

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



Bangladesh Water Development Board

PROJECT COMPLETION REPORT: IMED 04/2003 (Revised)

for

**Detailed Feasibility Study for Rehabilitation of Chandpur Town
Protection Project**

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** : Detailed Feasibility Study for Rehabilitation of Chandpur Town Protection Project (Project code- 224344700)
02. **Administrative** : Ministry of Water Resources (MoWR)
Ministry/Division
03. **Executing Agency** : Bangladesh Water Development Board (BWDB)
04. **Location of the Project** : District: Chandpur & Shariatpur
05. **Objective of the Project:**

The overall objective of the study is the sustainable management of the lower Meghna River by investigating its bank erosion processes and planform changes emphasizing Chandpur Town Protection Project and its adjacent areas. The study also aims to devising immediate and long-term erosion mitigation measures considering technical, environmental and social aspects. The study will be conducted in two components, hydrological and morphological model study as component-1 and environmental and social impact study as component-2. The specific objectives (component-wise) of the project are:

Hydrological and Morphological Model Study (Component-1)

- To enhance the understanding of the dynamic erosion phenomena in details;
- To analyze and assess the adequacy of river cross-section downstream of Chandpur for flowing combined flow of upper Meghna and Padma;
- To predict morphological changes both in long and short term;
- To develop different potential options for protection measures considering hydrodynamic and morphological condition;
- To assess the efficacy of existing protective works and its morphological changes;
- To assess the need of dredging, dredging alignment & dredging volume with design and prepare dredged material management plan;
- To develop integrated and sustainable river management plan for the lower Meghna river (Mainly for Chandpur Town and its adjacent areas) with "no regret" concept (BDP 2100).

Environmental and Social Impact Study (Component-2)

- To conduct Environmental and Social Impact Assessment (ESIA) study;
- To prepare environmental enhancement and conservation plan;
- To prepare biodiversity conservation plan;
- To develop Environmental Management and Monitoring Plan (EMMP) for conservation of aquatic resources, fisheries resources, bird sanctuaries, etc.
- To prepare Resettlement Action Plan (RAP).

06. Estimated Cost

:

(In lakh Taka)

	Original	Latest Revised
(a) Total	496.00	-
(b) Taka	496.00	-
(c) Foreign Currency	-	-
(d) Project Aid	-	-
(e) RPA	-	-

07.	Date of Approval	:	PCP/PFS	PP
	(a) Original	:	07/10/2021	-
	(b) Latest Revised	:	-	-
	(c) No Cost Time Extension	:	-	-

08. Implementation Period

:

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

09. Financing Arrangement (Source-wise):

9.1 Status of Loan/Grant

a) Foreign Financing : Not Applicable

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

b) GOB:

(In lakh Taka)

Total amount	Loan	Grant	Cash Foreign Exchange
1	2	3	4
496.00	-	496.00	-

9.2 Utilization of Project Aid: *Not Applicable*

(In million)

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

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

(In lakh Taka)

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

B. IMPLEMENTATION POSITION

01. Implementation Period:

Implementation Period as per PP		Actual Implementation Period	Time Over-run (% of original implementation period)	Remarks
Original	Latest Revised			
1	2	3	4	5
September 2021- June 2022 (10 months)	-	September 2021- June 2022 (10 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	496.00	-	477.63	-	-
TAKA	496.00	-	477.63	-	-
PA	-	-	-	-	-

03. Project Personnel:

Sanctioned strength as per PP	Manpower employed during execution	Status of the existing manpower			Manpower Employed	
		Manpower requirement for O&M as per pp	Existing manpower for O & M	Others		
1	2	3	4	5	Male	Female
Officer (s)	11	-	-	-	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 PFS)	Unit	Target (as per PFS)		Actual Progress		Reasons for deviation (±)
		Financial	Physical (%)	Financial	Physical (%)	
1	2	3	4	5	6	7
A. Revenue						
1. Hydrological and Morphological Model Study (28.5 MM)	Lot	370.35	100%	359.89	100.00%	-
2. Environmental and Social Impact Study (24 MM)	Lot	114.26	100%	114.00	100.00%	-
3. Stamps and seals	LS	0.10	100%	0.00	0.00%	-
4. Other stationery	LS	0.29	100%	0.27	100.00%	-
5. Honorarium	LS	5.00	100%	1.97	39.50%	-
6. Domestic travel expenses	LS	2.00	100%	0.51	25.34%	-
7. Fuel and Gas	LS	1.00	100%	0.00	0.00%	-
8. Petrol, Oil and	LS	1.00	100%	0.00	0.00%	-

Items of work (As per PFS)	Unit	Target (as per PFS)		Actual Progress		Reasons for deviation (±)
		Financial	Physical (%)	Financial	Physical (%)	
1	2	3	4	5	6	7
Lubricants						
9. General Supplies	LS	1.00	100%	0.99	100.00%	-
10. Entertainment Expenses	LS	1.00	100%	0.00	0.00%	-
Sub-total (Revenue):		496.00		477.63	98.46%	-
						-
B. Capital		0.00	0.00%	0.00	0.00%	-
Sub-total (Capital):		0.00	0.00%	0.00	0.00%	-
Grand-Total		496.00	100%	477.63	98.46%	-

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
Mr. Md. Sultan Mahmud Executive Engineer (Civil) Grade-5; 43,000-69,850	Full time	-	Yes	29.03.2022	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

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 Services for "Hydrological and Morphological Model Study of Rehabilitation of Chandpur Town Protection Project"	370.35	365.11	17/10/2021	01/12/2021	30/04/2022 Revised: 30/06/2022	30/06/2022
Consultancy Services for "ESIA Study for Rehabilitation of Chandpur Town Protection Project"	114.26	113.99	17/10/2021	01/12/2021	30/04/2022 Revised: 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 PP	As per contract		
1	2	3	4	5
a) Foreign	-	-	-	
b) Local	28.5 (Hydrological and Morphological Model Study)	28.5	28.5	Conducted by IWM
	24 (Environmental and Social Impact Study)	24	24	Conducted by CEGIS

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

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

C. FINANCIAL AND PHYSICAL PROGRAMME:

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

(In lakh Taka)

Financial Year	Financial provision & physical target as per original PP				Financial provision & physical target as per latest revised PP			
	Total	Taka	P.A	Physical %	Total	Taka	P.A.	Physical %
1	2	3	4	5	6	7	8	9
2020-21	496.00	496.00	-	100%	-	-	-	-
Total	496.00	496.00	-	100%	-	-	-	-

01. (b) Revised ADP allocation and progress:

(In lakh Taka)

Financial Year	Revised Allocation & target				Taka release	Expenditure & physical progress			
	Total	Taka	P.A	Physical %		Total	Taka	P.A	Physical %
1	2	3	4	5	6	7	8	9	10
2021-22	496.00	496.00	-	100%	495.00	477.63	477.63	-	98.46%
Total	496.00	496.00	-	100%	495.00	477.63	477.63	-	98.46%

D. ACHIEVEMENT OF OBJECTIVES OF THE PROJECT:

Objectives as per PP/PFS	Actual achievement	Reasons for shortfall, if any
<i>Hydrological and Morphological Model Study</i>		
To enhance the understanding of the dynamic erosion phenomena in details;	Through detailed satellite image analysis, the dynamics of the Padma-Meghna confluence have been portrayed. How the channel pattern of upstream of the confluence affects the erosion phenomena in and around Chandpur district have been explained. Historical bank erosion and its probable dynamics in the study area have also been shown. (Section 4.1.6, 4.1.7, 4.1.8 of the main report)	-
To analyze and assess the adequacy of river cross-section downstream of Chandpur for flowing combined flow of upper Meghna and Padma;	The historical changes of the cross-sections have been investigated, analyzed and explained in the report. Along with those historical changes at the confluence of the Padma-Meghna River has been shown. Dredging options were formulated based on historical alignments and channel widths while model simulations were done to see the effects of these. Comparison was made with respect to the base conditions and finally a dredging option was developed assessing the adequacy of river cross-section of the Meghna River. (Section 3.1, 4.1.6, 4.3.2 of the main report)	-
To predict morphological changes both in long and short term;	Having the understanding of the planform changes through satellite image analysis and through mathematical model analysis, the long- and short-term morphological changes in base condition and for the dredged conditions have been predicted. The requirement of maintenance dredging for both the short term and long term have been provided accordingly. (Section 4.1.11, 4.3.2, 4.3.3, 4.3.5 of the main report)	-
To develop different potential	Based on the knowledge gathered as outcomes of the above activities,	

Objectives as per PP/PFS	Actual achievement	Reasons for shortfall, if any
options for protection measures considering hydrodynamic and morphological condition;	three potential interventions were considered in the study. The possible interventions include: • 3360 m rehabilitation of the existing River Training Works of the Chandpur Town Protection Project • 2 Groynes, one at 1350 m u/s and another at 2700 m u/s of the Launch Terminal • 13.8 km Dredging at opposite side of Chandpur Town along the mini Cox's Bazar Chars. Tentative width of the to be dredged channel would be 800 m. Considering these possible interventions, three options were considered during the details analysis. These are: Option A: River Training Works plus dredging of 13.8 km Option B: River Training Works plus 2 Groynes Option C: River Training Works plus dredging of 13.8 km plus 2 Groynes (combination of A & B).	
	Based on the results of the evaluation on technical aspects only, it is seen that Option A and Option C shows similar kind of outcome. Option C is only just better than the Option A. However, the two groynes proposed in Option C does not seem to have significant benefits comparing to Option A. Considering the added cost and difficulties of constructing those two groynes, Option A seems to be the most preferable option from the Hydro-Morphological consideration (Section 9 of the main report).	
To assess the efficacy of existing protective works and its morphological changes;	Physical condition of existing protective works and morphological changes in the river regime with in the study reach have been	

Objectives as per PP/PFS	Actual achievement	Reasons for shortfall, if any
	investigated through field visits, review of the conducted past studies and collection of the following relevant data: • Bathymetric survey of 45 km of Padma River, 45 km of Upper Meghna River and 40 km of Lower Meghna River. • Water level and discharge data at different locations of the study area with special emphasis given to Chandpur. • 46 years satellite images analysis (1976 to 2022). Information in relation to the hydro-morphological characteristics, existing structures and riverbank protective works, their performance and present condition have also been studied through reviewing past & similar studies. (Section 3.1, Section 4.1.9, Section 4.1.10 of the main report)	-
To assess the need of dredging, dredging alignment & dredging volume with design and prepare dredged material management plan;	The need of dredging has been assessed through detailed data and satellite image analysis. The alignment has been set based on historical width of the channel, while the dredging volume with different dredging strategy and design, dredged material management plan have been proposed. (Section 4.2.2 and Section 4.2.3 of the main report)	-
To develop integrated and sustainable river management plan for the lower Meghna River (Mainly for Chandpur Town and its adjacent areas) with “no regret” concept (BDP 2100).	As a part of “no regret” concept (BDP 2100), the study has assessed and proposed interventions for the sustainability of the Meghna River as well as for a proper management of the Padma-Meghna confluence. Such as: • The erosion prone reaches of the Meghna River have been found out; • Future morphological	-

