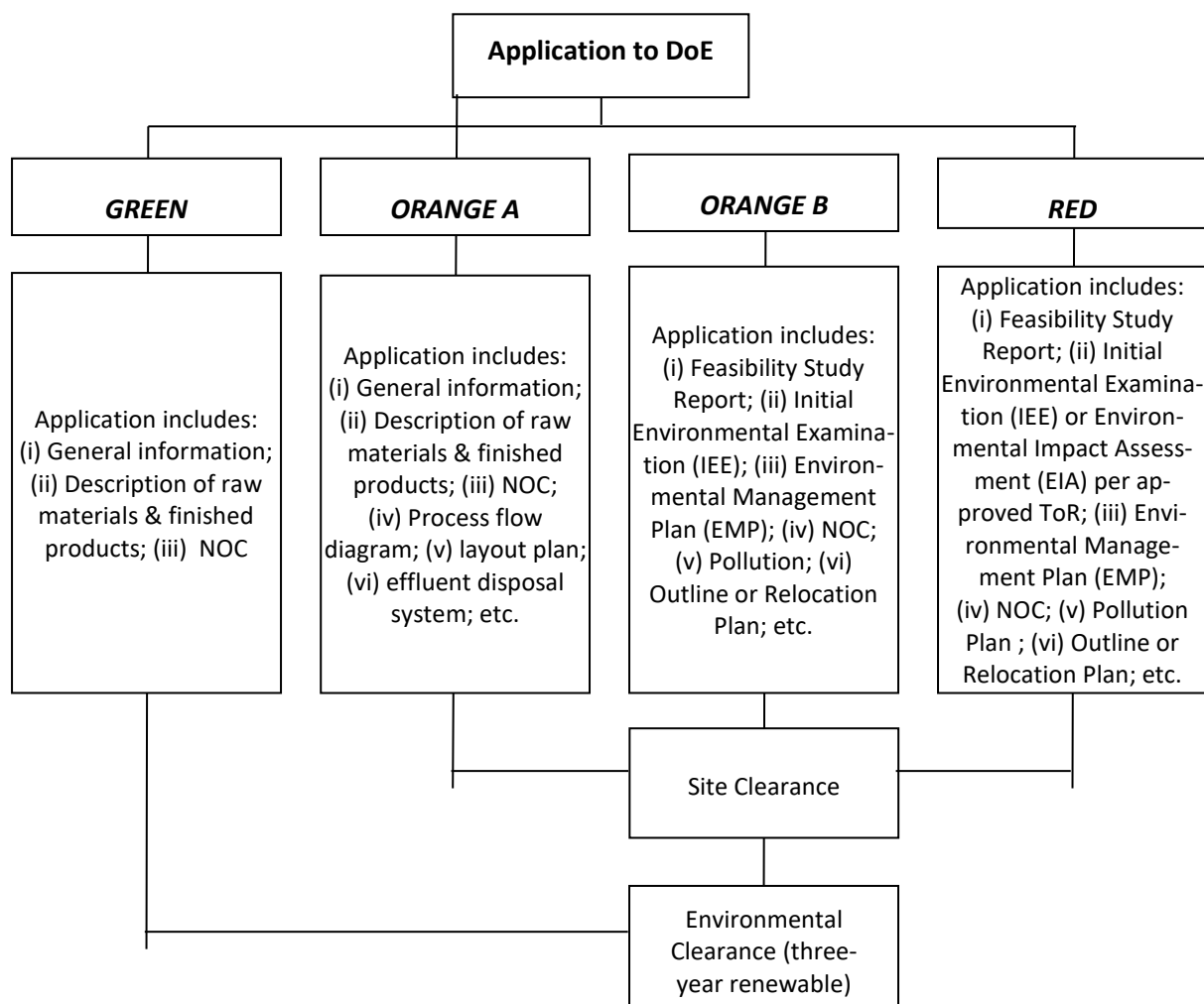
### **a) National Water Policy (1999)**

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

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

- (i) Develop early warning and flood-proofing systems; designate flood risk zones;
- (ii) Take appropriate measures to provide desired levels of protection for life, property, vital infrastructure, agriculture and wetlands guided by these principles:
  - (a) Highest priority is providing full flood protection to economical important regions (eg metropolitan areas, sea and air ports, export processing zones);
  - (b) A reasonable degree of flood protection will be gradually provided to other critical areas (district / upazila towns, important commercial centers and historic places);
  - (c) in other areas (except those protected by existing flood control infrastructure), people will be motivated to develop flood proofing measures (eg raised platforms for homesteads, market places, educational institutions, community centers) and adjust cropping patterns to suit the flood regime;

<sup>8</sup>Government of Bangladesh. 1997. Environment Conservation Rules, 1997, as Amended 2002 and 2003. [http://www.doe-bd.org/2nd\\_part/179-226.pdf](http://www.doe-bd.org/2nd_part/179-226.pdf)



**Figure 2.1: Application Procedure For Obtaining Site and Environmental Clearance**

- (d) All future national and regional highway, railway, and public building / facility new construction and reconstruction will be above the highest recorded flood level;
- (e) All road and railway embankment plans will provide for unimpeded drainage;
- (iii) Survey and investigate riverbank erosion problems, develop and implement river training and erosion control master plans that preserve scarce land and prevent landlessness and pauperization; and
- (iv) Plan and implement coastal and river char land reclamation schemes.<sup>9</sup>

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

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

<sup>9</sup>Ministry of Water Resources. 1999. “National Water Policy”. Government of Bangladesh, p. 6-7.

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

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

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

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

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

**e) National Policy for Arsenic Mitigation (2004)**

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

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

**f) Inland Water Transport Authority Ordinance (1958)**

<sup>10</sup>Water Resources Planning Organization (WARPO). 2001. “National Water Management Plan”. Ministry of Water Resources, Government of Bangladesh. <http://www.warpo.gov.bd/nwmp.html>

<sup>11</sup>Water Resources Planning Organization. 2005. “Guidelines for Environmental Assessment of Water Management (Flood Control, Drainage and Irrigation) Projects”. Dhaka, Bangladesh: National Water Management Plan Project, Ministry of Water Resources, Government of the People’s Republic of Bangladesh.

<sup>12</sup>Government of Bangladesh. 2004. “National Policy for Arsenic Mitigation”. Department of Public Health Engineering (DPHE). <http://www.dphe.gov.bd/pdf/National-Policy-for-Arsenic-Mitigation-2004.pdf>

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

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

### **a) Bangladesh Wildlife (Protection and Safety) Act 2012**

41. The Act:

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

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

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

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

<sup>13</sup>Government of Bangladesh. 1958. "Inland Water Transport Authority Ordinance."  
[http://bdlaws.minlaw.gov.bd/pdf/282\\_\\_\\_\\_.pdf](http://bdlaws.minlaw.gov.bd/pdf/282____.pdf)

<sup>14</sup>Government of Bangladesh. 2012. "Wild Life (Protection and Safety) Act 2012 [in Bangla]."  
<http://www.bforest.gov.bd/images/test/wildlife%20act.pdf>

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

43. The Act allows Government to relax any or all specified prohibitions for scientific purposes, for aesthetic enjoyment, or betterment of scenery.<sup>15</sup>

**c) Protection and Conservation of Fish Act (1950)**

44. This Act provides power to the government to:

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

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

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

**e) Protection and Conservation of Fish Rules (1985)**

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

**f) National Forest Policy (1994)**

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

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

<sup>15</sup>Government of Bangladesh. "Bangladesh Wild Life (Preservation) Order (1973)." [http://bdlaws.minlaw.gov.bd/print\\_sections\\_all.php?id=452](http://bdlaws.minlaw.gov.bd/print_sections_all.php?id=452)

<sup>16</sup>Government of Bangladesh. 1950. "Protection and Conservation of Fish Act, 1950." [http://bdlaws.minlaw.gov.bd/pdf/233\\_\\_\\_\\_.pdf](http://bdlaws.minlaw.gov.bd/pdf/233____.pdf)

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

**g) Biodiversity Conservation Strategy and Action Plan 2004**

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

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

**2.1.5 Agriculture and Land Use Policies and Legislation**

**a) National Agriculture Policy (1999)**

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

**b) New Agricultural Extension Policy (1996)**

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

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

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

### c) National Land Use Policy (2001)

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

#### 2.1.6 Environmental Quality Standards

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

**Table 2.1: Bangladesh Standards for Ambient Air Quality**

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

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

**Notes:**

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

**Table 2.2: Bangladesh Standards for Noise**

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

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

**Notes:**

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

**Table 2.3: Bangladesh Standards for Sewage Discharge**

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

Source: Schedule-8, Rule-13, Environment Conservation Rules, 1997. (Page 3131, Bangladesh Gazette, 28 August 199, trans. from Bengali).

**Notes:**

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

## 2.2 Project-Relevant International Environmental Agreements In Force In Bangladesh

56. Of the international environmental agreements to which Bangladesh is a party,<sup>17</sup> those potentially relevant to the Project are:

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

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

### 2.2.1 ADB Safeguards: Policy and Guidelines/Guidance Documents

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

59. Environment and Social

2009a. *Safeguard Policy Statement*.

2010. *Multi-Tranche Financing Facility, Section D14/BP, Operations Manual*

2011a. *Complaint Handling in Development Projects - Grievance Mechanisms: A Critical Component of Project Management*

2011b. *Complaint Handling in Development Projects - Building Capacity for Grievance Redress Mechanisms*

2012a. *Guidelines for Climate Proofing Investment in Agriculture, Rural Development, and Food Security*

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



60. Environment

2003a. *Environmental Assessment Guidelines*

2012b. *Environment Safeguards, A Good Practice Sourcebook—Draft Working Document.*

61. Social

2003b. *[Policy on] Gender and Development*

2006. *Gender Checklist: Agriculture*

2009b. *Project Gender Action Plans, Lessons for Achieving Gender Equality and Poverty Reduction Results.* Briefing Note

2012c. *Involuntary Resettlement Safeguards, A Planning and Implementation Good Practice Sourcebook – Draft Working Document.*

2012d. *Indigenous Peoples Safeguards, A Planning and Implementation Good Practice Sourcebook - Draft Working Document.*

2012e. *Handbook on Poverty and Social Analysis A Working Document.*

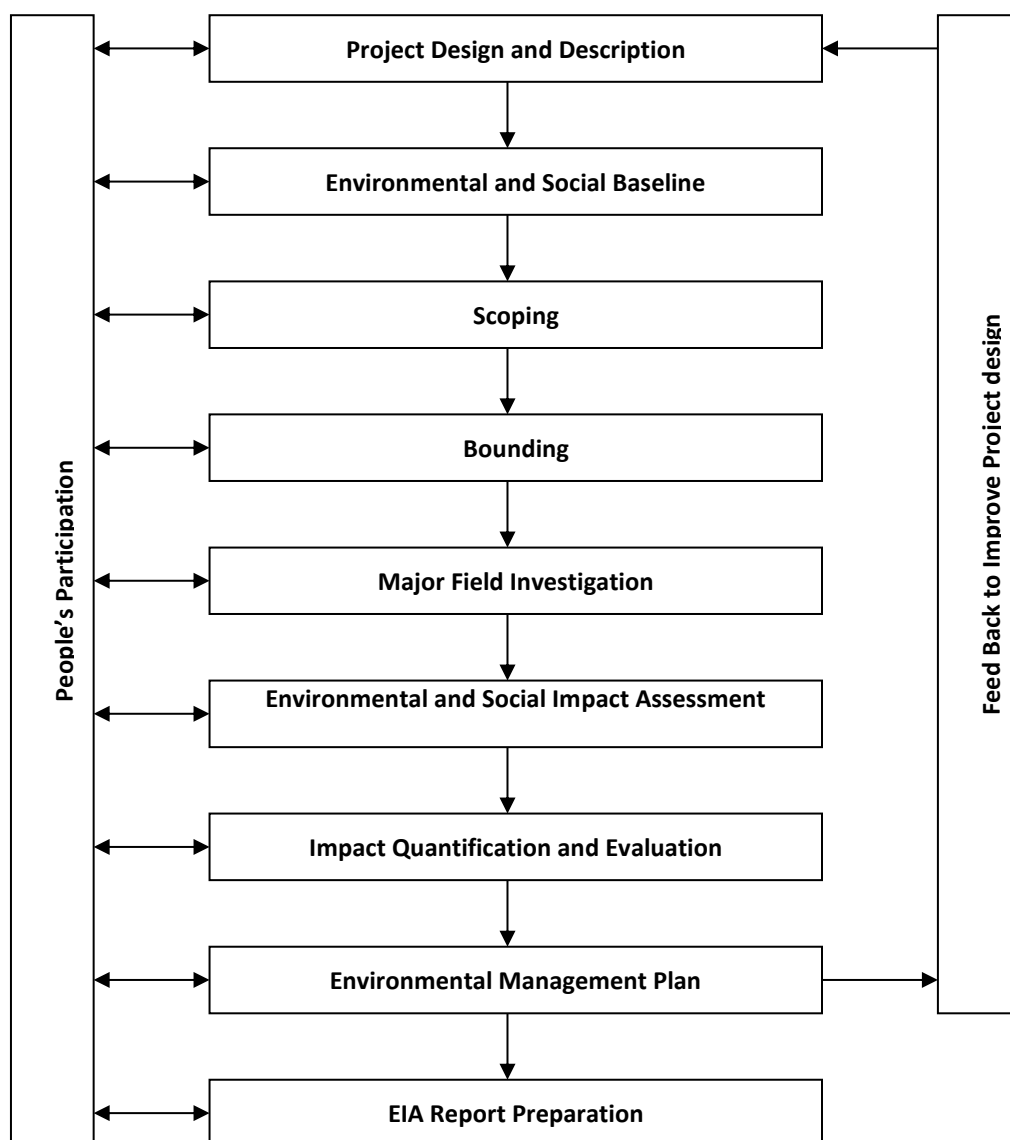
2012f. *Guidelines for Gender Mainstreaming Categories of ADB Projects.*

### 3. Approach and Methodology

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

#### 3.1 Overall Approach

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



**Figure 3.3-1: Overall approach of the EIA study**

## 3.2 Methodology

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

### 3.2.1 Project design and description

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

### 3.2.2 Baseline data collection and analysis

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

#### a) Water resources

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

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

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

| Parameter | Data Sources | Methodology |
|-----------|--------------|-------------|
|-----------|--------------|-------------|

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

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

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

## **b) Land Resources**

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

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

**c) Agriculture Resources**

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

**d) Livestock Resources**

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

**e) Fisheries Resources**

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

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

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

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

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

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

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

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

#### f) Ecology

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

#### g) Socio-economic Resources

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

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

- a) Data was collected from BBS, 2011 and reviewed relevant literatures from BWDB;
- b) Reconnaissance field visit and discussion with BWDB officials and local stakeholders for primary data collection;
- c) PRA /RRA, FGDs, KII for primary data collection
- d) Institutional Survey (IS) for primary data collection in district and Upazila level offices which included DC office, LGED office, Civil Surgeon office, Social Service office etc.

### 3.2.3 Scoping

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

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

### **3.2.4 Bounding**

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

### **3.2.5 Major Field Investigation**

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

### **3.2.6 Impact Assessment**

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

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

- i) Changes in the status of the IESCs pertaining to water resources;
- ii) Changes in the status of the IESCs pertaining to land resources, agriculture, livestock and poultry;
- iii) Changes in the status of the IESCs pertaining to fisheries;
- iv) Changes in the status of the IESCs pertaining to ecological resources; and
- v) Changes in the status of the IESCs pertaining to socio-economic condition.

### **3.2.7 Impact Evaluation**

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

### **3.2.8 Preparation of Environmental Management and Monitoring Plan**

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

### **3.2.9 EIA Report Preparation**

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



## 4. Project Description

### 4.1 Introduction

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

### 4.2 Project Context: The FRERMIP Programme

#### 4.2.1 FRERMIP Background and Objectives

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

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

96. FRERMIP aims to modify the flood season hydrology of a very large area of floodplain by providing new and rehabilitated embankments, leaving distributaries open, along selected reaches of the Padma / Jamuna River. To protect these embankments, river banks will be progressively stabilized, starting at critically eroding reaches. Over time, this approach may lead to general river stabilization, potentially transforming the geomorphology of the Padma / Jamuna in an unprecedented manner (particularly if a single-channel solution is implemented).<sup>18</sup> The anticipated benefits are considerable: (i) reduced loss of agricultural and other land to river erosion, (ii) reduced flood damage to agriculture (etc), and (iii) increased agricultural production on less-flooded agricultural land.

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

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

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

<sup>18</sup> As envisaged in: BWDB. 2012. Capital Dredging and Sustainable River Management Project, First Interim Report.

#### 4.2.2 FRERMIP Location and Area

100. The FRERMIP area encompasses the Jamuna River reach starting below the Jamuna Bridge and the proposed Ganges Barrage site, down to Chandpura on the Lower Meghna. Downstream of the Jamuna Bridge and the Barrage site, the Jamuna and Ganges river courses are somewhat independent of upstream river developments. The FRERMIP area covers 9,300 km<sup>2</sup> with a total population of 10.5 million (2011 census) in 40 upazilas and 431 unions, with an average population density of nearly 1,600 persons per km<sup>2</sup> of floodplain land.

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

#### 4.2.3 FRERMIP Implementation Schedule

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

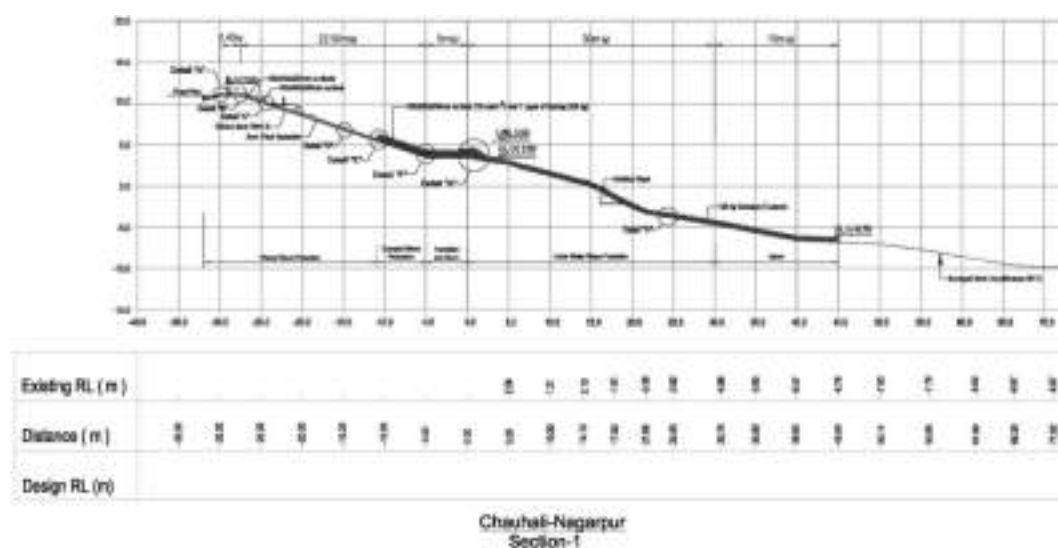
### 4.3 Project –Tranche 1

#### 4.3.1 Proposed Interventions

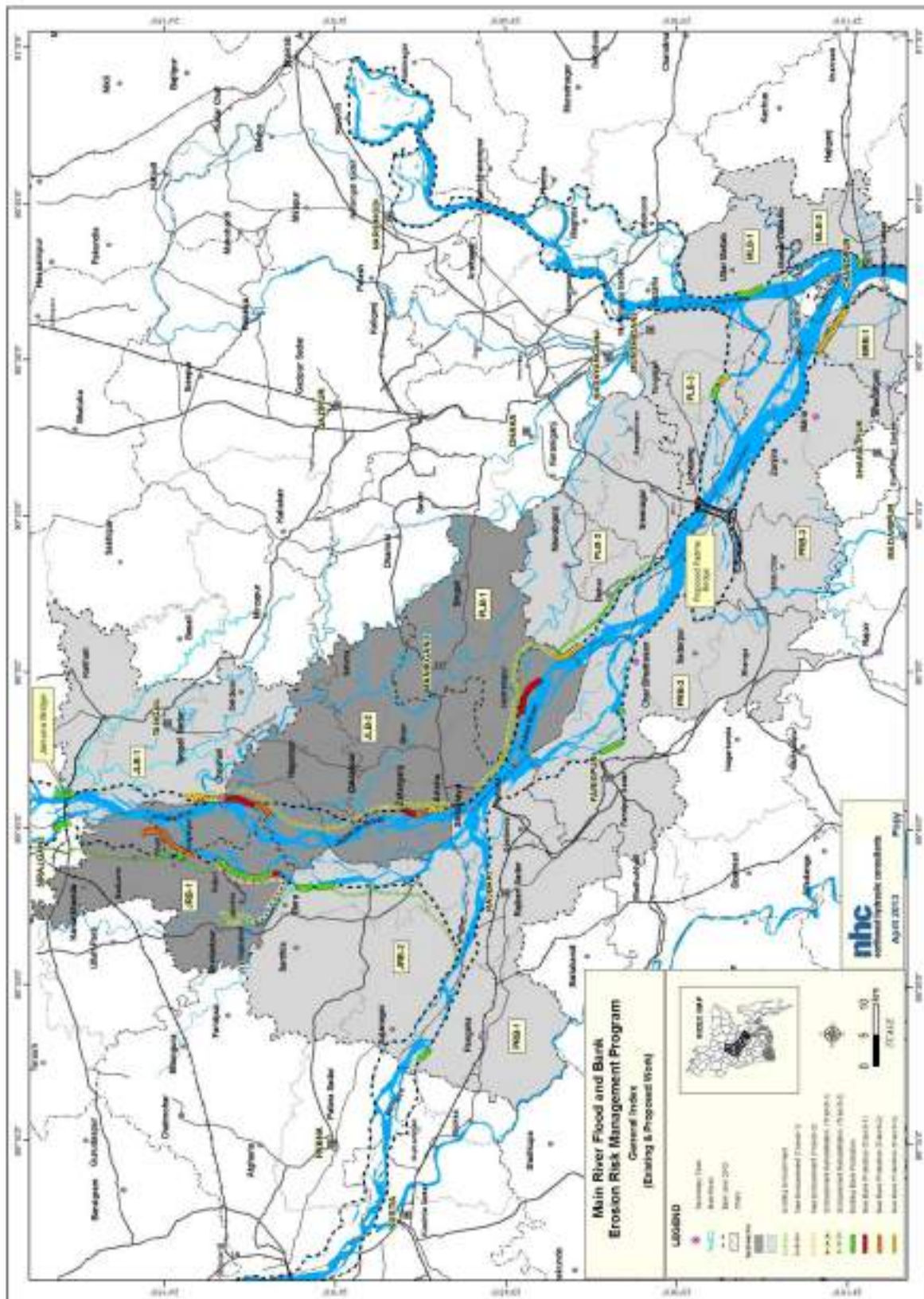
103. Proposed interventions under Tranche 1 fall into four categories: (i) riverbank protection, (ii) new and rehabilitated road/flood embankments, (iii) drainage sluices and (iv) afforestation.

##### a) Riverbank Protection

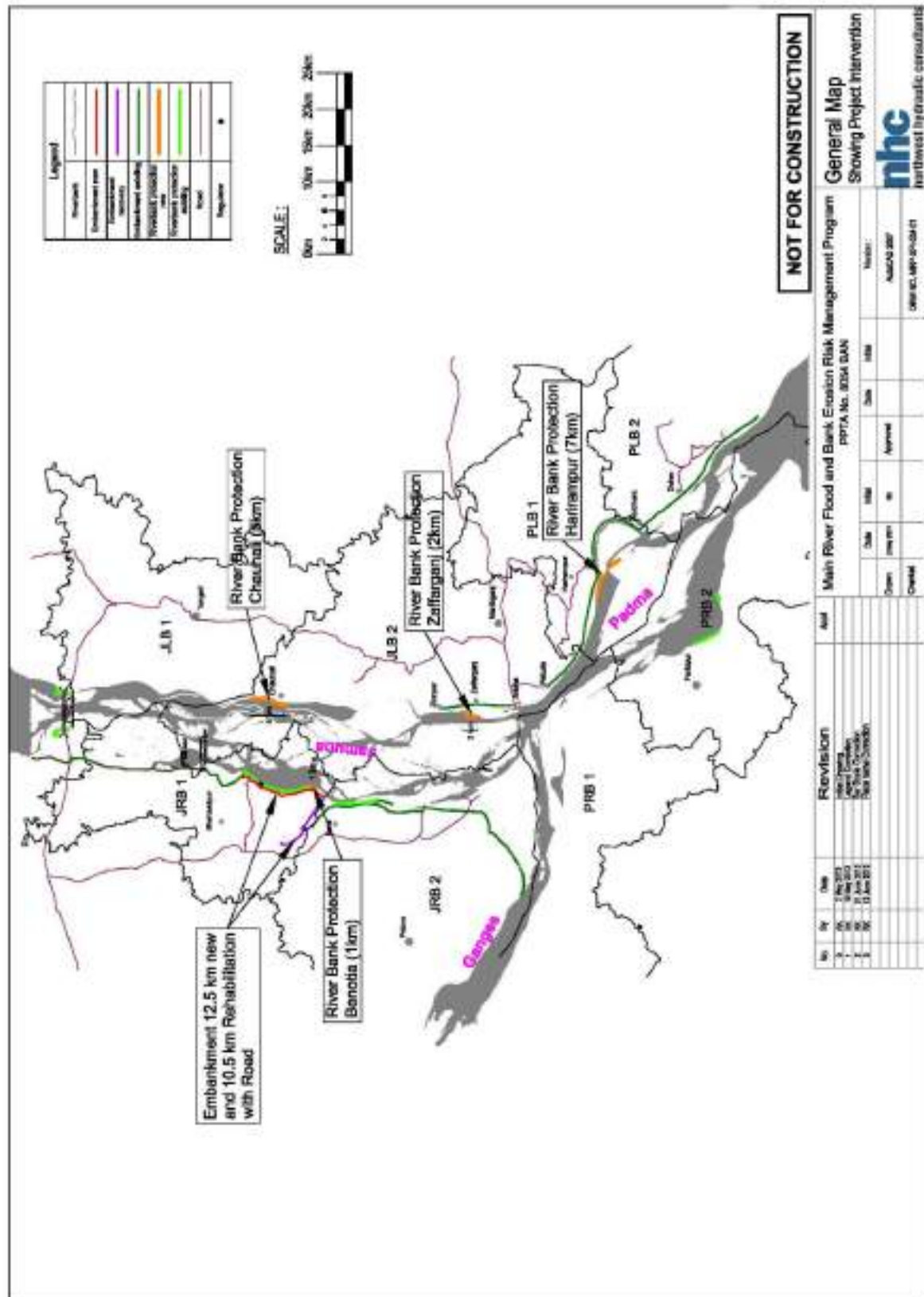
104. Figure 4.2 shows a representative cross-section of riverbank protection works. Construction of riverbank protection typically involves the following activities. Labor sheds are constructed and stocked with construction materials (sand, cement, wood, shuttering materials etc.). Sanitation facilities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



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



Map 4.1: Proposed Interventions Color-Coded by Tranche



### Map 4-2: Proposed Tranche 1 Interventions



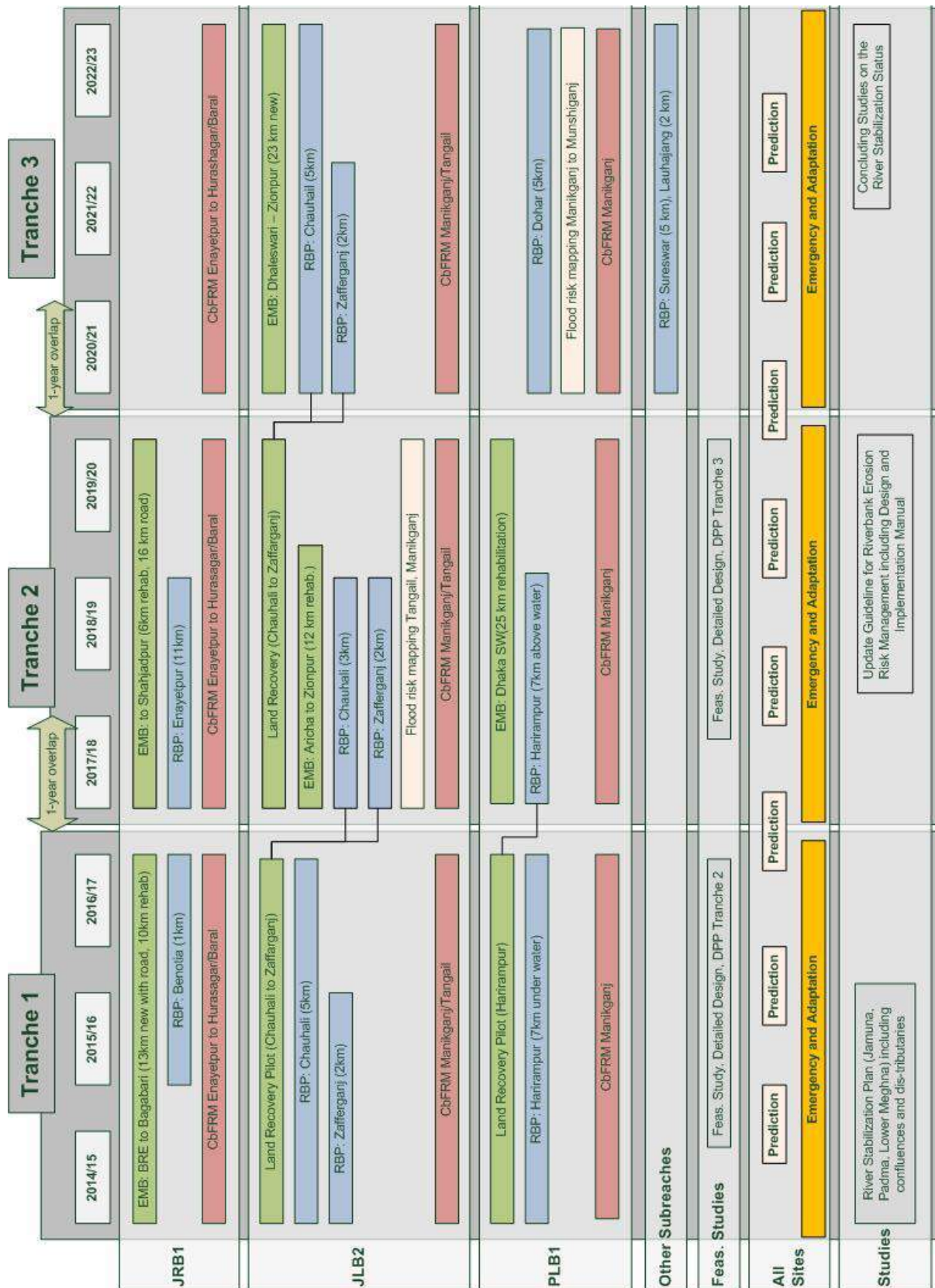


Figure 4.1: Construction Schedule

## b) Embankments

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

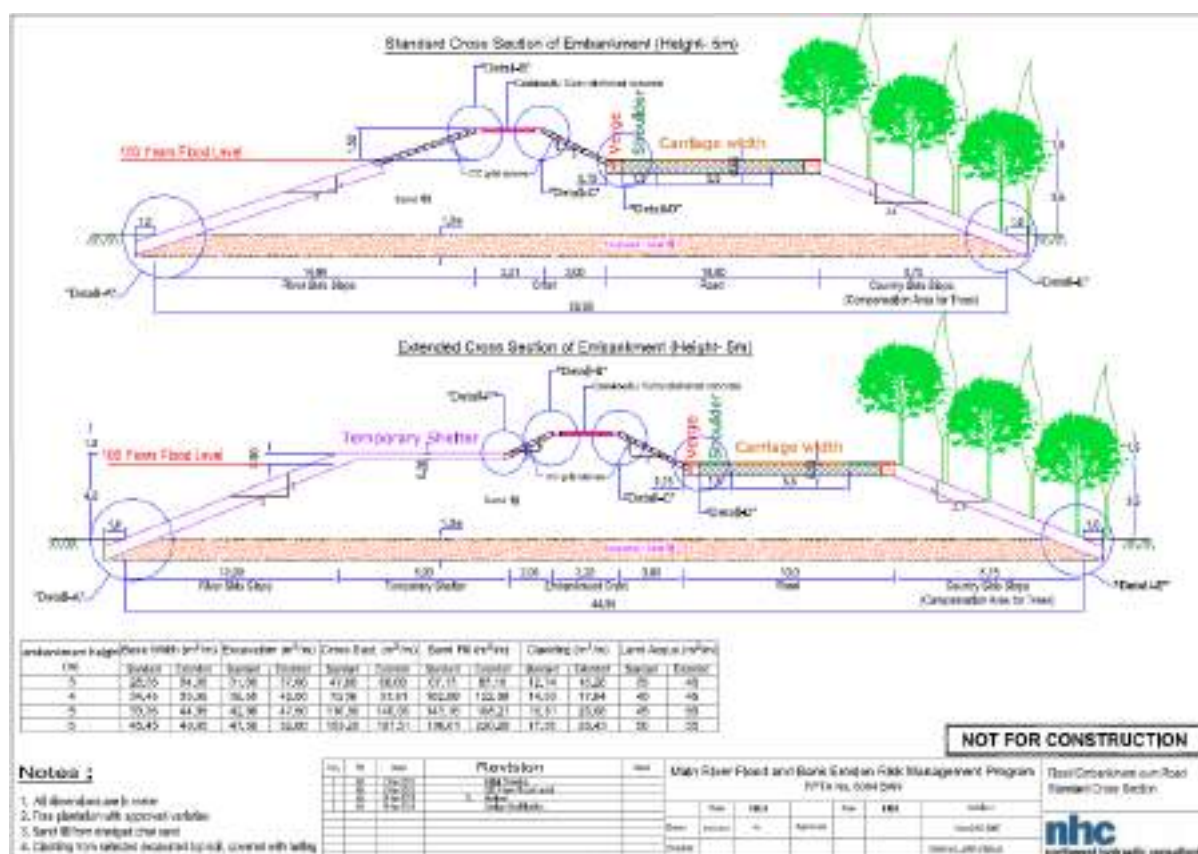


Figure 4.3: Embankment, Representative Cross-Section

## c) Drainage Sluices

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

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

#### **d) Afforestation**

107. Figure 4.3 shows a representative cross section of an afforested embankment. Afforestation helps protect the country-side slopes and toe of the embankment from erosion by drainage from the crest and the road. Afforestation activities include establishing a temporary nursery to ensure seedling availability and plantation of appropriate species seedlings at species-appropriate intervals.

### **4.3.2 Project Implementation Arrangements**

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

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

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

111. An Institutional Strengthening and Project Management Consultant (ISPMC) will provide consultancy and NGO services to support project implementation in a variety of ways, including the services of a specialist organization to conduct environmental assessment, planning and

management to support the PMO in environmental monitoring; and, in Tranches 2 and 3, to assist PMO to design and develop a new Environmental Monitoring and Management Unit.

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

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

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

#### 4.3.3 Implementation Schedule

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

#### 4.3.4 Tranche 1 Subprojects

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

**Table 4.1: Tranche 1 Embankment Rehabilitation**

| No. | Location                                    | Length (km) | Design Crest Width (m)                      | Design Crest RL (m +PWD) | Side Slope               |
|-----|---|-------------|---|--------------------------|--------------------------|
| 1   | Verakhola towards start of Hurashagar River | 6.5         | 16.2 (section with different top elevation) | 15.6                     | R/S 1V:3H<br>C/S 1V:2.5H |
| 2   | Start of Hurashagar River to Korotoa bank   | 4           | 16.2 (section with different top elevation) | 15.6                     | R/S 1V:3H<br>C/S 1V:2.5H |

Source: Final Report, Main Volume, 2013



**Table 4.2: Tranche 1 Embankment Construction**

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

Source: Final Report, Main Volume, 2013

**Table 4.3: Tranche 1 Riverbank Protection**

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

Source: Final Report, Main Volume, 2013

**Table 4.4: Tranche 1 Drainage Sluices**

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

Source: Final Report, Main Volume, 2013

#### 4.3.5 Associated Facility Analysis

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

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

118. With regard to condition (ii), the embankments are not essential to the successful operation of the erosion protection. In the case of JLB-2, the Tranche 2 embankment flood damage benefits (ie the “goods and services” of the flood embankment) do however substantially cross-subsidize the cost of the Tranche 1 JLB-2 erosion protection works.<sup>19</sup>

<sup>19</sup> The economic analysis presented in Sec. 18 of the Final Report, Main Volume (version dated 21 July 2013) includes costs and benefits of all tranches, broken out by subreach. For JLB-2, 66 per cent of the benefits derive from reduced flood

#### **4.3.6 Labor Requirement, Construction Materials, and Equipment**

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

---

damage, while 67 per cent of the costs derive from erosion protection works. For PLB-1, 72 per cent of the benefits derive from reduced erosion, and 77 per cent of the costs derive from the erosion protection.

Table 4.5: Embankment Re-Sectioning Details

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

Notes:

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

Table 4.6: New / Retired Embankment Construction Details

| Chainage and<br>Placenames<br>(Para, Village/Mouza) | Length<br>(km) | Land Ownership<br>and Land Use<br>Along Alignment | Design Crest<br>width (m) | Design<br>Crest R/L<br>(m) | Side Slope               | Soil Volume<br>Required<br>(m <sup>3</sup> ) | Borrow Pits –<br>Placenames, Area<br>(ha), Existing Land<br>Use | Skilled and<br>Unskilled Labour<br>Required<br>(person-day) | Earthworks<br>Labour Shed<br>Location | Soil Conveyance<br>Method(s) |
|---|----------------|---|---------------------------|----------------------------|--------------------------|--|---|---|---------------------------------------|------------------------------|
| Location 1: Kaizuri-<br>Hurasagar offtake           | 10.5           | Per LARP  | 3.2+3+10 =<br>16.2 m      | 15.60 m<br>PWD             | R/S 1V:3H<br>C/S 1V:2.5H | Sandy soil<br>1,236,585                      | Construction sand<br>will be dredged                            | Construction:<br>Skilled: 5600                              | Temporary,<br>in the                  | Sand pumped<br>from dredger  |

|   |     |  |  |  |  |  |   |   |           |   |
|---|-----|--|--|--|--|--|---|---|-----------|---|
| (JRB-1)                                 |     |  | (section with different top Elevation)   |  |  | m3   | from riverbed   | Unskilled: 105,000  | alignment | Excavator for clay collection from embankment |
| Location 2: Kaizuri Benotia (JRB-1)     | 2.0 |  | 8+2+3.2+3+10 = 26.2 m (section with different top Elevation, includes temp settlement) |  |  | Clay soil 174,405 m3<br>Sandy soil 282,540 m3<br>Clay soil 40,120 m3 | Clay is taken from topsoil removed from embankment alignment prior to construction (not all topsoil is clay; sand is used for embankment core; Any unsuitable (non-sand, non-clay) materials eg peat is disposed per Engineer in Charge instruction | Annual O&M Skilled: 380<br>Unskilled: 5200<br>Construction: Skilled: 1200<br>Unskilled 22,000<br>Annual O&M Skilled: 60<br>Unskilled: 1100<br>Construction Skilled: 2700<br>Unskilled: 48,000<br>Annual O&M Skilled: 140<br>Unskilled: 2400 |           |   |
| Location 3: Hurasagar-Baghabari (JRB-1) | 6.0 |  | 3.2+3+10 = 16.2 m (section with different top Elevation)                               |  |  | Sandy soil 597,000 m3<br>Clay soil 94,800 m3                         |   |   |           |   |

Notes:

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

Table 4.7: River Bank Protection Construction Details

| Chainage and Placenames<br>(Para, Village/Mouza) | Length (km) | Design Bed R/L (m) | Side Slope      | Soil Volume Required (m³) | Soil Collection Locations                       | Concrete Blocks (number and size)              | Geobags and Geotextile Filters                                      | Skilled and Unskilled Labour Required (person-day)     | Earthworks Labour Shed Location | Soil Conveyance Method(s)           |
|--|-------------|--------------------|-----------------|---------------------------|---|--|---|--|---------------------------------|-------------------------------------|
| Benotia (JRB-1)                                  | 2.0         | -8.0 m PWD         | 1V:3H above LWL | 0.204 Mm³                 | Bank slope from -2.00 to +9m PWD a 5.0m berm at | Construction 86,000 nos 40x40x30cm 197,000 nos | Construction 0.838M nos geobag-125 kg Geotextile filter- 74,000 sqm | Construction Skilled: 29000 nos Unskilled: 170,000 nos | Temporary rented locations      | Carried by dump truck and excavator |

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

| Chainage and Placenames<br>(Para, Village/Mouza) | Length (km) | Design Bed R/L (m) | Side Slope | Soil Volume Required (m³) | Soil Collection Locations | Concrete Blocks (number and size)                         | Geobags and Geotextile Filters                                   | Skilled and Unskilled Labour Required (person-day) | Earthworks Labour Shed Location | Soil Conveyance Method(s) |
|--|-------------|--------------------|------------|---------------------------|---------------------------|---|--|--|---------------------------------|---------------------------|
|  |             |                    | Below LWL  |                           |                           | appropriate here)<br><br>Annual O&M<br>[no blocks needed] | Annual O&M<br>40,000 nos geobag-125kg<br>30,000 nos geobag-250kg | Annual O&M<br>Skilled:-1700<br>Unskilled: 10,500   |                                 |                           |

## Notes:

1. Skilled and un-skilled labour person-days required are calculated taking into account expected construction methodologies.
2. Annual O&M labor for riverbank protection has been estimated at two per cent of total construction labour (see above). Unlike embankments, additional major repairs are not necessary.

Table 4.8: Drainage Sluice Construction Details

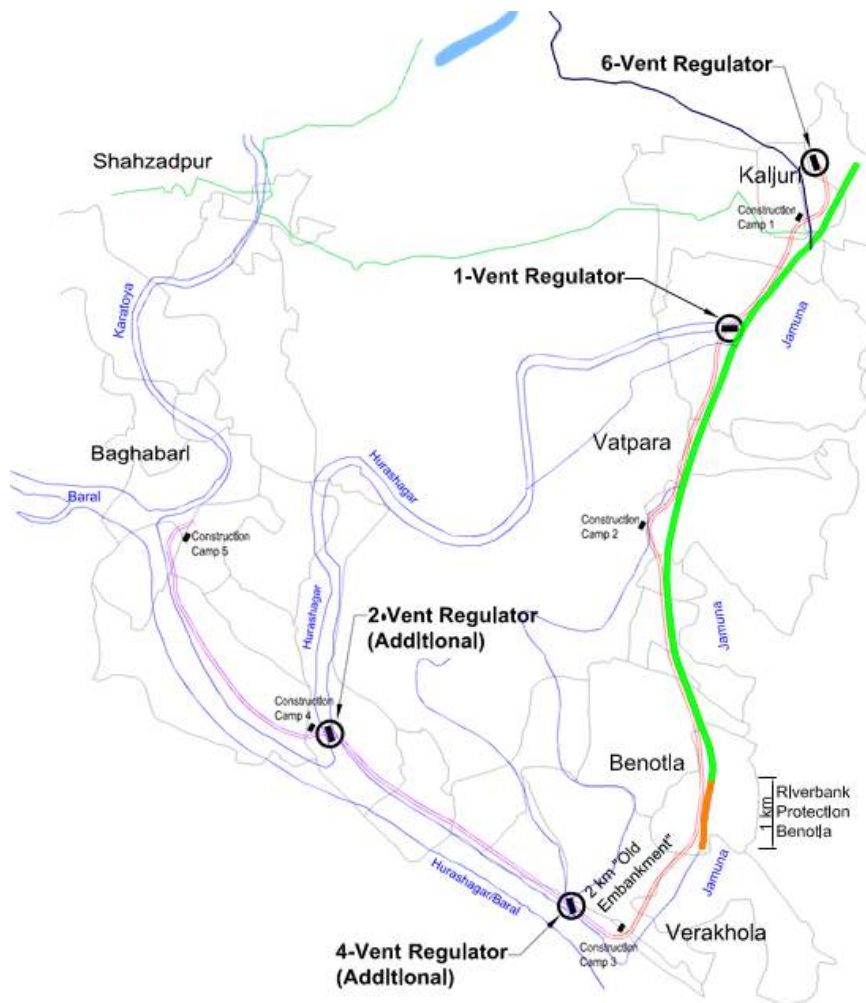
| Chainage and Placenames<br>(Para, Village/Mouza)   | Identifying<br>Landmark<br>(name of<br>mosque,<br>school etc) | Khal Name | Catchment<br>area<br>(ha) | Vents (number and<br>size)                       | Construction Materials<br>(type, number,<br>conveyance)  | Number of skilled/ unskilled labour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

## Notes:

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

### 4.3.7 Camps

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



**Map 4.3: JRB-1 Proposed Camp and Infrastructure Locations**

### 4.3.8 Transportation of Materials

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



## 5. Environmental and Social Baseline

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

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

### 5.1 Physical Environment

#### 5.1.1 Climate

##### *a) Seasonality*

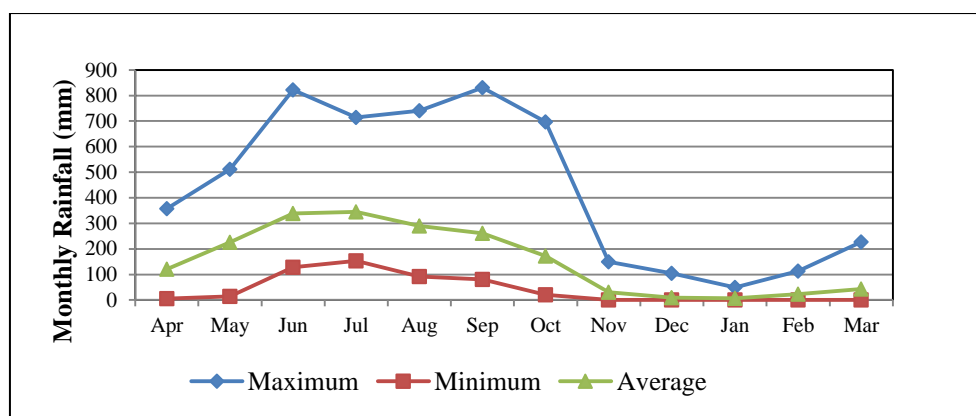
123. Bangladesh has a sub-tropical monsoon-dominated climate. Seasons progress from a hot and dry pre-monsoon season March to May, to a rainy south-west monsoon season June to October, through a cool dry winter November to February. During the pre-monsoon, violent thunderstorms (referred to as “northwesters”)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

##### *b) Meteorology Stations*

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

##### *c) Rainfall*

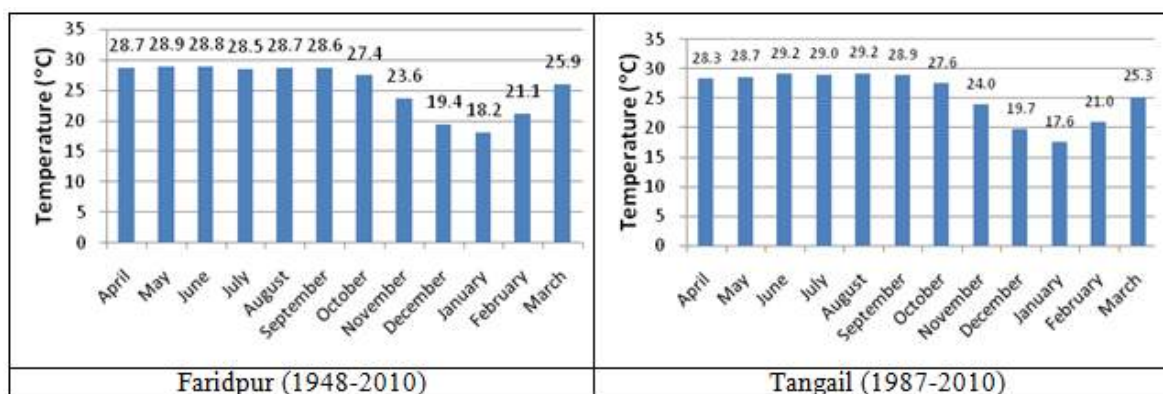
125. Mean annual rainfall in the project area is approximately 1800 mm/year (FAP-3, 1992). Figure 5.1 shows the 1959-2008 rainfall record from Faridpur station. Significant rainfall occurs from June to October, and little or no rainfall from November to February. The maximum recorded monthly rainfall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



**Figure 5.1: Monthly rainfall of the study area**

**d) Temperature**

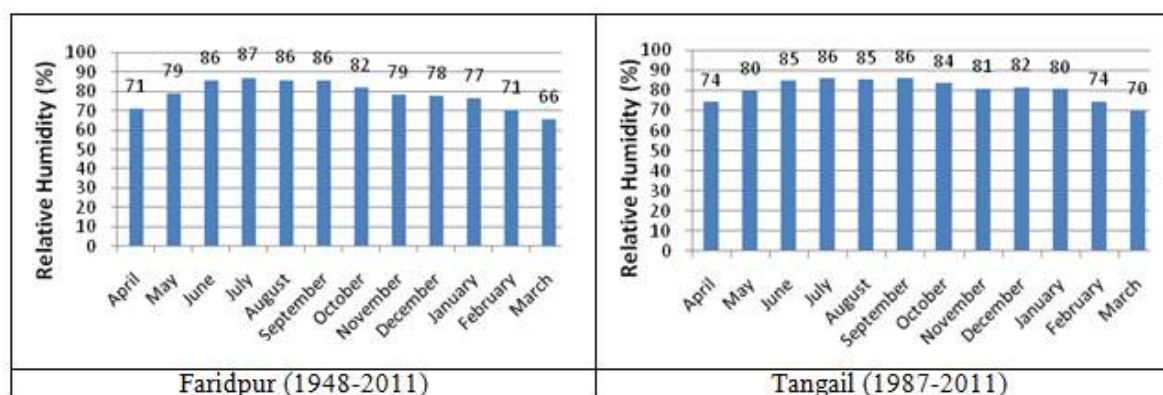
126. Figure 5.2 shows average monthly temperatures 1948-2010 at Faridpur and 1987-2010 at Tangail. These range from 18.2 to 28.9°C in Faridpur and 17.6°C-29.2°C in Tangail, with higher values (>27.4°C) from April to October, and lower values from November to March.



**Figure 5.2: Monthly temperature of the study area**

**e) Humidity**

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



**Figure 5.3: Relative humidity of the study area**

### f) Evaporation

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

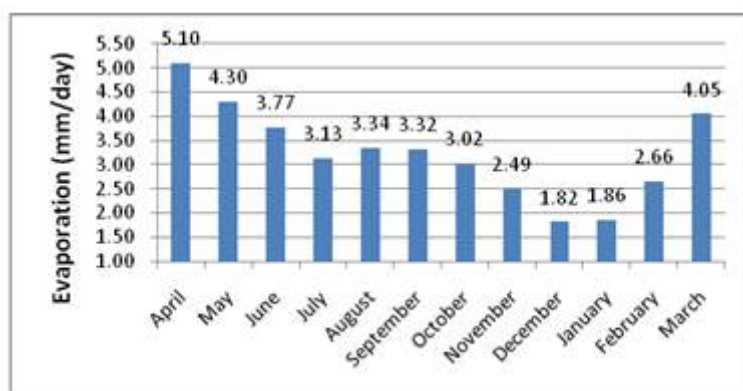


Figure 5.4: Evaporation of the study area

### g) Wind Speed

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

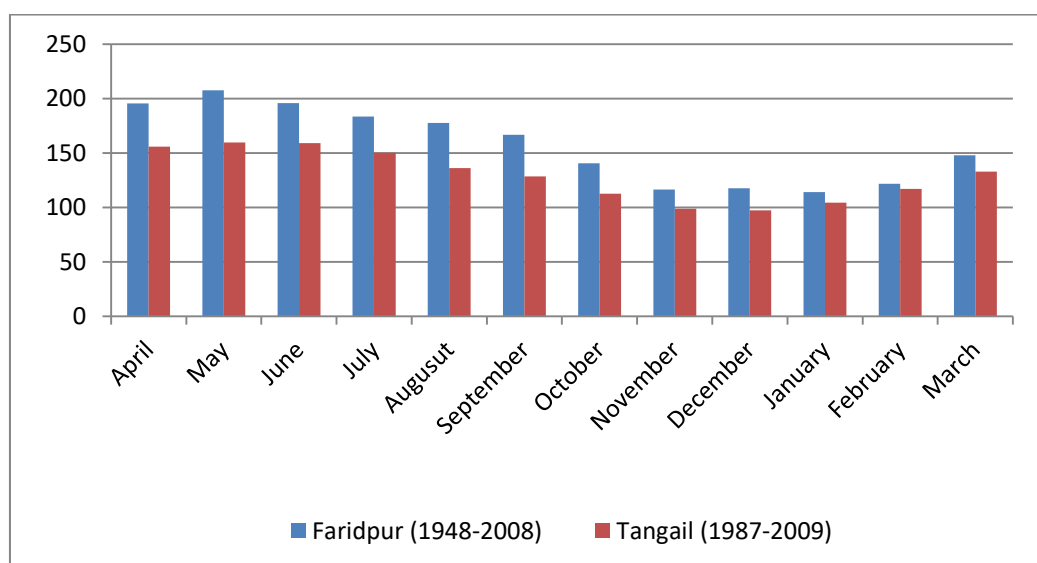
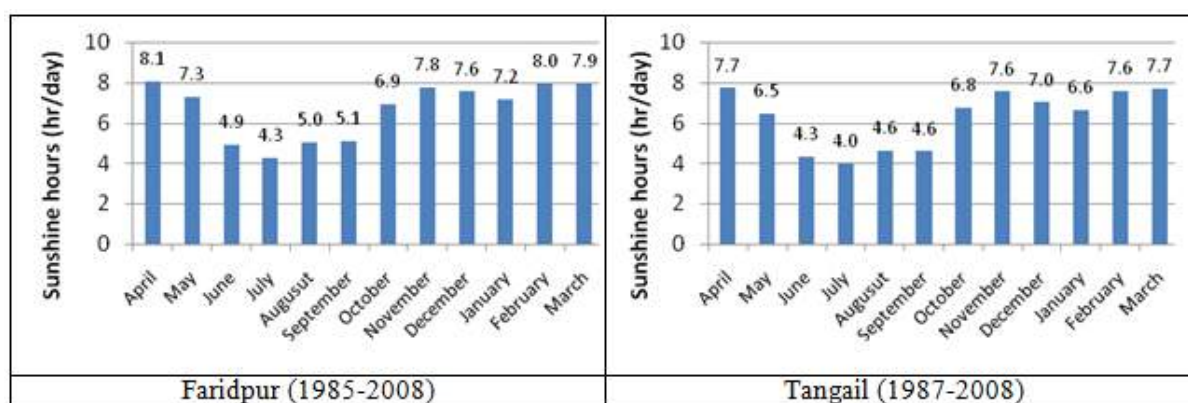


Figure 5.5: Windspeed of the study area

### h) Sunshine Hours per Day

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



**Figure 5.6: Sunshine hours per day**

### 5.1.2 Stratigraphy and Seismicity

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

### 5.1.3 Topography

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

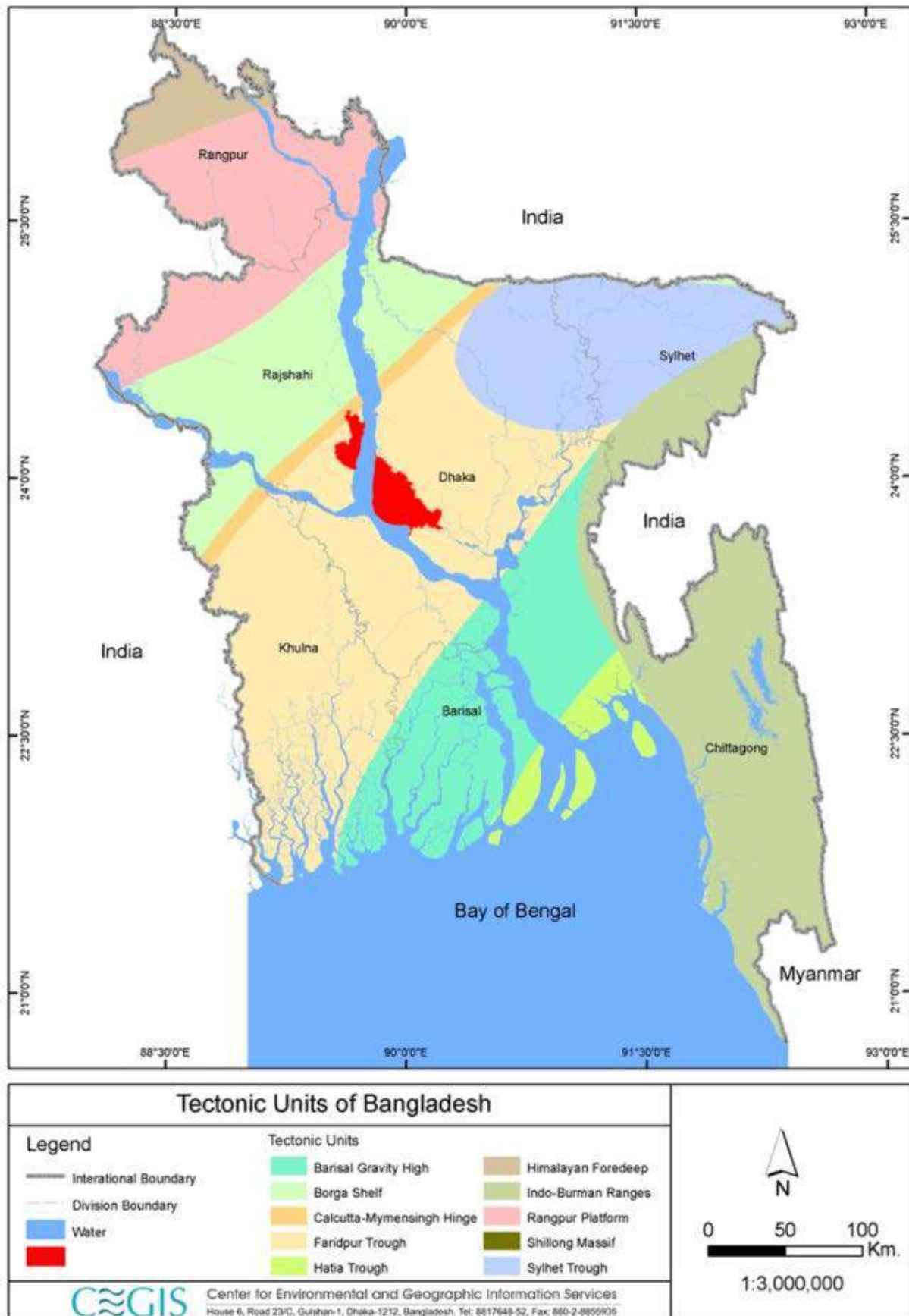
## 5.2 Water Resources

### 5.2.1 River System

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

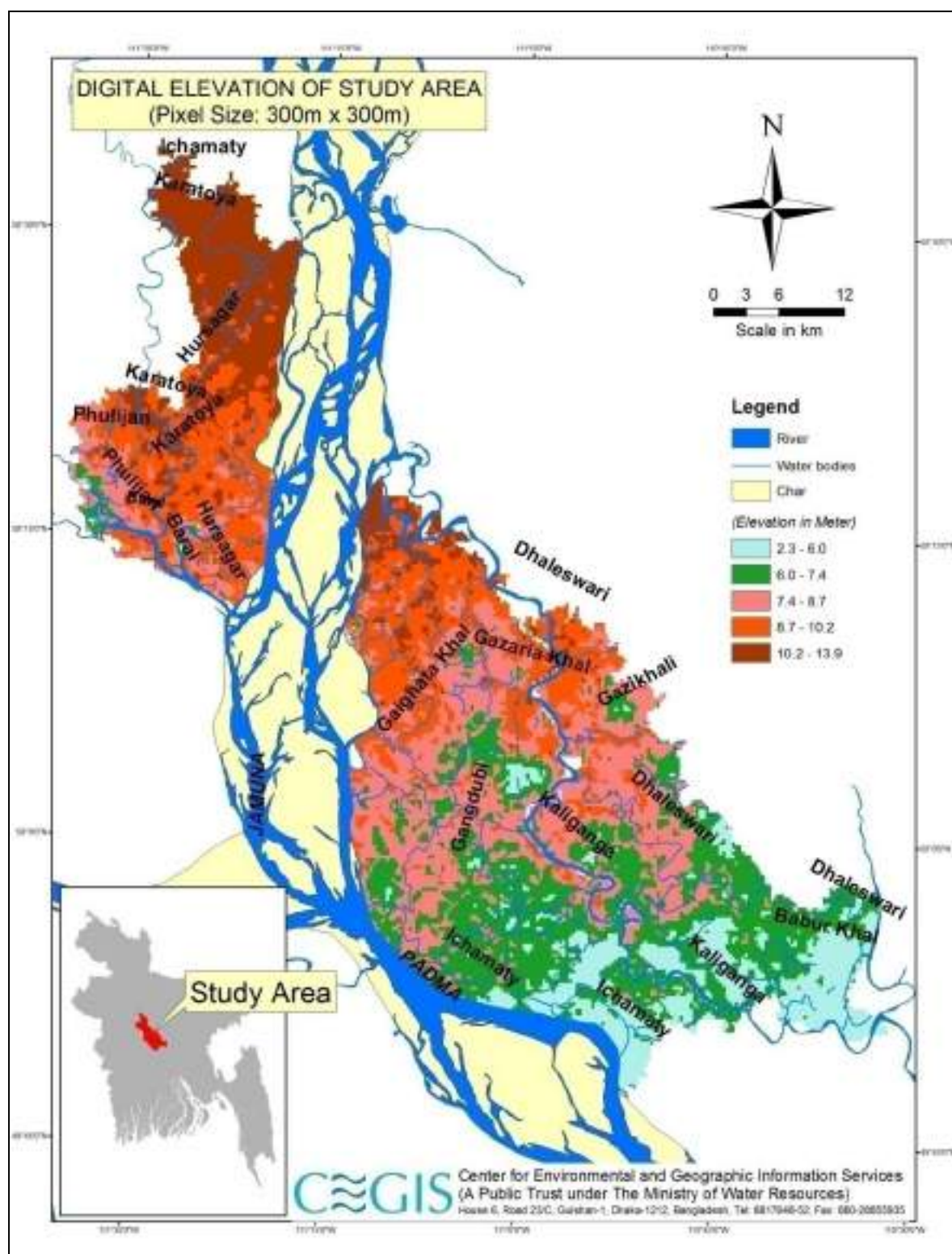
134. The Jamuna River is the 240 km-long lower reach of the Brahmaputra River from the India-Bangladesh border to the confluence with the Ganges. The Jamuna has an annual average discharge of around 20,000 m<sup>3</sup>/s at Bahadurabad Transit. The flow varies from a low of 8000 m<sup>3</sup>/s to a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

135. The Ganges/Padma (above its confluence with the Jamuna) has a long-term mean flow of about 12,000 m<sup>3</sup>/s or about 60 per cent of the Jamuna. Flood discharges reach 80,000 m<sup>3</sup>/s. The Ganges/Padma typically peaks later than the Jamuna in August-September. The Ganges/Padma has the lowest water yield, particularly in the dry season, with flows dropping below 650 m<sup>3</sup>/s.



**Map 5.1: Location of Study area in the Tectonnnnnnnic units of Bangladesh**





**Map 5.2: Topography of the Study area**

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

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

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

**Table 5.1: Seasonal Discharge of Jamuna and Padma**

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

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

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

Source: BWDB

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

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

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

## 5.2.2 Surface Water Levels and Quality

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

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

**Table 5.3: Water levels of Jamuna and Padma**

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

Source: Bangladesh Water Development Board

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

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

Source: Bangladesh Water Development Board

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

**Table 5.5: Surface Water Quality of Jamuna and Padma**

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

Source: Bangladesh Water Development Board



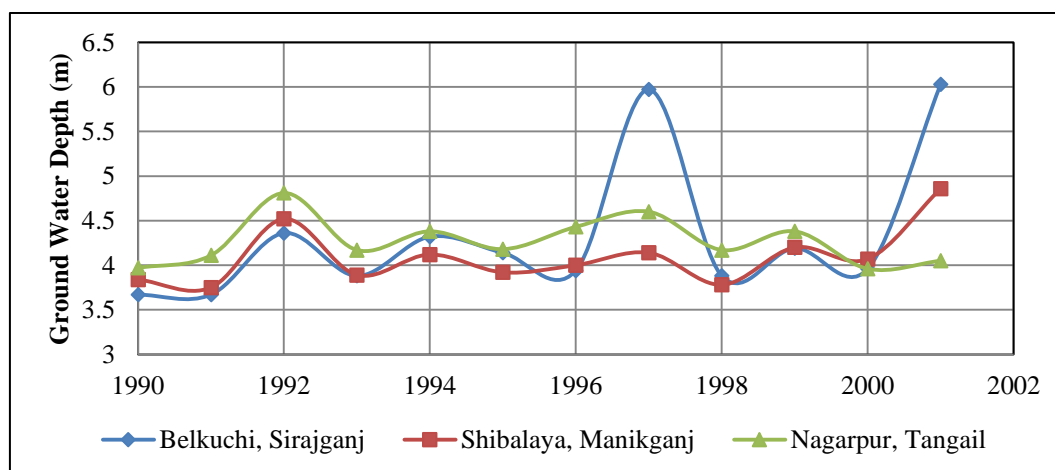
**Table 5.6: Bangladesh Water Quality Standard**

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

Source: Bangladesh Water Development Board

**(i) Ground Water**

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



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

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

### 5.2.3 Water Resources Functions

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

**(a) Irrigation**

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

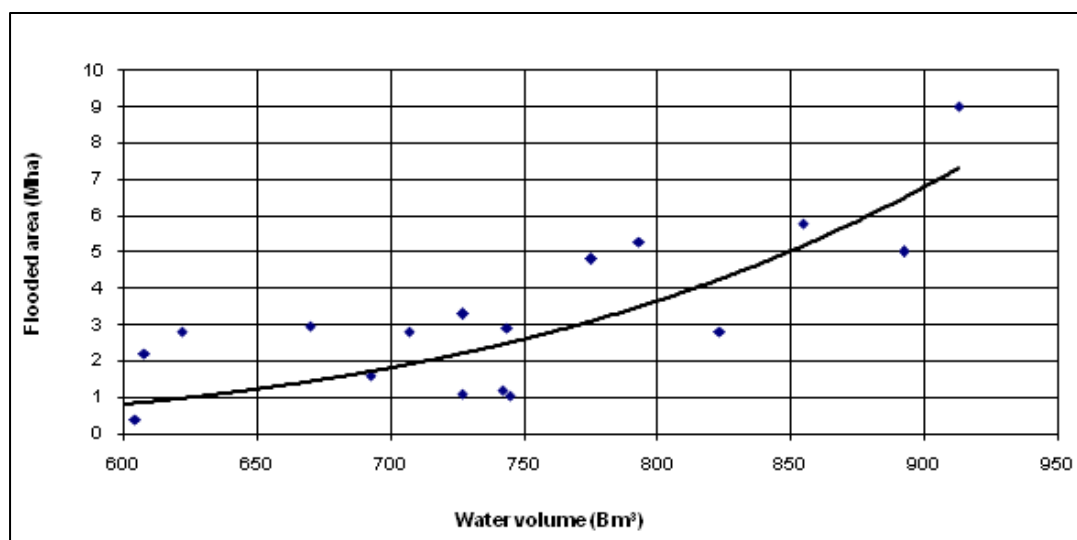
**Table 5.7: Irrigable Areas and Water Consumption**

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

Source: Minor irrigation Project, 2010

**(b) Flood Management**

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

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

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

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

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

Source: Flood Shelter Report, IWFM and BRAC

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

**Table 5.9: Flood Level Frequency Analysis, Jamuna at Bahadurabad**

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

Source: Flood Shelter Report, IWFM and BRAC

**Table 5.10: Flood Level Frequency Analysis, Padma at Mawa**

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

Source: IWFM and BRAC Flood Shelter Report.

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

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

### **(c) Morphology**

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

### **(d) Erosion**

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

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

### **(e) Char Formation**

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

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

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

### 5.3 Land Resources

#### 5.3.1 Agro-Ecological Regions

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

159. Thirty agro-ecological regions and 88 sub-regions have been identified by adding successive layers of information on the physical environment which are relevant for land use and assessing agricultural potential (Map 5.3). These layers are: (i) physiography (land forms and parent materials); Soils and their characteristics; (ii) depth and duration of seasonal flooding; (iii) length of the rain-fed kharif and rabi growing periods; Length of the pre-kharif period of unreliable rainfall; (iv) length of the cool winter period and frequency of occurrence of extremely low temperature (below 0.40°C); (v) winter temperature and (vi) frequency of occurrence of extremely high (> 40°C) summer temperature.

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

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

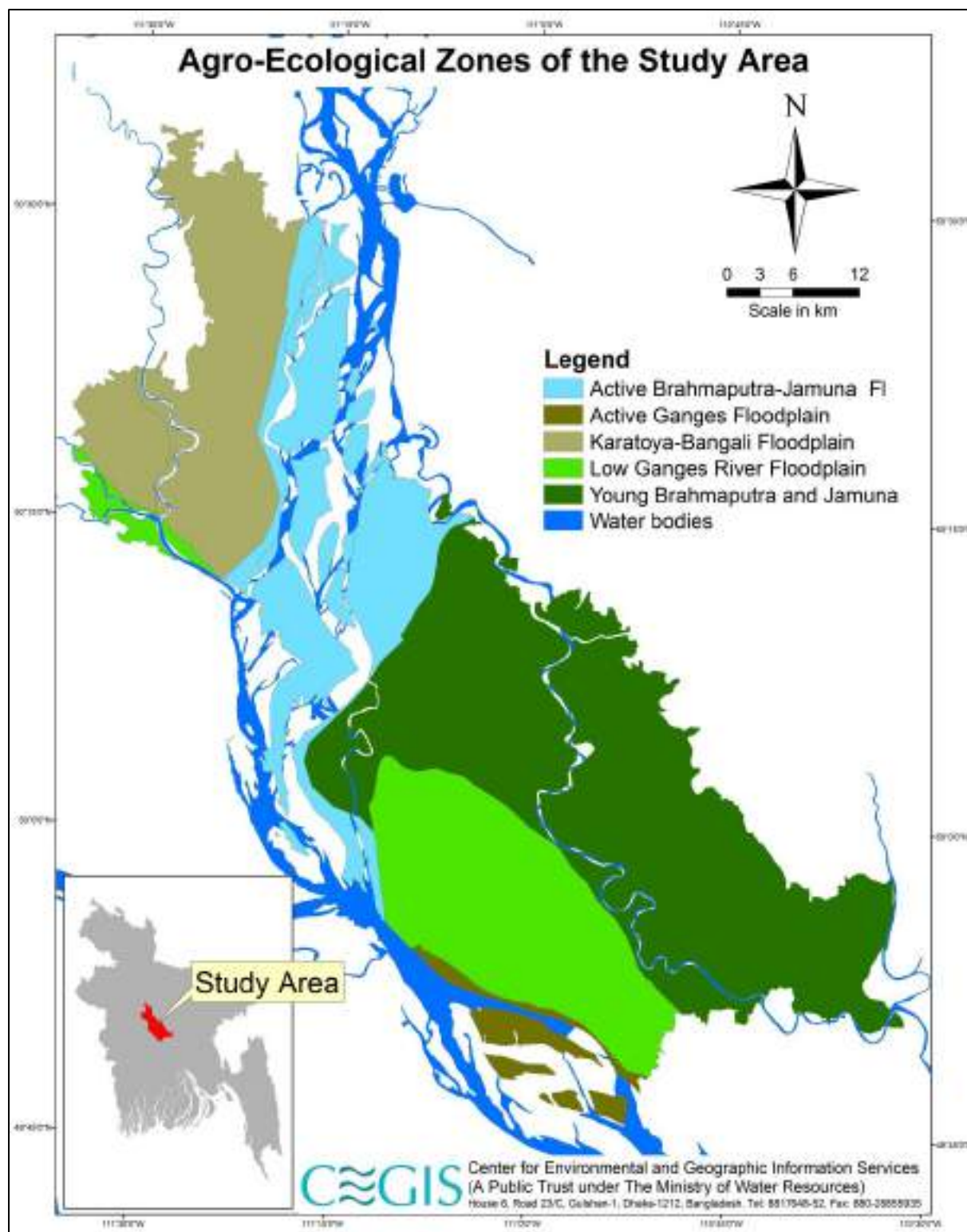
161. The distribution of agro-ecological regions in the study area is presented in **Error! Reference source not found.5.11**. Characteristics of study area agro-ecological regions are presented below.

**Table 5.11: Agro-Ecological Zones**

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

#### *Karatoya-Bangali Floodplain Region (AEZ-4)*

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



**Map 5.3: Agroecological Region of the Study Area**

**Table 5.12: Soil Characteristics, Karatoya-Bangali Floodplain Region**

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

Source: BARC Fertilizer Recommendation Guide-2005.

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

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

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

**Table 5.13: Soil Characteristics, Active Brahmaputra-Jamuna Floodplain**

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

Source: BARC Fertilizer Recommendation Guide-2005.

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

*Young Brahmaputra and Jamuna Floodplain Region (AEZ 8)*

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



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

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

Source: BARC Fertilizer Recommendation Guide-2005.

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

#### *Active Ganges Floodplain Region (AEZ-10)*

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

**Table5.15: Soil Characteristics, Active Ganges Floodplain Region**

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

Source: BARC Fertilizer Recommendation Guide-2005.

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

#### *Low Ganges River Floodplain (AEZ-12)*

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

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



**Table 5.16: Soil Characteristics, Low Ganges River Floodplain**

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

Source: Fertilizer Recommendation Guide-2005, BARC

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

### 5.3.2 Land use

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

**Table 5.17: Land Use of the Study Area**

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

Sources: CEGIS estimation from SOLARIS.

### 5.3.3 Land type

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

**Table 5.18: Land Types of the Study Area**

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

Sources: CEGIS estimation from SOLARIS.

### 5.3.4 Soil Texture

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

**Table 5.19: Soil Texture, 0-15 cm Depth**

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

Sources: CEGIS estimation from SOLARIS.

### 5.3.5 Available Soil Moisture

171. The available soil moisture is very important for the cultivation of Rabi crops. The high (72.9%) and medium level (26.9%) of available soil moisture has been observed in the study area. The distribution of available soil moisture is presented in Table 5.20.

**Table 5.20: Soil Moisture of the Study area**

| Soil Moisture | Area           | Per cent of NCA |
|---------------|----------------|-----------------|
| High          | 134,373        | 72.9            |
| Medium        | 49,485         | 26.9            |
| Low           | 342            | 0.2             |
| <b>Total</b>  | <b>184,200</b> | <b>100.0</b>    |

Source: CEGIS estimation from SOLARIS.

### 5.3.6 Drainage Characteristics

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

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

**Table 5.21: Drainage Characteristics of the Study Area**

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

Source: CEGIS estimation from SOLARIS (NWRD).

## 5.4 Agriculture Resources

### 5.4.1 Farming Practices

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

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

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

**Photo 5.1: Boro Seedbed**



**Photo 5.2: Mustard**



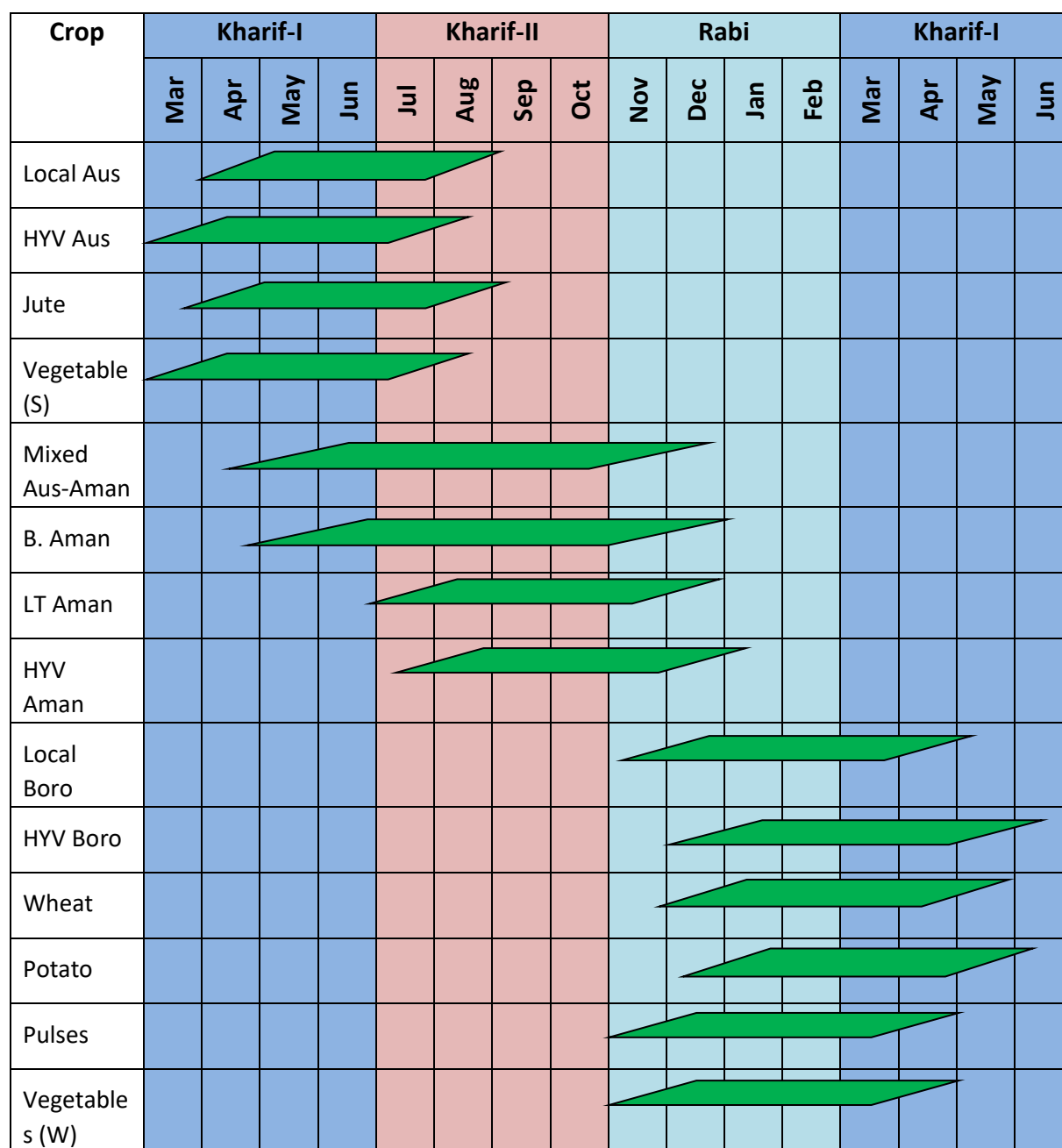
### 5.4.2 Crop Production Constraints

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

### 5.4.3 Crop Calendar, Crop Pattern and Cropping Intensity

178. Figure 5.9 shows the crop calendar.

**Figure 5.9: Crop Calendar**



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

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

Table 5.22: Cropping Pattern by Land Type

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

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

#### 5.4.4 Cropped Area

181. Detailed areas of crops are shown in Table 5.23 which exhibits that total cropped area is 335,099 ha of which 240,052 ha is under rice crop cultivation. Therefore, about 72 per cent of the total cropped area in the study area is under rice crop and the rest (28.3 per cent) is covered with non-rice crops. Pulses and Jutes are the major among the non-rice crops which occupied about 26.3 per cent and 17.1 per cent of the total cropped area respectively. The other non-rice crops covered 56.6 per cent of the total cropped area which include spices, oilseeds, wheat, potato and vegetables crops.

**Table 5.23: Crop Production**

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

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

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

#### 5.4.5 Crop Production

183. Crop production data, presented in Table 5.23, indicates that the major agricultural production of the study area comes from the rice crops. In the study area, the annual total rice production stands at about 268,154 metric tons. There is a production loss in rice production in the study which is calculated as 63,080 MT. Among the rice crops, Boro is contributing about 54 per cent (144,551 MT) followed by T. Aman 33 per cent (89,494 MT), T Aus 8 per cent (22,093 MT) and Mixed Aus-Aman 4 per cent (12,016 MT) of the total rice production. Different types of non-rice crops are grown in about 95,047 ha land and production is about 1,33,336 MT. The non-rice crops are Pulses (about 35,219 MT), Spices (about 17,676 MT), Jute (about 19,737 MT), Mustard (about 20,282 MT), Vegetables (about 4,994 MT) and Potato (about 2,111 MT).

#### 5.4.6 Crop Damage

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

#### 5.4.7 Agricultural Inputs

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

#### 5.4.8 Minor Irrigation

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

**Table 5.24: Fertilizer and Pesticides**

| Crop name | Fertilizer (Kg/ha) | Pesticides |
|-----------|--------------------|------------|
|-----------|--------------------|------------|



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

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

**Photo 5.3: Surfacewater-Irrigated Agricultural Field**



**Table 5.25: Minor Irrigation**

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

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

## 5.5 Livestock and Poultry

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



**Table 5.26: Livestock and Poultry**

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

Source: Upazila Livestock Offices and Census of Agriculture.

### 5.5.1 Livestock and Poultry Health

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

### 5.5.2 Constraints of Livestock and Poultry Rearing

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

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

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

## 5.6 Fisheries

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

**Photo 5.4: Openwater Fish Habitat****Photo 5.5: Openwater Fish Habitat**



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

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

### 5.6.1 Open Water Fish Habitat

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

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

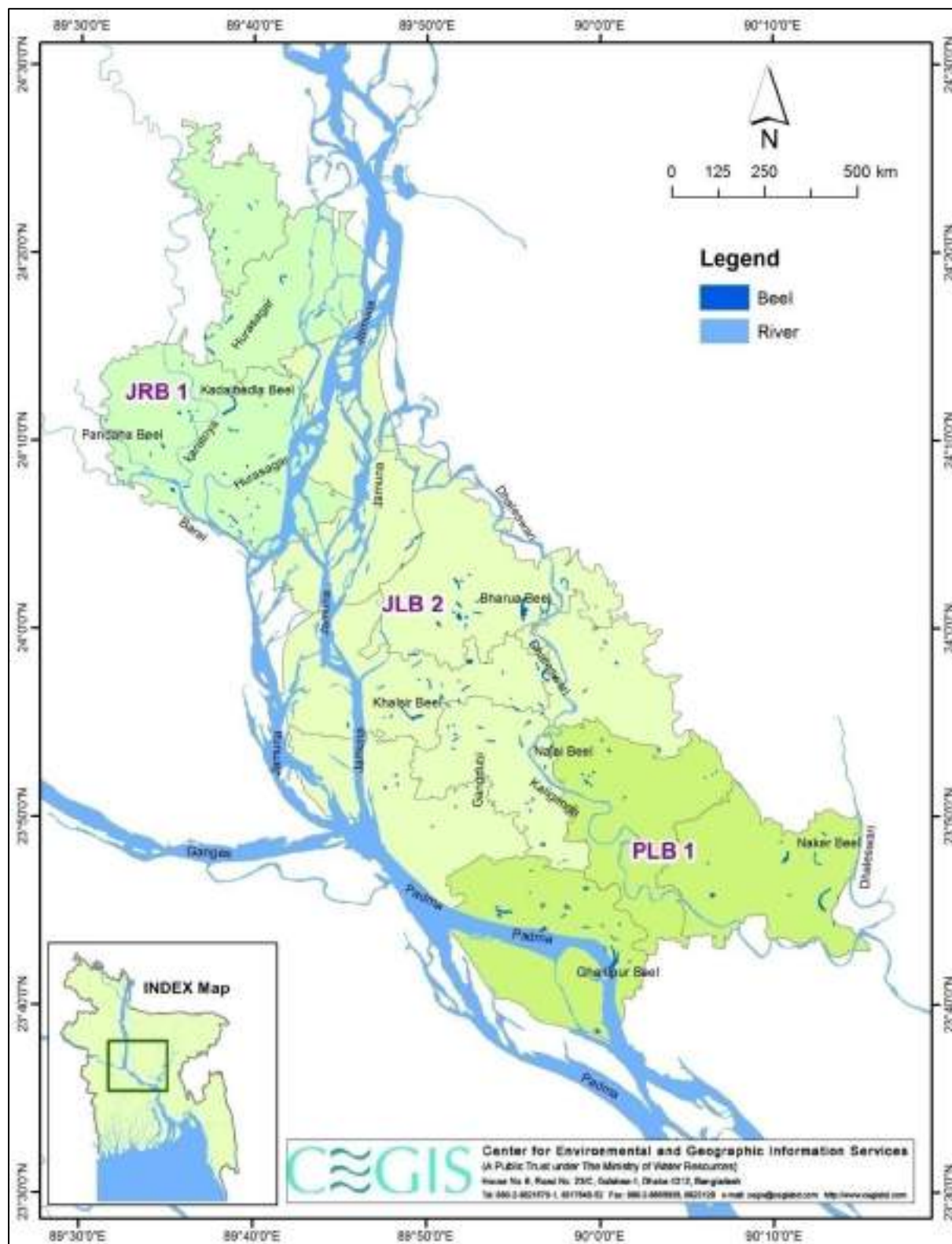
**Table 5.27: Fish Habitat**

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

Source: CEGIS field Survey, 2013

### Culture fisheries

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



**Map 5.4: Fish Habitat area in the study area**

### 5.6.2 Fish Production

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

**Table 5.28: Fish Production by Habitat**

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

Source: Field observation, FRSS 2010-11.

#### Fishing Effort

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

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

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

**Table 5.29: Seasonality of Fishing Types**

| Seasonality of fishing types |             |           |       |        |        |         |        |         |               |      |        |         |     |
|------------------------------|-------------|-----------|-------|--------|--------|---------|--------|---------|---------------|------|--------|---------|-----|
| Fishing types                | Seasonality |           |       |        |        |         |        |         |               |      |        |         |     |
|                              | Apr         | May       | Jun   | Jul    | Aug    | Sep     | Oct    | Nov     | Dec           | Jan  | Feb    | Mar     | Apr |
|                              | Boishakh    | Jaishthya | Ashar | Sravon | Bhadra | Ashyini | Kartik | Agrahay | Paush         | Magh | Falgun | Chaitra |     |
| Gill net (Curent jal)        |             |           |       |        |        |         |        |         |               |      |        |         |     |
| Lift net (Vesal jal)         |             |           |       |        |        |         |        |         |               |      |        |         |     |
| Seine net (Ber jal)          |             |           |       |        |        |         |        |         |               |      |        |         |     |
| Push net (Thela jal)         |             |           |       |        |        |         |        |         |               |      |        |         |     |
| Trap gear (Var)              |             |           |       |        |        |         |        |         |               |      |        |         |     |
| Lining (Borshi)              |             |           |       |        |        |         |        |         |               |      |        |         |     |
|                              | High        |           |       | Medium |        |         | Low    |         | No occurrence |      |        |         |     |

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

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

### 5.6.3 Fish Migration

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

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

**Table 5.30: Migratory Fish Species**

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

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

Source: FAP 17, Supporting Volume No. 10.

