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

Bangladesh Water Development Board

PROJECT COMPLETION REPORT: IMED 04/2003 (Revised)

for

# An Investigation on the Causes of Embankment Failure (CEF) and Recommendations for Sustainable Solutions.

**August, 2023**

**Government of the People's Republic of Bangladesh**
**Ministry of Planning**
**Implementation Monitoring and Evaluation Division**
**PROJECT COMPLETION REPORT: IMED 04/2003 (Revised)**

## A. PROJECT DESCRIPTION:

| | | | |
|---|---|---|---|
| **01.** | **Name of the Project** | : | An Investigation on the Causes of Embankment Failure (CEF) and Recommendations for Sustainable Solutions **(Project code- 222012600)** |
| **02.** | **Administrative Ministry/Division** | : | Ministry of Water Resources (MoWR) |
| **03.** | **Executing Agency** | : | Bangladesh Water Development Board (BWDB) |
| **04.** | **Location of the Project** | : | All over Bangladesh |

**05. Objective of the Project:**

The overall objective of the study is to investigate the mechanism of embankments (river and coast) and river training works across different regions of the country and to identify a long-term sustainable solutions. The specific objectives of the study are to:

- Investigate the causes of failure of different types of embankments, polders & other hydraulic structures at designated project areas;
- Identify the slope stability with or without water storage (at selected locations);
- Develop an integrated plan for char stabilization and livelihood improvement in the selected char area.
- Discuss the process of interaction between river banks and hydro-dynamic forces;
- Propose a socio-economic and eco-friendly feasible plan, design criteria & construction technique for embankment and riverbank erosion.
- Arrange capacity building of BWDB officials for adaptation in changed technologies for water engineering project planning and design.

**06. Estimated Cost:**

**(In lakh Taka)**

| | Original | Latest Revised |
|---|---|---|
| **(a) Total** | 496.50 | - |
| **(b) Taka** | 496.50 | - |
| **(c) Foreign Currency** | - | - |
| **(d) Project Aid** | - | - |
| **(e) RPA** | - | - |

| **07.** | **Date of Approval** | : | **PCP/PFS** | **PP** |
|---|---|---|---|---|
| | **(a) Original** | : | 16.06.2021 | |
| | **(b) Latest Revised** | : | - | |
| | **(c) No cost time extension** | | 09.06.2022 | |

**08. Implementation Period:**

| | Date of Commencement | Date of Completion |
|---|---|---|
| (a) Original | May 2021 | June 2022 |
| (b) Latest Revised | May 2021 | December 2022 |
| (c) Actual | May 2021 | December 2022 |

**09. Financing Arrangement (Source-wise):**

**9.1 Status of Loan/Grant**

**a) Foreign Financing : *Not Applicable***

| Source (s) | Currency as per Agreement | Amount in US $ (Million) | Nature (Loan/Grant/ supplier's/ credit) | Date of Agreement | Date of Effective-ness | Date of Closing | |
|---|---|---|---|---|---|---|---|
| | | | | | | Original | Revised |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| | | | | | | | |

**b) GOB:**

**(In lakh Taka)**

| Total amount | Loan | Grant | Cash Foreign Exchange |
|---|---|---|---|
| 1 | 2 | 3 | 4 |
| 496.50 | - | 496.50 | - |

**9.2 Utilization of Project Aid: *Not Applicable***

**(In million)**

| Source (s) | Total Amount | | Actual Expenditure | | Unutilized Amount | |
|---|---|---|---|---|---|---|
| | In US $ | In Local Currency | In US $ | In Local Currency | In US $ | In Local Currency |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| | | | | | | |

**9.3 Re-imbursible Project Aid (RPA): *Not Applicable***

**(In lakh Taka)**

| R P A Amount | | Amount Spent | Amount Claimed | Amount Re-imbursed | Remarks |
|---|---|---|---|---|---|
| As per PP | As per Agreement | | | | |
| 1 | 2 | 3 | 4 | 5 | 6 |
| | | | | | |

