2020-21

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

Bangladesh Water Development Board

PROJECT COMPLETION REPORT : IMED 04/2003 (Revised)

for

Feasibility Study for the Development and Management of Karnafuli River Basin (with Halda River)

August, 2021

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 the Development and Management of Karnafuli River Basin (with Halda River) **(Project code- 222008700)**
02.	**Administrative Ministry/Division**	:	Ministry of Water Resources (MoWR)
03.	**Executing Agency**	:	Bangladesh Water Development Board (BWDB)
04.	**Location of the Project**	:	Chattogram and Rangamati District

05. Objective of the Project:

The overall objective of the study is to carry out a holistic and integrated study for development of Karnafuli river basin improvement plan considering technical, environmental, social and economic aspects.

The specific objectives are:

- To identify past and present problems on water scarcity, sedimentation, flood, erosion, river ecology, fisheries in the Karnafuli river basin including interconnected tributaries/distributaries
- To establish Environmental Flow requirement of all the rivers within the Karnafuli river basin.
- To develop integrated river management plan for the restoration of Karnafuli river basin with **"no regret"** concept (BDP 2100).
    - To prepare afforestation plan considering classification of trees
    - Preparation of environmental enhancement and conservation plan
    - Preparation of biodiversity conservation plan
    - To conduct an Environment and Social Impact Assessment (ESIA) study.
    - To develop Environmental Management and Monitoring Plan (EMMP) for conservation of aquatic resources, fisheries resources, bird sanctuaries including forest resources considering the ecologically critical areas (ECA).

06. Estimated Cost :

(In lakh Taka)

	Original	**Latest Revised**
(a) Total	497.00	-
(b) Taka	497.00	-
(c) Foreign Currency	-	-
(d) Project Aid	-	-
(e) RPA	-	-

07.	Date of Approval	:	PCP/PFS	PP
	(a) Original	:	11.09.2019	
	(b) Latest Revised	:	-	
	(c) No cost time extension		15.09.2020	

08. Implementation Period :

	Date of Commencement	Date of Completion
(a) Original	September 2019	December 2020
(b) Latest Revised	N/A	-
(c) Actual	September 2019	June 2021

09. Financing Arrangement (Source-wise):

9.1 Status of Loan/Grant

a) Foreign Financing : *Not Applicable*

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

b) GOB:

(In lakh Taka)

Total amount	Loan	Grant	Cash Foreign Exchange
1	2	3	4
497.00	-	497.00	-

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 2019-December 2020 (16 month)	-	September 2019-June 2021 (22 month)	37.5 %	Due to covid-19 situation, the project could not be completed in the stipulated time.

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	497.00	-	481.58	-	The actual expenditure was less than the estimated cost.
TAKA	497.00	-	481.58	-	
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	-	-	-	10	1
Staff(s)	14	-	-	-	8	6
Total :	25	Existing Manpower of Directorate of Planning-1, BWDB			18	7

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

Field of Training /Study tour/workshop/ Seminer etc.	Provision as per PP		Actual		Remarks
	Number of person	Man - months	Number of person	Man - months	
1	2	3	4	5	6
a. Foreign	No provision of training in this project		N/A	N/A	
b. Local			N/A	N/A	

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 (±)
		Physical	Financial	Physical (%)	Financial	
1	2	3	4	5	6	7
A. Revenue						
1. Feasibility Study (Local Professionals)	Man-Month	75	484.83	75	473.87	
2. Stamps and seals	LS	100%	0.10	100%	0.10	
3. Other stationary	LS	100%	1.50	100%	1.48	
4. Honorarium	LS	100%	3.00	100%	3.00	
5. Domestic travel expense	LS	100%	1.07	55%	0.46	
6. Fuel and Gas	LS	100%	1.00	30%	0.20	
7. Petrol, Oil and Lubricants	LS	100%	1.00	30%	0.00	
8. Cleaning and Washing	LS	100%	0.50	100%	0.50	
9. General Supplies	LS	100%	1.00	100%	0.99	
10. Entertainment Expenses	LS	100%	2.00	50%	0.00	
Sub-total (Revenue):			**496.00**	**99.42%**	**480.60**	
B. Capital						
11. Computer and accessories	LS	100%	1.00	100%	0.98	
Sub-total (Capital):			**1.00**	**100%**	**0.98**	
Grand-Total		**100%**	**497.00**	**99.42%**	**481.58**	

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 Grade-4; 50,000-71,200	Full time	-	Yes	11.11.2018 (Charge assume date)	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	-	-	-	-	-	
Microbus	-	-	-	-	-	
Minibus	-	-	-	-	-	
Bus	-	-	-	-	-	
Pick-up	-	-	-	-	-	

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
Truck	-	-	-	-	-	
Motor Cycle	-	-	-	-	-	
By-cycle	-	-	-	-	-	
Speed Boat	-	-	-	-	-	
Launch	-	-	-	-	-	
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	Tender/Bid/Proposal Cost (in lakh Taka)		Tender/Bid/Proposal		Date of completion of works/services and supply of goods	
/consultancy) as per bid document	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 "Feasibility Study for the Development and Management of Karnafuli River Basin (with Halda River) in Sylhet District"	484.83	473.87	02.10.2019	28.12.2019	Original: 27.11.2020 Revised: 31.06.2021	30.06.2021

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	75	75	75	

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
2019-20	-	-	-	40.05%	-	-	-	-
2020-21	497.00	497.00	-	59.95%	-	-	-	-
Total	**497.00**	**497.00**	-	**100.00%**	-	-	-	-

01. (b) Revised ADP allocation and progress :

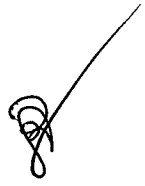
(In lakh Taka)

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
2019-20	100.00	100.00	-	40.05%	-	-	-	-	40.05%
2020-21	497.00	497.00	-	59.95%	497.00	481.58	481.58	-	59.37%
Total	**597.00**	**597.00**	-	**100.00%**	**497.00**	**481.58**	**481.58**	-	**99.42%**

D. ACHIEVEMENT OF OBJECTIVES OF THE PROJECT:

Objectives as per PP/PFS	Actual achievement	Reasons for shortfall, if any
Technical Feasibility Study		
The overall objective of the study is to carry out a holistic and integrated study for development of Karnafuli river basin improvement plan considering technical, environmental, social and economic aspects	Study has been carried out in a holistic and integrated approach for development and management of the river basin. Two options are devised and the best suited option is selected through multicriteria analysis which is technically feasible, environmental friendly, socially acceptable and economically viable.	N/A
To identify past and present problems on water scarcity, sedimentation, flood, erosion, river ecology, fisheries in the Karnafuli river basin including	The study highly emphasized on identification of the past and present problems of the river basin. Problems are identified based on analysis of data and model results, field visit, satellite image	N/A

Objectives as per PP/PFS	Actual achievement	Reasons for shortfall, if any
interconnected tributaries/distributaries	analysis, focus group discussion and community consultation. (Chapter 6 of main report)	
To establish Environmental Flow requirement of all the rivers within the Karnafuli river basin.	Environmental flow requirement is established and incorporated in Section 9.3.2 of the main report	N/A
To develop integrated river management plan for the restoration of Karnafuli river basin with **"no regret"** concept (BDP 2100).	The river basin management plan has been devised in a holistic and integrated approach considering every aspect. (Chapter 7 and Section 11.1 of the main report)	N/A
To prepare afforestation plan considering classification of trees	Afforestation plan has been prepared considering the classification of trees (Section 8.6 of the main report)	N/A
Preparation of environmental enhancement and conservation plan	Environmental enhancement and conservation plan is prepared and incorporated in section 9.5 and 9.6 of the main report. Details are provided in Volume-II	N/A
Preparation of biodiversity conservation plan	Biodiversity conservation plan is incorporated in Section 4.3 of Volume-IV (Ecology and Biodiversity Report)	N/A
To conduct an Environment and Social Impact Assessment (ESIA) study.	Environment and Social Impact Assessment (ESIA) study has been conducted. (Volume-II: Environmental and Social Impact Assessment Study)	N/A
To develop Environmental Management and Monitoring Plan (EMMP) for conservation of aquatic resources, fisheries resources, bird sanctuaries including forest resources considering the ecologically critical areas (ECA).	Environmental Management and Monitoring Plan (EMMP) has been devised and incorporated in Section 9.5 and 9.6 of the main report. Details are provided in Volume-II	N/A



E. BENEFIT ANALYSIS

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

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

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

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

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

F. MONITORING AND AUDITING

Monitoring:

Name & designation of the inspecting official	Date of Inspection	Identified Problems	Recommendations
1	2	3	4
Ministry/Agency:	-	-	
IMED: **Upama Akter** **Deputy Director, IMED-4,** **Ministry of Planning**	**13/01/2021**	Identified problems, recommendations and compliances are given as Annexure-1.	
Others:	-	-	

0.2. Auditing during and after Implementation:

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

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 yet.***

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

G. DESCRIPTIVE REPORT

1. General Observations/Remarks of the Project on:

1.1 Background

Karnafuli River originating in the Lushai hills in Mizoram state of India, is the largest and most important river in Chattogram and the Chattogram hill tracts of Bangladesh. After entering into Bangladesh the Karnafuli River meets with Choto Horina River in Barkal Upazila. In early sixties, the government constructed a dam for generation of hydroelectric power from the Karnafuli River (which is well known as Kaptai Lake) in Kaptai Upazila. At the downstream of the Kaptai dam, the main distributary rivers at its left bank are Kaptai, Shilok, Chondaria, Raikhali, Boalkhali and Shikalbaha and its right bank the Ichamati and Halda river along with the Chaktai khal and Mohesh khal are flowing through the Chattogram City. From economic perspective it is an important river of Bangladesh. Remarkably, the Chattogram port is situated on the bank of Karnafuli River and thousands of industries have been established based on this river. In spite of being economic importance, at present Karnafuli river and most of the interconnecting tributaries/distributaries/khals have been silted up. The source point of the most rivers connected to Karnafuli are in hilly areas and thus during rainy season the water from upstream carries huge volume of sediment in the river and creates char. Besides reserved forest degradation in hilly areas causes land slide. As a result the retention capacity of river is decreasing and consequently during rainy season the river water flow increases and affects the life and asset of people of the river bank area. Apart from this problem, the river water is being polluted by different ways specifically through agriculture fertilizers, pesticides, industrial wastes, wastes from Karnafuli Paper Mills, power plant etc. Certainly, this river is in threat in terms of its water quality and conveyance capacity. Besides Karnafuli river, Halda river is also significant because this river is famous for breeding Carp fishes. The role of Halda river in the country's fisheries sector is immense. According to the Fisheries Department, 18-19 percent of the carp fish hatching comes from Halda. Recently, hundreds of dead fishes have been floating in the Halda River near the port city following a suspected pollution by factories on its banks.

A meeting on proposed "Restoration of Karnafuli river" project was held in the conference room of the Ministry of Water Resources on 28th May 2018. Mr. Kabir Bin Anwar, Secretary, Ministry of Water Resources presided over the meeting. It was emphasized in the meeting to carry out a holistic and integrated study of Karnafuli river basin to solve all the prevailing problems which hinders socio-economic development. This river improvement is vital for restoration of bio-diversity, navigability, erosion and flood management. The meeting decided to conduct "Karnafuli river restoration" project through BWDB to develop a plan for revival of Karnafuli river basin. Bangladesh Delta Plan, BDP-2100 is a water centric, multisectoral techno-economic long term adaptive plan. The Mission for BDP 2100 formulated as "Ensure long term water and food security, economic growth and environmental sustainability while effectively reducing vulnerability to natural disasters and building resilience to

climate change and other delta challenges through robust, adaptive and integrated strategies, and equitable water governance."

There are 6 Goals to achieve the Delta Vision. Goal 1: Ensure safety from floods and climate change related disasters; Goal 2: Enhance water security and efficiency of water usages; Goal 3: Ensure sustainable and integrated river systems and estuaries management; Goal 4: Conserve and preserve wet-lands and ecosystems and promote their wise use; Goal 5: Develop effective institutions and equitable governance for in-country and trans-boundary water resources management; Goal 6: Achieve optimal and integrated use of land and water resources. Goals of enhancing water security, ensuring flood safety is related to river basin management. So in this context the current study project of Karnafuli River Basin Restoration is significant. Moreover Chattagram Hill Tracts and Coast is one of the Hotspots of Bangladesh Delta Plan (BDP), 2100. As the river Karnafuli flow through this Hotspot, the contribution of this study project may be considered significantly to achieve the goal of Delta Plan.

Under this circumstances, a comprehensive study is required on Karnafuli river basin including Halda River and Kaptai dam to identify the interventions to make this basin more active.

1.2 Justification/Adequacy

Karnafuli river is an important river of Bangladesh from economic perspective. Remarkably, the Chattogram port is situated on the bank of Karnafuli River and thousands of industries have been established based on this river. Chattogram City, International Airport, Hydroelectricity Center, Marine Academy, state oil refineries, fertilizer factories and other important structures are located on the banks of the river. In spite of being economic importance, at present Karnafuli river and most of the interconnecting tributaries/distributaries/khals has been silted up. The source point of the most rivers connected to Karnafuli are in hilly areas and thus during rainy season the water from upstream carries huge volume of soil/sand in the river and creates char. Beside reserved forest degradation in hilly areas cause land slide. As a result the retention capacity of river is decreasing and consequently during rainy season the river water flow increases and affects the life and asset of people of the river bank area. Apart from this problem, the river water is being polluted by different ways specifically through agriculture fertilizers, pesticides, industrial wastes, wastes from Karnafuli Paper Mills, power plant etc. Besides, Halda river which is one of the most prominent breeding places of Carp Fish in South Asia has also been affected by alarming water pollution. Industrial wastes of different factories are dumping directly into Halda river through connecting channels/khals. Researchers stated that the rate at which industrial wastes are mixing with the water of Halda river, in an instant will be turned into the similar conditions of Buriganga river at Dhaka. Apart from this, domestic waste has also been identified as one of the main causes of Halda pollution. Domestic wastes are being thrown into the river by the local households. During rainy season, these wastes decompose and due to rain the decomposed wastes are mixed with river water contains black color and emits bad odor. In the meantime, the amount of dissolved oxygen has reduced drastically due to pollution. Dissolved Oxygen, pH and Salinity level of river water has been tested and reported that generally the normal level of dissolved oxygen in water is 5 milligrams per liter. But the dissolved oxygen in Halda river water has been found less than 2 milligrams per liter. Moreover, amount of carbon dioxide has increased, which is unfavorable for survival of aquatic organisms including fishes. To meet Sustainable Development Goals (SDG), restoration of Karnafuli river basin with special attention to Halda river is the demand of time for the conservation of aquatic resources, fisheries resources and bird sanctuaries etc. and socio-economic development. A series of meeting have been held at government level, on this issue and it has been decided to undertake project on Karnafuli river basin restoration for the sake of people and environment as well.