**Table 5.31: Khal Locations and Connections**

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



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

Table 5.32: Beel Sanctuaries

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

Source: Upazila fisheries offices.

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

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

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

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

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

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

Notes: TL total length, Vc cruising velocity, maximum (burst) velocity

Source: FAP 6.

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

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

Source: FAP 6.

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

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

Source: FAP 6.

### 5.6.5 Fish Biodiversity

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

**Table 5.36: Fish Species of the Study area**

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

<sup>20</sup>1995. Flood Action Plan 17, Supporting Volume 10.



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

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

### 5.6.6 Species of Conservation Significance

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

**Table 5.37: Fish Species of Conservation Significance**

| Scientific name              | Local name    | Local Status |             |
|------------------------------|---------------|--------------|-------------|
|                              |               | Rare         | Unavailable |
| <i>Puntius sarana</i>        | Deshi Sarputi | √            |             |
| <i>Ompak pabda</i>           | Pabda         |              | √           |
| <i>Lepidosephalus guntia</i> | Gutum         |              | √           |
| <i>Notopterus chitala</i>    | Chital        | √            |             |
| <i>Mastacembelus armatus</i> | Sal baim      | √            |             |
| <i>Labeo bata</i>            | Bata          |              |             |

Source: Upazila fisheries offices.

### 5.6.7 Area of Conservation Significance

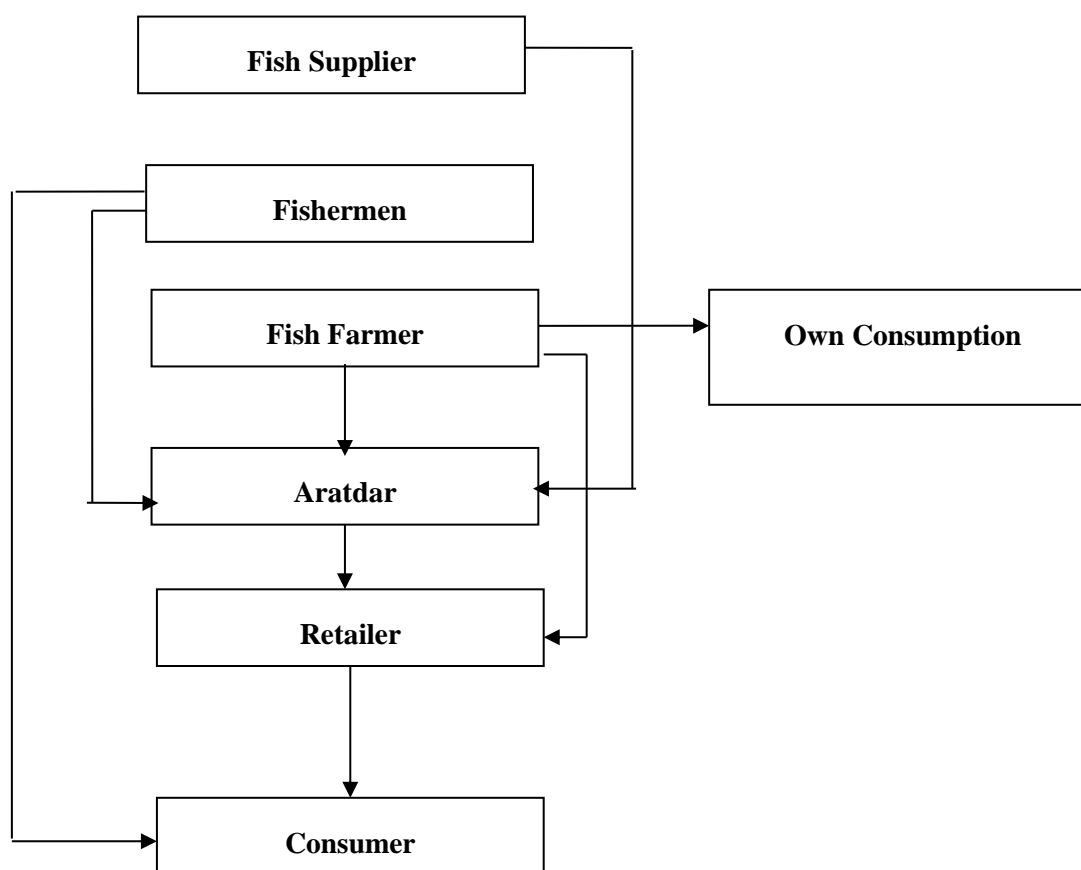
210. The water bodies in the study area are used as feeding and spawning ground of most of the open water fishes. Both perennial and seasonal beel are present in the study area. The deep portion of the *beel* can be conserved for fisheries propagation in the area. Department of fisheries (DoF) has declared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

water bodies for fishes' shelter. DoF and local people jointly manage these *beels* so that nobody can catch fish or disturb these fish species. In monsoon period when the water level rise up to 2m for all the beel area then the local people are allowed to catch fish in the beel except the sanctuary area. There are 10 *beel* sanctuaries present in the study area.

### 5.6.8 Fish Marketing and Post-Harvest Facilities

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

**Figure 5.10: Fish Marketing Channels**



### 5.6.9 Fisher's Lifestyle

212. Average daily income of commercial fishers is BDT 300-350 in monsoon period (May to November). Income level of commercial fisher is decreasing day by day. Consequently, they are changing their occupation. Most of the fishers are living in Horirampur Upazila. This upazila covers vast part of the study area. The fishers are also vulnerable to the musclemen who convert open water fish habitats into culture fishery. Some of the fishers are involved with fish trading, fry trading and some are working as labor in fish farm especially in dry season.

### 5.6.10 Fisheries Management

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

## 5.7 Ecological Resources

### 5.7.1 Bioecological Zones - Introduction

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

#### (a) Teesta Floodplain

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

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

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

#### (a) Major Rivers

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

#### (b) Brahmaputra–Jamuna Floodplain

218. The Brahmaputra-Jamuna floodplain comprises the active channel of the Brahmaputra River and the adjoining areas of the young floodplain lands formed since about 1780, when the river

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

### **(c) Chalan Beel**

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

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

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

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

### **(d) Ganges Floodplain**

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

224. Significant species diversity of the Ganges Floodplain is as follows. This floodplain is characterised by mixed vegetation. The presence of lot of stagnant water bodies and channels, rivers and tributaries in this zone support a habitat of rich biodiversity to some extent. In the beels and other water bodies, free-floating aquatic vegetation is prominent. The dominant floral types are Panimorich *Polygonum orientale*, Jhanji *Hydrilla verticillata*, Helencha *Alternanthera philoxeroides*, Topapana *Pistia strateote*, Chechra *Schenoplectus articulatus*, Shada shapla *Nymphaea nouchali*, Keshordam *Ludwigia adscendense*, Kolmi *Ipomoea aquatica*, Dhol kolmi *I. fistulosa*, Hijal

*Barringtonia acutangula*, Tentul *Tamarindus indica*, Biash *Salix tetrasperma*, etc. Moreover, grasses are abundant in the Ganges Floodplain and begin to grow as soon as the floodwater begins to recede. The Hunuman Langur, Five-Striped Palm Squirrel, Smooth-Coated Otter, Refuse-Tailed Hare, Water Cock, Bank Myna, Asian Paradise Flycatcher, River Tern, Yellow Monitor, Common Vine Snake, Painted-Roofed Turtle, Balloon Frog, etc, occur in this zone.

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

### 5.7.2 Terrestrial Habitats and Flora

226. Terrestrial habitats of the study area can be categorized under the following divisions:

(i) settlement/ homestead vegetation (ii) cropland vegetation, (iii) river-bank vegetation, (iv) social forest, and (v) roadside vegetation. Species lists of terrestrial flora and cropland vegetation are provided in Annex 1 (Table1 and Table).

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

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

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

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

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

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

### 5.7.3 Seasonal and Perennial Wetland Habitats and Flora

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

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

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

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

#### 5.7.4 Terrestrial Fauna

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

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

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

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

241. **Terrestrial birds – long-range migratory species.** Bangladesh is on the Central Asian Flyway between the Palaearctic and the Indian subcontinent (Map 5.5). Migratory birds that move along the Central Asian Flyway utilize the Brahmaputra-Jamuna-Padma-Ganges char and other habitats potentially affected by Tranch 1.<sup>21</sup>

242. **Mammals.** The situation of mammals in Bangladesh country is saddening, especially that of the large mammals which have gone extinct since the 1970s due to habitat shortage, food scarcity and hunting pressures. Mammal species still present are Field Rat *Mus booduga*, Jungle Cat *Felis chaus*, Asiatic Jackal *Canis aureus*, Common Mongoose *Herpestes edwardsi*, Malayan Giant Squirrel *Ratufa*

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

*bicolor*, Indian Flying Fox *Pteropus giganteus* and Greater Short-Nosed Fruit Bat (*Cynopterus sphinx*). The Asiatic Jackal *Canis aureus* is nationally categorized as Vulnerable (VU) by IUCN-Bangladesh.

### 5.7.5 Aquatic Ecosystems

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

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

#### (a) Aquatic Flora

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

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

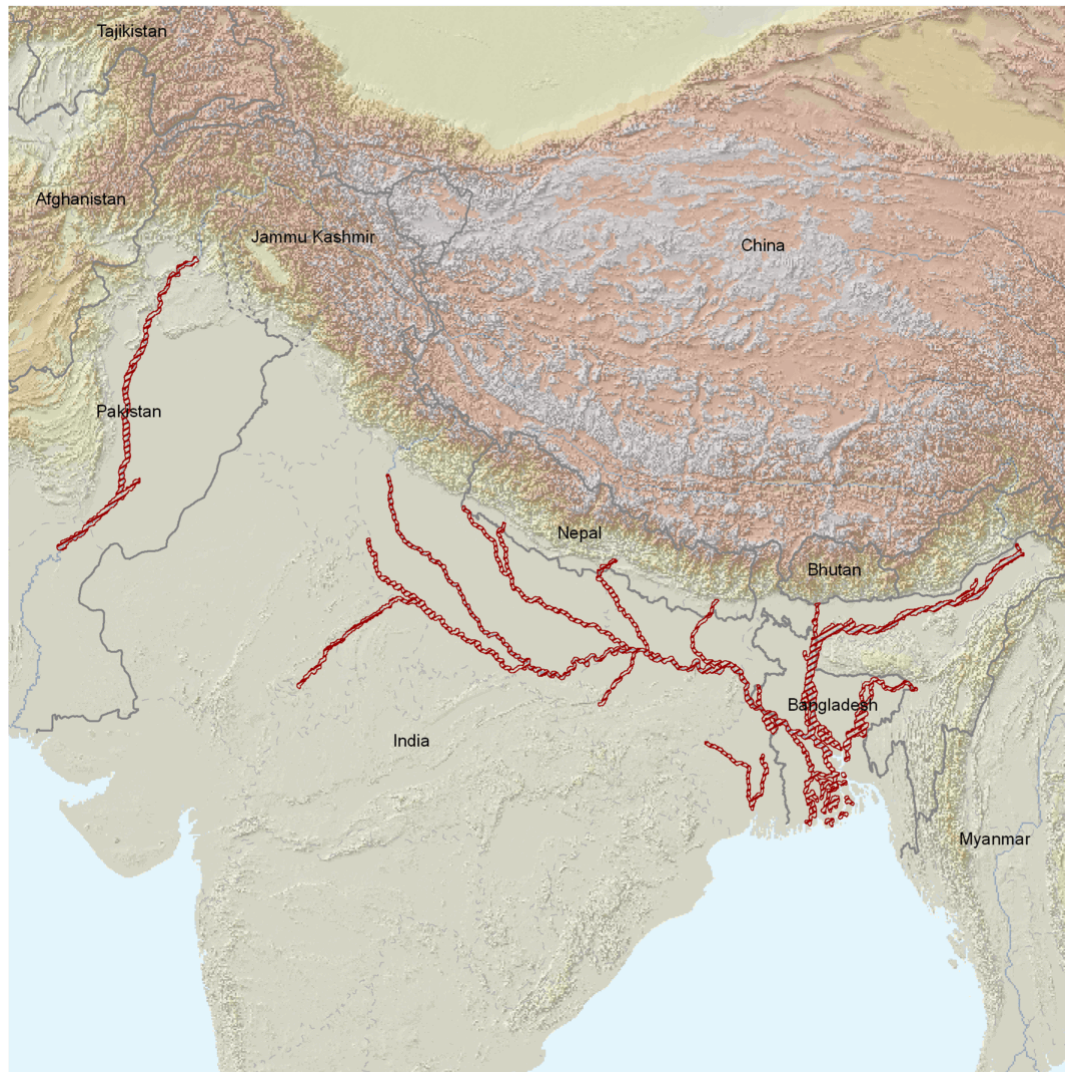
246. The South Asian River (Gangetic) Dolphin *Platanista gangeticaganetica* is native to the Ganges and Brahmaputra rivers in Bangladesh and India (Map 5.5).

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

<sup>22</sup>Rashid, S.M.A., Abdul Wahab Akonda, and Bashir Ahmed. 2012. "Occurrences of South Asian River Dolphin (*Platanista Gangetica*) in the Padma and Jamuna Rivers, Pabna." In Book of Abstracts, 130. Dhaka: Bangladesh Fisheries Research Forum.

<http://bfrf.org/bookofabstracts/BFRF%205th%20Fisheries%20Conference%20and%20Research%20Fair%202012%20-%20Book%20of%20Abstracts.pdf>.





*Platanista gangetica*

range type

Native (resident)

— national boundaries

----- subnational boundaries

lakes, rivers, canals

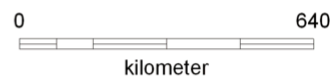
salt pans, intermittent rivers

data source:  
IUCN (International Union for Conservation of Nature)



gall stereographic central point: 0°, 0°

map created 10/27/2009



The boundaries and names shown and the designations used do not imply any official endorsement, acceptance or opinion I

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

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



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

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

### 5.7.6 Other Aquatic Fauna

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

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

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

### 5.7.7 Aquatic Ecosystem Services

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

### 5.7.8 Threats to Aquatic Ecosystems

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

## 5.8 Socioeconomic Condition

### 5.8.1 Area and Location

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

**Table 5.38: Administrative Units of Bangladesh**

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

Source: Spatial GIS Analysis, CEGIS 2012.

## 5.8.2 Demography

256. Table 5.39 presents key demographic data of the study area. The study area population is 2.89 million (BBS Census Report, 2011). This includes 1.42 million males and 1.47 million females in 661,000 households having an average household size of 4.37 persons. Population density is about 1200 persons km<sup>2</sup>.

**Table 5.39: Demographic Information**

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

Source: BBS Population Census 2011.

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

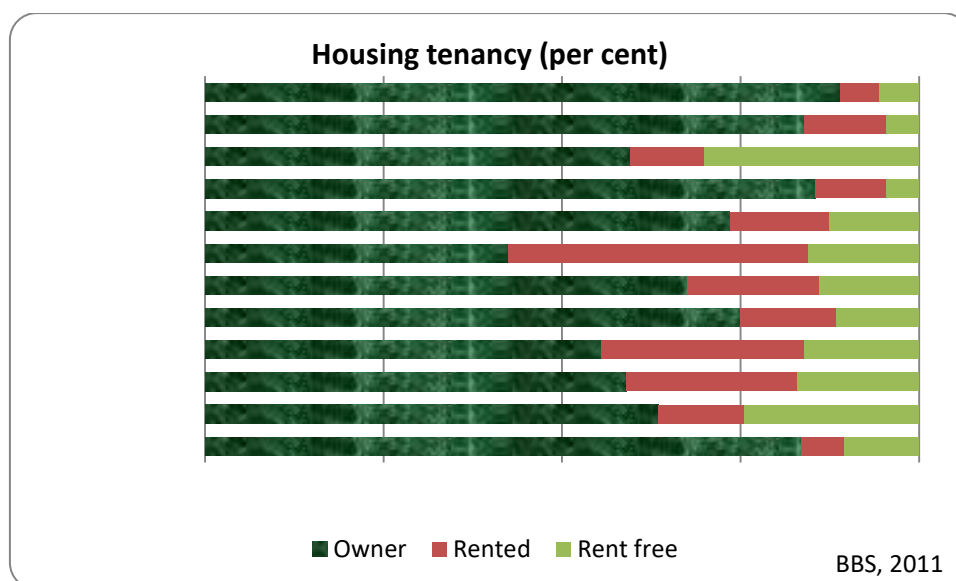
**Table 5.40: Age Distribution**

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

Source: BBS Population Census 2011.

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

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



**Figure 5.11: Housing Tenancy**

### 5.8.3 Livelihood

#### (a) Occupation

259. Agriculture is the main occupation of 76 percent of households. About 16 percent of the population works in the service sector; and the remaining 8 percent works in the industrial sector (Table 5.41 **Error! Reference source not found.** and Photo 5.6)

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

**Table 5.41: Primary Occupation**

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

Source: BBS Population Census 2011.

**Photo 5.6: Livelihoods**



**Photo 5.6.1: Jhupri House**

**Photo 5.6.2: Kutcha House**



**Photo 5.6.3: Semi-Pukka House**

**Photo 5.6.4: Pukka House**



## **(b) Employment**

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

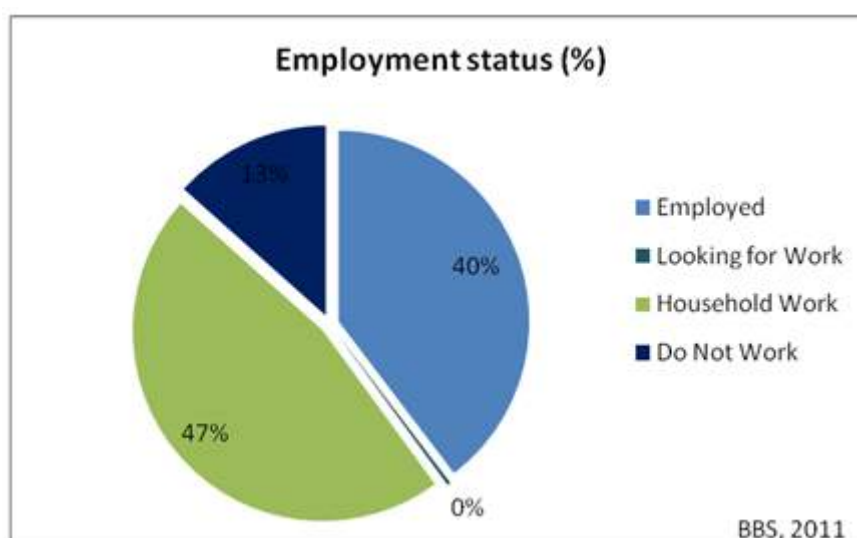


Figure 5.12: Employment Status

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

Table 5.42: Employment

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

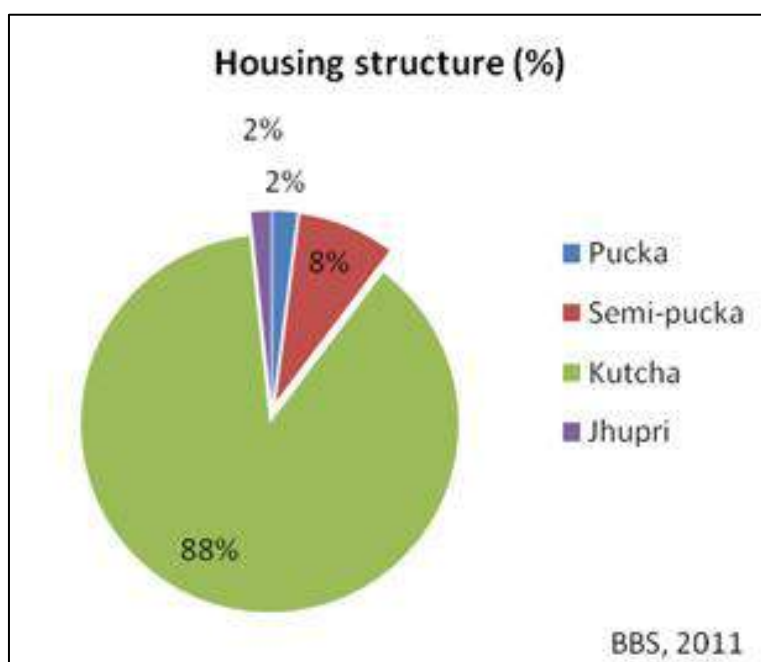
Source: BBS Population Census 2011.

## 5.8.4 Quality of Life

### (a) Housing

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

concluded that the people living in the study area belong to extremely poor category in term of housing type.<sup>24</sup>



**Figure 5-1.13: Distribution of Housing Types**

#### **(b) Drinking Water**

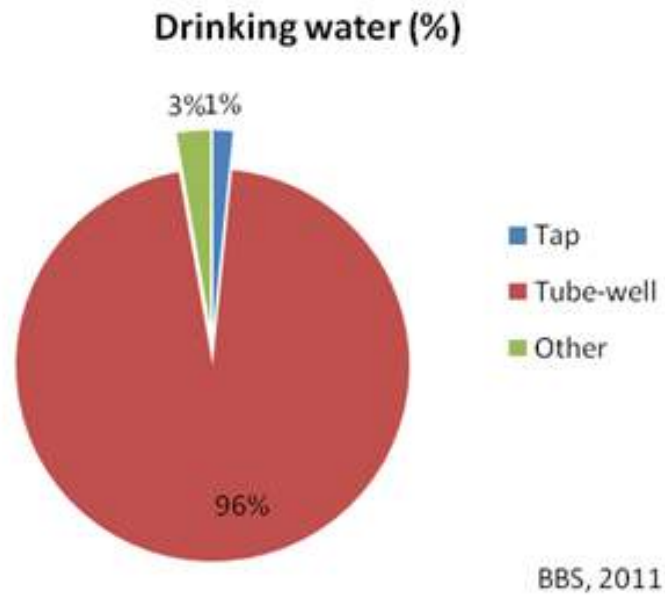
264. The overall status of drinking water in the area is satisfactory. Tube-well coverage is quite good in some upazilas eg Belikuchi, Ghior, Nagarpur, Shibabaya and Harirampur. But in other area, people collect water from biologically unsafe sources such as ponds (with or without pond sand filter) and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

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

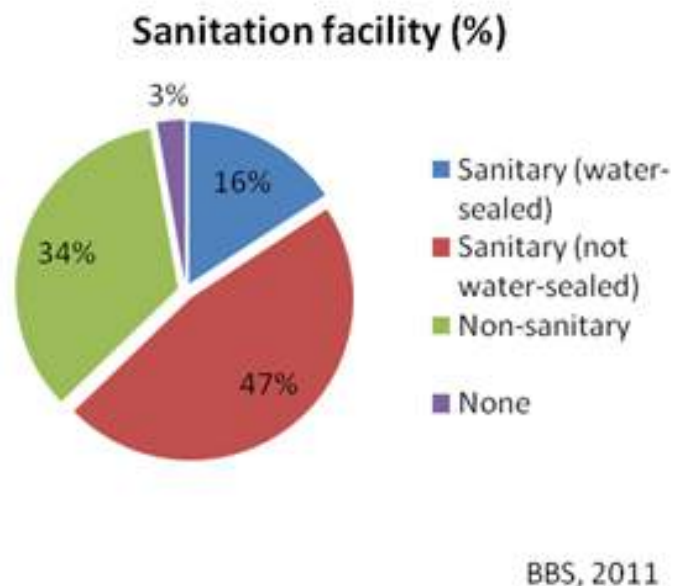
<sup>24</sup>BBS distinguishes housing structures into four classes such as- i) Jhupri: House which consist mud walls of 1.5 to 3.0 ft thickness, which carry the roof load. Earthen floor, thatch or CI sheets are used as roofing materials. . There is no monolithic joint between the wall and the roof.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

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





**Figure 5.14: Drinking Water Sources**



**Figure 5.15: Sanitation**

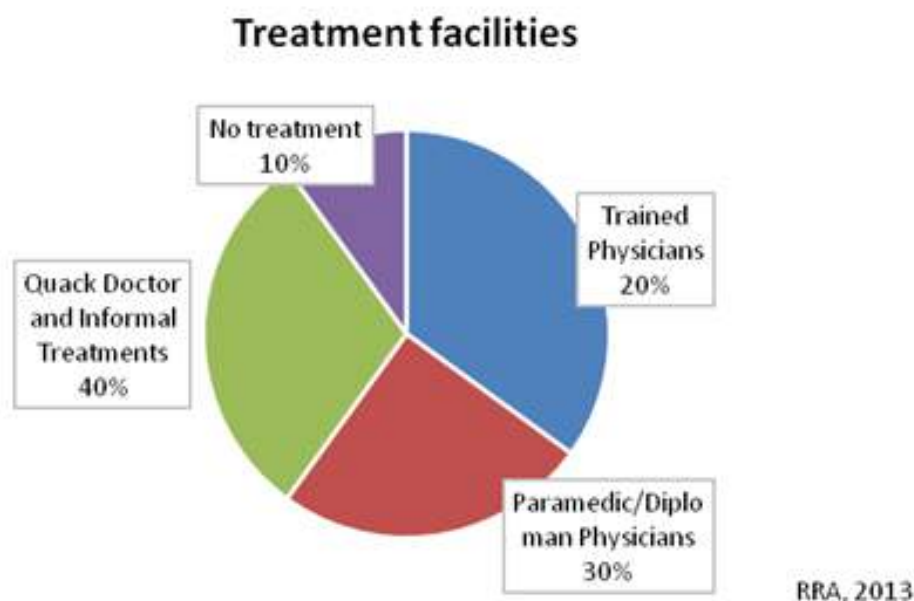
#### **(c) Disease Incidence Ranking**

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

#### **(d) Health Services and Facilities**

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

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



**Figure 5.16: Medical Treatment**

### 5.8.5 Education

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

**Table 5.43: Literacy Rates**

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

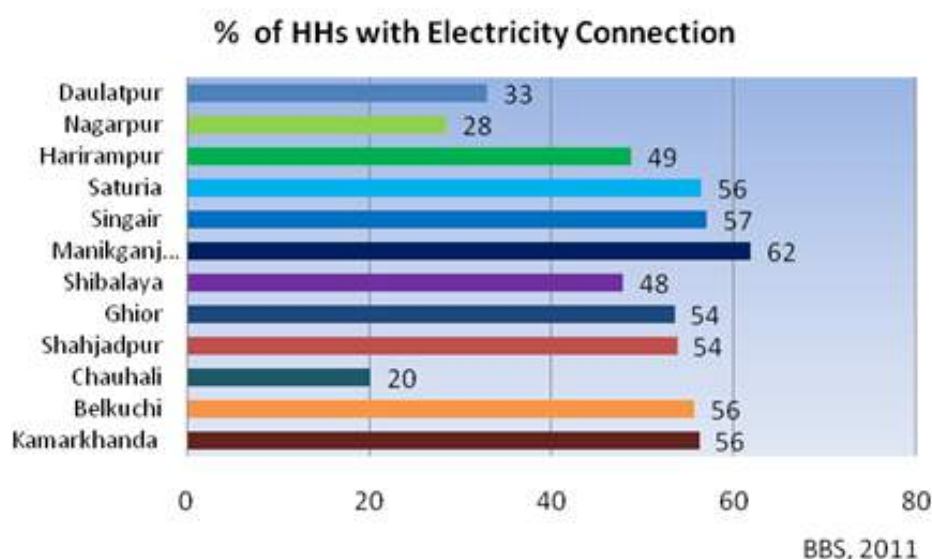
Source: BBS Population Census 2011.

### 5.8.6 Electricity

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



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



**Figure 5.17: Household Access to Electricity**

### 5.8.7 Poverty and Safety Nets

#### (a) Landownership Pattern

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

**Table 5.44: Landownership**

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

Source: CEGIS fieldwork 2013.

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

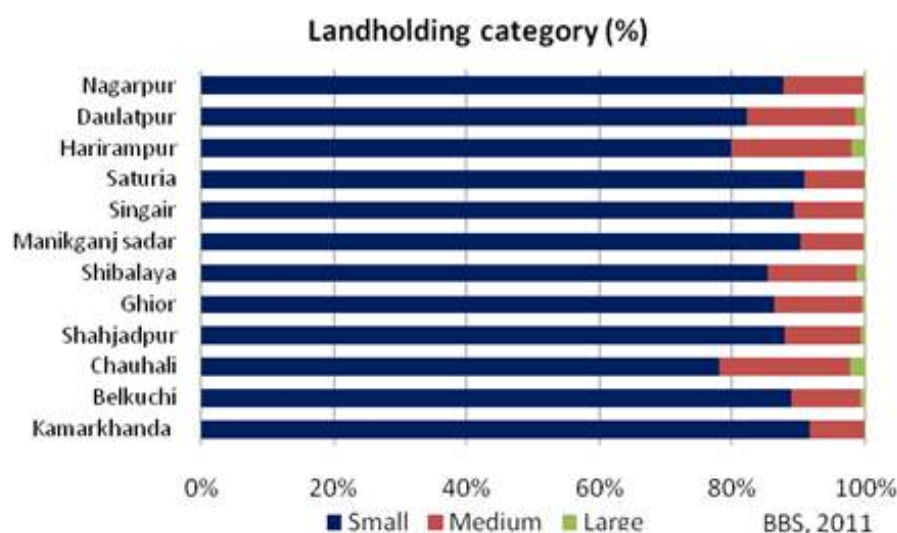


Figure 5.18: Landholding

### (b) Income Poverty

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

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

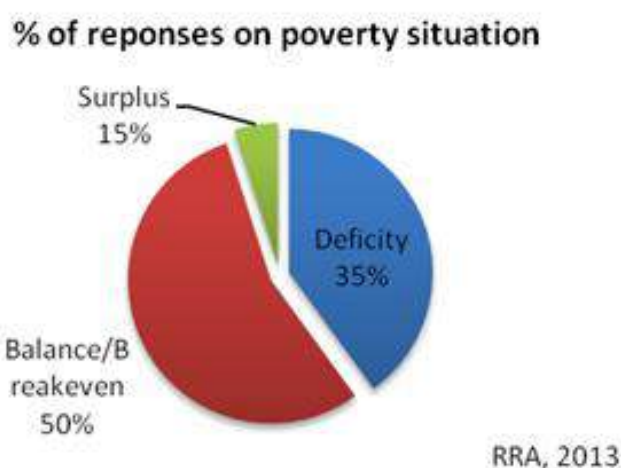


Figure 5.19: Self-Assessed Poverty Status

### (c) Income and Expenditure

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

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

**Table 5.45: Annual Income and Expenditure Level**

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

Source: CEGIS fieldwork 2013.

### 5.8.8 Natural Disasters

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

**Table 5.46: Effects of Recent Natural Disasters**

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

Source: CEGIS fieldwork 2012.

### 5.8.9 Social Safety Nets and Poverty Reduction Measures

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

**Table 5.47: Social Safety Net Programs**

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

Source: CEGIS fieldwork 2013.

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

(MMS), Proshika, Muslim Aid UK, CARE and Karitas (Table .48). These NGOs are serving with micro credit while BRAC, ASA, and Uttaran are working for non-formal education, Health, human rights, water and sanitation, gender and children development programs. About 40 per cent of households are found to benefit from NGO interventions.

**Table 5.48: NGOs Programs**

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

Source: CEGIS fieldwork 2013.

## 5.8.10 Transportation

### (a) Road way

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

**Table 5.49: Road Network**

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

Source: NWRD database 2013.

### (b) Waterways

279. Waterways are the most important means of communication in the area. Navigation routes in the study area include: 390 km of routes less than 25 m wide; 170 km of routes 25 to 50 m wide; 126 km that are 50 to 100 m wide and 207 km above 100 m wide (see Table 5.50). The area has one ferry

ghat, two inland river ports, and two pilot stations within the study area. Waterways are gradually decreasing in size due to siltation.

**Table 5.50: Navigation Routes**

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

Source: NWRD database 2013.

### 5.8.11 Educational Institutions

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

**Table 5.51: Academic Institutions**

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

Source: CEGIS fieldwork 2013.

### 5.8.12 Population Migration

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

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

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

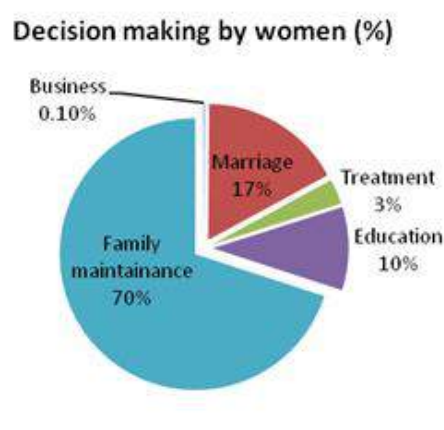
**Table 5.52: Labor Migration**

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

Source: RRA 2012.

**5.8.13 Gender and Women**

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

**Figure 5.20: Decision-Making By Women**

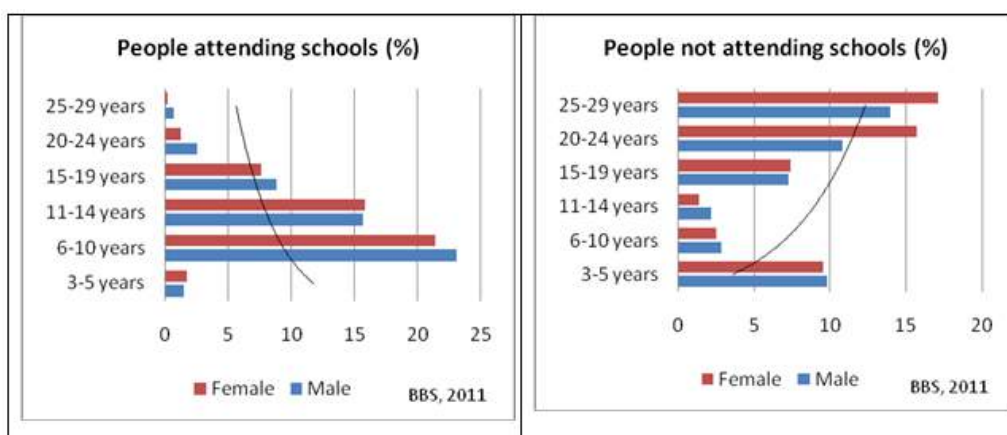
285. Women mobility in the area is mostly localized except for travel to obtain medical treatment, fetch water, engage in farming activities, and visit relatives.

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

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

288.

289.



**Figure 5.21: School Enrollment**

#### 5.8.14 Vulnerable Communities

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

#### 5.8.15 Common Property Socio-Cultural Places and Resources

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

## 6. Public Consultation and Disclosure

### 6.1 Disclosure, Consultation, and Participation during Project Preparation

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

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

### 6.2 Stakeholder Comments and Concerns

#### 6.2.1 First Round

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

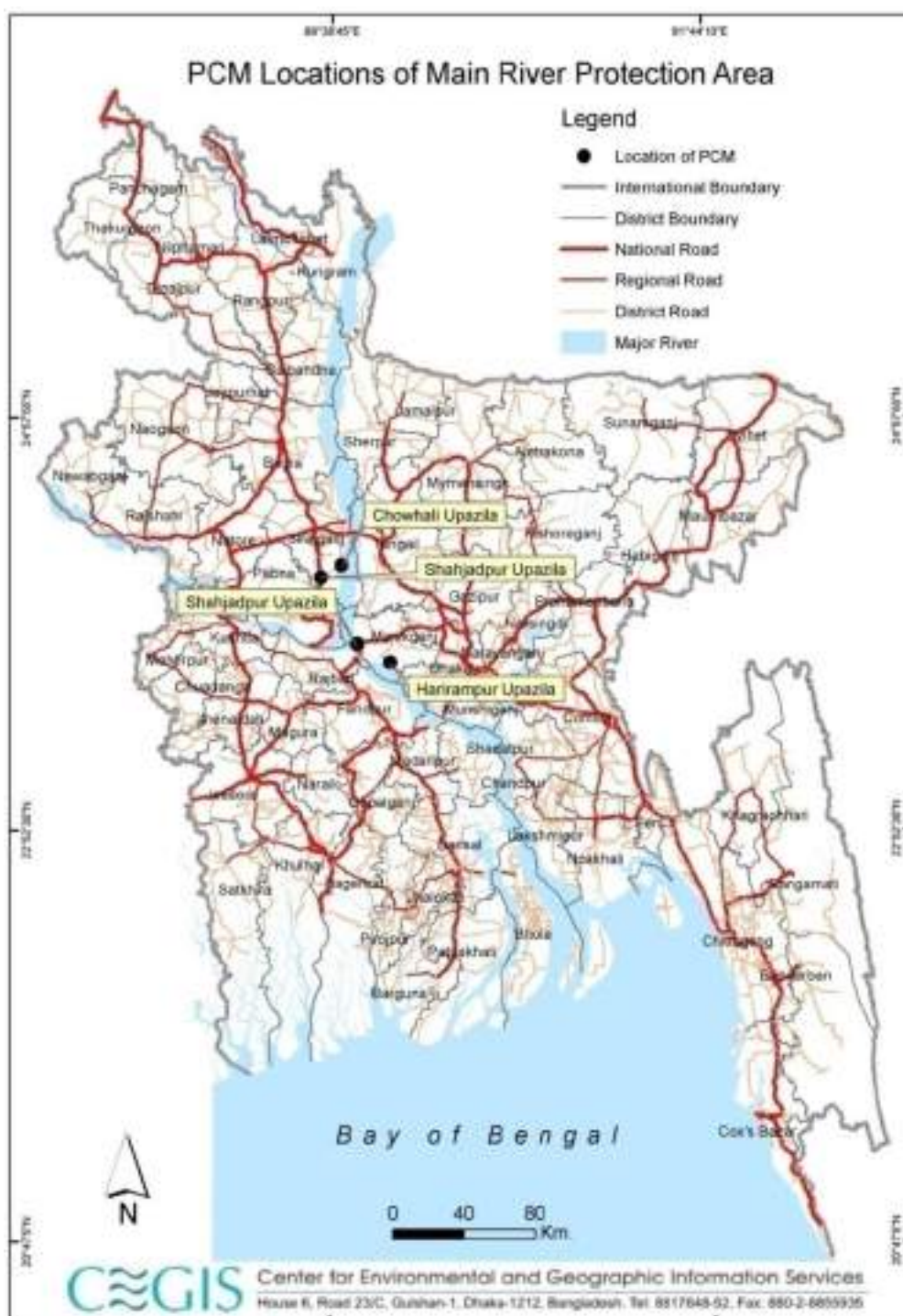
295. The purpose, time, and location of the first-round meetings were disseminated to stakeholders by sending hard-copy letters in Bengali to all relevant upazila-level officials in the meeting catchment. These letters included the request to circulate the information to other stakeholders. Meetings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

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

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

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





**Map 6.1: First Round Public Consultation Meeting Locations**

### 6.2.2 Second Round

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

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

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

### 6.3 Summary of Concerns, All Meetings

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

303. **Dredging.** River dredging has not been included in subproject designs. Participants stated that embankments will not control flooding or erosion without it, and therefore it should be incorporated in the project. Some participants suggested capital dredging from Jamuna Bridge to Brahmananda of Horirampur Upazila under Manikgonj District. Participants also suggested that fisheries habitat could be restored through dredging of internal channels in the Tranche 1 area.

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

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

### 6.4 Additional Concerns from Specific Meetings

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

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

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

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

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

## 6.5 Incorporation of Concerns in Project and Mitigation Designs

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

## 6.6 Implementation-Phase Stakeholder Disclosure, Consultation and Participation

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

## 6.7 Grievance Redress Mechanism

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

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

## 6.8 Reporting and Monitoring

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

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

<sup>26</sup> Annex J1, Resettlement Framework, version dated 2 Aug 2013.

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

## **7. Important Environmental and Social Components**

### **7.1 Introduction**

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

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

### **7.2 Water Resources**

#### **7.2.1 Erosion and Accretion**

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

#### **7.2.2 Flooding**

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

#### **7.2.3 Drainage Congestion**

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

#### **7.2.4 Water Logging**

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

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

### **7.2.5 Water Availability and Water Use**

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

### **7.2.6 Navigation**

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

### **7.2.7 Surface Water Quality**

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

## **7.3 Land Resources**

### **7.3.1 Land Type**

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

### **7.3.2 Sand Carpeting**

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

### **7.3.3 Land Loss**

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

## **7.4 Agriculture**

### **7.4.1 Cropping pattern and intensity**

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

### **7.4.2 Crop production**

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

### **7.4.3 Crop damage**

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

### **7.4.4 Irrigated Area& Irrigation Water Availability**

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

## **7.5 Fisheries**

### **7.5.1 Fish Habitat**

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

### **7.5.2 Riverine Fish Habitats**

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

### **7.5.3 Beel and Khal Fish Habitats**

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

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

#### **7.5.4 Floodplain Fish Habitat**

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

#### **7.5.5 Fish Migration**

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

#### **7.5.6 Fish Species Diversity**

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

#### **7.5.7 Capture and Culture Fish Production**

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

### **7.6 Ecological Resources**

#### **7.6.1 Terrestrial Ecosystem**

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

#### **7.6.2 Aquatic Ecosystem**

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

#### **7.6.3 Floral Composition and Diversity**

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



#### **7.6.4 Faunal Composition and Diversity**

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

### **7.7 Socio-Economic Condition**

#### **7.7.1 Land Acquisition**

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

#### **7.7.2 Income Generation**

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

#### **7.7.3 Communications**

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

#### **7.7.4 Poverty**

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

## 8. Impact Assessment and Mitigation Measures

### 8.1 Categorization and Quantification

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

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

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

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

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

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

No impact (0);

Low Impact (1-3);

Medium Impact (4-6);

High Impact 7-8;

Very High Impact (9-10).

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

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

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

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

352. Annual Crop production has been calculated as follows:

Baseline Situation:

| Sl. No.                   | Crop           | Area (ha)      | Damage-free    |              |                   | Damaged       |              |                   | Total production (Tons) |
|---------------------------|----------------|----------------|----------------|--------------|-------------------|---------------|--------------|-------------------|-------------------------|
|                           |                |                | Area (Ha)      | Yield (t/ha) | Production (Tons) | Area (Ha)     | Yield (t/ha) | Production (Tons) |                         |
| 1                         | Local Aus      | 8,080          | 6,060          | 1.4*         | 8,526             | 2,020         | 0.7*         | 1,353             | 9,880                   |
| 2                         | HYV Aus        | 11,026         | 7,718          | 1.7*         | 10,860            | 3,308         | 1.2*         | 2,216             | 12,213                  |
| 3                         | Jute           | 16,332         | 13,066         | 2.4          | 18,383            | 3,266         | 1.5*         | 2,188             | 19,737                  |
| 4                         | Maize          | 7,193          | 7,193          | 6.5          | 10,121            | -             | -            | -                 | 11,474                  |
| 5                         | Vegetables     | 3,450          | 2,588          | 14           | 3,641             | 863           | 8            | 578               | 4,994                   |
| 6                         | Sesame         | 4,650          | 4,650          | 0.95         | 6,543             | -             | -            | -                 | 7,896                   |
| <b>Kharif-1 Total:</b>    |                | <b>50,731</b>  | <b>41,274</b>  |              | <b>58,073</b>     | <b>9,457</b>  |              | <b>6,336</b>      | <b>59,426</b>           |
| 7                         | Mixed Aus-Aman | 8,540          | 8,540          | 0.80*        | 12,016            | -             | -            | -                 | 12,016                  |
| 8                         | B. Aman        | 29,841         | 19,397         | 0.85*        | 27,291            | 10,444        | 0.7*         | 7,697             | 28,644                  |
| 9                         | HYV Aman       | 39,185         | 23,511         | 2.1*         | 33,080            | 15,674        | 1.3*         | 11,552            | 34,433                  |
| 10                        | Local Aman     | 23,751         | 17,813         | 1.3*         | 25,063            | 5,938         | 0.8*         | 4,376             | 26,417                  |
| <b>Kharif-2 Total:</b>    |                | <b>101,317</b> | <b>69,261</b>  |              | <b>97,450</b>     | <b>32,056</b> |              | <b>23,625</b>     | <b>98,803</b>           |
| 11                        | HYV Boro       | 119,024        | 101,170        | 4.0*         | 142,347           | 17,854        | 2*           | 35,886            | 143,700                 |
| 12                        | Local Boro     | 605            | 605            | 1.9*         | 851               | -             | -            | -                 | 851                     |
| 13                        | Wheat          | 7,040          | 7,040          | 2.4          | 9,905             | -             | -            | -                 | 9,905                   |
| 14                        | Potato         | 1,500          | 1,500          | 15           | 2,111             | -             | -            | -                 | 2,111                   |
| 15                        | Mustard        | 14,415         | 14,415         | 0.96         | 20,282            | -             | -            | -                 | 20,282                  |
| 16                        | Pulses         | 25,031         | 25,031         | 1            | 35,219            | -             | -            | -                 | 35,219                  |
| 17                        | Spices         | 12,563         | 12,563         | 4.6          | 17,676            | -             | -            | -                 | 17,676                  |
| 18                        | Ground nut     | 2,873          | 2,873          | 1.5          | 4,042             | -             | -            | -                 | 4,042                   |
| <b>Rabi Total:</b>        |                | <b>183,051</b> | <b>165,197</b> |              | <b>232,433</b>    | <b>17,845</b> |              | <b>35,886</b>     | <b>233,786</b>          |
| <b>Total Cropped Area</b> |                | <b>335,099</b> | <b>275,733</b> |              |                   | <b>59,358</b> |              |                   |                         |

Source: CEGIS field information and consultation with DAE,\*Indicates cleaned rice

“Without Project” Situation (WOP)

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

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

With Project Situation (WIP)

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

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

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

## 8.2 Climate Change

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

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

355. The program addresses climate change in several ways: Increases in discharge only result in small increases in water levels in the rivers, first due to the vast expanse of the river system and secondly because alluvial rivers can cope with increased discharges by adjusting their bed within a short time (refer for example to the Padma Bridge Study). This means that design levels for embankment do not need to be raised (also given the large freeboard). The riverbank protection is built in an adaptive manner which allows adjustments in terms of river depth and location as and when required.

### 8.3 Physical and Water Resources

#### 8.3.1 Construction Phase

| IEC  | Location   | Baseline condition   | Impacts   | Magnitude of Impact* | Mitigation Measure   | Magnitude with EMP* |
|--|--|--|---|----------------------|--|---------------------|
| <b>Jamuna Right Bank 1</b>   |  |  |   |                      |  |                     |
| <b>Activity:</b> Construction of labor shed, stock yard and construction camp, mobilization of labor, materials, equipment and other machineries, construction of CC blocks at site. |  |  |   |                      |  |                     |
| <b>Air quality</b>   | <ul style="list-style-type: none"> <li>- Possible locations of labor shed (Dombarla, Locha, Dorta Mehi, Jagtala, Gopalpur mauzas); stock yard (to be selected by the Engineer in Charge) and site of CC block construction (Benotia Mauza).</li> <li>- Road side places used for transportation of materials (Kaijuri-shahjadpur road and the rural roads from Hat panchil to barnia mauzas and from Nagardala to Shelachapri mauzas).</li> </ul>              | Air quality is good as no dust is generated at present.                | Minor impact may occur from the small amount of dust generated due to movement of vehicles, construction materials and machineries; construction of labor shed and stock yard; preparation of CC block at site. | -2                   | <ul style="list-style-type: none"> <li>- Construction materials should be covered with thick materials (i.e. polythene) during transportation.</li> <li>- Water to be sprinkled to control the generation and spreading of dust; as and where required.</li> </ul> | -1                  |
| <b>Noise</b>   | <ul style="list-style-type: none"> <li>- Possible locations of labor shed (Dombarla, Locha, Dorta Mehi, Jagtala, Gopalpur mauzas), stock yard (to be selected by the Engineer in Charge), site of CC block construction (Benotia Mauza).</li> <li>- Road side places through which construction materials would be transported (Kaijuri-shahjadpur road and the rural roads from Hat panchil to barnia mauzas and Nagardala to Shelachapri mauzas).</li> </ul> | Sound is within tolerable limit, No significant source of noise found. | Low impacts caused due to noise generation for mobilization of construction materials and construction of labor shed, stockyard and CC blocks.  | -2                   | <ul style="list-style-type: none"> <li>- Noise levels due to vehicular movement are to be kept within permissible limit.</li> <li>- Construction camps, labor shed, and sites for CC blocks construction are to be located far away from settlements</li> </ul>    | -1                  |

| IEC  | Location  | Baseline condition   | Impacts  | Magnitude of Impact* | Mitigation Measure  | Magnitude with EMP* |
|--|---|--|--|----------------------|---|---------------------|
| <b>Jamuna Left Bank-2 (JLB-2)</b>  |   |  |  |                      |   |                     |
| <b>Activity:</b> Construction of labor shed with water and sanitation facilities, garbage disposal system, construction of stock yard and construction camp, labor and material/equipment mobilization |   |  |  |                      |   |                     |
| <b>Air quality</b>   | <ul style="list-style-type: none"> <li>- Possible locations of labor camps (Char Jajuria and Khashkaulia mauzas at Chauhali and Char Raghunathpur at Jafarganj).</li> <li>- Location of stock yard (to be selected by the Engineer In Charge).</li> <li>- Location of CC blocks construction (Khashkaulia mauza at Chauhali and Raghunathpur mauza at Jafarganj).</li> </ul>  | Air quality is good. No dust is generated at present.                  | Small amount of dust would be generated during movement of vehicles, construction materials and machineries; construction of labor shed and CC block.  | -2                   | <ul style="list-style-type: none"> <li>- Construction materials to be covered with thick materials i.e. polythene during transportation.</li> <li>- Water to be sprinkled to control the generation and spreading of dust; as and where needed.</li> </ul>                        | -1                  |
| <b>Noise</b>   | <ul style="list-style-type: none"> <li>- Possible locations of labor shed (Char Jajuria and Khashkaulia mauzas at Chauhali and Char Raghunathpur at Jafarganj).</li> <li>- Location of stock yard (to be selected by the Engineer In Charge).</li> <li>- Location of CC blocks construction (Khashkaulia mauza at Chauhali and Raghunathpur mauza at Jafarganj).</li> <li>- Roadside locations to be used during material transportation (Char Jajuria, Khashkaulia mauzas at Chauhali and Raghunathpur and Paila mauzas at Jafarganj)</li> </ul> | Sound is within tolerable limit, No significant source of noise found. | Low impacts caused due to noise generation due to mobilization of construction materials and construction of labor shed, stockyard and CC blocks. There is a high school and an upazilla office at the construction site of Chauhali and one primary school at Jafarganj which would face minor impacts due to noise generation. | -2                   | <ul style="list-style-type: none"> <li>- Noise levels due to vehicular movement are to be kept within permissible limit.</li> <li>- Construction camps, labor shed, and sites for CC blocks construction are to be located far away from settlements, school, offices.</li> </ul> | -1                  |



| IEC   | Location   | Baseline condition                                    | Impacts  | Magnitude of Impact* | Mitigation Measure   | Magnitude with EMP* |
|---|--|---|--|----------------------|--|---------------------|
| <b>Padma Left Bank-1 (PLB-1)</b>  |  |   |  |                      |  |                     |
| <b>Activity:</b> Construction of labor shed with water and sanitation facilities, garbage disposal system, construction of stock yard and construction camp, labor and materials/equipment mobilization |  |   |  |                      |  |                     |
| <b>Air quality</b>  | <ul style="list-style-type: none"> <li>- Possible locations of labor camps (Ramkrishnapur and Andarmanik mauzas)</li> <li>- Location of stock yard (to be selected by the Engineer In Charge),</li> <li>- Location of CC block construction (Andarmanik mauza)</li> <li>- Roadside locations to be used in carrying construction materials (Harirampur-Rathora road; Andarmanik and Ramkrishnapur mauzas)</li> </ul> | Air quality is good. No dust is generated at present. | Small amount of dust generation during movement of vehicles, construction materials and machineries, construction of labor shed and CC blocks. | -2                   | <ul style="list-style-type: none"> <li>- Construction materials to be covered with thick materials i.e. polythene during transportation</li> <li>- Water to be sprinkled to control the generation and spreading of dust; as and where needed</li> </ul> | -1                  |
| <b>Activity:</b> Construction of labor shed and construction camp; labor and materials/equipment mobilization   |  |   |  |                      |  |                     |
| <b>Noise</b>  | <ul style="list-style-type: none"> <li>- Possible locations of labor camps (Ramkrishnapur and Andarmanik mauzas)</li> <li>- Location of stock yard (to be selected by the Engineer In Charge),</li> <li>- Location of CC block construction (Andarmanik mauza)</li> <li>- Roadside locations to be used in carrying construction materials (Harirampur-Rathora road; Andarmanik and Ramkrishnapur mauzas)</li> </ul> | Noise level is within permissible standard            | Minor impact would be generated due to the construction of CC block, labor shed, stock yard and mobilization of materials.                     | -2                   | - Noise levels are to be kept within permissible standard  | -1                  |

### 8.3.2 Construction Phase

| IEC  | Location  | Baseline condition   | Impacts  | Magnitude of impact* | Mitigation Measure  | Magnitude with EMP* |
|--|---|--|--|----------------------|---|---------------------|
| <b>Jamuna Left Bank-1 (JLB-1)</b>  |   |  |  |                      |   |                     |
| <b>Activity:</b> Excavation of earth materials from the location of embankment; dredging of soil from the Jamuna River; dumping of earthen materials on the embankment; embankment surface levelling and compaction through mechanical equipment; movement of vehicles for carrying materials. |   |  |  |                      |   |                     |
| <b>Air quality</b>   | <ul style="list-style-type: none"> <li>- Places adjacent to the Jamuna River bank where the new embankment would be constructed (from Hat Panchil to Benotia mauzas).</li> <li>- Places adjacent to the existing embankment of the Baral river (from Verakhola to Dambarla mauzas).</li> <li>- At Benotia where the bank protection works is to be carried out.</li> <li>- Road side places through which transportation of construction materials would be carried out (Kaijuri-shahjadpur road and rural roads from Hat panchil to barnia mauzas and Nagardala to Shelachapri mauzas).</li> </ul> | Air quality is good.   | Minor amount of dust may be generated during excavating and dumping of earth materials, surface leveling with dumping machine and vehicular movements. | -3                   | Water to be sprinkled on regular intervals, as and where required.  | -2                  |
| <b>Noise</b>   | <ul style="list-style-type: none"> <li>- Road side places for transportation of construction materials (Kaijuri-shahjadpur road and rural roads from Hat panchil to barnia mauzas and Nagardala to Shelachapri mauzas).</li> <li>- Location of embankment (from Kaijuri to Karatoya offtake)</li> </ul>   | Sound is within tolerable limit, No significant source of noise found. | Low impacts would be caused during excavation and dredging of soil and vehicular movements.  | -2                   | - Noise levels due to vehicular movement, excavation and dredging activities are to be kept within permissible limit. | -1                  |
| <b>Activity:</b> Dredging of earth materials from the Jamuna Rivers; placing of geo-bags and CC blocks on the river banks; construction of sluices, disposal of waste generated from the labor shed.   |   |  |  |                      |   |                     |
| <b>Surface</b>   | - Jamuna River (from Hat Panchil to Benotia   | Aesthetic  | The surface water quality might  | -4                   | - Dredged spoil should be   | -1                  |

| IEC   | Location   | Baseline condition                           | Impacts  | Magnitude of impact* | Mitigation Measure   | Magnitude with EMP* |
|---|--|--|--|----------------------|--|---------------------|
| <b>water quality</b>                          | mauzas) and Baral River (from Verakhola to Dambarla mauzas).<br>- Possible locations of construction of drainage sluices | quality of river water is good.              | be affected due to the disposal of waste generated from the labor shed into the river. Additionally, minor quantity of sediments would be generated in the rivers during dredging of soil from river bed, which would temporarily hamper the aesthetic quality of river water. |                      | carefully dealt with.<br>- Proper waste disposal system is to be implemented.  |                     |
| <b>Activity:</b> Rehabilitation of embankment |  |  |  |                      |  |                     |
| <b>Drainage congestion</b>                    | - Hurasagar river  | Drainage characteristics are good at present | Low impact may occur due to the rehabilitation of embankment blocking the Hurasagar offtake. The river has two mouths at present, meeting the Baral river and blocking any one of these might stress the drainage characteristics of the other.                                | -2                   | - Constructing a sluice at one of the two channel mouths. (Currently there is a sluice at one of the two mouths of Hurasagar river, which will be rehabilitated and extended, another sluice will be built at the Jamuna. ). | -1                  |

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

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

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

### 8.3.3 Post-Construction Phase

| IEC                               | Location  | Baseline condition  | FWOP   | FWIP   | Impacts   | Magnitude of impact* | Mitigation Measure | Magnitude with EMP* |
|-----------------------------------|---|---|--|--|---|----------------------|--------------------|---------------------|
| <b>Jamuna Left Bank-1 (JLB-1)</b> |   |   |  |  |   |                      |                    |                     |
| <b>Erosion</b>                    | Location adjacent to the bank protection work (Benotia mauza) | Severe erosion at Benotia mauza, along the right bank of Jamuna River. Each year, approximately | Erosion along the bank of Jamuna river will continue to propagate inside Shahjadpur. Without | Bank erosion will be protected; roads and other valuable infrastructures, agricultural lands and | Savings in agricultural lands and settlements would take place. Roadway | +6                   | N/A                | N/A                 |

| IEC                        | Location   | Baseline condition   | FWOP   | FWIP  | Impacts  | Magnitude of impact* | Mitigation Measure   | Magnitude with EMP* |
|----------------------------|--|--|--|---|--|----------------------|--|---------------------|
|                            |  | 200 hectares of land are eroded by the Jamuna river, at and near Benotia mauza   | the project, in ten years, approximately 2,000 hectares of land would be eroded.   | settlements would be saved from erosion.  | communication will be established along the Jamuna river.  |                      |  |                     |
| <b>Drainage congestion</b> | Karatoya and Hurasagar rivers, which drain out water from the sub reach to the Baral and Jamuna rivers.  | The entire sub-reach is of high topography, with elevations ranging from 8 to 10 meters. As such, water drain out quickly from the area after of rainfall.   | The area will be free from drainage congestion problems.   | Drainage congestion problems might occur as water may be entrapped in the area due to the construction of new embankment.   | Low impact may be generated as the conveyance capacity of internal rivers and lakes will be stressed, resulting in drainage congestion problems.   | -1                   | Provision of sluices at the mouth of Hurasagar river, and places where required. | 0                   |
| <b>Flood</b>               | Entire sub reach (especially near the location of embankment works i.e. from Hat Panchil to Benotia mauzas and from Verakhola to Dambarla mauzas). | The area is susceptible to regular flooding. The existing values of Reduced Level (RL) near the river banks are within 6 to 8 meters and the same in the entire sub reach is around 8-10 meters. Regular flood level is around 8-9 meters and each year, around 80-90% of the entire sub reach area gets inundated. Average duration of flood is 30-45 days. | Regular damage due to flood will keep affecting the socio-economic status of the local people. The farmers would not be able to practice Aman cropping in the wet season. Regular monsoon flooding will affect the communication system as well. | Flooding would be reduced near the banks by a considerable margin. The tranche 1 of the project only entails embankment rehabilitation works from Verakhola to the Karatoya offtake (Dambarla mauza). However there is no embankment at present from the Nagardala-Ratankandi bridge to the Karatoya offtake (there used to be an embankment which has been eroded in the flood of 1998). This embankment breach covers a total length of 7 | The improvement in regular flooding would be around 30% in the entire sub-reach. This would lead to a better control in both irrigation and social status of the people in the subreach. | +5                   | N/A  | N/A                 |

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

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

| IEC                               | Location                | Baseline condition   | FWOP  | FWIP  | Impacts  | Magnitude of impact* | Mitigation Measure | Magnitude with EMP* |
|-----------------------------------|-------------------------|--|---|---|--|----------------------|--------------------|---------------------|
| <b>Jamuna Left Bank-2 (JLB-2)</b> |                         |  |   |   |  |                      |                    |                     |
| <b>Erosion</b>                    | - From Atapara to Khash | Severe erosion at both Chauhali and Shibalaya upazilas, at | Erosion along the bank of Jamuna river will continue to propagate | River banks will be protected. Roads and other infrastructures, | Massive impact to the livelihood of the local people. Due to the bank protection | +8                   | N/A                | N/A                 |

| IEC | Location  | Baseline condition  | FWOP   | FWIP  | Impacts   | Magnitude of impact* | Mitigation Measure | Magnitude with EMP* |
|-----|---|---|--|---|---|----------------------|--------------------|---------------------|
|     | kaulia mauzas at Chauhali upazila<br>- From Gangadia to the end of Paila mauzas at Jafarganj of Shibalaya upazila | the left bank of Jamuna River. Each year, approximately 1400 hectors of land in total are eroded in these locations (1000 ha at Chauhali and 400 ha at Shibalaya) | inside the sub reach, destroying various places under both Chauhali and Shibalaya upazilas. In a period of ten years, around 14,000 hectors of land would be eroded in the entire sub reach if no protective works are carried out immediately. Loss of livelihoods, assets and infrastructures would occur. | agricultural lands and settlements would be saved from erosion. | works at Chauhali and Jafarganj, huge amount of agricultural lands and settlements will be saved. Communication facilities will be re-established over the left bank of Jamuna river. |                      |                    |                     |

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

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

| IEC | Location  | Baseline condition   | FWOP   | FWIP   | Impacts                              | Magnitude of impact* | Mitigation Measure | Magnitude with EMP* |
|-----|---|--|--|--|--------------------------------------|----------------------|--------------------|---------------------|
|     | Andarmanik and Boyra mauzas of Harirampur upazilla. | flooding as the area is relatively low, with average RLs near the river banks ranging between 2-4 meters. Around 20-30% of the area gets inundated each year for 1~2 months. | local people as the farmers would be unable to cultivate Aman in monsoon. The communication system of the area will aggravate as well. | would be reduced to some extent near the left bank of the Padma river at Harirampur. | regular flooding would be around 5%. |                      |                    |                     |

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

## 8.4 Land Resources

### 8.4.1 Pre-Construction Phase

| IEC                                | Location  | Baseline condition    | Impacts   | Magnitude of impact* | Mitigation Measure  | Magnitude with EMP* |
|------------------------------------|---|-----------------------|---|----------------------|---|---------------------|
| <b>Jamuna Right Bank-1 (JRB-1)</b> |   |                       |   |                      |   |                     |
| <b>Activity</b>                    | <b>Construction of labor sheds, stocking yard with CC block preparation yard for Embankment Rehabilitation activities</b> |                       |   |                      |   |                     |
| Land loss                          | Location-1: Dombaria (Baghabari towards Shahzadpur-6.5km)   | About 1.04 ha of land | About 1.04 ha of existing embankment area would be used temporarily | 0                    | <ul style="list-style-type: none"> <li>Construction of labor sheds and stocking yard in existing embankment so that the agri. land would not be lost.</li> <li>Constructing materials of the protective works should be stored in such a manner that the agriculture lands and standing crops would not be damaged.</li> <li>Area for executing construction activities, storage of construction materials, labor sheds, and other project related activities should be optimized with the purpose of minimum disruption to cultivable lands and standing crops.</li> <li>The contractor should ensure that no vehicular movements would take place inside cultivation fields.</li> <li>The contractor should maintain liaison with communities (WMOs) for better performance.</li> </ul> | +1                  |
|                                    | Location-2: Lochha (Shahzadpur-Korotoa bank-4.0km)  | About 1.08 ha of land | About 1.08 ha of existing embankment area would be used temporarily | 0                    |   | +1                  |
|                                    | <b>Sub-total</b>  | <b>2.12 ha</b>        |   |                      |   |                     |



| IEC             | Location   | Baseline condition    | Impacts  | Magnitude of impact* | Mitigation Measure  | Magnitude with EMP* |
|-----------------|--|-----------------------|--|----------------------|---|---------------------|
| <b>Activity</b> | <b>Construction of labor shed and stocking yard for construction of new embankment activities</b>              |                       |  |                      |   |                     |
| Land loss       | Location-1: Gopalpur (Kaizuri-Hura sagar offtake-10.5km)   | About 1.02 ha of land | About 1.02 ha of agricultural land would be lost temporarily | -1                   | <ul style="list-style-type: none"> <li>Construction of labor sheds and stocking yard preferably is constructed in khas/fallow land.</li> <li>Constructing materials of the new embankment should be stored in such a manner that the agriculture lands and standing crops would not be damaged.</li> </ul>  | +2                  |
|                 | Location-2: Jagtala Kaizuri-Benotia-2.0km)   | About 1.04 ha of land | About 1.04 ha of agricultural land would be lost temporarily | -1                   | <ul style="list-style-type: none"> <li>Area for executing construction activities, storage of construction materials, labor sheds and other project related activities should be optimized with the purpose of minimum disruption to cultivable lands and standing crops.</li> </ul>  | +2                  |
|                 | Location-3: Doriamehi (Hura sagar – Baghabari-6.0km)   | About 1.0 ha of land  | About 1.0 ha of agricultural land would be lost temporarily  | -1                   | <ul style="list-style-type: none"> <li>In cases where the disruption to farming becomes unavoidable, adequate cash compensation should be provided to the land owners. /share croppers.</li> <li>Exact amount of compensation should be determined based on the amount of land temporarily going out of cultivation.</li> <li>The rate should be decided on the basis of the crop usually grown on the pieces of land.</li> <li>The contractor should ensure that no vehicular movements would take place inside cultivation fields.</li> <li>The contractor should maintain liaison with communities (WMOs) for better performance.</li> </ul>                                     | +2                  |
|                 | <b>Sub total</b>   | <b>3.06 ha</b>        |  |                      |   |                     |
| <b>Activity</b> | <b>Construction of labor sheds, stocking yard and CC block preparation yard for Bank Protective activities</b> |                       |  |                      |   |                     |
| Land loss       | Location-1: (Benotia-2.0km)  | About 1.0 ha of land  | About 1.0 ha of agricultural land would be lost temporarily  | -1                   | <ul style="list-style-type: none"> <li>Construction of labor sheds and stocking yard preferably be done in khas/fallow land.</li> <li>Constructing materials of the protective works should be stored in such a manner that the agriculture lands and standing crops would not be damaged.</li> <li>Area for executing construction activities, storage of construction materials, labor sheds, and other project related activities should be optimized with the purpose of minimum disruption to cultivable lands and standing crops.</li> <li>In cases where the disruption to farming becomes unavoidable, adequate cash compensation should be provided to the land</li> </ul> | +2                  |

| IEC                             | Location   | Baseline condition    | Impacts  | Magnitude of impact* | Mitigation Measure  | Magnitude with EMP* |
|---------------------------------|--|-----------------------|--|----------------------|---|---------------------|
|                                 |  |                       |  |                      | owners. /share croppers. <ul style="list-style-type: none"> <li>Exact amount of compensation should be determined based on the amount of land temporarily going out of cultivation.</li> <li>The rate should be decided on the basis of the crop usually grown on the pieces of land.</li> <li>The contractor should ensure that no vehicular movements would take place inside cultivation fields and would maintain liaison with communities (WMOs) for better performance.</li> </ul>  |                     |
|                                 | <b>Sub total</b>   | <b>1.0ha</b>          |  |                      |   |                     |
| <b>Jamuna Left Bank (JLB-2)</b> |  |                       |  |                      |   |                     |
| <b>Activity</b>                 | <b>Construction of labor sheds, stocking yard and CC block preparation yard for Bank Protective activities</b> |                       |  |                      |   |                     |
| Land loss                       | Location-2: (Chauhali-5.0km)   | About 1.02ha of land  | About 1.02 ha of agricultural land would be lost temporarily.            | -1                   | <ul style="list-style-type: none"> <li>Construction of labor sheds and stocking yard preferably is made in khas/fallow lands.</li> <li>Constructing materials of the protective works should be stored in such a manner that the agriculture lands and standing crops would not be damaged.</li> <li>Area for executing construction activities, storage of construction materials, labor sheds, and other project related activities should be optimized with the purpose of minimum disruption to cultivable lands and standing crops.</li> <li>The contractor should ensure that no vehicular movements would take place inside cultivation fields.</li> <li>The contractor should maintain liaison with communities (WMOs) for better performance.</li> </ul> | +2                  |
|                                 | Location-3: (Bachamara-2.0km)  | About 1.01 ha of land | About 1.01 ha of agricultural land would be lost temporarily.            | -1                   |   | +2                  |
|                                 | <b>Sub total</b>   | <b>2.03ha</b>         |  |                      |   |                     |
| <b>Padma Left Bank (PLB-1)</b>  |  |                       |  |                      |   |                     |
| <b>Activity</b>                 | <b>Construction of labor sheds and bag-filling yard for Bank Protective activities</b>                         |                       |  |                      |   |                     |
|                                 | Location-4: (Harirampur-7.0km)   | About 1.04 ha of land | About 1.04 ha of char land/ agricultural land would be lost temporarily. | -1                   | <ul style="list-style-type: none"> <li>Construction of labor sheds and stocking yard preferably is made in khas/fallow lands.</li> <li>Constructing materials of the protective works should be stored in such a manner that the agriculture lands and standing crops would not be damaged.</li> <li>Area for executing construction activities, storage of construction materials, labor sheds, and other project related activities should</li> </ul>   | +2                  |

| IEC                              | Location   | Baseline condition   | Impacts  | Magnitude of impact* | Mitigation Measure  | Magnitude with EMP* |
|----------------------------------|--|----------------------|--|----------------------|---|---------------------|
|                                  |  |                      |  |                      | be optimized with the purpose of minimum disruption to cultivable lands and standing crops. <ul style="list-style-type: none"> <li>The contractor should ensure that no vehicular movements would take place inside cultivation fields.</li> <li>The contractor should maintain liaison with communities (WMOs) for better performance.</li> </ul>  |                     |
|                                  | <b>Sub total</b>   | <b>1.04ha</b>        |  |                      |   |                     |
| <b>Jamuna Right Bank (JRB-1)</b> |  |                      |  |                      |   |                     |
| <b>Activity</b>                  | <b>Construction of labor sheds and stocking yard for construction of drainage sluices activities</b> |                      |  |                      |   |                     |
| Land loss                        | Location-1: (Not fix up)   | About 0.05ha of land | About 0.05 ha of agricultural land would be lost temporarily | -1                   | <ul style="list-style-type: none"> <li>Construction of labor sheds and stocking yard preferably is made in khas/fallow lands.</li> <li>Constructing materials of the protective works should be stored in such a manner that the agriculture lands and standing crops would not be damaged.</li> <li>Area for executing construction activities, storage of construction materials, labor sheds, and other project related activities should be optimized with the purpose of minimum disruption to cultivable lands and standing crops.</li> <li>The contractor should ensure that no vehicular movements would take place inside cultivation fields.</li> <li>The contractor should maintain liaison with communities (WMOs) for better performance.</li> </ul> | +1                  |
|                                  | Location-2: (Not fix up)   | About 0.08ha of land | About 0.08ha of agricultural land would be lost temporarily  | -1                   |   | +1                  |
|                                  | Location-3: (Not fix up)   | About 0.08ha of land | About 0.08ha of agricultural land would be lost temporarily  | -1                   |   | +1                  |
|                                  | <b>Sub total</b>   | <b>0.21ha</b>        |  |                      |   |                     |
|                                  | <b>Grand total</b>   | <b>9.46 ha</b>       |  |                      |   |                     |

## 8.4.2 Construction Phase

| IEC                 | Location   | Baseline condition  | Impacts  | Magnitude of impact* | Mitigation Measure  | Magnitude with EMP* |
|---------------------|--|---------------------|--|----------------------|---|---------------------|
| Jamuna Right Bank-1 |  |                     |  |                      |   |                     |
| Activity            | Collection and disposal of constructing materials for Embankment rehabilitation activities |                     |  |                      |   |                     |
| Land loss           | Location-3: Doriamehi (Hura sagar-Baghabari-6.0km)   | About 0.6ha         | About 0.6ha of agricultural land would be lost permanently   | 0                    | Top soil (0-15cm) should be managed properly for conserve the soil fertility.<br>The filling /disposal materials should be collected preferably from river bed using sand pumped from dredger and excavator and clay collection from existing embankment.   | +1                  |
|                     | Location-2: Lochha (Shahzadpur-Korotoa bank-4.0km)   | About 0.4ha of land |  | 0                    | Area for executing construction and other project related activities should be optimized with the purpose of minimum disruption to cultivable lands and standing crops.<br>Disposal of spoil/ constructing materials for bank rehabilitation work should preferably be place on existing embankment so that the new area might not be affected for growing crops.<br>In cases where the disruption to farming becomes unavoidable, adequate cash compensation should be provided to the land owners. /share croppers.<br>Exact amount of compensation should be determined based on the amount of land temporarily going out of cultivation.<br>The rate should be decided on the basis of the crop usuallygrown on the pieces of land. | +1                  |
|                     |  | Sub total           | 1.0 ha   |                      |   |                     |
| Activity            | Collection and disposal of earth materials for construction of new embankment activities   |                     |  |                      |   |                     |
| Land loss           | Location-1: Gopalpur (Kaizuri-Hura sagar offtake-10.5km)                                   | About 1.05ha        | About 1.05ha of agricultural land would be lost permanently. | -1                   | Top soil (0-15cm) should be managed properly for conserve the soil fertility.<br>The filling /disposal materials should be collected preferably from river bed using sand pumped from dredger and excavator and clay collection from existing embankment.   | +2                  |
|                     | Location-2: Jagtala Kaizuri-Benotia-2.0km)   | About 0.2ha         | About 0.2ha of agricultural land would be lost permanently   | -1                   | Area for executing construction and other project related activities should be optimized with the purpose of minimum disruption to cultivable lands and standing crops.   | +2                  |

| IEC                            | Location   | Baseline condition     | Impacts                                 | Magnitude of impact* | Mitigation Measure   | Magnitude with EMP* |
|--------------------------------|--|------------------------|---|----------------------|--|---------------------|
|                                |  |                        |   |                      | <p>Disposal of spoil/ constructing materials for bank rehabilitation work should preferably be place on existing embankment so that the new area might not be affected for growing crops.</p> <p>In cases where the disruption to farming becomes unavoidable, adequate cash compensation should be provided to the land owners. /share croppers.</p> <p>Exact amount of compensation should be determined based on the amount of land temporarily going out of cultivation.</p> <p>The rate should be decided on the basis of the crop usually grown on the pieces of land.</p>   |                     |
|                                | <b>Sub total</b>   | <b>1.25ha</b>          |   |                      |  |                     |
| <b>Activity</b>                | <b><i>Collection and disposal of construction materials for bank protection activities</i></b> |                        |   |                      |  |                     |
| Land loss                      | Location-1:<br>(Benotia-2.0km)   | About 0.2ha<br>of land | About 0.20 ha of land<br>would be lost. | -1                   | <p>Top soil (0-15cm) should be managed properly for conserve the soil fertility.</p> <p>The filling /disposal materials should be carried by dump truck and excavator for loading and unloading.</p> <p>Precautionary measure should be taken so that the dumping materials would not be spreading on agricultural land during carrying.</p> <p>Area for executing construction and other project related activities should be optimized with the purpose of minimum disruption to cultivable lands and standing crops.</p> <p>Disposal of spoil/ constructing materials for bank protective work should preferably be place on existing embankment so that the new area might not be affected for growing crops.</p> <p>In cases where the disruption to farming becomes unavoidable, adequate cash compensation should be provided to the land owners. /share croppers.</p> <p>Exact amount of compensation should be determined based on the amount of land temporarily going out of cultivation.</p> <p>The rate should be decided on the basis of the crop usually grown on the pieces of land.</p> | +2                  |
|                                | <b>Sub total</b>   | <b>0.2ha</b>           |   |                      |  |                     |
| <b>Jamuna Left Bank(JLB-2)</b> |  |                        |   |                      |  |                     |

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

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

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

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

| IEC      | Location                                  | Baseline   | FWOP   | FWIP   | Impacts  | Magnitude of impact* | Mitigation Measure  | Magnitude with EMP* |
|----------|---|--|--|--|--|----------------------|---|---------------------|
| Land use | Entire project areas ( for all locations) | Present land use is about:<br>(i) Single crop area:28.7%<br>(ii) Double crop area:49.8% and<br>(iii) Triple cropped area:21.5%<br>Present NCA=184,200ha. | Land use would be about:<br>(i)Single crop area:26.3%<br>(ii)Double crop area:43.5% and<br>(iii)Triple cropped area:30.2%<br>NCA would decrease to | Land use would be about:<br>(i)Single crop area:22.5%<br>(ii)Double crop area:32.4% and<br>(iii)Triple cropped area: 45.1%.<br>NCA would remain as | Minimize River bank erosion, so that,<br>(a)About 30% of the NCA might be impacted positively in JRB-1, (Kaizuri and Bachamara area).<br>(b)About 5% of the NCA (3% of the NCA in Chauhali and Nagarpur area and 2% of the NCA in Jafarganj-Bachamara area) might be impacted in JLB-2 area.<br>(c) About 5% of the NCA might be impacted positively | +2                   | <ul style="list-style-type: none"> <li>The community organizations should be formed and strengthening through orientation on embankment management, smooth functioning of regulators, improve of the drainage system of the project, integrated water management, on farm development etc.</li> </ul> | +4                  |



| IEC            | Location                                  | Baseline   | FWOP  | FWIP   | Impacts   | Magnitude of impact* | Mitigation Measure   | Magnitude with EMP* |
|----------------|---|--|---|--|---|----------------------|--|---------------------|
|                |   |  | 169,950 ha.   | baseline.  | in PLB-1, Harirampur area.  |                      |  |                     |
| Land type      | Entire project areas ( for all locations) | Highland -4.4%, Medium Highland - 36.9%, Medium Lowland-36.9%, Lowland-21.4%, and Very low land-0.3%.  | Highland- 4.5%, Medium Highland - 37.0%, Medium Lowland- 36.8%, Lowland- 21.4%, and Very low land-0.3%. | Highland- 5.8%; Medium Highland - 48.8%; Medium Lowland- 28.3%, Lowland- 16.8%, and Very low land-0.3% | Land type would be improved especially in JRB-1 area.                     | +2                   | The community organizations should be formed and strengthening through orientation on embankment management, smooth functioning of regulators, improve of the drainage system of the project, integrated water management, on farm development etc.  | +4                  |
| Sand carpeting | Entire project area(all locations)        | Presently sand carpeting affects (i) JRB-1 area, about 5%, (ii) JLB-2 area, about 3% and (iii) PLB-1 area ,about 1% of the NCA in concerned area | Sand carpeting would continue   | Sand carpeting area would be minimized   | Minimize sand carpeting for the rehabilitation of proposed interventions. | +4                   | <ul style="list-style-type: none"> <li>Formation of WMOs, strengthening through imparting training need to be done.</li> <li>Involvement of community organizations in project activities (maintenance of embankment, functioning of regulators, etc) would improve the project situation.</li> <li>Land of sand carpeting area might bring under cultivation through removal of coarse sand from field, incorporation of</li> </ul> | +6                  |

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

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

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

## 8.5 Agriculture Resources

### 8.5.1 Pre-Construction Phase

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

### 8.5.2 Construction Phase

| IEC  | Location   | Baseline condition   | Impacts   | Magnitude of impact* | Mitigation Measure   | Magnitude with EMP* |
|--|--|--|---|----------------------|--|---------------------|
| <b>Jamuna Right Bank(JRB-1),Jamuna Left Bank(JLB-2) and Padma Left Bank(PLB-1)</b> |  |  |   |                      |  |                     |
| Activity->   | Construction of labor sheds, stocking yard for Bank rehabilitation, construction of new embankment, bank protection and construction of drainage sluices and disposal of spoils activities |  |   |                      |  |                     |
| Loss of crop Production  | (i) Dombaria<br>(ii) Lochha<br>(iii) Gopalpur<br>(iv) Jagtala<br>(v) Doria mehi  | Total expected crop land loss is about 9.24 ha. for:<br>(a)Construction of labor sheds and | Expected crop production loss would be about 27.9 metric ton (Rice-23.1metric ton and Ground nut 4.8 metric | -2                   | <ul style="list-style-type: none"> <li>Top soil (0-15cm) should be managed properly to conserve the soil fertility.</li> <li>Construction of labor sheds and stocking yard/ disposal spoils for rehabilitation of embankment, construction of new</li> </ul> | +2                  |

| IEC                           | Location  | Baseline condition   | Impacts   | Magnitude of impact* | Mitigation Measure   | Magnitude with EMP* |
|-------------------------------|---|--|---|----------------------|--|---------------------|
|                               | (vi)Benotia<br>(vii)Chauhali<br>(viii)Bachamara<br>(ix) Harirampu<br>(x)Location-1( Yet to be fixed)<br>(xi)Location-2 (Yet to be fixed)<br>(xii)Location-3 (Yet to be fixed) | stocking yard: 7.34 ha<br>(b)Disposal of spoils for new embankment: 1.90 ha. | ton) for:<br>(a) Loss of rice 18.35metric ton for construction of labor sheds and stocking yard:<br>(b) Loss of rice 4.75 metric ton and ground nut 4.8 metric ton for disposal of spoils.                                |                      | embankment, bank protective work and construction of drainage sluices should be placed in non-agricultural land as far as possible.<br><ul style="list-style-type: none"> <li>In cases where the disruption to farming becomes unavoidable, adequate cash compensation should be provided to the land owners. /share croppers.</li> <li>Exact amount of compensation should be determined based on the amount of land temporarily going out of cultivation.</li> <li>The rate should be decided on the basis of the crop usually grown on the pieces of land.</li> </ul> |                     |
| Disrupt drainage system       | Entire project area   | River and khals silted up  | It is expected that the drainage congested area might increase during the implementation of rehabilitation of embankment, construction of new embankment, bank protection and construction of drainage sluice activities. | -2                   | <ul style="list-style-type: none"> <li>The sequence of work during construction of drainage sluices in the water channels would be carefully planned to avoid disruption of drainage.</li> <li>During construction period contractor should construct a by pass canal to avoid disruption of drainage.</li> <li>The contractor would ensure no negative impacts on crop cultivation in monsoon season.</li> <li>The contractor would maintain liaison with community organizations.</li> </ul>   | +2                  |
| Disrupt irrigation facilities | Entire project area   | Presently, surface water irrigated area is about 1% of the study area        | Irrigation facilities might be disrupted due to construction of embankment and  | -2                   | <ul style="list-style-type: none"> <li>The sequence of work during construction of embankment and drainage sluices in the water channels would be carefully planned to avoid disruption of irrigation.</li> </ul>  | +2                  |

| IEC | Location | Baseline condition | Impacts           | Magnitude of impact* | Mitigation Measure  | Magnitude with EMP* |
|-----|----------|--------------------|-------------------|----------------------|---|---------------------|
|     |          |                    | drainage sluices. |                      | <ul style="list-style-type: none"> <li>During construction period contractor should construct a by pass canal to ensure irrigation in dry season.</li> <li>The contractor would ensure no negative impacts on crop cultivation in monsoon season.</li> <li>The contractor would maintain liaison with community organizations.</li> </ul> |                     |

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

### 8.5.3 Post-Construction Phase (JRB-1)

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

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

## 8.6 Fisheries Resources

### 8.6.1 Pre-Construction Phase

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

### 8.6.2 Construction Phase

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

| IEC   | Location      | Baseline condition   | Impacts   | Magnitude of impact* | Mitigation Measure   | Magnitude with EMP* |
|---|---------------|--|---|----------------------|--|---------------------|
| <b>Activity: Collection of earth materials from Jamuna River through dredging</b> |               |  |   |                      |  |                     |
| Fish habitat  | Same as above | More than 10 deep pools or locally called dor/duars are located at 20-40m far from the right river bank. These areas play an important role for hilsa production. Moreover, other larger fish species, i.e., boal, ayr, baghayr, rui, catla etc. use these habitat particularly during the dry season (December-March) | <ul style="list-style-type: none"> <li>- Water quality (stream flow, temperature, pH, turbidity, DO, hardness etc.) of that portion of the Boral river will temporarily be changed which would change the behavior of riverine fish species (both the juveniles and adults).</li> <li>- Feeding habitat for the demersal (boal, ayr) and benthopelagic (baim) fish species would be damaged.</li> <li>- Deep pools (dor/duars) would temporarily be damaged.</li> </ul> | -2                   | 1. Dredging will have to be done during the dry season.<br>2. Proper protective device (silt fence) will have to take to protect the deep pools (dor/duars).     | -1                  |
|   |               |  |   | -1                   |  | -1                  |
| Fish migration  | Same as above | 1. Lateral migration occurs through flooding water.<br>2. Larvae and juveniles migrate from the river to the adjacent beels (Kadaibadla beel, Nuar beel, Mathavanga beel, Merpahnir beel, Kumirpecha beel, Moakholar beel etc) for feeding and growth during the dry season (December to March)                        | Both the Longitudinal (hilsa) and lateral migration for fish will be temporarily disturbed.   |                      | Dry season (December-March) is proposed for dredging.  |                     |
| Fish biodiversity   | Same as above | Riverine species diversity is rich with more than 100 species  | Riverine fish species i. e. hilsa, major carp species, eel ( <i>baim</i> ), big and small cat fish ( <i>boal</i> , <i>ayr</i> , <i>magur</i> ), etc. might shift from the project area  | -5                   | 1. Dredging will have to be done during the dry season.<br>2. Proper protective device (silt fence) will have to be taken to protect the deep pools (dor/duars). | -3                  |
|   |               |  |   |                      |  |                     |
| Fish production   | Same as above | Fish production from the proposed portion of the Jamuna river is 16.5 MT   | Capture fish production would temporarily be declined by 3.3 MT within the project area.  | -1                   |  | -4                  |
|   |               | Fish production from the proposed portion of the Jamuna river is 10 MT   | Capture fish production would temporarily be declined by 2 MT within the project area.  | -1                   |  |                     |

| IEC   | Location   | Baseline condition  | Impacts  | Magnitude of impact* | Mitigation Measure  | Magnitude with EMP* |
|---|--|---|--|----------------------|---|---------------------|
| <b>Activity: Construction of sluice gate</b>  |  |   |  |                      |   |                     |
| Fish Migration  | Not fixed up   | <ul style="list-style-type: none"> <li>- There is good connectivity between the Baral khal to Hurashagar which flows over the Mohakholar Beel and Kumir pecha Beel.</li> <li>- The water of Baral khal goes to the Nuar Beel, Mathavanga Beel, Merpahnir Beel, Kossailkar Beel and Gobindapur Beel through the Verakhola khal</li> </ul>  | Fish migration would be hindered   | -3                   | 1. Fish friendly structure with suitable water depth, water velocity etc. should be maintained.<br>2. Gates should be operated with the knowledge of fish migration behavior with suitable season | -1                  |
| Fish biodiversity   |  |   | Fish biodiversity would slightly be reduced, because they can enter the mentioned beel through another migration route.  | -2                   | Same as above   | -1                  |
| Fish production   |  |   | Production would slightly be lowered   | -2                   | Same as above   | -1                  |
| <b>New Embankment Construction</b>  |  |   |  |                      |   |                     |
| <b>Activity: Collection of earth materials from the location of embankment through excavator, pay loader, head load, dump truck and trolley</b> |  |   |  |                      |   |                     |
| Fish habitat  | 10.5 km of the Jamuna river bank from Hat Pachil Bazar, Kaizuri to Benotia Hat/Bazar | The proposed location generally contains vegetation covers (Chon, Nol, Kaisa, Mutha, Kolmi, Binna, Durba etc.). Fish and prawn species (major carps, i.e., rui, catla, mrigel etc., big and small catfishes, Golda, gura chingri etc.) use this habitat as spawning, grazing and refuge grounds during the inundation of habitat in the monsoon flood season (June to September). | Temporary damage would occur in the seasonal fish habitat due to either clearance of vegetation cover or draped by the filling earth during earth work for the fish species of marginal vegetation feeder. | -1                   | The area of vegetation clearance should be minimized  | -1                  |
|   | 2 km from Benotia Hat/Bazar to the start of Baral Khal, Verakola Hat                 |   |  | -1                   |   | -1                  |