## B. IMPLEMENTATION POSITION

**01. Implementation Period:**

| Implementation Period as per PP | | Actual Implementation period | Time Over-run (% of original implementation period) | Remarks |
|---|---|---|---|---|
| Original | Latest Revised | | | |
| 1 | 2 | 3 | 4 | 5 |
| May 2021- June 2022 (14 months) | May 2021- December 2022 | May 2021- December 2022 (20 months) | 42.85 % | Initially, the project was designed for detail hydro-morpological study on 4 sites (Fulchhari in Gaibandha, Chauhali in Sirajganj, Tazumuddin in Bhola and Assasuni in Satkhira). Later on to obtain the target of the project properly Naria upazilla of Shariatpur District was included for detailed Hydro-morphological Study. Also, due to covid19 pandemic, field visits and survey work were delayed. |

**02. Cost of the Project:**

**(In lakh Taka)**

| Description | Estimated Cost | | Actual expenditure | Cost over-run (% of original cost) | Remarks |
|---|---|---|---|---|---|
| | Original | Latest revised | | | |
| 1 | 2 | 3 | 4 | 5 | 6 |
| TOTAL | 496.50 | - | 456.84 | - | The actual expenditure is less than the project cost. |
| TAKA | 496.50 | - | 456.84 | - | |
| PA | - | - | - | - | |

**03. Project Personnel:**

| Sanctioned strength as per PP | Manpower employed during execution | Status of the existing manpower | | | Manpower Employed | |
|---|---|---|---|---|---|---|
| | | Manpower requirement for O&M as per pp | Existing manpower for O & M | Others | | |
| 1 | 2 | 3 | 4 | 5 | Male | Female |
| Officer (s) | 11 | - | - | - | 9 | 2 |
| Staff(s) | 8 | - | - | - | 4 | 4 |
| Total: | 19 | Existing manpower of Directorate of Planning-1, BWDB, Dhaka. | | | 13 | 6 |

**04. Training of Project Personnel (Foreign/Local):** No provision of training in this project

| Field of Training /Study tour/workshop/Seminer etc. | Provision as per PP | | Actual | | Remarks |
|---|---|---|---|---|---|
| | Number of persons | Man - months | Number of persons | Man - months | |
| 1 | 2 | 3 | 4 | 5 | 6 |
| a. Foreign | - | - | - | - | - |
| b. Local | - | - | - | - | - |

**05. Component-wise Progress (As per latest approved PFS):**

(In lakh Taka)

| Items of work (as per PFS) | Unit | Target (as per PFS) | | Actual Progress | | Reasons for deviation (±) |
|---|---|---|---|---|---|---|
| | | Financial | Physical (%) | Financial | Physical (%) | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| **A. Revenue** | | | | | | |
| 1.Feasibility Study (Local Consultatnt) | Lot | 458.89 | 100.00% | 451.05 | 100.00% | |
| 2.Other stationery | LS | 0.50 | 100.00% | 0.00 | 0.00% | |
| 3.Honorarium | LS | 4.00 | 100.00% | 1.83 | 50.00% | |
| 4.Entertainment expenses | LS | 0.61 | 100.00% | 0.00 | 0.00% | |
| 5.Gas and fuel | LS | 1.00 | 100.00% | 0.00 | 0.00% | |
| 6.Books & Journals | LS | 0.50 | 100.00% | 0.00 | 0.00% | |
| 7.Domestic travel expenses | LS | 2.00 | 100.00% | 0.00 | 0.00% | |
| **Sub-total (Revenue):** | | **467.50** | **100.00%** | 452.88 | 98.59% | |
| | | | | | | |
| **B. Capital** | | | | | | |
| 8. Computer and office equipment | Set | 2.00 | 100.00% | 1.99 | 100.00% | |
| 9. Furniture | Set | 2.00 | 100.00% | 1.97 | 100.00% | |
| 10. Computer software | Nos. | 25.00 | 100.00% | 0.00 | 0.00% | |
| **Sub-total (Capital):** | | **29.00** | **100.00%** | 3.96 | 13.66% | |
| **Grand-Total** | | **496.50** | **100.00%** | 456.84 | 92.01% | |

