



Methodology Article

Environmental Impact Assessment of Lebukhali Bridge Construction Project over the River of Paira, Bangladesh

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Abstract: This study focuses the possible impact assessment on environment of Lebukhali Bridge construction project which area is located in southern coastal part of Bangladesh. The main purposes of the study are to identify and analyse the potential environmental impacts, suitable alternatives and preparing environmental mitigation plan of this project. Both primary and secondary data were collected in doing this research. Primary data, such as the opinion from Union parishad offices, local NGOs, local people has been collected through in depth interview. Secondary data, such as statistics and reports on the parameter of environmental impacts, equation of Environmental Impact Value (EIV), procedure of Environmental Management Plan (EMP), was collected from past study reports, books and journals etc. The major environmental impact would be air pollution, water pollution and waste siltation, river erosion, migration, loss of Agricultural land etc. Environmental impact assessment is designed on the basis of ecological, physico-chemical and human interest. Environmental management plan prepared to minimize and control of negative impacts during pre-construction, construction and operation/management stages for its sustainability. The study found that there are no significantly sensitive ecological, physicochemical socio-cultural impact in the area. The environmental impact value was estimated +2 (Positive two) shows the acceptance of this project. This bridge will help to mitigate the transportation problem as well as increase the socio-economic development of southern coastal region of Bangladesh.

Keywords: Environmental Impact Assessment, Mitigation, Bridge Construction, Bangladesh

1. Introduction

Bridge and culvert activities involve the construction of permanent engineering structures across watercourses and larger rivers. The construction of bridges may impact upon the local environment and river dynamics particularly where in stream span supports are required [3, 4]. Environmental

Impact Assessment is a very crucial part of any construction. Environmental Impact Assessment (EIA) is considered as a new planning and decision making tool which was first established in the United States under the National Environmental Policy Act of 1969 [5, 8]. It is conducted for identifying the impacts both positive and negative for any construction. EIA helps us to know the bad circumstances at a

very early stage [11, 9]. Those will help to rethink about the project or take precautionary steps earlier. Especially EIA is necessary before construction a bridge because it can pose great threat to the areas near side the river [10]. Government under took the plan for making bridge on Paira river because of poor communication network with the southern coastal part of Bangladesh. Coastal part is known as a great tourist area especially for Kuakata Sea beach and also attracts tourist attraction. But the river Paira has become a physical barrier for for this region [1, 7]. This physical barrier is seen as an impediment to economic development and social unity. The construction of Lebukhali Bridge will establish a permanent link with the southern coastal part of the country. This paper provide Environmental Impact Assessment (EIA) report of Lebukhali Bridge Project to provide potential negative and positive environmental impacts of the project. It is hoped that this project will be proved as one of the successful project of Bangladesh Government. It will permanently solve the transportation problem of southern part with the country. The objectives of this study as follows (a) to identify and analyze the potential environmental impacts and EIV (b) To prepare Environmental Management Plan (EMP) and environmental mitigation plan of this project.

2. Methodology

Data were collected from primary and secondary sources. Primary data were collected by means of semi-structured questionnaire survey, site observation and key informants interview method. The sample size was 100 for questionnaire survey. Secondary data were collected from Bangladesh bureau of statistics (BBS), bridge construction authorities, construction manager, project manager, chief engineer of this bridge construction project, Local government and engineering department (LGED) and from relevant articles. Firstly environmental parameters were divided into three categories namely ecological, physico-chemical and human interest. Then the environmental impacts were identified according to those categories and documented each impacts as range from 0 to ± 5 . The degree of impact is the qualitative judgement and finally, cumulative environmental impacts of the project was calculated that may occur inside and outside the project area. Value of degree of impact is from the experience of similar Bridges related large projects in Bangladesh. Environmental impacts and mitigation measures for this bridge construction project have been identified according to pre-construction, during construction impact and post construction impacts.

Quantification of Environmental Impact

Impact assessed based on different environmental impact parameter was evaluated assigning score ranging from 0 to ± 5 for both positive (+) and negative (-) impacts. Changes of environmental parameters consider as (a) Severe (+5 or -5) (b) Higher (+4 or -4) (c) Moderate (+3 or -3) (d) Low (+2 or -2) (e) Very Low (+1 or -1) (f) No change (0).

Method Of Assessment

Environmental impact value (EIV) are estimated and

calculated by using mentioned below equation [7, 11] as follows.

$$EIV = \sum_{i=1}^n (V_i) W_i \quad (1)$$

Where, V_i = Relative change of the environmental quality of parameters, W_i = Relative importance or weight or parameter, N = total number of environmental parameters.