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



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

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

| IEC  | Location   | Baseline condition  | Impacts   | Magnitude of impact* | Mitigation Measure  | Magnitude with EMP* |
|--|--|---|---|----------------------|---|---------------------|
|  |  |   | Culture fisheries practice would be slightly increased.   |                      |   |                     |
| Jamuna Left Bank – 2 (Riverbank Protection Work)   |  |   |   |                      |   |                     |
| Activity: Riverbank protection slope pitching with concrete blocks (above low water level) |  |   |   |                      |   |                     |
| Fish habitat   | 5 km of the Jamuna Left bank from Chauhali Sadar to Atpara | 1. During the pre-monsoon (April-early June) period small to larger fish species (boal, ayr, baghayr, pangas, taki, magur, baim, gura chingri etc.) go against the higher water current nearby the river bank for their breeding.                                       | Boropit would be lost somewhat near the river bank at Chauhali sadar (East and North Khaskaulia   | -1                   | Not applicable  | -1                  |
|  | 2 km of the Jamuna Left bank from Jaffarganj to Bachamara  | 2. Cultured practice of high-valued fish species (tilapia, pangas and major carps) in cultured pond and baropit is happened near the river bank which is highly vulnerable to river bank erosion.   | Not applicable  | 0                    |   | 0                   |
| Fish biodiversity  | Same as above  | Riverine species diversity is moderate to rich with more than 60 species  | Not applicable  | 0                    |   | 0                   |
| Fish production  | Same as above  | Fish production from the proposed portion of the Jamuna river is 591.5 MT   | Capture and culture fish production would be the same as the base.  | 0                    | Proper training to increase the culture practice of high-valued fish species  | 0                   |
|  |  | Fish production from the proposed portion of the Jamuna river is 236.6 MT   | Culture fish production would temporarily be declined by 47.32 MT within the project area.  | -1                   |   | -1                  |
| Padma Left Bank -1 (Riverbank Protection Work)   |  |   |   |                      |   |                     |
| Activity: Riverbank protection temporary slope pitching with geobags above low water level |  |   |   |                      |   |                     |
| Fish habitat   | 7 km of the Padma Left Bank at Harirampur                  | 1. The proposed location generally contains vegetation covers (Chon, Nol, Kaisa, Mutha, Kolmi, Binna, Durba etc.). Fish and prawn species (major carps, i.e., rui, catla, mrigel etc., big and small catfishes, Golda, gura chingri etc.) use this habitat as spawning, | - Temporary damage would occur in the seasonal fish habitat due to clearance of vegetation cover for the fish species of marginal vegetation feeder.<br>- Spawning ground would be lost | -4                   | Vegetation clearance should be done as low as possible<br>Spawning ground should be taken under special consideration | -2                  |

| IEC               | Location | Baseline condition   | Impacts  | Magnitude of impact* | Mitigation Measure                                 | Magnitude with EMP* |
|-------------------|----------|--|--|----------------------|--|---------------------|
|                   |          | grazing and refuge grounds during the inundation of habitat in the monsoon flood season (June to September).<br>2. There is a major spawning ground of major carps (rui, catla, mrigel etc.) at Andharmanik Ghat of Bayra Union. |  |                      | during the earthwork and earth filling             |                     |
| Fish migration    |          | Major carps migrated toward the spawning ground (created before the 7 years) through the flooding water and Padma river channel.   | Migration route would be disturbed   | -3                   | Construction with take place during the dry season | 0                   |
| Fish biodiversity |          | Riverine species diversity is rich with more than 100 species  | Riverine fish species i. e. major carp species, grass carp and other herbivorous species, eel ( <i>baim</i> ), big and small cat fish ( <i>boal</i> , <i>ayr</i> , <i>magur</i> ), might shift from the project area | -2                   |  | -2                  |
| Fish production   |          | Fish production from the proposed portion of the Padma river is 1,183 MT   | Capture fish production would temporarily be declined by 592 MT within the project area.   | -1                   |  | -1                  |

### 8.6.3 Post-Construction Phase

| IEC  | Location  | Baseline condition  | FWOP  | FWIP  | Impacts  | Magnitude of impact* | Mitigation Measure   | Magnitude with EMP* |
|--|---|---|---|---|--|----------------------|--|---------------------|
| <b>Jamuna Right Bank – 1 (Embankment Rehabilitation)</b> |   |   |   |   |  |                      |  |                     |
| Fish habitat   | 6.5 km of the Verakhola towards start of Hurashagar river | Fish habitat area is 4322.5 ha<br>Capture: 4322.5 ha<br>Culture: 0 ha | Fish habitat area in FWOP would be 4429 ha<br>Capture: 4429 ha<br>(Capture area would increase since floodplain area would increase for ongoing | Fish habitat area in FWIP would be slightly reduced to 107.7 ha<br>Capture: 97.7 ha<br>(Capture area would decrease by 5814.8 ha because of embankment construction and ring bundh construction on floodplain area)<br>Culture: 10 ha | Estimated net loss to fish habitat area would be 4321.3 ha | -10                  | 1. Aquatic trees and herbs should be planted on the slope of the bank.<br>2. Proper protective | -6                  |

| IEC               | Location  | Baseline condition  | FWOP  | FWIP   | Impacts  | Magnitude of impact* | Mitigation Measure  | Magnitude with EMP* |
|-------------------|---|---|---|--|--|----------------------|---|---------------------|
|                   |   |   | siltation through spill over channel)   | (Culture area would be increased since flood induced risk would be minimized)  |  |                      | device will have to be taken to   |                     |
|                   | 4km from the starting point of Hurashagar to Korotoa bank | Fish habitat area is 1660 ha<br>Capture: 1660 ha<br>Culture: 0 ha | Fish habitat area in FWOP would be 1729 ha<br>Capture: 1729 ha<br>(Capture area would increase since floodplain area would increase for ongoing siltation through spill over channel) | Fish habitat area in FWIP would be 70 ha<br>Capture: 69 ha<br>(Capture area would decrease by 1591 ha because of embankment construction and ring bundh construction on floodplain area)<br>Culture: 1 ha<br>(Culture area would be increased since flood induced risk would be minimized) | Estimated net loss to fish habitat area would be 1659 ha | -4                   | protect the deep pools (dor/duars).<br>3. Use of surface water during the breeding period should be stopped.<br>4. Culture fisheries should be developed<br>5. Perennial beels should be developed under a biodiversity program | -2                  |
| Fish migration    | Same as above   | Fish migration is in good condition                               | Fish migration would be increased due to the increase of floodplain area  | Fish migration would be obstructed along the floodplain because of embankment rehabilitation   | Degraded fish migration                                  | -5                   | Sluice gates operated by communities following the GIZ approach at Pabna  | -3                  |
| Fish biodiversity | Same as above   | Riverine species  | Fish diversity would remain same as base  | The present structure (species composition, population size per  | Capture fish species diversity                           | -2                   | 1. Proper protective  | -2                  |

| IEC | Location        | Baseline condition                           | FWOP                                  | FWIP  | Impacts   | Magnitude of impact* | Mitigation Measure  | Magnitude with EMP* |
|-----|-----------------|--|---------------------------------------|---|---|----------------------|---|---------------------|
|     |                 | diversity is rich with more than 100 species | condition or increased slightly       | <p>species etc.) of the fish community particularly SIS would decline in the following way:</p> <p>Floodplain migration will be declined</p> <p>↓</p> <p>Habitat area will be declined</p> <p>↓</p> <p>Population size (number of individuals) of source habitat (rivers) will be declined</p> <p>↓</p> <p>Increase of Vulnerability to Natural calamities</p> <p>↓</p> <p>Increase of Demographic calamities</p> <p>↓</p> <p>Decrease of Fish biodiversity</p> <p>High-valued culture fish species (Major carps, minor carps, Tilapia, Pangas, Thai koi etc.) would be increased</p> | would be moderate to low                                |                      | <p>device will have to be taken to protect the deep pools (dor/duars).</p> <p>2. Use of surface water during the breeding period should be stopped.</p> <p>3. Culture fisheries should be developed</p> <p>4. Perennial beels should be developed under a biodiversity program</p> <p>5. Proper training to increase the culture practice of high-valued fish species</p> |                     |
|     | Same as above   | Same as above                                | Same as above                         | Same as above   | Capture fish species diversity would be moderate to low | -2                   |   | -                   |
|     | Fish production | Production: 1216 MT                          | Fish production in FWOP would be 1229 | Fish production in FWIP would be 49.5 MT  | Estimated net loss to fish                              | -5                   |   | -3                  |

| IEC | Location      | Baseline condition                                     | FWOP   | FWIP  | Impacts                                       | Magnitude of impact* | Mitigation Measure | Magnitude with EMP* |
|-----|---------------|--|--|---|---|----------------------|--------------------|---------------------|
|     |               | Capture: 1216 MT<br>Culture: 0 MT                      | MT<br>Capture: 1229 MT (Fish production would be declined because of capture fish habitat quality would deteriorate)<br>Culture: 0 MT (Culture fish production would decline due to flood induced risk; fish farmers would feel discourage to culture fish commercially) | Capture: 16.5 MT (Fish production would decrease because of migration obstacle along the floodplain through the bank protection work. All fish cannot migrate through high velocity water. During monsoon riverine fish species laterally migrate to floodplain and other capture habitat for food and spawning. Fish migration would totally be lost because of proposed intervention. Culture: 33 MT (Culture fish production would increase due to minimizing river bank erosion and flood induced risk) | production: 1179.5 MT                         |                      |                    |                     |
|     | Same as above | Production: 464 MT<br>Capture: 464 MT<br>Culture: 0 MT | Fish production in FWOP would be 476 MT<br>Capture: 476 MT (Fish production would be declined because of capture fish habitat quality would deteriorate)<br>Culture: 0 MT (Culture fish production would decline due to flood induced risk; fish farmers would feel      | Fish production in FWIP would be 15 MT<br>Capture: 12 MT (Fish production would decrease because of migration obstacle along the floodplain and huge flow of water through the regulator during wet season. All fish can not migrate through high velocity water. During monsoon riverine fish species laterally migrate to floodplain and other capture habitat for food and spawning. Fish would not migrate freely   | Estimated net loss to fish production: 461 MT | -9                   |                    | -5                  |

| IEC                                | Location   | Baseline condition  | FWOP  | FWIP  | Impacts   | Magnitude of impact* | Mitigation Measure  | Magnitude with EMP* |
|------------------------------------|--|---|---|---|---|----------------------|---|---------------------|
|                                    |  |   | discourage to culture fish commercially)  | because of proposed intervention. Culture: 3 MT (Culture fish production would increase due to minimizing flood induced risk)   |   |                      |   |                     |
| <b>New Embankment Construction</b> |  |   |   |   |   |                      |   |                     |
| Fish habitat                       | 10.5 km of the Jamuna river bank from Hat Pachil Bazar, Kaizuri to Benotia Hat/Bazar | Fish habitat area is 11183 ha<br>Capture: 11183 ha<br>Culture: 0 ha | Fish habitat area in FWOP would be 11206 ha<br>Capture: 11206 ha<br>(Capture area would increase since floodplain area would increase for ongoing siltation through spill over channel) | Fish habitat area in FWIP would be reduced to 167.5 ha<br>Capture: 157.5 ha<br>(Capture area would decrease by 11025 ha because of embankment construction and ring bundh construction on floodplain area)<br>Culture: 10 ha<br>(Culture area would be increased since flood induced risk would be minimized) | Estimated net loss to fish habitat area would be 11038.5 ha | -9                   | 1. Aquatic trees and herbs should be planted on the slope of the bank.<br>2. Proper protective device will have to take to protect the deep pools (dor/duars).<br>3. Use of surface water during the breeding period should be stopped. | -6                  |
|                                    | 2 km from Benotia Hat/Bazar to the start of Baral Khal, Verakola Hat                 | Fish habitat area is 460 ha<br>Capture: 460 ha<br>Culture: 0 ha     | Fish habitat area in FWOP would be 469 ha<br>Capture: 469 ha<br>(Capture area would increase since floodplain area would increase for ongoing siltation through spill over channel)     | Fish habitat area in FWIP would be 61 ha<br>Capture: 60 ha<br>(Capture area would decrease by 400 ha because of embankment construction and ring bundh construction on floodplain area)<br>Culture: 1 ha<br>(Culture area would be increased since flood induced risk would be minimized)                     | Estimated net loss to fish habitat area would be 409 ha     | -5                   |   | -4                  |
| Fish migration                     | Same as above  | Same as the above scenario  | Fish migration would increase due to the increase of floodplain   | Fish migration would be obstructed along the floodplain because of embankment   | Degraded fish migration                                     | -5                   | operation of regulators during  | -5                  |



| IEC               | Location      | Baseline condition         | FWOP   | FWIP   | Impacts   | Magnitude of impact* | Mitigation Measure | Magnitude with EMP* |
|-------------------|---------------|----------------------------|--|--|---|----------------------|--------------------|---------------------|
|                   |               |                            | area   | rehabilitation   |   |                      | migration periods  |                     |
|                   | Same as above |                            | Fish migration would increase due to the increase of floodplain area     | Fish migration would be obstructed along the floodplain because of embankment rehabilitation   | Degraded fish migration                                 | -5                   | Not applicable     | -5                  |
| Fish biodiversity | Same as above | Same as the above scenario | Fish diversity would remain same as base condition or increased slightly | <p>The present structure (species composition, population size per species etc.) of the fish community particularly SIS would decline in the following way:</p> <p>Floodplain migration will be declined<br/>↓<br/>Habitat area will be declined<br/>↓<br/>Population size (number of individuals) of source habitat (rivers) will be declined<br/>↓<br/>Increase of Vulnerability to Natural calamities<br/>↓<br/>Increase of Demographic calamities<br/>↓<br/>Decrease of Fish biodiversity<br/>High-valued culture fish species</p> | Capture fish species diversity would be moderate to low | -2                   | Not applicable     | -2                  |

| IEC             | Location      | Baseline condition                                     | FWOP  | FWIP  | Impacts   | Magnitude of impact* | Mitigation Measure   | Magnitude with EMP* |
|-----------------|---------------|--|---|---|---|----------------------|--|---------------------|
|                 |               |  |   | (Major carps, minor carps, Tilapia, Pangas, Thai koi etc.) would be increased   |   |                      |  |                     |
|                 | Same as above | Same as the above scenario                             | Fish diversity would remain same as base condition or increased slightly  | Same as above   | Capture fish species diversity would be moderate to low | -2                   | Not applicable   | -                   |
| Fish production | Same as above | Production: 890 MT<br>Capture: 890 MT<br>Culture: 0 MT | Fish production in FWOP would be 894 MT<br>Capture: 1094 MT (Fish production would be declined because of capture fish habitat quality would deteriorate)<br>Culture: 0 MT (Culture fish production would decline due to flood induced risk; fish farmers would feel discourage to culture fish commercially) | Fish production in FWIP would be 861 MT<br>Capture: 828 MT (Fish production would decrease because of migration obstacle along the floodplain and huge flow of water through the regulator during wet season. All fish cannot migrate through high velocity water. During monsoon riverine fish species laterally migrate to floodplain and other capture habitat for food and spawning. Fish would not migrate freely because of proposed intervention. Culture: 33 MT (Culture fish production would increase due to minimizing flood induced risk) | Estimated net loss to fish production: 33 MT            | -5                   | Proper training to increase the culture practice of high-valued fish species<br><br>Sluice gate construction and joint operation with communities following the GIZ approach at Pabna district | -3                  |
|                 | Same as above | Production: 78 MT<br>Capture: 78MT<br>Culture: 0 MT    | Fish production in FWOP would be 79 MT<br>Capture: 79 MT (Fish production would be  | Fish production in FWIP would be 13 MT<br>Capture: 10 MT (Fish production would decrease because of migration obstacle along the  | Estimated net loss to fish production: 66 MT            | -6                   | Not applicable<br><br>Sluice gate construction and joint   | -6                  |

| IEC   | Location   | Baseline condition  | FWOP  | FWIP   | Impacts   | Magnitude of impact* | Mitigation Measure   | Magnitude with EMP* |
|---|--|---|---|--|---|----------------------|--|---------------------|
|   |  |   | declined because of capture fish habitat quality would deteriorate)<br>Culture: 0 MT (Culture fish production would decline due to flood induced risk; fish farmers would feel discourage to culture fish commercially) | floodplain and huge flow of water through the regulator during wet season. All fish can not migrate through high velocity water. During monsoon riverine fish species laterally migrate to floodplain and other capture habitat for food and spawning. Fish would not migrate freely because of proposed intervention. Culture: 3 MT (Culture fish production would increase due to minimizing flood induced risk) |   |                      | operation with communities following the GIZ approach at Pabna district  |                     |
| <b>Jamuna Right Bank – 1 (Bank Protection Work)</b> |  |   |   |  |   |                      |  |                     |
| Fish habitat  | 2 km from Benotia Hat/Bazar to the start of Baral Khal | Fish habitat area is 60 ha<br>Capture: 60 ha<br>Culture: 0 ha | Fish habitat area in FWOP would be 69 ha<br>Capture: 69 ha<br>(Capture area would increase since floodplain area would increase for ongoing siltation through spill over channel)                                       | Fish habitat area in FWIP would be 58 ha<br>Capture: 57 ha<br>(Capture area would decrease by 12 ha because of embankment construction and ring bundh construction on floodplain area)<br>Culture: 1 ha<br>(Culture area would be increased since flood induced risk would be minimized)   | Estimated net loss to fish habitat area would be 1 ha | -2                   | 1. Aquatic trees and herbs should be planted on the slope of the bank.<br>2. Proper protective device (declaration of Sanctuary) will have to take to protect the deep pools (dor/duars).<br>3. Use of | -1                  |

| IEC               | Location | Baseline condition                                   | FWOP   | FWIP   | Impacts   | Magnitude of impact* | Mitigation Measure   | Magnitude with EMP* |
|-------------------|----------|--|--|--|---|----------------------|--|---------------------|
|                   |          |  |  |  |   |                      | surface water during the breeding period should be stopped.  |                     |
| Fish migration    |          | Same as the above scenario                           | Fish migration would increase due to the increase of floodplain area               | Fish migration would be obstructed along the floodplain because of embankment rehabilitation                                     | Degraded fish migration                                 | -4                   | Not applicable<br>Sluice gate construction and joint operation with communities following the GIZ approach at Pabna district | -4                  |
| Fish biodiversity |          | Same as the above scenario                           | Fish diversity would remain same as base condition or increased slightly           | Same as above  | Capture fish species diversity would be moderate to low | -2                   | Not applicable<br>Sluice gate construction and joint operation with communities following the GIZ approach at Pabna district | -2                  |
| Fish production   |          | Production: 10 MT<br>Capture: 10 MT<br>Culture: 0 MT | Fish production in FWOP would be 12 MT<br>Capture: 12 MT (Fish production would be | Fish production in FWIP would be 13 MT<br>Capture: 10 MT (Fish production would decrease because of migration obstacle along the | Estimated net gain to fish production: 1 MT             | +1                   | Not applicable<br>Sluice gate construction and joint operation with  | +1                  |

| IEC  | Location   | Baseline condition   | FWOP  | FWIP   | Impacts  | Magnitude of impact* | Mitigation Measure  | Magnitude with EMP* |
|--|--|--|---|--|--|----------------------|---|---------------------|
|  |  |  | declined because of capture fish habitat quality would deteriorate)<br>Culture: 0 MT (Culture fish production would decline due to flood induced risk; fish farmers would feel discourage to culture fish commercially) | floodplain and huge flow of water through the regulator during wet season. All fish can not migrate through high velocity water. During monsoon riverine fish species laterally migrate to floodplain and other capture habitat for food and spawning. Fish would not migrate freely because of proposed intervention. Culture: 3 MT (Culture fish production would increase due to minimizing flood induced risk) |  |                      | communities following the GIZ approach at Pabna district  |                     |
| <b>Jamuna Left Bank – 2 (Bank Protection Work)</b> |  |  |   |  |  |                      |   |                     |
| Fish habitat                                       | 5 km of the Jamuna Left bank from Chauhali Sadar to Atpara | Fish habitat area is 3511.4 ha<br>Capture: 3500 ha<br>Culture: 11.4 ha | Fish habitat area in FWOP would be 4900 ha<br>Capture: 4900 ha<br>(Capture area would increase due to the river bank erosion by 40%)<br>Culture: 0 ha. (Due to the river bank erosion)                                  | Fish habitat area in FWIP would be slightly reduced to 3511.4 ha<br>Capture: 3500 ha<br>(Capture area would be the same as the base condition)<br>Culture: 11.4 ha<br>(Culture area would be the same since erosion induced risk would be minimized)   | Estimated net loss to fish habitat area would be 1388.6 ha | -3                   | 1. Aquatic trees and herbs should be planted on the slope of the bank.<br>2. Proper protective device (i.e., declaration of | -1                  |
|  | 2 km of the Jamuna Left bank from Jaffarganj to Bachamara  | Fish habitat area is 1400 ha<br>Capture: 1400 ha<br>Culture: 0 ha      | Fish habitat area in FWOP would be 1960 ha<br>Capture: 1960 ha<br>(Capture area would increase due to the   | Fish habitat area in FWIP would be 1410 ha<br>Capture: 1400 ha<br>(Capture area would be the same as the base condition)<br>Culture: 10 ha   | Estimated net loss to fish habitat area would be 550 ha    | -3                   | Sanctuary) will have to take to protect the deep pools (dor/duars).<br>3. Use of  | -1                  |

| IEC               | Location      | Baseline condition   | FWOP   | FWIP   | Impacts                                 | Magnitude of impact* | Mitigation Measure   | Magnitude with EMP* |
|-------------------|---------------|--|--|--|---|----------------------|--|---------------------|
|                   |               |  | river bank erosion by 40%)   | (Culture area would be increased since flood induced risk would be minimized)  |   |                      | surface water during the breeding period should be stopped.                                    |                     |
| Fish migration    | Same as above | Have no significant migratory routes                                     | Would be developed   | Would be blocked   | Migration would be hindered permanently | -1                   | sluice gates would provide limited migration opportunity                                       | -1                  |
|                   | Same as above | Same as above  | Same as above  | Same as above  | Same as above                           | Same as above        | Same as above  | Same as above       |
| Fish biodiversity | Same as above | Riverine species diversity is moderate to rich with more than 60 species | Would be the same as the base condition  | Would be the same as the base condition  | Fish biodiversity would be reduced      | -1                   | Same as above  | -1                  |
|                   | Same as above | Same as the above scenario   | Same as above  | Same as above  | Same as above                           | Same as above        | Same as above  | Same as above       |
| Fish production   | Same as above | Production: 591.5 MT<br>Capture: 575 MT<br>Culture: 37.5 MT              | Fish production in FWOP would be 591.5 MT<br>Capture: 575 MT (Fish production would be the same as the base condition)<br>Culture: 37.5 MT (Fish production would be the same as the base condition) | Fish production in FWIP would be 591.5 MT<br>Capture: 575 MT (Fish production would be the same as the base condition)<br>Culture: 37.5 MT (Fish production would be the same as the base condition) | Not applicable                          | Not applicable       | Proper training to increase the culture practice of high-valued fish species<br>Not applicable | +2                  |

| IEC  | Location                                  | Baseline condition  | FWOP  | FWIP   | Impacts                                     | Magnitude of impact* | Mitigation Measure   | Magnitude with EMP* |
|--|---|---|---|--|---|----------------------|--|---------------------|
|  |   |   | the same as the base condition  |  |   |                      |  |                     |
|  | Same as above                             | Production: 236.6 MT<br>Capture: 236.6 MT<br>Culture: 0 MT  | Fish production in FWOP would be 284 MT<br>Capture: 284 MT (Fish production would be increased at 20%)<br>Culture: 0 MT (Culture fish production would be same) | Fish production in FWIP would be 285 MT<br>Capture: 236.6 MT (Due to the reduction of erosion induced risk).<br>Culture: 48 MT (Culture fish production would increase due to minimizing flood induced risk) | Estimated net gain to fish production: 1 MT | +1                   |  | +3                  |
| <b>Padma Left Bank – 1(Bank Protection Work)</b> |   |   |   |  |   |                      |  |                     |
| Fish habitat                                     | 7 km of the Padma Left Bank at Harirampur | Fish habitat area is 7,111 ha<br>Capture: 7000 ha<br>Culture: 111 ha  | Fish habitat area is 7811 ha<br>Capture: 7700 ha (Due to river bank erosion)<br>Culture: 111<br>Spawning ground would be lost                                   | Fish habitat area is 7133 ha<br>Capture: 7000 ha<br>Culture: 133 ha (Due to the increased erosion induced risk)  | Estimated net loss to fish habitat: 678 ha. | -6                   | 1. Vegetation clearance should be done as low as possible<br>Proper protective device will have to take to protect the deep pools (dor/duars). | -2                  |
| Fish migration                                   |   | Major carps migrate toward the spawning ground (created before 7 years) through the flooding water and Padma river channel. | Major carps migrated toward the spawning ground (created before the 7 years) through the flooding water and Padma river channel.                                | Migration route would be disturbed   | Migration route would be disturbed          | -2                   |  | -1                  |

| IEC               | Location | Baseline condition   | FWOP  | FWIP   | Impacts  | Magnitude of impact* | Mitigation Measure | Magnitude with EMP* |
|-------------------|----------|--|---|--|--|----------------------|--------------------|---------------------|
| Fish biodiversity |          | Same as above scenario                                     | Riverine species diversity is rich with more than 100 species | Riverine fish species i. e. hilsa, major carp species, eel (baim), big and small cat fish (boal, ayr, magur), etc. might shift from the project area | Riverine fish species i. e. hilsa, major carp species, eel (baim), big and small cat fish (boal, ayr, magur), etc. might shift from the project area | -5                   |                    | -3                  |
| Fish production   |          | Production: 1548 MT<br>Capture: 1183 MT<br>Culture: 365 MT | Production: 1666 MT<br>Capture: 1301 MT<br>Culture: 365 MT    | Production: 1620 MT<br>Capture: 1183 MT<br>Culture: 437 MT   | Estimated net loss to fish production: 46 MT   | -5                   |                    | -3                  |

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

## 8.7 Ecological Resources

### 8.7.1 Pre-Construction Phase

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

### 8.7.2 Construction Phase

| IEC   | Location | Baseline condition | Impacts | Magnitude of impact* | Mitigation Measure | Magnitude with EMP |
|---|----------|--------------------|---------|----------------------|--------------------|--------------------|
| <b>Jamuna Right Bank – 1(Embankment Rehabilitation)</b> |          |                    |         |                      |                    |                    |
| <b>Activity: Rehabilitation of embankment</b>           |          |                    |         |                      |                    |                    |



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

| IEC  | Location   | Baseline condition   | Impacts  | Magnitude of impact* | Mitigation Measure   | Magnitude with EMP |
|--|--|--|--|----------------------|--|--------------------|
| Terrestrial ecosystem.<br>Aquatic ecosystem.<br>Floral composition and diversity<br>Faunal composition and diversity | 2 km from Benotia Hat/Bazar to the start of Baral Khal, Verakola Hat.<br>5 km of the Jamuna Left bank from Chauhali Sadar to Atpara.<br>2 km of the Jamuna Left bank from Jaffarganj to Bachamara<br>7 km of the Padma Left Bank at Harirampur.  | River bank holds dense vegetations like trees, shrubs and herbs.<br>Faunal diversity is moderate in this region<br>Homestead and roadside vegetations like fruit bearing and timber trees, shrubs and herbs are located beyond the 2-10 m far from the river bank. | Vegetation of river banks will temporarily be damage and disturbed.<br>Aquatic fauna i.e., little egret, Indian pond heron etc. would not exist near the river bank. | -2                   | Do not dump the large volume of excavated soil on bottom of the aforesaid trees.<br>Bot, Pakur, Shimul and other big trees are suggested to be protected<br>Plantation of different species of saplings should be implemented along the country side slope of the embankment | +2                 |
| Activity: Plantation Activities  |  |  |  |                      |  |                    |
| Terrestrial ecosystem.<br>Aquatic ecosystem.<br>Floral composition and diversity<br>Faunal Composition and diversity | 6.5 km of the Verakhola towards start of Hurashagar river (Char Andharmanik)<br>4km from the starting point of Hurashagar (Char Andharmanik) to Korotoa river bank.<br>10.5 km of the Jamuna river bank from Hat Pachil Bazar, Koijuri to Benotia Hat/Bazar<br>2 km from Benotia Hat/Bazar to the start of Baral Khal, Verakola Hat. | River bank holds dense vegetations like trees, shrubs and herbs.<br>Faunal diversity is moderate in this region<br>Homestead and roadside vegetations like fruit bearing and timber trees are present  | Vegetation of river banks will temporarily be damage and disturbed.<br>Some trees will lose due to implementation of proposed intervention.                          | -3                   | About 50,000 species of different, sapling e.g. timber, fruit and water tolerance trees should the planted.<br>Cut the trees as less as possible.  | +5                 |

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

## 8.7.3 Post-Construction Phase

| IEC  | Location  | Baseline condition   | FWOP  | FWIP   | Impacts  | Magnitude of impact* | Mitigation Measure   | Magnitude with EMP |
|--|---|--|---|--|--|----------------------|--|--------------------|
| <b>Jamuna Right Bank – 1 (Embankment Rehabilitation)</b>   |   |  |   |  |  |                      |  |                    |
| Terrestrial ecosystem<br>Aquatic ecosystem.<br>Floral composition and diversity.<br>Faunal composition and diversity | 10.5 km from Verakhola toward the Korotoa bank at Mohakhola   | River bank holds dense vegetations like trees, shrubs and herbs.<br>Faunal diversity is moderate in this region<br>Homestead and roadside vegetations like fruit bearing and timber trees are present. | Vulnerable due to bank erosion and flooding.<br>Will be more vulnerable e.g. bank mayna due to flooding and bank erosion.<br>Wildlife population will be same as baseline | Bank erosion will be protected<br>Vegetation will be protected but less in quantity.<br>Vegetation will be improved and healthy.<br>Faunal composition will improve simultaneously | Protection of homestead, roadside and social forest habitat will improve bio-diversity.<br>Vegetation coverage of the project area will improve.<br>Faunal composition and diversity would be improve simultaneously | +3                   | Plantation of different species of saplings should be implemented  | +5                 |
| <b>Jamuna Right Bank – 1 (Construction of New Embankment)</b>  |   |  |   |  |  |                      |  |                    |
| Terrestrial ecosystem<br>Aquatic ecosystem.<br>Floral composition and diversity.<br>Faunal composition and diversity | 12.5 km of the Jamuna river bank from Hat Pachil Bazar, Kaizuri toward the Korotoa bank at Mohakhola. | Vegetation of embankment moderate.<br>Faunal composition is moderate to rich.  | Vulnerable due to bank erosion and flooding.<br>Will be more vulnerable e.g. bank mayna due to flooding and bank erosion.<br>Wildlife population will be                  | Habitat protection from river erosion and flood.<br>Vegetation will be improved and healthy.<br>Faunal composition will improve  | Protection of homestead, roadside and social forest habitat that will improve faunal diversity.  | +2                   | Plantation of different species of saplings should be implemented. | +4                 |

| IEC  | Location  | Baseline condition  | FWOP  | FWIP  | Impacts  | Magnitude of impact* | Mitigation Measure   | Magnitude with EMP |
|--|---|---|---|---|--|----------------------|--|--------------------|
|  |   |   | same as baseline  | simultaneously.   |  |                      |  |                    |
| <b>Bank Protection Work of Jamuna Right Bank -1, Jamuna Left Bank – 2, Padma Left Bank – 1</b>                       |   |   |   |   |  |                      |  |                    |
| <b>Activity:</b> Slope protection activities   |   |   |   |   |  |                      |  |                    |
| Terrestrial ecosystem<br>Aquatic ecosystem.<br>Floral composition and diversity<br>Faunal composition and diversity. | 2 km from Benotia Hat/Bazar to the start of Baral Khal, Verakola Hat. 5 km of the Jamuna Left bank from Chauhali Sadar to Atpara. 2 km of the Jamuna Left bank from Jaffarganj to Bachamara 7 km of the Padma Left Bank at Harirampur | Vegetation of embankment moderate. Faunal composition is poor to moderate. Homestead habitat moderate. Roadside vegetation moderate, but vulnerable due to flood. | Vulnerable due to bank erosion and flooding. Will be more vulnerable e.g. bank mayna due to flooding and bank erosion. Wildlife population will be same as baseline | Habitat protection from river erosion and flood. Vegetation will be improved and healthy. Faunal composition will improve simultaneously. | Protection of homestead, roadside and social forest habitat will improve bio-diversity | +3                   | Plantation action should be implemented                            | +3                 |
| <b>Activity:</b> Plantation Activities (JRB-1)   |   |   |   |   |  |                      |  |                    |
| Terrestrial ecosystem<br>Aquatic ecosystem.  | 6.5 km of the Verakhola towards start of Hurashagar   | River bank holds dense vegetations like trees, shrubs and herbs.  | River bank will eroded and destroyed the homestead and  | Protection of river bank will protect the trees that will   | Vegetation of river banks will temporarily be damage and                               | -3                   | Plantation of different species of saplings should be implemented. | +5                 |

| IEC   | Location   | Baseline condition   | FWOP                              | FWIP                             | Impacts  | Magnitude of impact* | Mitigation Measure | Magnitude with EMP |
|---|--|--|-----------------------------------|----------------------------------|--|----------------------|--------------------|--------------------|
| Floral composition and diversity.<br>Faunal composition and diversity | river (Char Andharmanik) 4km from the starting point of Hurashagar (Char Andharmanik) to Korotoa bank.<br>10.5 km of the Jamuna river bank from Hat Pachil Bazar, Kaijuri to Benotia Hat/Bazar 2 km from Benotia Hat/Bazar to the start of Baral Khal, Verakola Hat. | Faunal diversity is moderate in this region<br>Homestead and roadside vegetations like fruit bearing and timber trees are present. | road side plantation in the area. | maintain the ecological balance. | disturbed.<br>Some trees will lose due to implementation of proposed intervention. |                      |                    |                    |

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

## 8.8 Socio-economic

### 8.8.1 Pre-Construction Phase

| IEC                               | Location   | Baseline  | Impacts  | Magnitude of impact* | Mitigation Measure   | Magnitude with EMP* |
|-----------------------------------|--|---|--|----------------------|--|---------------------|
| <b>Jamuna Right Bank-1(JRB-1)</b> |  |   |  |                      |  |                     |
| Activity->                        | Construction of labor shed with proper water and sanitation facilities, garbage disposal system, construction of stock yard and construction camp, mobilization of labor, materials, equipment and other machineries; preparing CC blocks at site.   |   |  |                      |  |                     |
| Resettlement                      | 10.5 km of the Jamuna river bank from Hat Pachil Bazar, Kaizuri to Benotia Hat/Bazar 2 km from Benotia Hat/Bazar to the start of Baral Khal, Verakola Hat<br>These villages/mauzas are:<br>Ratankandi<br>Selachapri<br>Dumbaria<br>Alokdia<br>Nundao | About more than 2500 HHs are living near embankment area for last 20 years and those who are living on embankment, mostly they are migrated from outside of these area. | About 1130 HHs in the different locations of project area will be displaced. | -1                   | Proper land compensation, PAPs should be ensured for displaced people of project area (refer to the resettlement plan) | 0                   |
| Gender Issues                     | The whole project study area i.e. Ratankandi Mohakhola Sontosha  | Women are mainly engaged in household level works and their involvement in outside of the home is now growing.  | Labor mobilization may create disturbance for the local women.               | -2                   | The labor mobilization activities should be strictly followed up by project authority.                                 | -1                  |

| IEC           | Location                               | Baseline  | Impacts   | Magnitude of impact* | Mitigation Measure  | Magnitude with EMP* |
|---------------|--|---|---|----------------------|---|---------------------|
| Public Health | Kashipur<br>Dholai<br>Marma<br>Binotia | About 40 percent people tend to receive health service from quack and 30 percent from paramedic/ diploma physicians and 20 percent from trained physicians. But it is noteworthy that about 10 percent do not receive treatment facility due to their impoverishment and communication problems | Because of having limited access to toilet and unhygienic environment, huge gathering of labors can create disturbance to health. | -1                   | Proper health and sanitation system should be ensured for labors. | 0                   |

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

| IEC                               | Location   | Baseline  | Impacts   | Magnitude of impact* | Mitigation Measure  | Magnitude with EMP* |
|-----------------------------------|--|---|---|----------------------|---|---------------------|
| <b>Jamuna Left Bank-2 (JLB-2)</b> |  |   |   |                      |   |                     |
| Activity->                        | Construction of labor shed with water and sanitation facilities, garbage disposal system, construction of stock yard and construction camp, labor and material/ equipment mobilization |   |   |                      |   |                     |
| Resettlement                      | 5 km of the Jamuna Left bank from Chauhali Sadar to Atpara<br>2 km of the Jamuna Left bank from Jaffarganj to Bachamara<br>These villages/ mauzas are: Andharmanik                     | About more than 2000 HHs are living near embankment area for last 20 years and those who are living on embankment, mostly they are migrated from outside of these area. | About 534 HHs in the different locations of project area will be displaced. | -2                   | Proper land compensation, PAPs should be ensured for displaced people of project area | -1                  |

| IEC                               | Location   | Baseline   | Impacts   | Magnitude of impact* | Mitigation Measure  | Magnitude with EMP* |
|-----------------------------------|--|--|---|----------------------|---|---------------------|
| <b>Jamuna Left Bank-2 (JLB-2)</b> |  |  |   |                      |   |                     |
|                                   | Beda khola<br>Mohakhola<br>Kashipur<br>Ata para<br>Noya Para<br>Dholai<br>Kaulia<br>Marma  |  |   |                      |   |                     |
| Employment                        | Possible locations of labor camps (Char Janjira and Khashkaulia mauzas). Location of stock yard (to be selected by the Engineer In Charge). Location of CC blocks construction (at Khashkaulia mauza). | About 40 percent of total population is employed, 47 percent is engaged in household work, only less than one percent is looking for work and about 13 percent of total population is not working (it includes children and physically challenged population). | A temporary employment opportunity will be created for local labors during labor shed construction.                               | +1                   | -   | 0                   |
| Gender Issues                     | The whole study area i.e. Andharmanik Beda khola Mohakhola Kashipur Ata para Noya Para Dholai Kaulia Marma   | Women are mainly engage in household level works and their involvement in outside of the home is now growing.  | Labor mobilization may create disturbance for the local women.  | -2                   | The labor mobilization activities should strictly follow up by project authority. | -1                  |
| Public Health                     | Mohakhola Kashipur Ata para Noya Para Dholai Kaulia Marma  | About 40 percent people tend to receive health service from quack and 30 percent from paramedic/diploma physicians and 20 percent from trained physicians. But it is noteworthy that about 10 percent cannot   | Because of having limited access to toilet and unhygienic environment, huge gathering of labors can create disturbance to health. | -1                   | Proper health and sanitation system should be ensured for labors.                 | 0                   |



| IEC                               | Location | Baseline  | Impacts | Magnitude of impact* | Mitigation Measure | Magnitude with EMP* |
|-----------------------------------|----------|---|---------|----------------------|--------------------|---------------------|
| <b>Jamuna Left Bank-2 (JLB-2)</b> |          |   |         |                      |                    |                     |
|                                   |          | receive treatment facility due to their impoverishment and communication problems |         |                      |                    |                     |

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

| IEC                              | Location   | Baseline  | Impacts  | Magnitude of impact* | Mitigation Measure                           | Magnitude with EMP* |
|----------------------------------|--|---|--|----------------------|--|---------------------|
| <b>Padma Left Bank-1 (PLB-1)</b> |  |   |  |                      |  |                     |
| Activity->                       | Construction of labor shed with water and sanitation facilities, garbage disposal system, construction of stock yard and construction camp, labor and materials/equipment mobilization   |   |  |                      |  |                     |
| Resettlement                     | Possible locations of labor camps (Ramkrishnapur and Andarmanik mauzas)<br>Location of stock yard (to be selected by the Engineer In Charge),<br>Location of CC block construction (Andarmanik mauza)<br>These villages are:<br>Jaghannathpur<br>Boxor<br>Andharmanik<br>Bholabaj<br>Boyra | About more than 2000 HHs are living near embankment area for last 20 years and those who are living on embankment, mostly they are migrated from outside of these area. | Due to temporary slope protection no displacement will take place but some construction disturbance might take place | -2                   | Construction disturbance should be minimized | -1                  |
| Gender Issues                    | The whole project study area i.e. Jaghannathpur<br>Boxor   | Women are mainly engage in household level works and their involvement in outside   | Labor mobilization may create disturbance for the  | -2                   | The labor mobilization activities should     | -1                  |

| IEC                              | Location                   | Baseline   | Impacts   | Magnitude of impact* | Mitigation Measure  | Magnitude with EMP* |
|----------------------------------|----------------------------|--|---|----------------------|---|---------------------|
| <b>Padma Left Bank-1 (PLB-1)</b> |                            |  |   |                      |   |                     |
| Public Health                    | Andharmanik Bholabaj Boyra | of the home is now growing.  | local women.  |                      | strictly follow up by project authority.                          |                     |
|                                  |                            | About 40 percent people tend to receive health service from quack and 30 percent from paramedic/diploma physicians and 20 percent from trained physicians. But it is noteworthy that about 10 percent cannot receive treatment facility due to their impoverishment and communication problems | Because of having limited access to toilet and unhygienic environment, huge gathering of labors can create disturbance to health. | -1                   | Proper health and sanitation system should be ensured for labors. | 0                   |

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

### 8.8.2 Construction Phase

| IEC                                | Location  | Baseline condition   | Impacts  | Magnitude of impact* | Mitigation Measure | Magnitude with EMP* |
|------------------------------------|---|--|--|----------------------|--------------------|---------------------|
| <b>Jamuna Right Bank-1 (JRB-1)</b> |   |  |  |                      |                    |                     |
| Activity->                         | Excavation of earth materials from the location of embankment; dredging of soil from the Jamuna and Baral rivers; dumping of earthen materials on the embankment; embankment surface labeling through dumping machine; movement of vehicles for carrying earth materials. |  |  |                      |                    |                     |
| Employment                         | Places adjacent to the Jamuna River bank where the new embankment would be constructed (from Hat Panchil to Benotia   | About 40 percent of total population is employed, 47 percent is engaged in household work, only below than one percent is looking for work and about 13 percent of total | A temporary employment may be created for laborer during bailing out activities. | +1                   | -                  | 0                   |

| IEC               | Location   | Baseline condition   | Impacts  | Magnitude of impact* | Mitigation Measure | Magnitude with EMP* |
|-------------------|--|--|--|----------------------|--------------------|---------------------|
|                   | mauzas).<br>Places adjacent to the existing embankment of the Baral river (from Verakhola to Dambarla mauzas).<br>At Benotia where the bank protection works is to be carried out. | population is not working (it includes children and physically challenged population)<br><br>In the study area it is found that most of the income and expenditure are varying from 5,000 Tk. to 20,000 Tk. /month. About 75% of total household hire labor for agricultural production. The wage rate varies between 350 Tk. to 150 Tk. /day. |  |                      |                    |                     |
| Income generation |  |  | The additional income source may bring betterment of family happiness in the project area                  | +1                   | -                  | 0                   |
| Labor migration   | Labor would be internally in-migrated from adjacent upazilas/ districts.   | People from the project area tend to migrate to Dhaka, Tangail, Sylhet and Rajshahi for better livelihood (60%) while a significant number of labor (20%) migrate to the project area with a view to subsisting the economy.   | The in-migrated people may take part in construction work and this will bring opportunities for them also. | +2                   | -                  | 0                   |
| Activity->        | Dredging of earth materials from the Jamuna rivers; placing of geo-bags and CC blocks on the river banks; construction of sluices.   |  |  |                      |                    |                     |
| Employment        | Jamuna River (from Hat Panchil to Benotia mauzas).<br>Baral River (from Verakhola to Dambarla mauzas).<br>Other possible locations of construction of                              | About 40 percent of total population is employed, 47 percent is engaged in household work, only below than one percent is looking for work and about 13 percent of total population is not working. About 75% of total household hire labor for agricultural production.   | A temporary employment opportunity will be created for many labors.  | +1                   | -                  | 0                   |
| Income            | drainage sluices.  | About 55% of people earn   | A small number of  | +1                   | -                  | 0                   |

| IEC        | Location | Baseline condition   | Impacts   | Magnitude of impact* | Mitigation Measure | Magnitude with EMP* |
|------------|----------|--|---|----------------------|--------------------|---------------------|
| generation |          | 5000tk-20,000tk per month and also being unemployed for days in a year and they keen on to involve in alternative works. | low earned people will enhance their income with this additional income source. |                      |                    |                     |

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

| IEC                              | Location  | Baseline condition  | Impacts   | Magnitude of impact* | Mitigation Measure | Magnitude with EMP* |
|----------------------------------|---|---|---|----------------------|--------------------|---------------------|
| <b>Jamuna Left Bank-2(JLB-2)</b> |   |   |   |                      |                    |                     |
| Activity->                       | Movement of vehicles for carrying earth materials   |   |   |                      |                    |                     |
| Employment                       | Places along the left bank of the Jamuna river where bank protection works would be carried out (Char janjira, Khasdalai, Atapara, Khash kaulia mauzas at Chauhali upazilla and Char pailadhusar, | About 40 percent of total population is employed, 47 percent is engaged in household work, only below than one percent is looking for work and about 13 percent of total population is not working (it includes children and physically challenged population). | A temporary employment will be created for many labors during bailing out activities.             | +1                   | -                  | +1                  |
| Income generation                | Raghnathpur, Banghabari and Paila mauzas at Jafarganj of Sirajganj upazilla)  | Approximately over 55% of people earn 20000tk-5000tk per month also being unemployed for many days in a year and they are keen on to involve in alternative works.  | A small number of low earned people will enhance their income with this additional income source. | +1                   | -                  | +1                  |
| Labor migration                  | Labor would be internally in-migrated   | Overall 20% of labors are in-migrated in the study area.  | Opportunities for in-migrant labors   | +2                   | -                  | +2                  |

| IEC           | Location   | Baseline condition   | Impacts   | Magnitude of impact* | Mitigation Measure  | Magnitude with EMP* |
|---------------|--|--|---|----------------------|---|---------------------|
|               | from adjacent upazilas/districts.  |  | could be ensured during earthwork activities.   |                      |   |                     |
| Public Health | The whole project study area i.e.<br>Andharmanik<br>Beda khola<br>Mohakhola<br>Kashipur<br>Ata para<br>Noya Para<br>Dholai<br>Kaulia | About 40 percent people tend to receive health service from quack and 30 percent from paramedic/diploma physicians and 20 percent from trained physicians. But it is noteworthy that about 10 percent cannot receive treatment facility due to their impoverishment and communication problems | Because of having limited access to toilet and unhygienic environment, huge gathering of labors can create disturbance to health. | -1                   | Proper health and sanitation system should be ensured for labors. | -1                  |

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

| IEC                              | Location  | Baseline condition   | Impacts  | Magnitude of impact* | Mitigation Measure | Magnitude with EMP* |
|----------------------------------|---|--|--|----------------------|--------------------|---------------------|
| <b>Padma Left Bank-1 (PLB-1)</b> |   |  |  |                      |                    |                     |
| Activity->                       | Movement of vehicles for carrying earth materials   |  |  |                      |                    |                     |
| Employment                       | Places along the left bank of the Padma River, where bank protection works would be carried out (Ram krishnapur, Andarmanik and Boyra mauzas of | About 40 percent of total population is employed, 47 percent is engaged in household work, only less than one percent is looking for work and about 13 percent of total population is not working. About 75% of total household hire labor for | Temporary employment opportunities will be created for labors during bailing out activities. | +1                   | -                  | -                   |

| IEC               | Location  | Baseline condition  | Impacts   | Magnitude of impact* | Mitigation Measure | Magnitude with EMP* |
|-------------------|---|---|---|----------------------|--------------------|---------------------|
|                   | Harirampurupazilla).  | agricultural production.  |   |                      |                    |                     |
| Income generation |   | About 55% of people can earn 20000tk-5000tk per month, they are unemployed for many days in a year and keen on to involve in alternative works. | A small number of low earned people will enhance their income with this additional income source. | +1                   | -                  | -                   |
| Labor migration   | Labor would be internally in-migrated from adjacent upazilas/districts. | Overall 20% of labors are in-migrated in the study area.  | Opportunities of in-migrant labors could be created during earthwork activities.                  | +2                   | -                  | -                   |

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

### 8.8.3 Post-Construction Phase

| IEC                               | Location  | Baseline  | FWOP   | FWIP   | Impacts  | Magnitude of impact* | Mitigation Measure | Magnitude with EMP* |
|-----------------------------------|---|---|--|--|--|----------------------|--------------------|---------------------|
| <b>Jamuna Right Bank-1(JRB-1)</b> |   |   |  |  |  |                      |                    |                     |
| Communication                     | Possible locations for communication in project area<br>- Hat Panchil<br>- Benotia<br>- Verakhola<br>- Dambarla | Embankment cum road is locally used for communication and some light vehicle as well. | Embankment cum road could wipe out for last 10 years. In near future, main road of Hat Panchil to Benotia would be affected. | Communication facilities will be improved both in local and upazila level. | Road communication may be improved which convey better economy by expanding business option. | +3                   | -                  | 0                   |
| Employment                        | - Ratankandi<br>- Selachapri  | About 40 percent of total   | Temporary employment   | More employment  | In future, a number of   | +4                   | -                  | 0                   |

| IEC                               | Location  | Baseline   | FWOP  | FWIP   | Impacts   | Magnitude of impact* | Mitigation Measure | Magnitude with EMP* |
|-----------------------------------|---|--|---|--|---|----------------------|--------------------|---------------------|
| <b>Jamuna Right Bank-1(JRB-1)</b> |   |  |   |  |   |                      |                    |                     |
|                                   | <ul style="list-style-type: none"> <li>- Dumbaria</li> <li>- Alokdia</li> <li>- Nundao</li> </ul> | population is employed, 47 percent is engaged in household work, only below than one percent is looking for work and about 13 percent of total population is not working. About 75% of total household hire labor for agricultural production. | will be created for many labors during labor shed construction.                                   | opportunities will be created for farmers and fishers of the project area. | employment opportunities may be generated in culture fish and agriculture sector. |                      |                    |                     |
| Income generation                 |   | Approximately over 55% of people earn 20000tk-5000tk per month, are unemployed for many days in a year and keen on to involve in alternative works.  | A small number of low earned people will enhance their income with this additional income source. | People income will increase in future by creating more work options.       | Income will be increased for all classes i.e. labor to businessmen.               | +4                   | -                  | 0                   |

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

| IEC   | Location  | Baseline   | FWOP   | FWIP  | Impacts   | Magnitude of impact* | Mitigation Measure | Magnitude with EMP* |
|---|---|--|--|---|---|----------------------|--------------------|---------------------|
| <b>Jamuna Left Bank-2(JLB-2)</b>                              |   |  |  |   |   |                      |                    |                     |
| Protection of municipal area including markets and homesteads | Chouhali bazaar and adjacent villages<br>Jafarganj bazaar and adjacent village    | Damages of municipal areas due to erosion  | Municipal area including markets and homesteads will certainly be eroded               | Protective work will protect the municipal area including markets and homestead           | Municipal area, markets and homesteads will be protected and business will be run properly. Government office, and educational and religious institutions will be protected | +6                   | N/A                | N/A                 |
| Employment  | Char janjira<br>Khasdalai<br>Khash kaulia<br>Pailadhusar<br>Raghunathpur<br>Paila | About 40 percent of total population is employed, 47 percent is engaged in household work, only below than one percent is looking for work and about 13 percent of total population is not working. About 75% of total household | A temporary employment will be created for many labors during labor shed construction. | More employment opportunities may be created for farmers and fishers of the project area. | In future, a number of employment opportunities may be generated in culture fish and agriculture sector.  | +4                   | -                  | +4                  |



| IEC               | Location | Baseline  | FWOP  | FWIP   | Impacts   | Magnitude of impact* | Mitigation Measure | Magnitude with EMP* |
|-------------------|----------|---|---|--|---|----------------------|--------------------|---------------------|
|                   |          | hire labor for agricultural production.   |   |  |   |                      |                    |                     |
| Income generation |          | Approximately over 55% of people earn 20000tk-5000tk per month, are unemployed for many days in a year and keen on to involve in alternative works. | A small number of low earned people will enhance their income with this additional income source. | People income will increase in future by creating more work options. | Income will be increased for all classes i.e. labor to businessmen. | +4                   | -                  | 0                   |

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

| IEC                              | Location  | Baseline   | FWOP   | FWIP   | Impacts                                 | Magnitude of impact* | Mitigation Measure | Magnitude with EMP* |
|----------------------------------|---|--|--|--|---|----------------------|--------------------|---------------------|
| <b>Padma Left Bank-1 (PLB-1)</b> |   |  |  |  |   |                      |                    |                     |
| Communication                    | The possible locations for communication system are: Jaghannathpur Boxor Andharmanik Bholabaj Boyra | Bank protection cum road is locally used for communication and some light vehicle as well. | Bank protection cum road wiped out recently. In near future, main road of Alfadanga to Faridpur would be | Communication facilities will be protected at its current level both in local and upazila level. | Road communication will remain the same | +3                   | -                  | 0                   |

| IEC   | Location   | Baseline   | FWOP   | FWIP  | Impacts   | Magnitude of impact* | Mitigation Measure | Magnitude with EMP* |
|---|--|--|--|---|---|----------------------|--------------------|---------------------|
|   |  |  | affected.  |   |   |                      |                    |                     |
| Protection of municipal area including markets and homesteads | Ramkrishnapur bazaar and adjacent other villages<br>Andharmanik bazaar and adjacent other village                                    | Damages of municipal areas due to erosion  | Municipal area including markets and homesteads will certainly be eroded               | Protective work will protect the municipal area including markets and homestead   | Municipal area, markets and homesteads will be protected and business will be run properly. Government office, and educational and religious institutions will be protected | +6                   | N/A                | 0                   |
| Employment  | The possible locations for employment opportunities in future are:<br><br>Jaghannathpur<br>Boxor<br>Andharmanik<br>Bholabaj<br>Boyra | A number of labor, man powers are unemployed in many days in a year and 6% of skilled worker are permanently out-migrated. Also, 23% of seasonal out migrants daily out-migrated for employment. | A temporary employment will be created for many labors during labor shed construction. | More employment opportunities will be created in agriculture and fisheries field. | In future, a number of employments will generate in fish culture and agriculture activities.  | +4                   | -                  | 0                   |

| IEC               | Location | Baseline  | FWOP  | FWIP   | Impacts   | Magnitude of impact* | Mitigation Measure | Magnitude with EMP* |
|-------------------|----------|---|---|--|---|----------------------|--------------------|---------------------|
| Income generation |          | Over 55% of people earn 20000tk-5000tk per month, are unemployed for many days in a year and keen on to involve in alternative works. | A small number of low earned people will enhance their income with this additional income source. | People income will increase in future by creating more work options. | Income will be increased for all classes i.e. labor to businessmen. | +4                   | -                  | 0                   |

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

## 8.9 Summary of anticipated environmental Impacts and Mitigation Measures

### 8.9.1 JRB-1 Flood Embankment Potential Impacts

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

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

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

**Table 8.1: JRB-1 Impacts on Land Type**

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

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

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

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

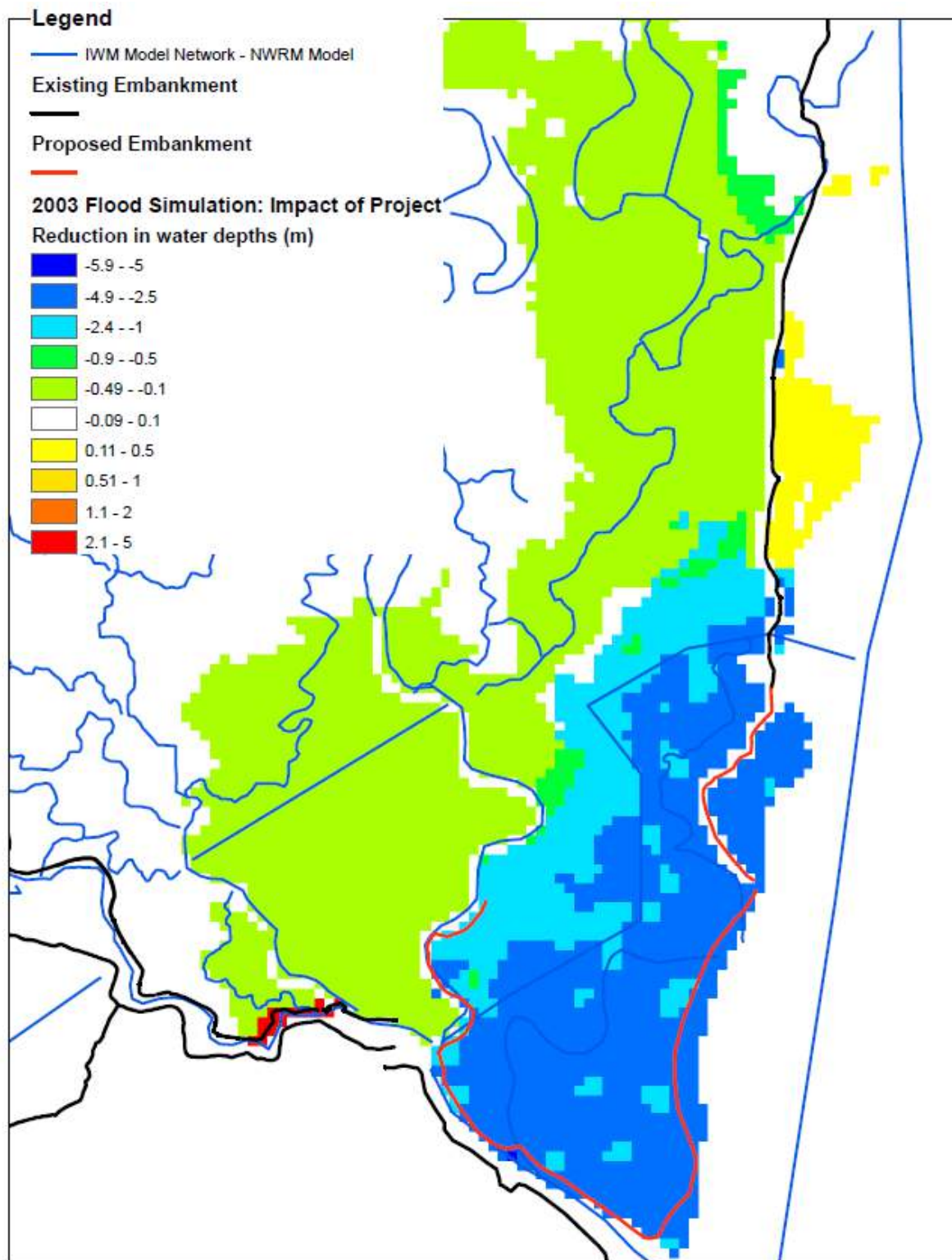
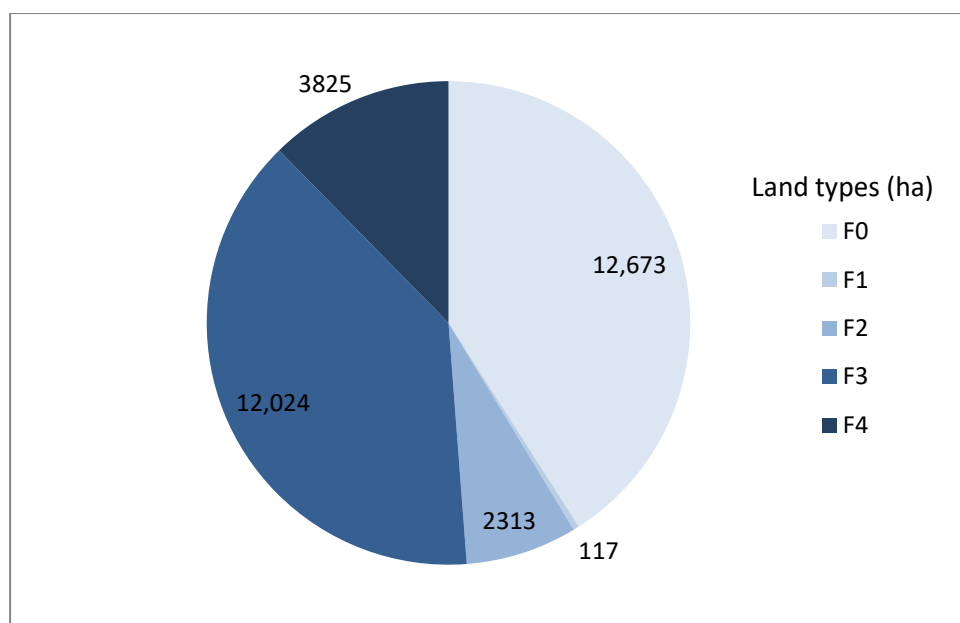
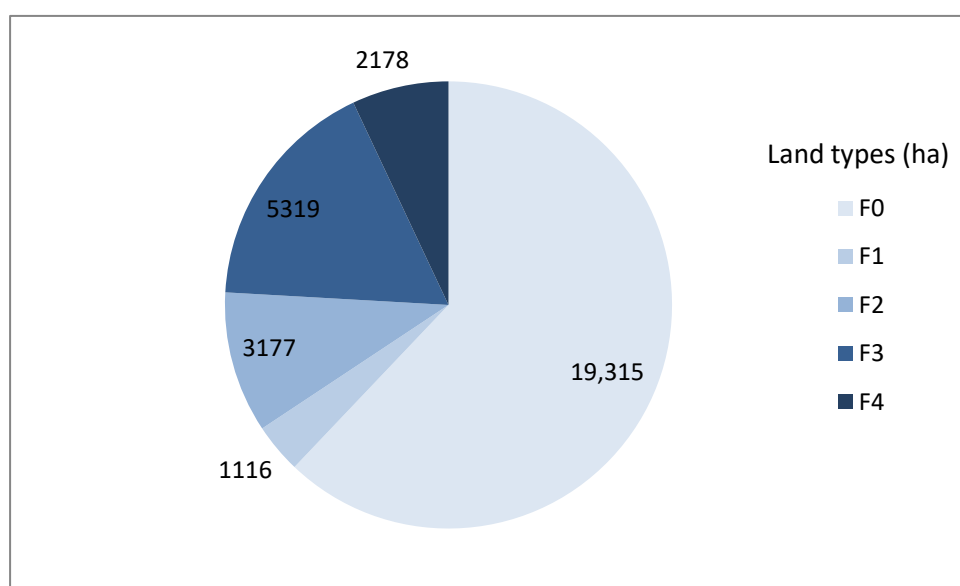


Figure 8.1: Effect of JRB-1 on Water Levels, 2003 Flood Condition



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



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

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

<sup>30</sup>The project team estimates the loss of 15.3MT in capture fish production (see Chapter 8)

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

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

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

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

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

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

---

Local Experience to Global Challenges, University of Gloucestershire, UK.

[http://iasc2008.glos.ac.uk/conference%20papers/papers/T/Thompson\\_220701.pdf](http://iasc2008.glos.ac.uk/conference%20papers/papers/T/Thompson_220701.pdf)

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

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

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

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

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

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

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

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

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

---

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

<sup>36</sup> Dolphins normally chose the thalweg, i.e. the deeper part of the river for migration



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

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

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

#### **8.10 Future Mitigation Measures**

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

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

376. Starting from there, the feasibility study for tranche-1, containing environmental assessment, will be supplanted by a specialist sanctuary study that details the requirements for a river sanctuary in response to negative impacts from river stabilization. The sanctuary study is part of the Tranche-1 design and scheduled for implementation during year-3 and 4. It will specifically address impacts on critical habitats and trans-boundary/internationally migrating/threatened species, following (i) the Padma Bridge Project terms of reference for biodiversity baseline studies and

monitoring, and a biodiversity sanctuary; and (ii) India's recently-promulgated Dolphin conservation action plan, as well as (iii) assessing migratory bird impacts.

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

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

## 9. Analysis of Alternatives

379. The three sub-reaches selected for FRERMIP physical works— JRB-1, JLB-2, and PLB-1 – were chosen from 13 sub-reaches into which the FRERMIP project area was divided based on discussions among BWDB, ADB, and the PPTA consultant. These 13 were evaluated using a multi-criteria assessment approach taking into consideration three primary criteria (riverbank erosion, flooding, and poverty) and several secondary criteria (related to planning, design, cost-benefit, and safeguards issues) (refer to Annex 10). Of the six sub-reaches scoring highest<sup>37</sup>, three were screened out due to a lack of active erosion and/or conflicts with other immediately planned interventions.

380. While riverbank protection was placed according to immediate needs especially for growth centers (“something to defend”), embankment construction considered alternatives especially for the areas JLB-2 and PLB-1. BWDB contemplates the establishment of two polders (ring-embankments) covering large parts of JLB-2 and PLB-1 with very long ring embankment lines. These were compared to the solution of an embankment only along the riverbanks of the main rivers, reducing the length of the embankments and as such minimizing the footprint and related land acquisition and resettlement. In addition, open distributaries would allow all-year-round water flow to the area, which specifically enhances the dry season water management<sup>38</sup>.

---

<sup>37</sup> The highest ranking sites scored between 300 and 370 points, while the lower ranking sites ranged between 200 and 260 points.

<sup>38</sup> Annex D of the feasibility study, “River and Charland Morphology and River Engineering” provides more background.

## 10. Environmental Management Plan

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

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

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

384. In addition to mitigating direct impacts of the tranche-1 work, a specialist firm/NGO will be retained to study the establishment of a river sanctuary, in accordance with future (Tranche-2 and Tranche-3) stabilization plans, looking beyond the localized Tranche-1 measures and aiming at identifying and mitigating any impacts from larger scale river-reach stabilization during Tranche-2 and Tranche-3.

## 10.2 Subproject JRB-1

### 10.2.1 Pre-Construction Phase

| IEC  | Location  | Impacts   | Magnitude of impact | Mitigation/ Enhancement/ Compensation/ Contingency   | Magnitude with EMP | EMP Cost (Lac Tk) | Responsible Agency  |
|--|---|---|---------------------|--|--------------------|-------------------|---|
| <b>Activity:</b> Construction of labor shed, stock yard and construction camp, mobilization of labor, materials, equipment and other machineries, construction of CC blocks at site. |   |   |                     |  |                    |                   |   |
| <b>Air quality</b>   | <ul style="list-style-type: none"> <li>- Possible locations of labor shed (Dombarla, Locha, Dorta Mehi, Jagtala, Gopalpur mauzas); stock yard (to be selected by the Engineer in Charge) and site of CC block construction (Benotia Mauza).</li> <li>- Road side places used for transportation of materials (Kaijuri-shahjampur road and the rural roads from Hat panchil to barnia mauzas and from Nagardala to Shelachapri mauzas).</li> </ul> | Minor impact may occur from the small amount of dust generated due to movement of vehicles, construction materials and machineries; construction of labor shed and stock yard; preparation of CC block at site. | -2                  | <u>Mitigation:</u> <ul style="list-style-type: none"> <li>- Construction materials should be covered with thick materials (i.e. polythene) during transportation to resist the generation of dust.</li> <li>- Water to be sprinkled to control the generation and spreading of dust; as and where required.</li> </ul> | -1                 | 1                 | Implementation:<br>Contractor Monitoring:<br>Nominated Engineer (SMO, BWDB) |
| <b>Noise</b>   | <ul style="list-style-type: none"> <li>- Possible locations of labor shed (Dombarla, Locha, Dorta Mehi, Jagtala, Gopalpur mauzas), stock yard (to be selected by the Engineer in Charge), site of CC block construction (Benotia Mauza).</li> <li>- Road side places through which construction materials would be transported (Kaijuri-</li> </ul>   | Low impacts caused due to noise generation for mobilization of construction materials and construction of labor shed, stockyard and CC blocks.  | -2                  | <u>Mitigation:</u> <ul style="list-style-type: none"> <li>- Noise levels due to vehicular movement are to be kept within permissible limit.</li> <li>- Construction camps, labor shed, and sites for CC block construction are to be located far away from settlements.</li> </ul>                                     | -1                 | N/A               | Implementation:<br>Contractor Monitoring:<br>Nominated Engineer (SMO, BWDB) |

| IEC | Location  | Impacts | Magnitude of impact | Mitigation/ Enhancement/ Compensation/ Contingency | Magnitude with EMP | EMP Cost (Lac Tk) | Responsible Agency |
|-----|---|---------|---------------------|--|--------------------|-------------------|--------------------|
|     | shahjadpur road and the rural roads from Hat panchil to barnia mauzas and Nagardala to Shelachapri mauzas). |         |                     |  |                    |                   |                    |

**Land Resources**

| IEC              | Location  | Impacts   | Magnitude of impact | Mitigation/ Enhancement/ Compensation/ Contingency   | Magnitude with EMP | EMP Cost (Lac Tk)   | Responsible Agency   |
|------------------|---|---|---------------------|--|--------------------|---|--|
| <b>Activity</b>  | <b>Construction of labor sheds, stocking yard with CC block preparation yard for Embankment Rehabilitation activities</b> |   |                     |  |                    |   |  |
| Land loss        | Location-1: Dombaria (Baghabari towards Shahzadpur-6.5km)   | Possibility of loss of 1.04 ha land for existing embankment | 0                   | <ul style="list-style-type: none"> <li>Construction activities should be carried out as per design.</li> <li>Labor shed should preferably be constructed on fallow or khas land.</li> <li>Landowners affected by the construction of labor shed and placement of filling materials on agriculture land should be noticed ahead of time so that the area might not be affected for growing crops.</li> </ul>        | +1                 | No cost involvement of cost for land due to activities in existing embankment | Implementation: Contractor<br>Monitoring: Nominated Engineer (SMO, BWDB) |
|                  | Location-2: Lochha (Shahzadpur-Korotoa bank-4.0km)  | Possibility of Loss of 1.08 ha existing embankment land     | 0                   | <ul style="list-style-type: none"> <li>Labor sheds, and other project related activities should be optimized with the purpose of minimum disruption to cultivable lands and standing crops.</li> <li>Adequate cash compensation should be provided to the land owners /share croppers.</li> <li>The compensation should be determined based on the amount of land temporarily going out of cultivation.</li> </ul> | +1                 |   | Implementation: Contractor<br>Monitoring: Nominated Engineer (SMO, BWDB) |
| <b>Sub-Total</b> |   |   |                     |  |                    | <b>00</b>   |  |
| <b>Activity</b>  | <b>Construction of labor sheds, stocking yard for construction of new embankment activities</b>                           |   |                     |  |                    |   |  |
| Land loss        | Location-1: Gopalpur  | Possibility of 1.02 ha of                                   | -1                  | <ul style="list-style-type: none"> <li>Construction activities should be carried out as</li> </ul>   | +2                 | 0.38  | Implementation: Contractor   |

| IEC             | Location  | Impacts   | Magnitude of impact | Mitigation/ Enhancement/ Compensation/ Contingency   | Magnitude with EMP | EMP Cost (Lac Tk) | Responsible Agency   |
|-----------------|---|---|---------------------|--|--------------------|-------------------|--|
|                 | (Kaizuri-Hura sagar offtake-10.5km)   | agricultural land would be lost temporarily                           |                     | per design.<br>• Labor shed and stocking yard should preferably be constructed on fallow or khas land.<br>• Landowners affected by the construction of labor shed and placement of filling materials on agriculture land should be noticed ahead of time so that the area might not be affected for growing crops.   |                    |                   | Monitoring:<br>Nominated Engineer (SMO, BWDB)                            |
|                 | Location-2: Jagtala Kaizuri-Benotia-2.0km)  | Possibility of 1.04 ha of agricultural land would be lost temporarily | -1                  | • Labor sheds and other project related activities should be optimized with the purpose of minimum disruption to cultivable lands and standing crops.  | +2                 | 0.39              | Implementation: Contractor<br>Monitoring: Nominated Engineer (SMO, BWDB) |
|                 | Location-3: Doriamehi (Hura sagar – Baghabari-6.0km)                                | Possibility of 1.0 ha of agricultural land would be lost temporarily  | -1                  | • Adequate cash compensation should be provided to the land owners /share croppers.<br>• The compensation should be determined based on the amount of land temporarily going out of cultivation.   | +2                 | 0.37              | Implementation: Contractor<br>Monitoring: Nominated Engineer (SMO, BWDB) |
|                 |   |   |                     |  | <b>Sub total</b>   | <b>1.14</b>       |  |
| <b>Activity</b> | <b>Construction of labor sheds and stocking yard for Bank Protective activities</b> |   |                     |  |                    |                   |  |
| Land loss       | Location-1: (Benotia-2.0km)   | Possibility of 1.0 ha of agricultural land would be lost temporarily  | -1                  | • Construction activities should be carried out as per design.<br>• Labor shed and stocking yard should preferably be constructed on fallow or khas land.<br>• Landowners affected by the construction of labor shed and placement of filling materials on agriculture land should be noticed ahead of time so that the area might not be affected for growing crops.<br>• Labor sheds, and other project related activities should be optimized with the purpose of minimum disruption to cultivable lands and standing crops.<br>• Adequate cash compensation should be provided to the land owners /share croppers. | +2                 | 0.37              | Implementation: Contractor<br>Monitoring: Nominated Engineer (SMO, BWDB) |

| IEC             | Location   | Impacts   | Magnitude of impact | Mitigation/ Enhancement/ Compensation/ Contingency  | Magnitude with EMP | EMP Cost (Lac Tk) | Responsible Agency   |
|-----------------|--|---|---------------------|---|--------------------|-------------------|--|
|                 |  |   |                     | <ul style="list-style-type: none"> <li>The compensation should be determined based on the amount of land temporarily going out of cultivation.</li> </ul>   |                    |                   |  |
|                 |  |   |                     |   | <b>Sub total</b>   | <b>0.37</b>       |  |
| <b>Activity</b> | <b>Construction of labor sheds and stocking yard for construction of drainage sluices activities</b> |   |                     |   |                    |                   |  |
| Land loss       | Location-1 (Hurashagar outfall)  | Possibility of 0.05 ha of agricultural land would be lost temporarily | -1                  | <ul style="list-style-type: none"> <li>Construction activities should be carried out as per design.</li> <li>Labor shed and stocking yard should preferably be constructed on fallow or khas land.</li> <li>Landowners affected by the construction of labor shed and placement of filling materials on agriculture land should be noticed ahead of time so that the area might not be affected for growing crops.</li> </ul> | +2                 | 0.01              | Implementation: Contractor<br>Monitoring: Nominated Engineer (SMO, BWDB) |
|                 | (ii)Location-2(Hurashagar intake)  | Possibility of 0.08ha of agricultural land would be lost temporarily  | -1                  | <ul style="list-style-type: none"> <li>Labor sheds, and other project related activities should be optimized with the purpose of minimum disruption to cultivable lands and standing crops.</li> </ul>  | +2                 | 0.03              | Implementation: Contractor<br>Monitoring: Nominated Engineer (SMO, BWDB) |
|                 | (iii)Location-3(at existing sluices)   | Possibility of 0.08ha of agricultural land would be lost temporarily  | -1                  | <ul style="list-style-type: none"> <li>Adequate cash compensation should be provided to the land owners /share croppers.</li> <li>The compensation should be determined based on the amount of land temporarily going out of cultivation.</li> </ul>  | +2                 | 0.03              | Implementation: Contractor<br>Monitoring: Nominated Engineer (SMO, BWDB) |
|                 |  |   |                     |   | Sub total          | <b>0.07</b>       |  |
|                 |  |   |                     |   | <b>Grand total</b> | <b>2.72</b>       |  |

### Agricultural Resources

385. There would be no impact during the pre-construction phase

### Fisheries Resources

386. There would be no impact during the pre-construction phase.

### Ecological Resources



387. There will be no impact during the pre-construction phase.

#### Socio-economic

| IEC           | Location   | Impacts   | Magnitude of impact* | Mitigation/ Enhancement/ Compensation/ Contingency   | Magnitude with EMP* | EMP Cost (in Lac Tk)              | Responsible Agency  |
|---------------|--|---|----------------------|--|---------------------|-----------------------------------|---|
| Activity->    | Construction of labor shed with proper water and sanitation facilities, garbage disposal system, construction of stock yard and construction camp, mobilization of labor, materials, equipment and other machineries; preparing CC blocks at site. |   |                      |  |                     |                                   |   |
| Resettlement  | 10.5 km of the Jamuna river bank from Hat Pachil Bazar, Kaizuri to Benotia Hat/Bazar 2 km from Benotia Hat/Bazar to the start of Baral Khal, Verakola Hat<br>These villages/mauzas are: Ratankandi, Selachapri Dumbaria, Alokdia, Nundao,          | About 1130 HHs in the different locations of project area will be displaced.  | -1                   | Proper land compensation, PAPs should be ensured for displaced people of project area as per resettlement plan                         | 0                   | Will be estimated from RAP report | Implementation: Deputy Commissioner, specialist NGO Monitoring: PMO   |
| Gender Issues | The whole study area i.e. Ratankandi Mohakhola Sontosha Kashipur Dholai Marma Binotia  | Labor mobilization may create disturbance for the local women.  | -2                   | The labor mobilization activities should be strictly followed up by project authority.   | -1                  | N/A                               | Implementation: Contractor Monitoring: Nominated Engineer (SMO, BWDB) |
| Public Health | Binotia  | Because of having limited access to toilet, unhygienic environment due huge gathering of labors can create disturbance to health. | -1                   | Labor shed should establish near to bazaar areas and also ring slab water-sealed sanitary latrines should be established in each shed. | 0                   | N/A                               | Implementation: Contractor Monitoring: Nominated Engineer (SMO, BWDB) |

## 10.2.2 Construction Phase

## Water Resources

| IEC  | Location  | Impacts  | Magnitude of impact | Mitigation/ Enhancement/ Compensation/ Contingency                                       | Magnitude with EMP | EMP Cost (Lac Tk) | Responsible Agency   |
|--|---|--|---------------------|--|--------------------|-------------------|--|
| <b>Activity:</b> Excavation of earth materials from the location of embankment; dredging of soil from the Jamuna and Baral rivers; dumping of earthen materials on the embankment; embankment surface labeling through dumping machine; movement of vehicles for carrying materials. |   |  |                     |  |                    |                   |  |
| <b>Air quality</b>   | <ul style="list-style-type: none"> <li>- Places adjacent to the Jamuna River bank where the new embankment would be constructed (from Hat Panchil to Benotia mauzas).</li> <li>- Places adjacent to the existing embankment of the Baral river (from Verakhola to Dambarla mauzas).</li> <li>- At Benotia where the bank protection works is to be carried out.</li> <li>- Road side places through which transportation of construction materials would be carried out (Kaijuri-shahjadpur road and rural roads from Hat panchil to barnia mauzas and Nagardala to Shelachapri mauzas).</li> </ul> | Minor amount of dust may be generated during excavating and dumping of earth materials, surface labeling with dumping machine and vehicular movements. | -3                  | <u>Mitigation:</u><br>Water to be sprinkled on regular intervals, as and where required. | -2                 | N/A               | Implementation:<br>Contractor<br>Monitoring:<br>Nominated Engineer (SMO, BWDB) |
| <b>Activity:</b> Excavation of earth materials from the location of embankment; dredging of soil from the Jamuna River; movement of vehicles for carrying earth materials.   |   |  |                     |  |                    |                   |  |
| <b>Noise</b>   | - Road side places for transportation of construction materials   | Low impacts would be caused during excavation and dredging of soil and vehicular movements.  | -2                  | <u>Mitigation:</u><br>Noise levels due to vehicular movement, excavation and             | -1                 | N/A               | Implementation:<br>Contractor<br>Monitoring:                                   |

| IEC   | Location  | Impacts  | Magnitude of impact | Mitigation/ Enhancement/ Compensation/ Contingency  | Magnitude with EMP | EMP Cost (Lac Tk) | Responsible Agency   |
|---|---|--|---------------------|---|--------------------|-------------------|--|
|   | (Kaijuri-shahjadpur road and rural roads from Hat panchil to barnia mauzas and Nagardala to Shelachapri mauzas).<br>- Location of embankment (from Kaijuri to Karatoya offtake)                 |  |                     | dredging activities are to be kept within permissible limit.  |                    |                   | Nominated Engineer (SMO, BWDB)   |
| <b>Activity:</b> Dredging of earth materials from the Jamuna River; placing of geo-bags and CC blocks on the river banks; construction of sluices, disposal of waste generated from the labor shed. |   |  |                     |   |                    |                   |  |
| <b>Surface water quality</b>  | - Jamuna river (from Hat Panchil to Benotia mauzas) and Baral river (from Verakhola to Dambarla mauzas).<br>- Possible locations within the embankment for construction of the drainage sluices | The surface water quality might be affected due to the disposal of waste generated from the labor shed into the river. Additionally, minor quantity of sediments would be generated in the rivers during dredging of soil from river bed, which would temporarily hamper the aesthetic quality of river water. | -4                  | <u>Mitigation:</u><br>- The dredging locations should be selected so that dredge spoil would be minimized.<br>- Proper waste disposal system is to be implemented.  | -1                 | 3                 | Implementation: Contractor<br>Monitoring: Nominated Engineer (SMO, BWDB) |
| <b>Activity:</b> Rehabilitation of embankment   |   |  |                     |   |                    |                   |  |
| <b>Drainage congestion</b>  | - Hurasagar river   | Low impact may occur due to the rehabilitation of embankment temporarily blocking the Hurasagar offtake. The river has two mouths at present, meeting the Baral river and blocking any one of these might stress the drainage characteristics of the other.  | -2                  | - Constructing a sluice at one of the two channel mouths. (Currently there is a sluice at one of the two mouths of Hurasagar river, which will be rehabilitated and extended while another one will be constructed at the channel mouth at the Jamuna riverbank). | -1                 | 200               | Implementation: Contractor<br>Monitoring: Nominated Engineer (SMO, BWDB) |

