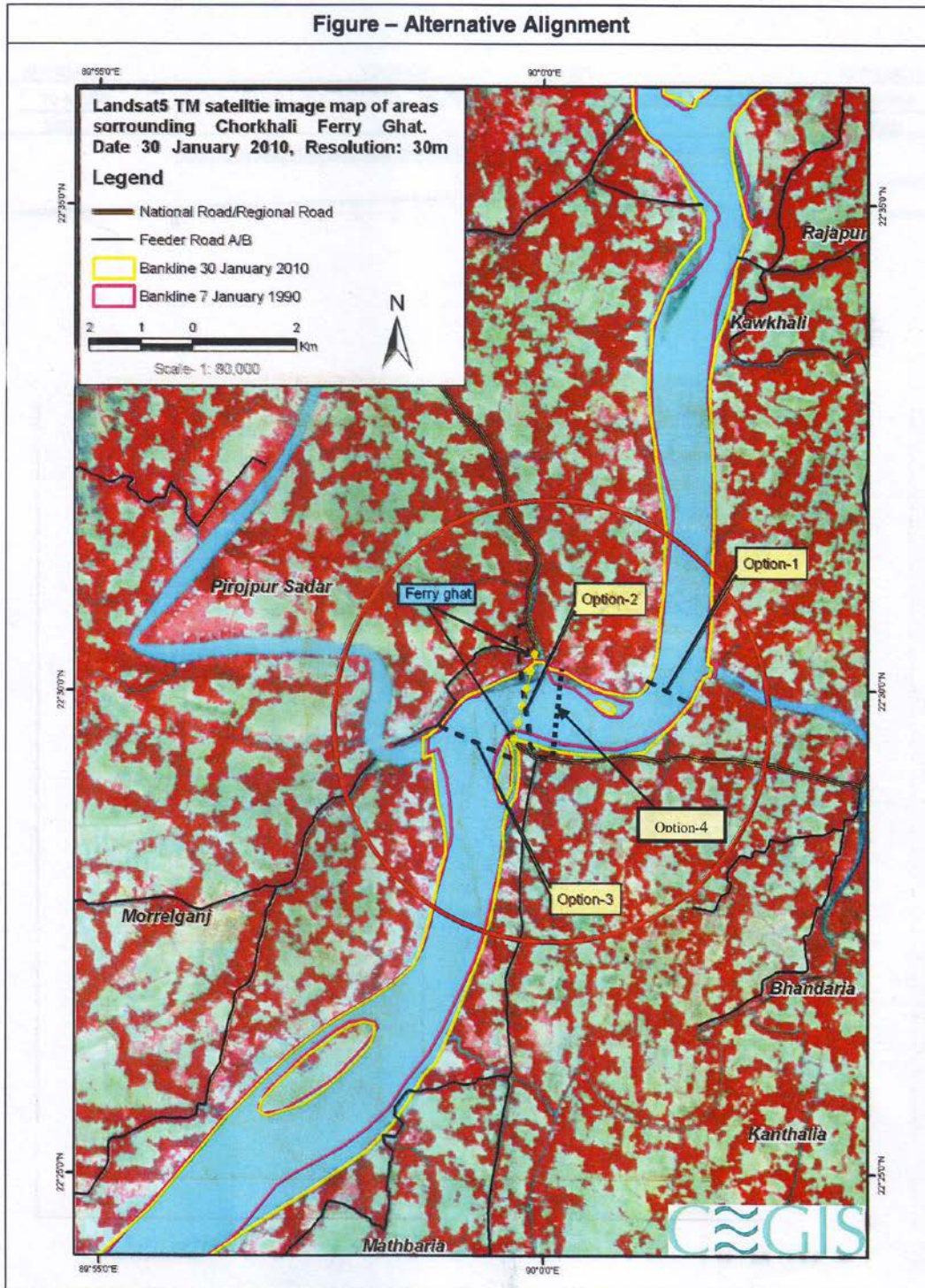


Feasibility Study and Preliminary Design for construction of Bridge at Ferry Location at 53<sup>rd</sup> Km. on Barisal-Jhalokhati-Bhandaria-Perojpur Road (R870).



## **OUT LINE OF THE PROJECT**

- ❖ Project site : Proposed Bridge Site is at 53<sup>rd</sup> km on Barisal-Jhalokhati-Bhandaria-Perojpur Road (R870)
  
- ❖ Bridge : Total length of the bridge is 1520.0m. The Main bridge and Viaduct are as follows;  
Main Bridge is 800.0m long consist of segmental pre-stressed post tensioned box girder.  
Structural forms: 2x50+7x100 =800.0m  
Viaduct is 720.0m long consist of pre-stressed I section  
Structural forms: 12x30+12x30 =720.0m
  
- ❖ Approach Road : Approx. 500.0m on each side
  
- ❖ River Training Work (RTW) : River Bank protection works would be 100m upstream and 50m downstream of the bridge centre line on both sides of the river.
  