**06. Information regarding Project Director (s):**

| Name & Designation with pay Scale. | Full time | Part time | Responsible for more than one project | Date of | | Remarks |
|---|---|---|---|---|---|---|
| | | | | Joining | Transfer | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Dr. Shamal Chandra Das<br>Superintending Engineer (Civil)<br>Directorate of Planning-1<br>BWDB, Dhaka<br>Grade-4 (50,000 to 71,200) | Full time | - | Yes | 06.07.2021 | Till date | - |

**07. Procurement of Transport (in Nos.):** ***Not Applicable***

| Type of transport | Number as per P.P. | Procured with date | Transferred to Transport Pool with date | Transferred to O & M with date | Condemned/ damaged with date | Remarks |
|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Car | - | - | - | - | - | |
| Jeep | - | - | - | - | - | |

**08. Procurement of Goods, Works and Consultancy Services:**

08.1 Goods & Works of the Project costing above Tk. 200.00 lakh. and Consultancy above Tk. 100.00 lakh:

| Description of procurement (goods/works/consultancy) as per bid document | Tender/Bid/Proposal Cost (in lakh Taka) | | Tender/Bid/Proposal | | Date of completion of works/services and supply of goods | |
|---|---|---|---|---|---|---|
| | As per PFS | Contracted value | Invitation date | Contract signing/ L.C opening date | As per contract | Actual |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| **Consultancy** | | | | | | |
| "An Investigation on the Causes of Embankment Failure (CEF) and Recommendations for Sustainable Solutions." | 458.89 | 458 | 05.07.2021 | 12.10.2021 | Original: 11.10.2022 Revised: 31.12.2022 | 31.12.2022 |

**8.2 Use of Project Consultant (s) (Foreign/Local):**

| Name of the Field | Approved man month | | Actual man month utilised | Remarks |
|---|---|---|---|---|
| | As per PP | As per contract | | |
| 1 | 2 | 3 | 4 | 5 |
| a) **Foreign:** | - | - | - | |
| b) **Local:** | 77 | 77 | 77 | Conducted by Institute of Water and Flood Management (IWFM), BUET |

08. **Construction/Erection/Installation Tools & Equipment:** Not Applicable

| Description of items | Quantity (as per PP) | Quantity procured with date | Transferred to O & M with date | Disposed off as per rule with date | Balance | Remarks |
|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| | | | | | | |

## C. FINANCIAL AND PHYSICAL PROGRAMME:

**01. (a) Original and revised schedule as per PFS:**

**(In lakh Taka)**

| Financial Year | Financial provision & physical target as per original PP | | | | Financial provision & physical target as per latest revised PP | | | |
|---|---|---|---|---|---|---|---|---|
| | Total | Taka | P.A. | Physical % | Total | Taka | P.A. | Physical % |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 2021-22 | 496.50 | 496.50 | - | 100.00% | 300.00 | 300.00 | - | 65 |
| 2022-23 | | | | | 196.00 | 196.00 | | 35 |
| **Total** | **496.50** | **496.50** | **-** | **100.00%** | **496.00** | **496.00** | **-** | **100** |

**01. (b) Revised ADP allocation and progress:**

**(In lakh Taka)**

| Financial Year | Revised Allocation & target | | | | Taka release | Expenditure & physical progress | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Total | Taka | P.A. | Physical % | | Total | Taka | P.A. | Physical % |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| 2021-22 | 300.00 | 300.00 | - | 65 | 300.00 | 268.18 | 268.18 | - | 65.91 |
| 2022-23 | 196.00 | 196.00 | | 35 | 196.00 | 188.66 | 188.66 | | 27.75 |
| **Total** | **496.00** | **496.00** | **-** | **100** | **496.00** | **456.84** | **456.84** | **-** | **93.63** |