Objectives as per PP/PFS	Actual achievement	Reasons for shortfall, if any
	changes have been predicted through mathematical model analysis; • Protection for the Chandpur Town have been designed. • Required length of the protection work of the vulnerable reaches have been predicted; • A dredging alignment has been proposed; • Dredged material management plan has been given etc. (section 4 of the main report)	
<i>Environmental and Social Impact Assessment (ESIA) study</i>		
To conduct Environmental and Social Impact Assessment (ESIA) study	The ESIA report as per the approved ToR of DoE has been prepared and submitted. (Chapter 1 to Chapter 11 of the main report)	-
To prepare environmental enhancement and conservation plan	Environmental enhancement and conservation plans have been prepared considering the aspects of different resources.	-
	Chapter 9 (Table 9.1) and Appendix III (Figure 6), Appendix VI, Appendix IX of the main report	
To prepare biodiversity conservation plan	Biodiversity conservation plan has been prepared considering major habitats based on field visit information. (Appendix IV of the main report)	-
To develop Environmental Management and Monitoring Plan (EMMP) for conservation of aquatic resources, fisheries resources, bird sanctuaries, etc.	Environmental Management and Monitoring Plan (EMMP) including mitigation measures, enhancement measures for different resources based on positive or negative impacts have been prepared considering the proposed interventions provided by Technical Study Team (IWM). Chapter 9 (Table 9.1 and Table 9.2) of the main report.	-
To prepare Resettlement Action Plan (RAP)	Resettlement Action Plan (RAP) has been prepared. (Appendix 10 of the main report.)	-

E. BENEFIT ANALYSIS

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

The project is a 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).
(a)			
(b)			
(c)			
(d)			

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

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

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

F. MONITORING AND AUDITING

01. Monitoring: Nil

Name & designation of the inspecting official	Date of Inspection	Identified Problems	Recommendations
1	2	3	4
a) <u>Ministry / Agency:</u>			
b) <u>IMED:</u>			
c) <u>Others:</u>			

02. 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: *No audit conducted.*

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 objection arised	-

G. DESCRIPTIVE REPORT

1. General Observations/Remarks of the Project on:

1.1 Background

Bangladesh is a land of rivers that carry huge amount of discharge during monsoon. Bank line erosion by shifting the thalweg of the riverbed or widening the flow passage is a common and the recent phenomenon especially for the lower Meghna River. The mighty Padma and Upper-Meghna rivers meet at Chandpur and cause huge scour at immediate downstream of the confluence. The width of the river at immediate downstream of mole-head has been reduced from about 5km to 2.6km due to formation of bars/chars along the right bank. Eventually velocity is increased and current protective measures are under threat. The Lower Meghna River conveys the combined discharge and sediment load of the three major rivers of Bangladesh (the Jamuna, the Ganges and the upper Meghna) into the Bay of Bengal. The peak discharge in the Lower Meghna is found in the order of 148,000 m³/s during 1 in 100-year return period flood (in 1998). The Chandpur town is bisected by the Dakatia river, which also plays a significant role to the fate of the Notun Bazar and the Puran Bazar.

It has been observed from the bathymetric survey data and previous studies that the riverbed and the riverbank slope at and around Mole-head experience severe scouring and erosion that threatens the existence of the protection works. A deep and wide scour hole exists in front of the Mole-head and its location and depth vary over the year. Its movement towards the Mole-head vary from 5m during dry season to 30m during monsoon season while the level of deepest scour hole varies from around -55mPWD during dry season to around -68 mPWD during monsoon. Design level of scour hole was considered -63 mPWD in FAP 9B study. The considerable movement of the deep scour hole makes the Mole-head vulnerable during monsoon. The existence of the Mole-head is very important to the national interest as it

serves to protect many valuable land and infrastructure such as the Chandpur Irrigation Project (CIP) and the town itself.

Over the years the erosion process has been aggravated and the situation becomes worsen along the protective works. Tremendous whirl action due to tidal effects and whirl action due to drainage flow during monsoon along with wave action, tidal surge of the lower Meghna causes damage to the protective measures. No significant maintenance work was done for Chandpur Town Protection Project during last ten years which have made it vulnerable to erosion. It requires major rehabilitations.

To overcome the present situation and relief the local people from the grievances and create a congenial situation against panic to the river erosion it is necessary to take intensive plan as preventive measures along the erosion vulnerable areas. A study needs to be carried out integrating Padma, Meghna, lower Meghna and Dakatia River. For the accomplishment of permanently integrated projects to protect the Chandpur Town Protection Project and to prevent river bank erosion on the left bank of Meghna River, the study area covers the stretches of the confluence of Padma-Meghna-Dakatia to Haimchar on the both bank of Meghna River.

The Lower Meghna River is hydraulically very complex in nature and carries huge water and sediment load. Both banks of the river have been experiencing severe erosion for the last few years. Implementation of mitigation measure against the bank erosion is important for the advancement of overall socio-economic conditions and other facilities. However, this may create new problems locally and/or at upstream and downstream, if not done judiciously. Morphological study by using mathematical modelling tool can be used as an effective approach to assess with and without project conditions in an integral manner and to devise erosion protection plan and design. Hence, BWDB decided to carry out a detailed feasibility study for rehabilitation of Chandpur town protection project.

1.2 Justification/Adequacy

It is to be admitted that "Chandpur Town Protection Project" plays the most vital role in protecting Chandpur town and adjacent areas from the erosion of Meghna River. Govt. institutions, schools, colleges, religious establishments, launch terminal etc. are situated along the river bank. Any type of erosion in the river bank, small or big can create an incident of serious catastrophe and be a reason of big economic loss. From 1973 to till date, bank protection works under "Chandpur Town Protection Project" is preventing the shifting of river bank, thus ensuring the security of life and property of people.

The Lower Meghna River is hydraulically very complex in nature and carries huge water and sediment load. Both banks of the river have been experiencing severe erosion for the last few years. Due to lack of required rehabilitaion Chandpur Town Protection Project is being vulnerable day by day. It is a crying need to rehabilitate this project considering erosion at the adjacent areas. The Implementation of mitigation measure against the bank erosion is crucial for the advancement of overall socio-economic conditions and other facilities but this may create new problems locally and/or at upstream and downstream, if not done judiciously. To meet Sustainable Development Goals, sustainable management of the lower Meghna River

(emphasizing Chandpur Town Protection Project) is the demand of time for the protection of infrastructure, fisheries resources and socio-economic development.

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

At these circumstances, a holistic approach is required to complete the study on protection of Chandpur town and adjacent area against river erosion so that the goal of Bangladesh Delta Plan can be achieved.

Linkage with Sustainable Development Goals (SDGs):

- Goal 1: No poverty
- Goal 2: Zero hunger (No hunger)
- Goal 4: Quality education
- Goal 5: Gender equality
- Goal 13: Take urgent action to combat climate change and its impacts

How can we expect to eradicate poverty (SDG 1) or hunger (SDG 2) when floods ruin crops and destroy people's livelihoods, or for children to receive a quality education (SDG 4) if their school is flooded and school material ruined, or their route there under water? Girls are more likely than boys to be pulled out of school when a flood results in loss of income, undermining gender equality (SDG 5). Also, to combat with combat climate change and its impacts (Goal 13) we need to take actions. At these circumstances, a holistic approach is required to complete the study on protection of Chandpur town and adjacent area against river erosion so that the goal of SDGs can be achieved.

1.3 Objectives

The overall objective of the study is the sustainable management of the lower Meghna River by investigating its bank erosion processes and planform changes emphasizing Chandpur Town Protection Project and its adjacent areas. The study also aims to devising immediate and long-term erosion mitigation measures considering technical, environmental and social aspects. The study will be conducted in two components, hydrological and morphological model study as component-1 and environmental and social impact study as component-2.

The specific objectives (component-wise) of the project are:

Hydrological and Morphological Model Study (Component-1)

- To enhance the understanding of the dynamic erosion phenomena in details;
- To analyze and assess the adequacy of river cross-section downstream of Chandpur for flowing combined flow of upper Meghna and Padma;
- To predict morphological changes both in long and short term;

- To develop different potential options for protection measures considering hydrodynamic and morphological condition;
- To assess the efficacy of existing protective works and its morphological changes;
- To assess the need of dredging, dredging alignment & dredging volume and to provide detail design;
- To develop integrated and sustainable river management plan for the lower Meghna river (Mainly for Chandpur Town and its adjacent areas) with “no regret” concept (BDP 2100).

Environmental and Social Impact Study (Component-2)

- To conduct Environmental and Social Impact Assessment (ESIA) study
- To prepare environmental enhancement and conservation plan
- To prepare biodiversity conservation plan
- To develop Environmental Management and Monitoring Plan (EMMP) for conservation of aquatic resources, fisheries resources, bird sanctuaries, etc.
- To prepare Resettlement Action Plan (RAP)

1.4 Project revision with reasons: Not Applicable

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

Chandpur Municipality was established on, 01, October, 1786, with an approximate area of 2.12 sq.-miles (Siddique, 2004). The mighty Padma and Upper-Meghna rivers meet at Chandpur and the combined flow causes huge scour at immediate downstream of the confluence. The Chandpur Township both Natun Bazar and Puran Bazar are located on the left bank of the Meghna River. While, Haimchar is situated at the downstream of Chandpur, about 20 km south of it, at the left bank of the Meghna River. Here the river width is about 10 km and since 1929, erosion along the left bank has been reported (Siddique, 2004). The width of the river at immediate downstream of mole-head has been reduced from about 5km to 1.6km due to formation of bars/chars along the right bank. As a result, velocity is increased and current protective measures are under threat. The Lower Meghna River conveys the combined discharge and sediment load of the three major rivers of Bangladesh (the Jamuna, the Ganges and the upper Meghna) into the Bay of Bengal. The Chandpur town is bisected by the Dakatia river, which along with the Lower Meghna play significant role to the fate of the Nutan Bazar and the Puran Bazar.

Over the years the erosion process has been aggravated and the situation have become worse along the protective works. Tremendous whirl action due to tidal effects and as well as the drainage flow during monsoon along with wave action, tidal surge of the lower Meghna cause damage to the protective measures. No significant maintenance work was done for Chandpur Town Protection Project during last ten years, which have made it vulnerable to erosion and it requires major rehabilitations. To overcome the prevailing situation and to relief the local people from the grievances and to create a congenial situation against panic to the river erosion it has become essential to take intensive program for preventive measures along the erosion vulnerable areas. A study needs to be carried out integrating the Padma River, the Upper and Lower Meghna River and Dakatia River. For the

accomplishment of integrated projects for sustainable protection of the Chandpur Town Protection Project and to prevent river bank erosion on the left bank of Meghna River, the study area has been designed covering the stretches of the confluence of Padma-Meghna-Dakatia up-to Haimchar on the both bank of Meghna River.

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

◆ Project Identification:

To combat the thrust of the combined flow of the Ganges, the Brahmaputra and the Meghna basins, the Bangladesh Water Development Board (BWDB) has been maintaining a comprehensive erosion mitigation program in the last 50 years. Although the bank protection works at Chandpur town has not been proved permanently effective, it has been successful in arresting its eastward movement and saved the Chandpur town from major erosion throughout its existence. However, no major rehabilitation works has been carried out on the protection works for a long since. Years of fatigue combined with the reduction of channel width of the confluence has increased the pressure on the existing Chandpur Town Protection Works. A long stretch of protection works has completely been damaged near the Hari Sava mondir on the Puran Bazar side of Chandpur. The 550m of river bank is currently being protected temporarily with geo-bags only, and the region remains very vulnerable to erosion. A rehabilitation project for Chandpur Town Protection Project was proposed by concerned field office. During the review meeting of that project, it was felt and decided that a comprehensive study should be conducted prior to take any decision. Hence, BWDB decided to carry out a detail feasibility study for rehabilitation of Chandpur town protection project.

◆ Project Preparation:

The Lower Meghna River is hydraulically very complex in nature and carries huge water and sediment load. Both banks of the river have been experiencing severe erosion for the last few years. Implementation of mitigation measures against the bank erosion is important for the advancement of overall socio-economic conditions and other facilities. However, this may create new problems locally and/or at upstream and downstream, if not done judiciously. Morphological study by using mathematical modelling tool can be used as an effective approach to assess with and without project conditions in an integral manner and to devise erosion protection plan and design. Hence, BWDB decided to carry out a detail feasibility study for rehabilitation of Chandpur town protection project.