- ❖ Project Cost : BDT 6081.36 Million
  
- ❖ Construction Period : 2014 to 2017 ( 4 years)
  
- ❖ NPV : BDT1095.60 Million
  
- ❖ BCR : 1.31
  
- ❖ EIRR : 18.72%
  
- ❖ Traffic Volume : Motorized Traffic 31,209 Veh /day at the Year 2047.
  
- ❖ Indirect Benefit : Will increase the economic activity, educational activity and overall benefit of the region.

## EXECUTIVE SUMMARY

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### 01) Introduction

Govt. of Bangladesh, through Bangladesh Bridge Authority as executing agency contracted JV of SARM Associates Ltd and BETS Consulting Engineers for carrying out Feasibility Study for constructing of bridges at 3 ferry locations namely

- a) At Charkhali Ferry Ghat (R870) on Kocha River
- b) At Galachipa Ferry Ghat (Z8806) on Galachipa River
- c) At Mirganj Ferry Ghat (Z8034) on Arial khan (Branch)

The purpose of the Executive Summary is to highlight the Major findings of various studies and the conclusions and recommendations of the study team.

The Notification of Award for providing Consultancy Services was issued by the Chief Engineer on 28 June 2011. The Consultant has started their work from July 2011. The Consultant submitted the reports as following table;

Types of Report	Date of submission
Inception Report	27 July 2011
Interim Report	29 December 2011
Draft Final Report	04 April 2012
Draft Final Report Revised	06 June 2012

### 02) Project Background

#### *Reasons for the project*

Bangladesh is a country with innumerable rivers flowing across its territory. The Padma River is the mightiest of all these and ranks as the fifth largest river in the world in terms of volumetric discharge. The western part of deltaic Bangladesh is physically detached from northern and eastern part including capital city, until a massive bridge is built across the Padma River.

Ferry crossing at Ferry locations which are the major tidal stream, considerably hampers road communication particularly during flood season. The 3 (Three) bridges at those ferry locations as mentioned will grossly improve the road communications. These will improve the socio-economic condition and industrial development of the area.

### ***Construction of Bridge At Charkhali Ferry ghat (R870) on Kocha river***

#### *Description of the River*

At Charkhali Ferryghat the name of the river is “kocha”. The combined effect of kaliganga River and Sandhya River (in Kawakhali and Perojpur upazilas respectively of Perojpur district) flows as Kocha River till it falls in the Balleswar River, which passes between Patharghata and Sharonkhola upazilas of Bagerhat districts respectively. After passing in between Borguna and Bagerhat as Boleswar, it falls into Bay of Bengal as Horinghata River. The Kocha river(BWDB ID No. 58) is about 35km long. It is a tidal river in the south west region of Bangladesh with reported tidal variation of 2-3m.

#### *Importance and justification of the proposed bridge at 53 km on Barisal-Jhalokati – Bhandaria-Perojpur Road(R870).*

The regional highway R870 starts from Barisal and ends at Perojpur via Jhalokati, Rajapur, Bhandaria etc places. At present it is only ferry crossing on the road (at 53 km) from Barisal and 12 km from Perojpur. The proposed Bridge will directly connect Barisal, Jhalokati district with Perojpur district and greater Khulna region. It will also connect Mathbaria, Bhandaria etc. Upazila with the Perojpur district. The proposed bridge will save time and money from transportation of people and goods. After the construction of the Padma Bridge the traffic will increase manifold and it will be very difficult for the ferry service for carrying all the transports smoothly and timely.

The ferry service at present is giving connectivity with other places. But at ferry points we have to wait average one and half hour or more. If the bridge is constructed, the commercial vehicles will give more trips and working hour of people will be saved.

At the natural calamity the ferry services disrupts economic and social activities seriously. The Consultant found the construction of the bridge is economically viable. So construction of the bridge at the ferry location is justified.

### **03) Traffic Survey and Forecast**

The main objective of traffic survey and analysis is to determine the extent of traffic demand on a road/bridge project. The result of this process will form the basis for traffic forecast and projection on the road/bridge project.

The summary of the study findings starting from traffic survey through traffic projection are as follows;

- From traffic projection of total motorized traffic(Table 2.5.4, Volume – 1), it is found that motorized AADT in the year 2047 is 31209, veh / day (Normal traffic 13512 nos, generated traffic 10411 nos and diverted traffic 7286 nos) which is less than 35,000, the saturation capacity of two lane Bridge & 2 lane carriage way (Ref: ADB TA# 4821- BAN 2009).
- From traffic projection of total non-motorized traffic (Table 2.5.5, Volume – 1) it is

Found that AADT in terms of PCU / hr. in the year 2047 is 126 PCU / hr. which is far less than 400 PCU / hr, the minimum requirement of provision of NMV lane according to the Roads & Highways Department rule.

- From the traffic survey, it may be concluded that the Bridge with both side approach road is feasible for 2-lane carriage way.