## D. ACHIEVEMENT OF OBJECTIVES OF THE PROJECT:

| Objectives as per PP/PFS | Actual achievement | Reasons for shortfall, if any |
|---|---|---|
| Investigate the causes of failure of different types of embankments, polders & other hydraulic structures at designated project areas; | Completed- Several causes of embankment failure are identified during the field survey, modeling and design review and geotehchnical investigation (Chapter 2,3,4,6 and 7 of the final report) | - |
| Identify the slope stability with or without water storage (at selected locations); | Completed- The stability of slope for bank protection at Naria, Rajbari, Islampur, Tazumuddin and Betagi Upazila have been assessed. (Chapter 6, Final Report) | - |

| Objectives as per PP/PFS | Actual achievement | Reasons for shortfall, if any |
|---|---|---|
| Develop an integrated plan for char stabilization and livelihood improvement in the selected char area. | Completed- The process has been investigated for Naria, Rajbari, Islampur, Tazumuddin and Betagi using 1D, 2D and 3D modelling has been assessed. (Section 3.1.4, 3.2,3.5.3, Final Report) | - |
| Discuss the process of interaction between river banks and hydro-dynamic forces; | Completed- The embankments around the country have been used for various purposes such as transportation, crop drying, temporary refuge of flood-affected people and river erodes, livestock stalling, and so on. Though some of the multipurpose use of embankments are not welcomed by BWDB, they are happy with the use of embankments as road. (Section 2.11.1, 2.11.2 , final report) | - |
| Propose a socio-economic and eco-friendly feasible plan, design criteria & construction technique for embankment and riverbank erosion. | Completed- Socio-economic investigation for embankment failure have been done (Chapter-2, final report). Recommendations and implementation guidelines of several aspects of embankments and riverbank protection such as river wise standardization of setback distance of embankment, river training works, climate resilient infrastructures design and prevention of piping and erosion at the bed level etc have been provided. Existing guidelines and implementation manuals of BWDB and other relevant organizations are also reviewed. (Chapter-8). | - |
| Arrange capacity building of BWDB officials for adaptation in changed technologies for water engineering project planning and design. | Completed- A 2-day capacity building workshop was held at BWDB. A total of 40 participants were attended this capacity building training programs. (Section 9.7, Final Report) | - |

## E. BENEFIT ANALYSIS

**01. Annual Out-put: Not Applicable for the Study Project.**

| Items of out-put | Unit | Estimated quantity expected at full capacity | Actual quantity of out-put during the 1st year of operation at full capacity (or during, real production for newly completed project). |
|---|---|---|---|
| - | - | - | - |

**02. Cost / Benefit:** ***Not Applicable*** **(It is not an investment project, hence** ***not applicable*****)**

| Item | Estimated | Actual |
|---|---|---|
| **(1) Benefit cost ratio of the project** | | |
| **(i) Financial** | - | - |
| **(ii) Economic** | - | - |
| **(2) Internal Rate of Return** | | |
| **(i) Financial** | - | - |
| **(ii) Economic** | - | - |

**02. Please give reasons for shortfall, if any, between the estimated and actual benefit:**
Not Applicable

## F. MONITORING AND AUDITING

**1. Monitoring:** Nil

| Name & designation of the inspecting official | Date of Inspection | Identified Problems | Recommendations |
|---|---|---|---|
| 1 | 2 | 3 | 4 |
| **Ministry/Agency:** | - | - | |
| | | | |
| **Others:** | - | - | |

**2. Auditing during and after Implementation:**

**2.1. Internal Audit:** No audit conducted.

| Period of Audit | Date of submission of Audit Report | Major findings/ objections | Whether objections resolved or not. |
|---|---|---|---|
| 1 | 2 | 3 | 4 |
| - | - | - | - |

