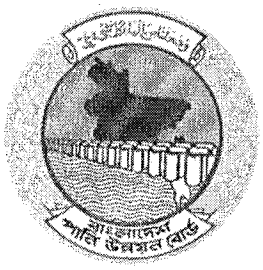
Government of the People's Republic of Bangladesh

Ministry of Water Resources



Bangladesh Water Development Board

PROJECT COMPLETION REPORT: IMED 04/2003

For

Feasibility Study for Rehabilitation of Barisal Irrigation Project (BIP)

November, 2022

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**	:	Feasibility Study for Rehabilitation of Barisal Irrigation Project (BIP) (Project Code: 224338200)
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 main objective of this study is to provide technical support by applying modern technique for rehabilitation of Barisal Irrigation Project (BIP) with a view of restoring agricultural production and Command Area Development. The study shall specially address the suitability of project design, change in land use, irrigation improvement based on mathematical model result. All necessary initiatives would be taken for rehabilitating the project and impart better irrigation facilities with adequate drainage. It is expected that any structure in addition to the existing ones, on requirement, would be presented under the recommendations of this consultancy service along with replacement, remodelling or repair of existing structural interventions.

Component of the Project:
The study is organized in two components for sake of clarity and easily understanding of the works. Component-1 will address the cross-section survey, hydrological measurement and mathematical modelling techniques. Component-2 will address the ESIA study.
Component-1: Mathematical Modelling Study for Feasibility Study for Rehabilitation of Barisal Irrigation Project (BIP)
Component-2: ESIA Study for Feasibility Study for Rehabilitation of Barisal Irrigation Project (BIP)
The specific objectives are as follows:

Component-1: Mathematical Modelling Study for Feasibility Study for Rehabilitation of Barisal Irrigation Project (BIP)

- To identify present situation of the existing irrigation facilities and drainage system;
- To investigate performance of all structural components and reason behind malfunctioning of the interventions constructed during the commencement of the irrigation projects using the mathematical model and field investigation;
- Examine the effectiveness of existing pump houses and the necessity of replacement/remodelling of pump houses and the necessity of new pump houses;
- Expand irrigation facilities for better water resources management based on the availability of surface water resources;
- Chalk out all remedial measures to restore irrigation facilities, to attain expected drainage service and increase of crop yield with assessment of need to new structures, replacements of non-functioning ones and remodelling of inadequate facilities;

- To identify the structural interventions and nonstructural (i.e. nature based solutions) for functioning and modernization of Barisal Irrigation Project.
- To provide detail design of the proposed interventions and pump houses;
- Detail investigation of power source to run the pump including bill payment system.
- To find out innovative solutions for the best utilization of water.
- Demarcation of the existing acquired land/disputed land (if any) on CS/RS map under BIP project.
- To estimate the detail cost of the project including economic and financial analysis to acquire the extended project outcomes.

Component-2: ESIA Study for Feasibility Study for Rehabilitation of Barisal Irrigation Project (BIP)

- To provide a consistent and common basis for the application of ESIA to protect environment by ensuring that the project is environmentally sound.
- Identifying, quantifying and evaluating the potential environmental consequences so that the impacts before implementation of the project & impacts of the projects are highlighted. The negative impacts would be addressed in a way conserving the society and environment.
- Ensure that all development with full consideration for economic and environmental optimization, and for a long-term sustainability and equitability of environmental resource conservation.
- Establish the environmental and social baseline conditions of the specified project;
- To develop multi-stakeholder oriented and eco-friendly implementation and management plan
- Select important environmental and social components presently being impacted and of course likely to be addressed by the proposed interventions;
- Assess environmental and social impacts of proposed project interventions;
- Prepare an Environmental Management Plan (EMP) which should include mitigation measures, enhancement measures, compensation measures and an environmental monitoring plan;

06. Estimated Cost:

(In lakh Taka)

	Original	Latest Revised
(a) Total	495.64	-
(b) Taka	495.64	-
(c) Foreign Currency	-	-
(d) Project Aid	-	-
(e) RPA	-	-

07.

Date of Approval	:	**PCP/PFS**	**PP**
(a) Original	:	**01/08/2021**	-
(b) Latest Revised	:	-	-
(c) No cost Time extension	:	-	-

08. Implementation Period :

	Date of Commencement	Date of Completion
(a) Original	August, 2021	June, 2022
(b) Latest Revised	-	-
(c) Actual	August, 2021	June, 2022

09. Financing Arrangement (Source-wise):

9.1 Status of Loan/Grant

a) Foreign Financing :

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
495.64	-	495.64	-

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 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 PFS		Actual Implementation period	Time Over-run (% of original implementation period)	Remarks
Original	Latest Revised			
1	2	3	4	5
August, 2021 to June, 2022 (11 months)	-	August, 2021 to June, 2022 (11 months)	-	-

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	495.64	-	478.82	-	-
TAKA	495.64	-	478.82	-	-
PA	-	-	-	-	-

03. Project Personnel:

Sanctioned strength as per PPF	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	-	-	-	11	0
Staff(s)	11	-	-	-	6	5
Total:	22	Existing Manpower of Directorate of Planning-1, BWDB			17	5

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 PP)	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 53.00MM) for Component-1	Lot	335.55	100.00%	334.95	100.00%	
Feasibility Study (Local professionals 24.00MM) for Component-2	Lot	145.84	100.00%	138.32	100.00%	
Stamps and seals	Lot	0.10	100.00%	0.00	0.00%	

Items of work (As per PP)	Unit	Target (as per PFS)		Actual Progress		Reasons for deviation (±)
		Financial	Physical (Quantity)	Financial	Physical (Quantity)	
1	2	3	4	5	6	7
Other stationery	Lot	0.25	100.00%	0.24	100.00%	
Honorarium	Lot	5.00	100.00%	2.42	48.47%	
Domestic travel expenses	Lot	3.00	100.00%	0.00	50.00%	
Fuel and Gas	Lot	1.00	100.00%	0.00	20.00%	
Petrol, Oil and Lubricants	Lot	1.00	100.00%	0.00	20.00%	
General Supplies	Lot	0.40	100.00%	0.39	100.00%	
Entertainment Expenses	Lot	1.00	100.00%	0.00	0.00%	
Capital Expenditure						
Digital Photocopier	Lot	2.50	100.00%	2.50	100.00%	
Total=		**495.64**	**100.00%**	**478.82**	**98.63%**	

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 Superintending Engineer (Civil) Directorate of Planning-1 BWDB, Dhaka Grade-4 (50,000 to 71,200)	Full time	-	Yes	26/08/2021	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	-	-	-	-	-	-
Others with name	-	-	-	-	-	-

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 Service for "Mathematical Modelling Study for Rehabilitation of Barisal Irrigation Project (BIP)"	335.55	334.95	10/08/2021	02/09/2021	30/06/2022	30/06/2022
Consultancy Service for "ESIA Study for Feasibility Study for Rehabilitation of Barisal Irrigation Project (BIP)"	145.84	142.89	10/08/2021	01/09/2021	30/06/2022	30/06/2022

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:				
• Mathematical Modelling Study	53.00	53.00	53.00	Conducted by Institute of Water Modelling
• ESIA Study	24.00	24.00	24.00	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
Digital Photocopier	1 Nos	1 Nos Date: 16/06/2022	-	-	1 Nos	Being used in Directorate of Planning-1, BWBD, Dhaka

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 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	495.64	495.64	-	100.00%	-	-	-	-
Total	495.64	495.64	-	100.00%	-	-	-	-

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	495.00	495.00	-	100.00%	494.50	478.82	478.82	-	98.63%
Total	495.00	495.00	-	100.00%	494.50	478.82	478.82	-	98.63%

D. ACHIEVEMENT OF OBJECTIVES OF THE PROJECT:

Objectives as per PFS	Actual achievement	Reasons for shortfall, if any
Obejctives of Mathematical Modelling Study:		
To identify present situation of the existing irrigation facilities and drainage system;	Physical condition of existing structure of each pump house has been investigated during field visit (Chapter-4). The findings of the investigations are as follows: • Raising of the bank of the canal is required for gravity irrigation. • In most cases, the offtake structure found damages. Renovation works is required for proper functioning. • Gate seals are all damaged and need replacement. • Painting of the existing steel gate is required. • New gate hoisting equipment for each pump house is required. • New gates are required during first phase of rehabilitation. • The pump houses are found in good condition. Renovation works (plastering, painting, new door and window and cleaning of roof) has been proposed.	-