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 three themes are directly related to Water

resources. Those themes are- i) Morphological Dynamics & River Management, ii) Water Resources, iii)Coastal Zone Issues.

Moreover Chattogram Hill Tracts and Coast is one of the Hotspots of Bangladesh Delta Plan(BDP), 2100. Under the investment plan there are two projects named "Development Catchment and Sub-catchment Management Plans" and "Flow control and water storage structures for water availability in the dry season".

At this circumstances, a holistic approach was followed to complete the study on Karnafuli river basin with special emphasis on Halda River so that the goal of Bangladesh Delta Plan can be achieved.

1.3 Objectives

The overall objective of the study is to carry out a holistic and integrated study for development of Karnafuli river basin improvement plan considering technical, environmental, social and economic aspects.

The specific objectives are:

- To identify past and present problems on water scarcity, sedimentation, flood, erosion, river ecology, fisheries in the Karnafuli river basin including interconnected tributaries/distributaries
- To establish Environmental Flow requirement of all the rivers within the Karnafuli river basin.
- To develop integrated river management plan for the restoration of Karnafuli river basin with **"no regret"** concept (BDP 2100).
    - To prepare afforestation plan considering classification of trees
    - Preparation of environmental enhancement and conservation plan
    - Preparation of biodiversity conservation plan
    - To conduct an Environment and Social Impact Assessment (ESIA) study.
    - To develop Environmental Management and Monitoring Plan (EMMP) for conservation of aquatic resources, fisheries resources, bird sanctuaries including forest resources considering the ecologically critical areas (ECA).

1.4 Project revision with reasons: Not Applicable

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

Karnafuli river originated in the Lushai hills in Mizoram state of India, is the largest and most important river in Chattogram and the Chattogram hill tracts of Bangladesh. After entering into Bangladesh, Karnafuli river meets with a number of tributary and charas. The source point of the most rivers connected to Karnafuli are in hilly areas and thus during rainy season the water from upstream carries huge volume of soil/sand in the river and creates char. Besides reserved forest degradation in hilly areas causes land slide. As a result, the retention capacity of river is decreasing and consequently during rainy season the river water flow increases and affects the life and asset of people of the river bank area. Moreover, the river water is being polluted by different ways specifically through agriculture fertilizers, pesticides, industrial wastes, wastes from Karnafuli Paper Mills, power plant etc. The Halda river, a tributary of Karnafuly river, is also a unique and only naturally occurring carp spawning area and source of pure gene bank of carps in Bangladesh. It is the only globallyknown tidal river supporting natural carp spawning ground with higher number of fish speciesthan many other larger Asian rivers system. Recently, hundreds of dead fishes have been observed as floating in the Halda River indicating water pollution by

municipal and industrialwaste.

A meeting on proposed "Restoration of Karnafuli river" project was held in the conference room of the Ministry of Water Resources on 28th May 2018. Mr. Kabir Bin Anwar, Secretary, Ministry of Water Resources presided over the meeting. It was emphasized in the meeting to carry out a holistic and integrated study of Karnafuli river basin to solve all the prevailing problems which hinders socio-economic development. This river improvement is vital for restoration of bio-diversity, navigability, erosion and flood management. The meeting decided to conduct "Karnafuli river restoration" project through BWDB to develop a plan for revival of Karnafuli river basin. Bangladesh Delta Plan, BDP-2100 is a water centric, multisectoral techno-economic long term adaptive plan. The Mission for BDP 2100 formulated as "Ensure long term water and food security, economic growth and environmental sustainability while effectively reducing vulnerability to natural disasters and building resilience to climate change and other delta challenges through robust, adaptive and integrated strategies, and equitable water governance."

The present study has been conducted to devise an effective plan for development and management of Karnafuli river basin with Halda river. Bangladesh Water Development Board (BWDB) engaged Institute of Water Modelling (IWM) through a formal contract agreement signed on 28th November 2019 to carry out this study.

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

- **Project Identification**

The study area mainly situated in the Eastern Hilly region of Bangladesh. Study area extended in three districts namely Chattogram, Rangamati and Khagrachori. Karnafuli river is the most important river of this basin. In early sixties, the government constructed a dam for generation of hydroelectric power from the Karnafuli River in Kaptai Upazila, which is well known as Kaptai Lake. At the upstream of Kaptai dam, the major tributaries of Karnafuli river are Kasalong, Maini, Chengi, Cholok and Rainkhiang river. At the downstream of the Kaptai dam, the main tributary rivers at its left bank are Kaptai, Shilok, Chondaria, Raikhali, Boalkhali and Shikalbaha and its right bank the Ichamati and Halda river along with the Chaktai khal and Mohesh khal are flowing through the Chattogram City. The total area of Karnafuli river basin is about 14008 sqkm among which 10163 sq km is situated in Bangladesh which is considered in this study. The physiography of the Chittagong hill tract is much different than the rest of the country, which in turn makes the rivers flowing through this region special in their own nature. This hilly region is characterized by hillslopes extending from north to south, and thus the rivers also flow through the hills from north to south. The rivers have not changed its course much in the last few decades as suggested from investigation of historical maps. The Halda river, a tributary of Karnafuly river, is also a unique and only naturally occurring carp spawning area and source of pure gene bank of carps in Bangladesh. It is the only globallyknown tidal river supporting natural carp spawning ground with higher number of fish speciesthan many other larger Asian rivers system. Recently, hundreds of dead fishes have been observed as floating in the Halda River indicating water pollution by municipal and industrialwaste.

- **Project Preparation**

Karnafuli river is the most important river in Chattogram and the Chattogram hill tracts of Bangladesh. After entering into Bangladesh, Karnafuli river meets with a number of tributary and charas. The source point of the most rivers connected to Karnafuli are in hilly areas and thus during rainy season the water from upstream carries huge volume of soil/sand in the river and creates char. Besides reserved forest degradation in hilly areas causes land slide. As a result, the retention capacity of river is decreasing and consequently during rainy season the river water flow increases and affects the life and asset of people of the river bank area. Moreover, the river water is being polluted by different ways specifically through agriculture fertilizers, pesticides, industrial

wastes, wastes from Karnafuli Paper Mills, power plant etc. The Halda river, a tributary of Karnafuly river, is also a unique and only naturally occurring carp spawning area and source of pure gene bank of carps in Bangladesh. It is the only globallyknown tidal river supporting natural carp spawning ground with higher number of fish species than many other larger Asian rivers system. Recently, hundreds of dead fishes have been observed as floating in the Halda River indicating water pollution by municipal and industrialwaste.

In view of the above, BWDB decides to carry out a Feasibility Study including EIA for for the Development and Management of Karnafuli River Basin (with Halda River).

Appraisal

The DPEC meeting regarding this project was held on 04/08/2019.

- **Credit Negotiation**
- **Credit Agreement**
- **Credit Effectiveness**
- **Loan Disbursement**
- **Loan Conditionalities**
- **Project Approval.**
- **Others (if any).**

Applicable for Investment Project

The project was approved by the Honorable State Minister, MoWR on 11.09.2021

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

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

4.2 Programme for use of created-facilities of the project

4.3 O & M programme of the project.

4.4 Impact of the project -

4.4.1 Direct

4.4.2 Indirect

4.5 Transfer of Technology and Institutional Building through the project

4.6 Employment generation through the project.

4.7 Possibility of Self employment

4.8 Possibility of women-employment opportunity

4.9 Women's participation in development

4.10 Probable Impact on Socio-Economic activity.

4.11 Impact on environment

4.12 Sustainability of the project

4.13 Contribution to poverty alleviation/reduction

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

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

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

5.1	**Project Management**	5.12	**Project aid disbursement and re-imbursment**
5.2	**Project Director**		
5.3	**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 clamity**	5.19	**Approval**
5.10	**Project financing, allocation and release.**	5.20	**Others.**
5.11	**Design formulation/approval**		

It is a contract base consultancy project. The above problems don't occur

6. Remarks & Recommendations of the Project Director:

The prime objective of this study is to carry out a Feasibility Study for the Development and Management of Karnafuli River Basin (with Halda River). The selection of best suited plan is done based on the simulation results, stakeholder consultation, social survey and potential environmental impacts due to implementation of the project interventions. Consultation with local stakeholders and field survey suggested dredging of the rivers upstream of Kaptai dam. It is also suggested to replace the Dhurang weir with a fish friendly structure.

Analysis of model result for base condition and dredged condition shows that the navigability situation will be improved significantly due to dredging in the river system situated upstream of kaptai dam. At present, Chengi, Maini, Kasalong, Karnafuli, Rainkhiang and Cholok rivers are navigable only during the monsoon season. However, this river system will be navigable for almost round the year due to dredging. It is also evident from community consultation and interview with fisheries expert that dredging in these rivers will enhance the fisheries resources. Moreover, navigability improvement will support to develop tourism facility in this area.

It is evident from community consultation and consultation with fisheries expert that development of fish sanctuary in the connected khal/loop of Halda river will significantly improve the fisheries resources of the study area.

Again, it is seen from analyzing the result of drainage model that the drainage performance of Changkhali khal will be improved due to construction of a new fish friendly regulator replacing the existing regulator. The high-water level during peak discharge will be reduced by 70cm to 100cm due to replacement of Changkhali regulator. Moreover, the maximum velocity of water in regulator will be reduced to 2 m/s from 4.7 m/s.

Excavation of Datkuppa khal can not ensure the availability of water for irrigation purpose during the dry season. However, construction of a rubber dam in the khal can reserve sufficient water for irrigation purpose during dry season.

Again, dismantling of Dhurang weir will ensure the smooth migration of fish from Halda to Dhurang river. However, it will adversely affect the existing dhurang irrigation project. On the other hand, replacement of Dhurang weir by Hydraulic elevator dam (HED) can ensure the fish migration as well as support the existing Dhurang irrigation project. Model simulation shows that, there is a significant head difference between upstream and downstream of the weir at present condition during the month of April and May when brood fish use to migrate. However, head difference between the upstream

and downstream will be reduced to 1m from 4m due to replacement of the weir by HED which will reduce the velocity and ensure smooth migration of fish. Moreover, the flood level during pick discharge also reduced about 2.4m due to replacement of weir by HED.

Social Impact Assessment (SIA) is carried out under the present study. The SIA included field observations, assessment of public opinion and experiences in group and different stakeholders' opinion independently. A great majority of the local people suggested to replace the dhurang weir with fish friendly structure.

Dredging in the river system will enhance the navigability, business and tourism facility which will create improved livelihood and employment opportunity. River bank plantation will improve the livelihood opportunity and reduces the losses by river bank erosion. Development of tourism facility in Chengi and Kasalong river basin will improve livelihood, employment, communication and national socio interest.

Environmental assessment suggests that the project is environment friendly and Environment Management Plan shall be followed to minimize the likely impacts. Without project in future the river will be silted up more, navigability will be reduced, flora and fauna will be deteriorated, crop production will also decrease.

29.08.2021
(Dr. Shamal Chandra Das)
Superintending Engineer (Civil)
Directorate of Planning-1
BWDB, Dhaka.

Date : ..... **Signature and seal of the Project Director**

7. Remarks/Comments of Agency Head

The study area falls in the two hotspots (Coastal and Chattogram Hill Tracts) zone identified by Bangladesh Delta Plan 2100. Because of the importance of Karnafuli and Halda river due to their vast aquatic resources and spawning capabilities, environment friendly, economically viable, socially acceptable and nature based solutions were selected. However, to get the maximum benefit and to ensure sustainability of the implementation project, suggestions and recommendations based on the feasibility study should be followed accordingly. The planned interventions put more emphasis on non-structural options rather than structural options for overall improvement of the basin. All the designs of protective measures, dredging and other interventions proposed with cost estimation has been described with design drawing. With the concent from MoWR, BWDB will soon take necessary steps to approve the DPP of the implementation project.

02/09/2021
(FAZLUR RASHID)
Director General
BWDB, Dhaka

Date : .....