- ◆ **Appraisal:** Appraised on Departmental Project Evaluation (DPEC) meeting held on 06/09/2021.
- ◆ **Credit Negotiation:** N/A
- ◆ **Credit Agreement:** N/A
- ◆ **Credit Effectiveness:** N/A
- ◆ **Loan Disbursement:** N/A
- ◆ **Loan Conditionalities:** N/A
- ◆ **Project Approval:** The project was approved by Honorable State Minister, MoWR on 07/10/2021
- ◆ **Others (if any).**

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)*

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

It is a consultancy service procurement project. The above problems don't occur

6. Remarks & Recommendations of the Project Director:

“Detailed Feasibility Study for Rehabilitation of Chandpur Town Protection Project” was sanctioned administrative approval by Ministry of Water Resources vide **Memo no: 42.00.0000.040.014.009.2021-364, Dated: 07-10-2021.** The Project has been completed on 30/06/2022 successfully.

The overall objective of the study is the sustainable management of the lower Meghna River by investigating its bank erosion processes and planform changes emphasizing Chandpur Town Protection Project and its adjacent areas. The study also aims to devising immediate and long-term erosion mitigation measures considering technical, environmental and social aspects. The study was conducted in two components, hydrological and morphological model study as component-1 and environmental and social impact study as component-2.

The width of the Padma-Meghna confluence has gradually been declined causing reduced conveyance capacity and increased thrust of the Meghna River on the Chandpur Town protection works. Although the bank protection works at Chandpur town has not been proved permanently effective, it has been successful in arresting its eastward movement and saved the Chandpur town from major erosion throughout its existence. However, no major rehabilitation works has been carried out on the protection works for a long since. Years of fatigue combined with the reduction of channel width of the confluence has increased the pressure on the existing Chandpur Town Protection Works. A long stretch of protection works has completely been damaged near the Hari Sava mondir on the Puran Bazar side of Chandpur. The 550m of river bank is currently being protected temporarily with geo-bags only, and the region remains very vulnerable to erosion. 3360m long of River Training Works for the Chandpur Town Protection Project needs immediate rehabilitation. A rehabilitation project for Chandpur Town Protection Project was proposed by concerned field office. During the review meeting of that project, it was felt and decided that to implement a sustainable development project a comprehensive study should be conducted prior to take any decision.

The present study has been carried out integrating the Padma River, the Upper and Lower Meghna River and Dakatia River, for the accomplishment of integrated projects for sustainable protection of the Chandpur Town Protection Project and to prevent river bank erosion on the left bank of Meghna River. The study area has been designed covering the stretches of the confluence of Padma-Meghna-Dakatia up-to Haimchar on the both bank of Meghna River.

On the basis of Hydro-Morphological considerations, the prime recommendation of the study is immediate rehabilitation of 3360m river training works of the Chandpur Town Protection Project. The estimated cost of the river training works is 81749.20 lakh Tk. 13.38 km Dredging along the right bank of the Padma-Meghna confluence i.e., opposite side of Chandpur Town along the mini-Cox Bazar Chars. The dredging channel width would be of 800m with a side slope of 1:4. The capital dredging volume is estimated as 69.02 million cubic meters and the estimated cost of dredging including the maintenance dredging would be about 242481.12 lakh Tk. The dredging will attract more flow towards the dredged channel and reduce the flow velocity on the Chandpur Town protection works. Cnsidering the

complex nature of the Meghna-Padma confluence, dredger availability in Bangladesh and proposed dredged material management plan in the study, multiple dredging strategies have been formulated. Among them, the capital dredging program in two consecutive years of 400 m/year, followed by an annual maintenance dredging program shows the least amount maintenance dredging requirement after completion of the project. The impact of this project was also analyzed in the point of view of environmental & social. Environmental enhancement and conservation plan, Environmental Management and Monitoring Plan (EMMP) for conservation of aquatic resources, fisheries resources, bird sanctuaries etc. have also been addressed.

Estimated cost for the project is BDT 324885.5 Lac where Economic IRR is 17.62%, Economic NPV is BDT 76787.18 Lac and Economic BCR is 1.37. As, Economic BCR is greater than 1, thus considering it, the project is economically feasible to implement. All the major activities have been accomplished under the project. The design, cost estimate and ESIA have been prepared through this study based on which the DPP of the investment project has been finalized.

Date: 24.11.2022

(Md. Sultan Mahmud)
Executive Engineer (Civil)
Signature and seal of the Project Director
Directorate of Projects
BWDB, Dhaka

7. Remarks/Comments of Agency Head

Chandpur town, a strategic center for commercial and industrial activities, is located on the left bank of the lower Meghna River. The location is in the vicinity of the confluence of three river system, a vulnerable reach. Although BWDB has been maintaining a comprehensive erosion mitigation program for around the last 5 decades, it is worth mentioning that no major rehabilitation work has been carried out on the protection works for a long time.

The project area offers an excellent opportunity for the sustainable management of the lower Meghna River by investigating its bank erosion processes emphasizing Chandpur Town Protection Project and its adjacent areas. Evaluation results and sensitivity analysis indicate that the proposed project is economically viable. The project is thus recommended for implementation.

However, to get the maximum benefit and to ensure sustainability of the investment project, suggestions and recommendations based on the feasibility study should be followed accordingly. BWDB has already furnished a DPP based on the study report. Soon it will be sent to MoWR.

Date:

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

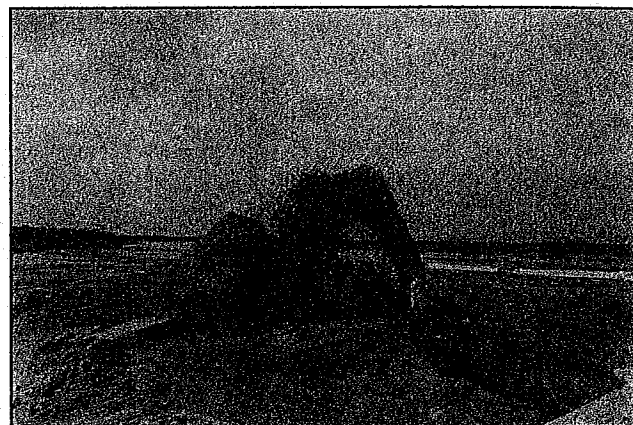
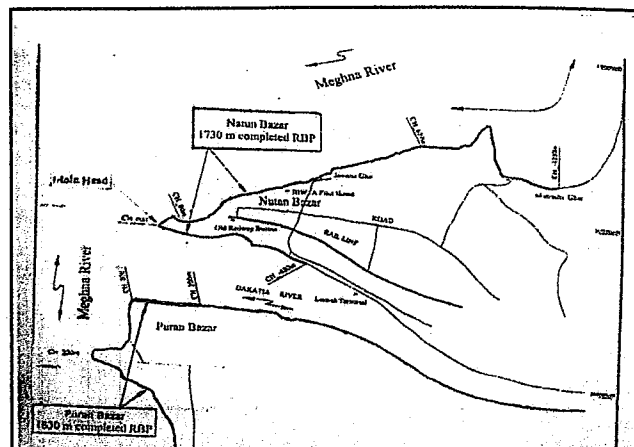
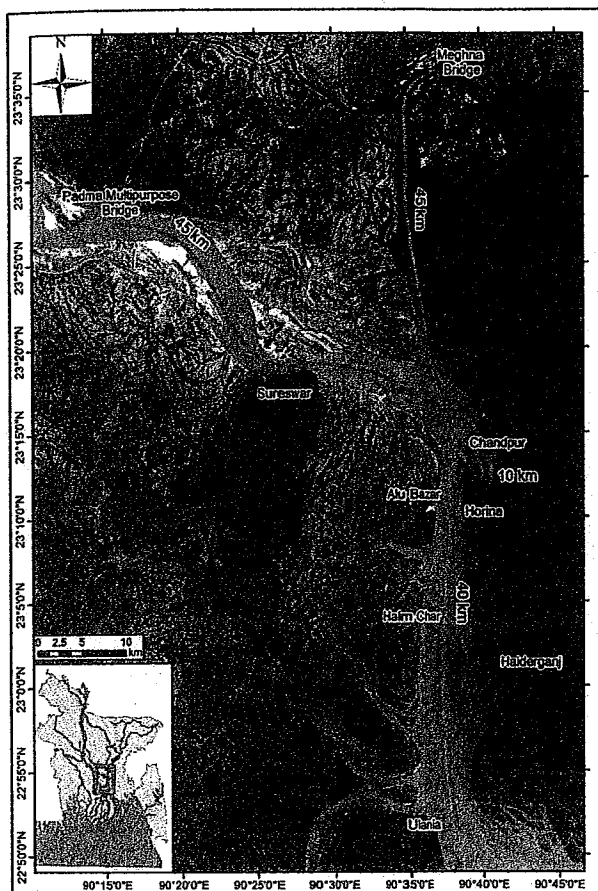
8. Remarks/Comments of the officer in- charge of the Ministry/Division

This study project has been conducted with the objective to study the sustainable management of the lower Meghna River by investigating its bank erosion processes and planform changes emphasising Chandpur Town Protection project and its adjacent area. The study also aims to devising immediate and long-term erosion mitigation measures considering technical, environmental and social aspects. On the basis of Hydro-morphological consideration in the study, the rehabilitation of 3360-meter river training works and 13.38 km dredging work at the confluence of Padma-Meghna River are needed to implementation. With the findings of this study, the proposed investment project "Rehabilitation of Chandpur Town Protection Project" will be taken.

Date:

Signature and Seal

Bangladesh Water Development Board



Hydrological and Morphological Model Study of Rehabilitation of Chandpur Town Protection Project

FINAL REPORT

JUNE 2022



INSTITUTE OF WATER MODELLING

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

Approved

(Signature) 30/06/2022
(FAZLUR RASHID)
Director General
BWDB, Dhaka.

Bangladesh Water Development Board

Hydrological and Morphological Model Study of Rehabilitation of Chandpur Town Protection Project

FINAL REPORT

JUNE 2022



INSTITUTE OF WATER MODELLING

Executive Summary

Introduction

Chandpur Municipality was established on, 01, October, 1786, with an approximate area of 2.12 sq.-miles (Siddique, 2004). The mighty Padma and Upper-Meghna rivers meet together at Chandpur. The Lower Meghna River conveys the combined discharge and sediment load of the three major rivers of Bangladesh (the Jamuna, the Ganges and the upper Meghna) into the Bay of Bengal. The combined flow causes huge scour at immediate downstream of the confluence. The Chandpur Township both Natun Bazar and Puran Bazar near the confluence and Haimchar at some downstream all are located on the left bank of the Meghna River. Erosion along the left bank has been reported since 1929 (Siddique, 2004). With the development of bars/chars along the right bank the width of the river at immediate downstream of Chandpur mole-head has been reduced from about 5km to 1.6km causing increased velocity and current protective measures under threat.

Over the years the erosion process has been aggravated. Tremendous whirl action due to tidal effects, the monsoon drainage flow along with wave action, tidal surge of the lower Meghna are causing damage to the protective measures. No significant maintenance work was done for Chandpur Town Protection Project during last ten years which, have made it vulnerable to erosion and it requires major rehabilitation. To overcome the prevailing situation, intensive program for preventive measures along the erosion vulnerable areas has become essential.

The present study has been carried out integrating the Padma River, the Upper and Lower Meghna River and Dakatia River, for the accomplishment of integrated projects for sustainable protection of the Chandpur Town Protection Project and to prevent river bank erosion on the left bank of Meghna river. The study area has been designed covering the stretches of the confluence of Padma-Meghna-Dakatia up-to Haimchar on the both bank of Meghna River. The extent of the study area has been shown in **Figure-ES1**.