Objectives as per PFS	Actual achievement	Reasons for shortfall, if any
	• New roof construction for two pump houses (KP-5 and KP-11) is proposed because the existing roof is made by tin. • Most of the cases the discharge and pumping chamber as well as the intake canal is badly silted up. • The condition of the motor is not found in good condition. • Most of the cases the electric panel board is not available, and the existing panel board is not in good condition. • Flood inundation map of the study area has been prepared to check the drainage condition and no major drainage congestion is observed (section 6.3.6)	
To investigate performance of all structural components and reason behind malfunctioning of the Interventions constructed during the commencement of the irrigation projects using the mathematical model and field investigation;	Several field visits have been made to check the physical condition of the existing structure. A mathematical model has been developed based on field survey data to estimate the water availability and water level at each pump location. The mathematical model also used to check whether the proposed FSL will attain or not. (Chapter 4, 6 and 8)	-
Examine the effectiveness of existing pump houses and the necessity of replacement/remodelling of pump houses and the necessity of new pump houses;	Effectiveness of existing pump houses has been investigated based on present as well as future possibility of urbanization, public demand, availability of pump and existence of the pump houses (Section 7.4). The outcomes are as follows: • Total 39 nos. of pump houses have been selected for rehabilitation during first phase • Total 28 nos. of pump houses have selected for rehabilitation during second phase • The remaining 11 nos. of pump houses has not selected for modification Pump efficiency test have been conducted which shows that the pump is in running condition (Section 7.3)	-
Expand irrigation facilities for better water resources management based on the availability of surface water resources;	Surface water availability has been assessed at each pump house location through mathematical modelling technique. It is found that sufficient water is available at each pump house location to meet the irrigation demand (Section 8.1.1 and 8.1.2) Possibility of irrigation expansion for Banaripara Upazila has been investigated.	-

Objectives as per PFS	Actual achievement	Reasons for shortfall, if any
	Two command area has been demarcated for future irrigation expansion. Four number of pump houses has been proposed for this purpose. The estimated command area for proposed irrigation expansion area is 930ha. (Chapter 10)	
Chalk out all remedial measures to restore irrigation facilities, to attain expected drainage service and increase of crop yield with assessment of need to new structures, replacements of non-functioning ones and remodelling of inadequate facilities;	Remodelling and renovation of pump houses, offtake structure and check structure has been proposed to restore irrigation facilities as well as to increase the crop yield (Chapter-7).	-
To identify the structural interventions and nonstructural (i.e. nature based solutions) for functioning and modernization of Barisal Irrigation Project.	Structural interventions have been proposed for functioning and modernization of BIP as follows (Chapter-7): • Raising of the banks of the main canal by 0.5m to 1.0m • Re-excavation of intake canal • Modification (raising by 0.5m to 1.0m) of 19 nos. of pump houses and associated offtake structure • Renovation works for 39 nos. of offtake structure • A total 63 nos. of new steel gates have been proposed. Painting and new gate seal has been proposed. • Construction of 123 nos. of check structure. • Construction of apron of offtake structure. • Renovation and modification of 198 nos. of check structure. • Construction of 942 nos. of turnout • Renovation of 39 nos. of pump houses • Dismantle of diesel accessories • Cleaning of pumping and discharge chamber • Replacement of existing primary diesel engine with 42 nos. electric motor • Electrification for 24 nos. of pump houses • New electric panel board for 39 nos. of pump houses • An automated pump operating system has been proposed for 6 nos. of pump houses	-
To provide detail design of the proposed interventions and pump houses;	Detail design of the proposed intervention has been conducted (Volume III and IV). The design includes:	-

Objectives as per PFS	Actual achievement	Reasons for shortfall, if any
	• Modification of pump houses and offtake structure • Construction of new check structure, turnout and dyke. • Roof design • Wheel system for gate operation • Replacement of existing primary diesel engine with electric motor • Control panel	
Detail investigation of power source to run the pump including bill payment system.	The existing condition of the power sources has been investigated (Section 7.6.13). The outcomes have been presented as below: • Total 24 nos. of pump house need electrification.	-
To find out innovative solutions for the best utilization of water.	An automated pump operating system called SCADA has been proposed for 6 nos. of pump houses under this study which will help to ease the run the irrigation project efficiently (Chapter-7).	-
Demarcation of the existing acquired land/disputed land (if any) on CS/RS map under BIP project.	Demarcations of the existing acquired land/disputed land has been conducted based on mouza maps available from field office (Chapter-9).	-
To estimate the detail cost of the project including economic and financial analysis to acquire the extended project outcomes.	Detail costing of the proposed intervention has been estimated (Chapter-11) • Total project cost of the proposed intervention is 37089.59 Lakh BDT considering existing pump. • Total cost of the proposed interventions is 41067.83 Lakh BDT considering replacing the existing pump with new pump.	-
Obejctives of ESIA Study:		
To provide a consistent and common basis for the application of ESIA to protect environment by ensuring that the project is environmentally sound.	The project objectives and relevant interventions to fulfill the objectives were disseminated through a public consultation, FGD etc. and provided in Chapter 8. Received suggestions from them to improve /modify interventions for socio-economic upgradation and environmental sustainability. Also received their opinion about IESCs, thereafter prepared EMP for ensuring the sustainability of the project, which are provided in Chapter 6 and Chapter 9 respectively. Besides, overall ESIA study was conducted following the Guideline for Environmental Assessment of Water Management Projects (WARPO, 2005), of which detail methodology is described in Chapter 3.	-

Objectives as per PFS	Actual achievement	Reasons for shortfall, if any
Identifying, quantifying and evaluating the potential environmental consequences so that the impacts before implementation of the project & impacts of the projects are highlighted. The negative impacts would be addressed in a way conserving the society and environment.	Environmental and social impacts for both before and after the implementation of the project have been identified and provided in Chapter 7. In the Chapter 9, mitigation measures are suggested to mitigate negative impacts; whereas an enhancement plan is provided for the positive impact.	-
Ensure that all development with full consideration for economic and environmental optimization, and for a long-term sustainability and equitability of environmental resource conservation.	All development plans are formulated by considering economic and environmental optimization, and long-term sustainability and equitability of environmental resource conservation.	-
Establish the environmental and social baseline conditions of the specified project;	In the Chapter 5, environmental and social baseline conditions have been established based on collection of data from primary sources as well as using references from reliable secondary sources.	-
To develop multi-stakeholder oriented and eco-friendly implementation and management plan	The multi-stakeholder oriented and eco-friendly implementation and management plan has been developed following environmental guidelines and are provided in Chapter 9.	-
Select important environmental and social components presently being impacted and of course likely to be addressed by the proposed interventions;	Important environmental and social components presently being impacted and are likely to be impacted by the proposed interventions have been selected and provided in Chapter 6.	-
Assess environmental and social impacts of proposed project interventions;	Environmental and social impacts have been assessed and provided in Chapter 7.	-
Prepare an Environmental Management Plan (EMP) which should include mitigation measures, enhancement measures, compensation measures and an environmental monitoring plan;	Environmental management plan has been prepared and provided in Chapter 9.	-

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
01/09/2022-07/09/2022	-	No objections arisen	-

G. DESCRIPTIVE REPORT

1. General Observations/Remarks of the Project on:

1.1 Background

Barisal Irrigation Project (BIP) was implemented in the period of 1975-1985 with the financial aid from the World Bank. The project was implemented in two phases. The first phase was completed in 1980 which was comprised Barisal Sadar, Babuganj Upazilla in Barishal District and Jhalakathi and Nalchiti Upazilla in Jhalkhathi District. The second phase was completed in 1985 comprising of the Bakerganj in Barishal District, Rajapur and Kawkhali Upazilla in Pirozpur District. 78 no. of pump houses along with 1,132 km.

of irrigation canal and 506 no. of sluices were constructed under the two phases of the project. Gross area of the project was 1, 48,573 ha and net cultivable area was 1,06,883 ha. Following project completion, irrigation water was supplied by double lifting method using diesel operated pumps. However, due to high operation cost, irrigation was almost stopped in 1990. Afterwards, 18 pump houses were rehabilitated and operated with electricity. After that due to high elevation difference between the canal bed level and crop field, irrigation facilities could not be provided properly. As a result, field irrigation is being provided on limited extent using single lifting gravity flow mechanism.