Signature and Seal

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

Date : ..... **Signature and Seal**

ডায়েরী নং ৯০০০	তারিখ ০২/০৫
নির্বাহী প্রকৌশলী	জরুরী ব্যবস্থা নিন
উপ-প্রধান, অর্থনীতি/কৃষি	ব্যবস্থা নিন
সহকারী প্রকৌশলী (পূর)	আলোচনা করুন/উপস্থা
সহকারী প্রধান (সয়েল)	নথিভুক্ত করুন/নথিতে
গবেষণা কর্মকর্তা (সমাজ)	আগিদপত্র দিন
গবেষণা কর্মকর্তা, মৎস্য/পরিবেশ ও বন	
ষ্টেনোগ্রাফার/উচ্চমান সহকারী/ডিইও	পরিচালক

গণপ্রজাতন্ত্রী বাংলাদেশ সরকার
পরিকল্পনা মন্ত্রণালয়
বাস্তবায়ন পরিবীক্ষণ ও মূল্যায়ন বিভাগ
পরিবীক্ষণ ও মূল্যায়ন সেক্টর-৪
শেরে বাংলা নগর, ঢাকা-১২০৭
www.imed.gov.bd

নং- ২১.০০.০০০০.১২১.১৪.২১০.১৯-৪৫

তারিখঃ ২৫/০২/২০২১

বিষয়ঃ "কর্ণফুলী নদীর অববাহিকা উন্নয়ন ও ব্যবস্থাপনার লক্ষ্যে সম্ভাব্যতা সমীক্ষা (হালদা নদীসহ)" শীর্ষক প্রকল্পের পরিদর্শন প্রতিবেদন প্রেরণ।

উপর্যুক্ত বিষয়ের আলোকে অত্র বিভাগ কর্তৃক প্রণীত মতামত/সুপারিশ সম্বলিত পরিবীক্ষণ প্রতিবেদন (Monitoring Report) পরিবর্তী প্রয়োজনীয় ব্যবস্থা গ্রহণের জন্য নির্দেশক্রমে প্রেরণ করা হলো। আইএমইডি'র মতামত/সুপারিশসমূহ নিম্নরূপঃ

- পরামর্শক প্রতিষ্ঠান কর্তৃক দাখিলকৃত Inception Report ও Interim Report এ KII (Key Informant Interviews) কতটি করা হবে বিষয়টি সুস্পষ্ট নয়। এছাড়া কি ধরণের Questionnaire এর ভিত্তিতে KII ও Focus Group Discussion (FGD) Data collection করা হচ্ছে বোঝার জন্য পরবর্তীতে দাখিলকৃত সকল প্রতিবেদনে সংযুক্তি হিসেবে Questionnaire সংযোজন করতে হবে;
- প্রকল্পের আওতায় নিয়োগকৃত ২৫ জন ভিন্ন ভিন্ন পরামর্শকের সম্ভাব্যতা সমীক্ষা প্রতিবেদন প্রণয়নে অংশগ্রহণ নিশ্চিত হচ্ছে কিনা বিষয়টিও সুস্পষ্ট নয়। এ ক্ষেত্রে প্রত্যাশী সংস্থা কর্তৃক ভিন্ন ভিন্ন ব্যক্তি পরামর্শকের প্রতিবেদনে প্রদত্ত Input যথার্থ কিনা তা যাচাই এর জন্য একটি Supervision কমিটি গঠন করা যেতে পারে;
- পরামর্শক প্রতিষ্ঠান কর্তৃক দাখিলকৃত বিভিন্ন প্রতিবেদন প্রত্যাশী সংস্থার কার্য পরিধি অনুযায়ী হচ্ছে কিনা সে বিষয়টি ০১টি কমিটির মাধ্যমে খতিয়ে দেখা যেতে পারে;
- সম্ভাব্যতা সমীক্ষা প্রকল্পের মোট ব্যাপ্তি ও ব্যয় বিবেচনায় IWM প্রতিষ্ঠানের বিভিন্ন ব্যক্তি পরামর্শকের সংখ্যা বেশি ও সম্মানী প্রচলিত সম্মানীর চেয়ে কিছুটা বেশি মনে হয়েছে। ভবিষ্যতে এ ধরনের সম্ভাব্যতা সমীক্ষায় ব্যক্তি পরামর্শকের সংখ্যা হ্রাস করাসহ সম্মানীর পরিমাণ প্রকৃত প্রয়োজন বিবেচনায় রেখে প্রচলিত ধারা অনুযায়ী নির্ধারণের বিষয়টি বিবেচনা করা প্রয়োজন;
- চট্টগ্রাম অঞ্চলে চলমান বিভিন্ন প্রকল্পের সাথে সম্পাদিত সম্ভাব্যতা সমীক্ষার কোন Over laping/দ্বৈততা হচ্ছে/হবে কিনা এ বিষয়টি রিপোর্টে প্রতিফলন করা প্রয়োজন। একই সাথে সংশ্লিষ্ট এলাকায় ইতোমধ্যে সম্পাদিত ও বর্তমানে চলমান বিভিন্ন প্রকল্পের আওতায় যে সকল ভৌত কাজ বাস্তবায়িত হয়েছে এবং বাস্তবায়নাধীন রয়েছে তা ক্ষেত্র বিশেষে টেকসই না হওয়ার কারণ ও তার সম্ভাব্য সমাধান কী হতে পারে এ বিষয়গুলো চূড়ান্ত প্রতিবেদনে সংযোজন করতে হবে;
- পানি সম্পদ মন্ত্রণালয় কর্তৃক ইতঃপূর্বে সম্পাদিত, বর্তমানে চলমান ও ভবিষ্যতে গৃহীতব্য বিভিন্ন সম্ভাব্যতা সমীক্ষা বিক্ষিপ্তভাবে নির্বাচনের পরিবর্তে অঞ্চল ভিত্তিক গ্রহণ করা প্রয়োজন বলে প্রতীয়মান হয়;
- বাপাউবো কর্তৃক পরবর্তিতে সম্ভাব্যতা সমীক্ষা পরিচালনার ক্ষেত্রে ক্রয় প্রক্রিয়া অধিক প্রতিযোগিতাপূর্ণ ও স্বচ্ছ করার স্বার্থে উন্মুক্ত দরপত্র পদ্ধতি (QCBS) অনুসরণ করা যুক্তিসংগত হবে;
- সম্ভাব্যতা সমীক্ষা প্রকল্পের আওতায় ২০২০-২১ অর্থ বছরের অডিট সম্পাদন এবং তা আইএমইডি-কে অবহিত করতে হবে
- প্রকল্প সমাপ্তির ৩ মাসের মধ্যে প্রকল্প সমাপ্তি প্রতিবেদন (পিসিআর) আইএমইডিতে প্রেরণ করতে হবে।

২। প্রণীত পরিবীক্ষণ প্রতিবেদনের উপর গৃহীত ব্যবস্থা সম্পর্কে এ বিভাগকে আগামী ১ (এক) মাসের মধ্যে অবহিত করার জন্য নির্দেশক্রমে অনুরোধ জানানো হলো।

সংযুক্তিঃ পরিদর্শন প্রতিবেদন।

২৫.০২.২১
(উপমা আকতার)
উপপরিচালক
ফোনঃ ৯১৮০৬৮১

সিনিয়র সচিব
পানি সম্পদ মন্ত্রণালয়
বাংলাদেশ সচিবালয়, ঢাকা।

সদয় অবগতি ও প্রয়োজনীয় ব্যবস্থা গ্রহণের জন্য অনুলিপি (জ্যেষ্ঠতার ক্রমানুসারে নয়):

১। সদস্য, কৃষি, পানি সম্পদ ও পল্লী প্রতিষ্ঠান বিভাগ, পরিকল্পনা কমিশন, শেরে বাংলা নগর, ঢাকা।
২। মহাপরিচালক, বাংলাদেশ পানি উন্নয়ন বোর্ড, পানি ভবন, লেভেল-৬, ৭২ গ্রীন রোড, ঢাকা।
৩। প্রকল্প পরিচালক (তত্ত্বাবধায়ক প্রকৌশলী), "কর্ণফুলী নদীর অববাহিকা উন্নয়ন ও ব্যবস্থাপনার লক্ষ্যে সম্ভাব্যতা সমীক্ষা (হালদা নদীসহ)" শীর্ষক প্রকল্প, বাংলাদেশ পানি উন্নয়ন বোর্ড, পানি ভবন, লেভেল-৬, ৭২ গ্রীন রোড, ঢাকা।
৪। পরিচালক, প্রকল্প মূল্যায়ন পরিদপ্তর, পানি ভবন (লেভেল-৪, ব্লক-ডি) ৭২ গ্রীন রোড, ঢাকা।
৫। সচিব মহোদয়ের একান্ত সচিব, আইএমইডি, পরিকল্পনা মন্ত্রণালয়, শেরে বাংলা নগর, ঢাকা।
৬। মহাপরিচালক (পরিবীক্ষণ ও মূল্যায়ন সেক্টর-৪) মহোদয়ের ব্যক্তিগত কর্মকর্তা, আইএমইডি, পরিকল্পনা মন্ত্রণালয়, শেরে বাংলা নগর, ঢাকা।

বাস্তবায়ন পরিবীক্ষণ ও মূল্যায়ন বিভাগ ডায়েরী নং ... তাং ... অফিস কপি পরিকল্পনা মন্ত্রণালয়

BOOK POST

বাংলাদেশ পানি উন্নয়ন বোর্ড
প্রধান প্রকৌশলী (পুর) পরিকল্পনা এর দপ্তর
পানি ভবন, ৭২ গ্রীন রোড,ঢাকা-১২০৫।
www.bwdb.gov.bd

স্মারক নম্বর: ৪২.০১.০০০০.০৩৪.১৬.০১৫.২১.২২ তারিখ: ১৩ জ্যৈষ্ঠ ১৪২৮
২৭ মে ২০২১

বিষয়: **"কর্ণফুলী নদীর অববাহিকা উন্নয়ন ও ব্যবস্থাপনার লক্ষ্যে সম্ভাব্যতা সমীক্ষা (হালদা নদীসহ)" শীর্ষক প্রকল্পের উপর আইএমইডি কর্তৃক প্রণীত পরিদর্শন প্রতিবেদনে বর্ণিত সুপারিশের আলোকে বাপাউবোর প্রতিপালন প্রতিবেদন প্রেরণ প্রসঙ্গে।**

সূত্র: আইএমইডি'র স্মারক নং-২১.০০.০০০০.১২১.১৪.২১০.১৯-৪৫, তারিখঃ ২৫-০২-২০২১ খ্রি.

মহোদয়,

যথাযথ সম্মান প্রদর্শনপূর্বক সূত্রস্থ স্মারকের চাহিদামতে পানি সম্পদ মন্ত্রণালয়ের আওতায় বাংলাদেশ পানি উন্নয়ন বোর্ড কর্তৃক বাস্তবায়নাধীন বর্ণিত প্রকল্পটির উপর আইএমইডি কর্তৃক প্রণীত পরিদর্শন প্রতিবেদনের সুপারিশ/ মতামত এর বিষয়ে বাপাউবো কর্তৃক গৃহীত পদক্ষেপ ও ব্যবস্থা সম্বলিত ব্যাখ্যা/প্রতিবেদন সদয় প্রয়োজনীয় ব্যবস্থা গ্রহণের জন্য অত্রসাথ প্রেরণ করা হল।

এ পত্র প্রেরণে মহাপরিচালক, বাপাউবো মহোদয়ের সম্মতি রয়েছে।

সংযুক্তিঃ বর্ণনামতে।

আপনার অনুগত,

২৭-৫-২০২১
মোঃ মাহবুর রহমান
প্রধান প্রকৌশলী (পুর) পরিকল্পনা
ফোন: ০২-২২২২৩০২০০
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সিনিয়র সচিব
পানি সম্পদ মন্ত্রণালয়

দৃষ্টি আকর্ষণঃ যুগ্মসচিব, পরিকল্পনা উইং, পানি সম্পদ মন্ত্রণালয়

স্মারক নম্বর: ৪২.০১.০০০০.০৩৪.১৬.০১৫.২১.২২/১(৪) তারিখ: ১৩ জ্যৈষ্ঠ ১৪২৮
২৭ মে ২০২১

সদয় অবগতি ও কার্যার্থে প্রেরণ করা হল:

১) পরিচালক , প্রকল্প মূল্যায়ন পরিদপ্তর, বাংলাদেশ পানি উন্নয়ন বোর্ড
২) তত্ত্বাবধায়ক প্রকৌশলী (পুর), পরিকল্পনা-১ পরিদপ্তর, বাংলাদেশ পানি উন্নয়ন বোর্ড
৩) সিএসও টু মহাপরিচালক, মহাপরিচালক-এর দপ্তর, বাংলাদেশ পানি উন্নয়ন বোর্ড
৪) ব্যক্তিগত সহকারী, পরিকল্পনা, বাংলাদেশ পানি উন্নয়ন বোর্ড

২৭-৫-২০২১
মোঃ মাহবুর রহমান
প্রধান প্রকৌশলী (পুর) পরিকল্পনা

IMED কর্তৃক "কর্ণফুলী নদীর অববাহিকা উন্নয়ন ও ব্যবস্থাপনার লক্ষ্যে সম্ভাব্যতা সমীক্ষা (হালদা নদীসহ)" শীর্ষক সমীক্ষা প্রকল্পের পরিদর্শন প্রতিবেদনের প্রতিপালন প্রতিবেদনঃ

