

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



Bangladesh Water Development Board

PROJECT COMPLETION REPORT: IMED 04/2003
For

**Detailed Study for East Gopalganj Integrated Water Resources
Management Project**

October, 2023

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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** : Detailed Study for East Gopalganj Integrated Water Resources Management Project
(Project Code: 224356700)
02. **Administrative Ministry** : Ministry of Water Resources (MoWR)
03. **Executing Agency** : Bangladesh Water Development Board (BWDB)
04. **Location of the Project** : Dhaka

05. **Objective of the Project** :

The overarching objective of the study is to find out a suitable development option for flood management, drainage, and irrigation and navigability improvement, protect salinity intrusion and riverbank protection through sustainable and eco-friendly interventions that is technically feasible, environmentally sustainable, socially acceptable and financially viable. The process and principles of integrated water resources management (IWRM) will be followed throughout the study. The specific objectives of the study are to:

- Protect the area from monsoon flooding through appropriate measures;
- Improve the drainage facilities and fresh water storage capacity;
- Increase the agricultural production by means of enhancing irrigation facilities and exploring the possibility of maximizing irrigation benefit;
- Resist salinity intrusion in the project area at present and future climate change condition;
- Protect the bank river against erosion of the Modhumati, Baghiarkul, Shyaldah river and Madaripur Beel Route (MBR) at the strategic locations;
- Improve the navigability of the rivers and khals in and around the study area;
- Alleviate poverty through livelihood improvement and enhancing agricultural and fish production;
- Minimize the adverse impact of interventions through environmental and social impact assessment (ESIA) and promote nature based solution;
- To devise suitable option for increasing sustainability of the development through effective community participation;
- To develop option for enhancing water use efficiency and promote livelihood through improved productivity.

06. **Estimated Cost:**

(In Lac Taka)		
	Original	Latest Revised
(a) Total	355.00	-
(b) Taka	355.00	-
(c) Foreign Currency	-	-
(d) Project Aid	-	-
(e) RPA	-	-

07.

Date of Approval	:	PCP/PFS	PP
(a) Original	:	21/04/2022	-
(b) Latest Revised	:	-	-

08. Implementation Period:

	Date of Commencement	Date of Completion
(a) Original	April, 2022	June, 2023
(b) Latest Revised	-	-
(c) Actual	April, 2022	June, 2023

09. Financing Arrangement (Source-wise):

9.1 Status of Loan/Grant

a) Foreign Financing:

(In Lac Taka)

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

b) GOB:

(In Lac Taka)

Total amount	Loan	Grant	Cash Foreign Exchange
1	2	3	4
355.00	-	355.00	-

9.2 Utilization of Project Aid: (Source wise)

(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):

(In Lac 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 PFS		Actual Implementation period	Time Over-run (% of original implementation period)	Remarks
Original	Latest Revised			
1	2	3	4	5
April, 2022 to June, 2023 (15 months)	-	April, 2022 to June, 2023 (15 months)	-	-

02. Cost of the Project:

(In Lac Taka)

Description	Estimated Cost		Actual expenditure	Cost over-run (% of original cost)	Remarks
	Original	Latest revised			
1	2	3	4	5	6
TOTAL	355.00	-	321.60	-9.41%	-
TAKA	355.00	-	321.60		-
PA	-	-	-	-	-

03. Project Personnel: There was no provision of manpower in the PFS¹

Sanctioned strength as per PPF	Manpower employed during execution	Status of the existin-g 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)	-	-	-	-	-	-
Staff(s)	-	-	-	-	-	-
Total	-	-	-	-	-	-

04. Training of Project Personnel (Foreign/Local):

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	-	-	-	-	-

¹ There was no provision of additional manpower in the approved PFS for conducting the project. So, existing officers and staffs of the Project Director's office i.e. Officer of the Superintending Engineer (Civil), Directorate of Planning-I, BWDB executed the project.

