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Economic feasibility of Dhaka-Laksam direct railway link

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Abstract

This paper addresses the present condition of rail transportation in Bangladesh especially between Dhaka-Chittagong by comparative analysis with other modes of transportation, i.e. road and inland water transport. The present railway link between Dhaka and Chittagong is not straight one; rather, it has a huge rounding loop between Dhaka and Laksam. It was not designed for the present geo-political situation of Bangladesh. This paper deals with the necessity of a direct railway connection between the two major cities for the transport related economic benefits of the country. Various components of cost and apparent tangible benefits are carefully estimated for the economic evaluation of the project. A stated preferential method of bus passenger survey has also been conducted to investigate the impact of direct link on the modal choice of bus passenger. Using the discounted net benefit and cost, the benefit/cost ratio of the proposed direct link has been estimated for different conditions. A sensitivity analysis of benefit / cost ratio with different project evaluation period and discount rate has also been performed in this paper.

Keywords: Railway, feasibility study and economic evaluation.

1. Introduction

The economy of Bangladesh is burdened by major transportation constraints resulting from a combination of factors such as physical (geographical and historical), developmental (low-level investments and maintenance) and institutional-cum-policy framework. These lead to lower the efficiency, higher the transport costs, and significantly increase the transport unreliability, with major adverse consequences for the economy. These increase the marketing risks, quality determination, and resulting lower price for farm products reduces farmer incentives. Furthermore, these also sometimes results in failure of delivery schedules in exports affecting competition.

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The Bangladesh Railway (BR) is the principal public transportation agency of the country serving a population of approximately 120 million living in 1,43,998 square kilometers. As railway is a very important mode of inland transport, its healthy growth naturally contributes to the economic development of the country. But the BR, at present, has been suffering from various operating bottlenecks. Critical analysis of the efficiency of the BR points up the worsening operating ratio over the last decade. Its continuing large deficit despite the high level of direct and indirect Government subsidies is probably the biggest issue-forcing the budget of Bangladesh Government in the transport sector.

The BR having a total of 2,706.01 route kilometers, is made up of truncated portions of the erstwhile the East Bengal Railway and the Bengal Assam Railway (of the then British Indian Rail system) which, after 1971 War of Liberation, fell in the Bangladesh territory. In the process, BR inherited a number of structural and physical weaknesses as a part of its legacy, since it was not specially designed and constructed to serve Bangladesh. Due to truncation from the main system, BR is handicapped to serve the country effectively and efficaciously without proper re-orientation and development.

At present, Dhaka, with the population of 9.0 million, is the capital city of Bangladesh, and has the control of the nation's politics and economy. While Chittagong, having 3.2 million population, is facilitated with the nation's commercial capital and is the most advanced industrialized area and the principal sea port of the country. Thus, the south-eastern districts, between the two largest cities of the country, is densely populated and is forming the nation's most productive area. This is why, Dhaka-Chittagong Corridor appears to be the most important one in terms of flow of passengers and freight traffic in the country. It is expected that in 2015, 134 million (46.05% of total of the country) passenger traffic and 42 million tons freight will move through this corridor. Moreover, as 76% foreign trade of the country is performed by Chittagong port, this corridor has utmost importance in the context of Bangladesh transport (BITSS, 1997). Thus, the Dhaka-Chittagong corridor is the most important one and the so called *"life-line"* of the country for the economical growth of Bangladesh. Therefore, a faster and direct railway connection between the two principal cities is a must for the economic benefits of the country.

The Dhaka-Chittagong corridor is used by road, rail and water transport, mainly dominated by road transport. It is evident that the present transport facilities will not be able to bear such expected heavy traffic in near future. This is why, government has to build up more transport facilities in this region. Besides this, the present rail link between Dhaka and Chittagong is not a straight one; rather it has a huge rounding loop (Figure 1) mainly because it was not planned for the present geo-political situation.