The feasibility study of the BIP was conducted during 1972-1975. The land-use pattern, cultivation/crop pattern, natural water supply, social status of the residents, etc. have been significantly changed over the years. During the decade of 1990, water way was the main transportation mode for inspection. Now, most of the navigational routes are disappeared. As a result, accessibility to the pump houses is very low and the operation and maintenance work is very difficult. A paradigm shifts in planning, design and as well as operation and maintenance are mandatory to make this project fruitful again.

1.2 Justification/Adequacy

Linkage with Sustainable Development Goal (SDGs)

Goals of SDGs	Targets to be attained under the project
Goal: 1 End poverty in all its forms everywhere	• The project will help to eradicate extreme poverty
Goal 2. End hunger, achieve food security and improved nutrition and promote sustainable agriculture	• The project will help to increase agricultural productivity and incomes of small-scale food producers, in particular women, indigenous peoples, family farmers, pastoralists and fishers, including through secure and equal access to land, other productive resources and inputs, knowledge, financial services, markets and opportunities for value addition and non-farm employment • The project will help to ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters and that progressively improve land and soil quality.
Goal 6. Ensure availability and sustainable management of water and sanitation for all	• The project will help substantially increase water-use efficiency • The project will help to implement integrated water resources management at all levels • The project will help to Support and strengthen the participation of local communities in improving water and sanitation management
Goal 11. Make cities and human settlements inclusive, safe, resilient and sustainable	• The project will help substantially increase the number of cities and human settlements adopting and implementing integrated policies and plans towards inclusion, resource efficiency, mitigation and adaptation to climate change, resilience to disasters, and develop and implement, in line with the Sendai Framework for Disaster Risk Reduction 2015-2030, holistic disaster risk management at all levels
Goal 13. Take urgent action to combat climate change and its impacts	• Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries

Goals of SDGs	Targets to be attained under the project
	• Improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning.

Linkage with Bangladesh Delta Plan-2100 (BDP-2100)

Goals of BDP-2100	Targets to be attained under the project
Higher Level Goals Goal 1: Eliminate extreme poverty by 2030;	• The project will help to eradicate extreme poverty
BDP-2100 Specific Goals Goal 2: Enhance Water Security and efficiency of water usages;	• The project will help substantially increase water-use efficiency
Strategies for Cross-Cutting Issues **2) Agriculture, Food Security, Nutrition and livelihoods** • Increasing resilience of agricultural production systems; • Diversification in agricultural output and livelihoods;	• The project will help to increase resilience of agricultural production systems; • The project will help in diversification in agricultural output and livelihoods;

1.3 Objectives

The main objective of this study is to provide technical support by applying modern technique for rehabilitation of Barisal Irrigation Project (BIP) with a view of restoring agricultural production and Command Area Development. The specific objectives are as follows:

- To identify present situation of the existing irrigation facilities and drainage system;
- To investigate performance of all structural components and reason behind malfunctioning of the Interventions constructed during the commencement of the irrigation projects using the mathematical model and field investigation;
- Examine the effectiveness of existing pump houses and the necessity of replacement/remodelling of pump houses and the necessity of new pump houses;
- Expand irrigation facilities for better water resources management based on the availability of surface water resources;
- Chalk out all remedial measures to restore irrigation facilities, to attain expected drainage service and increase of crop yield with assessment of need to new structures, replacements of non-functioning ones and remodelling of inadequate facilities;
- To identify the structural interventions and nonstructural (i.e. nature based solutions) for functioning and modernization of Barisal Irrigation Project.
- To provide detail design of the proposed interventions and pump houses;
- Detail investigation of power source to run the pump including bill payment system.
- To find out innovative solutions for the best utilization of water.
- Demarcation of the existing acquired land/disputed land (if any) on CS/RS map under BIP project.
- To estimate the detail cost of the project including economic and financial analysis to acquire the extended project outcomes.
- To provide a consistent and common basis for the application of ESIA to protect environment by ensuring that the project is environmentally sound.

- Identifying, quantifying and evaluating the potential environmental consequences so that the impacts before implementation of the project & impacts of the projects are highlighted. The negative impacts would be addressed in a way conserving the society and environment.
- Ensure that all development with full consideration for economic and environmental optimization, and for a long-term sustainability and equitability of environmental resource conservation.
- Establish the environmental and social baseline conditions of the specified project;
- To develop multi-stakeholder oriented and eco-friendly implementation and management plan
- Select important environmental and social components presently being impacted and of course likely to be addressed by the proposed interventions;
- Assess environmental and social impacts of proposed project interventions;
- Prepare an Environmental Management Plan (EMP) which should include mitigation measures, enhancement measures, compensation measures and an environmental monitoring plan;

1.4 Project revision with reasons: Not applicable

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

The condition of the canals has changed a lot more than ever before. Regulators have been built in the canal areas that are currently unused. Due to the lack of regulatory sluice in the required areas of irrigated land for irrigation in the Gravity Flow system, every year, irrigation is made by the local farmers and water supply is provided to the fields. The area from which the soil is cut for irrigation, it is wasted, and at the end of the irrigation season, the soil is washed away to maintain the normal flow of water. Every year, a lot of land and soil is wasted to create and cut barriers.

RL of high and low land under a pump house due to the absence of gravity flow method, the lower lands need to be constructed on two sides of the canal to protect the lower lands from drowning. Also, to reach the water in the Gravity Flow, different tertiary canals are required to be constructed and the construction of regulator/sluice is required.

In the past, water was the main mode of transportation for pump houses. Currently the route is closed on most of the canals, many have no access to the pump house. To travel to those pump houses, one has to go through the footpath, bridge made of bass, through the jungle, crossing the pond, through the man's house, etc. As a result, roads, culverts, etc. are needed to transport goods to the pump houses. Which may require acquisition of land.

In the meantime, all the Pump houses and canals under the Barisal Irrigation Project have to be rehabilitated in an electric motor driven single-lifting gravity flow irrigation system, with pumping houses that have already been merged into the river, but there is still a need for shifting houses. There is no need for irrigation of the people of the area under the pump house Determined through discussions with local farmers and public representatives, areas that are not currently under irrigation but demand local irrigation facilities can be covered under irrigation, some regulators need to be relocated, some regulators have to be rebuilt, where to build a new regulator, RL of the land accordingly, determining where to construct the dyke along the canal, determining where and how many roads and culverts should be constructed, performing surveys, collecting design data, preparing designs, etc. is very important for them. The study has recommended the optimum solution which is technically sound, socially acceptable and economically viable.

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

- **Project Identification:**

Barisal Irrigation Project (BIP) was implemented in the period of 1975-1985 with the financial aid from the World Bank. The project was implemented in two phases. The first phase was completed in 1980 which was comprised Barisal Sadar, Babuganj Upazilla in Barishal District and Jhalakathi and Nalchiti Upazilla in Jhalkhathi District. The second phase was completed in 1985 comprising of the Bakerganj in Barishal District, Rajapur and Kawkhali Upazilla in Pirozpur District. 78 no. of pump houses along with 1,132 km. of irrigation canal and 506 no. of sluices were constructed under the two phases of the project. Gross area of the project was 1, 48,573 ha and net cultivable area was 1,06,883 ha. Following project completion, irrigation water was supplied by double lifting method using diesel operated pumps. However, due to high operation cost, irrigation was almost stopped in 1990. Afterwards, 18 pump houses were rehabilitated and operated with electricity. After that due to high elevation difference between the canal bed level and crop field, irrigation facilities could not be provided properly. As a result, field irrigation is being provided on limited extent using single lifting gravity flow mechanism.