## Land Resources

| IEC             | Location  | Impact  | Magnitude of impact | Mitigation/ Enhancement/ Compensation/ Contingency   | Magnitude with EMP | EMP Cost (Lac Tk)   | Responsible Agency   |
|-----------------|---|---|---------------------|--|--------------------|---|--|
| <b>Activity</b> | <b>Collection and disposal of constructing materials for Embankment rehabilitation activities</b> |   |                     |  |                    |   |  |
| Land loss       | Location-1: Dombaria (Baghabari towards Shahzadpur- 6.5km)  | About 0.65ha of land                                  | -1                  | <ul style="list-style-type: none"> <li>Top soil (0-15cm) should be managed properly for conserve the soil fertility.</li> <li>Area for executing construction activities and other project related activities should be optimized with the purpose of minimum disruption to cultivable lands and standing crops</li> <li>The filling materials should be collected from khas/fallow land /river.</li> </ul>  | +1                 | No cost involvement of cost for land due to activities in existing embankment | Implementati on: Contractor Monitoring: Nominated Engineer (SMO, BWDB) |
|                 | Location-2: Lochha (Shahzadpur- Korotoa bank- 4.0km)  | About 0.4 ha of land                                  | -1                  | <ul style="list-style-type: none"> <li>Disposal of spoil/ constructing materials should preferably be stored on fallow or khas land so that the area might not be affected for growing crops.</li> <li>Compensation will be paid for any crop damage.</li> <li>The contractor will avoid cultivation fields during construction.</li> <li>The contractor will avoid agricultural land for material borrowing and material stockpiling.</li> <li>The contractor will ensure that no vehicular movements take place inside cultivation fields.</li> <li>The contractor will ensure that no material is dumped inside cultivation fields.</li> <li>The contractor will maintain liaison with communities</li> </ul> | +1                 | No cost involvement of cost for land due to activities in existing embankment | Implementati on: Contractor Monitoring: Nominated Engineer (SMO, BWDB) |
|                 |   |   |                     |  | <b>Sub total</b>   | <b>00</b>   |  |
| <b>Activity</b> | <b>Collection and disposal of earth materials for construction of new embankment activities</b>   |   |                     |  |                    |   |  |
| Land loss       | Location-1: Gopalpur (Kaizuri-Hura sagar offtake- 10.5km)   | 1.05ha of agricultural land would be lost permanently | -1                  | <ul style="list-style-type: none"> <li>Top soil (0-15cm) should be managed properly for conserve the soil fertility.</li> <li>Area for executing construction activities and other project related activities should be optimized with the purpose of minimum</li> </ul>   | +2                 | 39.38   | Implementati on: Contractor Monitoring: Nominated Engineer             |

| IEC             | Location  | Impact   | Magnitude of impact | Mitigation/ Enhancement/ Compensation/ Contingency  | Magnitude with EMP | EMP Cost (Lac Tk)   | Responsible Agency  |
|-----------------|---|--|---------------------|---|--------------------|---|---|
|                 |   |  |                     | disruption to cultivable lands and standing crops   |                    |   | (SMO, BWDB)   |
|                 | Location-2: Jagtala Kaizuri-Benotia-2.0km)  | 0.2ha of agricultural land would be lost permanently | -1                  | <ul style="list-style-type: none"> <li>The filling materials should be collected from khas/fallow land /river.</li> <li>Disposal of spoil/ constructing materials should preferably be stored on fallow or khas land so that the area might not be affected for growing crops.</li> <li>Compensation will be paid for any crop damage.</li> </ul>   | +2                 | 7.50  | Implementation: Contractor Monitoring: Nominated Engineer (SMO, BWDB) |
|                 | Location-3: Doriamehi (Hura sagar – Baghabari-6.0km)                                    | 0.6ha of agricultural land would be lost permanently | -1                  | <ul style="list-style-type: none"> <li>The contractor will avoid cultivation fields during construction.</li> <li>The contractor will avoid agricultural land for material borrowing, material stockpiling, and labor camps.</li> <li>The contractor will ensure that no vehicular movements take place inside cultivation fields.</li> <li>The contractor will ensure that no material is dumped inside cultivation fields.</li> </ul>   | +2                 | 22.5  | Implementation: Contractor Monitoring: Nominated Engineer (SMO, BWDB) |
|                 |   |  |                     |   | <b>Sub total</b>   | <b>69.38</b>  |   |
| <b>Activity</b> | <b>Collection and disposal of construction materials for bank protection activities</b> |  |                     |   |                    |   |   |
| Land loss       | Location-1: (Benotia-2.0km)   | 0.2ha of land would be lost permanently              | -1                  | <ul style="list-style-type: none"> <li>Top soil (0-15cm) should be managed properly for conserve the soil fertility.</li> <li>Area for executing construction activities and other project related activities should be optimized with the purpose of minimum disruption to cultivable lands and standing crops</li> <li>The filling materials should be collected from khas/fallow land /river.</li> <li>Disposal of spoil/ constructing materials should preferably be stored on fallow or khas land so that the area might not be affected for growing crops.</li> <li>Compensation will be paid for any crop damage.</li> </ul> | +2                 | No cost involvement of cost for land due to activities in existing embankment | Implementation: Contractor Monitoring: Nominated Engineer (SMO, BWDB) |

| IEC             | Location  | Impact  | Magnitude of impact | Mitigation/ Enhancement/ Compensation/ Contingency  | Magnitude with EMP | EMP Cost (Lac Tk) | Responsible Agency  |
|-----------------|---|---|---------------------|---|--------------------|-------------------|---|
|                 |   |   |                     | <ul style="list-style-type: none"> <li>The contractor will avoid cultivation fields during construction.</li> <li>The contractor will avoid agricultural land for material borrowing and material stockpiling.</li> <li>The contractor will ensure that no vehicular movements take place inside cultivation fields.</li> <li>The contractor will ensure that no material is dumped inside cultivation fields.</li> </ul> |                    |                   |   |
|                 |   |   |                     |   | <b>Sub total</b>   | <b>00</b>         |   |
| <b>Activity</b> | <b>Disposal of dumping spoil for construction of drainage sluices</b> |   |                     |   |                    |                   |   |
| Land loss       | Location-1: (Hurashagar outfall)                                      | 0.01ha of agricultural land would be lost permanently | -1                  | <ul style="list-style-type: none"> <li>Top soil (0-15cm) should be managed properly for conserve the soil fertility.</li> <li>Area for executing construction activities and other project related activities should be optimized with the purpose of minimum disruption to cultivable lands and standing crops</li> <li>The filling materials for backfill should be collected from khas/fallow land /river.</li> </ul>  | +2                 | <b>0.37</b>       | Implementation:<br>Contractor Monitoring:<br>Nominated Engineer (SMO, BWDB) |
|                 | Location-2: (Hurashagar inlet)  | 0.02ha of agricultural land would be lost permanently | -1                  | <ul style="list-style-type: none"> <li>Disposal of spoil/ constructing materials should preferably be stored on fallow or khas land so that the area might not be affected for growing crops.</li> <li>Compensation will be paid for any crop damage.</li> </ul>  | +2                 | <b>0.75</b>       | Implementation:<br>Contractor Monitoring:<br>Nominated Engineer (SMO, BWDB) |
|                 | Location-3: (at existing sluice gates)                                | 0.02ha of agricultural land would be lost permanently | -1                  | <ul style="list-style-type: none"> <li>The contractor will avoid cultivation fields during construction.</li> <li>The contractor will avoid agricultural land for material borrowing and material stockpiling.</li> <li>The contractor will ensure that no vehicular movements take place inside cultivation fields.</li> <li>The contractor will ensure that no material is dumped inside cultivation fields.</li> </ul> | +2                 | 0.75              | Implementation:<br>Contractor Monitoring:<br>Nominated Engineer (SMO, BWDB) |
|                 |   |   |                     |   | <b>Sub total</b>   | <b>1.87</b>       |   |
| Land type       | Entire study  | Drainage  | -2                  | <ul style="list-style-type: none"> <li>The sequence of work during construction</li> </ul>  | +2                 | 1.50              | Implementation  |

| IEC       | Location | Impact   | Magnitude of impact | Mitigation/ Enhancement/ Compensation/ Contingency   | Magnitude with EMP | EMP Cost (Lac Tk) | Responsible Agency   |
|-----------|----------|--|---------------------|--|--------------------|-------------------|--|
| change    | area     | congested area would be increased due to rehabilitation of embankment, construction of new embankment, bank protective work and drainage sluice. So that land type would be changed. |                     | <p>of regulators in the water channels would be carefully planned to avoid disruption of drainage system.</p> <ul style="list-style-type: none"> <li>The contractor would ensure that there would be no negative impacts on crop cultivation in monsoon season.</li> <li>The contractor would maintain liaison with community organizations .</li> </ul> |                    |                   | on:<br>Contractor<br>Monitoring:<br>Nominated Engineer (SMO, BWDB) |
| Sub total |          |  |                     |  |                    | 1.50              |  |

#### Agricultural Resources

| IEC                  | Location  | Impact  | Magnitude of impact | Mitigation/ Enhancement/ Compensation/ Contingency  | Magnitude with EMP | EMP Cost (Lac Tk) | Responsible Agency   |
|----------------------|---|---|---------------------|---|--------------------|-------------------|--|
| <b>Activity</b>      | <b>Construction of labor sheds, stocking yard for Bank rehabilitation, construction of new embankment, bank protection and construction of drainage sluices and disposal of spoils activities</b> |   |                     |   |                    |                   |  |
| Crop production loss | i) Dombaria<br>(ii) Lochha<br>(iii) Gopalpur<br>(iv) Jagtala<br>(v) Doria mehi<br>(vi) Benotia  | Loss of crop production is expected to be about 27.9 metric ton for Construction of | -1                  | <ul style="list-style-type: none"> <li>In cases where the disruption to farming becomes unavoidable, adequate cash compensation should be provided to the land owners. /share croppers.</li> <li>Exact amount of compensation should be determined based on the amount of land temporarily going out of cultivation.</li> </ul> | +3                 | 9.33              | Implementation:<br>Contractor<br>Monitoring:<br>Nominated Engineer (SMO, BWDB) |

| IEC                     | Location   | Impact  | Magnitude of impact | Mitigation/ Enhancement/ Compensation/ Contingency  | Magnitude with EMP | EMP Cost (Lac Tk) | Responsible Agency   |
|-------------------------|--|---|---------------------|---|--------------------|-------------------|--|
|                         | (vii)Chauhali<br>(viii)Bachamara<br>(ix) Harirampu<br>(x)Location-1(Not fix up)<br>(xi)Location-2(Not fix up)<br>(xii)Location-3(Not fix up) | labor sheds and stocking yard for bank rehabilitation, construction of new embankment, bank protection and construction of drainage sluices and disposal of spoils activities |                     | <ul style="list-style-type: none"> <li>The rate should be decided on the basis of the one crop usually grown on the pieces of land.</li> <li>Constructing materials</li> <li>like sand, cement, construction of labor sheds, concrete, block, etc. should be placed in non-agricultural land as far as possible. These materials should not be placed in standing crops.</li> </ul> |                    |                   |  |
| <b>Sub-Total</b>        |  |   |                     |   |                    | <b>9.33</b>       |  |
| Community Organizations | All locations of regulators  | Positive impact   | +2                  | <ul style="list-style-type: none"> <li>The community organizations should be formed prior to implementation of the project.</li> <li>The community organizations should be given orientation to protect their standing crops from river bank protection work, spoil soils, on farm water management, LCS, EMG etc.</li> </ul>   | +4                 | 2.50              | Implementation: specialist NGOs<br>Monitoring: PMO / DDM / DAE |
| <b>Sub Total</b>        |  |   |                     |   |                    | <b>2.50</b>       |  |

**Fisheries Resources**

| IEC   | Location | Impacts | Magnitude of impact* | Mitigation/ Enhancement/ Compensation/ Contingency | Magnitude with EMP* | EMP Cost (Lac Tk/Yr) * | Responsible Agency |
|---|----------|---------|----------------------|--|---------------------|------------------------|--------------------|
| <b>(Re-habilitation of Embankment)</b>                          |          |         |                      |  |                     |                        |                    |
| <b>Activity:</b> Dumping of earthen materials on the embankment |          |         |                      |  |                     |                        |                    |



| IEC   | Location   | Impacts  | Magnitude of impact* | Mitigation/ Enhancement/ Compensation/ Contingency  | Magnitude with EMP* | EMP Cost (Lac Tk/Yr) * | Responsible Agency  |
|---|--|--|----------------------|---|---------------------|------------------------|---|
| Fish habitat  | 6.5 km of the Verakhola towards start of Hurashagar river (Char Andharmanik) | Temporary damage would occur in the seasonal fish habitat of 10.5 km long right bank of the Boral river due to either clearance of vegetation cover or draped by the filling earth during earth work for the fish species of marginal vegetation feeder.   | -2                   | Vegetation clearance should be done as low as possible  | -1                  | 0.5                    | Implementation:<br>Contractor Monitoring: Nominated Engineer (SMO, BWDB) in coordination with Department of Fisheries |
|   | 4km from the starting point of Hurashagar (Char Andharmanik) to Korotoa bank |  | -2                   |   | -1                  |                        |   |
| Fish biodiversity   | Same as above  | Riverine fish species i. e. major carp species, grass carp and other herbivorous species, eel (baim), big and small cat fish (boal, ayr, magur), might shift from the project area   | -2                   |   | -1                  |                        |   |
|   | Same as above  |  | -2                   |   | -1                  |                        |   |
| Fish production   | Same as above  | Capture fish production would temporarily be declined by 3.3 MT within the project area.   | -2                   |   | -1                  |                        |   |
|   | Same as above  | Capture fish production would temporarily be declined by 2 MT within the project area.   | -2                   |   |                     |                        |   |
| <b>Activity:</b> Collection of earth materials from river/khal through dredging |  |  |                      |   |                     |                        |   |
| Fish habitat  | Same as above  | Water quality (stream flow, temperature, pH, turbidity, DO, hardness etc.) of that portion of the Boral river will temporarily be changed which would change the behavior of riverine fish species (both the juveniles and adults). Feeding habitat for the demersal (boal, ayr) and benthopelagic (baim) fish species would be damaged. | -2                   | 1. Dredging will have to done during the dry season.<br>2. Proper protective device (construction of silt fences) will have to take to protect the deep pools | -1                  | LS                     | Implementation:<br>Contractor Monitoring: Nominated Engineer (SMO, BWDB) in   |
|   | Same as above  |  | -2                   |   | -1                  |                        |   |

| IEC               | Location      | Impacts  | Magnitude of impact* | Mitigation/ Enhancement/ Compensation/ Contingency  | Magnitude with EMP* | EMP Cost (Lac Tk/Yr) * | Responsible Agency   |
|-------------------|---------------|--|----------------------|---|---------------------|------------------------|--|
|                   |               | Deep pools (dor/duars) would temporarily be damaged.   |                      | (dor/duars).  |                     |                        | coordination with Department of Fisheries  |
| Fish migration    | Same as above | Both the Longitudinal (hilsa) and lateral migration for fish will temporarily be disturbed.  | -2                   | Dry season (December-March) is proposed for dredging.   | -1                  | Not applicable         | Implementation: Contractor Monitoring: Nominated Engineer (SMO, BWDB) in coordination with Department of Fisheries |
|                   | Same as above |  | -2                   |   | -1                  |                        |  |
| Fish biodiversity | Same as above | Riverine fish species i. e. hilsa, major carp species, eel (baim), big and small cat fish (boal, ayr, magur), etc. might shift from the project area | -5                   | 1. Dredging will have to be done during the dry season.<br>2. Proper protective device will have to be taken to protect the deep pools (dor/duars). | -3                  | Not applicable         | Implementation: Contractor Monitoring: Nominated Engineer (SMO, BWDB) in coordination with Department of Fisheries |
|                   | Same as above |  | -5                   |   | -3                  |                        |  |
| Fish production   | Same as above | Capture fish production would temporarily be declined by 3.3 MT within the project area.   | -5                   | Same as above   | -3                  | Not applicable         | Implementation   |

| IEC   | Location   | Impacts  | Magnitude of impact* | Mitigation/ Enhancement/ Compensation/ Contingency     | Magnitude with EMP* | EMP Cost (Lac Tk/Yr) * | Responsible Agency  |  |
|---|--|--|----------------------|--|---------------------|------------------------|---|--|
|   | Same as above  | Capture fish production would temporarily be declined by 2 MT within the project area.   | -5                   |  | -3                  | able                   | on:<br>Contractor<br>Monitoring:<br>Nominated<br>Engineer<br>(SMO, BWDB)<br>in<br>coordination<br>with<br>Department<br>of Fisheries              |  |
| Construction of New Embankment  |  |  |                      |  |                     |                        |   |  |
| Activity: Collection of earth materials from the location of embankment through excavator, pay loader, head load , dump truck and trolley |  |  |                      |  |                     |                        |   |  |
| Fish habitat  | 10.5 km of the Jamuna river bank from Hat Pachil Bazar, Kaizuri to Benotia Hat/Bazar | Temporary damage would occur in the seasonal fish habitat due to either clearance of vegetation cover or draped by the filling earth during earth work for the fish species of marginal vegetation feeder. | -2                   | Vegetation clearance should be done as low as possible | -1                  | 0.5                    | Implementati on:<br>Contractor<br>Monitoring:<br>Nominated<br>Engineer<br>(SMO, BWDB)<br>in<br>coordination<br>with<br>Department<br>of Fisheries |  |
|   | 2 km from Benotia Hat/ Bazar to the start of Baral Khal, Verakola Hat                |  | -2                   |  | -1                  |                        |   |  |
| Fish migration  | Same as above  | Lateral migration for fish will temporarily be disturbed.  | -2                   |  | -2                  | Not applic able        |   | Implementati on:<br>Contractor<br>Monitoring:<br>Nominated |
|   | Same as above  | Same as above  | -2                   |  | -2                  |                        |   |  |

| IEC               | Location      | Impacts  | Magnitude of impact* | Mitigation/ Enhancement/ Compensation/ Contingency | Magnitude with EMP* | EMP Cost (Lac Tk/Yr) * | Responsible Agency   |
|-------------------|---------------|--|----------------------|--|---------------------|------------------------|--|
|                   |               |  |                      |  |                     |                        | Engineer (SMO, BWDB) in coordination with Department of Fisheries  |
| Fish biodiversity | Same as above | Riverine fish species i. e. major carp species, grass carp and other herbivorous species, eel (baim), big and small cat fish (boal, ayr, magur), might shift from the project area | -2                   |  | -1                  | 0.5                    | Implementation: Contractor Monitoring: Nominated Engineer (SMO, BWDB) in coordination with Department of Fisheries |
|                   | Same as above |  | -2                   |  | -1                  |                        |  |
| Fish production   | Same as above | Capture fish production would temporarily be declined by 13.3 MT within the project area. However, culture fisheries practice would be increased.                                  | -3                   |  | -1                  | 1                      | Implementation: Contractor Monitoring: Nominated Engineer (SMO, BWDB) in coordination with Department of Fisheries |
|                   | Same as above | Capture fish production would temporarily be declined by 2 MT within the project area.   | -3                   |  | -1                  |                        |  |

| IEC  | Location      | Impacts   | Magnitude of impact* | Mitigation/ Enhancement/ Compensation/ Contingency  | Magnitude with EMP* | EMP Cost (Lac Tk/Yr) * | Responsible Agency  |
|--|---------------|---|----------------------|---|---------------------|------------------------|---|
| Activity: Collection of earth materials from river/khal through dredging |               |   |                      |   |                     |                        |   |
| Fish habitat   | Same as above | Water quality (stream flow, temperature, pH, turbidity, DO, hardness etc.) of that portion of the Boral river will temporarily be changed which would change the behavior of riverine fish species (both the juveniles and adults).<br>Feeding habitat for the demersal (boal, ayr) and benthopelagic (baim) fish species would be damaged.<br>- Deep pools (dor/duars) would temporarily be damaged. | -2                   | 1. Dredging will have to done during the dry season.<br>2. Proper protective device (silt fence) will have to take to protect the deep pools (dor/duars). | -1                  | 0.5                    | Implementation:<br>Contractor Monitoring: Nominated Engineer (SMO, BWDB) in coordination with Department of Fisheries |
|  | Same as above |   | -2                   |   | -1                  |                        |   |
| Fish migration   | Same as above | Both the Longitudinal (hilsa) and lateral migration for fish will temporarily be disturbed.   | -5                   | Dry season (December-March) is proposed for dredging.   | -3                  | Not applicable         | Implementation:<br>Contractor Monitoring: Nominated Engineer (SMO, BWDB) in coordination with Department of Fisheries |
|  | Same as above |   | -5                   |   | -3                  |                        |   |
| Fish biodiversity  | Same as above | Riverine fish species i. e. hilsa, major carp species, eel (baim), big and small cat fish (boal, ayr, magur), etc. might shift from the project area  | -5                   | 1. Dredging will have to done during the dry season.<br>2. Proper protective device (silt fence)will  | -3                  | 0.5                    | Implementation:<br>Contractor Monitoring: Nominated   |
|  | Same as above |   | -5                   |   | -3                  |                        |   |

| IEC   | Location  | Impacts  | Magnitude of impact* | Mitigation/ Enhancement/ Compensation/ Contingency  | Magnitude with EMP* | EMP Cost (Lac Tk/Yr) * | Responsible Agency  |
|---|---|--|----------------------|---|---------------------|------------------------|---|
|   |   |  |                      | have to be taken to protect the deep pools (dor/duars).   |                     |                        | Engineer (SMO, BWDB) in coordination with Department of Fisheries   |
| Fish production                                 | Same as above   | Capture fish production would temporarily be declined by 13.3 MT within the project area. In opposite, culture fisheries practice would be increased. Net fish production would be increased by 25 MT      | -5                   | 1. Dredging will have to done during the dry season.<br>2. Proper protective device (silt fence) will have to be taken to protect the deep pools (dor/duars). | -3                  | 1.0                    | Implementati on: Contractor Monitoring: Nominated Engineer (SMO, BWDB) in coordination with Department of Fisheries |
|   | Same as above   | Capture fish production would temporarily be declined by 2 MT within the project area. Culture fisheries practice would be slightly increased.   | -5                   |   | -3                  |                        |   |
| Riverbank Protection Work                       |   |  |                      |   |                     |                        |   |
| Activity: Embankment slope pitching and turfing |   |  |                      |   |                     |                        |   |
| Fish habitat                                    | 1km from Benotia Hat/Bazar toward the start of Baral river. | Temporary damage would occur in the seasonal fish habitat due to either clearance of vegetation cover or draped by the filling earth during earth work for the fish species of marginal vegetation feeder. | -1                   | Vegetation clearance should be done as low as possible  | -1                  | 1                      | Implementati on: Contractor Monitoring: Nominated Engineer (SMO, BWDB) in coordination                              |
| Fish biodiversity                               |   | Riverine fish species i. e. major carp species, grass carp and other herbivorous species, eel (baim), big and small cat fish (boal, ayr, magur), might shift from the project area                         | -1                   |   | -1                  |                        |   |

| IEC   | Location   | Impacts  | Magnitude of impact* | Mitigation/ Enhancement/ Compensation/ Contingency  | Magnitude with EMP* | EMP Cost (Lac Tk/Yr) * | Responsible Agency   |
|---|--|--|----------------------|---|---------------------|------------------------|--|
| Fish production   |  | Capture fish production would temporarily be declined by 2 MT within the project area.   | -1                   |   | -1                  |                        | with Department of Fisheries   |
| Fish production   |  | Capture fish production would temporarily be declined by 2 MT within the project area. Culture fisheries practice would be slightly increased.   | -1                   |   |                     |                        |  |
| <b>Activity:</b> Placing and dumping of C.C. blocks as per design |  |  |                      |   |                     |                        |  |
| Fish biodiversity   | 1 km from Benotia Hat/Bazar to the start of Baral Khal | Riverine fish species i. e. hilsa, major carp species, eel (baim), big and small cat fish (boal, ayr, magur), etc. might shift from the project area. Different types disease producing materials/chemicals would be input | -5                   | 1. Dredging will have to done during the dry season.<br>2. Proper protective device (silt fence) will have to take to protect the deep pools (dor/duars). | -3                  | LS                     | Implementati on:<br>Contractor Monitoring: Nominated Engineer (SMO, BWDB) in coordination with Department of Fisheries |

## Ecological Resources

| IEC   | Location  | Impacts  | Magnitude of impact* | Mitigation/Enhancement/Compensation/Contingency                             | Magnitude with EMP | EMP Cost (Lac Tk.) | Responsible Agency            |
|---|---|--|----------------------|---|--------------------|--------------------|-------------------------------|
| <b>Embankment Re-habilitation</b>   |   |  |                      |   |                    |                    |                               |
| <b>Activity:</b> Collection of earth materials and construction of embankment |   |  |                      |   |                    |                    |                               |
| Terrestrial ecosystem<br>Aquatic  | 6.5 km of the Verakhola towards start of Hurashagar | Shrubs and herbs of bank slopes will be damaged by excavated | -5                   | Do not dump large volume of excavated soil on bottom of the existing trees. | +3                 | 2.0                | Implementation:<br>Contractor |

| IEC   | Location   | Impacts   | Magnitude of impact* | Mitigation/Enhancement/Compensation/Contingency   | Magnitude with EMP | EMP Cost (Lac Tk.) | Responsible Agency   |
|---|--|---|----------------------|---|--------------------|--------------------|--|
| ecosystem. Floral composition and diversity. Faunal composition and diversity   | River (Char Andharmanik) 4km from the starting point of Hurashagar (Char Andharmanik) to Korotoa River bank.   | soil dumping. Vegetation damage via dumping a high volume of excavated soil on the river banks  |                      | Observation of national and international days<br>Awareness development activities should be conducted by the committee or nature club to protect the saplings. |                    |                    | Monitoring :<br>Nominated Engineer (SMO, BWDB)                               |
| <b>Construction of New Embankment</b>   |  |   |                      |   |                    |                    |  |
| <b>Activity:</b> Collection of earth for construction of embankment   |  |   |                      |   |                    |                    |  |
| Terrestrial ecosystem<br>Aquatic ecosystem.<br>Floral composition and diversity.<br>Faunal composition and diversity. | 10.5 km of the Jamuna river bank from Hat Pachil Bazar, Kaizuri to Benotia Hat/ Bazar 2 km from Benotia Hat/Bazar to the start of Baral Khal, Verakola Hat.                | Aquatic flora as well as zooplankton and phytoplankton will destroy.<br>Shrubs and herbs of bank slopes will be damaged.                          | -3                   | Do not collect the soil from the fertile land and do not dump the soil.   | -1                 | -                  | Implementation:<br>Contractor Monitoring :<br>Nominated Engineer (SMO, BWDB) |
| <b>Riverbank Protection Work</b>  |  |   |                      |   |                    |                    |  |
| <b>Activity:</b> Slope protection   |  |   |                      |   |                    |                    |  |
| Terrestrial ecosystem<br>Aquatic ecosystem.<br>Floral composition and diversity.<br>Faunal composition and diversity  | 2 km from Benotia Hat/ Bazar to the start of Baral Khal, Verakola Hat.<br>5 km of the Jamuna Left bank from Chauhali Sadar to Atpara.<br>2 km of the Jamuna Left bank from | Vegetation of river banks and some aquatic flora will reduce.<br>Wildlife population like terrestrial birds and palm squirrels will be disturbed. | -5                   | Awareness development activities should be conducted by the committee or nature club to protect the saplings.   | +7                 | -                  | Implementation:<br>specialist NGOs<br>Monitoring :<br>PMO /                  |



| IEC   | Location  | Impacts                               | Magnitude of impact* | Mitigation/Enhancement/Compensation/Contingency   | Magnitude with EMP | EMP Cost (Lac Tk.)  | Responsible Agency                               |
|---|---|---------------------------------------|----------------------|---|--------------------|---|--|
|   | Jaffarganj to Bachamara 7 km of the Padma Left Bank at Harirampur   |                                       |                      |   |                    |   |  |
| <b>Activity: Plantation at JRB-1</b>  |   |                                       |                      |   |                    |   |  |
| Terrestrial ecosystem<br>Aquatic ecosystem.<br>Floral composition and diversity.<br>Faunal composition and diversity. | 6.5 km of the Verakhola towards start of Hurashagar river (Char Andharmanik) 4km from the starting point of Hurashagar (Char Andharmanik) to Korotoa bank. 10.5 km of the Jamuna river bank from Hat Pachil Bazar, Kaijuri to Benotia Hat/Bazar 2 km from Benotia Hat/Bazar to the start of Baral Khal, Verakola Hat. | Vegetation of river bank will damage. | -5                   | <ul style="list-style-type: none"> <li>Plantation of 50,000 saplings. (Bot, Pakur, Shimul, Jam, Pitali, Khajur, Tal and water tolerance fruit and timber are suggested for plantation).</li> <li>Do not dump large volume of excavated soil on bottom of the present trees.</li> <li>Awareness development on natural resources.</li> <li>Observation of national and international days.</li> <li>Nature club or Local committee should be formed to protect the saplings.</li> <li>Awareness development activities should be conducted by the committee or nature club.</li> </ul> | +5                 | 50.0 (Sapling-25 Tk. Stick-20Tk Fertilizer - 15 Plantation-10Tk. Guarding - 30tk/year). | Implementation: specialist NGOs Monitoring : PMO |

**Socio-economic**

| IEC                               | Location   | Impacts  | Magnitude of impact* | Mitigation/ Enhancement/ Compensation/ Contingency   | Magnitude with EMP* | EMP Cost (in Lac Tk) | Responsible Agency  |
|-----------------------------------|--|--|----------------------|--|---------------------|----------------------|---|
| <b>Jamuna Right Bank-1(JRB-1)</b> |  |  |                      |  |                     |                      |   |
| Activity->                        | Excavation of earth materials from the location of embankment; dredging of soil from the Jamuna and Baral rivers; dumping of earthen materials on the embankment; embankment surface labeling through dumping machine; movement of vehicles for carrying earth materials.                              |  |                      |  |                     |                      |   |
| Employment                        | Places adjacent to the Jamuna River bank where the new embankment would be constructed (from Hat Panchil to Benotia mauzas).<br>Places adjacent to the existing embankment of the Baral river (from Verakhola to Dambarla mauzas).<br>At Benotia where the bank protection works is to be carried out. | A temporary employment will be created for labors during bailing out activities.                           | +1                   | Ensure employment for local people for both technical and non-technical works. If possible, 60% labor should be recruited from locale. | N/A                 | N/A                  | Implementation :<br>Contractor<br>Monitoring:<br>Nominated Engineer (SMO, BWDB) |
| Labor migration                   | Labor would be internally in-migrated from adjacent upazilas/districts.  | The in-migrated people can take part in construction work and this will bring opportunities for them also. | +2                   | A number of labors should be recruited to prompt the work.   | N/A                 | N/A                  | Implementation :<br>Contractor<br>Monitoring:<br>Nominated Engineer (SMO, BWDB) |
| Activity->                        | Dredging of earth materials from the Jamuna and Baral rivers; filling placing of geo-bags and casting and placing of CC blocks on the river banks; construction of sluices.  |  |                      |  |                     |                      |   |

| IEC        | Location  | Impacts   | Magnitude of impact* | Mitigation/ Enhancement/ Compensation/ Contingency   | Magnitude with EMP* | EMP Cost (in Lac Tk) | Responsible Agency  |
|------------|---|---|----------------------|--|---------------------|----------------------|---|
| Employment | Jamuna River (from Hat Panchil to Benotia mauzas). Baral River (from Verakhola to Dambarla mauzas). Other possible locations of construction of drainage sluices. | Temporary employment opportunity will be created for many labors. | +1                   | Ensure employment for local people for both technical and non-technical works. If possible, 60% labor should be recruited from locale. | N/A                 | N/A                  | Implementation : Contractor<br>Monitoring: Nominated Engineer (SMO, BWDB) |

### 10.2.3 Post-construction Phase

#### Water Resources

| IEC            | Location  | Impact   | Magnitude of impact | Mitigation/ Enhancement/ Compensation/ Contingency   | Magnitude with EMP | EMP Cost (Lac Tk) | Responsible Agency   |
|----------------|---|--|---------------------|--|--------------------|-------------------|--|
| <b>Erosion</b> | Location adjacent to the bank protection work (Benotia mauza) | Agricultural lands and settlements will be saved from erosion. Roadway communication will be established along the Jamuna river. | +6                  | <u>Enhancement:</u><br>- Implementing Katkin and other small scale plantation along the slope of protective works<br>- Providing fencing, biological protection (bamboo, other trees) at the country side of protective works to ensure soil stability | +7                 | 15                | Implementation: Community organizations<br>Monitoring: Department of Forestry, BWDB Field Division |

| IEC                               | Location   | Impact   | Magnitude of impact | Mitigation/ Enhancement/ Compensation/ Contingency  | Magnitude with FMP | EMP Cost (Lac Tk) | Responsible Agency   |
|-----------------------------------|--|--|---------------------|---|--------------------|-------------------|--|
| <b>Drainage congestion</b>        | Karatoya and Hurasagar rivers, which drain out water from the sub reach to the Baral and Jamuna rivers.  | Low impact may be generated as the conveyance capacity of internal rivers and lakes will be stressed, resulting in drainage congestion problems.   | -1                  | <u>Mitigation:</u><br>Operation of sluices at the mouth of Hurasagar river, and places where required.  | 0                  | N/A               | Implementation:<br>Joint committee<br>Monitoring:<br>DoF, DAE, BWDB Field Division   |
| <b>Flood</b>                      | Entire sub reach (especially near the location of embankment works i.e. from Hat Panchil to Benotia mauzas and from Verakhola to Dambarla mauzas). | Significant impact in flooding. The improvement in regular flooding would be around 30% in the entire sub-reach. This would lead to a better control in both irrigation and social status of the people in the subreach. | +5                  | <u>Enhancement:</u><br>- Forwarding the rehabilitated embankment an additional seven kilometers upto the Nagardala-Ratankandi bridge along the karatoya river to ensure better flood protection<br>- Providing vegetative cover along the slope of the embankments and afforestation works in the countryside of the embankment | +8                 | 2,000             | Implementation:<br>PMO BWDB when planning Tranche-2,<br>Monitoring:<br>BWDB, DOE<br><br>Implementation:<br>Community organizations<br>Monitoring<br>Department of Forestry, Field Division, BWDB |
| <b>Water Availability and Use</b> | Agricultural lands near the possible location of regulators and sluices.   | The socio-economic status of the farmers would be enhanced due their increased chances of practicing Aman crops  | +3                  | <u>Enhancement:</u><br>Providing inlets through embankments to allow farmers in using river water in irrigation   | +5                 | 1                 | Implementation:<br>Joint committee<br>Monitoring:<br>DAE, DoF, BWDB Field Division   |

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

## Land Resources

| IEC              | Location            | Impact   | Magnitude of impact | Mitigation/ Enhancement/ Compensation/ Contingency   | Magnitude with EMP | EMP Cost (Lac Tk) | Responsible Agency   |
|------------------|---------------------|--|---------------------|--|--------------------|-------------------|--|
| Land type change | Entire project area | Minimize River bank erosion, drainage congestion/water logging, flooding, siltation etc to 1,84,200 ha of agricultural land. | +2                  | <ul style="list-style-type: none"><li>• Formation of community organizations, strengthening through imparting training need to be done.</li><li>• Involvement of community organizations in project activities (maintenance of embankment, functioning of regulators, etc) would improve the project situation.</li><li>• Crop rotation with leguminous crops, application of more organic materials, organic manure, and green manuring and soil management should be practiced to improve soil fertility in the project area.</li><li>• Crop diversification with multi-crops might improve environmental condition of the soil.</li></ul> | +4                 | 3.50              | Implementation: specialist NGOs<br>Monitoring: PMO / DDM / DAE |
| Sand carpeting   | Entire study area   | Sand carpeting minimized due to proposed interventions.  | +4                  | <ul style="list-style-type: none"><li>• Formation of community organizations, strengthening through imparting training need to be done.</li><li>• Involvement of community organizations in project activities (maintenance of embankment, functioning of regulators, etc) would improve the project situation.</li><li>• Land of sand carpeting area might bring under cultivation through removal of coarse sand from field, incorporation of organic manure in the land, practicing of green manure, crop diversification through leguminous crops etc.</li></ul>   | +6                 | 3.5               | Implementation: specialist NGOs<br>Monitoring: PMO / DDM / DAE |
| Sub-Total        |                     |  |                     |  |                    | 7.00              |  |
| Grand Total      |                     |  |                     |  |                    | 82.47             |  |

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

**Agricultural Resources**

| IEC                            | Location                            | Impact   | Magnitude of impact | Mitigation/ Enhancement/ Compensation/ Contingency   | Magnitude with EMP | EMP Cost (Lac Tk) | Responsible Agency   |
|--------------------------------|-------------------------------------|--|---------------------|--|--------------------|-------------------|--|
| Crop production                | Entire project area( All locations) | Additional rice production would be about 148,065 metric tons  | +3                  | <ul style="list-style-type: none"> <li>Organic manure should be applied for the increase of soil fertility;</li> <li>Farmers group should have close contact with DAE for adaptation of various measures of IPM/ICM;</li> <li>Irrigation should be provided in optimum level with minimum conveyance loss;</li> <li>Involvement of Community organizations in project activities would enhance crop production.</li> </ul> | +6                 | 3.50              | Implementation: specialist NGOs<br>Monitoring: PMO / DDM / DAE |
| Improved irrigation facilities | Entire project area( All locations) | Additional surface water irrigated area would be increased by about 75 ha due to re-excavation of khals. | +3                  | <ul style="list-style-type: none"> <li>Farmers expand surface irrigation during rabi and boro season</li> <li>community organizations get training in irrigation management</li> </ul>   | +4                 | 3.50              | Implementation: Community organizations<br>Monitoring: DAE     |

**Fisheries Resources**

| IEC                          | Location | Impacts | Magnitude of impact* | Mitigation/ Enhancement/ Compensation/ Contingency | Magnitude with EMP* | EMP Cost (Lac Tk/Yr)* | Responsible Agency |
|------------------------------|----------|---------|----------------------|--|---------------------|-----------------------|--------------------|
| Re-habilitation of Embanment |          |         |                      |  |                     |                       |                    |

| IEC               | Location  | Impacts  | Magnitude of impact* | Mitigation/ Enhancement/ Compensation/ Contingency   | Magnitude with EMP* | EMP Cost (Lac Tk/Yr)* | Responsible Agency   |
|-------------------|---|--|----------------------|--|---------------------|-----------------------|--|
| Fish habitat      | 6.5 km of the Verakhola towards start of Hurashagar river | Estimated net loss to fish habitat area would be 4321.3 ha | -7                   | 1. Aquatic trees and herbs should be planted on the slope of the bank.<br>2. Proper protective device will have to take to protect the deep pools (dor/duars).   | -4                  | 0.5                   | Implementation: specialist NGOs, community organizations<br>Monitoring: PMO in coordination with Department of Fisheries |
|                   | 4km from the starting point of Hurashagar to Korotoa bank | Estimated net loss to fish habitat area would be 1659 ha   | -4                   | 3. Use of surface water during the breeding period should be stopped.<br>4. Culture fisheries should be developed<br>5. Perennial beels should be developed under sanctuary program<br>6. Some flood water from the river should be allowed during normal or low floods (through sluice gates) | -2                  |                       |  |
| Fish migration    | 6.5 km of the Verakhola towards start of Hurashagar river | Degraded fish migration                                    | -5                   | Operation of sluice gates  | -3                  | Not applicable        | Implementation: joint management committees,<br>Monitoring: Department of Fisheries (DoF)                                |
|                   | 4km from the starting point of Hurashagar to Korotoa bank | Degraded fish migration                                    | -5                   | Operation of sluice gates  | -3                  |                       |  |
| Fish biodiversity | 6.5 km of the Verakhola towards start of Hurashagar       | Capture fish species diversity would be moderate to low    | -2                   | 1. Proper protective device) will have to take to protect the deep pools (dor/duars).  | -2                  | 0.5                   | Implementation: specialist NGOs, community   |

| IEC                                   | Location   | Impacts   | Magnitude of impact* | Mitigation/ Enhancement/ Compensation/ Contingency  | Magnitude with EMP* | EMP Cost (Lac Tk/Yr)* | Responsible Agency                                       |
|---------------------------------------|--|---|----------------------|---|---------------------|-----------------------|--|
|                                       | river  |   |                      | 2. Use of surface water during the breeding period should be stopped.   |                     |                       | organizations  |
|                                       | 4km from the starting point of Hurashagar to Korotoa bank                            | Capture fish species diversity would be moderate to low     | -2                   | 3. Culture fisheries should be developed  | -                   |                       | Monitoring: PMO / Department of Fisheries (DoF)          |
| Fish production                       | 6.5 km of the Verakhola towards start of Hurashagar river                            | Estimated net loss to fish production: 1179.5 MT            | -7                   | 4. Perennial beels should be developed under biodiversity program   | -5                  | 1                     | Implementation: specialist NGOs, community organizations |
|                                       | 4km from the starting point of Hurashagar to Korotoa bank                            | Estimated net loss to fish production: 461 MT               | -6                   | 5. Proper training to increase the culture practice of high-valued fish species   | -4                  |                       | Monitoring: PMO / Department of Fisheries (DoF)          |
| <b>Construction of New Embankment</b> |  |   |                      |   |                     |                       |  |
| Fish habitat                          | 10.5 km of the Jamuna river bank from Hat Pachil Bazar, Kaizuri to Benotia Hat/Bazar | Estimated net loss to fish habitat area would be 11038.5 ha | -9                   | 1. Aquatic trees and herbs should be planted on the slope of the bank.  | -6                  | 0.5                   | Implementation: specialist NGOs                          |
|                                       | 2 km from Benotia Hat/Bazar to the start of Baral Khal, Verakola Hat                 | Estimated net loss to fish habitat area would be 409 ha     | -9                   | 2. Proper protective device will have to take to protect the deep pools (dor/duars).<br>3. Use of surface water during the breeding period should be stopped. | -6                  |                       | Monitoring: PMO / Department of Fisheries (DoF)          |
| Fish migration                        | 10.5 km of the Jamuna river bank from Hat Pachil Bazar, Kaizuri to Benotia Hat/Bazar | Degraded fish migration                                     | -5                   | Operation of sluice gates   | -5                  | Not applicable        | Implementation: joint management committees,             |



| IEC                       | Location   | Impacts   | Magnitude of impact** | Mitigation/ Enhancement/ Compensation/ Contingency  | Magnitude with EMP* | EMP Cost (Lac Tk/Yr)* | Responsible Agency  |
|---------------------------|--|---|-----------------------|---|---------------------|-----------------------|---|
|                           | 2 km from Benotia Hat/Bazar to the start of Baral Khal, Verakola Hat                 | Degraded fish migration                                 | -5                    |   | -5                  |                       | Monitoring: Department of Fisheries (DoF)   |
| Fish biodiversity         | 10.5 km of the Jamuna river bank from Hat Pachil Bazar, Kaizuri to Benotia Hat/Bazar | Capture fish species diversity would be moderate to low | -2                    | Aquaculture program including reexcavation of khals and borrow pits, developing fish ponds, and operation of sluice gates during the flood season   | -2                  | 0.5                   | Implementation: community organizations, joint management committees<br>Monitoring: Department of Fisheries (DoF) |
|                           | 2 km from Benotia Hat/Bazar to the start of Baral Khal, Verakola Hat                 | Capture fish species diversity would be moderate to low | -2                    |   | -                   |                       |   |
| Fish production           | 10.5 km of the Jamuna river bank from Hat Pachil Bazar, Kaizuri to Benotia Hat/Bazar | Estimated net loss to fish production: 99 MT            | +3                    | Proper training to increase the culture practice of high-valued fish species  | +4                  | 1                     | Implementation: specialist NGOs<br>Monitoring: PMO / Department of Fisheries (DoF)                                |
|                           | 2 km from Benotia Hat/Bazar to the start of Baral Khal, Verakola Hat                 | Estimated net gain to fish production: 1 MT             | +1                    | Not applicable  | +1                  |                       |   |
| Riverbank Protection Work |  |   |                       |   |                     |                       |   |
| Fish habitat              | 2 km from Benotia Hat/Bazar to the start of Baral Khal                               | Estimated net loss to fish habitat area would be 1 ha   | -2                    | 1. Aquatic trees and herbs should be planted on the slope of the bank.<br>2. Proper protective device (i.e., declaration of Sanctuary) will have to take to protect the deep pools (dor/duars). | -2                  | 0.5                   | Implementation: specialist NGOs, community organizations<br>Monitoring: PMO / Department of Fisheries (DoF)       |

| IEC               | Location | Impacts   | Magnitude of impact* | Mitigation/ Enhancement/ Compensation/ Contingency                    | Magnitude with EMP* | EMP Cost (Lac Tk/Yr)* | Responsible Agency |
|-------------------|----------|---|----------------------|---|---------------------|-----------------------|--------------------|
|                   |          |   |                      | 3. Use of surface water during the breeding period should be stopped. |                     |                       |                    |
| Fish migration    |          | Degraded fish migration                                 | -5                   | Not applicable  | -5                  | Not applicable        | Not applicable     |
| Fish biodiversity |          | Capture fish species diversity would be moderate to low | -2                   | Not applicable  | -                   | Same as above         | Not applicable     |
| Fish production   |          | Estimated net gain to fish production: 1 MT             | +1                   | Not applicable  | +1                  | 1                     | Not applicable     |

### Ecological Resources

| IEC  | Location  | Impacts   | Magnitude of impact* | Mitigation/Enhancement/Compensation/Contingency   | Magnitude with EMP | EMP Cost (Lac Tk.) | Respons-ible Agency  |
|--|---|---|----------------------|---|--------------------|--------------------|--|
| <b>Embankment Rehabilitation</b>   |   |   |                      |   |                    |                    |  |
| Terrestrial ecosystem<br>Aquatic ecosystem.<br>Floral composition and diversity.<br>Faunal | 10.5 km from Verakhola toward the Korotoa bank at Mohakhola | Protection of homestead, roadside and social forest habitat.<br>Vegetation coverage of the project area will improve<br>Faunal composition and diversity would be | +3                   | Do not dump large volume of excavated soil on bottom of the present trees.<br>Observation of national and international days<br>Awareness development activities should be conducted by the committee or nature club to protect the saplings. | +5                 | -                  | Implementation: specialist NGOs, community organizations<br>Monitoring: PMO / Department of Forestry |

| IEC   | Location   | Impacts  | Magnitude of impact* | Mitigation/Enhancement/Compensation/Contingency   | Magnitude with EMP | EMP Cost (Lac Tk.) | Responsible Agency   |
|---|--|--|----------------------|---|--------------------|--------------------|--|
| composition and diversity   |  | deteriorated   |                      |   |                    |                    |  |
| <b>Construction of New Embankment</b>   |  |  |                      |   |                    |                    |  |
| Terrestrial ecosystem<br>Aquatic ecosystem.<br>Floral composition and diversity<br>Faunal composition and diversity | 12.5 km of the Jamuna river bank from Hat Pachil Bazar, Kaizuri toward the Korotoa bank at Mohakhola | Protection of homestead, roadside and social forest habitat will improve bio-diversity<br>Vegetation coverage of the project area will improve<br>Faunal composition and diversity would be deteriorated | +2                   | Observation of national and international days<br>Awareness development activities should be conducted by the committee or nature club to protect the saplings. | +3                 | Mention above      | Implementation: specialist NGOs, community organizations<br>Monitoring: PMO / Department of Forestry |
| <b>Riverbank Protection Work</b>  |  |  |                      |   |                    |                    |  |
| <b>Activity- Slope Protection Activities</b>  |  |  |                      |   |                    |                    |  |
| Terrestrial ecosystem<br>Aquatic ecosystem.<br>Floral composition and diversity.                                    | 2 km from Benotia Hat/ Bazar to the start of Baral Khal, Verakola Hat.                               | Protection of homestead, roadside and social forest habitat will improve bio-diversity<br>Vegetation coverage of the project area will improve   | +2                   | Awareness development activities should be conducted by the committee or nature club to protect the planted saplings.   | 5                  | -                  | Implementation: specialist NGOs, community organizations<br>Monitoring: PMO / Department of Forestry |

| IEC                    | Location | Impacts  | Magnitude of impact* | Mitigation/Enhancement/Compensation/Contingency | Magnitude with EMP | EMP Cost (Lac Tk.) | Responsible Agency |
|------------------------|----------|--|----------------------|---|--------------------|--------------------|--------------------|
| Faunal composition and |          | Faunal composition and diversity would be deteriorated |                      |   |                    |                    |                    |

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

#### Socio-economic

| IEC                               | Location  | FWOP  | FWIP   | Impacts   | Magnitude of impact* | Mitigation/Enhancement/Compensation/Contingency | Magnitude with EMP* | EMP Cost (in Lac Tk) | Responsible Agency |
|-----------------------------------|---|---|--|---|----------------------|---|---------------------|----------------------|--------------------|
| <b>Jamuna Right Bank-1(JRB-1)</b> |   |   |  |   |                      |   |                     |                      |                    |
| Communication                     | Possible locations for communication in project area Hat Panchil Benotia Verakhola Dambarla | Embankment cum road wiped out for last 10 years. In near future, main road of Hat Panchil to Benotia would be affected. | Communication facilities will be improved both in local and upazila level. | Road communication will be improved which convey better economy by expanding business option. | +3                   | Not applicable                                  | N/A                 | N/A                  | Not applicable     |

| IEC               | Location  | FWOP  | FWIP   | Impacts  | Magnitude of impact* | Mitigation/ Enhancement/ Compensation/ Contingency   | Magnitude with EMP* | EMP Cost (in Lac Tk) | Responsible Agency                                  |
|-------------------|---|---|--|--|----------------------|--|---------------------|----------------------|---|
| Employment        | Ratankandi<br>Selachapri<br>Dumbaria<br>Alokdia<br>Nundao | Temporary employment will be created for many labors during labor shed construction               | More employment opportunities will be created for farmers and fishers of the project area. | In future, a number of employments will generate in fish culture and agriculture activities. | +2                   | Ensure/arrange training from DAE and DOF for local labors.                                 | N/A                 | N/A                  | Implementation : specialist NGOs<br>Monitoring: PMO |
| Income generation |   | A small number of low earned people will enhance their income with this additional income source. | People income will increase in future by creating more work options.                       | Income will be increased for all classes i.e. labor to businessmen.                          | +4                   | Implement a livelihood program for vulnerable groups directly affected by the construction | N/A                 | N/A                  | Implementation : specialist NGOs<br>Monitoring: PMO |

### 10.3 Subproject JLB-2

#### 10.3.1 Pre-Construction Phase

##### Water Resources

| IEC  | Location  | Impacts  | Magnitude of impact | Mitigation/ Enhancement/ Compensation/ Contingency   | Magnitude with EMP | EMP Cost (Lac Tk) | Responsible Agency  |
|--|---|--|---------------------|--|--------------------|-------------------|---|
| <b>Activity:</b> Construction of labor shed with water and sanitation facilities, garbage disposal system, construction of stock yard and construction camp, labor and material/equipment mobilization |   |  |                     |  |                    |                   |   |
| <b>Air quality</b>   | <ul style="list-style-type: none"> <li>- Possible locations of labor camps (Char Jajuria and Khashkaulia mauzas at Chauhali and Char raghunathpur at Jafarganj).</li> <li>- Location of stock yard (to be selected by the Engineer In Charge).</li> <li>- Location of CC blocks construction (Khashkaulia mauza at Chauhali and raghunathpur amauza at Jafarganj).</li> </ul> | Small amount of dust would be generated during movement of vehicles, construction materials and machineries; construction of labor shed and CC block.  | -2                  | <u>Mitigation:</u> <ul style="list-style-type: none"> <li>- Construction materials to be covered with thick materials i.e. polythene during transportation.</li> <li>- Water to be sprinkled to control the generation and spreading of dust; as and where needed.</li> </ul>                        | -1                 | N/A               | Implementation:<br>Contractor Monitoring:<br>Nominated Engineer (SMO, BWDB) |
| <b>Noise</b>   | <ul style="list-style-type: none"> <li>- Possible locations of labor shed (Char Jajuria and Khashkaulia mauzas at Chauhali and Char raghunathpur at Jafarganj).</li> <li>- Location of stock yard (to be selected by the Engineer In Charge).</li> <li>- Location of CC blocks construction (Khashkaulia mauza at Chauhali and raghunathpur amauza at Jafarganj).</li> </ul>  | Low impacts caused due to noise generation due to mobilization of construction materials and construction of labor shed, stockyard and CC blocks. There is a high school and an upazilla office at the construction site of Chauhali and one primary school at Jafarganj which would face minor impacts due to noise generation. | -2                  | <u>Mitigation:</u> <ul style="list-style-type: none"> <li>- Noise levels due to vehicular movement are to be kept within permissible limit.</li> <li>- Construction camps, labor shed, and sites for CC blocks construction are to be located far away from settlements, school, offices.</li> </ul> | -1                 | N/A               | Implementation:<br>Contractor Monitoring:<br>Nominated Engineer (SMO, BWDB) |

| IEC | Location  | Impacts | Magnitude of impact | Mitigation/ Enhancement/ Compensation/ Contingency | Magnitude with EMP | EMP Cost (Lac Tk) | Responsible Agency |
|-----|---|---------|---------------------|--|--------------------|-------------------|--------------------|
|     | Jafarganj).<br>- Roadside locations to be used during material transportation (Char jajuria, khashkaulia mauzas at Chauhali and raghunathpur and paila mauzas at Jafarganj) |         |                     |  |                    |                   |                    |

#### Land Resources

| IEC             | Location  | Impacts   | Magnitude of impact | Mitigation/ Enhancement/ Compensation/ Contingency  | Magnitude with EMP | EMP Cost (Lac Tk) | Responsible Agency   |
|-----------------|---|---|---------------------|---|--------------------|-------------------|--|
| <b>Activity</b> | <b>Construction of labor sheds and stocking yard for Bank Protective activities</b> |   |                     |   |                    |                   |  |
| Land loss       | Location-2: (Chauhali-5.0km)  | Possibility of 1.02 ha of agricultural land would be lost temporarily | -1                  | <ul style="list-style-type: none"> <li>Construction activities should be carried out as per design.</li> <li>Labor shed and stocking yard should preferably be constructed on fallow or khas land.</li> <li>Landowners affected by the construction of labor shed and placement of filling materials on agriculture land should be noticed ahead of time so that the area might not be affected for growing crops.</li> </ul> | +2                 | 0.38              | Implementation: Contractor<br>Monitoring: Nominated Engineer (SMO, BWDB) |
|                 | Location-3: (Bachamara-2.0km)   | Possibility of 1.01 ha of agricultural land would be lost temporarily | -1                  | <ul style="list-style-type: none"> <li>Labor sheds, and other project related activities should be optimized with the purpose of minimum disruption to cultivable lands and standing crops.</li> <li>Adequate cash compensation should be provided to the land owners /share croppers.</li> <li>The compensation should be determined based on the amount of land temporarily going out</li> </ul>                            | +2                 | 0.37              | Implementation: Contractor<br>Monitoring: Nominated Engineer (SMO, BWDB) |

| IEC | Location | Impacts | Magnitude of impact | Mitigation/ Enhancement/ Compensation/ Contingency | Magnitude with EMP | EMP Cost (Lac Tk) | Responsible Agency |
|-----|----------|---------|---------------------|--|--------------------|-------------------|--------------------|
|     |          |         |                     | of cultivation.                                    |                    |                   |                    |
|     |          |         |                     |  | <b>Sub total</b>   | <b>0.75</b>       |                    |

### Agricultural Resources

388. There would be no impact during the pre-construction phase

### Fisheries Resources

389. There will be no impact during the pre-construction phase.

### Ecological Resources

390. There will be no impact during the pre-construction phase.

### Socio-economic

| IEC          | Location  | Impacts   | Magnitude of impact* | Mitigation/ Enhancement/ Compensation/ Contingency   | Magnitude with EMP* | EMP Cost (in Lac Tk)              | Responsible Agency   |
|--------------|---|---|----------------------|--|---------------------|-----------------------------------|--|
| Activity->   | Construction of labor shed with water and sanitation facilities, garbage disposal system, construction of stock yard and construction camp, labor and material/equipment mobilization |   |                      |  |                     |                                   |  |
| Resettlement | 5 km of the Jamuna Left bank from Chauhali Sadar to Atpara<br>2 km of the Jamuna Left bank from   | About 534 HHs in the different locations of project area will be displaced. | -2                   | Proper land compensation to the PAPs, displaced people of project area should be re-settled. | 0                   | Will be estimated from RAP report | Implementation: Deputy Commissioner, specialist NGO<br>Monitoring: PMO |



| IEC           | Location   | Impacts   | Magnitude of impact* | Mitigation/ Enhancement/ Compensation/ Contingency                                | Magnitude with EMP* | EMP Cost (in Lac Tk) | Responsible Agency   |
|---------------|--|---|----------------------|---|---------------------|----------------------|--|
|               | Jaffarganj to Bachamara<br>These villages/mauzas are:<br>Andharmanik<br>Beda khola<br>Mohakhola<br>Kashipur<br>Ata para<br>Noya Para<br>Dholai<br>Kaulia<br>Marma                                      |   |                      |   |                     |                      |  |
| Employment    | Possible locations of labor camps (Char Janjira and Khashkaulia mauzas). Location of stock yard (to be selected by the Engineer in Charge). Location of CC blocks construction (at Khashkaulia mauza). | A temporary employment opportunity will be created for local labors during labor shed construction. | +1                   | Recruit at least 60% of labors from locale for construction work.                 | N/A                 | N/A                  | Implementation: Contractor<br>Monitoring: Nominated Engineer (SMO, BWDB) |
| Gender Issues | The whole study area i.e.<br>Andharmanik<br>Beda khola<br>Mohakhola  | Labor mobilization may create disturbance for the local women.                                      | -2                   | The labor mobilization activities should strictly follow up by project authority. | -1                  | N/A                  | Implementation: Contractor<br>Monitoring: Nominated Engineer (SMO, BWDB) |

| IEC           | Location   | Impacts   | Magnitude of impact* | Mitigation/ Enhancement/ Compensation/ Contingency                | Magnitude with EMP* | EMP Cost (in Lac Tk) | Responsible Agency   |
|---------------|--|---|----------------------|---|---------------------|----------------------|--|
| Public Health | Kashipur<br>Ata para<br>Noya Para<br>Dholai<br>Kaulia<br>Marma | Because of having limited access to toilet, unhygienic environment and huge gathering of labors can create disturbance to health. | -1                   | Proper health and sanitation system should be ensured for labors. | 0                   | N/A                  | Implementation:<br>Contractor<br>Monitoring:<br>Nominated Engineer (SMO, BWDB) |

### 10.3.2 Construction Phase

#### Water Resources

| IEC  | Location  | Impacts  | Magnitude of impact | Mitigation/ Enhancement/ Compensation/ Contingency  | Magnitude with EMP | EMP Cost (Lac Tk) | Responsible Agency   |
|--|---|--|---------------------|---|--------------------|-------------------|--|
| <b>Activity:</b> Movement of vehicles for carrying earth materials |   |  |                     |   |                    |                   |  |
| <b>Air quality</b>   | Places along the left bank of the Jamuna river where bank protection works would be carried out (Char janjira, Khasdalai, Atapara, Khash kaulia mauzas at Chauhali upazilla and Char pailadhusar, Raghunathpur, Banghabari and Paila mauzas at Jafarganj of Shibalaya upazilla) | Small amount of dust generated due to movement of vehicles and construction materials.                               | -2                  | <u>Mitigation:</u><br>Water to be sprinkled on the roads at regular intervals.                  | -1                 | N/A               | Implementation:<br>Contractor<br>Monitoring:<br>Nominated Engineer (SMO, BWDB) |
| <b>Activity:</b> Waste disposal, generated from the labor shed     |   |  |                     |   |                    |                   |  |
| <b>Surface water quality</b>                                       | Possible locations of labor shed (Char Janjira and Khashkaulia mauzas at Chauhali and Char raghunathpur at Jafarganj).  | Impacts can be generated due to improper disposal system which may eventually contaminate the water of Jamuna River. | -4                  | <u>Mitigation:</u><br>Proper waste disposal system, not interfering with the Jamuna river flow. | -1                 | N/A               | Implementation:<br>Contractor<br>Monitoring:<br>Nominated Engineer (SMO, BWDB) |

## Land Resources

| IEC              | Location  | Impact  | Magnitude of impact | Mitigation/ Enhancement/ Compensation/ Contingency  | Magnitude with EMP | EMP Cost (Lac Tk)   | Responsible Agency  |
|------------------|---|---|---------------------|---|--------------------|---|---|
| <b>Activity</b>  | <b>Collection and disposal of construction materials for bank protection activities</b> |   |                     |   |                    |   |   |
| Land loss        | Location-2:<br>(Chauhali-5.0km)   | About 0.5ha of land would be lost permanently | -1                  | <ul style="list-style-type: none"> <li>Top soil (0-15cm) should be managed properly for conserve the soil fertility.</li> <li>Area for executing construction activities and other project related activities should be optimized with the purpose of minimum disruption to cultivable lands and standing crops</li> <li>The filling materials should be collected from khas/fallow land /river.</li> </ul>   | +2                 | No cost involvement of cost for land due to activities in existing embankment | Implementation:<br>Contractor Monitoring:<br>Nominated Engineer (SMO, BWDB) |
|                  | Location-3:<br>(Bachamara-2.0km)  | About 0.2ha of land would be lost permanently | -1                  | <ul style="list-style-type: none"> <li>Disposal of spoil/ constructing materials should preferably be stored on fallow or khas land so that the area might not be affected for growing crops.</li> <li>Compensation will be paid for any crop damage.</li> <li>The contractor will avoid cultivation fields during construction.</li> <li>The contractor will avoid agricultural land for material borrowing and material stockpiling.</li> <li>The contractor will ensure that no vehicular movements take place inside cultivation fields.</li> <li>The contractor will ensure that no material is dumped inside cultivation fields.</li> </ul> | +2                 |   | Implementation:<br>Contractor Monitoring:<br>Nominated Engineer (SMO, BWDB) |
| <b>Sub total</b> |   |   |                     |   |                    | <b>00</b>   |   |

## Agricultural Resources

| IEC             | Location  | Impact | Magnitude of impact | Mitigation/ Enhancement/ Compensation/ Contingency | Magnitude with EMP | EMP Cost (Lac Tk) | Responsible Agency |
|-----------------|---|--------|---------------------|--|--------------------|-------------------|--------------------|
| <b>Activity</b> | <b>Construction of labor sheds, stocking yard for Bank rehabilitation, construction of new embankment, bank protection and construction of drainage</b> |        |                     |  |                    |                   |                    |

| IEC  | Location   | Impact  | Magnitude of impact | Mitigation/ Enhancement/ Compensation/ Contingency  | Magnitude with EMP | EMP Cost (Lac Tk) | Responsible Agency   |
|--|--|---|---------------------|---|--------------------|-------------------|--|
| <b>sluices and disposal of spoils activities</b> |  |   |                     |   |                    |                   |  |
| Crop production loss                             | i) Dombaria<br>(ii) Lochha<br>(iii) Gopalpur<br>(iv) Jagtala<br>(v) Doria mehi<br>(vi) Benotia<br>(vii) Chauhali<br>(viii) Bachamara<br>(ix) Harirampu<br>(x) Location-1 (Not fix up)<br>(xi) Location-2 (Not fix up)<br>(xii) Location-3 (Not fix up) | Loss of crop production is expected to be about 27.9 metric ton for Construction of labor sheds and stocking yard for bank rehabilitation, construction of new embankment, bank protection and construction of drainage sluices and disposal of spoils activities | -1                  | <ul style="list-style-type: none"> <li>In cases where the disruption to farming becomes unavoidable, adequate cash compensation should be provided to the land owners. /share croppers.</li> <li>Exact amount of compensation should be determined based on the amount of land temporarily going out of cultivation.</li> <li>The rate should be decided on the basis of the one crop usually grown on the pieces of land.</li> <li>Constructing materials like sand, cement, construction of labor sheds, concrete, block, etc. should be placed in non-agricultural land as far as possible. These materials should not be placed in standing crops.</li> </ul> | +3                 | 9.33              | Implementation: Contractor<br>Monitoring: Nominated Engineer (SMO, BWDB) |
| <b>Sub-Total</b>                                 |  |   |                     |   |                    | <b>9.33</b>       |  |
| Community Organizations                          | All locations of regulators  | Positive impact   | +2                  | <ul style="list-style-type: none"> <li>The community organizations should be formed prior to implementation of the project.</li> <li>The community organizations should be given orientation to protect their standing crops from river bank protection work, spoil soils, on farm water management, LCS, EMG etc.</li> </ul>   | +4                 | 2.50              | Implementation: specialist NGOs<br>Monitoring: PMO / DDM / DAE           |
| <b>Sub Total</b>                                 |  |   |                     |   |                    | <b>2.50</b>       |  |

### Fisheries Resources

| IEC  | Location   | Impacts   | Magnitude of impact* | Mitigation/ Enhancement/ Compensation/ Contingency                           | Magnitude with EMP* | EMP Cost (Lac Tk/Yr) * | Responsible Agency  |
|--|--|---|----------------------|--|---------------------|------------------------|---|
| Activity: Riverbankslope protection with concrete blocks and geobags (under water) |  |   |                      |  |                     |                        |   |
| Fish habitat   | 5 km of the Jamuna Left bank from Chauhali Sadar to Atpara | Borrowpit would be lost near the river bank at Chauhali sadar (East and North Khaskaulia) | -1                   | Not applicable   | -1                  | Not applicable         | Not applicable  |
|  | 2 km of the Jamuna Left bank from Jaffarganj to Bachamara  | Capture and culture fish production would be the same as the base.                        | 0                    |  | 0                   |                        |   |
| Fish biodiversity  | Same as above  | Capture and culture fish production would be the same as the base.                        | 0                    |  | 0                   |                        |   |
|  | Same as above  |   | 0                    |  | 0                   |                        |   |
| Fish production  | Same as above  | Capture and culture fish production would be the same as the base.                        | 0                    | Proper training to increase the culture practice of high-valued fish species | +2                  | 0.5                    | Implementation: specialist fisheries NGOs<br>Monitoring: PMO in coordination with Department of Fisheries |
|  | Same as above  | Culture fish production would be increased by 47.32 MT MT within the project area.        | +5                   |  | +6                  |                        |   |
| Activity: Placing and dumping of C.C. blocks above low water as per design         |  |   |                      |  |                     |                        |   |
| Fish biodiversity  | 5 km of the Jamuna Left bank from Chauhali Sadar to Atpara | No Impact   | 0                    | Not applicable   | 0                   | Not applicable         | Not applicable  |

| IEC             | Location  | Impacts  | Magnitude of impact* | Mitigation/ Enhancement/ Compensation/ Contingency                                    | Magnitude with EMP* | EMP Cost (Lac Tk/Yr) * | Responsible Agency   |
|-----------------|---|--|----------------------|---|---------------------|------------------------|--|
|                 | 2 km of the Jamuna Left bank from Jaffarganj to Bachamara | Cat fish (boal, ayr, magur, etc.) might shift from the project area                | -3                   | Proper protective device will have to be taken to protect the deep pools (dor/duars). | -2                  | 0.2                    | Implementation: Contractor Monitoring: Nominated Engineer (SMO, BWDB) in coordination with Department of Fisheries |
| Fish production | Same as above   | Capture and culture fish production would be the same as the base.                 | 0                    | Proper training to increase the culture practice of high-valued fish species          | +1                  | 1                      | Implementation: specialist NGOs Monitoring: PMO in coordination with Department of Fisheries                       |
|                 | Same as above   | Culture fish production would be increased by 47.32 MT MT within the project area. | +5                   |   | +5                  |                        |  |

### Ecological Resources

| IEC                               | Location                          | Impacts  | Magnitude of impact* | Mitigation/Enhancement/Compensation/Contingency             | Magnitude with EMP | EMP Cost (Lac Tk.) | Responsible Agency |
|-----------------------------------|-----------------------------------|--|----------------------|---|--------------------|--------------------|--------------------|
| <b>Activity:</b> Slope protection |                                   |  |                      |   |                    |                    |                    |
| Terrestrial ecosystem             | 5 km of the Jamuna Left bank from | Vegetation of river banks and some aquatic flora | -5                   | Awareness development activities should be conducted by the | +7                 | -                  | Implementation:    |

| IEC   | Location  | Impacts   | Magnitude of impact* | Mitigation/Enhancement/Compensation/Contingency   | Magnitude with EMP | EMP Cost (Lac Tk.) | Responsible Agency                 |
|---|---|---|----------------------|---|--------------------|--------------------|------------------------------------|
| <b>Activity:</b> Slope protection   |   |   |                      |   |                    |                    |                                    |
| Aquatic ecosystem. Floral composition and diversity. Faunal composition and diversity | Chauhali Sadar to Atpara. 2 km of the Jamuna Left bank from Jaffarganj to Bachamara | will reduce. Wildlife population like terrestrial birds and palm squirrels will be disturbed. |                      | committee or nature club to protect the saplings. |                    |                    | specialist NGOs Monitoring : PMO / |

**Socio-economic**

| IEC                  | Location  | Impacts   | Magnitude of impact* | Mitigation/Enhancement/Compensation/Contingency                   | Magnitude with EMP* | EMP Cost (in Lac Tk) | Responsible Agency   |
|----------------------|---|---|----------------------|---|---------------------|----------------------|--|
| <b>Activity-&gt;</b> | Filling placing of geo-bags and casting and placing of CC blocks on the river banks   |   |                      |   |                     |                      |  |
| Employment           | Places along the left bank of the Jamuna river where bank protection works would be carried out (Char janjira, Khasdalai, Atapara, Khash kaulia mauzas at Chauhali upazilla and Char pailadhusar, Raghunathpur, Banghabari and Paila mauzas at Jafarganj of Sirajganj upazilla) | A temporary employment will be created for many labors during bailing out activities. | +1                   | Recruit at least 60% of labors from locale for construction work. | N/A                 | N/A                  | Implementation: Contractor<br>Monitoring: Nominated Engineer (SMO, BWDB) |
| Labor migration      |   | Opportunities for in-migrant labors could be ensured during earthwork activities.     | +2                   | A number of labors should be recruited to prompt the work.        | N/A                 | N/A                  |  |

| IEC                            | Location   | Impacts  | Magnitude of impact* | Mitigation/ Enhancement/ Compensation/ Contingency   | Magnitude with EMP* | EMP Cost (in Lac Tk) | Responsible Agency  |
|--------------------------------|--|--|----------------------|--|---------------------|----------------------|---|
|                                |  |  |                      |  |                     |                      | Engineer (SMO, BWDB)  |
| Public and Occupational Health | The whole project study area i.e. Andharmanik, Beda khola, Mohakhola, Kashipur Ata para, Noya Para, Dholai Kaulia Work sites | Because of having limited access to toilet, unhygienic environment and huge gathering of labors can create disturbance to health. Accidents during construction activities | -1                   | Proper health and sanitation system should be ensured for labors. Safety measures, first aid provisions, and arrangements for medical evacuation and attention | -1                  | N/A                  | Implementation: Contractor Monitoring: Nominated Engineer (SMO, BWDB) |

### 10.3.3 Post-construction Phase

#### Water Resources

| IEC | Location | Impact | Magnitude of impact | Mitigation/ Enhancement/ Compensation/ Contingency | Magnitude with EMP | EMP Cost (Lac Tk) | Responsible Agency |
|-----|----------|--------|---------------------|--|--------------------|-------------------|--------------------|
|-----|----------|--------|---------------------|--|--------------------|-------------------|--------------------|



| IEC            | Location  | Impact   | Magnitude of impact | Mitigation/ Enhancement/ Compensation/ Contingency   | Magnitude with EMP | EMP Cost (Lac Tk) | Responsible Agency   |
|----------------|---|--|---------------------|--|--------------------|-------------------|--|
| <b>Erosion</b> | <ul style="list-style-type: none"> <li>- From Atapara to Khash kaulia mauzas at Chauhali upazilla</li> <li>- From Gangadia to the end of Paila mauzas at Jafarganj of Shibalaya upazilla</li> </ul> | Massive impact to the livelihood of the local people. Due to the bank protection works at Chauhali and Jafarganj, huge amount of agricultural lands and settlements will be saved. Communication facilities will be re-established over the left bank of Jamuna river. | +8                  | <u>Enhancement:</u> <ul style="list-style-type: none"> <li>- Implementing Katkin and other small scale plantation along the slope of protective works</li> <li>- Providing bamboo protection at the country side of protective works to increase soil strength.</li> </ul> | +9                 | N/A               | Implementation: Community organizations<br>Monitoring: Department of Forestry, BWDB Field Division |

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

#### Land Resources

391. There will be no impact during the post-construction phase.

#### Agricultural Resources

392. There will be no impact during the post-construction phase.

#### Fisheries Resources

| IEC | Location | Impacts | Magnitude of impact* | Mitigation/ Enhancement/ Compensation/ Contingency | Magnitude with EMP* | EMP Cost (Lac Tk/Yr)* | Responsible Agency |
|-----|----------|---------|----------------------|--|---------------------|-----------------------|--------------------|
|-----|----------|---------|----------------------|--|---------------------|-----------------------|--------------------|

|                      |   |  |    |   |    |     |   |
|----------------------|---|--|----|---|----|-----|---|
| Fish habitat         | 5 km of the Jamuna<br>Left bank from<br>Chauhali Sadar to<br>Atpara | Estimated net loss to fish habitat<br>area would be 1388.6 ha            | 3  | 1. Aquatic trees and herbs should<br>be planted on the slope of the<br>bank.<br>2. Proper protective device (i.e.,<br>declaration of Sanctuary) will<br>have to take to protect the deep<br>pools (dor/duars).<br>3. Use of surface water during the<br>breeding period should be<br>stopped. | -1 | 1   | Implementation:<br>specialist NGOs,<br>community<br>organizations<br>Monitoring:<br>PMO /<br>Department of<br>Fisheries (DoF) |
|                      | 2 km of the Jamuna<br>Left bank from<br>Jaffarganj to<br>Bachamara  | Estimated net loss to fish habitat<br>area would be 550 ha               | -3 |   | -1 |     |   |
| Fish<br>biodiversity | 5 km of the Jamuna<br>Left bank from<br>Chauhali Sadar to<br>Atpara | Capture and culture fish<br>production would be the same<br>as the base. | 0  | Not applicable  | 0  | -   | Not applicable  |
|                      | 2 km of the Jamuna<br>Left bank from<br>Jaffarganj to<br>Bachamara  | Same as above  | 0  | Same as above   | 0  |     |   |
| Fish<br>production   | 5 km of the Jamuna<br>Left bank from<br>Chauhali Sadar to<br>Atpara | Capture and culture fish<br>production would be the same<br>as the base. | 0  | Proper training to increase the<br>culture practice of high-valued<br>fish species<br>Not applicable  | +2 | 0.5 | Implementation:<br>specialist NGOs<br>Monitoring:<br>PMO /<br>Department of<br>Fisheries (DoF)                                |

|  |   |   |    |  |    |  |  |
|--|---|---|----|--|----|--|--|
|  | 2 km of the Jamuna Left bank from Jaffarganj to Bachamara | Estimated net gain to fish production: 1 MT | +1 |  | +3 |  |  |
|--|---|---|----|--|----|--|--|

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

### Ecological Resources

393. There will be no impact during the post-construction phase.

### Socio-economic

| IEC                               | Location  | FWOP   | FWIP   | Impacts   | Magnitude of impact* | Mitigation/ Enhancement/ Compensation/ Contingency          | Magnitude with EMP* | EMP Cost (in Lac Tk) | Responsible Agency                   |
|-----------------------------------|---|--|--|---|----------------------|---|---------------------|----------------------|--------------------------------------|
| <b>Jamuna Left Bank-2 (JLB-2)</b> |   |  |  |   |                      |   |                     |                      |                                      |
| Communication                     | Possible locations for communication in project area Char janjira Khasdalai Khash kaulia Pailadhusar Raghunathpur Paila | Embankment cum road could be wiped out. In near future, road of Char janjira, Khasdalai, Atapara, Khash kaulia mauzas at Chauhali upazilla and | Communication facilities will be improved both in local and upazila level. | Road communication will be improved which convey better economy by expanding business option. | +3                   | Plan upgrading of embankment with road during next tranches | N/A                 | N/A                  | Implementation: PMO, Monitoring: ADB |

| IEC   | Location  | FWOP  | FWIP  | Impacts   | Magnitude of impact* | Mitigation/ Enhancement/ Compensation/ Contingency         | Magnitude with EMP* | EMP Cost (in Lac Tk) | Responsible Agency                              |
|---|---|---|---|---|----------------------|--|---------------------|----------------------|---|
|   |   | Char pailadhusar, Raghunathpur, Banghabari and Paila mauzas at Jafarganj of Sirajganj upazilla would be affected. |   |   |                      |  |                     |                      |   |
| Protection of municipal area including markets and homesteads | Chouhali bazaar and adjacent villages Jafarganj bazaar and adjacent village | Municipal area including markets and homesteads will certainly be eroded  | Protective work will protect the municipal area including markets and homestead | Municipal area, markets and homesteads will be protected and business will be run properly. Government office, and educational and religious institutions will be protected | +6                   | Extend protection where necessary during next tranches     | N/A                 | N/A                  | Implementation: PMO, Monitoring: ADB            |
| Employment  | Char janjira Khasdalai Khash kaulia Pailadhusar                             | A temporary employment will be created for many   | More employment opportunities will be created                                   | In future, a number of employments will generate in   | +4                   | Ensure/arrange training from DAE and DOF for local labors. | N/A                 | N/A                  | Implementation: specialist NGOs Monitoring: PMO |

| IEC               | Location           | FWOP  | FWIP   | Impacts   | Magnitude of impact* | Mitigation/ Enhancement/ Compensation/ Contingency   | Magnitude with EMP* | EMP Cost (in Lac Tk) | Responsible Agency                                 |
|-------------------|--------------------|---|--|---|----------------------|--|---------------------|----------------------|--|
|                   | Raghunathpur Paila | labors during labor shed construction.  | for farmers and fishers of the project area.                         | fish culture and agriculture activities.                            |                      |  |                     |                      |  |
| Income generation |                    | A small number of low earned people will enhance their income with this additional income source. | People income will increase in future by creating more work options. | Income will be increased for all classes i.e. labor to businessmen. | +4                   | Implement a livelihood program for vulnerable groups directly affected by the construction | N/A                 | N/A                  | Implementation: specialist NGOs<br>Monitoring: PMO |

#### 10.4 Subproject PLB-1

##### 10.4.1 Pre-Construction Phase

###### Water Resources

| IEC   | Location | Impacts | Magnitude of impact | Mitigation/ Enhancement/ Compensation/ Contingency | Magnitude with EMP | EMP Cost (Lac Tk) | Responsible Agency |
|---|----------|---------|---------------------|--|--------------------|-------------------|--------------------|
| <b>Activity:</b> Construction of labor shed with water and sanitation facilities, garbage disposal system, construction of stock yard and construction camp, labor and materials/equipment mobilization |          |         |                     |  |                    |                   |                    |

| IEC   | Location   | Impacts  | Magnitude of impact | Mitigation/ Enhancement/ Compensation/ Contingency  | Magnitude with EMP | EMP Cost (Lac Tk) | Responsible Agency   |
|---|--|--|---------------------|---|--------------------|-------------------|--|
| <b>Air quality</b>  | <ul style="list-style-type: none"> <li>- Possible locations of labor camps (Ramkrishnapur and Andarmanik mauzas)</li> <li>- Location of stock yard (to be selected by the Engineer In Charge),</li> <li>- Location of CC block construction (Andarmanik mauza)</li> <li>- Roadside locations to be used in carrying construction materials (Harirampur-Rathora road; Andarmanik and Ramkrishnapur mauzas)</li> </ul> | Small amount of dust generation during movement of vehicles, construction materials and machineries, construction of labor shed and CC blocks. | - 2                 | <u>Mitigation:</u> <ul style="list-style-type: none"> <li>- Construction materials to be covered with thick materials i.e. polythene during transportation</li> <li>- Water to be sprinkled to control the generation and spreading of dust; as and where needed</li> </ul> | -1                 | N/A               | Implementation: Contractor<br>Monitoring: Nominated Engineer (SMO, BWDB) |
| <b>Activity:</b> Construction of labor shed and construction camp; labor and materials/equipment mobilization |  |  |                     |   |                    |                   |  |
| <b>Noise</b>  | <ul style="list-style-type: none"> <li>- Possible locations of labor camps (Ramkrishnapur and Andarmanik mauzas)</li> <li>- Location of stock yard (to be selected by the Engineer In Charge),</li> <li>- Location of CC block construction (Andarmanik mauza)</li> <li>- Roadside locations to be used in carrying construction materials (harirampur-rathora road; andarmanik and ramkrishnapur mauzas)</li> </ul> | Minor impact would be generated due to the construction of CC block, labor shed, stock yard and mobilization of materials.                     | - 2                 | - Noise levels are to be kept within permissible standard   | -1                 | N/A               | Implementation: Contractor<br>Monitoring: Nominated Engineer (SMO, BWDB) |

**Land Resources**

| IEC             | Location  | Impacts  | Magnitude of impact | Mitigation/ Enhancement/ Compensation/ Contingency   | Magnitude with EMP | EMP Cost (Lac Tk) | Responsible Agency   |
|-----------------|---|--|---------------------|--|--------------------|-------------------|--|
| <b>Activity</b> | <b>Construction of labor sheds and stocking yard for Bank Protective activities</b> |  |                     |  |                    |                   |  |
| Land loss       | Location-4:<br>(Harirampur-7.0km)   | Possibility of 1.04ha agricultural land would be lost temporarily lost | -1                  | <ul style="list-style-type: none"> <li>Construction activities should be carried out as per design.</li> <li>Labor shed and stocking yard should preferably be constructed on fallow or khas land.</li> <li>Landowners affected by the construction of labor shed and placement of filling materials on agriculture land should be noticed ahead of time so that the area might not be affected for growing crops.</li> <li>Labor sheds, and other project related activities should be optimized with the purpose of minimum disruption to cultivable lands and standing crops.</li> <li>Adequate cash compensations should be provided to the land owners /share croppers.</li> <li>The compensation should be determined based on the amount of land temporarily going out of cultivation.</li> </ul> | +2                 | 0.39              | Implementation: Contractor<br>Monitoring: Nominated Engineer (SMO, BWDB) |
|                 |   |  |                     |  | <b>Sub total</b>   | <b>0.39</b>       |  |

**Agricultural Resources**

394. There would be no impact during the pre-construction phase

**Fisheries Resources**

395. There will be no impact during the pre-construction phase.

**Ecological Resources**

396. There will be no impact during the pre-construction phase.

### Socio-economic

| IEC           | Location  | Impacts   | Magnitude of impact* | Mitigation/ Enhancement/ Compensation/ Contingency                                    | Magnitude with EMP* | EMP Cost (in Lac Tk)              | Responsible Agency   |
|---------------|---|---|----------------------|---|---------------------|-----------------------------------|--|
| Activity->    | Construction of labor shed with water and sanitation facilities, garbage disposal system, construction of stock yard and construction camp, labor and materials/equipment mobilization  |   |                      |   |                     |                                   |  |
| Resettlement  | Possible locations of labor camps (Ramkrishnapur and Andarmanik mauzas)<br>Location of stock yard (to be selected by the Engineer In Charge),<br>Location of CC block construction (Andarmanik mauza). These villages are: Jaghannathpur, Boxor, Andharmanik, Bholabaj, Boyra | About 596 HHs in the different locations of project area will be displaced.                 | -2                   | Proper land compensation, PAPs should be ensured for displaced people of project area | -1                  | Will be estimated from RAP report | Implementation: Deputy Commissioner, specialist NGO<br>Monitoring: PMO   |
| Gender Issues | The whole study area, i.e. Jaghannathpur, Boxor, Andharmanik, Bholabaj, Boyra   | Labor mobilization may create disturbance for the local women.                              | -2                   | The labor mobilization activities should strictly follow up by project authority.     | -1                  | N/A                               | Implementation: Contractor<br>Monitoring: Nominated Engineer (SMO, BWDB) |
| Public Health |   | Because of having limited access to toilet, unhygienic environment due to huge gathering of | -1                   | Proper health and sanitation system should be ensured for labors.                     | 0                   | N/A                               | Implementation: Contractor<br>Monitoring: Nominated Engineer             |



| IEC | Location | Impacts                                  | Magnitude of impact* | Mitigation/ Enhancement/ Compensation/ Contingency | Magnitude with EMP* | EMP Cost (in Lac Tk) | Responsible Agency |
|-----|----------|--|----------------------|--|---------------------|----------------------|--------------------|
|     |          | labors can create disturbance to health. |                      |  |                     |                      | (SMO, BWDB)        |

#### 10.4.2 Construction Phase

##### Water Resources

| IEC   | Location  | Impacts   | Magnitude of impact | Mitigation/ Enhancement/ Compensation/ Contingency                       | Magnitude with EMP | EMP Cost (Lac Tk) | Responsible Agency   |
|---|---|---|---------------------|--|--------------------|-------------------|--|
| <b>Activity:</b> Placing of geo-bags                  |   |   |                     |  |                    |                   |  |
| <b>Air quality</b>                                    | Places along the left bank of the Padma river, where bank protection works would be carried out (Ramkrishnapur, Andarmanik and Boyra mauzas of Harirampurupazilla). | Minor amount of dust generation during placing and dumping of CC blocks, Geo-bags; slope preparation and pitching, construction of sluices and movement of vehicles and construction materials. | -2                  | <u>Mitigation:</u><br>Water to be sprinkled as and where needed.         | -1                 | N/A               | Implementation: Contractor<br>Monitoring: Nominated Engineer (SMO, BWDB) |
| <b>Activity:</b> Waste disposal from the labor sheds. |   |   |                     |  |                    |                   |  |
| <b>Surface water quality</b>                          | - Possible locations of labor camps (Ramkrishnapur and Andarmanik mauzas)   | Impacts can be generated due to improper disposal system which may eventually contaminate the water of Padma River.   | -4                  | Proper waste disposal system, not interfering with the Padma River flow. | -1                 | N/A               | Implementation: Contractor<br>Monitoring: Nominated Engineer (SMO, BWDB) |

**Land Resources**

| IEC              | Location  | Impact                                  | Magnitude of impact | Mitigation/ Enhancement/ Compensation/ Contingency  | Magnitude with EMP | EMP Cost (Lac Tk)   | Responsible Agency  |
|------------------|---|---|---------------------|---|--------------------|---|---|
| <b>Activity</b>  | <b>Collection and disposal of construction materials for bank protection activities</b> |   |                     |   |                    |   |   |
| Land loss        | Location-4: (Harirampur-7.0km)  | 0.7ha of land would be lost permanently | -1                  | <ul style="list-style-type: none"> <li>Top soil (0-15cm) should be managed properly for conserve the soil fertility.</li> <li>Area for executing construction activities and other project related activities should be optimized with the purpose of minimum disruption to cultivable lands and standing crops</li> <li>The filling materials should be collected from khas/fallow land /river.</li> <li>Disposal of spoil/ constructing materials should preferably be stored on fallow or khas land so that the area might not be affected for growing crops.</li> <li>Compensation will be paid for any crop damage.</li> <li>The contractor will avoid cultivation fields during construction.</li> <li>The contractor will avoid agricultural land for material borrowing and material stockpiling.</li> <li>The contractor will ensure that no vehicular movements take place inside cultivation fields.</li> <li>The contractor will ensure that no material is dumped inside cultivation fields</li> </ul> | +2                 | No cost involvement of cost for land due to activities in existing embankment | Implementation: Contractor Monitoring: Nominated Engineer (SMO, BWDB) |
| <b>Sub total</b> |   |   |                     |   |                    | <b>00</b>   |   |

**Agricultural Resources**

| IEC             | Location  | Impact | Magnitude of impact | Mitigation/ Enhancement/ Compensation/ Contingency | Magnitude with EMP | EMP Cost (Lac Tk) | Responsible Agency |
|-----------------|---|--------|---------------------|--|--------------------|-------------------|--------------------|
| <b>Activity</b> | <b>Construction of labor sheds, stocking yard for Bank rehabilitation, construction of new embankment, bank protection and construction of drainage sluices and disposal of spoils activities</b> |        |                     |  |                    |                   |                    |

| IEC                     | Location   | Impact  | Magnitude of impact | Mitigation/ Enhancement/ Compensation/ Contingency  | Magnitude with EMP | EMP Cost (Lac Tk) | Responsible Agency   |
|-------------------------|--|---|---------------------|---|--------------------|-------------------|--|
| Crop production loss    | i) Dombaria<br>(ii) Lochha<br>(iii) Gopalpur<br>(iv) Jagtala<br>(v) Doria mehi<br>(vi) Benotia<br>(vii) Chauhali<br>(viii) Bachamara<br>(ix) Harirampu<br>(x) Location-1 (Not fix up)<br>(xi) Location-2 (Not fix up)<br>(xii) Location-3 (Not fix up) | Loss of crop production is expected to be about 27.9 metric ton for Construction of labor sheds and stocking yard for bank rehabilitation, construction of new embankment, bank protection and construction of drainage sluices and disposal of spoils activities | -1                  | <ul style="list-style-type: none"> <li>In cases where the disruption to farming becomes unavoidable, adequate cash compensation should be provided to the land owners. /share croppers.</li> <li>Exact amount of compensation should be determined based on the amount of land temporarily going out of cultivation.</li> <li>The rate should be decided on the basis of the one crop usually grown on the pieces of land.</li> <li>Constructing materials like sand, cement, construction of labor sheds, concrete, block, etc. should be placed in non-agricultural land as far as possible. These materials should not be placed in standing crops.</li> </ul> | +3                 | 9.33              | Implementation: Contractor<br>Monitoring: Nominated Engineer (SMO, BWDB) |
| <b>Sub-Total</b>        |  |   |                     |   |                    | <b>9.33</b>       |  |
| Community Organizations | All locations of regulators  | Positive impact   | +2                  | <ul style="list-style-type: none"> <li>The community organizations should be formed prior to implementation of the project.</li> <li>The community organizations should be given orientation to protect their standing crops from river bank protection work, spoil soils, on farm water management, LCS, EMG etc.</li> </ul>   | +4                 | 2.50              | Implementation: specialist NGOs<br>Monitoring: PMO / DDM / DAE           |
| <b>Sub Total</b>        |  |   |                     |   |                    | <b>2.50</b>       |  |

^

**Fisheries Resources**

| IEC               | Location                                  | Impacts   | Magnitude of impact* | Mitigation/ Enhancement/ Compensation/ Contingency  | Magnitude with EMP* | EMP Cost (Lac Tk/Yr) * | Responsible Agency   |
|-------------------|---|---|----------------------|---|---------------------|------------------------|--|
| Fish habitat      | 7 km of the Padma Left Bank at Harirampur | Temporary damage would occur in the seasonal fish habitat due to either clearance of vegetation cover or draped by the filling earth during earth work for the fish species of marginal vegetation feeder.<br>Spawning ground would be lost | -6                   | 1. Vegetation clearance should be done as low as possible<br>2. There should be now work on spawning grounds during the spawning season | -2                  | 1                      | Implementation:<br>Contractor Monitoring:<br>Nominated Engineer (SMO, BWDB) in coordination with Department of Fisheries |
| Fish migration    |   | Migration route would be disturbed  | -6                   |   | -2                  |                        |  |
| Fish biodiversity |   | Riverine fish species i. e. major carp species, grass carp and other herbivorous species, eel (baim), big and small cat fish (boal, ayr, magur), might shift from the project area  | -6                   |   | -2                  |                        |  |
| Fish production   |   | Capture fish production would temporarily be declined by 592 MT within the project area.  | -1                   |   | -1                  |                        |  |

**Ecological Resources**

| IEC  | Location                                  | Impacts   | Magnitude of impact* | Mitigation/Enhancement/Compensation/Contingency   | Magnitude with EMP | EMP Cost (Lac Tk.) | Responsible Agency                                    |
|--|---|---|----------------------|---|--------------------|--------------------|---|
| <b>Activity:</b> Slope protection  |   |   |                      |   |                    |                    |   |
| Terrestrial ecosystem<br>Aquatic ecosystem.<br>Floral composition and diversity.<br>Faunal composition and diversity | 7 km of the Padma Left Bank at Harirampur | Vegetation of river banks and some aquatic flora will reduce.<br>Wildlife population like terrestrial birds and palm squirrels will be disturbed. | -5                   | Awareness development activities should be conducted by the committee or nature club to protect the saplings. | +7                 | -                  | Implementation: specialist NGOs<br>Monitoring : PMO / |

**Socio-economic**

| IEC                             | Location   | Impacts  | Magnitude of impact* | Mitigation/Enhancement/Compensation/Contingency                   | Magnitude with EMP* | EMP Cost (in Lac Tk) | Responsible Agency   |
|---------------------------------|--|--|----------------------|---|---------------------|----------------------|--|
| <b>Pdma Left Bank-1 (PLB-1)</b> |  |  |                      |   |                     |                      |  |
| <b>Activity-&gt;</b>            | filling placing of geo-bags on the river banks   |  |                      |   |                     |                      |  |
| Employment                      | Places along the left bank of the Padma River, where bank protection works would be carried out (Ram krishnapur, Andarmanik and Boyra mauzas of Harirampurupazilla). | Temporary employment opportunities will be created for labors during bailing out activities. | +1                   | Recruit at least 60% of labors from locale for construction work. | N/A                 | N/A                  | Implementation: Contractor<br>Monitoring: Nominated Engineer (SMO, BWDB) |
| Labor migration                 | Labor would be internally in-migrated from adjacent  | Opportunities of in-migrant labors could   | +2                   | A number of labors should be recruited to                         | N/A                 | N/A                  | Implementation: Contractor<br>Monitoring:                                |

| IEC                            | Location   | Impacts  | Magnitude of impact* | Mitigation/ Enhancement/ Compensation/ Contingency  | Magnitude with EMP* | EMP Cost (in Lac Tk) | Responsible Agency   |
|--------------------------------|--|--|----------------------|---|---------------------|----------------------|--|
|                                | upazilas/districts.  | be created during earthwork activities.  |                      | prompt the work.  |                     |                      | Nominated Engineer (SMO, BWDB)   |
| Public and Occupational Health | Places along the left bank of the Padma River, where bank protection works would be carried out (Ram krishnapur, Andarmanik and Boyra mauzas of Harirampurupazilla).<br>Work sites | Because of having limited access to toilet, unhygienic environment and huge gathering of labors can create disturbance to health. Accidents during construction activities | -1                   | Proper health and sanitation system should be ensured for labors.<br>Safety measures, first aid provisions, and arrangements for medical evacuation and attention | -1                  | N/A                  | Implementation: Contractor<br>Monitoring: Nominated Engineer (SMO, BWDB) |

### 10.4.3 Post-construction Phase

#### Water Resources

| IEC | Location | Impact | Magnitude of impact | Mitigation/ Enhancement/ Compensation/ Contingency | Magnitude with EMP | EMP Cost (Lac Tk) | Responsible Agency |
|-----|----------|--------|---------------------|--|--------------------|-------------------|--------------------|
|-----|----------|--------|---------------------|--|--------------------|-------------------|--------------------|

| IEC            | Location   | Impact  | Magnitude of impact | Mitigation/ Enhancement/ Compensation/ Contingency   | Magnitude with EMP | EMP Cost (Lac Tk) | Responsible Agency   |
|----------------|--|---|---------------------|--|--------------------|-------------------|--|
| <b>Erosion</b> | Ram krishnapur, Andarmanik and Boyra mauzas of Harirampur upazilla | Huge impacts in the impacted area. River Bank protection work at Harirampur will save agricultural lands and settlements. Communication system will be enhanced. The economic status of livelihood would improve. | +7                  | <u>Enhancement:</u> <ul style="list-style-type: none"> <li>- Implementing Katkin and other small scale plantation along the slope of protective works.</li> <li>- Providing biological protection at the country side of protective works to ensure soil stability.</li> </ul> | +8                 | N/A               | Implementation: Community organizations<br>Monitoring: Department of Forestry, BWDB Field Division |

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

### Land Resources

397. There will be no impact during the post-construction phase.

### Agricultural Resources

398. There will be no impact during the post-construction phase.

### Fisheries Resources

| IEC          | Location                                  | Impacts                                     | Magnitude of impact* | Mitigation/ Enhancement/ Compensation/ Contingency        | Magnitude with EMP* | EMP Cost (Lac Tk/Yr)* | Responsible Agency              |
|--------------|---|---|----------------------|---|---------------------|-----------------------|---------------------------------|
| Fish habitat | 7 km of the Padma Left Bank at Harirampur | Estimated net loss to fish habitat: 678 ha. | -6                   | 1. Vegetation clearance should be done as low as possible | -2                  | 0.5                   | Implementation: specialist NGOs |

| IEC               | Location | Impacts  | Magnitude of impact* | Mitigation/ Enhancement/ Compensation/ Contingency   | Magnitude with EMP* | EMP Cost (Lac Tk/Yr)* | Responsible Agency   |
|-------------------|----------|--|----------------------|--|---------------------|-----------------------|--|
|                   |          |  |                      | Spawning ground should be taken under special consideration during the earthwork and earth filling                                     |                     |                       | Monitoring: PMO / Department of Fisheries (DoF)                                    |
| Fish migration    |          | Migration route would be disturbed   | -2                   | Dredging will have to done during the dry season.<br>Proper protective device will have to take to protect the deep pools (dor/duars). | -1                  |                       | Implementation: specialist NGOs<br>Monitoring: PMO / DoF                           |
| Fish biodiversity |          | Riverine fish species i. e. hilsa, major carp species, eel (baim), big and small cat fish (boal, ayr, magur), etc. might shift from the project area | -5                   |  | -3                  | 0.2                   | Implementation: specialist NGOs<br>Monitoring: PMO / Department of Fisheries (DoF) |
| Fish production   |          | Estimated net loss to fish production: 46 MT   | -5                   |  | -3                  |                       |  |

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

### Ecological Resources

399. There will be no impact during the post-construction phase.



## Socio-economic

| IEC   | Location  | FWOP   | FWIP  | Impacts   | Magnitude of impact* | Mitigation Measure  | Magnitude with EMP* | EMP Cost (in Lac Tk) | Responsible Agency                   |
|---|---|--|---|---|----------------------|---|---------------------|----------------------|--------------------------------------|
| <b>Padma Left Bank-1 (PLB-1)</b>                              |   |  |   |   |                      |   |                     |                      |                                      |
| Communication   | The possible locations for communication system are: Jaghannathpur Boxor Andharmanik Bholabaj Boyra | Bank protection cum road wiped out recently. In near future, main road of Alfadanga to Faridpur would be affected. | Communication facilities will be improved both in local and upazila level.      | Road communication will be improved which convey better economy by expanding business option.   | +3                   | Plan upgrading of embankment with road during next tranches | N/A                 | N/A                  | Implementation: PMO, Monitoring: ADB |
| Protection of municipal area including markets and homesteads | Ramkrishnapur bazaar and adjacent other villages Andharmanik bazaar and adjacent other village      | Municipal area including markets and homesteads will certainly be eroded   | Protective work will protect the municipal area including markets and homestead | Municipal area, markets and homesteads will be protected and business will be run properly. Government office, and educational and religious institutions will be protected | +6                   | Extend protection where necessary during next tranches      | N/A                 | N/A                  | Implementation: PMO, Monitoring: ADB |

| IEC               | Location  | FWOP  | FWIP  | Impacts  | Magnitude of impact* | Mitigation Measure   | Magnitude with EMP* | EMP Cost (in Lac Tk) | Responsible Agency                                 |
|-------------------|---|---|---|--|----------------------|--|---------------------|----------------------|--|
| Employment        | The possible locations for employment opportunities in future are:<br><br>Jaghannathpur<br>Boxor<br>Andharmanik | Temporary employment will be created for many labors during labor shed construction.              | More employment opportunities will be created in agriculture and fisheries field. | In future, a number of employments will generate in fish culture and agriculture activities. | +4                   | Ensure/arrange training from DAE and DOF for local labors.                                 | N/A                 | N/A                  | Implementation: specialist NGOs<br>Monitoring: PMO |
| Income generation | Bholabaj<br>Boyra   | A small number of low earned people will enhance their income with this additional income source. | People income will increase in future by creating more work options.              | Income will be increased for all classes i.e. labor to businessmen.                          | +4                   | Implement a livelihood program for vulnerable groups directly affected by the construction | N/A                 | N/A                  | Implementation: specialist NGOs<br>Monitoring: PMO |

## 10.5 Monitoring Plan

### 10.5.1 Monitoring schedule for Pre-construction Phase

400. In this phase, no implementation monitoring plan is needed for checking EMP implementation works. The below provides an non-exhaustive example how the EMP could be monitored, which needs to be expanded to the site specific conditions.