The primary objective of this paper is to introduce a direct link between Dhaka and Chittagong that will reduce 90-km route distance comparing with the existing line, and, also to identify and quantify the total construction cost for different components of the proposed direct link and to determine the economic benefits that will result from the construction of the direct link in order to perform the feasibility study of the project.

A pilot study of Laksam-Doudkandi-Dhaka Chord Line was conducted by the Laksam-Dhaka Chord Line Project Authority of the erstwhile East Pakistan Railway in 1969 (Laksam-Dhaka Chord Line Project 1969). The study identified a rail distance reduction of 50 miles with the chord line and relevant economic analysis suggested an annual rate of return of 9.2% over the capital outlay. Although the study strongly recommended the

early construction of the chord line the project was abandoned in the turmoil of the liberation war. After liberation, the volume of traffic movement between the two cities increased manifold justifying the review of the same project in the light of present traffic and economic situations.

2. Proposed link

The alignment for the proposed direct link was selected by analysis of the map of Bangladesh. The proposed link will reduce about 90-km route distance in between Dhaka and Laksam as well as Dhaka and Chittagong. It has been proposed to construct a new route in between Dhaka (from Narayanganj) and Laksam which will pass over the Shitalakhya near Kanchpur Bridge, the Meghna near the Bangladesh-Japan Friendship Bridge-1 and the Meghna-Gumti river at Daudkandi. The rest of the link will be almost straight in between Daudkandi and Laksam (Figure 1). The existing Dhaka-Narayanganj link will be doubled. This is how our proposed link will be able to provide a 230-km route distance in between Dhaka-Chittagong by rail, whereas the road distance is 264 km. Thus the rail transport may be more competitive with road and more cost and time effective to all. Figure 1 shows the detailed layout of the proposed link comparing with the existing rail-road.