The feasibility study of the BIP was conducted during 1972-1975. The land-use pattern, cultivation/crop pattern, natural water supply, social status of the residents, etc. have been significantly changed over the years. During the decade of 1990, water way was the main transportation mode for inspection. Now, most of the navigational routes are disappeared. As a result, accessibility to the pump houses is very low and the operation and maintenance work is very difficult. A paradigm shifts in planning, design and as well as operation and maintenance is mandatory to make this project fruitful again.

- **Project Preparation:**

A technical committee headed by Superintending Engineer (Civil), Design Circle-3, BWDB, Dhaka was formed for necessary recommendation to prepare DPP for rehabilitation the project. The committee visited the project area and recommended for detail feasibility study for sustainability and detail design, and so the study project was prepared accordingly.

- **Appraisal:**
  Apprised on Departmental Projecr Evaluation (DPEC) meeting held on 25/05/2021 at Ministry of Water Resources

- **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 01/08/2021.
- **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**
- **5.2 Project Director**
- **5.3 Land Acquisition**
- **5.4 Procurement**
- **5.5 Consultancy**
- **5.6 Contractor**
- **5.7 Manpower**
- **5.8 law & Order**
- **5.9 Natural clamity**
- **5.10 Project financing, allocation and release.**
- **5.11 Design formulation/approval**
- **5.12 Project aid disbursement and re-imbursment**
- **5.13 Mission of the development partners.**
- **5.14 Time & Cost Over-run**
- **5.15 Project Supervision/Inspection**
- **5.16 Delay in Decision**
- **5.17 Transport**
- **5.18 Training**
- **5.19 Approval**
- **5.20 Others.**

6. **Remarks & Recommendations of the Project Director**

"Feasibility Study for Rehabilitation of Barisal Irrigation Project (BIP)" was sanctioned in administrative approval from Ministry of Water Resources given vide memo no: 42.00.0000.042.14.060.16-169, dated: 01/09/2022. The project was planned to be completed by 30/06/2022 and has been completed successfully within planned duration.

The first phase of the BIP was implemented in 1980 and the second phase was implemented in 1985. Irrigation was provided by 81 nos. of diesel operated pumps (78 nos. of pump houses) at different location. Double lifting irrigation method was used. Initially, the primary pumping of BIP was subsidized. The subsidized

system was withdrawn in 1989-90 and farmers are reluctant to cultivate the land due to high irrigation cost of double lifting irrigation method. Later, 18 pump houses have been modified to converted into full gravity system irrigation and 12 pump houses have been modified to partial gravity system irrigation. The feasibility study of the BIP was conducted during 1972-1975. The land-use pattern, cultivation/crop pattern, natural water supply, social status of the residents, etc. have been significantly changed over the years. Considering the facts BWDB engaged IWM and CEGIS for detail study to provide technical support by applying modern technique for rehabilitation of Barisal Irrigation Project (BIP) with a view of restoring agricultural production and Command Area Development.

Initially BIP seems to have been successful while the primary pumping for the double lift system was subsidized. However, once this subsidized system was withdrawn in 1989-90, most of the farmers stopped using the facilities. In 1992, it was estimated that only 20% (8000 ha) of single lift area was under Boro cultivation (DHV Consultants BV 1997). Short-comings of the original project were including socio-economic problems, agro-climatic conditions, defects in support services and technical problems. There are some other bottlenecks. The existing obstacles in the management of BIP is presented as below:

- Due to the lack of major renovations in the brick sluices built in the 70's and 80's, it is not possible to retain irrigation water through many sluices.
- Due to silted up the intake canal, many places do not have enough water to run the pump.
- Farmers are reluctant to cultivate the land as the price of paddy is low.
- Farmers have to pay electricity connection deposit and electricity bill.
- Cross dam needs to be constructed every year to retain the irrigation water, which is costly. It is necessary to build sluices in some places instead of cross dam.
- The dyke of the main canal is damaged. In some place the height of the dyke is not sufficient to retain the irrigation water.
- In order to make the water management organization effective, the budget needs to be allocated in favor of the extension department in this sector.
- Out of the 25 posts of pump operators set up in Barishal Irrigation Project, 25 are vacant.
- Budget allocation for irrigation projects is inadequate compared to demand.

Data related to surface water quality, suspended sediment, riverbed material, rainfall water level, discharge and cross section of river, khal and canal of the study area has been collected for mathematical modelling purpose. On the other hand, data of air quality, ground water quality, noise level, temperature, humadity evaporation, evapotranspiration, wind speed, sunshine hour, agriculte and fisherises resources etc have been collected for ESIA study. Water availability has been assessed for each pumping location considering 80% dependable flow. Mathematical model study has been used for this purpose. The comparison between water availability and demand shows that the water availability will meet the proposed abstraction at each pump station location. Mathematical model study also reveals that the proposed abstraction will not hamper the hydrological condition of source River. Simulated model results showed that the proposed FSL will be attained at the end of the main canal.

Rehabilitation of 39 nos. of pump (out of 81 pumps) and associated offtake structures is recommended for first phase whereas 28 nos. of pumps is recommended for second phase. A total 11 nos. of pumps are not considered for rehabilitation as because of present as well as future possibility of urbanization, public demand, availability of pump and existence of the pump houses. Supervisory Control and Data Acquisition (SCADA) is recommended to be applied on a pilot basis for 6 nos. of pump stations preliminarily. Formation of WMA and WMG as well as proper training for stakeholders in each pumping station is highly recommended. For future irrigation expansion, Banaripara upazila can be considered through a detailed study and investigations. Training

center/Site office in each upazila is recommended to implement using existing pump operator shade/godwon for the stakeholders.

Two scenarios have been investigated considering using existing pump and replacement of existing pump with new pump. Evaluation results and sensitivity analysis indicate that the proposed project with new pump is economically viable.

The Environmental Management Plan (EMP) has been prepared with the aim of ensuring avoidance, minimization, and offsetting of adverse environmental impacts and enhancement of beneficial impacts. The EMP includes mitigation and enhancement measures to be taken during pre-construction, construction and post-construction phases.

Implementation period of the project is assumed to be 3 (three) financial years. The full benefits are assumed to be achieved after 6th years of the completion of the proposed investment programme. This is consistent with FAP recommendations. But it is assumed that partial benefits will start from the 4th year of the project completion. Summary of the Analytical Results of Benefit and Cost Analysis is given below:

Viability Indicator	Financial	Economical
Capital cost (Lakh Taka)	41924.28	33205.37
Annual O&M cost (Lakh Taka)	741.47	585.85
BCR @ 12%	1.20	1.63
NPV (Lakh Taka) @ 12%	7320.26	18011.69
IRR (%)	14.57%	19.39%
Weighted Average Cost of Capital (WACC)	4.79%	-

All the objectives and scopes have been accomplished under this study project. The design, cost estimate and ESIA have been conducted through this study. The DPP of the investment project would be finalized for implementation of the proposed physical componenets based on the findings of this study project.

Date: .....

24-11-2022

Signature and seal of the Project Director

(Dr. Shamal Chandra Das)
Superintending Engineer (Civil)
Directorate of Planning-1
BWDB, Dhaka.

7. Remarks/Comments of Agency Head

Rehabilitation of Barishal Irrigation Project will improve the irrigation system which will remain functional throughout the year, even during Boro season. Conveyance capacity of the khals, crop and fish production, ecological environment will improve. Besides, drainage congestion and water logging will be reduced within the periphery of the project boundary

The project area offers an excellent opportunity for water management. The project is cost-effective and satisfies the current strategy of agricultural planning to contribute to the attainment of food-grain self-sufficiency at the earliest. Evaluation results and sensitivity analysis indicate that the proposed project is economically viable. The project is thus recommended for implementation.

28/11/2022
(FAZLUR RASHID)
Director General
BWDB, Dhaka.

Date: .....

Signature and seal

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

The main objective of the project is to provide support by applying modern techniques for rehabilitation of Barisal Irrigation Project (BIP) with a view of restoring agricultural production and command area development. The project will help to increase agricultural productivity and incomes of small-scale food producers thus eradicating extreme poverty. Evaluation results and sensitivity analysis indicate that the proposed Investment project considering Feasibility Study will be economically sustainable. The DPP of the investment project will be finalized soon considering the findings of the PFS.