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

(In Lac Taka)

Items of work (As per PFS)	Unit	Target (as per PFS)		Actual Progress		Reasons for deviation (±)
		Financial	Physical (Quantity)	Financial	Physical (Quantity)	
1	2	3	4	5	6	7
Revenue Expenditure						
Feasibility Study (Local Professionals 65.00MM)	MM	336.97	100.00%	316.93	100.00%	
Computer Consumables	Lot	1.03	100.00%	0.98	100.00%	
Printing & Binding	Lot	0.50	100.00%	0.48	100.00%	
Other stationery	Lot	1.00	100.00%	0.99	100.00%	
Map	Lot	1.00	100.00%	0.48	100.00%	
Honorarium	LS	7.00	100.00%	0.11	2.00%	
Domestic travel expenses	LS	3.00	100.00%	0.46	20.00%	
Fuel and Gas	LS	1.00	100.00%	0.00	0.00%	
Petrol, Oil and Lubricants	LS	1.00	100.00%	0.17	20.00%	
Entertainment Expenses	LS	1.50	100.00%	0.00	0.00%	
Capital Expenditure						
Computers and accessories	Lot	1.00	100.00%	0.98	100.00%	
Total=		355.00	100.00%	321.60	96.46%	

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. Robin Kumar Biswas Superintending Engineer (Civil) Directorate of Planning-1 BWDB, Dhaka Grade-4 (50,000-71,200)	Full time	-	Yes	22-05-2022	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	-	-	-	-	-	-
Others with name	-	-	-	-	-	-

08. Procurement of Goods, Works and Consultancy Services:

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

Description of procurement (goods/works /consultancy) as per bid document	Tender/Bid/Proposal Cost (in Lac 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 Services for "Detailed Study for East Gopalganj Integrated Water Resources Management Project"	336.97	329.36	01/06/2022	19/07/2022	18/06/2023	18/06/2023

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

Name of the Field	Approved man month		Actual man month utilised	Remarks
	As per PFS	As per contract		
1	2	3	4	5
a) Foreign:	-	-	-	-
b) Local:				
Feasibility Study including ESIA	65.00	65.00	65.00	Conducted by Center for Environmental and Geographic Information Services

09. Construction/Erection/Installation Tools & Equipment:

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 Lac Taka)

Financial Year	Financial provision & physical target as per original PFS				Financial provision & physical target as per latest revised PFS			
	Total	Taka	P.A.	Physical %	Total	Taka	P.A.	Physical %
1	2	3	4	5	6	7	8	9
2021-22	0.00	0.00	-	0.00%	-	-	-	-
2022-23	339.00	339.00	-	98.52%	-	-	-	-
Total	339.00	339.00	-	98.52%	-	-	-	-

01. (b) Revised ADP allocation and progress:

(In Lac 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	0.00	0.00	-	0.00%	0.00	0.00	0.00	-	0.00%
2022-23	339.00	339.00	-	98.52%	339.00	321.60	321.60	-	96.46%
Total	339.00	339.00	-	98.52%	339.00	321.60	321.60	-	96.46%

D. ACHIEVEMENT OF OBJECTIVES OF THE PROJECT:

Objectives as per PFS	Actual achievement	Reasons for shortfall, if any
Protect the area from monsoon flooding through appropriate measures;	There are 8 polders with a total length of 307 km and 83 water control structures in the project area to protect the study area from flooding and saline water intrusion to protect agriculture. Structures are suggested to be rehabilitated to control water when requires. Furthermore, additional 24 boatpasses are recommended in places where water enters directly within the project area from periphery rivers and affects crops due to saline water or early floods. However, local people demand the gate of the water control structures be opened in the full monsoon and closed to protect the study area from the early flooding, the project is designed to protect the area from monsoon flooding and early flooding. (Chapter 4 Section 4.11) (Executive Summary – Annexure 1)	-

Objectives as per PFS	Actual achievement	Reasons for shortfall, if any
Minimize the adverse impact of interventions through environmental and social impact assessment (ESIA) and promote nature-based solution;	Impact assessment has been done on the suggested intervention and proper Environment Management Plans (EMP) are suggested against the adverse impact of interventions through environmental and social impact assessment (ESIA). Besides eco-hydrology concept is considered as to adopt nature-based approach while planning the project (Chapter 5)	-
To devise suitable option for increasing sustainability of the development through effective community participation;	Union wise Public Consultation meeting (PCM) was conducted to identify the existing problem of the project area and to ensure the participation of local people in the planning process. (Chapter 4 Section 4.10.17)	-
To devise appropriate measures for protecting biodiversity;	Minimum hydrological requirements are considered through the eco-hydrology concept for protecting the biodiversity. (Chapter 4 Section 4.11.9)	-
To explore appropriate nature-based solution for solving flood, drainage and river bank erosion problem;	As eco-hydrology approach is considered for solving flood, drainage and river bank erosion problem as this approach leave its positive impacts on the agricultural, fisheries, ecological side. (Chapter 4 Section 4.11)	-
To develop option for enhancing water use efficiency and promote livelihood through improved productivity;	After completing the project surface water use can be increased effectively as water storage capacity will be increased in the khals. A total of 55,950 metric tons of crop production and 227 metric tons of fish production will be increased. With the improved productivity, poverty level will be reduced significantly with increase of 0.014% GDP within 2032. (Chapter 4 Section 4.7 and Section 4.10.18)	-
Prepare an Integrated Water Resources Management Plan (IWRMP).	Individual all sectors like water resources, agriculture, fisheries, biodiversity etc. are considered through the eco hydrology concept while the East Gopalganj Integrated Water Resources Management project is designed.	-