### 10.5.2 Monitoring schedule for construction Phase

|  |   |  |
|--|---|--|
|  | <b>Bangladesh Water Development Board</b>                       |  |
|  | <b><i>Integrated Flood and Riverbank Erosion Management</i></b> |  |
|  | <b><i>Investment Program</i></b>                                |  |

#### EMP IMPLEMENTATION

Book No. \_\_\_\_\_

Monitoring Report No. \_\_\_\_\_

Date: \_\_\_\_\_

Time: \_\_\_\_\_

Contract: \_\_\_\_\_

Contractor: \_\_\_\_\_

Work Sites (s): \_\_\_\_\_

| A | DAILY EHS CHECKLIST                          | Yes | No | Score<br>Yes=+5<br>No=-5 | A  | DAILY EHS CHECKLIST                             | Yes | No | Score<br>Yes=+5<br>No=-5 |
|---|--|-----|----|--------------------------|----|---|-----|----|--------------------------|
| 1 | Correct Disposal of Construction Solid Waste |     |    |                          | 15 | Dispensary working, Doctor present              |     |    |                          |
| 2 | Correct Disposal of Liquid Waste             |     |    |                          | 16 | Ambulance Functional                            |     |    |                          |
| 3 | Vehicles and dredger With No Smoke or Noise  |     |    |                          | 17 | No Loss to Flora or Fauna (Specially Tree)      |     |    |                          |
| 4 | Vehicles Within Speed Limit                  |     |    |                          | 18 | Re-excavation work                              |     |    |                          |
| 5 | No Pollution from construction site          |     |    |                          | 19 | Placement of dredging spoil                     |     |    |                          |
| 6 | No Oil/Diesel Spills on Land or Water        |     |    |                          | 20 | Top-soil protection system from embankment area |     |    |                          |
| 7 | No Social Issue Created                      |     |    |                          | 21 | Placement of Top Soil                           |     |    |                          |
| 8 | Any Threat Caused                            |     |    |                          | 22 | Plantation                                      |     |    |                          |

| A  | DAILY EHS CHECKLIST                       | Yes | No | Score<br>Yes=+5<br>No=-5 | A  | DAILY EHS CHECKLIST                                 | Yes | No | Score<br>Yes=+5<br>No=-5 |
|----|---|-----|----|--------------------------|----|---|-----|----|--------------------------|
|    | to Riverine area                          |     |    |                          |    | system  |     |    |                          |
| 9  | Water Sprinkled on embankment             |     |    |                          | 23 | Presence of Child Labour                            |     |    |                          |
| 10 | No embankment and bank Soil Erosion       |     |    |                          | 24 | Labour camp location & management in order          |     |    |                          |
| 11 | Safety dress, helmet and field boots used |     |    |                          | 25 | Drinking water and sanitation facilities for labour |     |    |                          |
| 12 | Health precautions taken                  |     |    |                          | 26 | No Burning of wood in camp                          |     |    |                          |
| 13 | Placement of C.C blocks                   |     |    |                          | 27 | Women wage  |     |    |                          |
| 14 | Turfing materials                         |     |    |                          |    |   |     |    |                          |

|   |                       |
|---|-----------------------|
| B. EXPLANATION (of any of above points) | Total Scores = _____% |
|   |                       |
|   |                       |

## C. NON COMPLIANCE:

| Non Compliance #<br>Period Description | Class   |
|--|---|
|  | 1. Minor: Under One Month (Contractor alerted)  |
|  | 2. Moderate: Over One Month but under Two Months (Contractor warned)                              |
|  | 3. Major: About Two Months (Contractor's local bill withheld by RE* till compliance)              |
|  | 4. Critical: Over Three Months (Contractor's overall bill withheld by RE and PM* till compliance) |

## D. CIRCULATION

1) DG, DOE, 2) DG, BWDB, 4) EE, Local BWDB Office

|   |   |
|---|---|
| Field EHS* Monitor of Consultant<br>(Full Name & Signature)<br>*EHS- Environment Health & Safety<br>*RE – Resident Engineer<br>*ES – Environmental Supervisor of Consultants. | Field EHS Expert of Contractor<br>(Full Name & Signature) |
|---|---|

### 10.5.3 Monitoring schedule for Post-construction Phase

401. A monitoring plan has been prepared to be carried out during the post-construction phase of the project. The monitoring plan has been prepared considering a number of environmental indicators related to the project interventions. The methods of carrying out the monitoring plan as well as the desired schedule of monitoring have also been recommended.

#### (a) Water Resources

| Indicator   | Method   | Location  | Frequency                              | Monitoring Cost (Lac Tk per year)* | Responsible Agency |
|---|--|---|--|------------------------------------|--------------------|
| Physical condition( <b>crest level, crest width, and slope</b> ) of the new and rehabilitated embankments | To check whether any breaching or physical failures have occurred in the new and rehabilitated embankments | At places along the embankment, preferably at Kaijuri, Verakhola and Hurasagar offtake.                   | Twice in a year (pre and post monsoon) | 1                                  | BWDB               |
| Technical performance of the drainage sluices   | To examine the functionality of drainage sluices   | At the locations of sluices (in every sub reach)  | Once in a year (post monsoon)          | 0.5                                | BWDB               |
| Physical condition of the river bank protection works   | To check if the CC blocks and Geo-bags are in place  | Locations where bank protection works have been carried out (Benotia, Chauhali, Jafarganj and Harirampur) | Twice in a year (pre and post monsoon) | 1                                  | BWDB               |
| River planform  | Checking the diversion phenomenon, conveyance characteristics and plan forms of a number of rivers         | Karatoya offtake (JRB-1), Ichamaty offtake (PLB-1), Kata khal at Andarmanik (PIB-1)                       | Once in a year (post monsoon)          | 1                                  | BWDB               |
| Sub-total   |  |   |  | 3.50                               |                    |

#### (b) Land and Agriculture Resources

| Indicator  | Method                             | Location                                     | Frequency                | Monitoring Cost (Lac Tk)* | Responsible Agency        |
|------------|------------------------------------|--|--------------------------|---------------------------|---------------------------|
| Crop yield | The Water Management Organizations | All Upazilas within the project area namely- | The appropriate time for | 3.0                       | DAE, BWDB with involvemen |

| Indicator            | Method  | Location  | Frequency  | Monitoring Cost (Lac Tk)* | Responsible Agency                                  |
|----------------------|---|---|--|---------------------------|---|
|                      | (WMOs) should be involved for monitoring the crop area and yield level of the crops. Focus Group Discussion (FGD) should be followed and also individual discussion has to be followed. | Balkuchi kamarkhanda, Shahjadpur, Nagarpur, Daulatpur, Satoria, Ghior, Manikganj sadar, Singair, Sibalaya, Harirampur and Chauhali  | monitoring yield would be harvesting time for each crop season.                |                           | t of beneficiaries (WMOs).                          |
| Crop damage          | The community organizations should be involved for monitoring the damage of the crops.  | All Upazilas within the project area namely- Balkuchi kamarkhanda, Shahjadpur, Nagarpur, Daulatpur, Satoria, Ghior, Manikganj sadar, Singair, Sibalaya, Harirampur and Chauhali | The appropriate time for monitoring damage would be harvest time of each crop. | 3.0                       | BWDB, DAE and Community organizations               |
| Irrigation Expansion | The Water Management Organizations (WMOs) should be involved for monitoring the activity related to the expansion of irrigated area.  | All Upazilas within the project area namely- Balkuchi kamarkhanda, Shahjadpur, Nagarpur, Daulatpur, Satoria, Ghior, Manikganj sadar, Singair, Sibalaya, Harirampur and Chauhali | Three times in dry season (mainly Boro crops).                                 | 3.0                       | DAE, BWDB with involvement of beneficiaries (WMOs). |
| <b>Sub-total</b>     |   |   |  | <b>9.0</b>                |   |

## (c) Fisheries Resources

| Indicator                        | Method                                  | Location  | Frequency  | Monitoring Cost (Lac Tk/Yr)* | Responsible Agency |
|----------------------------------|---|---|--|------------------------------|--------------------|
| Fish habitat status              | Habitat observation                     | Seven locations beside the Baral river bank:<br>6.5 km of the Verakhola towards start of Hurashagar river<br>4km from the starting point of Hurashagar to Korotoa bank<br>10.5 km from Hat Pachil Bazar, Kaizuri to Benotia Hat/Bazar<br>2 km from Benotia Hat/Bazar to the start of Baral Khal, Verakola Hat<br>5 km of the Jamuna Left bank from Chauhali Sadar to Atpara<br>2 km of the Jamuna Left bank from Jaffarganj to Bachamara<br>7 km of the Padma Left Bank at Harirampur, Andharmanik Ghat | Two times per year. (Will continue for 2 years)  | 0.5                          | DoF                |
| Fish migration                   | Catch monitoring, RRA and FGD           | Four locations:<br>The mouth of Baral river to Hurashagar connectivity near sluice gates at Char Andharmanik<br>near the end point of embankment at the mouth of Baral vs karotoa connectivity<br>Baral river to Karotoa and Baral to Hurashagar<br>Major carp migration route at Andharmanik Ghat of Bayra Union for spawning  | Two month e.g. May and June, per year. (Will continue for 2 years after completion of project activities). | 1.0                          | DoF                |
| Fish species and fish production | Catch monitoring and Fish Market Survey | Entire study area   | Once per month in each location for 2 year after completion of   | 1.0                          | DoF                |

| Indicator         | Method  | Location          | Frequency                                 | Monitoring Cost (Lac Tk/Yr)* | Responsible Agency  |
|-------------------|---|-------------------|---|------------------------------|---|
|                   |   |                   | proposed activities.                      |                              |   |
| Pond fish culture | Interviewing fish farmers and Fish Market Survey  | Selected ponds    | One time per month (Will continue 2 year) | 0.5                          | DoF   |
| Public awareness  | Observation of wetland based national and international days, e.g. Fish week. Environment day, wetland day etc. | In the study area | Selected schedule (Will continue 2 year)  | 2.0                          | DoF, Community based Fisheries Management Organizations (CBFMOs) and Community based Organizations (CBOs) and other nature clubs. |
| <b>Sub-total</b>  |   |                   |   | <b>5.00</b>                  |   |

**(d) Ecological resources**

| Indicator                         | Method                   | Location  | Frequency   | Cost (Lac Tk.) | Responsible Agency                    |
|-----------------------------------|--------------------------|---|---|----------------|---------------------------------------|
| Survival rate of planted saplings | Observation and counting | Locations are below: <ul style="list-style-type: none"> <li>• 6.5 km of the Verakhola towards start of Hurashagar river</li> <li>• 4km from the starting point of Hurashagar to Korotoa river bank</li> <li>• 10.5 km from Hat Pachil Bazar, Kaizuri to Benotia Hat/Bazar</li> <li>• 2 km from Benotia Hat/Bazar to the start of Baral Khal, Verakola Hat</li> <li>• 5 km of the Jamuna Left bank from Chauhali Sadar to Atpara</li> <li>• 2 km of the Jamuna Left bank from Jaffarganj to Bachamara</li> </ul> | 1 year after plantation (Every day by the recruited guard). | Mention above  | BWDB in coordination with local group |



| Indicator | Method | Location  | Frequency | Cost (Lac Tk.) | Responsible Agency |
|-----------|--------|---|-----------|----------------|--------------------|
|           |        | <ul style="list-style-type: none"> <li>7 km of the Padma Left Bank at Harirampur, Andharmanik Ghat</li> </ul> |           |                |                    |

## (e) Socio-economic

| Indicator   | Method | Location   | Frequency | Monitoring Cost (Lac Tk)* | Responsible Agency             |
|---|--------|--|-----------|---------------------------|--------------------------------|
| Roadway communication   | RRA    | <b>JRB-1</b><br>Hat Panchil, Benotia<br>Verakhola,Dambarla   | Once      | 3                         | BWDB/consultant and contractor |
| Income generation   |        | <b>JLB-2</b>   |           |                           |                                |
| Protection of municipal area including markets and homesteads |        | Char janjira, Khasdalai<br>Khash kaulia,Pailadhusar<br>Raghunathpur, Paila<br><b>PLB-1</b><br>Jaghannathpur, Boxor<br>Andharmanik, Bholabaj<br>Boyra |           |                           |                                |
| Sub-total   |        |  |           | 3.0                       |                                |

## 11. Conclusion and Recommendations

### 11.1 Conclusion

402. The program has a number of inbuilt mechanisms to reduce environmental impacts. Many mitigation measures have been aggressively mainstreamed into program planning and engineering designs. The flexibility of a phased MFF approach supports minimization and mitigation of potential negative impacts in a gradual manner. Works will start in Tranche-1 with protection of critically eroding riverbanks and the reconstruction of the destroyed Brahmaputra Right Embankment, while conducting extensive studies on future impacts of river stabilization and associated embankment works, including piloting new measures. During Tranche-2 first measures for larger scale river stabilization are planned, designed based on the Tranche-1 study outcomes and supported by environmental monitoring and mitigation measures. This approach will be carried forward and adapted in Tranche-3.

403. With respect to flood mitigation and river stabilization, the program considers the following detailed approach:

- (i) The program as a whole aims to reduce the flood risk at three priority sub-projects (JRB-1, JLB-2, and PLB-1) by providing new/rehabilitated embankments in all tranches. The program intends to mitigate negative impacts at the planning and design level, and through additional compensation measures. Planning and design account for: (a) leaving key distributaries open to limited flood flows to support the continued deposition of fertile sediments as well as flood season navigation, (b) designing the offtakes of the distributaries as part of the river stabilization work, in order to improve dry season flows, (c) providing embankments with sluice gates specifically for local drainage<sup>39</sup>, and (d) designing embankments in accordance to international practice to reduce the risk of failure. Mitigation measures address: (e) loss in floodplain biodiversity, and (f) open water fisheries. At community-level, flood risk management training will be provided to the flood affected population in order to raise the awareness to the residual risk after strengthening the existing flood embankment lines.
- (ii) To protect the flood embankments, river banks will be progressively stabilized through riverbank protection, starting in Tranche-1 at critically eroding reaches on an emergency basis. Over time, this approach may lead to general river stabilization. To avoid transforming the geomorphology of the Padma/Jamuna in an unprecedented manner, for example if a single-channel solution is implemented, as studied in the Capital Dredging and Sustainable River Management Project, (a) a multi-disciplinary river stabilization study<sup>40</sup> covering the whole Brahmaputra system from the Indian border will be conducted, supported by (b) piloting stabilization measures, focussing on bio-engineering techniques or “building with nature”; (c) siting of physical works will be planned over the three tranches using an innovative dynamic methodology that responds to evolving river behavior. Mitigation of potentially negative impacts of the

---

<sup>39</sup>As it is not possible to locate sluice gates for later tranches, cost have been reflected in the embankment kilometer cost.

<sup>40</sup>encompassing potential future river morphologies including the response of the system to man-made impacts on global (e.g. climate change), basin (e.g. sediment wave) and local (e.g. stabilization) scale, plus socio-economic and environmental impacts of potential stabilization scenarios on floodplain and char habitats and biodiversity.

planned river stabilization will be based on (d) a river sanctuary study covering river- and floodplain land and conducted in tranche-1 potentially followed by implementation of a sanctuary in a suitable river reach.

## **11.2 Recommendations**

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

- Aquaculture expansion (from Tranche-1).
- Wetland biodiversity mitigation and rehabilitation (from Tranche-1).
- Sanctuary (studied under Tranche-1, implemented from Tranche-2).

405. The anticipated environmental impacts of Tranch 1 are expected to be acceptable under the circumstances if the mitigation measures set forth in the EMP under Chapter 9 are implemented.

406. Tranch 1 can proceed without further environmental study. This EIA is the Project environmental assessment report.

## Annex 1: List of Tables

Table 1: Species Lists – Terrestrial Flora

| Terrestrial Flora               |                     |            |                          |          |
|---------------------------------|---------------------|------------|--------------------------|----------|
| Scientific Name                 | Local name          | Habit      | Importance               | Status   |
| <i>Acacia nilotica</i>          | Babla               | Tree       | Ornamental               | Common   |
| <i>Aegle marmelos</i>           | Bel                 | Tree       | Medicinal, Fruits        | Common   |
| <i>Adhatoda zeylanica</i>       | Bashak              | Shrub      | Medicinal                | Rare     |
| <i>Aeschynomene aspera</i>      | Shola               | Shrub      | Fuel                     | Rare     |
| <i>Albizia odoratissima</i>     | Shrish              | Tree       | Timber                   | Common   |
| <i>Albizia richardiana</i>      | Gagon serish        | Tree       | Firewood, timber, Avenue | Common   |
| <i>Abroma augusta</i>           | Ulatkambal          | Shrub      | Medicinal                | Rare     |
| <i>Acacia moniliformis</i>      | Akashmoni           | Tree       | Note known               | Common   |
| <i>Acalypha indica</i>          | Muktajhuri          | Shrub      | Medicinal                | Common   |
| <i>Achyranthes aspera</i>       | Apang               | Herb       | Medicinal                | Common   |
| <i>Adenanthera</i>              | Rakton              | Tree       | Firewood                 | Rare     |
| <i>Alostonia macrophylla</i>    | Chatim              | Tree       | Ornamental               | Common   |
| <i>Alstonia scholaris</i>       | Shatim/Shatian      | Tree       | Timber                   | Rare     |
| <i>Amaarthus spinosa</i>        | Katanatea           | Herb       | Medicinal                | Common   |
| <i>Anthocephalus chinensis</i>  | Kadam               | Tree       | Timber and fuelwood      | Common   |
| <i>Aphanamixis polystachya</i>  | Pitraj              | Tree       | Timber                   | Rare     |
| <i>Areca catechu</i>            | Supari              | Tree       | Fruit and Timber         | VC       |
| <i>Artocarpus heterophyllus</i> | Kanthal             | Tree       | Timber, Fruits           | Common   |
| <i>Artocarpus lakoocha</i>      | Deoa                | Tree       | Fruits                   | Rare     |
| <i>Averrhoa carambola</i>       | Kamranga            | Tree       | Fruits                   | Common   |
| <i>Azadirachta indica</i>       | Nim                 | Tree       | Timber and medicine      | Common   |
| <i>Bambusa sp</i>               | Bash                | Woody Herb | Furniture                | Common   |
| <i>Barringtonia acutangula</i>  | Hijal               | Shrub      | Fuelwood                 | Common   |
| <i>Bauhinia sp.</i>             | Kanson              | Tree       | Ornamental               | Rare     |
| <i>Bombax ceiba</i>             | Shimul              | Tree       | Cotton and Fuelwood      | Common   |
| <i>Borassus flabellifera</i>    | Tal                 | Tree       | Timber                   | Common   |
| <i>Calamus tenuis</i>           | Bet                 | Shrub      | Thatching                | Common   |
| <i>Calophyllum inophyllum</i>   | Sultan Chapa/Punnag | Tree       | Ornamental               | Rare     |
| <i>Calotropis gigantea</i>      | Akand               | Shrub      | Medicinal                | Common   |
| <i>Calotropis procera</i>       | Akand               | Shrub      | Medicinal                | Common   |
| <i>Carica papaya</i>            | Papay               | Shrub      | Fruit                    | Common   |
| <i>Carissa carandas</i>         | Karamcha            | Shrub      | Fruit                    | Common   |
| <i>Cassia fistula</i>           | Sonalu              | Tree       | Ornamental               | Common   |
| <i>Cassia alata</i>             | Dardmardon          | Shrub      | Medicinal                | Common   |
| <i>Cassia occidentalis</i>      | Barahalkasunda      | Shrub      | Fuelwood                 | Common   |
| <i>Centella asiatica</i>        | Thankuni            | Herb       | Medicinal and Vegetables | Common   |
| <i>Cestrum nocturnum</i>        | Hasnahena           | Shrub      | Ornamental               | Rare     |
| <i>Citrus grandis</i>           | Jambura             | Tree       | Fruits                   | Common   |
| <i>Clerodendrum viscosum</i>    | Bhat                | Shrub      | Medicinal                | Common   |
| <i>Cocos nucifera</i>           | Narikel             | Tree       | Fruit and Fuelwood       | V.Common |
| <i>Crataeva nurvala</i>         | Baroon              | Tree       | Fuel wood                | Common   |
| <i>Cuscuta australis</i>        | Swarnalata          | Herb       | Medicinal                | Common   |
| <i>Cynodon dactylone</i>        | Durba Gash          | Herb       | Medicinal                | Common   |

| Terrestrial Flora                             |                |         |                      |           |
|---|----------------|---------|----------------------|-----------|
| Scientific Name                               | Local name     | Habit   | Importance           | Status    |
| <i>Dalbergia sissoo</i>                       | Sisso          | Tree    | Timber               | Common    |
| <i>Datura metel</i>                           | Dhutura        | Shrub   | Medicinal            | Rare      |
| <i>Delonix regia</i>                          | Krichnochura   | Tree    | Ornamental           | Common    |
| <i>Dillenia indica</i>                        | Chalta         | Tree    | Fruit                | Common    |
| <i>Diospyros discolor</i>                     | Bilatigab      | Tree    | Fruit                | Common    |
| <i>Diospyros perigrina</i>                    | Deshigab       | Tree    | Fruit and Timber     | Rare      |
| <i>E. ovalifolia</i>                          | Tali Mander    | Tree    | Firewood             | Common    |
| <i>Eichornia crassipes</i>                    | Kachuripana    | Herb    | Fertilizer           | Common    |
| <i>Enhydra fluctuans</i>                      | Halencha       | Herb    | Vegetable            | Common    |
| <i>Erythrina ovalifolia</i>                   | Talimandar     | Tree    | Fuelwood             | Common    |
| <i>Erythrina variegata</i>                    | Mander         | Tree    | Firewood, Ornamental | Common    |
| <i>Excoecaria agallocha</i>                   | Gheoa          | Tree    | Fuel wood            | Common    |
| <i>Ficus hispida</i>                          | Dumur          | Tree    | Fuel wood            | Common    |
| <i>Ficus benghalensis</i>                     | Bot            | Tree    | Fuel wood            | Common    |
| <i>Ficus hispida</i>                          | Dumur          | Shrub   | Fruit and Fuelwood   | VC        |
| <i>Ficus religiosa</i>                        | Assawath       | Tree    | Fuel wood            | Common    |
| <i>Gardenia jasminoides</i>                   | Ghandhoraj     | Shrub   | Flower               | Common    |
| <i>Helectropium indicum</i>                   | Hatisuri       | Herb    | Medicinal            | Common    |
| <i>Hoya parasitica</i>                        | Parghaca       | Climber | Medicinal            | Common    |
| <i>Ipomea fistulosa</i>                       | Dhol Kalmi     | Shrub   | Fuel                 | Common    |
| <i>Leucaena leucocephala</i>                  | Ipil ipil      | Tree    | Timber               | Common    |
| <i>Litchi chinensis</i>                       | Lichu          | Tree    | Fruit                | Common    |
| <i>Musa sapientum</i>                         | Kacha kala     | Herb    | Vegetable            | Common    |
| <i>Mangifera indica</i>                       | Aum            | Tree    | Fruit and Timber     | Common    |
| <i>Marsilea quadrifolia</i>                   | Susnishak      | Herb    | Medicinal            | Common    |
| <i>Mimosa pudica</i>                          | Lajjaboti      | Shrub   | Medicinal            | Common    |
| <i>Moringa oleifera</i>                       | Sajna          | Tree    | Vegetable            | Common    |
| <i>Muntingia calabura</i>                     | China chari    | Tree    | Ornamental           | Very Rare |
| <i>Musa paradisiaca</i> var. <i>sapientum</i> | Kala           | Shrub   | Fruit                | Common    |
| <i>Musa paradisiaca</i> var. <i>sapientum</i> | Kala           | Shrub   | Fruit                | Common    |
| <i>Nerium odorum</i>                          | Karobi         | Shrub   | Medicinal            | Common    |
| <i>Nicotiana glauca</i>                       | Bantamak       | Herb    | Wild                 | Common    |
| <i>Nyctanthes arbor-tristis</i>               | Safali         | Herb    | Ornamental           | Common    |
| <i>Nymphaea nouchli</i>                       | Sapla          | Herb    | Medicinal, Vegetable | Common    |
| <i>Ocimum americanum</i>                      | Tulshi         | Herb    | Medicine             | Common    |
| <i>Oryza sativa</i>                           | Dhan           | Herb    | Food                 | Common    |
| <i>Phoenix paludosa</i>                       | Hental         | Tree    | Wildlife             | Common    |
| <i>Phoenix sylvestris</i>                     | Khejur         | Tree    | Fruit and Fuel wood  | Common    |
| <i>Pistia stratiotes</i>                      | Topapana       | Herb    | -                    | Common    |
| <i>Pithecolobium dulce</i>                    | Dakshnia Babul | Tree    | Ornamental, Avunue   | Common    |
| <i>Polyalthia longifolia</i>                  | Debdaru        | Tree    | Ornamental           | Common    |
| <i>Psidium guajava</i>                        | Peyara         | Shrub   | Fruit                | Common    |
| <i>Raulwolfia serpentina</i>                  | Sarpagandha    | Shrub   | Medicinal            | Rare      |
| <i>Ricinus communis</i>                       | Reri           | Shrub   | Oil                  | Common    |
| <i>Sesbania grandiflora</i>                   | Bakphul        | Shrub   | Medicinal            | Rare      |
| <i>Sesbania rostrata</i>                      | Dhaincha       | Herb    | Fuel / Fertilizer    | Common    |
| <i>Spondias dulcis</i>                        | Amra           | Tree    | Fruit                | Common    |
| <i>Streblus asper</i>                         | Sheora         | Shrub   | Fuel wood            | Common    |

| Terrestrial Flora           |              |       |                      |        |
|-----------------------------|--------------|-------|----------------------|--------|
| Scientific Name             | Local name   | Habit | Importance           | Status |
| <i>Swietenia mahagoni</i>   | Mahogoni     | Tree  | Timber, Medicinal    | VC     |
| <i>Tamarindus indica</i>    | Tetul        | Tree  | Fruit                | Common |
| <i>Tectona grandis</i>      | Segun        | Tree  | Timber               | Common |
| <i>Terminalia arjuna</i>    | Arjun        | Tree  | Timber and Medicinal | Common |
| <i>Terminalia bellirica</i> | Bhorae       | Tree  | Medicinal            | Rare   |
| <i>Terminalia catappa</i>   | Katbadam     | Tree  | Fruit                | Common |
| <i>Trewia nudiflora</i>     | Pitali/Latim | Tree  | Timber and fuel wood | Common |
| <i>Typha angustata</i>      | Hogla        | Herb  | Domestic use         | Common |
| <i>Zizyphus mauritiana</i>  | Baroi        | Tree  | Fruit                | Common |

Table2: Species Lists - Cropfield Vegetation

| Cropfield Vegetation             |              |       |                 |        |
|----------------------------------|--------------|-------|-----------------|--------|
| Scientific Name                  | Local name   | Habit | Importance      | Status |
| <i>Acalypha indica</i>           | Muktajhuri   | Herb  | Medicinal       | C      |
| <i>Achyranthes aspera</i>        | Apang        | Herb  | Medicinal       | C      |
| <i>Alternanthera sessilis</i>    | Sachishak    | Herb  | Vegetable       | VC     |
| <i>Amaranthus spinosus</i>       | Kata note    | Herb  | Vegetable       | VC     |
| <i>Calotropis gigantea</i>       | Akand        | Shrub | Medicinal       | C      |
| <i>Calotropis procera</i>        | Akand        | Shrub | Medicinal       | C      |
| <i>Carissa carandas</i>          | Karamcha     | Shrub | Fruits          | R      |
| <i>Cotula hemispherica</i>       | Kancha ghash | Herb  | Domestic food   | C      |
| <i>Crotolaria retusa</i>         | Ban-san      | Herb  | Medicinal       | VC     |
| <i>Cuscuta australis</i>         | Swarnalata   | Herb  | Medicinal       | C      |
| <i>Cynodon dactylon</i>          | Durba        | Herb  | Medicinal       | VC     |
| <i>Dentella repens</i>           | Hachuti      | Herb  | Medicinal       | C      |
| <i>Marsilea quadrifolia</i>      | Susnishak    | Herb  | Vegetable       | C      |
| <i>Nicotiana plumbaginifolia</i> | Bantamak     | Herb  | Wild            | C      |
| <i>Nyctanthes arbortristis</i>   | Sefali       | Herb  | Ornamental      | C      |
| <i>Rhynchospora rufescens</i>    | Shimbhatraji | Herb  | Medicinal       | VC     |
| <i>Rorippa indica</i>            | Bansarisha   | Herb  | Medicinal       | C      |
| <i>Sesbania rostrata</i>         | Dhaincha     | Herb  | Fuel/Fertilizer | VC     |

C – Common, VC – Very Common, R - Rare

Table 3: Species Lists - Wetland Vegetation

| Wetland Vegetation                 |             |       |               |        |
|------------------------------------|-------------|-------|---------------|--------|
| Scientific Name                    | Local name  | Habit | Importance    | Status |
| <i>Alternanthera philoxiroides</i> | Helencha    | Herb  | Medicinal     | VC     |
| <i>Aponogeton natans</i>           | Ghentu      | Herb  | Medicinal     | C      |
| <i>Azolla pinnata</i>              | Kutipana    | Herb  | Fish food     | C      |
| <i>Ceratophyllum desmersum</i>     | Jhangi      | Herb  | -             | C      |
| <i>Colocasia esculenta</i>         | Kachu       | Herb  | Medicinal     | C      |
| <i>Cyperus sp.</i>                 | Mutha       | Herb  | Domestic food | VC     |
| <i>Cheratopteris sp</i>            | Fern        | Herb  | -             | C      |
| <i>Eichhornia crassipes</i>        | Kochuripana | Herb  | Fertilizer    | VC     |
| <i>Enhydra fluctuans</i>           | Helencha    | Herb  | Vegetable     | VC     |
| <i>Ipomoea aquatica</i>            | Kalmi sak   | Herb  | Vegetable     | VC     |
| <i>Lemna perpusilla</i>            | Khudipana   | Herb  | -             | C      |
| <i>Limnophila sessiliflora</i>     | Bijatighas  | Herb  | Domestic food | C      |

| Wetland Vegetation              |            |       |               |        |
|---------------------------------|------------|-------|---------------|--------|
| Scientific Name                 | Local name | Habit | Importance    | Status |
| <i>Ludwigia abscondens</i>      | Keshordam  | Herb  | Medicinal     | C      |
| <i>Ludwigia hyssopifolia</i>    | Keshordam  | Herb  | Medicinal     | VC     |
| <i>Mersilea quadrifoliata</i>   | Susnisak   | Herb  | Vegetable     | VC     |
| <i>Nachamendra alternifolia</i> | Kaisha     | Herb  | Domestic food | C      |
| <i>Nymphaea nouchali</i>        | Shapla     | Herb  | Vegetable     | VC     |
| <i>Nymphaea stellata</i>        | Nilshapla  | Herb  | Vegetable     | R      |
| <i>Phragmites karka</i>         | Nol Khagra | Herb  | Fuel          | VC     |
| <i>Pistia stratiotes</i>        | Topapana   | Herb  | -             | VC     |
| <i>Polygonum barbatum</i>       | Bishkatali | Herb  | Medicinal     | C      |
| <i>Salvina cucullata</i>        | Kuripana   | Herb  | -             | C      |
| <i>Scirpus juncooides</i>       | Chasra     | Herb  | Fuel          | C      |
| <i>Spirodela polyrhiza</i>      | Khudipana  | Herb  | -             | C      |
| <i>Trapa natans</i>             | Singra     | Herb  | Fruit         | R      |
| <i>Vetiveria zizanioides</i>    | Binna      | Herb  | Domestic use  | C      |
| <i>Wolffia microscopica</i>     | Guripana   | Herb  | -             | C      |

C – Common, VC – Very Common, R - Rare

**Table 4: Species Lists - Birds**

| Birds                          |                           |                      |              |
|--------------------------------|---------------------------|----------------------|--------------|
| Scientific Name                | English Name              | Local Name           | Local Status |
| <i>Tyto alba</i>               | Barn Owl                  | Lokkhi Pecha         | UR           |
| <i>Eudynamis scolopaceus</i>   | Asian Koel                | Ashio Kalakokil      | CR           |
| <i>Sturnus ginginianus</i>     | Bank Myna                 | Gaang Shalik         | UR           |
| <i>Dicrurus macrocercus</i>    | Black Drongo              | Kala Fingey          | CR           |
| <i>Milvus migrans</i>          | Black Kite                | Bhubon Chil          | CR           |
| <i>Metopidius indicus</i>      | Bronze-winged Jacana      | Dol Pipi             | UR           |
| <i>Ketupa zeylonensis</i>      | Brown Fish Owl            | Khoira Mechopecha    | UR           |
| <i>Ixobrychus cinnamomeus</i>  | Cinnamon Bittern          | Khoira Bogla         | UR           |
| <i>Artamus fuscus</i>          | Ashy Wood swallow         | Metey Bonbabil       | CR           |
| <i>Anastomus oscitans</i>      | Asian Open bill           | Ashio Shamkhol       | CR           |
| <i>Terpsiphone paradisi</i>    | Asian Paradise-flycatcher | Ashio Shabulbuli     | UR           |
| <i>Anser indicus</i>           | Bar-headed Goose          | Dagi Rajhash         | UWV          |
| <i>Ploceus philippinus</i>     | Baya Weaver               | Deshi babui          | CR           |
| <i>Ciconia nigra</i>           | Black Stork               | Kala Manikjor        | WV           |
| <i>Sterna acuticauda</i>       | Black-bellied Tern        | Kalapet Panchil      | UR           |
| <i>Nycticorax nycticorax</i>   | Black-crowned Night Heron | Kalamatha Nishibok   | CR           |
| <i>Lonchura malacca</i>        | Black-headed Munia        | Kalamatha Munia      | UR           |
| <i>Oriolus xanthornus</i>      | Black-hooded Oriole       | Kalamatha Benebou    | CR           |
| <i>Haliastur Indus</i>         | Brahminy Kite             | Shonkho Chil         | CR           |
| <i>Lanius cristatus</i>        | Brown Shrike              | Khoira Latora        | CWV          |
| <i>Larus brunnicephalus</i>    | Brown-headed Gull         | Khoiramatha Gangchil | CWV          |
| <i>Bubulcus ibis</i>           | Cattle Egret              | Go Boga              | CR           |
| <i>Motacilla citreola</i>      | Citrine Wagtail           | Sitrin Khonjon       | CWV          |
| <i>Acrocephalus stentoreus</i> | Clamorous Reed Warbler    | Bachal Nolfutki      | CWV          |

| Birds                            |                             |                      |              |
|----------------------------------|-----------------------------|----------------------|--------------|
| Scientific Name                  | English Name                | Local Name           | Local Status |
| <i>Sarkidiornis melanotos</i>    | Comb Duck                   | Nakta Hash           | RWV          |
| <i>Larus ridibundus</i>          | Common Black-headed Gull    | Kalamatha Gangchil   | CWV          |
| <i>Dinopium javanense</i>        | Common Golden back          | Pati Kaththokra      | CR           |
| <i>Numenius nebularia</i>        | Common Greenshank           | Pati Shobujpa        | CWV          |
| <i>Hierococcyx varius</i>        | Common Hawk-Cuckoo          | Pati Chokhgelo       | CR           |
| <i>Aegithina tiphia</i>          | Common lora                 | Pati Fatikjal        | CR           |
| <i>Alcedo atthis</i>             | Common Kingfisher           | Pati Machranga       | CR           |
| <i>LC Acridotheres tristis</i>   | Common Myna                 | Bhat Shalik          | CR           |
| <i>Columba livia</i>             | Common Pigeon               | Gola Paira           | CR           |
| <i>Atthya ferina</i>             | Common Pochard              | Pati Bhutihash       | CWV          |
| <i>Tringa tetanus</i>            | Common Redshank             | Pati Lalpa           | CWV          |
| <i>Actitis hypoleucos</i>        | Common Sandpiper            | Pati Batan           | CWV          |
| <i>Tadorna tadorna</i>           | Common Shelduck             | Pati Chokachoki      | CWV          |
| <i>Gallinago gallinago</i>       | Common Snipe                | Pati Chega           | CWV          |
| <i>Orthotomus sutorius</i>       | Common Tailorbird           | Pati Tuntuni         | CR           |
| <i>Megalaima haemacephala</i>    | Coppersmith Barbet          | Shekra Boshonto      | CR           |
| <i>Nettaspas coromandelianus</i> | Cotton Pygmy Goose          | Dhola Balihash       | UR           |
| <i>Phylloscopus fuscatus</i>     | Dusky Warbler               | Kalchey Futki        | CWV          |
| <i>Upupa epops</i>               | Eurasian Hoopoe             | Pati Hoodhood        | UR           |
| <i>Zoothera torquatus</i>        | Eurasian Stone Chat         | Pati Shilafidda      | CWV          |
| <i>Anas crecca</i>               | Eurasian Teal               | Pati Tilihash        | CWV          |
| <i>Dendrocygna bicolor</i>       | Fulvous Whistling Duck      | Raj Shorali          | CWV          |
| <i>Anas querquedula</i>          | Garganey                    | Giria Hash           | CWV          |
| <i>Prinia gracilis</i>           | Graceful Prinia             | Shundori Prinia      | RR (DD)      |
| <i>Larus brunnicephalus</i>      | Great Black-headed Gull     | Palasi Gangchil      | CWV          |
| <i>Phalacrocorax carbo</i>       | Great Cormorant             | Boro Pankouri        | CWV          |
| <i>Casmerodius albus</i>         | Great Egret                 | Boro Boga            | CR           |
| <i>Parus major</i>               | Great Tit                   | Boro Tit             | CR           |
| <i>Centropus sinensis</i>        | Greater Coucal              | Boro Kubo            | CR           |
| <i>Chrysocolaptes lucidus</i>    | Greater Golden back         | Boro Kaththokra      | CR           |
| <i>Charadrius leschenaultii</i>  | Greater Sand Plover         | Boro Dhuljiria       | CWV          |
| <i>Merops orientalis</i>         | Green Bee-eater             | Shobuj Shuichora     | CR           |
| <i>Numenius ochropus</i>         | Green Sandpiper             | Shobuj Batan         | UWV          |
| <i>Phaenocophaeus tristis</i>    | Green-billed Malkoha        | Shobujthot Malkoa    | CR           |
| <i>Ardea cinerea</i>             | Grey Heron                  | Dhupni Bok           | CR           |
| <i>Charadrius squatarola</i>     | Grey Plover                 | Metey Jiria          | CWV          |
| <i>Motacilla cinerea</i>         | Grey Wagtail                | Metey Khonjon        | UWV          |
| <i>Dendrocopos canicapillus</i>  | Grey-cappedPygmy Woodpecker | Metetooi Batkurali   | UR           |
| <i>Ichthyophaga ichthyaetus</i>  | Grey-headed Fish Eagle      | Metematha Kura-eegol | UR           |
| <i>Gelochelidon nilotica</i>     | Gull-billed Tern            | Kalathot Panchil     | CR           |
| <i>Corvus splendens</i>          | House Crow                  | Pati Kak             | CR           |
| <i>Passer domesticus</i>         | House Sparrow               | Pati Chorui          | CR           |
| <i>Phalacrocorax fuscicollis</i> | Indian Cormorant            | Deshi Pankouri       | V            |
| <i>Cuculus micropterus</i>       | Indian Cuckoo               | Bokotakou Kokil      | CR           |
| <i>Ardeola grayii</i>            | Indian Pond Heron           | Deshi Kanibok        | CR           |



| Birds                             |                          |                      |              |
|-----------------------------------|--------------------------|----------------------|--------------|
| Scientific Name                   | English Name             | Local Name           | Local Status |
| <i>Coracias benghalensis</i>      | Indian Roller            | Bangla Nilkanto      | CR           |
| <i>Lonchura malabarica</i>        | Indian Silver bill       | Deshi Chandithot     | UR           |
| <i>Anas poecilorhyncha</i>        | Indian Spot-billed Duck  | Metey Hash           | UR           |
| <i>Turdoides striatus</i>         | Jungle Babbler           | Bon Satarey          | CR           |
| <i>Acridotheres fuscus</i>        | Jungle Myna              | Jhuti Shalik         | CR           |
| <i>Corvus macrorhynchos</i>       | Large-billed Crow        | Dar Kak              | CR           |
| <i>Caprimulgus macrurus</i>       | Large-tailed Nightjar    | Lenja Ratchora       | CR           |
| <i>Centropus bengalensis</i>      | Lesser Coucal            | Bangla Kubo          | CR           |
| <i>Dinopium benghalense</i>       | Lesser Golden back       | Bangla Kaththokra    | CR           |
| <i>Charadrius mongolus</i>        | Lesser Sand Plover       | Soto Dhuljiria       | CWV          |
| <i>Dendrocygna javanica</i>       | Lesser Whistling Duck    | Pati Shorali         | CR           |
| <i>Megalaima lineata</i>          | Lineated Barbet          | Dagi Boshonto        | CR           |
| <i>Phalacrocorax niger</i>        | Little Cormorant         | Choto Pankouri       | CR           |
| <i>Egretta garzetta</i>           | Little Egret             | Choto Boga           | CR           |
| <i>Charadrius dubius</i>          | Little Ringed Plover     | Choto Nothjiria      | CR & CWV     |
| <i>Arachnothera longirostra</i>   | Little Spider hunter     | Choto Makormar       | CR           |
| <i>Calidris minuta</i>            | Little Stint             | Choto Chapakhi       | CWV          |
| <i>Buteo rufinus</i>              | Long -Legged Buzzard     | Lombapa Tishabaj     | RWV          |
| <i>Lanius schach</i>              | Long-tailed Shrike       | Lenja Latora         | CR           |
| <i>Tringa stagnatilis</i>         | Marsh Sandpiper          | Bil Batan            | UWV          |
| <i>Anas acuta</i>                 | Northern Pintail         | Utturey Lenjahash    | CWV          |
| <i>Anthus hodgsoni</i>            | Olive-backed Pipit       | Jolpaipith Tulika    | CWV          |
| <i>Copsychus saularis</i>         | Oriental Magpie-Robin    | Udoi Doel            | CR           |
| <i>Alauda gulgula</i>             | Oriental Skylark         | Udoi Ovrobhorot      | CR           |
| <i>Zosterops palpebrosus</i>      | Oriental White-eye       | Udoi Dholachokh      | CR           |
| <i>Pluvialis fulva</i>            | Pacific Golden Plover    | Proshanto Shonajiria | CWV          |
| <i>Anthus rufulus</i>             | Paddy field Pipit        | Dhani Tulika         | CR           |
| <i>Alauda erythrorhynchos</i>     | Pale-billed Flowerpecker | Metethot Fuljhuri    | CR           |
| <i>Ceryle rudis</i>               | Pied Kingfisher          | Pakra Machranga      | CR           |
| <i>Sturnus contra</i>             | Pied Myna                | Ashio Pakrashalik    | CR           |
| <i>Gallinago stenura</i>          | Pin-tailed Snipe         | Lenja Chega          | CWV          |
| <i>Parus inornata</i>             | Plain Prinia             | Nirol Prina          | CR           |
| <i>Leptocoma zeylonica</i>        | Purple-rumped Sunbird    | Begunikomor Moutushi | CR           |
| <i>Streptopelia tranquebarica</i> | Red Turtle Dove          | Lal Konthighughu     | CR           |
| <i>Pycnonotus cafer</i>           | Red-vented Bulbul        | Bangla Bulbul        | CR           |
| <i>Vanellus indicus</i>           | Red-wattled Lapwing      | Hot Titi             | UR           |
| <i>Anthus richardi</i>            | Richard's Pipit          | Richarder Tulika     | CWV          |
| <i>Vanellus duvaucelii</i>        | River Lapwing            | Nodi Titi            | UR           |
| <i>Sterna aurantia</i>            | River Tern               | Nodia Panchil        | UWV          |
| <i>Psittacula krameri</i>         | Rose-ringed Parakeet     | Modna Tia            | CR           |
| <i>Anthus roseatus</i>            | Rosy Pipit               | Golapi Tulika        | CWV          |
| <i>Tadorna ferruginea</i>         | Ruddy Shelduck           | Khoira Chokachoki    | CWV          |
| <i>Dendrocitta vagabunda</i>      | Rufous Treepie           | Khoira Harichacha    | CR           |
| <i>Celeus brachyurus</i>          | Rufous Woodpecker        | Khoira Khathkurali   | CR           |
| <i>Lonchura punctulata</i>        | Scaly-breasted Munia     | Butibook Munia       | CR           |
| <i>Asio flammeus</i>              | Short-eared-Owl          | Chotokan Pecha       | RWV          |

| Birds                            |                            |                        |              |
|----------------------------------|----------------------------|------------------------|--------------|
| Scientific Name                  | English Name               | Local Name             | Local Status |
| <i>Pericrocotus cinnamomeus</i>  | Small Minivet              | Choto Saheli           | CR           |
|                                  | Small Pratincole           | Soto Babubatan         |              |
| <i>Streptopelia chinensis</i>    | Spotted Dove               | Tila Ghughu            | CR           |
| <i>Athene brama</i>              | Spotted Owlet              | Khuruley Kutipecha     | CR           |
| <i>Pelargopsis capensis</i>      | Stork-billed Kingfisher    |                        | UR           |
| <i>Ploceus manyar</i>            | Streak Weaver              | Dagi Babui             | RR(DD)       |
| <i>Picus xanthopygaeus</i>       | Streak-throated Woodpecker | Dagigola Kathkurali    | UR           |
| <i>Turdoides earlei</i>          | Striated Babbler           | Dagi Satarey           | UR           |
| <i>Megalurus palustris</i>       | Striated Grassbird         | Dagi Ghashpakhi        | CR           |
| <i>Butorides striata</i>         | Striated Heron             | Khude Bok              | CR           |
| <i>Gallicrex cinerea</i>         | Water cock                 | Deshi Kora             | UR           |
| <i>Motacilla flava</i>           | Western Yellow Wagtail     | Holdey Khonjon         | CWV          |
| <i>Chlidonias hybrida</i>        | Whiskered Tern             | Julphi Panchil         | CR/WV        |
| <i>Motacilla alba</i>            | White Wagtail              | Dhola Khonjon          | CWV          |
| <i>Amaurornis phoenicurus</i>    | White-breasted Water hen   | Dholabook Dahuk        | UR           |
| <i>Motacilla madaraspatensis</i> | White-browed Wagtail       | Dholavru Khonjon       | UR           |
| <i>Rhipidura albicollis</i>      | White-throated Fantail     | Dholagola Chatighurani | CR           |
| <i>Halcyon smyrnensis</i>        | White-throated Kingfisher  | Dholagola Machranga    | CR           |
| <i>Numenius glareola</i>         | Wood Sandpiper             | Bon Batan              | CWV          |
| <i>Egretta intermedia</i>        | Yellow-billed Egret        | Majhla Boga            | CR           |
| <i>Treron phoenicopterus</i>     | Yellow-footed Green Pigeon | Holdepa Horial         | CR           |
| <i>Cisticola juncidis</i>        | Zitting Cisticola          | Bhomra Soton           | CR           |
| <i>Alcedo hercules</i>           | Blyth's Kingfisher         | Machranga              | RR           |
| <i>Halcyon coromandra</i>        | Ruddy Kingfisher           | Lal Machranga          | RR           |
| <i>Heliopais personata</i>       | Masked Finfoot             | Giolo Hansh            | RR           |
| <i>Rynchops albicollis</i>       | Indian Skimmer             | Panikata               | RR           |
| <i>Haliaeetus leucogaster</i>    | White-bellied sea Eagle    | Sindhu Eagle           | RR           |
| <i>Platalea leucorodia</i>       | Eurasian Spoonbill         | Kodali Bok             | RR           |
| <i>Leptoptilos javanicus</i>     | Lesser Adjutant            | Modontak               | RR           |
| <i>Myctria leucocephala</i>      | Painted Stork              | Rangila bok            | RR           |

**Local Status:** CR-Common Resident; UR-Uncommon Resident; CWV- Common Winter Visitor; UWV- Uncommon Winter Visitor; RR-Rare Resident; DD-Data Deficient; WV-Winter Vagrant; RWV-Rare Winter Visitor

Table 5: Species List - Mammals

| Mammals                          |                  |                                   |             |              |
|----------------------------------|------------------|-----------------------------------|-------------|--------------|
| English name                     | Local Name       | Scientific Name                   | IUCN status | Local status |
| Asian House Shrew                | Chika/Chucho     | <i>Suncus murinus</i>             | NO          | CR           |
| Asian Palm Civet                 | Gandhogakul      | <i>Paradoxurus hermaphroditus</i> | VU          | CR           |
| Asiatic Brush-tailed Porcupine   | Sajaru           | <i>Atherurus macrourus</i>        | EN          | RR           |
| Asiatic Long tail Climbing Mouse | Gecho Indur      | <i>Vandeleuria oleracea</i>       | DD          | CR           |
| Bengal Fox                       | Pati Shial/Shial | <i>Vulpes bengalensis</i>         | VU          | CR           |
| Common Tree Shrew                | Gecho Chucho     | <i>Tupaia glis</i>                | DD          | RR           |
| Estern House Mouse               | Nenti indur      | <i>Mus musculus</i>               | NO          | CR           |

| Mammals                       |                       |                                     |             |              |
|-------------------------------|-----------------------|-------------------------------------|-------------|--------------|
| English name                  | Local Name            | Scientific Name                     | IUCN status | Local status |
| Eurasian Otter                | Ud Biral              | <i>Lutta lutra</i>                  | EN          | UR           |
| Eurasian Wild Boar            | Buno Shukar           | <i>Sus scrofa</i>                   | NO          | CR           |
| Finless Porpoise              | Shishu                | <i>Neophocaenoides phocaenoides</i> | EN          | UR           |
| Fishing Cat                   | Mecho Biral/Baghailla | <i>Felis viverrina</i>              | EN          | UR           |
| Ganges River Dolphin          | Shishu / Shushuk      | <i>Platanista gangetica</i>         | EN          | CR           |
| Golden Jackal                 | Sial                  | <i>Canis aureus</i>                 | VU          | CR           |
| Greater Bandicoot Rat         | Dhari indur           | <i>Bandicota indica</i>             | NO          | CR           |
| Greater False Vampire Bat     | Badur                 | <i>Megaderma lyra</i>               | NO          | CR           |
| Greater Short-nosed fruit Bat | Kola badur            | <i>Cynopterus sphinx</i>            | DD          | CR           |
| House Rat                     | Indur                 | <i>Rattus rattus</i>                | NO          | CR           |
| Indian crested Porcupine      | Shojaru               | <i>Hystrix indica</i>               | EN          | UR           |
| Indian Flying Fox             | Baro Badur            | <i>Pteropus giganteus</i>           | NO          | CR           |
| Indian Hare                   | Khargosh              | <i>Lepus nigricolis</i>             | EN          | UR           |
| Indian Pipistrelle            | Chamchika/ Cham Badur | <i>Pipistrellus coromandra</i>      | NO          | CR           |
| Irrawaddy Dolphin             | Mohonar Shushuk       | <i>Orcaela brevirostris</i>         | CR          | CR           |
| Jungle Cat                    | Ban Biral             | <i>Felis chaus</i>                  | EN          | RR           |
| Large- Indian Civet           | Baro Baghdash         | <i>Viverra zibetha</i>              | EN          | CR           |
| Lesser Bandicoot -rat         | Baro indur            | <i>Bandicota bengalensis</i>        | NO          | CR           |
| Little Indian Field Mouse     | Metho indur           | <i>Mus booduga</i>                  | NO          | CR           |
| Northern palm Squirrel        | Khatbirali            | <i>Funambulus pennantii</i>         | NO          | CR           |
| Oriental Small- Clawed Otter  | Bhodor/ Ud Biral      | <i>Amblonyx cinereus</i>            | EN          | CR           |
| Rofous-tailed Hair            | Khorgosh              | <i>Lepus nigricolis</i>             | EN          | RR           |
| Small- Indian Civet           | Choto Bagdash         | <i>Viverricula indica</i>           | VU          | CR           |
| Small- Indian Mongoose        | Benji, Nakul          | <i>Herpestes auropunctatus</i>      | NO          | CR           |
| Smooth -Coated Otter          | Ud Biral              | <i>Lutrogale perspicillata</i>      | EN          | RR           |

Local Status: CR – Common Resident, C – Common, UR – Uncommon Resident, RR – Rare Resident, V – Vagrant, WV – Winter Visitor; UWV – Uncommon Winter Visitor. IUCN Status code: CR – Critically Endangered, EN - Endangered, VU – Vulnerable, NO – Not Threatend

Table 6: Species Lists - Amphibians

| Amphibians             |                 |                                 |             |              |
|------------------------|-----------------|---------------------------------|-------------|--------------|
| English name           | Local Name      | Scientific Name                 | IUCN status | Local status |
| Asian Brown Tree Frog  | Gecho Bang      | <i>Polypedates leucomystax</i>  | NO          | CR           |
| Cricket Frog           | Jhijhi Bang     | <i>Limnonectes limnoccharis</i> | NO          | CR           |
| Green Frog             | Sabuj Bang      | <i>Euphlyctis hexadactylus</i>  | VU          | UR           |
| Indian Bull Frog       | Sona bang       | <i>Hoplobatrachus tigerinus</i> | NO          | CR           |
| Indian Tree Frog       | Gecho Bang      | <i>Polypedates maculatus</i>    | NO          | UR           |
| Large Tree Frog        | Baro Gecho Bang | <i>Rhacophorus maximus</i>      | VU          | UR           |
| Leaping Frog           | Pana bang       | <i>Hylarana tytleri</i>         | NO          | UR           |
| Ornate Microhylid      | Cheena Bang     | <i>Microhyla ornata</i>         | VU          | CR           |
| Southern Cricket Frog  | Jhijhi Bang     | <i>Fejervarya syhadrensis</i>   | NO          | CR           |
| Two-striped Grass Frog | Kaad Bang       | <i>Sylvirana taipehensis</i>    | EN          | RR           |

CR – Critically Endangered, EN - Endangered, VU – Vulnerable, NO – Not Threatened

**Table7: Species Lists - Reptiles**

| Reptiles                        |                            |                                  |             |              |
|---------------------------------|----------------------------|----------------------------------|-------------|--------------|
| English name                    | Local Name                 | Scientific Name                  | IUCN Status | Local Status |
| Bengal Monitor                  | Ghuy Shap                  | <i>Varanus bengalensis</i>       | VU          | CR           |
| Brooks House Gecko              | Tiktiki                    | <i>Hemidactylus brookii</i>      | NO          | CR           |
| Brown Roofed Turtle             | Baro Kori Kasim            | <i>Pangshura smithii</i>         | EN          | UR           |
| Checkered Keelback              | Dhora Shap                 | <i>Xenochropis piscator</i>      | NO          | CR           |
| Common Garden Lizard            | Roktochosha                | <i>Calotes versicolor</i>        | NO          | CR           |
| Common House Gecko              | Tiktiki                    | <i>Hemidactylus frenatus</i>     | NO          | CR           |
| Common Krait                    | Kal-keutey Shap            | <i>Bungarus caeruleus</i>        | EN          | UR           |
| Common River Terrapin           | Boro Kasim                 | <i>Batagur baska</i>             | CR          | RR           |
| Common Smooth Water Snake       | Painna Shap                | <i>Enhydris enhydris</i>         | NO          | CR           |
| Common Vine Snake               | Laodoga Shap               | <i>Ahaetulla nasuta</i>          | VU          | UR           |
| Common Wolf Snake               | Gharginni Shap             | <i>Lycodon aulicus</i>           | VU          | CR           |
| Crowned River Turtle            | Kali Kasim                 | <i>Hardella thurjii</i>          | EN          | UR           |
| Estuarine Crocodile             | Lonapanir Kumir            | <i>Crocodylus porosus</i>        | CR          | UR           |
| Ganges softshell Turtle         | Khalua Kasim               | <i>Aspideres gangeticus</i>      | EN          | UR           |
| Gharial                         | Ghorial/Baishal            | <i>Gavialis gangeticus</i>       | CR          | UR           |
| Indian Rat Snake                | Daraj Shap                 | <i>Ptyas mucosus</i>             | VU          | CR           |
| Indian Roofed Turtle            | Kori/Hali Kasim            | <i>Pangshura tectum</i>          | -           | CR           |
| Jerdon's Blind Snake            | Dumukh Shap                | <i>Typhlops jerdoni</i>          | -           | CR           |
| Keeled Grass skink              | Anjoni                     | <i>Mabuya carinata</i>           | -           | CR           |
| Median Roofed Turtle            |                            | <i>Pangshura tentoria</i>        | EN          | UR           |
| Monocled Cobra                  | Gokhra Shap                | <i>Naja kaouthia</i>             | VU          | RR           |
| Narrow-headed Softshell Turtle  | Sim Kasim                  | <i>Chitra indica</i>             | CR          | UR           |
| Olive Keelback                  | Maita Shap                 | <i>Atretium schistosum</i>       | -           | CR           |
| Olive Ridley Turtle             | Jalpaironga Samudrik Kasim | <i>Lepidochelys olivacea</i>     | EN          | CR           |
| Peacock-marked Softshell Turtle | Dhum Kasim                 | <i>Aspideres hurma</i>           | EN          | CR           |
| Pond tortoise                   | Kalo Kasim                 | <i>Melanochelys trijuga</i>      | EN          | UR           |
| Red Crowned Roofed Turtle       | Kori Kasim                 | <i>Kachuga kachuga</i>           | EN          | UR           |
| Spectacled Cobra                | Khoiya Gokhra Shap         | <i>Naja naja</i>                 | EN          | CR           |
| Spotted Flapshell Turtle        | Patapori                   | <i>Lissemys punctata</i>         | VU          | UR           |
| Spotted Litter skink            | Anzoni                     | <i>Sphenomorphus maculatus</i>   |             | CR           |
| Spotted Pond Turtle             | Mogom Kasim                | <i>Geoclemys hamiltonii</i>      | EN          | UR           |
| Three- Striped Roofed Turtle    | Dhoor Kasim                | <i>Kachuga dhongoca</i>          | CR          | UR           |
| Tokay Gecko                     | Takkhak                    | <i>Gekko gekko</i>               | VU          | CR           |
| Yellow Monitor                  | Sona Guy                   | <i>Varanus flavescens</i>        | EN          | RR           |
| Yellow-bellied House Gecko      | Tiktiki                    | <i>Hemidactylus flaviviridis</i> | -           | CR           |
| Ring Lizard                     | Ram Godi                   | <i>Varanus salvator</i>          | EN          |              |
| Painted Bronzedback tree Snake  | Gecho                      | <i>Dendrelaphis pictus</i>       | VU          |              |

CR – Critically Endangered, EN - Endangered, VU – Vulnerable, NO – Not Threatened

**Table6: Species Lists – Fish (Jamuna River March 1993 – February 1994)**

Table - List of Riverine fish Species

| Sl. | Local name of fish | Scientific name of Fishes     |
|-----|--------------------|-------------------------------|
| 1   | Bali chata         | <i>Nemaceheilus botia</i>     |
| 2   | Gharpoia           | <i>Somileptes gongota</i>     |
| 3   | Kachki             | <i>Corica soborna</i>         |
| 4   | Phasa              | <i>Setipinna phasa</i>        |
| 5   | Nuna baila         | <i>Brachygobius nusus</i>     |
| 6   | Chiring            | <i>Apocryptes bato</i>        |
| 7   | Ghaura             | <i>Clupisoma garua</i>        |
| 8   | Baghair            | <i>Bagarius bagarius</i>      |
| 9   | Kajuli             | <i>Ailia coila</i>            |
| 10  | Magur              | <i>Amblyceps mangois</i>      |
| 11  | Rita               | <i>Rita rita</i>              |
| 12  | Gang tengra        | <i>Gagata youssoufi</i>       |
| 13  | Gang tengra        | <i>Gagata nangra</i>          |
| 14  | Sisor              | <i>Sisor rhabdophorus</i>     |
| 15  | Kauwa/Cenia        | <i>Gagata cenia</i>           |
| 16  | Ilish              | <i>Tenulosa ilisha</i>        |
| 17  | Gang Magur         | <i>Plotosus canius</i>        |
| 18  | Koi Puti           | <i>Anodontostoma chacunda</i> |
| 19  | Khorsula           | <i>Sicamugil cascasia</i>     |
| 20  | Piali              | <i>Aspidoparia morar</i>      |
| 21  | Kalabata           | <i>Crossocheilus latius</i>   |
| 22  | Rani               | <i>Botia dario</i>            |
| 23  | Khorsula           | <i>Rhinomugil corsula</i>     |
| 24  | Shilong            | <i>Silong silondia</i>        |
| 25  | Kutakanti          | <i>Hara hara</i>              |
| 26  | Poa                | <i>Pama pama</i>              |
| 27  | Shangus            | <i>Himantura sp.</i>          |

Table - List of Migratory Fish Species

| Sl. | Local name of fish | Scientific name of Fishes           |
|-----|--------------------|-------------------------------------|
| 1   | Catla              | <i>Catla catla</i>                  |
| 2   | Kalibaus           | <i>Labeo calbasu</i>                |
| 3   | Rui                | <i>Labeo rohita</i>                 |
| 4   | Mrigal             | <i>Cirrhinus mrigala</i>            |
| 5   | Bata               | <i>Labeo bata</i>                   |
| 6   | Raik               | <i>Cirrhinus reba</i>               |
| 7   | Chital             | <i>Notopterus chittala</i>          |
| 8   | Ayre               | <i>Aorichthys aor</i>               |
| 9   | Guzza ayre         | <i>Aorichthys seengala</i>          |
| 10  | Golsha tengra      | <i>Mystus bleekeri</i>              |
| 11  | Kabashi tengra     | <i>Mystus cabasius</i>              |
| 12  | Bacha              | <i>Eutropiichthys vacha</i>         |
| 13  | Batashi            | <i>Pseudeutroplus atheridonoide</i> |
| 14  | Boal               | <i>Wallago attu</i>                 |
| 15  | Kani pabda         | <i>Ompok pabda</i>                  |
| 16  | Modhu pabda        | <i>Ompok bimaculatus</i>            |
| 17  | Pabda              | <i>Ompok pabo</i>                   |
| 18  | Katari             | <i>Salmostoma bacaila</i>           |

|    |             |                         |
|----|-------------|-------------------------|
| 19 | Fulchela    | <i>Salmostoma phulo</i> |
| 20 | Ghora chela | <i>Securicula gora</i>  |
| 21 | Chapila     | <i>Gudusia chapra</i>   |
| 22 | Kash khaira | <i>Chela laubuca</i>    |

Table - List of Floodplain Resident Fishes

|    |               |                               |
|----|---------------|-------------------------------|
| 1  | Baro baim     | <i>Mastacembalus armatus</i>  |
| 2  | Guchi baim    | <i>Macrognathus pancalus</i>  |
| 3  | Tara baim     | <i>Macrognathus aculatus</i>  |
| 4  | Lal Chanda    | <i>Chanda a ranga</i>         |
| 5  | Nama chanda   | <i>Chanda nama</i>            |
| 6  | Chanda        | <i>Chanda baculis</i>         |
| 7  | Shing         | <i>Heteropneus. fossilies</i> |
| 8  | Magur         | <i>Clarias batrachus</i>      |
| 9  | Shol          | <i>Channa striatus</i>        |
| 10 | Taki          | <i>Channa puncalus</i>        |
| 11 | Gojar         | <i>Channa marulius</i>        |
| 12 | Tit puti      | <i>Puntius ticto</i>          |
| 12 | Puti          | <i>Puntius sophore</i>        |
| 14 | Deshi Sarputi | <i>Puntius sarana</i>         |
| 15 | Phutani puti  | <i>Puntius phutunio</i>       |
| 16 | Gilli puti    | <i>Puntius gelius</i>         |
| 17 | Kanchon puti  | <i>Puntius conconius</i>      |
| 18 | Kanpona       | <i>Aplocheilus panchax</i>    |
| 19 | Gutum         | <i>Lepidocephalus guntea</i>  |
| 20 | Chep chala    | <i>Chela cachius</i>          |
| 21 | Baila         | <i>Glossogobius giurus</i>    |
| 22 | Napit Koi     | <i>Badis badis</i>            |
| 23 | Darkina       | <i>Rasbora daniconius</i>     |
| 24 | Chebli        | <i>Danio devario</i>          |
| 25 | Anju          | <i>Brachydanio rerio</i>      |
| 26 | Mola          | <i>Amblyphayngodon mola</i>   |
| 27 | Keti          | <i>Osteobrama cotio cotio</i> |
| 28 | Kaikla        | <i>Xenentodon cancila</i>     |
| 29 | Soto Kholisa  | <i>Colisa sota</i>            |
| 30 | Lal kholisa   | <i>Colisa lalius</i>          |
| 31 | Kholisa       | <i>Colisa fasciatus</i>       |
| 32 | Tengra        | <i>Mystus vittatus</i>        |
| 33 | Bajari tengra | <i>Mystus tengara</i>         |
| 34 | Potka         | <i>Tetradon cutcutia</i>      |

Total number of fish species in the Jamuna River, **March 1993 – February 1994**

| Sl. | Habitat Preference  | Number |
|-----|---------------------|--------|
| 1   | Riverine            | 27     |
| 2   | Migratory           | 22     |
| 3   | Floodplain Resident | 34     |
|     | Total               | 83     |

Source - FAP 17, Fisheries Studies and Pilot Project, FINAL REPORT (Draft) JUNE 1994, Supporting Volume No. 10, FISHERIES STUDY, THE JAMUNA AND PADMA RIVERS.

- After FAP 17 Study no intensive survey has conducted on fish in Jamuna River. Further study in required.
- But after this study some fish species like Deshi Sarputi , Rita, Pabda, Gojar are almost absent in the fish catch in Jamuna River.

**Table 9: Embankment and Dredging Projects Affecting River Cetaceans in Bangladesh**

| Project   | River and location   | Purpose   | Technical and Hydrological Specifications  | Status  | Summary of dolphin occurrence and potential or realized impacts   |
|---|--|---|--|---|---|
| <b>Embankments</b>  |  |   |  |   |   |
| Bank Protection and River Training Pilot Projects (FAP 21/22) | Right bank of Jamuna River near Kamarjani and left bank of Jamuna River near Bahadurabad | Prototype works to investigate whether river training is feasible or desirable. | Three embankments on right bank. Eight slope revetments on right and left banks.   | Embankments recently constructed. Slope revetments currently in construction. | Dolphins observed in the area during surveys in April 1996. Project will reduce hydraulic complexity and eliminate spawning habitat for floodplain-dependent fish.  |
| Brahmaputra Right Embankment (BRE)                            | Jamuna River near Serajgonj, Rajshahi  | Protection of Serajgonj and adjacent floodplain.                                | Embankment length 220km. Over half the length of the embankment has been eroded.   | Completion date unknown.  | Dolphins observed in the area during surveys in October 1995 and in April 1996. The embankment has reduced hydraulic complexity and eliminated spawning habitat for floodplain-dependent fish.              |
| Brahmaputra River Bank Priority Works (BPW)                   | Jamuna River near Serajgonj, Rajshahi  | Protection of Serajgonj from migration of Jamuna River                          | Two hard points linking the existing realigned BRE with low earth embankments.   | Advanced stages of planning   | Dolphins observed in the area during surveys in October 1995 and in April 1996. Additional impacts beyond the effects of the existing BRE are unknown.  |
| Jamuna Bridge Project Embankments                             | Jamuna River slightly upstream of Serajgonj, Rajshahi                                    | Protection of bridge foundation from erosive flooding.                          | Paired embankments upstream and a hard point/guide bund on the right bank downstream. Embankment on left bank will be linked to BPW.                               | Completed in 1998   | Dolphins observed in the area during surveys in October 1995 and in April 1996. Project will reduce hydraulic complexity and eliminate spawning habitat for floodplain-dependent fish.                      |
| Jamalur Priority Project (FAP 3.1)                            | Divergence of Jamuna and Old Brahmaputra rivers near Jamalpur                            | Flood control and drainage  | 82km embankment along left bank of the Jamuna river and a 43km embankment along the right bank of the Old Brahmaputra River.                                       | Detailed engineering study in progress.                                       | Dolphins observed in the area during surveys in April 1996. Project will reduce hydraulic complexity and eliminate spawning habitat for floodplain-dependent fish.  |
| <b>Dredging</b>   |  |   |  |   |   |
| Jamuna Bridge Project Dredging                                | Jamuna River upstream of Serajgonj, Rajshahi   | Facilitate construction of bridge   | ?  | Dredging believed to have been completed after bridge commissioned in 1998    | Dolphins observed in the area during surveys in October 1995 and in April 1996. Potential problem with increased turbidity during dredging operations and increased sedimentation downstream.               |
| Kalni-Kushiyara River Improvement Project                     | Kushiyara River between Asmiriganj and Katkhal, Chittagong                               | Facilitate passage of water in the Kushiyara River during the monsoon season.   | Dredging at three sites extending for 0.25-1.0 km each. If successful, 10 additional sites will be dredged in the 50km stretch of river between Markuli and Mudha. | Advanced stages of planning   | Dolphins observed in the area during surveys in October 1995. Potential problem with increased turbidity during dredging. Project could potentially benefit dolphins by increasing counter-current habitat. |

Source: Brian D. Smith, Ravindra K. Sinha, Zhou Kaiya, A. Aleem Chaudhry, Liu Renjun, Wang Ding, Benazir Ahmed, A.K.M. Aminul Haque, R.S.L. Mohan, and Kumar Sapkota. 2000. "Register of Water Development Projects Affecting River Cetaceans in Asia." In *Biology and Conservation of Freshwater Cetaceans in Asia*, edited by Randall R. Reeves, Brian D. Smith, and Toshio Kasuya. Occasional Paper 23. IUCN Species Survival Commission. <http://data.iucn.org/dbtw-wpd/edocs/ssc-op-023.pdf>.

**Table 10: Ground Water Depth**

| Well ID | Location                                    | Groundwater Depth (m) |           |       |           |       |           |
|---------|---|-----------------------|-----------|-------|-----------|-------|-----------|
|         |   | 1980                  |           | 1990  |           | 2000  |           |
|         |   | April                 | September | April | September | April | September |
| 8811001 | Shrenagar village, Belkuchithana, Sirajganj | 6.78                  | 2.83      | 4.51  | 1.70      | 5.84  | 1.42      |
| 5678012 | Uthali village, Shibalayathana, Manikganj   | 6.31                  | 1.39      | 5.91  | 1.89      | 7.07  | 0.90      |
| 9376032 | Bhalkutia village, Nagarpurthana, Tangail   | 6.46                  | 1.64      | 5.51  | 1.94      | 6.31  | 1.52      |

Source: BWDB.



## Annex 2: Dolphin Threats

### 1.1 Threats

Dolphins have been very adversely affected by human use of the river systems in the sub-continent. Entanglement in fishing nets can cause significant damage to local population numbers. Some individuals are still taken each year and their oil and meat used as a liniment, as an aphrodisiac and as bait for catfish. Irrigation has lowered water levels throughout the ranges. Poisoning of the water supply from industrial and agricultural chemicals may have also contributed to population decline. Perhaps the most significant issue is the building of more than 50 dams along many rivers, causing the segregation of populations and a narrowed gene pool in which dolphins can breed.

This species is considered to be particularly threatened by overfishing (incidental by-catch, direct exploitation, resource depletion), and high industrial and agricultural pollutant loads may also have a severe impact on dolphin immune competence and fertility. The immediate danger for the resident population of dolphin in the haor basin is the decrease in river depth due to sedimentation.

### 1.2 Threats from Other Human Activities

#### 1.2.1 Use of Dolphin Products

Dolphin oil is used by people in Bangladesh as a liniment, claimed to be effective for treating rheumatism, burns, and nervous disorders, and a tonic for treating impotence and asthma. It is noted that pregnant women sometimes drink the oil in the belief that it will ensure a healthy baby and that the oil is mixed with banana leaves and fed to cows to fatten them before being taken to market. Pelletier and described a factory in Chandpur used for processing dolphin oil. Recent survey recorded that the dolphin oil is used as mosquito repellent. On the bank of river Kushiyara near Kawadighi Haor, people are using oil of dolphin as mosquito repellent for the cattle and buffalo. They used to rub the oil over the body of cow and buffalo.

#### 1.2.2 Fisheries Bycatch

Cetaceans worldwide are threatened from incidental mortality in gillnets. According to local fishermen, incidental catch in monofilament gill nets, called *current jals*, is their primary source of dolphin products. It is difficult to determine if the catch of dolphins in nets is deliberate or accidental, especially since dolphin products are highly valued and nets are often deployed for multispecies catch (Reeves and others 1993). Although *current jals* with a stretched mesh size of below 4.5 cm are prohibited in Bangladesh, their use is increasing throughout the country. We were told by fishermen that dolphins are sometimes caught in *jam jals*. These rectangular nets have an 8- to 10-cm mesh size and are used to catch large broodstock in river *duars*.

#### 1.2.3 Directed Catch

Local villagers appeared to be unaware that hunting dolphins is prohibited under the laws of Bangladesh. In villages along the Kalni-Kushiyara river, a small group of fishermen from a Hindu minority caste in the Bhawal (Sylhet District) come every year during December or January to hunt

dolphins in major *duars*. They hunt dolphins at night with long iron-tipped harpoons made from bamboo.

### 1.2.4 Overexploitation of Fisheries

The Rivers of Bangladesh sustain one of the most productive freshwater fisheries in the world. Significant declines in carp and catfish production suggest that exploitation may be exceeding sustainable yields. Major factors cited for declines are the use of small mesh gillnets (*current jals* and *kona ber jals*) in tributaries and harvesting large fish in *duars* during their breeding season. The strong correlation between the distribution of river dolphins and large fish species and the reported decline of these fishes may indicate a potential problem in maintaining an adequate food base to support dolphins.

### 1.2.5 Pollution

The main sources of water pollution in Bangladesh are leather, paper and pulp, fertilizer, pharmaceutical, sugar, jute, textile, and petrochemical industries, which generally discharge untreated wastes directly into rivers. The widespread use of fertilizers and pesticides for “green revolution” rice crops also creates serious water-quality problems. Recent studies of the biodegradation capacity and residue patterns of organochlorines in dolphins inhabiting the Ganges river in India indicate that, similar to marine cetaceans, *P. gangetica* is unable to metabolize these chemicals. The high concentrations of heavy metals (Fe, Mn, Zn, Cu, Pb, Mi, and Cd) found in the tissues of one neonatal male dolphin and one slightly larger immature male dolphin suggest considerable transfer of these contaminants across the fetal membrane and through milk (Reeves and others 1993). The lack of systematic monitoring of pollutant levels in Bangladesh.

Scientists believe that eddy countercurrents, called *duars* in Bengali (or *koom* or *khari* in larger rivers), are essential to the survival of river dolphins and to the productivity of riverine biota. A recent fisheries study in the northeast region of Bangladesh supports the idea of a linkage between dolphin occurrence and *duars*. The same study also found that *duars* are essential overwintering habitat for *boromaach* (commercially important fishes including major carp, catfish, and other large migratory species). During surveys in the Kushiara River, all sightings of dolphins were located within the eddy boundaries of obvious *duars*. Larger *duars*, created by sharp meanders and convergent or divergent channels, contained a greater number of dolphins than smaller *duars*, created by gentle meanders. River channels in the Kushiara River are a few hundred meters wide and are generally contained within well-defined banks. The aggregate nature of river dolphin distribution can also be used to the dolphins’ advantage by allowing conservation strategies to focus on areas that already require judicious stewardship for protecting vital fishery resources. The concentration of dolphins in limited and circumscribed areas makes them particularly vulnerable to habitat disturbance from water development, direct exploitation, accidental entanglement in fishing nets, and local sources of pollution.

## Reference:

Biswas, S. P. and R. G. Michael (1992): Fishery characteristics and the present status of fisheries of the river Brahmaputra. *Proc. Seminar on Conservation of River Dolphin in Indian Sub-continent*, 18-19 August, New Delhi. (Abst.)

Biswas, S. P. and S. Baruah (2000): Ecology of river dolphin (*Platanista gangetica*) in the Upper Brahmaputra. *Hydrobiologia*, 430: 97 – 111. Choudhury, A. U. (1997): *Checklist of the Mammals of Assam*. Gibbons Books, Guwahati. 103 pp.

Mohan, R. S. L., S. C. Dey and S. P. Bairagi (1998): On a residential dolphin population of the Ganges river dolphin, *Platanista gangetica* in the Kulsi river (Assam), a tributary of Brahmaputra. *Ibid*, 95(1): 1 – 7.

Reeves, R. R., S. Leatherwood and R. S. L. Mohan (eds.) (1993): *A Future for Asian River Dolphins*: Report from the Seminar on the Conservation of River Dolphins of the Indian Subcontinent, 18-19 August 1992, New Delhi, India.

Whale and Dolphin Conservation Society, Bath, U.K. Reeves, R. R. and S. Leatherwood (1994): Dams and river dolphins: can they co-exist? *Ambio* 23: 172-175.

B. D. Smith and T. Kasuya), pp. 54-61. IUCN, Gland, Switzerland. Sinha, R. K. and G. Sharma (2003): Current status of the Ganges river dolphin, *Platanista gangetica* in the rivers Kosi and Son, Bihar, India. *J. Bombay nat. Hist. Soc.*, 100(1): 27-37.