নং	IMED-এর মতামত/সুপারিশসমূহ	গৃহীত ব্যবস্থা
১	পরামর্শক প্রতিষ্ঠান কর্তৃক দাখিলকৃত Inception Report ও Interim Report এ KII (Key Informant Interviews) কতটি করা হবে বিষয়টিও সুস্পষ্ট নয়। এছাড়া কি ধরণের Questionnaire এর ভিত্তিতে KII ও Focus Group Discussion (FGD) Data collection করা হচ্ছে বোঝার জন্য পরবর্তীতে দাখিলকৃত সকল প্রতিবেদনে সংযুক্তি হিসেবে Questionnaire সংযোজন করতে হবে।	চলমান প্রকল্পের আওতায় ৯০০ household survey, ২৯ টি FGD এবং ১৪ টি KII করা হয়েছে (সংযুক্তি-১)। এ সকল কাজের বিস্তারিত প্রতিবেদন Draft Final Report অন্তর্ভুক্ত করা হয়েছে। সমীক্ষায় ব্যবহৃত Questionnaire এর নমুনা সংযুক্ত করা হল। (সংযুক্তি-২)
২	প্রকল্পের আওতায় নিয়োগকৃত ২৫ জন ভিন্ন ভিন্ন পরামর্শকের সম্ভাব্যতা সমীক্ষা প্রতিবেদন প্রণয়নে অংশগ্রহণ নিশ্চিত হচ্ছে কিনা বিষয়টিও সুস্পষ্ট নয়। এক্ষেত্রে প্রত্যাশী সংস্থা কর্তৃক ভিন্ন ভিন্ন ব্যক্তি পরামর্শকের প্রতিবেদনে প্রদত্ত যথার্থ কিনা তা যাচাই এর জন্য একটি Supervision কমিটি গঠন করা যেতে পারে।	প্রকল্পের আওতায় নিয়োগকৃত ২৫ জন ভিন্ন ভিন্ন পরামর্শকের সম্ভাব্যতা সমীক্ষা প্রতিবেদন প্রণয়নে অংশগ্রহণ নিশ্চিত করা হয়েছে। পরামর্শকগণ মাঠ পর্যায় থেকে সংগৃহীত তথ্য ও উপাত্ত বিশ্লেষণপূর্বক সমীক্ষা প্রতিবেদন প্রণয়ন করেন। এছাড়াও বিভিন্ন পর্যায়ে দাখিলকৃত Inception, Interim ও Draft Final Report এর ওপর অনুষ্ঠিত পর্যালোচনা সভায় অংশগ্রহণ করেন ও সভায় প্রশ্নোত্তর পর্বে অংশগ্রহণ করেন।
৩	পরামর্শক প্রতিষ্ঠান কর্তৃক দাখিলকৃত বিভিন্ন প্রতিবেদন প্রত্যাশী সংস্থার কার্যপরিধি অনুযায়ী হচ্ছে কিনা সে বিষয়টি ১টি কমিটির মাধ্যমে খতিয়ে দেখা যেতে পারে।	প্রকল্পের বিভিন্ন পর্যায়ে পরামর্শক প্রতিষ্ঠান কর্তৃক দাখিলকৃত প্রতিবেদনসমূহ কার্যপরিধি অনুযায়ী হচ্ছে কিনা তা খতিয়ে দেখার জন্য প্রতিবেদনসমূহ বাপাউবোর নকশা, পরিকল্পনা ও মাঠ পর্যায়ের সংশ্লিষ্ট দপ্তরে প্রেরণ করা হয় এবং সুনির্দিষ্ট ও সুপরিকল্পিত মতামত চাওয়া হয়। এছাড়াও পরামর্শক প্রতিষ্ঠান দ্বারা দাখিলকৃত Inception, Interim ও Draft Final Report মূল্যায়ন ও অনুমোদনের জন্য প্রতিটি প্রতিবেদন দাখিলের পর BWDB ও সংশ্লিষ্ট অন্যান্য সরকারি সংস্থার কর্মকর্তাদের সমন্বয়ে সভা আয়োজন করে প্রতিটি প্রতিবেদন মূল্যায়ন পূর্বক অনুমোদন প্রদান করা হয়। (সংযুক্তি-৩)। এছাড়াও সমীক্ষা কাজের চূড়ান্ত প্রতিবেদন অনুমোদনকল্পে চূড়ান্ত প্রতিবেদনে প্রদত্ত সুপারিশসমূহ বাস্তব সম্মত ও প্রকল্পের মূল উদ্দেশ্যের সাথে সামঞ্জস্যপূর্ণ কিনা সেবিষয়ে সুস্পষ্ট মতামত প্রদান ও প্রতিবেদন পর্যালোচনার নিমিত্ত গঠিত কমিটির সুপারিশের পর চূড়ান্ত প্রতিবেদন অনুমোদন করা হয় (সংযুক্তি- ৪)।
৪	সম্ভাব্যতা সমীক্ষা প্রকল্পের মোট ব্যাপ্তি ও ব্যয় বিবেচনায় IWM প্রতিষ্ঠানের বিভিন্ন ব্যক্তি পরামর্শকের সংখ্যা বেশি ও সম্মানী প্রচলিত সম্মানীর চেয়ে কিছুটা বেশি মনে হয়েছে। ভবিষ্যতে এ ধরনের সম্ভাব্যতা সমীক্ষায় ব্যক্তি পরামর্শকের সংখ্যা হ্রাস করাসহ সম্মানীর পরিমাণ প্রকৃত প্রয়োজন বিবেচনায় রেখে প্রচলিত ধারা অনুযায়ী নির্ধারণের বিষয়টি বিবেচনা করা প্রয়োজন।	সমীক্ষা প্রকল্পের Technical ও Financial proposal এ প্রস্তাবিত পরামর্শকের সংখ্যা ও তাদের input month proposal evaluation committee এর মাধ্যমে মূল্যায়ন পূর্বক পরামর্শক প্রতিষ্ঠানের সঙ্গে negotiation এর মাধ্যমে নির্ধারিত হয়েছে। IWM এর পরামর্শকদের সম্মানী মন্ত্রণালয় দ্বারা অনুমোদিত (সংযুক্তি-৫) । যেমন IWM এর পরামর্শকদের সম্মানী নির্ধারণের ক্ষেত্রে সোশ্যাল চার্জ, ওভারহেড, গবেষণা

		ও উন্নয়ন ফি যথাক্রমে ৩০%, ৯০% ও ১০% বিবেচনা করা হয়েছে যা PPR এ উপরে বর্ণিত খাত সমুহে যথাক্রমে ৪০%, ৬০-১০০% ও ১০-১৫% নির্ধারণের সুযোগ রয়েছে। *(তফশিল-৯, অংশ খঃ [বিধি ১১২ (৮) দ্রঃ], পাবলিক প্রকিউরমেন্ট আইন ২০০৬ ও পাবলিক প্রকিউরমেন্ট বিধিমালা ২০০৮, জানুয়ারি ২০১৯ সন পর্যন্ত সংশোধিত) (সংযুক্তি-৬)।* ভবিষ্যতে পরামর্শক নিয়োগের ক্ষেত্রে IMED কর্তৃক পরিদর্শন প্রতিবেদনের সুপারিশ বিবেচনা করা হবে।
৫	চট্টগ্রাম অঞ্চলে চলমান বিভিন্ন প্রকল্পের সাথে সম্পাদিত সম্ভাব্যতা সমীক্ষার কোন Overlapping দৈততা হচ্ছে /হবে কিনা এ বিষয়টি রিপোর্টে প্রতিফলন করা প্রয়োজন। এই সাথে সংশ্লিষ্ট এলাকায় ইতোমধ্যে সম্পাদিত ও বর্তমানে চলামান বিভিন্ন প্রকল্পের আওতায় যে সকল ভৌত কাজ বাস্তবায়িত হয়েছে এবং বাস্তবায়নাধীন রয়েছে তা ক্ষেত্র বিশেষে টেকসই না হওয়ার কারণ ও তার সম্ভাব্য সমাধান কী হতে পারে এ বিষয়গুলো চূড়ান্ত প্রতিবেদনে সংযোজন করতে হবে।	প্রকল্প এলাকায় চলমান ও প্রস্তাবিত বিভিন্ন কার্যক্রমের ব্যাপারে সমীক্ষা প্রকল্পটির Draft Final Report এ বর্ণনা করা হয়েছে। এক্ষেত্রে দৈততা পরিহারের লক্ষ্যে অন্য প্রকল্পে অন্তর্ভুক্ত কার্যক্রম গুলো সমীক্ষা প্রকল্প থেকে বাদ দেয়া হয়েছে। সংশ্লিষ্ট এলাকায় ইতোমধ্যে সম্পাদিত ও বর্তমানে চলমান বিভিন্ন প্রকল্পের আওতায় যে সকল ভৌত কাজ বাস্তবায়িত হয়েছে এবং বাস্তবায়নাধীন রয়েছে তা ক্ষেত্র বিশেষে টেকসই না হওয়ার কারণ ও তার সম্ভাব্য সমাধান কী হতে পারে এ বিষয়গুলো চূড়ান্ত প্রতিবেদনে সংযোজন করা হবে।
৬	পানি সম্পদ মন্ত্রণালয় কর্তৃক ইতঃপূর্বে সম্পাদিত, বর্তমানে চলমান ও ভবিষ্যতে গৃহীতব্য বিভিন্ন সম্ভাব্যতা সমীক্ষা যিক্ষিপ্তভাবে নির্বাচনের পরিবর্তে অঞ্চল ভিত্তিক গ্রহণ করা প্রয়োজন বলে প্রতীয়মান হয়।	আলোচ্য সম্ভাব্যতা সমীক্ষা প্রকল্পটিতে সমীক্ষা অঞ্চল সমন্বিত ভাবে নির্বাচন করা সাপেক্ষে কর্ণফুলী নদীর (হালদা নদীসহ) সম্পূর্ণ বেসিন জুড়ে সমীক্ষা কাজ সম্পাদন করা হয়েছে।
৭	বাপাউবো কর্তৃক পরবর্তিতে সম্ভাব্যতা সমীক্ষা পরিচালনার ক্ষেত্রে ক্রয় প্রক্রিয়া অধিক প্রতিযোগিতাপূর্ণ ও স্বচ্ছ করার স্বার্থে উন্মুক্ত দরপত্র পদ্ধতি (QCBS) অনুসরণ করা যুক্তিসংগত হবে।	উন্নয়ন প্রকল্প প্রণয়ন, বাস্তবায়ন ও পরিচালনা, পানিতাত্ত্বিক মরফলজিকাল ও পরিবেশ সংক্রান্ত তথ্যাদি বিশ্লেষণ ও মূল্যায়ন বিষয়ক সমীক্ষায় গাণিতিক মডেলিং বর্তমানে এক অপরিহার্য ও সর্বাধুনিক প্রযুক্তি হিসাবে পরিগণিত। পাবলিক প্রকিউরমেন্ট আইন ২০০৬ ও পাবলিক প্রকিউরমেন্ট বিধিমালা ২০০৮ এর শর্তাবলী পূরন করায় গাণিতিক মডেলিং পরিসেবা প্রদানের ক্ষেত্রে single source হিসাবে Institute of Water Modelling (IWM) নিয়োগযোগ্য। তাছাড়া এধরনের সমীক্ষায় single source হিসাবে Institute of Water Modelling (IWM) কে নিয়গের ব্যাপারে পানি সম্পদ মন্ত্রণালয় একটি পরিপত্র জারি করেছে (সংযুক্তি-৭)
৮	সম্ভাব্যতা সমীক্ষা প্রকল্পের আওতায় ২০২০-২১ অর্থ বছরের অডিট সম্পাদন এবং তা আইএমইডি-কে অবহিত করতে হবে।	যথাসময়ে অডিট সম্পাদন পূর্বক আইএমইডি কে অবহিত করা হবে
৯	প্রকল্প সমাপ্তির ৩ মাসের মধ্যে প্রকল্প সমাপ্তি প্রতিবেদন (পিসিআর) আইএমইডিতে প্রেরণ করতে হবে।	যথাসময়ে পিসিআর আইএমইডিতে প্রেরন করা হবে

20.05.2020

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Government of the People's Republic of Bangladesh

Ministry of Water Resources

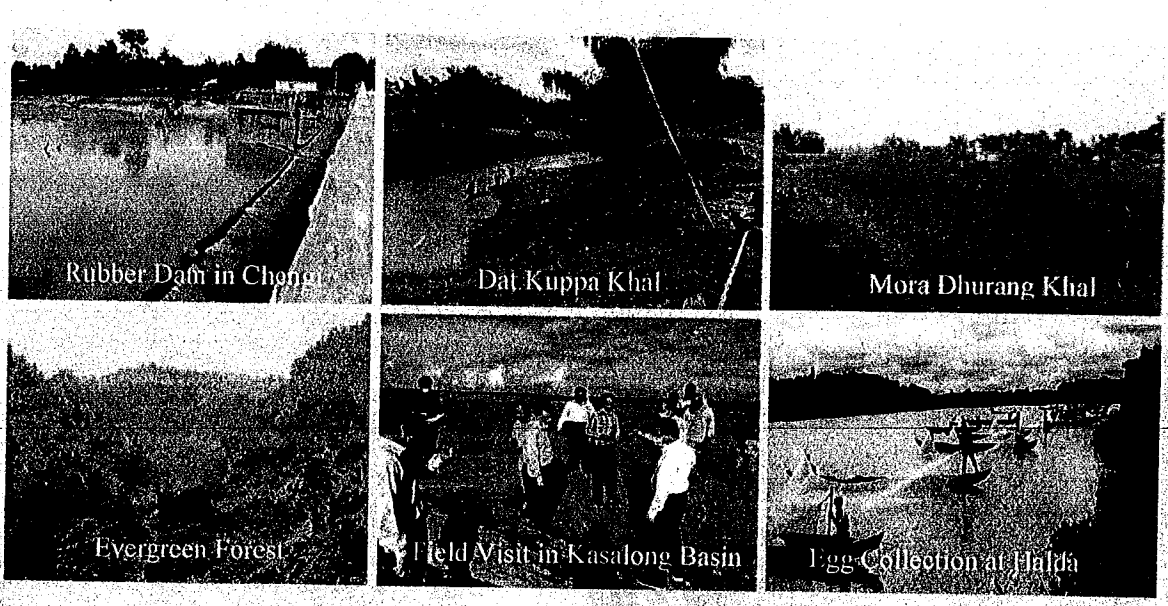
APPROVED

30.6.2021

(A K M Wahed Uddin Chowdhury)
Director General
BWDB, Dhaka.

Bangladesh Water Development Board

Feasibility Study for the Development and Management of Karnafuli river basin (with Halda river)



FINAL REPORT APPROVED BY DG, BWDB
Vide U.O. No. ৮২৯৫ -DG
Dated: ৩০/৬/২০২১

FINAL REPORT

Volume I: Main Report

June 2021

INSTITUTE OF WATER MODELLING

EXECUTIVE SUMMARY

E1. Introduction

Karnafuli river originated in the Lushai hills in Mizoram state of India, is the largest and most important river in Chattogram and the Chattogram hill tracts of Bangladesh. After entering into Bangladesh, Karnafuli river meets with a number of tributary and charas. The source point of the most rivers connected to Karnafuli are in hilly areas and thus during rainy season the water from upstream carries huge volume of sand in the river and creates char. Again, reserved forest degradation in hilly areas causes land slides. As a result, the retention capacity of river is decreasing and consequently during rainy season water flow spills river banks and affects the life and asset of people of the river bank area.

Moreover, the river water is being polluted by different ways specifically through agriculture fertilizers, pesticides, industrial wastes, wastes from Karnafuli paper mills, power plant etc. The Halda river, a tributary of Karnafuly river, is also a unique and only natural spawning area and source of pure gene bank of carps in Bangladesh. Recently, hundreds of dead fishes have been observed as floating in the Halda River indicating water pollution by municipal and industrial waste.

The present study has been conducted to devise a holistic and integrated plan for development and management of Karnafuli river basin with Halda river. Bangladesh Water Development Board (BWDB) engaged Institute of Water Modelling (IWM) through a formal contract agreement signed on 28th November 2019 to carry out this study.

Objective of the Study

The overall objective of the study is to carry out a holistic and integrated study for development of Karnafuli river basin improvement and investment plans considering technical, environmental, social and economic aspects.