This study assessed the morphological behavior of the study area by using mathematical modelling tool, to devise effective erosion protection plan and design. It also analyzed the effectiveness of the plan by simulating the models with and without project conditions in an integral manner

Problems in the Study Area

Chandpur town, a strategic center for commercial and industrial activities, is located on the left bank of the lower Meghna River. The location is in the vicinity of the confluence of three river system, a vulnerable reach. Although BWDB has been maintaining a comprehensive erosion mitigation program for around the last 5 decades, it is worth mentioning that no major rehabilitation work has been carried out on the protection works for a long time. Years of fatigue has caused some sections of the protection works weak. Even during January 2022, a part of the Protection Works near the 960m chainage of Notun Bazar collapsed creating panic among the local people. Between 780m and 1330m stretch of the protection works of Meghna River on the Puran Bazar side, the protection works have completely been damaged and this 550m river bank is currently been protected by geo-bags only. The presence of Hari Sava mandir at this stretch highlights the importance of this stretch to the local people.

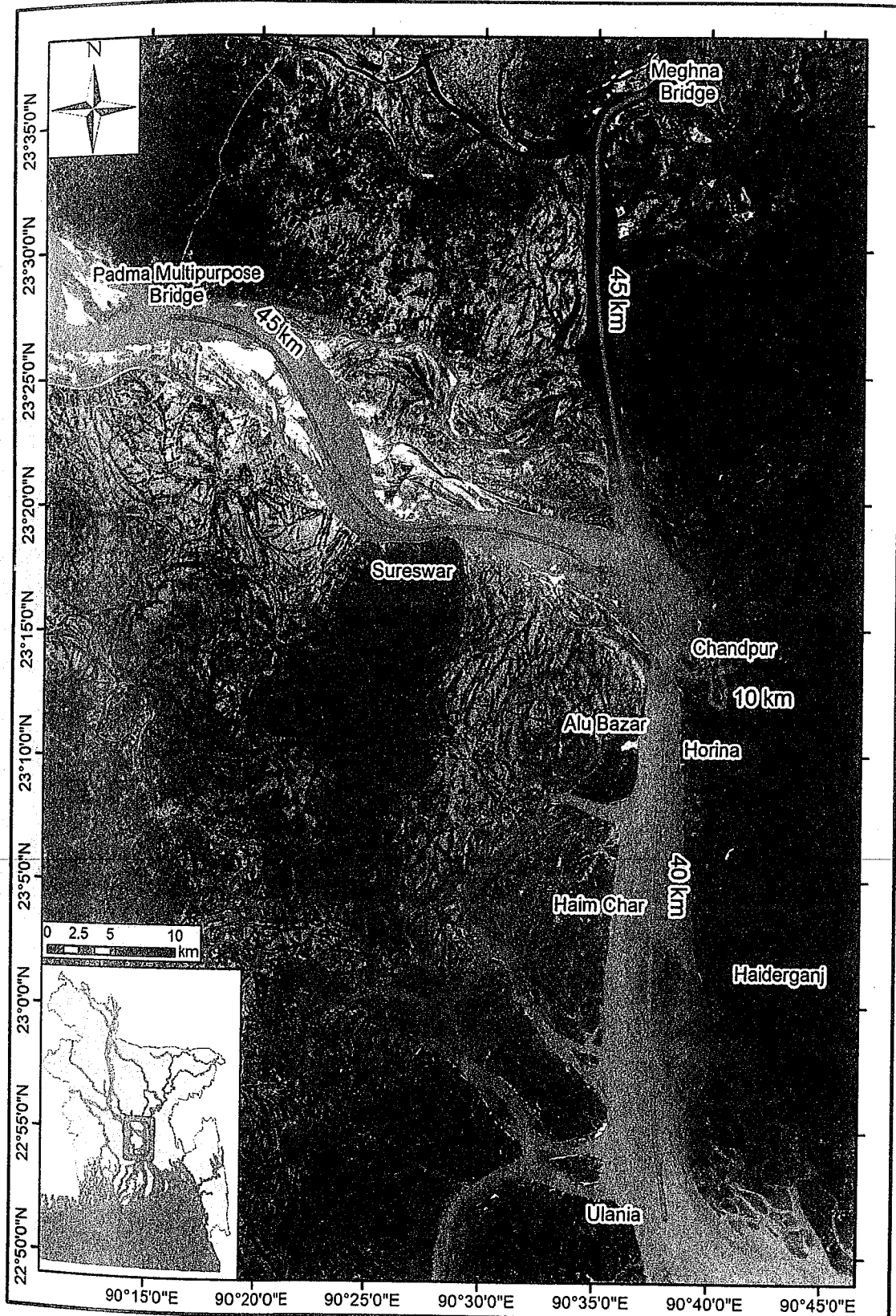


Figure-ES1 Study Area of the project

Historically the width of the Meghna River at the Meghna-Dakatia confluence is decreasing. The changes in the channel width over the years at the Meghna-Dakatia confluence is shown in **Figure-ES2**. It can be seen from the figure that the width of the channel during mid 1980s was at its peak approximately to 4750m, which was reduced drastically after the passage of the 1988 flood to around 2600m. After 2017, a sharp reduction of channel width is also seen from the figure. The channel width dropped to 2000m from 2400m between 2017 and 2018.

It has further been reduced to 1690 m in 2019. Since 2019, the channel width is remained around 1650m to 1690m during the last couple of years. Moreover, the historical changes to the cross-section of the Meghna River, upstream of the Chandpur Town (shown in **Figure-ES3**) also shows a decreasing trend of cross-section width. The cross-section width has reduced from 7500m for the year 1969-70 to 3960m for the year 1998-99.

Since the water from almost the entire Ganges-Brahmaputra-Meghna basin, drains through this narrow Chandpur-Shariatpur corridor, this decreased channel width at Chandpur creates huge pressure on the Chandpur Town Protection works and caused a deep scour hole (-57 mPWD as per surveyed in November, 2021), which also increases the vulnerability of the protection works.

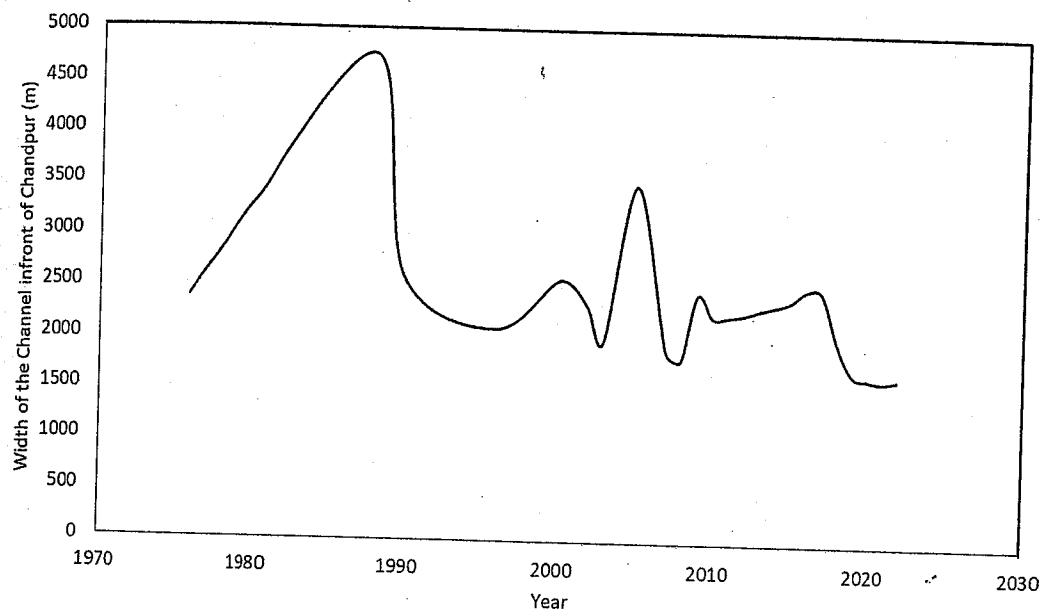


Figure-ES2 Changes of the channel width of the Meghna River in front of Chandpur since 1976 till to-date

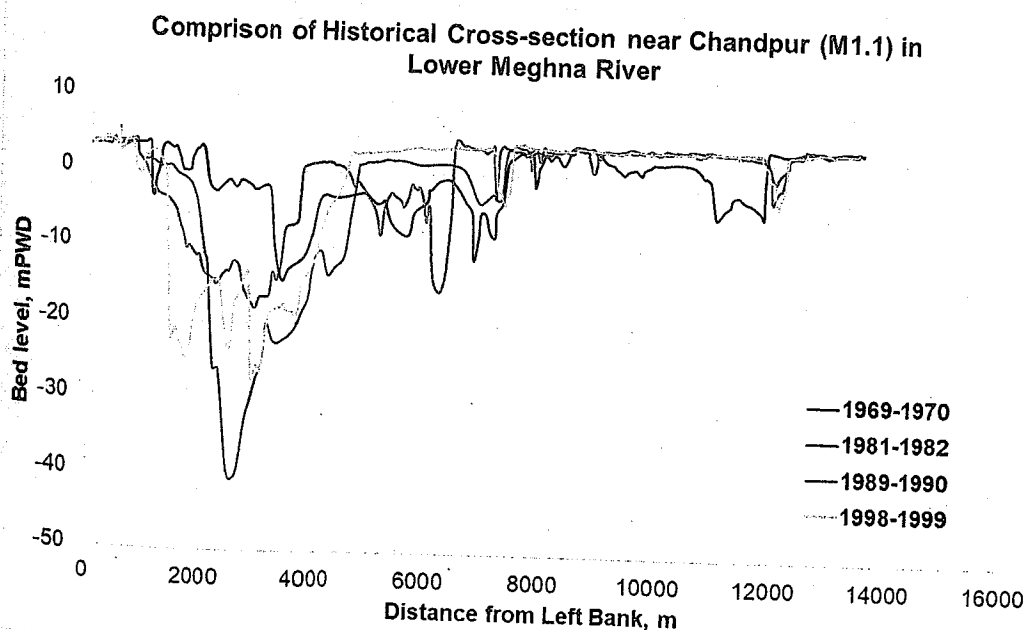


Figure-ES3 Changes to the cross-section of the Meghna River upstream of Chandpur Town (Cross-section ID: M1.1) from 1969 to 1999

Data Collection and Analysis

In order to develop one-dimensional hydrodynamic model and fully dynamic two-dimensional morphological model, extensive data collection, both primary and secondary, was made. The following data were collected:

- Bankline data
- Bathymetry/ cross-section data
- Water Level data
- Discharge data
- Bed Material data
- Suspended Sediment data
- Satellite images