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 for the Study Project

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

03. Please give reasons for shortfall, if any, between the estimated and actual benefit: N/A

F. MONITORING AND AUDITING

Monitoring: Nil

Name & designation of the inspecting official	Date of Inspection	Identified Problems	Recommendations
1	2	3	4
(a) Ministry / Agency:	-	-	-
(b) IMED:			
(c) Others: (Please specify)			

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:

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

The East Gopalganj area is located within the floodplain of the Modhumati, Baghiyarkul, Shaildah, Ghagar river, and Madharipur Beel Route (MBR). The total area of the project is 88,127 ha and the net cultivable area (NCA) is 65,571 ha. Agriculture and Fisheries is the main income source of the people inside the project area. Major crops are rice, jute, mustard, lentils, wheat and vegetable.

Due to the historical formation through marine deposits, the land level in the project area is close to the sea surface. As a result, most of the area remains underwater throughout the monsoon season. Except in the periphery and some indiscriminate higher grounds cultivation during monsoon is rarely possible. On the other hand, during dry periods people cannot best utilize their lands for the scarcity of irrigation water. The crops cultivated on the periphery of the depression pockets are also vulnerable to early floods due to accumulated rainwater and flooding from the peripheral rivers. In certain areas spring tide salinity intrusion also damages standing crops before harvest. Due to slow drainage during the post-monsoon, the people cannot take advantage of the early plantation of rice crops.

On this backdrop, the Bangladesh Water Development Board (BWDB) is initiated to conduct a feasibility study for Integrated Water Resources Management Project for the East-Gopalganj Area. The proposed study will be focused on feasibility analysis, identification of strategic and sustainable/nature-based solutions to improve livelihood and socio-economic development.

The proposed project will be implemented in Gopalganj District Sadar, Tungipara and Kotalipara Upazilas of Gopalganj District. The people and area of the project area are mentioned in the table below:

Sl.No.	Upazilla Name	Gross area	Net area
1.	Gopalganj District Sadar	39,135	29,119
2.	Tungipara	12,787	9,514
3.	Kotalipara	36,205	26,938
	Total	88,127	65,571

The gross area is 88,127 hectares and the net cultivable land is 65,571 hectares. The Madhumati River flows through the south and west of the study area whereas the Ghagar and Shaildah rivers to the east and north, Kumar River to the north and MBR Channel to the north-west.

1.2 Justification/Adequacy

Linkage With Bangladesh Delta Plan (BDP), 2100

Bangladesh Delta Plan (BDP) 2100 is a water centric, multi sectoral techno-economic long term adaptive plan. Delta Vision and Goals show a broader scope (water, food, economy) leading to a holistic approach with 19 themes. Among those themes first two themes are directly related to Water resources. Those themes are-

- i) Morphological Dynamics & River Management
- ii) Water Resources

The Project will contribute to the implementation of the Bangladesh Delta Plan 2100 from technical aspect. The concept of the project is in line with BDP2100. Particularly, the Project contributes to the following goals, strategies and sub-strategies:

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;

- Increase the agricultural production by means of enhancing irrigation facilities and exploring the possibility of maximizing irrigation benefit;
- Resist salinity intrusion in the project area at present and future climate change condition;
- Protect the bank river against erosion of the Modhumati, Baghiarkul, Shyaldah river and Madaripur Beel Route (MBR) at the strategic locations;
- Improve the navigability of the rivers and khals in and around the study area;
- Alleviate poverty through livelihood improvement and enhancing agricultural and fish production;
- Minimize the adverse impact of interventions through environmental and social impact assessment (ESIA) and promote nature-based solution;
- To devise suitable option for increasing sustainability of the development through effective community participation;
- To devise appropriate measures for protecting biodiversity;
- To explore appropriate nature-based solution for solving flood, drainage and river bank erosion problem;
- To develop option for enhancing water use efficiency and promote livelihood through improved productivity;
- Prepare an Integrated Water Resources Management Plan (IWRMP).