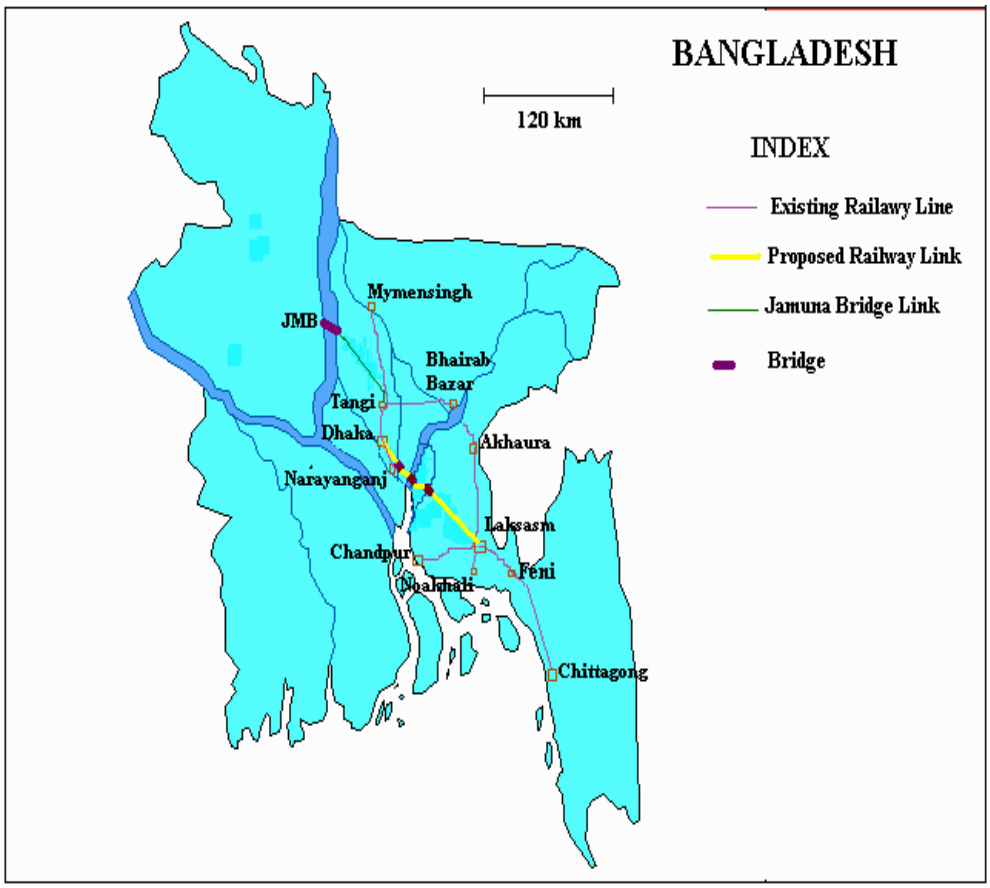


Fig. 1. Comparison of existing railway line and proposed railway link in between Dhaka and Laksam

3. Traffic flows between Dhaka and Chittagong

Estimated traffic on five corridors (Dhaka-Chittagong, Dhaka-Northwest, Dhaka-Khulna, Dhaka-Sylhet and Khulna-Northwest) of Bangladesh indicates that Dhaka-Chittagong corridor ranks first and appears to be the most important one in terms of flow of passenger and freight traffic. The importance of this corridor will persist to the year 2015 also (BITSS, 1997). It is estimated that freight traffic in between Dhaka and Chittagong will increase from 10.6 million tons in 1995/96 to 18.4 million tons by 1999/2000, and will reach to 42.0 million tons by the year 2014/2015. The passenger traffic forecast is much more sensitive to the timesaving that would result from improved facilities. It is estimated that passenger trips could grow from 26.5 million in 1995/96 to almost 134.0 million passenger trips by the year 2014/2015 (BITSS, 1997). Table 1 shows the flows of freight and passenger traffic between Dhaka-Chittagong.

Table 1
Flows of freight and passenger between Dhaka-Chittagong

Period	Freight (Million tons p. a.)	Passenger (Million passengers p. a.)
1992/93	10.4	23.2
1995/96	10.6	26.5
1999/2000	18.4	65.8
2014/2015	42.0	134.0

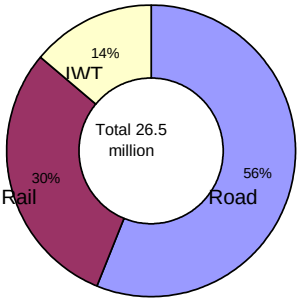
Sources: 1. BTSS, Final Main Report, 1994; . BITSS, Draft Final Report, 1997

Dhaka-Chittagong corridor is mainly dominated by road service. The existing rail road distance between Dhaka-Chittagong is 320.79 route kilometers. The link between Chittagong-Laksam is almost straight and it is 129.60 kilometers. The rail-road distance between Dhaka-Laksam is 191.19 kilometers with a huge rounding loop of about 90 kilometers and thus railway service between Dhaka-Chittagong is time consuming and less attractive. Modal split of estimated and projected Passenger and Freight Traffic are also shown in Figure 2.

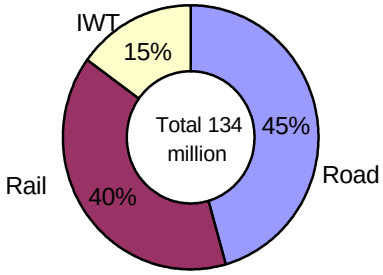
4. Traffic forecasting

Traffic forecasting creates a relationship between travel demand and a few key explanatory variables such as income, travel time, fares, etc. We have estimated the future traffic based on the Planning Commission Report (BITSS 1997) and also on Stated Preference (SP) survey methods. Stated Preference Methods (SP) present respondents with hypothetical data on alternatives involving tradeoffs between the various attributes of these alternatives. Respondents are asked to make some ‘response’ which may be generally taken as indicating their preference. The requirements for high quality and realism within the survey context lead to a preference for:

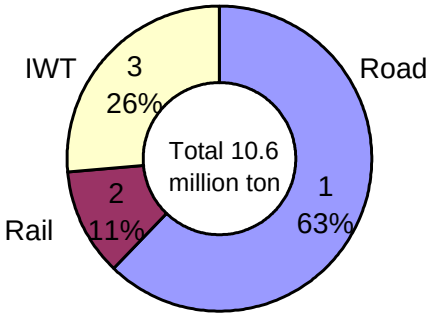
- face-to-face surveys (allowing interviewer interaction);
- customization (relate to a particular journey or activity) making it more meaningful;
- a response based upon respondent’s own experience on that occasion (situational constraints, planning processes, demographic characteristics).