The two lanes cost of bridge is found to be 6081.36 Million whereas the cost of four lane Bridge will be BDT 11551.82.Million.

From above study based on traffic volume and cost of the bridge, it is seen that the construction of four Lane Bridge is neither justified from traffic point of view nor from construction cost.

#### **04) Hydrological and Morphological Study**

The Ferry Ghat is located on the river “Kocha” and it connects Bhandaria upazila of Perojpur district with Perojpur Sadar upazila. The right bank is locally known as “Togra” while the left bank is locally known as “Chorkhali”

The Kocha River is about 35 km long. It is a tidal river in the south-west region of Bangladesh with reported tidal variation of 2 - 3 m. BWDB . During lean season of November the maximum depth at Umedpur has been found to be about 10m whereas during peak season of August – September the depth rises to about 12 – 13 m.

The following data and figures have been collected from field surveys

- The river is a tidal one.
- High bank to high bank distance of the river along analysis option: 1375 m
- Average ground level on Bhandaria side: 3.54 mPWD
- Average ground level on Perojpur side: 3.25 mPWD
- RL of the river at bank full stage: 3.4 mPWD
- Cross section area of the river at bank full level: 26,920 m<sup>2</sup>
- Length of the proposed main bridge: 800 m
- Length of the proposed viaduct: 720 m
- Observed lowest bed level of the river: (-) 34.58 m PWD
- Mean High Water Spring at Patuakhali (as per BIWTA Tide Table)  
= 2.907 m in CD = 2.907 – (3.785 – 2.889) = 2.011 mPWD
- Mean Low Water Spring at Patuakhali (as per BIWTA Tide Table)  
= 0.242 m in CD = 0.242 – (3.785 – 2.889) = (-) 0.654 mPWD
- Mean High Water Spring at Mongla (as per BIWTA Tide Table)  
= 4.296 m in CD = 4.296 + 0.46 = 4.756 mPWD
- Mean Low Water Spring at Mongla (as per BIWTA Tide Table)  
= 0.325 m in CD = 0.325 + 0.46 = 0.785 mPWD

Review and analyses of the prevailing hydrological and morphological environment of the proposed Chorkhali Bridge area leads to the following conclusions and recommendations:

- Design High Water Level: 3.384 mPWD
- Design Low Water Level: ( - ) 0.73 mPWD
- Regime Width of the Kocha River at Bridge Site: 1094 m
- Anticipated Maximum Scour at Bridge Pier: upto ( - ) 41.38 mPWD
- Bridge Soffit Level over Navigable Portion of the Channel: 21.684 mPWD
- Minimum Bridge Span Openings on Navigable Portion of the Channel: 76.22 m
- Bridge alignment: On or near morphological analysis option – 2.

### ***River Training work***

At Charkhali, the width of the bridge from bank to bank at the centreline of the proposed is about 1375m. The proposed bridge has been designed for a span length of 1520m. Thus from spanning of the bridge, it is evident that the bridge abutment are located at a safe distance from the main river channel. The river will be flowing normally under the bridge and no specific guide bank are required for the bridge.

Length of the river banks to be protected from site inspection at the proposed bridge site is stable. However, river bank protection works would be done for a length of about 100m upstream and 50m downstream of the bridge centreline.

The river banks could be protected by stone pitching or by concrete blocks or by growing vegetative cover. Concrete blocks are costly. For this reason the Consultant suggests for stone pitching work for river training work.

## **05) Bridge Location Study**

Selection of a bridge alignment on a specified road network route depends mainly on river width, river geometry, navigational clearance requirement, historical change in the river course, required length of approach road for a specific alignment and availability of land and its acquisition are for the bridge approaches.

The Consultant have undertaken detail bank line stability study of the river “Kocha” covering about 3.5 km upstream and 4.5 km down stream of the existing ferry ghat and the hydrographic survey covering sufficient upstream and downstream of the river. During preliminary stage a reconnaissance survey was done and 8 nos. X- Sections were taken. Due to meandering of the river & existence of bend, 3 nos. cross sections were not considered in 1<sup>st</sup> step screening. Then after 2 times screening on remaining 5 cross sections & from hydraulic considerations, 4 alternative locations were considered.

- From Hydrographic Survey it is seen that, the Option-2 bridge site along the existing road will connect the existing R870 route. About 1.8 hac less valuable land will be needed to be acquired and 57 temporary structure in government encroached land will be affected. This Option will involve minimum additional land to be acquired for the bridge approach.