Date: .....

Signature and seal

Approved

30/06/2022

(FAZLUR RASHID)
Director General
BWDB, Dhaka.

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

Final Report
on
Mathematical Modelling Study for Rehabilitation of Barisal Irrigation Project (BIP)

Volume-I: Main Report

IWM
Water Environment & Climate

Institute of Water Modelling

Executive Summary

Barishal Irrigation Project (BIP) was designed to provide irrigation and improved drainage. The feasibility study for BIP was conducted during 1972-1975. The project was implemented in two phases. The first phase was completed in 1980 and second phase was completed in 1985. The study area is spread over Barishal Sadar, Babuganj and Bakerganj Upazila of Barishal District; Jhalokati Sadar, Nalchity and Rajapur Upazila of Jhalokati District and Kawkhali Upazila in Pirojpur District. The original concept of the project was to utilize non saline tidal river water for dry season irrigation from adjacent perennial khals by means of LLP, or to utilize primary pump stations on the perennial khals to supply water to semi-perennial or non-perennial khals so that secondary lifting by Low Lift Pump (LLP) could be done. The available fresh water in peripheral rivers and khals was withdrawn by primary pump (25 cusec) and supplied to main khal/canal. This abstracted water was controlled by offtake structure, combined or separated from primary pump houses, and check structure placed at the end of main canal and supplied to branch canal. The supplied water in the branch canal was controlled by several check structure placed at the end of each branch canal. Irrigation was provided by double lifting method using 81 nos. diesel operated pumps (25 cusec each) and 3450 nos. of LLPs (2 cusec). Initially the primary pumping for the double lift system was subsidized. This subsidized system was withdrawn. Farmers are reluctant to cultivate their land using the BIP irrigation water due to high operating cost and irrigation was almost stopped in 1990. Afterwards 30 nos. of pump houses were remodeled for single lifting gravity and partial gravity irrigation method and operated with electricity. By this time 5 nos. of pump house have already been washed by river erosion.

The land-use pattern, cultivation/crop pattern, natural water supply, social status of the residents, etc. have been significantly changed over the years. A detailed study is required to redesign the project considering present situation and demands. Considering this, a contract agreement has been signed on September 02, 2021 between Bangladesh Water Development Board (BWDB) and Institute of Water Modelling (IWM) to conduct the feasibility study of Barishal Irrigation Project. The main objective of this study is to provide technical support by applying modern technique for rehabilitation of BIP with a view of restoring agricultural production.

The study area is characterized by monsoon climate with hot summer monsoon from June to September and cooler dry winter from December to February. About 80% of annual rainfall falls during the monsoon from June to September. The average annual rainfall is around 2066 mm/yr. (varying from 1063mm/yr. to 3627mm/yr.). Long-term annual Potential Evapotranspiration (ETo) for the study area is found as 1290mm/year. During the dry season irrigation is essential for rice production. Boro-Fallow-T. Aman is the major cropping pattern in the study area. The study area has several important rivers such as, the Arial Kha, Kirtonkhola, Sugandha, Shyandha, Tetulia (Barishal) etc.

Several field visits have been conducted to examine the performance of the structure. BWDB professionals from Dhaka and Barishal were present during the field visit. The main objective of the visit to observe the present condition of the pump houses and structures and to find out the problems and bottlenecks and to suggest remedial measures of these problems. As the pump house and structure were constructed during 1980-1985 most of the pump house and offtake structure are damaged and renovation works is required. New doors and windows are required for all the pump houses. Painting of each pump house is required. New roof construction for two pump houses is required because the existing roof is made by tin. The discharge and pumping chamber are silted up and cleaning is required. The intake canal is badly silted up and required re-excavation. The condition of the motor is not good. Most of the cases the electric panel board is not available, and the existing panel board is not in good condition. The structure was constructed by brick. Pier and column of some structure is damaged, but it is repairable. The gate hoisting frame is found in good condition. The channel groove of some structure is well but some need to repair. Gate seals are all damaged and need replacement. New gate hoisting equipment for each pump house has been required.

Available hydrometeorological data has been collected from secondary sources. The data has been quality checked and processed for further analysis. Following primary data has also been collected under this study:

- A total 1381 nos. of cross section survey of canal and rivers
- Water level gauge installation & monitoring at 8 locations
- Discharge measurement with sediment sampling at 5 locations
- Bed material sampling and grain size analysis in the laboratory
- In-situ surface water quality measurement
- Detail information (no. of vent and size, sill level and deck level, size of the pump house etc.) of the pump house and structure

The water level variation of different station has been presented in following table:

Station Name	River Name	Surface Water Level (mPWD)	
		Maximum	Minimum
Harina	Kalijira	2.02	-0.04
Varosakati	Sikarpur	2.55	-0.12
Uttar Gagir Char	Gabkhan	1.80	-0.57
Takerhat/Chadpura	Takerhat Canal	1.84	-0.53
Nehalgonj	Nehalgonj Khal	1.98	-0.34
Nilgonj	Pandhop River	2.12	-0.51
Naikati	Kaukhali Khal	2.08	-1.17
Kagasura	Arialkhan	2.54	-0.29

In-situ EC, TDS and salinity measurement has been conducted at the intake of different canal. The EC, TDS and salinity varies from 890~155.7μS/cm, 437~76.2mg/l and 0.44ppt~0.07ppt respectively. The measured water quality parameters are within the safe limit for irrigation.

The existing Southwest Regional Model (SWRM) has been used as the base model for this study. Necessary updating of the regional model has been done and the model has been updated incorporating recent surveyed cross-sections and structure information. The model has been developed by physically based hydrodynamic and hydrologic modelling system (MIKE 11) to simulate the main hydrologic and hydraulic processes; runoff from rainfall, flow, velocity and water levels in river/irrigation canal. A total of around 1381 nos. of cross-sections of different canal of BIP area has been included in the existing SWRM model. The boundary condition of BIP model area has been taken from simulated data of SWRM. The hydrodynamic model has been calibrated and validated against surface water level. Flood inundation map has been prepared for end of August. No significant drainage condition has been observed from flood depth map in BIP area.

Command area delineation of individual pump houses have been carried out based on the distribution of branch canal, topography of the area as well as consultation with the stakeholders. For identifying and delineating the settlements within the study area recent google image has been used. The homestead, school, water body etc. has been digitized from the google image. The total command area and net cultivable area for BIP is estimated as 41346ha and 26892ha respectively.

Efficiency test of pump has been conducted for BP-7 at Degreerchar of Babuganj upazila and NP-8 at Manpasha of Nalchity upazila. Both the pump has been found in running condition.

A total 39 nos. of pump and associated structure are selected for rehabilitation for first phase and 28 nos. of pump and associated structure are selected for rehabilitation for second phase. 11 nos. of pump are not selected for re-habilitation. The pumps have been selected based on present urbanization as well as future possibility of urbanization, public demand, availability of pump and existence of the pump houses. Area elevation curves has been prepared to estimate the full supply level (FSL) for gravity irrigation. It is observed that, the pump house, offtake structure, check structure and dyke along the main canal need to be raised 0.5m to 1.0m to convert gravity system irrigation.

Dykes has been proposed along the banks of the main canal in order to store water for gravity irrigation. The existing dykes will need to be raised about 0.5m to 1.0m high and will have a crest width of 1.0m with side slopes of 1:1.15 on both sides. Construction of dyke is required for 135km. The badly silted up intake canal and loop cut canal is proposed for re-excavation. Re-excavation of intake canal and loop cut will be required for 27km. Secondary canal has to be re-excavated by considering pre and post survey during implementation of the project to supply irrigation water as well as to provide adequate drainage facilities during monsoon. Land will be required for construction of dykes along the canal. All the canals are existing in the field and no new construction of canal will be required. According to the stakeholder consultation and the decision of the meeting with client and field officials land acquisition is not considered. During the implementation of the project field office will take decision about the requirement of land acquisition, if necessary.

A total 19 nos. of pump and associated offtake structure need to be modified for gravity system irrigation. All of these require civil works to modify the abutments and piers, loose apron and launching apron in order to withstand increased head (0.5m or 1.0m) required for gravity irrigation. A total 63 new steel gate will be required for offtake structure for functioning the system.