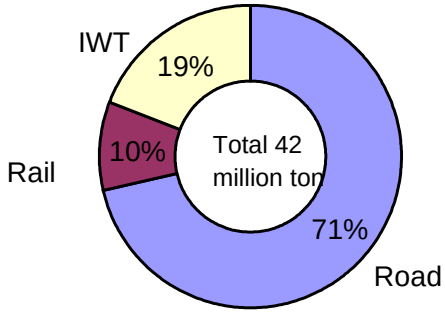
(a) Passenger Traffic: 1996



(b) Passenger Traffic: 2015



(c) Freight Traffic: 1996



(d) Freight Traffic: 2015

Fig. 2. Traffic shared by different modes of transport between Dhaka and Chittagong

In our passenger survey, 130 (45 Air Conditioned and 85 non-A.C.) bus passengers were been asked to consider which mode they would choice for their journey if the proposed direct link be constructed and if

- existing rail distance will reduce by 90 kilometers
- travel time will reduce by two hours
- fare will remain same over the time.

It is observed that more than 80% passengers show their willingness to change their mode of travel from road to rail if the proposed new link is constructed. In our analysis, we have considered 80% passengers will divert from road to rail. For lack of scope, survey for freight traffic was not performed and in this case the Planning Commission estimations has been considered. Figure 3 and 4 represent the expected traffic that will move by rail between Dhaka-Chittagong.