- The Option-1 is at about 2.5 upstream of ferry ghat where the river banks are stable, the side slope of river bank is mild & no significant bank shifting has occurred during last 20 years. However, this will involve nearly 3.6 km of approach road embankment through valuable agricultural land & homestead land which may not be accepted by the local community & will not be economical. About 5.2 hac. Land will need to be acquired and 4 structures will be affected
- The Option-3 is 0.5 km. downstream of ferry ghat but it is very near to the confluence of river. This will also involve nearly 1.8 km of approach road embankment on through valuable agricultural land and homestead. About 3.5 hac valuable land will need to be acquired and two structures will be affected.
- The Option-4 is 0.75 km. of upstream of ferry ghat. This will involve nearly 2.2 km of approach road embankment on through valuable agricultural land and homestead. About 4.0 hac land will need to be acquired.

## **06) Selection of Final Bridge Alignment**

The Consultant considered following bridges at the four options for selection of the final bridge alignment.

a) Option -1

Main Bridge     $2 \times 50 + 7 \times 100 = 800$  m  
Viaduct.        Bhandaria end:  $12 \times 30 = 360$ m  
                     Perojpur end:  $15 \times 30 = 450$ m  
Total length of the Bridge: **1610m**

b) Option-2

Main Bridge     $2 \times 50 + 7 \times 100 = 800$  m  
Viaduct         Bhandaria end:  $12 \times 30 = 360$ m  
                     Perojpur end:  $12 \times 30 = 360$ m  
Total length of the bridge: **1520m**

c) Option-3

Main Bridge     $2 \times 50 + 8 \times 100 = 900$  m  
Viaduct.        Bhandaria end:  $11 \times 30 = 330$ m  
                     Perojpur end:  $12 \times 30 = 360$ m  
Total length of the bridge: **1590m**

d) Option-4

Main Bridge     $2 \times 50 + 10 \times 100 = 1100$  m  
Viaduct.        Bhandaria end:  $12 \times 30 = 360$ m  
                     Perojpur end:  $13 \times 30 = 390$ m  
Total length of the bridge : **1850m**

The alternative alignments were then evaluated for technical & financial costs. The final location of the bridge is Option -2.

### **Comparative study of four options of the bridge**

**Feasibility Study and Preliminary Design for construction of Bridge at Ferry Location at 53<sup>rd</sup> Km. on Barisal-Jhalokhati-Bhandaria-Perojpur Road (R870).**

The Consultant performed detail study and prepared a comparative study of the four alternative options of the proposed bridge for social environmental and economic aspects for final selection. These are shown in the following table

*Table: Comparative Study of alternatives*

Description	Option -1	Option-2	Option-3	Option-4
Construction Cost (BDT)	6016.35 Million	4776.03 Million	5301.47 Million	6881.56 Million
Project cost (BDT)	7991.63 Million	6081.36 Million	7028.62 Million	8781.12 Million
Length of the approach road	3.6 km	500m on each side	1.8 km	2.2 km
Land Acquisition	5.20 hac.	1.80 hac	3.50 hac	4.0 hac
Land Acquisition, Resettlement & EMP cost (Million BDT)	31.22	3.03	15.31	22.25
Environmental impact	More land acquisition will result in environmental impact.	less land acquisition will result in less environmental impact	More land acquisition will result in environmental impact.	More land acquisition will result in environmental impact.
Affect on household and structures	4 nos.structures	4nos.household 57 nos temporary structures	02 no structures	1 household and 2 nos structures
Social Impact	More land acquisition will result in social impact	Less land acquisition will result less social impact	More land acquisition will result in social impact	More land acquisition will result in social impact
NPV (Million BDT)	5.46	1095.60	552.7	-406.84
BCR	1.00	1.31	1.14	0.92
EIRR	15.02%	18.72%	16.95%	14.04%
Ranking	3	1	2	Economically not feasible



The report concludes that the proposed bridge at Option -2 location along the existing R870 route would provide the minimum project cost with minimum disturbance to the existing properties and with maximum benefit for the techno-economic evaluation. Therefore, Option-2 location has been suggested by the Consultant for the proposed bridge and approach roads location.

### **Selection of Structural Configuration**

For structural configuration following two alternatives have been studied for the selected alignment

#### **Option-1: PSC Box Girder**

Main bridge - 7x100m + 2 x 50m in PSC box type = 800m

Viaduct - 12x30m + 12x 30m in PSC I - Girder type = 720m

Total Length of bridge = **1520m**

Total cost of the bridge: BDT 6081.36 Million

#### **Option-2: Extradosed PSC Box Girder**

Main bridge - 5x150m + 2 x 75m in Extradosed PSC box type = 900m

Viaduct - 11x30m + 11 x 30m in PSC I - Girder type = 660m

Total Length of bridge = **1560m**

Total cost of the bridge: BDT 9761.84Million

The bridge type selected through cost comparison between two options is PSC Box Girder.

### **07) Geotechnical Investigation for The Structure**

Here the soil is grey medium stiff to soft clay of approximately 10.0m thick, 10m~20m grey soft silt to dense silt with some fine sand and at larger depth below 20.0m & thereafter medium dense fine sand to dense sand have been found.