1.4 Project revision with reasons: Not applicable

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

The project area is very low-lying and submerged in water during the monsoon season. As a result, crops are not produced in the monsoon season except in high places. On the other hand, the plantation of Aman rice is delayed due to slow drainage. During the dry season, there is a scarcity of irrigation water and saline water intruded into the area due to the lack of upstream freshwater.

Due to the low-lying area, pre-monsoon rainfall causes early floods almost every year which results in the damage of crops. In addition, crops are also damaged due to saline water intrusion. The fertility of soil is also hampered for saline water intrusion. Siltation of the rivers and khals reduces the drainage capacity and navigability of the rivers. It creates long-term waterlogging in the project area and delays its cultivation as rainfed arable land.

Besides, due to erosion of Madhumati, Baghiarkul, Shaildah and Ghaghar rivers and MBR channels at various places in the project area, various government and private establishments including roads, ghats, croplands, houses, mosques, temples and Manras are under threat. Due to damage of various water control structures (boatpasses / regulators / outlets / inlets) already constructed in the project area, flood and saline water enters the agricultural land causing severe damage to crops due to ineffective drainage system.

In this context, it is necessary to protect flood and riverbank erosion, enhance drainage, river navigability and ensure irrigation water availability through an integrated water management project.

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

◆ Project Identification:

Considering monsoon flooding, delayed rice plantation, dry season water scarcity, saline water intrusion, pre-monsoon floods, siltation and reduced drainage capacity, erosion threats, damaged water control structures etc. Challenges and the need to protect against them, it has been deemed necessary to initiate an integrated water management project in the area. This project aimed to address these issues comprehensively and create a sustainable solution for the region's agricultural and environmental needs.

◆ **Project Preparation:**

◆ **Appraisal:**

Appraised on Departmental Project Evaluation (DPEC) meeting held on 16/02/2022 at Ministry of Water Resources. (Annexure-2)

◆ **Credit Negotiation:** N/A

◆ **Credit Agreement:** N/A

◆ **Credit Effectiveness:** N/A

◆ **Loan Disbursement:** N/A

◆ **Loan Conditionalities:** N/A

◆ **Project Approval:** Approved by Honorable State Minister, MoWR on 21/04/2022. (Annexure-3)

◆ **Others (if any):** N/A

4. Analysis of the Post-Implementation situation and result of the project: Not applicable for this study project

- 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): It is a consultancy service procurement project. The below mentioned problems do not occur.

- | | |
|------------------------|---|
| 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 | |

7. Remarks/Comments of Agency Head

The overall objectives of the project are to enhance the socio-economic condition of East Gopalganj area by means of integrated development. The implementation of interventions of this study will preserve biodiversity and eco-friendly in nature. The infrastructure proposed by the consultant is rational and aligned with the broad goals of the Bangladesh Delta Plan 2100. The result of economic analysis indicates that the project is economically viable, as it secures a rate of return that exceeds 12%. Upon implementation of the suggestive measures, long-term perspective of the sustainable and inclusive socio-economic growth may be achieved.

Date: 03/12/2023

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

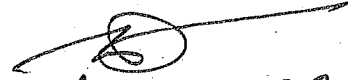
8. Remarks/Comments of the officer in- charge of the Ministry/Division

Bangladesh Water Development Board engaged Centre for Environmental and Geographic Information Services for detailed study to devise a plan for integrated water resources management of east Gopalganj. The consultant has investigated the problem of the area and suggested necessary measure. It is recommended to prepare DPP following the recommendations of the study project.

Date:

Signature and seal

Approved



22.06.2023

(Md. Romjan Ali Pramanik)
Director General
BWDB, Dhaka.

Final Report

on

**Detailed Study for East Gopalganj Integrated
Water Resources Management Project**

Executive Summary

East Gopalganj, with an area of 88,127 ha, consists of Tungipara, Kotalipara, and Gopalganj Sadar (partly) Upazilas, which is located within the floodplains of the Modhumati, Baghiyarkul, Shyaldhah, Ghagor Rivers, and Madharipur Beel Route (MBR). The area is a naturally depressed and consequently, remains mostly underwater throughout the monsoon. As a result, except in some high places, crops are not usually grown during the monsoon. On the other hand, the crops cultivated on the periphery of the depression pockets are also vulnerable to early floods. Besides, due to slow drainage during post-monsoon, the people cannot take advantage of the early plantation of rice crops. Damage of various water control structures in the project area results in flooding and salinity intrusion into the agricultural land causing further damage to crops.