Sinha, R. K., N. K. Das, N. K. Singh, G. Sharma and S. N. Ahsan (1993): Gut content of the Gangetic dolphin, *Platanista gangetica*. *Invest. Cetacea*, 24: 317-321. Smith, B. D. (1993): 1990 status and conservation of the Ganges River Dolphin (*Platanista gangetica*) in the Karnali River, Nepal. *Biological Conservation*, 66: 159-169.

Smith, B. D., A. K. M., Haque, M. S. Hussain and A. Khan (1998): River dolphins in Bangladesh: conservation and the effects of water development. *Environmental Management*, 22: 323-335.

Smith, B. D. and R. R. Reeves (2000): Survey methods for population assessment of Asian river dolphins. In *Biology and Conservation of Freshwater Cetaceans in Asia*, Occasional Papers of the IUCN Species Survival Commission no. 23 (eds. R. R. Reeves, B. D. Smith and T. Kasuya), pp. 97-115. IUCN, Gland, Switzerland.

Smith, B. D., R. K. Sinha, Z. Kaiya, A. A. Choudhury, L. Renjun, W. Ding, B. Ahmed, A. K. M. A. Haque, R. S. L. Mohan, K. Sapkota (2000): Register of water development projects affecting river cetaceans in Asia. In *Biology and Conservation of Freshwater Cetaceans in Asia*, Occasional Papers of the

Ahmed, A.T.A., Kabir, S.M.H., M., Ahmed, Z. U., Begum, Z.N.T., Hassan, M. A., and Khondker, m. (eds.). 2009. *Encyclopedia of Flora and Fauna of Bangladesh*, Vol.27 *Mammals*. Asiatic Society of Bangladesh, Dhaka. 264 p.

## Annex 3: Public Consultation Meeting, First Round

### A. Overview of Meetings

Four first-round meetings were conducted at Chowhali, Harirampur, and Shahjampur and Shibalaya, attended by 247 participants. Locations, dates, numbers and types of participants, and meeting photos are provided in Tables A8.1 and A8.2, and Photos A8.1 to A8.4.

### B. Stakeholder Concerns and Meeting Documentation

Summaries of stakeholder concerns expressed in each meeting are provided in Tables A8.3 to A8.6. Copies of the meeting sign-in sheets and Bengali questionnaire are shown in Photos A8.5 to A8.9.

**Table A8.1:**

| District  | Upazila    | Union | Meeting venue      | Meeting date | Time     |
|-----------|------------|-------|--------------------|--------------|----------|
| Sirajganj | Chauhali   | Sadar | UP conference room | 12/03/2013   | 11 am    |
| Sirajganj | Harirampur | Sadar | UP conference room | 26/02/2013   | 10 am    |
| Manikganj | Shahjampur | Sadar | UP conference room | 27/02/2013   | 10:30 am |
| Sirajganj | Shibalaya  | Sadar | UP conference room | 17/04/2013   | 02:00 pm |

**Table A8.2: Public Consultation Meeting Participant Details**

| Meeting venue                      | Type of Participants               | No. of participants |
|------------------------------------|------------------------------------|---------------------|
| Chauhali Upazila conference room   | Primary and secondary stakeholders | 30                  |
| Harirampur Upazila conference room | Primary stakeholders               | 57                  |
| Shahjampur Upazila conference room | "                                  | 26                  |
| Shibalaya Upazila conference room  | "                                  | 44                  |

Photo A8.1: PCM at Chouhali



Photo A8.2: PCM at Harirampur



Photo A8.3: PCM at Shahjadpur



Photo A8.4: PCM at Shibalya



**Table A8.3: First-Round Meeting Summary, Chouhali Upazila Complex, Sirajgonj**

|   |
|---|
| <b>Project/Subproject:</b> Integrated Flood and Riverbank Erosion Management Investment Program   |
| <b>Meeting date:</b> 12.03.2013   |
| <b>Place:</b> Chouhali Upazila Complex, Sirajgonj   |
| <b>Attending:</b><br><b>Proponents:</b> BWDB, NHC, ADB<br><b>Stakeholders:</b> <ul style="list-style-type: none"> <li>• <b>Primary:</b> farmers, fishermen, local business community as well as the households to be displaced, women groups, and caretakers of community properties.</li> <li>• <b>Secondary:</b> those who may not be directly affected but have interests that could contribute to the study, play a role in implementation at some stage, or affect decision making on Project aspects. In this Project NGOs, concerned government departments, and line agencies are considered.</li> </ul> <b>Reported by:</b> Manju Ara, Jr. Professional, CEGIS   |
| <b>Issues, questions, responses, comments - People's perception, opinion and attitude</b>   |
| <b>1.1 Main problems due to erosion and flooding:</b> <ul style="list-style-type: none"> <li>- Flooding and eroding of homesteads</li> <li>- Accommodation problems for livestock</li> <li>- Land erosion in river side areas</li> <li>- Spreading of water-borne diseases and resulting health hazards</li> <li>- Problems in crop cultivation</li> <li>- Students cannot go to the educational institutions</li> <li>- Siltation Problem in the Jamuna River</li> <li>- Communication and transportation problems</li> <li>- Problems in various rural infrastructures (educational institutions, religious institutions etc.)</li> <li>- Reduce employment opportunities for river erosion</li> </ul> <b>1.2 Peoples' responses to the FRERMIP project:</b> <ul style="list-style-type: none"> <li>- People are very much positive to the implementation of this projects. Additionally, they added the following suggestions:</li> <li>- Ensure the use of Geo-bag and CC-Block in protective work</li> <li>- Requirements of embankment</li> </ul> |

- Construction of new embankment along the river bank

### **1.3 Impacts of the project**

- People opined that this project must bring immense socio-economic benefits for them
- Save Chowhali upazila complex and different govt. office
- Prevent River erosion and protect house hold, livestock etc.

### **1.4 Impacts on Charlands**

- Increase density in Muradpur Char for relocation
- Erosion of Charlands if construction cross dam or river

## **Resettlement/ Relocation issues**

### **2.1. Impact of land acquisition on different group of people**

- Loss of homesteads
- Damages of agricultural land
- Increases the number of landless of people
- loss of market facilities
- Some of peoples have no land or not able to purchase land and they take shelter others home stated

### **2.2. Relocation of houses and other establishments**

- Landless people will be rehabilitated
- People will be economically benefited
- Price of adjacent land might be increased
- Relocation should be ensured through the consultation with local allied persons

### **2.3. Choice of relocation site, availability of land and its current price**

There is availability of land for relocation. The current price of land 1000 OBDT for cultivable land and 30,000 BDT for homesteads land.

People suggested that in compensation process, prices should be fixed by the consultation with the local people rather than the average price of sub-registered office.

### **2.4. Present community social services the affected areas and relocated areas**

Presently, there is inadequacy of social services both in the affected and relocated area

### **2.5. Will this situation be improved or deteriorated after relocation?**

The present situation must be improved if the concerned authority manage it effectively and relocate them in desired locations

### **2.6. Present level of access to market centers and towns/future level of access to market centers and towns after relocation**

At present, access level of local people to markets and towns is low. But, it will be improved if the project is implemented.

### **2.7. What are the patterns of transport and communication in the affected area/relocated area?**

Rickshaw, Nosiman, tempo, boat, CNG, Horse cab, cycle are the main transportation in the affected and relocated area. But, overall transportation and communication facilities are not good.

### **2.8. What are the patterns for utilizing cultural and religious facilities? Will it generate conflicts in the host community?**

There exists homogeneous religious and cultural scenario both in the affected and relocated area.

So, there is no possibility any sort of social conflict.

## **2.9. What types of conflicts may arise due to relocation/resettlement?**

There is no possibility of social conflict. In spite of this, local allied persons should be involved in the process of relocation the affected people.

### **Compensation issues**

#### **3.1. ADB and GoB policies on involuntary resettlement**

Local people do not know the policies on involuntary resettlement of ADB and GoB

#### **3.2. Discussion on entitlements, compensation rates, income restoration, and grievance redress mechanism**

- Compensation should be given on the basis current price land rather than traditional policy
- Ensuring compensated money to the actually affected people

#### **3.3. People's preference on mode of compensation payment and their previous experience**

In case of compensation they prefer money rather land as they feel freedom of choice

#### **3.4. Cut-off date for listing affected properties**

### **Income restoration and generation**

#### **4.1. What are the current income generating activities of APs?**

- Agriculture
- Fish culture
- Livestock rearing
- Small entrepreneurship
- Employed
- Business Etc.

#### **4.2. Are there possibilities for continuing employment in the project area? Which type of occupation?**

- It is possible to continue the current occupation in the project area

#### **4.3. What types of income-generating activities are available at relocation sites? and to be generated?**

- Agriculture
- Fish culture/capture
- Livestock rearing
- Small entrepreneurship
- Employed
- Business Etc.

#### **4.4. How does relocation of households affect the current market situation (job opportunities, competition, land price and market price situation)**

- Labour availability will be increased. There is a chance to be more labor than less work
- Land price will be increased
- Social neighborhood will increased

#### **4.5. How many people can be absorbed?**

About 75 to 80 percent people can be absorbed

#### **4.6. Does this require training for skill development and IGA?**

- Livestock roaring training
- Swinging training



|  |
|--|
| <ul style="list-style-type: none"> <li>- Health training</li> <li>- Fish culture training</li> <li>- Agricultural training</li> <li>- Skill development training is highly needed for the local people. In addition, training should be given on disaster risk reduction</li> </ul> <p><b>4.7. How many people need to be trained and for what occupation?</b></p> <ul style="list-style-type: none"> <li>- About 70% people need to be trained up. <i>Training sectors:</i> <ul style="list-style-type: none"> <li>- Fish culture</li> <li>- Farming</li> <li>- Livestock and poultry</li> </ul> </li> </ul>  |
| <b>Social Development Support</b>  |
| <p><b>5.1. Name of NGOs prevailing in the relocation site</b></p> <ul style="list-style-type: none"> <li>- Proshika, BRAC, ASA, Manob Mukti Sangstha, BDPC Etc.</li> </ul> <p><b>5.2. Willingness of NGOs to support the APs for savings and income generation programs, providing capital support for income restoration and poverty reduction.</b></p> <ul style="list-style-type: none"> <li>- Various NGOs show greater interest to support the affected people through poverty reduction activities</li> </ul> <p><b>5.3. Social safeguard and safety nets</b></p> <ul style="list-style-type: none"> <li>- At present the coverage of social safety net is quiet good</li> </ul> |
| <b>Outcome (s)</b>   |
| <ul style="list-style-type: none"> <li>- All livelihood sectors are affected by erosion and flood</li> <li>- They demanded immediate bank protection</li> <li>- They show willingness to be relocated in purpose of protective work</li> <li>- There is no social conflict regarding relocation</li> <li>- Prior consultation with local allied persons is highly required before starting work</li> <li>- Income and employment will be generated</li> <li>- Compensation should be given in money considering the current market price</li> <li>- Lifestyle of the local people will be improved</li> </ul>  |
| <b>Special Attention</b>   |
| <ul style="list-style-type: none"> <li>- Requirements of new embankment and protect work</li> </ul>  |

Table A8.4: First-Round Meeting Summary, Harirampur Upazila Complex, Manikganj

|  |
|--|
| Project/Subproject: <b>Integrated Flood and Riverbank Erosion Management Investment Program</b>  |
| Meeting date: <b>26 /02/ 2013</b>  |
| Place: <b>Harirampur Upazila Complex, Manikganj</b>  |
| <p>Attending:</p> <p><b>Proponents:</b></p> <p>BWDB, NHC, ADB</p> <p><b>Stakeholders:</b></p> <ul style="list-style-type: none"> <li>• <b>Primary:</b> Farmers, fishers, local business community as well as the households to be displaced, women groups, and caretakers of community properties.</li> <li>• <b>Secondary:</b> Those who may not be directly affected but have interests that could contribute to the study, play a role in implementation at some stage, or affect decision making on Project</li> </ul> |

| <p>aspects. In this Project NGOs, concerned government departments, and line agencies are considered.</p> <p>ported by: Muhammad Shifuddin Mahmud, Professional, CEGIS</p>   |  |
|--|--|
| Issues, questions, responses, comments   |  |
| People's perception, opinion and attitude  |  |
| <p><b>1.1 Main problems due to erosion and flooding:</b></p> <ul style="list-style-type: none"> <li>- Flooding and eroding of homesteads</li> <li>- Accommodation problems for livestock</li> <li>- Scarcity of safe drinking water</li> <li>- Sanitation problems</li> <li>- Spreading of water-borne diseases and resulting health hazards</li> <li>- Problems in crop cultivation</li> <li>- Students cannot go to the educational institutions</li> <li>- Problems in movements for population and livestock</li> <li>- Destruction in fishery sector</li> <li>- Communication and transportation problems</li> <li>- Problems in various rural infrastructures (educational institutions, religious institutions etc.)</li> </ul> |  |
| <p><b>1.2 Peoples' responses to the FRERMIP project:</b></p> <ul style="list-style-type: none"> <li>- People are very much positive to the implementation of this project. Additionally, they added the following suggestions:</li> <li>- Ensure the use of Geo-bag in protective work</li> <li>- Repairing of sluice gate at Kantapara</li> <li>- Construction of new embankment at Dhulshura, Boyra and Lesraganj UP</li> </ul>  |  |
| <p><b>1.3 Impacts of the project</b></p> <ul style="list-style-type: none"> <li>- People opined that this project would bring immense socio-economic benefits for them</li> </ul>  |  |
| Resettlement/ Relocation issues  |  |
| <p><b>2.1. Impact of land acquisition on different group of people</b></p> <ul style="list-style-type: none"> <li>- Loss of homesteads</li> <li>- Damages of agricultural land</li> <li>- Increases the number of landless of people</li> </ul>  |  |
| <p><b>2.2. Relocation of houses and other establishments</b></p> <ul style="list-style-type: none"> <li>- Landless people will be rehabilitated</li> <li>- People will be economically benefited</li> <li>- Price of adjacent land might be increased</li> <li>- Relocation should be ensured through the consultation with local allied persons</li> </ul>  |  |
| <p><b>2.3. Choice of relocation site, availability of land and its current price</b></p> <ul style="list-style-type: none"> <li>- There is availability of land for relocation. The current price of land is 10,000 BDT for cultivable land and 30,000 BDT for homesteads land.</li> <li>- People suggested that in compensation process, prices should be fixed in consultation with the local people instead of considering the average price of sub-registered office.</li> </ul>   |  |
| <p><b>2.4. Present community social services the affected areas and relocated areas</b></p> <ul style="list-style-type: none"> <li>- Presently, there is inadequacy of social services both in the affected and relocated area</li> </ul>  |  |
| <p><b>2.5. Will this situation be improved or deteriorated after relocation?</b></p> <ul style="list-style-type: none"> <li>- The present situation would improve if the concerned authority manage it effectively and relocate them in desired locations</li> </ul>   |  |
| <p><b>2.6. Present level of access to market centers and towns/future level of access to market centers and towns after relocation</b></p>   |  |

|  |   |
|--|---|
| <ul style="list-style-type: none"> <li>- At present, access level of local people to markets and towns is low. It will be improved if the project is implemented.</li> </ul> <p><b>2.7. What are the patterns of transport and communication in the affected area/relocated area?</b></p> <ul style="list-style-type: none"> <li>- Rickshaw, Nosiman, tempo are the main transportation in the affected and relocated area. But, overall transportation and communication facilities are not good.</li> </ul> <p><b>2.8. What are the patterns for utilizing cultural and religious facilities? Will it generate conflicts in the host community?</b></p> <ul style="list-style-type: none"> <li>- There exists homogeneous religious and cultural scenario both in the affected and relocated area. So, there is no possibility of any sort of social conflict.</li> </ul> <p><b>2.9. What types of conflicts may arise due to relocation/resettlement?</b></p> <ul style="list-style-type: none"> <li>- There is no possibility of social conflict. However, local allied persons should be involved in the process of relocation the affected people.</li> </ul>  | <p style="text-align: center;"><b>Compensation issues</b></p>               |
| <p><b>3.1. ADB and GoB policies on involuntary resettlement</b></p> <ul style="list-style-type: none"> <li>- Local people do not know the policies on involuntary resettlement of ADB and GoB</li> </ul> <p><b>3.2. Discussion on entitlements, compensation rates, income restoration, and grievance redress mechanism</b></p> <ul style="list-style-type: none"> <li>- Compensation should be given on the basis current price land rather than traditional policy</li> <li>- Ensuring compensated money to the actually affected people</li> </ul> <p><b>3.3. People's preference on mode of compensation payment and their previous experience</b></p> <ul style="list-style-type: none"> <li>- In case of compensation they prefer money rather than land as they feel freedom of choice</li> </ul> <p><b>3.4. Cut-off date for listing affected properties</b></p>   | <p style="text-align: center;"><b>Income restoration and generation</b></p> |
| <p><b>4.1. What are the current income generating activities of APs?</b></p> <ul style="list-style-type: none"> <li>- Agriculture</li> <li>- Fish culture/capture</li> <li>- Livestock rearing</li> <li>- Small entrepreneurship</li> <li>- Employed</li> <li>- Business</li> <li>- Etc.</li> </ul> <p><b>4.2. Are there possibilities for continuing employment in the project area? Which type of occupation?</b></p> <ul style="list-style-type: none"> <li>- It is possible to continue the current occupation in the project area</li> </ul> <p><b>4.3. What types of income-generating activities are available at relocation sites? and to be generated?</b></p> <ul style="list-style-type: none"> <li>- Agriculture</li> <li>- Fish culture/capture</li> <li>- Livestock rearing</li> <li>- Small entrepreneurship</li> <li>- Employed</li> <li>- Business</li> <li>- Etc.</li> </ul> <p><b>4.4. How does relocation of households affect the current market situation (job opportunities, competition, land price and market price situation)</b></p> <ul style="list-style-type: none"> <li>- Labour availability will be increased. There is a chance to be more labor than less work</li> <li>- Land price will increase</li> </ul> |   |

|   |
|---|
| <ul style="list-style-type: none"> <li>- Social neighbourhood will increase</li> </ul> <p><b>4.5. How many people can be absorbed?</b></p> <ul style="list-style-type: none"> <li>- About 70 to 75 percent people can be absorbed</li> </ul> <p><b>4.6. Does this require training for skill development and IGA?</b></p> <ul style="list-style-type: none"> <li>- Skill development training is highly needed for the local people. In addition, training should be given on disaster risk reduction</li> </ul> <p><b>4.7. How many people need to be trained and for what occupation?</b></p> <ul style="list-style-type: none"> <li>- About 70% people need to be trained up</li> </ul> <p><i>Training sectors:</i></p> <ul style="list-style-type: none"> <li>- Fish culture</li> <li>- Farming</li> <li>- Livestock and poultry</li> </ul> |
| <b>Social Development Support</b>   |
| <p><b>5.1. Name of NGOs prevailing in the relocation site</b></p> <ul style="list-style-type: none"> <li>- Proshika, BRAC, Grammeen Bank, GKT, BARSIC, Bangladesh Red Crescent Society</li> </ul> <p><b>5.2. Willingness of NGOs to support the APs for savings and income generation programs, providing capital support for income restoration and poverty reduction.</b></p> <ul style="list-style-type: none"> <li>- Various NGOs showed greater interest to support the affected people through poverty reduction activities</li> </ul> <p><b>5.3. Social safeguard and safety nets</b></p> <ul style="list-style-type: none"> <li>- At present the coverage of social safety net is quiet good</li> </ul>   |
| <b>Outcome (s)</b>  |
| <ul style="list-style-type: none"> <li>- All livelihood sectors are affected by erosion and flood</li> <li>- They demanded immediate bank protection</li> <li>- They showed willingness to be relocated in purpose of protective work</li> <li>- There is no social conflict regarding relocation</li> <li>- Prior consultation with local allied persons is highly required before starting work</li> <li>- Income and employment will be generated</li> <li>- Compensation should be given in money considering the current market price</li> <li>- Lifestyle of the local people will be improved</li> </ul>   |
| <b>Special Attention</b>  |
| <p>In Dhulshura union 5 schools, 4 mosques, one orphanage, 2 Madrashes and Dhulshura bazaar as well as crop land, homesteads and roadways may be eroded during the next April-May (Boisakh, Bangla month), if the government do not take effective initiative immediately to protect this resources.</p>  |

**Table A8.5: First-Round Meeting Summary, Shibalaya Upazila Complex, Manikgonj**

|   |
|---|
| Project/Subproject: <b>Integrated Flood and Riverbank Erosion Management Investment Program</b> |
| Meeting date: <b>17/04/2013</b>   |
| Place: <b>Shibalaya Upazila Complex, Manikgonj</b>  |
| Attending:  |
| <b>Proponents:</b>  |

BWDB, NHC, ADB

**Stakeholders:**

- **Primary:** farmers, fishermen, local business community as well as the households to be displaced, women groups, and caretakers of community properties.
- **Secondary:** those who may not be directly affected but have interests that could contribute to the study, play a role in implementation at some stage, or affect decision making on Project aspects. In this Project NGOs, Member of Parliamentarian (MP), concerned government departments, and line agencies are considered.

**Reported by:** Manju Ara, Jr. Professional, CEGIS

**Issues, questions, responses, comments**

**People's perception, opinion and attitude**

**2.1. Main problems due to erosion and flooding:**

- River erosion is main problem of Shibabaya Upazila.
- Flooding and eroding of homesteads, cultivable land, homestead, various institutions such as educational institutions, social and religious institutions as well as all immovable and material resources are evanescent to Jumana and Padma River.
- Due to river erosion, communication system based on embankment has broken down. People cannot carry their goods as a result carrying cost and sufferings become no bounds. It keeps a negative impact on their economy.
- Land erosion in river side areas
- Accommodation problems for livestock
- Spreading of water-borne diseases and resulting health hazards
- Problems in crop cultivation
- Students cannot go to the educational institutions
- Communication and transportation problems
- Problems in various rural infrastructures (educational institutions, religious institutions etc.)
- Losing cultivable land and all resources, they have become unemployed
- Reduce employment opportunities for river erosion

**2.2. Peoples' responses to the FRERMIP project:**

- People are very much positive to the implementation of this project. Additionally, they added the following suggestions:
- Ensure the use of Geo-bag and CC-Block in protective work
- Construction of new embankment along the river bank

**2.3. Impacts of the project**

- Both positive and negative impact will be occurring after implementation of the FRERMIP project intervention.
- Positive impact like- agricultural land, crops, homes, hat-bazaar, school, social institutions will be protected from riverbank erosion.
- Negative impact- Agricultural land will reduce due to land acquisition. On the other hands, houses will be needed to shift or migrate.

**2.4. Impacts on char lands**

- The char area will be protected from river erosion by implementation of the intervention and positive impact will occur in char area. Char area will sustain, as well as more crops will produce.

## Resettlement/ Relocation Issues

### **3.1. Impact of land acquisition on different group of people**

- Impact will be occurring after Impact of land acquisition of the FRERMIP
- Agricultural land will reduce due to land acquisition.
- On the other hands, houses will be needed to shift or migrate.
- Increases the number of landless of people
- loss of market facilities
- Some of peoples have no land or not able to purchase land and they take shelter others home stated

### **3.2. Relocation of houses and other establishments**

- There are severe economical effects on different professional due to migration of homes, school, and various social institution of this area
- Landless people will be rehabilitated
- People will be economically benefited
- Price of adjacent land might be increased
- Relocation should be ensured through the consultation with local allied persons

### **3.3. Choice of relocation site, availability of land and its current price**

- There is availability of land for relocation. The local people prefer both side of Utholy-Aricha highway's space as rehabilitation. The price of land is almost BDT 50,000. Per decimal for homesteads land.
- People suggested that in compensation process, prices should be fixed by the consultation with the local people rather than the average price of sub-registered office.

### **3.4. Present community social services the affected areas and relocated areas**

- There is no opportunity in river erosion area of Hat- Bazar as well as health and education services where relocation area has better facilities.
- Presently, there is inadequacy of social services both in the affected and relocated area.

### **3.5. Will this situation be improved or deteriorated after relocation?**

- The present situation must be improved if the concerned authority manage it effectively and relocate them in desired locations

### **3.6. Present level of access to market centers and towns/future level of access to market centers and towns after relocation**

- At present, access level of local people to markets and towns is low. But, it will be improved if the project is implemented.

### **3.7. What are the patterns of transport and communication in the affected area/relocated area?**

- The dwellers normally use rickshaw, van, Auto van etc to go to nearest place such as hat, bazaar in village. On the other hand, in upzilla people use CNG, Auto van, Motor cycle etc. same kind of vehicles will be used. There are street facilities for communication. Overall transportation and communication facilities are not good.

### **3.8. What are the patterns for utilizing cultural and religious facilities? Will it generate conflicts in the host community?**

- Simply socio-religious and cultural facilities are equally enjoyed by the local people and there is no major conflict about it. If it is needed due to project implementation, conflict might not be happened.

### **3.9. What types of conflicts may arise due to relocation/ resettlement?**

- There is no possibility of social conflict. In spite of this, local allied persons should be involved in the process of relocation the affected people.

| Compensation issues   |  |
|---|--|
| <b>4.1. ADB and GoB policies on involuntary resettlement</b>  | <ul style="list-style-type: none"> <li>- Local people do not know the policies on involuntary resettlement of ADB and GoB</li> </ul>   |
| <b>4.2. Discussion on entitlements, compensation rates, income restoration, and grievance redress mechanism</b>   | <ul style="list-style-type: none"> <li>- The local people have preferred to have compensation by Union Parishad or Bank. Some people believe that hard cash might create predicament. Sometimes landowner does get money. In that case, land can be provided as replace of land.</li> <li>- Compensation should be given on the basis current price land rather than traditional policy</li> <li>- Ensuring compensated money to the actually affected people</li> </ul> |
| <b>4.3. People's preference on mode of compensation payment and their previous experience</b>   | <ul style="list-style-type: none"> <li>- In case of compensation they prefer money rather land as they feel freedom of choice</li> </ul>   |
| <b>4.4. Cut-off date for listing affected properties</b>  |  |
| Income restoration and generation   |  |
| <b>4.1. What are the current income generating activities of APs?</b>   | <ul style="list-style-type: none"> <li>- The main sources of income of this area are agriculture and handloom. But there are also have a little range of fisher men, business men, job holder and other professionals.</li> </ul>  |
| <b>4.2. Are there possibilities for continuing employment in the project area? Which type of occupation?</b>  | <ul style="list-style-type: none"> <li>- Many of them will bound to change their occupation due to changed environment and situation. However, being migrated if population, present income generating source could be sustained.</li> </ul>   |
| <b>4.3. What types of income-generating activities are available at relocation sites? and to be generated?</b>  | <ul style="list-style-type: none"> <li>- There are almost same in income generating source between affected area and project relocated area. Nevertheless, in project relocated area has predominance of handloom occupation.</li> </ul>   |
| <b>4.4. How does relocation of households affect the current market situation (job opportunities, competition, land price and market price situation)</b> | <ul style="list-style-type: none"> <li>- Due to migration process, Abundance of labour force might be seen in newly relocated area, which might influence on local labour market. As a result, labour competition might increase and might lessen wage.</li> <li>- Labour availability will be increased. There is a chance to be more labor than less work</li> <li>- Land price will be increased</li> <li>- Social neighborhood will increased</li> </ul>             |
| <b>4.5. How many people can be absorbed?</b>  | <ul style="list-style-type: none"> <li>- Almost affected people could be people can be absorbed.</li> </ul>  |
| <b>4.6. Does this require training for skill development and IGA?</b>   | <ul style="list-style-type: none"> <li>- Livestock rearing training</li> <li>- Swinging training</li> <li>- Health training</li> <li>- Fish culture training</li> <li>- Agricultural training etc</li> <li>- Skill development training is highly needed for the local people. In addition, training should be given on disaster risk reduction</li> </ul>   |
| <b>4.7. How many people need to be trained and for what occupation?</b>   | <ul style="list-style-type: none"> <li>- By proper providing proper training, a great development of handloom will be brought</li> </ul>   |

|   |
|---|
| and will create more employment opportunities. Related with handloom should provide proper training and better opportunities by govt. and NGOs. Almost half of total people should be trained up.   |
| <b>Social Development Support</b>   |
| <p><b>5.1. Name of NGOs prevailing in the relocation site</b></p> <ul style="list-style-type: none"> <li>- BRAC, CEDIA, Grameen Bank, ASA, Paribar Unnoyn Samajik Sangasta, Pard, ASEA</li> <li>- CODAC and many other NGOs are working in this area.</li> </ul> <p><b>5.2. Willingness of NGOs to support the APs for savings and income generation programs, providing capital support for income restoration and poverty reduction.</b></p> <ul style="list-style-type: none"> <li>- NGOs worker are working in Savings, Income generating activities, financial assistance in re-settlement of income and in eradicating poverty. NGOs could expand their activities if they get financial assistance.</li> </ul> <p><b>5.3. Social safeguard and safety nets</b></p> <ul style="list-style-type: none"> <li>- The opportunities of social safety net are moderate. They need adequate financial assistance is needed. They also need training related to awareness. Employment generating activities should be increased.</li> </ul> |
| <b>Outcome (s)</b>  |
| <ul style="list-style-type: none"> <li>- All livelihood sectors are affected by erosion and flood</li> <li>- They demanded immediate bank protection</li> <li>- They show willingness to be relocated in purpose of protective work</li> <li>- There is no major social conflict regarding relocation</li> <li>- Prior consultation with local allied persons is highly required before starting work</li> <li>- Income and employment will be generated</li> <li>- Compensation should be given in money considering the current market price</li> <li>- Lifestyle of the local people will be improved</li> </ul>   |
| <b>Special Attention</b>  |
| quirements of new embankment and protect work   |

**Table A8.5: First-Round Meeting Summary, Shibalaya Upazila Complex, Manikgonj**

|  |
|--|
| Project/Subproject: <b>Integrated Flood and Riverbank Erosion Management Investment Program</b>  |
| Meeting date: <b>27.02.2013</b>  |
| Place: <b>Shahzadpur Upazila Complex, Sirajganj</b>  |
| <p>Attending:</p> <p><b><u>Proponents:</u></b></p> <p>BWDB, NHC, ADB</p> <p><b><u>Stakeholders:</u></b></p> <ul style="list-style-type: none"> <li>• <b>Primary:</b> Farmers, fishermen, local business community as well as the households to be displaced, women groups, and caretakers of community properties.</li> <li>• <b>Secondary:</b> Those who may not be directly affected but have interests that could contribute to the study, play a role in implementation at some stage, or affect decision making on Project</li> </ul> |



aspects. In this Project NGOs, concerned government departments, and line agencies are considered.

**ported by:** Mobasher Bin Ansari, Professional, CEGIS

### Issues, questions, responses, comments:

#### 1.1. People's perception, opinion and attitude

- Major problems relating to flood and riverbank erosion,
- Attitude of the people towards the project (FRERMIP) and its proper completion,
- Impact (positive and negative) of the project and mitigation measures against negative impact,
- Unanticipated Impacts on Charlands

#### 1.2. Resettlement/ Relocation issues

- Impact of land acquisition on different group of people (farmer, fisherman, vulnerable people, and others),
- Relocation of houses and other establishments,
- Choice of relocation site, availability of land (agricultural, homestead, etc.) and its current price,
- Present community social services (eg health care, education) in the affected areas and relocated areas,
- Will this situation be improved or deteriorated after relocation?
- Present level of access to market centers and towns/future level of access to market centers and towns after relocation,
- What are the patterns of transport and communication in the affected area/relocated area?
- What are the patterns for utilizing cultural and religious facilities? Will it generate conflicts in the host community?
- What types of conflicts may arise due to relocation/resettlement?

#### 1.3. Compensation issues

- ADB and GoB policies on involuntary resettlement,
- Discussion on entitlements, compensation rates, income restoration, and grievance redress mechanism,
- People's preference on mode of compensation payment and their previous experience,
- Cut-off date for listing affected properties

#### 1.4. Income restoration and generation

- What are the current income generating activities of APs?
- Are there possibilities for continuing employment in the project area? Which type of occupation?
- What types of income-generating activities are available at relocation sites? and to be generated?
- How does relocation of households affect the current market situation (job opportunities, competition, land price and market price situation)?
- How many people can be absorbed?
- Does this require training for skill development and IGA?
- How many people need to be trained and for what occupation?

#### 1.5. Social Development Support

- Name of NGOs prevailing in the relocation site,
- Willingness of NGOs to support the APs for savings and income generation programs, providing capital support for income restoration and poverty reduction.
- Social safeguard and safety nets

| Outcomes (s)  |  |
|---|--|
| People's perception, opinion and attitude   |  |
| <p><b>2.1. Main problems due to erosion and flooding:</b></p> <ul style="list-style-type: none"> <li>- Flooding</li> <li>- river bank erosion</li> <li>- Damage of households and assets</li> <li>- Damage of bridge, culvert and livestock etc.</li> </ul> <p><b>2.2. Peoples' responses to the FRERMIP project:</b></p> <ul style="list-style-type: none"> <li>- Participants expressed positive attitude to the project implementation and demanded its early implementation adjacent villages of Padma River bank;</li> </ul> <p><b>2.3. Impacts of the project</b></p> <ul style="list-style-type: none"> <li>- People opined that this project must bring immense socio-economic benefits for them</li> </ul>   |  |
| Resettlement/ Relocation issues   |  |
| <p><b>3.1. Negative impact of land acquisition on different group of people</b></p> <ul style="list-style-type: none"> <li>- Bank erosion will increase due to unplanned river management program</li> <li>- Lack of permanent protection work will not be enough to save households and agricultural and in project area.</li> </ul>   |  |
| <p><b>3.2. Positive impact of land acquisition on different group of people:</b></p> <ul style="list-style-type: none"> <li>- To save agricultural land, households, bridges and culvert from river bank erosion and flood.</li> <li>- Increase agricultural production</li> <li>- The stone base construction work from gravel layer will ensure its longevity.</li> </ul> <p><b>3.3. Unanticipated Impacts on Charlands</b></p> <ul style="list-style-type: none"> <li>- No unanticipated impacts will observe on Charlands people rather this activities will ensure more food production and safety for them.</li> </ul> <p><b>3.4. Impact of land acquisition on different group of people (farmer, fisherman, vulnerable people, and others),</b></p> <ul style="list-style-type: none"> <li>- The farmers and local people will lose their agricultural and homestead land due to land acquisition;</li> <li>- They demanded adequate compensation and other benefits for the loss of their assets and livelihood, as well as alternative place for relocation of their houses and business.</li> </ul> <p><b>3.5. Relocation of houses and other establishments,</b></p> <ul style="list-style-type: none"> <li>- Relocation of houses and other establishments will possible in new Charlands,</li> </ul> <p><b>3.6. Choice of relocation site, availability of land (agricultural, homestead, etc.) and its current price,</b></p> <ul style="list-style-type: none"> <li>- Government can decide best for relocation of site</li> <li>- There are available land for relocation</li> <li>- Current land price is now:</li> <li>- Agricultural land is 20,000BDT for each decimal.</li> <li>- Homestead land is 30,000BDT for each decimal.</li> </ul> <p><b>3.7. Present community social services (eg health care, education) in the affected areas and relocated areas,</b></p> <ul style="list-style-type: none"> <li>- The present health and education services in project area not satisfactory</li> <li>- Lack of health centres and schools in both project and relocated areas</li> </ul> <p><b>3.8. Will this situation be improved or deteriorated after relocation?</b></p> <ul style="list-style-type: none"> <li>- After relocation this situation may not improve as high but definitely improve after few years</li> </ul> <p><b>3.9. Present level of access to market centers and towns/future level of access to market centers and towns after relocation,</b></p> |  |

|   |  |
|---|--|
| <ul style="list-style-type: none"> <li>- At present access to market is not satisfactory.</li> </ul> <p><b>3.10. What are the patterns of transport and communication in the affected area/relocated area?</b></p> <ul style="list-style-type: none"> <li>- Modes of transportations in the project area are Rickshaw and van. Most of the people communicate through foot.</li> </ul> <p><b>3.11. What are the patterns for utilizing cultural and religious facilities? Will it generate conflicts in the host community?</b></p> <ul style="list-style-type: none"> <li>- People of these areas are practicing homogenous cultural practices for 100 of years. No social conflicts are exists in whole project area</li> </ul> <p><b>3.12. What types of conflicts may arise due to relocation/resettlement?</b></p> <ul style="list-style-type: none"> <li>- According to local people, no conflicts will happen due to relocation/resettlement. If any will rise, local power holder can solve this problem easily.</li> </ul> | <p style="text-align: center;"><b>Compensation issues, income restoration and generation</b></p> <p><b>4.1. ADB and GoB policies on involuntary resettlement</b></p> <ul style="list-style-type: none"> <li>- Local people are totally unknown about ADB and GoB policies on involuntary resettlement issues.</li> </ul> <p><b>4.2. Discussion on entitlements, compensation rates, income restoration, and grievance redress mechanism,</b></p> <ul style="list-style-type: none"> <li>- Compensation should be paid to actual people who are affected by land acquisition.</li> <li>- Land compensation should be given on the basis of present land price.</li> </ul> <p><b>4.3. People's preference and previous experience on mode of compensation payment</b></p> <ul style="list-style-type: none"> <li>- People's preferences on mode of compensation payment only through money.</li> </ul> <p><b>4.4. Cut-off date for listing affected properties</b></p> <ul style="list-style-type: none"> <li>- N/A</li> </ul> <p><b>4.8. What are the current income generating activities of APs?</b></p> <ul style="list-style-type: none"> <li>- Agricultural farming</li> <li>- Fishing (culture/capture)</li> <li>- Livestock rearing</li> <li>- Small cottage/Handicraft</li> <li>- Employed/service</li> <li>- Small business</li> </ul> <p><b>4.9. Are there possibilities for continuing employment in the project area? Which type of occupation?</b></p> <ul style="list-style-type: none"> <li>- The mentions above occupations are possible for continuing in the project area.</li> </ul> <p><b>4.10. What types of income-generating activities are available at relocation sites? And to be generated?</b></p> <ul style="list-style-type: none"> <li>- Agricultural farming</li> <li>- Fishing (culture/capture)</li> <li>- Livestock rearing</li> <li>- Small cottage/Handicraft</li> <li>- Employed/service</li> <li>- Small business</li> </ul> <p><b>4.11. How does relocation of households affect the current market situation (job opportunities, competition, land price and market price situation)?</b></p> <ul style="list-style-type: none"> <li>- Land price will be increased</li> <li>- Development of agriculture</li> <li>- Development of communication system</li> <li>- Improvement of livestock rearing practice etc.</li> </ul> <p><b>4.12. How many people can be absorbed?</b></p> <ul style="list-style-type: none"> <li>- About 50 percent people can be absorbed</li> </ul> |
|---|--|

|   |
|---|
| <p><b>4.13. Does this require training for skill development and IGA?</b></p> <ul style="list-style-type: none"> <li>- It is highly needed training programs on agriculture farming, livestock rearing and small cottage for the betterment of local people.</li> </ul> <p><b>4.14. How many people need to be trained and for what occupation?</b></p> <ul style="list-style-type: none"> <li>- People identified at least 80% of local are needed to trained up on these particular occupation as:</li> <li>- Improve agricultural farming</li> <li>- Fishing (culture/capture)</li> <li>- Small cottage/handicraft etc.</li> </ul>   |
| <p style="text-align: center;"><b>Social Development Support</b></p>  |
| <p><b>5.1. Name of NGOs prevailing in the relocation site</b></p> <ul style="list-style-type: none"> <li>- BRAC, Grameen Bank, PPD, Manab Mukti, UNDP, ASA</li> </ul> <p><b>5.2. Willingness of NGOs to support the APs for savings and income generation programs, providing capital support for income restoration and poverty reduction.</b></p> <ul style="list-style-type: none"> <li>- These NGOs are interested to support the APS for savings and income generation programs, providing capital for income restoration and poverty reduction.</li> </ul> <p><b>5.3. Social safeguard and safety nets</b></p> <ul style="list-style-type: none"> <li>- At present, the social safeguard and safety nets activities in the project area are not good. Local people argued more initiatives should have taken by government in this regard such as:</li> <li>- Old allowances</li> <li>- Maternity allowances</li> <li>- Widow allowances etc</li> </ul>   |
| <p style="text-align: center;"><b>Overall Findings</b></p>  |
| <p><b>Overall:</b></p> <ul style="list-style-type: none"> <li>- The local people desired for quick implementation of this project as they believe that the communication infrastructure and other facilities of the study area will be improved as well in the aftermath.</li> <li>- The land owners stated that they want higher prices of land than anticipated but still they agreed that the project would change the socio-economical condition of the area as well as of the country.</li> <li>- People demanded that the village cross road which run beside the river bank should be made as metalled road for the convenience of local people, contractor and the BWDB.</li> </ul> <p><b>Specific:</b></p> <ul style="list-style-type: none"> <li>- Participants expressed positive attitude to the project implementation and demanded its early implementation.</li> <li>- Local people expect employment opportunities during and after project implementation;</li> <li>- People suggested for the development of road communication network which in a sense would create income generating sources for the villagers;</li> <li>- The compensation should be fixed in conformity with the market value of the land; and</li> <li>- People strongly demanded a plan which will not affect the local development with an excuse of national development.</li> </ul> |

Photo A8.5: First Round Meeting Sign-in Sheet, Chauhali, Sirajganj

"প্রধান প্রধান নদীর বন্যা ও ভাঙ্গন কবলিত অঞ্চলের খুঁকি মোকাবেলা" প্রকল্পের জন্য মতবিনিময় সভার  
উপস্থিতির তালিকা "

স্থান: চৌহালী উপজেলার পরিচয় মিলনমাঠে তারিখ: ১১/০৬/২০১৬

| ক্রমিক<br>নং | নাম                                  | পেশা/পদবী                | মোবাইল নম্বর | স্বাক্ষর        |
|--------------|--------------------------------------|--------------------------|--------------|-----------------|
| ১            | আবদুল হক, ২য় বর্ডার অফিসার (সিআইসি) | সিআইসি                   | ০১৭২৭৬৩৬৮১   | [Signature]     |
| ২            | মো: আবদুল্লাহ হুসাইন                 | UNO                      | ০১৭১৬-০৭৭৭৭৩ | [Signature]     |
| ৩            | মো: কামরুল হাশিম (মুন্সী)            | ডাউন-৬২/১০<br>২য় বর্ডার | ০১৭১৬-৭৬৬৬৬  | মু.কামরুল হাশিম |
| ৪            | মো: আবদুল হক                         | ২য় বর্ডার               | ০১৭১২-৭৬৬৬৭  | [Signature]     |
| ৫            | মো: আবদুল হক                         | ২য় বর্ডার               | ০১৭১৬-২১৭১৭১ | [Signature]     |
| ৬            | মো: আবদুল হক                         | ২য় বর্ডার               | ০১৭১৬-২২৬২২৭ | [Signature]     |
| ৭            | মো: আবদুল হক                         | ২য় বর্ডার               | ০১৭১৭২৫৬৬৬   | [Signature]     |
| ৮            | মো: আবদুল হক                         | ২য় বর্ডার               | ০১৭২০৩৬৬৬২২  | [Signature]     |
| ৯            | মো: আবদুল হক                         | ২য় বর্ডার               | ০১৭১১৭৩৬৬৬১০ | [Signature]     |
| ১০           | মো: আবদুল হক                         | ২য় বর্ডার               | ০১৭১২-২৪২৪২২ | [Signature]     |
| ১১           | মো: আবদুল হক                         | ২য় বর্ডার               | ০১৭১৭২৬০২৭২  | [Signature]     |
| ১২           | মো: আবদুল হক                         | ২য় বর্ডার               | ০১৭২৭৬৭৬৭৬   | [Signature]     |
| ১৩           | মো: আবদুল হক                         | ২য় বর্ডার               | ০১৭৩০০৭৬৬৬৭  | [Signature]     |
| ১৪           | মো: আবদুল হক                         | ২য় বর্ডার               | ০১৭৪০৭৭৭৭৭৭১ | [Signature]     |
| ১৫           | মো: আবদুল হক                         | ২য় বর্ডার               | ০১৭৩০০৫০৫০   | [Signature]     |

আয়োজনে "সেন্টার ফর এনভায়রনমেন্টাল এন্ড জিওগ্রাফিক ইনফরমেশন সার্ভিসেস" (CEGIS)

CEGIS

Center for Environmental and Geographic Information Services  
(A Public Trust under The Ministry of Water Resources)  
House No. 9, Road No. 23C, Gulshan-1, Dhaka-1212, Bangladesh  
Tel: 880-2-604470-1, 6817643-10 Fax: 880-2-6050039, 6821128 e-mail: cegis@cegis.gov.bd http://www.cegis.gov.bd

"প্রধান প্রধান নদীর বন্যা ও ভাঙ্গন কবলিত অঞ্চলের খুঁকি মোকাবেলা" প্রকল্পের জন্য মতবিনিময় সভার  
উপস্থিতির তালিকা "

স্থান : উত্তরা বঙ্গবন্ধু সড়িক মিলনস্থল তারিখ: ২২/০৬/২০১৬

| ক্রমিক<br>নং | নাম                 | পেশা/পদবী                  | মোবাইল নম্বর | স্বাক্ষর |
|--------------|---------------------|----------------------------|--------------|----------|
| ০১           | মোঃ আব্দুল হক ইকবাল | চাকুরী                     | ০১৭১২৪৪৭৬৫   |          |
| ০২           | মোঃ সাইফুল ইসলাম    | ইউ পি সদস্য                | ০১৭২০-৩২০৭৫৩ |          |
| ০৬           | মোঃ জাহাঙ্গীর       | ইউ পি.                     | ০১৭৪৭৩৬৫৪৬১  |          |
| ০৮           | মোঃ মোস্তফা         | ইউ পি.                     | ০১৭৩১৪০৪০৭২  |          |
| ০৯           | মোঃ মোঃ হুমায়ুন    | ইউ পি.                     | ০১৭১২৬৬০৮৫৫  |          |
| ০৩           | মোঃ আব্দুল হাকিম    | ইউ.পি. সদস্য               | ০১৭৬৫০২২১৬০  |          |
| ০৭           | " ইউনুস আলী "       | " " মোস্তাফিজ              | ০১৭১৭-৬১৬৭৭৭ |          |
| ০৪           | আব্দুল্লাহ (বগড়া)  | ইউ পি<br>সদস্য             | ০১৭২১০৭৪০৫২  |          |
| ০১০          | মোঃ মোঃ হুমায়ুন    | ইউ.পি.<br>সদস্য            | ০১৭২৫৩৩৭০৩০  |          |
| ১০           | মোঃ মোস্তাফিজ       | মোঃ মোস্তাফিজ<br>মোস্তাফিজ | ০১৭৩০৭৫৫৭০   |          |
| ১১           | মোঃ হুমায়ুন        | মোঃ হুমায়ুন               | ০১৭১১০৭৬৬৭   |          |
| ১২           | মোঃ ফারুক           | ফারুক                      |              |          |
|              | নবীজ                | নবীজ                       |              |          |
|              | মোঃ মোস্তাফিজ       | মোঃ মোস্তাফিজ              |              |          |
|              | বাকার               | বাকার                      |              |          |

আয়োজনে "সেন্টার ফর এনভায়রনমেন্টাল এন্ড জিওগ্রাফিক ইনফরমেশন সার্ভিসেস" (CEGIS)

**CEGIS**

Center for Environmental and Geographic Information Services  
(A Public Trust under The Ministry of Water Resources)  
House No. 6, Road No. 23/1, Gulshan-1, Dhaka-1212, Bangladesh  
Tel: 880-2-8821576-1, 88217045-52 Fax: 880-2-8825805, 8821128 e-mail: cegis@cegisbd.com http://www.cegisbd.com



**Photo A8.6: First Round Meeting Sign-In Sheet, Harirampur, Sirajganj**

“প্রধান প্রধান নদীর বন্যা ও ভাঙ্গন কবলিত অঞ্চলের বুকি মোকাবেলা” প্রকল্পের জন্য মতবিনিময় সভার  
উপস্থিতির তালিকা”

हान: - इतिहासपूत्र उपप्लवक पत्रिका मिसावर्ग कानि: 24/02/2026

| ক্রমিক<br>নং | নাম                         | পেশা/পদবী                 | মোবাইল নম্বর | স্বাক্ষর |
|--------------|-----------------------------|---------------------------|--------------|----------|
| ১            | শ্রীঃ (মহাপ্রাণেশ্বর) শ্রীঃ | কৃষাভিঃ                   | ০১৭২২ ৯১৭২২  | শ্রীঃ    |
| ২            | শ্রীঃ, শ্রীঃ, শ্রীঃ         | শ্রীঃ, শ্রীঃ, শ্রীঃ       | ০১৭২৪-৪৬৪৬২  | শ্রীঃ    |
| ৬            | শ্রীঃ-০১৭২৪                 | শ্রীঃ-০১৭২৪               | ০১৭২৪-৩৪৩০৪  | শ্রীঃ    |
| ৪            | শ্রীঃ, শ্রীঃ, শ্রীঃ         | শ্রীঃ, শ্রীঃ, শ্রীঃ       | ০১৭২৪ ৩৪৩০৪  | শ্রীঃ    |
| ৫            | Md. Lutfar Rahman           | U Agri officer            | ০১৭৪৪২২৫৬    | শ্রীঃ    |
| ৬            | Md. Nazrul Islam            | UPR-24th Engineer         | ০১৭৪৪২২৫৬    | শ্রীঃ    |
| ৭            | A.K.M. MIZANUR RAHMAN       | U.L.O. (U.L.O. Manikganj) | ০১৭৪৪২২৫৬    | শ্রীঃ    |
| ৮            | Abubakar Siddik             | U.L.O. (U.L.O. Manikganj) | ০১৭৪৪২২৫৬    | শ্রীঃ    |
| ৯            | Mohsin ussamen Khan         | SAB/UPR                   | ০১৭৪৪২২৫৬    | শ্রীঃ    |
| ১০           | Murshidunna Begum           | UWAO                      | ০১৭৪৪২২৫৬    | শ্রীঃ    |
| ১১           | MR. JAHATIL-FIRDAUS         | U.S.O                     | ০১৭৪৪২২৫৬    | শ্রীঃ    |
| ১২           | শ্রীঃ, শ্রীঃ, শ্রীঃ         | শ্রীঃ, শ্রীঃ, শ্রীঃ       | ০১৭৪৪২২৫৬    | শ্রীঃ    |
| ১৬           | শ্রীঃ, শ্রীঃ, শ্রীঃ         | শ্রীঃ, শ্রীঃ, শ্রীঃ       | ০১৭৪৪২২৫৬    | শ্রীঃ    |
| ১৮           | শ্রীঃ, শ্রীঃ, শ্রীঃ         | শ্রীঃ, শ্রীঃ, শ্রীঃ       | ০১৭৪৪২২৫৬    | শ্রীঃ    |
| ১৯           | শ্রীঃ, শ্রীঃ, শ্রীঃ         | শ্রীঃ, শ্রীঃ, শ্রীঃ       | ০১৭৪৪২২৫৬    | শ্রীঃ    |

ଆହୋଧାନେ “ଲେଟିସ୍ ଡବ୍ଲ୍ୟୁ ଏମ୍‌ଜାଉରନମେଣ୍ଟ ଏଣ୍ଡ ଡିଜିଟାଲ୍‌ ଇନିସିଏଟିଭ୍‌ ଟର୍ଗିଟିଂସ” (CEGIS)

C≡GIS

Center for Environmental and Geographic Information Services  
(A Public Trust under The Ministry of Water Resources)  
House No. 6, Road No. 25D, Gulshan-1, Dhaka-1212, Bangladesh  
Tel: 880-2-8071476-1, 8807666-52 Fax: 880-2-8889978, 8807178 e-mail: [cegis@cegisbd.com](mailto:cegis@cegisbd.com) <http://www.cegisbd.com>

“প্রধান প্রধান নদীর বন্যা ও ভাঙ্গন কবলিত অঞ্চলের বুকি মোকাবেলা” প্রকল্পের জন্য মতবিনিময় সভার  
উপস্থিতির তালিকা ”

স্থান : হবিগড়পুর উপজেলা পরিষদ নিমন্ত্রণে তারিখ: ২৬/০২/২০১৬

| ক্রমিক<br>নং | নাম                   | পেশা/পদবী  | মোবাইল নম্বর | স্বাক্ষর |
|--------------|-----------------------|--|--------------|----------|
| ১৬           | আমিনুল হক খান         | স্বাস্থ্য ও পরিবার কল্যাণ<br>স্বাস্থ্য কর্মকর্তা | ০১৭২৬ ১১০৬১৬ |          |
| ১৭           | মোস্তাফিজুর রহমান     | স্বাস্থ্য কর্মকর্তা                              | ০১৭১৭৩৫৩৭০১  |          |
| ১৮           | বোমা জিয়াসমীন        | স্বাস্থ্য কর্মকর্তা                              | ০১৭৩৩০৭৬০২৬  |          |
| ১৯           | ডেপুটি ইন্সপেক্টর     | UP সদস্য   |              |          |
| ২০           | ইন্সপেক্টর            | UP সদস্য   | ০১৭৩৬২১৬৭৪   |          |
| ২১           | ডেপুটি ইন্সপেক্টর     | স্বাস্থ্য কর্মকর্তা                              | ০১৭ ২৬০৬০২০১ |          |
| ২২           | মো: মোস্তাফিজুর হোসেন | স্বাস্থ্য কর্মকর্তা                              | ০১৭৬২৫৬২০২   |          |
| ২৬           | মো: মোস্তাফিজুর হোসেন | স্বাস্থ্য কর্মকর্তা                              | ০১৭৬৫৭৭৭১০২  |          |
| ২৮           | মো: মোস্তাফিজুর হোসেন | স্বাস্থ্য কর্মকর্তা                              | ০১৭২২৬০২১১৫৩ |          |
| ২৮           | মো: মোস্তাফিজুর হোসেন | স্বাস্থ্য কর্মকর্তা                              | ০১৭২২৩৬৫৬৬৪  |          |
| ২৬           | মো: মোস্তাফিজুর হোসেন | স্বাস্থ্য কর্মকর্তা                              | ০১৭২২০০০৪৫৪  |          |
| ২৭           | মো: মোস্তাফিজুর হোসেন | স্বাস্থ্য কর্মকর্তা                              | ০১৭৬৩-৪৪৪৭০৪ |          |
| ২৮           | মো: মোস্তাফিজুর হোসেন | স্বাস্থ্য কর্মকর্তা                              | ০১৭২২৫১৬৬২৪  |          |
| ২৯           | মো: মোস্তাফিজুর হোসেন | স্বাস্থ্য কর্মকর্তা                              | ০১৭১৫৪৪৫৪০   |          |
| ৬০           | মো: মোস্তাফিজুর হোসেন | স্বাস্থ্য কর্মকর্তা                              | ০১৭৪১১৪১৪৬৪  |          |

আয়োজনে “সেন্টার ফর এনভায়রনমেন্টাল এন্ড জিওগ্রাফিক ইনফরমেশন সার্ভিসেস” (CEGIS)

CEGIS

Center for Environmental and Geographic Information Services  
(A Public Trust under The Ministry of Water Resources)  
House No. 8, Road No. 23/C, Gulshan-1, Dhaka-1212, Bangladesh  
Tel: 880-2-8821570-1, 8817648-52 Fax: 880-2-8855935, 8823128 e-mail: cegis@cegisbd.com http://www.cegisbd.com



“প্রধান প্রধান নদীর বন্যা ও ভাঙ্গন কবলিত অঞ্চলের ঝুঁকি মোকাবেলা” প্রকল্পের জন্য মতবিনিময় সভার  
উপস্থিতির তালিকা ”

স্থান :

তারিখ:

| ক্রমিক<br>নং | নাম                  | পেশা/পদবী               | মোবাইল নম্বর | স্বাক্ষর |
|--------------|----------------------|-------------------------|--------------|----------|
| ৩১           | আবদুল হান্নান ক্রিশ  | UNO                     | ০১৭৫২৪৬৩৪৬৬  |          |
| ৩২           | ডেওজান হাফিজুর রহমান | উপজেলা চেয়ারম্যান      | ০১৭৪৬১৭৪৪১   |          |
| ৩৬           | ইমরুল হামান ইমাম     | ডাঃ ডাঃ ডাঃ             | ০১৭১৫৪৬৭২৪৭  |          |
| ৩৪           | মোঃ মোস্তাফিজ        | সহকারী সিস্টেম এনালিস্ট | ০১৭১১-২৭৬০৬০ |          |
| ৩৫           | ডাঃ জুবায়েরুল্লাহ   | ডাঃ সিস্টেম এনালিস্ট    | ০১৭১৫৪৬৩৪৬   |          |
| ৩৬           | ডেওজান হাফিজুর রহমান | Value chain Specialist  | ০১৭২৫০৫৭৫    |          |
| ৩৭           | মোঃ মোস্তাফিজ        | সিস্টেম এনালিস্ট        | ০১৭১২০৭৬৩২   |          |
| ৩৮           | মোঃ মোস্তাফিজ        | সিস্টেম এনালিস্ট        | ০১৭২০৪২১৬৫৭  |          |
| ৩৯           | মোঃ মোস্তাফিজ        | সিস্টেম এনালিস্ট        | ০১৭৫১২১৬৬৬   |          |
| ৪০           | মোঃ মোস্তাফিজ        | সিস্টেম এনালিস্ট        | ০১৭১২০২৬০৪৫  |          |
| ৪১           | মোঃ মোস্তাফিজ        | সিস্টেম এনালিস্ট        | ০১৭১৭২২৭৭৭   |          |
| ৪২           | মোঃ মোস্তাফিজ        | সিস্টেম এনালিস্ট        | ০১৭৪০৪১৫৩৫৭  |          |
| ৪৬           | মোঃ মোস্তাফিজ        | সিস্টেম এনালিস্ট        | ০১৭৭২৫১০৬০   |          |
| ৪৪           | মোঃ মোস্তাফিজ        | সিস্টেম এনালিস্ট        | ০১৭০৩৩১১৫৬   |          |
| ৪৫           | মোঃ মোস্তাফিজ        | সিস্টেম এনালিস্ট        | ০১৭১৭২১০৭০   |          |

আয়োজনে “সেন্টার ফর এনভায়রনমেন্টাল এন্ড জিওগ্রাফিক ইনফরমেশন সার্ভিসেস” (CEGIS)



**Center for Environmental and Geographic Information Services**  
(A Public Trust under The Ministry of Water Resources)  
House No. 6, Road No. 23/C, Gulshan-1, Dhaka-1212, Bangladesh  
Tel: 880-2-8821570-1, 8817648-52 Fax: 880-2-8855935, 8823128 e-mail: [cegis@cegisbd.com](mailto:cegis@cegisbd.com) <http://www.cegisbd.com>

“প্রধান প্রধান নদীর বন্যা ও ভাঙ্গন কবলিত অঞ্চলের খুঁকি মোকাবেলা” প্রকল্পের জন্য মতবিনিময় সভার  
উপস্থিতির তালিকা ”

স্থান :

তারিখ:

| ক্রমিক<br>নং | নাম              | পেশা/পদবী                    | মোবাইল নম্বর | স্বাক্ষর        |
|--------------|------------------|------------------------------|--------------|-----------------|
| ৪৬           | মোঃ কামরুল হক    | ৬৮৬৮৮-                       | ০১৭৩২৪০৫৮২   | কামরুল          |
| ৪৭           | আবদুল হক         | ৮৮৮৮৮                        | ০১৭৭৮১৮৩৮৫   | আবদুল           |
| ৪৮           | মোঃ বাহের আলী    | কামরুল                       | ০১৭১৫৭২৫৩৭   | বাহের আলী       |
| ৪৯           | আবদুল হান্নান    | চাকরি                        | ০১৭৭৫২৫৫৭৭   | আবদুল           |
| ৫০           | মুহাম্মদ হান্নান | ৮৮৮                          | ০১৭৮০০৭২৩১   | মুহাম্মদ        |
| ৫১           | মোঃ কামাল হোসেন  | মোঃ কামাল হোসেন<br>কামরুল হক | ০১৭১১০৬০২১৭  | কামাল           |
| ৫২           | আবদুল            | মোঃ কামাল হোসেন              | ০১৭৭৮০৫৭০৬   | আবদুল           |
| ৫৩           | আবদুল            | মোঃ কামাল হোসেন              |              | আবদুল           |
| ৫৪           | মোঃ কামাল হোসেন  |                              | ০১৭৩১৫৬৬     | মোঃ কামাল হোসেন |
| ৫৫           | আবদুল            | কামরুল                       | ০১৭১৭২১০৭০২  | আবদুল           |
| ৫৬           | আবদুল            | কামরুল                       | ০১৭৬৬৮৬২৩    | আবদুল           |
| ৫৭           | আবদুল            | কামরুল                       | ০১৭৩৪-৭৭৭০৮৭ | আবদুল           |
|              |                  |                              |              |                 |
|              |                  |                              |              |                 |
|              |                  |                              |              |                 |

আয়োজনে “সেন্টার ফর এনভায়রনমেন্টাল এন্ড জিওগ্রাফিক ইনফরমেশন সার্ভিসেস” (CEGIS)

CEGIS

Center for Environmental and Geographic Information Services  
(A Public Trust under The Ministry of Water Resources)  
House No. 6, Road No. 23/C, Gulshan-1, Dhaka-1212, Bangladesh  
Tel: 880-2-8821570-1, 8817648-52 Fax: 880-2-8855935, 8823128 e-mail: cegis@cegisbd.com http://www.cegisbd.com


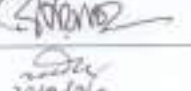
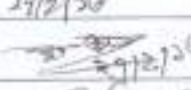

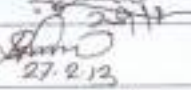
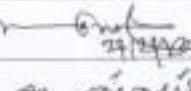


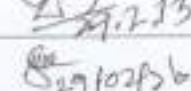










"প্রধান প্রধান নদীর বন্যা ও ভাঙন কমানোর উদ্দেশ্যে নদী তীর সুরক্ষা কর্মসূচী" প্রকল্পের জন্য মতবিনিময় সভার  
উপস্থিতির তালিকা "

স্থান : আশা-কামাখ্যা উপজেলা পরিষদ ভবন, মিলনবাড়ী

তারিখ: ২৭.১২.১৬

| ক্রমিক<br>নং | নাম                      | পেশা/পদবী                        | মোবাইল নম্বর | স্বাক্ষর  |
|--------------|--------------------------|----------------------------------|--------------|---|
| ০১           | শ্রী: হারুন আর রশিদ      | চাকরি<br>১২৩৪৫৬৭৮                | ০১৭৩ ৭১৫৪১৭  |    |
| ০২           | শ্রী: নূরুজ্জামান        | চাকরি                            | ০১৭২৩০৬৭৫৭   |    |
| ০৩           | শ্রী: আব্দুল মঈন         | ই.আ. সার্ভিস<br>কম্পানী/প্রকৌশলী | ০১৭১৫ ৩১৭০৩৭ |    |
| ০৪           | শ্রী: কামাল হোসেন        | চাকরি                            | ০১৭৩০১৭৪০৭   |   |
| ০৫           | শ্রী: মাহমুদুল্লাহ বিজয় | চাকরি                            | ০১৭১০ ৫২৬২৩০ |  |
| ০৬           | শ্রী: আব্দুল করিম        | চাকরি<br>৩.১৫                    | ০১৭১৭ ৭৬৫২৬৬ |  |
| ০৭           | শ্রী: মঈনুল হক           | চাকরি<br>১২৩৪৫৬৭৮<br>১২৩৪ ৫৬৭৮   | ০১৭১৭-০২৩৩২৩ |  |
| ০৮           | শ্রী: আব্দুল নসিম        | চাকরি<br>১২৩৪৫৬৭৮                | ০১৭৩০০২৫৪৫৩  |  |
| ০৯           | শ্রী: মোঃ আমিন           | চাকরি<br>১২৩৪৫৬৭৮                | ০১৭১২৭৫৯৩৫১  |  |
| ১০           | শ্রী: হানিফুর রহমান      | ইউ.সি.ও                          | ০১৭১৭৬৫৯৭৫   |  |
| ১১           | শ্রী: আব্দুল কাদের       | ইউ.সি.ও                          | ০১৭১০ ৭৬৫৫৫৫ |  |
| ১২           | শ্রী: আব্দুল জব্বার      | ইউ.সি.ও                          | ০১৭১৭-৮৫৬২০৭ |  |
| ১৩           | শ্রী: মোঃ হোসেন          | ইউ.সি.ও                          | ০১৭১৮-৮৫১৮৬৬ |  |
| ১৪           | শ্রী: মোঃ আব্দুল হক      | চাকরি<br>১২৩৪৫৬৭৮                | ০১৭১২ ৫৫৫৪৩৭ |  |
| ১৫           | শ্রী: মোঃ হোসেন          | চাকরি<br>১২৩৪৫৬৭৮                | ০২৭১২৭২২৩৫৬  |  |

আয়োজনে "সেন্টার ফর এনভায়রনমেন্টাল এন্ড জিওগ্রাফিক ইনফরমেশন সার্ভিসেস" (CEGIS)

CEGIS

Center for Environmental and Geographic Information Services  
(A Public Trust under The Ministry of Water Resources)  
House No. 8, Road No. 23/C, Duttan-1, Dhaka-1212, Bangladesh  
Tel: 880-2-8821570-1, 8821540-52 Fax: 880-2-8821535, 8821134 e-mail: cegis@cegis.org.bd www.cegis.org.bd



## Photo A8.8: First Round Meeting Sign-In Sheet, Shibalaya, Manikganj

“প্রধান প্রধান নদীর বন্যা ও ভাঙ্গন কবলিত অঞ্চলের ঝুঁকি মোকাবেলা” প্রকল্পের জন্য মতবিনিময় সভার  
উপস্থিতির তালিকা”

স্থান : শিবালয়া উপজেলা পরিষদ দিল্লীঘাট-৬৬ তারিখ: ২৭/০৪/২০১৬

| ক্রমিক<br>নং | নাম                 | পেশা/পদবী                         | মোবাইল নম্বর | স্বাক্ষর |
|--------------|---------------------|-----------------------------------|--------------|----------|
| ১            | একিউন এনালিসিস অফিস | একিউন                             | ০১৭১-৫১২৬৪৮  | ২৭/০৪/১৬ |
| ২            | আব্দুল হামিদ মল্লিক | ক্রিয়াকর্মী<br>ইপারিস লাইসেন্স   | ০১৭২০২১৬৬৭   | ২৭/০৪/১৬ |
| ৬            | একিউন এনালিসিস অফিস | UNO,                              | ০১৭১০৬৭৬৮    | ১৭.৪.১৬  |
| ৪            | একিউন এনালিসিস অফিস | ডা. সিরাজুল<br>হাসান, ডা. সিরাজুল | ০১৭১৩৩৭৩৪১   | ১৭.৪.১৬  |
| ৫            | একিউন এনালিসিস অফিস | ডা. সিরাজুল<br>হাসান, ডা. সিরাজুল | ০১৭১৭১১৬১৪   | ১৭.৪.১৬  |
| ৬            | একিউন এনালিসিস অফিস | ডা. সিরাজুল<br>হাসান, ডা. সিরাজুল | ০১৭১১-২৪২২২  | ১৭.৪.১৬  |
| ৭            | একিউন এনালিসিস অফিস | ডা. সিরাজুল<br>হাসান, ডা. সিরাজুল | ০১৭১৬০৬৩০৪৭  | ১৭.৪.১৬  |
| ৮            | একিউন এনালিসিস অফিস | ডা. সিরাজুল<br>হাসান, ডা. সিরাজুল | ০১৭১২২২৪৬৭০  | ১৭.৪.১৬  |
| ৯            | একিউন এনালিসিস অফিস | ডা. সিরাজুল<br>হাসান, ডা. সিরাজুল | ০১৭১১-০১৭১৮৬ | ১৭.৪.১৬  |
| ১০           | একিউন এনালিসিস অফিস | ডা. সিরাজুল<br>হাসান, ডা. সিরাজুল | ০১৭২০-৫৭৫৩৭৫ | ১৭.৪.১৬  |
| ১১           | একিউন এনালিসিস অফিস | ডা. সিরাজুল<br>হাসান, ডা. সিরাজুল | ০১৭১১-২৪৫৬৩৫ | ১৭.৪.১৬  |
| ১২           | একিউন এনালিসিস অফিস | ডা. সিরাজুল<br>হাসান, ডা. সিরাজুল | ০১৬৭৪-৭০০৫১৪ | ১৭.৪.১৬  |
| ১৬           | একিউন এনালিসিস অফিস | ডা. সিরাজুল<br>হাসান, ডা. সিরাজুল | ৭৭৬১১৪       | ১৭.৪.১৬  |
| ১৪           | একিউন এনালিসিস অফিস | ডা. সিরাজুল<br>হাসান, ডা. সিরাজুল | ০১৭১৩৩৭৪০৭   | ১৭.৪.১৬  |
| ১৫           | একিউন এনালিসিস অফিস | ডা. সিরাজুল<br>হাসান, ডা. সিরাজুল | ০১৭১৩৪৬২৪৫   | ১৭.৪.১৬  |

আয়োজনে “সেন্টার ফর এনভায়রনমেন্টাল এন্ড জিওগ্রাফিক ইনফরমেশন সার্ভিসেস” (CEGIS)

CEGIS

Center for Environmental and Geographic Information Services  
(A Public Trust under The Ministry of Water Resources)  
House No. 6, Road No. 23/C, Gulshan-1, Dhaka-1212, Bangladesh  
Tel: 880-2-8821570-1, 8817648-52 Fax: 880-2-8855935, 8823128 e-mail: cegis@cegisbd.com http://www.cegisbd.com



"প্রধান প্রধান নদীর বন্যা ও ভাঙ্গন কবলিত অঞ্চলের ঝুঁকি মোকাবেলা" প্রকল্পের জন্য মতবিনিময় সভার  
উপস্থিতির তালিকা "

স্থান: মিনারুল্লাহ-ইনস্টিটিউট ন্যাশনাল মিনারুল্লাহ

তারিখ: ২৭/০৪/২০১৬

| ক্রমিক<br>নং | নাম                   | পেশা/পদবী        | মোবাইল নম্বর  | স্বাক্ষর |
|--------------|-----------------------|------------------|---------------|----------|
| ১৬.          | জৈন্তা মন্ডল          | জ্যেষ্ঠ প্রকৌশলী | ০১০০৩৫১২৫১    |          |
| ১৭.          | ডেপুটি ডায়াল মন্ডল   | ডায়াল           | ০১৭১৪৪৭৬৪০    |          |
| ১৮.          | হাবিবুল্লাহ মন্ডল     | ডেপুটি ডায়াল    | ০১৭১১৩১০৫১৭   |          |
| ১৯.          | মোঃ মোস্তাফিজুর রহমান | ডেপুটি ডায়াল    | ০১৭১৩৫৭৭২৭৭   |          |
| ২০.          | মোঃ হাবিবুল্লাহ মন্ডল | ডেপুটি ডায়াল    | ০১৭১৬৫২০০৫১   |          |
| ২১.          | মোঃ আবুল কালাম মন্ডল  | ডেপুটি ডায়াল    | ০১৭১৭৭৭০৩৪    |          |
| ২২.          | মোঃ আমজাদ মন্ডল       | ডেপুটি ডায়াল    | ০১৭১৫-১৫২৫১০  |          |
| ২৩.          | মোঃ হাবিবুল্লাহ মন্ডল | ডেপুটি ডায়াল    | ০১৭১১-১১০৭০৭৭ |          |
| ২৪.          | ডেপুটি ডায়াল মন্ডল   | ডেপুটি ডায়াল    | ০১৮৩৪১০৬৩৯৪   |          |
| ২৫.          | জি.এ.এ. মন্ডল         | U.H. & F.P.O.    | ০১৭১২-৫৫৫৭১১  |          |
| ২৬.          | মোঃ হাবিবুল্লাহ মন্ডল | AC (L)           | ০১৭১৬৯৪৬৩৬৭   |          |
| ২৭.          | মোঃ হাবিবুল্লাহ মন্ডল | ডেপুটি ডায়াল    | ০১৭১৩-৫২০৫৭৪  |          |
| ২৮.          | মোঃ হাবিবুল্লাহ মন্ডল | ডেপুটি ডায়াল    | ০১৭১৪৫৭৪৭৭৭   |          |
| ২৯.          | মোঃ হাবিবুল্লাহ মন্ডল | ডেপুটি ডায়াল    | ০১৭১৩-৫২০৫৭৪  |          |
| ৩০.          | মোঃ হাবিবুল্লাহ মন্ডল | ডেপুটি ডায়াল    | ০১৭১৪৩৫১৩১৬   |          |

আয়োজনে "সেন্টার ফর এনভায়রনমেন্টাল এন্ড জিওগ্রাফিক ইনফরমেশন সার্ভিসেস" (CEGIS)















**CEGIS**

Center for Environmental and Geographic Information Services  
(A Public Trust under The Ministry of Water Resources)  
House No. 8, Road No. 2307, Gulshan-1, Dhaka-1212, Bangladesh  
Tel: 880-2-880120-1, 8807648-52 Fax: 880-2-8855935, 8805128 e-mail: cegis@cegisbd.com, http://www.cegisbd.com

“প্রধান প্রধান নদীর বন্যা ও ভাঙ্গন কবলিত অঞ্চলের বুঁকি মোকাবেলা” প্রকল্পের জন্য মতবিনিময় সভার  
উপস্থিতির তালিকা ”

স্থান : মির্জাপুর উপজেলা পরিষদ নিম্নমহল

তারিখ: ১৭/০৪/২০১৬

| ক্রমিক<br>নং | নাম                       | পেশা/পদবী                        | মোবাইল নম্বর | স্বাক্ষর  |
|--------------|---------------------------|----------------------------------|--------------|---|
| ৩১.          | মোঃ আব্দুল মলিক           | উপজেলা প্রকৌশলী                  | ০১৭২০-২৮৪৬৮০ |    |
| ৩২.          | মোঃ আব্দুল মলিক           | ই. এ. এ. এ. এ.                   | ০১৮১১২১২৩২   |    |
| ৩৩.          | মিঃ বেলাল                 | উপজেলা কালিদাস<br>বিশ্বাস অফিসার | ০১৮১২৮৬৪৬৬৬  |    |
| ৩৪.          | হুমায়ুন কামরুন           | উপজেলা শিক্ষা<br>অফিসার          | ০১৭১১৭৭৮০৮৫  |    |
| ৩৫.          | হামিদা হোসেন              | উপজেলা প্রকৌশলী<br>উপজেলা পরিষদ  | ০১৭১৪৬৪৭৮০   |   |
| ৩৬.          | আ.তা.ম. বৃষ্টিচন্দ্রমণ্ডল | উপজেলা প্রকৌশলী<br>উপজেলা পরিষদ  | ০১৭৭৬৬৮২০৮১  |  |
| ৩৭.          | মোঃ আব্দুল মলিক           | মাস্টার ইঞ্জিনিয়ার              | ০১৭৬৬৫৭৮১৫   |  |
| ৩৮.          | মুহিবুল হক                | উপজেলা প্রকৌশলী<br>উপজেলা পরিষদ  | ০১৭১২২৭২৭৭৩  |  |
| ৩৯.          | মোঃ আব্দুল মলিক           | উপজেলা প্রকৌশলী<br>উপজেলা পরিষদ  | ০১৭৬১৭৭৬৩১   |  |
| ৪০.          | মুহিবুল হক                | মিঃ উপজেলা<br>প্রকৌশলী           | ০১৭১২৫০২২৩   |  |
| ৪১.          | মোঃ আমজাদ হক              | ব্রাহ্ম উদ্ভিদ                   | ০১৭২২৮৫৫১৮২  |  |
| ৪২.          | আব্দুল আজহার              | কিষ্কর                           | —            |  |
| ৪৩.          | মতিঃ আব্দুল হক            | পিস ইমাম                         | ০১৬৭২৬২৬৫২৩  |  |
| ৪৪.          | আব্দুল হক                 | কসমারী                           | ০১৭৩৫৭৮২৫৬   |  |
| ৪৫.          |                           |                                  |              |   |

আয়োজনে “সেন্টার ফর এনভায়রনমেন্টাল এন্ড জিওগ্রাফিক ইনফরমেশন সার্ভিসেস” (CEGIS)

**CEGIS**

Center for Environmental and Geographic Information Services  
(A Public Trust under The Ministry of Water Resources)  
House No. 6, Road No. 23/C, Gulshan-1, Dhaka-1212, Bangladesh  
Tel: 880-2-8821570-1, 8817648-52 Fax: 880-2-8855935, 8823128 e-mail: cegis@cegisbd.com http://www.cegisbd.com



## Photo A8.9: Questionnaire, Public Consultation Meeting

## মত বিনিময় সভার আলোচ্য বিষয়

## ১। প্রকল্পের প্রভাব

- ১.১ রাস্তা ভাঙ্গন ও বন্যা সম্পর্কিত প্রধান প্রধান সমস্যা কি কি?
- ১.২ এম,আর,পি প্রকল্প বাস্তবায়ন সম্পর্কে জনগণের অভিমত কি?
- ১.৩ এম,আর,পি প্রকল্পের সম্ভাব্য প্রভাব (ইতিবাচক নেতিবাচক) কি?
- ১.৪ নেতিবাচক প্রভাব প্রশমনে প্রয়োজনীয় পদক্ষেপ গুলো কি কি?
- ১.৫ প্রকল্প বাস্তবায়িত হলে চর অঞ্চলের ওপর প্রভাব পড়বে কি? পড়লে, তা কি ধরনের?

## ২। পুনর্বসতি/স্থানান্তর

- ২.১ জমি অধিগ্রহণের ফলে ঘর-বাড়ী ও অন্যান্য স্থাপনা সমূহের স্থানান্তরের প্রয়োজন হলে বিভিন্ন পেশাজীবী গোষ্ঠীর (কৃষক, জেলে, বিপদাপন্ন/ঝুঁকিগ্রস্ত) ওপর কি প্রভাব পড়তে পারে তা বর্ণনা করুন।
- ২.২ স্থানান্তরের জন্য আপনাদের পছন্দের স্থান কোনটি? যে স্থানে যেতে চান সেখানে পর্যাপ্ত জমি পাওয়া যাবে কি? সেখানে জমির (বসতবাড়ী, ভিটা, কৃষি ইত্যাদি) দাম কত?
- ২.৩ ক্ষতিগ্রস্ত এলাকায় এবং স্থানান্তরকৃত স্থানে বিদ্যমান সামাজিক সেবা সমূহ (যেমন: স্বাস্থ্য সেবা, শিক্ষা, ইত্যাদি) সম্পর্কে বলুন।
- ২.৪ স্থানান্তরকৃত স্থানে বিদ্যমান সামাজিক সেবা সমূহের উন্নতি বা অবনতি হবে কিনা।
- ২.৫ শহরে/বাজারে যাওয়ার জন্য বর্তমান স্থানের (ক্ষতিগ্রস্ত স্থানের) যাতায়াত ব্যবস্থা (সড়ক, ইত্যাদি) কেমন, কি ধরনের যানবাহন ব্যবহার করা হয় এবং স্থানান্তরকৃত স্থান থেকে শহরে/বাজারে যাওয়ার জন্য যাতায়াত ব্যবস্থা কেমন, কি ধরনের যানবাহন ব্যবহার করা হয়?
- ২.৬ বর্তমান স্থানের (ক্ষতিগ্রস্ত স্থানের) সাংস্কৃতিক সুযোগ সুবিধা, আচার আদর্শ, গ্রন্থা, কি এবং কেমন? আপনাদের আচার আদর্শ, গ্রন্থা স্থানান্তরকৃত স্থানে পূর্ব থেকে বসবাসরত জনগোষ্ঠীর সাথে কোন ধর্ম/কলহ সৃষ্টির সম্ভাবনা আছে কি?
- ২.৭ ধর্ম/কলহ হলে, তা কি ধরনের হতে পারে?
- ২.৮ ক্ষতিগ্রস্ত জনগণ কিভাবে ক্ষতিপূরণ পেতে চান তা বলুন।
- ৩। আর-উপার্জনের পুনঃস্থান:

৩.১ ক্ষতিগ্রস্ত জনগণের আয়ের উৎস সমূহ কি কি?

৩.২ স্থানান্তরিত হওয়ার পরেও বর্তমান স্থানে (ক্ষতিগ্রস্ত স্থানে) আয়ের উৎস সমূহ টিকিয়ে রাখা সম্ভব কিনা; যদি সম্ভব হয়, তাহলে সে উৎস সমূহ কি কি?

৩.৩ স্থানান্তরিত স্থানে আয়ের বর্তমান উৎস সমূহ কি কি?

৩.৪ স্থানান্তরিত বর্তমান বাজার ব্যবস্থাকে (যেমন: কর্ম সংস্থানের সম্ভাবনা এবং প্রতিযোগিতা, জমির দাম, ইত্যাদি) কি ভাবে প্রভাবিত করবে?

৩.৫ স্থানান্তরিত স্থানে কত সংখ্যক মানুষের কর্ম সংস্থান হতে পারে?

৩.৬ কর্ম সংস্থানের জন্য স্থানান্তরিত জনগোষ্ঠীর দক্ষতা অর্জনে প্রশিক্ষণের প্রয়োজন আছে কি?

৩.৭ কত লোকের প্রশিক্ষণ প্রয়োজন এবং কি কি পেশার প্রশিক্ষণ প্রয়োজন?

৪ সামাজিক উন্নয়ন সহায়তা:

৪.১ স্থানান্তরিত স্থানে বর্তমানে কোল কোল এলজিও কাজ করছে?

৪.২ ক্ষতিগ্রস্ত জনগণের সঞ্চয়, উপার্জন মূলক কর্মকাণ্ড, আর পুনঃস্থানে আর্থিক সহায়তা প্রদান এবং দারিদ্র নিরসনে বিদ্যমান এলজিও সমূহ আশ্রয়ী কিনা।

৪.৩ সামাজিক নিরাপত্তা বেষ্টনী সুযোগ সুবিধা কেমন?

## Annex 4: Public Consultation Meeting, Second Round

### A. Overview of Meetings

Four second-round meetings were conducted at Chowhali, Harirampur, and Shahjadpur and Shibalaya, attended by 157 participants. Locations, dates, numbers and types of participants, and meeting photos are provided in Tables A9.1 and A9.2, and Photos A9.1 to A9.4.

### B. Stakeholder Concerns and Meeting Documentation

Summaries of stakeholder concerns expressed in the meetings are provided in Sections A9.C and A9.D. Copies of the meeting sign-in sheets are shown in Photos A9.5 to A9.8.

**Table A9.1: Meeting Venues, First Round Public Consultation Meetings**

| District  | Upazila    | Union | Meeting venue      | Meeting date | Time     |
|-----------|------------|-------|--------------------|--------------|----------|
| Manikganj | Shibalaya  | Sadar | UZ conference room | 02/07/2013   | 11:00 am |
| Sirajganj | Shahjadpur | Sadar | UZ conference room | 04/07/2013   | 11:30 am |
| Sirajganj | Chouhali   | Sadar | UZ conference room | 07/07/2013   | 11:00 am |
| Manikganj | Harirampur | Sadar | UZ conference room | 09/07/2013   | 11:00 am |

**Table A9.2: Public Consultation Meeting Participant Details**

| Meeting venue      | Type of Participants  | No. participants |
|--------------------|---|------------------|
| Shibalaya (JLB-2)  | BWDB staff, ADB consultants, Upazila Nirbahi Officer, teachers, UP Chairman, UP members (Male/Female), farmer, Fishermen, local notable persons, healthcare assistants, businessmen, traders, and NGO staff           | 69               |
| Shahjadpur (JRB-1) | BWDB staff, PPTA consultants, UP Nirbahi Officer, teachers, UP Chairperson, UP members (male and female), farmer, fishermen, local notable persons, healthcare assistants, businessmen, traders, and NGO staff        | 37               |
| Chouhali (JLB-2)   | BWDB representatives, ADB consultants, Upazila Nirbahi Officer, teachers, UP Chairman, UP members (Male/Female), farmer, Fishermen, local notable persons, healthcare assistants, businessmen, traders, and NGO staff | 56               |
| Harirampur (PLB-1) | BWDB representatives, ADB consultants, Upazila Nirbahi Officer, teachers, UP Chairman, UP members (Male/Female), farmer, Fishermen, local notable persons, healthcare assistants, businessmen, traders, and NGO staff | 85               |

**Photo A9.1: PCM at Chouhali**



**Photo A9.2: PCM at Harirampur**



**Photo A9.3: PCM at Shahjadpur**



Photo A9.4: PCM at Shibalya (JLB-2 area)



### C. Summary of Concerns, All Meetings

**Erosion.** Stakeholders were informed of average annual rates of land, homestead, and infrastructure loss to erosion in each subproject area, and that the proposed bank protection is expected to reduce these losses. Participants emphasized the need to ensure that construction work is of high quality.

**Flooding.** Stakeholders were informed that the proposed embankment will help to protect from flooding. Stakeholders stated that the embankment will not control flood without river dredging, and therefore dredging should be incorporated in the project.

**Land use.** Stakeholders were advised that the project would induce significant changes in land type, land use, and increased food production.

**Fish habitat.** Stakeholders were informed that the project is expected to have negative impacts on fish and other aquatic fauna due to reduction of wetland by the proposed interventions. Local participants suggested restoring fisheries habitat through pilot dredging of channels in the Tranche 1 area.

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

**Resettlement.** Participants were informed that, at the time of the meetings, 1726 households in Horirampur of Manikgonj and Chouhali of Sirajgonj district would require relocation to suitable alternate sites before the beginning of construction, per Tranche 1 resettlement plans.

**Improved road transportation.** Participants were informed that flood embankments would be provided with appropriate road facilities.

**Employment.** Participants were informed that the subproject's reduction of the areas' vulnerability will improve conditions for trade and commerce. Project construction will provide temporary employment opportunities to local people.

**Contingency funding to begin revetment construction this year (2013).** Almost all participants mentioned locations threatened by erosion, and that if the construction does not start for one year,



erosion will proceed in this areas and the subproject designs will have to be changed. They requested contingency funds to be arranged now so that protection work can begin in 2013.

**Addition of dredging to subproject designs.** River dredging has not been included in subproject designs. Participants strongly recommended that it be added, as they believe flood and erosion control cannot be achieved in these areas without it. Some participants suggested capital dredging from Jamuna Bridge to Brahmanakanda of Horirampur upazila under Manikgonj district.

**Successful implementation.** Participants are concerned that development projects initiated by the ruling party will lose priority if/when the opposition party is in power. Participants strongly urge a 2013 construction start avoid future problems.

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

#### **D. Notes of Specific Meetings**

##### **Shibalay, Manikganj (JLB-2 area)**

The upazila areas most affected by erosion are Zafarganj and Bachamara. Local MP Mr. A.B.M Anwerul Haq stated that over last five years, more than 9000 affluent households of Zafarganj area were forced by erosion to leave the area and now live in difficult circumstances in Dhaka city.