### **08) Design Approach and Technical Standards**

The Consultants preliminary designs are in accordance with international standards and procedures but are largely based on Roads and Highways Departments (RHD) standards for design of Bridges and geometric design standard. The principal international standards adopted are;

- a) For approach roads and bridge alignment:-Guide lines for Design of Flexible Pavement, and Pavement Design Guide followed by Roads and Highways Department (RHD), Latest revision of AASHTO (1993), guide for Design of Pavement structure, presently in use in Bangladesh.
- b) For the bridge: AASHTO latest revision applicable in use in Bangladesh on Standard Specifications for Highway Bridges.
- c) For Material standard: AASHTO latest revision in use in Bangladesh.

## **09) Findings and Sum-up**

The Consultant has conducted the following surveys and investigation;

- a) Extensive reconnaissance survey by the team members to select the possible locations of the bridge and associated approach roads/ link roads to existing roads.
- b) River Crossing Traffic Survey to assess the Normal Traffic and their mode of crossing, over the proposed bridge.
- c) Preliminary Social, Resettlement and Environmental impact study at the selected 4 possible bridge locations and approach roads.
- d) Topographic Survey at the selected bridge location.
- e) Hydrographic survey at the selected bridge location.
- f) Geotechnical Investigations along the selected bridge and approach road alignment, and
- g) Morphological (satellite imagery) studies over the last 20 year in the vicinity of the proposed bridge to assess the river bank shifting and requirement for bank protection work

In addition to the above Hydrological studies have been carried out including the study for Navigational clearance requirement.

## **10) Environmental Impact Assessments**

### *Potential Adverse Impact*

Among the physical negative environmental impact mainly on air quality may appear during construction of the bridge. During post –construction operational phase, the negative impacts on air quality will come from vehicle exhaust emission pollutants. As a result air will be deteriorated. The impacts on noise level may be increased during the time of construction. The impacts on biological environment will appear in cutting of some trees and plants on both side of the approach roads of the bridge. As a result roadside erosion and some negative impacts on ecology may be approved. Erosion may be appearing on both bank side earth work of the river during construction of the bridge. Some drainage congestion may arrive on the approach roadside of the bridges during construction phase. Some land acquisition and resettlement may be required. Navigation may be disrupted. Fish habitat may be affected. Quality of water may be affected.

### *Mitigation measures*

Increase channel capacity to handle big barges and water crafts. Providing adequate Flood passage structures for fish migration and careful alignment of the bridge without disturbing fish habitat and fishing. Limiting works to dry Season. Carefully planning navigation bypass. Restoring and Rehabilitation navigation Channel for safe transport and storing construction materials. Spraying water to reduce dust hazards and limited use of machinery to reduce noise. Proper monitoring of soil erosion, navigation, chemical storage and use; site inspection, condition of construction camp, surface water quality, measurement of DO, BOD,SS. FECAL coli forms, drinking water quality, inspection of brick, bitumen & cement

facilities as per methods/ procedures recommended by department of environment, checking noise and vibration and inspection of health and safety.

*Positive Impact*

In the long run the project will replace ferry services. Improve regional hydrology by cross drainage structures. Reduce dust pollution and improve water quality by bituminization of the pavement. Facilitate and improve access to markets for income generation. Allow easy movement of motorized and other traffic. Improve aesthetic quality of the region. Agricultural development will occur. Better access to growth center markets. Environmental quality enhancement.

*Environmental Management Plan*

Environmental Management Plan (EMP) is suggested to avoid any adverse impact during construction of the bridge and operation maintenance phases and it will ensure environmental provisions and management for the bridge. The EMP cost will include river bank erosion on the approaches of the bridge, drainage congestion, air quality, noise level, removal of trees and plantation, water quality, land loss/ acquisition, homestead loss, agricultural and commercial loss, health and sanitation, traffic management and congestion. The EMP cost will be approximately 3% of the cost of the bridge.

- On critical review of the potential environmental impacts, the specific mitigation and monitoring measures proposed and the benefits described, the project will not lead to any long term irreversible adverse impact on the adjacent environmental quality and resources.
- Most of the potential impacts are short-term and minor in nature. The anticipated adverse effects could be greatly controlled / minimized or eliminated through adoption of suggested mitigation measures and implementation of the Environmental Management Plan.
- Considering the civil engineering requirements from environmental advantage point of view, the current location and functional route of the project is acceptable.

**11) Operation & Maintenance:**

In order to ensure long time durability and services of the bridge operation and maintenance of different components of main bridge, viaducts, services and other ancillary structures of the bridge will be an essential activity. These will include routine inspections at weekly or monthly basis, general inspection after two year's time and principal inspection after every five year's time.

However, the Construction Company with due agreement and concurrence of supervision consultant and Manufacturer's specifications will prepare necessary Operation and Maintenance manual for the main bridge and Viaducts and connections, supports, services, and other ancillary structures . The qualified Operation and Maintenance Operator will follow the detail manuals in operation and maintenance work

## 12) Economic Evaluation

### Comparison of costs and Benefits.

To arrive at the conclusion of economic appraisal of the project, it is necessary to compare the costs and benefits and find out Net Present Value (NPV) Benefit – Cost Ratio (BCR), and the Internal Rate of Return (IRR).