Model Development and Applications

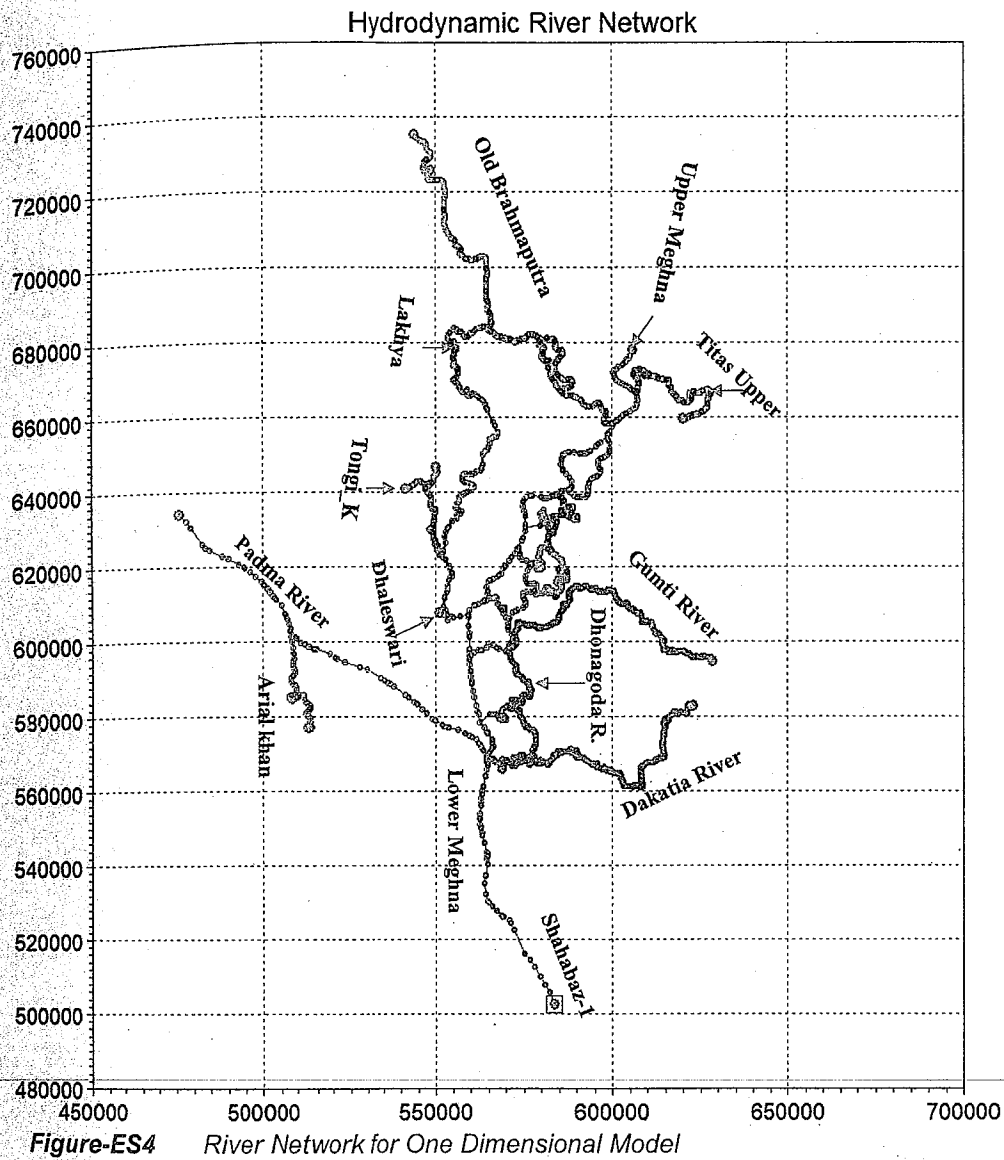
Using recent meteorological, hydrometric and hydrographic data collected under this study, one-dimensional and two-dimensional models have been developed.

A dedicated one-dimensional model using MIKE 11 has been developed for this project containing Padma, Meghna and Dakatia river as well as surrounding rivers and khals. The network of the one-dimensional model has been displayed in **Figure-ES4**. The name of the rivers deliberated for one dimensional model development is specified on the figure.

With the application of this model, flow distribution through different rivers, channels, khals, etc. in the vicinity of the study area are obtained. This model takes into account of rainfall-runoff and flood plain flow. In case of ungauged location, hydraulic parameters including flow and water level in the Meghna, Padma, Dakatia and other adjoining rivers are also output of this model. Recent surveyed cross-sections have been incorporated in the 1D model and the 1D model results have been used as the boundary condition of 2D model.

The two-dimensional model has been developed using MIKE 21C modelling tool in connection with the present study with special emphasis given to the confluence of Padma, Meghna and Dakatia, near Chandpur. The developed bathymetry for the model is shown in **Figure-ES5**. The boundary conditions were taken from the developed 1D Model. The Model has been hydrodynamically calibrated based on the data of that 1D Model as well, while it has been morphologically calibrated based on the measured suspended sediment by IWM in connection of the present project.

The developed two-dimensional model has been used to simulate the morphological changes under current condition and predict the design parameters i.e., design high water level, design discharge, scour levels, scour depth, velocity of in-front of the Chandpur mole-head. The simulated model was also used to predict bank erosion and point out the vulnerable locations within the study area. Morphological model outputs were also used to specify the length of the reach vulnerable due to bank erosion. Finally, models were used to simulate the morphological changes of the river due to the proposed interventions and assess effectiveness of different options. The outputs of the models aided the planners involved finalize the intervention for the project.



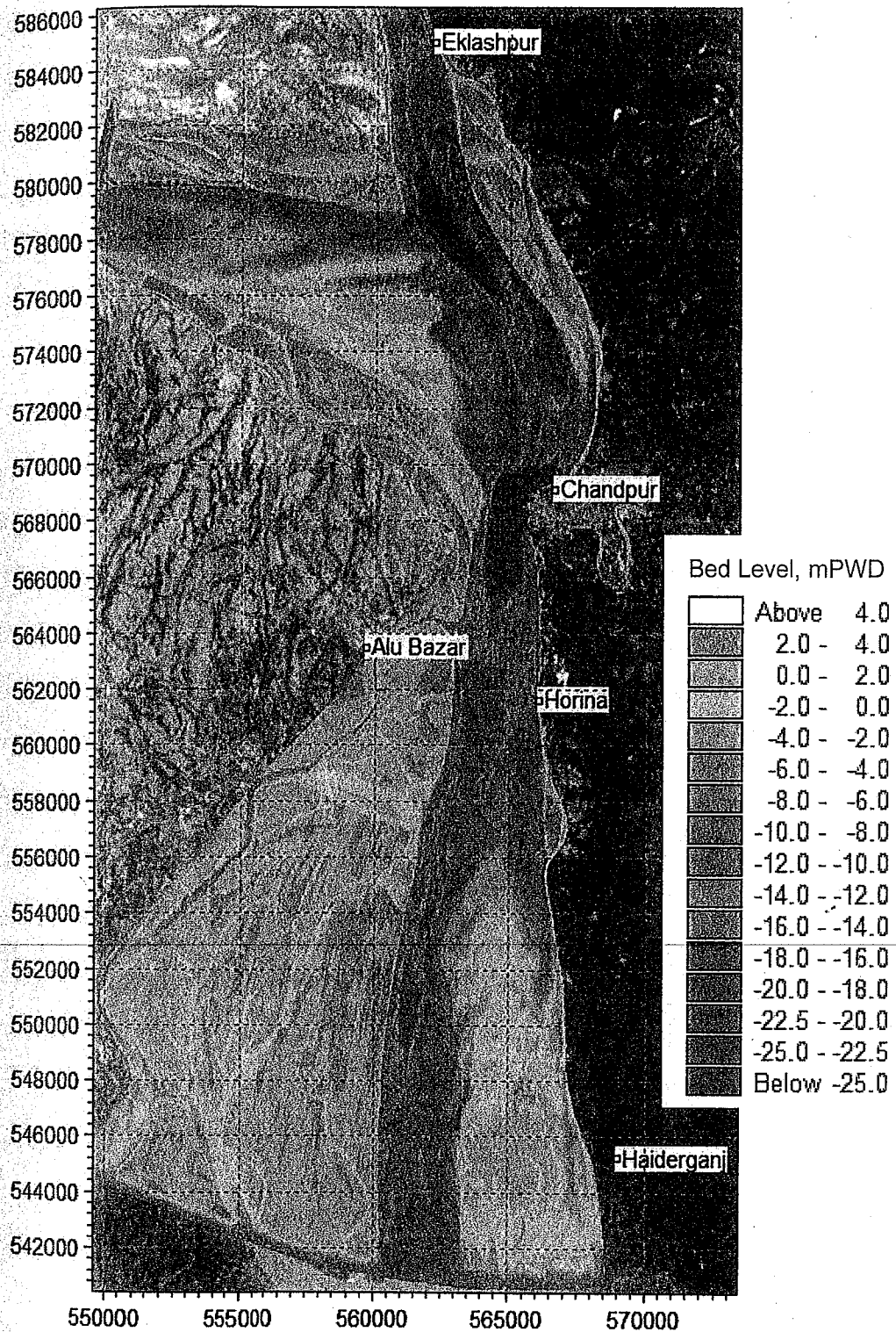


Figure-ES5 Bathymetry of the developed 2D Morphological Model

Proposed Interventions

Considering the Hydro-Morphological situation and the dynamic nature of the Padma-Meghna-Dakatia confluence, two major interventions are being proposed from technical point view evaluation and necessity to address the bank erosion of Meghna River at Chandpur as well as water resources management of the confluence of Meghna-Padma-Dakatia River. The proposed interventions are:

- i. 3360m rehabilitation of River Training Works of the Chandpur Town Protection Project
- ii. 13.38 km Dredging of 800m dredging channel width at opposite side of Chandpur along the Mini Cox Bazar Chars.

All the recommended interventions, their locations and extents have been shown in **Figure-ES6**.

River Training Works

After conducting a detailed field visit along with the officials from BWDB Planning -1, Design Circle-4 as well as field officials of BWDB and taking their valuable comments into consideration, essential 3360m River Training Works has been recommended, and designed accordingly for protection of the Chandpur Town Protection Project in this study. The location, extent and the length of the River Training Works has been given in **Table-ES1**.

Table-ES1 Location, Chainage and Length of proposed River Training Works

Location	River	Chainage	Length (km)
Notun Bazar	Meghna	0 km (Mole Head) to 1.25 km	1.25
	Dakatia	0 km (Mole Head) to 0.48 km	0.48
Puran Bazar	Meghna	0 km to 1.43 km	1.43
	Dakatia	0 km to 0.20 km	0.20

Dredging

As mentioned earlier, the width of the Meghna River at the Meghna-Dakatia confluence is decreasing. Over the years, it is evident that the width of corridor has been decreased from 4750m (1988) to around 1700m (2019). Based on a thorough reconnaissance survey, field survey as well as based on experience and consultation with the BWDB field officials, 13.38 km dredging on the right bank of Meghna River, opposite side of Chandpur has been planned under this study. The dredging is planned to increase the conveyance capacity of the corridor by increasing the corridor width from 1700m to 3000m. A dredging channel width of 800m with dredging level beginning at -7mPWD u/s where, to maintain a 5cm/km slope has been proposed. The dredging volume is calculated to the tune of 69.02 million m³. Several Dredged Material dumping and management sites have been identified based on satellite image and a two days reconnaissance survey through stakeholder consultation with local people. Chairmen, concerned UNO and DC. In general, approximately 70% of the total dredged volume can be retained and need to be managed. According to the dredged material management plan it is estimated that around 49.41 million m³ of dredged material can be dumped in the identified locations. The probable dredging alignment and dredged material dumping locations as well as Khas/Non-Khas lands of the dredged material dumping locations have been shown in **Figure-ES7**. The total area khas land was identified as 154.68 ha from the detailed mouza map and khotian analysis. Among planned total dredged material management locations 19.10% was found under khas lands.