Participants recommend that construction should start from November in the dry season.

The northern part of Zafarganj Bazar is very much threatened by erosion this year. To protect this area, participants suggested seeking preparatory funds from Asian Development Bank (ADB) and Water Development Board.

The subproject area needs access to contingency funds for emergency work.

Participants believe permanent protection works are required in the Padma and Jamuna Rivers as temporary erosion protection works are not viable there.

River dredging is essential to the success of the subproject and should be started in order to prevent erosion and flooding.

River bank protections from Kojuri to Baghabari are essential this year as these areas are vulnerable.

During construction, transparency should be ensured through BWDB monitoring of work quality.

A reservoir to hold water for rice cultivation and fish culture should be added to the subproject.

##### **Shahjadpur, Sirajganj**

Co-ordination among involved departments should be ensured during subproject implementation.

Eroding locations should be properly identified and protection works provided there.

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

Participants stated that a flood action plan was needed to improve flood proofing and response given the high flood levels in the subproject area.

Participants favor pilot dredging in area channels to increase fish production and maintain fish habitat.

### **Chouhali, Sirajganj**

The area of Chouhali upazila most vulnerable to erosion is the upazila sadar, where 40 to 50 per cent of the area has already eroded away. BWDB has been using sandbags in attempt to control the erosion, but these have been ineffective given the intensity of the erosive attack. Participants stated that sandbag revetments are ineffective in the Jamuna due to its erosion intensity.

Participants urged BWDB to appeal to ADB to allocate preparatory funds for emergency work. Construction of riverbank protection works should commence in the dry season, otherwise adequate work quality will not be achieved.

Most participants stated that capital dredging should be undertaken from the Jamuna Bridge to Aricha. River dredging is required to ensure the survival of any future embankment works. An embankment built in this upazila at a cost of BDT 38 crore was already destroyed by erosion.

A flow divider should be incorporated in the project design.

Participants expressed frustration that the subproject design does not reflect the concerns and suggestions of local people, even though these have been expressed repeatedly in meetings with the Project Implementation Officer (PIO).

### **Harirampur, Manikganj**

The 5 km riverbank protection proposed in this upazila should be extended an additional 2 km up to Dhulsura. Bahadurpur union should be included with the project.

Participants were concerned about the successful implementation of the project. They think that projects initiated by the ruling party will have lower priority if and when the opposition is in power. Participants hope the subproject will be implemented in 2013 and agreed to make whatever sacrifices would be required to expedite this.

Participants stated that the priority should be to protect Harirampur before providing protection to Manikganj town. Priority work should start as soon as possible.

A quality control committee should be struck to ensure quality construction work.

Local stakeholders should be involved in regular embankment maintenance.

Photo A9.5: Second Round Meeting Sign-in Sheet, Shibalaya, Manikganj

বন্যা ও নদীতীর ভাঙ্গন ঝুঁকি ব্যবস্থাপনা বিনিয়োগ প্রকল্পের মতবিনিময় সভায় উপস্থিতির তালিকা

স্থান : শিবালয় উপজেলা পরিষদ মিলনায়তন

তারিখঃ ০২ জুলাই, ২০১৩

| ক্রমিক<br>নং | নাম          | পদবী/পেশা | মোবাইল নম্বর  | স্বাক্ষর |
|--------------|--------------|-----------|---------------|----------|
| ১            | ডাঃ আবদুল হক | ডাঃ/সি    | ০১৭৩-৫৩২৫৪৩   | ০২/০৭/১৩ |
| ২            | ডাঃ আবদুল হক | ডাঃ/সি    | ০১৭৩-৫৩২৫৪৩   | ০২/০৭/১৩ |
| ৩            | ডাঃ আবদুল হক | ডাঃ/সি    | ০১৮৩৮/০৫৫০৮   | ০২/০৭/১৩ |
| ৪            | ডাঃ আবদুল হক | ডাঃ/সি    | ০১৭১২-১০০৬১   | ০২/০৭/১৩ |
| ৫            | ডাঃ আবদুল হক | ডাঃ/সি    | ০১৭১৫২৬৮১৭    | ০২/০৭/১৩ |
| ৬            | ডাঃ আবদুল হক | ডাঃ/সি    | ০১৭১০৬৭৫৭     | ০২/০৭/১৩ |
| ৭            | ডাঃ আবদুল হক | ডাঃ/সি    | ০১৭১৫ ৫০৫ ২৭৭ | ০২/০৭/১৩ |
| ৮            | ডাঃ আবদুল হক | ডাঃ/সি    | ০১৫৫২ ৮৭৬ ৭৭৬ | ০২/০৭/১৩ |
| ৯            | ডাঃ আবদুল হক | ডাঃ/সি    | ০১৭১৫-৩১৫২২৭  | ০২/০৭/১৩ |
| ১০           | ডাঃ আবদুল হক | ডাঃ/সি    | ০১৮৩৭৫৫৭১২৫   | ০২/০৭/১৩ |
| ১১           | ডাঃ আবদুল হক | ডাঃ/সি    | ০১৭১২-১৫৬১৭২  | ০২/০৭/১৩ |
| ১২           | ডাঃ আবদুল হক | ডাঃ/সি    | ০১৭১১-১৬১৭১১  | ০২/০৭/১৩ |
| ১৩           | ডাঃ আবদুল হক | ডাঃ/সি    | ০১৭১৬ ৫৫২৫১২  | ০২/০৭/১৩ |
| ১৪           | ডাঃ আবদুল হক | ডাঃ/সি    | ০১৭২০-৫৭৫৩৭৫  | ০২/০৭/১৩ |
| ১৫           | ডাঃ আবদুল হক | ডাঃ/সি    | ০১২১১-০১৭১৮৬  | ০২/০৭/১৩ |

আয়োজনেঃ

C&GIS

Center for Environmental and Geographic Information Services

House 6, Road 23/C, Gulshan-1, Dhaka-1212, Bangladesh. Tel: 8817648-52, Fax: 889-2-8823128



বন্যা ও নদীতীর ভাঙ্গন ঝুঁকি ব্যবস্থাপনা বিনিয়োগ প্রকল্পের মতবিনিময় সভায় উপস্থিতির তালিকা

স্থান : শিবালয় উপজেলা পরিষদ মিলনায়তন

তারিখ: ০২ জুলাই, ২০১৩

| ক্রমিক<br>নং | নাম                               | পদবী/পেশা                       | মোবাইল নম্বর | স্বাক্ষর |
|--------------|-----------------------------------|---------------------------------|--------------|----------|
| ১১           | ডাঃ বেন সিদ্দিকুল্লাহ<br>ডায়াল   | ডেপুটি ম্যাজিস্ট্রেট<br>শিবালয় | ০১৭৫৪৪৩৮৭০৭  | ০২/৭/১৩  |
| ১২           | মোঃ মোহাম্মদ হোসেন                | উপজেলা<br>চাকরিওয়ান কর্মকর্তা  | ০১১৭১৩৩৭৪০৭  | ০২/৭/১৩  |
| ১৩           | ব্রিজা বেসান্ত                    | উপজেলা কারিগর<br>শিবালয়        | ০১৪১৭৪৩৪৩৪৬  | ০২/০৭/১৩ |
| ১৪           | ডেপুটি ম্যাজিস্ট্রেট<br>মোঃ হোসেন | ডেপুটি ম্যাজিস্ট্রেট<br>শিবালয় | ০১৭/৪১৪৭৪৪০  | ০২/৭/১৩  |
| ১৫           | মোঃ মোহাম্মদ হোসেন                | উপজেলা কারিগর<br>শিবালয়        | ০১৭২০০৩৭৬১৭  | ০২/৭/১৩  |
| ১৬           | ব্রজেন চন্দ্র মুন্ডা              | উপজেলা কারিগর<br>শিবালয়        | ০১৭৪২০৮৩৮৫৫  | ০২/৭/১৩  |
| ১৭           | আ.ত.ম. ব্রজেন মুন্ডা              | উপজেলা কারিগর<br>শিবালয়        | ০১৭৭৬৬৮২০৮১  | ০২/৭/১৩  |
| ১৮           | ডাঃ নুরজাহান বেগম                 | উপজেলা কারিগর<br>শিবালয়        | ০১৭১৭-৭২৬৮৮৮ | ০২.০৭.১৩ |
| ১৯           | মোঃ আবদুল হান্নান                 | উপজেলা কারিগর<br>শিবালয়        | ০১৭১৭৪৫০৪৩১  | ০২/৭/১৩  |
| ২০           | মোঃ আবদুল হান্নান                 | উপজেলা কারিগর<br>শিবালয়        | ০১২২১৪৭২০৫৭  | ০২/৭/১৩  |
| ২১           | মোঃ হোসেন                         | উপজেলা কারিগর<br>শিবালয়        | ০১৭১৪৪৪০৩৬   | ০২/৭/১৩  |
| ২২           | বি. হোসেন                         | "                               | ০১৭১১৩৮৬২৮৫  | ০২/৭/১৩  |
| ২৩           | মোঃ আবদুল নাসির                   | উপজেলা কারিগর<br>শিবালয়        | ০১৭৪১১৭৬৭৩৭  | ০২/৭/১৩  |
| ২৪           | আবদুল হক মুন্ডা                   | উপজেলা কারিগর<br>শিবালয়        | ০১৭৩৪৪৭২৭৩   | ০২/৭/১৩  |
| ২৫           | মোঃ আবদুল হক মুন্ডা               | উপজেলা কারিগর<br>শিবালয়        | ০১৭১১-২৪৫৬৩৫ | ০২/৭/১৩  |

আয়োজনে:

CEGIS

Center for Environmental and Geographic Information Services  
House 6, Road 23/C, Gulshan-1, Dhaka-1212, Bangladesh. Tel: 8817648-52, Fax: 880-2-8823128

বন্যা ও নদীতীর ভাঙ্গন ঝুঁকি ব্যবস্থাপনা বিনিয়োগ প্রকল্পের মতবিনিময় সভায় উপস্থিতির তালিকা

স্থান : শিবালয় উপজেলা পরিষদ মিলনায়তন

তারিখ: ০২ জুলাই, ২০১৩

| ক্রমিক<br>নং | নাম              | পদবী/পেশা                      | মোবাইল নম্বর | স্বাক্ষর |
|--------------|------------------|--------------------------------|--------------|----------|
| ৬১           | মোঃ আব্দুল ওহাদ  | অধ্যক্ষ                        | ০১৭৬৪০১৪০৭৪  | ২৭/৭/১৩  |
| ৬২           | মোঃ আব্দুল হক    | চেয়ারম্যান<br>সিআইসি/সিআইসি   | ০১৭১৭১৩৫৫৫   | ২৭/৭/১৩  |
| ৬৩           | কাজী হুমায়ুন    | উপসচিব<br>উপসচিব               | ০১৭১১১০৭০৭৯  | ২৭/৭/১৩  |
| ৬৪           | পারভাতি হুমায়ুন | সিএলও<br>সিএলও                 | ০১৭১১৬৭৮৮৮   | ২৭/৭/১৩  |
| ৬৫           | মুহিবুল হক       | UPPO                           | ০১৭১২২৭২৭৭৩  | ২৭/৭/১৩  |
| ৬৬           | হামিদা হোসেন     | URDO                           | ০১৭১৪৬৪৮৮৮০  | ২৭/৭/১৩  |
| ৬৭           | মোঃ আব্দুল হক    | UCO                            | ০১৭১৬১৭৬৩১   | ২৭/৭/১৩  |
| ৬৮           | (মোঃ আব্দুল হক)  | মোঃ আব্দুল হক<br>মোঃ আব্দুল হক | ০১৭১৩-৫২০৪৭৮ | ২৭/৭/১৩  |
| ৬৯           | মোঃ আব্দুল হক    | মোঃ আব্দুল হক<br>মোঃ আব্দুল হক | ০১৭১৩-৫২০৪৭৮ | ২৭/৭/১৩  |
| ৮০           | মুদীপাশা (কম্বু) | মোঃ আব্দুল হক<br>মোঃ আব্দুল হক | ০১৭১৩-৫২০৪৭৮ | ২৭/৭/১৩  |
| ৮১           | মুদীপাশা (কম্বু) | মোঃ আব্দুল হক<br>মোঃ আব্দুল হক | ০১৭১৩-৫২০৪৭৮ | ২৭/৭/১৩  |
| ৮২           | মোঃ আব্দুল হক    | মোঃ আব্দুল হক<br>মোঃ আব্দুল হক | ০১৭১৩-৫২০৪৭৮ | ২৭/৭/১৩  |
| ৮৩           | মোঃ আব্দুল হক    | মোঃ আব্দুল হক<br>মোঃ আব্দুল হক | ০১৭১৩-৫২০৪৭৮ | ২৭/৭/১৩  |
| ৮৪           | মোঃ আব্দুল হক    | মোঃ আব্দুল হক<br>মোঃ আব্দুল হক | ০১৭১৩-৫২০৪৭৮ | ২৭/৭/১৩  |
| ৮৫           | মোঃ আব্দুল হক    | মোঃ আব্দুল হক<br>মোঃ আব্দুল হক | ০১৭১৩-৫২০৪৭৮ | ২৭/৭/১৩  |

আয়োজনে:

C&GIS

Center for Environmental and Geographic Information Services  
House 6, Road 23/C, Gulshan-1, Dhaka-1212, Bangladesh. Tel: 8817648-32, Fax: 880-2-6623126



বন্যা ও নদীতীর ভাঙ্গন ঝুঁকি ব্যবস্থাপনা বিনিয়োগ প্রকল্পের মতবিনিময় সভায় উপস্থিতির তালিকা

স্থান : শিবালয় উপজেলা পরিষদ মিলনায়তন

তারিখ: ০২ জুলাই, ২০১৩

| ক্রমিক<br>নং | নাম                    | পদবী / পেশা               | মোবাইল নম্বর | স্বাক্ষর    |
|--------------|------------------------|---------------------------|--------------|-------------|
| ৪৬           | শ্রী: আব্দুল হামিদ     | সিএসসি                    | ০১৬৭৩৬৪৫৪৫   |             |
| ৪৭           | শ্রী: মোকাদ্দাস        | ইন্সপেক্টর                | ০১৭৪২৭৬৬৮৮২  | মোকাদ্দাস   |
| ৪৮           | শ্রী: কাজী হাফিজ       | সিএসসি                    | ০১৭০৪২০৫০৯৩  | হাফিজ       |
| ৪৯           | আবদুল মজিদ খান         | সিএসসি (৩০০০)             | ০১৭১০২০০৬৪৪  |             |
| ৫০           | এবিসি এম. এম. এম.      | সিএসসি (৩০০০)             | ০১৭৩০৭১৬৭৪০  |             |
| ৫১           | শ্রী: মোকাদ্দাস        | সিএসসি (৩০০০)             | ০১৭১২-০১৫৫৬৭ | H-2         |
| ৫২           | আবদুল হামিদ            | সিএসসি (৩০০০)             | ০১৭১৬২১০১০   | আবদুল হামিদ |
| ৫৩           | আবদুল হামিদ            | সিএসসি                    | ০১৪৩৫৪১৫৬৭১  | Abul        |
| ৫৪           | মোহাম্মদ হিদ্রা আলমারী | সিএসসি                    | ০১৭১৪ ২৪৪২৭৪ | Moham       |
| ৫৫           | শ্রী: আবদুল হামিদ      | সিএসসি (৩০০০)             | ০১৭১১ ৩৪৫৭৭  |             |
| ৫৬           | আবদুল হামিদ            | Jr. Professional<br>CEGIS |              | Morjia Abu  |
| ৫৭           | আবদুল হামিদ            | সিএসসি (৩০০০)             | ০১৭৩৪৬৬২০০২  |             |
| ৫৮           | শ্রী: আবদুল হামিদ      | সিএসসি                    | ০১৭১৬৩৫১৩৭৩  |             |
| ৫৯           | শ্রী: আবদুল হামিদ      | সিএসসি                    |              |             |
| ৬০           | শ্রী: আবদুল হামিদ      | সিএসসি                    |              |             |

আয়োজনে:

CEGIS

Center for Environmental and Geographic Information Services  
House 6, Road 23/C, Gulshan-1, Dhaka-1212, Bangladesh, Tel: 8817646-52, Fax: 880-2-8823128

বন্যা ও নদীতীর ভাঙ্গন ঝুঁকি ব্যবস্থাপনা বিনিয়োগ প্রকল্পের মতবিনিময় সভায় উপস্থিতির তালিকা

স্থান : শিবালয় উপজেলা পরিষদ মিলনায়তন

তারিখ: ০২ জুলাই, ২০১৩

| ক্রমিক<br>নং | নাম                      | পদবী/পেশা                          | মোবাইল নম্বর | স্বাক্ষর |
|--------------|--------------------------|------------------------------------|--------------|----------|
| ৬১           | মোঃ মোহাম্মদ ইউনুস হোসেন | মহাসচিব                            | ০১৭১২৭৫৪৬৬   |          |
| ৬২           | মোঃ মোহাম্মদ ইউনুস হোসেন | আপারেন্ট                           | ০১৭১২৭৫৪৬৬   |          |
| ৬৩           | মোঃ আব্দুল হান্নান       | আবদুল হান্নান<br>পরিচালক, পল্লী    | ০১৭১৫৪৩৮৬২   |          |
| ৬৪           | মীর আমান হোসেন           | পরিচালক<br>ESAA (বহা)              | ০১৭১৮-০২৭১৭৭ |          |
| ৬৫           | ব্রজ কুমার মৈ            | মহাসচিব<br>মহাসচিব, বি.ক.স.        | ০১৭১৭-১৭৬১১৭ |          |
| ৬৬           | মোঃ আব্দুল নজির          | উপসচিব<br>আবদুল নজির               | ০১৭১১-১৮৪৩৮১ |          |
| ৬৭           | মোঃ ব্রজ কুমার           | পরিচালক                            | ০১৭১২-১৫৫৮৩৬ |          |
| ৬৮           | মোঃ আবদুল হান্নান        | মোঃ আবদুল হান্নান<br>আবদুল হান্নান | ০১৭১৩৫৭৭২৭৭  |          |
| ৬৯           | মোঃ আবদুল হান্নান        | উপসচিব                             | ০১৭১৩৬৫২৬৬৫১ |          |
|              |                          |                                    |              |          |
|              |                          |                                    |              |          |
|              |                          |                                    |              |          |
|              |                          |                                    |              |          |
|              |                          |                                    |              |          |
|              |                          |                                    |              |          |
|              |                          |                                    |              |          |



Photo A9.6: Second Round Meeting Sign-in Sheet, Shahjampur, Sirajganj

বন্যা ও নদীতীর ভাঙ্গন ঝুঁকি ব্যবস্থাপনা বিনিয়োগ প্রকল্পের মতবিনিময় সভায় উপস্থিতির তালিকা

স্থানঃ শাহজাদপুর

উপজেলা পরিষদ মিলনায়তন

তারিখঃ ০৪ জুলাই, ২০১৩

| ক্রমিক<br>নং | নাম                    | পদবী/পেশা                      | মোবাইল নম্বর  | স্বাক্ষর |
|--------------|------------------------|--------------------------------|---------------|----------|
| ১            | শ্রীঃ কামাল হোসেন      | UNO                            | ০১৭১৭৪৩৬৬৬    |          |
| ২            | শ্রীঃ হিউজ ওয়েলস      | MO                             | ০১৭১৬৪২৬৪২    |          |
| ৩            | শ্রীঃ মোঃ মুন্সুরা     | জিলা প্রশাসনিক<br>সিটিং অফিসার | ০১৭১১২৪০৪৫৫   |          |
| ৪            | শ্রীঃ মোঃ মোঃ মুন্সুরা | UFPO                           | ০১৭৪৫২-৬৮৪৪০৭ |          |
| ৫            | শ্রীঃ মোঃ মোঃ মুন্সুরা | উপজেলা পরিষদ<br>সচিব           | ০১৭১২৬৩৫৪৭৭   |          |
| ৬            | শ্রীঃ মোঃ মোঃ মুন্সুরা | URDO                           | ০১৭১৪-২৫১৫৭১  |          |
| ৭            | শ্রীঃ মোঃ মোঃ হাই      | ইউ.এল.ও                        | ০১৭১১২৭৬০৬৫   |          |
| ৮            | শ্রীঃ মোঃ মোঃ হাই      | উপজেলা পরিষদ<br>সচিব           | ০১৭১৪৪৫৫৩৭    |          |
| ৯            | শ্রীঃ মোঃ মোঃ হাই      | উপজেলা পরিষদ<br>সচিব           | ০১৭১১-২৫৭৭৭৭  |          |
| ১০           | শ্রীঃ মোঃ মোঃ হাই      | UPD                            | ০১৭১০৪৭৭৪০২   |          |
| ১১           | শ্রীঃ মোঃ মোঃ হাই      | সহকারী প্রশাসনিক<br>অফিসার     | ০১৭১০-৬৪৭৭১৬  |          |
| ১২           | শ্রীঃ মোঃ মোঃ হাই      | উপজেলা পরিষদ<br>সচিব           | ০১৭১৬৬৩২৫৫৬   |          |
| ১৬           | শ্রীঃ মোঃ মোঃ হাই      | উপজেলা পরিষদ<br>সচিব           | ০১৭১০৬০৭২৭৭   |          |
| ১৪           | শ্রীঃ মোঃ মোঃ হাই      | উপজেলা পরিষদ<br>সচিব           | ০১৭১৭৭৬৫২৬৬   |          |
| ১৫           | শ্রীঃ মোঃ মোঃ হাই      | হাফিজ<br>হাফিজ                 | ০১৭১০০২৫২২৩   |          |

আয়োজনে : **CEGIS** Center for Environmental and Geographic Information Services  
House 6, Road 23/C, Gulshan-1, Dhaka-1212, Bangladesh. Tel: 881/648-62, Fax: 880-2-8823126

বন্যা ও নদীতীর ভাঙ্গন ঝুঁকি ব্যবস্থাপনা বিনিয়োগ প্রকল্পের মতবিনিময় সভায় উপস্থিতির তালিকা

স্থানঃ কাছাড়াদপুর

উপজেলা পরিষদ মিলনায়তন

তারিখঃ ০৪ জুলাই, ২০১৩

| ক্রমিক<br>নং | নাম                    | পদবী/পেশা               | মোবাইল নম্বর | স্বাক্ষর    |
|--------------|------------------------|-------------------------|--------------|-------------|
| ৩১           | হাজিরা                 | ইউজিএস                  | ০১৭৪৮৬০৮৪২   | হাজিরা      |
| ৩২           | মোঃ রুহা চাদ আলী       | জাম মুন্সিফ             | ০২৭২৫৫৩৪৪২   | রুহা চাদ    |
| ৩৩           | মোঃ মোস্তাফিজ          | চাকরী                   |              | মোস্তাফিজ   |
| ৩৪           | মোঃ মোস্তাফিজ          | চাকরী                   |              | মোস্তাফিজ   |
| ৩৫           | মোঃ মিলন               | সহকারী                  |              | মিলন        |
| ৩৬           | মোঃ মোস্তাফিজ হুসাইন   | সহকারী<br>মোস্তাফিজ     | ০১৭২৬৭৪৮৯৬   | মিলন        |
| ৩৭           | মোঃ হাদি হুসাইন হুসাইন | ইন্সপেক্টর<br>মোস্তাফিজ | ০১৭২৬৭৪৮৯২   | হাদি হুসাইন |
|              |                        |                         |              |             |
|              |                        |                         |              |             |
|              |                        |                         |              |             |
|              |                        |                         |              |             |
|              |                        |                         |              |             |
|              |                        |                         |              |             |
|              |                        |                         |              |             |
|              |                        |                         |              |             |
|              |                        |                         |              |             |
|              |                        |                         |              |             |

আয়োজনে : **CEGIS** Center for Environmental and Geographic Information Services  
House 6, Road 23/C, Guishan-1, Dhaka-1212, Bangladesh. Tel: 881/648-52, Fax: 880-2-5823128



বন্যা ও নদীতীর ভাঙ্গন ঝুঁকি ব্যবস্থাপনা বিনিয়োগ প্রকল্পের মতবিনিময় সভায় উপস্থিতির তালিকা

স্থানঃ জাহাঙ্গীরনগর

উপজেলা পরিষদ মিলনায়তন

তারিখঃ ০৪ জুলাই, ২০১৩

| ক্রমিক<br>নং | নাম                             | পদবী/পেশা      | মোবাইল নম্বর | স্বাক্ষর |
|--------------|---------------------------------|----------------|--------------|----------|
| ২৬           | শ্রীঃ আবদুল মান্নান             | ইঞ্জিনিয়ার    | ০১৭২২৫৬২৫৭   |          |
| ২৭           | শ্রীঃ আবদুল কাদের<br>UAB        | চাকর           | ০১৭১০-৪৬৫৫৫৩ |          |
| ২৮           | শ্রীঃ নূরুল ইসলাম               | ইউ.পি.সি       | ০১৭৭৫৪৮৬৬    |          |
| ২৯           | শ্রীঃ আবদুল হাফিজ               | সহকারী         | ০১৭২৫-০৫৬৮৭৮ |          |
| ৩০           | শ্রীঃ সিরাজুল                   | ইউ.পি.সি       | ০১৭২৩৬৬৭৫৩২  |          |
| ৩১           | শ্রীঃ শুকুর                     | সহকারী         | ০১৮৩৭২০৭০২৫  |          |
| ৩২           | শ্রীঃ মোস্তাফা                  | ইউ.পি.সি       | ০১৭২৫-৬৭৭১৫৭ |          |
| ৩৬           | শ্রীঃ হালিমুল ইসলাম             | সচিব<br>সহকারী | ০১৭২৫-৫৫১৩৭৮ |          |
| ৩৮           | শ্রীঃ বেকার আলী                 | সচিব<br>সহকারী | ০১৭১৮-৪১১৫১১ |          |
| ৩৯           | শ্রীঃ আবদুল হাফিজ               | সচিব<br>সহকারী | ০১৭১৮-০৪৭৭৭৭ |          |
| ৩৫           | শ্রীঃ হুমায়ুন আলী              | সহকারী         | ০১৭৩০ ৩৫৭৩৪৭ |          |
| ৩৭           | শ্রীঃ আবদুল হাফিজ               | সচিব<br>সহকারী | ০১৭৩৭-১০৩৪০৫ |          |
| ৩৮           | শ্রীঃ হুমায়ুন আলী              | ইউ.পি.সি       | ০১৭২১৪৪৬৩৭২  |          |
| ৩৯           | শ্রীঃ আবদুল হাফিজ               | ইউ.পি.সি       | ০১৭২৪২৫৩৪৪   |          |
| ৩০           | শ্রীঃ হুমায়ুন আলী<br>বিরহাঙ্গন | ইউ.পি.সি       | ০১৭১৩৪৪৭৭৩৭  |          |

আয়োজনেঃ **CEGIS** Center for Environmental and Geographic Information Services  
House 9, Road 23/C, Gulshan-1, Dhaka-1212, Bangladesh. Tel: 881/646-62, Fax: 880-2-6623128

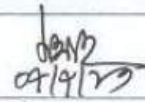
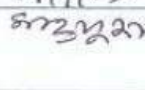
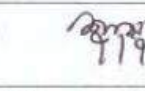
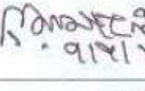
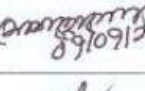

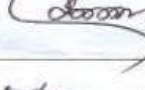
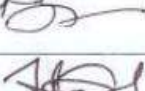
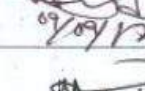
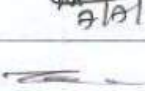
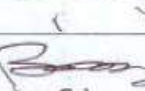
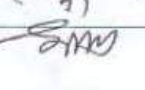
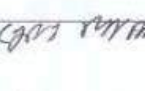
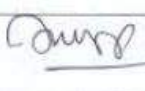

Photo A9.7: Second Round Meeting Sign-in Sheet, Chouhali, Sirajganj

বন্যা ও নদীতীর ভাঙ্গন ঝুঁকি ব্যবস্থাপনা বিনিয়োগ প্রকল্পের মতবিনিময় সভায় উপস্থিতির তালিকা

স্থানঃ চৌহালী

উপজেলা পরিষদ মিলনায়তন

তারিখঃ ০৭ জুলাই, ২০১৩

| ক্রমিক<br>নং | নাম                   | পদবী/পেশা                             | মোবাইল নম্বর | স্বাক্ষর  |
|--------------|-----------------------|---------------------------------------|--------------|---|
| ১।           | মোহাম্মদ আবদুল্লাহ    | UNO, চৌহালী                           | ০১৭১৮৩৬৪০৫০  |    |
| ২।           | মহম্মদ মাহমুদ         | চেয়ারম্যান                           | ০১৭১১৯৫৫৪৩৩  |    |
| ৩।           | কারীমুল্লাহ আক্তার    | U.W.A.O                               | ০১৭২৭-৩১৩৫৬০ |    |
| ৪।           | মোহাম্মদ আবদুল হক     | U.F.O.                                | ০১৭১৪২৬০২৪২  |    |
| ৫।           | মোঃ মোস্তফিজ মোস্তফা  | ইউ.পি.ও                               | ০১৭২০৩৬৬০২২  |    |
| ৬।           | মোঃ একবুল হোসেন       | পরিচালক<br>(সি.এম.ও.সি.)              | ০১৭১১৩৮৫৭২৯  |   |
| ৭।           | মোঃ দুলাল মিয়া       | জি.ও.<br>মহানুজ্জামান (সি.এম.ও.সি.)   | ০১৭১২০০৭৬১৭  |  |
| ৮।           | মোহাম্মদ মাহমুদুল হক  | সি.এম.ও.সি.                           | ০১৮২২৪১৪৭৬৪  |  |
| ৯।           | মহানুজ্জামান হোসেন    | U.F.O.                                | ০১৭১২-২৫২৫৪২ |  |
| ১০।          | নামির আহমেদ           | উপজেলা প্রাথমিক<br>(চৌহালী)           | ০১৭১২-২৩১৩৫৩ |  |
| ১১।          | মোঃ ইয়াসিন           | সি.এম.ও.সি.                           | ০১৭১৮৩৪১৮০৭  |  |
| ১২।          | মোঃ মোস্তাফিজুর রহমান | চেয়ারম্যান<br>সি.এম.ও.সি.            | ০১৭৩০৭৫৫১৮০  |  |
| ১৬।          | মোঃ মতিজা হোসেন       | সি.এম.ও.সি.<br>উপজেলা প্রাথমিক        | ০১৭১৪৮০৭০৭৬  |  |
| ১৮।          | মোঃ মাহমুদুল          | উপজেলা প্রাথমিক                       | ০১৭৩৬৭৭৭৭৭৭  |  |
| ১৯।          | মোঃ মাহমুদুল হোসেন    | উপ-ডিপার্টমেন্ট<br>প্রাথমিক<br>চৌহালী | ০১৫৫৬৩১৬৭৮   |  |

আয়োজনে : **CEGIS** Center for Environmental and Geographic Information Services  
House ৫, Road ২৩/৮, Gulshan-১, Dhaka-1212, Bangladesh. Tel: ৮৮১/৬৪৫-৫২, Fax: ৮৮০-২-৮৫২৩১২৮



বন্যা ও নদীতীর ভাঙ্গন ঝুঁকি ব্যবস্থাপনা বিনিয়োগ প্রকল্পের মতবিনিময় সভায় উপস্থিতির তালিকা  
স্থানঃ চৌহান্দা উপজেলা পরিষদ মিলনায়তন তারিখঃ ০৭ জুলাই, ২০১৩

| ক্রমিক<br>নং | নাম              | পদবী/পেশা                | মোবাইল নম্বর     | স্বাক্ষর |
|--------------|------------------|--------------------------|------------------|----------|
| ১৮           | মোঃ হাফিজ হোসেন  | সিআইসি                   | ০১২৭৬৩৬৪৯২৭      | হাফিজ    |
| ১৯           | মোঃ সাফাউল হক    | সিআইসি                   | ০১৭১৫-৭৪৮৩৭২     | সাফাউল   |
| ২০           | মোঃ মোঃ বাজান    | সিআইসি                   | ০১৭৭৩০৭৬১০৭      | বাজান    |
| ২১           | টি. এম. রাব্বি   | সিআইসি                   | ০১৭৩৫৪৫০৪২৩      | রাব্বি   |
| ২২           | মোঃ মাহমুদ হোসেন | সিআইসি                   | ০১৭২২৫০১২৭৭      | মাহমুদ   |
| ২৩           | মোঃ মাসুদ সিকদার | সিআইসি                   | ০১৭১৮-৩৭৪৩৬৭     | মাসুদ    |
| ২৪           | মোঃ হাদিদ আলী    | সিআইসি ও<br>মহান প্রকল্প | ০১২১৪ ৩০৪৬৬৫     | হাদিদ    |
| ২৫           | মোঃ হাদিদুল হক   | সিআইসি ও<br>মহান প্রকল্প | ০১৭১২-৭২০৬<br>৭২ | হাদিদুল  |
| ২৬           | মোঃ হাদিদুল হক   | সিআইসি ও<br>মহান প্রকল্প | ০১৭২৬-১৭৭৬৭৩     | হাদিদুল  |
| ২৭           | মোঃ হাদিদুল হক   | সিআইসি ও<br>মহান প্রকল্প | ০১৭৪০-৬৫২৫৫৫     | হাদিদুল  |
| ২৮           | মোঃ হাদিদুল হক   | সিআইসি ও<br>মহান প্রকল্প | ০১৭১৬১৩৭৬৩০      | হাদিদুল  |
| ২৯           | মোঃ হাদিদুল হক   | সিআইসি ও<br>মহান প্রকল্প | ০১৭৩০৩৭৬৭৬       | হাদিদুল  |
| ৩০           | মোঃ হাদিদুল হক   | সিআইসি ও<br>মহান প্রকল্প | ০১৭৫২৫৪১০৬       | হাদিদুল  |
| ৩১           | মোঃ হাদিদুল হক   | সিআইসি ও<br>মহান প্রকল্প | ০১৭৬৭৪১৬৭৫৪      | হাদিদুল  |
| ৩২           | মোঃ হাদিদুল হক   | সিআইসি ও<br>মহান প্রকল্প | ০১৭৬৭৪১৬৭৫৪      | হাদিদুল  |
| ৩৩           | মোঃ হাদিদুল হক   | সিআইসি ও<br>মহান প্রকল্প | ০১৭৬৭৪১৬৭৫৪      | হাদিদুল  |

আয়োজনে : **CEGIS** Center for Environmental and Geographic Information Services  
House ৫, Road ২৩/৮, Gulshan-১, Dhaka-১২১২, Bangladesh. Tel: ৮৮১৭৬৪৮-৫২, Fax: ৮৮১৭৬৪৮-৫২

বন্যা ও নদীতীর ভাঙ্গন ঝুঁকি ব্যবস্থাপনা বিনিয়োগ প্রকল্পের মতবিনিময় সভায় উপস্থিতির তালিকা

স্থানঃ চৌহালী

উপজেলা পরিষদ মিলনায়তন

তারিখঃ ০৭ জুলাই, ২০১৩

| ক্রমিক<br>নং | নাম                      | পদবী/পেশা                      | মোবাইল নম্বর | স্বাক্ষর |
|--------------|--------------------------|--------------------------------|--------------|----------|
| ৩১           | Dr. M. Mahmudul<br>Oslam | ULO,<br>Chowdhali              | ০১৭১২-৭৩৫৪৭৪ |          |
| ৩২           | মোঃ আবুল্লাহ             | উপজেলা কৃষি অফিসার             | ০১৭১০৭৬১৩৭৪  |          |
| ৩৩           | মোঃ হাবিবুল্লাহ          | মহাপালাক                       | ০১৭১১১০২৬৬৭  |          |
| ৩৪           | মোঃ হাবিবুল্লাহ          | মহাপালাক<br>উপজেলা কৃষি অফিসার | ০১৭১৭১০৫৪৫   |          |
| ৩৫           | মোঃ হাবিবুল্লাহ          | মহাপালাক                       | ০১৭২৭৫৩৬৪১   |          |
| ৩৬           | মুহম্মদ হাবিবুল্লাহ      | মহাপালাক                       | ০১৭১৫৬৬১৭৫   |          |
| ৩৭           | ডাক্তারী হাবিবুল্লাহ     | ডাক্তার                        | ০১২৬২০৭৭৩৭   |          |
| ৩৮           | মুহম্মদ হাবিবুল্লাহ      | মহাপালাক                       | ০১৭১২-২২০৫১৫ |          |
| ৩৯           | মুহম্মদ হাবিবুল্লাহ      | মহাপালাক                       | ০১৭১৪২৩৬৫৫৫  |          |
| ৪০           | মোঃ হাবিবুল্লাহ          | মহাপালাক                       | ০১৭১৬-২১৭১৭৭ |          |
| ৪১           | মোঃ হাবিবুল্লাহ          | মহাপালাক                       | ০১৭১২০৬২৫৪৪  |          |
| ৪২           | মোঃ হাবিবুল্লাহ          | মহাপালাক                       | ০১৭১১-২৬৩০১৬ |          |
| ৪৩           | মোঃ হাবিবুল্লাহ          | মহাপালাক                       | ০১৭৩৩৭৭১০    |          |
| ৪৪           | মোঃ হাবিবুল্লাহ          | মহাপালাক                       | ০১৭২৫৭১৩৪৫৭  |          |
| ৪৫           | মোঃ হাবিবুল্লাহ          | মহাপালাক                       | ০১৭২১৪৪৬৪০৭  |          |

আয়োজনে : **CEGIS** Center for Environmental and Geographic Information Services  
House 9, Road 23/C, Gushan-1, Dhaka-1212, Bangladesh. Tel: 8817848-52, Fax: 880-2-8523128



বন্যা ও নদীতীর ভাঙ্গন ঝুঁকি ব্যবস্থাপনা বিনিয়োগ প্রকল্পের মতবিনিময় সভায় উপস্থিতির তালিকা

স্থানঃ চৌথাকী

উপজেলা পরিষদ মিলনায়তন

তারিখঃ ০৭ জুলাই, ২০১৩

| ক্রমিক<br>নং | নাম             | পদবী/পেশা | মোবাইল নম্বর | স্বাক্ষর |
|--------------|-----------------|-----------|--------------|----------|
| ৪৫           | মোঃ হাঃ হাঃ হাঃ | কৃষি      |              | হাঃ হাঃ  |
| ৪৬           | মোঃ হাঃ হাঃ হাঃ | কৃষি      |              | হাঃ হাঃ  |
| ৪৭           | মোঃ হাঃ হাঃ হাঃ | কৃষি      |              | হাঃ হাঃ  |
| ৪৮           | মোঃ হাঃ হাঃ হাঃ | কৃষি      |              | হাঃ হাঃ  |
| ৪৯           | মোঃ হাঃ হাঃ হাঃ | কৃষি      |              | হাঃ হাঃ  |
| ৫০           | মোঃ হাঃ হাঃ হাঃ | কৃষি      |              | হাঃ হাঃ  |
| ৫১           | মোঃ হাঃ হাঃ হাঃ | কৃষি      |              | হাঃ হাঃ  |
| ৫২           | মোঃ হাঃ হাঃ হাঃ | কৃষি      |              | হাঃ হাঃ  |
| ৫৩           | মোঃ হাঃ হাঃ হাঃ | কৃষি      |              | হাঃ হাঃ  |
| ৫৪           | মোঃ হাঃ হাঃ হাঃ | কৃষি      |              | হাঃ হাঃ  |
| ৫৫           | মোঃ হাঃ হাঃ হাঃ | কৃষি      |              | হাঃ হাঃ  |
| ৫৬           | মোঃ হাঃ হাঃ হাঃ | কৃষি      |              | হাঃ হাঃ  |
| ৫৭           | মোঃ হাঃ হাঃ হাঃ | কৃষি      |              | হাঃ হাঃ  |
| ৫৮           | মোঃ হাঃ হাঃ হাঃ | কৃষি      |              | হাঃ হাঃ  |
| ৫৯           | মোঃ হাঃ হাঃ হাঃ | কৃষি      |              | হাঃ হাঃ  |
| ৬০           | মোঃ হাঃ হাঃ হাঃ | কৃষি      |              | হাঃ হাঃ  |
|              |                 |           |              |          |
|              |                 |           |              |          |
|              |                 |           |              |          |
|              |                 |           |              |          |
|              |                 |           |              |          |

আয়োজনে : **CEGIS** Center for Environmental and Geographic Information Services  
House 5, Road 23/C, Gulshan-1, Dhaka-1212, Bangladesh. Tel: 8817648-52, Fax: 880-2-8523126

Photo A9.8: Second Round Meeting Sign-in Sheet, Harirampur, Manikganj

বন্যা ও নদীতীর ভাঙ্গন ঝুঁকি ব্যবস্থাপনা বিনিয়োগ প্রকল্পের মতবিনিময় সভায় উপস্থিতির তালিকা

স্থানঃ হরিরামপুর উপজেলা পরিষদ মিলনায়তন

তারিখঃ ১ জুলাই, ২০১৩

| ক্রমিক<br>নং | নাম                        | পদবী/পেশা                         | মোবাইল নম্বর | স্বাক্ষর |
|--------------|----------------------------|-----------------------------------|--------------|----------|
| ১)           | ড. (মোঃ মোস্তাফিজুর রহমান) | Director<br>(Deputy Secy)<br>CEHS | 01715126819  |          |
| ২            | মোস্তাফিজুর রহমান          | UNO<br>হরিরামপুর                  | 01752843886  |          |
| ৬            | মোস্তাফিজুর রহমান, বসোনা   | উপজেলা<br>সহকারী                  | 0174648851   |          |
| ৪            | মুহাম্মদ আলী               | Ex- M.P.                          | 02922575164  |          |
| ৫            | মোঃ মোস্তাফিজুর রহমান      | জিআরএমপি<br>JGREMP, BWDB          | 01715315227  |          |
| ৬            | মুহাম্মদ আলী               | সহকারী                            | 01711-857395 |          |
| ৭।           | মুহাম্মদ আলী               | উপজেলা সহকারী                     | 02922575164  |          |
| ৮।           | মোঃ মোস্তাফিজুর রহমান      | সহকারী                            | 01712026025  |          |
| ৯।           | মোঃ মোস্তাফিজুর রহমান      | উপজেলা সহকারী                     | 01716-457948 |          |
| ১০।          | মুহাম্মদ আলী               | উপজেলা সহকারী                     | 0191301173   |          |
| ১১।          | মুহাম্মদ আলী (বাস)         | উপজেলা সহকারী                     | 01715615360  |          |
| ১২।          | মুহাম্মদ আলী               | সহকারী                            | 01741181464  |          |
| ১৬।          | মোঃ মোস্তাফিজুর রহমান      | উপজেলা সহকারী                     | 01724588482  |          |
| ১৮।          | মোঃ মোস্তাফিজুর রহমান      | উপজেলা সহকারী                     | 01932331327  |          |
| ১৯।          | মুহাম্মদ আলী               | উপজেলা সহকারী                     |              |          |

আয়োজনে: **CEGIS** Center for Environmental and Geographic Information Services  
House 5, Road 23/C, Guishan-1, Dhaka-1212, Bangladesh. Tel: 881/648-52, Fax: 880-2-8623126



বন্যা ও নদীতীর ভাঙ্গন ঝুঁকি ব্যবস্থাপনা বিনিয়োগ প্রকল্পের মতবিনিময় সভায় উপস্থিতির তালিকা

স্থানঃ হরিপুর

উপজেলা পরিষদ মিলনায়তন

তারিখঃ ১ জুলাই, ২০১৩

| ক্রমিক<br>নং | নাম                    | পদবী/পেশা                              | মোবাইল নম্বর              | স্বাক্ষর          |
|--------------|------------------------|--|---------------------------|-------------------|
| ১৬.          | মনিরুজ্জামান           | কাজী                                   | ০১৭১৪২৩৫২                 | Jamir             |
| ১৭.          | শ্রী: সুফর বখশ         | ডঃ কৃষি অধিদপ্তর                       | ০১৭২৭০৫৩০৭                | Sufur             |
| ১৮.          | আবুল কালাম খান         | কৃষি কর্মকর্তা                         | ০১৭২৩৪১৪৫১                | Abul Kalam        |
| ১৯.          | মহাম্মদুল হক খান       | SAB/PHD                                | ০১৭৫২৪৮১২৫২               | Mohammadul Haque  |
| ২০.          | মোঃ ইয়াসিন আলী চৌধুরী | উপজেলা মসজিদ (সহ-ইমাম)                 | ০১৭৭৬৬৮৭৬৬                | Mohammadul Haque  |
| ২১.          | মোঃ জাহিদুর রহমান খান  | সেবা কর্মকর্তা (মদ)                    | ০১৭১৩৫৫৭৭৭<br>০১৮২৭৩০০৭৫৬ | Mohammadul Haque  |
| ২২.          | মোঃ নবীয়াত হুসেন      | বেলাপা প্রকৌশলী                        | ০১৭১৫৫৭৩১৫৭               | Nabiyaat Hossain  |
| ২৩.          | মোঃ জাহিদুর রহমান      | মহিলা সমস্যা<br>সংক্রান্ত কর্মকর্তা    | ০১৭১১-২৭৬০৬৫              | Mohammadul Haque  |
| ২৪.          | মোঃ মিজবুর রহমান       | মহিলা সমস্যা<br>সংক্রান্ত কর্মকর্তা    | ০১৬৬-৭৪৪২০২৫              | Mohammadul Haque  |
| ২৫.          | আবুল কালাম খান         | সেবা কর্মকর্তা (মদ)                    | ০১৭১২-৫২৬০৫৪              | Abul Kalam        |
| ২৬.          | মোঃ জাহিদুর রহমান      | সেবা কর্মকর্তা (মদ)                    | ০১৬২০৮২৪৬০৬               | Mohammadul Haque  |
| ২৭.          | জামাল হোসেন            | সহ-মহিলা সমস্যা<br>সংক্রান্ত কর্মকর্তা | ০১৭১৭৩৭৬৬০৭               | Jamal Hossain     |
| ২৮.          | সিদ্দিকুর রহমান        | সহ-মহিলা সমস্যা<br>সংক্রান্ত কর্মকর্তা | ০১৭১৭২২৪৬০                | Siddiqueur Rahman |
| ২৯.          | মোঃ জাহিদুর রহমান      | সেবা কর্মকর্তা (মদ)                    | ০১৭১৪০৩৬৬০৭               | Mohammadul Haque  |
| ৩০.          | আবুল কালাম খান         | কাজী                                   | ০১৭২১৭৫৪৭৭                | Abul Kalam        |

আয়োজনে : **CEGIS** Center for Environmental and Geographic Information Services

House ৫, Road ২৩/৫, Gulshan-১, Dhaka-১২১২, Bangladesh. Tel: ৯৮১/৬৪৫-৫২, Fax: ৯৮১-২-৬৫২৩১২

বন্যা ও নদীতীর ভাঙ্গন ঝুঁকি ব্যবস্থাপনা বিনিয়োগ প্রকল্পের মতবিনিময় সভায় উপস্থিতির তালিকা

স্থানঃ হরিদাসপুর উপজেলা পরিষদ মিলনায়তন

তারিখঃ ৯ জুলাই, ২০১৩

| ক্রমিক<br>নং | নাম                 | পদবী/পেশা  | মোবাইল নম্বর    | স্বাক্ষর                |
|--------------|---------------------|------------|-----------------|-------------------------|
| ৬১           | মোঃ হুমায়ুন        | ডায়েরি    | ০১৭২৫৭৪৪<br>৩১৬ |                         |
| ৬২           | জৈনন্দ/ Jannar      | কম্পিউটার  | ০১৭১৫২০৫৫৩      |                         |
| ৬৩           | মহাঙ্গনা            | মহাঙ্গনা   | ০১৭৩১৫৪৮৬৭১     |                         |
| ৬৪           | মোঃ বাহাদুর         | গ্রামসুপার |                 |                         |
| ৬৫           | মোঃ হুমায়ুন        | কম্পিউটার  |                 |                         |
| ৬৬           | মোঃ জৈনন্দ/জৈনন্দ   | কম্পিউটার  |                 |                         |
| ৬৭           | মোঃ হুমায়ুন        | কম্পিউটার  |                 |                         |
| ৬৮           | মোঃ জৈনন্দ/জৈনন্দ   | কম্পিউটার  | ০১৭১২০৬২২০৭     |                         |
| ৬৯           | মোঃ জৈনন্দ/জৈনন্দ   | কম্পিউটার  | ০১৭২৩৬৩০৭০২     |                         |
| ৭০           | মোঃ হুমায়ুন/জৈনন্দ | কম্পিউটার  | ০১৭১৭৩২<br>৮৭৬৬ | ২মো.<br>হুমায়ুন/জৈনন্দ |
| ৭১           | মোঃ জৈনন্দ/জৈনন্দ   | কম্পিউটার  | ০১৭১৮৬৩০৭৭৭     |                         |
| ৭২           | মোঃ জৈনন্দ/জৈনন্দ   | কম্পিউটার  | ০১৭২৫৫৫৫৮৭৩     |                         |
| ৭৩           | মোঃ জৈনন্দ/জৈনন্দ   | কম্পিউটার  | ০১৭৩১৭৭১৭৭৫     |                         |
| ৭৪           | মোঃ জৈনন্দ/জৈনন্দ   | কম্পিউটার  | ০১৭১৭৮৫৫১২      |                         |
| ৭৫           | মোঃ জৈনন্দ/জৈনন্দ   | কম্পিউটার  | ০১৭১৬৩০২৫৫২     |                         |

আয়োজনে : **CEGIS** Center for Environmental and Geographic Information Services  
House ৫, Road ২৩/১, Gulshan-১, Dhaka-১২১২, Bangladesh. Tel: ৮৮১/৬৪৮-৫২, Fax: ৮৮০-২-৮৮২৩১২৮



বন্যা ও নদীতীর ভাঙ্গন ঝুঁকি ব্যবস্থাপনা বিনিয়োগ প্রকল্পের মতবিনিময় সভায় উপস্থিতির তালিকা

স্থানঃ হরিপুর উপজেলা পরিষদ মিলনায়তন

তারিখঃ ১ জুলাই, ২০১৩

| ক্রমিক<br>নং | নাম                    | পদবী/পেশা              | মোবাইল নম্বর | স্বাক্ষর                    |
|--------------|------------------------|------------------------|--------------|-----------------------------|
| ৪৪৭          | আবু জায়েদ হুসৈন আহমেদ | সহকারী প্রোগ্রামার     | ০১৭১২২৭৬৬৩৭  | আবু জায়েদ হুসৈন<br>১৭/৭/১৩ |
| ৪৪৮          | শেখ মুহাম্মদ হুসৈন     | ইউ.পি. মেম্বর          | ০১৭৩২৭০৮৭৭৮  | শেখ মুহাম্মদ হুসৈন          |
| ৪৪৯          | আবু বক্কর আলী          | বার্গারিক<br>Ass. P.O. | ০১৭১৭৩৫৩৭০১  | আবু বক্কর আলী               |
| ৪৫০          | মোহাম্মদ হুসৈন (নাম)   | আবু বক্কর<br>হুসৈন     | ০১৭৩৫৫৮১০২৮  | মোহাম্মদ হুসৈন              |
| ৪৫১          | মোহাম্মদ হুসৈন (নাম)   | আবু বক্কর<br>হুসৈন     | ০১৭৭৬৬৮৫৬৫৭  | মোহাম্মদ হুসৈন              |
| ৪৫২          | মোহাম্মদ হুসৈন (নাম)   | আবু বক্কর<br>হুসৈন     | ০১৭৭৮১০২৫৫০  | মোহাম্মদ হুসৈন              |
| ৪৫৩          | মোহাম্মদ হুসৈন (নাম)   | ইউ.পি. মেম্বর          | ০১৭২৭৬০৭১৫৩  | মোহাম্মদ হুসৈন              |
| ৪৫৪          | মোহাম্মদ হুসৈন (নাম)   | ইউ.পি. মেম্বর          | ০১৭২০৮২১৩৫৭  | মোহাম্মদ হুসৈন              |
| ৪৫৫          | মোহাম্মদ হুসৈন (নাম)   | ইউ.পি. মেম্বর          | ০১৭৮১৮০৫১৭৭  | মোহাম্মদ হুসৈন              |
| ৪৫৬          | মোহাম্মদ হুসৈন (নাম)   | ইউ.পি. মেম্বর          | ০১৭৩১৭৬৬৩৭২  | মোহাম্মদ হুসৈন              |
| ৪৫৭          | মোহাম্মদ হুসৈন (নাম)   | ইউ.পি. মেম্বর          | ০১৭৫৮৩৩০৮৭   | মোহাম্মদ হুসৈন              |
| ৪৫৮          | মোহাম্মদ হুসৈন (নাম)   | ইউ.পি. মেম্বর          | ০১৭৫৭২৪৩৩০   | মোহাম্মদ হুসৈন              |
| ৪৫৯          | মোহাম্মদ হুসৈন (নাম)   | ইউ.পি. মেম্বর          | ০১৭১২৫৮৫৭৩৭  | মোহাম্মদ হুসৈন              |
| ৪৬০          | মোহাম্মদ হুসৈন (নাম)   | ইউ.পি. মেম্বর          | ০১৮২২৫০২৮৭১  | মোহাম্মদ হুসৈন              |
| ৪৬১          | মোহাম্মদ হুসৈন (নাম)   | ইউ.পি. মেম্বর          | ০১৭৫৭২৪৩৩০   | মোহাম্মদ হুসৈন              |

আয়োজনে : CEGIS Center for Environmental and Geographic Information Services

House ৫, Road ২৩/৮, Gulshan-১, Dhaka-১২১২, Bangladesh. Tel: ৮৮১৭৬৮-৫২, Fax: ৮৮০২-৮৮২৩১২৮

| ক্রমিক<br>সংখ্যা | নাম                 | পেশা/সেবা        | যোগাযোগ<br>নম্বর | স্বাক্ষর            |
|------------------|---------------------|------------------|------------------|---------------------|
| ০৬০              | শ্রী: আক্তার হোসেন  | কৃষক             | ০১৭১৪০৯৯৫২০      | শ্রী: আক্তার হোসেন  |
| ০৬১              | শ্রী: মোকিম হোসেন   | সদস্য ইন্সপেক্টর | ০১৭২০৮২১৩৫৯      | শ্রী: মোকিম হোসেন   |
| ০৬২              | শ্রী: হুমায়ুন কবীর | শ্রমিক           | ০১৭২২৯২০২২০      | শ্রী: হুমায়ুন কবীর |
| ০৬৩              | শ্রী: আমানুল হোসেন  | সদস্য ইন্সপেক্টর |                  | আদাবাও              |
| ০৬৪              | শ্রী: হাতিম আলী     | কৃষক             |                  | শ্রী: হাতিম আলী     |
| ০৬৫              | আক্তার              | কৃষক             |                  | শ্রী: আক্তার        |
| ০৬৬              | শ্রী: রুহেল মিয়া   | চাকরি            | ০১৭১৫৯৬৫৫৩       | শ্রী: রুহেল         |
| ০৬৭              | আমির হোসেন          | কৃষক             | ০১৭৭৮১৮৩১৮৫      | A                   |



বন্যা ও নদীতীর ভাঙ্গন ঝুঁকি ব্যবস্থাপনা বিনিয়োগ প্রকল্পের মতবিনিময় সভায় উপস্থিতির তালিকা

স্থানঃ হরিদাসপুর উপজেলা পরিষদ মিলনায়তন

তারিখঃ ১ জুলাই, ২০১৩

| ক্রমিক<br>নং | নাম                | পদবী/পেশা                 | মোবাইল নম্বর | স্বাক্ষর       |
|--------------|--------------------|---------------------------|--------------|----------------|
| ১            | MD Kamel Hossain   | J. S. A                   | ০১৪৬১৩১৩৭    | Kamel          |
| ২            | স্বর্গিয়া         | UP সদস্য                  | ০১৭৩১২২৭৭২   | স্বর্গিয়া     |
| ৩            | নাসি               | UP সদস্য                  | ০১৭১০৮২৭৫৩০  | নাসি           |
| ৪            | আঃ মাকসুদ          | কর্তা                     |              | আঃ মাকসুদ      |
| ৫            | মোঃ হোসেন হোসেন    | ইমাম ইমতিয়াজ<br>আমেদগাঁও | ০১৮৩৪৭৬৫৭৭   | Jamul          |
| ৬            | সুলতান মাহমুদ      | কর্তা                     | ০১৭১৫৮১২২৩৭  | Sultan         |
| ৭            | মোঃ ইমতিয়াজ হোসেন | কর্তা                     | ০১৭১৮৮৮৭৭৬   | Imtiaz         |
| ৮            | হুদায়েদুল হক খান  | স্বাক্ষর                  | ০১৭২৩-৩৬৭০৭৭ | Huda           |
| ৯            | আঃ মাকসুদ          | সিমান্তর                  | ০১৭৭৭৭৭৭৭৭   | আঃ মাকসুদ      |
| ১০           | মোঃ সাদিকুল হক     | কর্তা                     |              | মোঃ সাদিকুল হক |
| ১১           | মোঃ মাহমুদ         | বিসম                      |              | মাহমুদ         |
| ১২           | মোঃ আব্দুল হান্নান | কর্তা                     | ০১৭৩০৬৭৫৮৭   | Abul Hannan    |
| ১৩           | মোঃ নাজিম হোসেন    | কর্তা                     | ০১৭৭৭৭৭৭৭৭   | Nazim          |
| ১৪           | মোঃ সুলতান মাহমুদ  | কর্তা                     | ০১৭১৭৫৬৮৭৭   | Sultan         |
| ১৫           | মোঃ মোকাম্মদ       | কর্তা                     | ০১৭১০৭৭৭৭৭৭  | Mokhammad      |

আয়োজনে : **CEGIS** Center for Environmental and Geographic Information Services  
House 6, Road 23/C, Gulshan-1, Dhaka-1212, Bangladesh. Tel: 8817648-52, Fax: 880-2-8823128

| ନାମ | ପଞ୍ଜୀକୃତ ନାମ                | ପଞ୍ଜୀକୃତ ନାମ                | ପଞ୍ଜୀକୃତ ନାମ                |
|-----|-----------------------------|-----------------------------|-----------------------------|
| 84  | ପଞ୍ଜୀକୃତ ନାମ (ପଞ୍ଜୀକୃତ ନାମ) | ପଞ୍ଜୀକୃତ ନାମ (ପଞ୍ଜୀକୃତ ନାମ) | ପଞ୍ଜୀକୃତ ନାମ (ପଞ୍ଜୀକୃତ ନାମ) |
| 85  | ପଞ୍ଜୀକୃତ ନାମ (ପଞ୍ଜୀକୃତ ନାମ) | ପଞ୍ଜୀକୃତ ନାମ (ପଞ୍ଜୀକୃତ ନାମ) | ପଞ୍ଜୀକୃତ ନାମ (ପଞ୍ଜୀକୃତ ନାମ) |

## **Annex 5: Standard Construction Contract Environmental Safeguard Clauses**

### **A. Environmental Protection and Control of Pollution**

#### **1. General**

The Contractor shall observe and comply with all National Laws and Government Regulations pertaining to environmental protection, pollution control, waste management, and biodiversity protection.

In conducting his construction activities, the Contractor shall take all necessary precautions to minimise environmental disturbance to the project area and surroundings and to prevent the escape of polluting substances into streams, water courses, and ground water. The Contractor shall also utilise all necessary practicable methods and devices as are available to prevent and otherwise minimize atmospheric emissions or discharges of air contaminants.

Except where otherwise agreed or provided for by the Employer or expressly stipulated in Particular Specifications or Technical Specifications forming part of the Contract Documents, no separate payment will be made for complying with the provisions of this Clause and attendant sub-clauses; and all costs shall be deemed to be included in the prices for the Contractor's mobilisation for construction, and the various rates and lump sum items for the works included in the priced Bill of Quantities.

#### **2. Pollution of Water Courses and Streams**

The emission of polluting liquids or other waste into drains, water courses or ground water shall not be permitted.

No concrete or cement washings from the works or drainage from the Contractor's concrete batching and mixing areas, asphalt (hot mix) plants or other manufacturing or production facilities shall be allowed to discharge into streams or drains without passing through an adequate system of settling ponds.

Storage of fuels, fuelling and maintenance of plant and vehicles, etc. shall take place only on sites and under conditions that do not allow spilt fuels to be discharged to water bodies. Fuel storage and fuelling areas shall be equipped with adequate protective measures to confine and retain accidental spillages. No drainage from fuel store and plant maintenance depots shall be allowed to be discharged without passing through an adequate arrangement of oil traps and separators.

Washing of vehicles shall not be permitted in streams but only in specially designated and equipped areas.

Operations in quarries and borrow areas shall be carried out in such a way as to minimize any possible pollution from particulate matter entering the streams.

Adequate sanitary waste control facilities shall be provided in site offices and workers camps, and sewage waste shall be collected regularly and disposed in accordance with relevant environmental legislation.

The Contractor shall accordingly be responsible for the installation, operation and maintenance of a comprehensive drainage system to all areas of the Works. The system shall be constructed such that no discharges of oil, cement, silt or other liquid or solid waste matter can enter the streams and water courses at the site; and it shall have all necessary solid waste and sediment traps, settling ponds, oil separators, etc. required to ensure that pollution of streams watercourses and natural bodies of water does not occur. The Contractor shall be responsible for maintaining the system to the satisfaction of the Employer's Construction Supervisor and all costs of providing the system shall be deemed to be included in the various rates and lump sum items for the works included in the priced Bill of Quantities.

### **3. Air Pollution**

The Contractor shall take all necessary steps to minimize air pollution resulting from his operations.

Except where stipulated in these Specifications for the disposal of natural vegetation and organic materials from clearing operations, the burning of waste materials for disposal, particularly oil and petroleum wastes, rubber, plastics and similar materials will not be permitted.

During the performance of the work required under the Contract or of any operations appurtenant thereto, whether on the Project Site or elsewhere, the Contractor shall take all steps necessary, and shall furnish all labor, equipment, materials and means, required to reduce dust nuisance from the Works, and to prevent dust originating from his operations from damaging crops, orchards, cultivated fields, and dwellings; or causing a nuisance to persons. The Contractor shall be held liable for any damage resulting from dust originating from his operations including on Government roads, rights-of-way or elsewhere.

The emission of dust into the atmosphere shall not be permitted during the manufacture, handling and storage and handling of cement and of concrete aggregates and the Contractor shall use such methods and equipment as are necessary for the prevention, or the collection and disposal, of dust during such operations. All truckloads of loose materials shall be covered during transportation

Concrete batching and mixing areas, asphalt (hot mix) plants, or other manufacturing or production facilities shall be sited at least 500m from the nearest habitation. Emission outlets shall be fitted with pollution control devices in compliance with relevant current Government of Bangladesh emission control legislation.

The cost of spraying water on haul roads, access roads, government roads, aggregate stockpiles, etc.; or of any other methods of reducing the formation of dust; and the cost of furnishing and applying materials to maintain the works areas, adjacent areas, and roads, in a dustless condition, shall be deemed to be included in the various rates and lump sum items for the works included in the priced Bill of Quantities.

### **4. Noise Pollution**

The Contractor shall take all necessary precautions to minimize the amount of noise and vibrations coming from construction activities.

The Contractor shall ensure that all plant and equipment is properly maintained in good operating condition, and that noisy construction activities shall be effectively sound reduced by means of silencers, mufflers, acoustic linings or shields, acoustic sheds or screens or other means, to avoid disturbance to any nearby noise sensitive receivers. All plant and equipment shall comply with relevant Government of Bangladesh legislation covering sound emissions.

Quarry operations and blasting shall be undertaken so as to minimize blasting and disturbance during the night and, insofar as possible, noise, vibration and dust. Operation of trucks and heavy vehicles and machinery shall be restricted to the hours of 06:30 to 19:00.

All necessary measures shall be undertaken to protect schools, hospitals and other adjacent noise sensitive receptors, including the use of noise barriers.

## **5. Damage to Property, Crops, and Vegetation**

The Contractor shall limit the movement of his employees and equipment within the project area and on adjacent land, including access routes approved by the Employer's Construction Supervisor, so as to minimize damage to natural vegetation, crops and property, and shall endeavor to avoid any damage to land.

The Contractor shall strictly ensure employees and equipment do not enter any sensitive environmental areas that are demarcated as "no-entry" zones.

The Contractor shall preserve existing trees, plants and other vegetation that are to remain within or adjacent to the Works and shall use every precaution necessary to prevent damage or injury thereto. Trees or shrubs shall only be felled or removed where such impinge directly on the permanent works or necessary temporary works areas; and where such is approved by the Employer's Construction Supervisor.

On completion of the Works all areas disturbed by the Contractor's construction activities shall be restored by the Contractor to their original condition, or as may be acceptable to the Employer.

The Contractor shall be responsible directly to the Employer for any excessive or unnecessary damage to crops or lands arising from his operations, whether within the project area, on lands adjacent thereto, or adjacent to approved access roads: and deductions will be made from the payment due to the Contractor to cover the cost of such excessive or unnecessary damage, as determined by the Employer.

## **B. Sanitation Facilities and Arsenic Safe Water Supplies**

At each construction area, (i) an appropriate number of tubewells will be installed to supply water for construction and safe drinking water to laborers and the construction camps, and (ii) latrines with septic tanks will be provided. Tubewells will be tested for arsenic and marked accordingly (green/red for safe/unsafe).

## **C. Reporting**

The Contractor shall maintain a record of all emissions and spills of liquid, solid and gaseous matter which occur at the site, whether into water courses, streams, on land, or into the air. This record shall be compiled daily and shall include details of date, time and nature of the event, along with details of the remedial and clean-up measures carried out. Copies of these records shall be given to the Employer monthly.

The Contractor shall also maintain a record of any complaints made by any Governmental or Community Organization or by the public, regarding his operations. This record shall contain the date and time of receipt of the complaint, the name and address of the complainant and the action taken to remedy the situation. Copies of these records shall be given to the Employer monthly.

**D. Environmental Management Plan**

The requirements of this clause and attendant sub-clauses on Environmental Protection and Pollution Control notwithstanding; the Contractor shall observe and comply with all relevant environmental protection and mitigation, monitoring and reporting requirements in the Environmental Management Plan (EMP) as stipulated in the Particular Specification. In the event of any conflict between the foregoing sub-clauses and the environmental protection and mitigation measures and pollution control requirements of the EMP, the EMP shall take precedence.

The Contractor shall prepare and submit to the Employer's Construction Supervisor a Construction Environmental Management and Monitoring Plan (CEMP) demonstrating the manner in which the Contractor will comply with the requirements of the foregoing sub-clauses on Environmental Protection and Pollution Control, the EMP, and any particular environmental mitigation measures as stipulated in the Particular Specifications or Technical Specifications forming part of the Contract Documents.

The CEMP shall be submitted within 15 working days of the Contractor receiving the Notice to Proceed with the Works, and shall include a waste management plan detailing procedures for waste management for the site covering all solid, liquid and gaseous waste materials and emissions. The waste management plan shall include procedures for the collection and disposal of all waste materials in such a way as to ensure that no damage is caused to the environment. Training shall be provided to workers about the appropriate implementation of the CEMP and waste management plan measures.

Where stipulated in the Particular Specifications or Technical Specifications forming part of the Contract Documents, and provision has been made in the Bill of Quantities; payment for the implementation of the CEMP will be made in accordance with the Unit Rates, Lump Sum or Provisional Sum Items included in the Priced Bill of Quantities.

## **Annex 6: Project Implementation Arrangements**

### **A. Steering and Guidance of Executing and Implementing Agencies**

The program is suggested to be implemented under the lead of BWDB (executing agency) with close relationships to DDM (implementing agency). Other associated organizations are WARPO, LGED and BIWTA. The participating organizations require clearly defined procedures of when, where, and how to coordinate their activities. To this end BWDB has a number of Memoranda of Understanding (MoU) in place, which will be suitably updated for the purpose of the program during the first year of the program.

In line with government principles program activities are regularly reviewed and discussed through annual inter-ministerial steering committee meetings. Given the complexities of the program, a Panel of Experts is expected to provide guidance related to key questions:

- (i) River morphology, engineering, and stabilization
- (ii) Flood Risk Management at regional and community level
- (iii) Institutional and capacity development at regional and community level

### **B. Integrated Program Management Office (PMO)**

The PMO will be integrated into the administrative setup of BWDB and placed at a high level given the importance and relevance of the program. The key features are:

- (i) Headed by an Additional Chief Engineer, similar in rank as the zonal Chief Engineers and supported by two Superintending Engineers
- (ii) Initially identical and later closely associated with the CE River Management, once the post gets approved. This is a vital element to activate the new river management wing and to institutionalize the broad river stabilization approach.
- (iii) Supported by an individual design office, exclusively dealing with river stabilization measures.
- (iv) Conducting river management activities of larger national importance, such as procuring materials for works and strategic stockpiling for emergencies, and guiding char reclamation activities
- (v) Implementing work through existing zonal division. These divisions already build embankments and riverbank protection, and will be strengthened in terms of staff during the implementation of the works.

Figure A3.1 depicts the program management principles agreed during discussion with the BWDB management, namely ADG and Chief Planning in early 2013.

### **C. Advisory Support**

The program will be supported by consultants and NGOs at different level. This addresses the program management requirements of ADB and supports BWDB during the current period of staff shortage, specifically of junior staff. An Institutional Strengthening and Project Management Consultant (ISPMC) will provide the main support in a number of different areas. The advisory support scope of work includes the services of a specialist organization to conduct environmental assessment and planning. Additional details regarding the financing and potential scope of work of the advisory support are provided in Section 15 of the Final Report, Main Volume.



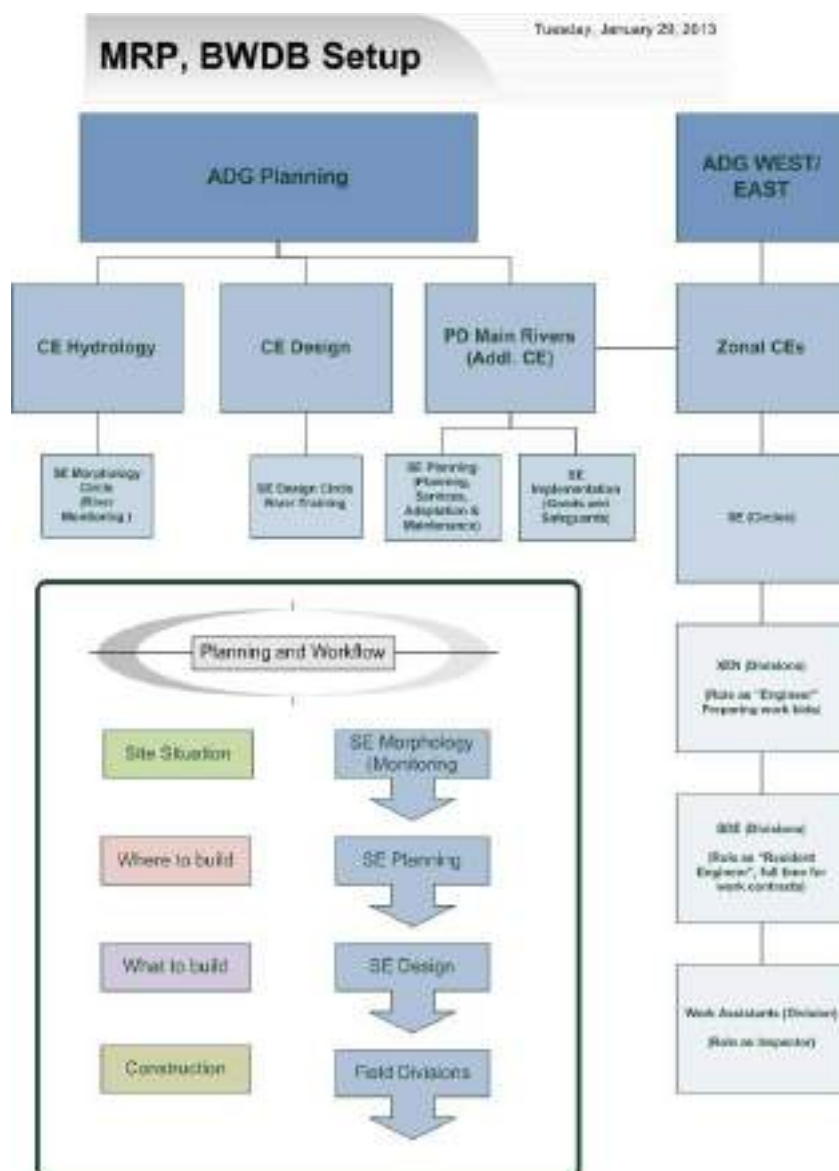
## D. Management Information and Reporting

The program requires data management at different levels for different purposes:

- (i) Baseline data for benefit assessment
- (ii) Project management data for progress documentation
- (iii) Asset information for BWDB operation, namely maintenance

A suitable MIS system for above three elements was outlined for AFRERMIP (Individual Consultants, 2012). Component (iii) has been developed further for the purpose of BWDB and forms part of the institutional report. The reporting requirements form also part of ADB's project implementation memorandum.

**Figure A3.1 Organization chart for BWDB program management**



## Annex 7: Project Description, Jamuna Right Bank 1<sup>41</sup>

| Project Name        | ID   | Upazilas (Unions) | Area                | River Area | Population |
|---------------------|------|-------------------|---------------------|------------|------------|
| Jamuna Right Bank 1 | JRB1 | 3 (24)            | 582 km <sup>2</sup> | 24 %       | 1,052,600  |

| Bankline length | Average Erosion (1973-2010/2007-2012) | Flood extent (1998 / 2007) | Area Boro/Aman | Population Density (total/floodplain) |
|-----------------|---------------------------------------|----------------------------|----------------|---------------------------------------|
| 37 km           | 1.52 km / 0.13 km                     | 69% / 56%                  | 65% / 37%      | 1810/2370                             |

### A. Situation

The JRB-1 subreach extends from from Jamuna Bridge to Shahjadpur on the right bank of the Jamuna. The Jamuna Bridge guide bunds impose a straight channel downstream of the bridge for about 15 km along the left bank of the braided belt (Sarker et al. 2011). As a consequence, a stable attached char about 15 km long and 5 km wide has formed along the right bank, south of the western guide bund.

This straight channel bifurcates into a western and eastern branch at about Enayetpur. The eastern channel is presently dominant. While the location of this bifurcation appears to be quite stable, discharges vary in the two downstream channels. During the early 2000s, very little dry-season flow occurred along the right bank. Recently most dry season flow has occurred along this bank.

Historically, the western floodplain was protected by the Brahmaputra Right Embankment (BRE) as far as the Hurashagar/Baral River, which is upstream of the Pabna Integrated Rural Development Project (PIRDP). The last 10 km or so of the BRE, from Kaijuri to the Hurashagar/Baral outfall, part of the Hurashagar FCD Project embankment, eroded during the 1990s (Figure A4.1 and Figure A4.2). This erosion brought once-protected areas back to the natural cycle of flooding and erosion, accompanied by substantial deposition of sand along the riverbanks (sand casting). It rendered the Hurashagar FCD project completely inoperational (FAP 2).

Riverbank protection constructed in 2010 and 2011 from Kaijuri to Benotia stabilized the riverbank (Figure A4.3) and as such induced cluster settlements along the derelict BRE. It also stabilized the larger channel pattern and substantially reduced the dredging volume (Figure A4.4) required to maintain navigation access to the important Bagabari Port (see Annex D of January 2013 report).

### B. Future Scenarios

During the 2012 dry season the Enayetpur area came under erosional attack. The existing riverbank protection (spur) in this area allowed the the Enayetpur spur to be eroded to the brink of collapse (Figure A4.5; note the absence of toe protection; Figure A4.6). Other infrastructure is at risk from

<sup>41</sup> Project descriptions were adapted from Final Report Annex A, 16 July 2013 version.

erosion at this location, notably the large Enayetpur hospital complex and the BRE which if breached will allow flooding of the adjacent area. The situation is comparable to that of PIRDP in the early 2000s, when the embankment was at risk of immediate erosion.

Future channel planforms downstream of the bifurcation at Enayetpur can consist of one or two channels. The initial morphological study for the lower Jamuna reach (Annex C, January Pre-Feasibility Report) indicates that the present two-channel system with one large char affords the most pragmatic future river stabilization approach.

### **C. Existing Works**

BWDB has built two RCC spurs at Betil and Enayetpur, which were rehabilitated two times from ADB flood damage repair funds (after the 2004 and 2007 flood), but which are not stable for major river attack as experienced at this moment.

BWDB, under JMREMP, has built 10 km of riverbank protection from Kaijuri towards the Hurashagar River. Some of this work shows local geotechnical failure (slip circles) and is presently (dry season 2013) repaired at cost of 1.5 Crore.

Three LGED small scale projects are situated in this area.

### **D. Project Concept**

This sub-project incorporates three BWDB priority projects: (i) riverbank protection along the right bank of the bifurcating channel from upstream of Enayetpur towards Kaijuri, (ii) riverbank protection upstream of the Hurasagar to close an existing gap, and (iii) reconstruction of the BRE and Hurashagar FCD embankment from Kaijuri to Shahjadpur

The Tranche 1 interventions are:

- Embankment reconstruction, of the BRE with road facilities for 12.5 km, and along the Hurashagar/Baral for 9.5 km
- 1 km of riverbank protection, from the existing protection downstream towards the Hurashagar/Baral
- Regulators for water management including rehabilitation of existing structures
- Immediate stabilization of the Enayetpur spur.

Tranche 1 will reinstate much of the flood protection afforded by the original BRE. Benefits will include reduction of overall flood levels, and in particular flood reductions in Hurashagar FCD (Figure A4.7 shows flood extent in 1987 when Hurashagar was still functioning vs in 1998 after the BRE breach had compromised it). The BRE reconstruction will complete the road connection along the Jamuna right bank, connecting the densely populated area along the bank with the Jamuna Bridge and with Shahjadpur via Kaijuri.

The Tranche 2 interventions are:

- Rehabilitation of the remaining 4 km of embankment from Bagabari to Shazadpur along the Kortoa River, and construction of a road from the Jamuna embankment to Bagabari and Shahjadpur
- About 11 km of priority riverbank protection from the upstream bifurcation towards Kaijuri to protect Enayetpur from erosion and flooding and to stabilize the off-take of the western Jamuna channel which is the main access to Bagabari Port.

- Potentially construction of the upstream riverbank protection will require excavation or dredging through some distance of low-lying charland. Excavated/dredged material created in this process can be used to fill in (create reclaimed land in) the bankline channel between Enayetpur and Betil.
- Existing riverbank protection may be adapted to greater river depth as needed.

The Tranche 2 benefits include:

- Rendering the Hurashagar FCD project fully operational with full flood benefits.
- Providing a road connection to Bagabari (via ferry) and Shahjadpur.
- Mitigation of Enayetpur area erosion risks, including the risk to Enayetpur hospital.

Optional work in this area, depending on morphological study, economic feasibility, and availability of funds, includes:

- Protection of char head for bifurcation stabilization (depending on morphological confirmation) so as to create an all-year-round navigable channel towards Jamuna Bridge.
- Future BRE construction over the attached char from Jamuna Bridge to Enayetpur. This has the potential to reclaim around 50 km<sup>2</sup> of land. Catkin plantation may be used to accelerate sedimentation and soil fertility.
- Construction of an additional 5 km of riverbank protection, and adaptation of the existing 10 km to the greater river depth expected for a more stable channel.

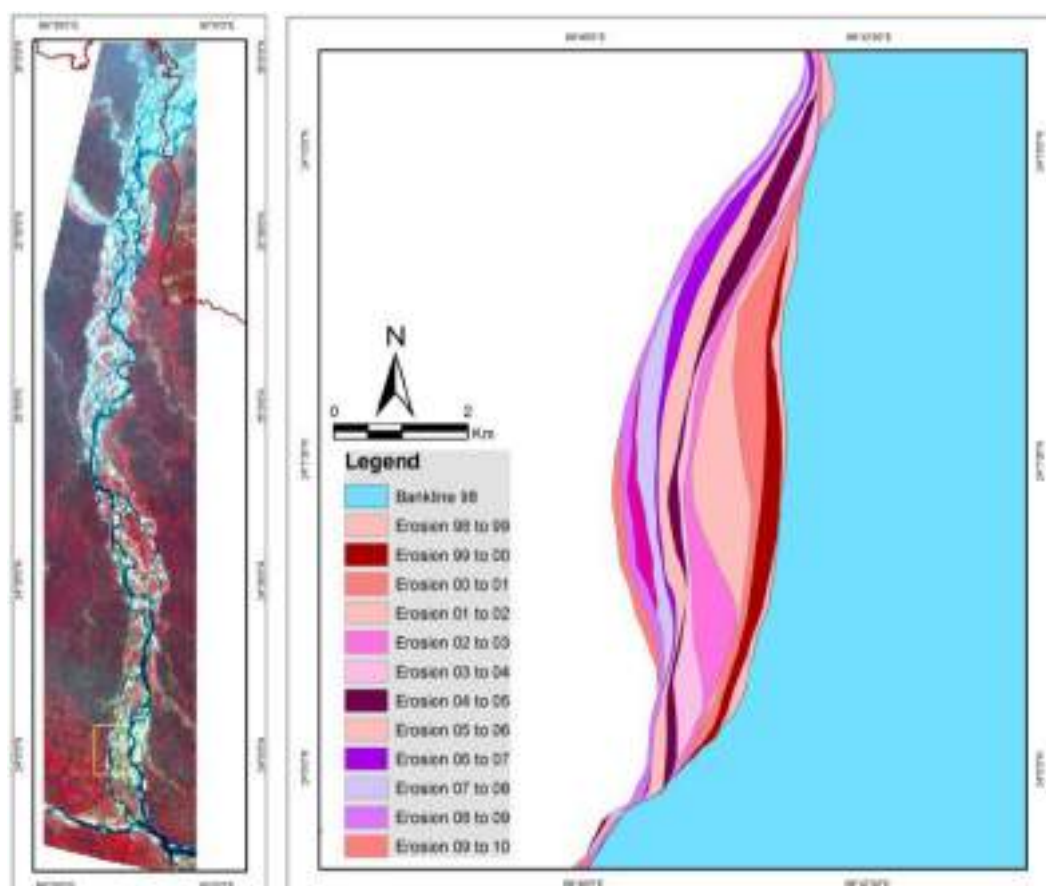
| Intervention Elements |   |
|-----------------------|---|
| <i>List by type</i>   | <i>Description (Location, dimensions or quantity)</i>   |
| <i>Infrastructure</i> | <b>TRANCHE 1</b>  |
| 1.RBP                 | 1 km at Benotia<br>Adaptation and Enayetpur spur stabilization  |
| 2. EMB                | 23 km for reconstruction of BRE and Hurashagar FCD scheme   |
| 3. Other              | 4 new regulators with 11 vents in total (1*1 vent, 1*4 vent, 1*6 vent) and rehabilitation of 2 existing 4 vent regulators |
| <i>Infrastructure</i> | <b>TRANCHE 2</b>  |
| 1.RBP                 | 11 km at Enayetpur for protection and stabilization of the bifurcation<br>LS adaptation work to greater river depth       |
| 2. EMB                | 4 km along Kortoia river. 13 km of road construction from Jamuna to Shahzadpur.   |
| 3. Other              | Buoys for navigation and fish protection along revetment work   |

| Intended Benefits (+) and Potential Adverse Impacts (-) |             |  |
|---|-------------|--|
| <i>Type</i>   | +<br>-<br>? | <i>Description</i><br><br><i>(impacted location, activity or asset; timing, extent or magnitude)</i> |

| Intended Benefits (+) and Potential Adverse Impacts (-) |   |  |
|---|---|--|
| Reduced flood damage                                    | + | Whole area from<br>(i) Rehabilitated embankments (BRE and Hurashagar FCD project)<br>(ii) Securing BRE at the Enayetpur area   |
| Reduced erosion   | + | Whole bankline through stabilized river course   |
| Navigation  | + | More stable channel along protected bank with increased draught<br>Dramatically reduced dredging cost  |
| Land reclamation  | + | Downstream part of Enayetpur char secured  |
| Water Management  | + | Improved conditions for HY aman and dry season irrigation after reconstruction of BRE  |
| Communication   | + | Improved access in case a dedicated national highway standar road is built along the embankment from Beira to Nagarbari and beyond   |
| Land acquisition/loss                                   | - | Associated with original BRE embankment – about 1 km <sup>2</sup> (20km*50m) floodplain land   |
| Resettlement  | - | To be confirmed  |
| Fisheries   | ? | Geotextile bag revetments provide shelter, attached chars potential spawning ground, protection from floating nets<br><br>Improved operation of regulators following GIZ biodiversity project (at Pabna) |

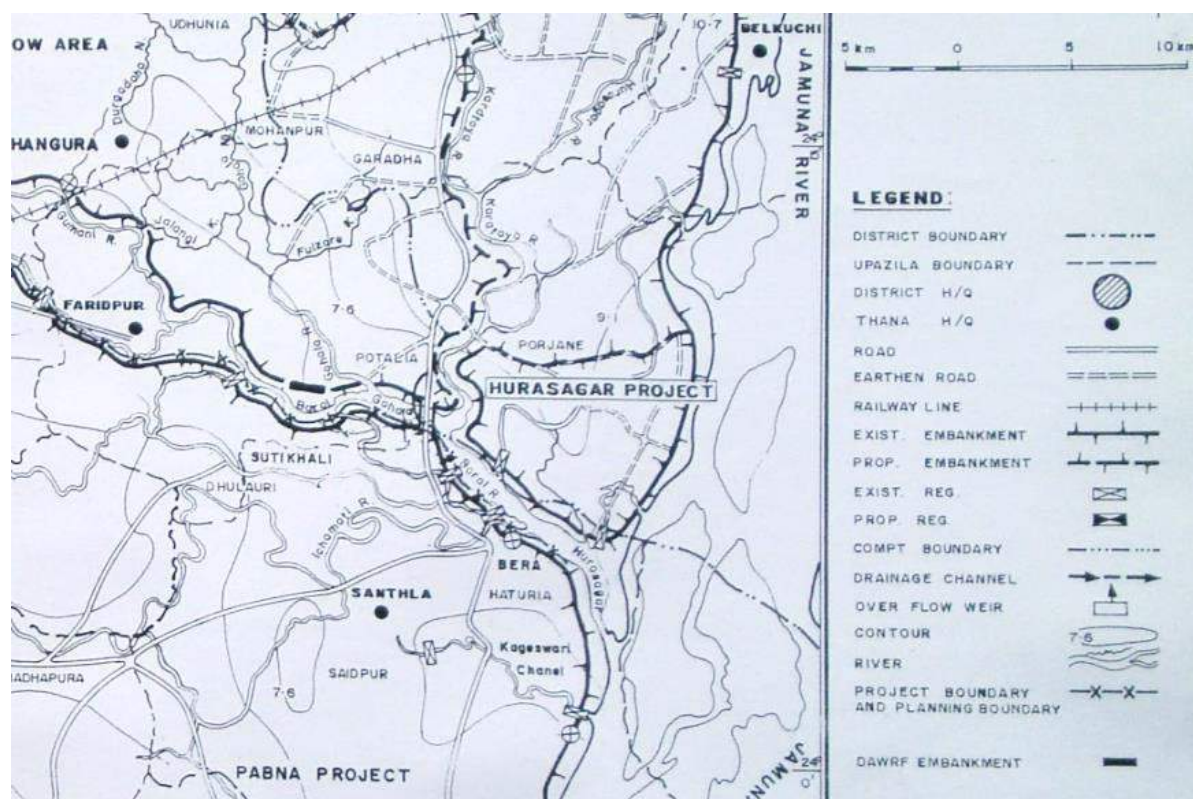
| Supporting Studies                   |   |
|--------------------------------------|---|
| Surveys                              | River surveys by BWDB and the PPTA team<br>Flood plain surveys along the Hurashagar and Kaijuri to Shariatpur   |
| Char-land Study                      | Investigation of deposition rates of the char opposite of the Hurashagar/Baral outfall and upstream between Enayetpur and Jamuna Bridge   |
| River Modeling & Analytical Approach | 1-D HEC RAS modeling of flow patterns to determine the minimum width of a single channel river solution   |
| Flood Modeling                       | Scenario 1: restoration of Hurashagar FCD embankment from Kaijuri to Benatia along the Jamuna, Benotia to Bagabari along the Hurashagar/Baral, and Bagabari to Shahjadpur along the Karatoa River<br><br>Scenario 2: loss of flood protection in the Enayetpur area due to erosion and breach of the embankment |
| EIA/SIA                              | Environmental baseline and impacts of above works   |
| Resettlement                         | 100% census and IOL, 20% SES for embankment and 2 km of riverbank protection  |

Figure A4.1: Jamuna Right Bank 1 – Bankline 1998-2010



Source: CEGIS. 2007. JMREMP Morphology Study.