Study Area

The study area mainly situated in the Eastern Hilly region of Bangladesh. Study area extended in three districts namely Chattogram, Rangamati and Khagrachori. Karnafuli river is the most important river of this basin. At the upstream of Kaptai dam, the major tributaries of Karnafuli river are Kasalong, Maini, Chengi, Cholok and Rainkhiang river. At the downstream of the Kaptai dam, the main tributaries at its left bank are Kaptai, Shilok, Chondaria, Raikhali, Boalkhali and Shikalbaha and its right bank the Ichamati and Halda river along with the Chaktai khal and Mohesh khal. The total area of Karnafuli river basin is about 14008 sqkm. among which 10163 sqkm. is situated in Bangladesh. The study area map is shown in Figure E1-1.

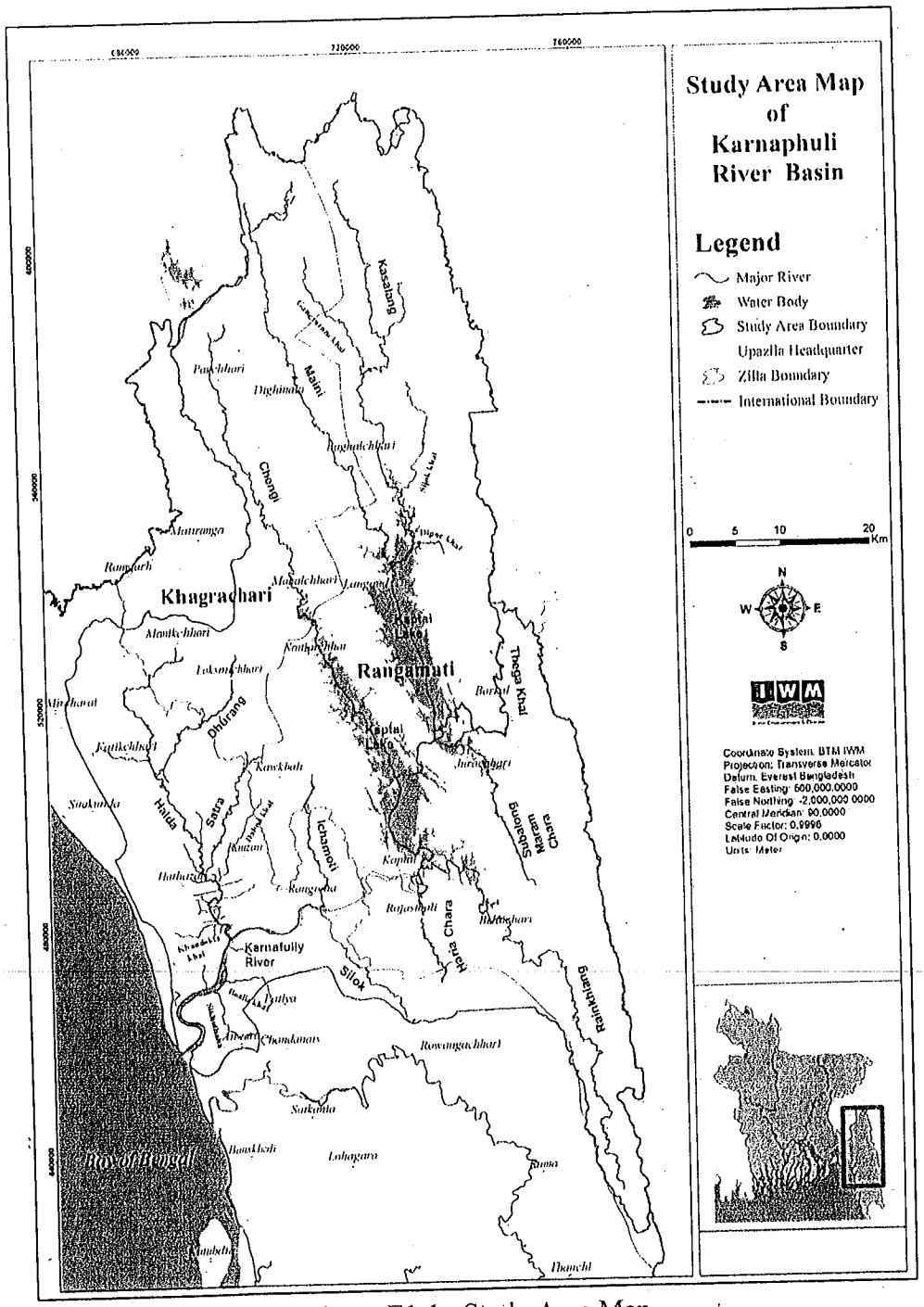


Figure E1-1: Study Area Map

E2. Problems of the Study Area

Deforestation

Satellite image analysis shows that tree-based forest area was highest in 2000 and lowest in 2020. With respect to 1989 forest area increases in 2000 (8.89 %) and afterwards a decreasing pattern is seen. However, forest cover in the study area was much stable during 2010-2020, only 1.88 % percent decrease is observed.

Most of the forest area possesses Baghaichhari and Dighinal upazila. These two upazila possesses about 75 percent of total forest area during 2000. However, highest deforestation took place in these upazilas during the year 2000 to 2020. On the other hand, opposite scenario observed in Rajasthali, Lakshmichhari and Boalkhali upazila. There is a significant increase in forest area in these three upazilas.

River Sedimentation

River sedimentation is one of the major problem of the study area which causing drainage congestion, river bank erosion, deteriorating the fisheries resources and navigability condition. Sedimentation in Karnafuli river is assessed comparing the river bathymetry of 2012 and 2018 and shown in Figure E2-1.

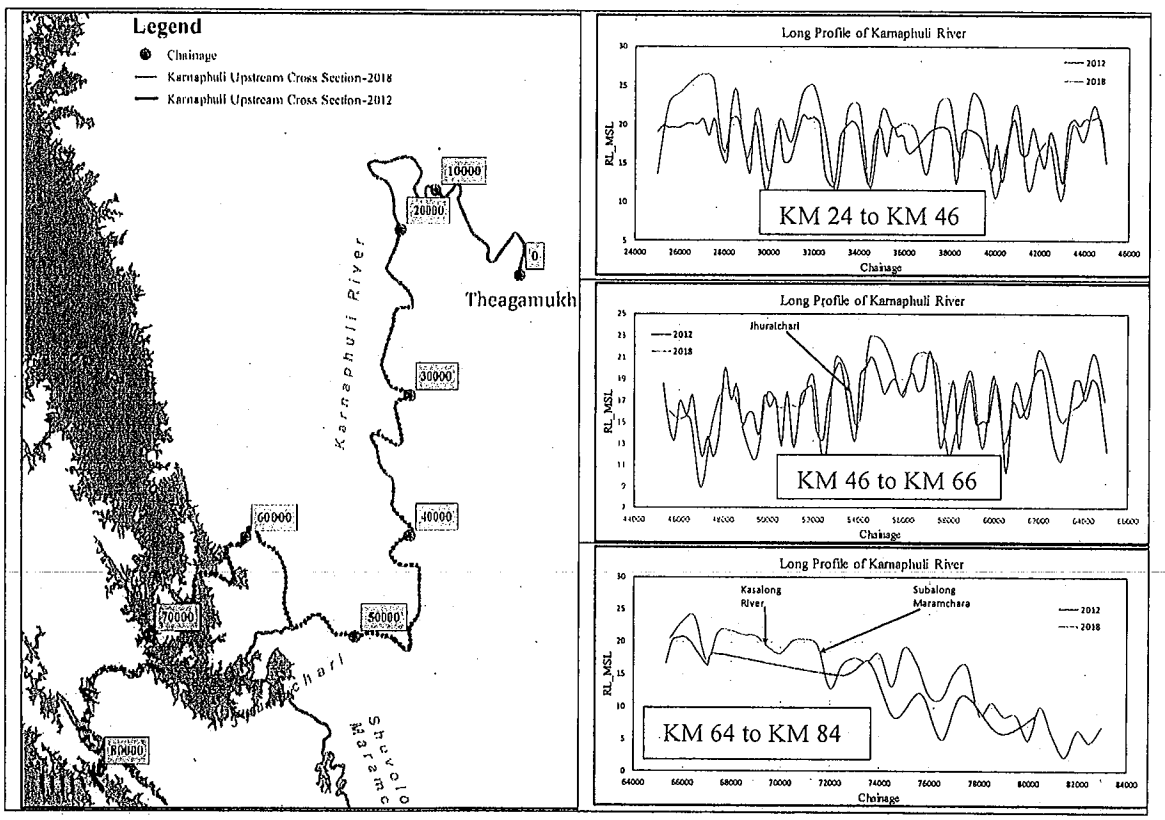


Figure E2-1: Change in Bed Level of Karnafuli River upstream of Kaptai dam during 2012 to 2018

Predominant deposition is observed almost all over the reach. Maximum 5-meter deposition is observed at KM 27, 39, 75 and 77. Again, slight erosion has been observed at some of the meander bend from chainage km 41 to km 44. Maximum deposition observed from km 26 to km 40 and also km 66 to km 78.

Survey data shows significant siltation in the connected khals of Kasalong river. It is evident from the field visit and community consultation that there is water logging problem in the catchment area of Amtoli, Sorbatoli, Chanmia, Jibongo, Gulishakhali and Dipor khal which are connected with Kasalong river.

Again, significant siltation is observed in the connected khals of Halda river which causes drainage congestion and reduces the irrigation efficiency. Present study identified about 197303 m^2 char at 44 nos. locations in Maini river and 601640 m^2 char at 179 nos. locations of Chengi river.

River Navigability

Navigability problem during dry season is the main problem for the rivers situated upstream of Kaptai dam. The minimum water depth of Karnafuli river (upstream of Kaptai dam) is shown in Figure E2-2.

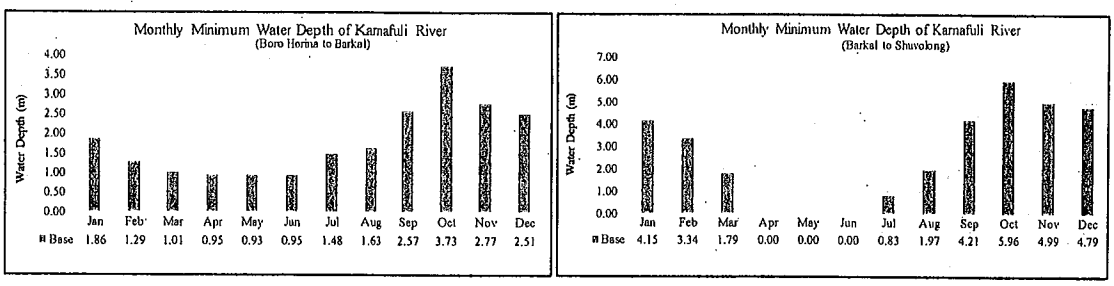


Figure E2-2: Minimum Water Depth of Karnafuli river (upstream of Kaptai dam)

Analysis shows that Karnafuli river from Shuvolong to Barkal remains navigable from September to January (5 months) as class III route. Again, the river reach from Barkal to Boro-Horina is navigable from Aug to Mar (8 months). It is seen from the analysis that other tributaries of Karnafuli river like Chengi, Maini, Kasalong, Cholok and Rainkhiang rivers remain navigable only for 5-7 months in a year.

River Bank Erosion and Flooding

River bank erosion and flash flood are also predominant problem of the study area. River bank erosion locations have been identified through field visit and satellite image analysis. Three erosion vulnerable locations are identified in Kasalong river namely Duchari bazar (350m), Durbinpara (175m) and Naillagona (400m) where bank protection is required.

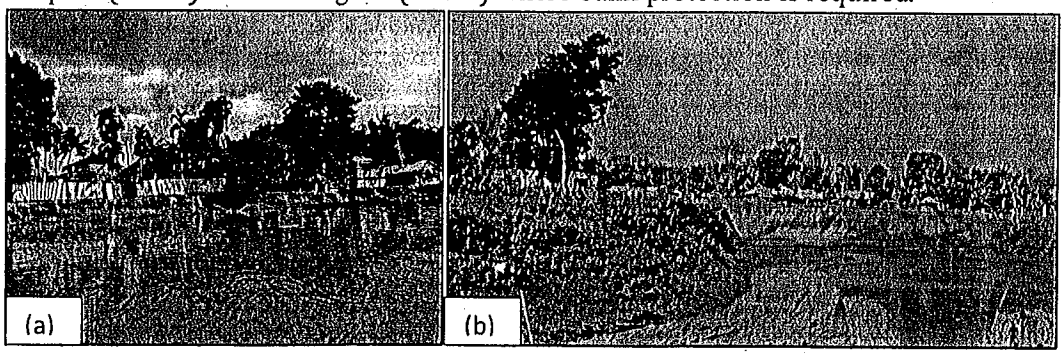


Figure E2-3: River Bank Erosion in Kasalong river at Naillagona (a) and Duchari bazar (b)

Again, it is identified through field visit that there are three erosion vulnerable locations in Chengi river and one location in Maini river namely Golabari (500m), Chengi bridge (400m), Baburupara (200m) and Boradam bazar (300m). These locations also need bank protection as there are many important infrastructures which are under the threat of this erosion.

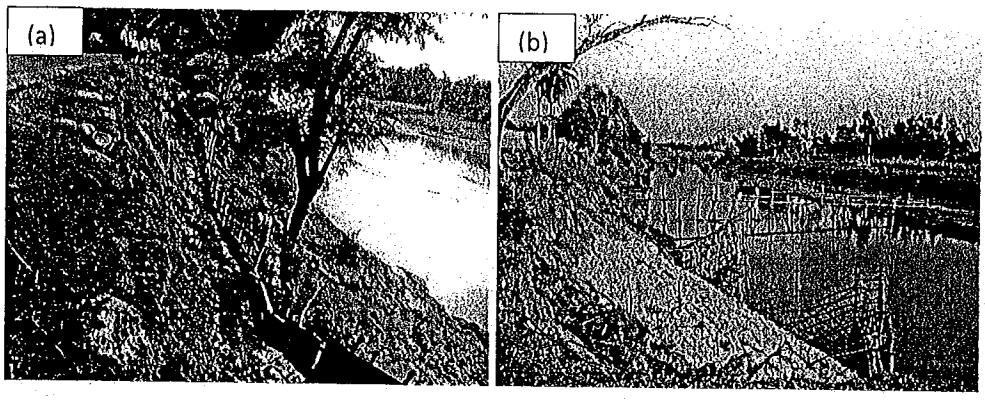


Figure E2-4: River Bank Erosion in Chengi river at Baburupara (a) and Golabari (b)

It is learnt from the stakeholder consultation, data analysis, satellite image analysis and field investigation that there is about 52 km erosion vulnerable area and 60 km flood prone area in Karnafuli river and its tributaries.