Bangladesh Water Development Board (BWDB) is conducting a detailed study for Integrated Water Resources Management for the East-Gopalganj Area. The study will be focused on feasibility analysis, identification of strategic and sustainable/nature-based solutions to improve livelihood and socio-economic development of the area.

State-of-the-art mathematical modelling, remote sensing and GIS tools and techniques have been utilized to assess the physical condition and thereby devise solutions incorporating IWRM concept. The land elevation of the study area ranges between 0.00 to 6.00 msl PWD with an average elevation of 1.7 msl. A large portion of the area is very low lying with permanent water bodies and rivers. About 75 % of the land of the study area has an elevation below 2 msl. Two BMD stations namely Madaripur (79%) and Khulna (21%) influences the study area where monthly average rainfall varies from 157.6 mm to 378.3 mm in monsoon. All of the peripheral and internal khals and rivers have tidal influences that carries both silt and salinity. Water level in BWDB WL station named Offtake of Atharobanki over Madhumati river where average monthly maximum water level varies from 0.7m to 4.53m PWD and the minimum WL varies from -0.16m to 3.62m PWD. Inside the project area, most of the beel areas are submerged under water over 8 months and are treated as single cropped area where Boro rice is produced in the dry to pre-monsoon season. In East Gopalganj, majority portion of the land is single cropped, 30% of the area is double cropped and only a few portion is triple cropped. The dominant cropping pattern of the Gopalganj Sadar area is Fallow-Fallow-HYV Boro, practiced in about 63.04% of the NCA followed by Fallow-B. Aman-HYV Boro crop in about 18.69% of the NCA. Besides, significant amount of fallow land both permanent (1869 ha) and temporary (2475 ha) are existing.

An inventory survey was conducted to identify the existing water related sub-projects, interventions, structures, rivers/ khals and beels. Currently, there are five sub-project of BWDB inside the project area, namely,

- Tarail-Pachuria sub-project (67 structures and 187 km embankment)
- Salta Bagda sub-project (59 structures and 36 km embankment)
- Ramsil-Kafulabari sub-project (6 structures and 37 km embankment)
- Rajoir-Kotalipara sub-project (6 structures and 20 km embankment)
- Madaripur beel route System (8 structures and 27 km embankment).

In the study area, there are 25 regulators with boat pass and 67 regulators without boat pass, and 307 km of flood control embankment. A total of 462 nos. khals have been identified with a total length of 902 km. In addition, river cross-section, topography, water level and other data and information have been collected from field survey and secondary sources. Five (5) water level gauges have been installed to collect water levels at 3-hour intervals. To understand the problems and issues of the

SL	Khal/Location name	SL	Khal/Location name
5	Tarail Bazar	15	Petkata Khal
6	Fanakhali Khal	16	Khejurbari
7	Fokir Bari	17	Bhanger Hat Bazar
8	Outfall of Kedar Khal	18	Noiyer Bari
9	Vennabari Purbapara	19	Kacharivita
10	Borashi Bazar	20	Mandar Khal
21	Kuciyamora	22	Madhya Tungipara Purbo Tungipara Khal
23	Patgati Sardarpara Khal	24	Pathuria Khal Boatpass

Replacement of 1 regulator with boat passes located in gazir khal for efficient drainage and improved navigability. River bank protection works of 9.08 km and details are given below:

SL	Location	River Name	Upazilla Name	Erosion Zone length (m) According to BWDB
1	Manikdah	MBR	Gopalganj Sadar	1.60
2	Gobra Erosion	Modhumati River	Gopalganj Sadar	1.22
3	Dattar Gate Adjacent Bashuria Borni	Bhagiyar River	Tungipara	0.50
4	Gojalia Erosion	Bhagiyar River	Tungipara	0.36
5	Narayankhali	Shailadaha River	Tungipara	1.20
6	Lebutoli Bridge LB	Shailadaha River	Tungipara	1.74
7	Munshipara	Bhagiyar River	Tungipara	2.47
Total length				9.08

Repair of Existing 83 Nos. of existing structure to regain the full functionality of structures. Around 57.96 km inspection dyke will be built in the number of khal's bank that are located in Tungipara. To develop the road connectivity system in Polder 3 and Polder 4 of Tarail Panchuria sub-project, construction of single bank inspection dyke is considered. A total of 18 Nos. of outlets will be constructed in Tungipara and Gopalganj Sadar in order to quick and ease drain of the logged water from particular specific beel locations. Among these 16 Nos lies in Tungipara and Kotalipara; whereas remaining two (02) Nos. in Gopalganj Sadar. Total costing to implement the interventions is BDT 89619.62 lac. However, during the implementation of the project, the may slightly increase considering the updated rate of schedule.