The costs and benefits were discounted initially at 15 percent (as prescribed by the Planning Commission) and based on the result, were further discounted at 10 percent to arrive at IRR. The following table provided the summary position of the economic analysis:

**Sensitivity Analysis:** Cost and Benefits of the project are based on estimates and projection. In reality it may vary with actual costs and available benefits. To test the worthiness of the project, it is considered that sensitivity analysis is carried out taking into account three alternative situations.

- (i) With 10% increase in cost stream ;
- (ii) With 10% decrease in benefit stream;
- (iii) With combined effect of (i) and (ii)

The results of Sensitivity Analysis as per alternatives (i) (ii) and (iii). above are presented in the following table.

### ECONOMIC ANALYSIS: NPV, BCR & IRR BASE CASE and Sensitivity Analysis

SI No.	Economic Evaluation	NPV (Million Taka ) at 15% discount	BCR	IRR (%)
01.	Base Case	1095.60	1.31	18.72
02.	Benefit (10% reduced)	750.89	1.19	17.62
03.	Cost (10% increased))	641.32	1.18	17.48
04.	Combined effect of benefit 10% reduced and cost 10% increased	296.60	1.07	16.18

The economic indicators for design options on the existing alignment justify the economic viability of the project.

## 13) Project Cost

The project Cost includes the following components of cost:

1. Total Construction Cost;
2. Engineering Cost
3. Land Acquisition, Resettlement
4. Administrative Cost;
5. Physical Contingencies.
6. Price Contingency

7. VAT, TAX and Duties.

The table below shows the cost of the components of the Project Cost:

**Total Project Cost (Charkhali Bridge, Option - 2)**

SI No.	Description	Amount in Million BDT	Remarks
1	Construction Cost		
	a) Bridge	BDT 4,562.21	
	b) Approach Road	BDT 35.00	
	c) River Bank Protection Work	BDT 178.82	
	<b>Total Construction Cost</b>	BDT 4,776.03	
2	Engineering Cost		
	a) Detailed design	BDT 119.40	2.5% of SI No. 01
	b) Construction Supervision	BDT 167.16	3.5% of SI No. 01
3	Land Acquisition, Resettlement and EMP.	BDT 3.03	
4	Administration Cost	BDT 28.96	10% of SI No. 02 & 03
5	Physical Contingencies	BDT 477.60	10%-15% of SI No. 01
6	Price Contingencies	BDT 288.95	5% of SI No. 01, 02 and 05
7	VAT, TAX and DUTIES	BDT 220.22	14.5% for importation @ 30% of SI No. 01 & 02
	<b>Total Project Cost</b>	<b>BDT 6,081.36</b>	

## 14) Conclusion from the Study

### 14.1 Structural Configuration

From the hydraulic (including navigational clearance requirement), topographical and Geotechnical studies and the acceptable (3.5%) longitudinal grade, the total length of the proposed bridge has come to 1520m, comprising of the main bridge over the main river channel followed by viaduct on either bank covering the flood plain.

The main bridge has been suggested in **Option-2** comprising of post-tensioned pre-stress concrete Single Box Girder (PSC Box Girder) continuous with segmental cantilever construction with span of 100m. The viaduct portions comprise of pre-stress Girder of span 30 m. The total length of option-2 being 1520m comprises of (7x100+2x50+24x30)m.

### 14.2 Foundation Type Consideration

The foundation type of 100m span PSC box type bridge is quite common in Bangladesh with large diameter (1200mm) cast-in-situ RCC bored piles and that of viaduct span being with 1000mm diameter Cast-in-situ bored piles.

#### **14.3 Social and Resettlement Impact Consideration**

The survey was conducted in the immediate vicinity of the final bridge alignment and both side of approach roads. The existing Bhandaria-Perojpur road(R870) route causes least disturbance to the existing settlement and is the least cost solution.

#### **14.4 Environmental Consideration**

On critical review of the potential environmental impacts, the specific mitigative and monitoring measures proposed and the benefits to be derived, the project at the proposed alternative-2 location will not lend to any long term irreversible adverse impact on the adjacent environmental quality and resources.

#### **14.5 Economic Justification**

The economic analysis carried out for the proposed Bridge for 30 years evaluation period shows that from the point of view of all the economic parameters considered the project is economically viable and the investment is highly justified.

The NPV of the bridge at 15% discount rate is placed Tk. 1095.60 million.