Impact of Natural Causes and Manmade interventions on Fisheries Resources

There are many natural and manmade causes which are adversely affecting the fisheries resources. Natural causes include flash flood, storm surge, salinity intrusion, siltation in the river etc. Again, several manmade interventions like sluice gate construction in Halda river, loop/oxbow bend cutting, industrial and municipal waste disposal in the river, withdrawal of water from Halda river, deforestation, movement of engine boat, construction of rubber dam and weir, disposal of debris of the large brickfields at the banks of the river etc. are the main causes which are adversely affecting the fisheries resources. Figure E2-5 shows the cutoff of mender bend of Halda river at Ghorduara. Figure E2-6 shows the present condition of Dhurang weir which is obstructing the migration of fish from Halda to Dhurang river.

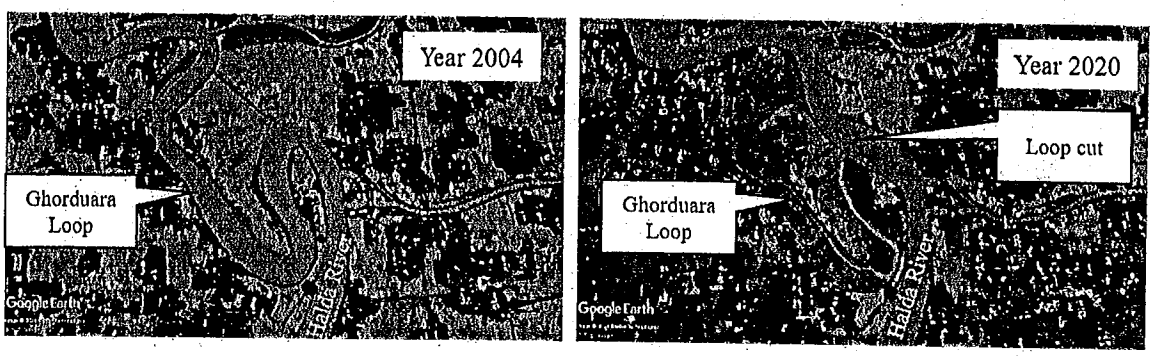


Figure E2-5: Loop cut in Halda river at Ghorduara

Figure E2-6: Dhurang weir obstructing fish migration from Dhurang – Halda - Dhurang river

E3. Focus Group Discussion and Community Consultations

A total 29 number of consultation programs were conducted in the project area involving local community and stakeholders in understanding the prevailing problems and devising improvement plan. Again, a regional stakeholder workshop at Chattogram and a consultation meeting with BWDB officials at Dhaka has been conducted after submission of Draft Final Report.

Figure E3-1: Focus group discussion at a) Changkhali regulator, Ghorduara Union, Hathazari b) Medinipur, Sharbatoli, Khagrachhari, c) Regional workshop at Chattogram d) Consultation meeting with BWDB at Dhaka

Major suggestions of focus group discussions and consultation meetings are summarized in Table E3-1.

Table E3-1: Major suggestions of the focus group discussion and consultation meeting

River Name	Suggestions
Halda River	▪ Replacement of Regulators with fish pass and introduce modern gate operating system ▪ Install deep tube well for irrigation water supply in Halda river basin which will reduce the dependency on surface water of Halda river; ▪ A gate can be built inside of Bhujpur rubber dam to ensure continuous flow to downstream and migration of brood fishes; ▪ Establish a linkage of Harina river with Halda river at the downstream of Bhujpur Rubber dam; ▪ Construction of an embankment .14 km. at the upstream of Bhujpur rubber dam to protect standing crop from flash flood; ▪ Stop deforestation at upstream ▪ Irrigation through Mora Dhurong should be continued, dismantling of the weir will hamper the running irrigation project ▪ Modernization of Dhurnag weir is required ▪ The slope of the weir should be moderate for easy fish migration; ▪ The weir could be redesigned keeping mind both agriculture and fisheries facilities ▪ The water retention height of the weir should be maintained in such a way that additional water can follow to Halda easily ▪ Water wastage can be reduced through CC lining of Mora Dhurong khal ▪ There is a rubber dam in Harualchari khal. If a Hydraulic Elevator Dam (HED) will construct in Baromashi and Fatikchari khal then another 5000-hector land will come under the irrigation facility
Chengi River	▪ The river should be dredged 15 - 20 feet from dry season low water level at Mahalchhari point; ▪ It will be better if dredging work start from Maischhari which will increase availability of irrigation water; ▪ To protect banks of river at Golabari area near Khagrachhari town; ▪ Dredging is required for improve navigability, reduce flash flood, enhance fisheries resources and irrigation facility ▪ A rubber dam is required on the mouth of Logang chara which will help in irrigation
Maini River	▪ Cut Talchhara hills to reduce flash flood ▪ Dredge the river from Merung Bazar to Mainimukh Bazar ▪ To protect river erosion at Baradam Bazar, Dighinala

River Name	Suggestions
Kasalong River	▪ Dredging up to Marisha ghat to improve the navigability, irrigation facility and fisheries resources ▪ Construct an embankment from Amtoli to Medinipur .2.89 km. to save the standing crops ▪ Re-excavation of Sharbatoli Khal, Chamiar khal, Dipur Khal and Gatachhara khal ▪ Protect the erosion vulnerable area at Naillagona, Duchari bazar and Durbin para
Rainkhiang River	▪ Excavation of Rainkhaing river up to Farua bazar through Belaichhari Bazar which is about 77 km in length
Cholok River	▪ Excavation from Shuvolong to Juraichori Bazar. This is very important for the whole people of Juraichori, Bonojogichora, Mydong and Dumdum
Shilok River	▪ It is required to build a gate with Rubber dam of Moromer Mukh to drain out over flow of water; ▪ Construction of an embankment at both bank of the river upstream of the rubber dam
Boalkhali River	▪ Bank protection at erosion vulnerable locations
Karnafuli River (upstream of Kaptai dam)	▪ To re-excavate River immediately to improve navigability enhance agriculture and fisheries resources ▪ There are 250 .approximately. charas from Thegamukh to Barkal. River excavation will open the mouth of the chara and reduce water logging

E4. Potential Options

Considering the issues of development and management of Karnafuli and Halda river basins, two potential options have been devised for detailed investigations .The options are formulated considering the suggestions of local community and social workers, consultation with BWDB officials, analysis of survey data and field visits. The interventions considered in both the option is presented in Table E4-1.

Table E4-1: List of Interventions considered in Option-1 and Option-2

Sl. No.	River Name	Measures	Option-1	Option-2
1	Halda River	Development of fish sanctuary	X	√
2		Dismantling of Chengkhali, Porali, Sonaimukh, Mogdai, Mandari, Katakhali, Khanakia, Kumirkhali and Kagtia Regulator	√	√
3		Replacement of Chengkhali, Porali, Sonaimukh, Mogdai, Mandari, Katakhali, Khanakia, Kumirkhali and Kagtia regulator	X	√
4		Excavation of Katakhali, Khanakia, Mandari, Sakarda and Sonaimukh khal	√	√

Sl. No.	River Name	Measures	Option-1	Option-2
5		Renovation of Sakarda and Boalia regulator	√	√
6		Dismantle the Weir from Dhurang River	√	√
7		Construction of HED replacing the weir	X	√
8		Excavation of Dhurang River	√	√
9		Restoration of Mora Dhurang khal	√	√
10	Chengi River	Excavation up to Mahalchori 34.55 km	√	√
11		River bank erosion protection about 500 m at Golabari, Khagrachori	√	√
12		River bank erosion protection at Chengi bridge about 400m	√	√
13		River bank erosion protection at Baburupara about 200m	√	√
14		Rubber Dam/HED at Dat-Kuppa Khal	X	√
15		Excavation of Dat-Kuppa Khal	√	X
16		Development of tourism facility	√	√
17		Char removal from Chengi river	√	√
18	Maini River	Excavation from Adarakchora Union to Mainimukh (23.6 km)	√	√
19		River bank erosion protection about 300m at Boradom bazar	√	√
20		Development of tourism facility	√	√
21		Char removal from Maini river	√	√
22	Kasalong River	Excavation of Dipor khal, Amtoli Khal, Sorbatoli Khal, Korangotoli Khal, Sijhok Khal, Gulishakhali Khal and Jibongo khal	√	√
23		Excavation of Kasalong river up to Baghaichori (46.9 km)	√	√
24		River bank erosion protection at Duchari bazar, Durbin para and Naillagona	√	√
25		Development of tourism facility	√	√
26	Rainkhiang River	Excavation up to Belaichori from Tengrachari (10.25 km)	√	√
27	Karnafuli River (Upstream of Kaptai Dam)	Excavation up to Boro Horina from Suvolong (54.5 km)	√	√
28		Development of tourism facility at Shuvolong	√	√
29	Karnafuli River (Downstream of Kaptai Dam)	Dredging about 37 km from KM 17 to KM 54	√	√
30	Cholok River	Excavation about 8.55 km from 1.3 km upstream of Paka Raster Matha to outfall at Karnafuli river	√	√
31	Afforestation	Afforestation in the deforested area	X	√

Effectiveness of Different Options

Effectiveness of different options have been assessed considering the issues of improvement of fisheries resources and enhancement of irrigation facility, drainage and navigability improvement.

The existing regulators on the bank of Halda river were constructed to enhance the irrigation facility, flood control and drainage improvement. However, the number of vent and size of the gates of some of the regulators are inadequate to drain out upstream rainwater quickly. Moreover, high velocity at the regulators are obstructing the migration of fish from river to khal. Considering the issues of irrigation, drainage, flood control and fish migration, Option-1 considered dismantling of the existing regulators and excavation of khals. On the other hand, Option-2 considered excavation of khals and replacement of the existing regulators with fish friendly regulators. Maximum water level in different khals during monsoon season, regulator velocity during fish migration season and available water depth in the khal during irrigation season for both the options are shown in Figure E4-1, E4-2 and E4-3 respectively.

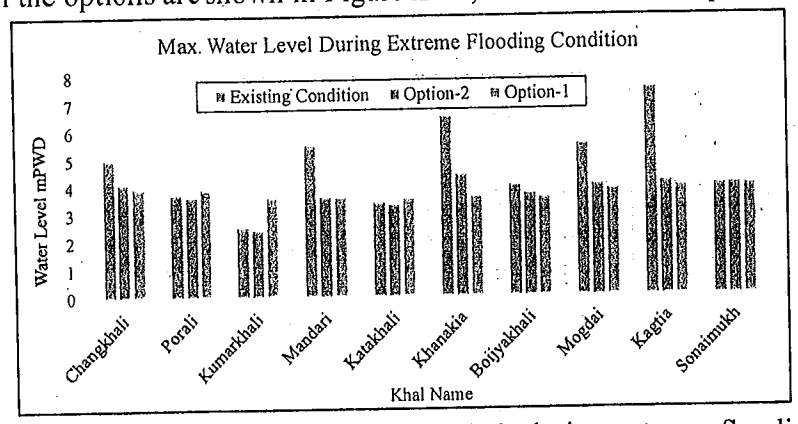


Figure E4-1: Maximum water level in different khals during extreme flooding condition

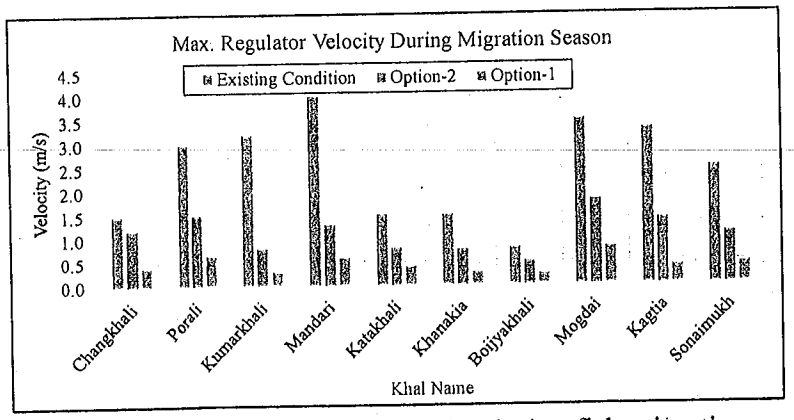


Figure E4-2: Maximum regulator velocity during fish migration season

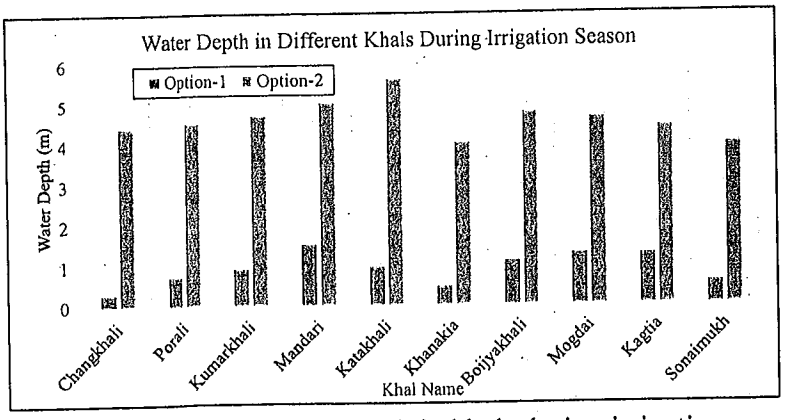


Figure E4-3: Available water depth in khals during irrigation season

Both the options are effective for drainage improvement and fish migration but only Option-2 is also effective for enhancement of irrigation facility. Option-2 can store adequate volume of water for irrigation water supply.

Again, existing Dhurang weir is playing a vital role in irrigation water supply through Mora Dhurang khal. However, this weir is obstructing the migration of different fish species and caused adverse impact on river hydrology and morphology in the downstream. Considering the issues of enable fish migration, improvement of hydro-morphological conditions and uninterrupted the existing Dhurang irrigation project, Option-1 considered excavation of Dhurang river and dismantling of existing weir. On the other hand, Option-2 considered excavation of Dhurang river and replace the existing weir by a HED. Water level difference between upstream and downstream of dam during fish migration season and available water depth in the river during irrigation season for both the options are shown in Figure E4-4.