Figure A4.2: Jamuna Right Bank 1 Historic Area Map



Source: FAP 2 report.



Figure A4.3: Jamuna Right Bank 1 - Channel Variability, 2007-9 vs. 2010-12

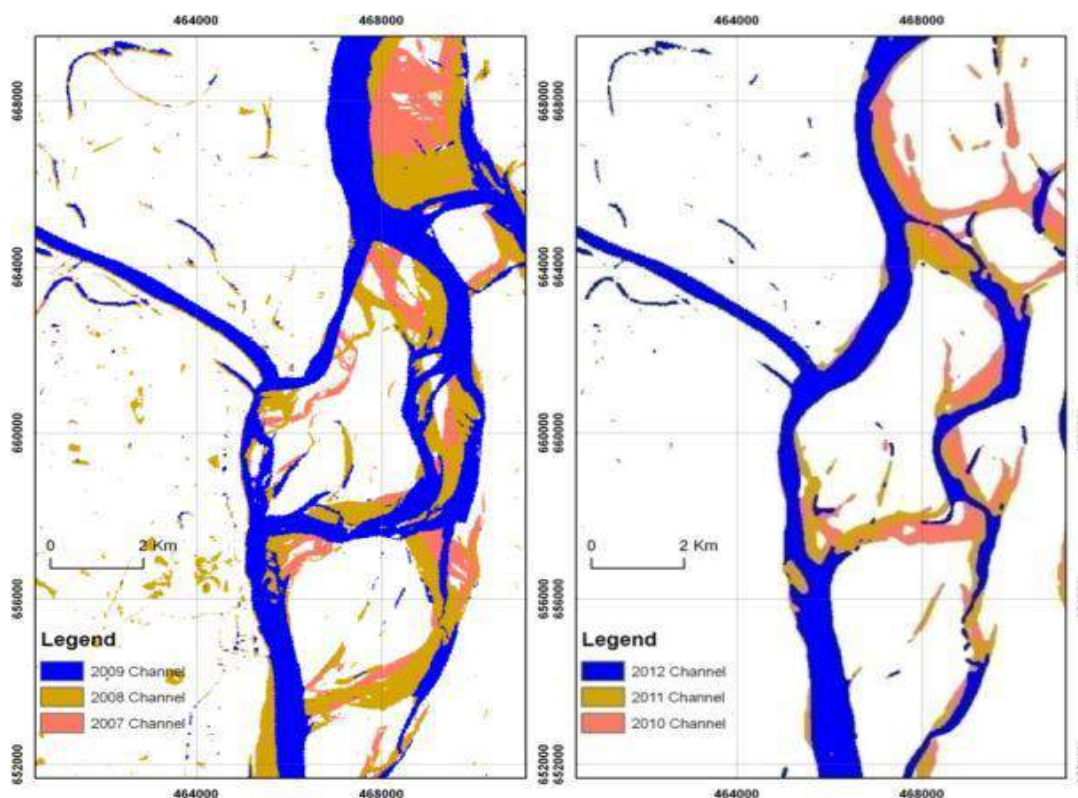
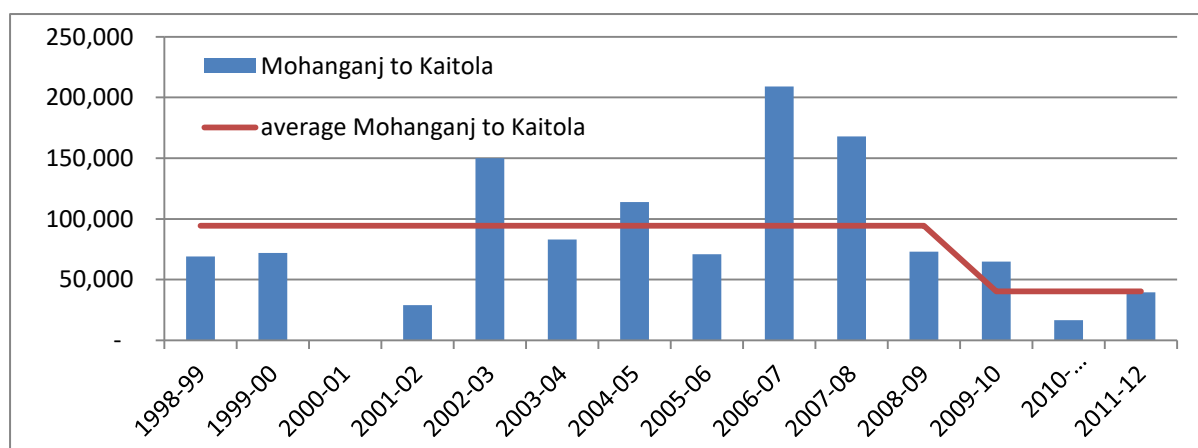


Figure A4.4: Jamuna Right Bank 1 – Dredging Volume, 2007-9 vs. 2010-12

(m<sup>3</sup>)

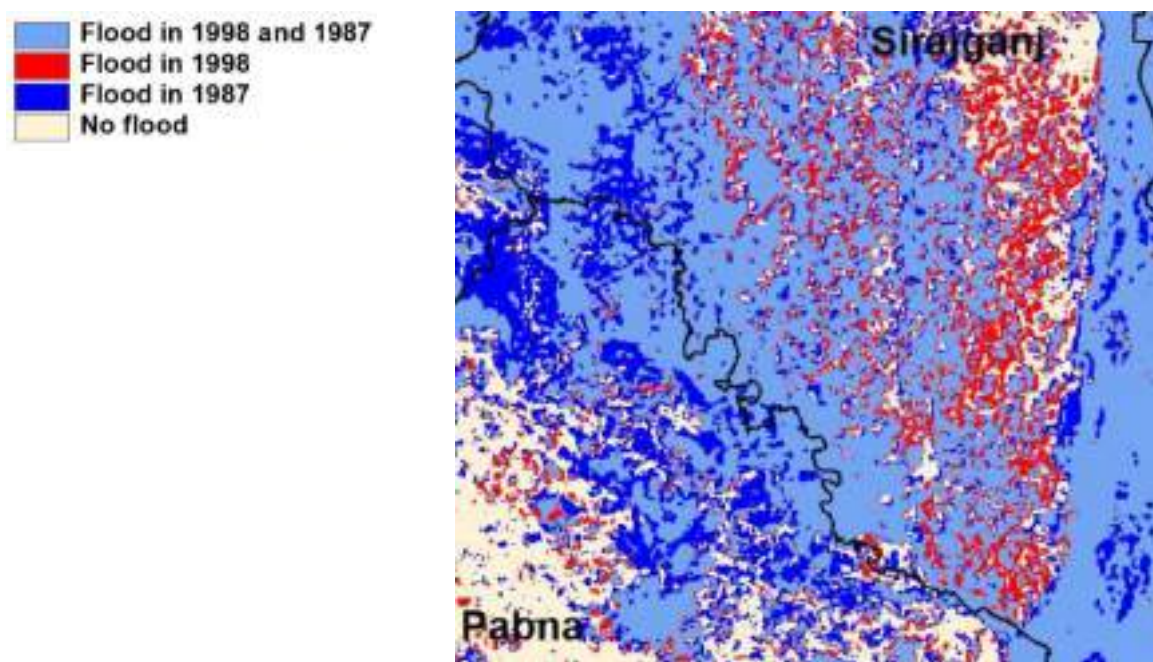
**Figure A4.5: Enayetpur Spur Erosion Damage, Post-2012**



**Figure A4.6: Erosion Damage Upstream of Enayetpur, Post-2012**



**Figure A4.7: Hurushagar Flood Control Project Area – 1987 vs 1998 Flooding**



Source: CEGIS.

## Annex8: Project Description, Jamuna Left Bank 2

### Jamuna Left Bank 2 – Aricha PRIORITY

| Project Name       | ID  | Upazilas (Unions) | Area                 | River Area | Population |
|--------------------|-----|-------------------|----------------------|------------|------------|
| Jamuna Left Bank 2 | JL2 | 6 (48)            | 1212 km <sup>2</sup> | 31 %       | 1,104,800  |

| Bankline length | Average Erosion (1973-2010/2007-2012) | Flood extent (1998 / 2007) | Area Boro/Aman | Population Density (total/floodplain) |
|-----------------|---------------------------------------|----------------------------|----------------|---------------------------------------|
| 56 km           | 2.59 km / 0.12 km                     | 62% / 58%                  | 32% / 44%      | 910/1340                              |

### Situation

The east bank of the Jamuna is erosion prone since the construction of Jamuna Bridge (see JRB-1).

The presently dominant eastern Jamuna channel flows as meandering (dry-season) channel along the bank leaving a larger attached char of more than 10 km in length in the upstream part of the project, between Dhaleswari and Ghior Khal (old Dhaleswari) offtake. This eastern Jamuna channel erodes its riverbanks at Chauhali and Zafferganj since several years putting both growth centers at the risk of extinction. The upazilla Chauhali has lost most of its floodplain land and nowadays consists mostly of a river and char environment.

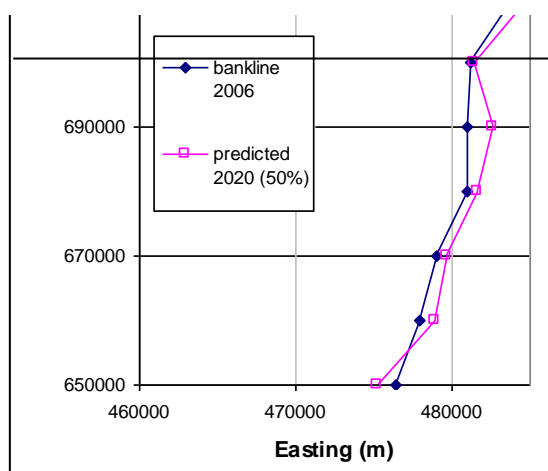
Apart from the main Dhaleswari river offtake, which consists of several offtake channels within an approximately 5 km bankline reach another distributary exists notably the Ghior Khal near Daulatpur. Both are vital to provide water to the river system around Dhaka (see map in JLB-1)

The flood plain is lower and prone to excessive flooding during higher floods (see figure in JLB-1).

### Future Scenarios

It can be expected that eastern and western Jamuna channel will be separated by a more stable char in future, however, it is not clear if either channel can break through the char to join the other channel.

Both channels experienced alternating times of nearly no dry season flow with the eastern channel presently carrying the majority of the water. During the flood season, however the discharge appears to be much more evenly distributed. The dry season variability results from the changing bifurcation morphology upstream of the Dhaleswari and has implications on the dry season navigation.



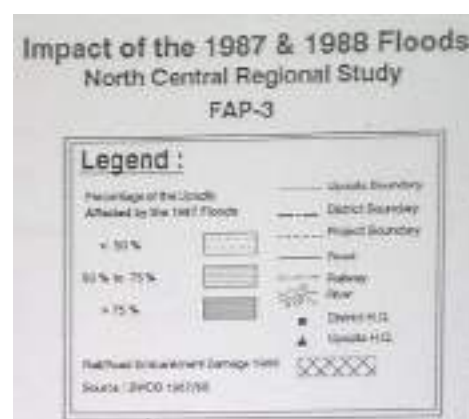
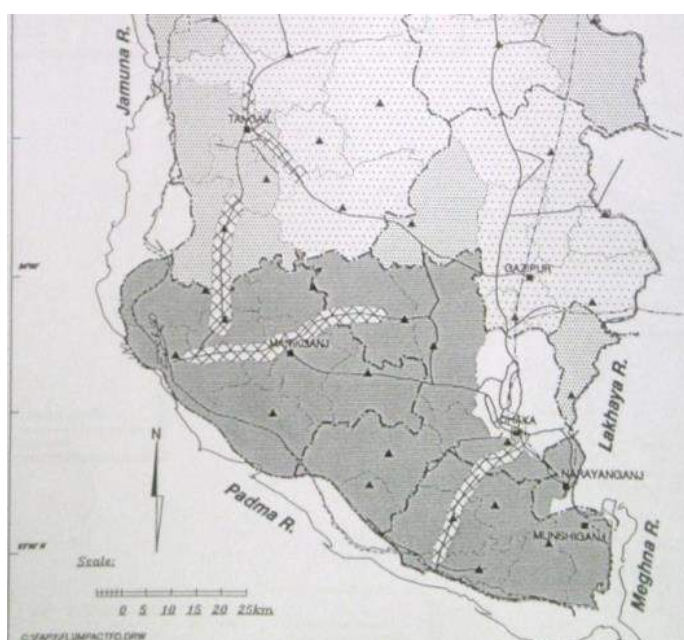
Given that little riverbank protection was built in this area, the future scenario without protective

measures predicts quite substantial riverbank erosion the order of kilometers (see next figure from CEGIS, 2007).

### Existing and Planned Works

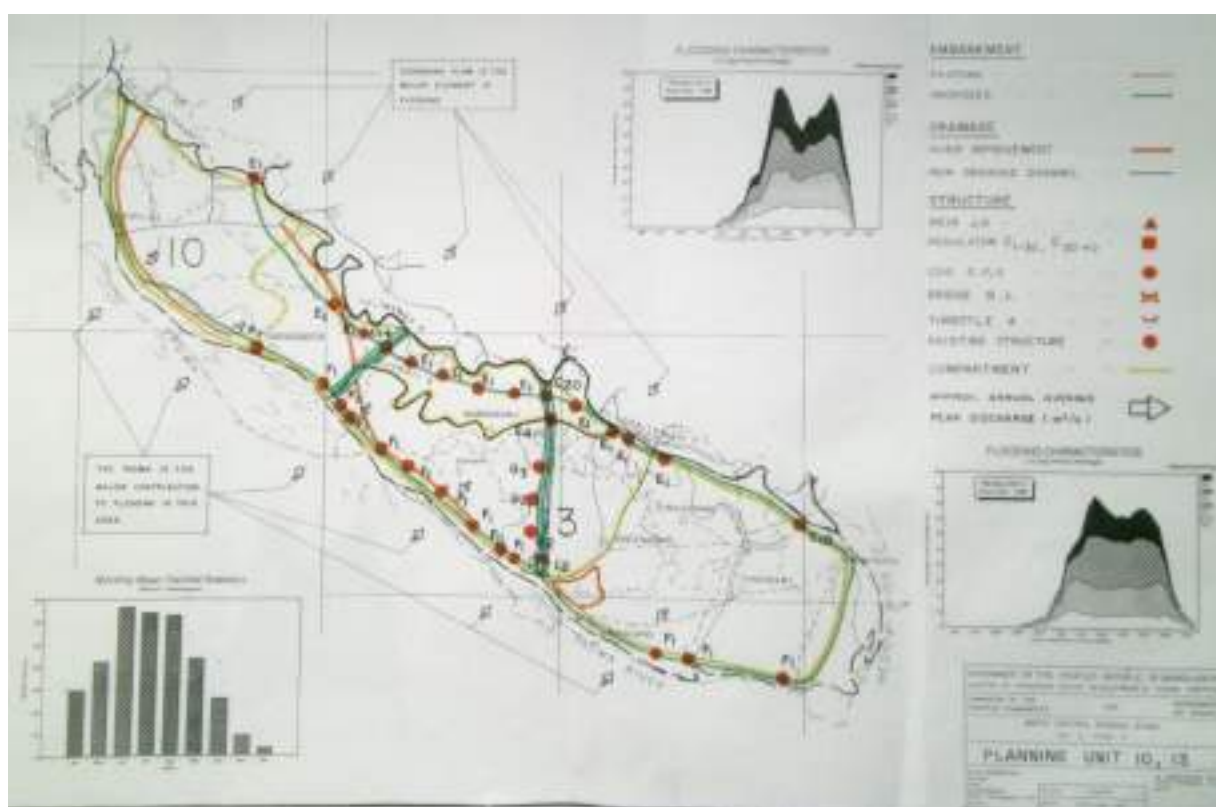
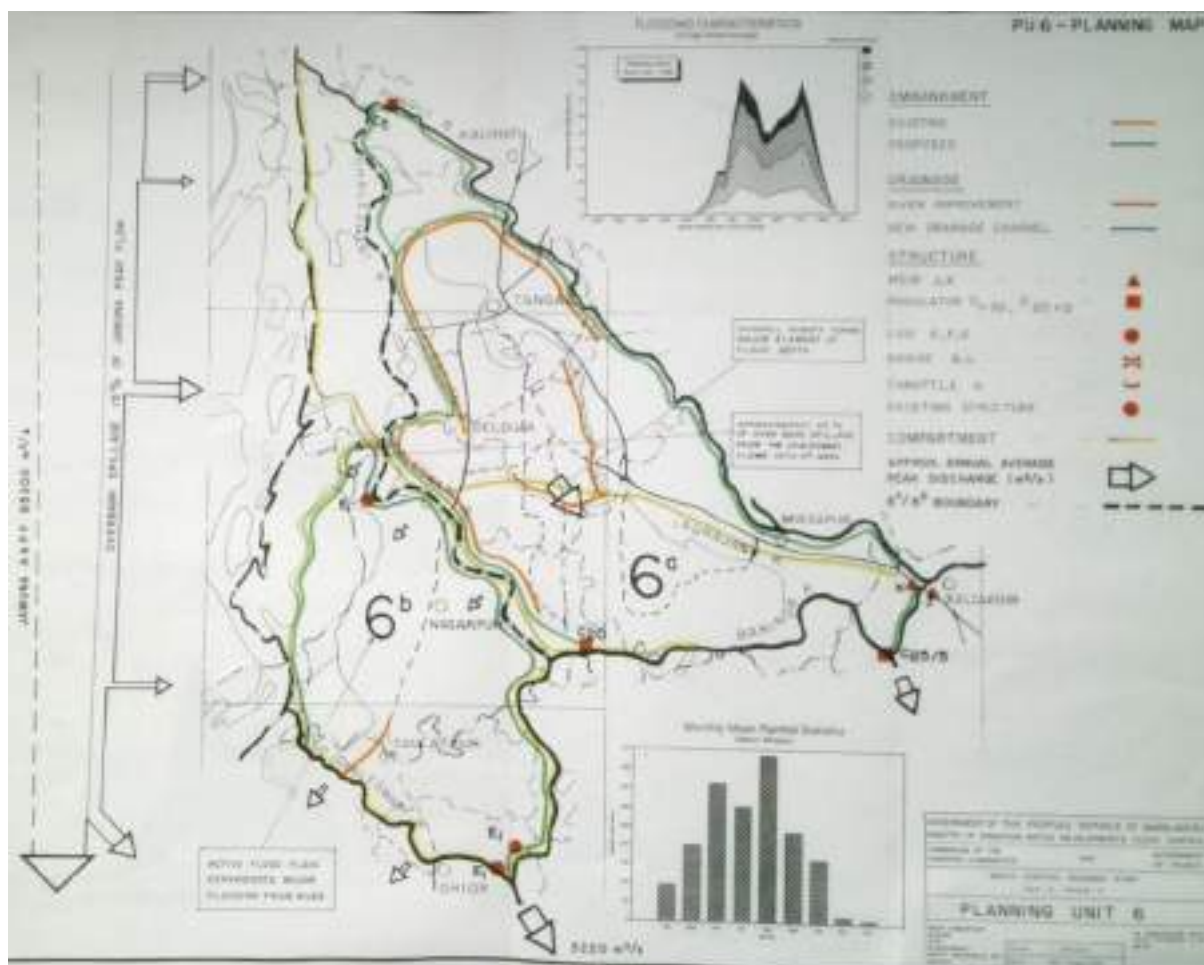
BWDB has provided 2 km of riverbank protection at Chauhali in 2011/12, which was largely destroyed during the 2012 flood.

BWDB plans an about 35 km long embankment along the riverbank from the Dhaleswari (Nagarpur upazila) to Aricha for two FCD projects, namely the Nagarpur-Chauhali and the Jamuna-Padma left bank Project (shown in the following figures, from FAP-3 documents). These two projects go back to the FAP-3 planning in the early 1990s recognizing the vulnerability of the area to flooding and flood damages



figures from FAP-3 report





Three LGED small scale projects are situated in this area.

The areas at Chauhail and Zafferganj were identified by BWDB as priority areas for riverbank stabilization during the preparatory phase of this FRERMIP PPTA in 2011.

### Project Concept

This subproject incorporates three BWDB priority projects: (i) riverbank protection along vulnerable reaches with a view to work towards river stabilization, (ii) strengthening of the existing 12 km long embankment from Aricha to Zionpur via Zaffarganj and extension to the Dhaleswari, (iii) provision of defined Dhaleswari and Ghior Khal offtake for dry and flood season flow including navigation. The central char is intended to be left unprotected to maintain natural river processes and to not disturb the established char societies. The project concept depends on further studies during Tranche 1.

#### Tranche 1

- Priority riverbank protection at Chauhali (about 5 km) and Zafferganj (about 2 km) to stabilize critically eroding reaches along the upazilla headquarters
- Pilot testing of guided, accelerated charland accretion of a suitable attached char through catkin plantation

#### Tranche 2

- Extension of existing riverbank protection in upstream and downstream direction  
Chauhali including Dhaleswari offtake (around 3km) with the purpose of stabilizing the attached char in that area  
Zafferganj area (2 km)
- Stabilization of attached char through guided, accelerated siltation (plantation of catkin as piloted in Bhuapur in the 1990s and other measures) with the purpose of reclaiming around 30km<sup>2</sup> of lost floodplain land
- Rehabilitation of 12 km of existing embankment

#### Tranche 3

- Extension of existing riverbank protection in upstream and downstream direction  
Chauhali including Dhaleswari offtake (around 5km) with the purpose of stabilizing the attached char in that area  
Zafferganj area (2 km)
- Optional offtake geometry of Dhaleswari likely distinguishing dry season and flood season offtake
- Offtake geometry at Ghior Khal
- Embankment rehabilitation and link embankment from Dhaleswari to Aricha (total length around 17km)
- Local placement of navigation buoys with combined navigation / fish protection purpose

| Intervention Elements |   |
|-----------------------|---|
| <i>List by type</i>   | <i>Description (Location, dimensions or quantity)</i>                       |
| <i>Infrastructure</i> | <b>TRANCHE 1</b>  |
| 1.RBP                 | Around 7 km initial left bank stabilization: 5km at and 2 km at Zaffarganj  |
| 2. Other              | Pilot test of guided, accelerated charland siltation (catkin and supporting |

| Intervention Elements |   |
|-----------------------|---|
|                       | measures)   |
| <i>Infrastructure</i> | <b>TRANCHE 2</b>  |
| 1.RBP                 | Extension of existing protection<br>Around 3 km at Chauhali,<br>Around 2 km at Zaffarganj             |
| 2. EMB                | Rehabilitation of 12 km of embankment from Aricha to Zionpur  |
| 3. Other              | Guided accelerated siltation of charland<br>Placement of buoys along the protected bank               |
| <i>Infrastructure</i> | <b>TRANCHE 3</b>  |
| 1.RBP                 | Around 5 km at Chauhali,<br>Around 2 km at Zaffarganj<br>Adaptation and maintenance                   |
| 2. EMB                | offtake geometry for Dhaleswari<br>offtake geometry for the Ghior Khal<br>Around 23 km new embankment |
| 3. Other              | Regulators, Fish passes<br>Placement of buoys along the protected bank                                |

| Intended Benefits (+) and Known Potential Adverse Impacts (-) |             |   |
|---|-------------|---|
| Type  | +<br>-<br>? | Description<br>(impacted location, activity or asset; timing, extent or magnitude)  |
| Reduced flood damage  | +           | Whole area  |
| Reduced erosion   | +           | Whole bankline  |
| Navigation  | +           | More stable channel along protected bank with increased draught   |
| Land reclamation  | +           | 30 km <sup>2</sup>  |
| Water Management  | +           | Improved dry season flow in Dhaleswari for boro irrigation and cleaning the rivers around Dhaka                                       |
| Communication   | +           | Improved access in case a dedicated national highway standard road is built along the embankment from Dhaleswari to Aricha and beyond |
| Land acquisition/loss   | -           | Associated with embankment – about 2 km <sup>2</sup> (40km*50m) floodplain land   |
| Resettlement  | -           | To be confirmed   |



|           |   |  |
|-----------|---|--|
| Fisheries | ? | Geotextile bag revetments provide shelter, attached chars potential spawning ground, protection from floating nets<br><br>Improved river fish diversity due to dry season flow in distributaries and protection from floating nets (buoys) |
|-----------|---|--|

| Supporting Studies                        |   |
|---|---|
| Surveys                                   | River surveys by BWDB and the PPTA team<br><br>Flood plain surveys along the Hurashagar and Kaijuri to Shariatpur   |
| Char-land Study                           | Investigation of deposition rates of the char opposite of the Hurashagar/Baral outfall and upstream between Enayetpur and Jamuna Bridge   |
| River Flow Modeling & Analytical Approach | 1-D HEC RAS modeling of flow patterns to determine the minimum width of a single channel river solution   |
| Flood Modeling                            | Scenario 1: restoration of Hurashagar FCD embankment from Kaijuri to Benatia along the Jamuna, Benotia to Bagabari along the Hurashagar/Baral, and Bagabari to Shahjadpur along the Karatoa River<br><br>Scenario 2: loss of flood protection in the Enayetpur area due to erosion and breach of the embankment |
| EIA/SIA                                   | Environmental baseline and impacts of above works   |
| Resettlement                              | 100% census and IOL, 20% SES for embankment and 2 km of riverbank protection  |

| Version change log (latest first) |                           |  |
|-----------------------------------|---------------------------|--|
| Change date                       | Version created by change | Changes made + reasons for changes           |
| 10 May 2013                       | 5.0                       | Updated for final report - ko                |
| 1 March 2013                      | 4.0                       | Expanded description – ko                    |
| 3 Oct 2012                        | 2.0                       | Full description entered – ko                |
| 25 Sep 2012                       | 1.0                       | Initial version of project description – slb |

## Annex9: Project Description, Padma Left Bank 1

**PadmaLeft Bank 1 –Paturia – Harirampur PRIORITY**

| Project Name      | ID   | Upazilas (Unions) | Area                | River Area | Population |
|-------------------|------|-------------------|---------------------|------------|------------|
| Padma Left Bank 1 | PLB1 | 3 (35)            | 682 km <sup>2</sup> | 22%        | 736,000    |

| Bankline length | Average Erosion (1973-2009/2004-2009) | Flood extent (1998 / 2007) | Area Boro/Aman | Population Density (total/floodplain) |
|-----------------|---------------------------------------|----------------------------|----------------|---------------------------------------|
| 25 km           | 3.35 km / 0.03 km                     | 62% / 46%                  | 18% / 34%      | 1080/1400                             |

### Situation

The Padma starts as single channel after the confluence of Jamuna and Ganges. 10 km downstream of the confluence it bifurcates into two channels, carrying different percentages of its flow over time and enclosing an around 25 km long and up to 10 km wide char. Presently the southern channel is declining.

At the downstream boundary of this subproject reach, about 25 km downstream of the confluence, a more erosion resistant clay forms the northern (left) bank (marked in figure below). Upstream of this clay the Padma tends to erode substantial amounts of floodplains through outflanking channels, which periodically close (see following figure with bankline development). At this moment a historic, extreme meander loop is filled in and the river is flowing rather straight. The filled in area is around 30 km<sup>2</sup> (3000 ha) in size. The historic Dhaka Southwest Project embankment in this area is eroded and was not rebuild (also refer to JLB-2 maps from FAP 3). The char age map (1973-2009, Padma Bridge report) indicates that the anabranh between Harirampur and Faridpur is presently contracting in width with substantial areas along both banks recently silted in.

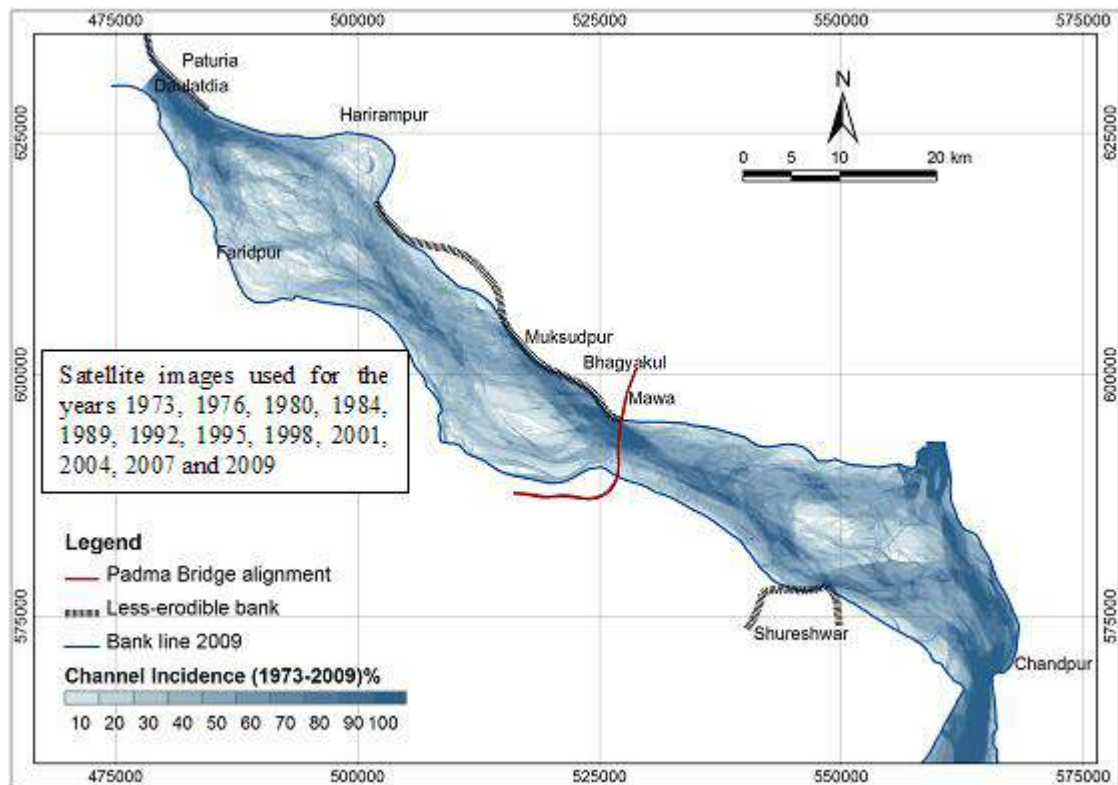
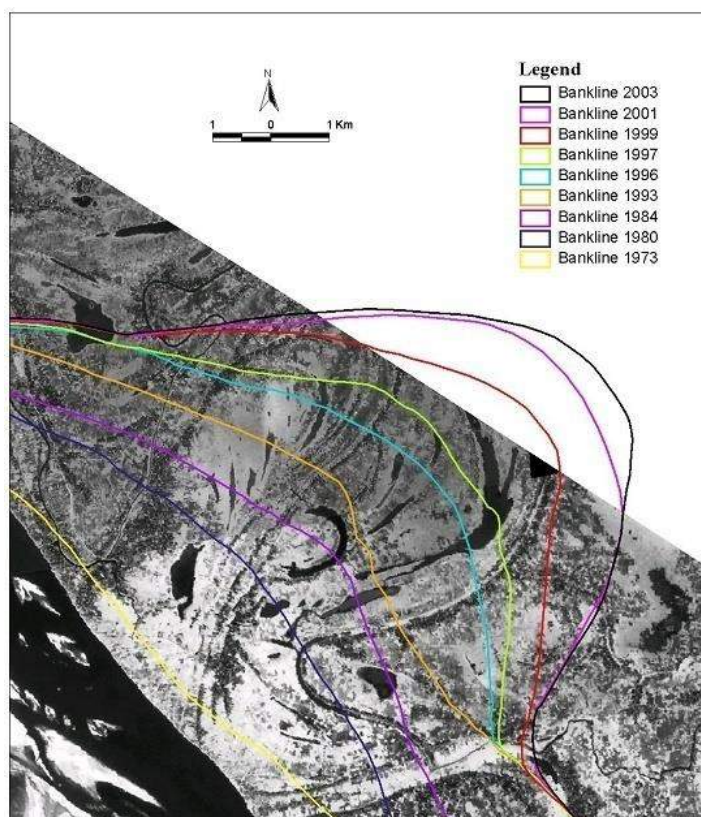
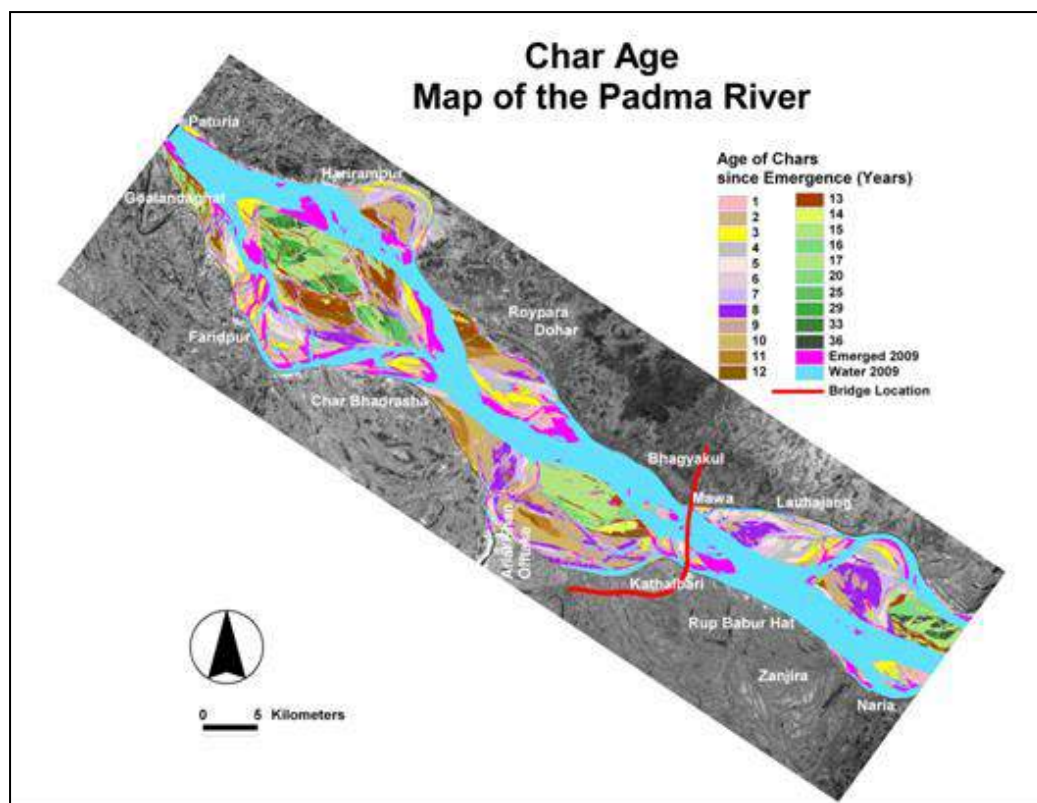


Figure from Padma Bridge design report



Erosion at Harirampur



Figures from Padma Bridge design report

### Future Scenarios

Future channel planforms downstream of the bifurcation can consist of one or two channels. The initial morphological study for the upper Padma reach (Annex C, January 2013 PPTA report) indicates that the present two-channel system with one large char provides an overall acceptable solution and in terms of future river management (or stabilization) efforts the most pragmatic approach.

It is expected that the Padma exhibits the currently straighter alignment along the north bank near Harirampur and continues building the recently deposited land to greater height. The field trip in December confirmed that roughly the upstream half has reached substantial height, while the downstream part is still low lying.

BWDB pursues some plans of the Nagarpur-Chauhali and the Jamuna-Padma left bank Project in this area going back to the FAP 3 recommendations (also refer to JLB-2). This project basically addresses the flooding issue in this area, providing drainage facilities and improved irrigation opportunities in addition.

### Existing Works

The Paturia ferry ghat is located at the upstream end of this subreach. For dry season ferry operation a navigation channel is dredged regularly.

Two LGED small scale projects are situated in this area.

| <b>Project Concept</b>  |
|---|
| <p>This area incorporates two BWDB priority projects: (i) riverbank protection along the left bank upstream of Harirampur to protect the large meander bend from forming again, and (ii) reconstruction of the Dhaka Southwest Project embankment from Paturia to Harirampur. The PPTA recognizes the opportunity of reclaiming around 3000 ha of lost flood plain land due to the present favorable morphological situation.</p> <p>Tranche 1</p> <ul style="list-style-type: none"> <li>• 7 km of riverbank protection at Harirampur covering the upstream of the old meander erosion, only geobag part</li> <li>• Pilot plantation of catkin for accelerated char growth</li> </ul> <p>Tranche 2</p> <ul style="list-style-type: none"> <li>• 7 km of riverbank protection at Harirampur covering the upstream of the old meander erosion, only wave protection part</li> <li>• Reconstruction of the embankment from Paturia towards Mawa</li> <li>• Sluice gates for water management (including rehabilitation of existing sluice gates)</li> </ul> <p>Tranche 3</p> <ul style="list-style-type: none"> <li>• About 5 km of riverbank protection in continuation of tranche 1 works</li> <li>• Sluice gates for water management (including rehabilitation of existing sluice gates)</li> </ul> |

| <b>Intervention Elements</b> |  |
|------------------------------|--|
| <b>List by type</b>          | <b>Description (Location, dimensions or quantity)</b>                                      |
| <i>Infrastructure</i>        | <b>TRANCHE - 1</b>   |
| 1.RBP                        | Around 7 km with temporary wave protection   |
| 2. EMB                       | none   |
| 3. Other                     | Pilot plantation of catkin and monitoring of vertical char growth (up to floodplain level) |
| 1.                           | Buoys for navigation and fish protection along revetment work                              |
| <i>Infrastructure</i>        | <b>TRANCHE –2</b>  |
| 1.RBP                        | Around 7 km of permanent wave protection   |
| 2. EMB                       | Around 17 km of rehabilitation with 8 km new embankment                                    |
| 3. Other                     | Plantation of catkin for vertical char growth (up to floodplain level)                     |
| <i>Infrastructure</i>        | <b>TRANCHE – 3</b>   |
| 1.RBP                        | Around 5 km of riverbank protection  |
| 2. EMB                       | None   |
| 3. Other                     | Buoys for navigation and fish protection along revetment work                              |

| Intended Benefits (+) and Known Potential Adverse Impacts (-) |                      |   |
|---|----------------------|---|
| <i>Type</i>   | <i>+<br/>-<br/>?</i> | <i>Description</i><br><i>(impacted location, activity or asset; timing, extent or magnitude)</i>  |
| Reduced flood damage  | +                    | Whole area  |
| Reduced erosion   | +                    | Whole bankline  |
| Navigation  | +                    | More stable channel along protected bank with increased draught   |
| Land reclamation  | +                    | Potential flood protected area around 30km <sup>2</sup>   |
| Water Management  | +                    | Improved conditions for dry season irrigation after reconstruction of embankment  |
| Communication   | +                    | Improved access in case a dedicated national highway standard road is built along the embankment from Aricha to Dohar and beyond                                      |
| Land acquisition/loss   | -                    | Associated with embankment strengthening– about 1 km <sup>2</sup> (20km*50m – assumption that existing land can be used)  |
| Resettlement  | -                    | To be confirmed   |
| Fisheries   | ?                    | Geotextile bag revetments provide shelter, attached chars potential spawning ground<br><br>Improved river fish diversity due to protection from floating nets (buoys) |

| Version change log (latest first) |                                  |   |
|-----------------------------------|----------------------------------|---|
| <i>Change date</i>                | <i>Version created by change</i> | <i>Changes made + reasons for changes</i>         |
| 30 May 2013                       | 5.0                              | Updated for final report - ko                     |
| 1 Mar 2013                        | 4.0                              | Expanded description – ko                         |
| 6 Feb 2013                        | 3.0                              | Finalization with more detailed work layouts – ko |
| 25 Sep 2012                       | 1.0                              | Initial version of project description – slb      |

## **Annex 10: Selection of Subreaches**

### **A. Multi-Criteria Assessment (MCA) of Tranche 1 Interventions**

#### **1. Approach and Key Criteria**

MCA is an appropriate approach when comparing quantitative and qualitative data that are otherwise incomparable. This is especially true for prefeasibility level assessment, when not all data are quantified or quantifiable.

In this PPTA, an MCA is used to select the sub-reaches to be brought forward for feasibility assessment and potential inclusion in Tranche 1. The MCA is the first step to identify three suitable sub-reaches, to which, in a second step, a simplified economic feasibility analysis will be applied for confirmation of their suitability. The purpose is to arrive at two or three sub-reaches to be covered by Tranche 1 subprojects.

We have identified issues and criteria in two categories, means-ends and impacts (Table 0-1). Issues in the means-ends group are vulnerability and planning-engineering aspects, and relate to the identification of priority sites suitable for MRP interventions. Issues in the impact group are safeguards and cost-benefit, and relate to acceptability of the potential impacts of the interventions. Criteria were then identified for each issue, nine criteria in total, each of which can have up to three sub-criteria. In addition, we assess if the identified priority interventions conflict with other planned major interventions. An example would be the Padma Bridge construction, which impacts on two sub-reaches directly and has the potential to affect four sub-reaches downstream.

Each of the following subsections systematically describes each criterion. In order to be transparent, we follow the same structure throughout. Starting with a short justification of the criterion we provide details about how we classify the criterion and how we arrived at the values used for the classification. The latter is important as we are using primary, qualitative data, and quantitative data, based on a more general assessment of an overall situation. Finally, we conclude with detailed tables explaining each sub-criterion. When there are measured data, this contains ranking and definition of limits, while for qualitative assessment detailed descriptions of the considerations leading to the ranking are provided for each sub-reach.



**Table 0-1: Grouping of criteria**

| Broad Category | Main Issues              | Criterion   |
|----------------|--------------------------|---|
| Means and ends | Vulnerability            | Riverbank erosion<br>Flooding<br>Social fabric  |
|                | Planning and engineering | Ease of engineering interventions<br>Complements existing work/schemes<br>Is consistent with predicted/expected future planform ("no regret") |
| Impacts        | Safeguards               | Social and environmental  |
|                | Cost and benefits        | Cost deviation from average low-cost work<br>Expected benefits for different sectors  |

## 1. Criteria

### a) River bank erosion

#### JUSTIFICATION:

Riverbank erosion along the main rivers has resulted in substantial land losses in Bangladesh and impacts on the development of the floodplains bordering the main rivers.

#### DETAILS FOR EACH SUB-CRITERION:

##### Historic Riverbank Erosion

This sub-criterion is based on primary data. Riverbank erosion is expressed as erosion per km of bankline. It is the result of the total loss of land in one sub-reach divided by the length of riverbank in this sub-reach. The reference lines are the 1973 and the 2010 bankline.

##### Recent Riverbank Erosion

This sub-criterion follows the same process as for historic riverbank erosion, only for the period 2007 to 2012.

##### Future Riverbank Erosion

This sub-criterion cannot be based on primary data. Given the uncertainties the most likely scenario for the future around 10 - 15 years has been developed. The timeframe of 10 – 15 years is relevant as the PPTA prepares an MFF with around 10 years implementation period. Consequently, future developments are highly relevant for any interventions that target the reduction of river instability and maximization of reclamation of land lost during the erosion process of the last 30 years. The criteria selected were expected substantial erosion, coded "1", no substantial erosion or accretion, coded "0", and likely accretion, coded "-1".

**DETAILED TABLES:**

| CATEGORY                | SUB-CATEGORY       | Unit  | JRB1     | JRB2     | JLB1     | JLB2     | PLB1     | PLB2     | PLB3     | PRB1     | PRB2     | PRB3     | MRB1     | MLB1     | MLB2     |
|-------------------------|--------------------|-------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| Area                    |                    | sq km | 580.4    | 914.6    | 787.5    | 1,211.8  | 681.7    | 789.5    | 440.9    | 876.3    | 1,055.2  | 801.4    | 435.1    | 277.5    | 440.5    |
| floodplain              |                    | ha    | 44,416.0 | 72,178.0 | 71,812.0 | 82,520.0 | 52,491.0 | 69,239.0 | 29,738.0 | 74,638.0 | 75,454.0 | 55,890.0 | 33,099.0 | 20,026.0 | 27,981.0 |
| bank length             |                    | km    | 36.7     | 66.0     | 21.2     | 56.3     | 24.8     | 30.4     | 47.6     | 55.4     | 50.3     | 46.5     | 34.1     | 21.4     | 24.4     |
| erosion                 | total (1973-2010)  | ha    | 5,561.4  | 2,053.5  | 5,224.2  | 14,579.7 | 8,312.9  | 2,048.0  | 6,042.9  | 7,673.6  | 9,125.9  | 8,356.6  | 6,313.4  | 2,022.0  | 1,096.1  |
|                         | recent (2007-2012) | ha    | 478.7    | 427.4    | 125.3    | 694.4    | 70.8     | 182.2    | 390.2    | 1,027.2  | 597.2    | 857.5    | 875.1    | 115.6    | 256.2    |
| <b>ABSOLUTE FIGURES</b> |                    |       |          |          |          |          |          |          |          |          |          |          |          |          |          |
| CATEGORY                | SUB-CATEGORY       | Unit  | JRB1     | JRB2     | JLB1     | JLB2     | PLB1     | PLB2     | PLB3     | PRB1     | PRB2     | PRB3     | MRB1     | MLB1     | MLB2     |
| erosion                 | total (1973-2010)  | km/km | 1.52     | 0.31     | 2.46     | 2.59     | 3.35     | 0.67     | 1.27     | 1.39     | 1.81     | 1.80     | 1.85     | 0.94     | 0.45     |
|                         | recent (2007-2012) | km/km | 0.13     | 0.06     | 0.06     | 0.12     | 0.03     | 0.06     | 0.08     | 0.19     | 0.12     | 0.18     | 0.26     | 0.05     | 0.11     |
|                         | future (2012-2020) | +/-   | 0        | 0        | 1        | 1        | 1        | -1       | 1        | 1        | 1        | 1        | 1        | 0        | 0        |
| <b>RANK</b>             |                    |       |          |          |          |          |          |          |          |          |          |          |          |          |          |
| erosion                 | total (1973-2010)  |       | 7        | 13       | 3        | 2        | 1        | 11       | 9        | 8        | 5        | 6        | 4        | 10       | 12       |
|                         | recent (2007-2012) |       | 4        | 9        | 11       | 5        | 13       | 10       | 8        | 2        | 6        | 3        | 1        | 12       | 7        |
|                         | future (2012-2020) |       | 9        | 9        | 1        | 1        | 1        | 13       | 1        | 1        | 1        | 1        | 1        | 9        | 9        |

**a) Flooding****JUSTIFICATION:**

Flooding is a major development impediment as it causes sporadic, unpredictable but substantial damages affecting the life on the floodplains in multiple negative ways.

**DETAILS FOR EACH SUB-CRITERION:****Average Flood**

This sub-criterion is based on primary data. The analysis of Radarsat flood season images allows the determination of areas in each sub-reach flooded during a flood with a 2-year return period, or an average flood. As such this sub-criterion reflects on the amount of land potentially taken from agriculture during normal flood years.

**Mean Flood**

Same as before this criterion is based on primary data, however for a higher return period. The range chosen lies between return periods of 5 to 15 years. This represents roughly the boundary between good flood and bad flood and could be considered to be the amount of flooded land that is accepted as an off-set of the beneficial fertilization of fields.

**High Flood**

Following along the same lines, as the other two sub-criteria, this flood represents areas flooded during some of the highest floods observed in Bangladesh during the recent past, namely 1998, 2004, and 2007. These were damaging floods and flooding to this extent is unwelcome.

**DETAILED TABLES:**

| CATEGORY                  | SUB-CATEGORY            | Unit  | JRB1   | JRB2   | JLB1   | JLB2    | PLB1   | PLB2   | PLB3   | PRB1   | PRB2    | PRB3   | MRB1   | MLB1   | MLB2   |
|---------------------------|-------------------------|-------|--------|--------|--------|---------|--------|--------|--------|--------|---------|--------|--------|--------|--------|
| Area                      |                         | sq km | 580.39 | 914.56 | 787.5  | 1211.82 | 681.68 | 789.46 | 440.87 | 876.27 | 1055.15 | 801.43 | 435.14 | 277.53 | 440.48 |
| floodplain                |                         | ha    | 44,416 | 72,178 | 71,812 | 82,520  | 52,491 | 69,239 | 29,738 | 74,638 | 75,454  | 55,890 | 33,099 | 20,026 | 27,981 |
| Total Area without River  |                         | ha    | 44,417 | 72,179 | 71,813 | 82,561  | 52,492 | 69,242 | 29,740 | 74,640 | 75,456  | 55,891 | 33,100 | 20,026 | 27,983 |
| Flooded Area 1998         |                         | ha    | 31,946 | 33,138 | 45,807 | 60,399  | 32,617 | 42,054 | 8,860  | 25,829 | 38,738  | 31,054 | 21,683 | 7,396  | 6,522  |
| approximate return period |                         | year  | 20     | 40     | 20     | 40      | 40     | 40     | 40     | 40     | 40      | 40     | 40     | 40     | 40     |
| 1998                      |                         | %     | 72%    | 46%    | 64%    | 73%     | 62%    | 61%    | 30%    | 35%    | 51%     | 56%    | 66%    | 37%    | 23%    |
| Flooded Area 2000         |                         | ha    | 19,982 | 15,383 | 17,098 | 28,194  | 19,041 | 27,692 | 3,990  | 4,339  | 10,010  | 12,904 | 6,038  | 1,699  | 4,795  |
| approximate return period |                         | year  | 3      | 3      | 3      | 3       | 3      | 3      | 3      | 3      | 3       | 3      | 3      | 3      | 3      |
| 2000                      |                         | %     | 45%    | 21%    | 24%    | 34%     | 36%    | 40%    | 13%    | 6%     | 13%     | 23%    | 18%    | 8%     | 17%    |
| Flooded Area 2001         |                         | ha    | 20,175 | 10,583 | 1,627  | 1,652   | 1,692  | 8,682  | 1,533  | 1,692  | 4,028   | 2,653  | 523    | 732    | 2,349  |
| approximate return period |                         | year  | 2      | 2      | 2      | 2       | 2      | 2      | 2      | 2      | 2       | 2      | 2      | 2      | 2      |
| 2001                      |                         | %     | 45%    | 15%    | 2%     | 2%      | 3%     | 13%    | 5%     | 2%     | 5%      | 5%     | 2%     | 4%     | 8%     |
| Flooded Area 2002         |                         | ha    | 21,816 | 17,238 | 20,657 | 36,710  | 16,279 | 21,348 | 2,136  | 8,012  | 14,923  | 12,387 | 3,243  | 1,410  | 3,304  |
| approximate return period |                         | year  | 6      | 10     | 6      | 10      | 10     | 5      | 5      | 10     | 5       | 5      | 5      | 5      | 5      |
| 2002flooded               |                         | %     | 49%    | 24%    | 29%    | 44%     | 31%    | 31%    | 7%     | 11%    | 20%     | 22%    | 10%    | 7%     | 12%    |
| Flooded Area 2003         |                         | ha    | 21,065 | 16,125 | 9,969  | 27,250  | 12,202 | 20,229 | 2,080  | 7,189  | 9,313   | 13,215 | 2,564  | 1,627  | 2,579  |
| approximate return period |                         | year  | 7      | 6      | 7      | 6       | 6      | 6      | 6      | 6      | 6       | 6      | 5      | 5      | 5      |
| 2004                      |                         | %     | 47%    | 22%    | 14%    | 33%     | 23%    | 29%    | 7%     | 10%    | 12%     | 24%    | 8%     | 8%     | 9%     |
| Flooded Area 2004         |                         | ha    | 26,020 | 15,137 | 30,880 | 48,384  | 23,764 | 30,750 | 5,328  | 9,127  | 21,929  | 18,904 | 7,097  | 3,096  | 4,942  |
| approximate return period |                         | year  | 25     | 15     | 25     | 15      | 15     | 15     | 15     | 15     | 15      | 15     | 15     | 15     | 15     |
| 2004                      |                         | %     | 59%    | 21%    | 43%    | 59%     | 45%    | 44%    | 18%    | 12%    | 29%     | 34%    | 21%    | 15%    | 18%    |
| Flooded Area 2007         |                         | ha    | 24,652 | 23,761 | 29,579 | 48,145  | 23,926 | 30,370 | 3,650  | 11,642 | 22,688  | 20,487 | 5,110  | 1,326  | 4,759  |
| approximate return period |                         | year  | 30     | 30     | 30     | 30      | 30     | 30     | 30     | 30     | 30      | 30     | 30     | 30     | 30     |
| 2007                      |                         | %     | 56%    | 33%    | 41%    | 58%     | 46%    | 44%    | 12%    | 16%    | 30%     | 37%    | 15%    | 7%     | 17%    |
|                           |                         |       |        |        |        |         |        |        |        |        |         |        |        |        |        |
| average 2 year event      |                         |       | 45%    | 18%    | 13%    | 18%     | 20%    | 26%    | 9%     | 4%     | 9%      | 14%    | 10%    | 6%     | 13%    |
| moderate (5-15year)       |                         |       | 48%    | 23%    | 21%    | 39%     | 27%    | 30%    | 9%     | 10%    | 16%     | 23%    | 10%    | 8%     | 11%    |
| severe (>15yr)            |                         |       | 62%    | 33%    | 49%    | 63%     | 51%    | 50%    | 20%    | 21%    | 37%     | 42%    | 34%    | 20%    | 19%    |
| RANK                      |                         |       |        |        |        |         |        |        |        |        |         |        |        |        |        |
| flooding                  | % flooded 2-yr event    |       | 1      | 5      | 7      | 4       | 3      | 2      | 11     | 13     | 10      | 6      | 9      | 12     | 8      |
|                           | % flooded 5-15-yr event |       | 1      | 5      | 7      | 2       | 4      | 3      | 12     | 10     | 8       | 6      | 11     | 13     | 9      |
|                           | % flooded >15-yr event  |       | 2      | 9      | 5      | 1       | 3      | 4      | 11     | 10     | 7       | 6      | 8      | 12     | 13     |

**a) Social Fabric****JUSTIFICATION:**

ADB's overarching goal is to fight poverty and consequently poverty incidence is an important criterion for any interventions. In addition, the envisaged MFF comes with some focus on the primary sector, not at last as agriculture provides the expected main benefits while employing still the majority of the Bangladeshi population.

**DETAILS FOR EACH SUB-CRITERION:****Poverty Level**

The poverty level is based on primary data from the earlier quoted (Chapter 3) BBS census. We are using the upper limit for the lower poverty line based on the cost of basic needs (upper poverty line). This reflects how many people are poor. The group of hard-core poor is included in this figure and a subset.

**Dependency on the Primary Sector**

The analysis is based on primary data from 2010 Household Income and Expenditure Survey (HIES). The reference unit is a dwelling unit. The primary sector dependency is expressed in

three categories: agriculture/forestry/livestock, agricultural labor, fishery. The total number is expressed as percentage of the total number of dwelling units.

#### DETAILED TABLES:

| CATEGORY   | SUB-CATEGORY   | Unit | JRB1      | JRB2      | JLB1      | JLB2      | PLB1      | PLB2      | PLB3      | PRB1      | PRB2      | PRB3      | MRB1         | MLB1      | MLB2      |
|--|----------------|------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|--------------|-----------|-----------|
| UPoverty   |                | %    | 49% - 60% | 49% - 60% | 37% - 48% | 37% - 48% | 37% - 48% | 37% - 48% | 21% - 36% | 37% - 48% | 37% - 48% | 21% - 36% | 21% - 36%    | 21% - 36% | 21% - 36% |
| LPoverty   |                | %    | 11% - 22% | 23% - 32% | 23% - 32% | 23% - 32% | 23% - 32% | 23% - 32% | 11% - 22% | 23% - 32% | 23% - 32% | 11% - 22% | % or greater | 11% - 22% | 11% - 22% |
| Total Dwelling Unit                              |                | no   | 177,316   | 159,245   | 209,784   | 218,324   | 144,721   | 183,163   | 132,133   | 153,375   | 180,137   | 146,039   | 140,190      | 57,543    | 124,381   |
| Dwelling Unit of Agriculture/ Forestry/Livestock |                | no   | 35,319    | 55,643    | 53,760    | 81,967    | 40,967    | 31,471    | 23,393    | 51,558    | 54,475    | 48,051    | 51,060       | 15,089    | 15,411    |
| Dwelling Unit of Agri labour                     |                | no   | 28,129    | 32,333    | 32,864    | 47,092    | 29,811    | 25,803    | 23,807    | 35,693    | 35,587    | 38,824    | 42,176       | 12,178    | 26,570    |
| Dwelling Unit of FISHERY                         |                | no   | 1,783     | 2,645     | 3,064     | 3,804     | 3,123     | 3,712     | 2,340     | 2,172     | 2,117     | 1,997     | 3,506        | 1,741     | 5,487     |
| U Poverty Level                                  |                | %    | 60%       | 60%       | 48%       | 48%       | 48%       | 48%       | 36%       | 48%       | 48%       | 36%       | 36%          | 36%       | 36%       |
| Dependency on Primary Sector (% total dwelling   |                | %    | 37%       | 57%       | 43%       | 61%       | 51%       | 33%       | 37%       | 58%       | 51%       | 61%       | 69%          | 50%       | 38%       |
| <b>RANK</b>                                      |                |      |           |           |           |           |           |           |           |           |           |           |              |           |           |
| poverty level                                    |                |      | 1         | 1         | 3         | 3         | 3         | 3         | 9         | 3         | 3         | 9         | 9            | 9         | 9         |
| primary sector                                   |                |      | 12        | 5         | 9         | 2         | 7         | 13        | 11        | 4         | 6         | 3         | 1            | 8         | 10        |
| <b>CLASSIFICATION (POINTAGE)</b>                 |                |      |           |           |           |           |           |           |           |           |           |           |              |           |           |
| lower  | upper boundary |      |           |           |           |           |           |           |           |           |           |           |              |           |           |
| 0.45   | 0.58           |      | 3         | 3         | 2         | 2         | 2         | 2         | 1         | 2         | 2         | 1         | 1            | 1         | 1         |
| 0.4  | 0.6            |      | 1         | 2         | 2         | 3         | 2         | 1         | 1         | 2         | 2         | 3         | 3            | 2         | 1         |

#### a) Ease of engineering

##### JUSTIFICATION:

Initial interventions need to be based on simple, straight forward engineering interventions for a number of reasons. Firstly, riverbank protection design can follow existing guidelines, while embankment design can be based on present best-practice, such as established in the International Levee Handbook (ILH, 2012). Secondly, easy implementation supports the quick initial success of a future program. Thirdly, initial implementation of riverbank protection does work during an emerging final planform and it is easier to accept some future adjustments to recently build low-cost work. Fourthly, the limited resources and time scale of a PPTA do not allow complicated design processes depending on costly, long supporting studies.

#### DETAILS FOR EACH SUB-CRITERION:

##### Riverbank Protection

Work in a sub-reach, contributing to large scale stabilization shall not depend on complicated engineering work. While long guiding geotextile bag revetments form the standard, offtake structures for distributaries are out of the ordinary. As example, the design for the Gorai offtake took multiple years and substantial resources. The ordinary construction receives one point, while out of the ordinary structures receive zero points.

##### Embankments

The standard is an embankment incorporating a road on the land side and a berm for temporary settlement towards the river. In addition, simple sluice gates for local drainage are considered. Complicated embankments would incorporate a number of offtakes or a large number of openings to let flow pass for example along the right bank of the Padma towards the coastal area. Points are awarded as above.

## Other Difficult Structures

Difficult structures relate mostly to the offtake regulators which requires specific structural designs. The work associated with a specific intake geometry is considered under riverbank protection. No additional structures are awarded one point, whereas additional difficult structures do not get any points.

### DETAILED TABLES:

|      | riverbank protection | embankment | other difficult structure | riverbank protection                           | embankment   | other difficult structure                  |
|------|----------------------|------------|---------------------------|--|--|--|
| JRB1 | y                    | y          | y                         | normal conditions                              | Kaijuri to Bagabari, potential u/s char                | regulator / fish pass                      |
| JRB2 | n                    | n          | y                         | confluence issues                              | reclamation at confluence on loose char soils          | potential additional regulator / fish pass |
| JLB1 | n                    | n          | y                         | number of distributary offtake geometries      | number of offtake geometries                           | offtake old Dhaleswari and Dhaleswari      |
| JLB2 | y                    | y          | y                         | largely normal conditions                      | largely normal floodplain                              | offtake old Ichamutti                      |
| PLB1 | y                    | y          | n                         | normal conditions                              | normal conditions                                      | no   |
| PLB2 | n                    | y          | n                         | erosion resistant area, deep                   | existing road, higher - check                          | no   |
| PLB3 | n                    | y          | n                         | stabilization of confluence                    | normal conditions                                      | no   |
| PRB1 | n                    | y          | n                         | Ganges barrage and confluence                  | normal conditions                                      | no   |
| PRB2 | n                    | n          | y                         | additional measures along long reclaimed bank, | around Faridpur, rest open for overland flow to south, | Arial Khan offtake                         |
| PRB3 | n                    | n          | y                         | response to Padma Bridge RTW with higher v     | open for overland flow to south,                       | regulator / fish pass                      |
| MRB1 | n                    | y          | y                         | stabilization of confluence                    | open for overland flow to south,                       | regulator / fish pass                      |
| MLB1 | y                    | y          | y                         | conductive existing conditions                 | normal conditions                                      | existing embankment                        |
| MLB2 | n                    | y          | y                         | Chandpur protection                            | normal conditions                                      | regulator / fish pass                      |

### a) Complements existing work

#### JUSTIFICATION:

Completion of existing work means less efforts and higher potential rewards. This is the more true in economic terms, as existing work is treated as sunken cost, which do not reduce the economic feasibility.

#### Details for each Sub-criterion:

##### Riverbank Protection

Riverbank Protection of several kilometers in length is considered existing work. This could, for example, provide the backbone for reconstruction of embankments. In case there is existing work, one point is awarded, otherwise none.

##### Embankments

Existing embankments provide potentially higher benefits at lower cost, if riverbank protection should be required. Consequently, existing embankments are awarded one point, while the non-existence of embankments receives none.

**DETAILED TABLES:**

|      | riverbank protection | embankment | riverbank protection                                | embankment                           |
|------|----------------------|------------|---|--------------------------------------|
| JRB1 | y                    | y          | existing work at Kaijuri, 10 km                     | existing BRE                         |
| JRB2 | y                    | y          | existing work at Kaitola, 7 km                      | PIRDP ring embankment is complete    |
| JLB1 | n                    | n          | no work, offtakes uncertain due to fund shortage    | no embankment                        |
| JLB2 | n                    | n          | marginal work at Chauhali                           | no major embankment                  |
| PLB1 | n                    | y          | no work   | Dhaka SW embankment                  |
| PLB2 | y                    | y          | natural protection                                  | some existing road close to bankline |
| PLB3 | n                    | n          | marginal work at Munshiganj                         | no embankment                        |
| PRB1 | y                    | n          | existing work at Rajbari                            | no embankment                        |
| PRB2 | n                    | n          | existing work at Faridpur useless if land reclaimed | no embankment                        |
| PRB3 | y                    | n          | Padma Bridge 12 km revetment                        | no embankment                        |
| MRB1 | n                    | n          | no work   | no embankment                        |
| MLB1 | y                    | y          | existing work at Eklashpur, 4.5 km                  | MDIP ring embankment complete        |
| MLB2 | y                    | n          | existing work at Chandpur, about 1.5 km             | no embankment                        |

**a) “No regret”****JUSTIFICATION:**

Any work that does not match with a future planform results in a potential waste of funds.

**DETAILS FOR EACH SUB-CRITERION:**

The only sub criterion is the assessment if there is a potential wastage as work built during the next decade (under an MFF program) could risk not match with the future desired planform.

**DETAILED TABLES:**

|      | no regret | no regret  |
|------|-----------|--|
| JRB1 | y         | existing straight channel and bifurcation to be maintained |
| JRB2 | y         | existing western bankline channel for navigation           |
| JLB1 | y         | existing straight channel and bifurcation to be maintained |
| JLB2 | y         | existing eastern bankline channel dominant                 |
| PLB1 | y         | reclamation of land due to favourable planform             |
| PLB2 | n         | potential char development alongside Mawa left bank        |
| PLB3 | n         | downstream consequence of Padma Bridge uncertain           |
| PRB1 | n         | unclear due to confluence                                  |
| PRB2 | n         | river planform not yet developed for reclamation           |
| PRB3 | n         | downstream consequence of Padma Bridge uncertain           |
| MRB1 | n         | not clear with confluence                                  |
| MLB1 | y         | bankline stable  |
| MLB2 | n         | not clear with confluence                                  |

**a) Safeguards****JUSTIFICATION:**

Safeguards play an important role in the densely populated and highly exploited deltaic environment. Any major implications could stop interventions as planned. On a somewhat lower level, complicated interventions could require more time than available for PPTA preparation and as such also need to be avoided during the initial PPTA.

**DETAILS FOR EACH SUB-CRITERION:****Land Acquisition and Resettlement**

Land acquisition and resettlement in Bangladesh is complex due to the fractured small landholdings often with unclear land titles. This problem is unavoidable and required to be addressed for any construction work. We consider three levels of complexity, also depending on the extent of the work: low, medium, high, with points in descending order from 3 to 1. Normal resettlement involves a 50 m wide strip along the bankline and a 50 m wide strip for embankment construction. If the embankment length is limited to less than 20 km and runs through less populated areas, and if there is only limited riverbank protection the impact is low. Medium impact relates to longer embankments and/or riverbank protection. High impact relates to areas that require embankment works and riverbank protection, both of substantial length.

**Environment**

There are no environmental sensitive areas in the areas under consideration. Consequently, environmental aspects focus also on potential effects beyond the boundaries. This is



especially true for the southern sub-reaches, with contribute substantial fresh water to the coastal area and as such restrict salinity intrusion.

#### DETAILED TABLES:

|      | land acquisition and resettlement | environment | land acquisition and resettlement                     | environment                                |
|------|-----------------------------------|-------------|---|--|
| JRB1 | m                                 | m           | embankment and limited riverbank protection           | existing embankment, char implications     |
| JRB2 | l                                 | l           | no embankment work, only limited riverbank protection | low impacts due to largely existing work   |
| JLB1 | h                                 | h           | both required   | distributary effects                       |
| JLB2 | h                                 | m           | both required   | normal impacts                             |
| PLB1 | m                                 | m           | full embankment but limited riverbank protection      | normal impacts                             |
| PLB2 | l                                 | l           | limited embankment work, no revetment                 | limited impacts as no riverbank protection |
| PLB3 | h                                 | m           | both required   | normal impacts                             |
| PRB1 | h                                 | m           | both required   | normal impacts                             |
| PRB2 | h                                 | h           | both required   | flow to south impacted                     |
| PRB3 | h                                 | h           | both required   | flow to south impacted                     |
| MRB1 | h                                 | h           | both required   | flow to south impacted                     |
| MLB1 | l                                 | l           | existing work, minimal impacts                        | existing work, minimal impacts             |
| MLB2 | h                                 | m           | both required   | normal impacts                             |

#### a) Cost

##### JUSTIFICATION:

Individual tranches have only limited total budgets. This is required for not overloading the implementing agency but also from budgetary considerations of ADB's pipeline.

##### DETAILS FOR EACH SUB-CRITERION:

##### Riverbank Protection

Addressing two or three sub-areas is potentially more beneficial for achieving the overall goal than putting all investment of one tranche into one area. For this reason high investment is less beneficial than lower investment. As such points are given for low, medium, and high investment in descending order, starting with three points for low.

##### Embankments

The same holds true for embankments.

#### DETAILED TABLES:

|      | riverbank protection | embankment | riverbank protection                                | embankment                                   |
|------|----------------------|------------|---|--|
| JRB1 | l                    | l          | normal new revetment, 10 km already existing        | normal new embankment, partly existing       |
| JRB2 | l                    | l          | normal new revetment, 7 km already existing         | existing embankment                          |
| JLB1 | h                    | m          | substantial offtake work                            | new embankment                               |
| JLB2 | m                    | m          | limited offtake work                                | new embankment                               |
| PLB1 | m                    | m          | normal new revetment                                | new embankment                               |
| PLB2 | l                    | l          | erosion resistant area                              | existing road can be converted to embankment |
| PLB3 | h                    | m          | higher requirement revetment d/s of Padma Bridge    | new embankment                               |
| PRB1 | m                    | m          | normal new revetment                                | new embankment                               |
| PRB2 | h                    | m          | normal new revetment, but offtake of Arial Khan     | new embankment                               |
| PRB3 | h                    | h          | higher requirement revetment d/s of Padma Bridge    | new embankment with many openings            |
| MRB1 | h                    | h          | deep confluence with high velocities and weak soils | new embankment with many openings            |
| MLB1 | l                    | l          | existing work, no revetment                         | existing work, no embankment                 |
| MLB2 | h                    | m          | deep confluence with high velocities                | new embankment                               |

#### a) Benefits

##### JUSTIFICATION:

High benefits provide attractive investments.

Details for each Sub-criterion:

##### Directly

A main consideration is that work in already protected areas is less likely to achieve lower incremental benefits than work in previously unprotected areas. As such this sub-criterion filters the potential for new investment. Direct benefits largely focus on the primary sector. The classification is only yes or no gaining one point for yes and zero points for no.

##### Additional

Apart from primary sector benefits obvious additional benefits where visible were identified. Again points were given for yes and no.

**DETAILED TABLES:**

|      | directly | additional | directly   | additional  |
|------|----------|------------|--|---|
| JRB1 | y        | y          | restoration of BRE   | flow along west bank for navigation, reclamation of charland        |
| JRB2 | n        | n          | existing scheme  | existing scheme   |
| JLB1 | n        | y          | higher area  | dry season flow due to offtakes                                     |
| JLB2 | y        | y          | increased due to reduced flood losses and incremental agri increases | dry season flow due to offtakes, additional reclamation of charland |
| PLB1 | y        | y          | increased due to reduced flood losses and incremental agri increases | reclamation of charland   |
| PLB2 | y        | n          | increased due to reduced flood losses and incremental agri increases | reclamation likely only after ten years                             |
| PLB3 | y        | n          | increased due to reduced flood losses and incremental agri increases | none  |
| PRB1 | y        | n          | increased due to reduced flood losses and incremental agri increases | none  |
| PRB2 | y        | n          | improvement of Faridpur flood situation                              | none  |
| PRB3 | n        | n          | open floodplain, reduced benefits                                    | none  |
| MRB1 | n        | n          | open floodplain, reduced benefits                                    | none  |
| MLB1 | n        | n          | existing scheme  | existing scheme   |
| MLB2 | y        | n          | increased due to reduced flood losses and incremental agri increases | none  |

**1. MCA WEIGHTING AND SCOREBOARD**

The MCA combines all above criteria, and applies weighing factors to each criterion. We applied weighing factors at two levels: (i) primary interest and (ii) evening out of the number of sub-criteria. Firstly, the three vulnerability criteria (riverbank erosion, flooding, social fabric) were set to obtain higher marks, in order to allow addressing these more urgent problems at higher priority. Secondly, we applied weighing factors, so that each group of sub-criteria (primary interest and others) obtains the same maximum marks. In combination this means that the vulnerability criteria get a maximum of 90 marks. If there are three classification groups, for example high, medium, low, the weighing factor applied was 10 (3 sub-criteria \* 3 points \* 10 weighing factor = 90), if there are two classification groups (for example yes - no) the weighing factor is 15 (3 sub-criteria \* 2 points \* 15 weighing factor = 90). For the second group, the same weighing factors apply, only with the goal to reach a maximum of 30 points. The result is presented in (Table 0-2 ).

A sensitivity run, setting all criteria equal, confirms the same selection as obtained by above method. Furthermore, a very similar result was obtained during an initial discussion with ADB, BWDB and members of the PPTA team in September, however with less refinement and quantification of sub-criteria.

Table 0-2: MCA scorecard

| CATEGORY                                | SUB-CATEGORY                 | Unit     | JRB1   | JRB2   | JLB1  | JLB2   | PLB1   | PLB2   | PLB3  | PRB1  | PRB2  | PRB3 | MRB1 | MLB1   | MLB2  |
|---|------------------------------|----------|--------|--------|-------|--------|--------|--------|-------|-------|-------|------|------|--------|-------|
| EROSION                                 | total (1973-2010)            | km²      | 2      | 1      | 2     | 3      | 3      | 1      | 2     | 2     | 2     | 2    | 2    | 1      | 1     |
|   | recent (2007-2012)           | km²      | 2      | 2      | 1     | 2      | 1      | 1      | 2     | 3     | 2     | 3    | 3    | 1      | 2     |
|   | future (2012-2020)           | km²      | 2      | 2      | 3     | 3      | 3      | 1      | 3     | 3     | 3     | 3    | 3    | 2      | 2     |
|   | WEIGHT                       | 10       | 60     | 50     | 60    | 80     | 70     | 30     | 70    | 80    | 70    | 80   | 80   | 40     | 50    |
| FLOODING<br>based on radarsat<br>images | average (2-year)             | %        | 3      | 3      | 2     | 3      | 3      | 3      | 1     | 1     | 1     | 2    | 1    | 1      | 2     |
|   | mean (5-15 year)             | %        | 3      | 2      | 2     | 3      | 2      | 3      | 1     | 1     | 2     | 2    | 1    | 1      | 1     |
|   | high(>15 years)              | %        | 3      | 2      | 3     | 3      | 3      | 3      | 1     | 1     | 2     | 2    | 2    | 1      | 1     |
| SOCIAL FABRIC                           | WEIGHT                       | 10       | 90     | 70     | 70    | 90     | 80     | 90     | 30    | 30    | 50    | 60   | 40   | 30     | 40    |
|   | poverty                      | %        | 3      | 3      | 2     | 2      | 2      | 2      | 1     | 2     | 2     | 1    | 1    | 1      | 1     |
|   | employment in agriculture    | %        | 1      | 2      | 2     | 3      | 2      | 1      | 1     | 2     | 2     | 3    | 3    | 2      | 1     |
|   | WEIGHT                       | 15       | 60     | 75     | 60    | 75     | 60     | 45     | 30    | 60    | 60    | 60   | 60   | 45     | 30    |
|   | Subtotal                     |          | 210    | 195    | 190   | 245    | 210    | 165    | 130   | 170   | 180   | 200  | 180  | 115    | 120   |
| ENGINEERING                             | riverbank protection first?  | yes/no   | 1      | 0      | 0     | 1      | 1      | 0      | 0     | 0     | 0     | 0    | 0    | 1      | 0     |
| INTERVENTION                            | existing embankment          | yes/no   | 1      | 0      | 0     | 1      | 1      | 1      | 1     | 1     | 0     | 0    | 1    | 1      | 1     |
|   | complicated structures       | yes/no   | 0      | 0      | 0     | 0      | 1      | 1      | 1     | 1     | 0     | 0    | 0    | 0      | 0     |
|   | WEIGHT                       | 10       | 20     | 0      | 0     | 20     | 30     | 20     | 20    | 20    | 0     | 0    | 10   | 20     | 10    |
| COMPLEMENTS                             | riverbank protection         | yes/no   | 1      | 1      | 0     | 0      | 0      | 1      | 0     | 1     | 0     | 1    | 0    | 1      | 1     |
| EXSITING SCHEME                         | embankment                   | yes/no   | 1      | 1      | 0     | 0      | 1      | 1      | 0     | 0     | 0     | 0    | 0    | 1      | 0     |
|   | WEIGHT                       | 15       | 30     | 30     | 0     | 0      | 15     | 30     | 0     | 15    | 0     | 15   | 0    | 30     | 15    |
| "NO REGRET"                             | consist. w future planform   | yes/no   | 1      | 1      | 1     | 1      | 1      | 0      | 0     | 0     | 0     | 0    | 0    | 1      | 0     |
|   | WEIGHT                       | 30       | 30     | 30     | 30    | 30     | 30     | 0      | 0     | 0     | 0     | 0    | 0    | 30     | 0     |
| EXPECTED COST                           | riverbank protection (2.5M)  | l/m/h    | 3      | 3      | 1     | 2      | 2      | 3      | 1     | 2     | 1     | 1    | 1    | 3      | 1     |
|   | embankment (0.5M)            | l/m/h    | 3      | 3      | 2     | 2      | 2      | 3      | 2     | 2     | 2     | 1    | 1    | 3      | 2     |
|   | WEIGHT                       | 5        | 30     | 30     | 15    | 20     | 20     | 30     | 15    | 20    | 15    | 10   | 10   | 30     | 15    |
| SAFEGUARD                               | expected social impact       | l/m/h    | 2      | 3      | 1     | 1      | 2      | 3      | 1     | 1     | 1     | 1    | 1    | 3      | 1     |
| IMPLICATIONS                            | expected environm. impact    | l/m/h    | 2      | 3      | 1     | 2      | 2      | 3      | 2     | 2     | 1     | 1    | 1    | 3      | 2     |
|   | WEIGHT                       | 5        | 20     | 30     | 10    | 15     | 20     | 30     | 15    | 15    | 10    | 10   | 10   | 30     | 15    |
| EXPECTED BENEFITS                       | primary sector (agriculture) | high/low | 2      | 1      | 1     | 2      | 2      | 2      | 2     | 2     | 2     | 1    | 1    | 1      | 2     |
|   | other (land-river transport) | high/low | 2      | 1      | 2     | 2      | 2      | 1      | 1     | 1     | 1     | 1    | 1    | 1      | 1     |
|   | WEIGHT                       | 7.5      | 30     | 15     | 22.5  | 30     | 30     | 22.5   | 22.5  | 22.5  | 22.5  | 15   | 15   | 15     | 22.5  |
|   | Subtotal                     |          | 160    | 135    | 77.5  | 115    | 145    | 132.5  | 72.5  | 92.5  | 47.5  | 50   | 45   | 155    | 77.5  |
| GRAND TOTAL                             | SUMMARY WEIGHT               | 107.5    | 370    | 330    | 237.5 | 330    | 325    | 297.5  | 202.5 | 262.5 | 257.5 | 250  | 255  | 330    | 197.5 |
|   |                              | Rank     | 1      | 2      | 11    | 2      | 5      | 6      | 12    | 7     | 8     | 10   | 9    | 2      | 13    |
|   |                              |          | winner | winner |       | winner | winner | winner |       |       |       |      |      | winner |       |

In conclusion the MCA indicates the following sub-reaches for potential initial investments (Table 0-3):

Table 0-3: Sub-reaches suitable for potential investment

| River  | Sub-reach                 | Division      |
|--------|---------------------------|---------------|
| Jamuna | Jamuna Right Bank 1 and 2 | North West    |
|        | Jamuna Left Bank 2        | North Central |
| Padma  | Padma Left Bank 1 and 2   |               |
| Meghna | Meghna Left Bank 1        | South East    |

### 1. Final Selection

The final selection considers the relevance of the findings of the MCA. There are two main criteria to be considered: (i) overlap or conflict with existing or planned schemes, and (ii) “nothing to protect” during Tranche 1. With the focus of ongoing or planned investments, there are three sub-reaches that might be affected: (i) Rajbari where BWDB is building riverbank protection, and the Padma Bridge river training works planned at Mawa and Char Janajat. This means the PLB2 and PRB 2 sites will overlap with Padma Bridge river training works. “Nothing to protect” holds true for two of the winning sub-reaches: (i) JRB2, where there is little erosion at the PIRDP this moment and embankment set-back distances are quite large along unprotected banklines, and (ii) MLB1, where there is no erosion along the

MDIP. Notwithstanding the lack of urgent protection, both sub-reaches should be covered under contingency measures during the first tranche, as their high ranking indicates the vulnerability and potentially viable investments. While the JRB2 site will have a clear focus on riverbank protection in support of an existing embankment line, MLB1 will have a clear focus on strengthening the flood embankment, which regularly is affected by “boiling” or seepage indicating a structural weakness.

Considering the relevance of immediate interventions, the most attractive projects are listed in Table 0-4.

**Table 0-4: Winning sub-reaches**

| <b>River</b> | <b>Sub-reach</b> | <b>Division</b> |
|--------------|------------------|-----------------|
| Jamuna       | JRB1             | North West      |
|              | JLB 2            | North Central   |
| Padma        | PLB 1            |                 |

## Annex 11: DOE Approved Terms of Reference



- 4.3 Land Resources
  - 4.3.1 Agroecological Regions
  - 4.3.2 Land Types
  - 4.3.3 Soil Textures
  - 4.3.4 Land Use
- 4.4 Agriculture Resources
  - 4.4.1 Farming Practice
  - 4.4.2 Cropping Pattern and Intensity
  - 4.4.3 Cropped Area
  - 4.4.4 Crop Production
  - 4.4.5 Crop Damage
  - 4.4.6 Main Constraints of Crop Production
- 4.5 Livestock and Poultry
  - 4.5.1 Feed and Fodder Shortage
  - 4.5.2 Livestock/Poultry Diseases
- 4.6 Fisheries
  - 4.6.1 Introduction
  - 4.6.2 Problem and Issues
  - 4.6.3 Habitat Description
  - 4.6.4 Fish Production and Effort
  - 4.6.5 Brackish Water and Pond Aquaculture
  - 4.6.6 Fish Migration
  - 4.6.7 Fish Biodiversity
  - 4.6.8 Fisheries Management
- 4.7 Ecological Resources
  - 4.7.1 Bio-ecological Zone
  - 4.7.2 Common Flora and Fauna
  - 4.7.3 Ecosystem Services and Function
- 4.8 Socio Economic Condition
  - 4.8.1 Socio Economic Condition
  - 4.8.2 Quality of Life Indicators
  - 4.8.3 Income and Poverty
  - 4.8.4 Gender and Women
  - 4.8.5 Common Property Resources
  - 4.8.6 Conflict of Interest and Law and Order Situation
  - 4.8.7 Historical, Cultural and Archaeological Sites
- 4.9 Ecological Resources
  - 4.9.1 Bio-ecological Zone
  - 4.9.2 Common Flora and Fauna
  - 4.9.3 Ecosystem Services and Function
- 5.0 Identification and Analysis of Key Environmental Issues (Analysis shall be presented with Scenarios, Maps, Graphics, etc. for the Case of Anticipated Impacts on Baseline)
  - 5.1 Environmental Sensitivity Investigation
  - 5.2 Environmental Asset
  - 5.3 Environmental Hot Spots
  - 5.4 Likely Beneficial Impacts
  - 5.5 Community Recommendations
  - 5.6 Alternate Analysis
- 6.0 Environmental and Social Impacts
  - 6.1 Introduction
  - 6.2 Impact on Water Resources
    - 6.2.1 Pre-Construction Phase
    - 6.2.2 Construction Phase
    - 6.2.3 Post-Construction Phase
  - 6.3 Impact on Land Resources
    - 6.3.1 Pre-Construction Phase
    - 6.3.2 Construction Phase
    - 6.3.3 Post-Construction Phase

*2.0*



- 6.4 Impact on Agriculture Resources
  - 6.4.1 Pre-Construction Phase
  - 6.4.2 Construction Phase
  - 6.4.3 Post-Construction Phase
- 6.5 Impact on Fisheries
  - 6.5.1 Pre-Construction Phase
  - 6.5.2 Construction Phase
  - 6.5.3 Post-Construction Phase
- 6.6 Impact on Eco System
  - 6.6.1 Pre-Construction Phase
  - 6.6.2 Construction Phase
  - 6.6.3 Post-Construction Phase
- 6.7 Socio Economic Impact
  - 6.7.1 Pre-Construction Phase
  - 6.7.2 Construction Phase
  - 6.7.3 Post-Construction Phase
- 7.0 Public Consultation and Disclosure
  - 7.1 Introduction
  - 7.2 Objectives of Public Consultation and Disclosure Meeting
  - 7.3 Approach and Methodology of Public Consultation and Disclosure Meeting
  - 7.4 Public Consultation Meetings (PCMs)
  - 7.5 Public Disclosure Meetings (PDMs)
- 8.0 Environmental Management Plan and Monitoring Indicators
  - 8.1 Introduction
  - 8.2 Mitigation Plan
  - 8.3 Enhancement Plan
  - 8.4 Contingency Plan
  - 8.5 Compensation Plan
  - 8.6 Monitoring Plan
  - 8.7 Monitoring Indicators
- 9.0 Cost Estimation for Environmental Mitigation Measures and Monitoring
- 10.0 Conclusions and Recommendations

- III. Without approval of EIA report by the Department of Environment, the project authority shall not be able to open L/C in favor of importable machineries.
- IV. Without obtaining Environmental Clearance, the project authority shall not be able to start the physical activity of the project.
- V. The project authority shall submit the EIA along with a filled-in application for Environmental Clearance in prescribed form, the applicable fee in a treasury Chalan, the no objection certificates (NOCs) from the local authority, NOCs from forest department (if it is required in case of cutting any forested plant, private or public) and NOC from other relevant agencies for operational activity etc. to the Head Office of DOE in Dhaka with a copy to the concerned Divisional Office of DOE.

  
 10.07-2013  
 (Syed Nazmul Ahsan)  
 Deputy Director (Environmental Clearance)  
 Phone # 02-8121793

Project Director  
 Project Management Office  
 JamunaMeghna River Erosion Mitigation Project  
 Bangladesh Water Development Board  
 28, Toynebe Circular Road (3<sup>rd</sup> Floor)  
 Metjheel C/A, Dhaka-1000.

Copy Forwarded to:

- 1) Assistant Director, Office of the Director General, Department of Environment, Head Office, Dhaka.