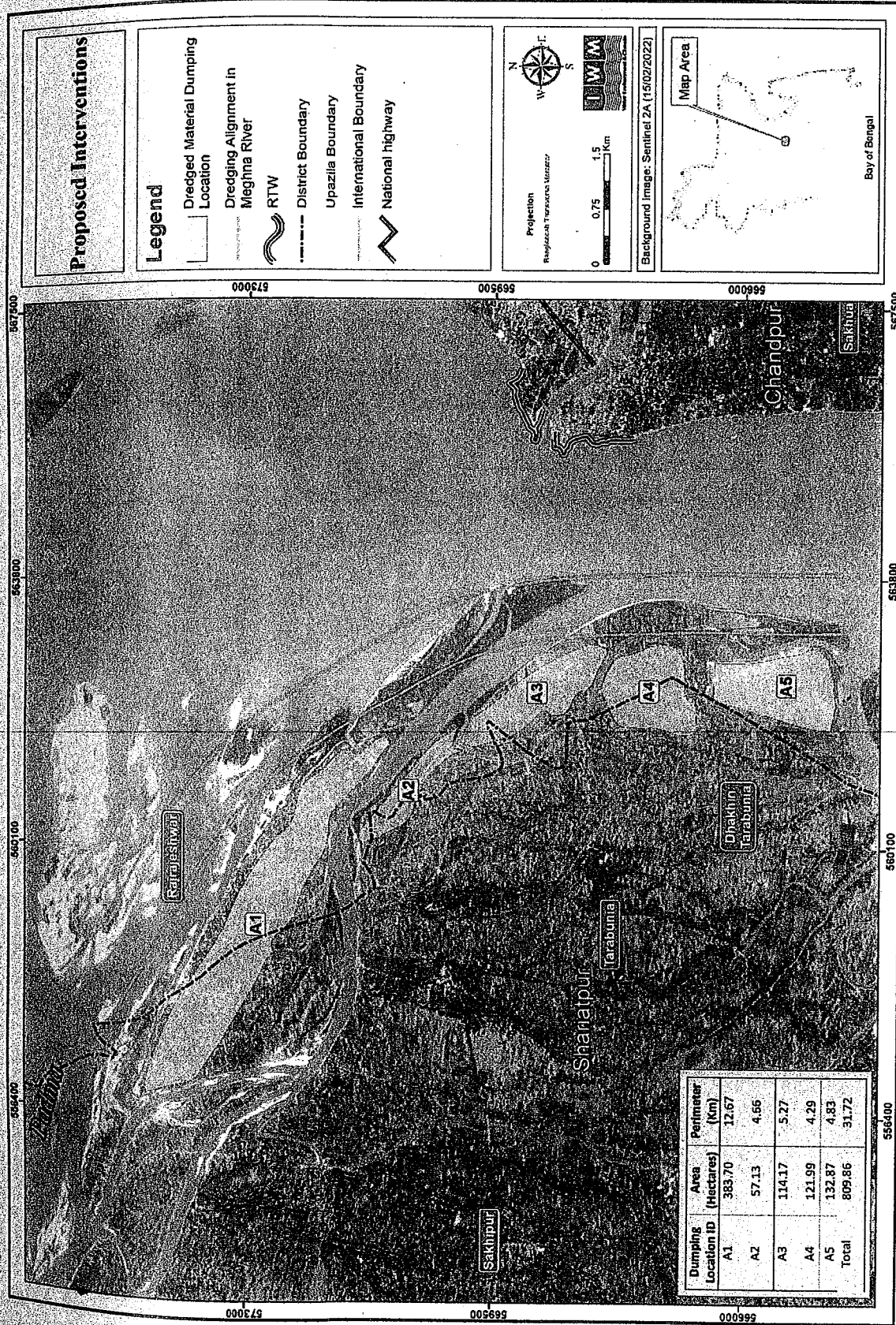


Figure-ES6 Proposed Interventions for Chandpur Town Protection

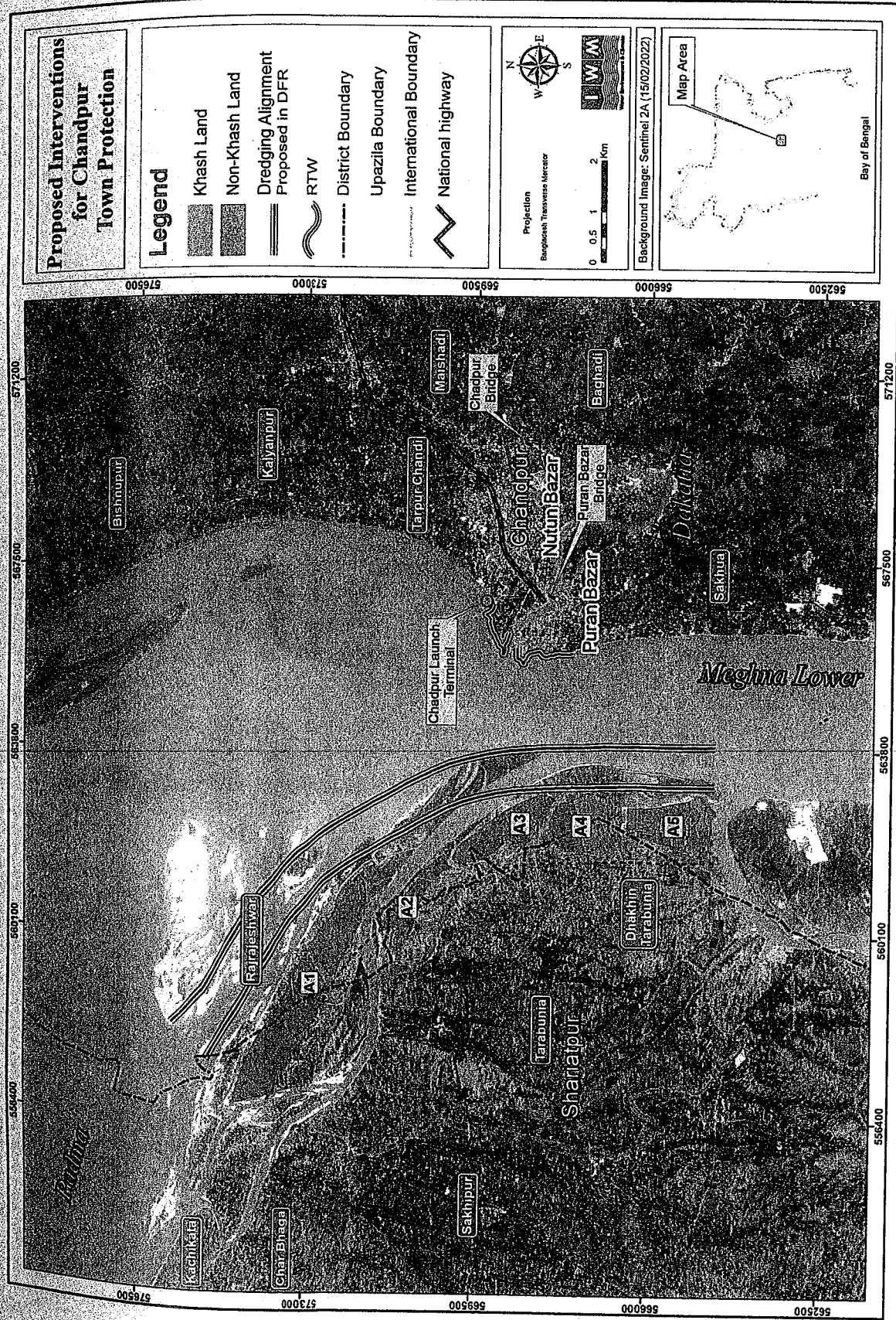


Figure-ES7 Probable Dredging alignment and dredged material dumping location

Dredging Strategy

Considering the huge amount of dredging volume in terms of availability of required nos. of dredgers, management of dredging and dredged earth and the cost associated with these dredging activities, it is highly unlikely that this capital dredging implementation will furnish within one year. Based on the available data, reconnaissance survey and consultation with the Project Director as well as concerned BWDB field officials, different dredging strategies have been developed. Finally, two different dredging options have been formulated. These are: Option 1- 200m dredging channel along the middle of the proposed dredging alignment would be excavated in the first year. In the subsequent years, further 200m @ 100m on each side would be added with the previous year's dredging channel. Hence, the bottom width of the dredging channel for this first option in the first year is 200m, the second year 400m, third year 600m, fourth year 800m. Maintenance dredging along the previous excavated channel would be carried out along with the current capital dredging program. After completion of capital dredging plus maintenance dredging during capital dredging implementation in the first four years, full maintenance dredging would be carried out in the fifth year. Option 2- plans for 400m dredging channel along the middle of the proposed dredging alignment would be excavated in the first year. Full 800m dredging channel would be dredged on the second year and in the subsequent years, maintenance dredging would be carried out all through the proposed dredged channel. The two different dredging strategy is shown graphically in Figure-ES8.

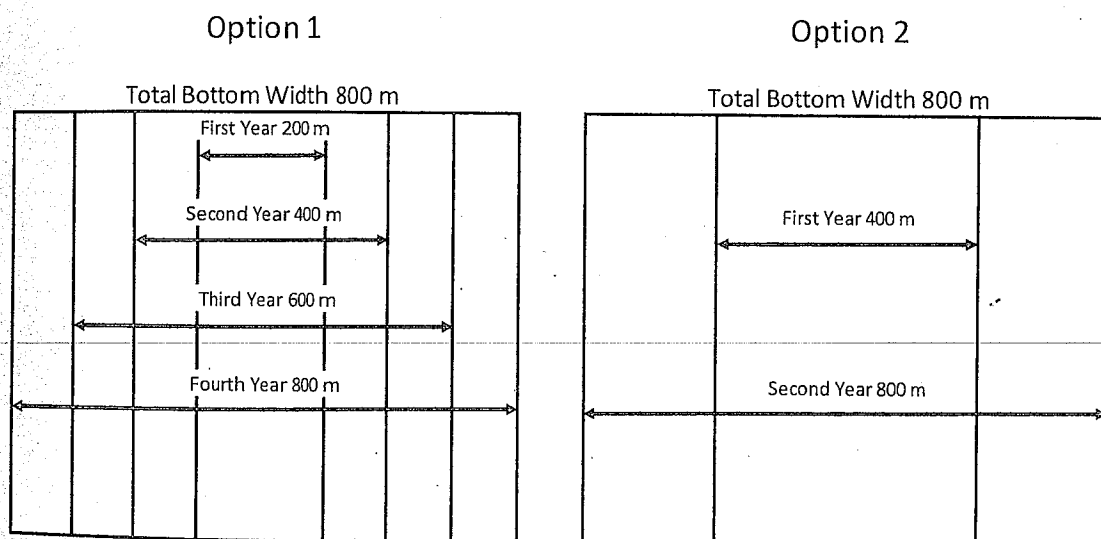


Figure-ES7 Dredging strategy

Morphological model simulations were carried out for both the above mentioned two strategies. Based on the outputs of the morphological model, the required amount capital and maintenance dredging required annually for a five-year period for each of the strategy is shown below in Table-ES2.

Table-ES2: Required amount of Capital and Maintenance Dredging for different dredging strategies

Year No	Option-1 (200m strip)				Option-2 (400m strip)			
	Dredging (M m³)		Total (M m³)	Backfill (M m³)	Dredging (M m³)		Total (M m³)	Backfill (M m³)
	Capital	Maintenance			Capital	Maintenance		
For KM 0.000 to KM 2.400								
1st year	3.68	-	3.68	3.55	6.89	-	6.89	5.62
2nd year	2.88	3.55	6.43	2.46	5.75	5.62	11.37	7.44
3rd Year	4.82	2.46	7.28	5.15	-	7.44	7.44	5.36
4th Year	1.79	5.15	6.94	5.41	-	5.36	5.36	3.41
5th Year	-	5.41	5.41	-	-	3.41	3.41	-
Sub Total			29.74	16.57			34.47	21.83
For KM 2.401 to KM 5.000								
1st year	4.40	-	4.40	3.40	8.01	-	8.01	4.91
2nd year	2.85	3.40	6.25	3.10	5.24	4.91	10.15	7.33
3rd Year	4.76	3.10	7.86	5.46	-	7.33	7.33	5
4th Year	1.40	5.46	6.86	5.75	-	5.00	5	3.18
5th Year	-	5.75	5.75	-	-	3.18	3.18	-
Sub Total			31.12	17.71			33.67	20.42
For KM 5.001 to KM 7.800								
1st year	4.38	-	4.38	1.14	8.75	-	8.75	0.96
2nd year	3.17	1.14	4.31	3.82	6.09	0.96	7.05	7.27
3rd Year	4.82	3.82	8.64	3.69	-	7.27	7.27	3.41
4th Year	1.52	3.69	5.21	3.88	-	3.41	3.41	2.17
5th Year	-	3.88	3.88	-	-	2.17	2.17	-
Sub Total			26.42	12.53			28.65	13.81
For KM 7.801 to KM 13.380								
1st year	5.81	-	5.81	0.98	12.32	-	12.32	0.86
2nd year	4.77	0.98	5.75	0.26	9.47	0.86	10.33	1.65
3rd Year	5.15	0.26	5.41	1.58	-	1.65	1.65	3.14
4th Year	4.97	1.58	6.55	1.66	-	3.14	3.14	2.01
5th Year	-	1.66	1.66	-	-	2.01	2.01	-
Sub Total			25.18	4.48			29.45	7.66
Total			112.46				126.24	

Vulnerable Reaches in the Study Area

Along with the rehabilitation of the Chandpur Town Protection Project, the model was used to predict vulnerable locations due to bank erosion in the study area. Model predicted bank erosion at Alu Bazar (2200m reach), Ishanbala Bazar (4300m reach), Hanarchar (4000m reach) and Haimchar EPZ (17km area surrounding the EPZ). Considering the importance of the locations, 1400m of bank protection works at Alu Bazar, 2800m bank protection works at Ishanbala Bazar and 4000m of bank protection works at Hanarchar has been suggested for the time being.