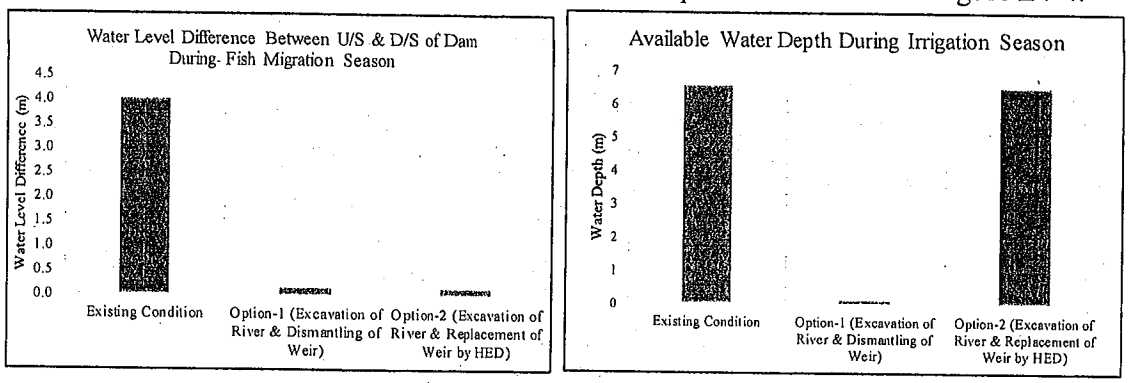


Figure E4-4: Water level difference between U/S and D/S of dam (left) and available water depth during irrigation season (right) in Dhurang river

At present, water level difference between upstream and downstream of the weir during fish migration season is about 4 m which is not suitable for fish migration. However, water level difference due to implementation of Option-1 and Option-2 will be 10 cm and 13 cm respectively. Thus, both the options are suitable for fish migration. Again, available water depth due to implementation of Option-1 is about 10 cm which is not suitable for irrigation water supply. Available water depth due to implementation of Option-2 is about 6.5 m. Although both the options are suitable for fish migration but only option-2 is suitable for irrigation water supply.

At present, Chengi, Maini, Kasalong, Cholok, Rainkhiang and Karnafuli river remain navigable only 5-7 months during monsoon season. Both the options considered excavation of these rivers for enhancement of fisheries resources and improve the navigability condition. Figure E4-5 shows the least available depth of Karnafuli river (upstream of Kaptai dam) from Shuvolong to Barkal for base and excavated condition.

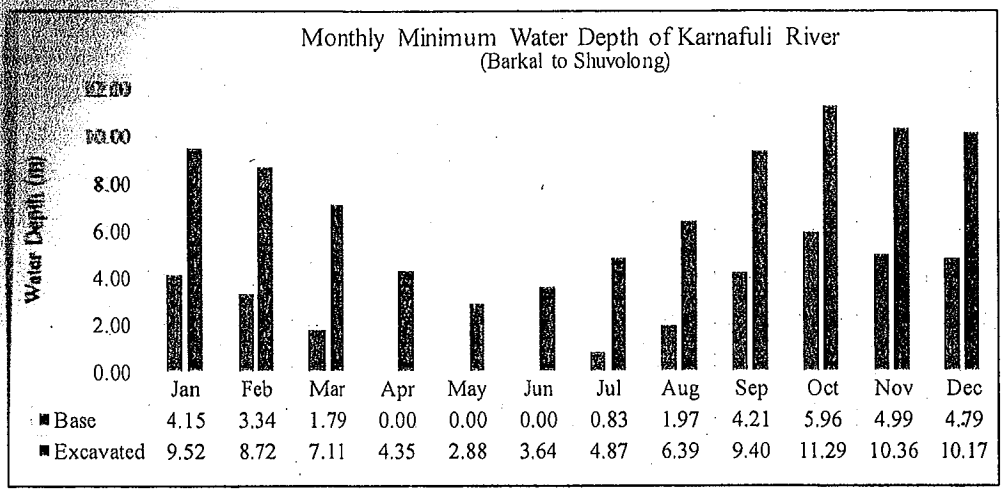


Figure E4-5: Least available depth of Karnafuli river for base and excavated condition from Barkal to Shuvolong

Karnafuli river from Barkal to Shuvolong will be navigable for round the year due to excavation in this river. This study reveals that other rivers will also become navigable for almost round the year due to excavation.

Datkuppa khal is a left bank tributary of Chengi river having 70 ha agricultural land. However, this khal become dry during dry season. To enhance the irrigation facility in this khal, Option-1 considered excavation of this khal whereas Option-2 considered construction of a Rubber Dam/HED. The available water depth in Dat Kuppa khal for both the options are shown in Figure E4-6.

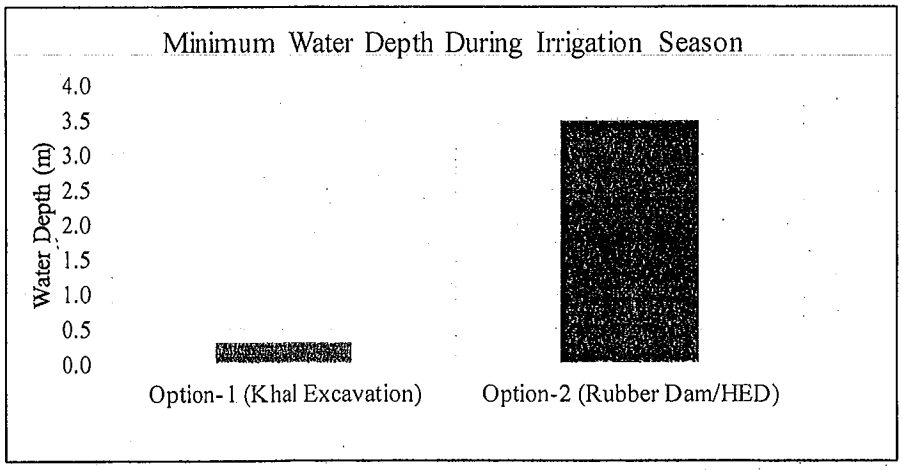


Figure E4-6: Available water depth in Dat Kuppa khal for both the options

Only excavation (Option-1) can't store sufficient water during dry season. On the other hand, construction of a Rubber Dam/HED (Option-2) can store adequate volume of water required for irrigation water supply.

Community consultation and consultation with fisheries expert suggest that development of fish sanctuary (Option-2) in the connected khal/loop of Halda river will significantly improve the fisheries resources of the study area.

Above analysis indicate that Option-2 is technically more effective than Option-1.

Multicriteria Analysis

Multicriteria analysis of the two potential options are done considering the issues of siltation in the river bed, river bank erosion, surface water irrigation, drainage improvement, agricultural benefit, enhancement of fisheries resources, navigability improvement, ecosystem and biodiversity, economic aspects, potential environmental impact and social acceptance. Table E4-2 shows multicriteria analysis for two potential options.

Table E4-2: Multi-Criteria Analysis of two Options

Sl. No.	Evaluation Criteria	Option-1 (Dredging/Excavation of River/Khal +Dismantling of Dhurang Weir and Regulators from the bank of Halda River)	Option-2 (Dredging/Excavation of River/Khal + Replacement of Dhurang weir by HED + Replacement of regulators by fish friendly structure + Fish Sanctuary + Rubber Dam/HED in Dat kuppa Khal)
1	Siltation in the River Bed	3	2
2	River Bank Erosion	2	2
3	Surface Water Irrigation	2	4
4	Drainage Improvement	3	3
5	Agricultural Benefit	2	3
6	Enhancement of Fisheries Resources	1	4
7	Navigability Improvement	3	3
8	Ecosystem and Biodiversity	1	2
9	Economic aspects	2	3
10	Potential Environmental impact	2	3
11	Social Acceptance	1	3
	Total	22	32

Note: The impact assessment scoring was done within the following points score scale ranging from (-)1 to (-)5 for negative impact and from (+)1 to (+)5 for positive impact.

By comparing the score of two potential options under different criteria given in the table, it appears that Option-2 is the best suited option and suggested for implementation.

Figure E4-7&8 shows suggested improvement measures for the Karnafuli and Halda river basins.

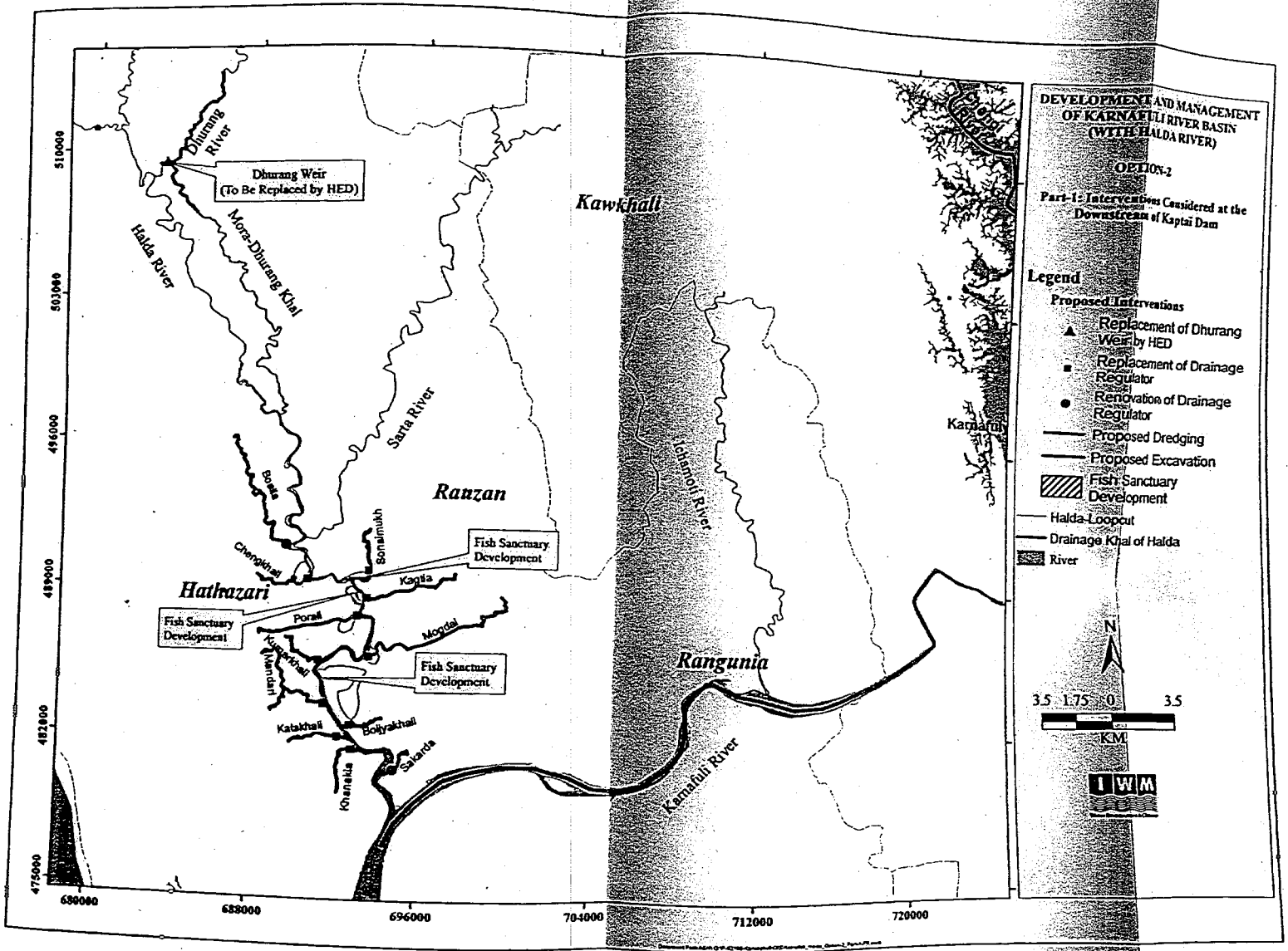


Figure E4-7: Physical interventions considered in (Option-2) the selected Option (Part-1: Downstream of Kaptai dam)

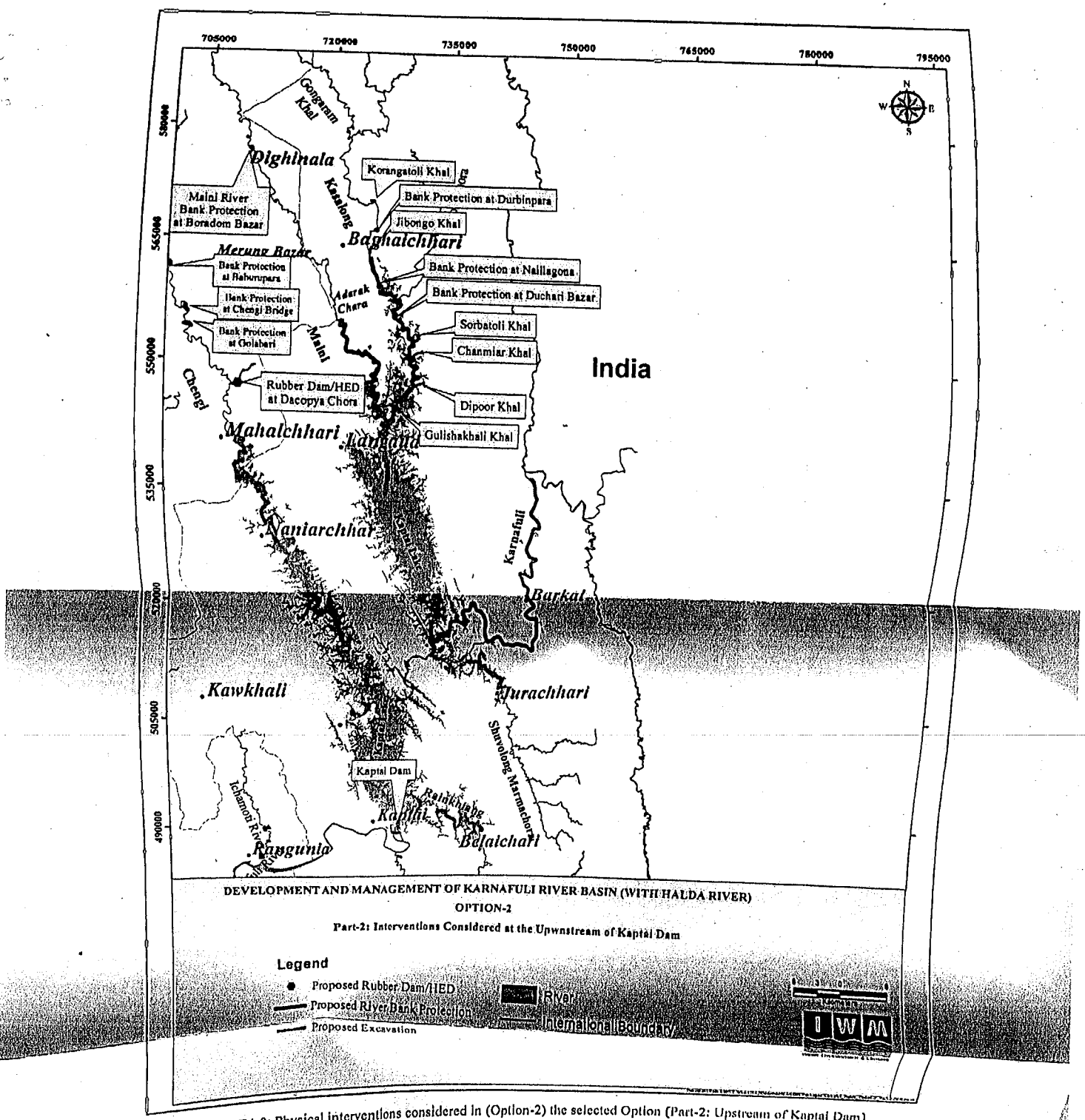


Figure E4-8: Physical interventions considered in (Option-2) the selected Option (Part-2: Upstream of Kaptai Dam)

E5. Social Impact Assessment

Social Impact Assessment (SIA) is carried out for the two different development options considered under the present study .A total of 900 house-hold surveys, 29 stakeholder consultations and 12 key informant interviews have been conducted to establish the baseline socio-economic condition and assess the potential impact of different interventions considered in this study.