**2.2. External Audit:** Not Yet Conducted

| Audit period | Date of submission of Audit Report | Major findings/ objections | Whether objections resolved or not. |
|---|---|---|---|
| 1 | 2 | 3 | 4 |
| | - | | - |

## G. DESCRIPTIVE REPORT

### 1. General Observations/Remarks of the Project on:

### 1.1 Background

Bangladesh is among the 10 most disaster-affected countries in the world, highly exposed to severe monsoon flooding and cyclones. In an "average" year, about a quarter of the country is inundated during the monsoon; every four to five years, severe floods may cover two thirds of the country. Intense floods at times exceed the ability of communities to cope, creating widespread humanitarian needs with longer-term adverse development consequences.

The 2020 floods in Bangladesh had some remarkable characteristics. The flooding started in late June – earlier than usual — with a never-before seen "triple peak", resulting in the second-highest level of flooding since 1989 and the second longest since the 1998. According to the Government of Bangladesh, 5.5 million people were affected, and 1 million houses were waterlogged. About 1.1 million people were displaced, and almost 100,000 were evacuated to some 1,500 shelters. Almost 1 million tube-wells and more than 100,000 latrines were damaged, 83,000 hectares of paddy fields were affected, and 257 people lost their lives.

After that A meeting was held on 22/07/2020 regarding flood situation across the country, flood forecasting and warning and measures to deal with floods. In that meeting, it was decided to conduct a research to find out the causes of failure of the existing polders/ embankments of Bangladesh Water Development Board in different parts of the country including coastal areas due to floods, cyclones and provide its sustainable solution.

For that reason, a project has been initiated namely "An Investigation on the Causes of Embankment Failure, and Recommendations for Sustainable Solutions" and has assigned the Institute of Water and Flood Management (IWFM) of Bangladesh University of Engineering and Technology (BUET) to conduct this study.

### 1.2 Justification/Adequacy

When embankments were built in the 1960s, the prime consideration was to protect the standing crops from repeated floods. This has been largely achieved over the years. Meanwhile, the bio-physical setting of the country has changed significantly due to various interventions such as embankments, roads, railways etc. Erosion protection has now become more urgent in order to safeguard the embankments. The embankments themselves are suffering from various problems. The continuing problem is the proper operation and maintenance of these structures. This issue has been highlighted regularly in many past studies. But no visible improvement has been found till now. For proper O&M, timely release of the adequate fund and addressing staff shortage need to be taken up urgently. The failure of embankments is very common in Bangladesh; unfortunately, there has been very little research that has adequately analyzed the main cause of such failure. It was decided to conduct a research program through IWFM, BUET to investigate the reasons for failure of the existing polders/ embankments of Bangladesh Water Development Board in different parts of the country including coastal areas due to floods, cyclones and floods as well as various natural disasters and its sustainable solution.

**Linkage with BDP 2100**

The Project will contribute to the implementation of the Bangladesh Delta Plan 2100 from institutional aspect. This project complies with the Delta (BDP 2100) Goal no 1 which is "*Ensure safety from floods and climate change related disaster*".

Since BWDB will play a lead role in water management by implementing 59 projects out of 80 of BDP 2100 so the institutional development of BWDB is must. This project will help to develop the overall institutional capacity of BWDB all over Bangladesh. So, the concept of the project is aligned with BDP2100.

**BDP 2100 Higher Level Goals**

Goal 1: Eliminate extreme poverty by 2030;
Goal 2: Achieve upper middle-income status by 2030; and
Goal 3: Being a Prosperous Country beyond 2041.

**BDP 2100 Specific Goals**

Goal 1: Ensure safety from floods and climate change related disasters;
Goal 3: Ensure sustainable and integrated river systems and estuaries management;
Goal 6: Achieve optimal and integrated use of land and water resources.