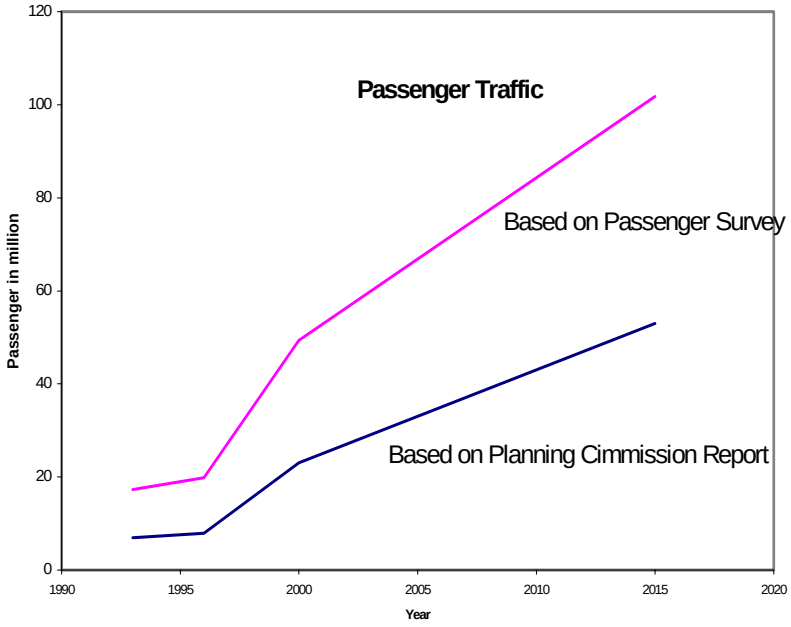


Fig. 3. Expected passenger traffic movements by rail between Dhaka-Chittagong

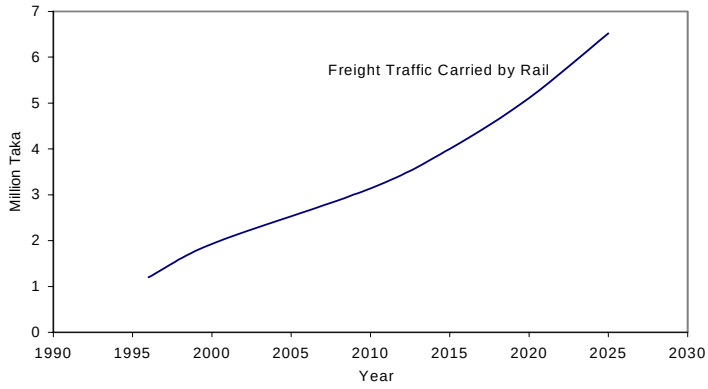


Fig. 4. Expected freight traffic movements by rail between Dhaka-Chittagong

5. Construction costs

Estimations of construction costs are prepared prior to constructing a project in order to determine the probable cost of the project. Thus an estimate is, at the best, a close approximation of the actual cost whose time value will not be known until the project is completed and all costs are recorded. For this study, construction costs are determined by estimating the costs of different components of the proposed facility on the basis of existing available data.

5.1 Physical Construction Cost

The total Physical construction cost includes the cost of a) General Requirements, b) Earthworks, c) Track Structure, d) Culverts and small Bridges, e) Station Buildings, f) Signalling, g) Telecommunications, h) Ancillary Works, i) Dayworks, j) Contingency and k) Broad Gauge (B.G.) and Meter Gauge (M.G.) rail. The physical construction cost

is estimated to Tk. 10925 million that is 36.85% of the total project cost. These costs are shown in Table 3.1.

Table 2
Physical construction cost

Item	Amount in million BDT
General Requirements	314
Earthworks	3190
Track Structure	3046
Culverts and small Bridges	1719
Station Buildings	124
Signaling	383
Telecommunications	115
Ancillary Works	88
Day Works (Provisional sum)	48
Contingency (5% of Item 1-8)	451
M.G. Rail	1447
Total	10925

Sources: 1. Project Concept Paper of JMB Railway Link Project. 2. BR

5.2 Land acquisition and resettlement cost

About 1182 acres land will be acquitted which will cost Tk.874 million. The resettlement cost is amounted to Tk.692 million. The total land acquisition and resettlement cost is estimated to Tk.1700 million which is 5.7% of the total project cost. These figures are based on the similar cost of Jamuna Multipurpose Bridge Railway Link construction, which are summarized in Table 3.

5.3 Major bridge construction costs

It is expected that for the increasing growth of traffic movement in future, Second Major Highway Bridge Project will be undertaken in between Dhaka-Chittagong. The Bridges on the major rivers may be shared by both rail and road and this is how the project may be more viable. If rail shares the Highway Bridge, the cost will be increased by 15% only (according to the JMB railway link connection cost). The salient features and estimated construction costs for the major river bridges are shown in Table 4.

Table 3
Land acquisition and resettlement cost

Item	Amount in million BDT
Land acquisition	874
Resettlement	692
Rehabilitation	88
Environment Management Project	23
Technical Support	8
Others	15
Total	1700

Sources: 1. Contract Documents for Contract No. 1 Jamuna Bridge Railway Link Project (Oct.' 1997); 2. Project Concept Paper of Jamuna Bridge Railway Link Project

Table 4
Major bridge construction costs

Bridges	Location	Length (m)	Width (m)	Estimated cost without rail (million BDT)	Estimated cost with rail (million BDT)**
Bridge on the Shitalakhya	On the Shitalakhya near Narayangong	500	18.3	3262	3753
Bridge on the Meghna	Near Bangladesh-Japan Friendship Bridge-1	930	18.3	6068	6978
Bridge on the Meghna-Gumti	Near Bangladesh-Japan Friendship Bridge-2 at Doudkandi	1410	18.3	5473	6294

** Assumed 15 per cent incremental cost for the connection of Railway Link with the Highway Bridge (according to the JMBA report)

5.4 Total project cost

The total cost of the project in present value is BDT 29650 million in the year 2000. The Physical construction cost as well as Land acquisition and resettlement cost is BDT 12625 million which is half (50.04%) of the total cost. The cost of the major three Bridges is BDT 12604 million, which covers 49.96% of the total cost. If 15% cost of the Bridges is accounted for rail, the total cost for rail link in between Dhaka-Chittagong will be BDT 15179 million that is 51.19% of the total project cost. Total Project cost is shown in Table 5.