The EIRR of the project at about 18.72% is above the 15% accounting rate of return considered for taking investment decision in Bangladesh. The benefit cost ratio is about 1.31

### **15. Recommendations of the Study**

The recommendations of the study for the proposed Charkhali Bridge are as follows:

a) The bridge for the options -2 is found to be feasible from technical and economic consideration and may be taken up for construction.

b) The most suitable foundations of the piers in the waterway are found to be large diameter (1200mm for the 100m span PSC Box Girder) RCC cast-in-situ bored piles with permanent steel casing and that of the viaduct portion in 1000mm diameter RCC cast-in-situ bored piles with temporary casing.

d) The bridge may not be effective for traffic flow without the minimum improvement of the R870 road starting from Bhandaria to Perojpur.

### Summary of Costs of Different Options At a Glance

<b><u>Charkhali Bridge</u></b>	Total Project Cost for 2 Lane Bridge (Mill BD)	Total Project Cost for 4 Lane Bridge (Mill BD)	Total Project Cost of Extra-dosed for 2 Lane Bridge (Mill BD)
Option – 1	7,991.63	13,342.39	-
Option – 2	6,081.36	11,551.82	9,761.84
Option – 3	7,028.62	12,719.52	-
Option – 4	8,781.12	15,913.50	

## **SUMMARY OF COST OF 2 LANE BRIDGE**



**Total Project Cost (Charkhali Bridge, Option - 1)**

<b>SI No.</b>	<b>Description</b>	<b>Amount in Million BDT</b>	<b>Remarks</b>
1	Construction Cost		
	a) Bridge	BDT 4,671.33	
	b) Approach Road	BDT 1,166.20	
	c) River Bank Protection Work	BDT 178.82	
	<b>Total Construction Cost</b>	BDT 6,016.35	
2	Engineering Cost		
	a) Detailed design	BDT 150.41	2.5% of SI No. 01
	b) Construction Supervision	BDT 210.57	3.5% of SI No. 01
3	Land Acquisition, Resettlement and EMP.	BDT 31.22	
4	Administration Cost	BDT 39.22	10% of SI No. 02 & 03
5	Physical Contingencies	BDT 902.45	15% of SI No. 01
6	Price Contingencies	BDT 363.99	5% of SI No. 01, 02 and 05
7	VAT, TAX and DUTIES	BDT 277.41	14.5% for importation @ 30% of SI No. 01 & 02
<b>Total Project Cost</b>		<b>BDT 7,991.63</b>	

**Total Project Cost (Charkhali Bridge, Option - 2)**

SI No.	Description	Amount in Million BDT	Remarks
1	Construction Cost		
	a) Bridge	BDT 4,562.21	
	b) Approach Road	BDT 35.00	
	c) River Bank Protection Work	BDT 178.82	
	<b>Total Construction Cost</b>	BDT 4,776.03	
2	Engineering Cost		
	a) Detailed design	BDT 119.40	2.5% of SI No. 01
	b) Construction Supervision	BDT 167.16	3.5% of SI No. 01
3	Land Acquisition, Resettlement and EMP.	BDT 3.03	
4	Administration Cost	BDT 28.96	10% of SI No. 02 & 03
5	Physical Contingencies	BDT 716.40	15% of SI No. 01
6	Price Contingencies	BDT 288.95	5% of SI No. 01, 02 and 05
7	VAT, TAX and DUTIES	BDT 220.22	14.5% for importation @ 30% of SI No. 01 & 02
<b>Total Project Cost</b>		<b>BDT 6,081.36</b>	

**Total Project Cost (Charkhali Bridge, Option - 3)**

SI No.	Description	Amount in Million BDT	Remarks
1	Construction Cost		
	a) Bridge	BDT 4,945.65	
	b) Approach Road	BDT 177.00	
	c) River Bank Protection Work	BDT 178.82	
	<b>Total Construction Cost</b>	<b>BDT 5,301.47</b>	
2	Engineering Cost		
	a) Detailed design	BDT 132.54	2.5% of SI No. 01
	b) Construction Supervision	BDT 185.55	3.5% of SI No. 01
3	Land Acquisition, Resettlement and EMP.	BDT 15.31	
4	Administration Cost	BDT 33.34	10% of SI No. 02 & 03
5	Physical Contingencies	BDT 795.22	15% of SI No. 01
6	Price Contingencies	BDT 320.74	5% of SI No. 01, 02 and 05
7	VAT, TAX and DUTIES	BDT 244.45	14.5% for importation @ 30% of SI No. 01 & 02
<b>Total Project Cost</b>		<b>BDT 7,028.62</b>	

**Total Project Cost (Charkhali Bridge, Option - 4)**

SI No.	Description	Amount in Million BDT	Remarks
1	Construction Cost		
	a) Bridge	BDT 5982.2	
	b) Approach Road	BDT 720.54	
	c) River Bank Protection Work	BDT 178.82	
	<b>Total Construction Cost</b>	BDT 6881.56	
2	Engineering Cost		
	a) Detailed design	BDT 172.03	2.5% of SI No. 01
	b) Construction Supervision	BDT 240.85	3.5% of SI No. 01
3	Land Acquisition, Resettlement and EMP.	BDT 22.4	
4	Administration Cost	BDT 43.30	10% of SI No. 02 & 03
5	Physical Contingencies	BDT 688.1	10%-15% of SI No. 01
6	Price Contingencies	BDT 368.16	5% of SI No. 01, 02 and 05
7	VAT, TAX and DUTIES	BDT 364.72	14.5% for importation @ 30% of SI No. 01 & 02
	<b>Total Project Cost</b>	<b>BDT 8781.12</b>	