Renovation works has been proposed to repair damaged offtake structure. A total 118 nos. of check structure are proposed for renovation and modification and 123 nos. of check structure are proposed for re-construction for first phase of rehabilitation. The location of re-construction of check structure will be finalized during implementation of the project considering the filed condition. A total 427 new steel gate has been proposed for the check structure during first phase of rehabilitation.

Renovation of pump house like cleaning of roof top, plastering and painting of all the pump houses and new door and windows has been proposed. New roof construction for two pump houses has been proposed as the present roof is made by tin. Silted up pumping and discharge chamber need to clean. The existing diesel accessories have to be demolished.

According to the stakeholder consultation, public demand and the decision of the meeting with client and field officials existing pump is proposed to be replaced by 25 cusec submersible pump. A total 42 nos. (dual pump at KP-6, BKP-8 and RJP-2) of submersible pump will be required for this purpose during first phase of rehabilitation. A total 28 nos. of 25 cusec submersible pump will be required during second phase of rehabilitation. Electrification for 28 nos. of pump houses has been proposed for first phase of rehabilitation.

An automatic pump operation system which has been named as SCADA (Supervisory Control and Data Acquisition) has been proposed for six number of pump house at Barishal Sadar, Babuganj, Bakerganj, Jhalokati Sadar, Rajapur and Nalchity upazila. The existing pump operator shed or godown has been proposed to renovation and 6 nos. of operator shed has been proposed to rehabilitate for site office/water management association office/training centers.

The calibrated and validated model has been simulated for various options. Following option has been developed and analyzed:

- Option 1: Base condition
- Option-2: Comparison of water availability at pump location for proposed abstraction for gravity irrigation with base condition
- Option-3: Comparison of water level at pump location for proposed abstraction for gravity irrigation with base condition
- Option-4: Checking of FSL due to raising of the creek banks by about 0.5m to 1m

Water availability at each pump house location has been assessed based on 80% dependable flow of long term simulated discharge data. The comparison of water availability and demand

shows that the water availability will meet the proposed abstraction at each pump station location.

Impacts on water level at pump house location for planned abstraction scenario have been assessed and reveals that there are no significant changes in the water level for future abstractions. Therefore, it can be concluded that the proposed abstraction will not hamper the hydrological condition at source of the river. Model simulation shows that the estimated FSL can be achieved for proposed interventions.

Irrigation expansion for Banaripara upazila has been investigated. Two areas have been demarcated for future irrigation expansion. Four number of pump house locations have been selected for this purpose. Detail study has been proposed for this purpose.

The estimated total investment cost of the project for first phase of implementation is about Tk. 41924.28 lakh (financial) as presented below:

Summary of Total Base Cost for Proposed Interventions during First Phase

Sl. No.	Description	Unit	Quantity	Total Cost (7+8+9)	GoB (FE)	Own Fund (FE)	Others	% of total cost of the project
1	2	3	4	5	6	7	8	9
(a) Revenue Component:								
1	**Supplies & Services:**							
a	PIU Support Cost	Item	1	612.20	612.20	-	-	1.46
b	WMG/WMA Formation and Training	Item	1	362.93	362.93	-	-	0.87
c	Implementation Support Service	Item	1	727.25	727.25	-	-	1.73
d	Survey and Geotechnical Investigation	Item	1	245.33	245.33	-	-	0.59
e	Comprehensive Feasibility Study for Irrigation Expansion at Banaripara Upazila, Barishal	Item	1	466.98	466.98	-	-	1.11
f	O&M cost during project implementation period	Item	1	214.50	214.50	-	-	0.51
Sub-Total (revenue component) (a)=				***2629.18***	***2629.18***	***0.00***	***0.00***	***6.27***
b) Capital Component								
2	**Construction Work:**							
a	Repair or Reconstruction of Primary Pump Houses & Operator-shades.	nos.	39	454.74	454.74	-	-	1.08
b	Remodeling of Offtake Hydraulic Structures adjacent of Primary Pump House.	nos.	19	1159.38	1159.38	-	-	2.77
c	Repair or Reconstruction of Offtake Hydraulic Structures adjacent of Primary Pump House.	nos.	20	982.87	982.87	-	-	2.34
d	Repair and Remodeling of Hydraulic Check Structures/Sluices for retaining water.	nos.	118	3587.89	3587.89	-	-	8.56
e	Reconstruction of Hydraulic Check Structures/Sluices for retaining water.	nos.	123	24163.00	24163.00	-	-	57.63
f	Construction of turnouts.	nos.	942	348.54	348.54	-	-	0.83
g	Renovation of Storeroom as Site office/WMA & WMG office/Training Centers.	nos.	6	30.00	30.00	-	-	0.07
3	**Earth work:**							
a	Construction of dykes	km	135	2121.66	2121.66	-	-	5.06
b	Re-excavation of Intake Canals	km	28	569.31	569.31	-	-	1.36
c	Re-excavation of Irrigation Canal	km	610	212.62	212.62	-	-	0.51
4	**Mechanical and Electrical Work:**							

Sl. No.	Description	Unit	Quantity	Total Cost (7+8+9)	GoB (FE)	Own Fund (FE)	Others	% of total cost of the project
1	2	3	4	5	6	7	8	9
a	Manufacturing, Painting, Supplying & Installation of M.S Lift Gates for Offtake and Hydraulic check structures (includes trash rack and steel net)	Nos.	490	901.95	901.95	-	-	2.15
b	Manufacturing, Supplying & Installation Gate Hoisting Systems.	Nos.	39	187.30	187.30	-	-	0.45
c	Supplying & Installation of 25 cusec Submersible Pumps & Electric Panel Boards for Primary Pump Houses.	Nos.	42	4200.00	4200.00	-	-	10.02
d	Installation of 440V 3-phase Electricity Lines by PDB or REB.	Nos.	24	131.61	131.61	-	-	0.31
e	Supplying & Installation of SCADA (Automation) System.	Nos.	6	144.24	144.24	-	-	0.34
Sub-total (Capital) (b)				***39195.11***	***39195.11***	**-**	**-**	***93.490***
Total (a+b)				***41824.28***	***41824.28***	**-**	**-**	***99.761***
(c) Physical Contingency (Ls)				50.00	50.00	-	-	0.12
(d) Price Contingency (Ls)				50.00	50.00	-	-	0.12
Grand Total (a+b+c+d) =				***41924.28***	***41924.28***	**-**	**-**	***100.00***

The estimated cost for proposed interventions for second phase implementation of the project has been given below:

Summary of Cost for Proposed Interventions for Second Phase of Impelmentation of Project

Sl. No.	Description	Unit	Quantity	Cost (Lakh BDT)
1	Repair or Reconstruction of Primary Pump Houses & Operator-shades.	Nos.	28	730.51
2	Remodeling of Offtake Hydraulic Structures adjacent of Primary Pump House.	Nos.	20	1435.35
3	Repair or Reconstruction of Offtake Hydraulic Structures adjacent of Primary Pump House.	Nos.	28	263.41
4	Remodeling of Hydraulic Check Structures/Sluices for retaining water.	Nos	86	3905.47
5	Reconstruction of Hydraulic Check Structures/Sluices for retaining water.	Nos.	92	18488.80
6	Construction of turnouts.	Nos.	711	263.07
7	Construction of dykes.	cum	122539	1874.18
8	Re-excavation of Intake Canals.	km	22	498.71
9	Manufacturing, Painting, Supplying & Installation of M.S Lift Gates for Offtake and Hydraulic check structures (includes trash rack and steel net)	Nos.	398	743.50
10	Manufacturing, Supplying & Installation Gate Hoisting Systems.	Nos.	28	149.52
11	Supplying & Installation of 25 cusec Submersible Pumps & Electric Panel Boards for Primary Pump Houses.	Nos.	28	2800.00
12	Installation of 440V 3-phase Electricity Lines by PDB or REB.	Nos.	28	155.90
Total				**31308.42**

Economic analysis has been performed only for first phase of the project. The summary of the analytical results is shown in below:

Summary of the Analytical Results of Benefit and Cost Analysis

Viability Indicator	Financial	Economic
1. Capital Cost (Lakh BDT)	41924.28	33205.37
2. O&M Cost (Lakh BDT)	741.47	585.85
3. Benefit Cost Ratio (BCR @ 12%)	1.02	1.42
4. Net Present Value (NPV @ 12%) Lakh BDT	828.21	12149.36
5. Internal Rate Return (IRR %)	12.30%	17.15%
6. Weighted Average Cos of Capital (WACC)	4.79%	-

The project area offers an excellent opportunity for water management through irrigation expansion. The project is cost-effective and of short-gestation, and satisfies the current strategy of agricultural planning to contribute to the attainment of food-grain self-sufficiency at the earliest. Evaluation results and sensitivity analysis indicate that the proposed project is economically viable.