Table 5
Total cost of the project

Item	Amount (million BDT)
Physical Construction Cost	10925
Land Requisition and Resettlement Cost	1700
Cost of Major Bridges : I. Bridge on the Shitalakya River II. Bridge on the Meghna River III.Bridge on Meghna-Gumti River	 3753 6978 6294
Total	29650

6. Economic aspects and benefits

Benefits of a transport project have several components such as benefits from reduction in vehicle operating cost, facilities maintenance costs, benefits from reduction in accident as well as benefits from travel time savings, etc. It is obvious that many benefits result from the transportation improvement or, to put it more broadly, from improved transportation facilities. Some of these benefits are direct and readily apparent that result from a reduction in user costs; others are indirect including benefits to adjacent property and to general public and more difficult of discernment. Likewise, some benefits may be readily evaluated in terms of money; others defy evaluation in this fashion, although they are nonetheless as real and lasting as monetary returns. The most quantifiable and, to the

analyst, the most significant benefits are those that result from a reduction in user costs. Such benefits result from decreased operating costs, higher operating speeds, fewer delays, and decreased accident losses. Usually, the imputed value of savings in time (especially for the developed countries) is the most dominant component of the benefits of transportation project, although it was not accounted in our economic analysis as suggested by some analysts for developing countries (Howe, 1976).

The tangible benefits of the proposed direct link is obtained from the savings in operating costs of BR for the transportation of expected passenger and freight traffic due to the reduction of 90 kilometers route distance between Dhaka and Chittagong. To estimate the probable benefits of the direct link, the following equation is used:

$B = \Sigma B_i$

where B = Total benefits in million Taka; Bi = Benefits of i-th year's savings from passenger / freight transportation = Ti * Ci * Rd. Ti = Passenger or Freight Traffic moved between Dhaka-Chittagong in i-th year in million; Ci = Cost per passenger per kilometer or Cost/ton/km in BDT; Rd = Reduced rail route distance (90 km. in this case).

7. Evaluation of the project

In this study, the purpose of the economic analysis is to determine the economic feasibility of the Dhaka-Laksam direct railway link. Three methods of economic analysis have been used in our study for evaluating the economic feasibility. These are: (i) Net Present Value (NPV) method, (ii) Benefit/Cost (B/C) ratio method and (iii) Internal Rate of Return (IRR) method.

Considering total Bridge cost, the estimated growth of traffic based on Planning Commission report shows that at the end of 25 years' operation, the NPV will be BDT 2428 million and our passenger survey results indicate that this amount will be BDT 28849 million. If 15% Bridge cost is considered, these amounts will be BDT 16899 million and BDT 43320 million respectively for the above cases. These are shown in Table 6 for different scenarios.

According to the traffic estimation of Planning Commission, a present direct benefit worth of BDT 33077 million and a present net cost of BDT 30649 million, gives a benefit / cost ratio of 1.1. The present worth benefit obtained from the saving based on our passenger survey is amounted to BDT 59498 million which gives a benefit/ cost ratio of 1.94. In this estimation, total Bridge cost has been considered. If 15% of Bridge cost is considered, the B/C ratio increases to 2.05 and 3.68 respectively for the above conditions.

From our economic analysis, it has been found that the savings provide an IRR ranging 11.34% to 28.9% in 25 years for different scenarios which are shown in Table 6. The benefits obtained from the projected traffic growth of Planning Commission shows that the pay back period (if total cost is considered) will be 21 years and benefits obtained from our survey results indicate that the pay back period will be 8 years.