**Strategy at National Level**

Flood Risk (FR) Management Strategies
- Strategy FR 1: Protecting Economic Strongholds and Critical Infrastructure.
- Strategy FR 2: Equipping the Flood Management and Drainage (FMD) Schemes for the Future
- Strategy FR 3: Safeguarding Livelihoods of Vulnerable Communities
- Sub-strategy FR 3.7: River management as well as improved flood management, drainage, O&M and flow management

**1.3 Objectives**

The overall objective of the study is to investigate the mechanism of embankments (river and coast) and river training works across different regions of the country and to identify a long-term sustainable solutions. The specific objectives of the study are to:

- Investigate the causes of failure of different types of embankments, polders & other hydraulic structures at designated project areas;
- Identify the slope stability with or without water storage (at selected locations);
- Develop an integrated plan for char stabilization and livelihood improvement in the selected char area.
- Discuss the process of interaction between river banks and hydro-dynamic forces;
- Propose a socio-economic and eco-friendly feasible plan, design criteria & construction technique for embankment and riverbank erosion.
- Arrange capacity building of BWDB officials for adaptation in changed technologies for water engineering project planning and design.

**1.4 Project revision with reasons: Not Applicable**

**2. Rationale of the project in respect of Concept, Design, Location and Timing:**

Transportation, accumulation and subsequent deposition of sediment carried by GBM (Ganges- Brahmaputra- Meghna) has created Bangladesh which is recognized as one of

largest deltas in the world. It faces monsoon floods, flash floods, cyclones, storm surges, drought, riverbank erosion and landslides (UNEP, 2001). Floods constitute about 50% of all-natural disasters, and as a result, life and livelihoods are regularly affected by flooding (Vos *et al.*, 2010; Guha-Sapir *et al.*, 2004; and Jonkman *et al.*, 2009). Bangladesh sufferes from different types of floods which causes enormous damage to properties and lives, and managing floods itself is a daunting task.

Structural countermeasures of flood protection include embankments, polders, floodwalls, dams, reservoirs, retention basins, river training works, flood bypass, flood diversion etc.

Thousands acres of crops are lost each year due to the failure and subsidence of flood control embenkment. Thousands of families lost their homes due to river erosion. The overall economic and social structure of the country depends to a large extent on proper and permanent rehabilitation of flood control embankment and river bank protection work.

The study project was undertaken to assess the current design of the embankment, river bank protection works and to formulate a scientific and practical design of the dams taking into consideration the impact of climate change, local needs, modernization etc.

Apart from flood control dams, river bank protection works and coastal embankment issues have also been covered under the study scheme for proper implementation of the project.

Considering the vulnerable areas across the country, 8 areas were identified for the discussion survey project.

A unique transdisciplinary and deeply stakeholder-driven approach for co-producing the climate-resilient infrastructure design has been applied in this study.

**3. Brief description on planning and financing of the project and its applicability.**

- **Project Identification**

Bangladesh is one of the most disaster-prone countries in the world, and still experiences several cyclonic storms each year, their impact amplified by the country's funnel-shaped bay. Floods and coastal erosion frequently cause devastation in the low-lying coastal region.

When embankments were built in the 1960s, the prime consideration was to protect the standing crops from repeated floods. This has been largely achieved over the years. Meanwhile, the bio-physical setting of the country has changed significantly due to various interventions such as embankments, roads, railways etc. Erosion protection has now become more urgent in order to safeguard the embankments. This issue has come out strongly during analysis of temporal satellite images as well as from field findings.

The embankments themselves are suffering from a host of problems. The continuing problem is the proper operation and maintenance of these structures. This issue has been highlighted regularly in many past studies. But no visible improvement has been found till now. For proper O&M, timely release of the adequate fund and addressing staff shortage need to be taken up urgently.