A great majority of the local people suggested to replace the Dhurang weir with fish friendly structure. They opined that dismantling of Dhurang weir will adversely affected the farmers of Dhurang river basin. Excavation in the river system will enhance the fisheries resources and improve the navigability condition, business and tourism facility which will create improved livelihood and employment opportunity. River bank plantation will improve the livelihood opportunity and reduces the losses by river bank erosion. Development of tourism facility in Chengi, Maini, Kasalong and Karnafuli river basin will improve livelihood, employment, communication and national socio interest.

E6. Environmental Impact Assessment

Environmental Impact assessment is done for all kind of project activities considered in this study (river dredging/khal excavations, river bank protection, replacement of regulators, construction of HED/rubber dam, fish sanctuary, river bank plantation, tourism facility). For each project activity, several parameters are identified which will be directly affected or hampered. At each project activity site, the parameters are ranked from -5 to +5. If activity of project component hampers, deteriorates or degrades the parameter (like water quality, noise, benthos, etc.) then it is ranked from (-1 to -5) depending on the vitality of the degradation. If certain parameters (like navigability, ecosystem and livelihood, etc.) is improved then it is ranked from (+1 to +5) depending on the anticipated benefits.

Dredging/excavation will degrade water quality temporarily due to accidental oil spill from dredger/excavator, increase of turbidity at the time of dredging/excavation. Therefore, water quality, benthic environment and turbidity parameter is ranked from -2 to -1. Noise and air will be increased temporarily during dredging/excavation. Hence, this parameter is ranked as -1. Navigability (enhanced as available water will increase and submerged sandbars will be dredged/excavated), fisheries resources (will enrich due to flow augmentation), livelihood will increase as opportunities of fishermen in harvesting fishing resources will increase and ecosystem (aquatic ecosystem will enhance as flow and exchange of nutrients will increase) will be improved therefore, these parameters are ranked positive.

For river bank protection work, stability of the river bank will be restored, valuable property (household and agricultural land) near the bank will be saved, therefore, livelihood will also be improved, hence these parameters are ranked from +3 to +2. During construction, air quality and noise quality will be deteriorated hence, this parameter is ranked to -1. Consideration of

impact assessment ranking for replacement of regulators is similar as river bank protection work.

Construction of HED (Hydraulic elevator Dam) and Rubber dam will temporarily hamper noise and water quality. However, after this structure goes into operation, fish migration in river will be improved and agriculture production will be enhanced. Impact of HED/rubber dam on fish migration and agriculture is ranked as +3 and +4 for Dhurang river and Dat Kuppa khal respectively. Dat Kuppa khal is a branch of Chengi river, construction of HED/rubber dam will slightly reduce flow at Chengi river. Impact of HED/rubber dam on agricultural land on the basin of Chengi river is ranked as -1. Construction of fish sanctuary at Halda river brings an overall benefit. However, minor sedimentation may be observed.

River plantation will bring overall benefit to the area. Hence Air Quality, Bank Erosion, Terrestrial ecosystem and Livelihood impact is ranked from +3 to +1. Development of eco-tourism facility will enhance livelihood and socio-economic condition in the study area. The impact is ranked +4 to +3. Slightly decrease of noise and water quality will be evident due to tourist activity but this is minor.

E7. Economic Viability

The total Investment cost includes the cost of Civil works, Dredging/Excavation, Bank protective works, etc. is about Financial BDT 234,503.54 lakh and Economic BDT 163,841.06 lakh.

It is necessary to mention that there is an ongoing project of BWDB titled "*River Bank Protection along the both bank of Karnafuli & Ichamati River and Shilok Khal at different locations in Rangunia & Boalkhali Upazila of Chittagong & Kaptai Upazila of Rangamati Hill District*" where dredging over 10 km reach of Karnafuli river (downstream of Kaptai dam) is considered along with other interventions. Present study also identified the necessatity of dredging in Karnafuli river (downstream of Kaptai dam) over 37 km reach of the river. However, the 10-km dredging reach under the ongoing project overlapped with the propoed 37 km dredging under the present study. In this circumstance, the cost of dredging of Karnafuli river (downstream of Kaptai dam) is considered only for 27 km (37 km-10 km = 27 km) reach instead of 37 km in the investment costs in order to avoid the duality of activities under different projects.

There are two more proposed projects of BWDB titled, "*River bank protection works to prevent erosion of Karnafuli river, Boalkhali, Chandaria, Raikhali khal along with other khals under Boalkhali Upazila of Chattogram district*" and "*River bank protection works to prevent erosion at different locations Karnafuli and Halda river along with connected other rivers under Raozan Upazila of Chattogram district*" which considered river bank protection works, flood wall and embankment construction, repairing works, afforestation etc. at different locations in the Karnafuli river and its tributaries. Present study considered river bank protection of 4.3 km in Halda river, 15.78 km in Karnafuli river, 1.51 km in Ichamati river, 0.65 km in Shilok river,

1.50 km in Kasalong river, 0.10 km in Rainkhaing river, 5.92 km in Kaptai lake and 11.48 km in different khals. Again, repairing of bank protection works of 0.70 km in Halda river, 0.90 km in Karnafuli river, 0.27 km in Ichamati river and 0.03 km in Shilok river is considered in this study. Present study also considered embankment construction of 16 km in Halda river, 1.1 km in Mahfuz khal, 14 km in Dabua khal, 19.15 km in Sattar khal and 6 km in Whitekhar khal, flood wall construction of 4 km in Halda river, 5 nos. surface sluice in Halda river, 2 nos. footover bridge in Whitkher khal and 1600m afforestation along the bank of kaptai lake. Above mentioned activities are already included in the said ongoing project and two proposed projects. Thus, cost of these activities has been excluded from the investment cost of this project.

Again, BWDB is planning to implement a project in Khagrachhari district titled, "*Protection of Khagrachhari City and Adjoining Important Infrastructures from River Bank Erosion*". Which considerd bank protection works and char removal works at different locations of Chengi and Maini river. Present study considered bank protection works of 7.88 km in Chengi river and 2.93 km in Maini river and 197303 m^2 char removal form 44 nos. locations of Maini river and 601640 m^2 char removal from 179 nos. locations of Chengi river. These activities are already included in the proposed project of BWDB in Khagrachhari district. Thus, the cost of bank protection and char removal from Chengi and Maini river is excluded from the investment cost of this project.

Economic analysis illustrates that the EIRR for option-2 is 16.29% which is the above 12%, i.e .the opportunity cost of capital .In view of the above, it is seen that Option-2 is economically viable. The analytical results are shown in Table E7-1.

Table E7-1: Summary of economic and financial indicators

Viability Indicator	Option-2
1. Capital Cost Financial (Lakh BDT)	234503.54
2. O&M Cost Financial (Lakh BDT)	6856.89
3. Capital Cost Economic (Lakh BDT)	163841.06
4. O&M Cost Economic (Lakh BDT)	5263.01
5. Benefit Cost Ratio (BCR @ 12%)	1.38
6. Net Present Value (NPV @ 12%) Lakh BDT	55000.41
7. Internal Rate Return (IRR %)	16.29%

E8: Recommendations

I. It is recommended to implement all the suggested improvement measures under Option-2 for development and management of Karnafuli and Halda river basin as it is technically feasible, economically viable, environment friendly and socially acceptable.

The suggested interventions area as follows;

Halda River

- Development of fish sanctuary in Barighona loop, Ghorduara loop and Sonaimukh khal
- Replacement of Chengkhali, Porali, Sonaimukh, Mogdai, Mandari, Katakhali, Khanakia, Kumirkhali and Kagtia regulator
- Renovation of Sakarda and Boalia regulator
- Excavation of Katakhali, Khanakia, Mandari, Sakarda and Sonaimukh khal
- Construction of HED replacing the weir
- Excavation of Dhurang River
- Restoration of Mora Dhurang khal

Chengi River

- Excavation up to Mahalchori (34.55 km)
- River bank erosion protection about 500 m at Golabari, Khagrachori
- River bank erosion protection at Chengi bridge about 400m
- River bank erosion protection at Baburupara about 200m
- Construction of Rubber Dam/HED in Dat-Kuppa Khal
- Development of tourism facility
- Char removal from Chengi river

Maini River

- Excavation from Adarakchora Union to Mainimukh (23.6 km)
- River bank erosion protection about 300m at Boradom bazar
- Development of tourism facility
- Char removal from Maini river

Kasalong River

- Excavation of Dipor khal, Amtoli Khal, Sorbatoli Khal, Korangotoli Khal, Sijhok Khal, Gulishakhali Khal and Jibongo khal
- Excavation of Kasalong river up to Baghaichori (46.9 km)
- River bank erosion protection at Duchari bazar (350m)
- River bank erosion protection at Durbinpara (175m)
- River bank erosion protection at Naillagona (400m)
- Development of tourism facility

Rainkhiang River

- Excavation up to Belaichori from Tengrachari (10.25 km)

Karnafuli River (Upstream of Kaptai Dam)

- Excavation up to Boro Horina from Suvolong (54.5 km)
- Development of tourism facility

Karnafuli River (Downstream of Kaptai Dam)

- Dredging about 37 km from KM 17 to KM 54

Cholok River

- Excavation about 8.55 km from 1.3 km upstream of Paka Raster Matha to outfall at Karnafuli river

Afforestation

- Plantation along the river bank

II. It is also recommended to implement river bank protection work of another 52.06 km along the bank of Chengi, Maini, Kasalong, Halda, Karnafuli, Ichamati, Shilok and Rainkhaing river, Kaptai lake and different khals. Again, repairing of bank protection works of 1.9 km along the bank of Halda, Karnafuli, Ichamati and Shilok river is recommended in this study. Embankment construction of 56.25 km along the bank of Halda river, Mahfuz khal, Dabua khal, Sattar khal and Whitekhar khal and flood wall construction of 4 km along Halda river is recommended. Construction of 5 nos. surface sluice in the connecting khals of Halda river, 2 nos. foot over bridge on Whitkher khal and 1600m afforestation along the bank of Kaptai lake is also recommended to implement. A summary of the recommended interventions is given in Table E8-1. Detail description of the interventions are given in Table 6-5 and Table 6-6.

Table E8-1: Summary of the recommended bank protection, embankment and flood wall construction works

River Name	Description of Works						
	Bank Protection (m)	Embankment (m)	Flood Wall (m)	Repairing of Bank Protection (m)	Surface Sluice (nos.)	Foot Over Bridge (nos.)	Afforestation (m)
Chengi River	7885 @ 26 locations						
Maini River	2930 @ 9 locations						
Halda River	4300 @ 17 locations	16000	4000	700 @ 6 locations	5		

River Name	Description of Works						
	Bank Protection (m)	Embankment (m)	Flood Wall (m)	Repairing of Bank Protection (m)	Surface Sluice (nos.)	Foot Over Bridge (nos.)	Afforestation (m)
Karnafuli River	15780 @ 58 locations			900 @ 3 locations			
Ichamati River	1510 @ 6 locations			270 @ 2 locations			
Shilok River	650 @ 2 locations			30 @ 1 location			
Bangalhalia Khal	1180 @ 11 locations						
Mahfuz Khal	120 @ 1 location	1100					
Varamba Khal	500 @ 1 location						
Boalkhali Khal	2300 @ 9 locations						
Raikhali Khal	1300 @ 4 locations						
Chandaria Khal	1550 @ 4 locations						
Dabua Khal	1280 @ 7 locations	14000					
Sattar Khal	1300 @ 7 locations	19150					
Kaptai Lake	5922 @ 10 locations						1600
Kasalong River	1500 @ 3 locations						
Monai Khal	700 @ 1 location						
Kaptai Khal	1150 @ 1 location						
Ichakhali Khal	100 @ 1 location						
Rainkhiang River	100 @ 1 location						
Whitkhar Khal		6000				2	

III. Afforestation in the deforested area by appropriate authorities
IV. Take necessary actions to control water pollution by industrial and household wastes
V. Stop the use of harmful pesticides and chemical fertilizers in the agricultural field
VI. It is also recommended to implement the environmental management and enhancement plan
VII. Physical, environmental, social and economic benefit monitoring is recommended to carry out before, during and after completion of the project;