Cost Estimate

The total cost of proposed works and component wise costs have been shown in **Table-ES2**

Table-ES2 Costs Estimates of different components of the proposed project

Sl.	Component	Unit	Quantity	Total Cost (Lakh taka)
1	Dredging & Maintenance Dredging (13.38km of Meghna River & 5.3km of Tarabunia Channel)	M m ³	118.10	242481.12
2	River Bank Protection	km	3.36	81749.2
3	Tree Plantation	no	30300	372.04
4	Ichuli Stack Yard Boundary Wall Construction	km	0.486	283.14
Total				324885.5

Economic Analysis

The economic indicators are computed for the Project to judge its economic viability. These indicators include Net Present Value (NPV), Benefit Cost Ratio (B/C Ratio) and Economic Internal Rate of Return (EIRR). The analytical results of economic analysis are summarized in **Table-ES3**.

Table-ES3 Results of Base case Economic and Financial Analysis (Lakh BDT)

Viability Indicator	Result
1. Capital Cost Financial (Lakh BDT)	326189.00
2. Capital Cost Economic (Lakh BDT)	257573.30
3. O&M Cost Financial (Lakh BDT)	8503.50
4. O&M Cost Economic (Lakh BDT)	6526.86
5. Economic Benefit Cost Ratio (BCR @ 12%)	1.37
6. Economic Net Present Value (ENPV @ 12%) Lakh BDT	76787.18
7. Economic Internal Rate Return (EIRR %)	17.62%

The economic analysis of projects is generally based on uncertain future events and imperfect data. Also, certain risks are inherent in project planning and implementation. So, a sensitivity analysis, Sensitivity Indicator and Switching Values of the project, EIRR has been conducted for the Project, based on variations in the level of costs and benefits, due to various uncertainties and risks involved in the project investment. By switching values, it can be indicated that EIRR will remain same for the opportunity cost of capital (12%) if the cost increases up to the indicated percent in the **Table-ES4** and EIRR will remain same for the opportunity cost of capital (12%) if the benefit decreases up to the indicated percent in the **Table-ES4**. The findings of sensitivity analysis and Switching Values are summarized in **Table-ES4**.

Table-ES4: Sensitivity and Switching Value Indicator

Sl no.	Variables	Variance	EIRR	NPV (Lakh Taka)	Sensitivity Indicator (SI)	Switching Values (SV) %
	Base Case	-	17.62%	76787.18	-	-
1	Investment Cost Increased by + 10%	10%	15.99%	58762.7	2.35	42.60
2	O & M Cost Increased by + 10%	10%	17.44%	74020.9	0.36	277.58
3	Total project Cost Increased by + 10%	10%	15.82%	55996.4	2.71	36.93
4	O&M Cost saving decreased by - 10%	-10%	17.55%	75727.6	0.14	724.69
5	Reclaimed Land Value decreased by - 10%	-10%	17.29%	73153.0	0.47	211.29
6	Protective benefits decreased by - 10%	-10%	16.03%	53011.4	3.10	32.30
8	Total benefits decreased by - 10%	-10%	15.63%	48317.7	3.71	26.97
9	Total Cost Increased by + 10% and Total Benefit decreased by - 10%	Both	13.93%	27526.9	6.42	15.59

SUMMARY FINDINGS AND RECOMMENDATIONS

A summary of the study findings has been listed below:

- The width of the Padma-Meghna confluence has gradually been declined causing reduced conveyance capacity and increased thrust of the Meghna River on the Chandpur Town protection works.
- Although the bank protection works at Chandpur town has not been proved permanently effective, it has been successful in arresting its eastward movement and saved the Chandpur town from major erosion throughout its existence.
- However, no major rehabilitation works has been carried out on the protection works for a long since. Years of fatigue combined with the reduction of channel width of the confluence has increased the pressure on the existing Chandpur Town Protection Works.
- A long stretch of protection works has completely been damaged near the Hari Sava mondir on the Puran Bazar side of Chandpur. The 550m of river bank is currently being protected temporarily with geo-bags only, and the region remains very vulnerable to erosion.
- 3360m long of River Training Works for the Chandpur Town Protection Project needs immediate rehabilitation. The design parameters for river training works have been developed through two-dimensional morphological model, which in term has been verified from relevant past literatures. The design velocity is found as 4.10 m/s at the 1 in 100-year flood event (1998) while, the design scour level is found as -62 mPWD from model simulations.
- To increase the river width of the Meghna-Dakatia confluence, a 13.38 km of dredging channel was developed. The capital dredging volume is calculated to the tune of 69.02 million m³. The flow velocity at the Chandpur Town Protection Works fell drastically once the dredging section was inserted in the mathematical model. The model estimated maximum velocity at the Chandpur Town Protection Works is found to fall down to 3.62 m/s from 4.10 m/s. The morphological analysis also shows formation of a more defined channel along the dredging alignment with the channel actually getting more eroded towards the downstream reach of the dredging alignment, indicating self-dredging in those reaches. However, some deposition is observed in the upstream sections of the dredging alignment. The volume of maintenance dredging is found as 18.05 million m³ after design flood event simulation.
- Considering the complex nature of the Meghna-Padma confluence and the availability of required nos. of dredgers, management of dredging and dumping of dredged earth, multiple dredging strategies were formulated.
- Dredging was also considered in the Tarabunia channel. The 5.30km dredging of the Tarabunia channel has 68% siltation rate for the design flood event simulations, but has only minor benefits from technical aspects. However, since Tarabunia channel is an important navigational channel, dredging would have a positive impact for the local people. Moreover, it would increase fish cultivation as well as act as a naval shelter.
- Considering these benefits, the dredging of the Tarabunia channel may be carried out. However, the dredging of the Meghna River has to be carried out before dredging the Tarabunia channel. The response of the confluence of the Padma-Meghna River, due to the dredging of the Meghna River has to be assessed before implementing the dredging of the Tarabunia channel. The design of dredging may have to be revisited based on the scenario of the river after implementation of dredging of the Meghna River.
- Morphological model predicted bank erosion in Alu Bazar (2200m river stretch), Ishanbala Bazar (4300m river stretch), Hanarchar (3000m river stretch) and Char Bhairabi (7000 river stretch). Around 17km stretch of the char surrounding the proposed Haimchar EPZ is found to be vulnerable to erosion.

On the basis of Hydro-Morphological considerations only, the recommendation of the study is described below:

- Immediate rehabilitation of 3360m River Training Works of the Chandpur Town Protection Project. The estimated cost of the River Training Works is 81749.20 lakh Tk.
- 13.38 km Dredging along the right bank of the Padma-Meghna confluence i.e., opposite side of Chandpur Town along the Mini Cox Bazar Chars. The dredging channel width would be of 800m with a side slope of 1:4. The capital dredging volume is estimated as 69.02 Mm³ and the estimated cost of dredging including the maintenance dredging would be about 242481.12 lakh Tk. The dredging will attract more flow towards the dredging channel and reduce the flow velocity on the Chandpur Town protection works.
- Phasing of the dredging work considering the complex nature of the Meghna-Padma confluence and the nos. of available dredgers, management of dredging and dumping of dredged earth. Multiple dredging strategy were formulized, among which the capital dredging program in two consecutive years of 400m/year, followed by an annual maintenance dredging program shows the least amount maintenance dredging requirement after completion of the project.
- Pre-dredging/check hydrographic survey before implementation. Revisit of the dredging plan and recalculation of dredging volume based on the prevailing conditions.
- Detailed morphological modelling study/monitoring during yearly implementation of the dredging to predict the channel movement and possible maintenance dredging requirement for upcoming year.
- The 5.30km dredging of the Tarabunia channel at the lower part along with regular maintenance dredging. Considering some essential benefits from social and local context of view such as, improved navigability in the channel, vessel shelter, increased fish cultivation etc. However, the dredging of the Meghna River has to be implemented fully and the response of the confluence of the Padma-Meghna River, due to the dredging of the Meghna River has to be assessed, which may require revisit of the requirement and extent of the dredging of the Talbunia channel.
- Considering the importance of these locations, 1400m of bank protection works at Alu Bazar, 2800m bank protection works at Ishanbala Bazar and 4600m of bank protection works at Hanarchar have been suggested for the time being.
- Strengthening of existing protection works at downstream of Chandpur Town Protection Works in Ibrahimpur- Shakua area under Chandpur Sadar Upazilla & from Katakhal to Charbhairabi area under Haimchar Upazilla followed by future monitoring & maintenance of these bank protection works.
- The multi-criteria analysis for different options have been assessed with only Hydro-Morphological considerations. The options which seem the best suited technically, might not be considered as environmental and social friendly. As such, a detailed ESIA study need to carried out for all the options and incorporated into the multi-criteria analysis.