In this circumstance, the authority of the Bangladesh Water Development Board has decided to solve this problem. For that reason, a project has been initiated namely "An Investigation on the Causes of Embankment Failure, and Recommendations for Sustainable Solutions" and has assigned the Institute of Water and Flood Management (IWFM) of Bangladesh University of Engineering and Technology (BUET) to conduct this study.

- **Project Preparation**

Almost every year during the monsoon season, upstream floods and inland torrential rains increase river erosion and damage flood control dams across the country. In addition, cyclones in coastal areas cause high tides and continuous sea wave shocks that cause erosion of coastal polders. As a result extensive erosion and waterlogging occur.

The State Minister and Deputy Minister of MoWR visited the affected areas from time to time and felt the need of investigating the root causes of failure of embankments and provide sustainable solutions regarding this issue. Also, Senior Secretary of MoWR conducted site visits and gave decision to take an initiative of forming a poject proposal. That's why BWDB took preparation for this project.

- **Appraisal**

The DPEC meeting regarding this project was held on 25/03/2021 at MoWR.

- **Credit Negotiation:** N/A
- **Credit Agreement:** N/A
- **Credit Effectiveness:** N/A
- **Loan Disbursement:** N/A
- **Loan Conditionalities:** N/A
- **Project Approval:** The project was approved by the Honorable State Minister, MoWR on 16.06.2021
- **Others (if any):** N/A

4. **Analysis of the Post-Implementation situation and result of the project:** *Not Applicable*

   **4.1** **Whether the beneficiaries of the project have clear knowledge about the Target/ Objectives of the project.**

   **4.2** **Programme for use of created-facilities of the project**

   **4.3** **O & M programme of the project.**

   **4.4** **Impact of the project -**

   **4.4.1 Direct**

   **4.4.2 Indirect**

   **4.5** **Transfer of Technology and Institutional Building through the project**

   **4.6** **Employment generation through the project.**

   **4.7** **Possibility of Self employment**

   **4.8** **Possibility of women-employment opportunity**

   **4.9** **Women's participation in development**

   **4.10** **Probable Impact on Socio-Economic activity.**

   **4.11** **Impact on environment**

   **4.12** **Sustainability of the project**

   **4.13** **Contribution to poverty alleviation/reduction**

   **4.14** **Opinion of the public representatives, local elite, local administration, teachers, religious leaders, women's representatives etc.**

   **4.15** **Contribution of Micro-credit programmes and Comments on overlapping with any NGO activities.**

5. *Problems encountered during Implementation (with duration & steps taken to remove those)*

| | | | |
|---|---|---|---|
| 5.1 | **Project Management** | 5.12 | **Project aid disbursement and re-imbursment** |
| 5.2 | **Project Director** | 5.13 | **Mission of the development partners.** |
| 5.3 | **Land Acquisition** | 5.14 | **Time & Cost Over-run** |
| 5.4 | **Procurement** | 5.15 | **Project Supervision/Inspection** |
| 5.5 | **Consultancy** | 5.16 | **Delay in Decision** |
| 5.6 | **Contractor** | 5.17 | **Transport** |
| 5.7 | **Manpower** | 5.18 | **Training** |
| 5.8 | **law & Order** | 5.19 | **Approval** |
| 5.9 | **Natural clamity** | 5.20 | **Others.** |
| 5.10 | **Project financing, allocation and release.** | | |
| 5.11 | **Design formulation/approval** | | |

*It is a research based study project to investigate the causes of failure of different types of embankments, polders & other hydraulic structures at designated project areas and provide improvement measures. The above problems don't occur*

## 6. Remarks & Recommendations of the Project Director:

"An Investigation on the Causes of Embankment Failure (CEF) and Recommendation for Sustainable Solutions" was sactioned in administrative approval from Ministry of water Resources given vide memo no. 42.00.0000.039.14.012.20-125 dated-16/06/2021. Project has been completed on 31/12/2022 successfully.