## **SUMMARY OF COST OF FOUR LANE BRIDGE**

**Total Project Cost (Charkhali Bridge, Option - 1)**

<b>SI No.</b>	<b>Description</b>	<b>Amount in Million BDT</b>	<b>Remarks</b>
1	Construction Cost		
	a) Bridge	BDT 8,716.94	
	b) Approach Road	BDT 1,166.20	
	c) River Bank Protection Work	BDT 178.82	
	<b>Total Construction Cost</b>	BDT 10,061.96	
2	Engineering Cost		
	a) Detailed design	BDT 251.55	2.5% of SI No. 01
	b) Construction Supervision	BDT 352.17	3.5% of SI No. 01
3	Land Acquisition, Resettlement and EMP.	BDT 31.22	
4	Administration Cost	BDT 63.49	10% of SI No. 02 & 03
5	Physical Contingencies	BDT 1,509.29	15% of SI No. 01
6	Price Contingencies	BDT 608.75	5% of SI No. 01, 02 and 05
7	VAT, TAX and DUTIES	BDT 463.96	14.5% for importation @ 30% of SI No. 01 & 02
<b>Total Project Cost</b>		<b>BDT 13,342.39</b>	

**Total Project Cost (Charkhali Bridge, Option - 2)**

SI No.	Description	Amount in Million BDT	Remarks
1	Construction Cost		
	a) Bridge	BDT 8,517.77	
	b) Approach Road	BDT 35.00	
	c) River Bank Protection Work	BDT 178.82	
	<b>Total Construction Cost</b>	<b>BDT 8,731.59</b>	
2	Engineering Cost		
	a) Detailed design	BDT 218.29	2.5% of SI No. 01
	b) Construction Supervision	BDT 305.61	3.5% of SI No. 01
3	Land Acquisition, Resettlement and EMP.	BDT 3.03	
4	Administration Cost	BDT 52.69	10% of SI No. 02 & 03
5	Physical Contingencies	BDT 1,309.74	15% of SI No. 01
6	Price Contingencies	BDT 528.26	5% of SI No. 01, 02 and 05
7	VAT, TAX and DUTIES	BDT 402.61	14.5% for importation @ 30% of SI No. 01 & 02
<b>Total Project Cost</b>		<b>BDT 11,551.82</b>	

**Total Project Cost (Charkhali Bridge, Option - 3)**

SI No.	Description	Amount in Million BDT	Remarks
1	Construction Cost		
	a) Bridge	BDT 9,248.43	
	b) Approach Road	BDT 177.00	
	c) River Bank Protection Work	BDT 178.82	
	<b>Total Construction Cost</b>	BDT 9,604.25	
2	Engineering Cost		
	a) Detailed design	BDT 240.11	2.5% of SI No. 01
	b) Construction Supervision	BDT 336.15	3.5% of SI No. 01
3	Land Acquisition, Resettlement and EMP.	BDT 15.31	
4	Administration Cost	BDT 59.16	10% of SI No. 02 & 03
5	Physical Contingencies	BDT 1,440.64	15% of SI No. 01
6	Price Contingencies	BDT 581.06	5% of SI No. 01, 02 and 05
7	VAT, TAX and DUTIES	BDT 442.85	14.5% for importation @ 30% of SI No. 01 & 02
<b>Total Project Cost</b>		<b>BDT 12,719.52</b>	



**Total Project Cost (Charkhali Bridge, Option - 4)**

<b>SI No.</b>	<b>Description</b>	<b>Amount in Million BDT</b>	<b>Remarks</b>
1	Construction Cost		
	a) Bridge	BDT 11,113.90	
	b) Approach Road	BDT 720.54	
	c) River Bank Protection Work	BDT 178.82	
	<b>Total Construction Cost</b>	BDT 12,013.26	
2	Engineering Cost		
	a) Detailed design	BDT 300.33	2.5% of SI No. 01
	b) Construction Supervision	BDT 420.46	3.5% of SI No. 01
3	Land Acquisition, Resettlement and EMP.	BDT 22.40	
4	Administration Cost	BDT 74.32	10% of SI No. 02 & 03
5	Physical Contingencies	BDT 1,801.99	15% of SI No. 01
6	Price Contingencies	BDT 726.80	5% of SI No. 01, 02 and 05
7	VAT, TAX and DUTIES	BDT 553.93	14.5% for importation @ 30% of SI No. 01 & 02
<b>Total Project Cost</b>		<b>BDT 15,913.50</b>	