Project Location

Lebukhali Bridge is located in south central part over Paira River near Patuakhali district. Lebukhali Bridge Project (LBP) at Paira River is situated at 189 km on Dhaka-Mawa-Faridpur-Barisal-Patuakhali Road (N8), which is at 26 km on Barisal-Patuakhali Road. The Latitude is $22^{\circ}30.07'$ N and Longitude is $90^{\circ}17.77'$ E. The Government of Bangladesh (GoB) through their nodal agency - Roads and Highways Department (RHD) within Ministry of Communication (MoC) has planned for construction of the Lebukhali Bridge for a long time. RHD had prepared a Development Project Proposal (DPP) for a 1450.9 m long Dual Carriage way bridge with the main bridge being in Pre-Stressed Concrete (PSC) box girder together with 2.75 km approach roads at an estimated investment cost of BDTK 4,461.002 million (US\$ 65M) in November 2010 [6]. It will be a 4-lane bridge and the 700 meters long bridge will have long approach roads on both sides. The approach road and bridge start in the north side are in Dudholmou under Patuakhali district and while ending in the same in the south side of Lebukhali under Patuakhali District. The main development objective of the project is to establish a permanent road crossing over the Paira River, replacing the existing unreliable and unsafe ferries. The bridge is likely to change socio-economic condition of the people of the southern region and boost the Kuakata tourist centre. It will also develop the communication system in the region as government is planning to set up a seaport in Kalapara area. This would eradicate an important hindrance in the development of southern coastal region of Bangladesh. The implementation of the project will require the acquisition of 74 ha of land. Almost half of the land to be acquired is required for the construction of river training works. Over 10 hectares are estimated to be needed temporarily for the construction operations [6].

3. Results and Discussions

The environmental Impact Assessment (EIA) components considered include Physicochemical, ecological, Socio-cultural and human interest. These components are divided into different parameters for identifying key and significant impact during different stages of the project, which need to be thoroughly addressed for proper mitigation and management and finally overall value are calculated for each component (Table 1, Table 2, Table 3 and Table 4). The EIV calculation showed that the induced development has both negative and positive impacts on the environment. The

positive impacts are socio-cultural parameters (+81) and Human interest parameters (+86). The negative impacts are Ecological parameters (-84) and Physicochemical parameters (-80). Major of these adverse negative effects are mainly construction related and it can be properly mitigated. The EIV calculation found the total environmental impact assessment value is +3 (Medium). This results represents that the project is medium positive impact on the environment and it is socially and environmentally acceptable. The results gives the clearance to go ahead with the project. The Lebukhali Bridge is positive in aspects of making the Dhaka-Mawa-Faridpur-Barisal-Patuakhali highway free from ferry service and its speedy implementation will boost tourism and trade activities with the southern region by establishing direct link with Kuakata and Payrabandar. Again Bangladesh has one of the lowest vehicles ownership levels in the world and through the improvement in employment conditions and economic growth in the coastal region, vehicle ownership is expected to be increased significantly. The project have also negative impact but if we can take precautionary measures to eliminate the negative impacts of this project then this project will be succeeded and people get more benefits from the project.

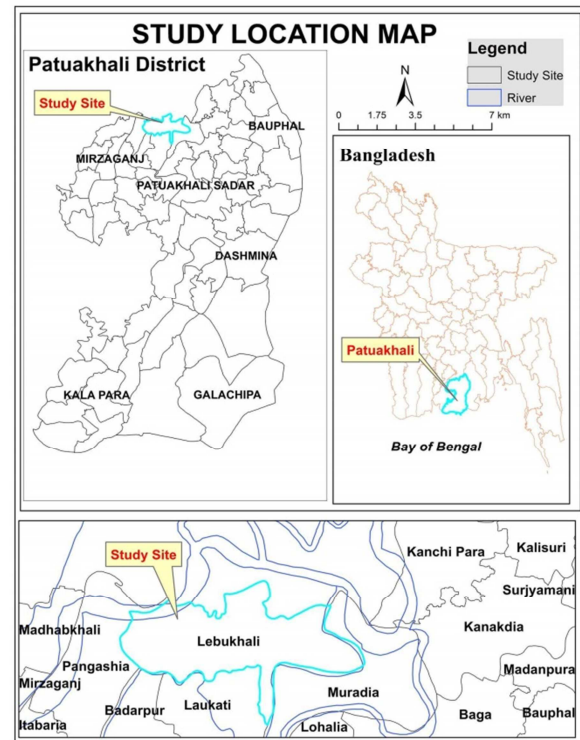


Figure 1. Location Map of the Study Area.