This is a research based study. The overall objective of the study is to investigate the failure of embankments across different regions of the country and find out a long-term sustainable solution against failures. To achieve this, a unique transdisciplinary and deeply stakeholder-driven approach for co-producing the climateresilient infrastructure design have been introduced and explored. This study considered 8 study sites in which located in rivers effected by monsoon floods and tidal floods as well as storm surges.

At the 5 locations Naria in Shariatpur district, Islampur in Jamalpur district, Sadar Upazila in Rajbari district, Chanchera, Tojumuddin, Bhola district and Betagi, Borguna district, detailed twodimensional modeling was performed. Based on two-dimensional numerical simulations, the evolution of the riverbed with several bank protection structures has been assessed in this study. Study Findings indicate that the Ganges' southward movement near Rajbari is quite severe, and the situation may be exacerbated by the presence of chars on the opposite bank.

It is observed that a few problems like riverbank erosion, setback distance, the untimely start of a project, Operation and maintenance are prominent in every region. Some of the issues, like sand mining and bureaucratic complexity are observed in a few regions and are not foremost in other regions. From the field findings and considering the different plans, policies and recent improvements, some recommendations have been provided that will be helpful in making the embankments sustainable.

Some valuable recommendetions regarding bank protection structures have came up from the study. Through costal modeling, polder stability as well polder heights and thrust force on the polders has been determined.

According to the expected output from the study Guideline for river training and bank protection measures, Recommendations for Designing Embankments and Protection works and Climate Resilient Infrasturctures Design have emerged from the research study.

These Guidelines for climate-resilient infrastructures design, Implementation guideline of river training works, suggestions and recommendations will be followed accordingly to get the maximum benefit and to ensure sustainability of different implementation projects.

08-11-2023

**Date:** .....

**Signature and seal of the Project Director**

(Dr. Shamal Chandra Das)
Addl. Chief Engineer (Civil) Planning
BWDB, Dhaka.

(Dr. Shamal Chandra Das)
Addl. Chief Engineer (Civil) Planning
**Former:** Superintending Engineer (Civil)
Directorate of Planning-1, BWDB, Dhaka.

**7. Remarks/Comments of Agency Head:**

Bangladesh is located in one of the largest deltas in the world with three mighty rivers of the Ganges, the Brahmaputra and the Meghna. This country is highly exposed to flood hazard and the severity is also high. Flood and River Bank Erosion are very common in Bangladesh which, widely damages life and livelihoods.

With growing demand for protecting people's health and homes, agriculture and city dwellers; the issue of earthen embankments in Bangladesh is getting much attention. This is because of the construction of earthen embankments in Bangladesh is the cheapest form to protect flood water.

It is evident that the earthen embankments in Bangladesh are overwhelmed with multi-facetted problems. The problem is acute in offshore islands and coastal belts where the embankments are in addition exposed to erosion by sea waves and tidal fluctuation of water levels. Even though a few studies have investigated the causes of failure of embankments in the past, they have not been investigated in an integrated manner. Therefore, a system-wide investigation was required, which has been attempted in this study.

This project has immense significance as we received some guidelines from this Research Study. The project has been completed successfully and satisfactorily. This project was taken to investigate the mechanism of embankments (river and coast) and river training works across different regions of the country and to identify a long-term sustainable solutions. The recommendations and guidelines obtained from the Study will be incorporated into various development projects that will contribute to sustainable development.

**Date:** .....

08/11/2023

**Signature and Seal**
(S. M. Shahidul Islam)
ID NO: 650307001
Director General
BWDB, Dhaka.

**8. Remarks/Comments of the officer in- charge of the Ministry/Division:**

The study focused on sustainable solution for failure of embankment and river training works of different parts of the country. It is expected that the recommendations and guidelines from this study would mitigate failure of embankments and river training works and implementation of these guidelines on different projects would contribute to socio-economic development in the area.

**Date:** .....

**Signature and Seal**