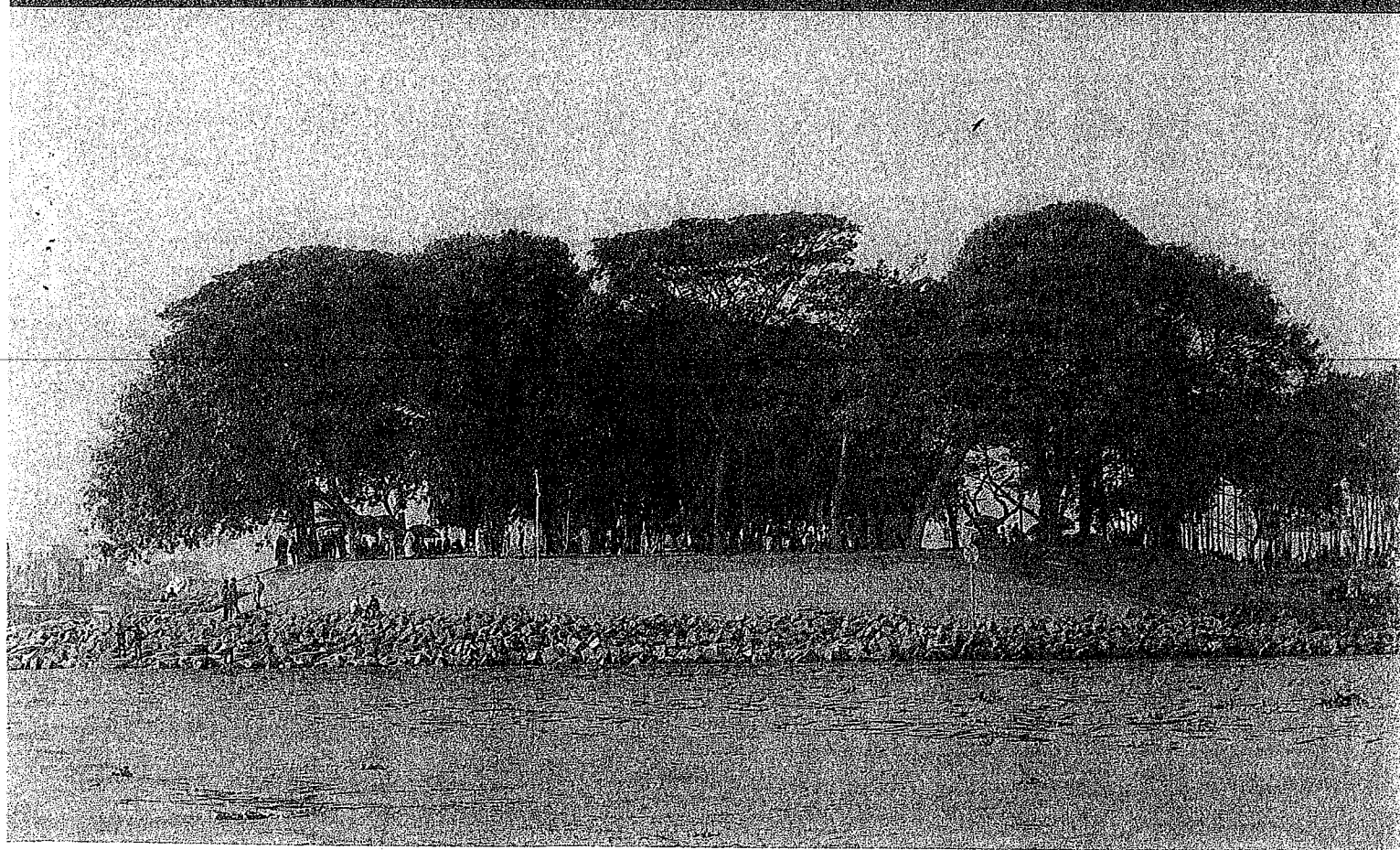


Bangladesh Water Development Board

Final ESIA Study Report

for

Rehabilitation of Chandpur Town Protection Project

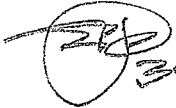


June 2022

C&GIS

Center for Environmental and Geographic Information Services

Approved

 30/06/2022

(FAZLUR RASHID)
Director General
BWDB, Dhaka.

Final ESIA Study Report
for
Rehabilitation of Chandpur Town Protection Project

Executive Summary

Chandpur town is situated at the junction of the Padma, Upper Meghna, Lower Meghna, and Dakatia rivers. The town encounters the onrush of huge upstream flow and sediment at onehand and tidal influence on the otherhand. As a consequence, it is subjected to severe bank erosion and other natural calamities. Riverbank erosion is a common phenomenon in this area. Every year severe bank erosion occurs and destroys thousands of settlements, agricultural lands, and and other vital installations. Local people lose their livelihood due to bank erosion and become refugees in some cases. The town however, provides services through the riverway, railway, and roadway transportation system due to its favourable geographical situation and significantly contributes to the national economy.

In this context, BWDB has been implementing river bank protection and other pertinent projects since the past to save the town from bank erosion and other calamities and keep running the transportation services for economic growth. However, the present condition of the earlier implemented protection work has been dilapidated. As such, BWDB has planned to strengthen river bank protection work. After the monsoon, BWDB has to strengthen riverbank protection work. Otherwise, there is the possibility to be damaged. To that end, BWDB has awarded IWM to conduct the feasibility study and CEGIS to conduct the ESIA study.

The feasibility study team (IWM) suggested a number of interventions, include 3360 m rehabilitation river training works and 13.38 km dredging of 800m channel width at the opposite side of Chandpur along the Mini Cox's Bazar Chars.

The Chandpur Sadar is an Upazila and one of the most densely inhabited places in the Chandpur District. It has an area of 308.8 km² with a density of 1,400 per km². It includes Chandpur Municipality and 14 Union Parishads. Chandpur city i.e. the municipality (22 km²) was established in 1778. This Upazila is situated at the intersection of three rivers: The Meghna, the Padma, and the Dakatia. The Sadar Upazila is separated into two portions by the Dakatia River: North and South. The north portion of the Chandpur Upazila is known as "Natun-Bazar," while the south is known as "Puran Bazar".

Chandpur is an important hub for the inland waterways of Bangladesh. As it is the confluence point of the Padma, Meghna, and Dakatia, all the water vessels of these rivers berth at Chandpur Terminal. Almost 40 launches move at Chandpur terminal per day. There are different types of launch such as one story, two-storied, three-storied, etc., which departs every hour. These launches move all day round and the terminal is busy all day long.

The study area is covered by seven (7) agro-ecological zones such as Active Brahmaputra-Jamuna Flood plain, Young Brahmaputra and Jamuna Floodplain, Old Brahmaputra Floodplain, Active Ganges Floodplain, Low Ganges River Floodplain, Ganges Tidal Floodplain, and Middle Meghna River Floodplain. The major land use category is river, which is 45,460 ha (61.60% of the gross area). On the other hand, the net cultivated area is 14,573ha (19.75% of the gross area) 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 (41.3% of NCA) falls under medium low land followed by medium high land (40.8% of the NCA) and low land (18.4% of the NCA) respectively. Besides, the soil texture of the study area is dominated by loam (49.4% of the NCA) followed by sandy loam (32. 7% of the NCA), clay loam (16.2% of the NCA), clay loam/loam (1.5% of the NCA) and clay (0.2% 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 medium level (70.3%) of soil moisture followed by high level (23.6%) and low (6.1%).

From the SRDI Lab Test analysis, it reveals that the pH ranges of the study area are very strongly acidic to slightly alkaline. The salinity level is non-saline in all the locations. The level of Organic Matter (OM) and Nitrogen (N) concentration is high and medium in all the locations. The concentration of Phosphorus (P),

is low to high and Sulphur (S) content is high. The concentration of Potassium (K) is low to high. Heavy metals like Lead (Pb), and Cadmium (Cd) concentration are present in all the locations.

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. The single, double and triple cropped area is 16.02%, 77.24%, and 6.74% respectively of the net cultivated area, while cropping intensity is 191%. Total cropped area of the study area is 27,794 ha, of which rice cropped area is 12,117 ha (43.8%) and non-rice cropped area is 15,677 ha (56.2%) in the study area.

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 river. The estimated area of total fish habitats is about 55,830 hectares (ha) of which the share of 'river and khal' is about 81% followed by the floodplain of about 18%, a semi-intensive fish pond of about 0.25%, and other habitats are of negligible percentages. The maximum erosion rates of highly erodible banks were informed to be attracted by some scour-loving fishes, like Boal (*Wallago attu*), Aire (*Sperata aor*), and Pangas (*Pangasius pangasius*). Some key fish species of the study area is Ilish, Ayre, Rita, Poa, Chewa, Bele, Shilong, pangus, Kachki, Chital, Foli. Among this species, 33% is hilsha; 14% Ayre and Poa; Chewa and Rita each occupy 10%. There are three reasons behind migration. They may be physical, chemical, and biological. Department of Fisheries (DoF, 2020) has identified the Meghna River in Chandpur as very important for the fisheries sector, especially for hilsa fisheries and breeding zone for other fish species. Riverbank is very important for the availability of nutrients, a large number of primary productions hence, it is one of the most important spawning sand nursery grounds of different fish.

The proposed "Rehabilitation of Chandpur Town Protection Project" study area has fallen under four Bio-ecological Zones namely; Major Rivers, Meghna Floodplains, Meghna Estuarine Floodplain, and Ganges Floodplain. But the major portion of the study area has fallen over the zone namely Major Rivers (74%) and the rest of the area has fallen over Meghna Floodplains (14%), Meghna Estuarine Floodplain (7%), and Ganges Floodplain (5%). The major terrestrial habitat patterns in the study area are Homesteads, Roadside, Crop field, and Floodplain and Char land vegetation.

This area houses 454175 people (*area percentage from GIS spatial analysis*), which has been worked out from the Population and Housing Census 2011 BBS, 2012. This population reside in 98707 households. Here the number of males is 222939 (49%) and females is 231236 (51%), whereas the sex ratio is 96 indicating 96 numbers of males in the counterpart of 100 females.

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. Besides, Dust particles may be generated during filling of geo-bag, manufacturing of CC block, vehicle movement, and transportation of construction materials and equipment. Apart from that, Vegetation will be damaged at footprint areas due to the construction of the site office, labor shed, and stock yard.

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. Noise will be generated from the mixture machine, vibrator, for manufacturing of CC block and dredging. The increased noise level may cause health hazards such as disturbance in sleeping, anxiety, hearing impairment, etc. of the workers as well as of the local people around the project area. The water

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quality might be affected in various ways during the river training works of the Chandpur Town Protection project. A huge amount of dredged materials will be generated from the dredging activities, which will then be transported to the mainland for safe disposal. To dredge a huge volume a number of dredgers will be engaged for a period. This long time dredging will increase the suspended matters at the dredging sites and their close vicinity. The proposed activities, dredging in particular may hinder the longitudinal migration of different fish species (Hilsa Shad, Bacha, Kakila, Ghonia, Chapila, Gharua, Boro Baim, etc.) temporarily. The proposed activities, dredging in particular may hinder the longitudinal migration of different fish species (Hilsa Shad, Bacha, Kakila, Ghonia, Chapila, Gharua, Boro Baim, etc.) temporarily. Implementation of protection works is suspected to damage vegetation along the bankside at Bangabandhu Parjatan Park and from Molehead to Chandpur Launch terminal. The Dredging footprint sites are suspected to increase turbidity and unstable the benthic layer of the river. As such, the habitat quality for aquatic animals like dolphins, fishes and mollusks will be deteriorated. The bankside cluster villages will be vulnerable to erosion due to dredging in Mini Cox's Bazar area. The livelihood of the boatmen as well as small businessmen at the Mini Cox's Bazar area developed on tourism, may also be affected by the dredging of this spot.

A number of mitigation measures have been proposed for mitigating the negative impact of the project. These are: the onsite wastes should be properly contained and prevented from escaping into neighboring fields and properties; there should be a provision for geo-bag/sandbag dumping/placing on an emergency basis if riverbank failure occurs; 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; throwing/Releasing of construction and other wastes (unused concrete, washed off coarse aggregates, litters etc.) into the water body should be prohibited; a confinement area should be built so that small fish and juvenile do not enter the construction/dredging site; in the case of hilsha migration, dredging should be suspended during minor spawning season (February-March) and major spawning season (September-October); avoid dredging during dolphin movement time, especially at dusk and dawn; dredged materials should be placed in the barren area; there should be coordination among the BWDB, DC, and BR for temporary relocation of those evicted households to the spare Bangladesh Railway (BR) lands. The dredged material management plan; biodiversity conservation plan; development plan for agriculture, fisheries, navigation & urbanization should be implemented properly.

Riverbank will be stable at Chandpur in the post-construction phase. Total crop production would be increased by about 5,468 metric tons (5.5%) in the future with the project in the study area compared to the future without project. Similarly, fish production will be 23.374 MT/year out of which capture fish will be 21.816 MT, and culture fish will be 798 MT as well a newly riverbank habitat would be established to promote flagellate-dependent food chain. The fish migration rate will increase due to dredging activity. On the other hand, the migration rate will decrease for a certain period due to maintenance dredging. Besides, aquatic habitat conditions will be improved by increasing the depth of the water in the river and vegetation damage will be reduced in the erosion-prone area for riverbank protection. On the other hand, Out-migration due to the erosion effect could be controlled and decreased as well. Town will be protected and scope of commercial and industrial development will be created. As a result, investors will be interested in land purchasing for industrial development, thus employment opportunities will be created for literate and semi-skilled workers in newly developed industries and commercial enterprises.

In the above context, it is recommended that the project should be implemented for protection of the Chandpur Town and saving the lives and livelihood of its population, vital installations of the town, the socio-economic benefit and livelihood improvement of the area in particular and of the country as a whole.