The East Gopalganj area is also ecologically very enriching for fish resources and ecosystem services. The wetlands of the area support the floral and faunal life to sustain ecological services. The extent of flood areas during dry and wet seasons is very important for crops and aquatic fauna. Fish and other aquatic flora and fauna have a high dependency on water flow and wetland area and a minimum amount of depth is required during the dry season for its survival. The design water level inside the project area for the different seasons have been selected considering fisheries, ecological, and agricultural water requirements. The optimum water level has been used for the design of regulator's sill levels, opening and requirement of khal re-excavation to ensure a balance between agricultural crop production and the natural ecosystem of the area.

The East Gopalganj project area will be benefitted from the proposed interventions for improving drainage, irrigation, navigability, salinity intrusion protection, and riverbank protection through proposed sustainable and environmentally friendly structures. By implementing the interventions, production in the primary industries, such as agriculture and fishing, will be significantly increased.

11. Conclusions and Recommendations

11.1 Conclusions

The East Gopalganj area is a naturally depressed area and located within the floodplain of the Modhumati, Baghiyarkul, Shyaldhah, Ghagor River, and Madharipur Beel Route (MBR) and these rivers are interconnected with numerous small khals and canals. The total area of the project is 88,127 ha consists of Tungipara, Kotalipara, and Gopalganj Sadar (partly) Upazilas and the net cultivable area (NCA) is 65,571 ha inside the project area. The total population of the project area is 648,421. Agriculture and Fisheries is the main income source of the people inside the project area. Major crops are rice, jute, mustard, lentils, wheat, and vegetable. During the monsoon season, the project area is particularly low-lying and immersed in water, the wetlands gets flooded with the tidal water and the wetlands become the habitat for fishes. As a result, except in high places, crops are not grown during the monsoon season.

As topographically, the project area low-lying area, the study area remains the majority of the monsoon season underwater. Because of this, crops are usually not planted during the monsoon, with the rare exception of a few highlands. On the other hand, crops grown outside these depression pockets are similarly susceptible to early floods. Additionally, the locals are unable to benefit from the early rice crop planting because of delayed drainage during the post-monsoon. Flooding and saline intrusion into the agricultural land caused by damaged water control structures in the project region further harm crops. People cannot make the most of their lands during dry periods due to a lack of irrigation water. In some places, saline intrusion caused by spring tides destroys standing crops before harvest. The locals are unable to benefit from the early rice crop planting because of the poor drainage during the post-monsoon. Flood and saline water penetrates agricultural land through damaged water control infrastructure (boat passes, regulators, outlets, and inlets) already built in the project area, severely damaging crops due to an inadequate drainage system.

The dominant cropping pattern of the Gopalganj Sadar area is Fallow-Fallow-HYV Boro, practiced in about 63.04% of the NCA followed by Fallow-B. Aman-HYV Boro crop in about 18.69% of the NCA. Estimated total annual fish production is about 22,942 Metric Ton (MT) inside the project area. The Rice crop area of the project area would be increased by about 30% after the successful intervention of the project phase by phase. A total of 55,950 metric tons of crop production would be increased from the project area, which is about a 26% increase from the baseline crop production. The project area covers three upazilas of Gopalganj and 32 unions where it is expected that livelihood of 613,815 people will be improved through the proposed interventions.

The main considerations in formulating the mitigation measures are to protect the proposed area from flooding. The proposed measures include re-excavation of khal around 552.65 km (218 khals), 24 Nos. boatpass cum gated weir to protect area from slow drainage, 1 Nos. of structures replacement with Boatpass, 81 Nos. of structures to be repaired, Total 9.08 km bank protective works, around 57.96 km inspection dyke, construction of 18 Nos outlets.

Multi-Criteria Analysis (MCA) showed that Option-2 is the best choice among the three options. It is considered the protection of the Boro crop. This option focuses on fully protecting Boro crops. To protect the Boro crop, water will be allowed to enter during monsoon. But during the season of Boro cultivation, the flood water will be receded to prepare the land for cultivation. So drainage of water needs will be ensured. This will be an eco-friendly solution and biodiversity will prevail here as the existing natural process will not be hampered. However, agriculture production will decrease as only one crop (Boro) is intended here to protect from flooding. Based on a thorough analysis supported