Approved

30/06/2022

(FAZLUR RASHID)
Director General
BWDB, Dhaka.

Final Report

on

ESIA Study for Feasibility Study for Rehabilitation of Barisal Irrigation Project

Executive Summery

Barishal irrigation project implemented during from 1975 to 1985 with financial aid from the World Bank with the goal of providing irrigation facilities by surface water. During the first phase, the project was executed at Barisal Sadar and Babuganj Upazilas in Barisal District; and Jhalokathi and Nalchiti Upazilas in Jhalokathi District. The second phase was implemented in Bakerganj in Barisal District; Rajapur and Kawkhali Upazilas in Pirozpur District. Seventy (78) pump houses, 1,132 km. irrigation canal, and 506 sluices were constructed under two phases of the project. The gross area of the project was 1,57,085 ha, and the net cultivable area was 1,06,883 ha. But over the time, this project has lost it's functionality due to high operation cost by the double lifting method using diesel-operated pumps, high elevation difference between the canal bed level and crop field, risen bed of khals due to siltation, lack of proper irrigation management and ineffectiveness of Water Management Association/Group (WMA/WMG).

In this backdrop, BWDB has contemplated to rehabilitate the Barishal Irrigation Project (BIP). The study is organized in two components for the sake of clarity and easily understanding of the works. Component-1 will address the cross-section survey, hydrological measurement and mathematical modelling techniques. Component-2 will address the ESIA study. To that end, BWDB has engaged Center for Environmental and Geographic Information Services (CEGIS) to undertake the ESIA under component-2. CEGIS will also estimate sectoral water demand, which will serve as the basis for rehabilitating the project in light of current and future scenarios. Under this title of the project, CEGIS will investigate the current situation and effectiveness/ requirement of the WMG/WMA for different pump houses and it's solution.

This project is subject to provide yearlong irrigation facilities to the farmers by rehabilitating of existing pump houses along with existing check structures lying in the project area under the jurisdiction of BIP and will sort out of drainage congestion or water logging problem in the low lying areas by re excavation of khals and construction of dykes. As supplement, minimum natural flow will also be maintained in the khals and control siltation throughout the year. Thus, this project will put significance by restoring agricultural production and Command Area Development. Besides, ecological environment will be enhanced by restoring virgin state of khals by removing silt from khal bed. Under the jurisdiction of this project,

The consulting team conducting the technical study (IWM), suggested a two-phased rehabilitation plan for 67 pump houses out of total 78 pum houses. Under this rehabilitation plan, 39 pump houses have been selected for rehabilitation in the first phase and 28 are selected for rehabilitation in the second phase. while the remaining 11 pumps have been not chosen for rehabilitation. First phase of rehabilitation proposes modifications to 241 structures and offtake structures of pump houses, as well as the construction of 156 kilometers of dikes and the re-excavation of 23,1018 cum of intake canal.

The proposed project is consistent with significant national and international plans, policies, and programs (PPP). All of these PPPs were consulted throughout the feasibility study development. The PPP consultation found that rehabilitation and new construction of pump house for irrigation supply to improve crop production, ecological enhancement and lessen drainage congestion are the most important conclusions. Relevant Bangladesh Legislation i.e. Environment Conservation Rules- 1997, Bangladesh Water Act- 2013, The National Agriculture Policy (NAP) 2013, Irrigation Act, 1876 (Act No. III of 1876), Bangladesh Irrigation Water Rate Ordinance, 1983 (Ordinance No. XXXI of 1983). National Environment Management Action Plan 1995 and different Relevant International Legal Obligation among the PPPs that have been consulted.

The project area is located in the central southern zone, which is criss-crossed by tidal rivers, namely, Kirtonkhola, Sugandha, Lohalia, Pandab, Bishkkhali, Gabkhan Channel etc. and numerous interconnected khals. These areas are geographically lowland, with RLs ranging from 0.37 m PWD to 4.55 m PWD (NWRD) and consisting primarily of agricultural lands, water bodies, and urban areas. 80% of land lies below 2.27m PWD.

During the study, water sample collected from both SW and GW from 15 pre-determined locations. Parameters namely, pH, Temperature, DO, Turbidity, TDS, EC, Salinity, Nitrate, Phosphate, Sulphate, Total Iron, Arsenic, Hardness, TSS, Potassium, Calcium, Magnesium, Chloride, BOD, COD. Salinity is found in both

SW and GW. The saline level observed in the project region are not hazardous to irrigation. SW salinity ranges from 0.02 to 0.08 ppt, and GW salinity ranges from 0.4 to 1.30 ppt. Values from other parameters also satisfies both ECR'97 and Draft ECR'2017 rules which is satisfying for irrigation purposes.

Meteorological parameters such as precipitation, temperature, relative humidity, evaporation, evapotranspiration, wind speed, and sunlight hours were collected and statistically analysed at the Barishal BMD station. This station recorded a maximum annual rainfall of 2858 mm in 1998, a low of 1439 mm in 1992, and an average annual rainfall of 2077 mm. The maximum temperature ranges between 29.07°C and 36.24°C, with April being the warmest month. The minimum temperature ranges between 8.40°C and 24.05°C, with January being the coldest month.

To undertake hydrological study, three WL stations, namely Uzirpur(ID:253A), Barihsal (ID18), and Tongibari (ID287.3), are selected. All stations are influenced by tides, with average high WL ranging from 1.23 to 2.52 m PWD and average low WL ranging from -0.303 to 1.11. There is no discharge station within the periphery of project boundary. The project area suffers drainage congestion due to the frequent siltation of khals; nonetheless, flooding is not a common occurrence. In the case of a tidal surge or cyclone, the project area is also protected by sundarband or a nearby coastal district.

The study area comprises the Ganges Agro Ecological Zone (AEZ-13). The major land use category is cropped area which is 70,517 ha (44.89% of the gross area). On the other hand, rural settlement, rivers and khals area covered by 67,409ha (42.91% of the gross area) and 13,661ha (8.69% of the gross area). Overall land use followed by aquaculture, baor, beel, brickfield, built-up area, canal, ditch, dumping sites, embankment, grassland/fallow/non-cultivated land, orchard and other plantations(tress), pond, railway, river, rural settlement with homestead vegetation, sand bar and road respectively. It reveals from the study analysis that the maximum of the study area (95.06% of NCA) falls under medium high land followed by high land (2 % of the NCA) and medium low land (2.3% of the NCA) respectively. Besides, the soil texture of the study area is dominated by clay loam (46.15 % of the NCA) followed by loam (45.02 % of the NCA), loam (8.6 % of the NCA) respectively. According to SRDI (1988), the available soil moisture has been classified into four categories such as Low, Medium, High, and Very high. It reveals that the study area is dominated by lowlevel (43.49%) of soil moisture followed by medium (40.02%) and high (15.6%).

There are two distinct cropping seasons in a year: 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-I (March-June) and Kharif-II (July-October) season. There are several cropping patterns being practiced by the farmers in the study area on different land types. The most prominent cropping patterns in the study area are (a) Fallow-HYV Aman- Pulses, (b) Fallow-HYV Aman- HYV Boro, (c) Fallow-HYV Aman-Other Robi crops, and (d) Aus-HYV Aman-Fallow. In the study area, HYV Aman is the most dominating crop, which is followed by Pulses. The single, double and triple cropped area is 15.23%, 67.88%, and 16.89% respectively of the net cultivated area, while cropping intensity is 202%. Total cropped area of the study area is 67,732 ha, of which rice is cultivated in about 62% of total cropped area and rest area is covered with non-rice crops. Pulses is the major crop among non-rice crops (51% of non-rice crops).