Thus, the economic analysis of the project shows that the proposed direct link is economically feasible and potential. If indirect benefits and the monetary value of time savings for both passenger and freight traffic due to the direct improved link are

included, the figure will further increase. Besides this, the probable incremental freight traffic for the proposed link has not been considered in our analysis.

Table 6
Net present values and internal rates of return for different conditions

Scenarios	NPV (in million taka)	IRR (in percent)
Considering total cost (Based on Planning Commission Report)	2428	11.34
Considering15%Bridge cost (Based on Planning Commission Report)	16899	24.60
Considering total cost (Based on Passenger Survey)	28849	18.38
Considering 15% Bridge cost (Based on Passenger Survey)	43320	28.90

8. Sensitivity analysis

The economic analysis results an arithmetical answer, the magnitude of which depends upon engineering judgement in selecting factors and estimating the future. To gain some understanding of how certain factors affect the solution, a good practice is to solve for economy by using low, medium, and high values of the critical factors, and in different combinations. The sensitivity of different factors such as sensitivity to terminal value, sensitivity to length of analysis period and sensitivity to the discount rate in controlling the result should be considered.

Table 7 and Table 8 show the sensitivity of NPW and B/C ratio of the project to the different length of analysis period and to the different discount rates including total Bridge cost and excluding the cost of Highway sharing portion respectively.

Table 7
Variation of B/C ratio to the different length of analysis period at 11.5% discount rate

Analysis Period	Considering Total Cost				Considering 15% Bridge Cost			
	NPW (in million BDT)		B/C		NPW (in million Taka)		B/C	
(Operation Period)	Based on Planning Commission Report	Based on Survey	Based on Planning Commission Report	Based on Survey	Based on Planning Commission Report	Based on Survey	Based on Planning Commission Report	Based on Survey
20 Years	-1825	22621	0.94	1.74	12646	37092	1.78	3.30
25 Years	2428	28849	1.1	1.94	16899	43320	2.05	3.68
30 Years	9720	44235	1.31	2.44	24192	58707	2.49	4.62

Table 8
Variation in net present value and b/c ratio for different discount rate

Discount Rate	Considering Total Cost				Considering 15% Bridge Cost			
	NPW (in million BDT)		B/C		NPW (in million BDT)		B/C	
	Based on Planning Commission Report	Based on Survey	Based on Planning Commission Report	Based on Survey	Based on Planning Commission Report	Based on Survey	Based on Planning Commission Report	Based on Survey
7%	20556	62460	1.66	3.0	35027	76931	3.11	5.63
11.5%	2428	28849	1.1	1.94	16899	43320	2.05	3.68
16%	-7242	11330	0.76	1.37	7229	25801	1.45	2.62

9. Conclusions

In this study, a direct railway link between Dhaka and Laksam has been proposed which is expected to reduce the rail distance between Dhaka and Chittagong by around 90 kilometers. From cost estimation it has been found that total construction cost of the project will be BDT 29650 million including three major river bridges parallel and near to the existing highway bridges. If only 15% of the major bridge costs are accounted for rail as in the case of Jamuna Multipurpose Bridge, an investment of BDT 15179 million will be necessary from the railway side.

Analysis of the net present value indicates a sound feasibility of the project. Using the discounted net costs and discounted net benefits, B/C ratios are estimated. If total bridge costs are included, B/C ratio 1.1 and 1.94 are resulted for the Planning Commission traffic forecasts and our survey traffic forecasts respectively. However, if 15% of the bridge costs are accounted for rail (as in the case of JMB), B/C ratios obtained are 2.05 and 3.68 respectively for the above cases. Analysis of IRR reveals that an IRR in the range of 11.34% to 28.38% can be achieved from the project depending on the conditions used in estimation. Sensitivity of net present value and the B/C ratio to the analysis period and discount rate has also been investigated and for majority of the conditions the project has been proved to be economically sound.

Considering the sound economic feasibility of the project as obtained from this study, we suggest for further rigorous study of the project for possible implementation.

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