Table 1. Ecological Impact Value Calculation.

Environmental Parameters		RIV*	DoI**	Individual EIV***
I	Ecological Parameters			
	Loss of Fish Habitat	15	-2	-30
	Loss of Vegetation	21	0	0
	Ecosystem Destruction	29	-1	-29
	Plantation	25	+1	+25
	Water pollution	15	-2	-30
	Soil pollution	5	-2	-10
	Coastal resources	5	-2	-10
Total amount of ecological impact value				-84

Table 2. Physicochemical Impact Value Calculation.

Environmental Parameters		RIV*	DoI**	Individual EIV***
II	Physico-Chemical Parameters			
	Water Logging	14	-1	-14
	Erosion and Siltation	20	0	0
	Regional Hydrology Change	6	0	0
	Surface and Ground water	18	-1	-18
	Sound Pollution	30	-2	-60
	River Excavation	12	+1	+12
Total amount of Physicochemical Parameter Value				-80

Table 3. Socio-Cultural Impact Value Calculation.

Environmental Parameters		RIV*	DoI**	Individual EIV***
II	Socio-cultural Parameters			
	Health facilities	13	-1	-13
	population and communities	30	-1	-30
	Socio-economic conditions	20	1	+20
	Cultural heritage	6	0	0
	Current use of lands/ resources	18	-1	-18
	Social well-being	20	-2	-40
Total amount of Socio-Cultural Impact Value				+81

Table 4. Human Interest Impact Value Calculation.

Environmental Parameters		RIV*	DoI**	Individual EIV***
III	Land Use Change	7	-1	-7
	Loss of Agricultural Land	13	-1	-13
	Flood Protection	7	+2	+14
	Road Communication	30	+2	+60
	Employment Opportunity	5	+3	+15
	Migration	10	-1	-10
	Economic Development	10	+1	+10
	Tourism Facilities	17	+1	+17
	Total amount of Human Interest Impact Value			+86

$$\text{Total Environmental Impact Value: } EIV = \sum_{i=1}^n (Vi) Wi = (-84-80+81+86) = +3$$

Note: RIV* is relative impact value, DoI** is degree of impact and EIV*** is environmental impact value.

4. Mitigation Measures

The project intervention should be taken in such a way so that minimum disturbance of infrastructures, people and vegetation in the project area. For reducing negative impacts

in this project, mitigation measures (Table 5) are considered in three phase's namely pre-construction stage, construction stage and operation & maintenance stage.

Table 5. Possible Mitigation Measures.

Project Phase	Potential Environmental Impacts	Proposed Mitigation Measures
Pre-Construction Stage	Land Acquisition for project	Compensation according to resettlement action Plans
	Loss of vegetation coverage	Enhancing tree plantation programme
	Loss of 45 ha of agricultural land and crops	Agricultural development plan, Compensation for loss of land, crops and stock families
	Loss of fish ponds and wetlands	Full compensation for loss of fish, Construction of fish sanctuary
Construction Stage	Impacts from land and river transport of materials	Construct and maintain temporary road bypasses
	Water pollution	Create the alteration way to pass waste water
	Sound pollution	Using environmental friendly technology
	Occupational Health Problem	Use the provided safety equipment
Operation and Maintenance Stage	Increased Vehicular Traffic During Mobilization	Prepare a traffic management plan
	Dredging and Maintenance	Project authority should properly maintain
	Oil spills from bridge	Oil gutters
	Waterlogging because of raised alignment	Adequate drainage systems (underpasses, gutters)

5. Environmental Management Plan (EMP)

Environmental Management Plan is prepared to identify all environmental impacts during pre-construction, construction and Operation/Maintenance stages due to implementation of different types of project activities [2]. A suitable number of environmental management plans is set up for getting sustainable outcome of this bridge construction project. Those plans comprises (a) Sustainable waste management plan (b) Dust management by water sprayer/watering (c) Water management plan (d) Hazardous materials and management plan (e) Top Soil Stripping, storage and reuse (f) Biodiversity management plan (g) Community environment management plan (h) Land acquisition and resettlement (i) Provision of

cross drains (j) Construction camp and yard facilities (k) Engagement of environmental specialists (l) Agricultural development plan.

5.1. Compensation and Enhancement

Compensation and enhancement for this project includes (a) Paira (river) protected sanctuary (b) Tree plantation measures (c) Public health and occupational safety action plan (d) Income and livelihood restoration plan (e) Development of resettlement plan (f) Safeguard alternative income for displaced people.

5.2. Economic Analysis

Economic analysis of the project (Table 6) is based on a relative study scrutinizing what would arise with and without the project at the local, regional, and national levels, without numerous effects.