The farmers of the study area are very much interested to produce more Boro rice or other high value robi crops by getting proper irrigation facilities. The cost of irrigation is high in the study area but coverage is very low. Farmers are to pay two times irrigation cost, firstly they pay to Water Management groups (WMGs) for pumping water in Khal; and secondly pay to the group, who provide water to crop land. Total irrigation cost of Boro rice is about 11,500-13,000 BDT per hectzre Sometimes, in some areas, second group take one-fourth crops as irrigation cost.

In this study, both present and future water demand for agriculture and fisheries sectors have been calculated. In the present situation a total of 177 Mm3 of water is required as crop water demand in every crop year. A future scenario is also projected to assess the future water demand considering SSP585 (Shared Socioeconomic Pathway) scenario under CMIP6 climate model. This prediction gives an approximate estimate of future water demand of 296, 303, and 305 Mm3 for 2030, 2040, and 2050

respectively. The highest water demand for riverine fisheries was found in case of the Payra River in all the scenarios (about 664cumec in base scenario, and about 672cumec in SSP585 scenario).

The contribution of the livestock sector to overall GDP has been provisionally estimated at 1.78% for 2013-14. Its share of agricultural GDP in 2016-17 was 15% (provisionally estimated). Despite its modest share of overall GDP, livestock serves an essential role as a source of protein, employment generation, export earning, and provision of food security. Livestock resources play an important role in the sustenance of landless people, livelihood options for the rural poor families, and are potentially important for poverty reduction.

The study area possesses both capture and culture fishery with the predominance of hilsa fishery in the project area. Total fish habitat in the project area is 14,317 Ha of which 98% is capture habitat and only 2% is culture habitat of which the share of 'river and khal' is about 95.418% and other habitats e.g. mud flats or intertidal area, aquaculture, pond, baor are of negligible percentages. The adjacent floodplain area is inundated in monsoon and water stay for about 3 to 4 months and is used by fish for grazing, breeding and feeding ground by both small and big fishes, Total yearly production is 5.085MT of which capture fish brings 4,718 MT whereas culture fish brings 367 MT. The rivers in the study area are tidal in nature and the tidal action help longitudinal migration of a good numbers of riverine fish species. spawning and feeding purpose. About 70 fish species are present in the project area. The available fish species are taki, kakila, baila, boal, tengra, tara baim, baro baim, guchi baim chanda Khoira, Foli, Shol, chital, ayre, puti, chapila, Gutum, koi, khorsula, mola, prawn, rui, catla, mrigal etc. There are some species found namely, Boal, Ayre, Mola / Molongi / Moya, Tara baim, Fulchela, Baim / Sal Baim, Bagair, Pangus, Gharua which has conservation significances to increase species richness.

Two distinct Bio-Ecological Zones (BEZ), namely: Ganges Floodplain and Coastal Marine Water covers study area. Both terrestrial (flora and fauna) and aquatic (flora and fauna) ecosystems is found within the study area. Settlement, fallow land and agriculture land are the main landscape in the study area. There is no protected area inside the study area.

This area houses 1,235,896people (*area percentage from GIS spatial analysis*), which has been worked out from the Population and Housing Census 2011 BBS, 2012. This population reside in **274,880** households. Here the number of males is 593,368 (48.1%) and females is 642,528 (51.9%), whereas the sex ratio is 92 indicating 92 numbers of males in the counterpart of 100 females.

Implementation period of intervention provided by technical study team (IWM) different activities will be conducted are followings

- remodeling and repair damaged portion (door, window, plastering and painting) of the pump house of existing pump house and offtake structure (sluice gate, steel frame on sluice, masonry work, u/s loose apron, d/s loose apron),
- replacement of all broken pieces, such as gates, trash racks, steel net beside trash rack and valves, replacement of the equipment on the control panel with new parts, replacement of unserviceable components (Pumps, motors, and the reduction gearbox) or repairing,
- repair and maintenance of electrical substations, including the replacement of obsolete and non-serviceable components etc.

Different Important Environmental and Social Components (IESCs) will be impacted by the abovementioned activites. Selected IESCs are surface water availability, drainage congestion, wastes, environmental quality, land Use, cropping pattern and intensity, crop production, Habitat condition, quality and fish production, fish movement and migration, fish diversity and species richness, income and livelihood, economic benefits, skill development, occupational safety and public health and conflict in O & M of the pump. Negatively impacted component will be mitigated by mitigation measures.

During the pre-construction phase, wastes and noise will be generated during site preparation, labor shed construction including toilets and material stockyard, clearing of vegetation and debris within the demarcated alignment, etc.

Construction Wastes will pollute the surrounding environment. Besides, dike will be constructed from carrying earth, waste may have generated at pathway of transportation During the construction phase, the construction workers will also generate domestic solid waste. Unmanaged wastes and surplus concrete, empty cement bags, litter, etc. can also pollute the surrounding environment. Various construction related activities viz. new construction/ rehabilitation of structures and pump house, dismantling of irrigation structures, re-excavation of khals and construction of dyke etc. might increase noise level and fugitive gas. This will deteriorate ambient air quality and cause hearing impairment of labors and other workers and local people in the adjacent area. The water quality might be affected by different dust of construction activity. Implementation period will change land use and both the habitat quality and fish production will be declined of due to increased water turbidity, temporarily changed DO and pH. Fish migration will also be hampered during re-excavation work.

A number of mitigation measures have been proposed for mitigating the negative impact of the project such as, excavated materials should be disposed of at designated areas to avoid sliding back to khals or dispersion of dust according to the material management plan. Construction wastes should also be properly transported and dumped outside immediately from the site after generation; to avoid dispersion of dust.; Exhaust emissions from vehicles and machinery should comply with the Environmental Conservation Rules (ECR); Noise levels should be restricted within national noise standards (Noise control rules, 2006); Water should be sprayed at the construction yard and connected road twice a day in order to suppress fugitive dust; fallow land should be used for the temporary storage of construction materials ; contractor should avoid cultivable fields during construction; farmers should be informed well ahead (before the start of cropping season) about the construction activities; avoid re-excavation of khals during spawning migration period (May-July/July)

Surface water in the study area will significantly increase after proposed interventions such as re-excavation of canals, construction and renovation of new pump houses, renovation of existing pump house structures etc. As a result, enough water will be available for Irrigation to more agricultural land, boosting agricultural production in the area. Furthermore, the increased supply of water will aid in the improvement of the project area's ecosystem. Besides, increased surface water will enhance GW recharge and eventually increase the availability of GW. After re-excavation of khal storage capacity will increase. As a result, drainage congestion during heavy rainfall will be reduced. After implementation of the project 3336.6 ha fallow/ grazing/ low land might be converted to agricultural land, irrigation coverage during the dry season would be increase from 13,869 ha to 22,780 ha which would be about 34% of NCA. Total annual crop production will increase by about 17,078 metric tons (12.3%) and cropping intensity would be 216%. Besides, Capture habitat will be same but area of culture habitat may increase partially. Moreover, after completion of the project, decreasing irrigation cost with availability of water will improve the cropping pattern in the catchment area which will create extra scope of employment for the farmers. Proposed project will arrange different types of skill development programs which will develop farmer's skill on management, modern technology use, technical and mechanical equipment operation and other social development.

To increase the irrigation management effective and sustainable Water Management Association /Group (WMA/WMG) will be formed for improved functionality and sustainability of the BIP. It is recommended from this project is to involve WMA/WMGs in maintenance and O&M activities. Training for of WMGs/WMAs members, involvement of WMA/WMGs in administrative and logistics management etc. During O&M of the pump conflict may raise between the WMG/WMA and water users. Due to this reason, lot of motivational activities will be applied from the WMG/WMA, in decision making for implementation of the pump properly.

As this is a rehabilitation project, all rehabilitation measures must be carried out otherwise the project's goal will be compromised. So, there is no alternatives other than rehabilitating the existing project to reap full benefit out of this project.