Table 6. Scheduling of the Action plan.

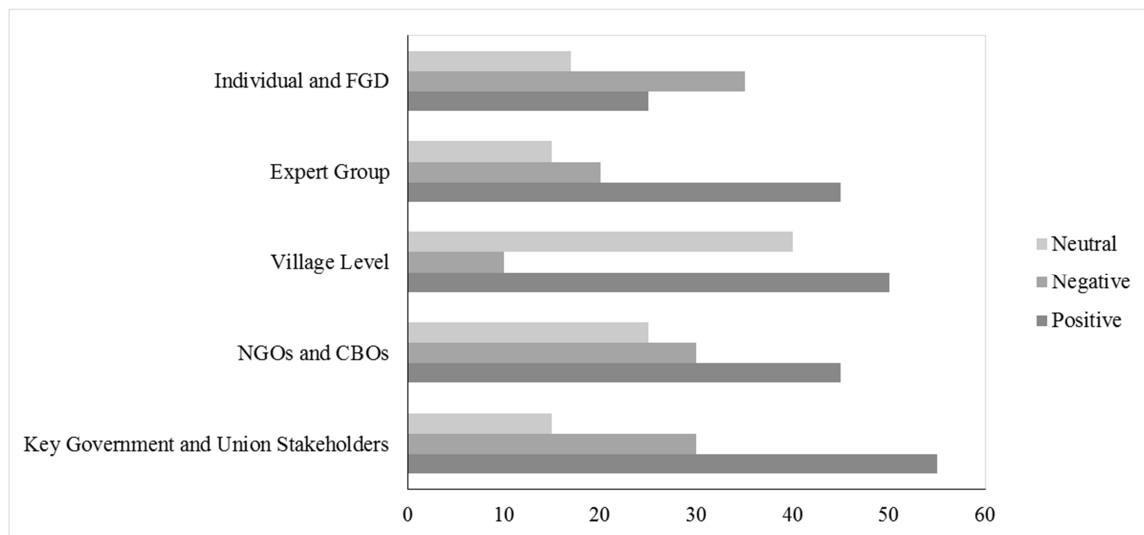
Scheduling and Reporting												
Actions	Year-1				Year-2				Year-3			
	Q ₁	Q ₂	Q ₃	Q ₄	Q ₁	Q ₂	Q ₃	Q ₄	Q ₁	Q ₂	Q ₃	Q ₄
Mitigation Measures												
Resettlement action plan												
Fish Sanctuary												
Tree Plantation Program												
Capital and Maintenance Dredging												
Installation of Outlets												
Awareness Raising												
Agriculture development measures												
Monitoring												
Pollution (water, sound, air)												
Siltation and erosion												
Bridge Monitoring												

Note: Q₁ is first quarter, Q₂ is second quarter, Q₃ is third quarter and Q₄ is fourth quarter in a year. (Here, one quarter refers the four month in a year like Q₁).

5.3. Public Consultation

Public consultation was involved regarding this project work encompasses as individual and FGD, consultation with expert groups, village level, NGOs and CBOs and key government/Union stakeholders. During the discussion, the authors explained the initial baseline condition and the project intervention activities. All the respondents perceived the impact on environmental impact along with perceived risks, threats, benefit. Then they were asked to point out the project related major environmental problems and solutions. It was

found that majority of the people were strongly supportive and fully willing to cooperate with the project. In spite of having some negative impacts of this project, people of the project area including associated areas, vehicles drivers, passengers, and small traders are very much positive to get a bridge on this location. Besides that some land owners, small traders within this location, a little number of fishermen shows reversed opinion for constructing this bridge. The public consultation opinions are given details in Figure 2.

**Figure 2.** Public Consultation of EIA at Lebukhali Bridge Construction.

6. Conclusion

An attempt has been taken from this study to identify the environmental impacts related to Lebukhali Bridge project. The major negative impacts are loss of fish habitat, ecosystem destruction, sound pollution, erosion and siltation, loss of

agricultural land, migration etc. Some of the impacts are permanent and some can easily handle by taking measures during construction stage and operational stage. It should be remembered that the expected benefits resulting from this project by far outweigh the negative impacts which has led to realization of Lebukhali Bridge. The major positive impact of this project includes plantation, road communication,

employment opportunity, economic development etc. Those positive impacts are added the value of the acceptance of this project. From this assessment it can be declared that the project may be treated as the development pile for the coastal region of Bangladesh inspite of some negative impacts that can be easily reduced by taking proper environmental management plan and planned mitigation measures.

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